TOWN OF LINCOLN, RHODE ISLAND

FINAL
WASTEWATER FACILITIES PLAN

NOVEMBER 2006

Prepared by:

C&E Engineering Partners, Inc.
342 Park Avenue
Woonsocket, Rhode Island 02895

C&E Project No. J0506

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Executive Summary

The Town of Lincoln is located in the northeast area of Rhode Island, bordered by the Towns of Smithfield and North Smithfield to the west, the city of Woonsocket to the north, the Town of Cumberland to the north and east, the City of Central Falls to the east, and the Town of North Providence and City of Pawtucket to the south. The total size of the Town is approximately 12,100 acres (18.9 square miles). The Rhode Island Statewide Planning Program reports an estimated 2005 population of 21,449 people for the Town of Lincoln and a projected 2025 population of approximately 24,000.

The Town identified the need for and established the task to develop a Town – wide wastewater facilities plan in its 2003 Comprehensive Plan update. The Wastewater Facilities Plan is intended to address the current and anticipated future needs for management of wastewater generated within the Town of Lincoln. This Plan is prepared in accordance with the requirements and guidelines established by the Rhode Island Department of Environmental Management as necessary for the Town to utilize financing obtained through the State Revolving Fund (SRF) Program. This Wastewater Facilities Plan also is intended serve as part of the Town response to the April 2003 Notice of Deficiency (NOD) issued by the Rhode Island Department of Environmental Management (RIDEM) as a result of raw sewage discharges to water bodies that occurred between 1999 and 2002 due to pump station and sewer line operational problems experienced in Lincoln during that period.

Municipal sewers are available to approximately 99% of the geographic area of the Town. Areas where municipal sewer service is not available are served by individual sewage disposal systems (ISDS). All sewage flow conveyed by the Town facilities is directed to the Narragansett Bay Commission (NBC) system for treatment and disposal at the Bucklin Point Wastewater Treatment Facility in East Providence or the Field's Point Wastewater Treatment Facility in Providence. The Town does not own or operate any municipal wastewater treatment facilities.

Although the Town has an extensive existing system of municipal wastewater pumping stations and gravity collection sewers, these facilities could not be constructed in strict accordance with the proposed sewer system planning documents prepared in 1971 and amended in 1984. Proposed gravity conveyance facilities apparently were deemed to be infeasible due to various constraints necessitating additional pumping stations. Wastewater facilities for subsequent development were constructed as needed to satisfy the wastewater disposal needs for individual areas, resulting additional small pumping stations scattered throughout the collection system.

Review of the planning and record documentation indicates that the criteria used to develop estimated wastewater volumes and size the existing facilities was conservative in comparison to recent water use records. The system design was premised upon saturation development of the zoning conditions in existence at that time, in addition to relatively high per unit wastewater generation rates, with the result that the sewer system is sized to accommodate a peak day design flow of 19.6 MGD. The peak day wastewater flow projected by this Facilities Plan is 4.28 MGD based upon metered water use data and the capacity of the existing facilities was determined to be satisfactory for the future conditions.

The majority of the existing wastewater facilities were installed during the major sewer system construction program conducted during the late 1980s to early 1990s. The gravity sewers installed during this program are expected to remain serviceable to beyond the end of the planning period, but the pump stations are approaching 20 years in service and replacement of equipment is anticipated for all stations during the planning window. Additionally, gravity sewers pre-existing the major sewer construction program remain in service at various locations of the system. In some cases, generally within the older mill village centers, these sewers are estimated to be over 100 years old. Rehabilitation of existing sewers is expected to be necessary.

During the preparation of the Facilities Plan flow metering data obtained from the NBC was reviewed and evaluated for the purpose of gaining insight into whether Infiltration / Inflow (I/I) is a significant issue in Town. A detailed analysis was not conducted within the framework of this project due to lack of available data, but the existence of excessive extraneous flows occurring within the existing sewers is suggested by the limited evaluations performed. NBC interceptor sewer system investigations are ongoing and findings reports are expected to be available prior to the implementation of this Facilities Plan. These reports should be utilized as references in planning and identifying where similar investigation of the Town's sewer system should be conducted.

Although sewers are available to most of the Town, on site individual sewage disposal systems (ISDS) must remain in use in isolated areas where convenient access to sewers does not exist. An excessive failure rate was not identified during review of RIDEM information on ISDS applications and no need was found to extending sewers to the isolated areas to address unsuitable ISDS conditions.

The primary recommendations of this Plan include:

- Investigation and evaluation of existing collection sewers (specifically those pre-dating 1980) to identify sources of potentially excessive extraneous flows and specific rehabilitation requirements.
- Staged sequence of rehabilitation for the existing pump stations.
- Continued employment of ISDS treatment in areas isolated from the existing sewer system.

The estimated total capitol cost of implementing the recommended plan is $6,390,000. Based upon the assumption that the cost will be 100% user financed, and SRF loans with an interest rate of 4% over 30 years are available, the cost to the average sewer system user is estimated to be approximately $50 per year.

Chapter 1 – Introduction

1.1 Purpose and Scope

The purpose for developing a Wastewater Facilities Plan for the Town of Lincoln is to provide a comprehensive plan for managing wastewater generated within in the Town for the 20-year planning period. Facilities planning considers various factors, including existing wastewater systems, environmental and economic impacts, and geophysical conditions, such as geology, topography, water quality, land use and demographic information, to develop alternatives and establish recommendations for wastewater management. The Facilities Plan will assess current conditions and address existing and future needs for wastewater facilities within the Town to establish compliance with the Federal Water Pollution Control Act. The Rhode Island Department of Environmental Management Office of Water Resources has developed guidelines describing the required components and analyses to be included in the planning process and is the primary regulatory agency for review of wastewater facilities planning documents. This Facilities Plan will be prepared in accordance with these guidelines as applied to the specific concerns of the Town of Lincoln.

As municipal sewer service currently is available to a majority of the Town, a primary concern of this Facilities Plan will be the proper management and maintenance of the existing sewer systems and related pumping facilities. The current conditions and anticipated useful service life for the existing wastewater pump stations is a significant consideration in addressing this concern. A conditions assessment study was conducted in order to establish necessary information for the pump stations and allow for the Facilities Plan recommendations to be developed. Available record documents, operation and maintenance information, operating histories and significant events reported by Town personnel, and observations made during on site inspections conducted at each of the Town's 31 pump stations were utilized to perform the conditions assessment.

An inventory of the existing gravity sewers also is needed to address the proper management of the Town facilities. A Town - wide sewer system map was developed

from available manhole location surveys previously mapped by the Town, record plans of sewer construction projects, and coordination inquiries with the Town's Engineering and Sewer Departments. Once the Town – wide map was developed, assessment of the current system was performed and conclusions regarding operations, maintenance, and any need for subsequent detailed studies, such as capacity analyses and specific infiltration and inflow (I/I) investigations, were developed. The Town-wide sewer system map also was evaluated in effort to determine if any potential system modifications to improve operations and / or reduce the number of individual pump stations were feasible wastewater management alternatives.

To address the wastewater needs of areas where municipal sewers are not available, the Facilities Plan includes assessments, evaluations, and recommendations regarding any need for improvements to current sewage disposal practices or expansion of sewers to serve these areas. The Town-wide sewer system map provided the basis and reference point for evaluating potential future sewer systems and assessing the feasibility of various alternatives for extending sewers to unsewered areas.

The Facilities Plan documents the information collected, the evaluations conducted, the alternatives investigated, and the recommendations and conclusions reached during planning process. The evaluation of alternatives encompasses financial aspects of probable costs of implementation and maintenance, technical feasibility of addressing specific wastewater needs, potential environmental impacts, and overall constructibility to arrive at the recommended plan to address the Town's specific wastewater management needs.

The last facet of the planning process is public participation. Public participation and awareness is of utmost importance to the planning process and the effectiveness of the Facilities Plan lies greatly in the clarity with which the specific wastewater needs of the Town are presented. Public meetings and hearings are conducted so that the citizens may understand fully these needs and so that the views and opinions of the community may be

considered when concluding specific measures to be recommended to address wastewater management in the Town.

1.2 Planning Area

The planning area for this Facilities Plan is the entire Town of Lincoln, Rhode Island. The Town of Lincoln is located in Providence County and is bordered by the Towns of Smithfield and North Smithfield to the west, the City of Woonsocket to the north, the Town of Cumberland to the north and east, the City of Central Falls to the east, and the Town of North Providence and City of Pawtucket to the south.

The Comprehensive Plan divides the Town into eight districts that include seven local villages, and the industrial corridor generally bounded by State Highway Route 116 and Interstate Highway Route 295. The eight districts are identified as follows:

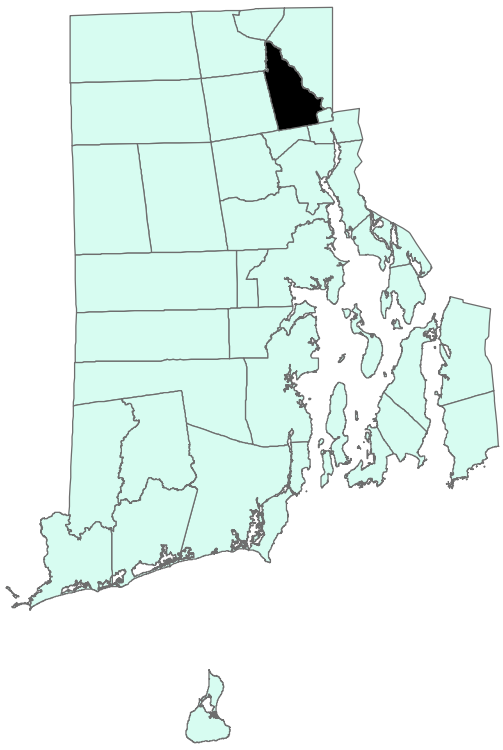
- Lonsdale
- Fairlawn
- Limerock
- Albion
- Saylesville
- Quinnville
- Industrial Areas
- Manville

Figure 1-1 depicts the general location of the planning area within the State and identifies the eight planning districts of the Comprehensive Plan.

The total area of the Town is approximately 12,100 acres (18.9 square miles), with approximately 11,890 acres of land area and approximately 210 acres of surface waters. The U.S. Census Bureau reports an estimated 2004 population of 22,188 people for the Town of Lincoln and the Rhode Island Statewide Planning Program projects the 2025 population will be approximately 24,000.

The Town government is in the form of and elected Town Administrator and five member elected Town Council with Home Rule Charter. The term of office for the Town

N



MANVILLE

ALBION

INDUSTRIAL CORRIDOR

QUINNVILLE

LONSDALE

SAYLESVILLE

LIMEROCK

FAIRLAWN

RIGIS

0 5,000 10,000 Feet

FIGURE NO.
1 – 1

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
PLANNING AREA

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Administrator and Town Councilors is two years with elections held biennially. All powers of the Town are vested in the Town Council. The Town Administrator is responsible for execution of the Town laws and administration of the Town government. These responsibilities include administration of the Town Department of Public works.

The Comprehensive Plan assigned the task of developing a wastewater facility plan to the Department of Public Works. The head of the Department of Public Works is the Director of Public Works who reports to the Town Administrator. The departments of concern within the Department of Public Works in regard to wastewater facilities are the Engineering Department and the Sewer Department. The Sewer Department is responsible for the operation and maintenance of the Town gravity sewers and wastewater pumping facilities. The Sewer Department Supervisor manages the department's staff of operations and maintenance personnel under the supervision of the Director of Public Works.

Duties of the Engineering Department include providing technical support to all Town departments, review and approval of development plans, maintaining engineering records and maps, and design of Town infrastructure and facilities. The Town Engineer manages the Engineering Department staff to perform these duties under the supervision of the Director of Public Works. The task of developing this Facilities Plan has been assigned to the Engineering Department.

The Sewer Department operating budget is provided from sewer system user fees. All residential users pay an annual flat rate fee per residential dwelling unit connected to the Town sewer system. Fees for non-residential users derived from a minimum fee as adjusted for annual water consumption above a predetermined volume. The current residential user fee is $75.00 and minimum non-residential user fee is $75.00 per annum. The fee for non-residential users with annual water consumption above 90,000 gallons is calculated by multiplying the $75.00 base fee by the total annual water consumption in gallons and dividing by 90,000. Sewage treatment and disposal is provided by the

Narragansett Bay Commission; treatment and disposal fees are charged directly to individual customers based upon metered water use.

Capital costs for sewer system components are assessed at a flat rate fee per structure for residential structures. Non-residential structures are assessed at a flat rate fee per connection for structures up to 10,000 square feet of floor area and are assessed an additional flat rate fee for each additional 10,000 square feet of portion thereof of building floor area. The current sewer assessment is $1,900.00 per structure / connection for residential and non-residential structures up to 10,000 square feet, with non-residential structures charged and additional $1,900.00 for each additional 10,000 square feet or fraction thereof of building area.

Chapter 2 – Discharge Limitations

The Town of Lincoln does not hold a Rhode Island Pollutant Discharge Elimination System (RIPDES) permit to discharge treated wastewater to the waters of the State. Town wastewater flows are conveyed to the Narragansett Bay Commission (NBC) wastewater collection and treatment facilities either by direct connection or indirectly via the municipal sewer systems of the Town of North Providence and City of Pawtucket. These wastewater flows ultimately are conveyed to the NBC system for treatment. Sewage from most of the geographic area of the Town is conveyed to the NBC Bucklin Point Wastewater Treatment Facility. Sewage from the southwesterly portion of Town that is tributary either to the NBC Louisquisset Pike Interceptor or North Providence sewers is conveyed to the NBC Field's Point Wastewater Treatment Facility. As such, the Town is subject to meeting the discharge limitations and requirements of these entities. The activities recommended in this Facilities Plan will not impair state water quality goals, standard and objectives.

Chapter 3 – Current Conditions

3.1 General

The Town of Lincoln is located in the northeast area of Rhode Island, bordered by the Towns of Smithfield and North Smithfield to the west, the city of Woonsocket to the north, the Town of Cumberland to the north and east, the City of Central Falls to the east, and the Town of North Providence and City of Pawtucket to the south. The planning area for this Facilities Plan is the entire Town of Lincoln.

The Town has a rolling topography and is tributary to two major drainage areas, the Moshassuck River and the Blackstone River. Land use within the Town is diverse, ranging from developed urban areas to historic villages to commercial / industrial campuses to suburban and pastoral landscapes. The Town has an extensive existing wastewater collection and conveyance system with approximately 100 miles of gravity sewers and thirty-one pumping stations.

3.2 Planning Area

3.2.1 Geophysical

Climate: Rhode Island experiences all of the four weather seasons with the predominate direction of prevailing weather patterns moving from west to east. The Atlantic Ocean also impacts weather conditions and seasonal transitions due to its proximity to the State. Table 3-1 provides seasonal and annual average temperature and precipitation figures for Rhode Island as reported by the National Climatic Data Center based upon data collected by the National Oceanic & Atmospheric Administration (NOAA) between from 1895 to 2005. Precipitation is distributed evenly throughout the year, with Summer average precipitation only slightly lower than the other three seasons. NOAA data indicates 104ºF and minus-13ºF as the highest and lowest temperatures, and 36.0 inches as the average annual snowfall amount, as recorded for Providence for the 51-year period through 2004.

Table 3-1

Average Temperature and Precipitation
Rhode Island 1895 - 2005

Period	*Temperature (°F)*	*Precipitation (Inches)*
Winter (Dec-Feb)	30.5	11.1
Spring (Mar-May)	46.1	11.3
Summer (Jun-Aug)	68.2	9.8
Fall (Sep-Nov)	52.9	11.3
Annual	49.4	43.5

Source: NOAA - National Climatic Data Center

Soils: The Soil Survey of Rhode Island published by the U.S. Department of Agriculture National Resources Conservation Service (NRCS), formerly the Soil Conservation Service, presents data on soil properties and characteristics throughout the State. This data was reviewed to determine the soil types and conditions that occur in the Town planning area. The potential for development depends significantly upon these documented soil properties, which establish the suitability for particular land use of the various soil classifications. NRCS classifies various soil groups with common characteristics by series and within each series, soils are subdivided further into phases by texture, degree of slope, and other physical characteristics.

Soils in Lincoln are generally classified as glacial till. Topography generally varies from nearly level to gently sloping to sloping areas. Based on mapped areas, less than 10% of Town soils are identified as very steep with slopes exceeding 15%. The Soil Survey maps and tables identify fifty-six (56) soil phases within the Town. The soil series occurring most frequently in the Town are described further below.

Canton and Charlton is the predominant mapped soil series in Lincoln, occurring on 5,300 acres scattered throughout the Town. This series consists of well drained sandy loams found in areas of varying slope from nearly level to moderately steep. These soils can have a surface layer typically in the range of 2 to 6-inches thick, a subsoil layer from 19 to

25-inches thick, and a substratum to 60-inches and greater depths. Permeability generally is moderate to moderately rapid in the surface and subsoil layers and rapid in the substratum. These soils generally are suitable for community development, except in steeper sloped areas; on-site sewage disposal systems designs must carefully consider potential for effluent seepage to the surface in rock outcrop areas. Canton and Charlton soils are found in areas of irregular shape ranging in size from 5 to 250 acres.

Hinckley series soils are mapped for more than 700 acres in Lincoln and generally are found in areas of irregular shape ranging from 5 to 75 acres in size. This series consists of excessively drained sandy loams occurring in level to hilly areas. Steeper sloped areas are found generally along the Blackstone River and milder slopes are scattered to the westerly side of the Town. Surface layers in this series typically fall between 2 and 6-inches, subsoil layers between 11 and 20-inches, and substratum to 60-inches and greater depths. Permeability is rapid in the surface and subsoil layers and very rapid in the substratum. Hinckley series soils are suitable for community development except in steeper sloped hilly locations. On-site sewage disposal systems require careful design and installation to prevent groundwater pollution, and to prevent effluent seepage to the surface in hilly areas.

Ridgebury series soils are poorly drained sandy loams found in level to nearly level areas in drainageways in glacial uplands. Top surface layer thickness can vary from 4 to 10-inches thick, subsoil layer generally falls between 16 and 18-inches thick, and substratum extends to 60-inches and greater depth. Permeability is moderate to moderately rapid in the surface and subsoil layers, and generally is slow in substratum. These soils are poorly suited to community development due to high water table and low permeability. On-site sewage disposal systems cannot be used without extensive filling. Soils in this series occur in long and narrow shaped areas ranging from 5 to 150 acres in size and are found on over 1,200 acres scattered throughout the westerly and southwesterly areas of the Town.

Sutton series soils are identified on over 800 acres primarily occurring in the southwestern section of Lincoln. These moderately well drained soils are fine sandy loams found in nearly level to gently sloping areas of irregular shape ranging in size from 3 to 150 acres. The surface layer in this series is about 3-inches thick, the subsoil layer is 22-inches, and the substratum extends to 60-inches and beyond. Permeability is moderate to moderately rapid. Seasonal high water table levels to within 20-inches of the ground surface are associated with these soils from late fall to mid-Spring. These soils are suitable for community development but on-site sewage disposal system design and installation requires special consideration of the seasonal high water table conditions.

Urban Land and Urban Land complexes are identified on over 1,850 acres in Lincoln. Urban land consists of developed areas of buildings, roads, parking lots and other urban structures. Areas mapped as Urban Land complexes consist of urban land interspersed with other soil series. The size and distribution of individual areas within the mapped complex area prevents the soil types from being shown separately on the soils maps. Urban Land and Urban Land complex soils are found in densely built up areas of mill village areas, in industrial parks, and in specific use locations including the Amica corporate campus, Davies School, the Community College of Rhode Island, Lincoln Mall and Lincoln Park. Development in Urban Land and Urban Land complex areas requires on site investigations to establish the suitability for specific uses.

Hydrology: The NRCS soil survey identifies four (4) hydrologic soils groups on the basis of infiltration rates as follows.

Group A: Soils having a high infiltration rate / low runoff potential when thoroughly wet consisting of well drained to excessively drained sands or gravels. Group A soils have a high rate of water transmission.

Group B: Soils having a moderate infiltration rate when thoroughly wet consisting of moderately well drained to well drained soils with moderately fine to moderately coarse texture. Group B soils have a moderate rate of water transmission.

Group C: Soils having a slow infiltration rate when thoroughly wet with a layer that impedes downward water movement or have moderately fine to fine texture. Group C soils have a slow rate of water transmission.

Group D: Soils having a very slow infiltration rate / high runoff potential when thoroughly wet consisting of clay soils with a high shrink-swell potential, soils with a permanent high water table, soils with a clay layer at or near the surface, and very shallow soils over nearly impervious materials. Group D soils have a very slow rate of water transmission.

Soils within the Canton and Charlton series are classified as hydrologic Type B soils. Soils within the Hinckley series are classified as Group A soils. Soils within the Ridgebury series generally are Group C soils; the Whitman phase soils within this series are Group D. Soils within the Sutton series are Group B soils. Canton – Urban land complex soils are classified as Group B and Merrimack – Urban Land complex soils are classified as Group A. NRCS does not identify a hydrologic group for Urban Land or Udorthents – Urban Land complex soils. Urban Land generally is comprised of impervious surfaces and Udorthents – Urban Land soils include impervious urban surfaces and disturbed soils that have been cut or filled.

Development in Group A soils must consider the potential for impact to and pollution of groundwater due to high permeability and rapid infiltration rates. On-site sewage disposal systems require special design and construction techniques in Group A soils where public sewers are not available. Some Group B soils with higher permeability rates can require similar special considerations for development. Development in Group C soils must address the lower permeability and slower infiltration rates associated with these soils. Again, special design and construction considerations are necessary for development in

Group C soils where public sewers are not available and on-site sewage disposal is required. Development in Group D soils is restrictive and these soils are not suitable for on-site sewage disposal methods. A majority of the Town soils are classified as Group B. Development constraints based upon soils conditions as mapped by RIGIS are presented in Figure 3-1.

Topography: Topographic characteristics impact significantly upon the design of sewer collection, transmission and conveyance systems. The existing characteristics of ground slope and natural drainage patterns generally dictate the required layout of gravity sewers and necessary locations for pumping stations. The design of sewer systems should utilize the natural slope and drainage patterns to the extent practical to minimize the need for pumping.

The nearly level to sloping soils occurring in Lincoln provide a gently sloping topography that can be well suited to various types of development. Very few areas of Lincoln have slopes greater than 15% and development in the Town generally is not limited due to steeply sloped conditions. However, the rolling terrain of Lincoln has resulted in the many segregated gravity collection systems and thirty-one (31) wastewater pump stations that comprise the Town's existing wastewater facilities.

Lincoln lies within two (2) major drainage basins, the Blackstone River basin and Moshassuck River basin, as depicted in Figure 3-2. In general, the areas north of Route 116 and the easterly side of Town that lies in the river valley drain to the Blackstone River, and the southwesterly areas of Town drain to the Moshassuck River. Twelve (12) of the wastewater pump stations are located in the Blackstone River Basin and nineteen (19) are in the Moshassuck Basin.

