WASTEWATER MANAGEMENT CONCEPT PLAN for the TOWN OF STRATHAM, NH

PRELIMINARY REPORT

March 2011

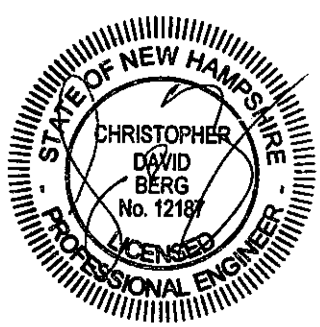
WRIGHT-PIERCE
Engineering a Better Environment

WASTEWATER MANAGEMENT CONCEPT PLAN

TOWN OF STRATHAM,

NEW HAMPSHIRE

March 2011



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WASTEWATER MANAGEMENT PLAN

TOWN OF STRATHAM

NEW HAMPSHIRE

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SECTION 1

WASTEWATER PLANNING AREA

1.1 INTRODUCTION

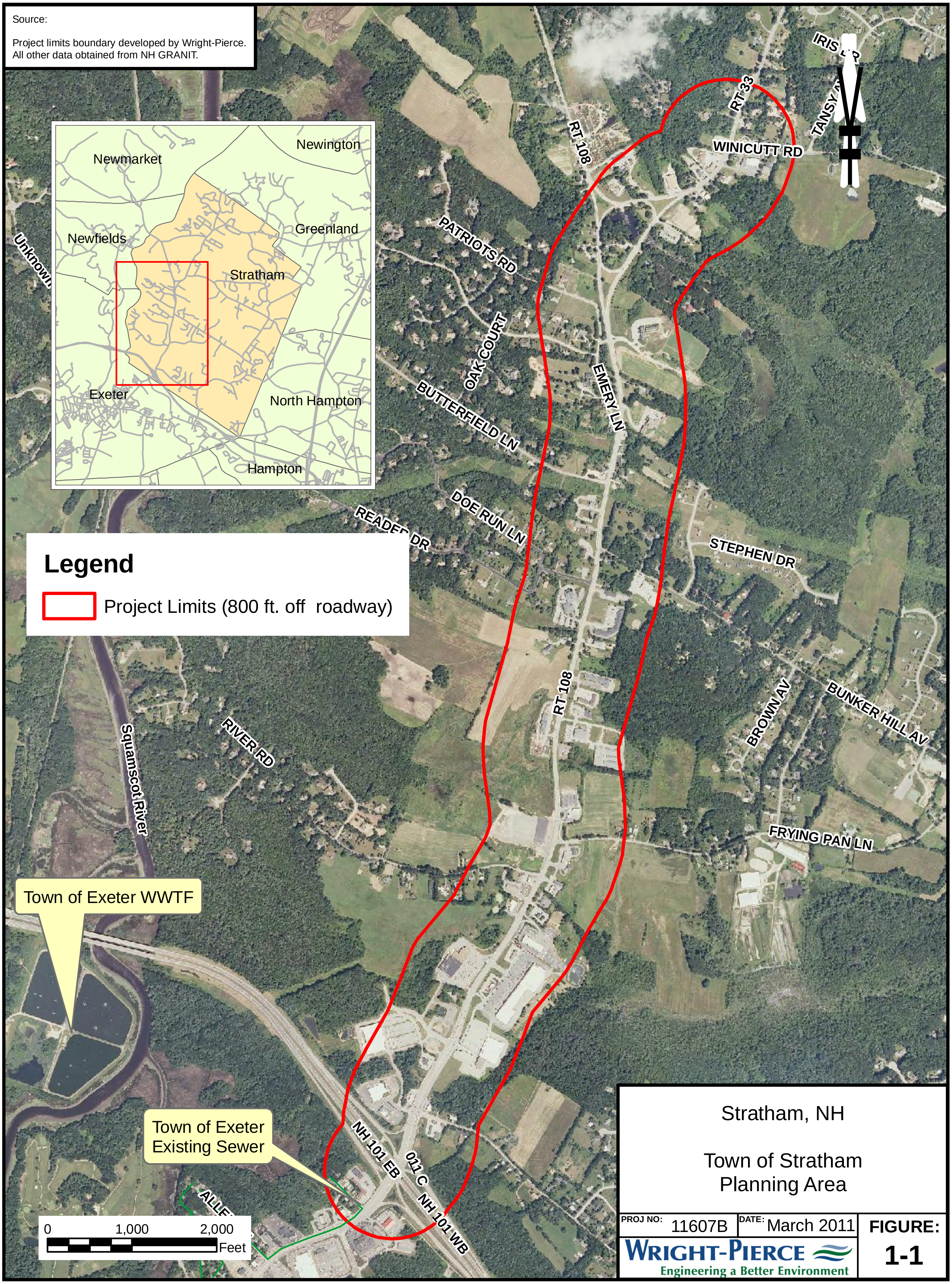
The Town of Stratham is characterized by largely rural, residential area, a historic New England town feel, and an agriculturally based culture. This is contrasted with the Town's primary commercial corridor, General Commercial District (GCM), along Route 108 (Portsmouth Avenue). This commercial corridor extends 800 feet on either side of Route 108 north of Route 101 to Bunker Hill Avenue. It is desirable that a wastewater collection system for this area be capable of future expansion to the Stratham "Town Center" located north of the GCM at the intersection of Route 33 and Winnicutt Road, similar to that of the proposed water distribution/fire suppression system delineated in the Fire Suppression and Potable Water Supply Study, developed by Wright-Pierce for the Town of Stratham dated May 2010.

In March 2010, the Town formally approved a new "form-based code" zoning ordinance termed the Gateway Commercial Business District (GCBD). The GCBD was created as an overlay district that primarily utilizes the district boundaries of the existing General Commercial Zoning District. The new zoning allows for greater density and development opportunities within the GCBD by encouraging a system of streets east and west of Route 108 that create a "village" environment that allows for closely spaced multi-story structures having a mix of retail, office, restaurant, and residential uses. The GCBD would add value to the tax base and encourage economic development where the Town desires it to occur. To accomplish this goal, additional municipal services, particularly a wastewater collection system will be necessary.

1.2 DESCRIPTION OF PLANNING AREA

The planning area for this study utilizes the Route 108 commercial corridor used for the Fire Suppression and Potable Water Supply Study within the Town of Stratham as shown on Figure 1-1. The Town can be characterized as a growing residential community with geographically concentrated growing commercial and industrial zones. Rapid commercial growth appears immanent within the Gateway Commercial Business District (GCBD) near Exit 11 off Route 101. One of the factors inhibiting growth in the GCBD is individual septic disposal requirements consuming a substantial portion of buildable land in this zone.

To properly consider the applicability and potential size of various available wastewater disposal methods, it is first necessary to investigate land use, zoning, existing and future development. The following sections will present this information in order to fully describe the planning area for this study.



Stratham, NH

Town of Stratham Planning Area

PROJ NO: 11607B DATE: March 2011

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FIGURE: 1-1

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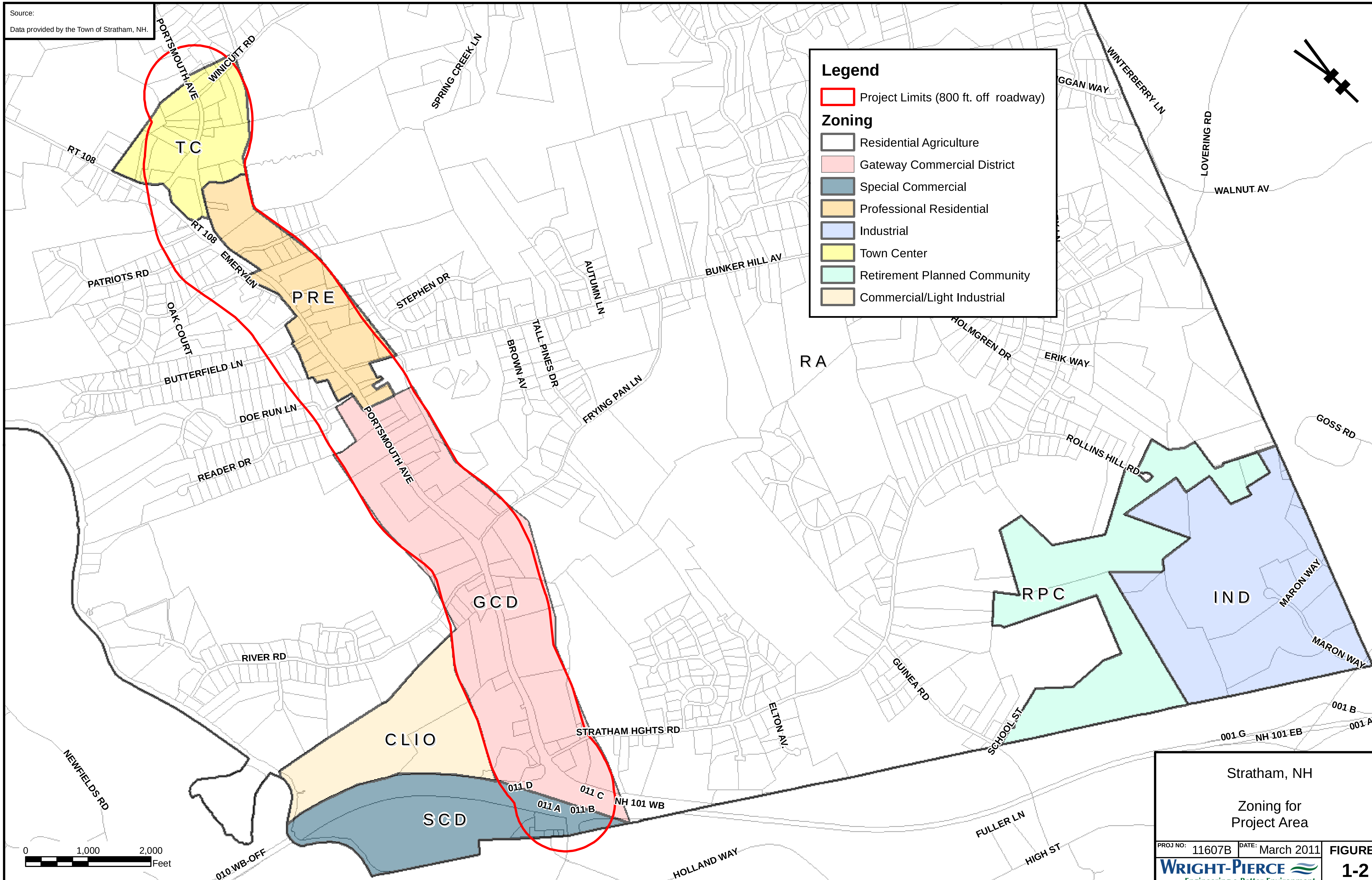
1.2.1 Land Use

Land use in the Town of Stratham is characterized by an industrial area located to the southeast, commercial areas along NH Routes 108 and 33, and residential/agricultural development along the secondary road system. Although the commercial and industrial opportunities continue to grow within the Town of Stratham, the majority of the residents are employed outside of the planning area and commute to other major population centers including Manchester to the west; Nashua to the southwest; Concord to the northwest; Lawrence, Massachusetts to the south; and Portsmouth to the East.

1.2.2 Existing Development

Existing zoning within the study area is shown in Figure 1-2. The existing land uses permitted can best be characterized as residential, residential/agricultural, commercial, mixed-use, and industrial. This study will focus on the areas in Stratham that will have a direct impact on wastewater collection and treatment alternatives; namely, residential, and commercial on the Route 108 and Route 33 corridor previously studied during the Fire Suppression and Potable Water Supply Study (May 2010).



Stratham, NH

Zoning for Project Area

PROJ NO: 11607B | DATE: March 2011 | FIGURE: 1-2

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1.2.3 Future Development

The importance of Route 108 and Route 33 as a transportation corridor, reinforced by the remaining roadway network, has made Stratham an attractive community for further growth and development. Access to a major highway has encouraged greater residential growth and the new zoning regulations in the Gateway Commercial Business District will foster commercial and mixed used development in this area.

Along with the increase in residential growth, there has been commercial and retail growth along the major roadways. Demand for additional highway commercial activities will likely continue because of Stratham's location and the need to support a growing population.

The need for a viable wastewater collection system is imperative to allow the permitted density for the Gateway Commercial Business District to thrive as envisioned. This is a cornerstone for the continued economic growth of the Town. The wastewater projections for this proposed development are presented in a subsequent section.

