Wastewater Facilities Plan

for

Town of Branford, Connecticut

September 25, 1996

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I. INTRODUCTION

A. PROJECT OVERVIEW

This Facilities Plan has been developed for the Town of Branford as part of the comprehensive Facilities Plan for the Town's wastewater treatment plant. This Plan has been developed in response to an Order issued by the Connecticut Department of Environmental Protection (DEP), to the Town. This Order requires the study and evaluation of the wastewater treatment needs for the Town and a means of implementing those improvements recommended to achieve State water quality objectives.

Facilities Planning must be performed in order to obtain Grant Assistance from the DEP for wastewater collection and treatment system improvements. The information in this Plan is consistent with State and Federal regulations regarding Clean Water funding.

B. BACKGROUND

The Town of Branford operates a wastewater treatment plant that serves the needs of the Town's sewered population. This wastewater treatment plant is currently operating under the terms and conditions of NPDES Permit number CT0100048, under which limitations on the amount and character of treated sanitary sewage that it may discharge to Branford Harbor and Long Island Sound are established. Order #5177 was issued to the Town by the State of Connecticut Department of Environmental Protection (DEP) to investigate and provide a Plan to evaluate alternative methods to accommodate the increase in flows and loadings currently experienced at the wastewater treatment plant so that state water quality requirements may be met. The Order also requires that a schedule of implementation be established as well as a means to finance the improvements. As part of the future requirements to remove nutrients in Long Island Sound, the Plan is also required to investigate the means to remove nitrogen in the treated effluent from the treatment plant to two separate attainment levels in compliance with anticipated nutrient limits for Long Island Sound. The Town of Branford entered into an Agreement with Whitman & Howard on April 28, 1995 to provide this Facilities Plan.

C. OVERVIEW OF FACILITIES PLANNING

Facilities planning is the first in a three part construction grant and revolving loan program administered by the DEP. The second part of the program is the preparation of detailed design plans and specifications, and the third part is the actual construction of the facilities needed to improve receiving stream water quality.

Facilities planning, of which this report is the culmination of, determines the wastewater treatment system needs for a planning period of 20 years and develops strategies for meeting those needs. The Plan provides the basis for subsequent design and construction, substantiates the need for those facilities, provides a cost effective analysis of a number of feasible alternatives and demonstrates that the selected alternatives are implementable from a legal, financial and management perspective. The selection of the best alternative to meet the future wastewater treatment needs of the service community is the objective of the facilities planning process.

In addition to a comprehensive evaluation of the existing facilities and future system needs within the study area, the Facility Plan also evaluates existing and projected demographic characteristics, topographic, hydrologic and institutional features of the study area and evaluates their impact on the wastewater treatment needs. Analysis is provided herein for historic and future planning periods. For the purposes of this Plan, the historic period includes the operating years from 1992 to the present. Facility operations are evaluated during this period relative to the treatment plant capacity and operation and includes such concerns as flow rates, pollutant loadings, permit compliance and operating efficiency.

The future planning period includes the 20 year period beginning in the year 2000 and extending through the year 2020. This is 20 years beyond the date in which the proposed facilities are anticipated to be operational. It is during this time frame that the future wastewater treatment needs are evaluated. A number of wastewater and solids handling techniques were identified and examined for feasibility in meeting the Town's needs as well as State and Federal regulatory requirements during the future planning period.

D. PLAN ORGANIZATION

This Plan has been organized such that it is compatible with the Facilities Planning guidance document entitled "Construction Grants 1985" (CG-85) published by the Environmental Protection Agency in 1984. This document provides a comprehensive interpretation of the 1982 amendments to the Clean Water Act as they apply to funding for wastewater treatment facilities. A brief description of the chapters contained in this Plan and their content is described below.

__Chapter 1__ provides background information relative to the Facilities Plan process, describes the organization of the Plan, and provides a list of previous studies that provide data and information relative to this Facilities Plan.

__Chapter 2__ presents information relative to the water quality objectives expected by the State and specific information on compliance in Branford.

__Chapter 3__ includes information on the existing physical, organizational, environmental and demographic conditions within the Study area. This information is used to establish the existing conditions, determine trends, possible development potential and predict future conditions within the study area that are pertinent to the future wastewater treatment requirements. This chapter also includes information relative to the existing environmental conditions within the study area. Environmental conditions include land use requirements, air quality, climate, subsurface soil conditions, flood and floodway zones, public water supply analysis, hydrology of the area and other considerations that may have an impact on the results of this Plan.

__Chapter 4__ establishes the current wastewater flows and nutrient loadings at the treatment plant and establishes the discrete flows and loads directly related to domestic and commercial uses, industrial, septage, infiltration and inflow. This information on individual waste characterizations is then used in Chapter 5 to establish, in conjunction with demographic projections, the future flows and nutrient loads at the treatment plant for the planning period.

This chapter also establishes the deficiencies of the existing wastewater treatment plant and collection system pumping stations. This review determines the existing treatment plant deficiencies and provides recommendations for corrective action required for improved performance of the treatment plant and pumping stations. This evaluation is then used in later chapters to evaluate the most cost-effective means to meet future wastewater quality needs. Operation and maintenance procedures are reviewed here also, as is the current sewer use ordinance.

__Chapter 5__ establishes the future planning area conditions based upon population projections, existing and past trends and projected flow rates and loadings to the treatment plant for the 20 year planning period. An evaluation of the "No Action" alternative and its potential effects on future environmental conditions in the planning area is included in his Chapter.

Chapter 6 evaluates the alternatives for the wastewater treatment system and pump station upgrade. Alternatives are investigated relative to effluent treatment technology for nitrification, nitrogen removal to two attainment levels, and disinfection of the treated effluent as well as an investigation into energy recovery and energy saving alternatives. This Chapter also presents a detailed alternatives analysis of viable options presented. Consistency of these alternatives with future planning needs and wasteload allocations are demonstrated here. This analysis is the basis for evaluation of viable alternatives.

Chapter 7 includes an evaluation of all of the viable alternatives and selects for recommendation the plan that most fits the wastewater treatment needs for the planning period.

Chapter 8 provides a detailed presentation of the selected plan. As part of this presentation, a detailed description of both the proposed treatment works and the complete waste treatment system of which it will be a part is provided . A plant layout, hydraulic analysis and design information are presented in this chapter. A discussion of the reuse of existing facilities is presented as well as a description of each unit process and its fit within the overall plan. Plant staffing based on the selected plan is reviewed as are laboratory requirements. Finally, capital and operating cost estimates of the selected Plan are provided as is a schedule of implementation.

Chapter 9 presents the assessment of the direct and indirect environmental impacts associated with the planned construction activities. This would include effects on air quality, noise, traffic, wetland impacts, secondary impacts, surface and groundwater quality and the establishment of mitigating measures, if necessary.

E. PREVIOUS STUDIES

A number of previous engineering studies have been performed in the recent past that have addressed various wastewater needs for the Town of Branford. These reports have been utilized as applicable within the Facilities Plan. Relevant reports are listed below:

1. Sewer System Evaluation Survey, Gannett Flemming, Inc., May 1995.

2. Wastewater Treatment Facility Evaluations, Gannett Flemming, Inc., June 1991.

3. Evaluation of the Ad Valorem System for Operating and Maintaining the Wastewater Facilities, Gannett Flemming, Inc., June 1994.

4. Interim Nitrogen Reduction Assessment (updated), Gannett Flemming Inc., August, 1995.

II. WATER QUALITY OBJECTIVES

A. STATE WASTEWATER TREATMENT GOALS

The wastewater treatment goals of the State are to preserve the water quality for the beneficial use of the planning area residents as well as others. These goals are to provide adequate wastewater treatment to protect surface water quality and to provide wastewater management to protect area groundwater. The goals for protection of surface waters are to meet the minimum effluent standards required by the State Department of Environmental Protection for secondary treatment and to meet more stringent effluent limits necessary for the protection of the receiving waters, in this case, Long Island Sound.

B. REGULATIONS

The enactment of the Federal Water Pollution Control Act Amendments in 1982 established the basis for control of water pollution in the nation's waterways. The objective of the Act and its amendments is to restore and maintain the integrity of the nation's waterways.

Section 303 of this Act requires the State to adopt surface water quality standards for review and modify these standards every three years. Section 22a-426 of the Connecticut General Statutes further requires the State to adopt standards of water quality for all State waters. These standards are enforceable under a number of State regulations. These water quality classifications establish the designated uses for all surface waters and establish goals for improvement.

Water Quality Management (WQM) Plans are required by the Clean Water Act to provide the basis for regulatory control and enforcement of water pollution abatement activities. In Connecticut, WQM Plans generally take on the form of a wasteload allocation. This will act to translate water quality criteria into wastewater discharge effluent limitations which are incorporated into a National Pollutant Discharge Elimination System (NPDES) Permit.

Wasteload allocations develop pollutant loadings and concentration limits to the major contributors to a waterbody. The major pollutants of concern for a municipal wastewater treatment facility are biochemical oxygen demand (BOD), suspended solids and nutrients such as nitrogen or phosphorous. Aesthetic quality may also be considered. By establishing limitations for pollutants through the NPDES Permit program, the waterbody is assured of achieving the water quality identified in the State's Water Quality Standards.

C. STATE POLICIES

For the last eight years, the Long Island Sound Study (LISS) has been investigating the most serious water quality problems that impact Long Island Sound and how they might best be managed. This investigation has focused on the low levels of oxygen that are prevalent in the bottom waters of the Sound, especially during the summer months. It has been determined that nitrogen from point sources are a major contributor to the depressed oxygen level in Long Island Sound. To determine the best means to increase the oxygen levels in the Sound, a model is being developed that will determine the levels of nitrogen removal required to obtain the desired levels of oxygen. This model is currently being developed as part of the LISS.

Until this model is completed, and to ensure that the low oxygen level problem does not worsen, the State of Connecticut has developed a "No Net Increase in Nitrogen Policy" for Long Island Sound which was adopted in November, 1990. The outcome of this policy is to halt increases of nitrogen discharges to Long Island Sound from wastewater treatment plants and to reduce the nitrogen discharges to 1990 levels in aggregate. Nitrogen discharges from treatment plants has been identified as the key element causing severe oxygen deficits in Long Island Sound and contributing to the conditions of hypoxia. This "No Net Increase" policy establishes 1990 baseline nitrogen loads for each of the fifteen shoreline treatment plants in Connecticut from Greenwich to Branford, and establishes the interim requirements for nitrogen reduction for the Branford treatment plant. A aggregate baseline nitrogen limit of 600 lbs. per day has been set for Branford. Final waste load allocations for nitrogen removal will be adopted for each shoreline wastewater treatment plant once the Long Island Sound Comprehensive Conservation and Management Plan (CCMP) is completed.

D. CURRENT WASTEWATER TREATMENT REQUIREMENTS

The current effluent limitations for the Branford treatment plant are shown in Table 2-1.

TABLE 2-1

CURRENT EFFLUENT LIMITATIONS

Parameter	Average Monthly Concentration mg/l	Maximum Daily Concentration mg/l
BOD	30	50
Suspended Solids	30	50
pH	Between 6.0 and 9.0	

In addition, coliform counts are seasonally limited to 200 bacteria per 100 ml for a 30 day geometric mean and no counts shall exceed 400 per 100 ml in any 7 consecutive days. This requirement is in effect year round. Other discharge limitation requirements are that the discharge of settleable solids will not be greater than 0.1 ml/l on a monthly average and shall not exceed 0.3 ml/l at any time. There is also a requirement that the treatment plant must remove at least 85% of both BOD and suspended solids from the wastewater at all times. A copy of the current NPDES permit is included in Appendix A.

In the specific case of Branford, it has been determined by the DEP that the existing wastewater treatment facilities are operating at a level that may impact the water quality in Long Island Sound. Branford currently does not consistently meet the minimum secondary treatment levels for percentage removal of suspended solids nor does it meet the effluent limitations for suspended solids. In addition, the treatment plant was operating near its design flow condition. This in itself requires that Branford undertake a facilities plan to determine the best needs to upgrade the treatment plant to meet water quality criteria. Because the discharge of the treatment plant is to Long Island Sound, additional nutrient removals will be required as part of the long range plan for improving water quality in Long Island Sound.

E. PLANNED WASTEWATER TREATMENT GOALS FOR BRANFORD

As presently planned, a number of water quality limitations will affect Branford. First, Branford must consistently meet the minimum standards of secondary treatment for discharge into the receiving waters. Also, by virtue of the ongoing eutrophication study in the Long Island Sound, Branford will also have a nutrient limitation for nitrogen.

This nutrient limitation for nitrogen typically takes the form of a two-level limit; one is for high levels of nitrogen removal and the other is for low levels of nitrogen removal. The final determination of which level will be applicable to Branford will be established by the DEP at a later date once the CCMP model is complete. High Level Nutrient Discharge (HLND) limits establish that the discharge will achieve a year-round average of 9 mg/l of total nitrogen. Low Level Nutrient Discharge (LLND) limits establish a year-round average of 4 mg/l total nitrogen.

In addition to nutrient limits, it is expected that the new NPDES permit to be issued to Branford will consist of the additional limitations shown in Table 2-2.

TABLE 2-2

ADDITIONAL EFFLUENT LIMITATIONS

Parameter	Average Monthly	Maximum Daily
BOD	30	50
Suspended Solids	30	50
Settleable Solids	0.1 ml/l	N/A
pH	Between 6.0 and 9.0	
Chlorine Residual	Between 0.2 mg/l and 1.5 mg/l	
Flow	To be established	
Fecal Coliform	200/100 ml* 400/100 ml**	

* Geometric mean of values for samples collected over 30 consecutive days

** Geometric mean of values for samples collected over 7 consecutive days

F. AVAILABILITY OF FUNDING

The State of Connecticut has a grant/loan program whereby a 20% grant is made available to certain municipalities that establish as a priority the removal of pollutants from the wastewater. A 2% loan is available for the remaining 80% of the engineering and construction costs. This funding is available on a priority and eligibility basis which considers, among other concerns, the impairment of the receiving waterbody caused by the discharge. This funding program is administered by the Construction Grants Section of DEP Bureau of Water Management.

III. EXISTING CONDITIONS IN THE PLANNING AREA

A. INTRODUCTION

The information contained in this Chapter defines the planning area and describes the existing physical conditions and demographics within the study area. This information provides the basis for the analysis of alternatives in the following chapters and the assessment of the environmental impacts that will be provided later.

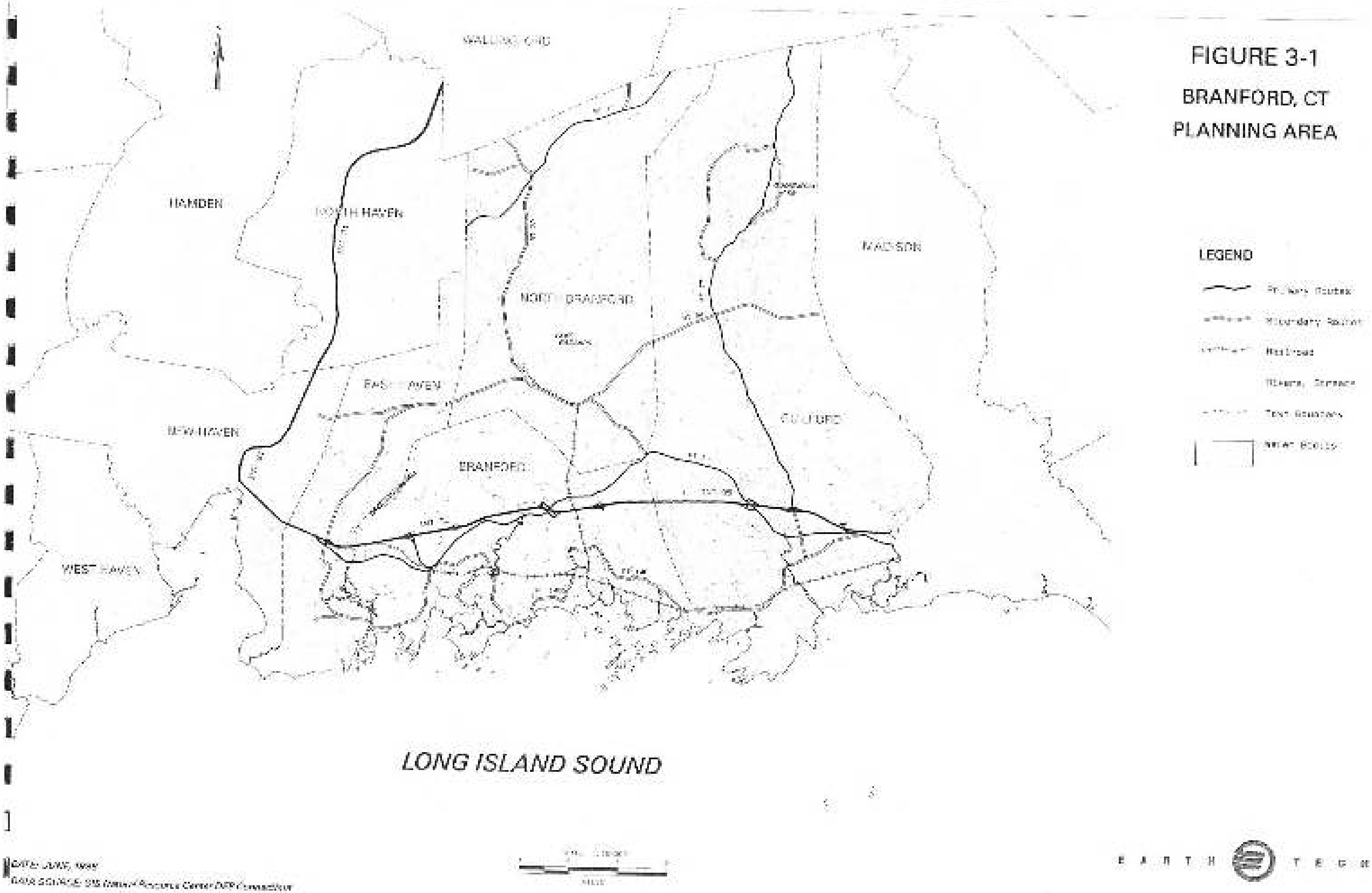
B. PROJECT LOCATION AND PLANNING AREA

The Town of Branford encompasses an area of 27.9 square miles and is located on the North Shore of Long Island Sound approximately six miles east of New Haven in New Haven County. The Town is bordered on the east by Guilford, to the north by North Branford and to the west by East Haven. Long Island Sound provides the entire southern border.

The study planning area includes the Town of Branford as well as the planned sewered portions of North Branford that enter the Branford sewer system at Branford Road, Schoolground Road and East Main Street. The Town of North Branford had its own independent Facilities Plan, completed in 1977, that projected sewage flows for a 20 and 50 year planning period. The information contained in this 1977 Plan was reviewed by the Town of North Branford as to whether it met the planning needs of the Town. Subsequent to this review, the Town of North Branford completed its own study of the sewer system tributary to the Branford sewer system and determined that an average daily flow of 500,000 gallons would be sufficient for their future planning needs. This Plan reflects this flow allocation.

No sewers are connected or planned to be connected to Branford from Guilford or East Haven within the planning period; therefore, any potential sewage flows from these communities are not considered in this Plan. East Haven's sewage presently goes to the regional treatment plant in New Haven, and Guilford presently has no plans for sewering any portion of the Town. It is expected that this situation will continue for the planning period. See Figure 3-1 for a location plan of the Town of Branford and its relationship to nearby communities.

FIGURE 3-1
BRANFORD, CT PLANNING AREA



C. DEMOGRAPHICS

The Town of Branford is located within the South Central Region planning area of the State. The South Central Region comprises the towns of Bethany, Branford, East Haven, Guilford, Hamden, Madison, Meriden, Milford, New Haven, North Branford, North Haven, Orange, Wallingford, West Haven and Woodbridge. The Council of Governments (COG) is the regional planning authority for this South Central Region. Demographic information has been obtained and compiled from a number of sources including the COG, the Office of Policy and Management (OPM) and the Town Planning Department. The following discussion is a compilation of the pertinent data and is provided for the purpose of establishing the general demographic trends in the Town.

The Town of Branford has experienced steady population growth over the past century but has seen a significant increase in that growth rate since 1950. In the ten years from 1980 to 1990, the population in town increased at a rate of 18.1%, which is three times that experienced by New Haven County and the State. According to the 1990 census, Branford has a population of 27,603. OPM population projections for the Town of Branford are that the town population will increase from a current estimated population of 28,500 to a maximum of approximately 32,400 in the year 2020. After a review of the availability of vacant land for expansion, using current household sizes and deducting the unusable portions of vacant land that would be unbuildable or dedicated to open space or wetland preservation, this 32,400 projection is reasonable and able to be assimilated with the land area available for residential use.

According to the most recent census data, household size in Branford has decreased also, reflecting State-wide trends. Currently, the average household size is 2.34 people per household, down from the 1970 rate of 3.1.

D. LAND USE

The Town of Branford is divided into residential, business and industrial districts as well as other special development districts. Present land use shows that 31% of the land area is utilized for housing. Dedicated open space and watershed areas account for another 33%, retail and office/industrial covers 6%, and the remaining 30% is farm and vacant land. Of the land area remaining for development (2155 Ac.), residential areas comprise 73%, commercial areas 5%, and industrial areas 22% of the remaining gross developable area.

Of the available developable residential acreage of 1570 acres, the vast majority is in areas requiring a lot size of ½ or 1 acre (R-4 and R-5 zones). These areas are defined in the zoning regulations as being on lots of sufficient size to support subsurface disposal systems but with the intent that sewers will eventually be provided in the R-4 zones. These land areas are situated mostly north of the Connecticut Turnpike. Unbuildable land within these areas comprises wetlands, open space requirements, access roads and other restrictions.

The available vacant commercial areas for development are relatively small in town and comprise approximately 97 acres. All of this acreage is located along or near West Main Street, East Main Street and North Main Street. Some redevelopment sites are also available, mostly in the western sections of town. All of these areas listed for commercial development have sanitary sewers.

The available areas for industrial development are scattered throughout the Town, but by far the largest tract available is located north of the Connecticut Turnpike northeast of Exit 56. This area comprises approximately 300 acres of the available 488 acres. Other larger tracts of potential development are located in the south central part of Town. All industrial areas are currently provided with sanitary sewers, or sewers that are easily accessible once development occurs.

E. TOPOGRAPHY

The study planning area is located in what is classified as the Central Lowlands. The local topography in the planning area is characterized by steeper slopes to the extreme northern parts of town, the highest elevations being along Lidyhites Hill which is part of the larger Saltonstall Ridge. This area has a maximum elevation of approximately 300 feet, based on the 1929 NGVD survey by the Department of the Interior. The topography then rapidly drops in elevation southward to the Pisgah Brook area, which has an elevation of between 50 and 100 feet. The topography then remains at or about this elevation, with the noted exceptions of Sunset Hill and Beacon Hill, until the shoreline is approached. At this point the elevation drops slowly to about an elevation of 10 - 20 feet for the shoreline communities. The treatment plant itself, located near Branford Harbor, has a ground elevation of about 14 feet.

F. CLIMATE

The climate in the study area is typical of the often variable nature of Connecticut weather, although it is somewhat tempered by the area's proximity to Long Island Sound. Climatological data is compiled by the National Weather Service, which maintains a monitoring station in New Haven, the closest station to the planning area. Data has been compiled at this monitoring station for over 100 years with the latest compilation and analysis of data completed in 1980.

This compiled data shows that the average annual precipitation at the New Haven monitoring station is 46.02 inches. The least annual precipitation for the period of record was 33.89 inches and the most rainfall recorded for a year was 60.26 inches.

The average annual mean maximum temperature is 58.9 degrees F which is warmer than interior portions of the State. Seasonal mean temperatures are 30.5 degrees for winter, 47.0 degrees for Spring, 69.6 degrees for Summer and 53.8 degrees for Fall. The annual seasonal mean temperature is 50.2 degrees.

G. WATER QUALITY MANAGEMENT AND WATER RESOURCES

Branford lies within two major drainage basins. The first is the South Central Shoreline drainage basin, which includes the shoreline and interior lands some of which are as far north as the Connecticut Turnpike. The other drainage basin is called the South Central Eastern Complex and covers the majority of Branford as well as North Branford and beyond. This drainage basin is the water supply area for both Lake Gaillard and Lake Saltonstall.

The larger surface water bodies in town include Lake Saltonstall, Wards Mill Pond, Furnace Pond, Youngs Pond, Griffing Pond, Marcus Pond, Talmage Pond, Talmage Ice Pond, Red Hill Pond, Cooke Pond and Lidyhites Pond. Long Island Sound provides the entire southern border for the Town. The discharge from the wastewater treatment plant is to Branford Harbor and from there to Long Island Sound.

Lake Saltonstall is by far the largest inland water body. The Lake is operated by the South Central Connecticut Regional Water Authority to provide potable water to Branford as well as other towns. The Lake watershed area covers approximately 3.5 square miles in Branford, some of which is developed area and some which is maintained as forested area. The Saltonstall Land Use Plan prepared for the South Central Connecticut Regional Water Authority in 1993 shows almost all of this undeveloped watershed land remaining as forest management land and it is planned that about 50 acres of the total forested watershed area as being available for residential development and 24 acres as being available for other, more intensive uses.

Major tributaries in Branford include the Farm River, Pisgah Brook, Notch Hill Brook and the Branford River. The Farm River is mostly located in East Haven and enters Branford near the southern end of Lake Saltonstall at the extreme western end of Town. The Branford River runs north-south from North Branford through the middle of town and terminates at Branford Harbor. Pisgah Brook in combination with what are called the Branford supply ponds once were protected areas for the Town water supply prior to service by the Regional Water Authority. This land is now Town owned open space. Numerous other small streams and wetland and coastal management areas are located throughout the Town.

The surface waters within Branford are classified by the Department of Environmental Protection as to their current and long term goals for water quality. The water quality classifications for surface waters in Branford are described below:

SAA: Uncontaminated surface waters designated for use as a potential public water supply. The State goal is to maintain existing natural quality characteristics by banning discharges to these watercourses.

SA: Potential drinking water supply, recreational use and fish and wildlife habitat.

SB: Surface waters where the water quality goal is fishable and swimmable condition. Waste water discharges may be allowed under permit.

Lake Saltonstall is classified as SAA, meaning that its present and future use is designated for public water supply. The Branford River and Farm River are classified as SB/SA, meaning that some degradation of the rivers has occurred but that its long term goal is to be upgraded to SA classification. Long Island Sound, including Branford Harbor, is classified as SB meaning that its present and future use is that for recreation, as a fish and wildlife habitat and for navigation. All other surface waters in Branford are classified as SA.

Groundwater is classified in much the same way as surface waters. Based on the "Water Quality Classifications for the South Central Coast Basin" map, Branford falls into a number of groundwater classifications. These classifications are described below:

GAA: Groundwaters within public water supply watershed or within the area of influence of public water supply wells. Suitable for direct human consumption without need of treatment. The goal is to maintain drinking water quality by banning all discharges to the groundwater.

GA: Groundwaters within the area of influence of private and potential public water supply wells. Presumed suitable for direct consumption.

GB: May not be suitable for direct human consumption due to waste discharges, spills or leaks of chemicals or land use impacts. The goal is to prevent further degradation by preventing any additional discharges which would cause irreversible contamination and to restore these waters through cleanup actions.

Groundwater quality in Branford as characterized by mostly GA or GAA areas north of the Connecticut Turnpike and within the Saltonstall watershed. GB areas are located south of the Turnpike and generally include the center of town and the Branford Harbor areas. Coastal areas are generally classified as GA areas. Public water supply is available within all GB classified areas. In addition, most of the future housing development is planned to occur in GAA or GA areas.

See Figure 3-2 for a plan showing the various groundwater classifications in Branford.

H. AIR QUALITY

The State of Connecticut Department of Environmental Protection, acting under the 1990 Clean Water Act, monitors air quality throughout the State. Classifications of "attainment" or "non-attainment" for six pollutants are designated for regional areas based upon data collected by the DEP. Attainment means that the region is in compliance with the National Ambient Air Quality Standards (NAAQS). The Town of Branford currently holds "attainment" status for nitrogen dioxide, lead, sulfur dioxide and particulates. It currently holds a status of non-attainment

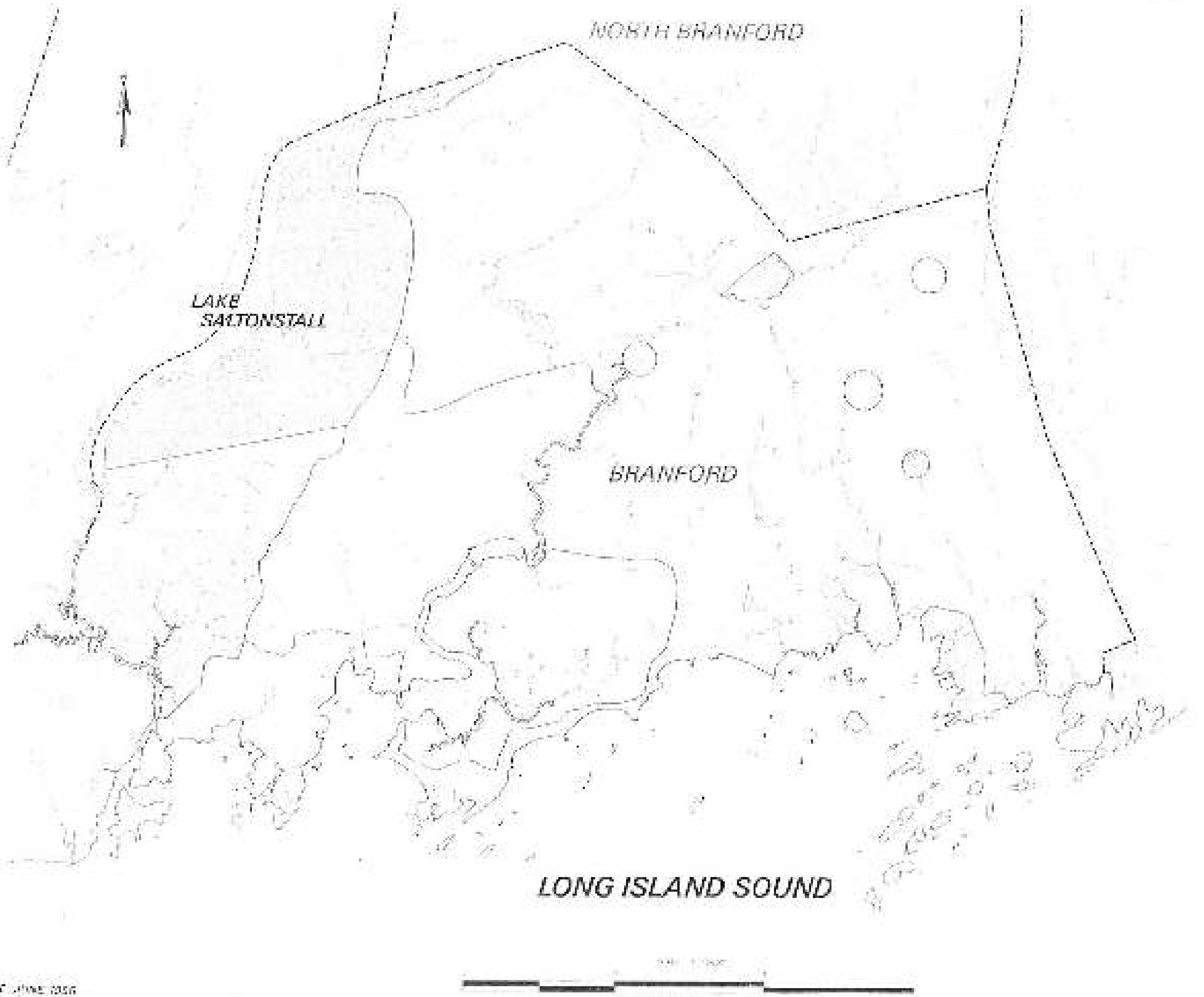


FIGURE 3-2

BRANFORD, CT GROUNDWATER CLASSIFICATIONS

LEGEND

Town Boundary

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(unclassified) for carbon monoxide meaning the non-attainment designation is based on data collected outside of Branford. Ozone is classified as non-attainment throughout the State. In Branford, it is further designated as "serious", which is actually the least severe rating state-wide. The DEP is currently developing plans to accomplish the task of attainment for all six pollutants. More local to the wastewater treatment plant, air quality in the immediate vicinity of the plant has generated complaints in the past mostly from the nearby marina and residential housing. Additional odor complaints have been filed for the Damascus Road pumping station.

I. FLOOD ZONES

Flood insurance studies have been prepared for all communities in the country by the Federal Emergency Management Agency (FEMA). These studies investigate the existence of flood hazards and present the data on a map which denotes flood zones. These zones are defined as follows:

Zone A: Special flood hazard area inundated by the 100 year flood. Near the harbor area in Branford, this is at Elevation 12. (Elevation 112 if previous datum used).

Zone B: Areas between the Special Flood Hazard Area and the 500 year flood plain. These areas may be subject to shallow water flooding in the 100 year interval.

Zone C: Area of minimal flooding.

The treatment plant site and the local surrounding areas are located within Zone B and C areas. Therefore, no special flood control measures will need to be taken with respect to the treatment plant improvements. Elevations of all structures at the treatment plant will be established above elevation 12.0 to ensure no water damage in the event of flooding.

J. GEOLOGIC

The Town of Branford is underlain by two distinctly different groups of bedrock. The two groups are divided by the Triassic Border Fault which trends southwest to northeast generally along the lines of Pisgah Brook. Northwest of this fault, the bedrock is in the Central Lowland region of the state. This bedrock is pink, brown and red arkosic sandstone, conglomerate, siltstone and shale. Southeast of this fault, in the eastern highland region of the state, the rock consists mainly of granite and gneiss that have white, pink and grey coloring. This rock surface tends to decline southward to the sound where numerous rocky coves are then formed. Local topography tends to follow the bedrock elevations since the glacial drift that overlies the bedrock is thin. Outcrops are numerous and sometimes close together. The bedrock itself constitutes the surface geology in the Saltonstall Ridge, Wards Millpond and Stony Creek Road areas.

The surficial geology in the area is mostly glacial till consisting of compact, non-sorted, non-stratified rock particles of all sizes. This glacial till forms a mantle over the bedrock surface although it is discontinuous in some areas. The composition of the till includes a coarse fraction of pebbles, cobbles and boulders although this fraction rarely is more than 20% of the total. The remainder is sand, silt and clay. Colors of the glacial till tend to match that of the bedrock below.

Another large segment of the surficial geology consists of ice-contact stratified drift. The areas mostly covered by this material are in the Branford River drainage basin and in the northeastern section of town. Ice-contact stratified drift are sediments deposited in streams and other water bodies by melting glacier ice. These deposits tend to be smaller sand and stone particles that are well sorted in this area.

The remainder of the surficial geology is swamp deposits and a very small amount of alluvium. These swamp deposits consist mainly of a mixture of silt, clay and fine sand with a high percentage of decayed plant matter. Deposit depths are typically 10 - 12 feet, but may be thicker in some areas.

A plan of surficial geology and wetlands is shown in Figure 3-3.

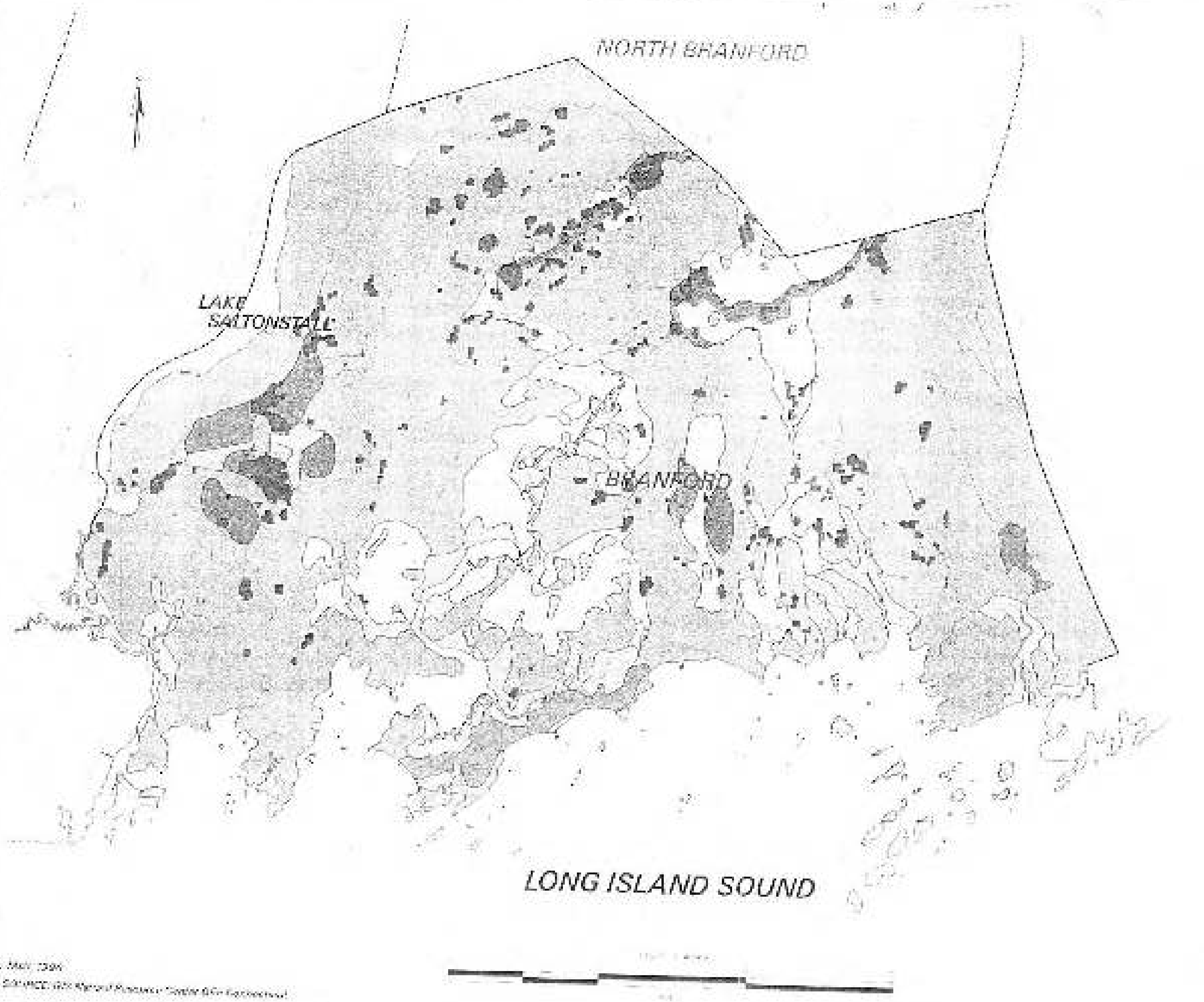
K. WETLANDS

Branford has identified wetland soils within the Town boundaries on a map entitled "Branford Wetlands" and dated 1977. Wetland soils are typically identified as alluvial soils, poorly drained or very poorly drained soils. The majority of soils in Branford are of the poorly drained soils classification and are mostly concentrated in the southern and western parts of town.

Wetland soils prevalent within Branford are the Westbrook series, and to a lesser extent, the Carlisle, Saco, and Adrian soils. The Westbrook series soils are tidal marsh soils and are typically located along the Branford and Farm rivers, coastal Long Island Sound and its inlets. These soils are

FIGURE 3-3

BRANFORD, CT SURFICIAL GEOLOGY & WETLANDS



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flooded daily, are very poorly drained, and typically consist of a 48 inch deep layer of brown or gray organic material over a silt loam material.

The Carlisle and Saco soils are more prevalent north of the Connecticut Turnpike but are found in pockets south of the turnpike mostly in areas of no or very mild slopes. In areas north of the turnpike, the Carlisle soils are found near the tributaries to Lake Saltonstall and the Saco soils are found mostly in the flood plains of major streams. The Carlisle soils are characterized by a deep layer, up to 30 feet, of organic material. The soils are very poorly drained and are of irregular shape. The Saco series covers a much smaller area in Town and is designated by a rather thin 8 inch layer of muck over a 50 inch gray silt loam material and then underlain by silt loam and stratified sand and gravel.

L. VEGETATION AND NATURAL RESOURCES

The State DEP Natural Resources Center was visited to review the possibility that endangered species may in fact be located within Branford. This information is compiled in the State Natural Diversity Data Base that is updated regularly regarding critical biological resources in the State. The information contained here has been collected over many years by the Natural Resource Center's Geological and Natural History Survey in cooperation with other DEP units and conservation groups.

Based on a review of the current data base, a number of areas within Branford are highlighted on the Natural Diversity Data Base maps one of which is the site on which the wastewater treatment plant is built. A subsequent follow-up to the DEP has determined that no known extant populations of federal or state endangered, threatened, or special concern species occur at the site.

M. HISTORIC DISTRICTS AND LANDS OF SIGNIFICANCE

The Natural Historic Preservation Act defines procedures for consultation and commentary by the Advisory Council on Historic Preservation for all EPA grant actions that will affect a property listed or eligible to be listed on the National Register of Historic Places. To this end, the Connecticut Historical Commission was contacted. Those locations in Branford that are classified as historic have been tabulated in Table 3-1 along with their dates of registry. No historic places are located at or near the treatment plant site so that any work conducted on the site will not impact any historic areas.

BRANFORD NATIONAL REGISTER SITES

TABLE 3-1

BALDWIN, TIMOTHY, HOUSE	186 Damascus Rd.	12/01/88
BALDWIN, ZACCHEUS, HOUSE	154 Damascus Rd.	12/01/88
BEACH, SAMUEL, HOUSE	94 E. Main St.	12/01/88
BLACKSTONE HOUSE	37 First Ave.	12/01/88
BRADLEY, TIMOTHY, HOUSE	12 Bradley St.	12/01/88
BRANFORD CENTER HISTORIC DISTRICT	Roughly bounded by U.S. 1, Branford River on E. and S., Monroe and Kirkham Streets	06/06/87
BRANFORD ELECTRIC RAILWAY HISTORIC DISTRICT	(Also in East Haven) 17 River St. to Court St.	06/03/83
BRANFORD POINT HISTORIC DISTRICT	Roughly along Harbor St. N. from Curve St. to Branford Point, also Maple St. E. from Reynolds St. to Harbor St.	09/15/88
COLONIAL HOUSES OF BRANFORD TR.	Townwide	12/01/88
FRISBIE, EDWARD, HOMESTEAD	240 Stony Creek Rd.	05/16/85
FRISBIE, EDWARD, HOUSE	699 E. Main St.	12/01/88
HARRISON, THOMAS, HOUSE	23 N. Harbor St.	12/01/88
HARRISON-SWAIN HOUSE	124 W. Main St.	10/10/75, HABS
HOADLEY, ISAAC, HOUSE	9 Totoket Rd.	12/01/88
HOADLEY, JOHN, HOUSE	213 Leetes Island Rd.	12/01/88
HOADLEY, ORRIN, HOUSE	15 Sunset Hill Rd.	12/01/88
HOUSE AT 161 DAMASCUS ROAD	161 Damascus Rd.	12/01/88
HOUSE AT 29 FLAT ROCK RD.	29 Flat Rock Rd.	12/01/88
HOWD, ELIPHALET, HOUSE	675 E. Main St.	12/01/88
NORTON HOUSE	200 Pine Orchard Rd.	12/01/88
PALMER, HEZEKIAH, HOUSE	340-408 Leete's Island Rd.	12/01/88
PALMER, ISAAC, HOUSE	736-756 Main St.	12/01/88
ROGERS, JOHN, HOUSE	690 Leete's Island Rd.	12/01/88
ROUTE 146 HISTORIC DISTRICT	(Also in Guilford), Rt. 146 between Flat Rock Rd. And West River Bridge	04/05/90
STICK STYLE HOUSE AT STONY CREEK	34 Prospect Hill	12/27/72
STONY CREEK-THIMBLE ISLANDS HISTORIC DISTRICT	Roughly Thimble Islands Rd., between Rt. 146 and Long Island Sound and Thimble Islands	12/16/88
TYLER, JOHN, HOUSE	242-250 E. Main St.	12/01/88
TYLER, SOLOMON, HOUSE	260-268 E. Main St.	12/01/88

N. WATER SUPPLY

Potable water is supplied to the Town of Branford by the South Central Connecticut Regional Water Authority (SCCRWA) via the Lake Saltonstall surface water supply system. Raw water is collected in the 13.9 square mile watershed area which is located mostly north and east of the lake. There are no other public utilities that provide water in this area according to the Inventory of Community Water Systems by the DEP. See Figure 3-4 for water shed area within Branford.

The watershed area is characterized by farmland and general development of the land, which in turn has caused nutrient levels to increase in the Lake over time. To provide potable water, the raw water is treated at the Arthur Corbin, Jr. filtration plant located on the west side of Furnace Pond prior to distribution. In addition to the filtration plant, the Saltonstall supply system includes a storage tank at the base of Saltonstall Ridge and another storage tank west of Brushy Plains Road in Branford.

Lake Saltonstall has an overall capacity of approximately 5.5 billion gallons of water with a usable capacity of 1.5 billion gallons. It has a safe yield of 7.6 mgd, or approximately 14% of SCCRWA total safe yield. The water supply is strictly a surface water supply system - there are no public groundwater wells that are part of this water supply. This supply system serves Branford, East Haven and a portion of New Haven east of the Quinnipiac River.

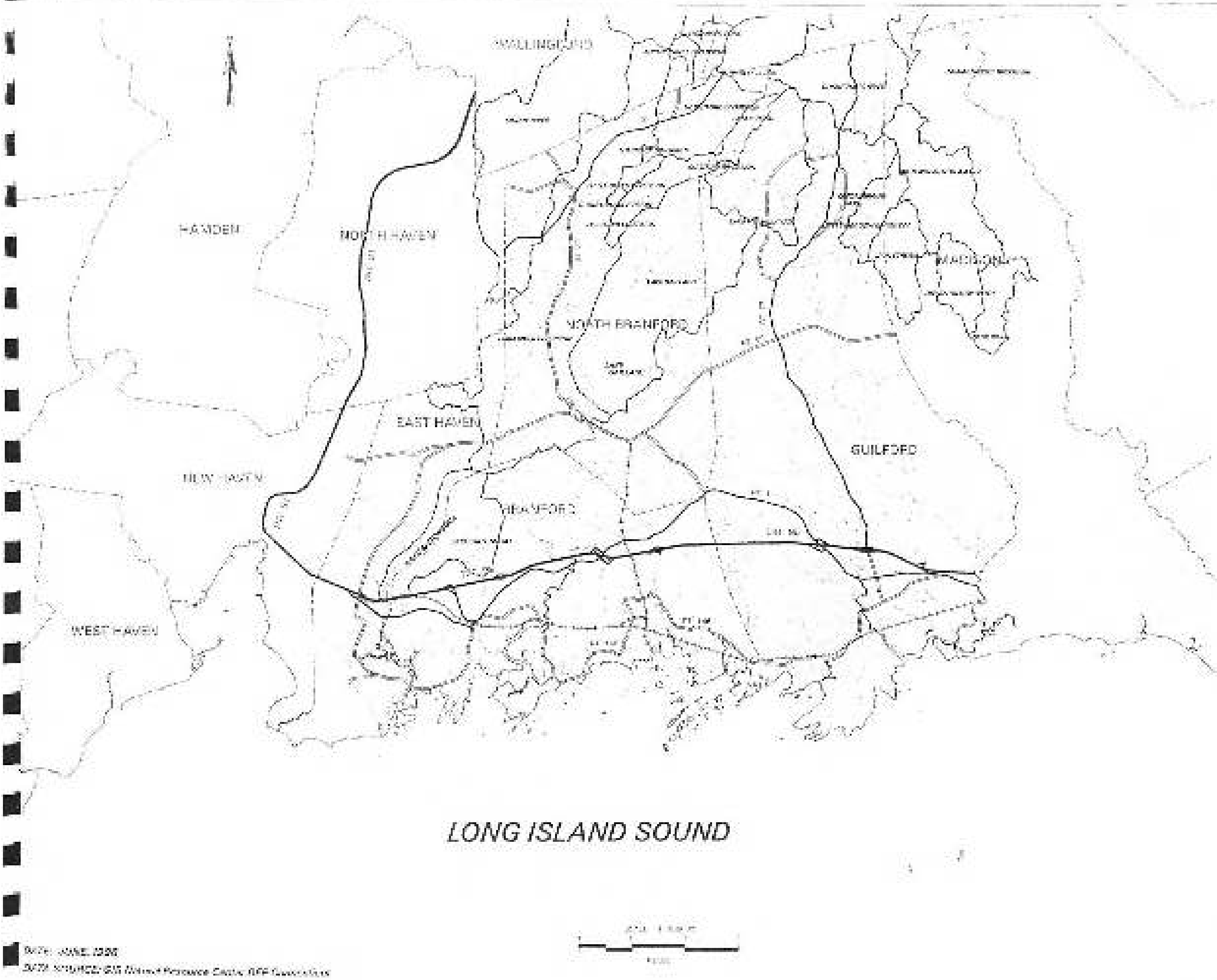
The Saltonstall system provides potable water to 91% of the residences in Branford and is projected to cover 100% of the residences within the planning period, according to the most recent long range demand study by the Authority. All commercial buildings and industries are served by this same water supply. Current metered consumption of water is 3.023 mgd and is projected to reach 3.815 mgd in the year 2020. Most of the additional demand is expected to come from residential sources.