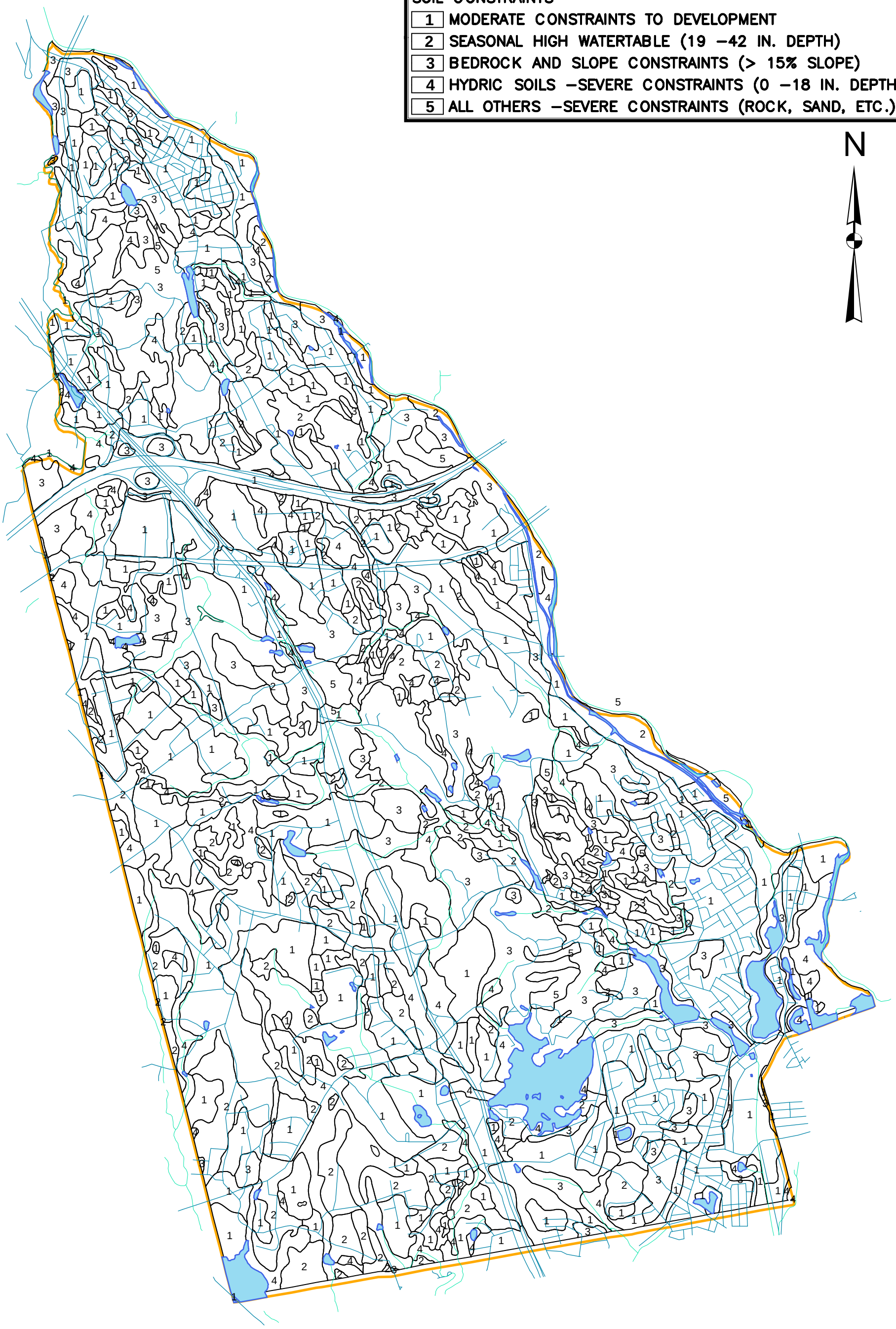
Geology: Geologic characteristics also impact upon the design of sewer systems and on-site sewage disposal systems. Shallow depth to bedrock adversely affects the treatment performance of on-site disposal systems were sewer service is not available and can result

LEGEND

SOIL CONSTRAINTS

1	MODERATE CONSTRAINTS TO DEVELOPMENT
2	SEASONAL HIGH WATERTABLE (19 –42 IN. DEPTH)
3	BEDROCK AND SLOPE CONSTRAINTS (> 15% SLOPE)
4	HYDRIC SOILS –SEVERE CONSTRAINTS (0 –18 IN. DEPTH)
5	ALL OTHERS –SEVERE CONSTRAINTS (ROCK, SAND, ETC.)

N



RIGIS

0 5,000 10,000 Feet

FIGURE NO.
3–1

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
SOIL CONSTRAINTS

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in increased construction costs for conventional sewer system installations. While depth to bedrock is greater than 60-inches in most areas, shallower depths and rock outcrops occur in various areas most predominantly in Lincoln Woods State Park north of Olney Pond, and west of Old Louisquisset Pike between Wilbur Road and Route 116.

The geological deposits of Rhode Island primarily were formed from glacial deposits. The geology of the Town of Lincoln generally can be grouped into two classifications, upland till plains and outwash deposits. Upland till plains are characterized by unconsolidated drift deposited by glaciers on hills, ridges, and side slopes. Outwash deposits are areas of stratified materials sorted by ice melt runoff and deposited on terraces, plains and valleys. Upland till soils are found throughout the Town and outwash deposits occur near natural drainage channels and mostly along or near the Blackstone River.

3.2.2 Demographic and Land Use Data

The 2000 Census population was 20,898 residents; the Rhode Island Economic Development Corporation (EDC) reports that 265 of the 8,508 total housing units reported for the 2000 Census were vacant. The US Census Bureau estimates the 2004 population for the Town at 22,188. Utilizing the 2000 Census and EDC data to determine a population density per housing unit results in a figure of 2.54 persons per household. Applying this density to the estimated 2004 population results in approximately 8735 occupied housing units. This Facilities Plan will utilize these figures as baseline existing conditions. Population figures by census tract for the 2000 Census are provided in Table 3-2.

Historically, land use in Lincoln grew from development around the mill villages along the Blackstone River. These villages along with the major transportation corridors through the Town, State Routes 116 and 146, Interstate Route 295, serve as the general framework and boundaries for land use within the Town.

Table 3-2

Population by Census Tract

	1970	1980	1990	2000
Tract 115	4,593	4,717	5,207	6,186
Tract 116	3,079	3,925	4,421	5,701
Tract 117.01	4,740	4,479	4,453	4,859
Tract 117.02	3,770	3,828	3,964	4,152
Total	16,182	16,949	18,045	20,898

In general, lot sizes are smaller and residential density is higher in the mill villages along the Blackstone River than in the areas in the westerly portions of the Town developed more recently. The mill village centers have a mixture of residential, commercial and industrial usage and for the most part are now well developed with limited potential for growth. New industrial development is limited to the industrial corridor generally bounded by State Route 116 and Interstate Route 295, and the industrial parks along Albion Road. Residential land use is dominant throughout the rest of the Town interspersed with specific areas of institutional, commercial and recreational uses. Table 3-3 provides an inventory by acreage for residential and business land use categories.

Table 3-3

Residential and Business Land Use Inventory

Category	1995 Acres
Residential	3,298
Business	919
Total	4,217
Residential to Business Land Use Ratio	3.6

Source: Town of Lincoln, RI 2003 Comprehensive Plan

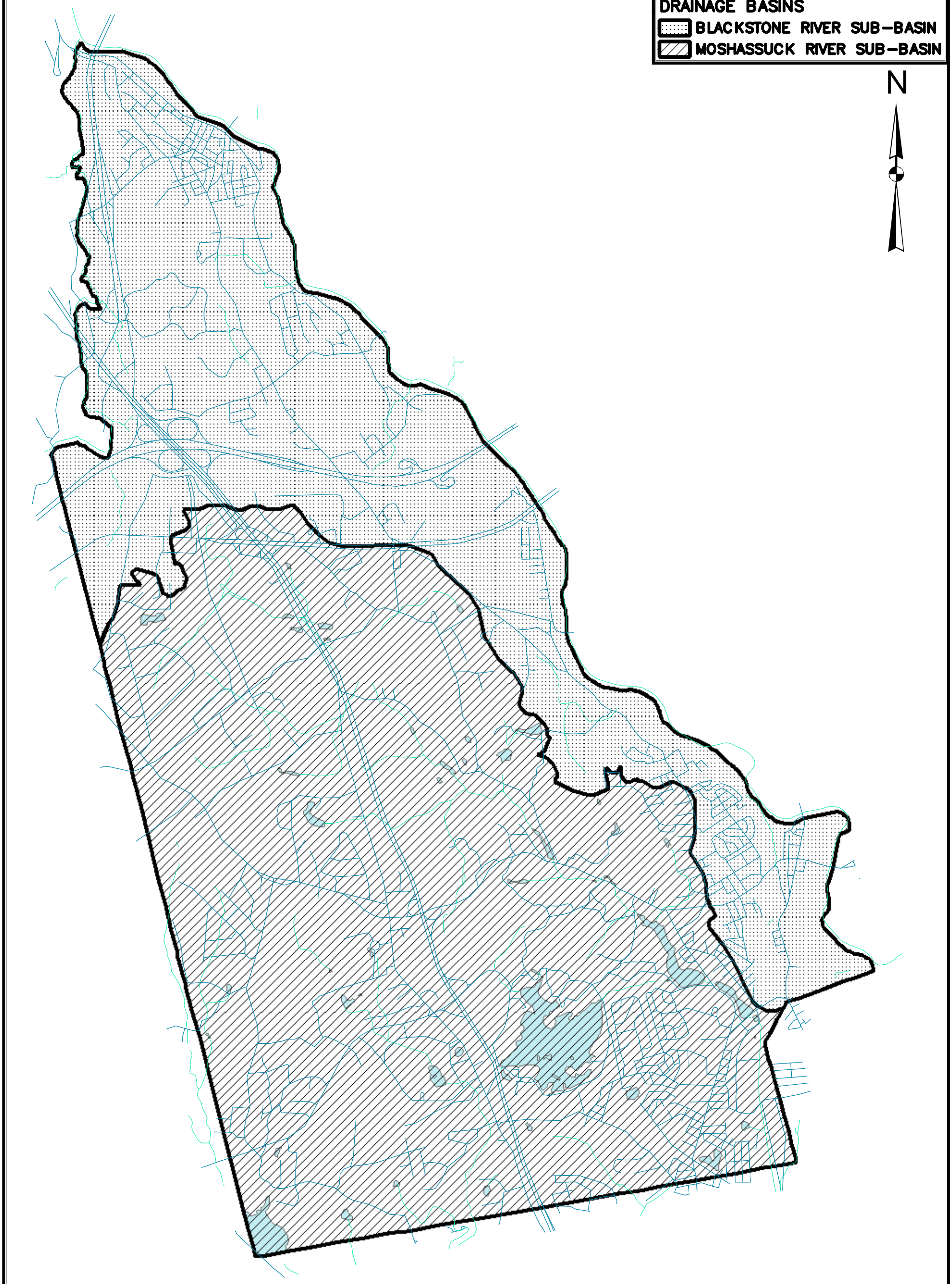
3.2.3 Surface Water

The Town of Lincoln has various inland water surface bodies within its borders. The most prevalent surface water body is the Blackstone River, which forms the Town's municipal boundary to the east. Other significant inland surface water bodies lying either fully or in part within the Town of Lincoln include the Moshussuck River, West River, Crookfall Brook, Barney Pond, Olney Pond, Handy Pond, Scott Pond and Wenscott Reservoir, as well as various other small ponds, creeks and drainage tributaries. No coastal surface water occurs within the Town.

The major drainage basins and the tributary areas of the Town of Lincoln are depicted on Figure 3-2. The Town lies within the major drainage basins of the Blackstone River and Moshassuck River. Generally, the easterly portion of the Town lies in the valley that slopes directly to Blackstone River. The northwesterly area of Town also is tributary to the Blackstone River via the Town Line Swamp and Crookfall Brook. The southwesterly area of the Town generally bounded to the east by State Route 123 (Jenckes Hill Road) and State Route146 drains to the Moshassuck River via the West River, the Wenscott Reservoir, and several smaller tributaries. The remaining area of the Moshassuck basin generally lies east of State Routes 123 and 146 and west of the Blackstone basin. This area drains to the Moshassuck River directly and via various tributaries including streams from Olney Pond and Barneys Pond.

RIDEM has established surface water criteria in the Water Quality Classification Descriptions dated August 6, 1997 provided as Appendix A of the current State Water Quality Regulations. All surface waters of the state are categorized according to the water use classifications of the regulations based on considerations of public health, recreation, propagation and protection of fish and wildlife, and economic and social benefit.

RIDEM Freshwater Use Classifications are as follows:



RIGIS

FIGURE NO.
3-2

TOWN OF LINCOLN
Incorporated 1871

WASTEWATER FACILITIES PLAN
DRAINAGE BASINS

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- Class A – These waters are designated as a source of public drinking water supply, for primary and secondary contact recreational activities and for fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.

- Class B – These waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.

- Class B1 – These waters are designated for primary and secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value. Primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However all Class B criteria must be met.

- Class C – These waters are designated for secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses these water shall have good aesthetic value.

The Blackstone River from the Massachusetts border through Lincoln and into Central Falls is classified by RIDEM as B1. Scott Pond and its tributaries are Class B waters. Crookfall Brook including Woonsocket Reservoir No. 3 and its headwaters is Class A. The Moshassuck River from its headwaters, including Bleachery and Barney Ponds in Lincoln is a Class B waterbody. Olney Pond in Lincoln Woods State Park is Class B. The West River headwaters in Lincoln and the Wenscott Reservoir are also Class B waters.

RIDEM has not classified any waters as Class C in Lincoln. The RIDEM Water Quality Regulations also stipulate that all streams tributary to Class A waters shall be Class A waters; all freshwaters hydrologically connected by surface waters and upstream of Class B waters shall be Class B waters unless otherwise identified; all other fresh waters, including, but not limited to, ponds, kettleholes and wetlands not listed in the regulations shall be considered as Class A.

Rhode Island is required to develop a list of impaired waters for the State in accordance with the requirements of Section 303(d) of the federal Clean Water Act. The list identifies waterbodies that may not meet current state water quality standards for aquatic life, drinking water supply, shellfishing, fish consumption and swimming.

RIDEM published the 2004 303(d) List of Impaired Waters - Final in May 2005. This list identifies Scott Pond, Barney Pond and the Blackstone River as surface water locations within Lincoln that do not attain state standards. The cause(s) identified by RIDEM for not meeting the state water quality standards for these water is listed in Table 3-4.

Table 3-4

List of Impaired Waters

Water Body	*Impairment*
Scott Pond	Low Dissolved Oxygen, Excess Algal Growth, Phosphorus
Barney Pond	Phosphorus
Blackstone River	Copper, Pathogens, Biodiversity Impacts, Lead

Additionally, the 2004 303(d) List identifies sections of the Moshassuck River and West River as not meeting state standards for pathogens. However, the RIDEM description of the impaired sections of these rivers identifies locations downstream of the portions of these waterbodies within the Town. The 2003 Comprehensive Plan indicates that area of the upper reaches of the Moshassuck River and Limerock Quarry area are noted for good

water quality. RIDEM has assisted the Blackstone River Watershed Council in development of a Draft Blackstone River Watershed Action Plan with the objective to restore impaired sections, including implementing the Total Maximum Daily Load (TMDL) process, of the Blackstone River and its tributaries.

The RIDEM 2004 Section 305(b) State of the State's Waters Report indicates that the beach at Lincoln Woods was closed for six days during 2002 and that the beach at Camp Meehan was closed seventeen days during 2003 due to elevated fecal coliform bacteria levels. The report identifies elevated rainfall and temperatures for Lincoln Woods in 2002 and wildlife for Camp Meehan in 2003 as problems related to the beach closures.

3.2.4 Groundwater

RIDEM establishes and regulates groundwater quality standards and divides groundwater into the following four (4) classifications: GAA, GA, GB and GC.

Groundwater that is protected to maintain drinking water quality is classified as GAA and GA. Class GB and GC groundwaters are known or presumed as unsuitable drinking water sources. Groundwater aquifers in Lincoln are stratified drift type. Areas overlying groundwater aquifers and groundwater aquifer recharge areas within the Town of Lincoln are depicted on Figure 3-3.

Class GAA groundwater resources are known or presumed to be suitable for drinking water use without treatment and are located in one of the following three areas.

- The states's major stratified drift aquifers that are capable of servicing as a significant source for a public water supply ("groundwater reservoirs") and the critical portion of their recharge area as delineated by RIDEM
- The RIDEM delineated wellhead protection area for each community water supply well or another delineation accepted by RIDEM

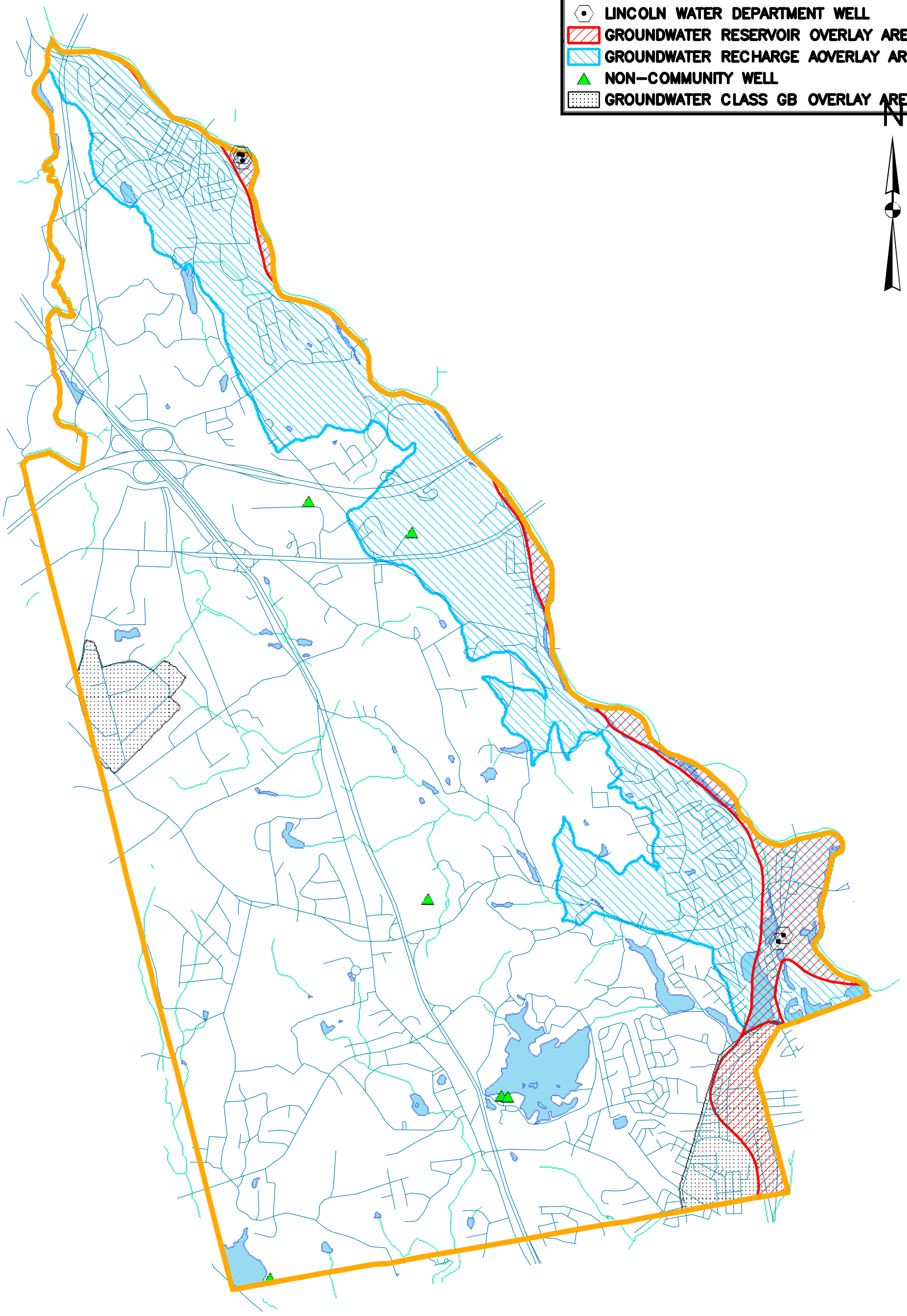

FIGURE NO.
3-3

WASTEWATER FACILITIES PLAN
GROUNDWATER AQUIFERS

Civil & Environmental Engineering Partners, Inc.
342 Park Avenue, Woonsocket, RI 02895

- Groundwater dependent areas that are physically isolated from reasonable alterative water supplies and where the existing groundwater warrants the highest level of protection.

Approximately 23% of groundwater area within the Town is Class GAA. Areas classified as GAA occur along the easterly side of Lincoln in the general vicinity of the Blackstone River.

Class GA groundwater resources are known or presumed to be suitable for drinking water use without treatment, but do not fall within any of the three priority areas associated with Class GAA resources. Approximately 71% of groundwater area within the Town is Class GA. When combined with GAA areas, approximately 94% of the groundwater areas within the Town are known or presumed to be suitable drinking water sources without treatment.

Class GB groundwater is groundwater that may not be suitable for drinking water use without treatment due to known or presumed degradation. RIDEM utilized data from known sources of contamination and land use in delineating Class GB areas. All Class GB areas are served by public water supply systems. Remediation of Class GB areas to restore drinking water quality is not mandated, but may be necessary to address public health and environmental considerations. Class GB groundwater areas in Lincoln occur at the industrial area in the vicinity of Wellington, Powder Hill and Albion Roads, and in the Saylesville and Fairlawn sections east of Smithfield Road and Walker Street. Less than 4% of the groundwater areas in Lincoln are Class GB.

Class GC groundwater is or may be unsuitable for drinking water use due to certain waste disposal practices that are associated with RIDEM permitted solid waste landfills. No Class GC groundwater areas occur in Lincoln.

Locations occur within Class GAA and GA areas where groundwater conditions do not meet the appropriate standards for these classes due to contamination associated with specific sources. The groundwater classification for these non-attaining areas remains GAA or GA and the goal is to restore the water quality to compliance with the applicable standards. Groundwater non-attaining areas include portions of Quinnville and Lonsdale along the Blackstone River impacted by the Peterson Puritan Superfund site and areas impacted by various releases from the industrial parks at Wellington Drive, Powder Hill Road, and Albion Road. EPA groundwater treatment and monitoring associated with the Peterson Puritan Superfund site is expected to continue for 20 to 30 years. Some cleanup reportedly has occurred at sites in the industrial park. Several sites in Lincoln are listed as awaiting priority determination for eligibility for funding under the EPA Superfund program.

Lincoln receives most of its water from the Scituate Reservoir, but does utilize groundwater from well sources in Town to supplement supply as needed. Lincoln's Zoning Ordinance (adopted November 15, 1994) has been amended to include a watershed and wellhead protection district. New construction and substantial alternation to structures or buildings within this district is subject to an additional review by the Zoning Enforcement Officer. The review addresses minimizing the flow of runoff into the water supply, removing or prohibiting any potentially polluting uses, and assuring consistency of development with the Lincoln Comprehensive Plan.

3.2.5 Water Use

Water use records can be used to estimate generated wastewater flow rate volumes in the absence of metered wastewater flow data. The Lincoln Water Commission provides public drinking water in the Town of Lincoln. The Lincoln Water Commission is not affiliated with the municipal government of the Town and is not funded by local taxes. The Lincoln Water Commission provided the information presented in Table 3-5 for metered flow billed to its customers in 2004.