SECTION 2

WASTEWATER COLLECTION AND FLOWS

2.1 INTRODUCTION

The objectives of a centralized wastewater collection and treatment system for the Town of Stratham are:

- Protect public health and sensitive water bodies from contamination
- Protect groundwater quality, private water supply wells, and potential future public water supplies
- Promote quality growth and development within Stratham's Route 108/33 commercial corridor
- Enhance the economic vitality, density, and business diversity of the Route 108/33 commercial corridor utilizing the Gateway Commercial Business District regulations.

In addition, the commercial and economic growth of Stratham and desired density is highly dependent on its ability to provide public water and wastewater services. The growth of the Route 108/33 corridor makes commercial development ideal with the proper supporting infrastructure. Any substantial future development within Stratham's Route 108/33 commercial corridor will require the construction of a centralized wastewater collection and treatment system.

2.2 CENTRALIZED SEWER COVERAGE AREA

The main goal of a centralized wastewater collection system in Stratham is to provide wastewater collection services to the Route 108/33 commercial corridor, enabling present and future growth of the built environment at an increased density. Figure 2-1 provides a conceptual plan of potential future development under the GCBD.

Within the project area, Wright-Pierce has developed a series of "sewer sheds" based on natural collection basins within an overall sewer collection area. A discussion of these sewer sheds is presented in the following sections.

Potential Gateway Commercial Business District Development

2.2.1 Areas for Centralized Sewer Collection System

The Town of Stratham has developed an overall sewer collection area recommended for centralized sewer collection. The project area has been divided into three individual sewer sheds to assist with various phasing alternatives for collection and treatment. The sewer collection and sewer sheds are shown in Figure 2-2. The three sewer sheds are identified as follows:

- Commercial District
- Stratham Industrial Park
- Town Center & Professional/Residential District (PRE).

The centralized sewer collection system will exclusively serve commercially zoned properties depicted within the project area. Further, residential properties within the Professional/Residential Zoning District will not be connected to said system. The breakdown of sites served, projected flows, infrastructure required, and budgetary costs for each individual sewer basin are presented in subsequent sections.

2.2.2 Prioritization and Phasing Alternatives

There are many factors that affect prioritization and potential phasing alternatives. Financing, the ability to feasibly expand the wastewater treatment plant, the ability to dispose of treated effluent volume, and potential for increased economic growth are just a few factors to note.

In the Town of Stratham, the ability to dispose of treated effluent is likely to be a primary factor behind what gets sewered and when. Effluent disposal is discussed in Section 4. In reality, partial development within each of these sewer sheds may occur based on the ability of the treatment plant to handle the flow, desire to connect, and dispose limitations.


Source:
Utility data developed by Wright-Pierce.
Imagery obtained from GRANIT.
Parcel data provided by the Town of Stratham, NH.
CHASE LN
IRIS DR
TANSY AV
SPRING CREEK LN
WINICUTT RD
MURFIELD DR.
BARKER LN
SMITH FARM DRIVE
BALSAM WAY
WIGGAN WAY
UNION RD
CHRISTIE LN
North Hampton
FIFIELD LN
HERSEY LN
BUNKER HILL AV
AUTUMN LN
STEPHEN DR
PATRIOTS RD
EMERY LN
OAK COURT
BUTTERFIELD LN
BROWN AV
TALL PINES DR
Unknown
FRYING PAN LN
DOE RUN LN
READER DR
WWTF
ROLLINS FARM LN
STRATHAM HGHTS RD
MARON WAY
MARON WAY
GUINEA RD
ELTON AV.
SCHOOL ST
NH 101 EB
NH 101 WB
Exeter
Legend
Pump Station
Force Main
Gravity Sewer
Transmission Main
Commercial District Sewer Shed
Town Center Sewer Shed
Industrial Park Sewer Shed
0
1,000
2,000
Feet
Stratham, NH
Sewer Collection
Sewer Sheds
PROJ NO: 11607B
DATE: March 2011
FIGURE:
2-2
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2.3 CONCEPTUAL SEWER DESIGN

The conceptual sewer design was developed within the recommended sewer coverage area using available topographical information and visual field verification. For the majority of the Town, USGS 20-foot contour maps were the best topographic information available.

Twenty-foot contours do not provide sufficient information to develop accurate sewer layouts which are highly dependent on grade for gravity systems. In order to verify potential locations of pump stations and possible deep sewers, a field investigation was performed to visually identify changes in grade not represented by 20-foot contours. In order to verify the conceptual sewer design presented here, a more detailed survey will be required.

Based on the preliminary analysis, the Lindt & Sprungli USA Property was identified as the most probable location for the Wastewater Treatment Facility (WWTF) and will be the focus of this study. See Section 4 for a detailed description. All collector pipes would be 8-inch or larger and all interceptor pipes would be 12-inch or larger. A minimum grade was utilized to maintain a 2-foot per second velocity for a pipe flowing full. A minimum bury depth of 6-feet and a maximum bury depth of 15 feet were assumed. Final pipe sizing and slope will be designed to carry the peak hourly flow rate at full pipe capacity. Pump stations were sized to carry the peak hourly flow rate, which was calculated as the product of the average daily flow rate for the service area multiplied by a peaking factor, plus the allowance for infiltration. Peaking factors for average daily flow rates were derived in accordance with NHDES Env-Wq 704. All force main will be a minimum of 4-inch diameter, to be sized for a minimum velocity of 3.0 ft/sec.

2.3.1 System Layout

The sewer collection area sewer sheds are shown in Figure 2-2. The entire system would require approximately 2 pump stations, 11,500 linear feet of gravity sewer, and 19,000 linear feet of force main. The actual number of lots served, boundaries of each sewer shed, numbers and size of each pump station and lengths of all sewers will be developed during preliminary planning and design. Sewer service stubs for each cross street were not accounted for in the gravity sewer. These quantities are provided for general planning purposes only. It is assumed that wastewater sewer from the industrial park will be piped to the WWTF by a private sewer force main. This piping is not included in the above quantities.

A breakdown of lots served and infrastructure required within each sewer shed is presented in Table 2-1. The corresponding projected flows from each of these sewer sheds are presented later in this section.

TABLE 2-1
SEWER SHED SERVICE AREA
SEWER DESIGN

	# of Pump Stations	Length of Gravity Sewer	Length of Force Main
Commercial District	1	6,500 ft	14,700 ft
Stratham Industrial Park	0	--	--
Town Center / PRE	1	5,000 ft	5,000 ft
Totals	2	11,500 ft	19,700 ft

2.3.2 Pump Station Evaluation

The design and cost of pump stations is highly dependent on site specific conditions. The depth of the wet well, the proximity of available power, provisions for backup emergency power and the housing structure can all greatly affect the cost and feasibility of constructing a pump station to service some areas. Table 2-2 identifies the recommended pump station options. For the purposes of this Feasibility Study, pump station recommendations were based on the following flow ranges:

- Submersible Grinder Pump Station: < 75 gpm
- Submersible Non-Clog Pump Station: 75 - 500 gpm
- Suction Lift Pump Station: 500 - 1,000 gpm
- Custom Design Pump Station: > 1,000 gpm

All pump stations are assumed to be duplex (two pumps) designed for 100% redundancy, with each pump designed to handle the total peak hourly flow.

TABLE 2-2
GENERAL PUMP STATION INFORMATION

Recommended Pump Station Type	Pump Station I.D.	Approximate Construction Cost Range (each) (1)
Suction Lift	Commercial District	\$150,000 - \$500,000 (2)
Submersible Non-clog	Town Center / PRE	\$150,000 - \$500,000 (2)

(1) For total project cost planning, project implementation items such as construction contingencies, design engineering, construction engineering, permitting, as well as fiscal and legal expenses need to be added to the construction costs. For planning-level studies, 40-percent is typically added to estimated construction costs.

(2) Need to quantify the costs.

2.3.3 Planning Level Capital Cost

As part of this study, planning-level cost estimates were developed for providing sewer to the proposed sewer coverage area. These planning-level costs were developed using concept layouts and unit cost information with allowances for contractor installation overhead and profit. Capital project costs also include allowances for project implementation items, such as, construction contingency, design engineering, construction engineering, permitting, as well as fiscal and legal expenses. Gravity sewer costs include manholes and sewer services to property lines. The construction cost information presented herein is in current dollars and is based on an ENR Index of 8920.

TABLE 2-3
SUMMARY OF SEWER COLLECTION INFRASTRUCTURE COSTS
AT FULL BUILD-OUT

	Quantity	Unit Price	Total
Commercial District			
Gravity Sewer	6,600	\$175	\$1,155,000
Force Main	14,700	\$100	\$1,470,000
Pump Station	1	\$500,000	\$500,000
Total			**\$3,125,000**
Town Center / PRE			
Gravity Sewer	5,000	\$175	\$875,000
Force Main	5,000	\$100	\$500,000
Pump Station	1	\$500,000	\$500,000
Total			**\$1,875,000**

Industrial	Quantity	Unit Price	Total
Private force main **Total**	--	--	
Total all Sewer Sheds			**$5,000,000**

2.4 WASTEWATER FLOWS

All wastewater flow projections were developed in accordance with New Hampshire Department of Environmental Services Water Quality Standards (NHDES Env-Wq 704 Design of Sewers). These standards indicate that wastewater flows for existing facilities shall be measured for design purposes. For proposed facilities, NHDES Env-Wq 704 (and its noted references) were utilized which include M&E, "Wastewater Engineering Treatment Disposal Reuse" 4th Edition and TR-16 Guides for the Design of Wastewater Treatment Works, New England Interstate Water Pollution Control Commission, 1998 edition.

The physical measurement of wastewater flows for each occupied residential, commercial and industrial lot within the recommended sewer coverage area was not feasible as part of this study. All sewerage flows for occupied and unoccupied lots were estimated using the recommended engineering design standards with the general assumption that each lot would reach a maximum build-out capacity within the life span of the centralized sewer collection system. Some specific properties included in the proposed sewer collection area have been 'discounted' as a result of a known wetland or otherwise difficult site to develop.

2.4.1 Wastewater Flow Components

Wastewater flows typically consist of several different components including residential, commercial, industrial, institutional, infiltration and septage. Each of these is presented below.

2.4.1.1 *Residential Wastewater Discharge*

The 2000 US Census indicates that the average household size in the Town of Stratham is 2.76 persons per housing unit. NHDES standards require using a minimum average daily wastewater flow of 70 GPD per person. Using these parameters it is estimated that each housing unit produces an average 193 GPD sanitary wastewater.

For the purpose of this study, it was assumed that each lot zoned as residential within the recommended sewer coverage area contained a single housing unit as the ultimate build-out occupancy (i.e. it was not assumed existing lots zoned residential would subdivide to increase housing density) .

The Commercial District is the only significant potential for multi-use, multi-unit residential development within the recommended coverage area identified during the field survey. These lots were estimated using residential assuming an average of 2 persons per dwelling for residential discharge parameters.

2.4.1.2 *Commercial and Industrial Wastewater Discharge*

Depending on the function and activity, unit flow rates for commercial facilities can vary widely. Referenced guidelines provide typical design flows for a variety of commercial sources. These design flows are expressed as a gal/unit*day for sources such as stores, restaurants, offices, gas stations, etc. The units for these sources are typically expressed as customers, employees, seats or parking spaces, etc.

The actual commercial or industrial enterprise that currently exist or potentially could exist on every other parcel in town was not known. Consistent with referenced guidelines, a more generalized approach was required for this feasibility level of analysis. Using these guidelines, a typical unit flow rate allowance for commercial and industrial developments normally ranges from 800 to 1,500 gal/acre-day. The lower value (800 gal/acre-day) was used for the current conditions and future use in the Town Center and Professional / Residential Zoning District and the value of 1,500 gal/acre*day was used to estimate wastewater flows for all future development/redevelopment within the Commercial District sewer coverage area. This higher value was used assuming greater building density will occur and flow rate/acre will increase accordingly. The acreage for each commercial and industrial property identified for sewerage was reduced by 25% to account for paved surfaces and set backs associated with a potential development.

Lindt & Sprungli USA have expressed interest in expanding their wastewater volume if the Lindt Property site is used for disposal. Their current capacity is limited. They have expressed interest in contributing ~50,000 GPD at full capacity.

Properties that were identified as possible wetlands have conservation easements, and properties where topography would limit development were not included as part of the sewer shed.