The Saltonstall service area, which also includes parts of New Haven and East Haven, is also projected to grow in the future. The flow capacity required for New Haven in the planning period is 1.719 mgd. For East Haven, it is 1.202 mgd for a total projected water use for the planning period of 6.736 mgd. This is 89% of the current safe yield of approximately 7.6 mgd. Supply capacity for the planning period is therefore adequate and will not be limiting to growth.

Groundwater well water supply is utilized by approximately 9% of the homeowners in Branford. Some of the homeowners have public water available to them but do not elect to use it while others

FIGURE 3-4

BRANFORD, CT
PLANNING
PUBLIC WATER
SUPPLY WATERSHEDS



LEGEND

EARTH TECH

FORMERLY WHITMAN & HOWARD, INC.

do not have the availability to connect to the public supply. The exact breakdown of this division is not able to be determined. The present plan for the Water Authority, however, is to connect 100% of the population during the planning period covered by this study.

O. SANITARY SEWER SERVICE

Sewer service within the Town is provided to 82% of the residences according to the 1995 data summary provided by the Town. Sewer service consists of approximately 100 miles of sanitary sewer ranging in size from six to thirty inches in diameter. Some of the oldest sewers in town were built in the early 1960's to serve the Town center and were constructed of vitrified clay. Most of the sewer construction, however, was completed to more distant reaches within the Town in the 1960's and 1970's, when town growth and population was rapidly increasing. These sewers are constructed of transite, ductile iron and PVC with most of the construction believed to be PVC.

Some of the largest areas of town without sewers are the Stony Creek area (which is defined within this Plan as being the area south of State Route 146, west of the Guilford border and otherwise bounded by Long Island Sound), Northford Road and areas north, the Sunset Hill Drive area and the Rose Hill/Pent Road area.

The Town also maintains some 48 sewage pumping stations throughout the Town. Most are small submersible pumping stations serving small sewer sheds in town but there are six larger wet pit/dry pit type stations that serve larger areas.

P. ON-SITE WASTE DISPOSAL SYSTEMS

On-site wastewater disposal is practiced by all those not served by sanitary sewers. This amounts to some 18% of the residences in Town. Subsurface disposal systems are regulated by the State Health Code whose requirements are implemented by the regional or other local health official. Current Health Code requirements for sizing of subsurface disposal systems dictate that each residence provide a minimum 1,000 gallon septic tank for settling out of heavy solids and a leaching field with at least 375 square feet of effective area (larger depending on the number of bedrooms in the house and the type of soil conditions). In addition, 100% reserve areas are required to be located on-site and there are further requirements for distances from water supply wells and lot boundaries.

Discussions with the East Shore District Health Department and a review of the records of past subsurface disposal problems show that potential problem areas and candidates for sanitary sewers for long term sewage disposal are in the Stony Creek area, the Rose Hill/Pent Road area and the Ridge Acres Road area in the northern section of town. These areas are characterized by either smaller lots, poor soils, shallow rock, or steep slopes. The remaining unsewered areas in Town, mostly located to the north and east, will most likely not need sewers in the near future since the homes are built on larger lots and have acreage available for reserve areas.

In the Stony Creek area, the surficial geology maps show that the soils in the area are not well suited for use with subsurface sewage disposal systems. Soils in this area are the Holyoke rock outcrop complex, Cheshire-Holyoke complex, Branford-Holyoke silt loams and Westbrook mucky peat, among others, all of which exhibit moderate to severe soil features with respect to subsurface sewage disposal systems. In addition, many of the homes are built on small lots which leave little room for subsurface disposal system repairs when they become necessary.

The surficial geology maps for the areas north of the Connecticut Turnpike show significant variability in the soil series. In the undeveloped areas in this section and other areas of potential development of residential housing, the prevailing soils are the Yalesville, Holyoke and other soil series, most of which also exhibit negative qualities for subsurface disposal systems. Most of the soil types in this area are classified as moderate to severe for sanitary sewage disposal, due mostly due to the shallow depth of rock or steep slope of land. These types of soils, while not ideal, are able to be developed sufficiently to meet Health Code requirements providing land area is available for this purpose. It is therefore expected that new housing built on 1 acre lots and able to meet the current Health Code requirements will most likely not require sewers for the planning period. The existing housing that is constructed on lots of nominal 1 acre in size will most likely also be able to avoid sewers, although the repairs to meet the current Health Code may be expensive. Lots with areas smaller that 1 acre may best be served by sanitary sewers.

IV. EXISTING TREATMENT AND COLLECTION SYSTEM

A. INTRODUCTION

The Facilities Planning process includes a review of the existing treatment and collection systems. This review provides a basis for the analysis of treatment alternatives and provides an inventory of the current wastewater characteristics and the existing treatment and collection facilities.

Included in this evaluation is the establishment of existing plant flows and loads and a breakdown of these flows and loads into residential and commercial, septage, industrial and I/I components. These major influent characteristics that impact waste treatment options are identified as is their variability. This information is used to determine future plant flows and loadings.

Also reviewed in detail is the existing treatment plant and pumping station facilities, their mechanical condition, design criteria, operational status, and maintenance procedures. This information provides an indication of the status of the existing facilities and how they may best be utilized in to meet the present and future needs of the Town.

Each of these topics will be reviewed in this Chapter.

B. EXISTING TREATMENT PLANT FACILITIES

The wastewater treatment plant is located on a 3.5 acre parcel of land on the north side of Block Island Road. The treatment plant collects sewage from approximately 100 miles of sewers and 48 pump stations in Branford as well as sewage from a portion of North Branford. In addition, septage from Branford is received and treated at the plant. Once treated, the effluent from the plant is piped to Branford Harbor and ultimately to Long Island Sound.

The treatment plant was originally constructed in 1962 to provide secondary treatment for 1.5 MGD of flow that was expected to be generated from a number of newly constructed sanitary sewers. The treatment plant at that time generally consisted of an inlet area with a barminutor in combination with a bypass channel and bar screen, an aerated grit collector, inlet pumping, two rectangular primary settling tanks, two aeration tanks for biological treatment, two rectangular secondary settling tanks and one chlorine contact tank for disinfection of the effluent. After treatment, the treated wastewater was discharged to the harbor via a 24 inch diameter pipe.

Waste activated sludge from the secondary treatment process and primary sludge from the primary settling tanks were directed to a sludge concentration tank for additional thickening. From this tank, the sludge was pumped to a single primary anaerobic digester for volatile solids reduction and then to a secondary digester for settling. Digested sludge from the secondary digester was dewatered on a single vacuum filter utilizing ferric chloride and lime as conditioning chemicals.

The treatment plant was upgraded in 1982 to treat a flow of 4.5 MGD. This increase in flow capacity was the result of the rapid increase in town population and a corresponding increase in the sewer service area. This plant upgrade generally included an additional barminutor, the addition of four primary settling tanks for a total of six, the conversion of the open aeration tanks to a closed tank pure oxygen aeration system, corresponding on-site oxygen generation equipment, four additional secondary settling tanks for a total of six, an additional chlorine contact tank, and a new 32 inch diameter fiberglass outfall pipe. From a solids handling perspective, this latest upgrade included a new septage receiving facility, an additional larger sludge concentration tank, an additional primary and secondary digester and a belt filter press. This plant layout is the one currently in operation in Branford.

The existing plant site plan is shown in Figure 4-1. A plant flow schematic and hydraulic profile are shown in Figure 4-2 and 4-3 respectively. A detailed description of each unit of the existing facilities is presented in Table 4-1. Operational statistics including tank sizes, depths, pump capacities and other performance criteria is presented in Tables 4-2 and 4-3. In Table 4-3, recycle flows and loadings are not included in the mass balance because of limited flow and laboratory data. A detailed description of each plant unit operation and its design method of operation is described below.

C. TREATMENT PLANT UNIT PROCESSES - LIQUID

1. Headworks

Plant flow enters the sewage treatment plant via a 30 inch diameter concrete sanitary sewer located in Block Island Road. The wastewater is directed to a two foot wide channel in which is located a single channel grinder. The flow passes through the grinder and in the process, the larger particles in the sewage are cut into smaller sizes by the cutting blades. The grinder is able to be isolated from the flow for repairs by slide gates located before and after the unit.

TABLE 4-1
EXISTING TREATMENT PLANT
TOWN OF BRANFORD FACILITIES PLAN

DESIGN DATA: 4.5 mgd (avg) BOD = 9,000 lbs/day TSS = 11,200 lbs/day
Effluent BOD = 30 mg/l Effluent TSS = 30 mg/l
11.2 mgd (max)

TYPE OF TREATMENT: Comminution followed by primary treatment, pure oxygen activated sludge process, secondary settling with chlorination, outfall to Branford Harbor. Primary and waste activated sludge gravity thickened, anaerobically digested, dewatered and landfilled.

PRIMARY FACILITIES:

- 2 - INLET CHANNELS, Dimensions 2' x 14' x 1.58' SWD at ADF. One channel equipped with grinder.
- 1 - GRIT CHAMBER, aerated. Dimensions: 16.5' x 7' x 10' SWD.
- 1 - RAW SEWAGE LIFT STATION, three variable speed horizontal, non-clog, sewage pumps with a total capacity of 8 mgd with largest pump out of service.
- 6 - RECTANGULAR PRIMARY SETTLING TANKS, Dimensions: 15' x 50' x 9.05' SWD. Surface overflow rate: 916 gpd/sf at ADF.

SECONDARY TREATMENT FACILITIES:

- 2 - PURE OXYGEN ACTIVATED SLUDGE AERATION TANKS, with mechanical aerators. Dimensions: 22' x 100' x 12' SWD. Detention time: 2.3 hours. BOD loading: 34 lbs/day/100 lb MLSS. 3,600 mg/l MLSS concentration.
- 1- OXYGEN DELIVERY SYSTEM, pressure swing adsorption air separation facility, oxygen production capacity: 5 tons contained oxygen/day, oxygen backup: one 3,000 gal. liquid oxygen storage tank.
- 8 - MECHANICAL AERATORS WITH BOTTOM MIXERS, four single-speed units per aeration tank.
- 6 - RECTANGULAR SECONDARY CLARIFIERS, Dimensions: 21' x 60' x 8.54' at ADF. Overflow rate 670 gpd/sf at ADF.
- 2 - CHLORINE CONTACT TANKS, Dimensions: 32' x 17' x 10' deep. 50 minutes detention including outfall at ADF.

SLUDGE HANDLING FACILITIES:

- 2 - SLUDGE THICKENING TANKS, gravity type. One 30' diam., one 20' diam. Solids loading: 11,794 lbs/day.
- 2 - PRIMARY SLUDGE DIGESTERS, Dimensions: 50' diam. x 20' deep with 3' deep cone. Solids loading rate: 0.10 lb/day/cf. HRT: 23 days.
- 2- SECONDARY DIGESTERS, Dimensions: 50' diam. x 20' deep with 3' deep cone, gas holder cover capacity: 9,560 cf.
- 1 - BELT FILTER PRESS, 1.5 m belt, 15 - 20 % solids.

TABLE 4-2
CHARACTERISTICS OF FACILITY PUMPS
TOWN OF BRANFORD FACILITIES PLAN

Service	Location	Number	Type	Nominal Capacity (gpm)	Horse-Power	Nominal Head (ft)
Raw Sewage	Control Building Basement	3	Horiz. non-clog	650 1300 2250 3600	40	18 19 21 24
Primary Sludge/ Gravity Thickener Underflow	Control Building Basement	3	Simplex plunger	48	3	25
RAS	Control Building Basement	4	Vertical non-clog	833	10	32
WAS	Control Building Basement	1	Progressive cavity		5	N/A
Secondary Clarifier Scum	Pump Station	2	Submersible	100	5	20
Digester Recirculation	Digester Pipe Gallery	4	Vertical, non-clog	150	2	10
BFP Feed	Control Building Basement	1	Progressive cavity	21	5	N/A
Plant Water	Control Building Basement	2	End suction centrifugal	100 150	25	108 108

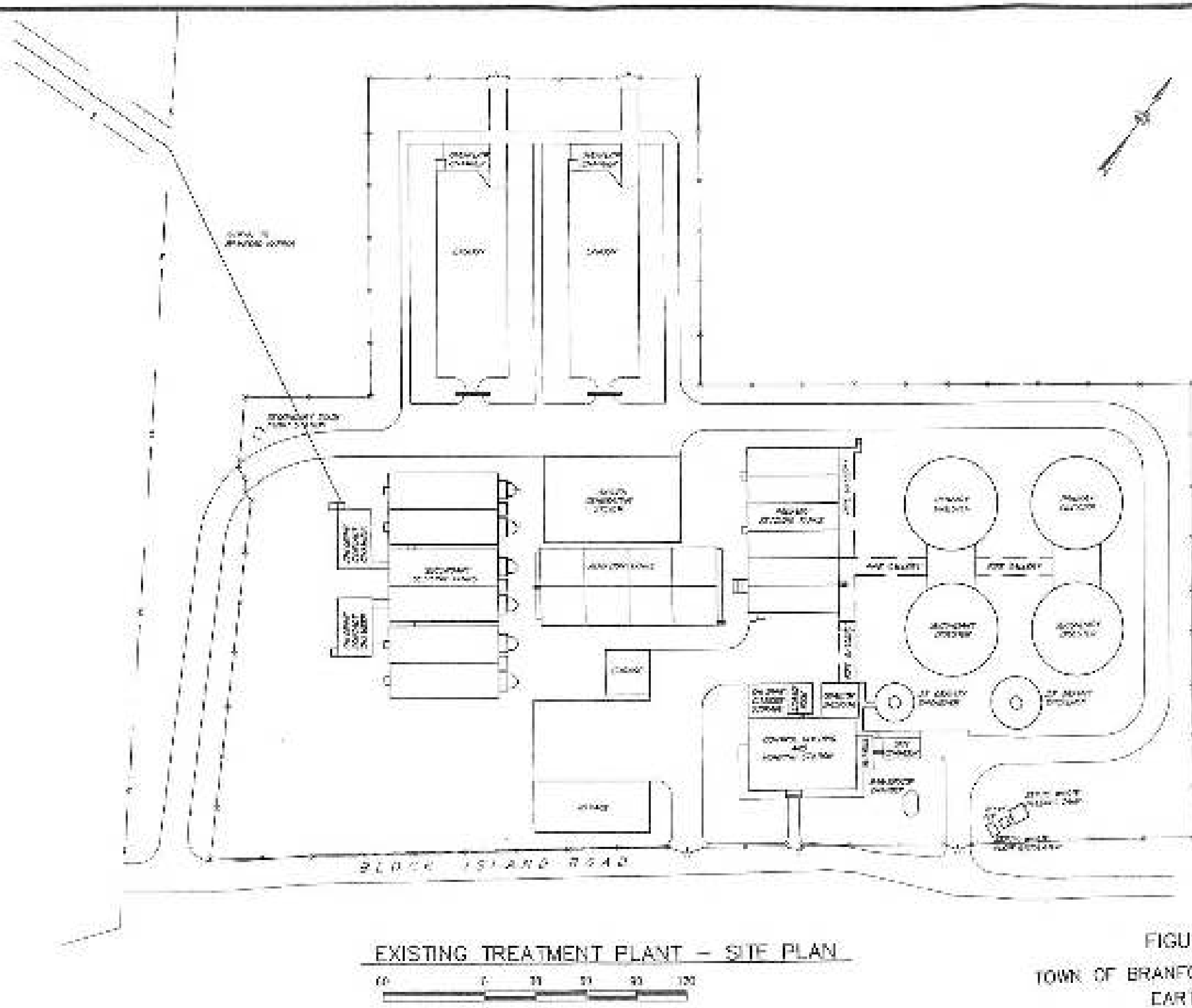
TABLE 4-3
OPERATIONAL STATISTICS
TOWN OF BRANFORD FACILITIES PLAN

	DESCRIPTION	AVERAGE YEAR	MAXIMUM MONTH	HYDRAULIC MAXIMUM	TYPICAL
RAW WASTEWATER DATA	TOTAL FLOW IN MGD	4.12	5.35	12.11	
	BOD5 CONCENTRATION, MG/L	170	159		
	BOD5 LOADING, LBS/D	5,842	7,098		
	SUSP SOLIDS CONC IN MG/L	171	165		
	SUSP SOLIDS LOADING IN LBS/D	5,884	7,379		
	TKN MG/L	27	30		
	TKN LBS/D	915	1,321		
	NH3-N MG/L	21	21		
	NH3-N LBS/D	722	926		
INLET AREA	CHANNEL LENGTH, FT	14.00	14.00	14.00	
	CHANNEL WIDTH, FT	2.00	2.00	2.00	
	LIQUID DEPTH, FT	1.58	1.70	2.30	
	VELOCITY THROUGH CHANNEL, FPS	2.02	2.42	4.07	> 2
GRIT COLLECTION	NUMBER OF CHANNELS	1	1	1	
	UNIT LENGTH, FT	16.50	16.50	16.50	
	UNIT WIDTH, FT	7.00	7.00	7.00	
	LIQUID DEPTH, FT	10.00	10.28	10.72	
	VOLUME, CF	1,155	1,187	1,238	
	DETENTION TIME AT Q, SEC	181	143	66	120 - 300
PRIMARY SETTLING	NUMBER OF UNITS	6	6	6	
	UNIT WIDTH, FT	15.00	15.00	15.00	
	UNIT LENGTH, FT	50.00	50.00	50.00	
	SWD, FT	9.05	9.06	9.10	
	UNIT SURFACE AREA, SF	750	750	750	
	TOTAL SURFACE AREA, SF	4,500	4,500	4,500	
	OVERFLOW RATE, GPD/SF	916	1,189	2,691	800 - 1200
	TOTAL WEIR LENGTH, FT	180	180	180	
	WEIR OVERFLOW RATE, GPD/LF	22,900	29,700	67,300	20,000
	TANK HORIZONTAL VELOCITY, FPM	0.47	0.61	1.37	
	UNIT VOLUME, GAL	50,800	50,800	51,000	
	TOTAL VOLUME, GAL	304,800	304,800	306,000	
	DETENTION TIME, AT Q, HRS	1.78	1.37	0.61	2
PURE OXYGEN ACTIVATED SLUDGE SYSTEM	NUMBER OF UNITS	2	2	2	
	UNIT WIDTH	22.00	22.00	22.00	
	UNIT LENGTH	100.00	100.00	100.00	
	UNIT DEPTH	12.00	12.00	12.00	
	UNIT VOLUME, GAL	197,500	197,500	197,500	
	TOTAL VOLUME, GAL	395,000	395,000	395,000	
	TOTAL VOLUME, CF	52,800	52,800	52,800	
	DETENTION TIME IN HRS AT Q	2.30	1.77	0.78	2 @ ADF
	BOD5 LOADING, LBS/D/1000 CF AVG	77.65	100.38		120
	MLSS, AVG MG/L	3,600	4,700		3800
	MLSS UNDER AERATION, LBS	11,880	15,480		
	BOD5 LOADING, LBS/D/100 LB MLSS	35	34		
	MLVSS/MLSS	0.80	0.80		
	MLVSS, AVG	2,900	3,800		
	F/MLVSS RATIO, AVG	0.43	0.43		0.75
	RETURN RATE	23%	23% ADF		0.4
	MLSS WASTED, LB/D	5,800	7,700		
	MCRT, DAYS	2.04	2.01		2

TABLE 4-3
OPERATIONAL STATISTICS
TOWN OF BRANFORD FACILITIES PLAN

	DESCRIPTION	AVERAGE YEAR	MAXIMUM MONTH	HYDRAULIC MAXIMUM	TYPICAL
SECONDARY CLARIFICATION	NUMBER OF TANKS	6	6	6	
	WIDTH	21.00	21.00	21.00	
	LENGTH	60.00	60.00	60.00	
	TANK SWD, FT	8.54	8.55	8.58	
	UNIT SURFACE AREA, SF	1,260	1,260	1,260	
	TOTAL SURFACE AREA, SF	7,560	7,560	7,560	
	FLOW TO CLARIFIERS (INCL. RAS), MGD	5.09	6.20	12.11	
	OVERFLOW RATE, GPD/SF	670	813	1,602	400 - 800
	TOTAL WEIR LENGTH, FT	252	252	252	
	OVERFLOW RATE, GPD/LF OF WEIR LENGT	20,100	25,000	48,100	
DISINFECTION	REACTOR DEPTH, FT	10.00	10.00	10.00	
	REACTOR WIDTH	32.00	32.00	32.00	
	REACTOR LENGTH	17.00	17.00	17.00	
	NUMBER OF REACTORS*	1	1	1	
	UNIT CAPACITY, CF	5,440	5,440	5,440	
	TOTAL REACTOR CAPACITY, CF	5,440	5,440	5,440	
	DISCHARGE PIPE VOLUME, CF	8,155	8,155	8,155	
	DET. TIME AT Q INCL. DISCHARGE PIPE, MI	36	27	12	15 @ MAX
GRAVITY THICKENING	NUMBER OF THICKENERS*	1	1		
	DIAMETER, FT	30.00	30.00		
	SURFACE AREA EACH, SF	706.50	706.50		
	TOTAL SURFACE AREA, SF	706.50	706.50		
	CONCENTRATION OF WAS, MG/L	8,000	10,000		
	WAS SLUDGE, LB/D	5,800	7,700		
	WAS FLOW, GPD	86,900	92,300		
	PRIMARY FLOW TO THICKENER, GPD	7,230	10,010		
	PRIMARY SLUDGE, LB/D	1,568	2,171		
	CONCENTRATION OF PRIM. SLUDGE, MG/L	26,000	26,000		
	FLOW TO THICKENER, GPD	94,130	102,310		
	TOTAL LOADING RATE, LBS/D	7,368	9,871		
	FLOOR LOADING, LB/D/SF	10	14		8 - 12
PRIMARY ANAEROBIC SLUDGE DIGESTION	NUMBER OF TANKS	2	2		
	TANK DIAMETER, FT	50.00	50.00		
	TANK SWD, FT	20.00	20.00		
	CONE DEPTH, FT	3.00	3.00		
	UNIT SIDEWATER VOLUME, CF	39,250	39,250		
	UNIT CONE VOLUME, CF	1,963	1,963		
	TOTAL VOLUME, CF	82,425	82,425		
	THICKENED SOLIDS LOADING, LBS/D	2,160	4,200		
	THICKENED SOLIDS FLOW, GPD	9,250	18,000		
	PRIMARY SOLIDS LOADING, LBS/D	1,370	1,890		
	PRIMARY SOLIDS FLOW, GPD	6,320	8,720		
	TOTAL SOLIDS LOADING, LBS/D	3,530	6,090		
	TOTAL SOLIDS FLOW, GPD	15,570	26,720		
	TOTAL SOLIDS LOADING, LBS/D/CF	0.04	0.07		0.1 - 0.3
	HRT, D	39.60	34.25		15
SLUDGE DEWATERING	NUMBER OF BELT PRESSES	1	1		
	BELT PRESS SIZE, M	1.50	1.50		
	SLUDGE FEED RATE, GPM	21	21		
	SLUDGE FEED RATE, GPM/M	14	14		
	SLUDGE FEED RATE, LB/HR	36	36		
	SLUDGE FEED RATE, LB/HR/M	24	24		
	FEED CONCENTRATION, MG/L	34,000	34,000		
	SLUDGE PROCESS RATE, LB/D	2,920	3,000		
	SLUDGE PROCESS RATE, LB/WK	12,500	15,000		

* Only one unit is in permanent operation



EXISTING TREATMENT PLANT – SITE PLAN

FIGURE 4–1
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

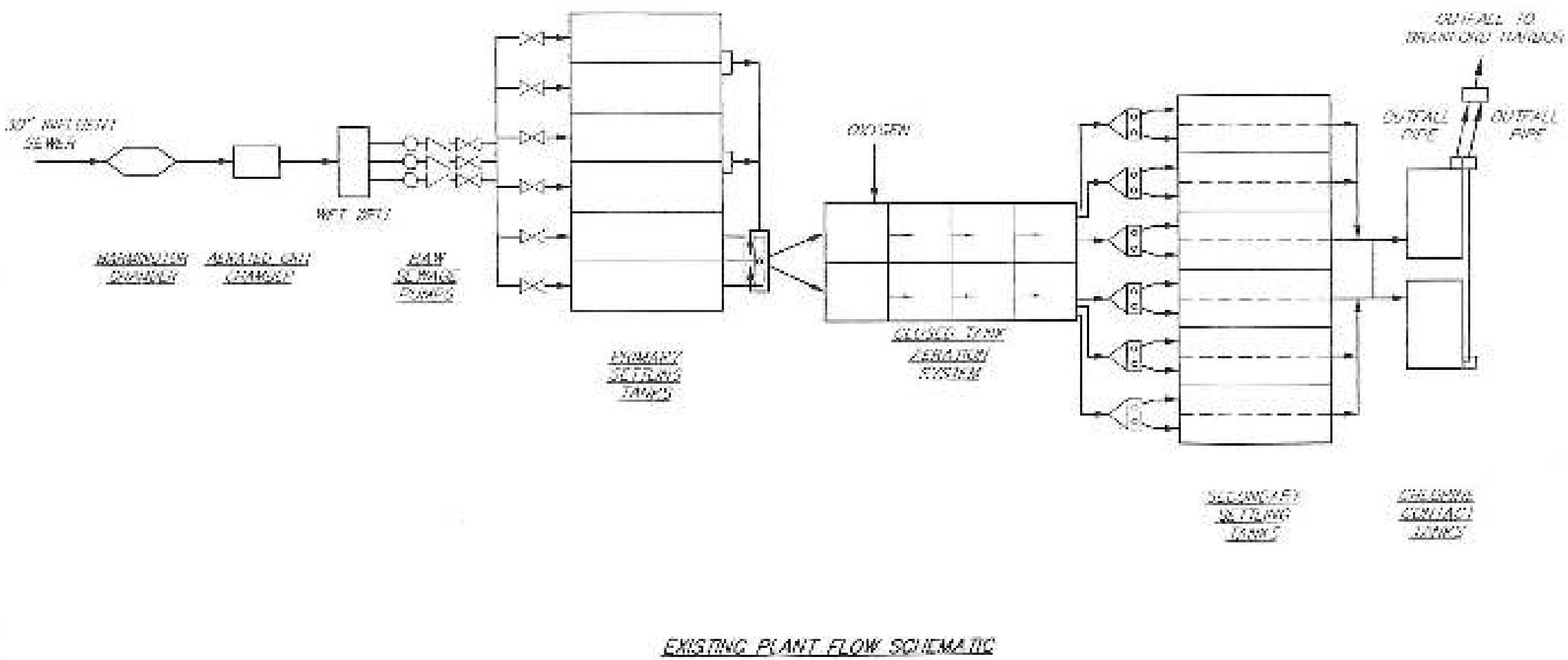
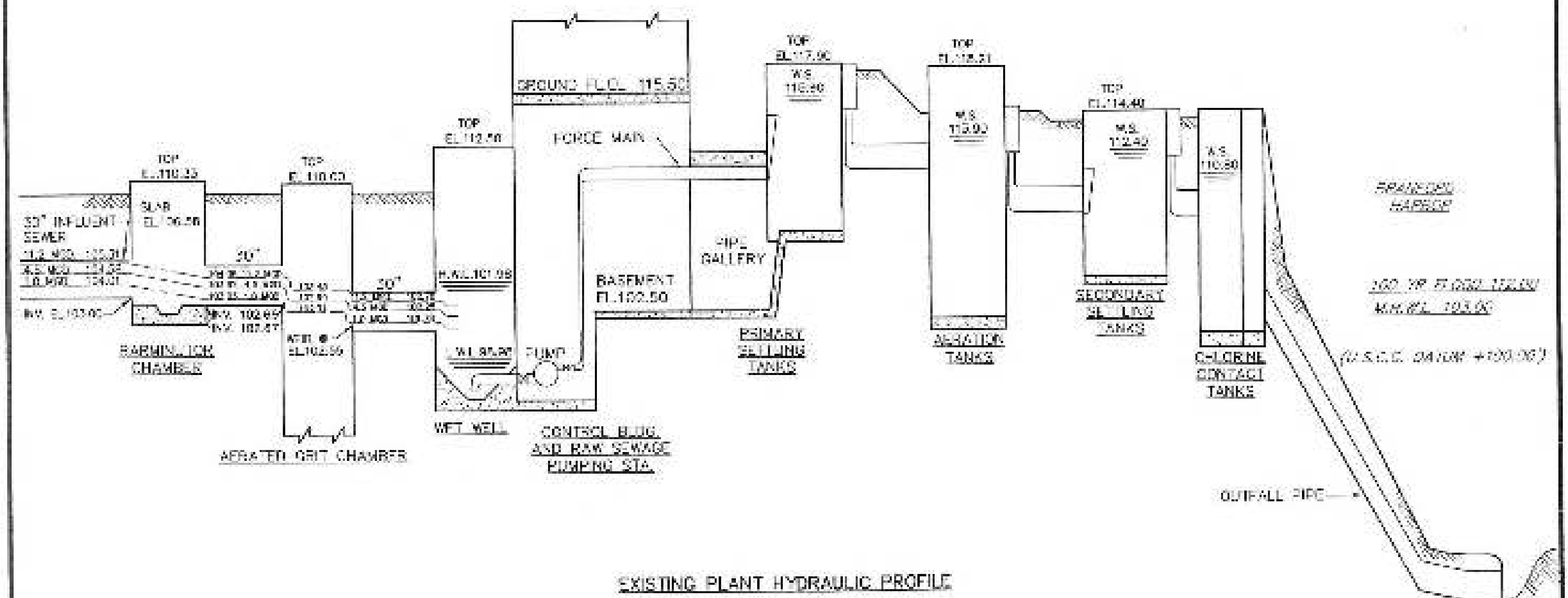


FIGURE 4–2
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.



EXISTING PLANT HYDRAULIC PROFILE

FIGURE 4–3
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

If the grinder is out of service or if the flow exceeds the nominal capacity of the grinder, the wastewater then overflows the top of the slide gate and into the 24 inch wide bypass channel. No screening or comminution is accomplished in the bypass channel.

2. Grit Removal

After the channel grinder chamber, the wastewater flows by gravity to the aerated grit chamber for removal of grit and other heavier particles. Air is provided in the grit chamber by means of an air header and diffuser assembly located within the tank under the water surface. The location of the diffusers at one end of the grit chamber is intended to impart a spiral motion to the wastewater. This motion has the effect of separating the organics from the heavier inorganic material and provide a relatively clean grit, essentially free of odor-causing organics. Once the grit has settled in a hopper at the bottom of the grit chamber, it is removed by use of air ducted through a pipe. Grit is removed from the plant site to a landfill.

The aerated grit chamber is also the location where all supernatant flows from the secondary digesters and the overflows from the gravity thickeners are directed.

3. Raw Sewage Pumping

After passing through the grit chamber, the wastewater flows via a 30 inch pipe to an undivided, enclosed wet well that is attached to the Control Building. This wet well also collects the belt filter press filtrate, the floor drains within the control building, waste sludge if co-settling is desired and is the location where prechlorination can take place. There are three, horizontal non-clog sewage pumps located in a sub-basement of the control building that pump the grit chamber effluent from this wet well to the primary tanks. Pump level control is accomplished by an ultrasonic type liquid level controller which generates a signal for use by the variable speed pump control panels. The sewage pumps are operated by varying the pump motor speed in relation to wet well liquid level. The greater the liquid level, the greater the pump speed and capacity. As the wet well liquid level is lowered, the pump motor speed slows down. The intent with the variable speed controller is to match pump output to the treatment plant influent flow.

4. Primary Settling

The wastewater is pumped from this wet well to the primary settling tanks via a 16 inch pipe located in a pipe gallery that connects the control building with the digesters and primary settling tanks. Primary tank influent flow is measured in this 16 inch pipe by means of a Doppler style exterior-of-pipe mounted flow meter.

The flow is distributed to each of the six primary settling tanks by gate valves which can be used to balance the flows to each tank as well as to shut off flow to any individual tank. Once flow enters the primary settling tanks, the inlet velocity is reduced and the flow is distributed over the width of the tank by means of a submerged diffuser box in each tank.

As the flow is distributed over the tank, solids are settled out to the bottom of the tank for collection by a chain type longitudinal collector mechanism. These settled solids are collected in a hopper at the head end of each primary tank and are directed to a suction pipe connected to the primary sludge pump for removal. Floatable materials are collected on the surface and are then periodically skimmed off into a scum hopper located at the southernmost primary tank. Skimmings are removed by hand and disposed of with the belt press cake.

The liquid flow in each primary tank overflows a double weir located just inboard of the end of each primary tank. The primary tank overflow is collected into three effluent chambers, one for each set of two primary tanks. Flow from each effluent chamber is able to be isolated by a gate valve on the discharge pipe. This overflow is then piped to a primary tank effluent splitter box and from there to the two enclosed oxygenation tanks.

Return activated sludge (RAS) is mixed with the primary effluent in the primary effluent splitter box at the discharge of southernmost two primary tanks. RAS enters the effluent box and overflows a weir to mix with the primary effluent. These weirs are able to be adjusted to either isolate RAS flow to either of the two oxygenation tanks or to adjust the RAS feed to the oxygenation tanks if unbalancing is noted. From this effluent box, flow is directed to the two oxygenation tanks.

5. Secondary Treatment

The covered aeration tanks are converted from the open aeration tanks from the original 1962 treatment plant. By enclosing the original aeration tanks and feeding nearly pure oxygen to support the biomass, additional aeration tank construction was not required during the most recent plant upgrade. There are two distinct aeration tank trains and each tank is divided by concrete interstage walls into four equally sized compartments (or stages) each with its own mixer/aerator. The primary tank effluent, which has been mixed with return activated sludge, enters the covered aeration tanks at the top of the tank in the first stage. Pure oxygen is fed into the interstitial space above the water surface and the enclosed concrete top and is then driven into the liquid by a mixer/aerator. The liquid is mixed by virtue of the bottom mixers mounted on the mixer/aerator. Flow goes from the first stage to each succeeding stage by means of an opening at the bottom corner of each interstage wall. In each successive compartment, the mixed liquor is mixed and the oxygen atmosphere above the water surface is driven into the mixed liquor by the mixer/aerators. These conditions provide a suitable environment for the bacteria to remove the BOD and in the process multiply and grow. Once the flow reaches the final compartment, biological treatment is completed and the mixed liquor overflows a weir for discharge to the secondary clarifiers.

Control of the oxygen is available to be accomplished by means of a pressure sensing mechanism in the first stage of the aeration tanks. As oxygen is used, the pressure in the space above the liquid surface drops. When it has dropped sufficiently, the lower pressure is sensed and a valve is opened to allow more oxygen to enter the first stage. As the oxygen in the space above the liquid level is depleted from stage to stage by biological respiration, it is vented to the atmosphere at the final stage by means of an oxygen vent valve. The resultant loss in pressure once again activates the oxygen pressure sensor in the first stage and additional oxygen is then added.

Other process control mechanisms include baffles at each stage to help mix the mixed liquor, gas sample ports, grab sample port for mixed liquor, access manholes (final stage only), a combustible gas detection system and pressure relief valves.

The oxygen is supplied to the enclosed aeration tanks under normal operations by a Union Carbide PSA (pressure swing adsorption) oxygen generation system that can produce 5 tons of oxygen per day. A backup liquid oxygen supply is also provided and consists of a 3,000 gallon capacity storage tank and vaporizer. The PSA system consists of three adsorbent vessels each filled with molecular sieves, an air feed compressor and water separator, piping and controls.

Flow from the final stage of the aeration tanks are collected in a common trough at the end of the aeration tanks prior to distribution to the secondary clarifiers. Each of the six secondary clarifiers is fed from this trough by a 14 inch diameter pipe with isolation slide gates for each pipe. The slide gates allow any of the secondary settling tanks to be isolated for repairs or cleaning. The aerated biomass (activated sludge) is settled in these clarifiers and the clarified overflow is sent to the chlorine contact tanks for disinfection. Most of the settled biomass is returned to the aeration tanks to continue the biological process and the remainder, consisting of the additional growth from the reduction of BOD, is wasted to the gravity thickener.

6. Secondary Settling

The six secondary clarifiers are rectangular units of a similar configuration as the primary settling tanks. Flow from the two aeration tanks is transported through six, 14 inch diameter pipes to six dividing chambers, one for each secondary tank. Each of these dividing chambers is split into two compartments to distribute the flow over the secondary tanks and to shut off the flow to any one tank by means of slide gates.

The flow in the secondary settling tanks then overflows a double weir located at the end of the tank. Sludge collected on the tank bottom is scraped toward the front of each secondary tank into a hopper integral with the tank. From these hoppers, sludge flows to three (one for each two tanks) sludge draw-off wells by means of telescoping valves located in the sludge hopper of each secondary tank. Connected to each of these drawoff wells is an 8 inch diameter pipe each of which is connected to a manifold in the control building to which four vertical activated sludge pumps (one spare) are connected. Return activated sludge is sent to the aeration tanks for mixing with the primary effluent. Waste sludge can be sent to the either of the two gravity thickeners or to the primary tanks via the raw sewage pumps for co-settling. Control of wasting or return sludge is by a Doppler style flowmeter located on the inlet pipe to the waste sludge pump.

The secondary scum collected from the surface of the secondary settling tanks is collected in one of two scum chambers located at the sides of two of the settling tanks. Collected secondary scum flows to a submersible pump chamber and is pumped back to the inlet manhole in the street prior to the barminutor chamber.

7. **Disinfection**

Once the clarified effluent overflows the secondary tank weirs, the vast majority of the biomass has been settled. The clarified overflow from three of the secondary tanks can be directed to one chlorine contact tank and the overflow from the other three can be directed to the other chlorine contact tank. There is also a means to direct all secondary effluent to either of the contact tanks if one is out of service. Chlorine is injected into the wastewater at the beginning of the contact tanks by a diffuser and is mixed with the effluent. The chlorinated effluent then follows an over/under/around path within the contact chamber.

Chlorine for disinfection is obtained from one ton containers located in the Control Building. Two chlorinators are utilized and the gas is fed from the ton containers to the chlorinators. Water supplied by the plant water system creates a vacuum when it passes through the eductor and the resultant gas and water mixture is distributed to the contact chamber. Residual is continually monitored and recorded by a residual analyzer. Chlorinated water is also available to the primary influent for odor control and to the activated sludge system for control of filamentous organisms.

The flow from both contact tanks is then combined into a common discharge and flows to Branford Harbor via a 32 inch diameter outfall pipe.

D. TREATMENT PLANT UNIT PROCESSES - SOLIDS

1. Gravity Thickening

Primary sludge solids collected in the primary settling tank hoppers (one for each of the six tanks) are removed periodically by one primary sludge plunger pump. Primary sludge is able to be pumped to either the 20 foot diameter thickener or the 30 foot diameter thickener by operation of valves or is able to be pumped directly to the anaerobic digesters. Currently, only the 30 foot diameter thickener is operational. Waste activated sludge, as described previously, is also pumped to the one operating thickener.

Flow enters the thickener through a center well which serves to distribute the flows. Solids are settled to the bottom where they are concentrated by means of a circulating arm with pickets attached. Gas bubbles and water are allowed to escape from the sludge thereby thickening it. The supernatant is returned to the grit chamber, the concentrated sludge is pushed by a rake mechanism to the center of the thickener where it is pumped to the digesters by the concentrated sludge pump. The system is designed such that flows can be directed to either thickener or both can be operated in parallel. There are three plunger type sludge pumps; one is dedicated to primary sludge, one to gravity thickened sludge and the third as a standby for the other two pumps.

2. Digestion

The underflow from the thickeners is sent to either of the two 50 foot diameter fixed cover anaerobic digesters. The sludge is kept mixed with two 5,000 gpm capacity draft tube mixers located in each of the two primary digesters. A total of two recirculation pumps send sludge through a single heat exchanger to add heat to promote the rapid digestion of the sludge. Temperature is maintained at approximately 95 degrees F for this purpose. The large majority of sludge digestion occurs in the primary digester and is a function of time, pH and other variables. The function of the primary digester is to biologically reduce the volatile portion of the sludge and in the process reduce the sludge volume, generate useable digester gas, and also produce a sludge that is stabilized.

The digested sludge from the primary digester is displaced to the secondary digesters when fresh sludge is pumped in from the gravity thickener. This digested sludge is allowed to settle in the two secondary digesters and the gas from the digestion process is collected in the floating cover of the secondary digesters. This gas from the digestion process is used in the heat exchanger to provide fuel for the sludge heating process in the primary digesters and as a heat source for the Control Building. Excess methane gas is flared by two surface mounted flare units. The supernatant liquid in the secondary digesters is returned to the grit collector by means of manually opening a series of valves. Each valve is connected to the digester at a different depth and the operator selects the liquid level in the digester that looks the least turbid and opens the corresponding valve. Control is by means of visual observation of the liquid when discharged into the sample sink.

The internal piping arrangement allows either of the four digester tanks to be utilized as a primary or secondary digester during periods of cleaning or upset. Piping is also available to empty the contents of any digester into the others.

Digested sludge from the secondary digesters is fed to a single, 1.5 meter belt press for further thickening. The belt filter press is located on the main floor of the Control Building. Sludge is pumped from the digesters by one pump located in the basement of the Control Building and is conditioned with polymer prior to distribution onto the belt press. The belt press is equipped with a gravity dewatering section and a pressure zone for taking the approximate 4% solids from the digester to the 15-20% desired for the ultimate disposal. The dewatered cake is collected onto a conveyor and transported to a dump truck. The cake is then transported nearby to the town landfill where it is mixed with other soil and used as cover material for capping the landfill. It is projected by plant personnel that this process of disposal will be available until new facilities are brought on-line. The filtrate is collected in the building drainage system and is returned to the waste stream via the wet well located after the grit chamber.

E. COLLECTION SYSTEM - PUMPING STATIONS

The collection system includes all sanitary sewers as well as the pumping stations. Each of the 48 pumping stations was reviewed to assess the mechanical reliability of the pumping stations, to determine if their present pumping capacity is sufficient for the estimated present and future flows, and to determine if the associated force main is sufficiently sized for the flows to be pumped.

To accomplish the existing conditions survey, a record search of the pumping station files was undertaken to establish repair and replacement records of equipment. In conjunction with this record search, all pump station sites were visited to generally assess the mechanical condition of the pumping stations as best possible from an above-grade survey. Service area and associated flows were established for the present conditions by establishing the number of homes, industries and commercial businesses congruent to that pumping station. Future service areas were established by review of planned development within the town, and determining the pump station that would serve the development.

To determine the current flow capacity of the pumping stations, pump installation records were reviewed. When pump curves were available, the pump head/flow characteristics were developed to establish pump output and compare to the installation records. Where pump data was lacking, pump drawdown tests were performed where feasible and practical to determine capacity. This information was compiled and compared to the present and future service areas. It is noted here that in many instances, especially with some of the older submersible pumping stations, information is not available. This information shortfall is being corrected as new equipment is installed under the present capital improvement program.

Important features of each pump station site such as number of pumps, capacity of the pump station, current and future service area flow, forcemain size and velocity is shown in Table 4 - 4. The documentation of site visits for the major pump stations is included in Appendix B. Also included in the Appendix are the system curves for each of the major pump stations transposed onto the pump curves.

A generalized discussion of the important findings of this conditions survey is discussed below. In general, most of the pumping stations in town are submersible pumping stations consisting of two submersible solids handling or grinder pumps, a wet well, an electrical service and control panel and an alarm telemetry system. Larger pumping stations that are more critical to the sewer system integrity are generally wet pit/dry pit types, with two to three solids handling pumps, a separate wet well, on-site emergency power systems with automatic power transfer, and a building to house the

TABLE 4-4
PUMP STATION LIST
TOWN OF BRANFORD FACILITIES PLAN

DESIG.	NAME	YEAR IN SERVICE OR REBUILT	LOCATION	TYPE OF STRUCTURE	NO. OF PUMPS	AUX. PWER *	INDIV. PUMP CAPACITY (GPM)	TOTAL STATION CAPACITY (GPM) **	FORCEMAIN DIAM. (INCHES)	FORCEMAIN LENGTH (FEET)	PIPELINE VELOCITY (FPS)	CURREN FLOW (GPM)	FUTURE FLOW (GPM)	EXIST. CAPACITY ADEQUATE (Y/N)	FUTURE CAPACITY ADEQUATE (Y/N)	MECH. COND.
E1	CENTRAL	1969	MEADOW ST. ACROSS FROM EEL POT RESTAURANT	SUPER/SUB	3	F	1,900	2,800	14	1,450	5.84	4,600	4,600	N	N	F-G
E2	BRADLEY	1992	AT END OF BRADLEY AVE.	SUPER/SUB	3	F	1,040	1,400	8	595	6.94	1930	1930	Y	Y	G
E3	ROUTE 139	1973	INTERSECTION OF RT 139 & EAST MAIN ST.	SUPER/SUB	3	F	2,000	2,400	12	2,300	5.61	1450	1930	Y	Y	P
E4	SYBIL AVE.	1979	SYBIL AVE. NEXT TO SYBIL CREEK	SUPER/SUB	2	F	2,200	2,200	18	1,400	3.51	2230	2230	N	N	G
E6	PAGES COVE	1992	SHORE DR. NEAR PAGES COVE	SUPER/SUB	2	F	600	600	8	2,700	3.63	630	630	Y	Y	F-G
E8	DAMASCUS RD.	1973	DAMASCUS RD. ALONGSIDE JOSEPH WAY	SUPER/SUB	3	F	3,000	3,800	14	1,200	7.51	1650	2100	Y	Y	G
C1	SO. MONTOWESE ST.	1993?	SO. MONTOWESE ST. NEAR [illegible]	SUB/DRY PIT	2	P	200	200	4	1,360	5.11	57	62	Y	Y	F-G
C2	BRANFORD PT	1984	INSIDE ANCHORAGE CONDOS	SUB	2	N	40	40	2	700	4.09	10	10	Y	Y	F-G
C3	BLOCKS	1990	BEHIND CASPER BLOCKS HOUSE	SUB	2	P	210	210	6	1,200	2.38	155	200	Y	Y	G
S1	TIDELANDS	1972	BEHIND TIDELANDS CONDOS	SUB	2	P	200	200	6	500	2.27	127	127	Y	Y	F-G
S2	SHOPPING CENTER	1983	END OF PARKING LOT OF BFD SHOPPING	SUB	2	P	650	650	8	1,600	7.38	100	200	Y	Y	F
S3	BURBAN DR.	1973	BEHIND ST. ELIZABETH'S CHURCH	SUB	2	P	680	680	8	1,750	4.34	620	625	Y	Y	G
S4	HEMLOCK	1987	CORNER OF HEMLOCK AND HEMLOCK	SUB/DRY PIT	2	F	750	750	10	3,300	3.07	475	475	Y	Y	G
S5	LANPHIERS	1975	INSIDE LANPHIER COVE ASSOC.	SUB	2	N	40	40	2	250	4.09	10	10	Y	Y	F-G
S6	SUNRISE COVE	1975	INSIDE LANPHIER COVE ASSOC.	SUB	2	F	300	300	6	450	3.41	118	118	Y	Y	F-G
S7	HOTCHKISS GROVE	1977	INTERSECTION OF 3RD & 4TH AVE.	SUB	2	F	375	375	6	500	4.28	150	150	Y	Y	F-G
S8	MILO DR.	1981	AT THE END OF MILO DR.	SUB	2	P	200 ***	200	4	1,700	5.11	54	54	Y	Y	F
S9	HOSLEY	1972	HOSLEY NEAR WEST MAIN ST.	SUB	2	F	750	750	8	1,000	4.79	220	250	Y	Y	G
S10	GREENFIELD	1971	OFF OF GREENFIELD & GREENFIELD	SUB	2	F	300	300	4	500	7.68	46	46	Y	Y	F-G
S11	DOMINICAN	1972	OFF ALEX WARFIELD RD.	SUB	2	P	200	200	4	1,880	5.11	22	42	Y	Y	F-G
S12	CLARK AVE.	1961	CLARK AVE. ACROSS FROM JOHNSON'S BEACH	SUB	2	F	200	200	6	750	2.27	45	55	Y	Y	F-G
S13	LITTLE BAY LN.	1976	AT END OF LITTLE BAY LN.	SUB	2	F	200	200	4	450	5.11	13	13	Y	Y	G
S14	BECKETT AVE	1973	BECKET AVE. NEXT TO BECKET PARK	SUB	2	F	900	850	8	500	3.97	255	330	Y	Y	F-G
S15	SQUIRE HILL	1975	INSIDE SQUIRE HILL APTS.	SUB	2	F	250	250	4	300	6.39	51	251	Y	N	F
S16	RIVERSIDE	1977	INTERSECTION OF OAKDALE RD.	SUB	2	F	100	100	4	200	2.55	58	58	Y	Y	F-G
S17	RED ROCK RD.	1975	AT END OF RED ROCK ROAD	SUB	2	P	80	80	3	1,700	3.63	68	144	Y	N	F
S18	VICTOR HILL	1975	INTERSECTION OF BROOKWOOD DR.	SUB	2	P	350	350	8	2,600	2.24	40	112	Y	Y	F-G
S19	FARM RIVER	1974	AT THE END OF COURT STREET	SUB	2	P	200 ***	200	4	500	5.11	45	45	Y	Y	F-G
S20	MARINA	1980	ON TREATMENT PLANT SITE	SUB	2	P	100	100	4	1,000	2.55	20	20	Y	Y	G
S21	FRANK ST.	1974	FRANK ST.	SUB	2	P	200	200	4	1,400	5.11	107	107	Y	Y	G
S22	RAWSON RD.	1983	RAWSON RD. NEAR FENWAY RD.	SUB	2	P	600	600	6	1,580	5.85	100	105	Y	Y	G
S23	MALTBY ST.	1983	AT THE END OF MALTBY ST. EXT	SUB	2	F	200 ***	200	4	1,300	5.39	72	95	Y	Y	F-G
S24	RIVER RD.	1983	AT THE END OF RIVER RD	SUB	2	P	100 ***	100	4	240	2.55	35	35	Y	Y	F-G
S25	SUMMER ISLAND RD.	1983	AT INTERSECTION OF SUNSET BEACH	SUB	2	P	200	200	4	1,000	5.11	40	60	Y	Y	F-G
S26	PINE ORCHARD	1990	ELIZABETH ST AND CLUB PKWY	SUB	2	F	300	300	5	4,100	2.97	30	30	Y	Y	G
S27	LUDLOW CT.	1990	AT THE END OF LUDLOW CT.	SUB	2	P	400 ***	400	4	1,390	10.22	35	90	Y	Y	F-G
S28	BIRCH RD.	1991	BIRCH RD. NEAR PINE ORCHARD SCHOOL	SUB	2	N	60	60	2	250	5.11	5	5	Y	Y	F-G
S29	RAMONA WAY	1991	OFF OF RAMONA WAY	SUB	2	P	160	160	4	650	3.83	10	10	Y	Y	G
S30	CHESTNUT ST.	1991	INTERSECTION OF CHESTNUT & N. MAIN ST.	SUB	2	P	150	100	4	1,280	3.83	33	60	Y	Y	G
G1	LANPHIERS	1989	AT END OF LANPHIER COVE RD.	SUB	2	P	400	400	5	1,000	4.54	180	180	Y	Y	G
G2	RICE TERRACE	1989	AT RICE TERRACE ELDERLY HOUSING	SUB	2	N	40 ***	40	2	400	4.09	25	25	Y	Y	F-G
G3	JOHNSON PT.	1975	AT END OF JOHNSON PT. RD.	SUB	2	N	60	60	2	2,500	5.11	18	30	Y	Y	F-G
G4	HARBOR ST.	1987	HARBOR ST.	SUB	2	P	400	400	5	unkn	4.54	230	230	Y	Y	F-G
G5	PONDS	1987	INSIDE THE PONDS GROVE	SUB	2	N	60	60	2	450	5.11	13	13	Y	Y	G
	HUNTING RIDGE	1987	INSIDE HUNTING RIDGE CONDOS	SUB	2	N	55	55	2	300	5.62	20	20	Y	Y	G
S33	WATCH HILL	1984	INSIDE WATCH HILL CONDOS	SUB	2	N	60	60	2	1,700	6.13	42	60	Y	Y	F
S31	LINDEN SHORES	1987	INSIDE LINDEN SHORES HOUSING DEVELOPMENT	SUB	2	P	150 ***	150	4	800	3.83	35	35	Y	Y	G
	SYCAMORE	1992	SYCAMORE WAY	SUB	2	P	500	500	6	1,000	5.68	0	470	Y	Y	G

* F=fixed generator, P = portable generator, N = none
** with largest pump out of service
*** estimated- pump curves not available

mechanical, electrical, control and telemetry equipment. Some of the smaller submersible pumping stations were installed by developers and are now serviced by the town forces headquartered at the treatment plant. Others were installed under Town contracts as the sewer system expanded and are also serviced by Town forces. Because of the large number of installations, there is a variation in the type of equipment and quality of construction at these pumping stations.