The primary source of public water supply in Lincoln is via direct wholesale purchase from the Providence Water Supply Board. The Lincoln Water Commission also utilizes Well No. 4 in Lonsdale as a supplemental source of supply. Historically, 90 to 95 percent of the water consumed is from the Providence Water Supply Board wholesale source and 5 to 10 percent from Well No. 4. The Lincoln Water Commission maintains other wells in Lonsdale and Manville in "inactive" status for emergency use in the event of the failure of all other sources. Public water is available to nearly 100 percent of the Town and approximately 95 percent of the Town is connected to the system.

Table 3-5

2004 Water Consumption

Water District	*Accounts*	*Total Gallons*
Saylesville	1376	113,129,113
Lonsdale	987	77,627,918
Manville, Albion, Fairlawn	1618	150,608,915
Limerock	1597	168,326,907
Apartments	237	55,114,600
Commercial (Monthly)	56	155,323,700
Commercial (Quarterly)	76	29,207,700
Commercial (Annual)	128	9,601,300
Total Billed	6075	758,940,153

The water use data in Table 3-5 reveals higher per service residential water use in the Limerock and Manville, Albion, Fairlawn water districts. This difference is attributed to non-consumptive water uses, such as swimming pools and landscape watering that typically are less prevalent in higher density residential areas. The average residential service (excluding apartments) used approximately 250 gpd based upon metered water use and number of service connections, and the average residential service used 185 gpd based upon serving 21,079 people (95 percent of 2004 population) and a density of 2.54 person/unit, or approximately 73 gpd per person. This Facilities Plan will utilize a water

use figure of 200 gpd per residential water service for future water use projections. This figure is approximately 80 gallons per person per day based upon the density of 2.54 person/unit, and is consistent with water use figures indicated the Comprehensive Plan.

The Comprehensive Plan identifies a total of 1,727 acres available for business use and 919 acres of current business land use in 1995, or approximately 53 percent of the total available commercial land. Utilizing commercial coverage and water use figures indicated in the Comprehensive Plan and adjusting to account for lower density coverage of commercial recreational zones results in an estimate of 957 acres of current commercial land use. This estimate represents approximately 55 percent of the total available commercial land and compares favorably with the documented land use for 1995. 2004 Commercial water consumption was approximately 767 gpd/acre based upon metered water use and adjusted for commercial recreation zones. The average commercial water service used approximately 2,040 gpd based upon metered water use. This Facilities Plan will utilize a water use figure of 1,500 gpd/acre for future commercial water use projections.

3.2.6 Environmental Conditions

3.2.6.1 Air Quality

Rhode Island is in compliance with the National Ambient Air Quality Standards (NAAQS) established under the federal Clean Air Act for all categories except Ozone according to RIDEM Office of Air Resources. RIDEM indicates that the entire state is in non-attainment for this category and Ozone levels are a concern throughout Rhode Island as well as neighboring states. Ozone problems are associated with motor vehicle exhaust and industrial emissions. RIDEM has implemented a plan for compliance with the NAAQS for Ozone and reports that Rhode Island is on track for attainment by 2007. Because Ozone and pollutants that form it can be transported hundreds of miles by wind currents, Ozone levels and attainment of NAAQS for Ozone in Rhode Island are dependent on upon emissions from upwind states. The RIDEM Ozone attainment plan identifies one facility

in Lincoln, BICC General Cable, in the Rhode Island VOC Point Source Emission Inventory.

Odorous emissions from wastewater conveyance facilities also are an air quality concern. Many of the Town's pump stations are located in residential areas in close proximity to adjacent homes and odor complaints can be problematic with these conditions. While odor complaints have been received for various facilities, the Town does not identify odors as an issue of concern or recurrent problem for any specific location.

3.2.6.2 Noise Levels

Specific noise studies were not conducted for this Facilities Plan. High traffic volume along major highway Routes 295, 146 and 116 in the planning area can be a source of noise. Air traffic to and from the North Central Airport and industrial processes in the adjacent industrial park also can be noise sources. The higher density of development in the mill villages also is associated with higher traffic volumes and increased noise levels. Noise levels are not considered to be an issue of concern with respect to this Facilities Plan.

3.2.6.3 Wetlands

Lincoln has a variety of wetlands areas scattered throughout the Town, with approximately 15% of the total land area identified as wetlands. Wetlands occur where water covers or is very near the soil surface for varying periods and include open water areas, such as rivers, ponds and streams, and vegetated areas, such as swamps and forested wetlands. Wetlands are valuable natural resources that serve to store water and control flooding during wet weather, maintain stream flow during dry periods, and filter and treat nutrients and stormwater pollutants, which is beneficial in maintaining both surface and groundwater quality. Wetlands provide habitat and support a wide array of plant and animal species and also have important aesthetic and recreational value. Mapped wetlands areas in Lincoln are shown on Figure 3-4.

LEGEND

WETLANDS

N

10,000 5,000 0 Feet

RIGIS

FIGURE NO.
3–4

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
WETLANDS AREAS

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Palustrine System wetlands, as defined by the United States Geologic Survey (USGS), is the dominant wetlands classification occurring in Lincoln. Palustrine wetlands include all non-tidal wetlands dominated by trees and shrubs traditionally identified as marsh, swamp, bog, fen and prairie, and also include small shallow water bodies often called ponds. Over 70% of the wetlands in Lincoln fall within the Palustrine classification. The remaining wetlands fall under the Riverine and Lacustrine Systems defined by USGS. Riverine Systems include wetlands habitats not dominated by vegetation that are contained in a channel. Water usually, but not always, is flowing in Riverine wetlands. Lacustrine Systems include wetlands habitats situated in a topographic depression that have vegetative coverage of less than 30% in area. Lacustrine wetlands generally are greater than 20 acres in size. Lacustrine and Riverine wetlands respectively account for approximately 20% and 7.5% of the wetlands in Lincoln. No Estuarine (coastal) or tidal wetlands are identified in Lincoln.

Wetlands can become clogged and degraded if they are overloaded. Development must be sensitive to wetlands habitat to prevent overloading from surface runoff or wastewater effluents, as well as filling and water diversion that can reduce the capacity of the wetlands and also result in overloading. Development in wetlands is strictly regulated and wetlands generally are not suitable for on-site sewage disposal systems because high water tables. However, where development occurs in areas where public sewers are not available and is in the vicinity of wetlands habitats, special considerations need to be taken in the design of on-site sewage disposal systems in order to prevent negative impacts.

The Town has identified the following areas of special concern for protection of wetlands:

- The periphery area of Lincoln Park that be reused at some point in the future.
- Conklin Quarry, where wetlands now are protected as open space.
- Lonsdale Marsh Restoration Project along the Blackstone River (site of former Lonsdale Drive-In).

- Moshassuck River Valley in East Limerock where much of the remaining developable land is found.
- The West Limerock and Twin River areas and Crookfall Brook watershed along Route 146 where infill development may occur.

3.2.6.4 Floodplains

Floodplains provide water storage when the capacity of rivers and streams channels is exceeded. The Federal Emergency Management Administration (FEMA) defines 100-Year Flood as the flood elevation that has a 1% chance of being equaled or exceeded each year. Areas mapped within the 100-Year floodplain in Lincoln occur along the Blackstone River, Moshassuck River and Crookfall Brook. Little developable land is located in the 100-year floodplain. Figure 3-5 depicts FEMA floodplains in Lincoln.

3.2.6.5 Historical and Archaeological Significance

The Town of Lincoln has many locations, sites and structures of historical and archeological importance. The Comprehensive Plan provides a detailed listing of Historic Resources of Lincoln based upon information gathered from the Rhode Island Historical Preservation Commission, the Blackstone River Valley National Heritage Corridor Commission and the National Register of Historic Places. The following areas are identified as National Register Districts in Lincoln:

Albion Historic District	Blackstone Canal Historic District
Great Road Historic District	Limerock Village Historic District
Lonsdale Historic District	Old Ashton Historic District
Saylesville Historic District	Crookfall Brook District *
Lincoln Woods State Park *	

* - Candidate eligible for listing or being considered for eligibility.

The Blackstone River Valley National Heritage Corridor Commission was established in 1986 by the United States Congress. The Blackstone River Valley National Heritage

LEGEND

FEMA FLOODWAY

N

0 5,000 10,000 Feet

RIGIS

FIGURE NO.
3–5

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
100 YEAR FLOOD WAY

Civil & Environmental Engineering Partners, Inc.
342 Park Avenue, Woonsocket, RI 02895

Corridor is an affiliated area of the National Park System comprised of communities located along the river in both Massachusetts and Rhode Island, including Lincoln. The Blackstone River Valley National Heritage Corridor Commission promotes tourism and preservation of historic resources throughout the Corridor, and is committed to improving the health of the river system.

In addition to locations and structures of historical importance, Native America artifacts have been found at sites in Lincoln. The Rhode Island Historical Preservation Commission should be consulted for determination of potential impacts when considering development in areas of known or suspected archeological importance. Figure 3-6 depicts areas of historical and archeological significance.

3.2.6.6 Energy Use

Detailed energy usage studies were not performed for this Facilities Plan. The primary energy sources utilized in Rhode Island include electricity, petroleum, natural gas and propane, and coal. The Rhode Island Statewide Planning Program reports that petroleum products historically provide approximately three quarters of the states's primary energy consumption. Petroleum uses include transportation, heating, and fuel for power plants. Electric utility service is provided by National Grid. Natural gas utility service is provided by New England Gas Company where service is available. Fuel oil and propane are provided by various independent suppliers.

In addition to established energy efficiency policies, government agencies are promoting the use and investigation of alternative fuel sources in effort to reduce dependence on petroleum based fuels while maintaining energy supplies to support economic growth and prevent service disruptions. It expected that energy use in the Town generally will follow and reflect that of the State, including changes to alternative fuels, as they may develop.

The Town reports fluctuations in the electric utility power to various pump station locations have been observed that have resulted in interruptions to pumping operations.

N

LEGEND

HISTORIC DISTRICT

ARCHEOLOGICALLY SIGNIFICANT AREAS

HISTORIC SITES

1. ARNOLD (ISRAEL) HOUSE GREAT ROAD
2. BALLOU HOUSE
3. ELEAZER ARNOLD HOUSE
4. ELLIOTT–MINER–HARRIS HOUSE
5. HEARTHSIDE
6. JENCKES HOUSE
7. LIME KILNS
8. PULLEN CORNER SCHOOL
9. WHIPPLE–CULLEN HOUSE AND BARN

RIGIS

0 5,000 10,000 Feet

FIGURE NO.
3–6

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
ARCHEOLOGICAL & HISTORIC AREAS

Civil & Environmental Engineering Partners, Inc.
342 Park Avenue, Woonsocket, RI 02895

The Town has identified concerns regarding recurrent failures, 'brown outs' or other power reductions to National Grid in effort to address these concerns to assure continuous pumping operations. National Grid has replaced utility power equipment components in the vicinity of some of the Town's stations, which apparently has reduced the occurrence of power reductions or failures that result in interruption of pumping operations. The Town has found that the utility service / pumping operation interruptions may be associated with operations and maintenance activities performed periodically by National Grid. In effort to coordinate these activities so that appropriate measures can be implemented in advance in order to maintain continuous pumping operations, the Town has requested that National Grid notify the Sewer Department when the activities that have been associated with pumping operation interuptions are scheduled to occur.

3.2.6.7 Related Projects

Related projects that are ongoing or anticipated to occur in the near future include:

- NBC Interceptor Sewers Capacity Analysis
- NBC Washington Highway Pump Station Improvements
- NBC Bucklin Point WWTF Improvements
- NBC Interceptor Cleaning, Inspection, Repairs
- RIDOT Route 146 / 116 Interchange Reconstruction
- RIDOT Berkeley and Martin Street Bridge Replacement
- RIDOT Smithfield Avenue Resurfacing (Woodland Street to Front Street)
- RIDOT Route 246 Resurfacing (Breakneck Hill Road to Route 116)
- RIDOT School Street Resurfacing (Main Street to Route 126)
- RIDOT Railroad Street Resurfacing (Main Street to Old River Road)
- RIDOT Blackstone River Bikeway Segment 7A
- RIDOT Blackstone River Bikeway Segment 4A

The NBC Interceptor Sewer Capacity Analysis project includes collecting flow metering data at various locations of its interceptor system in order to evaluate existing sewage and

extraneous flows and quantify available capacity. Conditions assessment and evaluation of interceptor repair and replacement alternatives also are to be conducted. These studies could have significant impact upon the Town if NBC identifies substantial extraneous flows and determines the sources to be within Lincoln's sewers. Particular attention should be paid to the Louisquisset Interceptor evaluation to ensure that the Town's sewerage needs are addressed fully by the final recommendations. Other NBC projects involve maintenance, upkeep and improvements to existing facilities. Immediate impacts due to construction activities may be observed on projects occurring within the Town. These projects are expected to have a positive impact on Lincoln's wastewater facilities by establishing more accurate system data and providing for long-term reliability of the NBC facilities.

The RIDOT projects are not expected to have substantial impact upon this Facilities Plan. For the most part, the highway projects involve maintenance or improvement of existing roadways that should not result drastic traffic increases or changes in overall traffic patterns. The existing sewers in the segment of Smithfield Avenue to be reconstructed were installed during the major sewer system construction projects in the 1980s. These sewers should be in satisfactory condition to remain in service, but there are older sewers in some connecting streets. Summer 2006 construction is anticipated for this project, therefore assessing the sewer system conditions and coordinating any necessary replacement to occur coincide with the roadway construction may not be possible.

Much of the segment of Route 246 (Old Louisquisset Pike) to be resurfaced has sewers that were installed during the major sewer system construction projects that also are expected to be in satisfactory condition. However, there are no sewers in Old Louisquissett Pike extending approximately 1,800 feet north from Breakneck Hill Road. If sewers are to be extended to this area in the future, the possibility of coordinating the work with the roadway resurfacing project should be investigated and implemented to the extent practical. Similarly, any necessary repair or replacement of sewers in Railroad Avenue and School Street should be coordinated with these respective RIDOT projects.

The non-highway projects associated with bike and walking paths serve to enhance recreational accessibility and should have no impact on this study. However, the Town should monitor all individual projects, whether highway or non-highway, with respect to existing sewer systems in the vicinity of construction activities for potential impacts. Of particular importance and concern is protection of existing manholes, frames and covers so that these remain fully functional and are not buried or paved over. Start of construction for Bikeway Segments 7A and 4A are scheduled for Spring 2006 and Summer 2006 respectively.

3.2.6.8 Rare and Endangered Species

Information on rare and endangered species habitats in Lincoln obtained from the Rhode Island Natural Heritage Program and RIDEM is presented in the 2003 Comprehensive Plan. RIDEM was contacted and confirmed that the information included in the Comprehensive Plan remained valid. The Limerock Quarry area is identified as the only significant limestone outcropping in Rhode Island and provides habitat for various rare plant species. The Lonsdale Marshes are identified as one of the largest freshwater marshes in Rhode Island and provide habitat to several species of rare birds. The following list of rare species found in Lincoln are identified in the Comprehensive Plan:

Agalinis Acuta	Sandplain Gerardia
Adlumia Fungosa	Climbing Fumitory
Aralia Racemosa	Spikenard
Asplenium Rhizophyllum	Walking Fern
Galearis Spectabilis	Showy Orchis
Pellaea Atropurpurea	Purple Cliff-Brake
Hirundo Pyrrhonota	Cliff Swallow
Asclepias Quadrifolia	Four-Leaved Milkweed
Coeloglossum Virde Var Virescens	Long-Bracted Green Orchis
Corallorhiza Odontorhiza	Autumn Coralroot
Coreopsis Rosea	Pink Tickseed
Cypripedium Pubescens	Large Yellow Lady's-Slipper
Desmodium Ciliare	Small-Leaved Tick-Trefoil

Gentianopsis Crinita	Fringed Gentian
Liparis Liliifolia	Lily-Leaved Twayblade
Liparis Loeselii	Yellow Twayblade
Platanthera Hyperborea	Northern Green Orchid
Triosteum Aurantiacum	Wild Coffee
Anas Crecca	Green-Winged Teal
Cistothorus Palustris	Marsh Wren
Ixobrychus Exilis	Least Bittern
Porzana Carolina	Sora
Actaea Rubra	Red Baneberry
Anemone Cylindrica	Long-Fruited Anemone
Botrychium Lasnceolatum Var Angustisegmentum	Triangle Grape-Fern
Botrychium Matricariifolium	Daiseyleaf Grape-Fern
Botrychium Simplex	Dwarf Grape-Fern
Corallorhiza Maculata	Large Coralroot
Cornus Rugosa	Round-Leaved Dogwood
Hedeoma Pulegioides	American Pennyroyal
Hottonia Inflata	Featherfoil
Juncus Debilis	Weak Rush
Ulmus Rubra	Slippery Elm
Asplenium Trichomanes	Maidenhair Spleenwort
Equisetum Sylvaticum	Woodland Horsetail
Hepatica Nobilis Var Obtusa	Hepatica
Matteuccia Struthiopteris	Ostrich Fern
Platanthera Psycodes	Small Purple Fringed Orchid
Sanguinaria Canadensis	Bloodroot
Saxifraga Virginiensis	Early Saxifrage
Sorghastrum Nutans	Indian Grass
Zizia Aurea	Golden Alexanders
Agrimonia Pubescens	Hairy Agrimony
Castilleja Coccinea	Painted Cup
Eupatorium Aromatucum	Snakeroot
Geum Laciniatum Var Trichocarpum	Hairy Herb-Bennet
Linnaea Borealis Ssp Americana	Twinflower
Parnassia Glauca	Grass-Of-Parnassus
Spiranthes Lucida	Shining Ladies'-Tresses
Southern New England Rich Mesic Forest	Southern New England Rich Mesic Forest

Protection of these rare or endangered species and their habitat should be included when considering and evaluating potential future development.

3.3 Wastewater Systems

The Comprehensive Plan reports that municipal sewers are available to approximately 99% of the geographic area of the Town and Town personnel estimate that approximately 95% of the Town is connected to the public sewer system. Areas isolated from the municipal sewer systems are served by individual sewage disposal systems (ISDS). There also are properties that remain served by ISDS scattered within sewered areas. Town ordinance requires properties where existing ISDS systems have failed to connect to the sewer system where public sewers are available. Existing sewers include: sewers constructed prior to 1900, normally found in older mill village center areas; sewers constructed in the 1960s to serve industries in the area of Wellington and Powder Hill Roads; sewers constructed by the Blackstone Valley Sewer District Commission (BVSDC) during regionalization projects in the 1970s, which now are owned and operated by NBC; and sewers constructed since 1985 that have extended service to nearly the entire Town. The existing collection system is segregated into numerous smaller tributary sub-systems and there are thirty-one pumping stations owned and operated by the Town. The Town is divided into 23 drainage sub-areas based upon property information from Tax Assessor's plat map, the extent of existing sewers, and the limits of existing pump station service areas as indicated on Figure 3-7.

The older village systems originally discharged to the Blackstone River, and the industrial park area originally was connected to a septic system and leach field, and subsequently to a packaged wastewater treatment plant, before these systems were connected to the regional sewers. Previously constructed sewers were replaced to a varying extent during construction of the Town and regional systems, but some older sewers do remain in service in the village centers. All sewers in the Town now discharge to the NBC system, either by direct connection or through municipal sewers in Pawtucket and North Providence. Approximately 20 properties are tributary to Pawtucket sewers and 64 to

LEGEND

UNSEWERED AREAS

N

NBC BLACKSTONE VALLEY INTERCEPTOR

NBC WASHINGTON HIGHWAY PUMP STATION

NBC WASHINGTON HIGHWAY INTERCEPTOR

NBC LOUISQUISSET INTERCEPTOR

NBC SAYLESVILLE PUMP STATION

NBC MOSHASSUCK VALLY INTERCEPTOR

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

RIGIS

0 5,000 10,000 Feet

FIGURE NO.
3–7

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
CONTRIBUTORY AREA PLAN

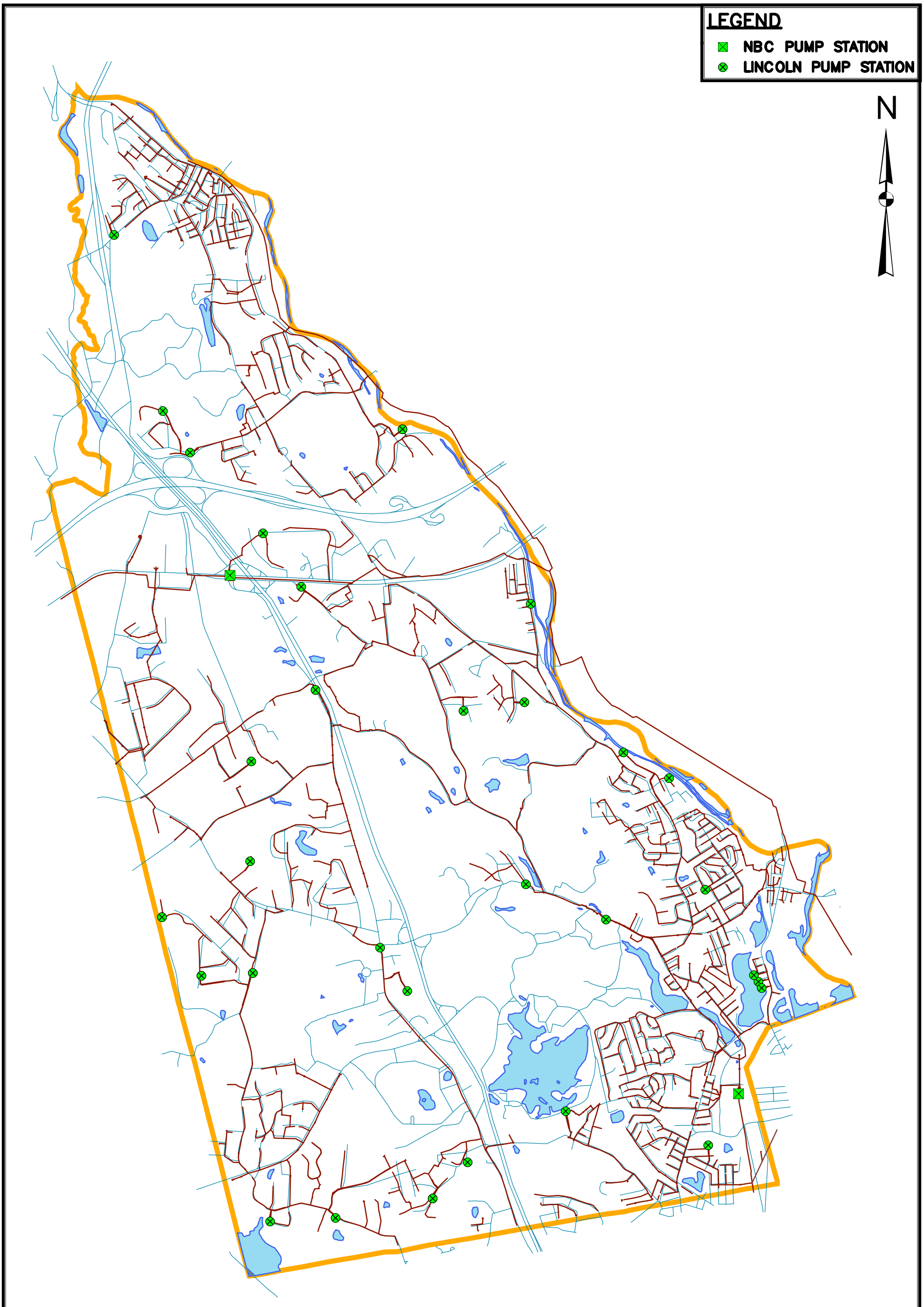
Civil & Environmental Engineering Partners, Inc.
342 Park Avenue, Woonsocket, RI 02895

North Providence sewers. All flows from the Town's sewers ultimately are conveyed to NBC for treatment and disposal, either to the Bucklin Point Wastewater Treatment Facility in East Providence or to the Field's Point Wastewater Treatment Facility in Providence.