2.4.1.3 Infiltration

Infiltration into the sewer collection system was also determined based on NHDES Env-Wq 704 standards. A value of 300 gallons per inch diameter per mile per day was used for all interceptor and collector sewers.

2.4.1.4 Septage

For any homes or businesses not connected to a central wastewater collection system, individual on-site wastewater treatment and disposal facilities would be used. It is typical that these facilities consist of a septic tank and leach field. It is anticipated that the majority of the Town of Stratham will continue to use on-site septic disposal systems.

By law, the Town must provide for disposal of septage generated within the Town. The provisions can require very little with respect to new infrastructure such as an inter-municipal agreement, where a facility in another Town agrees to process septage from Stratham, or can be as elaborate as providing a dedicated wastewater treatment facility to treat septage.

In general, the NH Department of Environmental Services recognizes three methods for the management of septage: land application, co-treatment at a municipal wastewater treatment facility, and independent treatment. Land application is just that, applying the septage to land in a controlled manner. Land application is regulated on a federal level according to 40 CFR, Part 503, and on a state level according to Env-Ws 1600. Co-treatment at a municipal wastewater treatment facility is probably the most commonly used method of controlling septage in New England. The septage is received and treated at the municipal wastewater treatment facility where it is incorporated into either the liquid stream unit processes or the solid stream unit processes. Co-treatment is regulated under the New Hampshire Code of Environmental Rules Env-Ws 700 and 1600. Independent septage treatment involves septage that is treated at its own facility from receiving to disposal, or it can serve as a pretreatment facility where the processed, “pretreated” septage is released to the municipal collection system or directly to the wastewater treatment facility. Independent septage treatment facilities are regulated under Env-Ws 1600, New Hampshire Code of Environmental Rules.

Two options have been identified for the Town to manage its septage:

- Transport septage to other municipal WWTF(s) or private entity for processing (inter-municipal or private agreement)
- Provide capability to allow septage receiving and co-treatment at the Town's proposed WWTF.

For the purpose of this study, we have assumed that the Town will continue to rely upon transport of septage to an outside municipal WWTF(s) for processing. If the Town would like to consider receiving septage at the proposed facility, this can be reviewed and incorporated in a future design phase.

2.4.1.5 Wastewater characteristics

It is anticipated that the sanitary sewer characteristics will be considered a typical medium to high strength waste stream due to low inflow and infiltration because all sewer infrastructure will be newly installed. It is assumed that the industrial waste stream from Lindt will be pretreated before being sent to the collection system.

2.4.2 Summary of Projected Flows

Table 3-5 shows the projected wastewater flows for the overall sewer collection area broken up into the individual sewer sheds discussed in previous sections.

Table 2-4
CURRENT DEVELOPMENT
PROJECTED ANNUAL AVERAGE WASTEWATER FLOWS

	Residential Flow	Commercial Flow	Industrial Flow	Institutional Flow	Infiltration	Total Flow
Commercial District	8,000	120,000	--	--	4,500	132,500
Industrial Area	--	--	10,000	--	--	10,000
Town Center / PRE	23,000	21,000	--	--	3,500	47,500
Totals	**31,000**	**141,000**	**10,000**		**8,000**	**190,000**

Table 2-5
PROJECT AREA BUILD OUT
PROJECTED ANNUAL AVERAGE WASTEWATER FLOWS

	Residential Flow	Commercial Flow	Industrial Flow	Institutional Flow	Infiltration	Total Flow
Commercial District	227,000	300,000	--	--	4,500	531,500
Industrial Area	--	--	50,000	--	--	50,000
Town Center / PRE	28,000	25,000	--	--	3,500	56,500
Totals	**255,000**	**325,000**	**50,000**		**8,000**	**638,000**

The projected flow of approximately 600,000 gallons per day is for the ultimate build-out of the entire sewer area. Additional build-out flows may also be possible should the Town consider planning for extension of a centralized collection system beyond the area identified in this study. Stratham does not currently possess the ability to treat or dispose of this quantity of treated effluent or have the funding or need to sewer the entire Town. A phased approach from a collection standpoint was discussed earlier in this section. This approach will be combined with the phased approach presented for treatment and disposal in order to develop final recommendations.

SECTION 3

WASTEWATER TREATMENT

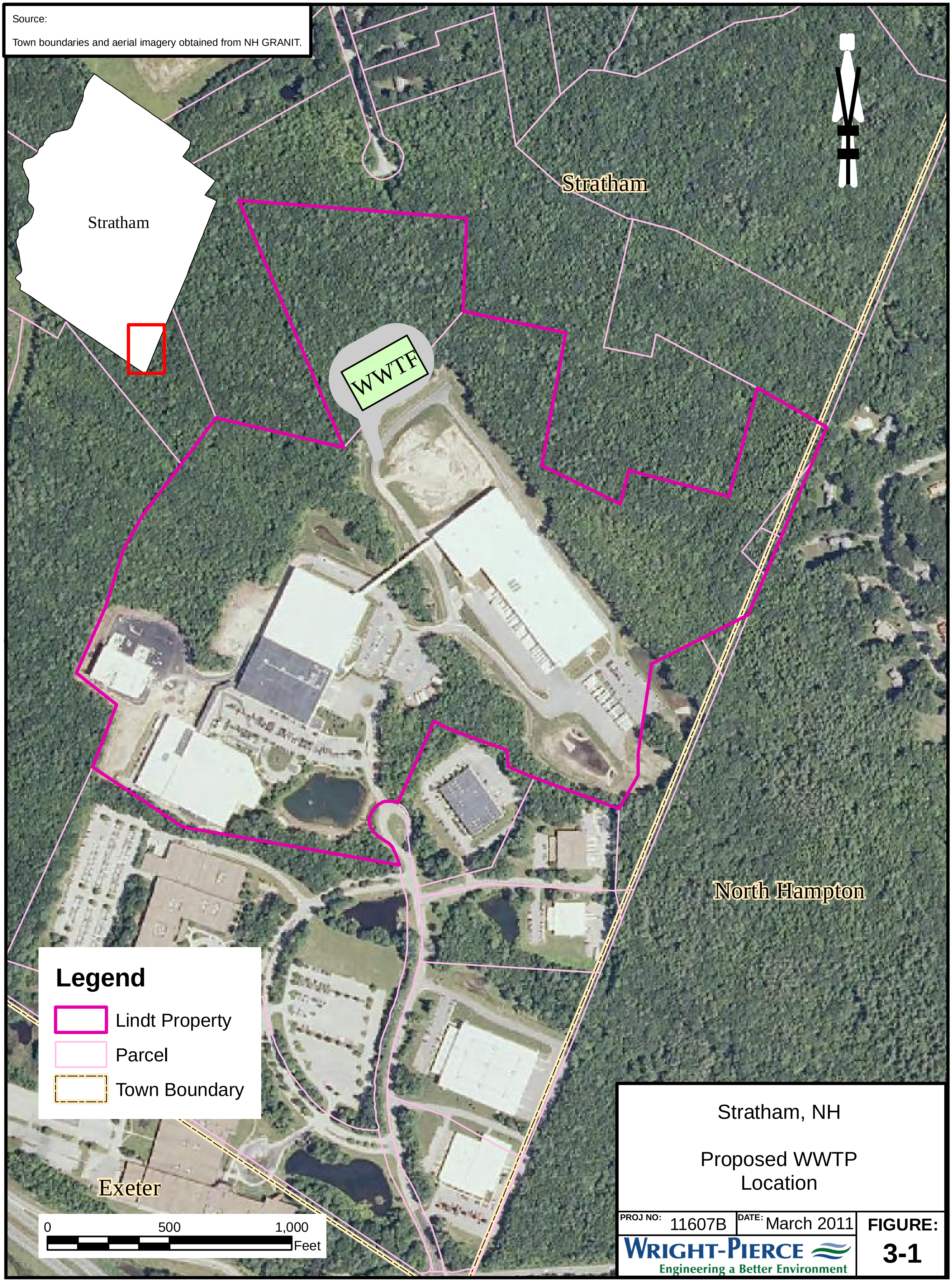
3.1 INTRODUCTION

The volume and characteristics of wastewater flows requiring treatment will be dependent on the constituents being discharged to or otherwise entering the Town's wastewater collection system, as well as the nature of the collection infrastructure system itself (i.e., pumped versus gravity flow). The level of wastewater treatment necessary for collected wastewater is driven by the effluent disposal requirements. For the case of Stratham, the treatment goals will be confirmed during the groundwater discharge permitting process. The type of treatment process that is ultimately selected to meet those goals will need to also meet various other criteria. The purpose of this section is to present the factors that will influence the selection of the preferred wastewater treatment facility for the Town of Stratham.

3.2 TREATMENT PLANT SITING

There are several factors involved with selecting the location for a wastewater treatment facility (WWTF). In general terms, a WWTF should be located (and designed) such that the impact of possible odor, health and safety concerns to adjacent properties is minimized to the extent practical. NHDES regulations [Env-Wq 706.02(h)] stipulate that processing units in a new conventional WWTF cannot be closer than 300 feet from any residence. The Town conducted a preliminary analysis of potential sites to locate municipal septic and WWTF and identified six (6) properties (discussed in Section 4). Figure 4-1 illustrates said locations.

The proposed location for the WWTF is on the Lindt & Sprungli USA property which was determined to be the most practical as it allows the Town to meet several objectives simultaneously. The benefits for utilizing this site for a WWTF include: its location relative to the proposed effluent disposal facilities (discussed in Section 4) and it provides adequate distance from existing housing. Figure 3-1 depicts the potential location of proposed WWTF subject to further field analysis and study.



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The Site is located on a parcel of land identified as Tax Map 3, Lot 1 at the terminus of Fine Chocolate Place in Stratham, Hew Hampshire. The majority of this property is associated with the current industrial operation including multiple buildings for the manufacturing and packaging of Lindt & Sprungli products. The remainder of the site is undeveloped. The immediate vicinity of the site is industrial and vacant woodland. Residential property is located to the north and east.

Table 3-1 below summarizes specific factors that have been evaluated for the selected location of the proposed WWTF at the Lindt & Sprungli USA site.

TABLE 3-1
SUMMARY OF WWTF SITING FACTORS

Factors	Lindt & Sprungli USA Site
1. Type of WWTF to be constructed and level of odors that are typically generated from that type of WWTF	As presented herein, the proposed WWTF will have a relatively compact footprint, be largely enclosed, and be provided with odor control. Primary clarifiers are not proposed (primary sludge has much greater potential to generate odors) and proposed solids handling facilities would consist of on-site storage, decanting and dewatering, with ultimate disposal/reuse off-site.
2. Current and projected land use surrounding proposed site	As noted above, the proposed site is a working industrial facility. 300 to 500 feet to the northeast exists some residential development. There is no existing residential development within 500 feet to the west, south and east of the proposed location.
3. Current and projected population surrounding proposed site	Current population within 500 and 1,000 feet of the proposed located is estimated to be 0 and 45 (~15 lots), respectively. The residents within 1000 ft are located in North Hampton. This population may increase if the property to the North of the site is developed.
4. The direction of prevailing winds in relation to populated areas	A westerly prevailing wind would direct toward a residential area.
5. Proposed location's susceptibility to flooding	The proposed site is located above the 100-year flood plain. (FIRM map #33015C0410E)
6. Regionalization options of WWTF for sewage and septage receiving	As presented herein, regionalization of treatment and septage has been considered.

Factors	Lindt & Sprungli USA Site
7. Impacts to surface waters, wetlands, habitat, and wildlife, including any threatened or endangered species	Assumed to be none. Site presently is in an industrial area.
8. Traffic patterns of surrounding areas	The site is located at the end of an Industrial Park in Stratham and it is not expected that a WWTF in the proposed location would significantly modify overall area traffic patterns.

3.3 DESIGN BASIS FOR WASTEWATER TREATMENT FACILITY

As presented in Section 2, build-out wastewater flows for the defined sewer collection area could exceed 600,000 GPD. For any given planning period, a variety of factors need to be considered in order to determine the magnitude of flows and loadings to be used as the design basis for planned wastewater facilities. For the purposes of this study and a planning period to 2030, it has been assumed that average daily wastewater flows generated from within the Town would be 400,000 GPD. It is not expected that the Gateway Commercial Business District will be redeveloped immediately in order to generate these flows. Instead, it is likely that the Town's wastewater facilities will build out in phases.