Because of this quality variance in the submersible stations, the age of some of the equipment and the large number of pumping stations, the town is presently pursuing a long term program to replace pumps, control systems, electrical equipment and telemetry systems and in the process standardize on specific suppliers as much as possible. This program has had a positive effect on the reliability of the pumping stations that have been rehabilitated under this program.

From a mechanical condition perspective, pumps in most of the submersible and some of the wet pit/dry pit pumping stations have been outfitted with at least one new pump in the past three to four years. This has substantially increased pumping station reliability. Some of the older pumping stations which service smaller areas have not had new pumps installed recently and would be recommended for pump replacement in the near future. The Town's current pump replacement program takes this into consideration and these pump stations are slated for mechanical replacement in this fiscal year. The exception to this program is the Route 139 pump station which is recognized as being in need of rehabilitation but is not able to be accomplished by Town forces.

This replacement program, with the current inspection program and the future alarm telemetry system planned to be installed is sufficient at this time to maintain a reasonable degree of mechanical and electrical reliability of the pumping stations. We would recommend, however, that since some pumping stations are being upgraded with new pumps, many of which are the same model, that a program be initiated to have spare pumps on hand for the important submersible stations for use during a pump outage. Current practice is to depend on the remaining single pump to cover for the duplex system while the other pump is out for repairs. This could be a serious problem if the pump repair takes weeks to complete or if the remaining pump is of the same age as the one taken out for repairs or if the remaining pump becomes clogged or otherwise non-functional.

From a capacity perspective, the pumping station survey found that all but two of the pumping stations were of sufficient capacity to pump the flows from the present service area with the largest pump out of service. This is the standard criteria for pumping station capacity design. These two pumping stations are the Central pump station and the Sybil Creek pump station, each of which will be discussed in more detail below. In addition, two pump stations will need to be increased in capacity when flows from future service areas are included, but for the present, their capacity is sufficient. These are the Red Rock and Squire pump stations. If the full planned development occurs in the areas to the east of these two pump stations, they will need to be increased in capacity.

From a forcemain capacity perspective, the forcemains for all 48 pumping stations were found to be of sufficient size for the pumps installed and for any future pump increase in capacity that may be required if the service area expands. The criteria for this evaluation is that a forcemain should not have velocities exceeding 10 fps during peak flow.

The current capacity deficiencies at the Central and Sybil Creek pump stations and the Route 139 pump station rehabilitation needs are discussed below.

1. Central Pump Station

The Central pumping station is located on Meadow Street and through it passes approximately 70% of the flow received at the treatment plant. The pumping station is a cast-in-place pumping station with three sewage pumps, one of which is almost always in operation. During many times during the day, two pumps are operating to handle the peak flows. If there is a rainfall event, the additional inflow causes all three pumps to run. If the rainfall event is significant, overflows of numerous manholes in Maple Street and Meadow Street occur since the pumps cannot pump the amount of flow received. This has already occurred on two occasions in 1996. If one of the three pumps is out of service, overflows will occur with lesser rainfall events.

Currently, none of the three pumps in the Central pump station is at their design capacity of 2,000 gpm each (3,800 gpm with two pumps in operation) due to wear and age of the pumping components and because the impellers were machined to a smaller diameter to reduce a cavitation problem that was experienced after they were first installed. Currently, with two pumps running, they can pump 2,800 gpm, with three pumps, 3,200 gpm. Machining the impellers, while helping the cavitation problem, reduced the pump output and decreased the efficiency of the pumps. The cavitation problem is caused by a poor wet well configuration and small diameter pump suction piping causing suction side pump starvation, and a small, shallow wet well and air entrainment of the pump influent that when combined with the NPSH requirements of the pumps, causes pump cavitation. In addition, to alleviate the overflow problems due to pump station undercapacity and service area flows, it is recommended that this pump station be increased in capacity to 4,600 gpm.

Increasing the pumping capacity will alleviate the overflow problems in the manholes on Meadow Street and the manholes near the pump station on Maple Street that currently overflow during heavy rainfall events. Overflows in manholes further upstream on Maple Street at the Brook crossing and on Short Beach Road are believed to be caused not only by the capacity of the Central pumping station but also by undercapacity gravity sewers in the service area. Recognizing that this capacity problem is only exhibited during rainfall events and is therefore due to I/I, the Town will undertake a program to reduce I/I in these service areas as their program to alleviate the capacity problems at these two locations. If unsuccessful, augmentation of the sewers in this area will be required.

2. Sybil Creek Pump Station

The Sybil Creek pump station pumps approximately 25% of the town-wide sewage flow to the treatment plant. This pump station has four pumps, only two of which are connected and able to operate. The other two pumps are smaller pumps that were totally disconnected from service many years ago and were initially installed to handle the low flows at the pump station. For the majority of the time, one pump at this pump station is able to pump all of the sewage flows received. During extreme rainfalls, both pumps operate. This allows for no spare capacity since the two small pumps are disconnected. An additional pump in this station of similar capacity to the two operational pumps will be required to provide this necessary spare capacity.

3. Route 139 Pump Station

While the Route 139 pump station has sufficient capacity for both present and future flows, its electrical and pumping components are all approaching their expected operational life.

This pumping station, while functional, is in need of an electrical and mechanical upgrade to provide the level of reliability that this pump station requires and to allow it operate more efficiently.

When first installed, this pump station was planned to serve a smaller section of Town. By accepting significant additional flows from North Branford, the Town upgraded the pump station capacity to accept these flows, however, the legacy of a small pump station design is still present. Among the current deficiencies are a small wet well which causes excessive pump cycling, interior suction piping that is too small for the pumps, and a pump control system that is unable to match the incoming flows to pump output. These deficiencies, unlike similar ones at the Central pump station, are correctable by use of variable frequency drives, new piping and pumps and an electrical control system that will allow the most efficient use of the pumping capability.

4. Collection System - Treatment Plant Vicinity

In addition to the pump capacity situation at the Central pump station, there is also a flow limiting situation with the downstream gravity interceptor sewer that receives the pumped discharge from the Central pump station. This sewer runs down Indian Neck Avenue, to South Montowese Street, to Block Island Road where it connects with the gravity sewer from the Sybil Creek pump station service area. An investigation into whether this downstream piping had the capacity to accept the additional flow proposed for the Central pump station was investigated. The investigation determined that under all but the most severe rainfall situations, the downstream piping capacity on Indian Neck Road and South Montowese Street is sufficient to allow unsurcharged flow conditions. During those times when the full capacity (4,600 gpm) of the Central pump station is used, some surcharging (up to two feet over pipe crown) will occur in this downstream interceptor. The infrequent surcharging is preferred over the expensive installation of a relief sewer, however, a detailed investigation into the possibility of surcharge impact on service connections in the area should be undertaken. A review of the capacity in Block Island Road determined that a 600 foot section of sewer pipe from the point where the Sybil Creek pump station connects to the main interceptor on Block Island Road to the treatment plant site is undercapacity and in need of augmentation. Its current capacity in this section is approximately 8.1 mgd which is due to the flat slope of the pipe as it enters the treatment plant. At this capacity, even under the present flow conditions, it is occasionally surcharged. This sewer will need to be augmented with an additional 36 inch pipe for the full 600 feet to be able to accept the peak flows at the plant and the increased flows projected for the Central pump station.

F. COLLECTION SYSTEM - INFILTRATION/INFLOW

Infiltration is clean water that enters the sewer system from the ground through cracked pipes, offset joints, leaky house connections, leaky manholes or other means. This could be caused by groundwater entering the sewer pipe or manhole or it could be from individual house foundation drains. Infiltration can be characterized by a continual source of flow in the sewer at all times during high groundwater periods, or it can be related to a rainfall event.

Inflow is water other than sanitary sewage that enters the sewer system directly from a rainfall event. The means of entering the sewer system could be from individual house or building roof leaders connected to the sanitary sewers, catch basins that are cross-connected to the sanitary sewer, direct runoff into manhole covers or similar means. Inflow is characterized in the sewer system by an increase in flow for a relatively short period of time that is directly related to the rainfall event.

The combination of the two is called Infiltration/Inflow (I/I). Not being wastewater, I/I is not desired in the sewer system nor at the treatment plant. I/I takes up sewer and treatment plant capacity, dilutes the wastewater, can dictate hydraulic capacity at the treatment plant and also has a cost associated with its transport and treatment. Excessive I/I is that portion of the total I/I that, based on an economic analysis, is cheaper to remove from the collection system through repair or other means than it is to transport and process at the treatment plant. The remaining portion is called non-excessive I/I. This portion of the total I/I is not cost-effective to remove.

A sewer system evaluation survey was completed in May, 1995 for the Town of Branford. This study was undertaken to determine the extent of problem infiltration/inflow areas and to determine in which of those areas it is cost-effective to remove the infiltration or inflow. This study included a number of tasks including flow metering in the sewer system, limited smoke testing and television inspection of the sewers, estimating quantities of extraneous flows and performing a preliminary cost-effective analysis.

From an inflow perspective, the study concluded that very few inflow sources were determined by smoke testing of 56,000 feet of sewer (approximately 11% of the total system) that was performed during this study. The study found some direct sources such as catch basins, roof leaders and some foundation drains but concluded that most of the inflow in these areas was from manhole cover holes in which surface drainage was entering. It was also concluded that the Town should implement a program to address the inflow sources identified in this study and to undertake a town-wide program to locate other, similar, inflow sources. The study also recommended eliminating inflow generated from manhole cover holes by installing solid covers or installing flow protectors in the manholes.

From an infiltration perspective, the study has determined, based on a preliminary economic analysis, that the infiltration in Branford is all non-excessive and therefore not cost-effective to remove. This conclusion is based on two important assumptions. The first is that the treatment plant is operating in compliance with its permit requirements and that no improvements are required. The second assumption in the economic analysis is that it is based on the existing costs of operation at the treatment plant. The improvements that are recommended in the Facilities Plan will require that the economic analysis be revisited to verify that with the cost of the proposed improvements, that the I/I in town can still be classified as non-excessive. This will be reviewed in Chapter VIII.

G. WASTEWATER CHARACTERIZATION

Table 4-5 presents the current flows and loadings into the Branford treatment plant. This information is based on a record period from January, 1993 to April, 1995. Records prior to 1993 were not considered valid because the treatment plant flowmeter was reported by treatment plant personnel to be under-recording the flow rate at that time. The wastewater flows and loads at the treatment plant are comprised of a number of components each with their own separate characteristics. Sanitary wastewater within the sewer system is broadly characterized as either of residential, commercial or industrial origin. The I/I component of the wastewater can sometimes generate significant flows but very little loading. Septage is a separate component not found in the collection system itself but is delivered to the treatment plant on a regular basis for treatment. The septage component of wastewater can at times create a significant load at the plant but have a negligible flow component. At the Branford treatment plant, flows are contributed by Branford and a section of North Branford. Flows and loadings are divided into a residential and commercial component, an industrial portion, a septage portion, an infiltration and an inflow component. Branford currently contributes approximately 92% of the average daily treatment plant flow of 4.12

TABLE 4 - 5
CURRENT FLOWS AND LOADS
TOWN OF BRANFORD FACILITIES PLAN

		ANNUAL AVERAGE	MAXIMUM MONTHLY AVERAGE	HYDRAULIC PEAK
RESIDENTIAL AND COMMERCIAL				
BRANFORD				
FLOW, gpd		2,074,000	2,281,400	2,592,900
BOD, lb/d		4,805	5,550	
TSS, lb/d		4,688	5,730	
TKN, lb/d		774	1,115	
NH4-N, lb/d		624	798	
NORTH BRANFORD				
* FLOW, gpd		307,000	440,000	1,249,000
BOD, lb/d		712	822	
TSS, lb/d		694	849	
TKN, lb/d		115	165	
NH4-N, lb/d		92	118	
INDUSTRIAL				
BRANFORD				
FLOW, gpd		175,000	350,000	438,000
BOD, lb/d		134	426	
TSS, lb/d		3	16	
TKN, lb/d		0	0	
NH4-N, lb/d		0	0	
NORTH BRANFORD				
FLOW, gpd		15,000	30,000	38,000
BOD, lb/d		0	0	
TSS, lb/d		0	0	
TKN, lb/d		0	0	
NH4-N, lb/d		0	0	
SEPTAGE (BRANFORD ONLY)				
FLOW, gpd		4,600	7,200	36,000
BOD, lb/d	(5,000 mg/l)	192	300	
TSS, lb/d	(13,000 mg/l)	499	781	
TKN, lb/d	(677 mg/l)	26	41	
NH4-N, lb/d	(157 mg/l)	6	9	
INFILTRATION				
FLOW, gpd		1,120,000	1,640,000	3,060,000
INFLOW				
FLOW, gpd		424,400	601,400	4,700,000
TOTALS				
FLOW, gpd		4,120,000	5,350,000	12,113,900
BOD, lb/d		5,842	7,098	
TSS, lb/d		5,884	7,379	
TKN, lb/d		915	1,321	
NH4-N, lb/d		722	925	

* INCLUDES INFILTRATION AND INFLOW

mgd and North Branford contributes the remaining 8%. The proportion of flows and loads and their distribution are discussed below.

1. **Domestic and Commercial**

The 1990 water consumption records supplied by the South Central Connecticut Regional Water Authority (SCCRWA) were used to determine the per unit domestic, commercial and public building water and wastewater flows in Branford. The 1990 water data was used for the domestic/commercial flows since this data can be directly correlated with 1990 census data in which the number of households and population served by public water is most recently established in exact terms. Once the per unit rate was established, 1994 water consumption data was used to determine actual present day water use. It is noted here that the SCCRWA does not segregate commercial use from residential use records. Therefore, the Town's commercial component is included in the water consumption and wastewater flows and is labeled as domestic and commercial flows.

Based on SCCRWA metered water records, the per capita domestic water consumption rate in Branford is 107 gallons per day when averaged for the entire year. This number is established by the water company, is based on metered water use, and is used by them for future projections of water consumption. Excluding the summer months of June, July and August due to lawn watering and other summertime uses, the per capita use of water is reduced to 97 gpcd. It is estimated that 10% of this water used is then lost to consumption. Based on this relationship, the domestic sewage flow is estimated to be 87 gallons per day per capita which includes commercial flows. Municipal buildings supplied by public water are estimated to generate wastewater in the same proportion to water use.

North Branford sewage flow information, including the I/I component, is obtained from sewage flowmeter records provided by North Branford. There is no data on waste characteristics, so its pollutant concentration is assumed to be similar to Branford and was therefore equally distributed based on total flow recorded by North Branford after deducting for industrial flows.

The Office of Policy and Management (OPM) estimates that the 1995 population in Branford is 28,500 people. This is some 897 more people than in 1990. To compare to 1994 water company and wastewater treatment plant flow records, it was assumed that the population growth was linear between 1990 and 1995. Therefore, the 1994 population in town was estimated at 28,320 people.

Based on a Town report that was compiled from 1990 census data, approximately 82% of the households in Branford are connected to the sanitary sewer. According to Regional Water Authority records and Town data, very little additional water and sewer service increases have occurred since 1990 and it is therefore estimated that the current percentage of sanitary sewer service is equivalent to 1990 ratios. Using the information that 82% of the households are connected to the sanitary sewer and that wastewater is generated at a rate of 87 gpcd, the current annual average domestic and commercial flows to the wastewater treatment plant for a 1994 sewered population of 23,222 is 2,020,000 gallons per day.

Residential and commercial flow maximum month values are also based on water consumption records. Water company records were reviewed and those months exhibiting the highest water use rates, excluding summer months, were used as maximum month flow values from which maximum month sewage values are obtained.

Based on water company records, water use in public buildings was 60,000 gallons per day in 1994. Using a 90% waste generation rate, this amounts to 54,000 gallons per day of wastewater generated in municipal buildings in 1994. Therefore, the total for the domestic and commercial annual average flows in Branford is the sum of these two values, or 2,074,000 gallons per day.

2. Industrial

An industrial waste survey of all industries located in the service area was conducted to determine the industrial waste component of the wastewater. This was accomplished by obtaining a list of industries currently permitted by the DEP to discharge into the sewer system. This list is shown in Table 4-6.

TABLE 4 - 6
INDUSTRIAL DISCHARGES TO THE SEWER SYSTEM
TOWN OF BRANFORD FACILITIES PLAN

DISCHARGER	PERMIT NUMBER	NATURE OF DISCHARGE
BRANFORD		
* ATLANTIC TRUCKING	SP0000824	FLOOR DRAINS
AUTOCRAFT CORP.	GVS000356	GENERAL PERMIT
BERKSHIRE PETROLEUM	GVW000105	CAR WASH
BLAKESLEE ARPAIA-CHAPMAN	GVW000100	CAR WASH
BRANFORD CAR WASH	GVW000156	CAR WASH
BRANFORD CITGO MART	GVW000176	CAR WASH
* BRANFORD TRANSFER STATION	SP0001423	TRANSFER STATION
BRANHAVEN CHRYSLER PLYMOUTH	GVS000244	GENERAL PERMIT
CINTAS CORP.	SP0000093	INDUSTRIAL LAUNDRY
DEPENDABLE MOTORS	GVS000344	GENERAL PERMIT
* DURABLE WIRE CO.	SP0000188	UNKNOWN
GIOVANI AUTO BODY	GVS000398	GENERAL PERMIT
GRAVYMASTER, INC.	SP0000720	FOOD PRODUCTS
MOBIL OIL SERVICE STATION	SP0000879	CAR WASH
MOBIL STATION	GVW000147	CAR WASH
NEUROGEN CORP.	SP0001063	LAB WASTE
PROCESS CHROME	GPH000182	PHOTOGRAPHIC PROCESSING
SETON NAMEPLATE	GPH000259	PHOTOGRAPHIC PROCESSING
SUBARU OF BRANFORD	GVS000511	GENERAL PERMIT
NORTH BRANFORD		
FIRESTONE BUILDING PRODUCTS	CT0029181	UNKNOWN
FIRESTONE BUILDING PRODUCTS	GCW000001	UNKNOWN
FIRESTONE BUILDING PRODUCTS	GSW000547	UNKNOWN
FIRESTONE BUILDING PRODUCTS	SP0001180	UNKNOWN
FLEXCON CO.	GSW000166	GENERAL PERMIT

* NO LONGER DISCHARGING

Discharge monitoring reports (DMR's) for 1994 were obtained from DEP for the four industries (one in North Branford) required to submit reports in compliance with their NPDES permit. A larger data base was not able to be used since most permits issued to users in town are general permits, meaning that the reporting requirements are limited or not required. Mass loadings and flows were then able to be determined for that monitoring year for these four industries. This provided the industrial component breakdown of the flows to the wastewater treatment plant. These industries and their DMR results are included in Appendix C.

In addition, the DMR's were reviewed to verify that no industrial discharges would be inhibitory to any proposed treatment process or would increase the plant loadings beyond that normally expected. None were noted.

Based on the DMR information available, it is estimated that the industrial flow portion to the treatment plant averages 190,000 gallons per day, some of which is domestic type wastes. Some 15,000 gallons per day of this total is generated in North Branford. For a maximum month flow, flows were expected to increase at a rate of two times the average rate. This multiplier is based on those industries in which DMR flow records are available. Peak flows were estimated to be 25% above these maximum monthly rates.

3. Septage

Septage is generated strictly from Branford residents. Septage flows are based on facility records that are submitted to the DEP with the monthly DMR's. The current procedure is that all septage haulers must provide data on the pump-out location and must then get a permit from the treatment plant. Each septage truck is assumed by the plant operators to contain 2,000 gallons of septage when it is dumped at the plant inlet area. There is no means to verify this, although haulers will advise the plant if less than a full truck is unloaded. On average, the treatment plant receives 4,600 gallons of septage each day with maximum monthly average of 7,200 gallons per day. Based on treatment plant records, septage deliveries peak at 36,000 gpd.

H. I/I FLOWS

Infiltration and inflow impact the total volume of wastewater which flows to the treatment plant. The current base wastewater flow rate of 2,074,000 gpd from Branford (including public building flows), a North Branford flow component of 307,000 gpd, a 190,000 gpd industrial portion, and a septage component of 4,600 gpd sums to a total base flow rate of 2,580,000 gpd or 2.58 mgd. The total average daily infiltration/inflow at the treatment plant is therefore the measured average daily flow of 4.12 mgd less the base flow of 2.58 mgd, or 1.54 mgd. Of this 1.54 mgd I/I component, 1.12 mgd is established as a year-round infiltration value and the remainder of 0.42 mgd is year-round inflow. The 1.12 mgd value is derived by subtracting the average base wastewater flow of 2.58 mgd from the measured average daily dry weather plant flow of approximately 3.70 mgd.

The maximum month infiltration was derived by determining the largest monthly average daily flow during high groundwater periods, but not during or immediately after periods of rainfall. This flow is 4.22 mgd achieved in April of 1994. Deducting the 2.58 mgd base flow establishes a monthly sustained infiltration of 1.64 mgd.

The peak one day infiltration rate was recorded on March 15, 1994. On this day, the daily plant flow was 5.64 mgd. Deducting for the base sewage flow of 2.58 mgd, the peak infiltration is 3.06 mgd.

The peak inflow rate is derived by a review of the treatment plant records and relating this information to rainfall events. A comparison of the peak hourly flow rate is compared to the nearest previous non-rainfall day flow rate at the same hour. The difference is the maximum inflow. Based on this procedure, the maximum inflow occurred on December 5, 1993 when 8.9 mgd of flow was recorded after a 2 inch rainfall. Deducting the previous no rainfall day flow rate at that hour, the maximum inflow is 4.7 mgd. This correlates well with treatment plant personnel information and data established in the I/I study.

I. TREATMENT PLANT LOADS

The Facility's historical data is used to determine the current pollutant loadings of the wastewater and to project future wasteloads. Table 4-7 depict facility flow, influent and effluent BOD and TSS and percent BOD and TSS removals for the historical planning period. Table 4-8 depicts the plant nitrogen loading as determined by the continuing data collected and analyzed in conjunction with the Long Island Sound Study for the noted planning period.

TABLE 4-7
PLANT FLOW & LOADING
TOWN OF BRANFORD FACILITIES PLAN

MONTH	AVERAGE DAILY FLOW mgd	BOD IN (mg/l)	BOD IN (#/d)	BOD OUT (mg/l)	BOD OUT (#/d)	% Removal	TSS IN (mg/l)	TSS IN (#/d)	(mg/l)	TSS OUT (#/d)	% Removal
4/1/95	3.97	182	6,026	25	828	86	178	5,894	43	1,424	76
3/1/95	4.13	167	5,752	21	723	87	164	5,649	35	1,206	79
2/1/95	4.08	171	5,819	15	510	91	156	5,308	26	885	83
1/1/95	4.29	151	5,403	7	250	95	143	5,116	12	429	92
12/1/94	4.12	174	5,979	10	344	94	184	6,322	14	481	92
11/1/94	3.57	184	5,478	8	238	96	194	5,776	14	417	93
10/1/94	3.65	179	5,449	10	304	94	201	6,119	15	457	93
9/1/94	3.73	186	5,786	11	342	94	196	6,097	14	436	93
8/1/94	3.91	156	5,087	17	554	89	156	5,087	24	783	85
7/1/94	3.65	195	5,936	14	426	93	195	5,936	21	639	89
6/1/94	3.83	185	5,909	13	415	93	190	6,069	22	703	88
5/1/94	4.07	176	5,974	16	543	91	182	6,178	27	916	85
4/1/94	4.57	155	5,908	9	343	94	152	5,793	14	534	91
3/1/94	5.35	112	4,997	11	491	90	111	4,953	19	848	83
2/1/94	4.03	143	4,806	11	370	92	132	4,437	16	538	88
1/1/94	4.08	147	5,002	19	647	87	150	5,104	25	851	83
12/1/93	4.33	139	5,020	10	361	93	150	5,417	14	506	91
11/1/93	3.87	169	5,455	12	387	93	176	5,681	25	807	86
10/1/93	3.84	173	5,540	13	416	92	188	6,021	24	769	87
9/1/93	3.76	176	5,519	13	408	93	222	6,962	23	721	90
8/1/93	4.16	180	6,245	18	624	90	176	6,106	24	833	86
7/1/93	3.81	201	6,387	25	794	88	203	6,450	43	1,366	79
6/1/93	3.95	210	6,918	26	857	88	224	7,379	30	988	87
5/1/93	3.94	216	7,098	15	493	93	223	7,328	19	624	91
4/1/93	4.7	147	5,762	14	549	90	149	5,841	15	588	90
3/1/93	5.13	165	7,059	17	727	90	149	6,375	21	898	86
2/1/93	4.17	188	6,538	22	765	88	153	5,321	22	765	86
1/1/93	4.55	177	6,717	21	797	88	159	6,034	25	949	84
Average	4.12	172	5,842				173	5,884			

TABLE 4-8

PLANT NITROGEN FLOW AND LOADING - MONTHLY AVERAGES

TOWN OF BRANFORD FACILITIES PLAN

MONTH	FLOW (mgd) Avg During Sampling	TOTAL KJELDAHL NITROGEN Influent Avg. (mg/l)	(#/d)	Pri. Eff. Avg. (mg/l)	(#/d)	Sec. Eff. Avg. (mg/l)	(#/d)	TOTAL NITROGEN Influent Avg. (mg/l)	(#/d)	Pri. Eff. Avg. (mg/l)	(#/d)	Sec. Eff. Avg. (mg/l)	(#/d)
Dec-94	4.06	20.7	701.8	28.9	978.8	17.7	601.3	20.7	701.8	28.9	978.8	17.7	601.3
Nov-94	3.58	24.5	730.8	33.7	1006.1	16.7	499.3	24.5	730.8	33.7	1006.1	16.7	499.3
Oct-94	3.69	26.7	822.8	32.1	988.0	17.2	530.3	27.4	843.0	32.1	988.0	17.1	530.8
Sep-94	3.68	26.0	797.8	31.7	971.6	19.8	607.0	26.0	797.8	31.7	971.6	19.8	607.0
Aug-94	3.83	24.1	768.3	39.9	1277.4	20.6	658.2	24.1	768.3	39.9	1273.6	20.6	658.2
Jul-94	3.69	27.2	837.4	44.8	1379.3	20.9	644.6	27.2	837.4	44.8	1379.3	20.9	644.6
Jun-94	3.82	26.8	852.2	42.0	1330.5	22.8	724.7	26.8	852.2	42.0	1338.9	22.8	724.7
May-94	4.75	28.7	909.4	40.6	1370.2	23.5	753.9	28.7	859.4	40.6	1370.2	23.5	790.9
Apr-94	4.20	25.7	888.0	42.1	1579.7	15.2	558.6	25.7	888.0	42.1	1579.7	15.2	570.5
Mar-94	5.59	21.8	1016.7	38.3	1786.2	11.7	541.9	21.8	1018.7	38.3	1786.2	11.8	550.3
Feb-94	4.19	21.6	726.1	36.7	1253.5	11.5	427.1	21.5	736.1	36.7	1253.5	12.2	415.1
Jan-94	3.82	30.0	954.5	41.4	1316.8	22.8	725.8	30.2	954.5	41.4	1316.8	22.8	726.8
Dec-93	4.94	19.0	741.6	23.6	947.6	7.5	309.0	19.3	782.8	23.6	972.3	7.5	309.0
Nov-93	3.89	31.0	997.3	43.0	1381.9	19.5	627.5	31.0	997.2	43.0	1381.9	19.5	627.5
Oct-93	3.78	31.1	977.7	44.1	1387.0	19.8	622.2	31.1	977.7	44.1	1387.0	19.3	633.3
Sep-93	3.83	29.5	955.8	50.2	1628.3	19.4	629.8	29.5	955.8	50.2	1628.3	19.4	629.8
Aug-93	4.25	37.3	1321.4	129.4	4589.0	22.9	810.9	37.3	1321.4	129.4	4589.0	22.9	810.9
Jul-93	3.65	32.5	985.9	89.0	2707.0	25.9	787.5	32.5	986.0	89.0	2707.0	25.9	787.5
Jun-93	3.99	37.4	1244.3	84.4	2804.4	30.9	1025.7	37.4	1244.3	84.4	2804.4	30.9	1025.7
May-93	3.94	30.8	1010.1	63.9	2096.3	21.7	711.1	30.8	1010.1	63.9	2096.3	21.7	711.1
Apr-93	4.48	---	---	---	---	---	---	23.0	859.4	42.0	1569.3	12.0	448.4
Mar-93	4.89	25.3	1028.9	72.9	2971.5	16.9	686.9	29.2	1188.7	39.6	1615.3	23.8	970.7
Feb-93	4.80	28.6	1142.4	53.5	2141.5	13.6	542.5	28.6	1143.4	53.5	2141.5	13.6	542.6
Jan-93	5.05	27.3	1146.8	38.3	1609.8	24.1	1015.3	27.3	1146.8	38.3	1659.6	24.1	1015.9
AVERAGE *	4.16	26.4	915.1		1646.5		642.1	27.3	946.2		1555.0		1488.7

* AVERAGES BASED ON COMPILATION OF WEEKLY REPORTS

A review of this data shows that the monthly average BOD at the Branford plant is 172 mg/l with a low month of 112 mg/l and a maximum sustained month of 216 mg/l. Monthly average TSS is 173 mg/l with a minimum month of 111 mg/l and a maximum sustained month of 224 mg/l. Based on current criteria, this wastewater can be characterized as being in the weak to medium strength sewage range. This is a reasonable characterization considering the relatively low level of heavy industrial development and a high residential flow component common with suburban areas and the quantity of I/I received at the facility.

The nitrogen nutrient loadings at the treatment plant show that the average influent nitrogen load to the plant is 27.3 mg/l with a minimum monthly value of 19.0 mg/l and a maximum of 37.4 mg/l.

This is typical of most municipal wastewaters. This information was compiled from the samples sent to the testing lab in Stamford as part of the data gathering program as part of the LISS. The sample dates have been coordinated with plant flows for that day to generate the pounds per day loading data.

Table 4-7 is shown graphically in Figures 4-4 for BOD, Figure 4-5 for TSS and Figure 4-6 for plant flow. Percent removals of BOD and TSS within the treatment plant process, an additional permit requirement, are shown graphically in Figure 4-7 and 4-8 respectively. Within these graphical depictions, plant design capacity as well as required levels of treatment are shown. As can be seen from these graphs, plant flow has exceeded the design capacity of 4.5 mgd in four months within the historical period of record. A review of the BOD removals show that BOD removals have always been within the permit requirements, but TSS removal levels have occasionally violated permit requirements for both percent removed and effluent concentration.

J. INDUSTRIAL LOADS

The industrial component of the total plant load was compiled from effluent information provided as part of the NPDES permitting requirements. Four industries are required to report by this method. The remainder in town are dischargers allocated to general permit status and as such are not required to report or perform a sampling program that would provide useful data for this study. The data from three of the four industries is compiled in Appendix C. The fourth industry is only required to report twice yearly, so its data was considered not statistically significant for this study. The

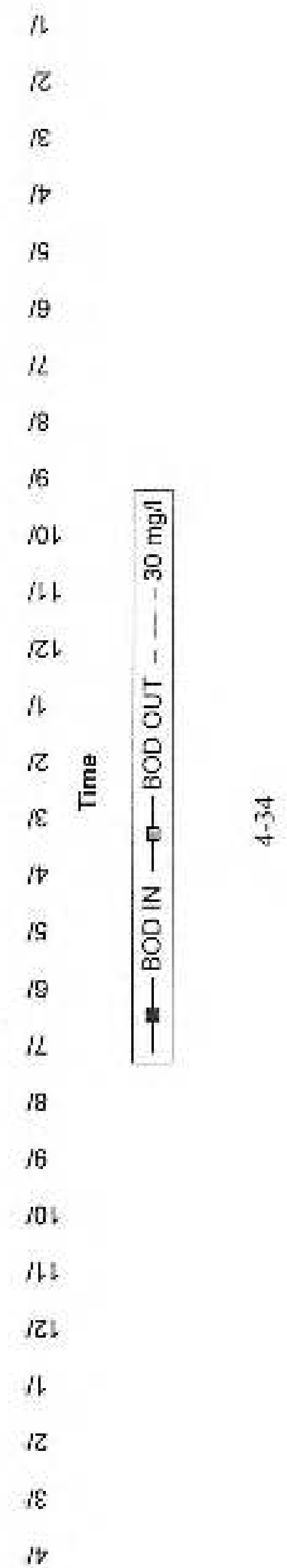


Figure 4-5
TSS INFLUENT AND EFFLUENT
Town of Branford Facilities Plan

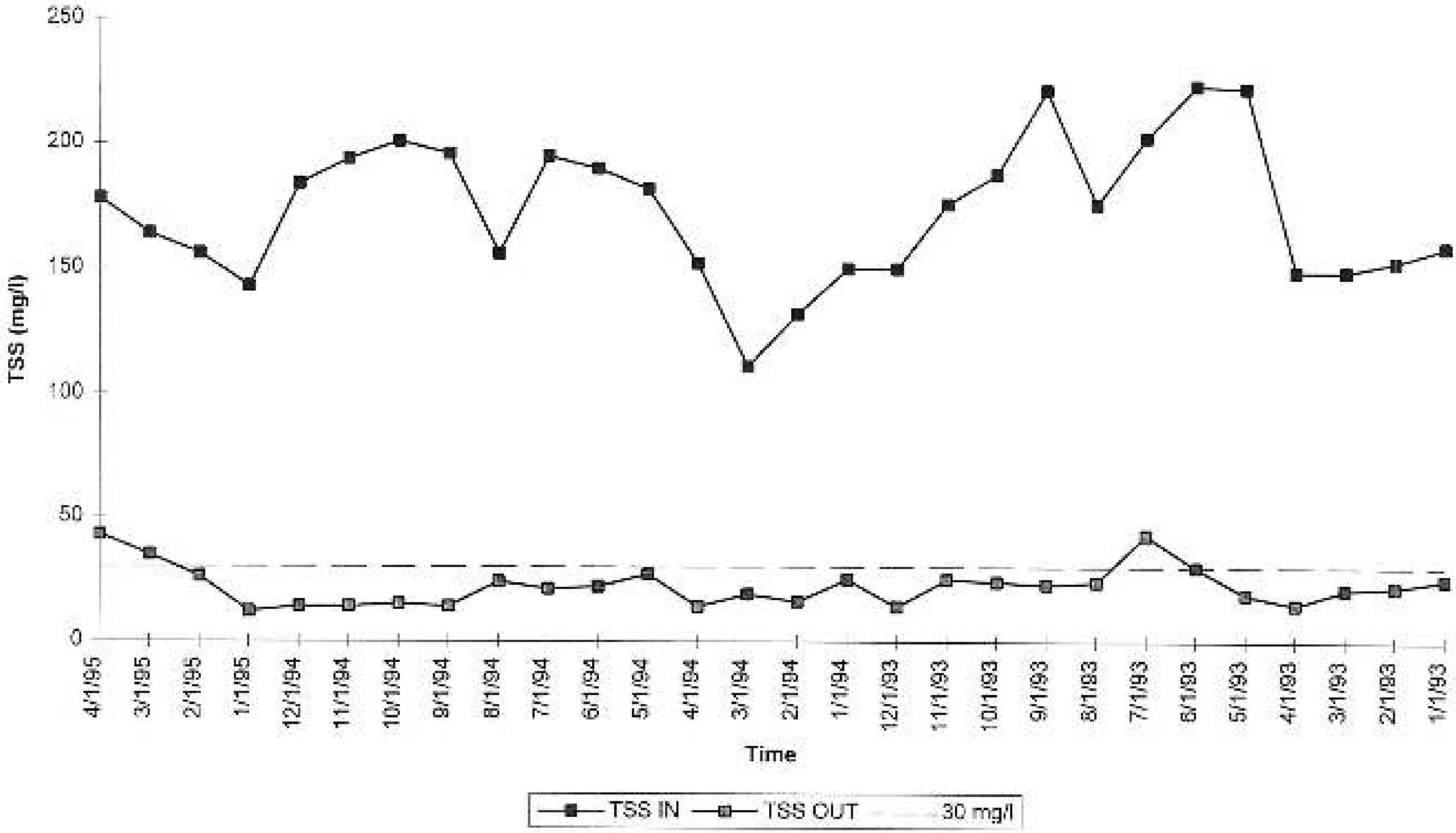


Figure 4-6
AVERAGE DAILY PLANT FLOW

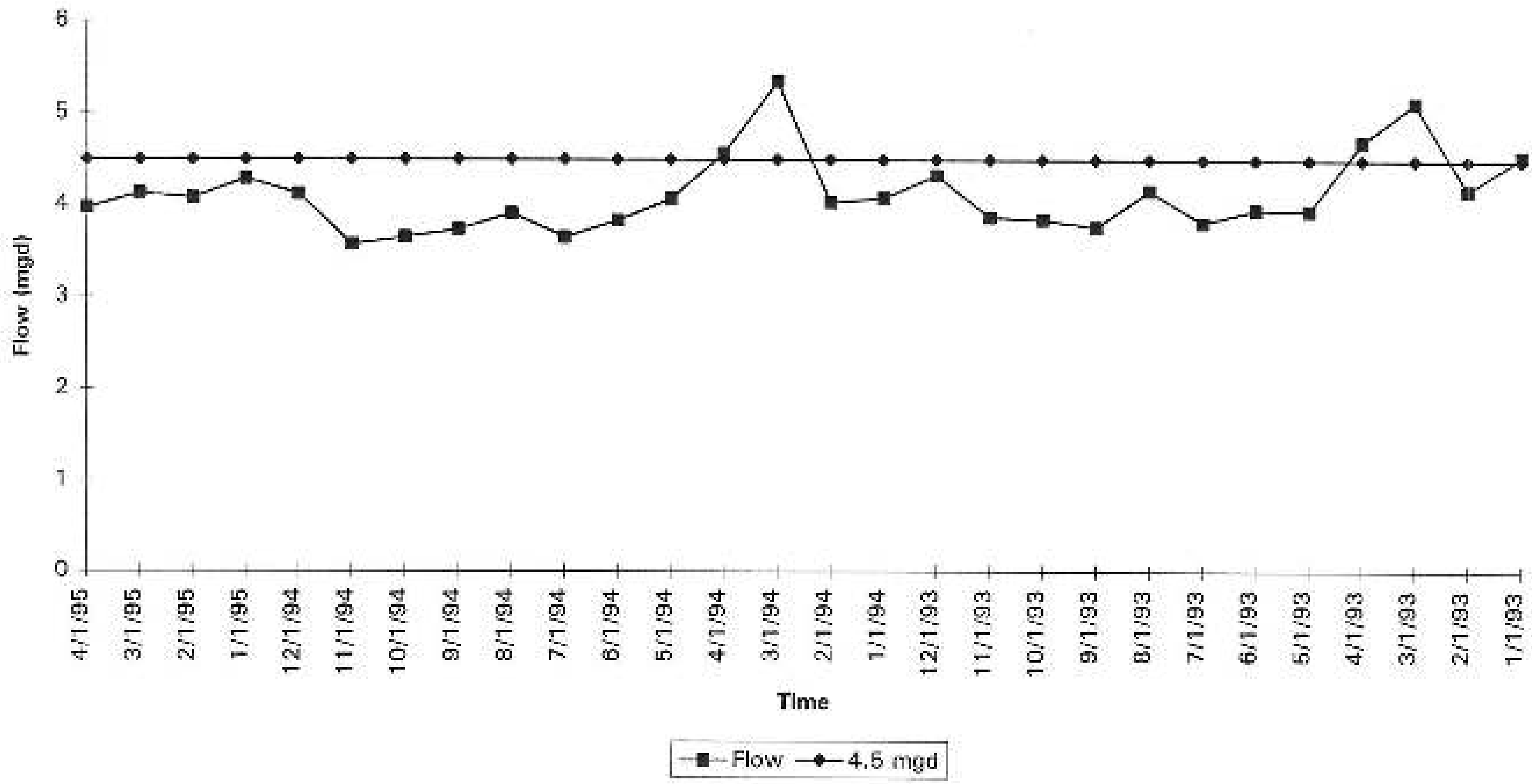


Figure 4-7
% BOD REMOVAL

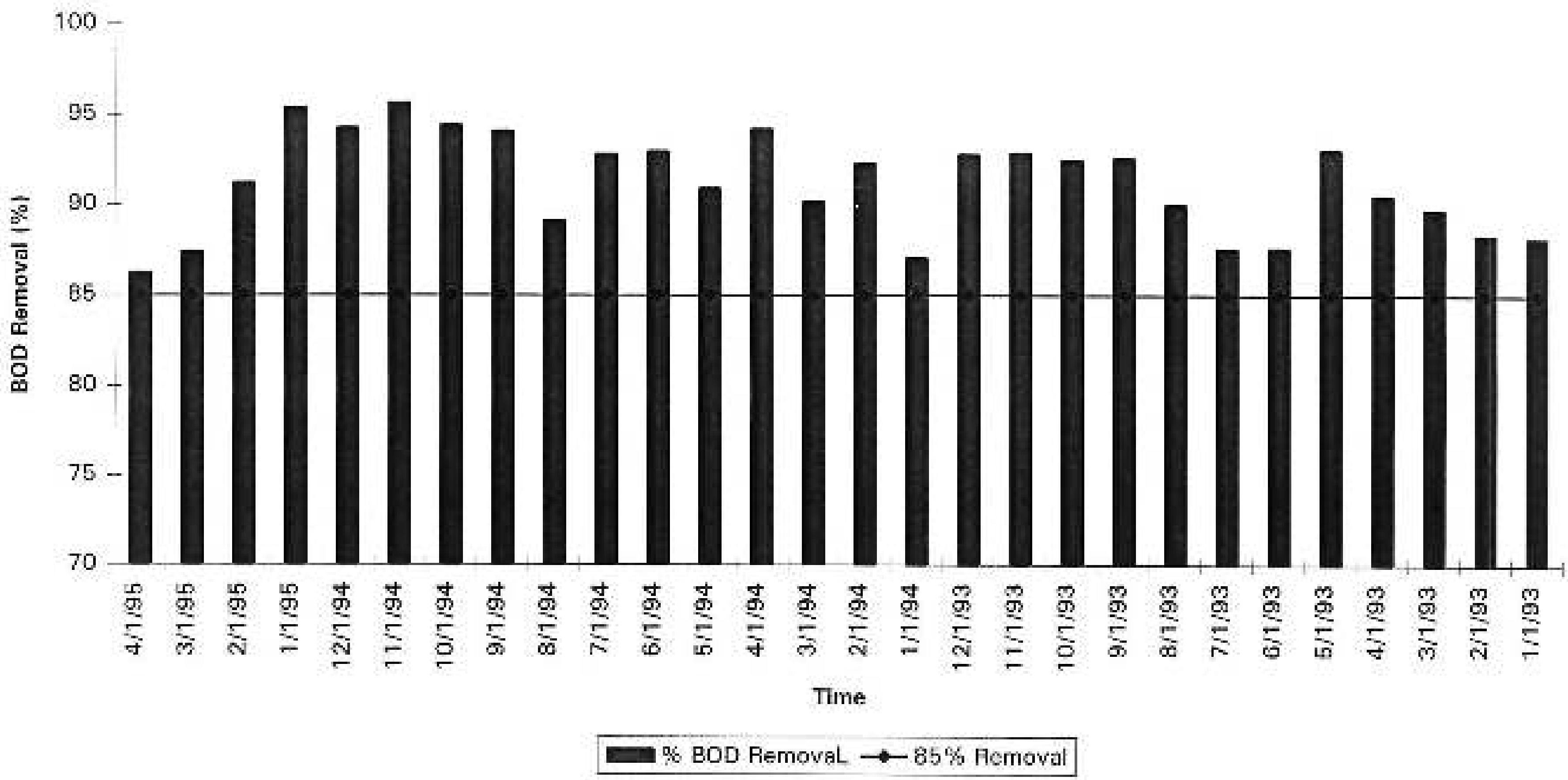
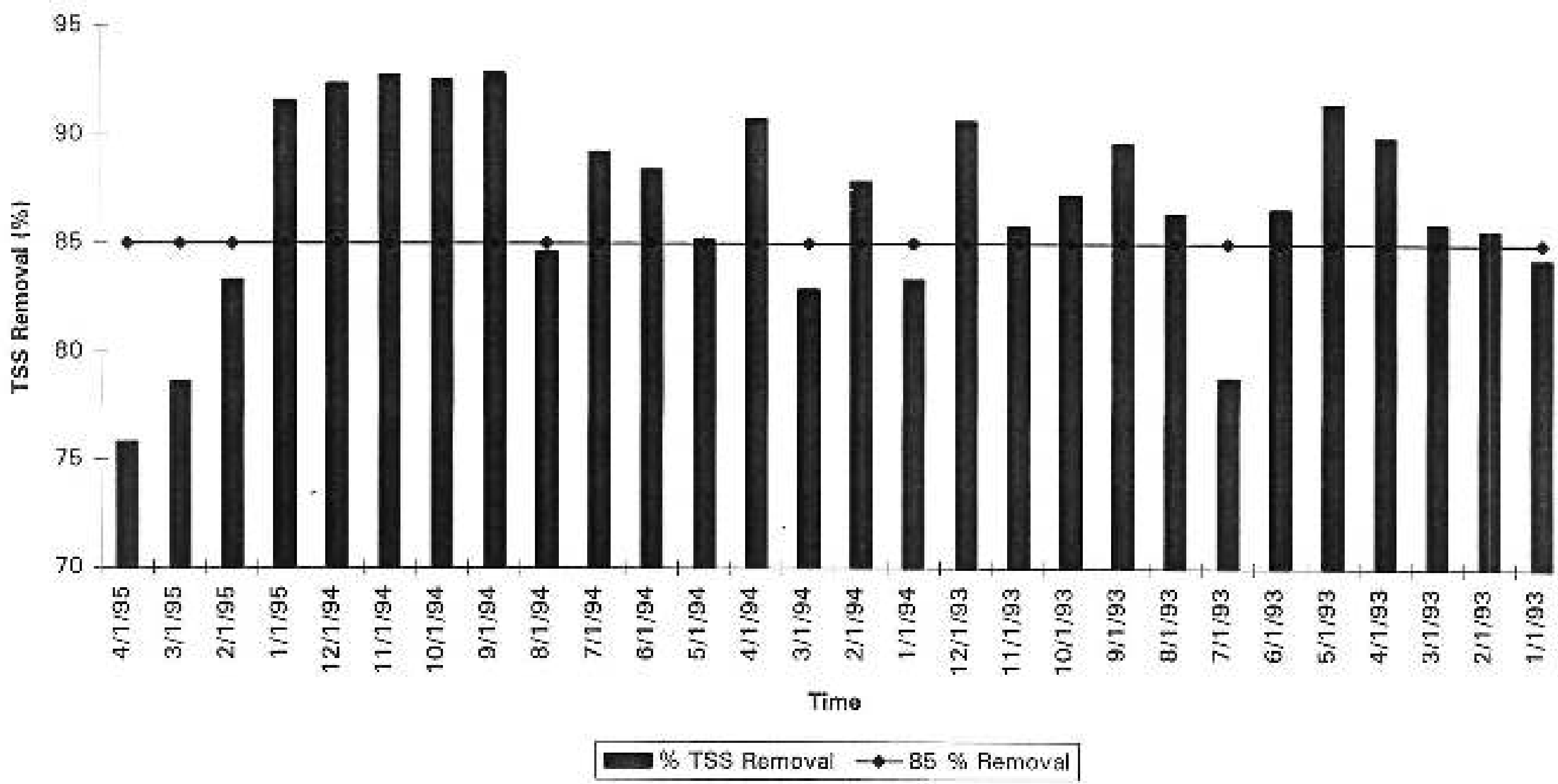


Figure 4-8
% TSS REMOVAL



information contained in this data shows that the BOD and TSS loads contributed by industry is small in proportion to the total plant load.