3.3.1 Collection System

There are approximately 97 miles of gravity sewers and 6 miles of forcemain within the Town's collection system. These sewers were constructed during various periods, and the existing system ranges from sewers dating prior to 1900 that remain in service in some sections of the Town to sewers installed during recent development and subdivision projects. Many of the sewers were installed under the Town's major sewer system projects constructed between 1985 and 1992. The prevalent pipe material found in the Town's system is PVC. Most sewers installed since 1985 are of PVC construction, with ductile iron utilized where necessitated by installation constraints, such as shallow depth of cover. Other pipe materials include vitrified clay, asbestos cement, and reinforced concrete. Mapping of existing sewers is provided in Figure 3-8 and Appendix A. An inventory of sewer pipe lines by size is presented in Table 3-6.

The 1971 "Report on Proposed Sewerage System" prepared by Whitman & Howard, Inc. indicates that all existing sewer systems at that time were separate sanitary type sewers with the exception of combined storm and sanitary sewers in the Manville section. Additional sewers had been constructed and these storm sewers were separated from the sanitary sewers by 1984 as indicated in the "Report on Proposed System of Sanitary Sewers" prepared by Siegmund & Wilkins, Inc. Based upon this information, all sanitary sewers in Lincoln are considered to be separate sanitary type designed to convey only sanitary wastes. However, the Town has observed isolated areas where stormwater connections are suspected. Standard procedures for sewer system maintenance include provisions for smoke testing and dye testing to determine sources of infiltration and inflow so that stormwater sources can be identified for separation from the sanitary sewer system where illegal connections are suspected.



RIGIS

FIGURE NO.
3-8

TOWN OF LINCOLN Incorporated 1871

WASTEWATER FACILITIES PLAN
EXISTING SEWERS

Civil & Environmental Engineering Partners, Inc.
342 Park Avenue, Woonsocket, RI 02895

Table 3-6

Sewer Pipeline Inventory

Pipe Diameter (Inches)	*Approximate Linear Feet*	*Miles*
8	421,000	79.7
10	26,100	4.9
12	30,000	5.7
14	1,200	0.2
15	15,100	2.9
16	1,900	0.4
18	8,800	1.7
20	500	0.1
21	1,800	0.3
24	4,200	0.8
Total	510,600	96.7

Construction of the Town-wide sewer system was proposed in the 1971 and 1984 planning documents listed above, and the existing system was constructed generally in accordance with the proposed plans. However, construction of several reaches of gravity sewers apparently were deemed infeasible due to environmental constraints, including wetlands and river crossings. While the originally proposed systems envisioned at least ten pumping stations due to the rolling topography of the Town, four of the Town's five larger pump stations became necessary. Subsequent development employed sewage pumping as needed to accommodate topographic constraints in order to connect to existing sewers. As such, the Town's sewer system includes thirty-one Town owned pumping stations.

The 1984 report indicates the design of the Town sewers is based upon flows projected to the year 2040. The flow projections assume development to saturation by the design year, which resulted in a projected population of 46,870. This projection is nearly twice the

current population projection to the end of the planning period. The 1984 report indicates the following per unit flow rates were used to develop the design flow for the sewer system: Residential – 1,000 gallons per capita per day, Business - 2,000 gallons per acre per day, Industrial - 3,000 gallons per acre per day.

Based upon these generation rates, the an average daily design flow of 10.889 MGD and a peak day design flow of 19.600 MGD were projected. As the 1984 design areas and population served exceed current projections to the end of the planning period and per unit figures exceed current estimates of projected wastewater flow based upon existing water use data, the overall design capacity of the existing sewers is significantly greater than the flows projected currently. As such, the existing sewer system capacity is considered to be adequate to beyond the end of the current planning period. The Town has identified the specific areas of concern within the existing system based upon operational history, which are identified in Table 3-7.

Table 3-7

Existing Sewer Pipeline Areas of Concern

Location	Description
AP 6 Lots 196, 197 from Seventh Day Adventists' Church	Old clay pipe runs in private property back yards; building connection and line experience blockages
AP 7 Lots 70- 76 south of Ballou Street	Old clay pipe runs in private property back yards; line blocks up occasionally
AP 4 Lot 70 and AP 5 Lots 17, 19, 20 21 Lonsdale	Old clay pipe runs in private property back yards, pipe runs flat, SMH in poor condition, occasional blockage
School Street in Albion from Kennedy Blvd. To NBC interceptor	Old clay pipe in poor condition, suspected inflow / stormwater connections
AP 3 Lot 34 to Industrial Drive	Old clay pipe, runs flat, in poor condition, occasional blockage
AP 37 Lots 90,91,92,113,114,115 Post Office parking lot and Spring Street properties	Old clay pipe runs in parking lot and in private property back yards, pipe in poor condition, occasional blockage
AP 35 Lots 7, 9, 10 Manville	Old clay pipe in poor condition, runs in private property back yards, occasional blockage
Woodland Court	Suspected inflow / stormwater connections

As part of the Plan preparation the Narragansett Bay Commission (NBC) was contacted to establish the capacities of the treatment and conveyance facilities that currently and will continue to serve the Town of Lincoln through the planning period. NBC stated that sufficient capacity exists at these facilities, even with the projected increase of flows of the planning period.

3.3.2 Pump Stations

The Town's thirty-one (31) existing wastewater pumping stations can be segregated into three (3) general types: Submersible Grinder Pump station, Wet Well / Dry Well Pump station, and Screw Pump station. Twenty-five (25) of the Town's pump stations are Submersible Grinder Pump type stations, five (5) stations are Wet Well / Dry Well type stations, and one (1) station is a Screw Pump type station. A limited physical conditions assessment was conducted for each of the Town's pump stations during the preparation of this Facilities Plan, reports of the conditions observed are provided in Appendix B.

Odor control is a concern common to all wastewater pump stations. Town personnel indicated that odor complaints have occurred generally due to the proximity of adjacent residential areas to the existing pump station locations. Excessive complaints or recurrent concerns for odors were not identified for any specific location, therefore no provisions for odor controls are deemed to be necessary at this time for any pump station. However, odor control considerations should be re-evaluated if an increase in the frequency of complaints or other change in conditions is observed to suggest excessive odor emissions may be occurring.

3.3.2.1 Submersible Grinder Pump Stations

As noted above, 25 of the Town's 31 wastewater pump stations are of the Submersible Grinder Pump type. The 1998 Edition of the Guidelines for the Design of Wastewater Treatment Works Technical Report #16 (TR-16) as prepared by the New England Interstate Water Pollution Control Commission recommends wet well / dry well type

stations as preferable but allows for other types of stations under certain circumstances. TR-16 requires a minimum of two pumps, with each pump being capable of handling the peak design flows. Two pumps are provided for all Submersible Grinder pump stations and record documents provided by the Town indicate that each pump is capable of discharging the full design load. As such, the existing station design and capacities generally conform to the current TR-16 capacity guidelines. As the pump stations are in serviceable condition and each conveys a relatively small flow volume, station replacement at each location for the sole purpose of providing a Wet Well / Dry Well type station would not be recommended. A summary listing of the Submersible Grinder type pump stations is provided in Table 3-8.

The wet well for each station is constructed of precast concrete manhole ring and base sections and a flat slab top section with a cast-in aluminum access hatch. An aluminum ladder is provided to allow access to the base level of the wet well chamber. A vent pipe through the top slab provides passive ventilation of the wet well chamber. Influent flow enters the wet well via gravity sewer connection(s) constructed primarily of PVC pipe, with concrete materials apparently utilized at a few stations. The Birchwood station receives flow from an individual residential pressure sewer connection in addition to gravity flow.

At grade construction consists of the wet well and valve chamber (where provided) top slabs and the main electrical cabinet enclosure. Access hatches and the main electrical cabinet are secured by padlock, and chain link security fencing with padlocked gate is provided at some stations. Based on their proximity to adjacent streets, most stations appear to be located within public right of way. Paved bituminous access / parking drives occur at some stations.

Electrical and control equipment is housed in a pad mounted enclosure cabinet. The electric service meter socket and receptacle for connecting a portable emergency generator

Table 3-8

Submersible Grinder Pump Stations

Station Name	Pump Size (HP)	Approximate Age	Projected Rehabilitation
Applewoood	3	18	2007
Arlington	3	19	2006
Ashley	3	16	2009
Belmont	3	7	2018
Birchwood	5	16	2009
Butterfly	5	14	2011
Cider Mill	3	16	2009
Davies	5	12	2013
Eagle Nest	5	16	2009
Edgehill	3	19	2006
Great Road (116)	3	18	2007
Heidi	3	14	2011
Hillside	3	19	2006
Jason	5	17	2008
Lincoln Center	3	15	2010
Lori Ellen	5	16	2009
Middle	3	19	2006
Mount	3	19	2006
Newland	3	19	2006
Oak Hill	5	16	2009
Old Pike	5	14	2011
Paddock	5	17	2008
Rollingwood	5	15	2010
Whitney	3	10	2015
Woodridge	3	15	2010

are mounted on the exterior of the cabinet. Only the Davies station is provided with a permanent emergency diesel generator installation on-site. No utility meter is provided at the Lincoln Center station as this station reportedly is fed by the local (Amica) electrical power distribution system. The electric service panelboard, switches / breakers for transfer between emergency and utility power supply, pump controls and motor starters, and alarm dialer with a battery backup power supply are located in the main enclosure. Provisions for transfer between utility and emergency power vary from station to station.

Some stations are provided with a manual transfer switch in a separate enclosure. Other stations have the Utility and Emergency power main breakers mounted side by side with a slide bolt guard to prevent both breakers from being set to the "On" position at the same time; the slide bolt guard is configured with a set screw to maintain its position over the selected breaker. An automatic transfer switch is provided for the permanent emergency generator at the Davies station.

The pump control system is based on changing level in the wet well. All but one station is equipped with a compressed air bubbler level sensing system and an "electro-gage" mercury level gauge / switch controls. A microprocessor based pump controller and submersible pressure transducer that responds to changing water level in the wet well are provided at the Belmont station, which is not equipped with a bubbler level system and mercury level gauge controls. Replacement of the mercury level gauge based control systems should be considered due to the potential for environmental impacts should a release of mercury occur.

Pump controls are segregated behind a separate inner door inside the main enclosure cabinet. The pump level gauge, status and alarm lights, pump run time meters, and pump H-O-A switches are mounted on the face of the inner door, as are the side by side Emergency and Utility power main breakers for stations without a separate enclosed manual transfer switch. Pump controller module, relays, motor starters and bubbler system equipment is mounted behind the pump control panel door.

The pump stations originally were equipped with a computer based monitoring system within a separate panel inside the main enclosure. Town personnel indicate that the use of this system was discontinued due to malfunction and unsatisfactory performance. The Town subsequently has installed autodialers, replacing the computer based system, to transmit selected alarms to the Sewer Department (weekday working hours) and Police Department (nights / weekends). Abandoned hardware from the original computer system remains in the enclosure at some stations. An uninterruptible power supply (UPS) battery

backup unit is provided for the autodialers in the main enclosure. The possibility of implementing a new computer based monitoring system can be evaluated if replacement of the existing controls systems is considered.

Record documentation provided by the Town indicates that the mechanical systems are designed for a 20 to 25 year service life and that the pipelines and pump stations at the following stations are designed to accommodate a future flow projected to the year 2035: Hillside, Edgehill, Newland, Arlington, Mount, Middle, Applewood, and Great Road (116). The future flow design year is beyond the end of the 20-year planning period for the current Plan and, as such, it is expected that the buried pipelines and pump station wet wells will be serviceable and capable of accommodating flows to the end of the planning period. Documentation was not available for review to determine the design capacity for other Submersible Grinder pump stations. Based upon the consistency with the above listed stations similar design considerations are assumed, and the capacities of the pipelines and wet wells for the remaining stations are considered to be capable of accommodating flows from their contributory areas to the end of the planning period. However, many of these Submersible Grinder pump stations appear to be associated with specific areas and developments, therefore detailed capacity evaluations should be conducted before any future developments or sewer extensions are approved to convey flows to individual pump stations.

Construction of the Submersible Grinder Pump stations occurred between 1986 and 1998, with the majority of stations constructed prior to 1992 and three stations (Belmont, Davies, and Whitney) constructed in 1993 or later. This information indicates that the mechanical systems at the many of these facilities are approaching the end of their intended service life and may require replacement in the near future. The age and anticipated equipment rehabilitation schedule for the Submersible Grinder Pump stations are listed in Table 3-8. The structural components of these stations are expected to be serviceable to beyond the end of the planning period. Pumps, discharge piping and valves are anticipated to require replacement at all stations. Electrical installations in the wet well chambers may also

require repairs or replacement. Controls systems are expected to be serviceable to the end of the planning period, with replacement the small air compressors, however replacement should be evaluated with respect to continued use of the mercury filled level gauge / controllers.

3.3.2.2 Wet Well / Dry Well Pump Stations

The Town's five Wet Well / Dry Well type wastewater pump stations are: Angell Road North, Angell Road South, Great Road, Maria Street, and Kirkbrae. TR-16 recommends wet well / dry well type stations as preferable and requires a minimum of two pumps for all stations, with each pump being capable of handling the peak design flows. Two pumps are provided at four of the five Wet Well / Dry Well pump stations and record documents provided by the Town indicate that each pump is capable of discharging the full design load at these stations. Three pumps are provided at the Great Road pump station. For stations with three (or more pumps), TR-16 requires that peak flows be handled with any one pump out of service. Record documents indicate that the capacity of the Great Road station with two pumps running exceeds the peak design flow. Based on this information, the existing station design and capacities generally conform to the current TR-16 capacity guidelines. A summary listing of the Wet Well / Drywell type pump stations is provided in Table 3-9 later in this section.

The Wet Well / Dry Well stations are constructed of precast concrete rectangular structures with the wet well and dry well chambers cast separately. The upper sections of the wet well and dry well chambers are exposed above grade, with the top slab general a few feet above the surrounding ground surface. Aluminum access hatches are provided in the top / roof slabs to provide entry to the chambers. Aluminum ladders are provided to allow access to the wet well operator platform and to the control level and pump level in the dry well. The Town has constructed wood framed building structures above the precast concrete chambers at the Great Road, Maria and Kirkbrae stations. The pump station structures are expected to be serviceable to beyond the end of the current planning period.

Influent flow enters the stations via gravity sewer connection and flows through a manually cleaned bar rack as it enters the wet well. The Great Road station has a divided wet well with slide gates to isolate the two sections, the other four stations have a single undivided wet well. All stations are equipped with centrifugal pumps with close-coupled vertically mounted 3-phase electric drive motors. Seal water systems are provided at the Great Road and Angell Road South stations. The pumps do not required seal water at the other stations. There are no odor control systems at the stations. Each pump is connected to the wet well by individual suction piping with isolation gate valve. Each individual pump discharge is provided with a check valve and isolation gate valve prior to joining at a common force main and exiting the station. The pump suction and discharge piping is constructed of flanged ductile iron. The pumps and piping systems are located in the lower (pump) level of the dry well chamber. There are no provisions for connecting temporary bypass pumping equipment to the existing discharge forcemain.

The pump control system is based on changing level in the wet well. Similar to the Submersible Grinder Pump stations, all Wet Well / Dry Well stations are equipped with a compressed air bubbler level sensing system and an "electro-gage" mercury level gauge / switch controls. Pump controls are segregated from other electrical equipment in a separate control panel enclosure(s) in the dry well upper level. Variable Frequency Drive equipment that changes the pump speed in response to changing wet well water level conditions in effort to match pumping rates to station influent is provided at the Great Road pump station. The pumps operate at constant speed, in response to pump "On" and "Off" wet well level controls at the other four stations. As recommended for the Submersible Grinder pump stations, replacement of the mercury level gauge based control systems should be considered due to the potential for environmental impacts should a release of mercury occur.

The wet well / dry well pump stations also were equipped originally with a computer based monitoring system. This equipment was housed within a separate enclosure in the upper control level. As was the case with the submersible grinder pump stations, the

performance of the computer based monitoring system was unsatisfactory and its has been discontinued. An autodialer has been installed, replacing the computer based system, to transmit selected alarms to the Sewer Department (weekdays, working hours) and Police Department (nights / weekends). Abandoned computer system hardware remains in the enclosure at some stations. An uninterruptible power supply (UPS) battery backup unit is provided for the autodialer.

Wet wells and dry wells are provided with separate mechanical ventilation systems, however, most of the ventilation equipment was not functional and requires repair or replacement in order to be fully operational. Electric unit heaters are provided in the dry wells, no heating is provided to the wet wells. Dehumidifiers are provided at four stations; the Town has found that dehumidification is not necessary at the Great Road station. A sump pump is provided in the pump level of each station dry well. Sump pump discharge piping is provided with two check valves and an isolation gate valve prior to penetrating through the structure to discharge back into the wet well.

Electrical and control equipment generally is located in the upper (control) level of the dry well chamber. The seal water control panel at the Great Road and Angell Road South stations is located in the lower pump level. Main electrical disconnects, distribution panels, automatic transfer switch, and pump controls are located in the upper level. Phase conversion equipment is provided at the Angell Road North and Kirkbrae stations because only single-phase utility power service is available at those locations. The electric service meter socket is located on the exterior of the stations. A stationary emergency diesel generator unit is provided at each station mounted on the top slab of the precast concrete chambers. The emergency generators are inside the building at stations where wood structures have been added. Town personnel have indicated that the electrical systems in the wet wells are either partially or fully inoperable. These systems need to be replaced or restored to proper functional status. Dry well electrical systems at four of the stations appear to be functional and Town personnel did not identify specific operational concerns or problems. The Angell Road South station experienced flooding conditions that partially

submerged the lower dry well. All or portions of the dry well electrical system installation at that station may require replacement.

Table 3-9

Wet Well / Dry Well Pump Stations

Station Name	Number of Pumps	Pump Size (HP)	Approximate Age	Projected Rehabilitation
Angell Road North	2	15	15	2010
Angell Road South	2	60	16	2007*
Great Road	3	60	16	2009
Kirkbrae	2	20	16	2009
Maria Street	2	40	17	2008

*- Expedited rehabilitation schedule due dry well flood impacts.

Record documentation provided by the Town indicates that the pipelines and pump stations are designed to accommodate a future flow projected to the year 2035 and mechanical systems are designed for a 20 to 25 year service life. Construction of the Wet Well / Dry Well Pump stations occurred between 1986 and 1990. This information indicates that the mechanical systems at these facilities are approaching the end of their intended service life and may require replacement in the near future. The age and anticipated rehabilitation schedule for the wet well / dry well pump stations is listed in Table 3-9. Rehabilitation of the Angell Road South should be expedited because the station has experienced flooding conditions that partially submerged the lower dry well. The pumps currently are operational, but the seal water system is not functional.

There no provisions for combustible and hazardous gas detection at any pump station station. TR-16 requires combustible and hazardous gas detection systems for medium to large pumping stations. Provisions for combustible and hazardous gas monitoring and alarm system to be installed should be included as part of the mechanical and / or control systems replacements for the Wet Well / Dry Well stations.

There are no provisions for direct flow metering or totalizing at any station. TR-16 recommends that a flow measuring device be provided at large pump stations. Wet Well / Dry Well pump station rehabilitation and major equipment replacement projects should include provisions for flow metering equipment to be installed. The Town does not need to measure flow for billing purposes and metered flow information generally would be utilized for operations and maintenance purposes, such as determining equipment maintenance intervals and identifying abnormal flow conditions.

The estimated existing average daily flow to each station is approximately 75% to 85% below station design capacity, based upon 2004 NBC billing information for tributary connections. As the estimated existing flow is substantially less than the design capacity for each station and the future flow design year is beyond the end of the 20-year planning period for the current Plan, it is expected that the buried pipelines and pump station wet wells will serviceable and capable of accommodating flows to the end of the planning period and that no increase in pumping capacity is needed.

3.3.2.3 Screw Pump Station

The Lower River Road pump station is the Town's Screw Pump type wastewater pump station. As previously noted, TR-16 recommends wet well / dry well type stations as preferable but allows for other types of stations under certain circumstances. TR-16 requires a minimum of two pumps, with each pump being capable of handling the peak design flow. Two screw pumps are provided at the Lower River Road station and record documents provided by the Town indicate that each pump is capable of discharging the full design load. As such, the existing station design and capacity generally conforms to the current TR-16 capacity guidelines. Record documents indicate each pump is rated for a peak design flow of 300 gallons per minute at 12 feet total dynamic head. Each pump is powered by a 1.5 HP electric motor.

Screw pumps are well suited to low lift pumping applications and have the advantage of providing variable output from constant speed pumps. Pump output matches station

influent and varies based upon the wet well sump level. As a result, simple controls systems are inherent in the design of screw pumps. Because there essentially is only one component that requires maintenance (pump / motor) and the simplicity of the controls, screw pump stations are relatively easy to operate and maintain. However, screw pumps require an open system that operates at atmospheric pressure and can be the source of odor complaints due to turbulent and / or septic conditions. Town personnel identified that odor complaints have occurred generally due to the close proximity of adjacent residential areas but specific concerns for odors or excessive complaints were not indicated for this station.

The pumps are constant speed and operate continuously without any level sensing input. The control panel includes a Hand-Off-Auto switch and run time meter for each pump and a pump alternating timer. With each pump in the Auto position, the timer selects and alternates operation between the two pumps. One pump is operating at all times. If one pump is down for service or otherwise, the other pump can be operated continuously in the Hand mode. Sewer Department personnel indicated the pump controls were operational. Based upon this information, continued satisfactory service is expected for the Planning period. However, replacement of the controls could be necessary in conjunction with related electrical and mechanical equipment replacements.

Similar to the other stations, an alarms autodialer has been installed in the telemetry panel inside the main electrical enclosure replacing the original computer based system. The autodialer transmits alarms to the Sewer Department (weekdays, working hours) and Police Department (nights / weekends). An uninterruptible power supply (UPS) battery backup unit is provided for the autodialer. The only alarm condition monitored is wet well flood level. Sewer Department personnel indicated that the controls and alarms were operational. Based upon this information, continued satisfactory service is expected for the Planning period.

No major repairs to or replacement of the existing pump station structure is expected to be necessary during the Planning period. Electrical systems inside the station wet well

structure are expected to require replacement during the planning period. Electrical code and TR-16 compliance should be incorporated into any major renovations. Replacing the existing enclosure cabinets could be considered if the majority of the components housed in the enclosure are being replaced.

Ventilation equipment is not operational at this station. Portable ventilation equipment reportedly is connected to the vent piping outside the wet well to provide ventilation during maintenance personnel access. Permanent ventilation equipment should be included in the rehabilitation of this station.