TABLE 3-2
SUMMARY OF BASIS FOR PHASED WASTEWATER FLOWS

Phase	Areas to be Served	Anticipated Average Daily Flow	Anticipated Development Period
Phase I	• GCBD from Frying Pan Lane South to the Stratham Town line • Industrial Area	125,000 GPD	0 - 5 years
Phase II	• GCBD from Bunker Hill Road South to the Stratham Town line • Industrial Area	150,000 GPD	5 - 10 years
Phase III	• GCBD • Industrial Area • Town Center / PRE	400,000 GPD	10 - 20 years

3.3.1 Wastewater Flows

For the purposes of WWTF design, the average daily flow (ADF) is considered in conjunction with other flows such as the maximum daily flow (MDF) and the peak hourly flows (PHF). It is these maximum daily and peak hourly flows that are used as the design basis key process and equipment systems. Based on the anticipated size and characteristics of the wastewater collection system, a summary of projected wastewater design flows is presented in Table 3-3.

TABLE 3-3
SUMMARY OF WASTEWATER DESIGN FLOWS
(GALLONS PER DAY, GPD)

Flow Type	Phase I	Phase II	Phase III
Average Daily Flow (ADF)	25,000	150,000	400,000
Maximum Daily Flow (MDF)	72,500 (2.9 x ADF)	405,000 (2.7 x ADF)	960,000 (2.4 x ADF)
Peak Hourly Flow (PHF)	135,000 (5.4 x ADF)	675,000 (4.6 x ADF)	1,680,000 (4.2 x ADF)

3.3.2 Septage

For homes and business not connected to a central wastewater collection system, individual on-site wastewater treatment and disposal facilities would continue to be used. As noted in previous sections, it is anticipated that residential properties outside of the project area will continue to use on-site septic disposal systems and it is assumed that septage will not be received at the proposed WWTF. If the Town would like to consider receiving septage at the proposed WWTF, this can be incorporated at a later design stage.

3.4 SOLIDS HANDLING

Solids are generated at any WWTF and these solids need to be handled. Ultimately, solids removed from wastewater can be digested/stabilized and land spread, landfilled, incinerated or composted, or otherwise stabilized prior to beneficial use. Two options have been identified for the Town to manage its solids produced at the proposed WWTF:

- Transport raw, thickened or dewatered sludge to another municipal WWTF or private entity for processing (inter-municipal or private agreement).
- Provide capability to process at the Town's proposed WWTF.

Given the size and nature of the proposed WWTF, it is not cost-effective to perform ultimate on-site or local solids handling for only waste produced from the proposed WWTF because of the additional land area required and substantial capital cost required.

For the purposes of this study, it is assumed that during the initial Phase(s), on-site solids handling will consist of waste sludge storage and decanting (to pre-thicken solids) for liquid sludge transport off-site. At a minimum, space should be planned for on-site mechanical sludge thickening or dewatering facilities in the future. Given the nature of the solids to be removed (biological with possible use of chemicals for phosphorus removal), facility size, and the need to transport off-site, the centrifuge technology is considered to be the most cost-effective dewatering option, and the rotary drum is considered to be the most cost-effective thickening option.

3.5 WASTEWATER TREATMENT ALTERNATIVES

3.5.1 Treatment Goals

As presented herein, the WWTF's treatment goals are based on its discharge permit requirements. The proposed form of discharge is land-based infiltration as described in Section 4. To reduce the potential for system clogging, a rapid infiltration basin system will require a low solids loading. As a result of this and the need for phosphorus removal, tertiary filtration is proposed prior to discharge. With filtration, it would be anticipated that biological oxygen demand (BOD) and total suspended solids (TSS) would be reduced to less than 10 mg/l.

Land-based discharge can also provide for wastewater treatment to remove BOD, phosphorus, and metals, and in some situations, total nitrogen (TN). However, nitrogen uptake in high permeability granular soils is less likely and it has, therefore, been assumed that total nitrogen would need to be reduced to less than 5 mg/l. Based on the above, a summary of projected treatment goals are presented in Table 3-4.

TABLE 3-4
SUMMARY OF TREATMENT GOALS
(PROJECTED EFFLUENT REQUIREMENTS)

Parameter	Effluent Characteristics
Biological Oxygen Demand (BOD)	< 10 mg/l*
Total Suspended Solids (TSS)	< 10 mg/l*
Total Nitrogen (TN)	< 5 mg/l
Nitrate	< 5 mg/l
Total Phosphorus (TP)	TBD (1 to 0.25 mg/l)
pH	6.5 - 8.5

* Anticipated levels due to technology required to achieve nutrient limits

3.5.2 Initial Screening of Alternatives

There are many types of wastewater treatment facilities that could be used to provide treatment for municipal wastewater. Many typical treatment alternatives are presented below:

- Aerated Lagoon/Stabilization Pond processes
- Fixed Film processes
    - Trickling Filters
    - Rotating Biological Contactors (RBC)
- Suspended Growth processes
    - Oxidation Ditches.
    - Conventional Activated Sludge.
    - Sequencing Batch Reactors (SBR).
    - Membrane Bioreactors (MBR).

These alternatives are generally listed from least complex to most complex and level of treatment performance. In general, the least complex processes require much more land than the more complex alternatives listed.

In general, given Stratham's situation, aerated lagoon/stabilization pond alternatives would require more space than is available and would not provide the level of treatment necessary. Fixed film alternatives do not have inherent flexibility to perform necessary treatment without the addition of tankage and units and are more impacted by colder wastewater temperatures than suspended growth alternatives. Further, they do not remove as much particulate matter as compared with suspended growth alternatives. Oxidation ditch and activated sludge suspended growth processes are viable, but would require more treatment tankage (i.e., secondary clarifiers) than SBR and MBR suspended growth processes and thus, would require more space and result in initial higher construction costs.

Based on the above and recognizing that the WWTF will serve a new wastewater collection system without significant quantities of infiltration and inflow, SBRs and MBRs have been selected for detailed evaluation for Stratham due to the ability of the processes to: reliably meet treatment goals; reduced site requirements; ability to cost-effectively contain WWTF odor; and future expansion considerations.

3.5.3 Description and Conceptual Design of Selected Alternatives

As with most other treatment alternatives, SBR and MBR treated wastewater would require additional forms of treatment to perform well and meet overall treatment goals. These additional processes include preliminary treatment via fine screening and grit removal prior to the SBR or MBR process. There are also several differences between the SBR and MBR processes. A general description of the processes and requirements to meet the treatment goals for Stratham is provided below.

3.5.3.1 *Sequencing Batch Reactor (SBR)*

The SBR activated-sludge process utilizes a common tank for both aeration and clarification. All SBR systems have five steps in common, which are carried out in sequence as follows: (1) fill, (2) react (mixing and/or aeration), (3) settle (sedimentation/clarification), (4) draw (decant), and (5) idle. For continuous-flow applications, such as would be the case for Stratham, at least two SBR tanks must be provided. At least two tanks are provided so that one tank receives new influent flows while the other completes its treatment cycle. Figure 3-2 provides a schematic of treatment using the SBR process.

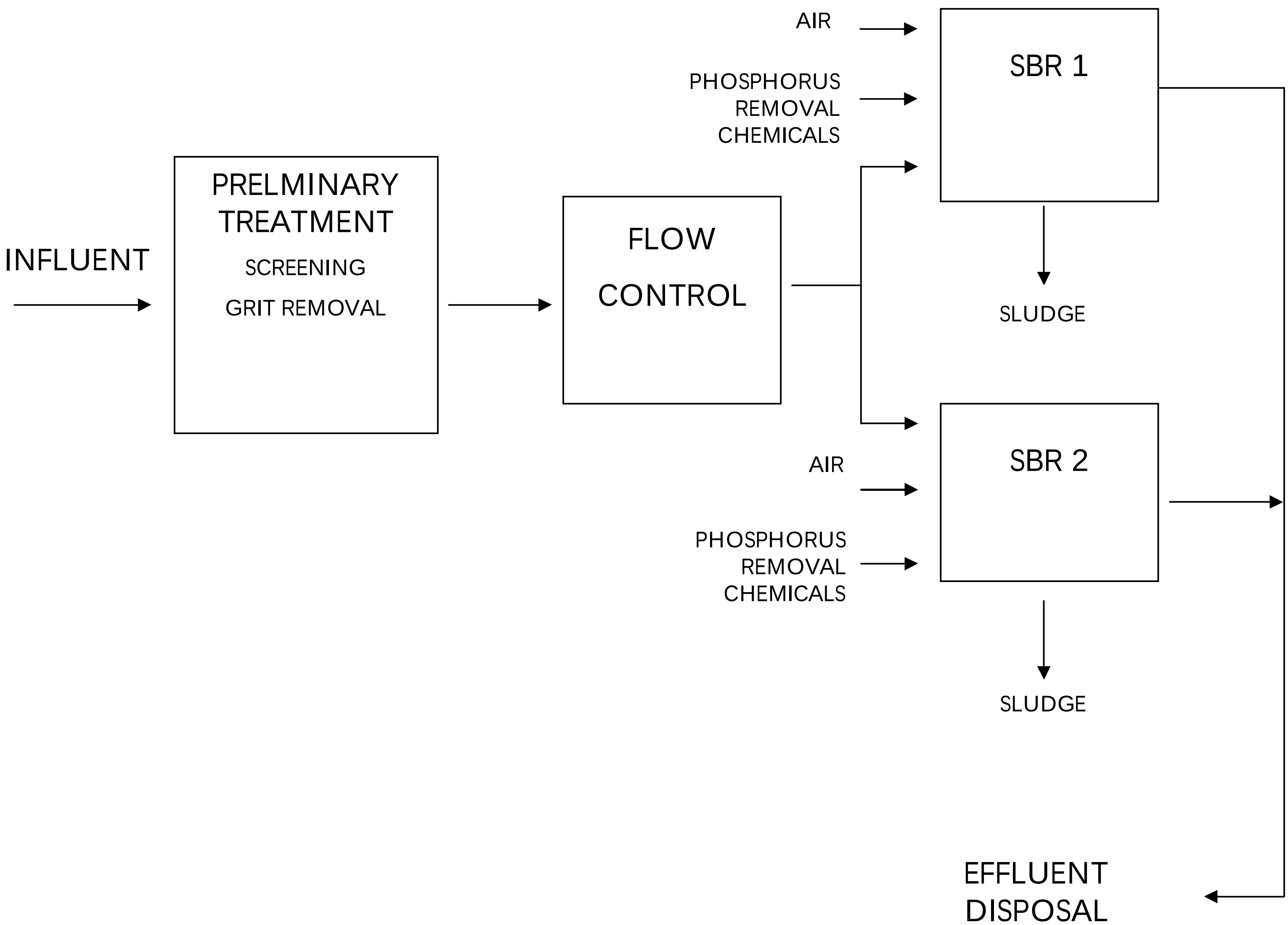
The SBR alternative would be designed for nitrification and denitrification with the option to provide biological phosphorus removal. Phosphorus reduction can also be accomplished with chemical addition. As noted above, since both aeration and clarification occur in the same tank, the SBR process does not use separate clarifiers. This reduces the amount of space required for the process, which is a significant advantage in cases where a limited amount of room is available. One disadvantage of the batch process is that the treated flows normally must be equalized after decanting in order to avoid the need to oversize all downstream filtration and disinfection processes. Construction of multiple SBR tanks can often minimize the necessary equalization volume.

An advanced SBR WWTF facility to meet Stratham's treatment goals would typically consist of the following processes:

- Preliminary treatment consisting of fine screening and grit removal
- SBR tanks with aeration, mixing, and decanting equipment
- Aeration system blowers
- Chemical systems (for alkalinity adjustment and possibly phosphorus reduction)
- Waste sludge, storage, thickening and/or dewatering, as necessary for off-site disposal.

Based on the above, the design basis and treatment goals previously presented, a concept design of an SBR facility has been developed. A conceptual building layout of the SBR facility is presented in Figure 3-3.