K. SEPTAGE LOADS

Because there is no long term septage sampling program at the treatment plant, typical pollutant concentrations from EPA's "Monitoring Septage Additions to Wastewater Treatment Plants" were used to project septage loadings. Table 4-9 shows the average loadings that were used to determine plant loads from septage:

TABLE 4-9

Parameter	Concentration
5 day BOD	5,000 mg/l
TSS	13,000 mg/l
TKN	677 mg/l
Ammonia-N	157 mg/l

Based on plant records, the average daily and monthly maximum loadings were calculated for the combined commercial and domestic flows by subtracting the septage, industrial flows and North Branford components from the total. For the purpose of this Plan, loading contributions by commercial users is distributed equally among the residential users. These per capita loading rates are shown in Table 4-10 and will be used in Chapter V for projecting future plant loadings.

TABLE 4-10
PER CAPITA POLLUTANT LOADINGS

Parameter	Average Loading lb/cap/d	Monthly Maximum Loading, lb/cap/d	Ratio
BOD	0.21	0.24	1.15
TSS	0.20	0.25	1.22
TKN	0.033	0.048	1.45
Ammonia -N	0.027	0.034	1.26

The values shown in Table 4-10 above compare favorably with typical loadings that would be expected from a town with these demographics and land use.

L. SLUDGE CHARACTERISTICS

The characterization of the sludge currently generated at the treatment plant is based on data collected quarterly by plant personnel as required by the NPDES Permit. Table 4-11 summarizes the quarterly sludge monitoring data for 1993 to the present.

Disposal or use of sewage sludge biosolids currently falls under "The Standards for the Use or Disposal of Sewage Sludge", Title 40 of the Code of Federal Regulations, Part 503 more commonly known as the "Part 503" regulations. Under these regulations, sewage sludge is classified for use or disposal based on its pollutant levels and its degree of pathogen and vector reduction. Land application, disposal, and incineration criteria are established in these regulations. Sewage sludge which has been suitably stabilized for land application can be referred by the term "biosolids."

This data shown in Table 4-11 indicates that the dewatered sludge at the treatment plant has the potential to meet the least regulated biosolids land application requirements providing certain pathogen reduction limits and vector attraction reductions are met. This would be the classification of exceptional quality (EQ) biosolids with Class A pathogen reduction. This Class A status essentially allows the unregulated reuse of the biosolids for such beneficial purposes as application to parkland, golf courses, gardens and other public or non-public contact sites.

The treatment plant currently would not meet the Class A pathogen or vector attraction reduction requirements since anaerobic digestion is used. If the pathogen reduction limits are not met for Class A levels, use restrictions on biosolids disposal are established. End use of solids will be addressed in Chapter VIII.

M. SYSTEM DEFICIENCIES

A review of the treatment plant operational characteristics and system deficiencies was undertaken as part of the facilities planning process. Major unit processes and pertinent operating conditions and criteria were presented earlier in this Chapter. This section will evaluate the treatment system deficiencies found within the plant processes.

TABLE 4 - 11

QUARTERLY SLUDGE MONITORING REPORTS

1993 TO 1995

TOWN OF BRANFORD FACILITIES PLAN

SAMPLE DATE

PARAMETER	Mar-93	Jun-93	Oct-93	Dec-93	Mar-94	May-94	Aug-94	Nov-94	Mar-95	AVERAGE	CEILING LIMITS	EQ LIMITS
TOTAL SOLIDS IN %	12.7	16.37	25.33	16.74	15.28	15.05	16.22	14.01	14.7	16.35		
FIXED SOLIDS IN %	38.64	31.61	32.55	30.88	33.06	31.36	28.35	29.55	25.5	31.06		
VOLATILE SOLIDS IN %	61.36	68.39	67.45	69.12	66.94	68.64	71.65	70.45	74.5	68.94		
pH	7.4	8.2	7.7	7.5	7.4	7.5	7.3	7.2	7.5	NA		
TOTAL ORGANIC NITROGEN (mg/kg)	66610	59344	35240	42958	18576	49472	52035	37822	65770	43658		
AMMONIA AS N (mg/kg)	4990	4157	2808	3220	4146	2224	2544	2108	10600	4235		
TOTAL PHOSPHOROUS (mg/kg)	18200	22990	15750	9266	16517	20576	17803	16066	14902	15878		
ZINC (mg/kg)	2650	1934	2571	50	2060	2579	4545	2062	1511	2152	7500	2800
BERYLLIUM (mg/kg)	<1.6	<14.2	<9.5	<5.6	<12.6	<15.0	<4	<4.43	<1.52	NA		
COPPER (mg/kg)	1785	585.9	1423	51.8	1060	1203	1083	1405	966	1073	4300	1500
NICKEL (mg/kg)	87	55.3	234	2.76	82	51.1	67	72.1	55.8	79.35	420	420
LEAD (mg/kg)	258	54.5	325	3.4	142	129	142	206	147	148	840	300
CADMIUM (mg/kg)	16	5.2	11.4	0.43	11.4	<1.29	9.9	13.8	6.8	9.24	85	39
CHROMIUM (mg/kg)	83	49.3	182	7.1	62	33.6	55	63.4	32.1	62.59	3000	1200
MERCURY (mg/kg)	2.3	1.4	5.01	3.34	2.81	15.1	16.8	5.78	1.29	5.98	57	17
HYDROCARBONS (mg/kg)	11910	6284	11612	16816	5977	12292	11559	5174	24235	11864		

1. Pre-treatment Area

The pre-treatment area consists of the septage receiving facilities and in-line channel grinder. Septage receiving facilities currently consist of an underground concrete tank in which two submersible pumps are located. None of this system is currently operational and the present practice is for septage trucks to dump their loads into the manhole in Block Island Road. This creates a traffic problem since this road is an access road for a marina and restaurant. It also creates an odor problem and a problem of solids collecting in the manhole, and can create a plant loading problem since the loads are all dumped within a 15 minute period of time. A better means of access to septage receiving facilities are needed. Also, a covered tank with the means to collect and remove large stones and other debris inherent in septage, and a means to aerate and slowly feed the septage into the treatment plant is necessary to eliminate the odors and shock loads currently experienced.

The pre-treatment area was originally sized for the 1.5 mgd facility constructed in 1962. An additional channel and barminutor was added in the 1982 upgrade. Currently, only one channel grinder is operational, the other was removed and not replaced. This channel grinder is capable of processing approximately 7 mgd, a flow that is reached on a regular basis during rainfalls. In practice, the channel grinder operation is such that it cannot process the peak daily flows without significant head loss. When this occurs, the rise in the water surface from the additional flow overflows a slide gate and flows into the bypass channel where the raw wastewater flow receives no screening or comminution. Many solids are noted to be settled out in this channel contributing to the odor problems at the plant. Also, the configuration of the inlet area is such that it is hazardous to operate any of the slide gates since all are located within a below grade structure. Operators must balance themselves over the flow in the channels when any of the gates are operated. A new pre-treatment area is needed for safety purposes and to process all the flow that the treatment plant receives.

2. Grit Collection

The grit collector is a configuration that was designed as part of the original treatment plant. It does not operate efficiently and is a major generator of odors since all raw wastewater (including septage), digester supernatant and thickener overflows discharge to this point.

While the detention times in the chamber are within standard values, there is a significant short-circuiting problem within the chamber due to the outlet configuration. Also, the air diffusers are located so that a good air distribution pattern is not achieved. While strategically placed baffle plates may help this situation, the tank configuration does not lend itself to this while maintaining a proper diffused air feed.

The grit removal process itself is not well suited to remove the grit once collected. The air eductor system piping is frequently blocked from collected grit and storage area for the grit. Once the grit is removed, it accumulates in an open area for removal and additional dewatering. This is a difficult process in inclement weather and extremely difficult in cold weather since the tank is uncovered. Also, any adjustments to the overflow system requires an operator to enter the tank, a safety hazard. A covered tank to control odors, a better means to remove collected grit, a better means to initiate a proper air flow into the tank, and a way to control short circuiting is required for grit removal to function properly.

3. Raw Sewage Pumping

Once the flow exits the grit chamber, it flows to a wet well where all flow is pumped to the primary tanks by the raw sewage pumps. These three horizontal pumps are located in a pit that is below the basement floor elevation. The configuration is such that they can be flooded if there is a leak in the wall or if a pipe breaks. Standard design practice would not place pump motors in a position where they could be flooded, especially in this critical application where the only alternative in this event is bypassing the flow to Branford Harbor. In addition, the pumps are capable of approximately 8.0 mgd with one pump out of service, a flow that is exceeded many times during the year at the treatment plant. Additional pump capacity is required to be able to pump the 10+ mgd flows that have been recorded. Additionally, the pump piping is such that it is nearly impossible to access the check and gate valves since they are located in inaccessible points in the discharge piping. The fact that the pumps are located in a pit and there is limited room for corrective measures suggests that a different pumping and piping configuration be designed.

4. Primary Settling Tanks

The wastewater is pumped to the primary settling tanks through a pipe that gets progressively smaller in diameter as it reaches the final two settling tanks. Flow distribution is accomplished by this means and by adjustment of a gate valve at the influent to each tank.

Theoretical tank surface loading rates and linear flow-through velocities are all within common design parameters for average and peak flows. The tank depths and hydraulic detention time are somewhat less than the standard design practice in use today; however, the measured removal efficiency of the tanks verifies a 50% removal of suspended solids under current average flow conditions. This removal efficiency decreases as the flows increase.

While the theoretical overflow rates of the tanks are within common design parameters, in practice the overflow rates are higher for some tanks due to poor flow distribution. The means that the method provided for flow distribution does not work well in practice - more flow enters the first two primary tanks than the final two and adjustment of the valves ahead of each tank only provides a short term solution. Once the flows increase or decrease, the valves must be adjusted again to regain the balance. This unequal flow distribution increases the overflow rates in the first two tanks and decreases the rates in the final two. A means to equally distribute the flow in the primary tanks is necessary for efficient removals.

Primary sludge is removed by a single plunger pump for all six tanks. This requires that the operator open and close valves in sequence for removal of solids. Since the valves are located in a difficult position to operate, the solids removal task is difficult. This problem, coupled with the poor flow distribution to the final two primary settling tanks has meant that the final two tanks have been taken off-line, increasing the flows to the remaining four tanks.

Primary scum handling is accomplished by collecting the scum in a basin, allowing the scum to float and removing it by hand in buckets. The operation is an undesirable procedure and is made worse by the hydraulic overload in the first two primary tanks which has the effect of submersing the scum trough. Better procedures for scum removal and hydraulic distribution are necessary for proper operation in the future.

5. Secondary Treatment

All flows from the primary settling tanks enter either of the two aeration tanks. There is no means to direct flow to one tank only, consequently, there is no means to take an aeration tank out of service for inspection. The aeration tanks have therefore not been thoroughly inspected since their installation. The oxygen supply system is covered under a maintenance contract and is in reasonably good operating condition, however, none of the automatic operating controls for the oxygen control system are operational since they have been a continuing maintenance problem. Oxygen is therefore fed on a constant rate basis regardless of flow rate which, while operationally adequate, can waste electricity if more oxygen is fed than necessary. Oxygen levels are adequate, and MLSS values and loadings are within design parameters for a pure oxygen system.

The liquid oxygen system storage, used as a backup system for the on-site generation system, is not in use since the storage tanks provided for this purpose leak. There is a maintenance contract with the oxygen generation system manufacturer so that immediate response to a mechanical problem is available.

Return activated sludge is fed into the aeration tanks via the primary settling tanks distribution box at the end of the first two tanks. There is a hydraulic problem at this location since the return sludge and primary tank effluent regularly overflow the box onto the ground while being mixed. Also, the piping arrangement from the six primary tanks is very convoluted with underground valving and pipes of different sizes. This causes the flow to the aeration tanks to be unequal causing different MLSS values and flow rates in the two tanks.

Return activated sludge rates are estimated to be 23% of the plant flow on average although there is currently no means of measuring this number. RAS flow is not paced with influent flow, but is kept at a constant rate throughout the day. Flow metering and flow pacing of the RAS is desirable from a process control perspective.

6. Secondary Settling Tanks

All six secondary settling tanks are operational. Flow distribution to each is accomplished by overflow weirs located ahead of the tanks. This means of flow distribution appears adequate but in reality sludge blankets and flows through each of the six tanks is different for each tank. This causes some difficulty in operations. Overflow rates are within design parameters although the tanks are designed with a relatively shallow eight foot depth. This shallow depth causes solids washout and permit violations at higher flows. Current design practice would be to have a 13 or 14 foot clarifier depth for these flows.

Solids removal from the secondary settling tanks is efficient, however, the telescoping valves provided with the original design are not used. Secondary sludge is removed by means of shear gates which allow the secondary sludge to flow into three concrete structures from which the sludge is delivered through three suction lines to three centrifugal pumps. It is then pumped by these three pumps through a common discharge header to the primary settling tank effluent distribution box. The fact that a common discharge header is used may contribute to the difference in solids removal efficiencies among the secondary settling tanks since the amount of flow pumped with a centrifugal pump can vary for the three pumps and is dependent upon the head and the mechanical condition of the pumps.

7. Disinfection

The chlorine distribution system consists of a single chlorine solution pipe which was fed to each of the two chlorine contact tanks. This method of delivery was not able to deliver chlorine effectively to both of the two chlorine contact tanks, resulting in residual control problems in the furthest contact tank. Efforts to correct this situation have not been successful - equal distribution to both tanks was never able to be achieved and can most likely be attributed to the single underground delivery pipe which was to feed solution to both tanks equally but has never accomplished this objective. Therefore, only one contact tank is used. A means to equally distribute the chlorine to both tanks is needed if chlorination is the desired disinfection method.

8. Gravity Thickening

There are two gravity thickeners, one 20 feet and one 30 feet in diameter. The 20 foot diameter thickener is not operating due to lack of parts - it was part of the original treatment plant. The single operating gravity thickener receives primary sludge when it is noticed by the operators that the primary sludge is thin and requires additional processing prior to digestion. The thickener also receives all of the waste activated sludge.

Floor loading rates to the thickener are within design parameters, however, it is not effective in thickening waste activated and primary sludge in practice as can be seen by the performance of the unit. A means to thicken the waste activated sludge separate from gravity thickening is needed.

9. Anaerobic Digestion

The primary digesters have sufficient capacity and hydraulic retention time, and are generally underloaded with respect to volatile solids per unit volume. According to DMR results, volatile acid levels, pH and alkalinity are all within typical operational parameters. The digested sludge, however, sometimes has a high odor level associated with it indicating that digestion is incomplete. Also, two of the four draft tube mixers on the primary digesters are not operable. This indicates that mixing is not effective and/or that the digesters are loaded up with sand and other grit thereby reducing their available volume. They have not been cleaned for many years and inefficient grit removal at the head of the plant may be cause for some of the problem.

The digesters themselves appear structurally sound although there are some problems most notably with the building roof structure, the digester roofs and groundwater intrusion through the newer secondary digester. The heat exchanger, recirculation pumping, piping, and mixing are all original equipment and are in need of replacement.

10. Sludge Dewatering

The belt filter press is located inside of the Control Building. Current operational procedure is to dewater sludge on a daily basis and occasionally on weekends to keep up with the sludge generated. The belt filter press is old, installed in 1980, and has a very low throughput when compared to modern presses. Its location is also not ideal and odors generated from the dewatering operation are significant. To keep ventilation within the belt press area, the building doors are opened, allowing the odors to drift beyond the plant boundary. This dewatering operation will need to be replaced in any upgrade and the preference would be to locate the dewatering operations to a separate building so that administrative functions can be conducted separate from dewatering operations.

N. O & M PROGRAM

The wastewater collection system, consisting of the pumping stations and sanitary sewers in Branford, is operated under the Wastewater Department as are all treatment plant functions. Staff to operate and maintain the treatment plant and collection system consists of 11 people with various levels of responsibility and expertise. Table 4-12 shows a breakdown of personnel and their function. The following discussion outlines the current operation and maintenance considerations and responsibilities. For the purposes of this discussion, the wastewater department O & M will be divided into three separate areas; pumping stations, sanitary sewers and forcemains, and the treatment plant.

O. PUMPING STATIONS

All pumping stations are visited by treatment plant staff at least once per week. Two treatment plant staff people are dedicated to this inspection. All 48 pump stations are visited over a four day period of time on Monday, Tuesday, Wednesday and Friday. Some of the pumping stations that sewer small service areas are visited twice during the week because they are not equipped with an alarm system. Thursday is an open day reserved for repair or maintenance on any pump station or ancillary equipment noted in the site inspections to be in need. Additional treatment plant staff such as a mechanic or electrician are assigned as needed to perform repairs, capital improvements or maintenance. Pump stations are not visited on weekends unless an emergency situation arises at which time plant staff are assigned to investigate.

TABLE 4-12

BRANFORD FACILITIES PLAN

WASTEWATER DEPARTMENT STAFFING AND FUNCTIONS

Job Titles	No. of Personnel in Yr, 95/96	Functions of Staff Members (See Footnotes)
Superintendent of Plant	1	1, 2, 3
Mechanic	1	5
Operator/Process Operator	1	6, 7
Operator/Process Operator	1	6, 7
Operator/Lab Technician	1	8
Asst. Mechanic	1	4
Laborer/Operator	1	7, 9
P.O. Oper./Coll. Sys. Maint.	1	7, 10
Operator/Mechanic	1	7, 11
Collection System Supervisor	1	12, 13, 14
Electrician/Mechanic	1	7, 15
Total	11	

Footnotes

1. Supervises daily operation of treatment plant.
2. Assists with daily operations and maintenance of collection system
3. Provides administration of Wastewater Department
4. Performs general maintenance activities for collection system.
5. Performs general maintenance of collection system, including:
    a) Pump, pipe, and valve repairs.
    b) Small vehicle repair and maintenance.
6. Handles day to day operation of plant.
7. Assists with collection system maintenance on an as-needed basis.
8. Laboratory technician at treatment plant on a full time basis.
9. Assists with daily operations and maintenance of plant.
10. Handles septic tank pump out service.
11. Performs general maintenance of treatment plant components including:
    a) Pumps, valves, and pipe.
    b) Unit operations equipment.
12. Supervises daily operations of collection systems.
13. Assists with daily operations and maintenance of treatment plant.
14. Assists with general administration of Wastewater Department.
15. Wastewater Department electrician with activities associated with all new installation, repairs, etc. for treatment plant and collection system.

The maintaining of the mechanical and electrical components of the 48 pumping stations is mostly accomplished by the treatment plant personnel. There is a schedule of pump station visits, a checklist of inspecting duties, operational checks, and maintenance items that are required at each site. This checklist includes inspection of the operation of all pumps and level controls, maintaining the grounds, and inspecting the emergency power supply. Because of the large number of pumping stations and the current staff assignments, it is difficult to effectively perform all of the tasks associated with the pump station visit schedule and checklist.

Preventive or predictive maintenance is generally not able to be accomplished at present because of time constraints. Because of this, a larger than desired portion of the pumping station repair or maintenance work performed is of the "immediate" variety. Utilizing staff on this basis to effect repairs, while necessary on occasion, is not an efficient way to utilize personnel since it may take away staff from performing other necessary functions at the treatment plant. It also places the operation of the pumping station at a disadvantage since repairs may take weeks to accomplish, especially if the pumps or equipment are old and availability of parts is limited. In recognizing this situation, the treatment plant staff have over the years, as much as possible, collected spare parts and pumps that they are sometimes able to be used at other pumping stations in an emergency. Future staffing levels in this department should include pumping station assignments for preventive and predictive maintenance.

Maintenance of the pumping station emergency generators are contracted out yearly. The contract agreement covers regular maintenance items of all generators such as coolant level checks, oil and filter changes, proper operation and belt inspections among other items. Repairs are made as needed and the additional cost of parts and labor are added to the maintenance contract. There is also a provision in the contract for emergency call-out if necessary. Pumping station personnel also exercise the equipment on a weekly basis to ensure proper operation.

Currently, the Town is undertaking a systematic replacement of pumping equipment, controls and electrical equipment. This program has been underway for a number of years and many positive improvements have occurred. However, to bring 48 pumping stations into a reasonable level of reliability will require more staff and funds than currently allocated. Otherwise, it will take a number of years to complete the necessary improvements and the current method of emergency repairs will be prolonged until the program is completed. It is preferable to quickly reach a high level of reliability in all pumping stations and then perform preventive and predictive maintenance than to continue on an emergency repair program. The replacement and upgrade program should be funded at a higher level so that all older pumping stations (some from the 1960's and 1970's) have their pumps and necessary electrical equipment replaced within three years. Consideration should be made to hire additional staff to maintain and perform predictive maintenance to extend pump station life. Also, a long term pump station preventive maintenance program should be implemented to systematically maintain all pump stations in good operating condition.

At present, 38 of the 48 pumping stations are alarmed. Those that are not alarmed are located in small service areas and are visited twice weekly to ensure proper operation. The Town has decided to replace the current telemetry system at the pumping stations that currently have alarms, alarm the ten unalarmed pumping stations, and transmit all alarms to a master panel to be located at the treatment plant. Earth-Tech/Whitman & Howard, Inc. undertook an investigation into the best means to accomplish this telemetering as part of this Plan. The report of our investigation is attached as Appendix D. Once this telemetering program is implemented, all pumping stations will be alarmed thereby significantly reducing the possibility of a problem in any station service area. Integration of this alarm system with any treatment plant upgrade should be coordinated.

P. SANITARY SEWERS AND FORCEMAINS

In the past, no regularly scheduled maintenance work was performed on the sanitary sewers, manholes or forcemains. Sewer system blockages are responded to when they occur by borrowing a truck from Public Works. Blockages unable to be cleared this way are then contracted out. Last year, however, the Town initiated a program to clean 25,000 feet of sewer on a yearly basis. Sanitary sewer lines should be cleaned to reduce the potential for odors, remove accumulated grease, grit, and biodegradable material, and to ensure that pipe capacity is maintained. Typically, sewer system maintenance would consist of cleaning sewer lines and manholes by high velocity water jetting and inspecting the sewers and manholes for leaks and general system integrity. Severely dirty sewer lines containing heavy grit, settled solids and roots are not able to be cleaned by water jetting and are usually cleaned on a contract basis.

Q. TREATMENT PLANT

The treatment plant was last upgraded in 1982. Much of the mechanical and electrical equipment is now 14 years old and at the time of the treatment plant upgrade will be nearing 20 years old. In addition, some of the original 1962 treatment plant structures are still being used regularly.

The treatment plant is staffed by 11 people eight hours per day Monday through Friday from 7:00 a.m. until 3:30 p.m., and by one person for five hours each day on weekends. Facility O & M responsibilities include:

- Exercising operational control over all plant processes;
- Training operating personnel in the proper operation and maintenance of equipment, safety and treatment processes;
- Keeping continuously informed of the best operating and maintenance practices;
- Scheduling start-up and shut-down operations of equipment and processes as necessary for proper operation of treatment facilities;
- Providing training and ensuring the efficient and safe operation of all equipment, appurtenances, processes and physical facilities;
- Vigilance over operations to ensure against overloading in any process or equipment area;
- Providing budget planning for capital improvements and maintenance;
- Conducting laboratory tests for process control and unit performance evaluation;
- Analyzing and interpreting the operating and laboratory data to maintain optimum operation of the processes and equipment and for developing a data base for implementing improvements in operation;
- Inspecting equipment on a regular basis with respect to preventive and predictive maintenance;
- Determining the need and method of repair, overhaul and replacement of equipment;
- Maintaining records of all repairs;
- Maintaining a clean workplace.

Current operational procedures at the treatment plant are to utilize in-plant process laboratory testing and operator experience to control the treatment operations. Important process parameters that are used to control the operations at this plant are the MLSS inventory in the aeration tanks, chlorine residual, SVI, D.O. in the aeration tanks, overall solids inventory including wasting volumes and percent solids from the primary and secondary settling tanks, digester temperature, alkalinity, volatile acids and pH for digester operation control, and occasional waste solids testing for additional control of the solids inventory. Plant personnel use this data and experience to maintain plant process and operational parameters at levels that they have found to be effective.

Current maintenance procedures at the treatment plant are to have each process operator inspect their respective plant pumping, piping, and process equipment on a daily basis. Basic maintenance such as greasing of bearings and oiling of equipment is performed by the plant operators on a regular basis. Equipment noted by the operators as being in need of repair or not operating properly is reported to the plant supervisor who then schedules the repair of the equipment either with in-house staff or an outside contractor. Spare equipment is then used by the operators until the equipment is repaired.

The treatment plant currently has a mechanic and an electrician who are used to effect most of these repairs with help from the operators. This method of repair allows the operators to become more familiar with the plant equipment which in turn helps them in maintaining it in the future. Complicated maintenance or repair projects such as pump seals, motor repair, oxygen generator work and similar projects are contracted out to a reliable group of repair firms that have been successfully used at the treatment plant in the past. Excluding the oxygen generation and emergency generator equipment, there is no formal program for preventive or predictive maintenance at the treatment plant.

The most complicated equipment at the plant is the oxygen generating equipment. Recognizing this, the plant supervisor maintains a contract with the equipment manufacturer to inspect and test the oxygen generating equipment over a one week period on an annual basis. Minor repairs to the equipment are accomplished by plant personnel. In addition, the contract typically will include an emergency call-out service for repair. The aeration system backup liquid oxygen tank is currently not maintained in a full state because of leaks, however, liquid oxygen can be obtained quickly if needed in an emergency. The emergency power supply maintenance is also contracted out to the same firm that does the pumping station generators.

The purchase of parts and services for equipment repairs is accomplished under a separate line item in the yearly budget. At the beginning of the budget year, this budget for equipment repairs is estimated based on past experience and an understanding of the current condition of equipment. If this line item in the budget is exceeded in the fiscal year for an emergency repair, the plant superintendent first completes the emergency work and then presents the repair bill to the finance board for approval. In the past, these bills for additional repair money in an emergency have always been approved and there has been no loss of treatment plant processes for lack of repair money. A line item in the current budget for a sinking fund would alleviate this process.

If it is recognized by the plant supervisor that a major repair or upgrade is needed, it is included as a separate line item in the budget so as not to use the operational or repair budget.

Within the operation of the treatment plant, an in-house laboratory staffed by one person performs nearly all of the plant operational monitoring and testing. This testing includes BOD, TSS, temperature, pH, settleable solids, MLSS, DO, SVI, chlorine residual, fecal coliform, and turbidity as well as other in-plant process functions such as percent solids of waste streams and digester parameters such as volatile acids, temperature, pH and alkalinity. In addition, the laboratory operator is in charge of the purchase of lab chemicals and also the maintenance of all plant testing records.

To perform these functions, the treatment plant is equipped with a laboratory provided under the 1982 upgrade. A list of major laboratory equipment and its age and condition are included in Table 4-13. A list of testing frequency, parameter and sample type is shown in Table 4-14.

Other testing required by the NPDES permit that are currently contracted outside are quarterly toxicity testing and quarterly dewatered sludge testing. Nitrogen series testing is performed by the Stamford laboratory by contract through the DEP.

TABLE 4-13

TOWN OF BRANFORD

FACILITIES PLAN

IN-HOUSE LABORATORY TESTING

INFLUENT

PARAMETER	FREQUENCY	SAMPLE TYPE
Biochemical Oxygen Demand (Five Day)	12/Month	Daily Composite
Total Suspended Solids	12/Month	Daily Composite
pH	20/Month	Grab
Settleable Solids	20/Month	Grab

AERATION UNITS

PARAMETER	FREQUENCY	SAMPLE TYPE
Dissolved Oxygen	1/Day	Grab
Total Suspended Solids	1/Day	Grab
Sludge Volume Index	1/Day	Grab

EFFLUENT

PARAMETER	FREQUENCY	SAMPLE TYPE
Biochemical Oxygen Demand (Five Day)	12/Month	Daily Composite
Total Suspended Solids	12/Month	Daily Composite
Chlorine Residual	4/Working Day	Grab
Fecal Coliform	12/Month	Grab
Dissolved Oxygen	20/Month	Grab
Temperature	20/Month	Grab
Settleable Solids	20/Month	Grab
Turbidity	20/Month	Grab
pH	20/Month	Grab

DIGESTERS

PARAMETER	FREQUENCY	SAMPLE TYPE
Temperature	1/Week	Grab
Alkalinity	1/Week	Grab
Volatile Acids	1/Week	Grab
pH	1/week	Grab

TABLE 4-14

MAJOR LABORATORY EQUIPMENT LIST

	Unit	Condition	Comments
1.	Turbidimeter	Fair	13 years old
2.	Desk Top Programmable Incubator	Fair	13 years old
3.	Analytical Balance	Fair	13 years old
4.	Binocular Microscope	Fair	13 years old
5.	Bench Top Vacuum Pump	Poor	13 years old
6.	Pressure Cooker (Coliform Equipment)	Good	2 years old
7.	Compact Water Distiller (BOD Dilution Water)	Inoperable (Glass Condenser Cracked)	
8.	Colerimeter, Cl_2 (Hand Held))	Good	New
9.	pH Meter	Fair	13 years old
10.	Large Incubator (for BODs and Dilution Water Storage)	Fair	13 years old
11.	Plant Influent and Effluent Sampling Systems	Poor	Effluent (No Refrigeration) Influent (No Refrigeration, Temperature Adjustment))
12.	DO Meters	Good	1 for Aeration, 5 years old 1 for BOD, New
13.	DO Probes	Good	1 Aeration (New) 1 BOD (New)
14.	Centrifuge	Inoperable	Broken Tube Holder - Repaired Locally, Broke Again
15.	Muffle Furnace	New	
16.	Small Refrigerator (Sample Storage)	Fair	13 years old
17.	Small Drying Oven	Fair	13 years old
18.	Large Drying Oven	Fair	13 years old

R. SEWER USE ORDINANCE

Section 22a-482-3(f) of Connecticut Clean Water fund Regulations require that any municipality applying for funding assistance to demonstrate that a sewer use ordinance has been or will be enacted prior to construction of proposed facilities and be enforced.

The sewer use ordinance is intended to:

- Inform the public as to the technical and administrative procedures to be followed in obtaining a connection to the sanitary sewer;
- Prevent the introduction of pollutants into the sanitary sewer system which will interfere with the collection or treatment system;
- Prevent the introduction of pollutants into the treatment system which will pass through the treatment system, inadequately treated, into the waters of the State or otherwise be incompatible with the system; and
- Improve the opportunity to recycle and reclaim wastewaters and sludges from the system.

This sewer use ordinance must, by regulation:

- Prohibit any new connections of inflow to the sanitary sewer system;
- Ensure that new sewers and connections are properly designed and constructed; and
- Require that all wastewaters discharging to the treatment plant not contain toxics or other pollutants in amounts or concentrations that endanger public safety or the integrity of the treatment system, cause violations of the discharge permit, or preclude the selection of the most cost-effective alternative for wastewater treatment or sludge disposal.

In 1962, the Branford sewer use ordinance was originally developed and adopted. This date coincides with the first installation of sewers in town and with the construction of the wastewater treatment plant. In the years following adoption of this ordinance, modifications were made to enhance the document and to comply with all modifications to the State of Connecticut Model Sewer

Ordinance for Connecticut Municipalities, 2nd Edition, March 1982. This document was then approved by the Department of Environmental protection on March 10, 1982. Appendix E contains a copy of the current Sewer Use Ordinance and all amendments and additions.

In developing the Facilities Plan, this Ordinance was reviewed for consistency with State and Federal Regulations and with the planned mode of future operations at the treatment plant. As a result of this review, the following suggestions are presented to update the ordinance to protect the operation of the wastewater treatment plant in anticipation of the new level of treatment that will be required:

1. **Section 204-16:**

   In addition to BOD and suspended solids, a limit should be set as to what constitutes "normal sewage" with specific reference to ammonia levels. This "normal sewage" level is suggested to be set at 28 mg/l for ammonia. Any discharges above this level will become subject to a cost recovery surcharge as defined under Section 204-41.

2. **Section 204-31:**

   Discharged wastewaters that reduce the alkalinity of the wastewater shall not be accepted.

V. FUTURE CONDITIONS

A. INTRODUCTION

One of the key elements in Facilities Planning is to forecast conditions in the study area throughout the future planning period. The planning period is established as being 20 years past the date when the proposed treatment plant facilities are to become operational. For this Facilities Plan, the planning period will begin in the year 2000 and end in the year 2020.

To evaluate future wastewater treatment system needs, the conditions that are to be expected in the 20 year planning period must be established. To accomplish this, historic trends in the Town, the available land for residential, commercial and industrial development, projections of water use and population growth must all be established as accurately as possible. This is not an entirely analytical process and best professional judgement is used in conjunction with historic data to help establish the future trends, flows and loads.

To effectively project future trends, existing and historical demographic data is reviewed and used where it applies. In Chapters III and IV, applicable information pertaining to the existing conditions that could conceivably impact future development within the planning area were established. The information developed in those chapters included such data as wetland and watershed areas unavailable for development, water supply and subsurface disposal limitations, demographic trends and topographic limitations and also the establishment of flow breakdowns and per capita plant loadings that pertain strictly to Branford. These Chapters also described the problems with the operation of the existing treatment and collection system and the deficiencies that will need to be corrected to meet new NPDES permit limitations and nutrient removals. This information provides the basis for projecting land development, population and waste loadings which are then used to establish the future waste loads and flow to the treatment plant. The deficiencies at the treatment plant and their cost of correction are established which, in turn, is used to determine the most cost-effective means to accommodate the projected development and treatment requirements through the planning period.

The following sections describe how future development, population, flows and loadings were established for the planning period. These projections will be used as the basis for determination of the best means to accomplish wastewater treatment to meet the new NPDES permit limitations.

B. POPULATION PROJECTIONS

Population projections for Branford are extrapolated from data supplied by the State Office of Policy and Management (OPM). For Branford, the population projections by OPM for the planning period are shown in Table 5-1.

TABLE 5-1

TOWN OF BRANFORD POPULATION PROJECTIONS

YEAR	POPULATION
1990	27,603
1994	28,320
1995	28,500
2000	29,200
2005	30,000
2010	30,800
2015	31,600
2020	32,400

The population in Branford is expected to grow steadily from an estimated population of 28,500 in 1995 to a peak of 32,400 in the year 2020. For the purposes of this plan, therefore, a planning period population of 32,400 will be used.

The same population projection report also determined that the North Branford population growth is expected to increase to the year 2020, however, the more important concern is the actual projected increase in the sewered population to Branford. This is established by the Town of North Branford to be an annual average flow of 500,000 gallons per day. See Appendix F for a report from North Branford on its sewer system needs for the planning period. Currently, they discharge 307,000 gallons per day plus a 15,000 gallon per day industrial flow.

C. UNSEWERED AREAS

In addition to population and other industrial and commercial growth in town, there is the likelihood that some currently unsewered areas in town may best be served by providing sanitary sewers within the planning period. Three areas have been defined as being likely candidates for sewering based on discussions with the East Shore District Health Department and a review of the surficial geology maps and current zoning regulations. These three areas are described as follows:

- Rose Hill Road area in the southwestern section of town; This area is characterized by R-4 zoning (20,000 SF lots) and poor soil conditions. Also in this area is a poultry distributor which generates 4,000 gallons per week of wastewater from cleanup operations in addition to domestic wastes from the employees. It is estimated that there are some 43 homes or lots in this area that would be connected in addition to the poultry operation.

- Stony Creek area south of Route 146; This area is characterized by small lots, poor soils, high ledge and high groundwater tables. It is estimated that there are some 325 lots in this area.

- Northford and Ridge Acres Road area; This area is an area of older homes some of which now are currently experiencing subsurface disposal problems. Site constraints determine that sanitary sewers would best serve this area. It is estimated that about 65 homes and lots are included.

D. FUTURE WATER SUPPLY

Potable water is supplied to the Town of Branford by the South Central Connecticut Regional Water Authority (SCCRWA) via the Lake Saltonstall surface water supply system. There are no other public utilities that provide potable water in this area. The Saltonstall service area, which also includes parts of New Haven and East Haven, is projected to grow in total population and public water service population in the planning period. As planned by SCCRWA in their "Long Range Demand Study, 1990 - 2040", the flow capacity required for the Saltonstall service area is 6.74 mgd. This is 89% of the current safe yield of approximately 7.6 mgd. Supply capacity for the planning period is therefore adequate and will not be limiting to growth.

E. PROJECTED WASTEWATER FLOWS AND LOADINGS

Wastewater to the treatment plant consists of individual flows and loads from residential and commercial sources, industries, and septage. These waste generators comprise the base flows to the treatment plant. These flows and loads are established exclusive of infiltration and inflow which is essentially uncontaminated water that is added to these base flows to comprise the total plant flow and load.

To forecast the future flows and loads to the Branford treatment plant, existing unit base flows and loads established in Chapter IV for each of the above categories are used. Projection for future population, industrial and commercial growth are based on published projections for growth in concert with local planning agencies projections and use of sound judgement. Flows from North Branford are provided by that Town's planning projections.

Details of each unit wasteload projection and flow establishment are described below. The compilation of the data is included in Table 5-2.

1. Domestic and Commercial

To forecast domestic and commercial wastewater flows and loads due to future population growth within Branford, OPM population projections were used as the basis. This population growth, as discussed previously, will add an additional 4,080 people to the current population in town. Flows and loads from this increase are calculated using unit flows and loads established in Table 4-10 and estimating that 60% of the additional population will be served by sewers. This number is lower than the current 82% but reflects that available land for development is split between non-sewered areas and areas likely to be sewered within the planning period. The additional sewered population due to population increase is therefore 2,448 people.

To this expected population increase are added the estimated flows and loads from unsewered areas within town that are expected to be sewered within the planning period. These areas are the Stony Creek area, Rose Hill Road area and the Ridge Acres Road area. In total, these areas add 433 homes to the current sewered population. Using a town-wide density of 2.34 people per household, a number based on census data, this is an additional

1014 people added to the current sewered population of 23,222 people. Table 5-3 shows the expected sewered population for the planning period.

TABLE 5 - 3

PROJECTED SEWERED POPULATION

Current sewered population	23,222
Population increase to be sewered	2,448
Stony Creek, Rose Hill and Ridge Acres areas	1,014
Total future sewered population	26,684

The sewered population is projected to contribute an annual average of 87 gallons per capita per day as established in Chapter IV. It is expected that per capita water consumption will not increase during the planning period, an assumption that is also expected by SCCRWA, and that wastewater flows will not increase accordingly. Loading rates are expected to be contributed based on historical data established in Chapter IV and shown in Table 4-10.

It is planned that municipal building flows and loads will not increase over the planning period and remain at 54,000 gpd. It is also planned that the increase in sewered population and its corresponding increase in flows and loads includes any additional increase in commercial flows and loads.

To determine the maximum monthly flows and loads and the peak hydraulic flows for the domestic and commercial flows, historical peaking factors established in Chapter IV are used. These are 1.1 and 2.5 respectively for monthly maximum and peak hydraulic flows. To establish maximum monthly loadings, peaking factors established from historical data and shown in Table 4-10 were used.

2. Industrial

Industrial flows and loads are based on historic water usage and the available land area remaining in town for industrial development. Currently, 488 acres of gross useable space is available for development in areas that are already sewered. It is expected that industry will occupy this acreage in the planning period. The current rate of water use is 350 gallons per gross acre per day for industry presently in town and it is estimated that the waste generation rate is 70%. This provides a waste generation rate of 245 gallons per acre per day (g/ac/d) which is low for industrial flows. To account for future industrial flows, a water consumption value of 500 gallons per gross acre per day was used. With a waste generation rate of 70%, the wastewater flows projected from industry are 350 gallons per gross acre per day.

Loadings generated by industry are difficult to establish under any circumstances due to the variable nature of industry. Future industrial waste loads are therefore assumed to have the same pollutant levels as domestic wastewater. Maximum monthly flows are projected to have a peaking factor similar to the present day peaking factor of two. An additional 25% is anticipated for peak hydraulic flowrates over the maximum monthly rate.

3. Septage

Septage is accepted from town residents only. It is expected that this septage policy will remain in effect for the planning period. The additional septage flows that will be generated are therefore due to the increase in the sewered population expected by OPM projections and deducting for the planned sewered population.

4. Infiltration and Inflow

The Town of Branford expects to remove known or suspected I/I sources in a planned program. This removal of I/I is based on the Gannet-Flemming I/I report completed in May of 1995 and based on plant personnel's knowledge of the collection system. The program to reduce inflow will be to remove public sources such as catch basins, and also to eliminate sump pumps, roof leaders and foundation drains noted in the report. Areas suspected of serious infiltration will be repaired on a case by case basis.

Recognizing that the town plans to pursue I/I removal aggressively, it is expected that inflow will not increase during the planning period. System wide, infiltration is expected to increase at a rate of ½ % per year which reflects the towns plans to remove infiltration and takes into account the deterioration of piping in town.

5. Hydraulic Capacity - Central Pump Station

As discussed in Chapter IV, the Central pumping station is undersized for its current flows. To increase its flow capacity and alleviate the manhole overflows near the pump station, it is recommended that this pump station be increased in size to 4,600 gpm capacity. Since the basis for the hydraulic peaks in Table 5-2 are extrapolated from current treatment plant records, this increased flow capacity from the Central pump station is not reflected in the treatment plant hydraulic peak and must be added in separately. The hydraulic capacity at the treatment plant will need to be increased by the difference of the current capacity of the Central pump station to that of the future capacity of 4,600 gpm. This difference is 1,400 gpm, or 2.0 mgd.

6. North Branford

Based on a May 9, 1996 letter prepared by the Town of North Branford and approved by the Town Water Pollution Control Authority, the projected average daily flows to the Branford sewer system for the 20 year planning period will be 500,000 gallons per day. This letter is attached in Appendix F. Projections for the maximum month flows were then established based on current peak to average ratios. Peak hydraulic flows are the same as the current peak since the flows from North Branford are pumped. This peak hydraulic flow reflects the pump station capacity.

F. WATER REDUCTION AND CONSERVATION

The Facilities Planning process requires that flow reduction and conservation measures be evaluated. Recent legislation has aggressively targeted water conservation from the supply perspective. The following is a list of some of the most recent laws pertaining to water conservation that impact wastewater generation rates:

Public Act 89-327, "An Act Establishing A Water Resources Policy";

Public Act 89-265, "An Act Establishing a Residential Water Saving Program";

Public Act 89-303, "An Act Concerning Minimum Efficiency Standards for Plumbing Fixtures";

Updated Connecticut Building Code, 1987, Establishes flow rates for fixtures;

Public water is supplied to Branford by the South Central Connecticut Regional Water Authority (SCCRWA). The following discussion establishes their approach to these requirements and is excerpted from their "Five Year Water Conservation Plan" dated May, 1994 and approved on June 2, 1994. While some of the Branford residents are not connected to the public water supply system, 91% currently are connected and it is planned that 100% will be connected within the planning period.

As required by Public Act 89-327, "An Act Establishing a Water Resources Policy", the South Central Connecticut Regional Water Authority prepared a water conservation plan. This Plan was prepared to protect the water supply resources to the customers in the event of a long-term drought, contamination or increased demand from the service area. Adopted in this Five Year Water Conservation Plan are the following conservation criteria:

- To make water conservation a priority in all decisions;
- To conserve water resources through technology, methods and procedures designed to promote efficient use of water, and to eliminate waste of water;
- To reduce or eliminate the waste of water through water supply management practices.

The goals of the Five Year Water Conservation Plan are to be achieved by conservation in water supply and in water demand. Water supply conservation does not impact this Plan and the utility's methods to decrease unmetered water use, repair meters and detect water leaks is not included here. Their methods of water demand conservation have a direct impact on the results of this Facility Plan and will be discussed in detail. SCCRWA plans to reduce water demand by the following methods; assistance to users, rate reform, and public education. Each will be discussed separately.

1. **Assistance to Users**

SCCRWA has notified all of its residential customers of the availability of free water saving kits. These kits include a low-flow showerhead, two toilet tank displacement devices, two low-flow faucet aerators, a package of leak detection tablets, and a handbook with water saving tips. It is estimated that forty percent of the households served have requested these kits with a use rate estimated at between 24% - 75% for the various devices included in the kit. SCCRWA plans to stock these conservation kits and other water saving devices on an annual basis.

For the largest industrial customers, SCCRWA has offered free water use audits by their engineering consultant to assist the industries in finding ways to operate with less water. It is anticipated that if these high use industrial users implement all of the recommendations by the consultant, that current water consumption will be reduced from 10% to 50% for the various industries visited.

For smaller industries and its commercial users, handouts have been provided containing technical assistance in water conservation strategies. SCCRWA is exploring the possibility of a joint venture with other water utilities to design bulletins that could be distributed to industries and commercial users that would contain additional conservation measures.

2. **Rate Reform**

In 1992, SCCRWA adopted a more uniform water rate structure that will eventually eliminate declining blocks. The first part of this rate change is already in effect, and the second part is expected to be implemented later. The object of this rate structure change is to achieve a uniform rate structure thereby encouraging water conservation by the largest users.

3. **Public Education**

Their is a recognized need that to maintain a successful water conservation program that an aggressive public education program is essential. This education program must include notification of the availability of assistance in water conservation and of the importance of water conservation. To achieve this, SCCRWA inserts messages and information in its water bills, advertises for water conservation in the media, provides classroom workbooks, an annual calendar, publication of a bulletin, and provides an educational facility for students and teachers at its Whitney Water Center.

The educational programs and availability of conservation devices and technical help that the water authority provides is expected to reduce water consumption in the residential and commercial area by 5%, 10% in the industrial area and 3% in the public service area. For the purposes of this study, it is assumed that increasing unit demand for water will be offset by these conservation measures and that actual unit water use will remain at its current rates. Water conservation is a difficult task to implement long-term since it requires end user cooperation which can diminish in participation over time. This logic is in keeping with the SCCRWA Long-Range Demand Study which assumes no reduction in unit use rates over a 20 year planning period.