Record documentation provided by the Town indicates that the pipelines and pump stations are designed to accommodate a future flow projected to the year 2035 and mechanical systems are designed for a 20 to 25 year service life. The fabrication date inside the control panel indicates that this station was constructed in 1988, so the approximate age of the station is 17 years and the mechanical systems are approaching the end of their intended service life. Satisfactory continued performance is expected based upon the conditions observed and reported for this station, but the electrical and mechanical equipment will require replacement in the near future. Based upon the age of this station, rehabilitation / replacement is projected to be necessary in 2008.

There are no provisions for combustible and hazardous gas detection at the pump station. TR-16 requires combustible and hazardous gas detection systems for medium to large pumping stations. Provisions for combustible and hazardous gas monitoring and alarm system to be installed should be included as part of the mechanical and / or control systems replacements for this station.

There are no provisions for direct flow metering or totalizing at this station. The Town does not need to measure flow for billing purposes and metered flow information generally would be utilized for operations and maintenance purposes, such as determining equipment maintenance intervals and identifying abnormal flow conditions. Although TR-16 recommends that a flow measuring device be provided at large pump stations, run time

meters effectively can provide operational information to determine required maintenance milestones for screw pumps because the pump(s) run continuously regardless of flow conditions. Metered flow information is not essential to the effective operation of the Screw Pump station and incorporating a gravity flow measuring device into the existing station influent chamber or on the effluent sewer line would present significant additional construction costs, therefore provisions for flow metering are not recommended for the Lower River Road Screw Pump station.

The estimated existing average daily flow to this station is approximately 90% below station design capacity, based upon 2004 NBC billing information for tributary connections. The future flow design year is beyond the end of the 20-year planning period for the current Plan. As such, it is expected that the buried pipelines and station influent and effluent channels will be serviceable and capable of accommodating flows to the end of the planning period and that no increase in pumping capacity is needed.

3.3.3 ISDS

Although public sewers serve a majority of the Town, there are a few areas generally isolated from the public system where sewers have not been extended and on-site Individual Sewage Disposal Systems (ISDS) are required for wastewater treatment. These areas occur in the following general locations:

- Breakneck Hill Road at Old Louisquisset Pike and Route 146
- Twin River Road at Old Louisquisset Pike and Route 146
- Whipple Road, Lantern Road and East Lantern Road area
- North of Wilbur Road along Old Louisquisset Pike and Route 146
- Old Great Road at Route 146, Sayles Hill Road at Route 99
- Woodward Road

In addition to these isolated areas, ISDS systems remain in use in scattered locations throughout the sewered areas of the Town. Septage generated in Town is privately hauled

for disposal. NBC owns and operates a regional septage receiving station in Lincoln located on Route 116.

Historically, ISDS systems consisted of cesspools and septic systems with leach fields. Regulation and enforcement of design standards was limited prior to 1979 when the State adopted new design standards and began stricter enforcement. Current regulations were adopted in January 2002. RIDEM allows installation of conventional septic systems and innovative / alternative systems that do not conform to location, design or construction requirements of a conventional system, but have documented evidence of satisfactory performance.

Detailed records were not available to document the actual number of existing ISDS currently in use in Lincoln. Based upon a review of Town sewer billing records there are approximately 1,400 existing ISDS systems. This estimate assumes that properties with a specific mailing address (street and number) where no billing cycle or sewer connection information is provided are developed lots with on-site treatment and that no "dry sewers" were provided for recent development that currently has sewer access (i.e. all recent developments constructed with sewers were immediately connected and no ISDS systems built where sewers are available). Assuming the ratio of residential to commercial (business) ISDS is equal to 3.6, the existing ratio of residential to business land use identified in the Comprehensive Plan, there are approximately 1,100 residential and 300 commercial ISDS existing systems. Of the 1,400 total estimated ISDS units, only 170 occur in locations currently without access to the public sewer system.

Based upon the 2004 population of 22,188 and density of 2.54 persons per unit, and 265 unoccupied units as reported for the 2000 Census, there are approximately 9,000 total housing units in Lincoln. The estimated residential ISDS units represent approximately 12% of this estimated total of existing housing units, which exceeds 5% assumed unsewered units based upon the Town's assessment 95% connected units, however, the estimated ISDS quantity is considered to be conservative. As indicated above, the

estimated ISDS units are based upon the Town's sewer billing list assuming properties identified with a street number address are developed lots and require wastewater disposal. Many properties listed with a street address may actually be undeveloped and without on-site ISDS units. In addition, NBC acknowledges that there may be gaps in their billing data that was partially inherited from the Blackstone Valley District Commission (BVDC). The Town should work with NBC to address any billing data deficiencies.

As public sewers are widely available and the quantity of estimated ISDS units without access to public sewers should be minimal, further analyses and evaluation to refine this estimate generally is not warranted. Any discrepancy in the estimated quantity of ISDS units will impact only the estimated existing septage generated in the Town. No impact to existing wastewater flow estimates will occur because these estimates are based upon serving 95% of the Town population. A decrease in septage production is anticipated in the future as ISDS systems in sewered areas are abandoned and replaced by connections to the public sewer system. In discussion with NBC, who runs the existing septage receiving facility that services the Town of Lincoln, it was made clear that adequate capacity exists to continue to serve the residences with ISDS in Town throughout the planning period.

A review of RIDEM ISDS permit histories indicates that 21 repair or alteration applications have been submitted from Lincoln since 1980. Repair and alteration applications can be indicative of ISDS system inadequacy. Failures can occur due to such conditions as unsuitable soils, high groundwater, shallow depth to bedrock, improper maintenance practices, incorrect sizing, overloading and incorrect construction and installation. Alteration applications can be associated with a proposed change in use or increase in applied loading to an ISDS treatment system and may not necessarily represent failure. For the purposes of evaluation for this Plan, all repair and alteration applications will be considered due to ISDS failure. Based upon this interpretation of the repair and alteration applications, the average rate of ISDS failure in Lincoln since 1980 is less than one per year.

Two of the 21 repair applications were in locations with access to public sewers, and one has since connected to the Town system. Although the several repair locations and times appear to be grouped together, there does not appear to be a specific pattern of failures due to unfavorable conditions or site constraints. Groupings of repairs and alterations are attributed to the fact that ISDS use generally is isolated to the specific areas listed above and the likelihood that development in these areas occurred such that these systems would be expected to need replacement at approximately the same time due similar age and system construction. The repair rate for existing ISDS systems in Lincoln does not suggest an urgent need to provide public sewers to these unsewered areas. However, it should be noted that several ISDS permit applications included either a request for variance and / or use of innovative and alternative technologies, which suggests that public sewers might be preferable due to area constraints. The Town should monitor ISDS failures and repair applications for comparison to past occurrences in order to identify if an increased rate of failures, repairs or implementation of alternative technologies suggests unsuitable site conditions.

3.3.4 Wastewater Flows

Limited flow metering information is available on existing wastewater flows for the Town of Lincoln. NBC operates flow meters at various locations of its interceptor system and the flow computation for the Town of Lincoln involves addition and subtraction of data from eight individual metering locations. According to NBC, the flow meters have not been operational for several years at two metering locations; the flow computation for Lincoln would require using data from temporary metering equipment that NBC recently installed near these locations. Temporary metering equipment installed within a manhole structure generally is expected to be less accurate that permanent facilities due to space and flow channel limitations. Additionally, NBC does not calibrate its meters on a regular basis and in many cases the recorded data is intermittent. Initial computations utilizing raw meter data resulted in negative flows for portions of the Town. Due to these conditions, the accuracy of the data from these meters is not considered to be fully reliable and the available flow metering data should only be use for general reference. Existing

wastewater flows for this Facilities Plan have been based upon metered water use data as described below.

Table 3-10 presents existing wastewater flow figures estimated for the Town of Lincoln based upon average water use for the 5-year period from 2000 to 2004 inclusive and assuming 85% of the total water use is directed to the sewer system. NBC bills individual customers for sewage treatment and disposal based upon metered water use records and the billing rate formula is based upon 85% of meter water use entering the sewer system.

Table 3-10

Estimated Existing Wastewater Flow
Based Upon Metered Water Use

Category	Flow (MGD)
Commercial	0.29
Industrial	0.19
Residential	1.33
I / I Allowance	0.43
Average Day	2.24
Peak Day	3.77

Water use data provided by the Lincoln Water Commission identifies Commercial water usage but does not provide a breakdown between Industrial and Commercial use categories. Utilizing billing information provided by NBC for 2004, Industrial use represents approximately 40% and Commercial use represents approximately 60% of the total non-residential water use. Wastewater flow estimated for Industrial and Commerical categories is based upon applying these percentages to the Commercial (i.e. non-residential) Lincoln Water Commission water use data. Using the Residential wastewater estimated in Table 3-10 and assuming the sewered population is 95% of the total population results in an average generated Residential wastewater of 65 gallons per person per day, which is a reasonable per capita flow figure. Peak day flow is calculated by applying a peaking factor of 2.15 to the average daily Residential flow quantity. This

peaking factor is derived from TR-16 Figure 2-1 Ratio of Extreme to Average Daily Flow based on the average estimated Residential flow of 1.33 MGD.

To determine an approximate infiltration/inflow (I / I) contribution, a "high-end" factor of 500 gal/in. dia./ mile of sewer was applied to the approximate length of Town sewers as determined from the sewer system map. This figure represents a maximum allowance for a normal I / I amount as recommended in TR-16. NBC currently is conducting I / I analyses of the interceptor systems that receive flow from Lincoln. These analyses are ongoing and no final reports of findings or conclusions have been issued. Further discussion of I / I is presented later in this chapter.

NBC billing information identifies 20 services as Industrial customers. Seven of the Industrial customers use in excess of 10,000 gallons of water per day based upon the NBC billing information. These larger customers and their approximate daily wastewater flow generated based upon 85% of 2004 metered water use is provided in Table 3-11.

Table 3-11

Approximate Daily Wastewater Flow
High Volume Industrial Sources

Name	Address	Flow (GPD)
General Cable Industries LLC	3 Carol Drive	23,500
Stern-Leach Company	4 Carol Drive	10,800
Richard E Beaupre	11 New England Way	11,600
Tanury Industries Inc	6 New England Way	32,700
A T Cross Co	1 Albion Road	22,900
Arcrivis Ltd	1 Crownmark Drive	12,200
Technical Materials Inc.	5 Wellington Road	54,900

These approximate flow figures are based upon the assumption that the production operations are continuous for 7-day per week without weekend shutdowns. These seven customers account for approximately 93% of the flow from Industrial customers identified in the 2004 NBC billing information.

3.3.5 Infiltration / Inflow Preliminary Assessment

A preliminary assessment of existing I / I conditions was performed utilizing available wastewater flow meter data. NBC provided preliminary flow monitoring data for several temporary flow monitoring stations located in Lincoln that are collecting data for its I / I investigations and also for its permanent meter stations that receive flows from Lincoln. As noted above, the accuracy of the NBC meter data is not considered to be fully reliable and should only be used for general reference and broad comparison.

The flow meter data provided by NBC collected during 2004 and 2005 from its permanent and temporary metering stations was compiled to allow for a comparison with the estimated wastewater flow figures based on water use and the "high end" I / I allowance. This compilation included a limited review of average daily flow data figures in effort to eliminate data that appeared to be erroneous, such as negative flows or figures substantially lower than the overall averages. Table 3-12 presents the flows compiled from NBC metering data alongside the estimated flow for the drainage areas tributary to each metering location.

Table 3-12

Comparison of Estimated Existing Wastewater Flow
to Available Metered Flow Data

Tributary Areas	Estimated Flow (MGD)	I/I Allowance (MGD)	Total Estimated Flow (MGD)	NBC Metered Flow (MGD)	Difference (MGD)
1 – 5	0.35	0.083	0.433	0.60	0.167
6 – 8	0.37	0.034	0.404	0.44	0.036
9 – 12, 16, 17	0.61	0.185	0.795	1.81	1.015
18 - 21	0.19	0.067	0.257	0.48	0.223

Comparison of the flow meter data against the estimated flow figures indicates the probable entry of extraneous flows into the sewer systems upstream of the NBC metering locations and suggests that investigations to identify sources of excessive I / I are warranted. However, two items must be noted with respect to the information presented in Table 3-12. First, wastewater flows from sources outside of Lincoln occur in the flow

metered at some locations. Second, the I / I allowance is based on the approximate length of Lincoln sewers in the tributary sewer drainage area only and no accounting of the NBC interceptors, or adjacent tributary municipal sewers, is included in the estimated figures. Once completed, the ongoing NBC studies likely will provide some refinement as to separation of identifiable source locations, but additional investigations of the Town's sewer system will be required to identify specific sources of excessive I / I in Lincoln.

While areas 9 through 12, 16 and 17 encompass a substantial portion of the existing sewer system and proportionately higher I/I is expected due to the longer length of tributary sewers, area 16 covers most of Saylesville, including areas of older sewers that were not replaced under the major sewers system construction program. Similarly, areas 1 through 5 include Manville and Albion where portions of the older sewer systems remain in service. Excessive I/I occurring sewers over 100-years is not unexpected, especially where sewers were installed in close proximity to the river by necessity to service the mills. Areas 18 through 21 cover the southwesterly portion of the Town and generally the sewers in this area were installed under the major sewer construction program. These areas are tributary to the Louisquisset Interceptor, which is included in the current NBC interceptor sewer investigations projects due to concerns regarding potentially deteriorated conditions. Areas 6 through 8 include the Industrial park, Route 116 corridor and Quinnville.

Chapter 4 – Future/Planning Conditions

4.1 Demographic Projections

To determine the projected domestic wastewater flow to be generated within the Town of Lincoln, it is necessary to estimate the population that will be served. Treatment facilities are generally designed to handle the needs within a particular planning area for a 20 year period. Therefore, the population that will have sewer service available by the year 2025 will provide the most accurate estimate of wastewater flow generation. Buildout conditions must also be evaluated in order to develop a basis for the proper sizing of interceptor sewers and other appurtenances that have useful lives far in excess of the 20 year planning period. As established in Chapter 3, the design year flow for the existing pump stations and conveyance facilities is beyond the end of the current planning period and these facilities generally have sufficient capacity to accommodate future flows.

Total population projections for the Town were based on data obtained from the Town's Comprehensive Plan and from the Office of Statewide Planning. From this information, the total residential population in the year 2025 is projected at 24,019. Projections are shown in Table 4-1.

Table 4-1

Population Projections

Year	Population
2000	20,898
2005	21,449
2010	21,098
2015	22,596
2020	23,363
2025	24,019

Source: Statewide Planning Program Technical Paper 154

The US Census estimated the 2004 population of Lincoln at 22,188, which exceeds the projected 2005 population listed in Table 4-1. The Statewide Planning Program projected

change in population between 2005 and 2025 is 2,570. Adding this projected change to the current (2004) population provides a projected population figure of 24,758, which will be utilized as the maximum service population for this Facilities Plan. The estimated sewered population is dependent upon the extent to which sewers are extended to currently unsewered areas. Evaluation and discussion on future sewered population is presented the Wastewater Projections section later in this Chapter.

4.2 Land Use Projections

The premise for future land use projections in the Town is based on the following assumptions:

1. The same proportions of land uses now in existence will continue for future development.
2. Residential density will remain at the present level of 2.54 persons per household.

Based on the population projections presented previously, the Town's population is expected to increase by 2,570 by 2026. Using the current population density of 2.54 persons/household, approximately 1,010 additional dwelling units will be required to accommodate the projected growth. Adding this quantity to the 9,000 estimated existing housing units results in a total of 10,010 housing units at the end of the planning period. The buildout analysis included in the Comprehensive Plan indicated the Town could accommodate a total of 13,206 dwelling units based upon 2001 zoning. Based upon the buildout projection the Town sufficient area to accommodate the year 2026 housing demand based upon 2001 zoning conditions.

Recommendations of the Comprehensive Plan call for the Town to maintain current zoning practices with respect to commercial development and to protect the residential character within village center areas. An estimate of 957 acres currently is used for commercial (business) purposed as described previously in this Facilities Plan. Based upon the existing residential to business use ratio of 3.6 there is approximately 3,446 acres

of current residential land use. Utilizing this figure and the 2004 population of 22,188 results in a population density of 6.4 persons per developed acre, and applying this ratio to

Table 4-2

Land Use by Business and Residential Categories

Land Use Category	1995 Land Use Acreage	Future Land Use Acreage
Business	919	1,727
Residential	3,298	7,200
Total	4,217	8,927
Ratio Residential to Business Use	3.6	4.2

Source: 2003 Town of Lincoln Comprehensive Plan

the projected 2026 population results in a future residential land use of approximately 3,870 acres. Based on this residential use acreage the business use acreage for 2026 will be 1,075 acres, assuming the ratio of residential to business land use will remain at 3.6 until saturation of commercial and industrial zoned areas, or an additional 118 acres of developed business land use. The Comprehensive Plan indicates an available future business land use of 1,727 acres for the Town based upon the buildout study, therefore the Town should be able to accommodate the estimated 2026 business land use demand of 1,075 acres. Existing and future land use data provided in the Comprehensive Plan is listed in Table 4-2.

4.3 Economic Projections

Increases in residential housing figures and changes in the rate of increase often are used as an indicator of economic conditions. Census data presented in the Comprehensive Plan, indicates that the average increase in housing was 94 new units per year from 1980 to 1990 and 123 units per year from 1990 to 2000 was unit. Changes in the rates of new housing units are attributed to cyclical economic conditions. The Comprehensive Plan notes that the housing growth in Lincoln between 1950 and 2000 consistently averaged about 100 units per year.

A review of Town certificate of use and occupancy data indicates that 237 of the 397 certificates issued by the Town Building Official's office during the period of 2001 through 2005 were residential use (i.e. at least one bed room). Based on this information, the average annual housing increase was approximately 47 units per year. While this figure is less than the demonstrated history of housing increases, a reduction in the rate of increase is not unexpected due to a corresponding reduction in available land through development. As such, the slower pace of recent housing increases is not attributed to a negative trend in overall economic conditions.

For the most part, local business enterprises are permanent in nature and require a stable work force. There currently are no significant single occurrence or finite projects (i.e. large scale construction project or manufacturing plant closing / relocation) that would result in substantial job losses at conclusion due to specialized employment needs that would give cause to anticipate associated adverse economic impacts. These conditions also suggest a healthy economic status and warrant a positive future outlook. Based upon these conditions and the consistent history of housing increases over extended periods and varying economic conditions, it is expected that the Town will experience similar economic stability in the future. Given the current economic strength and the reduced demand for expansion in comparison to historic development, it is expected that future economic conditions will be favorable and will be suitable to support the projected growth.

4.4 Wastewater Projections

4.4.1 Wastewater

Present development data was used to determine a base wastewater flow. Future flows from an increase in population and development are addressed separately. Average daily residential flows are based on the total number of housing units with 2.54 persons per unit and a daily per capita wastewater contribution of 68 gallons. This wastewater flow is based upon 85% of the 80 gallon per person per day water use projection. This figure exceeds the estimated existing per person water use derived from actual water consumption data as presented in Chapter 3. To estimate average non-residential flows, a

wastewater generation rate of 1,500 gallons per developed acre per day was applied to the projected 118 acres of new business land use. This figure exceeds the 767 gpd / acre rate identified in Chapter 3, in order to provide a conservative projection. The proportions of the projected non-residential flow are assumed to be 60% Commercial and 40% Industrial based upon the existing water use information. Estimated average daily flows projected to 2026 are presented in Table 4-3. For planning purposes, the increased flow volumes assume that all future development will be connected to the public sewer system.

Table 4-3

Projected 2026 Wastewater Flow

Category	Existing Flow MGD	Increased Flow MGD	Projected Flow MGD
Commercial	0.29	0.11	0.40
Industrial	0.19	0.07	0.26
Residential	1.33	0.18	1.51
I / I	0.43	0.02	0.45
Average Day	2.24	0.38	2.62
Peak Day	3.77	-	4.28

To determine the approximate infiltration/inflow contribution, the existing length of lateral and interceptor sewers was determined from the sewer system map and a “high-end” factor of 500 gal/in. dia./ mile of sewer was applied. Additional infiltration / inflow is projected based upon the several assumptions. As described previously, 1,010 new residential units will be needed to accommodate projected population growth during the planning period. According to the Comprehensive Plan, the majority of new residential development is anticipated to occur in the Limerock area as single family homes. Assuming that all new development to be single family units and that 35% of lots will be on new subdivision roads, as utilized in the Comprehensive Plan, and applying a 150 frontage width results in approximately 5 miles of new subdivision roads. The additional infiltration / inflow was projected for 5 miles of new 8-inch diameter lateral sewers at 500 gal/in. dia./ mile is 0.02

MGD. New commercial and industrial development generally will occur within existing developed areas and is not expected to require extensive new lateral sewer construction.

Peak day flow is calculated by applying a peaking factor of 2.1 to the average daily Residential flow quantity based upon Figure 2-1 of TR-16. As described in Chapter 3, the existing sewer system design capacity accommodates a peak day flow of 19.600 MGD. The projected 2026 flows do not exceed this design capacity and based upon this information the existing system capacity is adequate for the planning period.

4.4.2 Septage

There are estimated to be approximately 1,400 lots with active ISDS system in Lincoln as developed in Chapter 3. Based on this quantity of existing systems and assuming an average tank capacity of 1,500 gallons the total ISDS holding volume is 2.1 MG. Under a three year pump out interval the annual septage production will be 700,000 gallons. NBC currently accepts waste at its Lincoln Septage Receiving Station for five days per week, and the daily septage generation for Lincoln will be approximately 2,700 gallons per day when applying this mode of operation to the estimated annual septage production. The NBC Lincoln Septage Facility can receive approximately 118,000 gallons per day of septage waste and there currently are no reported concerns with respect to septage disposal volume for the Town.

As described in Chapter 3, the majority of the existing estimated ISDS systems are located in sewered areas, leaving approximately 170 systems without access to public sewers. It is presumed that lots with access to the public sewer system that are served currently by ISDS will be required to connect to the public system if the ISDS system fails. In this manner, an increase in the total number ISDS served lots is not expected and the quantity of active ISDS systems will be reduced over time by attrition. Based upon this assessment no new or expanded septage receiving facilities will be necessary during the planning period.

Chapter 5 – Wastewater Management Alternatives

5.1 Operation of Existing Facilities

The Town will need to continue operation of existing wastewater facilities in order effectively to manage and convey wastewater for treatment and disposal. Due to the extent of the existing system and areas served connected areas, it is anticipated that all of the existing pumping stations will need to remain in service. As identified in Chapter 3, the existing pump stations are approaching the end of their expected useful service life and replacement of major equipment components and systems during the planning period will be necessary. The estimated existing wastewater flows through the six (6) larger Town pump stations are substantially less than the design capacity for these stations and no increase in pump station capacity is necessary to accommodate increased flow during the planning period. The existing capacities of the Submersible Grinder pump stations also are expected to be adequate for the planning period. However, specific capacity analyses should be conducted when development beyond the current service area is proposed for connection to a particular station or stations.

Pump station rehabilitation generally will be limited to mechanical, control and electrical systems and components. Re-establishing a computerized monitoring system or upgrading to a computerized monitoring and control system should be investigated during detailed pump station rehabilitation evaluations. Major structural renovations are not envisioned based upon the age and existing conditions of structural components.