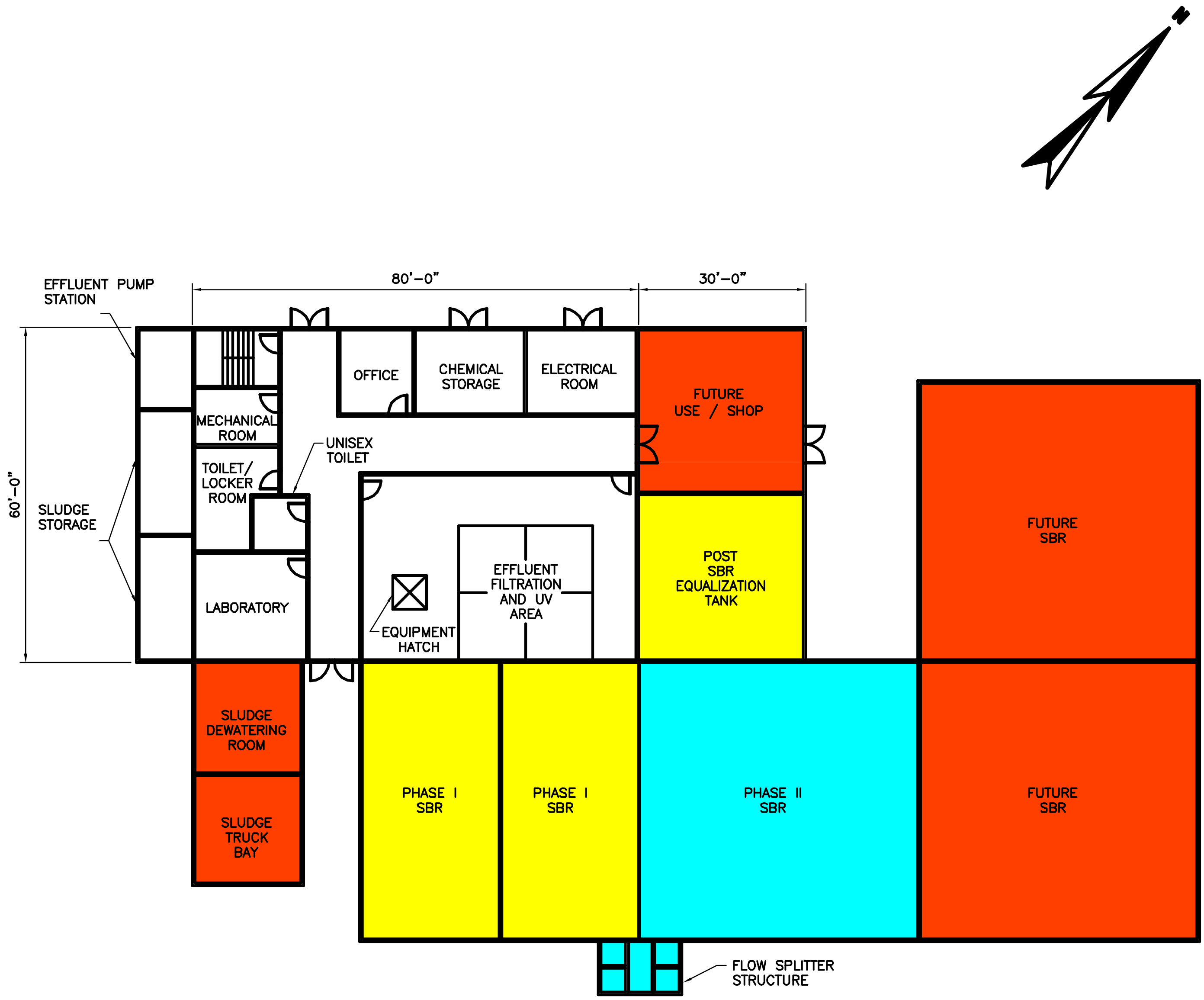
SBR PROCESS DIAGRAM



SBR Process Diagram

Stratham, NH

PROJ NO. 11607B	DATE. MAR 2011	**FIGURE:**
WRIGHT-PIERCE Engineering a Better Environment		**3-2**



OPERATIONS BUILDING FIRST FLOOR PLAN

SCALE: NTS

LEGEND

(yellow)	PHASE I
(cyan)	PHASE II
(red)	PHASE III

STRATHAM, NEW HAMPSHIRE

CONCEPTUAL DESIGN – SBR OPTION

OPERATIONS BUILDING FIRST FLOOR PLAN

PROJ NO:	DATE:	FIGURE:
11607B	3/7/2011	3-3

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3.5.3.2 Membrane Bioreactor (MBR)

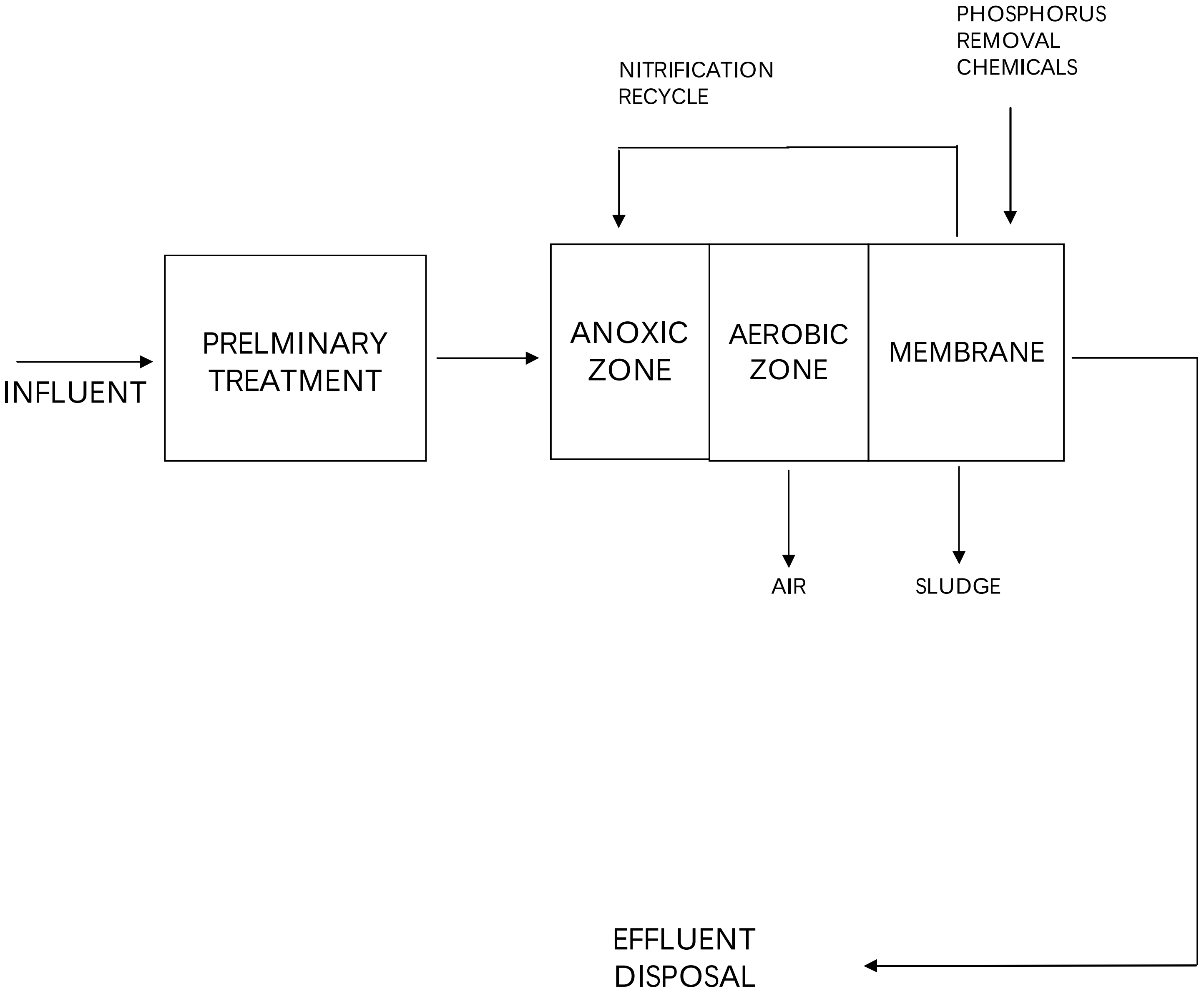
The MBR activated-sludge process was initially introduced for use in drinking water treatment and industrial wastewater treatment to produce high purity water. In the recent past (over the past 10 years or so), the technology was adapted for domestic wastewater applications and has been used for many smaller private wastewater treatment systems. More recently, MBRs have been used more in the municipal wastewater industry in smaller and mid-size applications similar Stratham's. Membrane bioreactors have been very attractive when discharge limits are very stringent and the effluent may be used for reuse with little dilution and detention time.

The technology is an activated sludge process consisting of a bioreactor with very high mixed liquor suspended solids (MLSS) concentration (i.e. 8,000-12,000 mg/l) followed by highly permeable, hollow fiber or plate membranes which form a filtration barrier to keep the MLSS and other solids/precipitates contained in the bioreactor. The most common membranes are synthetic fibers (approximately 1/16" diameter) which are manifolded together. These membranes are mounted to modules that fit into a cassette. Up to 48 modules can be placed on a cassette and one or more cassettes can be provided. A vacuum pump is required to "pull" the treated effluent through the membrane. Figure 3-4 provides a schematic of treatment using the MBR process.

Membrane filtration aeration systems typically consist of both coarse bubble and fine bubble aeration systems which are intended to provide for process air requirements, mixing air requirements, as well as to scour the membrane surfaces on a continuous basis. This aeration system can result in significant connected horsepower for blowers and is the main reason annual power costs of an MBR are higher than other activated sludge processes. Biological nitrogen removal is accomplished by using submersible pumps in the bioreactor tanks to recycle two to four times the influent flow back to an influent anoxic tank that uses submersible mixers to keep solids suspended. Phosphorus removal has been performed through the use of chemical precipitation within the bioreactor or enhanced biological phosphorus uptake by incorporating anaerobic zones into the process.

Sludge is wasted from the bioreactor tank using a submersible pump at the concentration achieved by conventional settling. Since the solids concentration is so high, no special concentrating provisions are needed.

MBR PROCESS DIAGRAM



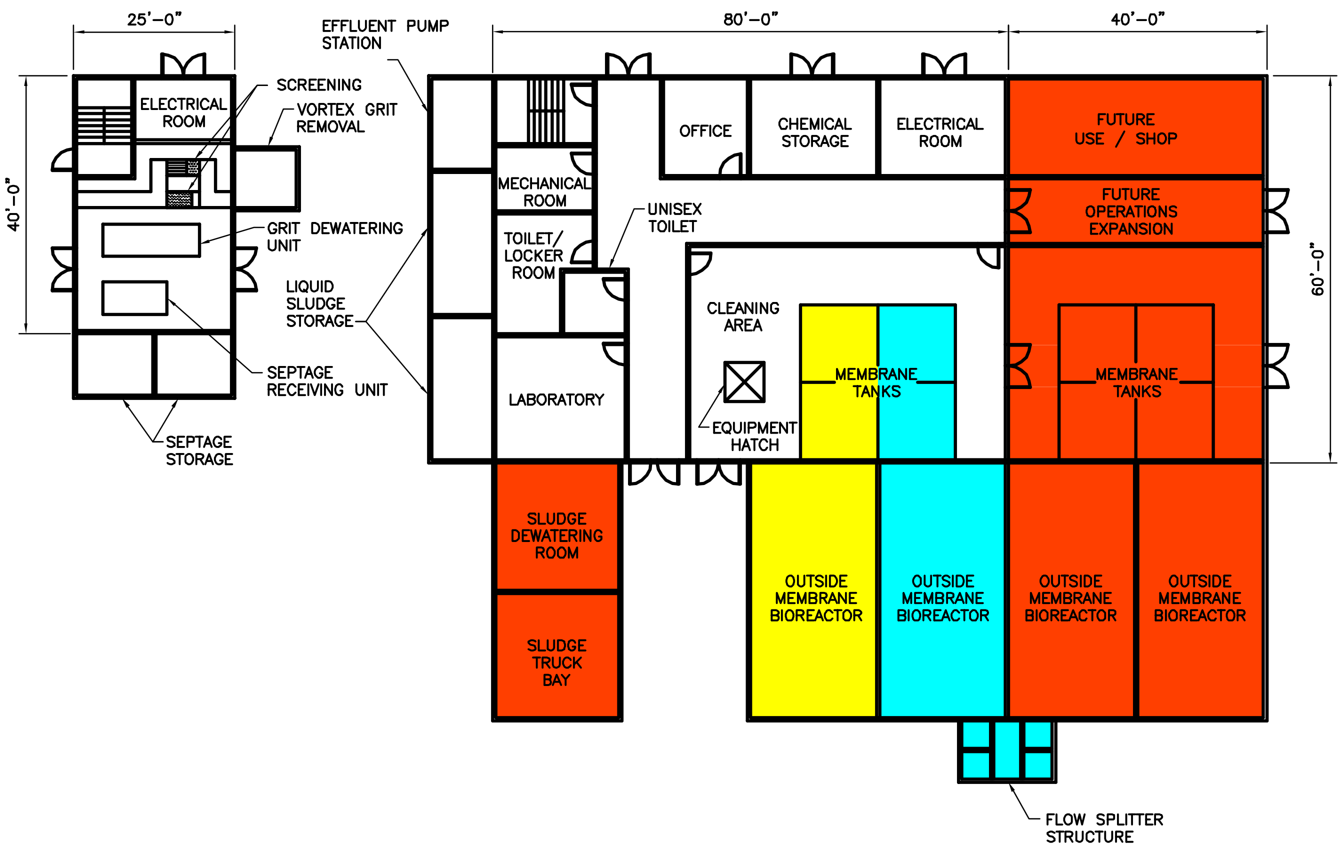
MBR Process Diagram Stratham, NH		
PROJ NO. 11607B	DATE. MAR 2011	**FIGURE:** **3-4**
WRIGHT-PIERCE Engineering a Better Environment		

At times, the membranes pores can fill with fine particulates and become coated with biomass becoming clogged and reducing hydraulic capacity. The membranes require periodic backwash with a chlorinated effluent to regain hydraulic capacity. Since some of the units will always be in the backwash mode, the system needs to be sized to provide for one or more units to be off line at a time.