G. FUTURE ENVIRONMENT WITHOUT THE PROJECT

At this time, it is worthwhile to consider the "No Action" alternative which includes a discussion of the planning area without the project. The following potential impacts have been identified:

- The wastewater treatment plant would not be able to meet the limitations for Biochemical Oxygen Demand, Total Suspended Solids and total nitrogen in the plant discharge. Continued degradation of Long Island Sound water quality would occur;

- The economic climate in the study area would suffer as a result of restricted development if a sewer construction or connection moratorium was implemented. Expansion of existing commercial and industrial facilities would not be able to occur, and potential development of new economic growth would be curtailed;

- Expansion of the number of residential users would not be able to occur causing or continuing localized health problems;

- The Town of North Branford would be faced with inadequate sewer expansion potential causing localized health problems and the inability to attract or expand the economic base of the Town. In addition, they would need to revisit their Facilities Plan to assess alternatives to sewering and treating their own wastes;

- Transport and treatment of the wastewater during periods of hydraulic and loading peaks would continue to be substandard;
- The Town would be expected to maintain existing treatment facilities in operation. Current facilities are nearing the end of their expected mechanical life. The cost to maintain and upgrade equipment will be expensive and will be passed on to the users as an increased user cost;
- Odors would continue to emanate from the facility and potentially worsen as the flows increase and the mechanical components degrade in effectiveness;
- The Town of Branford would likely lose funding through the DEP Construction Grants Program for the upgrade of the wastewater treatment facility;
- The Town would be in violation of Order WC 5177;
- The Town would be subject to fines levied by the regulatory agencies and be subject to potential lawsuits by citizen or environmental groups;

Due to the severe impact of the "No Action" alternative, it is not investigated further in this Plan.

H. REGIONALIZATION

The Branford wastewater treatment plant collects wastewater from Branford as well as from the southern portion of North Branford, the community that is situated directly to the north. A continuation of the sewage discharges from North Branford for the planning period has been verified by the Town of North Branford. An intermunicipal agreement governs the conditions of these discharges.

With regard to the other border communities, no wastewater flows generated in East Haven are presently discharged or would reasonably be expected to be discharged to Branford. East Haven currently directs all wastewater flows to the New Haven regional treatment plant and expects to continue with this disposal method. The only remaining border community is Guilford, located to the east of Branford.

Guilford is a community with no sanitary sewers and one with no immediate plans to provide sewer service within the Town. A review of the general status of subsurface disposal systems within the town with the town Department of Health has determined that on-site disposal problems in Guilford are localized and are presently being addressed on a case specific basis. The town has a sewer avoidance plan in place and conducts walk-overs of subsurface disposal systems on a regular basis as required by their plan. Septic tank pump-outs from town residences are disposed of in Town operated lagoons which are monitored as required by the DEP. The Town has requirements for tank pumpout frequency and enforces the rules set forth in the sewer avoidance plan. Any possibility of sanitary sewage from Guilford going to Branford is therefore unlikely and is not considered in this Plan.

With regard to the possibility of a regional authority overseeing the Branford and North Branford systems, it is not advantageous to do so. The cost to construct and maintain the sewer systems and pumping stations within Branford and North Branford is presently provided for by the individual towns. North Branford currently has a department with staff assigned whose responsibility it is to maintain the sewer system, maintain the flowmeters at the discharge points to Branford, and to supervise the design and construction of any new sewers or repairs to existing sewers or equipment. This department must cover those portions of the North Branford sewer system that discharges to East Haven and North Haven also. To create a regional authority to manage the sewer system to Branford would be cumbersome and is not advantageous to either town.

VI. EVALUATION OF ALTERNATIVES

A. INTRODUCTION

One of the most important requirements of this Facilities Plan is to investigate the means to accomplish the wastewater treatment objectives of the NPDES permit. Anticipated permit limits for the treatment plant were discussed in Chapter II and are restated below:

TABLE 6-1
ANTICIPATED PERMIT LIMITS

PARAMETER	AVERAGE DAILY EFFLUENT LIMIT
BOD	30 mg/l
TSS	30 mg/l
TOTAL NITROGEN HIGH LEVEL NUTRIENT DISCHARGE (HLND)	9 mg/l
TOTAL NITROGEN LOW LEVEL NUTRIENT DISCHARGE (LLND)	4 mg/l
CHLORINE RESIDUAL	<1.5 mg/l

The major permit requirement of accomplishing BOD, TSS removals, and year round nitrogen removal to either 9 mg/l total nitrogen (HLND) or 4 mg/l total nitrogen (LLND), are important parameters which will be evaluated in this Chapter. The means of achieving nitrogen removal is the primary objective behind all process alternatives, so the discussion of the means to attain nitrogen removal to these two levels will be the focus of the analysis. Also, the means to disinfect the treated effluent will be discussed here as will the means for odor control at the facility.

The technologies presented in this Chapter to meet the NPDES permit discharge requirements are then considered further in Chapter VII prior to selection of the recommended plan.

B. EFFLUENT TREATMENT TECHNOLOGIES

As part of the evaluation of alternatives for the Branford wastewater treatment plant, a number of treatment technologies were identified and examined for their potential use. One of the underlying goals of the facilities planning process is to provide for the application of the best practicable waste treatment technology (BPWTT). An alternative is considered best practicable if it is determined to be cost-effective in accordance with regulatory criteria and acceptable cost-evaluating procedures. The three broad classes of treatment alternatives include:

- Alternatives employing reuse.
- Alternatives employing land application techniques and land utilization practices.
- Alternatives employing treatment and discharge to surface waters.

A discussion of each of these follows.

C. REUSE TECHNOLOGIES

The feasibility of wastewater reuse is highly case specific. Many times water for reuse requires a degree of treatment beyond secondary or even beyond advanced waste treatment either for process control in manufacturing or to protect the ultimate receiving stream such that water quality standards are met.

In order for wastewater reuse to be feasible, a water must meet the requirements of the end user and a consistent demand must be present. This is generally the case in arid and agriculturally oriented regions where the cost and restrictions on use of drinking water makes it desirable to utilize wastewater in industrial processes, groundwater recharge, irrigation and agriculture.

The cost and availability of water in the study planning area is both adequate and reasonably priced such that it does not promote a demand for water reuse on a small or large scale. There are no known industries in the planning area which could utilize a significant supply of treated wastewater; most of those industries in the area use little water. Those that could would likely require water of higher quality than that which is required by DEP for discharge. Therefore, reuse is not considered a viable alternative.

D. LAND APPLICATION AND UTILIZATION

Overland Flow, Infiltration-Percolation, and Irrigation are the three common approaches to land application of wastewater. All three are limited by soil type and depth, topography, underlying geology, climate, surface and groundwater hydrology and quality, crop selection, and land slope and availability.

Overland flow involves applying wastewater to the ground surface such that it travels as sheet flow. Generally grass or other suitable vegetation is planted to provide a habitat for the bacteria which purify the wastewater. Suitable surface water must be nearby to receive this overland flow. This process can typically reduce ammonia levels up to 90% of influent levels. This would not provide a sufficient level of treatment to meet the anticipated NPDES permit limits for nitrogen removal.

Infiltration-percolation has been used to treat wastewater as well as to recharge groundwater. In this type of system, water is applied to a soil of high permeability such as sand, sandy loams and gravel. This type of soil is found in parts of Branford but is not available in the amounts required for this type of application nor in areas that are available for this use.

Spray irrigation is the most widely used type of land application. Moderately permeable soil is required for this type of system and land slopes cannot exceed 20%. Spray irrigation can remove between 90% and 95% BOD, 80% TSS, and 85% nitrogen. However, feasible sites must be within economic transmission distance from the source.

The Branford treatment plant is located in a developed area which is near residential and some commercial development. The closest open space lands with the requisite amount of land area are located north of the Connecticut Turnpike in an area slated for industrial development and in the areas nearer to North Branford. The Town does not own most of this land, some is near a water supply watershed area, much is steep slopes and the remainder is near residential developments. This precludes spray irrigation from consideration within the Town boundaries.

The topography and soil classifications in surrounding towns is also not suitable for land application. Locating available land area in adjacent towns would require lengthy conveyance piping and the costs and political implications of acquiring land and treating sewage in an adjacent community are significant.

Due to the extent of development in Branford and the fact that available vacant land is scarce near the existing treatment plant site, land application would be difficult and expensive to implement. Land application becomes less feasible from an economic perspective as the travel distance from the treatment plant to the application site increases. This is due, in part, to the cost of installing sewer main to carry the wastewater and pump stations to handle the large volume of flow generated. Based on the lack of available land near the plant site and after consideration of the other related issues, land application in any form is not considered a viable option for Branford.

E. TREATMENT & DISCHARGE TECHNOLOGY

Wastewater treatment with discharge to a receiving waterbody is the most widely used technique in treating municipal sanitary sewage. This is also the current practice in Branford. Under this broad category of treatment there are various alternatives to attain the levels of BOD, TSS and nitrogen removal that will be required by the NPDES permit in Branford. Most of these alternatives are classified as biological, and the others are classified as physical/chemical processes.

Regardless of the process used, these treatment and discharge alternatives must have access to a receiving stream to discharge the treated effluent. This type of system is currently in place at Branford with Branford Harbor as the outfall location. No change in discharge location is planned since the dilution effects of the present location have been determined as adequate by the State Department of Environmental Protection.

A review of the process alternatives follows.

1. Biological Processes

Biological treatment systems are commonly used for nitrogen removal in municipal sanitary sewage. Biological systems use aerobic and anaerobic metabolism to remove the pollutants contained in sanitary wastewater. Those biological systems available are generally categorized as follows:

- Biological Nitrification/Denitrification - suspended growth
- Biological Nitrification/Denitrification - attached growth

The various suspended growth systems available are applicable to meeting the total treatment requirements in Branford. The attached growth systems available to accomplish nitrification and denitrification in a single reactor have had limited successful experience in this combined type of application and with meeting the stringent nutrient removal required to be achieved in Branford. The attached growth processes that will be evaluated in Branford will therefore be limited to those processes that provide denitrification of an already nitrified wastewater. This is an application with which experience has been successfully demonstrated by attached growth processes.

One of the newer biological processes that was reviewed for applicability was a high biomass process, specifically Ringlace Products, Inc. This high biomass process concept is to use a submerged flexible biological growth media used to increase treatment efficiency by increasing the biomass concentration available to the treatment process. In the case of Ringlace, the media is a series of polyvinylidine chloride filaments enclosed in a support frame to which the biological growth attaches. In theory, the process would increase the biomass under aeration and reduce the size of the tankage required to accomplish the treatment objective.

The high biomass process, if to be used cost-effectively, must be used within the existing closed tank oxygen aeration system in Branford. If not used in the existing tankage, its cost advantages vanish since any additional tankage needed by the high biomass process would preferably be utilized by a more conventional treatment process. In Branford, it was determined by the Ringlace manufacturer that its only means of use in Branford would be to install it in a separate tank from the oxygen aeration system and use it to nitrify the wastewater once the BOD was removed. Denitrification would then occur in another, separate process. This additional tankage for nitrification and denitrification stages present serious drawbacks to the use of a high biomass process in Branford. This additional tankage and equipment, coupled with the manufacturers lack of any experience with oxygen activated sludge systems and general overall limited experience in the U.S. has determined that this process is not suitable for Branford. It was not considered further.

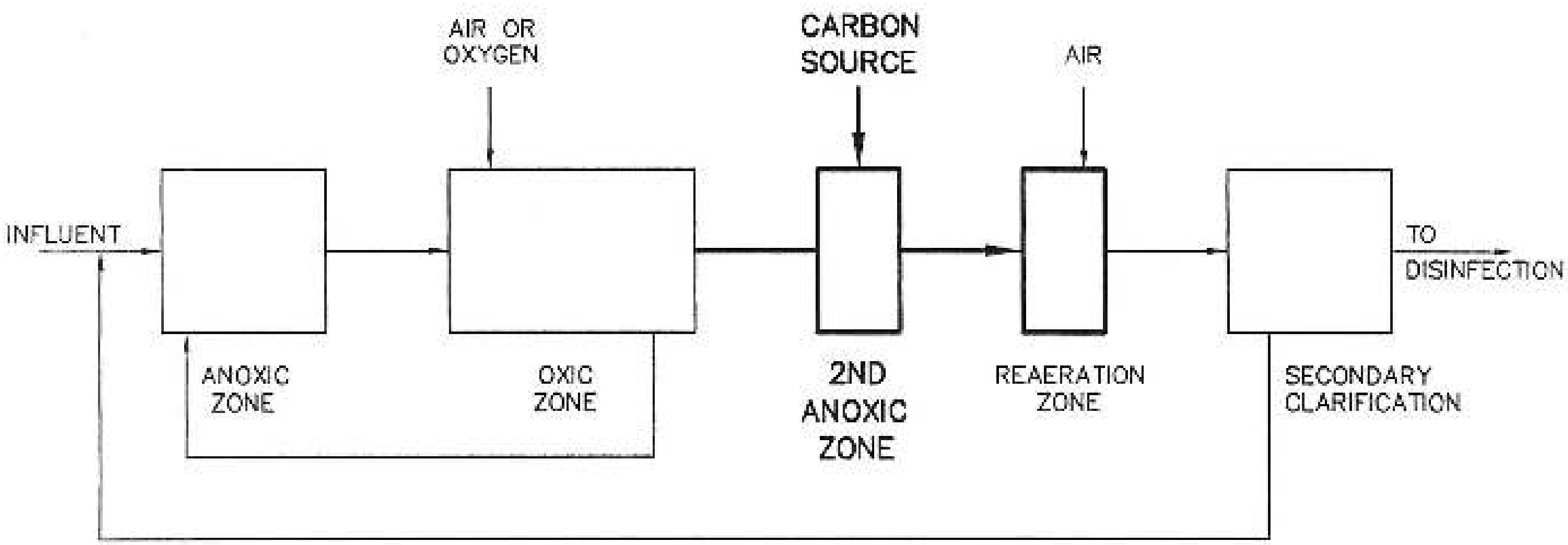
The biological processes to be reviewed will therefore consist of the various suspended growth processes that will accomplish nitrification/denitrification in one reactor, and also utilizing suspended growth processes for nitrification and attached growth processes to accomplish denitrification.

2. **Physical/Chemical Processes**

Of the physical/chemical processes available, three are applicable to the needs in Branford. Physical/chemical processes differ from biological processes in that they do not rely on a bacterial population to provide nitrogen removals and is their main advantage in use. However, they do require a biological system for BOD removal ahead of the physical/chemical process although this is typically smaller in size than a biological nitrification/denitrification system. These three physical/chemical processes that are applicable are listed as follows:

- Breakpoint Chlorination
- Ammonia Stripping
- Selective Ion Exchange

A discussion of these viable biological and physical/chemical alternatives follows. The chemical or biological pathways by which nitrogen removal occurs and the corresponding process schematics are shown in Figures 6-1 through 6-5.



BIOCHEMICAL PATHWAY

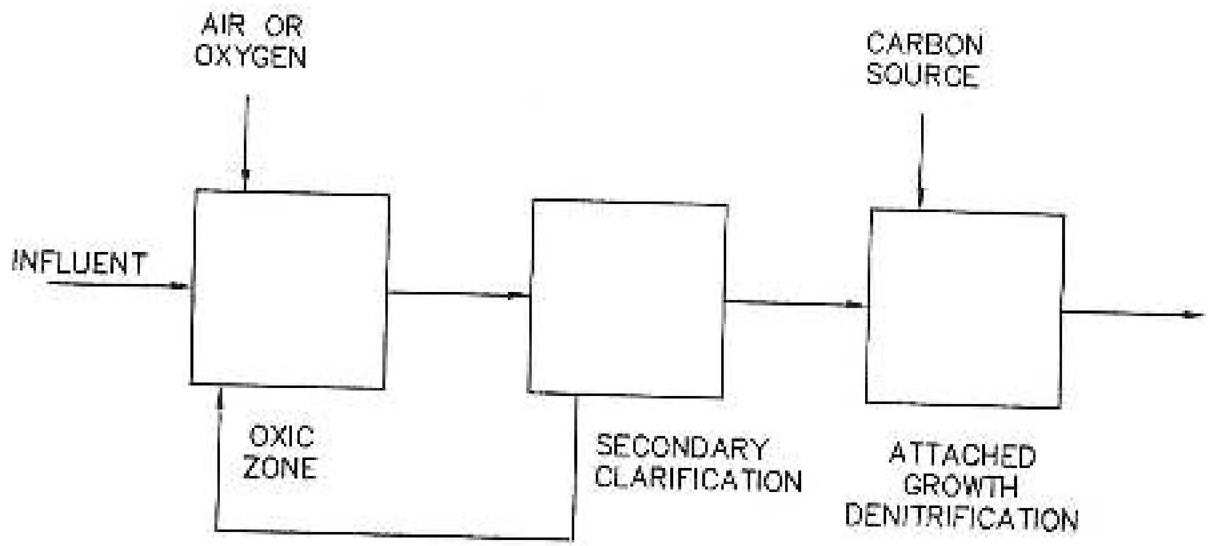
$$2NH_4^+ + 3O_2 \xrightarrow{\text{BACTERIA}} 2NO_2^- + 2H_2O + 4H^+ + \text{NEW CELLS}$$

$$2NO_2^- + O_2 \xrightarrow{\text{BACTERIA}} 2NO_3^- + \text{NEW CELLS}$$

BIOLOGICAL NITRIFICATION / DENITRIFICATION
SUSPENDED GROWTH PROCESS

FIGURE 6–1

TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.



BIOCHEMICAL PATHWAY

$$2NH_4^+ + 3O_2 \xrightarrow{\text{BACTERIA}} 2NO_2^- + 2H_2O + 4H^+ + \text{NEW CELLS}$$

$$2NO_2^- + O_2 \xrightarrow{\text{BACTERIA}} 2NO_3^- + \text{NEW CELLS}$$

SEPARATE STAGE NITRIFICATION / ATTACHED GROWTH DENITRIFICATION

FIGURE 6-2

TOWN OF BRANFORD FACILITIES PLAN

EARTH TECH

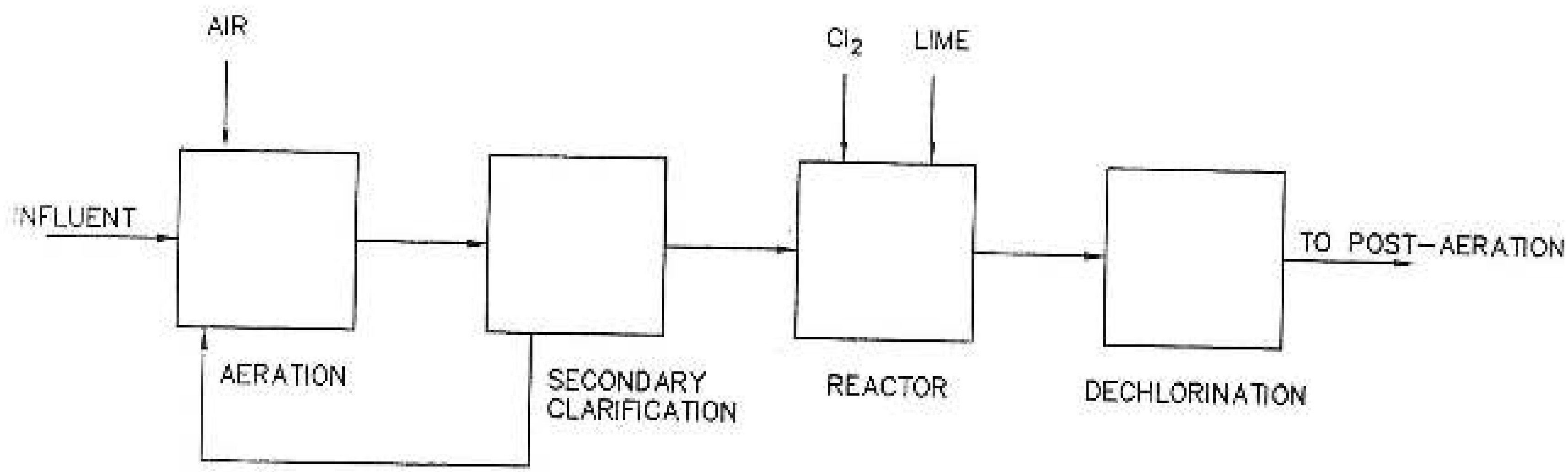
Formerly Whitman & Howard, Inc.

Option 1: Single-Sludge Sequencing Batch Reactor (SBR) Process

The SBR process at Branford for HLND would consist of four SBR tanks located at the northern end of the site where the former sludge lagoons are located. These tanks will utilize common wall construction to save costs and to best fit within the site boundary. Even still, the tanks will overlap the site fenced area and the construction of the tanks will impact it further since they are at least 20 feet in depth and will require excavation outside the actual tank boundaries. However, this construction can have the original wetland materials stockpiled and replaced so that the final impact is minimized.

The batching operation requires that there be a means to distribute the incoming flow to each tank in sequence. This will be accomplished by directing the flow from the primary tanks to a distribution structure ahead of the SBR's. The separate pipes to feed the four SBR tanks will be outfitted with motor controlled valves that will be opened and closed in sequence based on a programmable logic controller (PLC) included as part of the control panel for the process. Once the treatment process is completed for each batch reactor, two decanters per tank will discharge the flow to an equalization tank. Because of the rate of the discharge from an SBR process, the size requirements of the equalization tank are substantial. For this reason, two of the existing six rectangular settling tanks will be used as the equalization tank. Because of the sequencing operation, piping to and from the SBR's is greater than for other processes as is the requirements for some process equipment such as blowers. An aeration system consisting of fine bubble air diffusers, air supply piping, a means to remove scum and provide access to the air diffusers are additional requirements of the SBR tanks.

From the equalization tank, flow will be pumped through the disinfection process. The pumping process is necessary since the SBR process is not a continuous flow discharge process and disinfection systems do not operate effectively when subjected to an intermittent flow. The equalization tank and the pumping station will eliminate the flow variations and allow this process to work properly. After the disinfection process, the flow will proceed to the outfall pipe for final discharge. No secondary clarifiers are required with an SBR process. See Figure 7-1 for a layout of the proposed SBR system and a proposed process schematic. From the perspective of continuing treatment at the existing plant while new construction is proceeding, the SBR's, pump station, blowers for air supply, and the SBR control system will be constructed in a separate area so that it

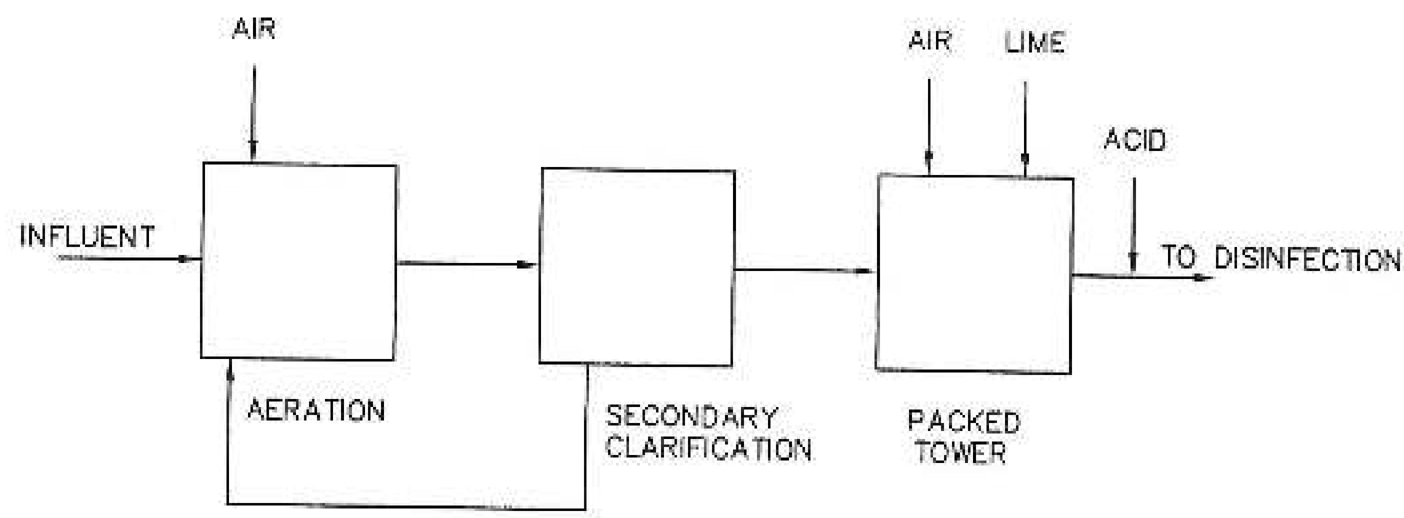


CHEMICAL PATHWAY

$$NH_4^+ + HOCl \longrightarrow N_2 + H_2O + H^+ + Cl^-$$

BREAKPOINT CHLORINATION

FIGURE 6–3
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

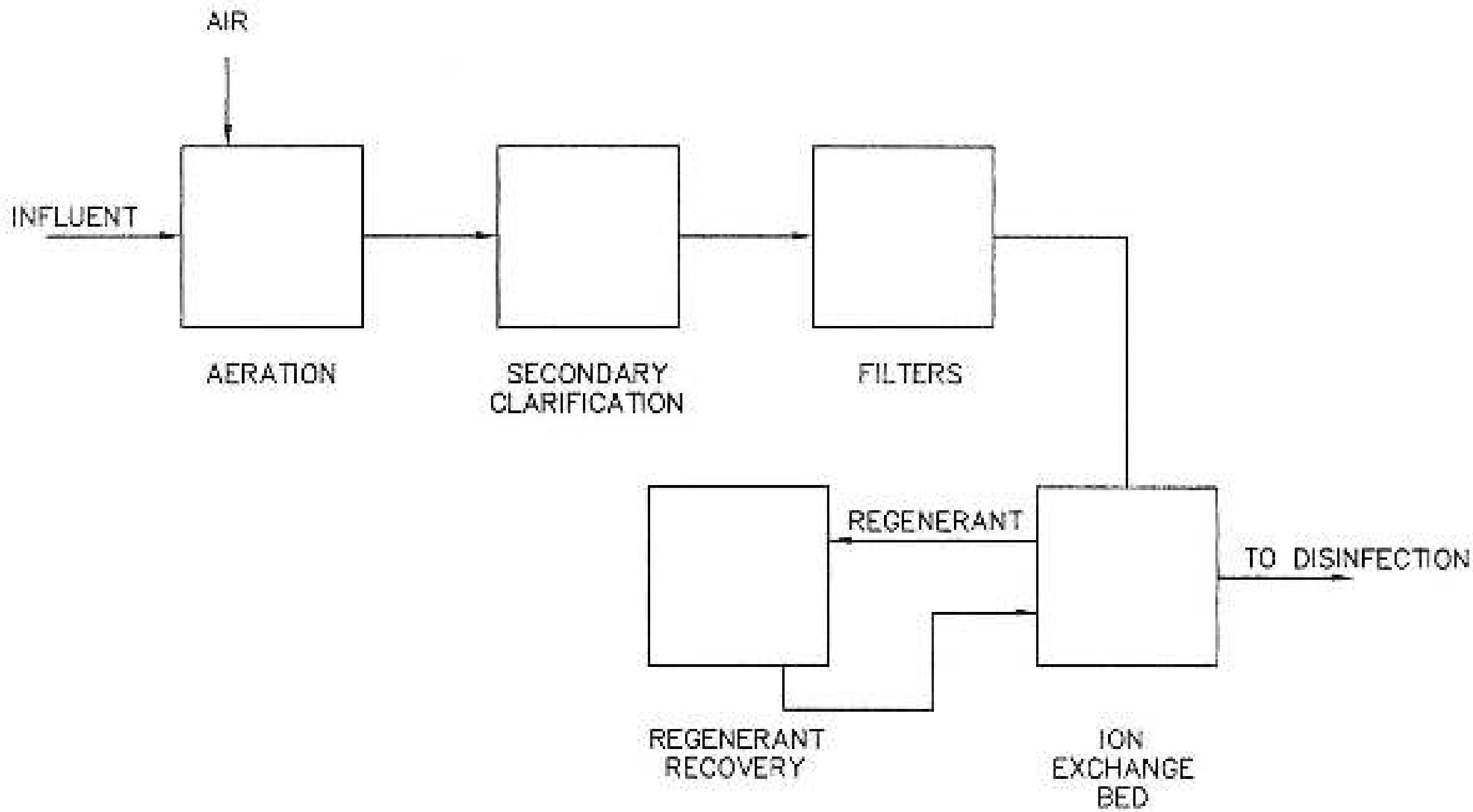


CHEMICAL PATHWAY

$NH_4^+ + OH^- \longrightarrow NH_3 + H^+ + O_2$

AMMONIA STRIPPING

FIGURE 6–4
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.



SELECTIVE ION EXCHANGE

FIGURE 6–5

TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

F. BIOLOGICAL PROCESSES

1. Biological Nutrient Removal (BNR) - Overview

Biological nitrification/denitrification is the most widely used method of nitrogen removal in sanitary wastewater. Removals of total nitrogen can be as high as 90% with this type of treatment. Ammonia is first oxidized to its nitrate form by certain oxidizing bacteria known as nitrosomonas and nitrobacter and then denitrified under anoxic conditions for reduction of the nitrates to nitrogen gas. The bacteria must be present under the right conditions and in the correct amounts for proper operation of the system.

There are two basic methods to accomplish biological nitrification/denitrification. One method is a suspended growth process in which the entire nitrification/denitrification process is accomplished in a compartmentalized tank. The schematic for this process is shown in Figure 6-1. The other method is a suspended growth system which combines biological nitrification in a separate tank and denitrification in an attached growth process separate from the nitrification process. This is shown in Figure 6-2. Either method is applicable to Branford and are discussed in greater detail below.

2. Biological Nitrification/Denitrification - Suspended Growth Processes

A single sludge suspended growth processes removes both nitrogen and carbonaceous materials in the same reactor. This chemical reaction is first accomplished by first converting the ammonia in the wastewater to its most oxidized form, nitrate. This is commonly accomplished by the addition of oxygen, whether by use of air or pure oxygen, to a population of biomass. Once nitrification has occurred, the wastewater is available for denitrification which is the removal of the oxygen component in nitrate with the resultant being nitrogen gas. This is accomplished in a portion of the tank devoid of oxygen and with a carbon food source for the bacteria. This is typically accomplished at the beginning of the reactor since savings can be accomplished by using the influent BOD as the carbon source. Carbonaceous BOD is removed in both the anoxic and oxic zones. This process is shown in Figure 6-1.

For this reaction to proceed and the process to be successful, certain requirements must be met. First is the air requirement of the process, especially the nitrifiers, which utilize approximately 4.6 pounds of oxygen per pound of ammonia oxidized; the second is the requirement of alkalinity in the wastewater since the nitrification process destroys approximately 7.14 pounds of alkalinity per pound of ammonia nitrified. Other factors affecting the process are temperature, pH, the age of the biomass, internal recycle rates, F/M ratios, TKN to BOD ratios, toxic compounds, and dissolved oxygen levels (or lack thereof).

Settling is required following the process to separate the biomass from the treated wastewater. A portion of the sludge is recycled to the anoxic zone at a rate dependent upon the amount of nitrogen removal required. Sludge wasting is controlled so that the required oxic solids retention time (SRT) of approximately 20 days is maintained.

To attain the nutrient limit requirement of 9 mg/l is relatively easily achieved by the process described above. The suspended growth process is generally reliable for a total year round nitrogen removal of 9 mg/l but is less consistent on removals to 4 mg/l total nitrogen. To achieve a nutrient limit of 4 mg/l total nitrogen usually requires the addition of an external carbon source. This carbon source, usually methanol or ethanol, is necessary to achieve the low levels of nutrient removal since there is always a certain amount of nitrogen bleed- through inherent in the process. The additional carbon source will be utilized by denitrifying bacteria that are located in the second anoxic zone of the nitrification/denitrification tank. An additional reaeration zone is then added to fully nitrify any remaining ammonia. This addition to the process is shown in Figure 6 - 1 also.

3. Separate Stage Nitrification Followed by Attached Growth Denitrification

Separate stage nitrification followed by a separate stage biological denitrification process requires that the carbonaceous BOD and the nitrification of the wastewater occur in a separate tank prior to the denitrification process. This first stage removes the BOD from the wastewater and nitrifies the ammonia to its nitrate form. The biomass created in this stage is settled in a clarifier and returned to the beginning of the process to maintain a biomass in the reactor. Wasting of the new cells is accomplished to maintain the desired sludge age and biomass in the reactor.

ethanol. By using an external carbon source, these processes are more expensive to operate than those using influent BOD as the carbon source. This additional expense, however, may be offset by the smaller first stage reactor and the increased kinetic rates associated with the use of an easily utilized external carbon source.

The nitrification system consists of a tank in which air or oxygen is added to promote the growth of the biomass and is therefore similar in many respects to the suspended growth system. The denitrification reactor is typically a deep bed (six feet) media supported by a porous system of support plates and gravel, or in another process, a fluidized bed in which the wastewater flows upward through the reactor causing the media bed to expand. Nitrified wastewater from the clarifiers is pumped to the filter, methanol or other carbon source is added, and the denitrifying process occurs by means of the denitrifying bacteria attached to the filter media. The methanol provides the carbon source and the filter is kept devoid of oxygen for the biological process to proceed. Typically, multiple filters are used since they must be backwashed and occasionally "bumped" to release the nitrogen gas that has accumulated. Care must be taken in the addition of methanol, since it will impact the plant effluent BOD if overdosed.

An advantage of the denitrification filters is that either the low or high level nitrogen removal requirements can be met year round. The filters can be the sole means of denitrification or can act as a polishing step for a suspended growth denitrification process. The carbon source requirement is a disadvantage since it has an operating cost associated with it. The filters also require additional pumping to overcome the head losses inherent in the system. Additionally, there is a capital cost and land space requirement for the units as well as additional maintenance requirements.

All other control requirements, factors affecting operation, and the biochemical pathways are the same as for the suspended growth process for nitrification/denitrification. This process is shown in Figure 6-2 and is applicable to both HLND and LLND. The only requirement to achieve the increased levels of nutrient removal is the additional filter area and methanol requirements.

G. PHYSICAL/CHEMICAL PROCESSES

1. Breakpoint Chlorination

Breakpoint chlorination (superchlorination) utilizes chlorine to oxidize ammonia to nitrogen gas, thus completely removing nitrogen from the water. This process must take place at pH of about 6.0 to 7.0. The amount of chlorine addition must be precisely adjusted to a level which is sufficient for the oxidation of ammonia (the breakpoint) with the minimal residual chlorine and by-product formation. Hydrochloric acid is co-produced during this process and must be neutralized by adding lime or caustic soda. Breakpoint chlorination is economically more attractive at low concentrations of ammonia and becomes much less attractive above an ammonium ion concentration of 15 mg/l. The influent concentration of ammonia in Branford is consistently over 20 mg/l with peaks above 40 mg/l and therefore can be expected to fall into a greater than average treatment cost range.

The effluent from this type of system will most likely need to be dechlorinated prior to discharge to protect the receiving waterbody against chlorine toxicity. This is typically accomplished through addition of sulfur dioxide. Aeration or activated carbon adsorption may also be used.

Breakpoint chlorination is typically used in conjunction with physical/chemical treatment. It has been used with activated sludge treatment in limited instances where secondary BOD and TSS removal is very good and the effluent produced is consistent and reliable. However, this combination of treatment technologies is not particularly well suited for Branford. In Branford it would involve the installation of a higher level of secondary treatment in addition to the breakpoint chlorination system.

There are a number of potential problems with breakpoint chlorination. Failure of such a system may not only result in the release of high levels of ammonia nitrogen to the receiving body, it could produce an acutely toxic condition in the river if excessive chlorine were introduced and/or if the dechlorination system failed. There is also a potential for the formation of chlorinated hydrocarbons in the effluent.

2. Ammonia Stripping

Ammonia stripping is a desorption process which can be used to remove nitrogen by elevating the pH to about 11.0 and subjecting the wastewater to high volumes of air and agitation. Lime or caustic soda must be added prior to stripping for the purpose of converting ammonium ions to ammonia gas which can then be stripped by air.

This methodology is subject to a number of operational problems. Of particular significance, it is highly dependent upon air/water temperature ratios and experiences a significant loss in efficiency at lower air temperatures. This type of system cannot operate in freezing conditions. Other operational problems such as scaling also occur at low temperatures typically experienced in the fall, winter and spring (0°C - 10°C).

O&M costs associated with this process are high with respect to power requirements and manpower to operate and maintain the system.

3. Ion Exchange

Ion exchange systems reduce nitrogen by replacing the ammonium ion with a resin ion, typically sodium or calcium. Similar to breakpoint chlorination, the influent water to the ion exchange process must be of high quality. Typically the level of treatment is that which is provided by secondary treatment with filtration and carbon adsorption. This combination of treatment would be extremely costly.

The ion exchange media must be periodically regenerated. The backwash generated from this process must be treated to remove the high concentrations of ammonia. This can be done by steam distillation, electrolytic or chlorine oxidation, or by a combination of hot air stripping, acid readsorption, and precipitation. Handling the spent regenerant is often the major drawback of the ion exchange process. The reliability of this type of system is also a concern.

These various nitrogen removal processes will be investigate further in Chapter VII.

H. DISINFECTION TECHNOLOGY

Disinfection of the treated wastewater is currently accomplished at the Branford treatment plant by chlorination with chlorine gas. The contact time necessary to inactivate the organisms in the wastewater is provided in the chlorine contact chamber(s) and in the outfall pipe prior to discharge to Branford Harbor.

The chlorinators, scales, cylinders and other chlorine delivery equipment is located in the Control Building. Chlorine gas is mixed with ejector water and piped to the beginning of the chlorine contact chambers where it is mixed with the secondary effluent. Chlorine is also available for other process uses.

The NPDES discharge permit will require year round disinfection with residual chlorine less than no greater than 1.5 mg/l or less than 0.2 mg/l. Fecal coliform must not exceed 200 organisms per 100 milliliters, based upon the geometric mean of effluent samples collected over 30 consecutive days. If chlorine is used for disinfection, dechlorination will not be required prior to discharge since the means to maintain residuals in this range of values is relatively easy to accomplish. Other viable methods available for achieving disinfection of the effluent are ultraviolet light, ozonation, chlorine dioxide and chlorination with chemicals other than gaseous chlorine. A discussion and analysis of these alternatives follows.

1. Ultraviolet Radiation

Ultraviolet radiation accomplishes disinfection using mercury vapor lamps which operate at a specific wavelength. The operational wavelength penetrates the cell walls and causes deactivation of the reproductive process of bacterial and viral cells. Ultraviolet light systems are relatively simple to use, have no impact on the environment and the required contact times to deactivate the cells are short, resulting in smaller reactor size and less construction costs. However, its operational costs can be high due to electrical power requirements, the need for cleaning of the quartz sleeves and the need to replace burned out lamps and ballasts. In addition, the disinfection performance can be reduced by high suspended solids, color and turbidity of the wastewater.

2. Ozone

Ozone is an unstable gas that is a proven disinfectant that has beneficial qualities beyond disinfection. Ozone is transferred to the wastewater by diffusers. After it disinfects the wastewater, it decomposes to oxygen, thereby eliminating a treatment step if aeration of the effluent prior to discharge is required. Its major disadvantages are that it is an unstable gas which requires on-site generation, and the process itself is relatively complex to operate. This translates to large capital and operating expenses. Additionally, the ozone off-gasses are irritating and can be toxic, so the off-gases must be collected and the ozone removed prior to atmospheric discharge, adding to the operating expense. Ozone is a hazardous material and as such exposure by operating personnel must be limited.

3. Chlorine Dioxide

The use of chlorine dioxide as a disinfectant has typically not been a consideration in wastewater treatment because of its prohibitive chemical costs. However, its use may be cost effective in relation to other methods and warrants review. Chlorine dioxide is an effective disinfectant and has the advantage of no chlorine residual. Its major disadvantage is that chlorine dioxide is an unstable gas and therefore must be generated on site. The chemicals required to generate it, chlorine and sodium chlorite, are both hazardous materials and the consistent availability and cost of sodium chlorite is cause for concern.

4. Chlorination

Chlorination is an established and effective process. In larger plants chlorination is typically accomplished by chlorine gas or a hypochlorite compound. Advantages of chlorine over other methods include its low cost, chemical and equipment availability, and reliability. Many times, an additional advantage is gained due to the low capital cost to install the equipment in an existing plant since the building and reactor are generally in place. However, this is not the case in Branford. The existing reactor is too small and the chlorine storage building is in need of extensive rehabilitation. Disadvantages of this process include the hazard associated with handling and storage of the chemicals and the instrumentation systems required to control the chemical feed.

It is apparent from the above discussion that all of the disinfection processes exhibit advantages and disadvantages. These will be evaluated further in Chapter VII.

I. ODOR CONTROL

Odor control will be required at this facility due to its proximity to residential and commercial properties. Positive odor control methods will be included for such processing areas as the screening and grit collection area, the septage receiving area, solids processing areas, any aerated holding tanks, and the gravity thickener. These areas, by virtue of their size, will require an air change requirement of approximately 16,000 cfm. Those unit processes that have the potential to generate odors, such as the primary settling tanks or during maintenance of tanks or equipment, will be controlled operationally and by good housekeeping practices.

The major odor control techniques are activated carbon adsorption, soil filters, chemical oxidation processes (scrubbers) and direct chemical oxidant use such as potassium permanganate, hydrogen peroxide, other proprietary chemicals, or ozone which are injected into the waste stream.

Activated carbon, while effective, is best suited for use with much smaller air volumes than that which will be necessary in Branford since the carbon is a passive system requiring attention and occasional carbon regeneration and replacement. The other oxidants proposed typically employ expensive oxidizing chemicals and in many cases are used only if other means of control are not available or practical. This is not the case in Branford. Less expensive chemical processes can be incorporated during the design.

Another potential technology is the soil filter, a biological process. While possibly effective, the process does have some drawbacks associated with it, most notably in the case of the Branford site is the large space requirements for the filter. At a small site such as Branford, space is at a premium and technology such as this is not practical for this location.

With the volumes of air necessary to be treated for proper odor control at Branford, the least costly and effective means of odor control at this site is a centralized chemical oxidation facility (wet scrubber) using sodium hypochlorite and sodium hydroxide as the chemicals used. This system uses sodium hypochlorite as the means to oxidize ammonia and sulfur compounds while the sodium hydroxide is used to maintain pH control. These systems are well proven and effective. By virtue of the small plant site, ductwork cost is minimized making this method of odor control the method of choice.

J. ENERGY RECOVERY ALTERNATIVES TECHNOLOGY

Energy conserving methods and processes are considered during the review of process alternatives. The selected plan should be flexible so that opportunities for energy savings can be easily incorporated at any stage of the process. Particular attention will be directed toward the inclusion of energy saving equipment such as variable speed pump and blower motors, motor timers on intermittent processes, dissolved oxygen control systems to regulate oxygen delivery, fine bubble diffused air for greater efficiency, and instrumentation systems that provide data and/or control processes for the most optimum performance of process operations. Close cooperation with CL&P will be maintained during the design of the treatment plant so as to gain from their experience in the use of energy saving equipment and therefore benefit as much as possible from their energy conservation incentive program. This program as currently configured allows for at least partial payment of the difference in capital cost between efficient energy equipment and those that may cost less initially but are less energy efficient.

The ability of using waste heat recovery to provide heat or electricity will also be evaluated. Additionally, the amenability of systems to accept future electrical and instrumentation controls that will allow the equipment to operate more efficiently and which take advantage of the power cost savings during off-peak hours or reduce demand charges will be investigated.

The following specific items were considered in plan selection:

- The ability of the system to use variable speed motors to minimize power use and to decrease induction motor demand charges.
- Ability of the process to utilize timers on motors to decrease total power costs from that expected for continual operation.
- The ability of the process to utilize fine bubble aeration and high efficiency blowers in lieu of other, less efficient means to deliver oxygen to the secondary process.

- Use of instrumentation and control systems to select efficient operating points and to control motor speeds to match process demand.

- Capability and flexibility of the process to operate effectively during off-peak hours thereby reducing electrical power costs.

- The ability of the process to provide building heat through heat exchangers.

- The capability of the system to efficiently operate on standby or primary diesel driven generator systems so as to take advantage of alternative power sources during peak electrical demand and to lower power factor correction charges.

In addition to the new systems under review, proposals to correct existing operational problems are also reviewed, taking energy conservation into consideration.

VII. PLAN SELECTION

A. ALTERNATIVES EVALUATION SUMMARY

The requirement of the Facilities Plan is to determine how best to meet the nutrient wasteload to Branford Harbor and Long Island Sound. Therefore, the Facilities Plan must address the means by which the existing treatment plant must be modified to accomplish the required BOD and suspended solids removal, denitrification to two nutrient levels, high level nutrient discharge (HLND) and low level nutrient discharge (LLND), and disinfection of the effluent prior to discharge.

The nitrogen removal requirement for Branford is the driving force behind all process considerations. In this Plan, it is required that two levels of nitrogen removal be investigated. The first is high level nutrient discharge (HLND) in which the total nitrogen limit allowable is 9 mg/l on a year round, rolling average basis. The second is low level nutrient discharge (LLND) with a year round, rolling average effluent nitrogen content of 4 mg/l. The following discussion in this Chapter summarizes the various options available to accomplish these objectives and a detailed evaluation of the viable alternatives.

The means to disinfect the wastewater will also be reviewed in this chapter. Many processes utilizing various chemical and non-chemical means are available, and will be reviewed for applicability. Those that apply to Branford will be evaluated on a cost-effective basis.

B. SELECTION PROCESS

The best alternative is selected based on an evaluation of cost among the viable alternatives and a regard for non-monetary concerns that may influence the decision process. Cost comparisons are made based on a present worth analysis similar to the model developed by EPA for the facilities planning process. The analysis is based upon a 20 year planning period and an interest rate of 6%, a rate in keeping with current Town bonding costs. This economic analysis includes projections for first year operational costs (year 2000) for such items as electrical power, chemicals, and maintenance as well as capital and installation costs of the equipment and structures in the projected bid year of 1998. Capital and installation costs were calculated by establishing the structural, building and process requirements for each alternative and providing this information to a construction estimating firm. This firm's detailed analysis of the alternatives are included in

Appendix G. By taking into account the yearly operating cost and initial capital cost, it is possible to determine the funds that would be required in present day dollars to cover all capital and operating expenses for the planning period at the interest rate selected. This is called the present worth value of the investment. The treatment process which has the lowest present worth is the least costly alternative.

Non-monetary concerns which may have a bearing on the process selection must then be addressed. These non-monetary concerns are different for each available process and include such items as public safety, environmental impacts, the possibility of odor generation, and land use requirements. The process scheme that will be selected will be the one that is the least costly based on a present worth analysis and which does not exhibit any overriding non-monetary concerns.

C. NON-MONETARY CONCERNS

The treatment plant site is located on a 3.5 acre parcel of land. This is a relatively small site for treatment plants of this capacity. Consideration was given to relocating the treatment plant to another site, however, any site for this option for this would require pumping from the existing plant site to another location, the construction of an entire treatment plant without the benefit of being able to reuse the existing structures and buildings, and the additional disadvantage of locating a discharge point that has adequate dilution factors for the discharge. The additional construction costs would be significant and the relocation of the treatment plant was deemed as not practical by the Town of Branford and was not investigated further.

To the east of the site is senior housing, to the south is the treatment plant access road (Block Island Road) and new residential housing, and a marina is located to the west. Land area is available to the north, however, it is all wetland area and the soils are of poor quality for the purposes of construction. Limited use of this land is foreseen since the cost to develop it will be high and the environmental impact and permitting process will be significant. Site constraints of the recommended process must therefore take process tankage and ancillary equipment space requirements into consideration. Expansion beyond current site boundaries is limited and will have a distinct impact during the construction phase of this project whether it be for existing treatment process maintenance or for construction mobilization or storage space. It is therefore preferable that all new plant construction be completed within the existing plant boundaries as much as possible.

Future treatment requirements must also be taken into consideration. While it is not possible to determine what future treatment requirements may be, it could include additional treatment processes for wastewater treatment or additional processes or land area for sludge processing. Consideration to leave land area available and room for piping, conduit, ductwork, etc. for connection of future processes should be considered for any viable process options. Any additional hydraulic requirements should also be reviewed.

The treatment plant site is located near residential areas. Consideration will therefore be given to the odor generation capabilities of the processes evaluated, especially septage receiving, preliminary treatment processes, and any solids handling processes. Those that have the potential to generate odors will need to be covered and processed through an odor control facility. The same is true for noise generation. Those processes that generate significant noise will need noise attenuation and these costs added into the cost comparison of the alternatives.

Safety to the public is also an important non-monetary issue because the treatment plant is located close to residential areas. In addition, the treatment plant access road is a Town road used by the public to access the marina. Current road safety problems with the septage receiving area will need to be corrected and those processes which have the potential for creating a public hazard will need to be carefully reviewed. Those that rely on repeated bulk delivery of chemicals for process operation, control, or sludge removal will also need to be carefully reviewed.