Review of planning documentation associated with design of the collection system reveals that many more pump station than originally were envisioned were constructed due to environmental constraints associated with installing utilities in regulated areas and associated buffers. In the evaluations for rehabilitation of the pump stations, some considerations should be given to the possibility that some of these pump stations could be replaced with gravity sewers through alternative routing scenarios. While pump station elimination may be possible conceptually, in the 15 to 20 years since these facilities have been constructed environmental regulations have been reinforced and made stricter.

Therefore, it is doubtful that any environmental limitations to the installation of gravity sewers, as opposed to pump stations, that were identified in the 1980's most likely are still in existence and probably would be more difficult to overcome under the current regulatory environment. In addition, mechanical / electrical rehabilitation of pump stations typically are much less costly than sewer rerouting (especially the smaller stations that are prevalent in Lincoln) even when considering life cycle costs of multiple upgrades of a single station.

As described in Chapters 3 and 4, the existing sewer system design capacity and intended service life extend beyond the end of the 20-year planning period. New construction to replace existing gravity facilities to accommodate increased flows due to development during the planning period is not anticipated to be necessary. However, existing collection facilities with a documented history of operation problems and deteriorated conditions should be repaired or replaced to correct deficiencies. The following projects should be considered:

- Identify sewers constructed prior to 1900 and / or with suspected deteriorated conditions and conduct I / I analyses and Sewer System Evaluation Surveys (SSES), and initiate Rehabilitation / Replacement program.
- Evaluate feasibility of replacing existing sewer systems located on private properties with new sewers constructed in public right-of-way or establishing easement rights, legal ownership, and maintenance responsibility. (Note: Town currently pursuing such investigations for replacement of the existing "Lonsdale Village Sewers".)
- Evaluate Rehabilitation / Replacement alternatives for approximately 1,500 LF of existing 8-inch sewer in School Street from NBC interceptor connection to Berkshire Drive to repair deficient conditions.
- Identify areas of suspected stormwater intrusion, perform investigations to confirm inflow locations, and eliminate identified illegal connections to sanitary sewers.
- Review and update Town Sewer Ordinance.
- Perform Sewer Rate Study and reset sewer use fees as necessary.

5.2 Regional Solutions

All flows from the Town of Lincoln's sewers are conveyed to the NBC regional system for treatment and disposal. Areas tributary to the NBC Blackstone Valley Interceptor and Moshassuck Valley Interceptor, either directly or via the Saylesville Pumping Station, ultimately are conveyed to the Bucklin Point Wastewater Treatment Facility in East Providence. Areas that flow to the City of Pawtucket public sewer system also are conveyed to Bucklin Point. Areas tributary to the NBC Louisquisset Interceptor and the Town of North Providence public sewers ultimately are conveyed to the Field's Point Wastewater Treatment Facility in Providence. As such, the Town is fully integrated into the NBC regional system. Regional alternatives for currently unsewered areas include the possibility of coordinating conveyance facilities with adjacent communities. The Town should continue to participate in regional discussions with NBC and neighboring communities concerning matters relating to proper wastewater management.

The May 1993 Facilities Plan for Wastewater Management in the Town of North Smithfield indicates that extension of sanitary sewers to serve the Sayles Area properties along Route 146, Sayles Hill Road and Old Great (Old Smithfield) Road. The abutting areas of Lincoln along along Route 146 north of Route 99 and at the intersection of Sayles Hill Road and Route 99 currently are served by ISDS treatment. As noted previously, Lincoln has not experienced excessive ISDS failures, and extending sewers to these areas is not a priority. Should future conditions warrant abandonment of ISDS treatment, the possibility of providing coordinated service with the Town of North Smithfield should be investigated.

The area of Lincoln along Route 146 north of Route 99 is separated from other areas of the Town sewer system physically by Route 99 and topographically. The area of Lincoln at Sayles Hill Road and Route 99 is physically accessible to the existing sewer system in Sayles Hill Road, but additional gravity sewers and an additional pump station or relocation of the Birchwood station would be required to extend service there. As existing

Lincoln sewers can be accessible from portions of the existing unsewered areas, the possibility of directing some of the North Smithfield wastewater flow to the Lincoln system also exists. Approval by both North Smithfield and Woonsocket would be necessary for Lincoln to connect to the proposed North Smithfield system because North Smithfield directs its wastewater to Woonsocket for treatment via intermunicipal agreement. NBC also would need to approve additional flows that would be introduced from North Smithfield, and any proposed interconnections or coordinated systems would need to be accepted by RIDEM.

The September 2002 Town of Smithfield Wastewater Facilities Plan indicates that public sewers are proposed to provide service to the area surrounding Whipple Road west of Route 7 (Douglas Pike). The area of Lincoln at Whipple Road, Lantern Road and East Lantern Road currently is served by ISDS treatment system. The proposed Town of Smithfield sewers are approximately 4,500 feet away from the town boundary with Lincoln at Whipple Road. However, the existing Lincoln sewers in Angell Road are in the immediate vicinity of Whipple Road. Pumping would be necessary to convey wastewater from the unsewered area either to the proposed Smithfield sewers or to the existing Lincoln sewers. As the existing Lincoln sewers are more accessible and no intermunicipal negotiations or agreements would be necessary to connect to the existing sewers in Angell Road, pursuing an interconnection with the Town of Smithfield is not considered feasible. Should future conditions warrant abandonment of ISDS treatment for this area of Lincoln, connection to the existing sewer sytsem in Angell Road would be recommended.

5.3 Unsewered Areas

Alternatives to address future wastewater needs for currently unsewered areas include continued use of ISDS systems, extending public sewers to provide for centralized treatment, and the use of innovative and alternative collection and treatment technologies in certain districts. The existing Lincoln sewer system is connected to regional NBC facilities and centralized treatment is the primary existing wastewater management means in use. Excessive ISDS failure rates were not identified in the evaluation of repair

histories conducted in Chapter 3 and continued use of ISDS treatment in developed areas where public sewers do not exist is recommended. As noted in Chapter 3, the Town should continue to monitor ISDS failures and repair histories for acceptable performance. Based upon the excess capacity evident in the existing sewer system design, sufficient capacity is available to accommodate the additional flows should future conditions warrant abandonment of ISDS treatment in the limited areas currently not accessible to the public sewer system.

Given the widespread availability and accessibility of public sewers coupled with the generally acceptable performance and limited total area using individual on-lot systems, implementing innovative and alternative systems to treat wastewater on districtwide basis is considered to be less viable than either public sewers or ISDS. The capitol cost to construct sewers to convey flows to a treatment site within unsewered districts would be comparable to the cost to construct sewers to convey sewage to the existing public system. Capital and operations and maintenance costs for any innovative and alternative treatment system for a small district would exceed greatly the cost of sewer maintenance fees. For this reason, district-wide innovative and alternative treatment alternatives will not be considered further.

5.3.1 Individual Sewage Disposal Systems

A conventional system is a traditional ISDS with a septic tank, pump chamber with pump or siphon (if needed), distribution box and a standard leach field with gravity distribution. An Innovative/Alternative (I/A) System or Technology is an ISDS system that does not meet the location, design or construction requirements of a conventional system, but has been demonstrated through field testing, calculations and other engineering evaluations to provide the same degree (or better) of environmental and public health protection. RIDEM's Individual Sewage Disposal Systems Rules and Regulations provide the basis for approval of I/A Technologies in Rhode Island. I/A systems are designed as alternatives to conventional ISDS systems or parts of a conventional system. Evaluation of I/A systems must consider the specific conditions and constraints of the particular site for

individual on-lot systems. Accordingly, these evaluations are performed case by case on a site specific basis. Information on available I/A technologies is readily available from RIDEM. Further description of specific I/A technologies with respect to ISDS treatment is considered to be beyond the level of detail necessary for this Town-wide Facilities Plan.

5.3.1.1 ISDS and Septage Management

Like most municipalities, the Town of Lincoln relies on individual property owners/managers to maintain their private on-lot wastewater disposal systems. Unfortunately, negligence or improper operation on the part of the property owner, along with unsatisfactory site conditions, can lead to early failure of the system. Failed septic systems present potential threats to the health of residents and can adversely impact the environment. Failure of a system can be attributed to one or more of the following factors:

- Improper siting
- Inadequate sizing
- Hydraulic overloading
- Introduction of large quantities of non biodegradable solids
- Failure to pump the system regularly
- Improper installation or substandard construction materials
- Adverse activities around the leaching field (i.e. planting trees)

Although State legislation allows municipalities to establish wastewater management districts for the purpose of preventing contamination of state waters due to malfunctioning disposal systems, based on the limited extent of areas where the use of on - site wastewater disposal systems will continue, establishing a wastewater management district in the Town of Lincoln is not recommended. There are several options available to insure the proper performance of ISDS and individual on-lot I/A systems in the Town, which are described further below.

Community Operated Maintenance Program - The basis for this alternative establishes a program, financed through user fees assessed to individual property owners, whereby the Town would require that subsurface disposal systems be pumped out on a regular schedule and allow the Town to conduct periodic inspections of all systems. The service would be provided by the Town either directly or through private firms under contract to the Town. Legislation would be necessary to issue orders to the property owners requiring participation in the program. Bonds would also have to be issued to cover capital expenditures, should the Town provide pumpout services directly.

This alternative carries several negative aspects. Additional operating cost, predominantly in the form of additional Town personnel required to implement and administer the program, will be incurred. By taking this approach, the Town also assumes significant amounts of liability. Difficult legislation requiring owner participation is also necessary.

Conversely, by the Town assuming responsibility for ISDS pumping schedules and periodic ISDS inspection, proper system maintenance and operation would be assured. This would have a tremendous environmental benefit on the community by protecting groundwater and surface water resources form contamination associated with ISDS failure. This type of program would serve to remove the general complacent attitudes of the public toward ISDS system function.

Community Required Maintenance - Under this alternative, the Town would require homeowners to provide proof of periodic maintenance to their subsurface disposal systems, but would not provide the service directly. A notice would be sent every three years to system owners to remind them that it is time to pump out their system. A return receipt attached to the notice could then be returned to the Town by the pumping contractor as confirmation. Local legislation requiring periodic maintenance by property owners would need to be established. The Town also should have the authority to randomly inspect systems to ensure their proper operation. This alternative has a fairly low cost since the Town will not provide any services directly and few, if any, additional

personnel would be necessary to cover additional administrative duties. However, the effectiveness of this program is contingent upon owner participation and the Town's ability to enforce such an ordinance; the potential exists for a high degree of delinquency which could create overbearing enforcement problems.

Educational Program - This type of management program would involve the mailing of reminders and educational material describing the need for system maintenance. In this manner, the Town would have no enforcement authority over the property owner. This is a low cost alternative that will likely be ineffective if implemented on its own, but should serve as the base level of the selected program.

The recommended management program for Lincoln should consist of a combination of features from the Community Required Maintenance program alternative and the areawide Educational Program. It can be assumed that the greater the scope of responsibility given to the Town, the greater will be the costs incurred in implementing the plan. To accomplish the goals of a management program, several basic management functions need to be defined. These include:

- Public education
- Site evaluation
- System design
- Installation/Construction supervision
- Operation monitoring
- Financing
- System rehabilitation

A discussion of each of the key elements of the management program and recommendations for the level of participation to be provided by the Town is presented below.

Public Education - An active education program can prevent system problems by making the public aware of proper maintenance and operating procedures, proper design and installation techniques, and the required licenses for system construction. It can also make the public cognizant of the environmental benefits of properly functioning systems and aware of the negative impacts from failing systems. Public education is capable of providing positive results in preventing system failure. Instructional and informational pamphlets, describing potential system problems and solutions should be mailed and/or made available at the public library or authority office. This effort should result in a low cost and effective means of establishing a baseline for managing on - site systems, regardless of the level of control the Town takes.

Site Evaluation - A potential site for an ISDS system is evaluated for its soil, geology, groundwater, topographic characteristics and its proximity to surface water bodies. Unfavorable conditions may be alleviated by proper design. Site evaluation is foremost in implementing a management program. To receive a permit from the RIDEM Division of ISDS to construct an on - site system, certain evaluation procedures, such as a test pit, a percolation test, and the compilation of a topographic map, must have been completed. These services are offered by a large number of professional engineers and land surveyors. In addition, the RIDEM has regulations and procedures in place to assure that site evaluations are conducted properly. Therefore, the Town should not become involved in this management function.

System Design - A design review will insure that site constraints revealed in a site evaluation have been incorporated into a design and that design is completed in accordance with all applicable regulations. The RIDEM publishes design criteria and engineering standards that are reviewed and enforced by their technical staff. Due to the availability of private sector professionals and existing state regulations, it is recommended that the Town not become involved with this management function. The Town should maintain a local file to document septic system designs for reference.

Installation/Construction Supervision - Improper construction methods or materials can nullify the most prudent site evaluations or designs. Substandard materials are subject to breakage, premature decomposition or poor conveyance of wastewater. Field changes by a contractor, made without the knowledge or approval of the designer, can hinder the design's original intent. An inspector can assure adherence to the design and authorize changes in the field that maintain design criteria. Inspection service can range from certification of design to a complete construction management program. The RIDEM Division of ISDS provides spot inspection services during construction only. Licensed ISDS designers are responsible for system inspections at key points during construction to assure proper installation. The Town's construction supervision should be limited to receiving notification of completion from the responsible designer, which should be routed to both the Sewer Department and Building Official for record purposes.

Operation Monitoring - Monitoring the performance of an on-site wastewater disposal system is aimed at assuring proper mechanical operation and proper treatment, which will preclude the potential for groundwater contamination. Although groundwater is a limited source of potable water for the Town of Lincoln and the areas overlying groundwater reservoirs and recharge areas generally have been provided with public sewers, proper performance of on-site disposal systems remains extremely important in protecting groundwater resources for private wells utilized in remote areas not serviced by the public water supply system, as well as environmentally sensitive areas.

In addition to verifying proper and necessary system maintenance, the inspection process should insure that the system does not represent a health threat by exhibiting conditions such as ponding in the yard or basement and back-up of wastewater in toilets and sinks. An evaluation of system performance during rain events and spring run-off should be made to assess the threat of surface water contamination.

The Town should establish the current status for individual systems through a community survey process. Based upon the maintenance history documented by the survey, the future

pumpout and owner notification schedule can be established. A pumpout frequency of three to four years generally is acceptable for most domestic septic tank. Systems requiring more frequent pumping cycles will be determined from on-site inspections. Proper ISDS maintenance is to be documented to the Town by the return of receipts from private contractors for pumpout services performed.

Financing - A wastewater management authority must have the ability to finance activities through such means as establishing and collecting user fees, issuing bonds, and levying assessments or taxes. The main expenditure of funds by the management authority should be for construction assistance for ISDS system rehabilitation. Construction expenses are the single largest obstacle to the homeowner considering system rehabilitation. The Rhode Island Clean Water Financing Agency has developed a Community Septic System Loan Program that makes low interest loans available to fund ISDS upgrades. Property owners within areas designated for or with existing sewer service should be excluded from rehabilitation funding. Funds should also be made available only for systems approved by RIDEM. Administrative procedures must be developed by the Town for loan applications and fund disbursal.

System Rehabilitation - The Town must have the staff and materials that will enable it to assist the homeowner in solving ISDS problems either by directly instructing the homeowner or by referring the homeowner to a qualified professional. The authority also must have the legislative backing that will provide a recourse to insure that a problem will be corrected once identified.

Administration - A new committee can be formed to administer the ISDS management or this program can be administered through the Department of Public Works by the Town Engineer and or Sewer Division. Given the limited extent of continued ISDS treatment in the Town, formation of a new department to administer the ISDS management program is not warranted and it is recommended that these duties be the responsibility of the Engineering and Sewer Departments.

5.4 Sewer Extensions

Viable collection system alternatives include grinder pumps with pressure sewers, septic tank effluent pumps with pressure sewers, and gravity sewers. Each of these systems is described further below. Vacuum sewers are not considered to be viable due to limited lift, inefficient operation resulting in high operation costs, and because system failures will usually result in backflow and accumulation of waste in the connected buildings.

Grinder Pump/Pressure Sewer - The grinder pump/pressure sewer alternative includes a small pump at each home that discharges to a pressurized sewer in the street. The grinder pump, typically a 1 to 2 horsepower, is used to grind solids in the wastewater to form a slurry. The slurry is discharged through a service main to a small diameter (2 to 4-inch) polyvinyl chloride pipe, shallowly buried below the frost line, following the ground profile. A check valve is provided on the service main to prevent backflow. A septic tank is not required for this alternative. Pressure sewers are typically economically attractive over conventional sewers in less sparsely populated areas because less excavation is required (particularly in areas where there is shallow rock and/or high groundwater). They also have the advantage that they can be placed in area where existing ISDS influent pipes can be easily intercepted and pumped out into the pressure sewer located in the streets as apposed to gravity sewers that sometimes require rerouting of domestic plumbing to drain homes by gravity to collection pipes in the street.

Disadvantages are that grinder pump systems can cost between $10,000 and $15,000 per installation installed and capital costs escalate rapidly as the number of buildings served increases. Due to expense, emergency power usually is not provided at each home and when experiencing a prolonged service outage, these systems will be left without sewer service. In addition, these systems require maintenance, which usually is beyond the capabilities of the typical homeowner, requiring a service contract with a service vendor. There is limited use of low-pressure sewers in Lincoln and, although the Town is not responsible for these private systems, the Town has noted that homeowners have contacted the Sewer Department when maintenance is necessary or operational problems have

occurred. The Town does not have the equipment necessary to service private systems and responding to such requests places additional burdens on Sewer Department personnel and resources. Disagreeable situations can result when the Town must advise homeowners of their responsibilities in regard to ownership and operation of these private systems.

Septic Tank Effluent Pump/Pressure Sewer - The septic tank effluent pump (STEP) / pressure sewer alternative includes an open impeller pump which is used to pump wastewater from a septic tank to a pressurized sewer in the street. This is similar to a grinder pump installation except that instead of grinding solids, they are settled out in a septic tank similar to a conventional ISDS. The septic tank is used to remove solids including grit, grease, sludge and floatables and to reduce pollutant strength. The septic tank in a STEP system is commonly made of fiberglass reinforced polyester or low density polyethylene. The STEP pump can be located in a vault external or internal to the septic tank. This vault is typically made of fiberglass reinforced polyester. The pump discharges through a service main to a pressure sewer as described above.

Disadvantages of STEP systems are similar to the grinder pump. The open impeller pumps are somewhat less costly than the grinder pumps, requiring less horse power but the added need for a septic tank offsets the savings for the lower cost pumps. In addition, solids will need to be removed periodically from the septic tank similar to an ISDS (every 3 to 5 years). Failure to do so can result in solids accumulating in the pump chamber and clogging or damaging the pumps. Like grinder pumps, these systems are usually installed without emergency power. The potential for additional burden upon Town resources and for homeowner misunderstanding regarding ownership and maintenance responsibilities described above also are associated with low-pressure STEP systems.

Gravity Sewers - Gravity sewers are the preferable alternative for wastewater collection and conveyance systems because these systems typically are the less expensive to operate and require the less maintenance than other systems. Gravity collection sewers can be installed where a minimum pipe slope of 4 vertical feet per 1,000 horizontal feet can be

achieved to convey wastewater to the desired location. Manholes are installed with spacing 400 feet apart or less, and at changes in direction and grade. Local topographic considerations generally are the limiting factor in the feasibility of gravity sewers for specific areas. Pumping is necessary within systems where topography does not accommodate gravity sewers to the required point of discharge. Pumping may also be employed to avoid construction of sewers to unreasonable depths. Initial construction costs for gravity sewers with manholes are higher than pressure sewers but they do not require mechanical pumping equipment at each individual home, which is a great savings.

Combination Systems (Gravity Sewers plus Grinder or Effluent Pumps in Select Areas) - The final alternative for collection of wastewater from unsewered areas consists of a combination of one or more of the technologies described above. In some cases, remote areas of the service territory may be at grades or distances that would require installing the gravity sewer at greater depths to achieve the required slopes thereby lowering the system as a whole and increasing costs due to the greater depths of excavation and encountering groundwater or rock. In such cases, a cost benefit analysis would typically be conducted to see where the installation of grinder or effluent pumps with limited pressure sewers or force mains would be better served to convey flows from these remote areas to the gravity sewers. This would allow the most cost efficient installation of the gravity sewer system (i.e. shallow as possible) and minimize the number of onsite pumping systems needed.

5.4.1 Summary of Sewer Extension Alternatives

As the Town sewer system is well established and sewers occur throughout a majority of the Town, large scale sewer extension projects are not envisioned. Topographic constraints generally prevent the extension of gravity sewers from existing developed areas of Lincoln that are without public sewers and currently are served by ISDS treatment. Had gravity sewers been feasible for these areas, sewers likely would have been provided under the major sewer system construction program. It is presumed that some form of pressure sewers, or gravity sewers and additional pump stations, would be necessary to extend sewers to these developed areas. Detailed investigations and

evaluations of the available alternatives would need to be conducted for specific areas should future conditions (i.e. increased failure rates) warrant abandonment of ISDS in areas without public sewers.

New sewers necessarily will be associated with new development in order to convey wastewater flows. These new systems will likely be financed and installed by the developers and new sewer connection assessments charged in accordance with Town ordinance. As indicated above, gravity sewers are the preferred alternative for collection sewer systems. As the Town will assume ownership, and maintenance responsibilities, for most of these systems upon completion, extensive use of pump stations and pressure sewers is undesirable. However, because new development must connect to the existing sewer system, the depth of the existing sewers where connection will occur restricts the new systems and may necessitate pressure sewers or additional pump stations. The Town has established the order of acceptability for new sewer systems in Table 5-1 listed in order of most favorable to least favorable.

Table 5-1

Sewer System Order of Acceptability

1	Gravity sewer
2	Gravity sewer/existing pump station combination
3	Grinder pumps/gravity sewer combination
4	New pump station to replace one or more existing pump stations.
5	Additional pump stations

Sewer extensions for new development should be evaluated and implemented with the goal of providing the most favorable system. ISDS systems are to be implemented in areas that are to remain inaccessible to public sewers. Should the Town consider extending sewers to existing development in unsewered ISDS areas in the future, the detailed evaluations for specific locations should rate alternative systems based on the above order of acceptability.

Chapter 6 – Recommended Plan and Evaluation of Alternatives

6.1 Recommended Plan

The recommended plan for the Town of Lincoln wastewater facilities is established based upon the information, evaluations and assessments presented in the previous Chapters of this Facilities Plan. In general, new facilities or expanded facilities are not needed to address the existing or future wastewater disposal capacity needs of the Town and the recommended plan involves anticipated maintenance of existing facilities and investigations to identify deficient conditions in order to establish a rehabilitation and replacement program. The following evaluations and administrative activities should be conducted.

- Review and update Town Sewer Ordinance.
- Perform Sewer Rate Study and reset sewer use fees as necessary.

6.1.1 Collection System

As described in Chapters 3 and 4, the existing sewer system design capacity and intended service life extend beyond the end of the 20-year planning period, assuming a proper program of system maintenance (i.e. cleaning and flushing). Extensive construction to replace existing gravity facilities to accommodate increased flows due to development during the planning period is not anticipated to be necessary. New gravity conveyance facilities possibly may be constructed as replacements to existing pumping stations as discussed later in this Section. Existing facilities with a documented history of operation problems and deteriorated conditions should be repaired or replaced to correct deficiencies. The following recommendations are made with respect to the existing gravity collection facilities.