An MBR WWTF facility to meet Stratham's treatment goals would typically consist of the following processes:

- Preliminary treatment consisting of fine screening and grit removal
- Bioreactor tankage
- MBR equipment, including permeate pump system, aeration and membrane air scour system
- Sludge recirculation and wasting system
- Chemical systems (for alkalinity adjustment and possibly phosphorus reduction)
- Waste sludge storage, thickening, and/or dewatering as necessary for off-site disposal.

Based on the above, and the design basis and treatment goals previously presented, a concept design of an MBR facility has been developed. A conceptual building layout of the MBR facility is presented in Figure 3-5.



OPERATIONS BUILDING FIRST FLOOR PLANS

SCALE: NTS

LEGEND

- PHASE I
- PHASE II
- PHASE III

STRATHAM, NEW HAMPSHIRE

CONCEPTUAL DESIGN – MBR OPTION

OPERATIONS BUILDING FIRST FLOOR PLAN

PROJ NO: 11607B	DATE: 3/5/2011	FIGURE:
WRIGHT-PIERCE Engineering a Better Environment		3-5

3.5.4 Planning Level Costs

A summary of estimated planning level capital, operation and maintenance (O&M), and life-cycle costs for the selected alternatives is presented in Table 3-5. These planning-level costs were developed using concept layouts and unit cost information with allowances for contractor installation overhead and profit. Capital project costs also include allowances for project implementation items such as, construction contingency, design engineering, construction engineering, permitting, as well as fiscal and legal expenses. The construction cost information presented herein, is in current dollars and is based on ENR Index 8920.

TABLE 3-5
SUMMARY OF ESTIMATED PLANNING LEVEL COSTS
FOR SELECTED ALTERNATIVES

	SBR			MBR		
	Phase I	Phase II	Phase III	Phase I	Phase II	Phase III
Capital (1)	$8.7M	$10.1M	$13.8M	$8.3M	$9.0M	$12.8M
Annual Bond Payment on Capital(2)	$672,000	$778,000	$1,061,000	$637,000	$690,000	$981,000
Annual O&M(3)	$264,000	$390,000	$505,000	$310,000	$460,000	$650,000
Life-Cycle Costs (4)	$18.7M	$23.4M	$31.3M	$18.9M	$23.0M	$32.7M

(1) Capital costs do not include land or easement costs.
(3) Based on 4.5% interest over 20 years
(2) O&M consist of labor, power, chemical and costs
(4) Sum of O&M costs and annual bond payment over a 20 year period

Based on the above, the estimated life-cycle cost differences between Phase I and II alternatives is less that 1% and the cost difference between Phase III alternatives is less than 5%. As a result, for the purposes of this study, the costs can be considered equivalent. The selection of the preferred alternative for the Town may need to take into account non-quantitative features of a particular alternative. It should also be noted that a more refined capital and O&M cost analysis can be completed as part of a Basis of Design Report.

3.5.5 Evaluation of Selected Alternatives

The evaluation of wastewater treatment alternatives is based on the following criteria:

- Operations

    - Reliability (ability to consistently meet treatment goals).
    - Ease of Operation (simplicity, staffing needs).
- Flexibility
    - Ability to respond to initial and future flows and loadings.
    - Ability to readily expand on selected site.
- Costs
    - Capital.
    - Annual O&M costs.
        - Ability to minimize labor, power and/or sludge production.

Each selected alternative was ranked relative to the other in each of these categories. A ranking of 1 indicates the preferred alternative for specific criteria. When the rankings are totaled, the lowest total score indicates the preferred treatment alternative. The evaluation matrix is presented in Table 3-6.

TABLE 3-6
EVALUATION MATRIX

Criteria	SBR	MBR	Notes
Reliability	2	1	Membrane more reliable barrier
Ease of Operations	2	1	MBR physical barrier rather than biological process
Response to Varying Flow/Loading	1	2	Both respond well; SBR more of a batch process and has larger tanks
Expandability	2	1	Use of modules allows MBR more incremental expansion
Treatment Performance	2	1	MBR will produce better quality effluent
Compatibility with Various Discharge Options	2	1	Better effluent quality from MBR would allow greater effluent discharge flexibility (e.g., reuse)
Capital Costs	2	1	Table 3-5
Annual O&M Costs	1	2	Table 3-5
Totals:	14	10	

In addition to being ranked as the preferred alternative, it is important to note that the MBR technology offers several ancillary benefits that may assist the Town in obtaining the critical and necessary near and longer-term permitting for the proposed groundwater disposal facility. It has been demonstrated that MBR treatment technology is one of the most advanced systems on the market and will produce a treated effluent at levels lower than the treatment goals presented in Table 3-4.

SECTION 4

WASTEWATER DISCHARGE

4.1 INTRODUCTION

Three possible alternatives exist for the disposal of the Town's wastewater: 1) discharge to the Squamscott River; 2) transport to Exeter as part of a regional solution; or 3) a land-based discharge. As a result of preliminary investigation results, discussions and feedback from various sources during the early stages of completing this feasibility study, it was decided to pursue in more detail, land-based discharge.

4.2 LOCAL DISCHARGE TO SQUAMSCOTT RIVER

The regulatory review and approval process for this alternative would have a significant impact on project schedule (i.e., up to 3 years has been reported with no assurance a discharge permit would be granted). As a result of the above and the fact that another feasible option likely exists (i.e., land-based discharge), this alternative is not considered viable at this time.

4.3 TRANSPORT TO THE EXETER WASTEWATER TREATMENT FACILITY

As a result of stated capacity issues and growth pressures within Exeter itself, this alternative is not considered viable at the present time absent significant upgrades. The key issues associated with this alternative include the following:

- **Distance and Route of Transmission Facilities -** Exeter's wastewater collection system is within a mile of the planned project area for the Town of Stratham collection system. The capital and operational and maintenance cost of the necessary pipeline and pump stations for this alternative will be a large portion of the total project cost, and will likely need to include improvements and expansions to Exeter's collection system downstream of the interconnection. An alternate forcemain route would be directly to the Exeter WWTF.

- **Available Capacity of Exeter WWTF** - The Exeter WWTF is currently licensed to discharge up to 6 MGD. However, the aerated lagoon treatment facility is presently receiving a revised discharge permit that will likely require tertiary treatment at the WWTF to continue discharging effluent into the Squamscott River. Additional capacity for Stratham's wastewater flow needs could be designed into Exeter's WWTF at that time.
- **Municipal Negotiations** - It has not been confirmed at this time whether Exeter would be willing to make available its excess capacity to Stratham and at what cost. This alternative is also likely to present opportunities for involvement and debate by the citizens and leaders of both communities. As a result, it is anticipated that the review and approval process for this alternative would have a significant impact on project schedule and would thus not be a viable alternative at this time.
- **Summary of preliminary discussions between Exeter and Stratham**.

4.4 LOCAL LAND-BASED DISCHARGE

As discussed in the previous sections, discharge to the Squamscott River or transport of wastewater to the Exeter Wastewater Treatment Facility are not considered viable options for this report. This leads to the evaluation of land-based discharge alternatives. All land-based discharges will require a groundwater discharge permit in accordance with DES Env-Ws 1500. NHDES provides additional guidance in a document titled, "Groundwater Discharge Permitting Guidance Document for recharging Aquifers with Reclaimed Wastewater" (July 2005).

In general, treatment requirements for groundwater discharges are less stringent than surface water discharges. Additional natural treatment occurs within the unsaturated soil column along with dilution and mixing with groundwater. The impacted groundwater then flows to a receptor such as a stream or river and discharges as base flow. Impacted groundwater must meet drinking water standards at the boundary controlled by the owner. As such, the DES currently promotes consideration of groundwater discharge alternatives for WWTF discharges that discharge into sensitive or impaired water bodies and/or are faced with stringent surface water quality based limitations.

Although various slow/moderate rate land-based discharge systems exist, only rapid rate discharge systems (i.e., rapid infiltration beds, subsurface disposal systems, and wick wells) have been considered as part of this study. Slow rate infiltration systems, such as spray irrigation, requires a very large land area and large storage facilities to store wastewater flows during the non-spray season, and is not considered as part of this study for the Town of Stratham. Drip irrigation, which is another type of slow rate infiltration system, applies treated effluent through perforated small diameter flexible tubing. This method imparts minimal land disturbance and has low aesthetic impact. Significant land area is required for this method.

4.4.1 Areas Identified for Land-Based Discharge

As part of this study and as part of subsequent hydrogeological investigations, work has been completed to identify potential areas and perform a field evaluation on sites that are viable for land-based discharge. Identification of such sites followed a protocol that began with a wide focus and built on initial tasks completed to continually refine subsequent work tasks. Once the most viable sites were identified, field activities were staged in order to develop an increased confidence in a site's potential capacity prior to proceeding with future hydrogeologic investigation work.

4.4.1.1 Preliminary Identification of Potentially Suitable Sites

Preliminary identification of potentially viable in-ground wastewater disposal sites was evaluated within a 3-mile radius from the center of the GCBD. For this evaluation, it was assumed that the near- and longer-term planning range of wastewater flows requiring disposal would range between 250,000 to over 600,000 gallons per day. Potential areas identified for land-based discharge are sites where suitable granular soils exist that would handle the projected flow and the infiltrated water would move downward until it reached the water table and create a mound. The treated effluent would then flow horizontally and eventually discharge as base flow to streams or rivers within the local watershed. The soils would provide additional treatment including metals attenuation and bacteria and viral removal. The groundwater would provide dilution making it much more likely to achieve ambient surface and groundwater quality standards.

The first step in the site selection was to perform a "desktop" review of all readily available data. Color Orthophotos (2003), surficial geology, Town of Stratham tax, USGS 7.5 minute topographic and Rockingham County Soils maps were reviewed along with USGS Water Resources Investigation and Open File reports.