Finally, the process should minimize the impact on the area during the construction phase. Minimizing truck traffic, dust generation, air quality concerns, vegetation and wildlife impact and noise will need to be evaluated.

Nutrient removal processes and then disinfection processes will be reviewed in this order.

D. EVALUATION OF ALTERNATIVES FOR NUTRIENT REMOVAL

1. Summary of Alternatives

The options that will be evaluated to accomplish denitrification can be summarized from Chapter VI as follows:

PHYSICAL/CHEMICAL PROCESSES

- Breakpoint Chlorination
- Selective Ion Exchange
- Ammonia Stripping

BIOLOGICAL PROCESSES FOR HLND (9 mg/l TN)

- Sequencing Batch Reactor (SBR)
- Suspended growth process using second anoxic zone and reaeration
- Separate stage nitrification followed by attached growth denitrification
- Suspended growth process (MLE) utilizing oxygen
- Suspended growth process (MLE) utilizing air

BIOLOGICAL PROCESSES FOR LLND (4 mg/l TN)

- Separate stage nitrification followed by attached growth denitrification
- Suspended growth process utilizing oxygen followed by attached growth denitrification
- Sequencing Batch Reactor (SBR)
- Suspended growth process using second anoxic zone and reaeration
- Suspended growth process (MLE) utilizing air

The three latter processes for LLND may be followed by an attached growth process using an external carbon source if warranted or a supplemental food source may be added to the reactor itself.

These treatment options are reviewed in detail in the next section.

E. EVALUATION OF NITROGEN REMOVAL ALTERNATIVES

1. Introduction

The denitrification processes to be evaluated will be analyzed for site requirements, the ability to consistently provide the level of treatment necessary for the projected flow and load conditions under the current climate, compatibility with additional treatment processes, integration of the new equipment while maintaining existing treatment operations during construction, hydraulic considerations, safety to the public, noise and odor considerations, cost, environmental impacts, and the potential for reuse of the existing structures. These and other non-monetary considerations comprise some of the more important facets of the selection process.

2. Physical/Chemical Processes

The three physical/chemical processes discussed in the previous chapter all have significant drawbacks associated with their operation. All exhibit serious operational, safety or cost concerns which preclude them from being further investigated as realistic process options.

The process of breakpoint chlorination has its problems centered around the need for storage of large amounts of chlorine on the plant site. The storage and continuous use of large quantities of chlorine in a residential area coupled with the high operational cost of the process precludes it from being considered further. The additional requirement of a highly clarified effluent to ensure consistent results is also a serious drawback.

Ion exchange suffers from much of the same operational problems as breakpoint chlorination and has its own environmental problems as well. This process requires a highly clarified effluent, additional pumping, a means to treat the ammonia laden regenerant, and component redundancy to ensure uninterrupted operation. The operational difficulties, the small quantity of systems of this type in use, and the high capital and operating costs preclude this process from further consideration.

Although ammonia stripping has the advantage of simplicity over other operations, the chemical costs for pH control, the control requirements itself, its propensity for scale formation and subsequent maintenance, and its unsuitability for cold weather operation eliminates this process from further consideration in Branford.

All physical/chemical processes are not suitable for operation in Branford and were not considered further. Biological processes to achieve denitrification are reviewed next.

3. Biological Processes

The remaining options for nutrient removal are all biological processes. These processes have the advantage of familiarity with the plant personnel, are able to be integrated into the existing process or other biological processes in the future, are proven technology in the prevailing climate in Branford, and the processes are able to reuse, if needed, some of the available tankage thereby reducing construction costs.

F. BIOLOGICAL NUTRIENT REMOVAL FOR HLND

Since all of the physical chemical processes have been eliminated from consideration as has land treatment and a high biomass process, the following remaining options for HLND will be evaluated on a cost effective basis:

Option 1: Single-sludge, multi-phase SBR process;

Option 2: Single sludge, multi-staged nitrification/denitrification process using air, a second anoxic zone and a re-aeration zone;

Option 3: Separate stage nitrification followed by attached growth denitrification;

Option 4: Single sludge, multi-staged nitrification/denitrification process (MLE) using air;

Option 5: Single sludge, multi-staged nitrification/denitrification process using oxygen.

Those of the above that are viable alternatives based on this analysis will then be reviewed for non-monetary concerns. A discussion of each process and its required ancillary equipment will be discussed separately.

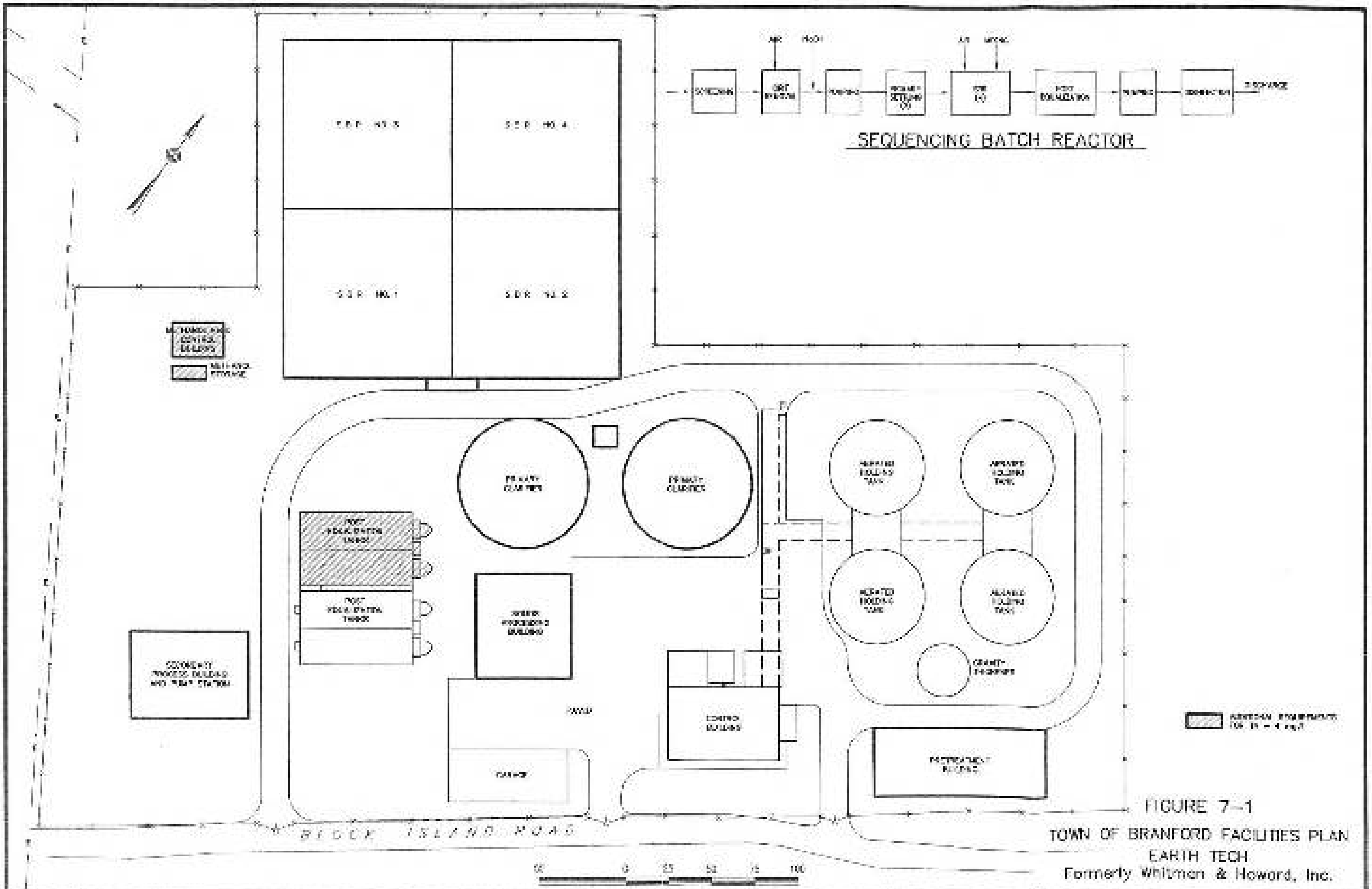


FIGURE 7-1
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

does not interfere with current operations. The area is located toward the west end of the existing secondary clarifiers. This will require that waste sludge be removed from the SBR tanks with submersible pumps since the suction lines would otherwise be too long to be of practical use.

Pretreatment consisting of screening and grit removal, primary settling, and in-plant pumping, as with all proposed biological processes, will be required.

Option 2: Single Sludge, Multi-staged Nitrification/Denitrification Process Using Air, a Second Anoxic Zone and a Re-aeration Zone;

This biological process with air is a process that will accomplish nitrification/denitrification of the influent in one process step. This is accomplished by directing the primary effluent through an anoxic zone for denitrification of the nitrified waste formed in another step of the process, an aeration zone for nitrification and a second anoxic and final aeration zone for polishing the effluent.

Mixers for the anoxic zones and an aeration system consisting of air supply blowers and a fine bubble diffuser grid for the aerobic zone are requirements of this process as is a means to control their operation. The mixers and fine bubble diffusers are located in the reactor tank which will be situated in the area of the existing sludge lagoons.

Locating the process in the area of the existing settling tanks was not considered a viable option since this would require that the existing aeration process discharge to new clarifiers that would be located in the lagoon area. Hydraulically, this will not work since the new clarifiers will have a higher water elevation due to the disinfection channel requirements.

The denitrified effluent will then be discharged to three new secondary clarifiers to settle out the biomass. Return and waste sludge will be controlled from pumps located in a building situated between the clarifiers. All nitrification/denitrification process controls, blowers and other equipment will also be located inside this building. From the clarifiers, the flow is disinfected before final discharge.

The reactor tankage requirements for this process will require a large amount of land area. The boundaries of the lagoon area will be fully utilized and the construction of the tanks will extend beyond the boundaries of the lagoons thereby impacting wetland areas. However, this impact is temporary and the final tank area requirements will be within the present lagoon boundaries. All pretreatment, pumping and primary clarification processes will be the same as for all other processes. See Figure 7-2 for a plan of equipment and building locations of this option.

Option 3: Separate Stage Nitrification followed by Attached Growth Denitrification

The separate stage nitrification process will nitrify the primary effluent. Denitrification will take place in a separate process with a deep bed fixed film system to which a food source such as methanol will be added.

The separate stage nitrification process in Branford will consist of three, three pass aeration tanks operated in parallel in a plug flow mode. The aeration tanks fit within the area of the old sludge lagoons but will still have an impact to areas outside of the lagoon area due to the depth of the structures. Air supply will be by low pressure blowers through a grid of fine bubble diffusers.

At the end of the process, nitrification is complete and flow will overflow weirs to the secondary clarifiers.

Once the biomass is settled in the secondary clarifiers, the flow will be pumped to a deep bed denitrification filter to which methanol will be added as a carbon source to reduce the nitrates to nitrogen gas. This method of denitrification requires that an additional pumping station be installed after the clarifiers to provide the head necessary for gravity flow through the filters. In addition to the filter beds, which consist of support gravel and media, a building to house the methanol storage, feed and control system, backwash pumps and blowers, air compressors, and other control and instrumentation systems is necessary. This building will be located separately from all other structures due to the flammability of methanol. Because of this requirement, additional wetland area is required to be utilized due to lack of land availability on the site.

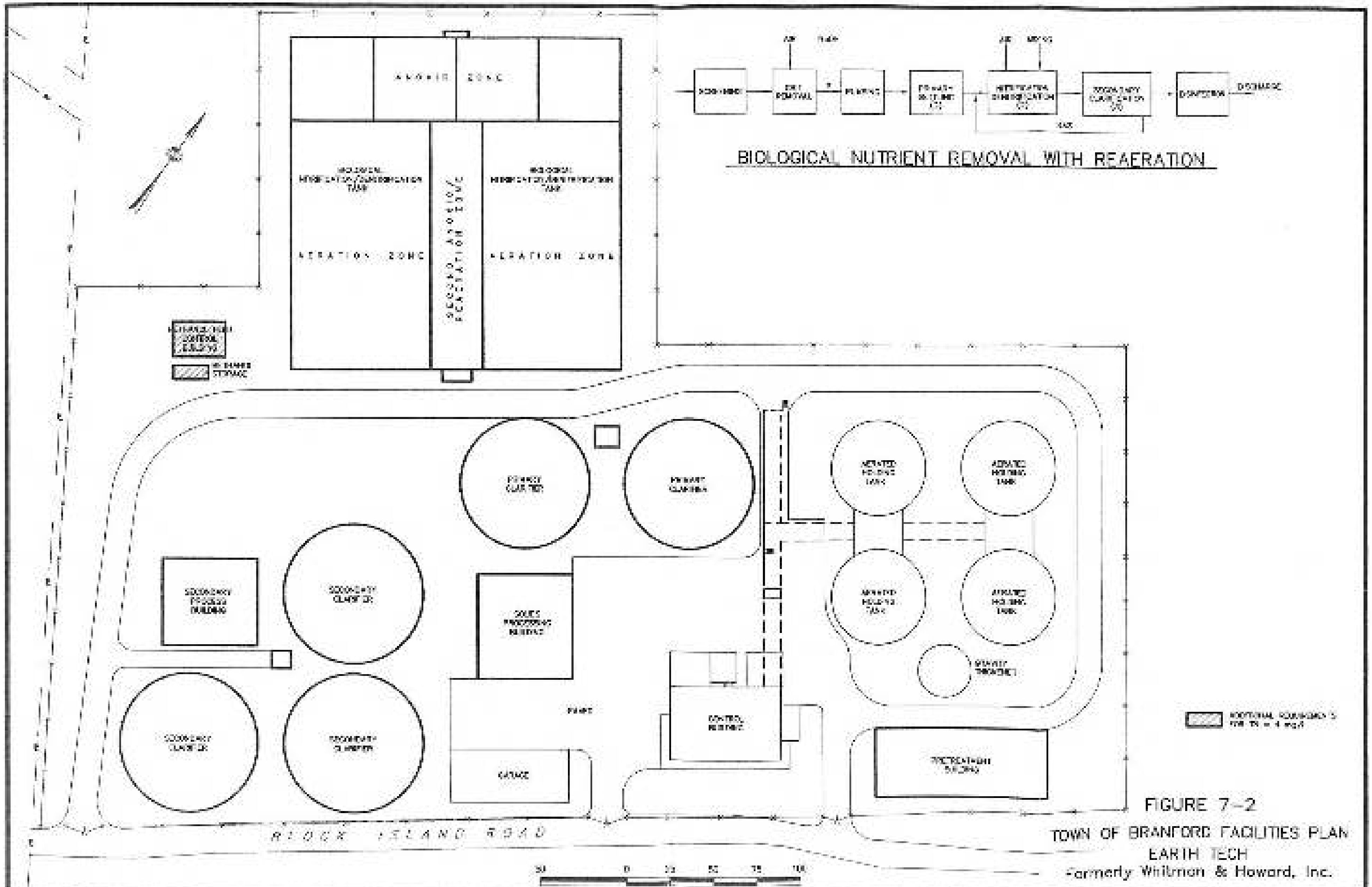


FIGURE 7-2
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

Once flow is passed through the filters and is denitrified, flow will proceed to the disinfection system, and final discharge. A schematic of the process and proposed locations of equipment and buildings is shown in Figure 7-3.

Option 4: Single Sludge, Multi-staged Nitrification/denitrification Process (MLE) Using Air;

This process is similar in all respects to Option 2 except that this option does not include a second anoxic zone or reaeration zone for the removal of nitrogen. Denitrification to a TN of 9 mg/l is accomplished by directing the wastewater overflow from the primary tanks through an anoxic zone followed by treatment in an aerated zone. An internal recycle system consisting of wall mounted axial mixers will serve to recycle wastewater nitrified in the aerated zone back to the anoxic zone for denitrification. Mixers will be provided in the anoxic zone to achieve the necessary complete mix environment. Aeration of the wastewater in the aeration zone will be accomplished by fine bubble aeration.

To achieve a total nitrogen level of 4 mg/l will not be able to be accomplished with the secondary process reactor alone. Denitrification to this level will require that an additional process consisting of a high-rate, fluidized bed denitrification filter system be included. This filter system will consist of two, equally sized, at-grade concrete tanks in which a sand or granular activated carbon (GAC) media is fluidized by pumping the effluent from the secondary clarifiers into the bottom of the filter.

Methanol is be added to the filter inlet providing the carbon source for the denitrification growth media which operates in a suspended environment. Additional equipment required for this process includes a methanol storage tank and feed system, controls, a growth control mechanism, recycle piping, and a wasting system. The advantage of this system over a fixed, deep bed filter is that the surface area available for the biological process is much greater allowing for a greater loading rate. This reduces the size of the total tankage and media thereby reducing the cost and footprint of the reactor. By the nature of the fluidizing process, additional equipment to control growth, recycle requirements, and wasting requirements increases the complexity and cost.

A schematic of the process and proposed locations of buildings and equipment is shown in Figure 7-4.

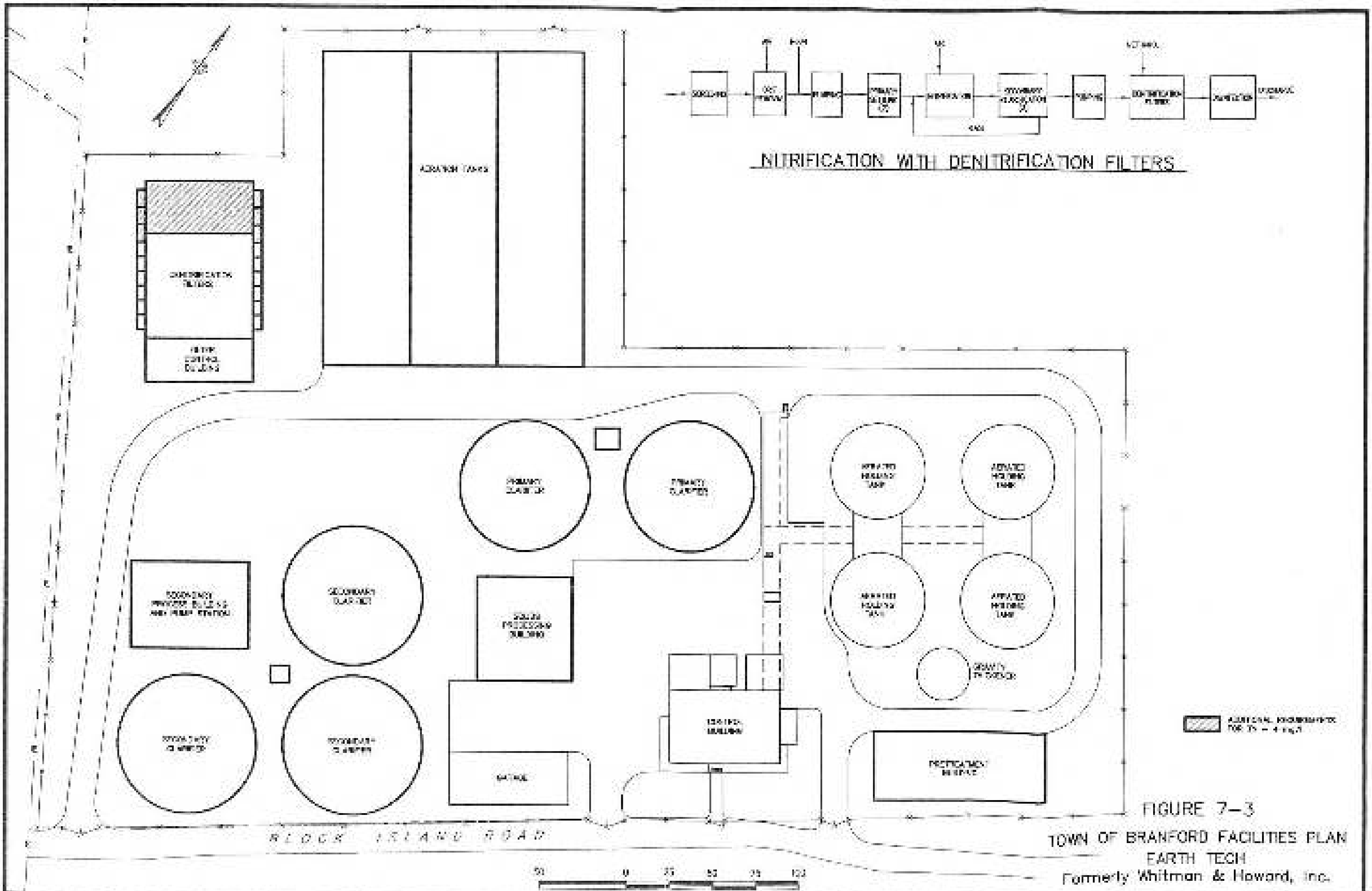


FIGURE 7-3
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

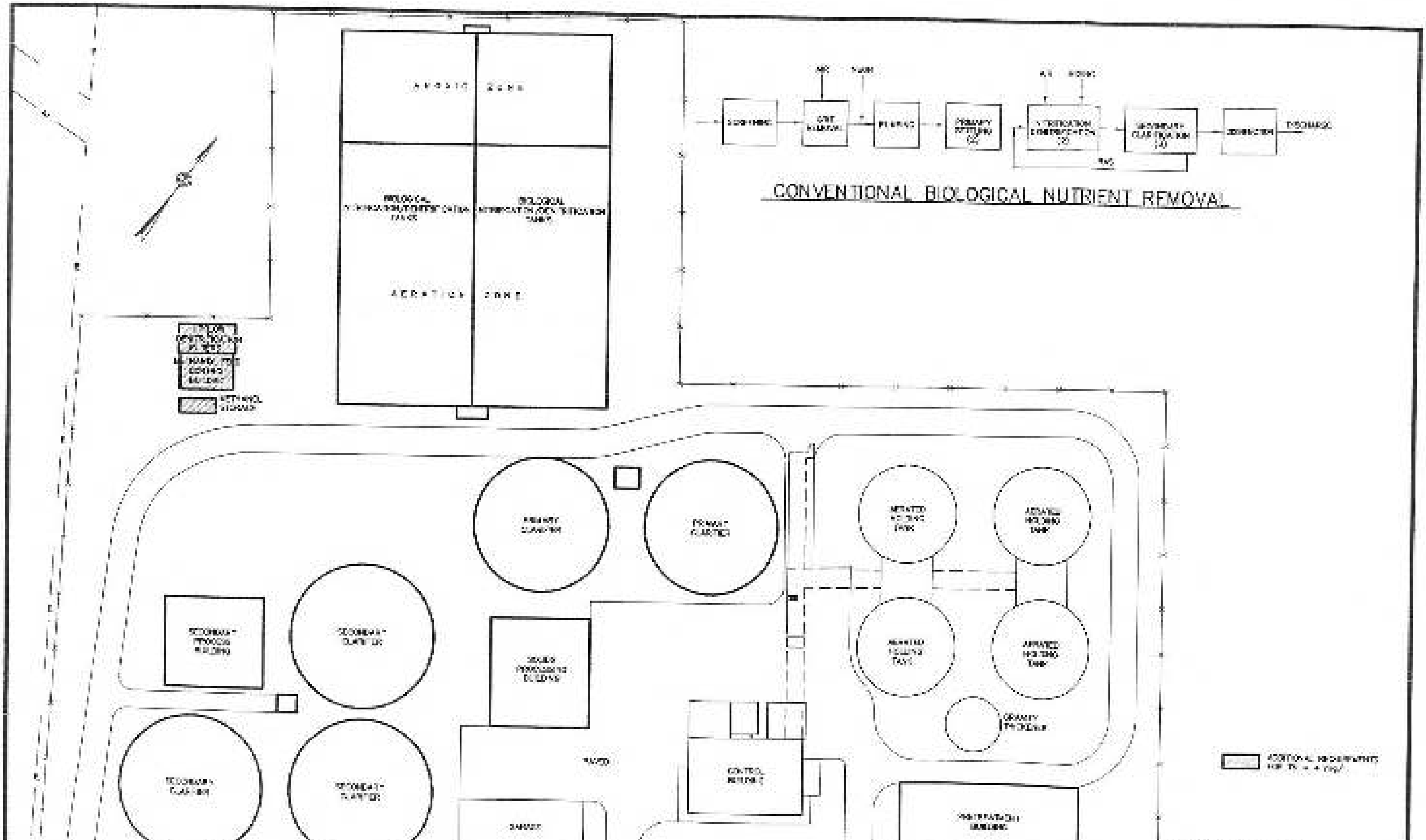


FIGURE 7-4
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

Option 5: Single Sludge, Multi-stage Nitrification/Denitrification Process Using Oxygen:

This process is similar to Option 2 above except that pure oxygen is used to supply oxygen to the biomass instead of air. The advantage of this system is that the process consumes less land area than other processes. The nitrification/denitrification reactor tanks would be located in the area of the existing lagoons allowing their construction while the existing treatment plant remains operational. The space requirements are approximately 180 feet by 150 feet and the depth of the tanks are 16 feet vs. 18 feet for the other processes. This smaller footprint and depth will minimize the impact on the wetland areas. Clarification of the denitrified effluent would be accomplished in the same manner as Option 2 above.

Inherent in an oxygen activated system are a number of specific requirements of the process that need to be addressed. First is that the oxygenation tanks are covered - an additional expense. The second is that additional alkalinity is required to be added since the carbon dioxide will accumulate in a closed tank reducing the pH of the wastewater. Thirdly, the denitrification recycle pumps are located in a separate structure - a step that other processes do not require. And fourthly, the process requires an oxygen generating system on-site along with its operating cost and noise, a backup liquid oxygen system, and a more sophisticated control system than other processes. Also, the storage of liquid oxygen on-site presents a potential fire hazard and the process will need noise control to reduce noise levels from the site.

An important concern also is the experience level of the oxygen system suppliers with operating a pure oxygen system in a denitrification mode. Currently, they have no operating plants with this process although two plants are now under construction. This lack of operating experience is a significant drawback to a process that depends heavily on automatic control of oxygen delivery to the wastewater - a control system that is inoperable at the existing plant and one that must work well if an anoxic environment is to be maintained. The space saving virtue of the process is not deemed as significant enough to warrant installation of this process in Branford. This process was therefore not investigated further.

Cost-Effective Analysis

A cost-effective analysis of the four viable options for LLND is presented in Table 7-1. Note that in this cost-effective analysis, only those costs that can be directly associated with the secondary treatment process are included. Capital and operating costs common to all processes such as the pre-treatment processes, primary treatment and solids processing, among others, are not included in this specific analysis. Also, the costs associated with site development were assumed to be essentially the same for all options. Based on this analysis, the SBR process, Option 1, is the least costly alternative.

G. BIOLOGICAL NUTRIENT REMOVAL FOR LLND

All of the options reviewed above are applicable, with modification, to an additional level of nutrient removal. In the case of the SBR process, Option 1, the tank sizes would increase slightly and the addition of a supplemental food source would be required. While suppliers of the SBR process do not believe there is a need for a supplemental food source, it is prudent at this time to consider that provisions be made to add methanol to the process. This configuration is shown in Figure 7-1 as a shaded area.

For the nitrification/denitrification process using air, Option 2, the impact would be to provide a means to feed methanol into the second anoxic zone. This configuration is shown in Figure 7-2.

For the separate stage nitrification process followed by denitrification filters, Option 3, this level of removal will require additional denitrification filter area above that necessary for the HLND requirements. This configuration is shown in Figure 7-3.

Process Options 3 and 4, which require a fixed film denitrification filter, will require that a pumping station be installed to provide the head and flow control necessary for the operation of the filters. In addition to the filter beds, a building to house the methanol storage, feed and control system, backwash pumps and blowers, air compressors, and other control and instrumentation systems is necessary. This building will be located separately from all other structures due to the flammability of methanol. All processes that will require a denitrification filter will also require wetland area be utilized due to lack of suitable land area on the site.

TABLE 7 - 1

TOWN OF BRANFORD FACILITIES PLAN

COST-EFFECTIVE ANALYSIS FOR BIOLOGICAL NITROGEN REMOVAL

TN = 9 MG/L (IILND)

	OPTION 1	OPTION 2	OPTION 3	OPTION 4
	SEQUENCING BATCH REACTOR (SBR)	BIOLOGICAL NUTRIENT REMOVAL (BNR) WITH REAERATION	NITRIFICATION WITH DENITRIFICATION FILTERS	CONVENTIONAL BIOLOGICAL NUTRIENT REMOVAL (BNR)
CAPITAL COSTS				
EARTHWORK	$1,691,979	$1,365,911	$1,353,731	$1,292,191
BUILDING WORK	$515,000	$404,350	$603,200	$404,350
CONCRETE	$1,869,323	$3,031,276	$3,101,395	$2,854,926
MISCELLANEOUS METAL	$80,000	$129,000	$158,000	$129,000
SITE ELECTRICAL	$200,000	$200,000	$200,000	$200,000
YARD PIPING	$400,000	$350,000	$550,000	$350,000
PROCESS PIPING	$405,000	$433,000	$618,000	$433,000
PROCESS EQUIPMENT	$1,802,031	$1,997,724	$2,734,845	$1,985,724
OPERATION AND START-UP	$9,599	$12,032	$22,550	$12,068
PAINTING	$46,000	$81,000	$132,000	$81,000
DEMOLITION	$74,600	$139,040	$139,040	$139,040
CAPITAL SUBTOTAL *	$6,995,532	$8,143,233	$9,612,761	$7,881,199
OPERATING COSTS				
ELECTRICAL POWER	$218,144	$215,654	$161,414	$213,693
CHEMICALS	$0	$0	$211,700	$0
OPERATION	$63,232	$51,000	$190,000	$51,000
MAINTENANCE	$41,770	$46,181	$63,400	$45,035
OPERATING SUBTOTAL	$323,146	$312,835	$626,514	$309,728
PRESENT WORTH				
OPERATING PRESENT WORTH	$3,706,485	$3,588,217	$7,186,110	$3,552,580
CAPITAL SUBTOTAL	$6,995,532	$8,143,233	$9,612,761	$7,881,199
TOTAL PRESENT WORTH	$10,702,017	$11,731,450	$16,798,871	$11,433,779

* DOES NOT INCLUDE COSTS COMMON TO ALL ALTERNATIVES. SEE TABLE 8-7 FOR TOTAL TREATMENT PLANT CONSTRUCTION COSTS

The total capital cost implication of LLND for each of the proposed options is presented in Table 7-2. Note that in this cost-effective analysis, only those costs that can be directly associated with the secondary treatment process are included. Capital and operating costs common to all processes such as the pre-treatment processes, primary treatment and solids processing, among others, are not included in this specific analysis. Also, the costs associated with site development were assumed to be essentially the same for all options.

An important consideration evident in this cost analysis is the fact that to meet the LLND levels, the SBR option would require a three foot increase in tank size for each tank as well as the addition of a methanol feed system. The Single Sludge, Multi-staged Nitrification/Denitrification Process Using Air, Option 2, would only require the addition of methanol to the second anoxic zone and the total tank size would not increase. In consideration of future treatment requirements, it would be prudent at this time to recommend that for the additional SBR tank dimension of three feet each tank over the HLND tank size, that the SBR be constructed to the LLND criteria. This forward planning would allow for future increased levels of treatment that could be inexpensively installed at this time.

Because of the additional tank requirements of the SBR process, the cost differential between Option 1 and Option 2 for the HLND option is much less than shown in Table 7-1. The additional capital cost would make the capital cost of Option 1 in Table 7-1 equal to $7,405,294 and the present worth of Option 1 at $11,111,779. Based on this analysis, the least alternative to achieve HLND is still Option 1, the SBR process, although within the accuracy of the estimate, Option 2 is now essentially as cost-effective as Option 1.

Since both Option 1 and 2 have essentially equivalent life-cycle costs, the Town of Branford was advised that they should select the process they felt was more acceptable to their staff and current operations. Town personnel decided to select the Single Sludge, Multi-staged Nitrification/Denitrification Process Using Air, Option 2, over the SBR process as the process of choice. It provided them with a familiar, flow through activated sludge process, was less dependent upon electronic controls and motorized valves, was more common in treatment plants of this size, is operationally flexible, and has a proven track record of successful operation in denitrifying wastewater.

TABLE 7 - 2

TOWN OF BRANFORD FACILITIES PLAN

COST-EFFECTIVE ANALYSIS FOR BIOLOGICAL NITROGEN REMOVAL

TN – 4 MG/L (LLND)

	OPTION 1	OPTION 2	OPTION 3	OPTION 4
	SEQUENCING BATCH REACTOR (SBR)	BIOLOGICAL NUTRIENT REMOVAL (BNR) WITH REAERATION	NITRIFICATION WITH WITH DENITRIFICATION FILTERS	CONVENTIONAL BNR WITH DENITRIFICATION FILTER
CAPITAL COSTS				
EARTHWORK	$1,804,026	$1,387,964	$1,393,280	$1,482,962
BUILDING WORK	$603,200	$492,450	$603,200	$603,200
CONCRETE	$2,060,038	$3,038,139	$3,363,700	$2,966,298
MISCELLANEOUS METAL	$90,840	$131,000	$166,400	$155,000
SITE ELECTRICAL	$220,000	$220,000	$220,000	$200,000
YARD PIPING	$320,000	$270,000	$570,000	$370,000
PROCESS PIPING	$423,500	$443,000	$660,000	$518,000
PROCESS EQUIPMENT	$1,842,893	$2,038,386	$3,399,845	$3,553,165
OPERATION AND START-UP	$10,599	$13,032	$22,550	$16,512
PAINTING	$55,000	$87,000	$135,000	$107,000
DEMOLITION	$74,600	$139,040	$139,040	$139,040
CAPITAL SUBTOTAL *	$7,613,496	$8,360,011	$10,475,015	$10,109,177
OPERATING COSTS				
ELECTRICAL POWER	$240,701	$215,654	$161,414	$213,693
CHEMICALS	$69,990	$69,990	$281,690	$69,990
OPERATION	$67,392	$55,160	$190,000	$51,000
MAINTENANCE	$50,090	$54,501	$63,400	$45,035
OPERATING SUBTOTAL	$428,173	$395,305	$696,504	$379,718
PRESENT WORTH				
OPERATING PRESENT WORTH	$4,911,144	$4,534,148	$7,988,895	$4,355,365
CAPITAL SUBTOTAL	$7,613,496	$8,360,011	$10,475,015	$10,109,177
TOTAL PRESENT WORTH	$12,524,640	$12,894,159	$18,463,910	$14,464,542

* DOES NOT INCLUDE COSTS COMMON TO ALL ALTERNATIVES. SEE TABLE 8-8 FOR TOTAL TREATMENT PLANT CONSTRUCTION COSTS

H. EVALUATION OF ALTERNATIVES FOR DISINFECTION

Disinfection by chlorination and ultraviolet radiation will be reviewed in detail in this section. Disinfection by ozone will not be reviewed because its high capital and operating costs and the need to generate ozone on-site make it a poor choice for a treatment plant of this size and location.

1. Chlorination

Disinfection requirements for treatment plants with discharges located in Long Island Sound is to have tank volume that will provide a 30 minute chlorine contact time for the maximum expected treatment plant flow of 15.3 mgd. Disinfection with chlorine also requires that two contact tanks be installed, each with half the capacity to allow a 30 minute contact time at 15.3 mgd. This will require two reactors of 140,000 gallon capacity each at this location. The existing chlorine contact tanks are 97,000 gallons in total capacity and will therefore not be able to be used for the proposed treatment plant.

The chlorine delivery equipment must have the capacity to provide a 25 mg/l dosage at the average design flow of 4.9 mgd. Chlorination feed equipment must be able to deliver the maximum dose rate described above with adequate provisions for system redundancy. Dechlorination is not necessary since the effluent limits for chlorine will be 1.5 mg/l which is readily and consistently achievable with current chlorination instrumentation.

Chlorine can be delivered to the treatment plant clarified effluent by the use of chlorine gas as is presently accomplished, by using sodium or calcium hypochlorite or by chlorine dioxide. The use of chlorine gas, while possibly the most cost-effective means of chlorination, is not recommended for this location due to the treatment plant proximity to residential areas and the safety concerns inherent in the use and delivery of chlorine gas near populated areas. Many locations in or near residential areas have discontinued chlorine gas use for this safety reason. In addition, there is concern among plant personnel about its safety. For these reasons, chlorine gas as a means of chlorination will not be investigated further. Calcium hypochlorite will also not be considered further since it is extremely corrosive and generates sludge deposits in piping and storage tanks. Chlorine dioxide, a toxic gas formed by the combination of sodium chlorite and chlorine, exhibits the same safety concerns as chlorine gas. There is also a concern about the ready availability and cost of sodium chlorite. Therefore, chlorine dioxide as a disinfectant was also not investigated further.

Sodium hypochlorite, a liquid that is delivered in various chlorine strengths, does not have the same safety concerns as the gaseous forms of chlorine and is the chlorination system of choice for many facilities using chlorine as a disinfectant. Its advantages are that it is easily stored, controlled and delivered but it is a caustic solution and does require precautions in its use. Also, it does have the disadvantage of deteriorating in potency over time but this is able to be controlled by designing chemical storage capacity and delivery with this in mind. This type of chlorination system will require a building and storage tank(s) for the sodium hypochlorite, tank containment, a chemical feed system, residual analyzers and recorders, an instrumentation system for control of the hypochlorite feed in relation to flow, and containment piping, flash mixing and pumping assemblies in addition to the chlorine contact tank requirements.

2. Ultraviolet Radiation Disinfection

The design requirements for ultraviolet radiation (UV) disinfection are that there be system redundancy so that disinfection will take place at peak flow with one of the UV units out of service. No additional channel is required if the UV lamps are easily accessible for replacement from the floor surface. Redundant electrical service transformers are also required to insure an uninterrupted power supply to the lamps in the event of a transformer failure.

It was first reviewed to determine if the existing chlorine contact chambers could be used for the ultraviolet disinfection system. In some applications, this is a significant cost-saving measure. After review, it was determined that the channels were not long enough to provide an effective flow pattern for the UV modules and therefore the possibility of utilizing the existing contact tanks as a UV reactor was abandoned.

The UV equipment requires a series of UV modules, a module removal mechanism, a level control means and electrical service and control equipment for the operation of the lamps. In addition, a channel of specific dimensions to allow proper contact of the wastewater with the UV radiation is required. It is preferable to install UV systems in an enclosed area although it is not absolutely necessary to the process. For the purposes of this analysis, though, it is planned that the UV system will be installed within a building that will house other process functions.

The cost-effective analysis of both options is shown in Table 7-3. This analysis shows that the alternative with the lowest overall cost is the ultraviolet radiation disinfection system.

I. THE SELECTED PLAN

Based on the cost-effective analysis of process and disinfection options in Branford and coupled with other requirements of the treatment process, the following is a description of the recommended plan:

1. **Liquid Processing:** 9 mg/l total nitrogen (HLND)

- Preliminary treatment consisting of mechanical coarse bar screening followed by aerated grit removal.
- In-plant pumping of the screened and degritted wastewater to primary clarifiers. Primary sludge to gravity thickener.
- Nutrient and BOD removal in a suspended growth biological nutrient removal process which includes an anoxic zone, aeration zone, second anoxic zone, and a re-aeration zone.
- Settle waste activated sludge in secondary clarifiers. Underflow return to secondary process. Waste to storage for further processing.
- Direct clarifier overflow through an ultraviolet radiation disinfection system.
- Discharge to Branford Harbor via the existing outfall pipe by gravity. Utilize effluent pumps if water surface in the harbor is high.

TABLE 7 - 3
TOWN OF BRANFORD FACILITIES PLAN

COST-EFFECTIVE ANALYSIS FOR DISINFECTION

	ULTRAVIOLET RADIATION	CHLORINATION WITH HYPOCHLORITE
CAPITAL COSTS		
SITEWORK	$30,000	$144,355
REACTOR (CONTACT) TANK	$66,600	$413,172
EQUIPMENT	$334,700	$26,200
MISC. METALS	$8,000	$16,613
CONTAINMENT PIPING	$0	$27,000
ELECTRICAL SERVICE	$20,000	$1,000
BUILDING	$110,250	$88,200
EMERGENCY POWER (ADDITIONAL)	$30,000	$0
CAPITAL SUBTOTAL	$599,550	$716,540
OPERATING COSTS		
ELECTRICAL POWER	$37,700	$3,270
CHEMICALS	$0	$38,690
MAINTENANCE	$4,320	$11,500
MISCELLANEOUS	$8,000	$1,000
OPERATING SUBTOTAL	$50,020	$54,460
PRESENT WORTH		
OPERATING PRESENT WORTH	$573,729	$624,656
CAPITAL SUBTOTAL	$599,550	$716,540
TOTAL PRESENT WORTH	$1,173,279	$1,341,196

2. **Liquid processing:** 4 mg/l total nitrogen (LLND)

- Process stream same as for 9 mg/l total nitrogen except for the addition of a methanol storage and feed system, its accompanying building and chemical pumping system.

3. **Solids Processing:**

- Thicken waste activated sludge (WAS) from the secondary clarifiers on a gravity belt thickener. Store thickened WAS in aerated holding tanks. Filtrate to preliminary treatment.

- Thicken primary sludge in a gravity thickener. Store thickener underflow in aerated holding tanks. Thickener overflow to preliminary treatment.

- Remove thickened primary and waste activated sludge to tank trucks for disposal off-site in thickened form.

- Sludge processing alternative is to dewater aerated sludge for disposal in cake form. Odor control will be provided for this option.

4. **Miscellaneous:**

- Provide an aerated septage receiving station near the preliminary treatment building.

- Provide a centralized odor control system.

- Renovate the existing Control Building to include all administrative functions and laboratory.

- Provide sodium hydroxide feed system for alkalinity control.

- Convert the existing anaerobic digesters to aerated holding tanks.

- Consolidate solids processing and odor control system into a separate building.

A detailed description of the selected plan and its implementation is provided in Chapter VIII.

VIII. DETAILED PLAN DESCRIPTION AND IMPLEMENTATION

A. INTRODUCTION

The design and implementation of the treatment options provided in Chapter VII need to take into account other items related to waste treatment before a final plan can be implemented. Items that impact the selected plan include correction of existing facility operational problems, need for other unit operations, plant hydraulics, the reuse of existing facilities, the means of sludge processing and disposal, odor and noise control, and the means to implement the plan while maintaining the necessary level of wastewater treatment at the present facility.

All of these items are taken into consideration during the development of the complete wastewater treatment plan that will achieve the desired effluent results for both LLND and HLND. This plan will be discussed in detail in this Chapter.

In addition to the plan at the treatment plant, a plan of implementation for corrective action for the collection system pumping stations needs to be addressed. This will be discussed in detail in this Chapter also.

B. WASTEWATER PUMPING STATIONS AND COLLECTION SYSTEM

1. Pumping Stations

As discussed in Chapter IV, one of the wastewater pumping stations reviewed under this Plan is in need of additional pumping capacity to meet the current and future pumping needs. This is the Central pumping station. The Central pump station requires additional flow capacity from the current 2,800 gpm to approximately 4,600 gpm. A review of the existing Central pump station drawings and the requirements of the additional pump station flow requirements has determined that the existing pumping station size and inlet hydraulics are not able to be cost-effectively corrected. To fit the pumps of the size required in this pump station would require that these new larger pumps be too close to each other for proper maintenance. In addition, the pump station would require a new wet well to correct the inlet conditions and alleviate the sewer hydraulics problems near the pump station. It is recommended that a new pump station to replace the existing Central pump station be installed.

In addition, and Sybil Creek pumping station needs an additional pump to provide standby capability, and a complete mechanical and electrical rehabilitation of the Route 139 pump station is needed since this pumping station is at the end of its mechanical life.

2. Collection System

Review of the collection system was limited in this facilities plan to that related to the pump station forcemains, however, in reviewing the need to increase the capacity of the Central pump station, it was prudent to review the downstream impacts of this increased capacity prior to a flow increase recommendation. It was determined during this review that augmentation of approximately 600 feet of 30 inch sewer on Block Island Road from the treatment plant site to the manhole where the Sybil Creek pump station flow meets the Central pump station flow will need to be augmented to be able to accept the current and future flows to the treatment plant without surcharge. A 36 inch sewer in addition to the existing 30 inch sewer is recommended to be able to transport the peak flows of 15.3 mgd to the treatment plant without sewer surcharge.

3. Infiltration/Inflow (I/I)

The sewer system evaluation study (SSES) previously referenced and completed in May, 1995 determined that all I/I in town was not cost-effective to remove. This determination was based on the assumption that the existing treatment and transport facilities (pump stations, piping, and treatment plant) were to remain without upgrade or modification. Also, FY 1994-95 operation and maintenance costs were used in this report. Since the proposed treatment plant will have an increased capital and operational cost associated with it and there will be an increased cost to transport the flows, the assertion that all I/I is not cost-effective to be removed needs to be re-evaluated using up-to-date costs.

The re-evaluation of the initial data provided in the SSES report is shown in Table 8-1. In Table 8-1, operational costs have been updated and projected to the year 2000 - the first year of operation.

TABLE 8 - 1

I/I COST COMPARISON

COST TO REMOVE VS. COST TO TRANSPORT AND TREAT

TOWN OF BRANFORD FACILITIES PLAN

PERCENT OF TOWN-WIDE I/I

		25% **	50% **	75% **	100% **
	PUMP STATION OPERATING COSTS				
1.	LABOR *	$17,389	$19,708	$22,026	$26,663
2.	ELECTRICAL POWER	$14,700	$29,359	$44,117	$58,825
3.	FUELS *	$1,159	$2,087	$2,752	$3,710
4.	PUMP STATION MAINTENANCE *	$9,854	$23,755	$38,169	$55,004
5.	MISCELLANEOUS/OTHERS *	$3,478	$6,956	$10,433	$13,912
	TREATMENT PLANT OPERATING COSTS				
6.	ELECTRICAL	$5,519	$10,981	$16,501	$22,021
7.	CHEMICALS	$4,800	$9,658	$14,528	$19,385
8.	MAINTENANCE	$2,350	$4,675	$7,025	$9,375
9.	OPERATING TOTAL	$59,318	$107,198	$153,582	$210,749
10.	I/I REMOVAL COSTS *	$92,364	$178,856	$292,959	$453,441

* FROM SSES REPORT, MAY 1995, GANNETT FLEMING, INC. TABLES 12 AND 15 WITH INFLATION FACTOR OF 3% PER YEAR

** 25% OF I/I IS 386,000 GPD, 50% = 772,000 GPD, 75% = 1,158,000 GPD, 100% = 1,544,000 GPD.

These operational costs are then compared to the cost to remove I/I at the 25%, 50%, 75%, and 100% removal level. The costs to remove these flows, line 10 in Table 8-1, are taken from the previously mentioned SSES report adjusted for an inflation rate of 3% per year. The costs to transport and treat the flows, line 9 in Table 8-1, are based in part upon the data contained in the SSES report and in part by new operational cost data contained in this facilities plan. I/I flows are taken from Table 4-5 of this facilities plan.

In Table 8-1, no amortized costs of the new treatment plant capital costs attributable to I/I are included in the evaluation. This is because the majority of the treatment plant processes are sized based on nutrient loadings of which I/I contributes little or none. Those processes that are impacted hydraulically will not be reduced in size unless significant I/I removals are achieved, which is unlikely. Therefore, any I/I costs associated with the capital cost of the new treatment plant are incremental and are not quantified in this analysis.

Based on this analysis, Table 8-1 confirms that it is still less expensive to transport and treat the I/I than it is to remove it. However, it is still within the best interests of the Town to proceed with their previously described program to eliminate inflow in Town as it is always advantageous to remove and will reduce the Town's operational costs and minimize, or correct, hydraulic problems in the collection system that were noted previously.