- Prepare / complete detailed information database of all Town pipe lines and manholes to identify location, size, age, materials of construction, slope, etc.

- Target sewers constructed prior to 1900 and sewers with suspected deteriorated conditions to conduct I / I analyses (this activity should be coordinated with the findings of the current NBC studies being conducted).
- Perform Sewer System Evaluation Surveys (SSES) where excessive extraneous flow is indicated by the I / I analyses.
- Initiate Rehabilitation / Replacement program for sewers with confirmed sources of excessive I / I identified under the SSES.
- Continue to evaluate alternatives for rehabilitating / replacing existing sewer systems located on private properties. Generally, new sewers constructed in public right-of-way are preferable to establishing Town easement rights, legal ownership, and maintenance responsibility, but specific recommendations must be based upon detailed studies for individual areas.
- Continue to target and conduct I / I, SSES and Rehabilitation / Replacement evaluations for remaining pipelines based on age (i.e. older than 1950s, older than 1980s, etc.) and areas of suspected stormwater intrusion until entire system has been evaluated and deficient conditions corrected as necessary.
- Perform detailed analyses based upon data compiled in the sewer system database to confirm that existing pipe line and facilities capacities are consistent with the original planning and design documents and identify areas of concern should actual capacities vary substantial from that required or originally proposed.

Investigations, evaluations, rehabilitation / replacement analyses for areas of known or persistent problems should be expedited where necessary. One such area is the existing sewer in School Street from NBC interceptor connection to Berkshire Drive. The RIDOT School Street resurfacing project is proposed to occur in 2008 and the sewer study and corrective measures for this area should be coordinated with this RIDOT project to the extent practical. Completion of activities that require excavation or other pavement disturbance prior to or in conjunction with the final roadway resurfacing should factor into the rehabilitation alternatives analyses and enable the Town to realize some cost savings or

implement a technically superior alternative by sharing costs (i.e. pavement restoration) with RIDOT.

6.1.2 Pump Stations

Staged rehabilitation based upon age and existing conditions is recommended for the Town's wastewater pump stations. The projected rehabilitation schedule presented in Chapter 3 is based upon the age of each pump station and the minimum intended service life of 20 years unless specific deficiencies or deteriorate conditions are apparent that indicate earlier rehabilitation is necessary.

6.1.2.1 Submersible Grinder Pump Stations

Based upon the age and general conditions, the staged rehabilitation the Submersible Grinder Pump Stations will be spread over several years with three to five stations rehabilitated per year. Rehabilitation of the Submersible Grinder Pump Stations is recommended to include complete replacement of the pumps and discharge piping systems (including valves and gauges) in the wet well chambers, repairs to the electrical system installation where necessary, and replacement of control system bubbler air compressors. Stainless steel guide rails and lifting chains, and PVC discharge piping is recommended for corrosion resistance. Additionally, access ladder safety extensions should be installed at stations without extensions.

Sewer Division personnel are most familiar with the physical and mechanical conditions of these stations and, due to the similarity of the basic design, detailed assessment of each Submersible Grinder Pump Station likely would not identify any information the Town is not aware of already. Town personnel can prioritize these stations annually and develop a specific rehabilitation schedule based upon operations and maintenance histories and occurrences. Once the priority schedule is established each year, the Town would then arrange for construction plans and specifications to be prepared based upon detailed assessment of the existing conditions at the specific stations to be rehabilitated. The detailed assessment and design recommendations also should investigate the feasibility

and cost effectiveness of eliminating existing pump stations by construction of alternate routing gravity sewers. Refer to the Wet Well / Dry Well Pump Station section below for further discussion on this topic. The Heidi pump station may have been constructed in lieu of gravity sewers through wetlands areas.

As noted in Chapter 3 the control systems for all but one of these pump stations utilize a mercury filled "electro-gage" controller. Although these control systems are generally in serviceable condition, the rehabilitation of these stations should consider replacing these systems to eliminate the possibility of accidental release and potential environmental impacts associated with this hazardous material. Microprocessor based control systems with level sensing pressure transducers and backup float systems are recommended. Depending on the sophistication desired, the microprocessors can be used to collect more detailed data, such as specific timing of pump operations and cycling, which cannot be obtained from elapsed run time meters that can be of use in documenting system operating conditions and identifying if changes in system use as they may occur. Additionally, these control system could be incorporated into the operations monitoring system recommended below for the Wet Well / Dry Well Pump Stations if desired.

6.1.2.2 Wet Well / Dry Well Pump Stations

Rehabilitation of the Wet Well / Dry Well Pump Stations should include a detailed assessment of the existing structural, mechanical, electrical, and instrumentation and control systems to verify the existing conditions and establish specific preliminary design recommendations for rehabilitation of each station. Detailed final design of construction plans and specifications for the rehabilitation of each station would follow the report of detailed assessment and design recommendations. The assessment and preliminary design recommendations portion of the rehabilitation tasks should be conducted under as a single project for all Wet Well / Dry Well stations, rather than individually, so as to provide consistency in the evaluation as well as the recommended design for all stations. Lower River Road Screw Pump pump station also should be included in the assessment and preliminary design project with these stations to promote consistency and minimize to

cost of the preliminary engineering phase to the Town. TR-16 recommends that fully valved connections be provided to allow the use of portable pumps in the event of equipment malfunction. The pump station rehabilitation evaluations should include consideration of providing bypass connections for the Wet Well / Dry Well stations.

As noted in Chapter 5 Lincoln has more pump stations than were envisioned in the original planning documentation for the original system design due to environmental constraints associated with installing utilities in regulated areas and associated buffers. Specifically, the Kirkbrae and Maria stations were constructed in lieu of river crossings to connect to the NBC interceptor on the opposite side of the Blackstone River; the Great Road station was constructed in lieu of gravity interceptor along the Moshassuck River and Barney Pond; and the Angell Road North was constructed in lieu of gravity sewers along the utility easement south to Twin River Road. The evaluations for rehabilitation of the pump stations should include investigations into the feasibility and cost effectiveness of replacing pump stations with gravity sewers through alternative (original) routing scenarios. The assessment project should include a detailed comparison of design, construction, and operations and maintenance costs in order to determine if elimination of specific pump stations can be recommended.

The pump station assessment project should also include evaluation of supervisory control and data acquisition (SCADA) system alternatives for the Wet Well / Dry Well. Computerized SCADA systems have a proven history of reliability in the period since the now abandoned pump station monitoring system was constructed and data obtained by continuous monitoring can be valuable tool in evaluating wastewater facilities operations and planning effective maintenance programs. SCADA system is recommended for the Wet Well / Dry Well stations and should include provisions for flow metering equipment to be installed for these stations. The SCADA system base station likely would be located at the Sewer Department or Engineering office and should be included in the initial pump station rehabilitation project. Later projects would need to be compatible with and provide appropriate modifications to add the subsequent projects to the system.

Similarly to the Submersible Grinder Pump Stations, the Wet Well / Dry Well Pump Stations also utilize a mercury filled "electro-gage" controller that are generally in serviceable condition. As recommended for the Submersible Grinder Pump Stations, the rehabilitation of these stations should consider replacing these systems to eliminate the possibility of accidental release and potential environmental impacts associated with this hazardous material. It is recommended that each Wet Well / Dry Well Pump Station rehabilitation include replacement of the existing control system. Eliminating the potential environmental impact liability is considered to be well worth the additional incremental cost of new control systems.

6.1.2.3 Screw Pump Stations

As indicated above, Lower River Road Screw Pump pump station is recommended to be included in the assessment and preliminary design project with the Wet Well / Dry Well stations. Complete rehabilitation of the mechanical and electrical systems for this pump station is recommended. The control system is expected to be serviceable for continued operation, but may require replacement for compatibility with the replacement mechanical pumping equipment. Additional equipment will be necessary to provide input data and communications with the above recommended SCADA system. The rehabilitation should include a new control system that is compatible with the proposed SCADA system accordingly.

6.1.3 ISDS

Continued use of ISDS treatment is recommended for the areas that currently are inaccessible to the existing public sewer system. These areas generally occur in the locations identified in Table 6-1 below, however, other scattered properties and areas occur elsewhere that do not have convenient access to existing sewers.

Properties with existing ISDS treatment that occur in sewered areas and have connection access to the existing sewer system should not be allowed repair, replace or otherwise

modify on-lot systems and should be required to connect to the existing available sewer system upon ISDS failure, proposed change of use, or proposed increased loading.

Table 6-1

ISDS Treatment Areas Generally
Inaccessible to Existing Public Sewers

- Breakneck Hill Road at Old Louisquisset Pike and Route 146
- Twin River Road at Old Louisquisset Pike and Route 146
- Whipple Road, Lantern Road and East Lantern Road area
- North of Wilbur Road along Old Louisquisset Pike and Route 146
- Old Great Road at Route 146, Sayles Hill Road at Route 99
- Woodward Road north / east of King Phillip Road

It is recommended that Lincoln implement a management program that consists of combination of features from the Community Required Maintenance program and the areawide Educational Program detailed in Chapter 5 in order to promote the proper operation, maintenance and use of ISDS treatment systems in areas that are to remain unsewered.

6.2 Evaluation of Alternatives

The extent of the existing service area and general suitability of the existing sewer system to accommodate future needs limits the available alternatives to be evaluated. New developments should be evaluated based upon the acceptability criteria listed in Chapter 5 based on specific projects, locations, and proposed point of connection to the existing sewer system with the goal of no net increase in pumping stations. Isolated development in areas inaccessible to the existing sewers will require ISDS treatment for wastewater disposal. New development in these areas is anticipated to be low-density and limited to individual property sites. Evaluation of extending sewers should be considered if any significant subdivision or extensive development projects are proposed for currently isolated areas.

6.2.1 Collection System

As established previously in this Plan, construction of new collection facilities to accommodate future increased flows is not envisioned to be necessary. As such, the alternatives for the future management of the collection system generally are limited to the No Action alternative and the system investigations and evaluations discussed above. Under the No Action alternative, existing deficient conditions would remain in areas and would continue to present intermittent operational problems. These areas require special attention and a disproportional level of effort in order maintain satisfactory operations. It can be expected that conditions will at best remain as exist at this time without programs to identify and correct deficiencies, but it is likely that system operations will degrade further over time if deficiencies are not corrected. Further degradation would necessitate that additional maintenance resources be applied, increasing the disproportional effort to maintain these areas. Additionally, the level of service could degrade to the point that unacceptable performance would require construction of emergency replacement facilities without being afforded time to develop and evaluate alternative designs.

Under the recommended program of system evaluation and rehabilitation, deficient conditions would be identified and corrected in a logical fashion. Under this approach, the system operations and reliability would be improved, thereby reducing the anticipated maintenance required of historically problematic areas and allowing these resources to be applied more evenly throughout the system. This scenario will lead to the overall improvement of the entire system and for this reason is recommended over the No Action alternative.

Without completing specific investigations, analyses, and evaluations of the existing system conditions, detailed comparison of individual sewer repair, replacement and rehabilitation technologies is not possible. The merits and drawbacks of the various viable alternatives for collection sewer system rehabilitation are provided below. It should be noted that in all cases by-pass pumping of sewage around facilities under repair will be necessary.

Excavation and Replacement – Excavation and replacement is the most disruptive means of correcting deficient conditions in existing sewers. This method is employed when the structural integrity of the pipeline is degraded to the point where in-place repair methods are not possible. Examples where replacement would be necessary include pipe that is crushed, missing sections, is excessively cracked, or is misaligned. The extent of replacement can vary from individual lengths of damaged pipe to entire runs of pipe and manhole structures. Advantages of pipe replacement are improvements associated with current construction materials and methods that will provide an increased service life for the pipe. Replacement typically will require disturbance and restoration of existing pavement and may encounter buried utility or other unforeseen interferences. Replacement pipe bedding materials generally will be required and additional select backfill materials often may be needed because existing materials do not conform to current pipe installation requirements. These aspects of excavation and replacement lead to higher installation costs than other rehabilitation alternatives.

Chemical Grouting – Internal grouting is the most commonly used method for sealing leaking joints in structurally sound sewer pipes. Small holes and cracks can also be sealed with chemical grouts. Chemical grouts are applied inside the pipe using specialized equipment that force the grout through the leaking joint or crack and into the surrounding soil, which is stabilized by the grout. Repair of small to medium sized pipes employ a "packer" that can seal off pipe segments, air test the isolated segment, and injecting grout where air testing indicates leaks occur. The primary advantage of this rehabilitation method is that repairs are effected in-place without requiring costly excavation and surface restoration, or potentially disturbing other underground utilities. Chemical grouting is not a structural repair and does not result in increased pipe strength. Changes in groundwater conditions and the moisture content of the surrounding soil can reduce the effectiveness of grout. Additionally, leaks can be difficult or impossible to seal if large voids exist outside the pipe. Chemical grouting is not suitable for repair of misaligned or offset joints or longitudinal cracks.

Pipe Lining – There are several methods of in-place pipe rehabilitation that fall under the general category of pipe lining. These methods include slip lining, deformed pipe, cured-in-place pipe (CIPP).

- *Slip Lining* – In the slip lining rehabilitation process whereby a replacement pipe is inserted inside the existing pipe. The lining pipe must be slightly smaller in diameter than the existing pipe and is installed by either pushing or pulling. Slip lining requires an excavation pit to access the existing pipe and begin the insertion process at one end of the pipe segment to be repaired. Winching equipment usually can fit into standard manholes, which allows the slip lining installation to terminate at a manhole structure. Slip lining can be accomplished with continuous (fusion butt welded) or segmental lengths of piping. Spiral wound piping where the strips of liner material are wound into the existing pipe and the spiral joint is sealed by interlocking, gaskets or adhesive. Spiral would lining sometimes can be installed through manholes without excavation. Service connections must be reconnected by excavating or remote control cutter after slip lining pipe installation. Although an insertion pit is necessary for each repair segment, slip lining requires substantially less excavation in comparison to complete pipe replacement. Disadvantages of are associated with the necessary reduction in size from the original pipe diameter. Where the existing pipe has offset joints or excessive service lateral taps, the liner pipe may need to substantially smaller than the original pipe. These conditions may result in a reduction in carrying capacity such that the slip lining method becomes unsuitable for the application.

- *Deformed pipe* – The deformed pipe lining method is similar to slip lining in that the liner pipe is inserted into the existing host pipe. The flexible liner pipe is deformed, commonly by folding into a "U" shape, to reduce the cross section temporarily so that it can be pulled through the existing pipe. The liner pipe then is heated and pressurized to expand to the existing pipe to complete the installation. Service laterals are identified by a dimple in the liner pipe and reconnected by remote cutting device.

Deformed pipe linings usually can be installed via standard manhole structure without requiring excavation, which provides for reduced installation costs. Disadvantages include reduced pipe diameter and the possibility that the liner pipe can shrink or deform after expansion.

- *Cured-in-Place Pipe* – This method pipe rehabilitation utilizes a flexible fabric tube impregnated with a thermosetting resin to reline the existing pipe by inversion. Inversion is the process of turning the resin impregnated tube inside out by the use of water or air pressure. Heated water or steam is applied to cure the liner and bond it to the existing carrier pipe to complete the installation. The CIPP method uses existing manholes as access points for inverting and curing the liner tube. Service lateral connections are identified by dimples in the cured liner and reconnected by remote cutting device. The advantages of CIPP are that excavation usually is not required, the liner material forms a tighter bond and seal with the existing pipe, and the liner / resin materials with distinct resistance to specific wastewater characteristics can be provided. As with other lining methods, the pipe diameter is reduced for the original pipe. The curing time required for CIPP generally requires that repair segments be out of service for longer periods that other lining methods, and curing of long segments can be difficult. Resin materials can collect in the pipe invert and improper or deficient installations can be problematic to correct.

Pipe Bursting – New piping can be installed by the pipe bursting method to replaced damage existing piping. Under this repair method, an expansion head is used to force the existing pipe outward until it breaks. Expansion heads can be static with no moving parts, or dynamic applying additional force on the existing pipe by pneumatic pulsation or hydraulic expansion. A bursting device is pulled behind the expansion head to break up the existing pipe and the new pipe is pulled through behind the bursting device. Pipe bursting normally requires an access pit to be excavated to accommodate inserting the bursting equipment and installing new pipe segments. Service laterals are reconnected by excavation or remote control device. This in-place rehabilitation method has the distinct

advantage of replacing the existing pipe without requiring a reduction in size, and sometimes can be used to installed larger size pipe to increase capacity. Pipe bursting may not be a suitable based upon the existing pipe materials, and the potential exists for surface and underground disturbance to occur with this method.

6.2.2 Pump Stations

New construction to increase the capacity of the existing pump stations to accommodate future increased flows is not envisioned to be necessary. Similar to the collection facilities discussion presented above, the alternatives for the future management pump stations generally are limited to the No Action alternative and the equipment replacement and station rehabilitation programs recommended above, which include evaluation of new gravity sewers to replace existing pump stations.

Basic arguments against the No Action alternative for pump stations are the same as for collection facilities, whereby existing deficiencies would continue to place undue demand on maintenance resources reducing the efficiency of overall system operations and continued deterioration would serve to compound the situation. Immediate response to major equipment failure likely would require transportation of wastewater by tanker truck because no provisions exist for temporary bypass pump connections to the existing discharge forcemain piping. This concern generally is associated with the Wet Well / Dry Well stations, as an inventory of spare pumps maintained for the Submersible Grinder stations that allows for prompt equipment replacement, and portable pumps with short runs of discharge hose could be implemented at the Screw Pump station without difficulty if needed. Without a planned program for rehabilitation, system reliability would not be assured and all stations eventually would experience equipment malfunction or failure that would require emergency replacement activities. The No Action alternative is deemed to be infeasible for this reason.

Under the recommended program of staged rehabilitation, the actions and projects necessary to maintain satisfactory operating conditions at the pump stations would be

identified, sequenced, and implemented in a logical fashion. Station operations and reliability would be assured and emergency response maintenance activities would be reduced correspondingly. Reliable pump station operations are essential to the overall satisfactory service of the Town's wastewater facilities, and rehabilitation of the existing pump stations is recommended over the No Action alternative accordingly.

6.2.2.1 Gravity Sewer Pump Station Replacement

The possibility of replacing pump stations replacing pump stations with gravity sewers through alternative (original) routing scenarios may exists for some stations. As indicated earlier in this Section, the detailed pump station rehabilitation assessments to be performed should include a comparison of design, construction, and operations and maintenance costs in order to determine if elimination of specific pump stations can be recommended. These detailed evaluations would include investigation of the specific environmental constraints and mitigation requirements associated with the gravity routing alternatives. Final recommendations as to the viability of station replacement over rehabilitation until these investigations are performed that anticipated costs to address the specific constraints associated with the alternative routing can be established.

For the purposes of comparison in this Plan, the projected cost for pump station rehabilitation projects includes replacement of pumps, controls, heating and ventilation equipment, and wet well electrical systems. The proposed facilities identified in the 1971 Phase I Sewers Proposed Sewerage System plan will be used as the basis for gravity routing alternatives and projected costs will be based upon conventional design and construction utilizing ductile iron pipe, with a 20% increase in expense assumed due to environmental constraints. Cost to abandon or demolish existing pump stations is not included. The projected costs, including engineering, construction and contingencies, for the stations identified earlier in this Chapter where replacement may be possible are provided in Table 6-2 below.

Table 6-2

Pump Station Rehabilitation and Gravity Sewer Replacement Estimated Costs

Location	Pump Station Rehabilitation	Gravity Sewer Replacement
Great Road	$380,000	$1,060,000
Maria	$165,000	$360,000
Kirkbrae	$185,000	$280,000
Angell Road North	$160,000	$805,000
Heidi	$35,000	$70,000

Based only upon these estimated costs, gravity sewers would not be recommended as to replace any of these stations. However, as noted previously, the gravity sewer replacement alternative costs are based upon the broad assumption that project costs will be increased by 20% due to environmental factors, under certain conditions where severe constraints must be overcome actual costs may be much higher. These factors can include activities such as wetlands permitting and restoration, additional dewatering, and special pipe bedding requirements. Additionally, the above listed estimated costs represent initial project capital costs without anticipated lifetime operation and maintenance cost considerations. As such this information is presented here for general reference only. Formal comparison of station rehabilitation against replacement must be deferred until further investigation of specific alternative routing scenarios has been conducted and additional detailed information is available for evaluation.

6.2.3 ISDS

The alternatives evaluated for areas without access to the existing sewer system where ISDS treatment is in use, and thus required for any future development are continued use of ISDS treatment (with education and community required maintenance), and extending public sewers. Various topographic and physical barriers occur that isolate these areas and limit the practicality of sewer extension. Given the extent of the existing sewer system, it is reasonable to expect that the major sewer system expansion projects would have

included construction of sewers to service these areas if such construction was reasonably feasible or if a specific need (i.e. excessive ISDS failure) was evident.

Various sewer system alternatives are discussed in Chapter 5, and a combination of individual grinder or effluent pump with pressure sewers, gravity sewers, and small pump station methods typically would be necessary in order extend sewers to most of the existing unsewered. For general comparison, extending sewers to service approximately 20 lots along Old Louisquisset Pike north of Wilbur Road would entail construction of 3,400 feet of new 8-inch gravity sewer, 1,400 feet of new 3-inch forcemain, and relocation of the existing Old Pike pump station. The estimated construction cost for these facilities is approximately $615,000, or approximately $31,000 per lot, and assumes that no environmental constraints exist that would necessitate extensive mitigation or special construction methods.

Projects to extend sewers to the Town's other unsewered areas would require individual grinder or effluent pumps and pressure sewers, with an approximate cost of $15,000 per service, in addition to comparable gravity sewers construction. Assuming and extension with the same length of gravity sewer and number of services, with half of the services requiring grinder pumps, and no further centralized pump station is necessary, the estimated cost per service would increase to approximate $35,000 due to the expense of individual pumping systems and pressure sewers. If one new centralized pump station were required, the cost per service would increase to approximately $37,500. Additionally, relocation of the Old Pike pump station includes only the cost of a new pump station wet well chamber structure and not the complete cost of a new centralized pump station. The Town will incur equipment costs to rehabilitate this station regardless of its possible relocation and therefore equipment costs are not included in the estimated sewer extension costs.

This estimated cost to extend sewers along Old Louisquisset Pike north of Wilbur Road is considered to be generally optimistic due to the specific conditions associated providing

service to this area and higher per unit cost would be anticipated for sewer extensions to other unsewered areas. Additionally, the limited evaluations above do not consider potential additional cost to address environmental impacts or special construction methods to clear other physical barriers, such as pipe jacking to cross state highways. As the cost of conventional on-site wastewater disposal systems can range from $12,500 to $19,000 and advanced I / A systems from $23,000 to $41,000, the continued use of ISDS treatment is the financially more attractive alternative unless specific local conditions necessitate implementation of advanced I / A systems with increasing frequency. There is no emergent evidence of excessive ISDS failure or unsuitability based upon existing repair histories, therefore continued use of ISDS treatment is recommended for areas without access to the existing sewer system. However, the Town should monitor ISDS operating conditions, failures, and repairs in order to identify if any of the conditions that form the basis of this recommended have changed in the future whereby re-evaluation of the need to extend sewers would be warranted.