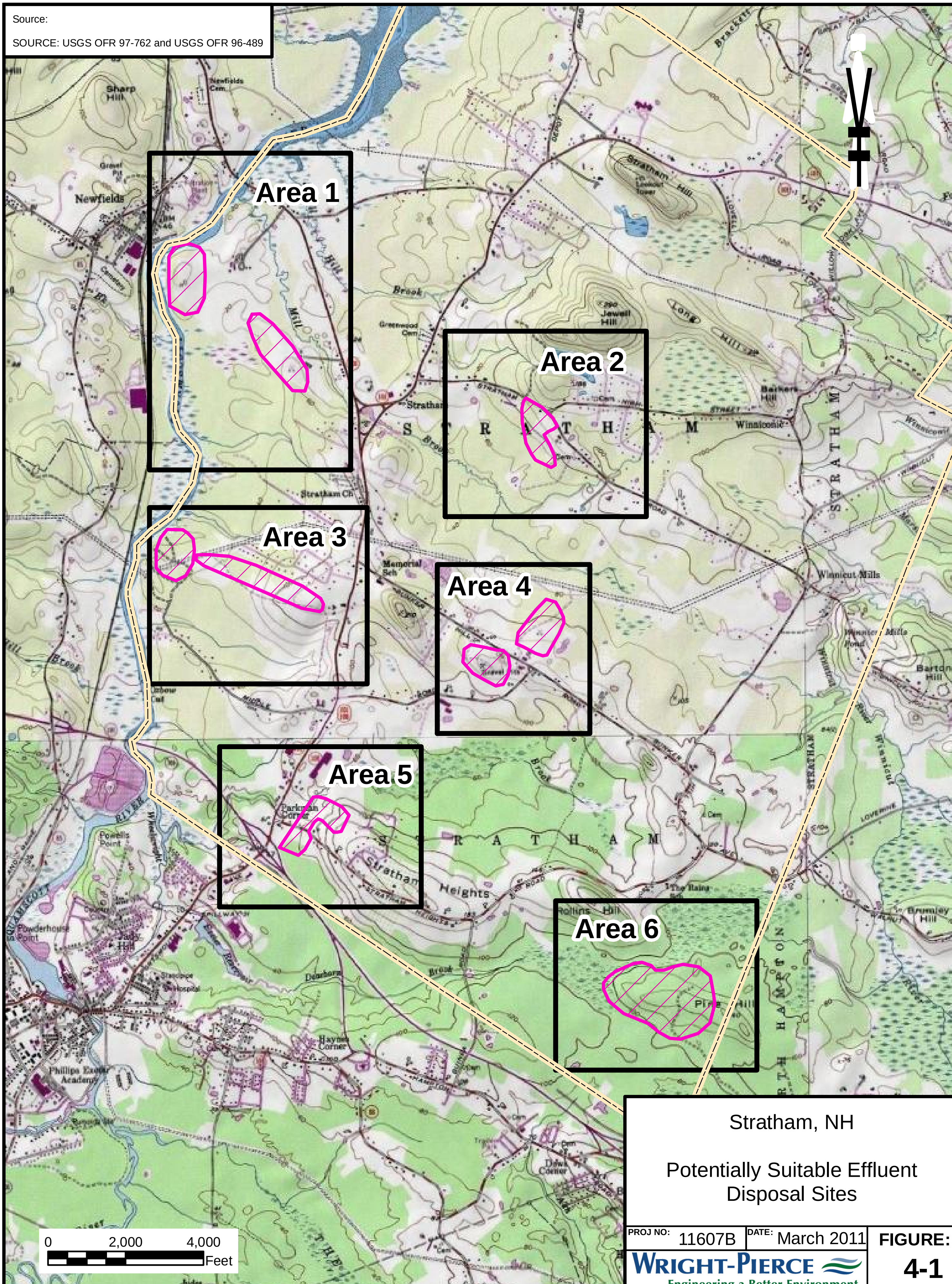
The second step was to preliminarily select sites that would have a likely hydraulic connection to the Squamscott River. Highly transmissive soils are ideal for in-ground wastewater disposal. As an example, glacial geomorphic landforms identified as kame deltas or grounding-line kame deltas are considered less favorable due to the occurrence of alternating beds of sand/gravel and fine sand/silt. The fine sand/silt beds will restrict the downward infiltration of wastewater thereby creating an unacceptable mounding height and side-slope wastewater breakout.

The third step consisted of a field "windshield" inspection of the potential sites. Nine sites located in six different areas were initially identified. Each site identified was based upon data suggesting favorable conditions may exist such as soil grain size, glacial geomorphology, open space, topography, and height above the water table, unsaturated thickness and aerial extent. The sites that could be considered for further assessment are shown on Figure 4-1.

Next, the Town requested permission from the landowners to perform test pitting to determine grain size characteristics and depth of unsaturated soils. The landowners granting initial approval to perform test pits are presented in Table 4-1. However, landowner approval was withdrawn from Area 5.

Source:

SOURCE: USGS OFR 97-762 and USGS OFR 96-489



Stratham, NH

Potentially Suitable Effluent Disposal Sites

PROJ NO: 11607B	DATE: March 2011	FIGURE: 4-1

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TABLE 4-1

PROPERTY OWNERS OF TEST PIT PARCELS

Location	Parcel ID	Address
Area 1	Map 17 Lot 23	16 French Lane
Area 4	Map 9 Lot 82	69 Bunker Hill Ave.
Area 5	Map 4 Lot 18 & Map 5 Lot 2	12 Stratham Heights & 11 Stratham Heights
Area 6	Map 3 Lot 1	One Fine Chocolate Place

4.4.1.2 Hydrogeologic Investigations

Of the 6 areas considered, 3 areas (Areas 1, 4 and 6) were investigated by test pitting based upon hydrogeologic characteristics, access rights and proximity to the Commercial District. A general discussion of the results of the test pitting work is presented below.

Area 1- Test pitting was conducted to determine the distribution of soils both vertically and horizontally on this site. Sand and gravel has been mined from the site for construction of Route 101. The mined area has been backfilled with stumps and capped with topsoil. Favorable unsaturated sand and gravel was found in the immediate vicinity of the old farmhouse. However, the sand and gravel is not aerially extensive enough to support the land-based discharge volume. These factors eliminated this site for further consideration.

Area 4- Test pitting was conducted to determine the distribution of soils both vertically and horizontally on this site. Sand and gravel has been mined over the years from the site. Fill has been placed at many of the mined locations. Suitable unsaturated soils were not found on the site. This site was eliminated from further consideration for land-based discharge of wastewater.

Area 6 - Lindt & Sprungli - Test pitting was conducted to determine the distribution of soils both vertically and horizontally on this site. Favorable unsaturated sand and gravel was encountered in many of the test pits. Dense soils known as till were found in two test pits. Till will not rapidly transmit treated effluent both vertically and horizontally and represents a boundary where a subsurface disposal system should not be sited. The location of the test pits and the preliminary till/sand and gravel contact are shown on Figure 4-2.

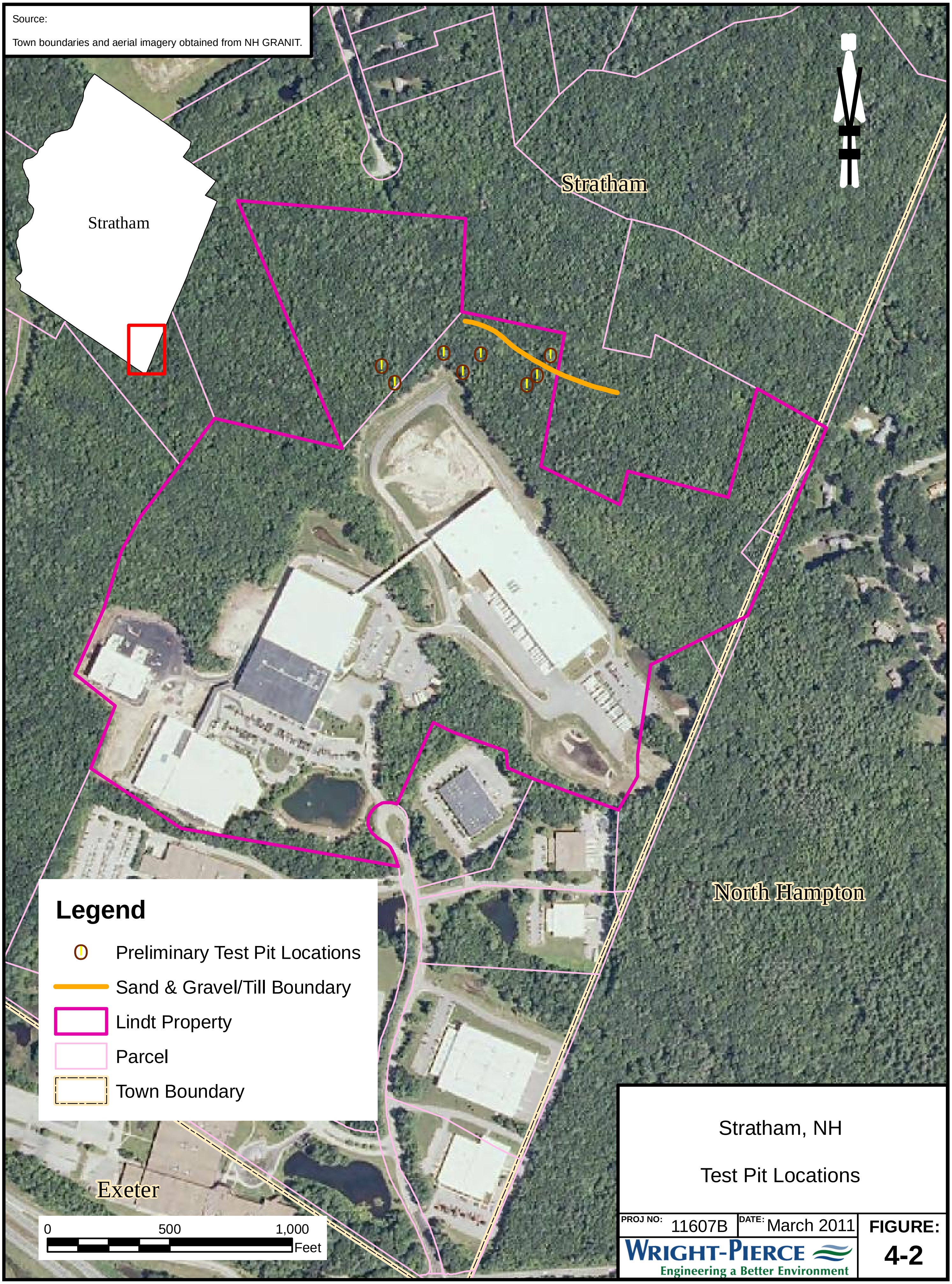
Additional field investigations are required on the Lindt & Sprungli site to determine the vertical and horizontal extent of the favorable sand and gravel soils. To better determine the site's potential maximum discharge capacity, this investigation should consist of identification of property boundaries, consideration of acquiring abutting land if necessary, additional test pitting, test borings, determination of aquifer hydraulic properties as well as the groundwater gradient and flow direction, infiltrometer testing, load cell testing and numerical groundwater modeling.

4.4.2 Land-Based Discharge Alternatives

As noted above, only rapid rate discharge systems (i.e., rapid infiltration beds and subsurface systems) have been considered as part of this study. At this time and based on the work completed to date, land-based discharge efforts and this review of alternatives, focus only on the Lindt & Spungli (USA) site.

4.4.2.1 Discharge Goals

Given the limited amount of viable land available in Stratham for land-based effluent discharge, the goal for the proposed discharge facilities is to maximize their potential for effluent disposal, but at least be able to provide disposal capacity for 125,000 to 250,000 GPD for likely initial phases of wastewater facilities construction. Additional site investigation and evaluation will be required to estimate the infiltration capacity of the Lindt & Sprungli USA site.



Stratham, NH

Test Pit Locations

PROJ NO: 11607B	DATE: March 2011	FIGURE: 4-2

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4.4.2.2 Initial Screening of Alternatives

Each of the three rapid rate discharge systems (i.e., rapid infiltration beds, subsurface bed systems, and wick wells) may be viable for the Lindt site.

4.4.2.3 Subsurface Bed Disposal

Subsurface disposal is similar in design to a leach field found for individual private wastewater disposal. The disposal system can be a series of individual trenches or a trench bed system where perforated pipes or open bottom chambers are bedded in highly porous bedding material. Treated effluent flows through the perforated pipes or chambers into the ground for further treatment and disposal. The entire system is buried underground and has less visual impact compared to rapid infiltration basins. Reclamation of a clogged subsurface disposal trench is much more difficult than with rapid infiltration surface disposal and typically requires removal and replacement of the system.

DES has standard loading rates for leach field systems that are based on individual disposal systems where wastewater is allowed to settle in a septic tank and decant (primary effluent) is sent to the leach field. The loading rates established by DES for leach fields are typically low because of the small quantities of wastewater handled by individual systems and in order to prevent clogging from the poorer quality effluent. These loading rates are a conservative measure to account for relatively little investigation prior to design. NHDES may be amenable to higher loading rates in this instance due to a more comprehensive site investigation and higher levels of pretreatment; however, further coordination with NHDES would be necessary to confirm this assumption.