C. TREATMENT PLANT DESIGN OF THE SELECTED PLAN (HLND)

1. Introduction

Table 8-2 contains pertinent design data such as tank sizes, overflow rates, loading rates, storage times and other design criteria that are necessary to achieve the high level nutrient discharge (HLND) requirements of 9 mg/l total nitrogen for the selected plan. The additional requirements for a total nitrogen discharge of 4 mg/l (LLND) includes the addition of a methanol feed, storage and control system to the requirements for the HLND treatment system. The design information data for this methanol system is also provided in Table 8-2 and is highlighted by the use of bold, italic type. The treatment plant layout

TABLE 8-2
OPERATIONAL STATISTICS
TOWN OF BRANFORD FACILITIES PLAN

		AVERAGE YEAR	MAXIMUM MONTH	HYDRAULIC MAXIMUM	ONE UNIT OUT OF SERVICE
RAW WASTEWATER DATA	TOTAL FLOW IN MGD	4.90	6.50	15.20	6.50
	BOD5 CONCENTRATION, MG/L	185	167		167
	BOD5 LOADING, LBS/D	7,569	9,029		9,029
	SUSP SOLIDS CONC IN MG/L	184	177		177
	SUSP SOLIDS LOADING IN LBS/D	7,523	9,609		9,609
	TKN MG/L	29	31		31
	TKN LBS/D	1,166	1,702		1,702
	NH4-N MG/L	23	22		22
	NH4-N LBS/D	932	1,176		1,176
SCREENING	NUMBER OF CHANNELS	2	2	2	1
	CHANNEL LENGTH, FT	14	14	14	14
	CHANNEL WIDTH, FT	3	3	3	3
AERATED GRIT COLLECTION	NUMBER OF CHANNELS	2	2	2	1
	UNIT LENGTH, FT	45	45	45	45
	UNIT WIDTH, FT	7	7	7	7
	LIQUID DEPTH, FT	6.80	6.86	7.13	7.07
	VOLUME, CF	4,281	4,320	4,492	2,226
	DETENTION TIME AT Q, SEC	585	429	191	221
PRIMARY SETTLING	NUMBER OF UNITS	2	2	2	1
	UNIT DIAMETER, FT	70	70	70	75
	SWD, FT	10.03	10.04	10.06	10.05
	UNIT SURFACE AREA, SF	3,847	3,847	3,847	4,416
	TOTAL SURFACE AREA, SF	7,693	7,693	7,693	4,416
	OVERFLOW RATE, GPD/SF	637	845	1,970	1,472
	WEIR OVERFLOW RATE, GPD/LF	11,100	14,800	34,600	27,600
	TOTAL VOLUME, GAL	577,124	577,475	579,030	332,067
	DETENTION TIME, AT Q, HRS	2.83	2.13	0.91	1.23
	BOD REMOVAL RATE	30%	25%		
	TSS REMOVAL RATE	60%	55%		
BNR PROCESS ANOXIC ZONE	NUMBER OF UNITS	2	2	2	1
	UNIT WIDTH	33.30	33.30	33.30	33.30
	UNIT LENGTH	92.00	92.00	92.00	92.00
	UNIT DEPTH	18.50	18.50	18.50	18.50
	TOTAL VOLUME, GAL	847,800	847,800	847,800	423,900
	DET TIME IN HRS AT Q (EXCL INTERN. REC.)	4.15	3.13	1.34	1.57
AEROBIC ZONE	NUMBER OF UNITS	2	2	2	1
	UNIT WIDTH	74.00	74.00	74.00	74.00
	UNIT LENGTH	142.00	142.00	142.00	142.00
	UNIT DEPTH	18.00	18.00	18.00	18.00
	TOTAL VOLUME, GAL	2,828,600	2,828,600	2,828,600	1,414,800
	DETENTION TIME IN HRS AT Q	13.85	10.45	4.47	5.22
	BOD5 LOADING, LBS/D/1000 CF AVG	18.85	22.83		
	TKN LOADING, LB/D	1,180	1,702		
	BOD/TKN	5.10	5.07		
	MLSS, AVG MG/L	4,000	4,000		
	MLSS UNDER AERATION, LBS	94,395	94,395		
	BOD5 LOADING, LBS/D/100 LB MLSS	8	9		
	F/MLVSS RATIO, AVG	0.11	0.13		
	MLSS WASTED, LB/D	3,550	4,300		
	MCRT, DAYS	27	22		

TABLE 8-2
OPERATIONAL STATISTICS
TOWN OF BRANFORD FACILITIES PLAN

		AVERAGE YEAR	MAXIMUM MONTH	HYDRAULIC MAXIMUM	ONE UNIT OUT OF SERVICE
METHANOL FEED SYSTEM	*FEED RATE, GPH*	3.90	5.17		
	METHANOL STORAGE TANK, GAL	3,000	3,000		
SECONDARY CLARIFICATION	NUMBER OF TANKS	3	3	3	2
	DIAMETER, FT	75	75	75	75
	TANK SWD, FT	13	13	13	13
	TOTAL SURFACE AREA, SF	13,247	13,247	13,247	8,831
	OVERFLOW RATE, GPD/SF	370	491	1,147	736
	SOLIDS LOADING RATE, LB /D/SF	12.34	16.37		
	SOLIDS LOADING RATE, LB /D/SF (100% RAS)	24.68	32.74		
ULTRAVIOLET DISINFECTION	NUMBER OF REACTORS	1	1	1	
	REACTOR WIDTH, IN	47	47	47	
	REACTOR LENGTH, FT	10	10	10	
	NUMBER OF LAMPS	40	40	40	
GRAVITY THICKENING	NUMBER OF THICKENERS	1	1		
	DIAMETER, FT	30	30		
	TOTAL SURFACE AREA, SF	707	707		
	PRIMARY SLUDGE FLOW TO THICKENER, GPD	20,800	24,400		
	FLOOR LOADING, LB/D/SF	6	7		
	UNDERFLOW, LBS/D	4,059	4,761		
	UNDERFLOW RATE, GPD/SF	14	16		
WAS SLUDGE HOLDING	NUMBER OF TANKS IN OPERATION	2	2		
	TANK DIAMETER, FT	50	50		
	TANK SWD, FT	20	20		
	TOTAL VOLUME, CF	82,425	82,425		
	WAS LOADING, LBS/D	3,550	4,300		
	WAS FLOW, GPD @0.8%	53,207	64,448		
	NON-VOLATILE TSS (30% of pri.effl.TSS), GPD	13,534	18,424		
	STORAGE, DAYS	9	7		
WAS SLUDGE THICKENING	NUMBER OF THICKENERS	2	2		1
	THICKENER SIZE, M	2	2		2
	SLUDGE FEED RATE, GPM	250	250		250
	SLUDGE FEED RATE, GPM/M	125	125		125
	SLUDGE PROCESS RATE, GPD (6 HR DAY)	180,000	180,000		90,000
	GBT OPERATION, HRS/WK	16	20		86
	TWAS GENERATION RATE, GPD @5% AND 95% CAPTURE	10,145	14,717		
PRIMARY AND WASTE ACTIVATED SLUDGE HOLDING	NUMBER OF TANKS IN OPERATION	1	1		
	TANK DIAMETER, FT	50	50		
	TANK SWD, FT	20	20		
	CONE DEPTH, FT	3	3		
	UNIT SIDEWATER VOLUME, CF	39,260	39,260		
	UNIT CONE VOLUME, CF	1,963	1,963		
	TOTAL VOLUME, GAL	308,270	308,270		
	PRIMARY SOLIDS FLOW, GPD	9,734	11,417		
	TWAS FLOW, GPD	10,145	14,717		
	TOTAL FLOW, GPD	19,879	26,134		
	STORAGE, DAYS	16	12		

for both HLND and LLND, and hydraulic profile is shown in Figure 8-1 and 8-2 respectively. The plant layout represents the locations and size of individual structures and processes on the plant site. The hydraulic profile provides details of the means that flow will proceed through each process. The details of the selected plan are discussed below.

2. Plant Hydraulics

The hydraulic profile is shown in Figure 8-2 for plant flows of 15.3 mgd. This flow represents the maximum peak hourly flow to the treatment plant. This value was established previously in Chapter V.

The flow capacity of the sewer on Block Island Road from a point where the Sybil Creek pump station discharge ties in to the treatment plant will be augmented by the addition of a 36 inch pipe. This is a distance of approximately 600 feet. The sewer slope for this section of sewer is 0.1% and has a capacity of 8.4 mgd. This augmentation will eliminate the sewer backups in this area and provide free flow to the treatment plant for the full 15.3 mgd.

All flows transported to the treatment plant will be directed by gravity through a new 36 inch pipe to the screening and aerated grit removal processes. From these preliminary treatment processes, flow will be pumped by variable speed pumps to a distribution box ahead of the two primary clarifiers. This distribution box will provide for equal hydraulic distribution of the flow to each primary tank. This will alleviate the hydraulic distribution problem presently encountered at the existing primary settling tanks and provide for efficient BOD and suspended solids removals. Variable speed pumping is provided to reduce the effects of influent flow variations on downstream processes and equipment.

From the two primary clarifiers, flow will proceed by gravity to a flow distribution box ahead of the secondary treatment process. Flow will be equally split hydraulically at this distribution box allowing for equal flow distribution to this process.

After nitrification/denitrification has occurred in the suspended growth secondary process, flow will proceed by gravity to a secondary clarifier distribution box which will equally split

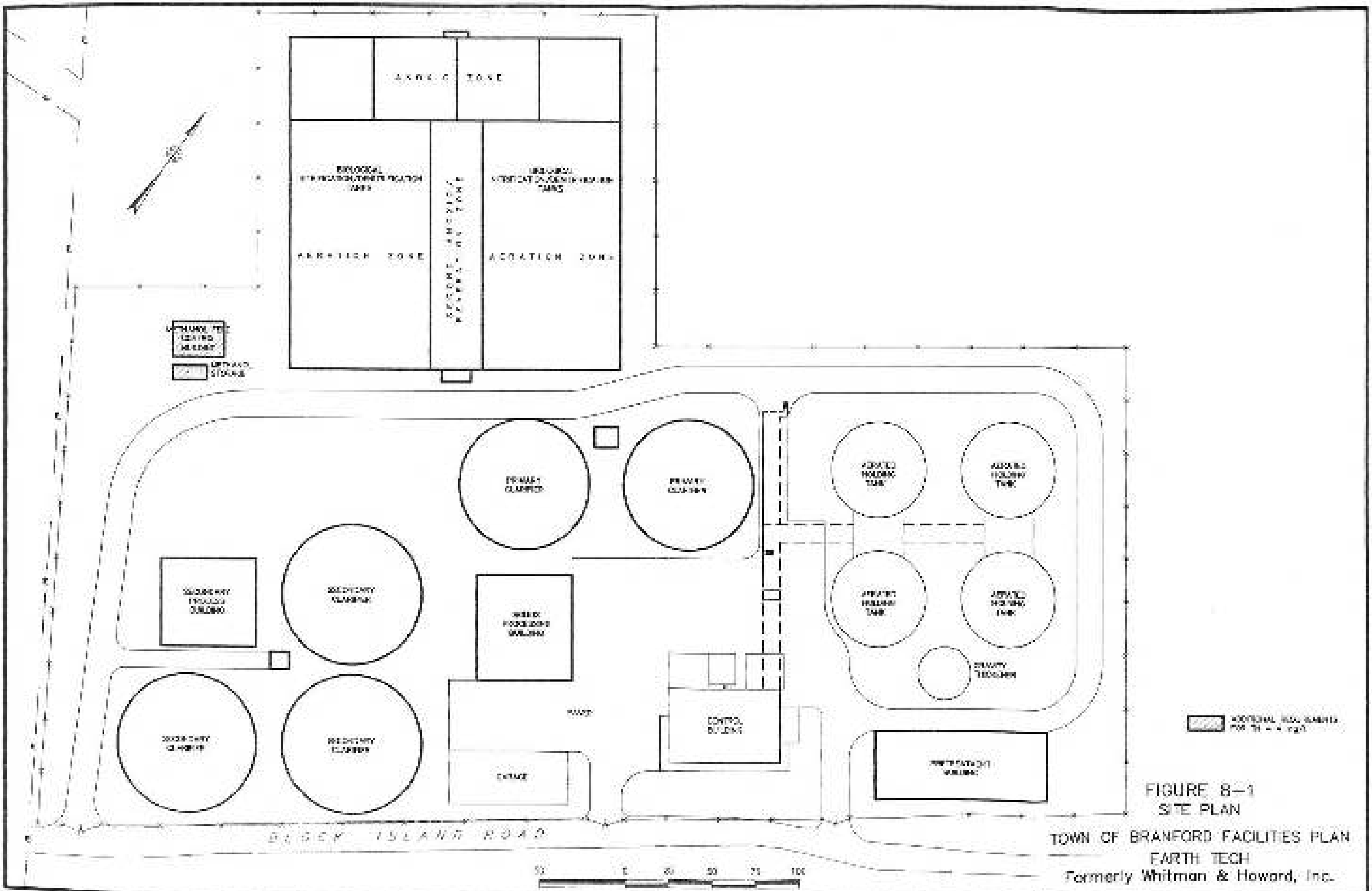


FIGURE 8-1
SITE PLAN
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

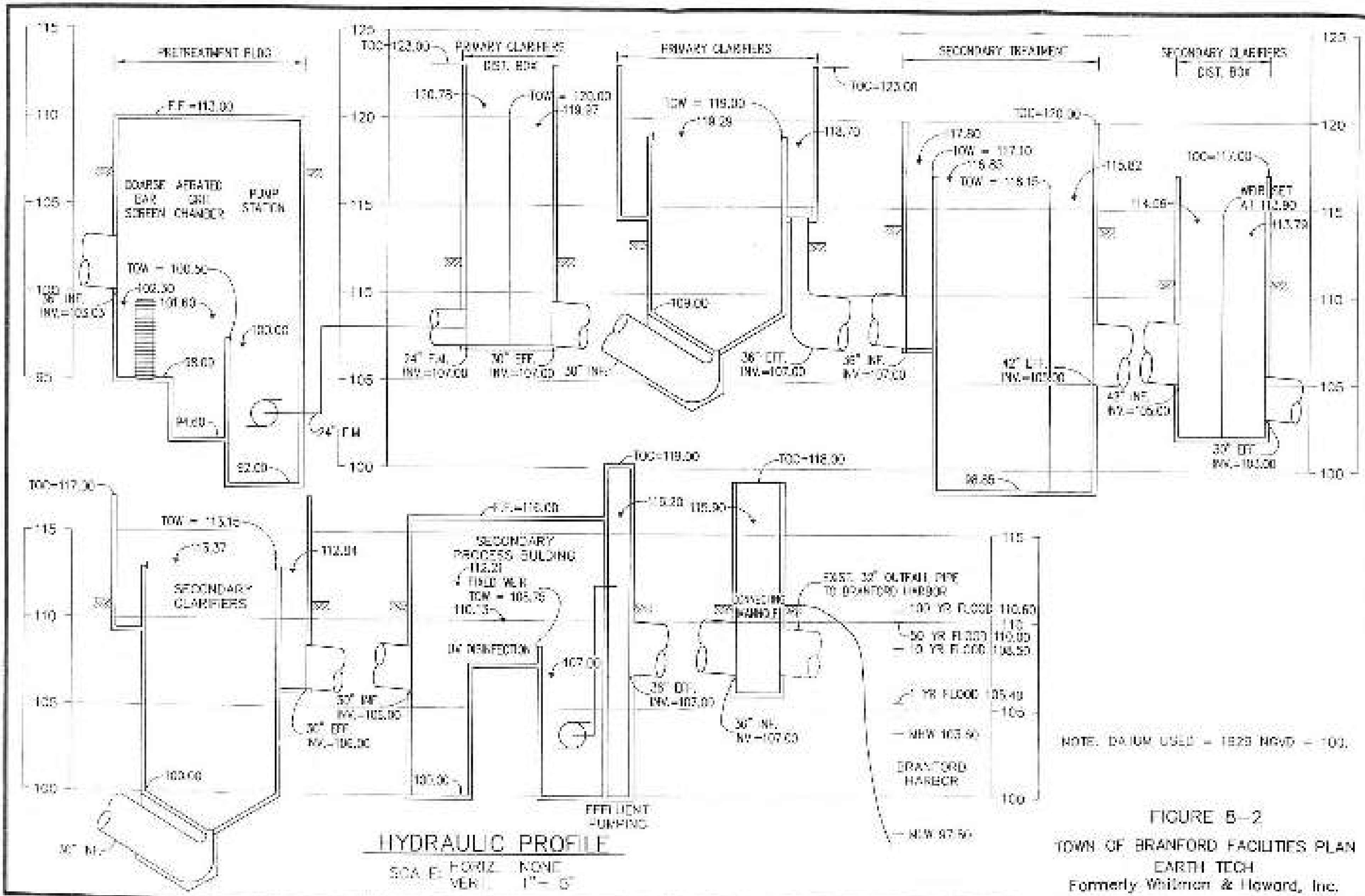


FIGURE 5-2
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

the flow to the three new circular clarifiers. The overflow from the clarifiers will then proceed to a common wet well for flow distribution to the ultraviolet (UV) disinfection system. Proper water level will be maintained in the UV disinfection channel by means of a full channel fixed weir.

Flow from the UV disinfection process will be discharged by gravity to Branford Harbor through the existing 32 inch diameter outfall pipe during periods when water levels in the harbor allow this. This is the majority of the time since mean high water is at elevation 3.6, 1929 NGVD, or 103.6 if using the datum commonly used at the treatment plant. During those periods when the water level in the harbor is high due to tide or flood and gravity discharge of the effluent is not possible, the treated effluent will be diverted to a wet well and pumped by low head, high volume pumps to an elevation above flood stage so that gravity discharge will occur.

Flood elevation in Branford Harbor is established at elevation 12.0 by the Flood Insurance Administration section of the Federal Emergency Management Agency (FEMA). All structures in the upgraded treatment plant will be set above this elevation so that treatment and equipment will remain operational during this frequency flood. Hydraulically, the plant will be able to process the full peak flow of 15.3 mgd without detrimental effects to equipment or bypassing any treatment process. No plant bypass piping will be provided.

3. Preliminary Treatment

Flow entering the treatment plant from the sanitary sewer in Block Island Road will be redirected to flow by gravity to a new preliminary treatment building that will be constructed to the south of the existing gravity thickeners. A new 36 inch pipe will connect the new processes within this building to the existing influent pipe at a location near the existing barminutor chamber. By providing new unit processes to replace the barminutor and grit chamber, the existing barminutor channel and grit removal facilities hydraulic, safety and operating problems are eliminated.

Within this pretreatment building, flow will pass through two new mechanically operated coarse bar screens each designed for approximately 8.0 mgd. A manually screened bar rack will be provided in a screen bypass channel which will be set at an elevation higher than the mechanical screen channels to allow for automatic bypassing through the manual bar rack in the event of a mechanical screen failure. From the bar screens, flow will proceed to an aerated grit removal process. Air will be provided to each grit chamber for enhanced settling of the grit and for removal of organics from the grit by two blowers located within the building. Screenings and grit will be moved by conveyors to containers for disposal.

Flow will proceed from the aerated grit chamber to the influent pumping station also located within this building. Pumping is required to obtain the necessary hydraulic head for gravity flow to the downstream treatment processes.

As noted in Chapter IV, the existing raw sewage pumps are nearing the end of their mechanical life. In addition, the current pump capacity and wet well size is too small for current as well as future flows. No spare pumping capacity is available, the use of horizontal pumps in a sub-basement area subject to flooding is not good practice, and the maintenance on the pumps and piping due to their configuration is difficult. For all of these reasons, a new pump station is provided in the new treatment process. The existing pump wet well will be utilized for a plant sewer wet well as described later in this Chapter.

Three pumps will be provided for this pump station, with two capable of pumping the full 15.3 mgd leaving the third pump as a spare. Variable speed control for each pump will be provided so that all plant flow conditions are able to be pumped.

4. **Primary Treatment**

Pumped wastewater from the new pump station will flow to a new distribution box located ahead of the two new mechanically cleaned primary clarifiers. This distribution box will consist of a concrete structure with adjustable overflow weirs to distribute the flow equally to each of the primary clarifiers. Flow to either tank will be able to be shut off by this means. An additional means will be provided to divert a portion of the primary influent flow, if desired as a supplemental carbon source, to the secondary process.

Two new 70 foot diameter primary clarifiers are provided in this upgrade. The existing settling tanks exhibited many operational problems including poor hydraulic distribution, poor scum removal means, and solids removal problems that would not easily nor inexpensively be corrected. In addition, the new plant flow hydraulics would require extensive modifications and additional structural support to the tanks themselves to attain the elevational head required for downstream processes. This tank retrofit work would be expensive and it is unlikely that all of the problems exhibited by the existing tanks could be completely corrected.

The new primary clarifiers will have separate pump suction lines for sludge collection. Sludge pumps will be located within a new solids processing building located near the clarifiers. Automatic scum collection and pumping will be provided for each tank.

5. Secondary Treatment and Clarification

Flow from the primary clarifiers will be piped to a distribution box ahead of the two identical secondary process tanks. The distribution box will serve to split the flow evenly to the two process trains as well as provide a place for mixing and distribution of the return activated sludge (RAS). The secondary process itself will consist of a compartmentalized anoxic zone with mixers. In this zone, nitrates recycled from the aerobic zone will be reduced to elemental nitrogen. Mixers are provided to keep the solids in suspension.

From the anoxic zone, flow will proceed to the aerobic zone. This zone consists of a racetrack type design complete with air distribution piping, air headers, air diffusers, and in-line mixers. Some of the flow from this aerobic zone will be returned to the anoxic zone by variable flow wall pumps and the remainder will proceed over the effluent weirs into a common second anoxic zone for further denitrification. Mixers will be installed in the second anoxic zone to keep the mixed liquor in suspension. From this zone, the flow will enter the reaeration zone where air will be added to reaerate the effluent and oxidize any remaining ammonia nitrogen.

From the reaeration zone, the flow will be directed to a distribution box ahead of the three, 75 foot diameter secondary clarifiers. Flow will be equally divided in this distribution box to any of the clarifiers in service. Return activated sludge (RAS) and waste activated sludge (WAS) will be removed from these clarifiers as process conditions dictate. RAS and WAS pumps will be located in the basement of a new secondary process building located near the secondary clarifiers. Clarified effluent will proceed to ultraviolet disinfection.

6. **Disinfection**

The clarified effluent will flow to a new disinfection channel and associated UV equipment located inside the new secondary process building. Flow will enter the disinfection channel via a wet well located ahead of the channel. This wet well will serve to collect all overflows from the clarifiers. Flow will proceed to the UV reaction chamber where the 40 UV lamps will disinfect the wastewater. The UV system will consist of lamps sufficient to disinfect the full 15.3 mgd flow.

7. **Final Discharge/Effluent Pumping**

A new pipe will be installed after the UV channel weir and connect to the existing 32 inch outfall pipe on the treatment plant site. Discharge to Branford Harbor will be by gravity through this existing 32 inch pipe during most flow conditions. During those times when the harbor water elevation is sufficiently high to prevent gravity discharge, flow from the UV disinfection process will be diverted to a wet well where pumps will lift the effluent flow to a sufficient elevation to overcome the additional water elevation in the Harbor.

8. **Solids Storage**

The existing four anaerobic digesters will be converted to aerated sludge holding tanks by the removal of the anaerobic digester equipment and the installation of diffusers, blowers and covers. New covers will be provided for the tanks and the air collected will be chemically scrubbed in a centralized odor control system.

Waste activated sludge generated in the secondary treatment process will be pumped to two of the converted tanks for storage prior to further processing into thickened form. At design generation rates, the two storage tanks will provide from 5 to 10 days of storage depending on concentration of the solids. This will allow weekend storage of WAS and provide operator flexibility in scheduling the WAS thickening operations. The third converted digester tank will be used to store thickened waste activated sludge and thickened primary sludge prior to disposal in thickened form or for further processing. At the expected generation rates, the third tank will have the capacity to store approximately 12 days of thickened waste activated and gravity thickened primary sludge. The fourth tank will be used for additional storage in case it is necessary. This tank would be used during gravity belt thickener equipment failure situations, days when the gravity thickener is out of service or during disposal problems or delays.

9. **Primary Solids Processing**

Primary sludge collected in each primary tank underflow will be piped directly to a dedicated primary sludge pump that will be located in the basement of the new solids processing building. Piping will be arranged that either pump can be used to pump the sludge collected in both primary clarifiers. Motor operated valves controlled by timers will allow intermittent removal of primary sludge and allow operator flexibility in obtaining the highest solids content of the primary sludge.

Pumped primary sludge will be processed for further thickening in the existing 30 foot diameter gravity thickener which will be mechanically rehabilitated. Currently, it is used to thicken both waste activated and primary sludge, a method previously described as inefficient mostly due to the waste activated sludge component. In the new process schematic, waste activated sludge will be thickened separately leaving the gravity thickener as the main method of thickening primary sludge. Gravity thickener underflow will be pumped by two new positive displacement pumps to one of the aerated sludge holding tanks to be blended with thickened waste activated sludge. Gravity thickener overflows will be directed to the plant pre-treatment area.

With the reduced hydraulic load to the gravity thickener, dilution water pumps using plant effluent will be provided in the secondary process building to provide an increased overflow rate to the gravity thickener. Piping will also be provided to allow primary sludge to bypass the gravity thickener and discharge directly to the aerated holding tank as a alternate process option. A tank cover with ductwork and a fan will be provided for odor control.

Primary scum collected on the primary clarifier surface will be transferred to troughs in each of the primary clarifiers. Collected scum will be pumped directly to the aerated holding tanks used for storing thickened sludge or will be pumped to the storage tanks used for WAS storage and further thickening.

10. Secondary Solids Processing

Secondary sludge will be wasted daily from the secondary clarifiers into two aerated holding tanks discussed previously. Timers and variable speed wasting pumps will be provided so that the operator can exercise control of the wasting rate and also waste on weekends without operator attendance. Waste activated sludge pumps will be located in the basement of the secondary process building. Aerated holding will also allow further processing of the waste activated sludge at a convenient time, typically during weekday hours, and allow plant personnel time to repair thickening processes while not interfering with a wasting schedule. No return flows to the treatment process will be observed since these tanks will be used for the sole purpose of storing sludge and not as aerobic digesters.

From the two aerated holding tanks, the waste activated sludge will be pumped to two, 2 meter gravity belt thickeners for thickening of the sludge to approximately 5% solids. Two gravity belt thickeners are provided so that WAS processing is able to be accomplished in a typical work week at design conditions. Two gravity belt thickener feed pumps will be located in the aerated holding tank building. Variable speed motors will be provided on the pumps for control of the feed rate. Optional wasting options for secondary sludge will be to the gravity thickener or to the primary clarifiers but this is not expected to be utilized often since the storage capacity of the holding tanks allows enough slack time to repair the gravity belt thickeners if they are out of service.

The gravity belt thickeners and their associated operations such as a polymer storage, mixing and feed system will be located within a new solids processing building. Thickened waste activated sludge will be pumped to a third aerated holding tank where it will be blended with the gravity thickened primary sludge. From this aerated holding tank, the blended sludge will be removed in thickened form by tank truck or stored for dewatering. Gravity belt thickener filtrate will be directed back to the pre-treatment area.

Return activated sludge (RAS) will be pumped by pumps located in the basement of the secondary process building. RAS will be returned to the distribution box ahead of the anoxic zone. Flow control will be by variable speed pumping which will either be manually controlled or flow paced.

11. Sludge Disposal

Once the primary and waste activated sludges are thickened, they can either be disposed of in this thickened form, expected to be 5%-6%, or be dewatered further. While it is expected that disposal in thickened form will be the method of choice, options for final disposal are prudent. For this purpose, two variable speed positive displacement pumps and piping will be provided to pump the aerated and thickened WAS and primary sludge blend to a solid bowl centrifuge or belt filter press for dewatering to cake form (>22% solids). This dewatering option provides additional flexibility and provides plant operations with the ability to dispose of sludge in the most cost-effective manner. Lime would be mixed with the sludge for transport.

The centrifuge or belt press would be located on the second floor of the solids processing building as would the gravity belt thickeners. The accompanying polymer mixing, storage and feed system would be located on the ground floor of this same building. A means to store the dewatered cake will be provided by locating a truck or container on the building ground floor. Centrate or filtrate will be returned to the pre-treatment area. Odor control will be provided.

12. Septage Receiving

The present septage receiving station is plagued with operating problems, has insufficient capacity for the current deliveries, and is located too close to Block Island Road. The new pre-treatment building will be located in the area of the existing septage receiving area and therefore a new septage receiving station will be provided near the pre-treatment building. This will consist of two interconnected tanks of 15,000 gallon capacity each, a truck unloading station with bar rack, and an aeration system consisting of diffusers in the tanks and blowers in the pre-treatment building. Pumps will feed septage into the plant influent at a controlled rate.

13. Odor Control

The proximity of the treatment plant to nearby residences dictates that odor control be provided at this facility. This will be accomplished by covering odor generating processes and routing the off-gases with ducts and fans to a centralized wet scrubber that will be located within the solids processing building. Unit processes that will be served by the odor control system include the septage receiving station, gravity thickener, the screening and grit removal area, the aerated sludge holding tanks, and the dewatered sludge drop-off and container area. A potassium permanganate feed system for waste activated sludge thickening and for dewatered sludge will also be provided.

The odor control scrubber, feed pumps, chemical storage and control equipment will be housed on the ground floor of the solids processing building. Sodium hypochlorite and sodium hydroxide will be provided for odor control but will also serve a dual purpose; the sodium hydroxide will be used for alkalinity control of the wastewater and the hypochlorite will be used as a means to pre-chlorinate the plant influent, and provide process control for the gravity thickener, septage receiving, and return activated sludge.

14. Flow Metering

Flow metering will be provided for treatment plant influent and effluent, return activated sludge, waste activated sludge, primary sludge, gravity thickener underflow, thickened waste activated sludge (TWAS), and centrifuge/belt filter press feed pumping.

15. Alkalinity Control

Alkalinity control will be required at times. A separate sodium hydroxide chemical feed pump discharging to the primary clarifier effluent will be provided. Manual dosage control of this pump will be the preferred method of operation. The sodium hydroxide tank for the odor control system will be used for chemical storage.

16. Instrumentation

Instrumentation systems to efficiently operate and monitor individual equipment and processes at the treatment plant will be provided. Process control and most equipment will be microprocessor based and the data that is generated will be relayed to a supervisory control and data acquisition system (SCADA). All process functions and equipment, including off-site pumping stations, will be monitored, the operating and alarm information logged, and the data further used to set preventive and predictive maintenance schedules and monitor biological processes. Computers will be provided to access and analyze the data and perform other supervisory functions.

17. Secondary Process Building

A secondary process building will be constructed near the three secondary clarifiers. This building will house the controls for the secondary process, blowers for the air supply system, RAS and WAS pumps, plant water system, UV disinfection system and controls. The installation of the secondary process control system in this building will allow the new treatment process to be constructed while maintaining the operation of the existing process.

18. Solids Processing Building

The current method of solids dewatering in the administrative section of the Control Building will be eliminated. All solids processing functions will be located within a new solids processing building to be located near the primary tanks. The gravity belt thickeners, centrifuge or belt filter press, odor control system, polymer feed system and alkalinity control system will be housed in this building as will some truck storage functions.

19. Control Building

The existing control building will be reused as an administrative and laboratory facility as described later in this Chapter.

D. DESIGN OF THE SELECTED PLAN (LLND)

The method to achieve low level nutrient discharge requirements of 4 mg/l total nitrogen will be to add methanol into the second anoxic zone of the suspended growth process. This will provide the carbon source necessary to allow biological denitrification to proceed to this level of removal.

The methanol feed system will consist of a methanol storage tank, methanol feed pumps, control system and other ancillary equipment necessary to feed methanol. The location of this equipment will be separate from other structures, on the northwestern part of the site.

E. USE/REUSE OF EXISTING FACILITIES

It is desirable to reuse the existing structures on the site if it is practical and cost-effective. To determine the viability of reusing existing structures, either to maintain their existing function or to provide service in a new function, a review of the condition of the buildings and tanks was undertaken. Among the structures that were part of the original plant construction of 1962 is the Control Building, the 20 foot diameter gravity thickener, the barminutor channel, the grit chamber, two of the digesters, two of the primary and secondary settling tanks, the aeration (oxygenation) tanks, and one chlorine contact chamber. All of the other structures were constructed as part of the 1982 upgrade.

A review of the existing structures determines that with some structural and architectural repair, all of the existing tankage and buildings are physically able to be reused in the plant upgrade. However, as stated previously, some of the existing structures from the 1962 upgrade are under capacity for the present flows indicating that their use as presently configured is not viable. This includes the barminutor chamber, the grit chamber and the 20 foot diameter gravity thickener. Their physical condition, as with many structures from the 1962 construction, while still serviceable, is generally poorer than the more recent construction, and reuse of these structures needs to be carefully reviewed for the proposed end use. Other items that need to be taken into consideration is the design criteria of existing tankage. As noted in Chapter IV, some of the structures, in particular the secondary settling tanks, do not meet current standards of operating criteria and are unable to serve in their present function. Other detrimental observations noted with some of the structures are safety and operationally related issues some of which have already been previously described. Structures fitting into this category are the primary settling tanks and the raw waste pumping station.

With the above discussion in mind, and based on the process flow schematic and site related limitations, the following discussion describes existing building and structure reuse in the plant processes:

- **Gravity Thickener (30 foot diameter)**: The thickener mechanical equipment will be removed and replaced with new mechanical equipment. Minor repairs to the structure will be performed and the tank will be covered for odor control. Underflow suction piping will remain. Underflow pumps in the Control building basement will be replaced.

- **Control Building**: The Control Building will be renovated to provide administrative functions for the upgraded plant. Included in the renovation will be a superintendents office, assistant/operations office, laboratory, lavatories, conference room, cafeteria, plant sewer pumps, and thickener underflow pumping. All solids processing and chlorine storage and delivery functions will be removed from the building. Renovations for Americans with Disabilities Act (ADA) compliance will be included. Asbestos removal from the basement ceiling and walls will be completed.

- **Raw Waste Pumping**: The wet well will be reused as a plant sewer wet well if hydraulically necessary. Plant sewer pumps will be located in the Control Building basement.

- **Anaerobic Digesters**: The digester structures will be converted to aerated sludge holding tanks. The digester equipment will be removed, the digester covers replaced with fiberglass domes, a diffuser grid installed and a blower provided for each holding tank. Pumps to feed the solids processing facilities will be located in the building basement. Minor structural repairs and architectural work are required.

- **Pipe Gallery**: The pipe gallery will retain its current use for piping, ductwork and electrical conduits and as an access point from the Control Building to the aerated holding tanks.

- **Garage**: Retain in its current use.

- **Outfall Pipe**: Retain in its current use.

F. STRUCTURES TO BE DEMOLISHED

The following structures have no function in the selected plan and will need to be demolished to provide space for new structures. Demolition includes removal of structures to an elevation that does not interfere with new process structures, piping or buildings. The structures slated for demolition are as follows:

- **20 foot diameter thickener**: Not needed in the new process. In the way of vehicle access driveway.

- **Primary settling tanks**: Functionally unusable. Replaced with new primary tanks.

- **Grit chamber**: Undersized and poorly configured. Replaced with new aerated grit process.

- **Septage receiving station**: Undersized and poorly configured. Replaced with a larger, aerated system.

- **Barminutor chamber**: Undersized. Replaced with mechanical screening.

- **Secondary settling tanks**: Too shallow to serve in present function. Replaced by deeper, circular tanks.

- **Aeration tanks and oxygen supply system**: Not needed for new process.

- **Chlorine contact chambers**: Undersized and difficult to operate properly. Replaced with ultraviolet disinfection to remove chlorine gas from the site.

- **Secondary scum well and pumps**: Not needed in new process.

- **Chlorine room and storage (part of Control building)**: Chlorine gas not used with UV disinfection. Sodium hypochlorite will be used for odor control and process control. Convert space to administrative functions.

- **2-bay garage (used for lawn equipment)**: Area needed for solids processing building. Lawn equipment will be stored in the new building.

G. LABORATORY FACILITIES

The existing laboratory facilities will not be adequate for the upgraded facility from both a type of equipment as well as condition of the existing equipment perspective. Additional influent, process and effluent monitoring requirements will be specified in the new NPDES permit, necessitating the need for new lab equipment, additional lab space and staff. An alternative would be to contract out all laboratory operations but this is not practical for process control and is the most costly option.

It is therefore recommended that the current practice of process control lab work and any regular daily or weekly testing continue to be performed by the treatment plant staff. Quarterly testing for toxicity and heavy metals, and any other irregular or quarterly testing requirements unable to be performed by in-plant staff should be contracted to outside laboratories as is the current practice.

With the additional testing requirements of the nitrogen removal process, additional laboratory space and equipment will be required. The current laboratory space consists of 240 square feet of space, far short of the minimum 400 square feet currently recommended for design standards. A new laboratory of sufficient size complete with the necessary lab equipment and glassware for process control and DMR reporting requirements will be provided in this upgrade. Included in the new laboratory space will be storage space, counter space, cabinets, a desk, chair and computer. Space for the laboratory will be provided in the Control Building at the location currently occupied by the solids processing operation.

To supplement the current laboratory staff of one, an additional lab person, dedicated to process control testing on an estimated half-time basis will be necessary. This person will be utilized for other process control functions when needed since the process control testing should not occupy this person's time all day. This frees the laboratory technician to concentrate on other testing requirements. Automatic samplers for the influent and effluent will also be provided.

II. FACILITY STAFFING

The Branford wastewater treatment plant is currently staffed by a total of 11 employees. This staffing level includes a superintendent, a laboratory technician, collection system supervisor, electrician, and the remainder of the staff serving in multiple functions at both the treatment plant and collection system. Chapter IV describes in detail the current staffing levels and operator functions.

Future staffing levels were estimated using methodology developed by the EPA. This methodology was developed by them based upon information obtained by visits to 35 sewage treatment plants across the country and by information supplied by regional offices of EPA, trade organizations and water pollution control agencies. This method of estimating staffing levels is applicable to treatment plants between 0.5 mgd and 25 mgd, a range in which Branford falls within.

The methodology initially involves calculation of staffing required for an "average" facility and then adjusting staffing levels to account for local conditions such as climate, level of treatment to be achieved, level of automation, staff training and competence among other variables. These adjustments from an "average" treatment plant provides corrections that apply to the individual treatment plant. The adjustment factors established for Branford are shown in Table 8-3.

Once the adjustment factors are established for local conditions, estimated annual staffing hours are then calculated individually for each of the following categories:

- Operations
- Maintenance
- Supervisory
- Clerical
- Laboratory
- Yard (includes janitorial and other unclassified duties)

Supervisory, clerical, laboratory, and yard staffing estimates are based on plant design flow only, while that for maintenance and operations are based on both the treatment plant unit processes and

TABLE 8 - 3

STAFFING ESTIMATE WORKSHEET
ADJUSTMENT FOR LOCAL CONDITIONS
TOWN OF BRANFORD FACILITIES PLAN

TYPE	AWT
DESIGN FLOW	6.5 MGD
PLANT	BRANFORD
LOCATION	BRANFORD
DATE	20-Sep-95

LOCAL CONDITION	COMMENT	OPERATION	MAINTENANCE	SUPERVISORY	CLERICAL	LABORATORY	YARD
PLANT LAYOUT	COMPACT	-10%	-10%				-50%
UNIT PROCESSES	STANDARD						
LEVEL OF TREATMENT	ADVANCED	10%	-20%	2%	3%	2%	10%
REMOVAL REQUIREMENT	% AND LIMIT	5%				10%	
INDUSTRIAL WASTES	CONSTANT						
PRODUCTIVITY	LOW	15%	15%				
CLIMATE	EXTREME		10%				
TRAINING	NEITHER	10%		10%			
AUTO MONITORING	W/ FEEDBACK	-5%	5%				
AUTO SAMPLING	INFL/EFFL	-5%				-5%	
OFF-PLANT LAB	NONE		-25%				
OFF-PLANT MAINTENANCE	CORRECTIVE						
AGE OF EQUIPMENT	NEW						
TOTAL		20%	-25%	12%	3%	7%	-40%

plant design capacity. Annual projections are based on the assumption that treatment plant staff productivity is 6.5 hours per day and then deducting for vacations, holidays and sick time for a total annual availability of 1,500 hours per year. This is a reasonable assumption for staff in Branford.

From this information, Table 8-4 is established which estimates the hours needed to operate and maintain a new treatment plant of the capacity and type of treatment process proposed in Branford. The adjustment factors from Table 8-3 are then used to adjust the estimated hours up or down for a total estimated staffing hours on an annual basis. Note that in Table 8-4, individual categories for collection system maintenance were included since the EPA method does not include a means to establish those hours.

The estimated staff shown in Table 8-4 are translated into numbers of projected staff in Table 8-5. Table 8-5 indicates that the treatment plant in Branford requires a total staff of 17 people including collection system staff which would be the estimated staffing level for a treatment plant in this area, of this type, and at design flow, that would be staffed at night and on weekends.

These staff estimates are then adjusted based on the specific requirements of this facility. Most particular is the need for staff dedicated to the collection system in Branford. At present, the collection system covers some 100 miles of sewers and 48 pumping stations. In addition, it is desired to reduce infiltration and inflow using the collection system staff and also upgrade and maintain the pumping stations with the same staff. This effort must be taken into account with any staffing level estimation and is the basis for dedicating five staff members to the collection system. Two will be assigned to inspections of the 48 pumping stations and collection system maintenance, two for pumping station repair and improvements, and a supervisor whose duties will encompass any collection system activities including I/I removal and upgrading of the collection system. Repairs will be made by collection system staff with occasional input from the treatment plant staff.

EPA, in their estimation of staffing levels, assumes that the total staff of 17 is a staff level that includes weekend and night shift staff. For these off-hours staff, a total of seven staff members beyond the daytime staff levels are estimated using the EPA method. In actuality, no night shift staff is currently planned for Branford since the new plant will have a higher level of automation than the current plant. Weekends are planned to be staffed by two individuals for an eight hour day (1,500 hours per year total, or one man-year) instead of the EPA estimate of four full-time weekend staff.

TABLE 8 - 4

STAFFING ESTIMATE WORKSHEET
ANNUAL STAFFHOURS
TOWN OF BRANFORD FACILITIES PLAN

TYPE	AWT
DESIGN FLOW	6.5 MGD
PLANT	BRANFORD
LOCATION	BRANFORD
DATE	20-Sep-96

UNIT PROCESS	COMMENT	OPERATION	MAINTENANCE	SUPERVISORY	CLERICAL	LABORATORY	YARD
COLLECTION SYSTEM		3,000	200				
PUMP STATIONS		3,000	1,500				
IN-PLANT PUMPING			440				
SCREENING		600	34				
GRIT REMOVAL		570	50				
PRIMARY CLARIFICATION		1,500	440				
AERATION		1,250	1,400				
SECONDARY CLARIFICATION		1,300	370				
DISINFECTION		290	360				
AEROBIC SLUDGE HOLDING		300	60				
GRAVITY THICKENING		300	300				
BELT THICKENING		312	328				
CENTRIFUGATION		655	218				
TOTAL		13,077	5,700	1,700	540	1,800	1,650
ADJUSTMENT FROM TABLE 8-3		20%	-25%	12%	2%	7%	-40%
INCREMENTAL INCREASE/DECREASE		2615	-1425	204	11	126	-660
ADJUSTED TOTAL		15,693	4,275	1,904	551	1,926	990
GRAND TOTAL (HOURS)		15,693	4,275	1,904	551	1,926	990
GRAND TOTAL (STAFF)		10.46	2.85	1.27	0.37	1.28	0.66

TABLE 8 - 5

STAFFING ESTIMATE WORKSHEET
STAFFING LEVELS
TOWN OF BRANFORD FACILITIES PLAN

TYPE	AWT
DESIGN FLOW	6.5 MGD
PLANT	BRANFORD
LOCATION	BRANFORD
DATE	20-Sep-96

	TOTAL HOURS PER YEAR	TOTAL STAFF	WEEKEND STAFF	WEEKNIGHT STAFF
OPERATIONS	15,693	10.46	2.62	1.96
MAINTENANCE	4,275	2.85	0.71	0.53
SUPERVISORY	1,904	1.27	0.32	0.24
CLERICAL	551	0.37	0.09	0.07
LABORATORY	1,926	1.28	0.32	0.24
YARD	990	0.66	0.17	0.13
TOTAL STAFF EXCLUDING CORRECTION AT DESIGN FLOW		16.85	4.22	3.17

	YEAR 2005	YEAR 2020
TOTAL ESTIMATED STAFF AT DESIGN FLOW	16.89	16.89
ADJUST ESTIMATED WEEKEND STAFF (DEDUCT)	4.22	4.22
ADJUST ESTIMATED WEEKNIGHT STAFF (DEDUCT)	3.17	3.17
WEEKDAY STAFF	10.02	10.02
TOTAL STAFF (CORRECTED) *	12	14
COLLECTION SYSTEM STAFF	5	5
TREATMENT PLANT STAFF	7	9

* ANTICIPATE TWO PERSONS, EIGHT HOUR SHIFT ON WEEKENDS , THIS IS ONE ADDITIONAL STAFF PER YEAR
PLAN FOR 1 ADDITIONAL STAFF MEMBER FOR PROCESS CONTROL
ANTICIPATE NO WEEKNIGHT STAFF UNTIL FUTURE FLOWS REACHED

This is partly because the treatment plant flow expected in the year of construction completion will be less than the design flow from which the EPA estimates are based, and partly because of the level of automation planned. These adjustments are shown in Table 8-5.Thus the total staff planned for the year of construction completion of 2000 is estimated at a total of 17 less the five for the collection system, less the four for weekends and less the three for the night shift. This leaves a total of five for the treatment plant to which will be added the weekend staff hours and one additional person to control process operation. This is a total of seven at the treatment plant. The nine total staff for the plant projected in Table 8-5 are not expected to be necessary until full future flows are reached. Collection system personnel and overtime work will account for any emergencies. Money is included in the budget for such work.

Staff job classifications are planned as shown in Table 8-6.

TABLE 8 - 6

JOB CLASSIFICATIONS

	Number	Classification
	1	Superintendent - treatment plant
	1	Laboratory technician
	1	Process Chief, Class 3
	2	Operators, Class 2
	1	Operator, Class 1
	1	Mechanic *
	1	Supervisor - collection system
	1	Electrician *
	1	Mechanic *
	2	Maintenance
Total	12	

* Planned to be used for both treatment plant and collection system on a regular basis.

The staffing level for the year 2000 of 12 people is used later in this Chapter to establish budget estimates for the plant operation.

I. CAPITAL AND OPERATING COSTS

The previous sections have described the technical aspects of how the Town of Branford will meet the future wastewater needs of the Town as well as meet the present and future water quality objectives that the State of Connecticut has specified for Long Island Sound. The program to be undertaken to meet these present and future needs requires capital for construction of new facilities and operating funds associated with the cost of operating the new facilities. Engineering, legal and administrative costs to implement this Plan also add to the overall cost of the project. With a program of this scope, it is necessary to accurately establish these costs, prepare a schedule that can be followed for the separate projects within this Plan and to determine how to finance and schedule these projects so as to best implement the construction program. The capital and operating costs aspects of this Plan will be described in this section. The next section will describe the plan to finance this project and its impact on the Town tax system. The final section of this Chapter includes a schedule of implementation.

1. Capital Costs

The major upgrade requirements as described in this facilities plan and their eligibility for State funding are listed below:

- Design and construction of the wastewater treatment facility to either the high level or low level nutrient discharge requirements. These costs are generally grant/loan eligible from the State revolving fund program.

- Design and construction of the sanitary sewer augmentation on Block Island Road and implementation of the pumping station upgrade program. These costs are not grant/loan eligible.

The construction costs, engineering, legal and other administrative costs are shown in Table 8-7 for the recommended plan for high level nutrient discharge (HLND) and Table 8-8 for the recommended plan low level nutrient discharge (LLND). These Tables show that the cost to construct the HLND treatment plant including engineering, legal, administrative and construction phase services is

TABLE 8-7
WASTEWATER TREATMENT FACILITY
CAPITAL COST - BIOLOGICAL NITROGEN REMOVAL
HLND

TOWN OF BRANFORD FACILITIES PLAN

	CONSTRUCTION TASK	CAPITAL COST
1.	SITEWORK	$219,000
2.	PRE-TREATMENT BUILDING	$2,002,756
3.	PRIMARY CLARIFIERS	$894,771
4.	SECONDARY PROCESS TANKS	$3,967,511
5.	SECONDARY CLARIFIERS	$1,157,735
6.	SECONDARY PROCESS BUILDING	$2,329,938
7.	SOLIDS PROCESSING BUILDING	$2,263,948
8.	GRAVITY THICKENER	$91,394
9.	AERATED HOLDING TANKS	$1,592,540
10.	CONTROL BUILDING	$959,684
11.	ELECTRICAL	$1,000,000
12.	YARD PIPING	$750,000
13.	DEMOLITION	$452,122
	CONSTRUCTION TASK SUBTOTAL	$17,681,399
14.	CONTINGENCY	$3,158,998
15.	CONTRACTOR FIELD SUPERVISION	$828,095
16.	PROJECT INDIRECTS	$103,593
17.	INSURANCE AND BONDS	$248,080
	SUBTOTAL	$22,020,165
18.	CONTRACTOR OVERHEAD AND PROFIT (8%)	$1,761,613
19.	TREATMENT PLANT CONSTRUCTION COST	$23,781,778
20.	ENGINEERING	$2,600,000
21.	ADMINISTRATION, LEGAL, ETC.	$237,818
	TOTAL PROJECT	$26,619,596

TABLE 8-8
WASTEWATER TREATMENT FACILITY
CAPITAL COST - BIOLOGICAL NITROGEN REMOVAL
LLND

TOWN OF BRANFORD FACILITIES PLAN

	CONSTRUCTION TASK	CAPITAL COST
1.	SITEWORK	$219,000
2.	PRE-TREATMENT BUILDING	$2,002,756
3.	PRIMARY CLARIFIERS	$894,771
4.	SECONDARY PROCESS TANKS	$3,967,511
5.	METHANOL STORAGE AND FEED	$195,778
6.	SECONDARY CLARIFIERS	$1,157,735
7.	SECONDARY PROCESS BUILDING	$2,329,938
8.	SOLIDS PROCESSING BUILDING	$2,263,948
9.	GRAVITY THICKENER	$91,394
10.	AERATED HOLDING TANKS	$1,592,540
11.	CONTROL BUILDING	$959,684
12.	ELECTRICAL	$1,000,000
13.	YARD PIPING	$750,000
14.	DEMOLITION	$452,122
	CONSTRUCTION TASK SUBTOTAL	$17,877,177
15.	CONTINGENCY	$3,194,238
16.	CONTRACTOR FIELD SUPERVISION	$828,095
17.	PROJECT INDIRECTS	$103,593
18.	INSURANCE AND BONDS	$248,080
	SUBTOTAL	$22,251,183
19.	CONTRACTOR OVERHEAD AND PROFIT (8%)	$1,780,095
20.	TREATMENT PLANT CONSTRUCTION COST	$24,031,278
21.	ENGINEERING	$2,600,000
22.	ADMINISTRATION, LEGAL, ETC.	$240,313
	TOTAL PROJECT	$26,871,590

$26,619, 596 and the cost to construct the LLND treatment plant is $26,871,590. Construction costs were prepared using a construction estimating subconsultant as described previously. Details of their estimate are included in Appendix G. In addition, to more accurately define the construction costs, a geotechnical report was prepared for this Plan to better define the site conditions. This report is provided in Appendix H. These costs for this portion of the project are generally eligible for State funding.