6.3 Environmental Impacts of the Recommended Plan

The purpose of an environmental evaluation is to identify the project alternatives selected in the Facilities Plan and determine the impacts these alternatives have on the environment. The recommended plan for the Town of Lincoln was presented in the preceding sections of this chapter and is briefly outlined as follows:

- Investigation, evaluation, rehabilitation / replacement of collection facilities
- Staged rehabilitation of pump stations
- Continued ISDS treatment in selected areas inaccessible to the sewer system

6.3.1 Future Environmental Environment without the Project

By adopting the No Action alternative, the existing system conditions discussed in this and previous chapters will prevail and continued degradation of performance of portions of the existing sewer system would be anticipated. Environmental impacts associated with the No Action alternative include the potential for release of sewage to the environment due to

pipeline blockages, failures, and failed pumping systems. Such releases could necessitate notification of public safety and health officials, or other emergency responses.

6.3.2 Water Quality and Aquatic Life

The proposed activities and improvements to the Town of Lincoln sewer systems are those required to maintain and provide for the proper operation of these facilities throughout the planning period. There are no discharges to surface waters existing or proposed from the Town system and no appreciable change or impact to local water quality or aquatic life is anticipated to result from implementation of the recommended plan.

6.3.3 Wetlands and Floodplains

In general, the above discussion of water quality impacts associated with areas of continued ISDS treatment apply equally to the anticipated impact upon wetlands and floodplains. No projects are proposed at this time that would require new or extensive construction activities in regulated areas. Should the future evaluation of pump stations and potential rerouting alternatives conclude that pump stations replacement is to be recommended, these evaluations necessarily will need to provide detailed assessment of the expected impacts and required mitigation measures associated with the proposed construction activities. Similarly, any sewer rehabilitation or replacement projects resultant from the recommended studies and evaluations of the existing collection system would include specific detail of the environment impacts and necessary mitigation requirements for the proposed work. Significant impacts are not envisioned, as the rehabilitation projects would involve existing systems in developed areas. Where existing piping in wetlands or floodplains must be rehabilitated, impacts associated with the temporary disturbance would be expected based upon the extent of work necessary and a requirement to completely restore all disturbance would be anticipated for any project.

Potential construction impacts to wetlands and floodplains are primarily in the form of erosion and sedimentation. The washout of soil excavated from trenches could severely affect local storm drainage structures and private property, increasing maintenance costs,

reducing water quality, and possibly causing localized flooding problems. These impacts are regulated by RIDEM and permits would be required for work within jurisdictional wetlands. Potential need for permits should be identified and permits should be sought as early as practical in evaluation and planning phases of the collection system and pump station rehabilitation projects. No significant permanent effects to any floodplain such as storage, aesthetics, habitat, human health, and welfare are being compromised by adoption of the selected plan.

6.3.4 Traffic and Noise

Disruption of traffic is a direct impact associated with most sewer construction and rehabilitation projects. Public safety and traffic flow concerns can post a variety of lifestyle problems during construction. Interference with normal access to commercial and residential facilities generally can be anticipated. In cases where troublesome traffic flow patterns exist, congestion could become more severe during construction projects.

Traffic impacts during sewer system investigation activities are associated with accessing existing manhole structures to install metering or observational equipment and perform conditions assessments. These impacts usually are confined to a single manhole location or reach between two manholes and will occur only when access is required. Traffic impacts from sewer pipe rehabilitation activities will be dependent upon the extent of excavation required under the specific method of pipe rehabilitation to be implemented as determined through the SSES program, with anticipated traffic impacts increasing with increased excavation. The greatest amount of excavation is required with the excavation and replacement method, lesser excavation is needed for slip lining and pipe bursting methods, and the least excavation is necessary for CIPP and deformed pipe methods. Temporary controls during investigation and construction activities, including warning signage, flagmen, lane closures, detours, or police details, usually are necessary to mitigate impacts and maintain acceptable traffic flow.

The pump station rehabilitation projects will impact traffic in the immediate vicinity of each station during the work. Many of the Submersible Grinder stations are located in primarily residential areas encroachment of activities into the roadway, which typically will be necessary due to the location and small size of each site, the anticipated impacts to traffic are expected to be minimal because these streets mostly are lightly traveled and many stations are located at a dead end or cul-de-sac. One exceptions to this generality are the Davies stations located on Route 246 / Old Louisquisset Pike at the intersection with Route 123 / Breakneck Hill Road. This intersection is heavily traveled due to its proximity to both the Davies Vocational School and Community College of Rhode Island, and also because Route 123 serves as a direct route towards Route 146 south to Providence and Route 95 from the industrial park. However, this site is larger than most other Submersible Grinder pump station sites, with area available on site to accommodate some construction vehicle parking, and no significant traffic impacts are expected to occur due to the proposed station rehabilitation project.

Lower River Road is a narrow street and there is no off street accessibility at the Lower River Road pump station. Lower River Road is not a heavily traveled street, but moderate traffic impacts to residents of Quinnville could occur during construction. The Wet Well / Dry Well stations each occur on larger sites that generally provide for off street parking of construction vehicles similar to the Davies station and only the Great Road station is located on a road that sees a substantial traffic load. Substantial traffic impacts during construction of the pump station rehabilitation projects are not anticipated and no long-term traffic impacts are expected to result from these projects.

Noise impacts are predominately short term, and derived from construction vehicles involved with pavement breaking, trench excavation, backfilling, and repaving existing streets. As with traffic impacts, the impact of noise from these activities will be dependent upon and increase as the extent of excavation required increases based upon the specific method of pipe rehabilitation to be implemented. The effect of these impacts will be less in densely developed areas, where background noise is relatively high, than in quieter

residential areas where increased background noise levels would occur during normal working hours. Rehabilitation of the existing pump stations is not expected to have a permanent effect on noise levels. Temporary impacts are expected to be minor, as little or no excavation is expected to be necessary. However, permanent reduction in noise levels would be expected in the immediate vicinity of any stations eliminated or relocated

6.3.5 Air Quality

One of the factors affecting air quality during construction is increased emissions of carbon monoxide and hydrocarbons from heavy duty vehicles and gasoline driven pumps and generators. These effects will be more pronounced in residential neighborhoods than in the high traffic commercial district. A second factor affecting air quality is dust which will be generated during trench excavation, backfilling and vehicular transport. Air quality impacts from construction are temporary in nature and will be localized at the point of disturbance.

Odors are a typical concern, especially in residential areas, for wastewater pump stations, where raw wastewater is subjected to turbulent conditions causing the release of hydrogen sulfide and other potentially odorous compounds. As noted previously in this Plan, while odor complaints do occur, the frequency of these complaints does not suggest a particular air quality problem is associated with pump station odors. As no substantive changes for any pump stations are proposed, air quality conditions with respect to odors are expected to remain the same. However, changes such as increased loading over time and new occupants in adjacent dwellings may occur and odor control may become a future issue.

6.3.6 Hydrology and Drainage

No appreciable effect on hydrologic conditions is anticipated from the proposed plan. The impact of reduced flow to groundwaters as ISDS treatment is abandoned and replaced by sewer connections will be minimal because these occurrences will be scattered throughout the Town and groundwater is utilized as a drinking water supply in limited practice.

Water quality conditions in areas of continued ISDS treatment should only benefit from the proposed plan. Through the education and required maintenance program, public awareness of the importance in properly servicing these systems will be raised and the performance of these systems generally would be expected to improve accordingly. Improved ISDS performance would result in reducing the pollutant loading to local groundwater. Further, the Town's continued monitoring of ISDS conditions and repair histories will enable problems to be identified and addressed promptly so that necessary measures are taken to assure water quality is maintained.

There will be no effect on topography as a result of the proposed plan. Drainage may be affected by the potential increase in base flow to streams and storm drains resulting from elimination of extraneous I / I sources from the sewer system. The overall effect will be most evident during wet weather, but should be minimal if noticeable at all.

6.3.7 Economic Impact

There are numerous benefits associated with the proposed plan. The most obvious benefit arises from the potential of construction projects to provide short term jobs for local contractors and their work force. The projects will also create a need for materials and may produce an influx of business to local entities to address worker needs. Secondly, sewers will continue to address the need for wastewater disposal for many of the commercial establishments in Lincoln, enabling large water consumers such as restaurants, and laundromats to remain in Town without concerns that inadequate ISDS systems might hinder the operations and allowing new commercial establishments to consider locating in Lincoln with similar confidence. The third and most important economic benefit will result improved water quality by reducing polluting effects of failing subsurface disposal systems. Improved water quality will serve to enhance the existing conditions and features of the Town that promote its attractiveness to potential residents and commercial enterprises.

6.3.8 Cultural, Historical and Archeological Impacts

Numerous locations were identified within the Town that are included in the Federal Historic Register. Since most of the work is proposed in existing streets or easements, impacts to historic and archaeological resources is expected to be minimal.

6.3.9 Wild and Scenic Rivers

Sections of rivers registered in Rhode Island as wild and scenic are located in southern Rhode Island. The Blackstone Valley National Heritage Corridor was established by U.S. Congressional act acknowledging the historical and aesthetic importance of this region. None of these will be affected by the proposed wastewater facilities rehabilitation or continued proper use ISDS treatment technologies.

6.3.10 Secondary Impacts

The presence of sewers in an expanding residential community is virtually certain to increase land use pressures, particularly where soil conditions have previously limited the use of on site sewage disposal systems. These pressures can result in less stringent zoning regulations and increases in population unless the Town takes the necessary measures to protect against this. In turn, increased urbanization leads to additional air and noise pollution, energy demands, and impairment of aesthetic qualities. However, it is anticipated that the Town will abide by current zoning regulations in keeping with the goal of maintaining the Towns rural and village character. Since majority of the Town is provided with public sewers, strict enforcement of zoning regulations will serve to keep growth to a minimum. The wastewater generation rates projected for the sewered areas was based on the premise that future development will proceed in accordance with existing zoning.

6.3.11 Mitigation Measures for the Proposed Alternative

The majority of the negative environmental impacts are related to construction activities. Important elements necessary to mitigate impacts include a detailed erosion and sediment

control plan, a dust control plan, traffic control, and construction phasing to avoid excessive traffic conflicts and to reduce noise.

Erosion and sediment control is designed to protect hydraulic structures such as culverts, inlet structures and catch basins and to protect water courses particularly at planned river crossings. Protective measure such as hay bale sediment traps and siltation fences will be installed as needed during construction operations to minimize short - term erosion and to prevent sedimentation in surface waters. In the event that dust becomes a problem during construction, water and/or calcium chloride will be sprayed on critical areas to minimize disturbances. After construction is complete, all disturbed areas will be graded and revegetated.

The traffic control plan should address normal vehicular traffic as well as construction traffic within an area to be disturbed. To the extent possible, main traffic arteries will be kept open, which will likely lead to alternating one - way traffic lanes and subsequent vehicle slowdowns. In some cases, particularly on narrow streets, complete detouring may be necessary. Pedestrian safety also is an important consideration in residential areas and adjacent to schools, churches, and other public buildings where a large number of street crossings are anticipated. As part of the erosion control plan, the contractor will be required to backfill all sewer trenches at the end of each working day to minimize public safety concerns.

Appropriate security measures will be taken to prevent vandalism and to protect the public from entry to excavations. Construction phasing to avoid annoying times of day and weekends in residential areas will minimize noise impacts and interference with regular neighborhood activities. The potential for encountering undocumented cultural of historical resources, particularly those involving indian artifacts or indian burial sites exists. The Rhode Island Historic Preservation Commission will be consulted and archaeological surveys conducted, if deemed necessary.

6.4 Summary of Costs

A summary of the costs for the proposed activities is presented in Table 6-3 below.

Table 6-3

Estimate of Probable Construction Cost

Description	Cost
Collection Sewer Rehabilitation	$4,175,000
Angell Road North PS Rehabilitation	$160,000
Angell Road South PS Rehabilitation	$200,000
Great Road PS Rehabilitation	$380,000
Kirkbrae PS Rehabilitation	$185,000
Maria PS Rehabilitation	$165,000
Lower River Road PS Rehabilitation	$250,000
Submersible /Grinder PS Rehabilitation	$875,000
Total	$6,390,000
Amortized Cost	$639,000

Development of these costs is based upon the following assumptions:

- Rehabilitation will be required for approximately 5% of collection sewer total length, all repairs by excavation and replacement, and 8-inch diameter average pipe size.
- Screw Pump and Wet Well / Dry Well pump station costs include replacement of pumps, controls, ventilation systems, and electrical systems in wet wells.
- Submersible / Grinder pump station cost include replacement of pumps, guide rails and all wet well discharge piping, controls, and electrical systems in wet wells for 25 stations.
- Amortized cost based on factor of 0.10.

Chapter 7 – Recommended Plan Implementation

7.1 Institutional Responsibilities

As identified in prior chapters, the Town of Lincoln directs all of its wastewater flow to the Narragansett Bay Commission for treatment at either the Bucklin Point WWTF or Field's Point WWTF. Neither the Town nor NBC was able to provide a copy of any inter-jurisdictional agreement that describes the terms of services and uses between these two entities. Similarly, the Town does not have records of any inter-jurisdictional agreements with the Town of North Providence or the City of Pawtucket in regard to Lincoln wastewater flows that are directed to the local sewer systems of these municipalities prior to reaching downstream regional NBC facilities. When inquired regarding this matter, public works personnel in North Providence and Pawtucket indicated they were not aware of any agreements with the Town of Lincoln for local sewer use.

The Town should coordinate with adjacent municipalities to determine if there is justification to establish a formal agreement for continued use of their local sewers. The Town also should coordinate with NBC to verify if an agreement exists between these two entities, to document its terms and conditions, and determine if any renegotiation is necessary or, if no agreement exists or can be documented, to negotiate the terms and conditions of a new agreement in order to accommodate future Town wastewater disposal needs. In either case, the terms of the agreement should address the following issues:

- *Flow Rates* – The agreement should identify permitted flow rates and approved tie-in locations to the NBC system.
- *Flow Metering* – The agreement should identify locations where NBC flow metering occurs and the formula utilized to calculate wastewater flows attributable to Lincoln. The agreement should afford Lincoln the opportunity to review and be provided with meter data as well as calibration and maintenance information, including on-line electronic data accessibility if available.

- *Characteristics of Waste* – Waste delivered by Lincoln must conform to the NBC requirements established to in order to maintain the integrity of the treatment processes.
- *NBC Responsibilities* – NBC must agree that as long as Lincoln conforms to the terms of the agreement that it will accept, receive, treat and dispose of waste delivered to the treatment facilities to the best of its ability. Language should also be included regarding damages resulting from the failure or inadequacy of the NBC facilities. Lincoln should be held harmless for damages due to negligence on the part of NBC.
- *Right to Inspect* – Lincoln should maintain the right to inspect any and all records concerning construction, expansion, modifications, operation and maintenance of the NBC facilities to which it directs wastewater flows, including: Bucklin Point WWTF, Fields Point WWTF, Sayleville Pump Station, Washington Highway Pump Station, Ernest Street Pump Station, Blackstone Valley Interceptor, Washington Highway Interceptor, Moshassuck Valley Interceptor, and Louisquisset Interceptor.
- *Operating Charges and Future Expansion Costs* – NBC is a regulated public utility and, as such, its rates are subject to Rhode Island Public Utilities Commission approval. The Town should maintain awareness of the NBC rate structure and participate in the public hearing and approval process for proposed changes as deemed necessary to assure that the future interests and needs of the Town and its sewer system users are properly protected and addressed.

The Town's duties, authority, rights and responsibilities with respect to providing wastewater services are established in the Town of Lincoln Sewer Ordinance as legislated by the Town Council. This Ordinance enables the Town to control the planning, financing, construction and operation of all major wastewater facilities and establishes the Town's authority to issue notes and borrow money, establish and collect sewer connection and sewer use charges, and levy taxes for the purposes of providing wastewater facilities within the Town. The Town will need to pass legislation to amend the Town's duties, rights and responsibilities with respect to the area wide Education and Community Required Maintenance program for privately owned ISDS treatment units, as well as

authorizing new bonds or assessments to fund the future activities of the recommended Plan.

Money must be raised to finance the recommended plans. The Town will be obligated to secure financing and distribute costs equitable among those benefiting from the services and improvements. The Town therefore should have reliable sources of capital and income. Such sources are general obligation and revenue bonds, taxes, and user charges. Financing for capital improvements and related projects for wastewater facilities also can be obtained in the form of low interest loans via the State Revolving Fund (SRF) financing program. Normally major improvements that benefit the entire community are financed through long-term general obligation bonds issued against the entire community, while capital improvements that benefit a limited area become the obligation of that area. Administrative, operation and maintenance costs should be distributed over the area sewered and financed by user fees.

7.2 Implementation Schedule

In order to implement the recommended plan, appropriate funds must be made available. RIDEM approval of this Facilities Plan is prerequisite to eligibility for SRF financing and it is anticipated that any financing program requiring public approval would be presented to voters in November 2006. As such, funding for the major portions of the proposed projects is not expected to be available until early to mid-2007. However, many portions of the proposed activities fall within the criteria of system maintenance and could be funded through the existing maintenance budget if sufficient monies are available. The Town might be able to secure additional funding via the Community Development Block Grant program, to finance projects similar to the "Lonsdale Village Sewers" project. If available funding is identified from these or other sources the Town might be able to initiate certain aspects of the recommended plan prior to securing financing for the entire program. The proposed implementation schedule with approximate dates for engineering and construction of the various projects is presented in Table 7-1.

Note that this projected implementation schedule is based only upon pump station age unless existing conditions are evident to suggest that earlier equipment replacement may

Table 7-1

Project Implementation Schedule

Description	Anticipated Start
Collection Sewer I / I Studies	March 2007
Collection Sewer SSES	June 2007
Collection Sewer Rehabilitation	September 2007
Wet Well / Dry Well and Screw Pump Stations Assessment and Design	January 2007
Angell Road South PS Rehabilitation	June 2007
Maria PS Rehabilitation	June 2008/2013
Lower River Road PS Rehabilitation	June 2008/2013
Great Road PS Rehabilitation	June 2009/2014
Kirkbrae PS Rehabilitation	June 2009/2014
Angell Road North PS Rehabilitation	June 2010/2015
Submersible /Grinder Pump Stations Assessment and Design	January 2007
Submersible /Grinder PS Rehabilitation	
Arlington, Edgehill, Hillside, Middle, Mount, Newland	June 2007/2012
Applewoood, Great Road (116), Jason, Paddock	June 2008/2013
Ashley, Eagle Nest, Birchwood, Cider Mill, Lori Ellen, Oak Hill	June 2009/2014
Lincoln Center, Rollingwood, Woodridge	June 2010/2015
Butterfly, Heidi, Old Pike	June 2011/2016
Davies, Whitney, Belmont	June 2013/2018

be necessary. Where a range is listed range, the dates identified generally represent 20 and 25 years in service. Additionally, it is assumed that the collection system investigations and rehabilitation will be an ongoing program. Findings and conclusions of detailed investigations, assessments, and evaluations to be performed should be used to amend and refine this schedule as necessary.

7.3 Operation and Maintenance

Administration, operation and maintenance of Town's wastewater facilities the fall under the responsibility of the Department of Public Works and are delegated to the Sewer Department and Engineering Department. The Sewer Department is responsible for the operation and maintenance of the Town gravity sewers and wastewater pumping facilities. The Sewer Department Supervisor manages the department's staff of operations and maintenance personnel under the supervision of the Director of Public Works. The Engineering Department provides technical support to all Town departments, reviews and approves development plans, maintains engineering records and maps, and provides for the design of Town infrastructure and facilities. The Town Engineer manages the Engineering Department staff to perform these duties under the supervision of the Director of Public Works. The additional duties associated with oversight of the recommended ISDS programs should be incorporated into the responsibilities of the Engineering and Sewer Departments.

Sewer inspections and preventative maintenance measures are conducted on a daily basis by Sewer Department staff. Inspections and preventative maintenance are on-going tasks that performed at a rate that results in the complete inspection of the entire Town sewer system over a ten (10) year period. Maintenance inspections are to be performed on a weekly or more frequent basis for all pump stations. Pump station alarms, sewer blockages and other emergency conditions are addressed as they are identified and occur. The Town's Sanitary Sewer Management Program included in Appendix C details the plan of operations to be followed to maintain the proper performance of the sewer system.

7.3.1 Staffing Plan

The Sewer Department consists of a full time staff of one supervisor and four operators who are responsible for routine operations, maintenance and emergency response. Significant expansion of the wastewater facilities is not proposed and the current staffing levels are expected to sufficiently address the operation and maintenance requirements of the recommended plan.

7.4 Financial Impact Analysis

The estimated total capital cost for the proposed projects is $6,390,000 as presented in Table 6-3. Based upon projected budget revenues and the current $75 base user fee, there are 7,400 current sewer users. Assuming SRF loan program financing over a 30-year term with an average interest rate of 4%, a total capital cost $6,390,000 equates to an annual debt service of $365,767, and the average user share of the debt service would be $49.43 based upon 7,400 users. Utilizing the current base rate user fees, approximately 66% of user fees would be required to cover the annual debt service cost. For comparison, the current median residential home valuation assessment is $325,000 and the current tax rate is $19.18 per $1,000 of assessed value, which translates to an annual average residential property tax of $6,233.50. If additional sewer assessment taxes were levied to cover the debt service, the tax burden upon the average residential sewer user would increase approximately 0.8% to $6,282.93.

Chapter 8 – Public Participation

8.1 General

Due to the nature of this project and its impact on the community from both an economic and environmental perspective, a public participation program was instituted. The intent of the public participation program is to solicit input from the local governing body and the community at large, as well as from other governmental agencies. Goals of the public participation program are summarized as follows:

- Identify public perceived concerns regarding wastewater management.
- Quantify past and current problems in regard to wastewater disposal in the Town.
- Gain public input regarding the desirability of various wastewater management alternatives.
- Evaluate and gather community support for implementation of the recommended plan of action.
- Meet regulatory requirements.

8.2 Public Presentations

To achieve the goals of the public participation program, a public meeting and formal public hearing are to be conducted. Newspaper advertisement of these activities will be published in effort to provide notification so that interested parties may be in attendance to provide public input. The formal public hearing will be conducted when both the Town and RIDEM are prepared to approve the completed Wastewater Facilities Plan. Copies of information relating to these public presentations such as newspaper advertisements, meeting minutes, attendance sign in sheets, public hearing transcript, will be included as an addendum to Appendix D of this report.

8.3 Intergovernmental Reviews

The draft Facilities Plan was submitted to the institutions and agencies listed below in order to solicit comments and provide for intergovernmental review of the proposed plan.

- Rhode Island Statewide Planning Program
- Rhode Island Historical Preservation and Heritage Commission
- Rhode Island Department of Transportation
- The Narragansett Indian Tribe
- RIDEM Natural Heritage Program

Copies of related correspondence are provided in Appendix D.

APPENDIX A

Sewer System Map

See separate link for sewer maps.

APPENDIX B

Pump Stations Condition Assessment Reports

See office copy.

APPENDIX C

Sanitary Sewer Management Program

See office copy.

APPENDIX D

Public Participation Information

See office copy.

The Town of Lincoln conducted a hearing for public consideration of the proposed Wastewater Facilities Plan on October 31, 2006. Minutes of this hearing were documented via an audiotape recording of the proceedings. A cassette copy of the recorded minutes is forwarded to RIDEM with the Final Wastewater Facilities Plan for record purposes. Written copies of the presentation notes prepared for the Public Hearing are included herein.