4.4.2.4 Wick Well Disposal

A wick well is simply a rapid infiltration trench constructed in a vertical manner. A typical wick well is drilled, gravel packed, and screened through the unsaturated permeable soil layer. Wick wells require highly treated effluent low in dissolved and suspended solids.

The vertical nature of the wick well requires considerably less surface area than infiltration basins or trench disposal systems. Typically, the surface disruption of a wick well is limited to a 2-4 foot diameter concrete cap. The wick well can be used where space considerations or geologic conditions do not allow the installation of conventional surface or subsurface rapid infiltration systems. The amount of water that can be discharged into a given wick is primarily dependent on the effluent quality, hydraulic conductivity of the aquifer, and the height that the water table can raise without breaking out at the surface. The current trend in wick well disposal is that treatment should produce the highest quality effluent possible in order to limit potential clogging.

NHDES considers wick wells an innovative technology. There are no permitted wick well effluent disposal systems in the State of New Hampshire, although two wick well systems have been constructed in Massachusetts. Initial discussions with DES staff indicate that the department is amenable to this disposal method as long as an approved hydrogeologic investigation and pilot program supports their use. DES staff has indicated that a wick well disposal system would need to have a conventional backup reserve area, such as infiltration basins or subsurface disposal beds, with 100% redundancy until wick wells have proven themselves for a particular application.

4.4.2.5 Rapid Infiltration Beds

Rapid infiltration technology generally consists of a series of rectangular earthen berm beds excavated four to six feet below ground surface. The bed bottoms are completed with natural existing granular soils and treated effluent is discharged onto the bed surface. The effluent receives additional treatment as it flow through the soils. The effluent percolates vertically downward through the unsaturated soil column forming a mound beneath the beds. The mound height must remain a minimum of two feet below the bed bottom. Rapid infiltration beds are relatively easy to maintain and the effluent may require less treatment than other subsurface disposal methods. Higher loading rates can be applied if the hydrology of the site is favorable.

The Town of Stratham would be disposing of higher quality effluent from a centralized wastewater treatment facility which would likely allow consideration of higher loading rates.

The investigation is similar to what is required for the rapid infiltration basin evaluation and it is anticipated that loading rates established for a rapid infiltration basin would be similar to allowable loading rates of other sites with similar soil characteristics. For the purposes of this study, we have assumed an allowable loading rate of 3-5 GPD/sf. This will be confirmed in subsequent site investigations this year.

Based on the above, the design basis and discharge goals previously presented, a concept design for a rapid infiltration basin to discharge approximately 250,000 GPD is recommended if the capacity is available onsite. A concept layout of the system is presented in Figure 4-3.

4.4.3 Planning Level Costs

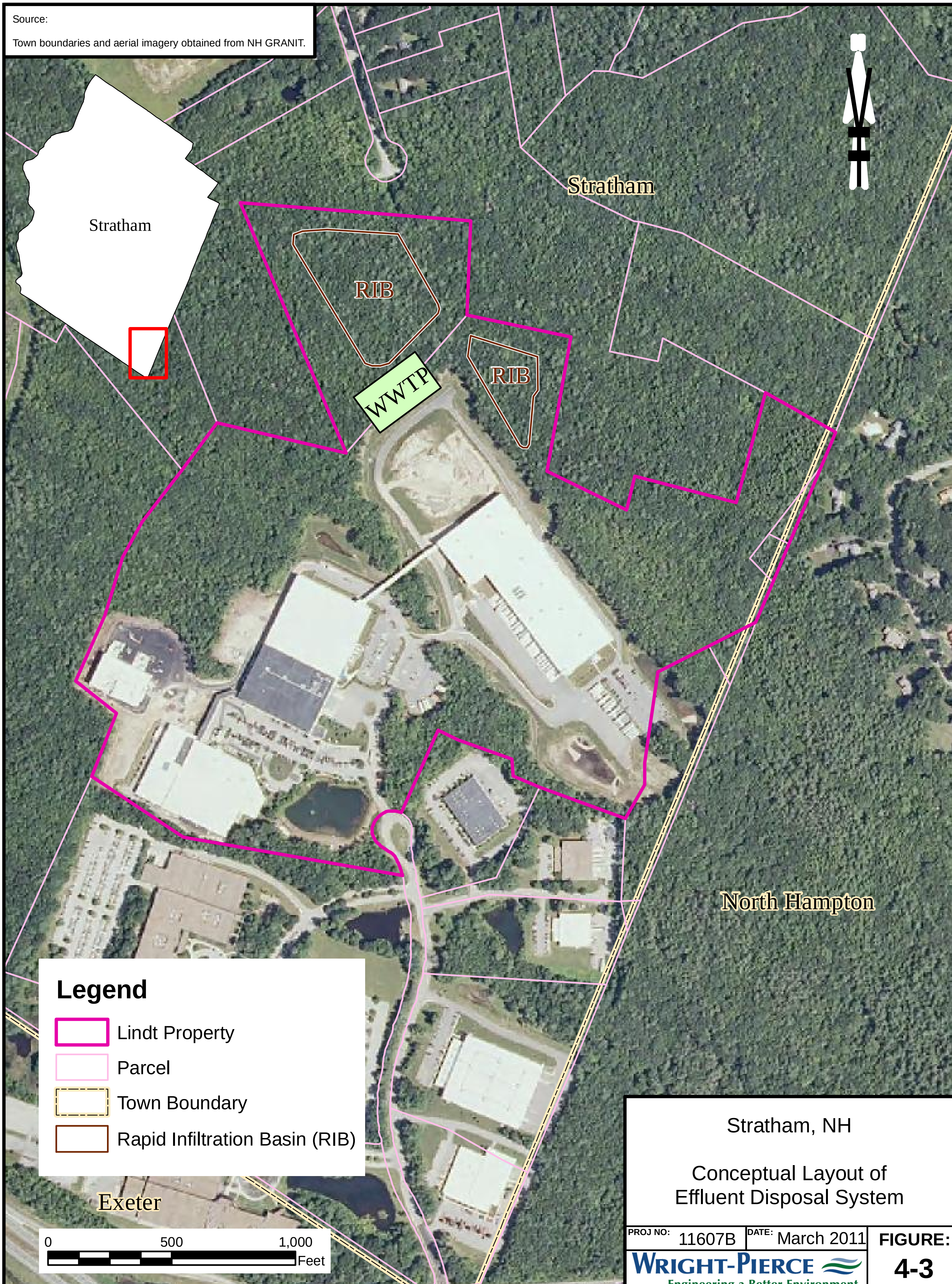
A summary of estimated planning level capital, operation and maintenance (O&M) costs for the selected alternatives for the Lindt & Sprungli site is presented in Table 4-2.

These planning-level costs were developed using concept layouts and unit cost information with allowances for contractor installation overhead and profit. Capital project costs also include allowances for project implementation items such as construction contingency, design engineering, construction engineering, permitting, as well as fiscal and legal expenses. The construction cost information presented herein is in current dollars and is based on ENR Index 8920.

TABLE 4-2
SUMMARY OF ESTIMATED PLANNING LEVEL COSTS
FOR SELECTED ALTERNATIVES

	Initial Phases (up to 250,000 GPD)
Force main from proposed WWTF site	$200,000
Access Roads	$50,000
Rapid Infiltration Basins	$500,000
Subtotal Capital	$750,000 [1]
Annual Operation & Maintenance	$25,000

[1] Does not include any land purchase or easement costs.



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Stratham, NH

Conceptual Layout of Effluent Disposal System

PROJ NO: 11607B	DATE: March 2011	FIGURE: 4-3

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SECTION 5

RECOMMENDATIONS

5.1 CONCEPTUAL DESIGN RECOMMENDATIONS

Based on the results presented in the previous sections and review with Town officials, the following is a summary of the recommended plan for the Town's wastewater collection, treatment and disposal systems:

Wastewater Collection

1. Provide wastewater collection for part of the Commercial District, beginning at Route 101, heading north along Route 108 / Portsmouth Avenue, and ending at Frying Pan Lane.
2. Within 5 to 10 years (or sooner depending on demand) provide wastewater collection for the entire Commercial District.
3. Within 10 to 15 years (or sooner depending on demand) provide wastewater collection for the Town Center / PRE.

Wastewater Treatment

1. Provide MBR wastewater treatment facilities for an average daily flow of 250,000 GPD (i.e., Phase II) to accommodate all near-term wastewater collection priorities.
2. When necessary, expand treatment facilities to accommodate additional wastewater needs.

Wastewater Disposal

1. Continue negotiations with Lindt & Sprungli USA to utilize their land for effluent disposal.
2. Determine the extent of the sand and gravel deposit on the Lindt & Sprungli USA property and determine the infiltration capacity of the site.

3. Permit and construct a 250,000 GPD groundwater disposal facility on selected disposal site.
4. Monitor performance of the groundwater disposal facility and determine the site's ability to accommodate additional wastewater flows.
5. As necessary, investigate additional groundwater disposal sites to accommodate additional wastewater flows.

5.2 ESTIMATED COSTS

A summary of the capital costs for the recommended plan is presented below in Table 5-1.

TABLE 5-1

SUMMARY OF CAPITAL COSTS FOR PHASE II RECOMMENDED PLAN

Project Element	Recommended Plan
Collection System	$3.1M [1]
MBR WWTF	$9.0M
Disposal System	$0.8M [2]
Total:	$12.9M

[1] Includes interceptor sewer and one pump station for the Commercial District from Bunker Hill Road to Stratham Heights Road.
[2] Includes effluent force main and rapid infiltration basins construction.

A summary of the estimated annual O&M costs for the recommended plan is presented below in Table 5-2.

TABLE 5-2

SUMMARY OF ESTIMATED ANNUAL O&M COSTS FOR RECOMMENDED PLAN

Project Element	Years 1-5	Years 10-15
Collection System	$ - [1]	$ - [1]
WWTF	$280,000	$430,000
Disposal System	$ - [2]	$ - [2]
Total:	$280,000	$430,000

[1] Costs assumed to be included with WWTF costs. Costs may also be carried separately if O&M of collection system is provided by Town Public Works Department.
[2] Costs included with estimated WWTF cost.

5.3 IMMEDIATE NEXT STEPS

We recommend the Town move forward with the following items in the next fiscal year:

A. Geophysical Investigation for Land Disposal Site

1. Perform additional test pitting at the Lindt & Sprungli USA property to further define the limits of the sand and gravel deposit. The use of an excavator capable of excavating a 15-20 foot deep hole will be required.
2. Conduct sieve analysis of the soil samples collected during test pitting.
3. Meet with NHDES to discuss project and their particular requirements.
4. Conduct soil borings and install monitoring wells.
5. Conduct a 10-day load test on the site consisting of a continuous 60-70 gpm hydraulic load. The previously installed monitoring wells will be used to monitor the influence the load test has on groundwater levels. This will require purchasing water from Lindt & Sprungli or the Town of Exeter directly.
6. Develop a professional opinion of the disposal capacity of the proposed infiltration site.
7. Develop a preliminary numerical groundwater model of the site.**
8. Submit a Groundwater Discharge Permit application to the NHDES.**

**Tasks 7 and 8 may not occur until the following year.

B. Conceptual Collection System Development Assistance

1. Meet with the property owners to discuss their wastewater disposal requirements. This information is needed to determine the actual volume of wastewater (Lindt & Sprungli USA and Commercial District) to be disposed of on the site.
2. Obtain information from the property owners as to the extent of their property.
3. Determine potential locations for a Pump Station near the intersection of Stratham Heights Road and Route 108.

4. Develop a memorandum of understanding between the property owners and the Town as to ownership of facilities and financing arrangements.

5. Develop bylaws for the proposed sewer system.

TABLE 5-3
SUMMARY OF ESTIMATED 2011
COSTS FOR IMMEDIATE NEXT STEPS

Part	Description	Wright-Pierce	Subcontractor
A. GEOPHYSICAL INVESTIGATION OF LAND DISPOSAL SITE			
1-6	Geophysical Analysis and Testing	$60,000	$52,000
7	Groundwater Modeling	$7,000	$15,000
8	NHDES Permit Application Preparation	$25,000	-
	Subtotal	**$159,000**	
B. CONCEPTUAL COLLECTION SYSTEM DEVELOPMENT ASSISTANCE			
1-5	CONCEPTUAL COLLECTION SYSTEM DEVELOPMENT	$5,000	-
	Subtotal	**$5,000**	
TOTAL COST		**$164,000**	

WRIGHT-PIERCE
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