The second part of the Plan includes recommended pump station improvements and the augmentation of a 600 foot section of sanitary sewer on Block Island Road. These capital costs, including engineering, legal, and administrative costs are shown in Table 8-9. This Table shows that to correct pump station deficiencies and to augment the sanitary sewer as described previously will cost $3,830,000.

2. Operation and Maintenance Costs

The new treatment plant processes as described in the recommended plan will cost more to operate than the current treatment plant costs to operate. This is due to a number of factors. First is that there is additional labor required to operate the plant simply because of the increase in sophistication of the treatment processes over those that are currently in use. There will also be additional costs for electricity, chemicals, and laboratory work that are unavoidable and are inherent in the operation of a nitrification/denitrification plant. Sludge disposal, which is currently accomplished at an extremely low cost at the Town landfill will be added to the plant operational budget once the town landfill closes. Savings in operational costs from the current operational budget also are realized with the new treatment plant since the plant mechanical equipment will be replaced. These cost savings are realized in the areas of equipment maintenance and repair and in labor in the form of reduced overtime.

The estimated operational cost for the treatment plant in its first operational year is shown in Table 8-10 for both HLND and LLND. Table 8-10 is divided into four sections; personnel services, non-personnel services, utilities, and other. This is in keeping with the Town's current budget line items and allows a line by line comparison to the current budget. In Table 8-10, many of the fixed costs for operations are not expected to change from this current year to the year 2000 except for inflation. These costs include the cost of telephone service, uniforms, safety and training, labor unit costs, pump station repair, fuel, water, LP gas, etc. In addition, deductions from the current budget for

TABLE 8-9

WASTEWATER TREATMENT FACILITY

CAPITAL COST - PUMP STATIONS AND SEWER AUGMENTATION

TOWN OF BRANFORD FACILITIES PLAN

CONSTRUCTION TASK	CENTRAL PUMP STATION	ROUTE 139 PUMP STATION	SYBIL CREEK PUMP STATION	SEWER AUGMENTATION
1. SITEWORK	$30,000	$0	$0	$0
2. SHEETING	$31,800	$0	$0	$0
3. BUILDING/STRUCTURE	$190,000	$45,000	$0	$0
4. CONCRETE	$320,000	$0	$0	$0
5. MISCELLANEOUS METALS	$20,000	$15,000	$0	$0
6. MECHANICAL EQUIPMENT	$180,000	$180,000	$50,000	$0
7. PROCESS EQUIPMENT/PIPING	$45,000	$45,000	$15,000	$255,000
8. MISCELLANEOUS EQUIPMENT	$70,000	$0	$0	$0
9. HVAC	$12,000	$12,000	$5,000	$0
10. PLUMBING	$5,000	$5,000	$0	$0
11. ELECTRICAL	$86,000	$80,000	$15,000	$0
12. INSTRUMENTATION	$15,000	$25,000	$5,000	$0
13. PAINTING, STARTUP, MISC.	$9,000	$9,000	$3,000	$0
14. DEMOLITION	$50,000	$20,000	$5,000	$0
15. EMERGENCY POWER SUPPLY	$65,000	$55,000	$0	$0
16. SITE CONDITIONS	$80,000	$0	$0	$0
CONSTRUCTION TASK SUBTOTAL	$1,228,800	$481,000	$96,000	$255,000
17. CONSTRUCTION CONTINGENCY	$221,184	$86,580	$17,280	$45,900
18. CONTRACTOR FIELD SUPERVISION	$98,304	$38,480	$7,680	$20,400
19. PROJECT INDIRECTS	$12,288	$4,810	$960	$2,550
20. INSURANCE AND BONDS	$24,576	$9,620	$1,920	$5,100
SUBTOTAL	$1,585,152	$620,490	$123,840	$328,950
21. CONTRACTOR OVERHEAD AND PROFIT	$126,812	$49,639	$9,907	$26,316
CONSTRUCTION COST	$1,711,964	$670,129	$133,747	$355,266
22. DESIGN AND CONSTRUCTION PHASE SERVICES	$554,803	$217,172	$43,344	$115,133
23. ADMINISTRATION, LEGAL, ETC.	$17,120	$6,701	$1,337	$3,553
INDIVIDUAL PROJECT TOTAL	$2,283,887	$894,002	$178,429	$473,952
GRAND TOTAL	$3,830,269			

TABLE 8-10
ESTIMATED ANNUAL OPERATION AND MAINTENANCE BUDGET
YEAR 2000

TOWN OF BRANFORD FACILITIES PLAN

	BUDGET LINE ITEM	HLND	LLND
	PERSONNEL SERVICES		
1.	LABOR	$438,000	$438,000
2.	OVERTIME	$43,800	$43,800
3.	EDUCATION, LONGEVITY, ETC.	$6,200	$6,200
	SUBTOTAL PERSONNEL SERVICES	$488,000	$488,000
	NON-PERSONNEL SERVICES		
4.	TELEPHONE, ALARM	$13,100	$13,100
5.	PLANT EQUIPMENT REPAIR	$25,000	$25,000
6.	LABORATORY	$16,100	$16,100
7.	SERVICES CONTRACTS	$40,900	$40,900
8.	UNIFORMS, OTHER ADMIN.	$4,900	$4,900
9.	SAFETY AND TRAINING	$6,000	$6,000
10.	PUMP STATION EQUIPMENT REPAIR	$60,000	$60,000
11.	SEWER LINE REPAIR AND INSPECTIONS	$50,000	$50,000
12.	CHEMICALS	$51,700	$93,700
13.	PERMITS	$1,000	$1,000
14.	SLUDGE DISPOSAL	$510,900	$510,900
	UTILITIES		
15.	ELECTRICITY - PUMP STATIONS	$171,600	$171,600
16.	ELECTRICITY - TREATMENT PLANT	$362,500	$364,460
17.	NATURAL GAS	$21,900	$21,900
18.	WATER	$4,900	$4,900
19.	GASOLINE	$3,400	$3,400
20.	LP GAS	$850	$850
	OTHER		
21.	VEHICLES	$0	$0
22.	GENERATOR RESTORATION PROGRAM	$0	$0
23.	PUMP STATION RENOVATION PROGRAM	$0	$0
	TOTAL	$2,320,750	$2,364,710
24.	SEPTAGE REVENUE (DEDUCT) *	$0	$0
25.	NORTH BRANFORD USE CHARGE (DEDUCT) **	$178,266	$181,880
	COST PER 1000 GALLONS	$1.48	$1.51

* Revenue from septage receiving is negligible

** Based on a flow of 330,000 gpd and a cost per 1000 gallons as shown vehicles, generator restoration program, pump station renovation program, equipment repair, and overtime are realized either because of the program completion or because the new treatment facilities will not need the level of maintenance that is currently part of the existing budget.

Areas of increased cost over the current budget include that for the addition of one labor position, increased electricity use at the new plant, sludge disposal costs due to the closing of the landfill, and services contracts (mostly due to the increased level of instrumentation at the plant). The labor position increase is based on calculations from the staffing level section of this Plan. Power cost estimates are based on expected equipment operating schedules, calculated horsepower requirements and an estimated cost of electricity, including demand charges, of 10 cents per kilowatt-hour. The cost of sludge disposal is based on the estimated wasting requirements of the process, an expected final solids concentration of 5%, and a cost to dispose of thickened sludge of 8.3 cents per gallon. All estimates are based on an estimated flow in the year 2000 of 4.3 mgd and the corresponding loadings associated with this flow. In all, the estimated year 2000 budget, as shown in Table 8-10, is $2,320,750 for high level nutrient discharge (HLND), and $2,364,710 for low level nutrient discharge (LLND) excluding North Branford's contribution. This corresponds to a cost to treat 1,000 gallons of flow at $1.48 and $1.51 respectively. This would place the Branford treatment plant approximately at the median point for all treatment plants in Connecticut as noted in the "1993 Sewer Use Charge Survey", prepared by the State of Connecticut DEP.

J. FINANCIAL PLAN

The summary of the construction costs for the total project, including engineering, legal, administrative, and construction phase services for the treatment plant is shown in Table 8-11. Financial aid to partially offset the cost of the treatment plant construction program is provided by the State of Connecticut through grants and/or low-interest loans. Typically, the State funding availability for treatment plant projects consists of a 20% grant on eligible items and a 2%, 20 year loan on the remaining portion. No funding is available for the pump station and sewer augmentation work. This table therefore includes an expected breakout of the costs that are associated with the State grant, low interest loan and the non-State funded portion of the project.

The construction of the treatment plant, pump station and sewer work will require that the Town of Branford appropriate money equal to the estimated cost of the total project. At this time, it is prudent to bond for the LLND version of the treatment plant and include the costs of the pump station and sewer augmentation work in the same appropriation for a total of $30.7 million.

TABLE 8-11

TOTAL PROJECT COST ANALYSIS

FUNDING ALLOCATION

TOWN OF BRANFORD FACILITIES PLAN

		GRANT/LOAN ELIGIBLE	NON-ELIGIBLE	TOTAL
	TREATMENT PLANT			
1.	TREATMENT PLANT CONSTRUCTION	$24,031,000	$0	$24,031,000
2.	ENGINEERING, ADMIN., LEGAL	$2,840,000	$0	$2,840,000
	SUBTOTAL TREATMENT PLANT	$26,871,000	$0	$26,871,000
	PUMP STATIONS, SEWER AUGMENTATION			
3.	CENTRAL PUMP STATION	$0	$1,712,000	$1,712,000
4.	ROUTE 139 PUMP STATION	$0	$670,000	$670,000
5.	SYBIL CREEK PUMP STATION	$0	$134,000	$134,000
6.	SEWER AUGMENTATION	$0	$355,000	$355,000
7.	ENGINEERING, ADMIN., LEGAL	$0	$959,000	$959,000
	SUBTOTAL PUMP STATIONS, SEWERS	$0	$3,830,000	$3,830,000
	TOTAL PROJECT COST	$26,871,000	$3,830,000	$30,701,000
	FUNDING ALLOCATION			
8.	20% GRANT (ASSUME 18% FOR FINAL ELIGIBILITY)	$4,836,800	$0	$4,836,800
9.	2% LOAN FROM STATE REVOLVING FUND	$22,034,200	$0	$22,034,200
10.	NO FUNDING AID	$0	$3,830,000	$3,830,000
	TOTAL PROJECT			$30,701,000

As shown in Table 8-11, the LLND treatment plant project has an estimated cost of $26.9 million and the Town is should receive both a grant and a low interest loan from the Connecticut Department of Environmental Protection for this part of the project. The grant portion of this $26.9 million is expected to be approximately $4.84 million, and the 2% loan portion from the State Revolving Fund (SRF) Program would be for the remaining $22.0 million. The pump station and sewer work is not eligible for State funding and will be funded by appropriating funds for the capital cost of $3.8 million at the Town's current borrowing rate of 6%.

The debt service allocation for both the treatment plant and pump station capital expenditure is shown in Table 8-12. This Table delineates the total capital cost of the treatment plant and pump station/sewer augmentation work, and the associated operational and maintenance costs. Once these costs are defined, Table 8-12 establishes the mil rate associated with the cost to retire debt.

This table shows that the average annual debt service attributable to the capital cost for the first five years is $1.9 million (line 3), $1.5 million attributable to the treatment plant and $0.4 million associated with the sewer and pump station work.

In addition, the annual operations and maintenance expense is expected to total $2.36 million (line 7), which represents an increase of $1.31 million over fiscal year 1994-95 expense of $1.05 million. Since the Town has typically financed this operational cost through its Ad Valorem system of taxation, this operational cost is added into the total debt service in line 8. Of this total debt service, North Branford will contribute their portion which in Table 8-12 is estimated to be 10% for the capital cost and 8% for the operating cost. Branford's share would be the total, less the North Branford share, which amounts to some $3.0 million annually as shown in line 12.

The conventional means that Towns and Cities use for repaying bond debt for a project such as this are:

- Property taxes,
- Betterment assessments based on frontage of property or another uniform unit method,
- Supplementation by special assessments such as connection charges, fines, interest, etc..
- Use charges including tipping fees for septage haulers.

TABLE 8-12

FINANCIAL IMPACT

TOWN OF BRANFORD FACILITIES PLAN

		DEBT SERVICE AND OPERATING COST TOTAL	DEBT SERVICE AND OPERATING COST INCREASE ABOVE FY 1994-95
	CAPITAL		
1.	FIVE YEAR AVERAGE DEBT SERVICE ON $22.0 MILLION AT 2%	$1,498,300	$1,498,300
2.	FIVE YEAR AVERAGE DEBT SERVICE ON $3.8 MILLION AT 6%	$398,320	$398,320
3	**CAPITAL SUBTOTAL**	$1,896,620	$1,896,620
	OPERATION AND MAINTENANCE		
4.	FY 2000-01 OPERATING COSTS $2,364,710 (TOTAL)	$2,364,710	$2,364,710
5.	FY 1994-95 OPERATING COST $1,050,505 (TOTAL)		$1,050,505
6.	OPERATING COST INCREASE		$1,314,205
7.	**OPERATING SUBTOTAL**	$2,364,710	$1,314,205
8.	**CAPITAL AND OPERATING TOTAL**	$4,261,330	$3,210,825
	NORTH BRANFORD SHARE		
9.	*CAPITAL COST DEBT SERVICE (10%)*	*$149,830*	*$149,830*
10.	*OPERATING (8%)*	*$189,177*	*$84,630*
11.	***NORTH BRANFORD SUBTOTAL***	*$339,007*	*$234,460*
12.	**BRANFORD SHARE**	$3,922,323	$2,976,365
13.	YEAR 2001 GRAND LIST (ESTIMATED, IN THOUSANDS)	$2,082,195	$2,082,195
14.	MIL RATE INCREASE DUE TO CAPITAL COST	0.84	0.84
15.	MIL RATE ATTRIBUTABLE TO OPERATIONS	1.04	0.59
16.	MIL RATE INCREASE		1.43

In order to retire the bond debt, the Town will need to distribute the yearly costs among the tax base. Historically, Branford has financed costs of wastewater treatment through its Ad Valorem system of taxation. Bond retirement covered under a general tax rate increase is the usual method of debt repayment. If debt was to be retired this way, it is estimated that the general tax rate increase to cover the $3.0 million annual cost increase (line 12), based on an estimated grand list for the year 2001, would be approximately 1.43 mils.

K. SCHEDULE FOR IMPLEMENTATION

The selected treatment plant design and construction schedule needs to be coordinated with the pump station rehabilitation work and the augmentation of the sewer capacity on Block Island Road. These projects themselves may be separate construction projects but are interrelated to the treatment plant work and therefore must be scheduled to ensure a logical progression of the construction. Individual tasks within the treatment plant construction project scope also need to be completed in a logical order to maintain availability for users and to maintain adequate effluent quality. Each project and its interrelationship with the treatment plant construction is described below.

One of the major concerns that need to be addressed in the construction scheduling relates to the inability of the existing treatment plant to pump and effectively treat the flows that can be delivered to it in a severe rainfall event. Since the plant construction is expected to occur over a 2-1/2 year period, it is necessary that no additional flows be delivered to the treatment plant until the ability to adequately process the flows is available. This will only occur once the new pumping and secondary processing facilities are on-line. Therefore, the general progress of construction will be to construct the secondary and pre-treatment process areas of the new plant, then complete the sewer augmentation, and then upgrade the capacity of the Central pump station. The additional work at the Route 139 pump station and the Sybill Creek pump station will have no impact on the treatment plant and can be completed at any time but is recommended to be scheduled near the beginning of this project so as to achieve the desired reliability at these two pump stations.

The other major impact is the need to keep wastewater treatment processes functional throughout the construction. The existing treatment plant is planned to be kept operational throughout the construction process until all new secondary processing facilities are on-line. Facilities and structures have been located on the site for this to occur with a minimum of disruption. With this in mind, the following facilities will be constructed in the first phase of plant construction:

- Pre-treatment facilities and influent pumping
- Secondary treatment process
- Two secondary clarifiers
- Secondary process building and effluent pumping station
- Disinfection facilities
- Rehabilitation of two of the sludge holding tanks.
- Methanol feed system, if needed

The third clarifier, primary tanks and the solids processing building cannot be constructed until other existing structures are removed.

Once construction is completed on these treatment facilities, plant influent flow will be diverted to the new treatment process. Once this flow diversion is completed, the augmentation of the sewer in Block Island Road can proceed and the work at the Central pump station can begin.

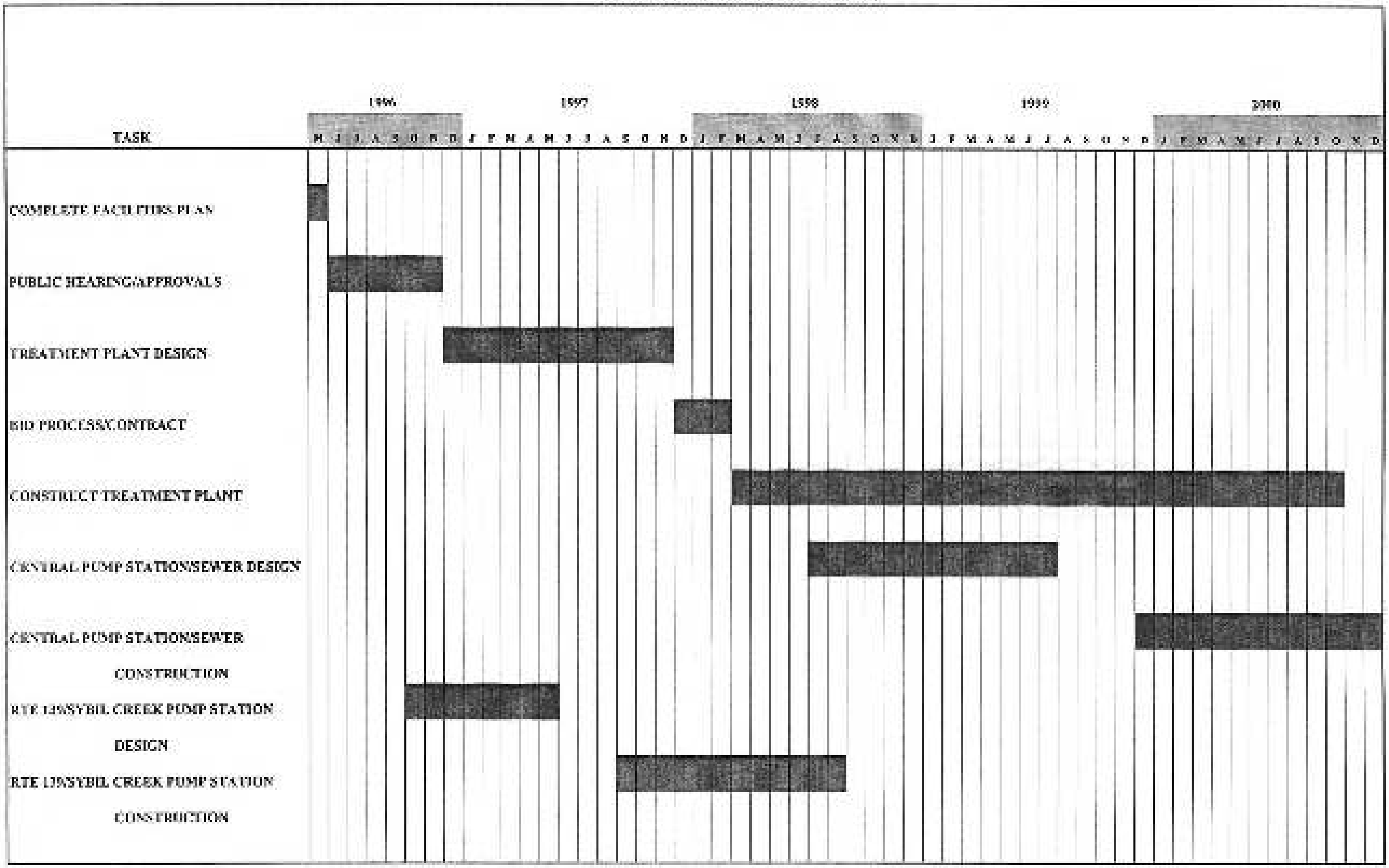
The existing primary tanks, barminutor, grit chamber, small gravity thickener, aeration tanks, secondary clarifiers and the chlorination tanks will be demolished after the flow diversion is completed and the remaining construction at the treatment plant can begin.

See Figure 8-3 for a bar graph of the proposed schedule for project implementation.

FIGURE 8-3

SCHEDULE OF IMPLEMENTATION

TOWN OF BRANFORD FACILITIES PLAN



IX. ENVIRONMENTAL IMPACTS OF RECOMMENDED PLAN

A. GENERAL

The previous chapters evaluated alternatives for compliance with the NPDES discharge permit the Branford facility will operate under. Potential environmental impacts associated with these alternatives were also evaluated during the selection process. The selected plan, presented in Chapter VIII, was selected based on its technical feasibility while recognizing the environmental impacts each option would create. While the selected plan represents an environmentally feasible and acceptable plan, potential impacts have been identified in the implementation of the selected plan. Much of the impact is due to the construction of the new facilities and will therefore be temporary in nature. These impacts, as well as mitigating strategies, are presented in the following sections.

B. SURFACE WATER QUALITY

The treatment facility upgrade to remove nitrogen from the treated wastewater will have a beneficial impact on the receiving water. Strict permit requirements for BOD, TSS and total nitrogen concentrations, dissolved oxygen requirements and the absence of a chlorinated effluent are all improvements over the existing discharge conditions. There are no provisions in the upgraded facility to bypass treatment processes, all required mechanical systems will be designed to operate in power failure situations, and all unit processes will be sized to accommodate future flows, both hydraulically and from a treatment perspective.

During construction of the upgraded treatment facilities, existing treatment capability will be maintained until the new facilities are installed and tested.

C. WETLANDS

Two general types of wetland are located within Branford. One is inland wetlands which are under the jurisdiction of the local Inland Wetland Commission and the other is tidal wetland which is under the jurisdiction of the State Department of Environmental Protection.

At the treatment plant site, inland wetlands are only located near the treatment plant outfall structure where it discharges into Branford Harbor. The existing outfall pipe from the treatment plant site will be reused in this upgrade thereby avoiding any disturbance of inland wetlands that may be located at the outfall pipe discharge.

Tidal wetlands in the vicinity of the treatment plant are located on Town property to the north of the existing treatment plant structures. The existing treatment plant structures and disturbed areas are all located within a chain link fence that encompasses the site. The new treatment plant facilities would require a larger area than the existing facilities because of the additional tankage and equipment requirements to remove nitrogen from the wastewater. This additional land requirement for treatment is not available to the east, west or south dictating that some encroachment into land areas north of the existing treatment facilities is necessary. Understanding that it is tidal wetlands, previously used or filled plant sites were preferentially utilized for new structures or buildings before additional land area to the north was used. Even still, some additional land area beyond the present fence line is required to be used for treatment processes.

Recognizing this, the impact of the wetland disturbance has been minimized by deepening the treatment structures as much as practical while still allowing for effective treatment and by using sheeting in the construction process to minimize the encroachment. Also, the bulk of the treatment structures in tidal wetland areas have been located in an area previously used as a sludge lagoon. Tidal wetland disturbances will therefore be mostly temporary in nature, and after the construction, will be restored to their original contours with tidal wetland soils that will be stockpiled by the contractor. See Figure 9-1 for a plan of the tidal wetland areas that are anticipated to be utilized for construction beyond already disturbed areas. Based on this plan, the anticipated additional wetland disturbance (beyond that already disturbed) is approximately 0.2 acres to achieve HLND, and an additional 0.1 acres (0.3 acres total) to achieve LLND.

All other treatment plant structures have been located within the existing plant site.

The potential for increased erosion and sedimentation into the river (via catch basins), and tidal wetland exists during the construction phase of this project. This will be mitigated by the use of properly selected, installed and maintained erosion control devices that will be the responsibility of the Contractor to maintain and the construction inspector to enforce. The State of Connecticut "Guidelines for Soil Erosion and Sediment Control" will be used as a basis for all soil erosion control. The potential also exists to impact tidal wetland areas accidentally during the construction operations. This will be mitigated by the use of construction fencing delineating areas that are not

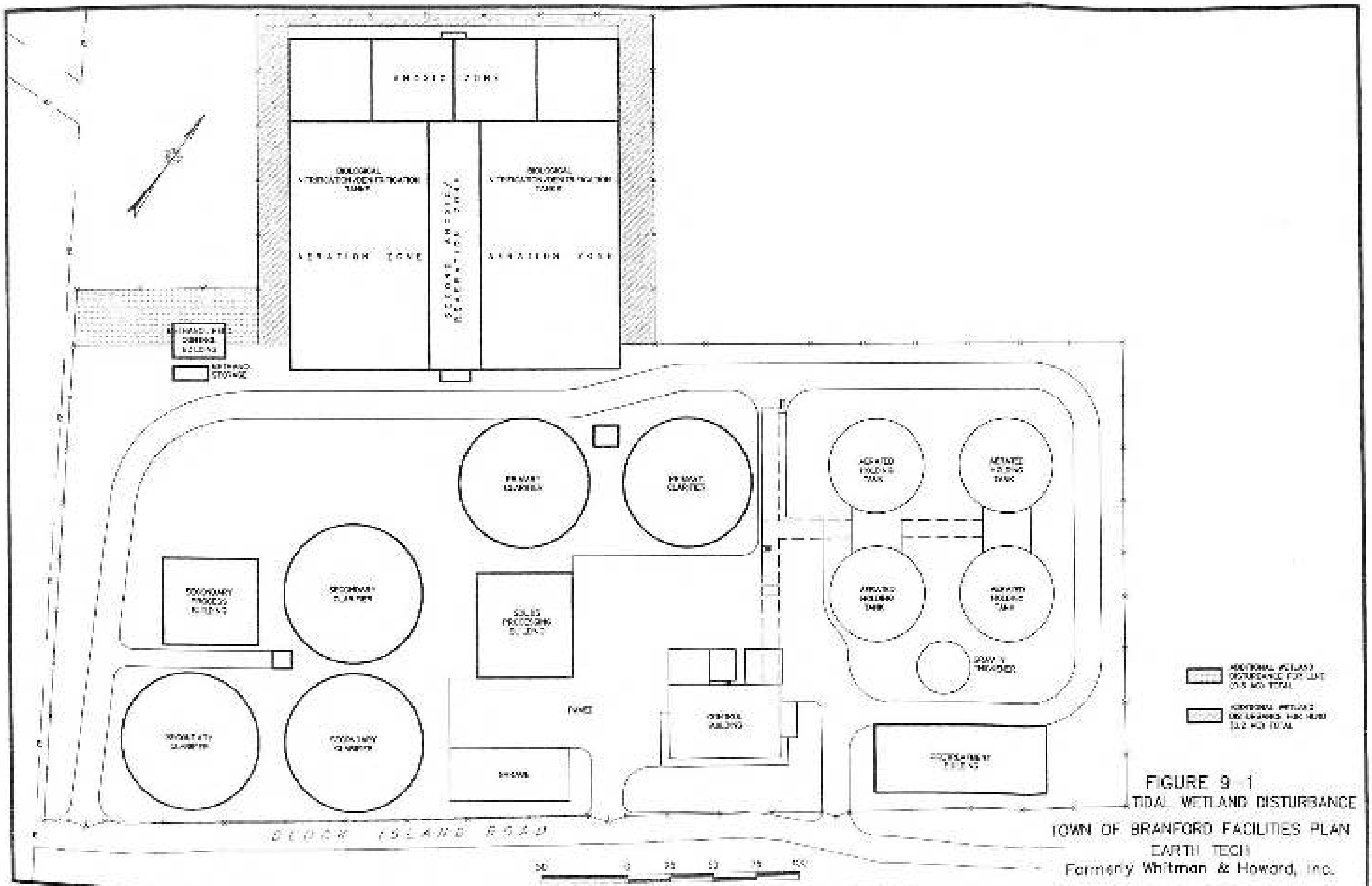


FIGURE 9-1
TIDAL WETLAND DISTURBANCE
TOWN OF BRANFORD FACILITIES PLAN
EARTH TECH
Formerly Whitman & Howard, Inc.

to be disturbed. The contractor will not be able to store equipment, materials or otherwise disturb these areas.

D. LAND USE

The existing land use of the site is as a wastewater treatment facility and has been since the early 1960's. The proposed structures and processes in the selected plan are consistent with the operations currently located at the treatment plant.

The land surrounding the treatment plant is presently used for a marina, senior housing and as other residential development. Zoning will allow a variety of commercial development to the west of the treatment plant site and residential development to the east and south, although any development will be severely restricted by floodplain and tidal wetlands prevalent in the area. Except for odor complaints and the poor traffic patterns caused by septage truck deliveries, no other negative impact on the local area is documented for the treatment plant facilities. The installation of odor control facilities and the relocation of the septage truck drop-off location to within the plant site will alleviate these problems. All other truck deliveries and pick-ups will be restricted to the plant site except when arriving or departing.

The recommended plan for treatment plant also should not affect the land use and development patterns in the areas immediately adjacent to the treatment plant. The probable enhancement of surface waters and reduction in odors should help preserve current values of properties.

It is also unlikely that zoning patterns will change dramatically toward increased density or that sewers would be installed in areas other than those described in Chapter V during the planning period solely because of the construction of the treatment plant. Historically, this has not been the case and with the current funding situation for sanitary sewers, is unlikely to change.

E. VEGETATION AND WILDLIFE

The vegetation within the treatment plant site fenced area, excluding the former sludge lagoon area, is mostly comprised of lawn grasses and other low value plants that typically inhabit disturbed and heavily used areas. This vegetation has a low value for any wildlife.

The sludge lagoon area consists of two lagoons that were used for sludge storage in the past. Headwalls, drainage structures and piping are located within this approximate one acre area and there are signs of material stockpiling to the north of the lagoon area. The lagoon area is partially covered with vegetation common to a tidal wetland area. This vegetation is possibly useable by wildlife species although the presence of sludge deposits limits its value as a habitat.

Outside of the lagoon area, the tidal wetlands are less disturbed. The new treatment plant structures will minimize impact on these areas since the vast majority of the structures will be located in the sludge lagoon area. Any overexcavation beyond that needed for permanent structures will be temporary in nature and will be stockpiled by the construction contractor for re-establishment after construction is completed.

The Natural Resources Center at the CTDEP has reviewed the Natural Diversity Data Base maps and files and has concluded that no endangered species, threatened species or species of special concern are located in the area of the treatment facility. This correspondence can be found in Appendix I.

F. GROUNDWATER

The treatment plant site is not located on or near any existing public water supply groundwater source. The use of the plant site in the future as a source of potable groundwater is both impractical and unlikely since its current and future classification is GB. Public water supply is currently provided to most residents and businesses by the SCCRWA Lake Saltonstall water supply system and any future water supply in Branford is planned to be supplied by this system.

There will be no impact on individual wells or groundwater quality. The plant discharge is a point source discharge into Branford Harbor and therefore will not have any impact on existing water quality conditions.

G. FLOODPLAIN

The Federal Emergency Management Agency (FEMA) has prepared a Flood Insurance Study for the Town of Branford which includes flood mapping and elevations for the treatment plant site and vicinity as well as Branford Harbor. FEMA establishes the flood elevation in the area of the treatment plant discharge at Elevation 12.0 (112.0 if using treatment plant datum) for the 100 year frequency flood. Some existing treatment plant site areas are below this elevation although all existing treatment plant structures are above this flood elevation.

All future structure elevations will also be set above this 100 year flood elevation. Treatment plant hydraulics will be established so that all plant functions will be operational during the 100 year flood. See Figure 8-2 for the hydraulic profile through the treatment plant.

H. AIR QUALITY

Once construction is completed, the treatment plant structures and process will have no negative impact on air quality. Odors associated with the anaerobic digesters, septage delivery and sludge processing facilities at the existing treatment plant will be eliminated or contained and treated at the upgraded treatment plant. The anaerobic digesters, a source of odors, are to be replaced with aerobic holding tanks which will be ducted to an odor control system. The solids processing facilities and other odor generating areas of the treatment plant including the gravity thickener, pre-treatment area, and the septage receiving facility will have all odors contained by covers and then ducted to a centralized odor control facility for treatment of the ducted air.

During the construction of the treatment plant upgrade, temporary increases in dust, carbon monoxide and other fossil fuel byproducts will increase. Dust will be controlled by the use of water, temporary gravel roads and the establishment of groundcover during extended periods of inactivity. The increase in fossil fuel byproducts is a feature of any construction and is difficult to avoid. The temporary increase will be mitigated by the prevailing wind in the area and will be ultimately be offset by the reduction in permanent odors at the facility.

I. NOISE

The upgraded facilities at the treatment plant will be designed to permanently reduce noise levels from operations. At present, significant noise from the site is created by the oxygen generating compressors and control valves. These compressors will be replaced with blowers enclosed in an acoustic enclosure in the upgraded facilities. In addition, all other noise generating operations will be mitigated by acoustical enclosures, location of the equipment away from the road, use of sound attenuating construction materials such as acoustic block and insulation, and equipment specifications that will dictate allowable noise levels emanating from the equipment. Finally, increased vegetative buffering between the treatment plant and the property boundary will be included in the upgrade.

The construction of the upgraded facilities will involve the use of various trucks and construction equipment. The demolition of existing facilities and the new construction may temporarily elevate the noise levels from the treatment plant site above current background levels. The nearest residences are located approximately 600 feet east along Block Island Road, so the distance from the plant site will help mitigate the impact of the construction noise.

The impact of construction and demolition noise can be mitigated by enforcing a weekday work schedule and normal daytime working hours. Equipment and construction noise, while noticeable, is not expected to raise noise levels from the site boundary above levels that would be considered deleterious.

J. TRAFFIC

During estimated 30 month construction time of the treatment plant upgrade, the daily volume of truck and other vehicular traffic to and from the site during project working hours, typically 7:00 AM to 3:30 PM, will increase significantly. Upon completion of the daily work routine and on weekends and holidays, existing traffic patterns will prevail. It is also expected that the lack of site storage areas for the contractors operations will contribute to the local traffic increase above what would otherwise normally be expected since the contractor may need to store equipment and materials off of the plant site.

Access to the treatment plant site is from Block Island Road only, and to there, access for truck traffic from the Connecticut Turnpike is limited to using Exits 53 or 54, accessing Maple Street, proceeding to Indian Neck Road and then to South Montowese Street. The use of alternate routes to the plant site is undesirable since this would require that the construction traffic use the already congested center of town area or travel through residential areas. South Montowese Street north of the Indian Neck Road intersection is also considered of limited use because of a low clearance railroad bridge which is expected to be unusable for some trucks. Construction traffic will therefore be mostly limited to the above mentioned route and for the sake of safety, will be limited as such by specification in the contract documents. Traffic control flagmen for egress from the plant site and from South Montowese Street will be provided by the construction contractor during periods of high truck traffic.

There is also expected to be an increase in traffic generation from daily treatment plant operations since sludge will need to be removed from the site in greater quantities during the period of sludge storage tank construction. This will be a small impact in comparison to the contractors operations.

The permanent access drives to the facility will be relocated to allow maintenance access to new plant structures and to provide better sight distances for trucks and cars leaving and entering the site. Septage trucks will no longer discharge their loads in Block Island Road but will now do so within the confines of the treatment plant site. Parking for plant personnel will be relocated from Block Island Road to within the treatment plant site thereby eliminating the dangerous pedestrian traffic condition on Block Island Road. Once operations at the upgraded treatment plant commence, additional truck traffic consisting of twice daily sludge removal operations and occasional chemical deliveries will prevail in addition to the current vehicular traffic, which will not decrease due to the plant upgrade.

K. SECONDARY IMPACTS

The proposed treatment plant provides for an average daily flow of 4.9 MGD to be generated in the design year of 2020. This is an additional flow of 0.4 MGD (400,000 gallons per day) over the current plant design capacity and a flow of approximately 0.8 MGD (800,000 gallons per day) over the present average daily flow. This additional flow attributable to sanitary sewage is projected to be generated as shown in Table 9-1:

TABLE 9-1

FUTURE FLOW EVALUATION

LOCATION	AVERAGE FLOW IN GPD
1. Population growth to 2020	213,000
2. Undeveloped industrial/commercial land in Branford	170,800
3. North Branford reserve capacity	193,000
4. Stony Creek area	66,200
5. Northford Road area	13,200
6. Rose Hill Road area	8,800
SUM OF FLOWS	665,000

By providing for additional capacity at the treatment plant for an expanded sewered population, it is important to verify that any proposed sewered areas are consistent with State and local planning requirements. In addition, by providing sewers to an area, secondary development along the sewer route may occur. Any additional development, however, must be consistent with the Town Planning and Zoning regulations and meet these requirements for development. Indirect impacts, as these are collectively called, will be compared here to the Town Plan of Development and the State of Connecticut Conservation and Development Policies Plan for Connecticut, 1992-1997.

1. Population Growth to Year 2020

Future population growth in Branford is expected to be distributed equally throughout the Town within existing and new housing. Where new housing is to be constructed, it will occur in areas presently zoned by the Town of Branford as R-4 and R-5 residence districts. Those areas zoned R-4 (20,000 SF lots) are in denser population areas and most likely to have a need for sewers in the 20 year planning period. This need is reflected in the Town zoning regulations. The available R-4 zones in Branford are all in areas classified by the State as urban growth areas, are near urban areas, and are in locations in which existing sanitary sewers are located nearby. The indirect impact of providing small scale sanitary sewers to these potential housing developments is small and any planned development here would therefore be consistent with Town and State planning policies. Development slated to occur in R-5 zones (40,000 SF lots) are not expected to be provided with sewers in this Plan since site requirements will allow adequate subsurface disposal systems including reserve areas. This is also consistent with State and Town planning policies.

2. Undeveloped Industrial/Commercial Areas

The major remaining industrial areas in town are located on partially developed rural land and in urban centers. Development from these areas are planned to contribute 170,800 gpd of flow. All of the available industrial land in Town is already sewered in anticipation of development so the additional impacts of providing sewers to these areas have already been realized.

3. North Branford Reserve Capacity

Additional sewering of areas classified in the State of Connecticut Conservation and Development Policies Plan as urban growth areas in North Branford are possible. Sewered areas in North Branford that currently flow to the Branford sewer system are generated from the "Section A" part of North Branford which includes the areas directly south of Lake Gaillard. A facility plan completed for North Branford and recently reviewed and updated by the Town of North Branford has determined that the maximum flow from Section A would be 500,000 gallons per day. This will limit any future sewered population growth in this area since any flow requests from North Branford above this value would not be able to be accepted at the Branford treatment plant.

4. Stony Creek, Northford Road, Rose Hill Road Areas

The Stony Creek, Northford Road area and Rose Hill Road areas are locations determined earlier in this Plan as eventually being in need of sanitary sewers for a permanent solution to subsurface disposal problems. Both the Northford Road and Rose Hill Road areas in town are classified as urban growth areas and the Stony Creek area is classified as a Preservation area in the State Conservation and Development Policies Plan.

The Northford Road area is an area of approximately 65 widely spaced homes who are experiencing subsurface disposal difficulties. There is a nearby sewer to the south to which these homes could connect that would provide service for these residents area only. Additional expansion beyond the immediate area is unlikely as the general area is zoned R-5 and other residences are not experiencing any subsurface problems at this time. Connections to the sanitary sewer by these additional homes would also be expensive since the local topography is not conducive to sewering.

The proposed sewers to serve the approximate 43 homes in the Rose Hill Road area would also serve the immediate area only. There is a nearby interceptor to which the sewers from the Rose Hill Road area would connect so additional development along the sewer route would not occur. The open areas surrounding these homes is a combination of wetland area and State of Connecticut/Town Land Trust owned and administered open space that is presently used for walking trails and related functions. This open space area will not be developed due to its current and planned future use.

The Stony Creek area is a densely populated area of approximately 325 homes and commercial development that is currently experiencing subsurface disposal problems. If this area is sewered, the sewer system proposed would collect all flows from the Stony Creek area and most likely pump to the existing sewer in Damascus Road. Pumping the flow to Damascus Road sewer would preclude any additional sewer connections from areas outside of the Stony Creek area. Sewering the Stony Creek area would be consistent with the State Plan since it would eliminate the current subsurface disposal problems in the area.

L. PERMITS

The following applications will be required to be filed and approval received before the construction of the modifications to the wastewater treatment plant is able to proceed:

- Certificate of Zoning Compliance - To be filed with the Town Planning and Zoning Commission. The site must comply with Town zoning regulations for setback distances, use, dimensions of lot, and other requirements. A special exception may be required for setback from street line for the pre-treatment building.

- Building Permit - The Town of Branford Building Department will require a building permit for the construction activities. This permit is required to be filed with the Building Department.

- Flood Plain Permit - A flood plain permit is required because some of the construction is at an elevation below the 100 year flood level. This permit is required to be filed with the Office of the Town Engineer.

- Tidal Wetlands Permit - The Office of Long Island Sound Programs (OLISP) of the Department of Environmental Protection (DEP) regulates all work within a tidal wetlands, and in tidal, coastal or navigable waters of the state. This jurisdiction is defined as the area waterward of the one year high tide line (Elevation 5.4 NGVD at Branford Harbor). Tidal wetlands are defined in the Regulations of Connecticut State Agencies, Section 22a-29 of the Connecticut General Statutes (CGS), and includes areas mapped pursuant to Section 22a-30 CGS. Regulations are covered under Section 22a-28, 22a-32, 22a-33 CGS, and Sections 22a-30-1 through 17 of the Regulations of Connecticut State Agencies. It is possible that there are tidal wetlands in the area of some of the new construction although much of the area appears disturbed and previously filled. The tidal wetland areas will need to be identified by a qualified scientist and then surveyed to exactly locate these areas so that the permit filing and approval process is completed prior to design completion.

- Structures, Dredge and Fill Permits - This permit must be filed with the DEP prior to conducting any dredging, fill or structures within the area waterward of the high tide line. This permit is issued and administered by the Office of Long Island Sound Programs and is regulated under Section 22a-361 of the CGS.

- Coastal Area Management - A coastal site plan must be submitted for approval to the Town Planning and Zoning office. This plan must show consistency with the coastal policies in Section 22a-106 of the General Statutes and define the potential adverse impacts of the proposed construction. The use and structures must be reviewed and approved in accordance with the Connecticut Coastal Management Act.

- U.S. Army Corps of Engineers (ACOE) Permit - ACOE jurisdiction for tidal waters under Section 404 of the Clean Water Act extends to any adjacent wetlands beyond the highest annual tide (Elevation 5.4 NGVD). An ACOE permit must be filed for if there is any filling in these wetland areas. New regulations delegating much authority to State jurisdiction is possible via the Connecticut Programmatic General Permit in concert with OLISP. Since this is a new process, little information is available. Regardless, some form of a permit under this regulation will be required.

REFERENCES

REFERENCES

1. Aeration, Water Pollution Control Federation, Manual of Practice FD-13, 1988.

2. Design of Municipal Wastewater Treatment Plants WEF Manual of Practice No. 8, Water Environment Federation and American Society of Civil Engineers, 1992.

3. Design and Retrofit of Wastewater Treatment Plants for Biological Nutrient Removal, Clifford W. Randall, James L. Barnard, H. David Stensel, 1992.

4. Design of Wastewater Treatment Facilities - Major System, Department of The Army Corps of Engineers Office of the Chief of Engineers, 1978.

5. Estimating Staffing for Municipal Wastewater Treatment Facilities, Environmental Protection Agency, 1973.

6. Federal Emergency Management Agency (FEMA). 1990. Flood Insurance Rate Map for the Town of Branford. Federal Insurance Administration FEMA. Washington, D.C.

7. Great Lakes-Upper Mississippi River board of State Public Health and Environmental Managers, Recommend Standards for Wastewater Treatment Facilities ("Ten States Standards"). 1990.

8. New England Interstate Water Pollution Control Commission. TR-16: Guides for the Design of Wastewater Treatment Works, 1980.

9. Nutrient Control, Manual of Practice FD-7, Facilities Design, Water Pollution Control Federation, 1983.

10. Phosphorus and Nitrogen Removal from Municipal Wastewater - Principles and Practice, Second Edition, Richard Sedlak, Editor, 1991.

11. Process Design Manual for Upgrading Existing Wastewater Treatment Plants, Environmental Protection Agency Technology Transfer, 1974.

12. Process Design Manual for Nitrogen Control, Environmental Protection Agency Technology Transfer, 1975.

13. Manual for Nitrogen Control, Environmental Protection Agency, Office of Research and Development, September 1993.

14. Soil Survey of New Haven County, Connecticut, United States Department of Agriculture, Soil Conservation Service in Cooperation with Connecticut Agricultural Experiment Station and Storrs Agricultural Experiment Station, 1964.

15. Wastewater Engineering - Treatment Disposal Reuse, Third Edition, Metcalf & Eddy, 1991.

16. Process Design Manual for Sludge Treatment and Disposal, USEPA, September 1979.

17. Operations Manual - Anaerobic Sludge Digestion, USEPA Office of Water Programs Operations, February 1976.

18. Hypoxia and Nutrient Enrichment, Assessment of Condition & Management Recommendations, January 1993; The Long Island Sound Study Comprehensive Conservation & Management Plan Support Document, The Long Island Sound Study.

19. Comprehensive Conservation & Management Plan, November 1993 Draft, The Long Island Sound Study.

20. Disinfection of Wastewater and Water for Reuse, George White, 1978, Van Nostrand, Reinhold.

21. Process Design Manual - Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants., USEPA, October 1985.

22. Design Manual - Municipal Wastewater Disinfection, USEPA, October 1986.

23. The 1993 Sewer Use Charge Survey, State of Connecticut DEP, March 1994.

24. Sewer System Evaluation Survey, Gannett Flemming, Inc., May 1995.

25. Wastewater Treatment Facility Evaluations, Gannett Flemming, Inc., June 1991.

26. Evaluation of the Ad Valorem System for Operating and Maintaining the Wastewater Facilities, Gannett Flemming, Inc., June 1994.

27. Interim Nitrogen Reduction Assessment (updated), Gannett Flemming Inc., August 1995.

28. Five Year Water Conservation Plan for South Central Regional Water Authority, May 1994, Wilbur Smith, Assoc.

29. Land Use Plan (Draft), 1993 Update. Regional Water Authority Regional Water Authority Distribution System, Map, January 15, 1995.

30. Town of North Branford, District Customer Report, June 28, 1995.

31. Sewerage Feasibility Study - North Branford, CT, 1971, Flaherty-Giavara & Associates.

32. Evaluation: Initial Phase of Sewer Program, May 1976, Flaherty-Giavara & Associates.

33. Final Report, South Central Regional Water Authority Long Range Demand Study 1990-2020, October 1991, Wilbur Smith Associates.

34. Regional Water Authority Service Area Draft Comparison Year 1994.

35. Monitoring Septage Addition to Wastewater Treatment Plants.

36. POTW Report, List of Industrial Users, 1994. State of Connecticut Department of Environmental Protection.

37. Branford Planning and Zoning Commission, Zoning Map, Revised April 22, 1993.

38. Town of Branford Data Summary, March 1995.

39. South Central Region Council of Governments, OPM Population Projections for the Town of Branford.

40. Branford Plan of Development Update, Acres of Undeveloped Land, May 1995.

41. Water Quality Classifications for the South Central Coast Basin, CT DEP Water Management Bureau, February 1993.

42. Sewer System Investigation, Section "A" Sewers, Draft Report, April 16, 1996, Town of North Branford Engineering Department.

43. Conservation and Development Policies Plan for Connecticut, 1992-1997, Office of Policy and Management.

44. Environment 2000, Connecticut's Environmental Plan, 1992-1997, First Revised Edition, 1992, Connecticut Department of Environmental Protection.