FINAL

PENDER COUNTY

WASTEWATER MASTER PLAN

Prepared For

Pender County
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Burgaw, North Carolina 28425

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Project No. 00542-0047

July 2006

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I. Executive Summary

A. Purpose

McKim & Creed, P.A. was authorized by Pender County to conduct a Wastewater Master Plan for the period from 2005 to 2030 to aid in planning and implementation of public wastewater facilities in the County. Over the past decade, the County has experienced tremendous growth, which has brought about a need for municipal wastewater service to support growth which is relatively incompatible with traditional small-scale individual on-site disposal systems, and which safeguards the rich natural resources of the County. Growth is expected to continue into the foreseeable future, furthering the need for dependable wastewater collection and treatment.

B. Scope

The scope of the Wastewater Master Plan provides for County-wide planning of future wastewater service needs, identification of wastewater conveyance, treatment and dispersal system infrastructure required, and recommendations for implementation. Specifically, the study includes the projection of wastewater flows for the study period, identification of wastewater system needs, evaluation of wastewater treatment and dispersal alternatives, opinions of probable project cost, and schedules of implementation for the recommended alternatives.

C. Existing Facilities

The majority of Pender County residents and businesses depend on decentralized wastewater treatment systems (onsite septic systems or packaged treatment systems). Pender County currently owns and operates several wastewater pumping stations including the Del Labs, Cape Fear Middle School, Heidi Trask Senior High School, and NC133/US117 Regional Pump Station. All four stations convey flow to New Hanover County for treatment at the Wilmington Northside WWTP. Pender County currently has a 75,000 gpd wastewater allocation from the City of Wilmington. Several package treatment plants and onsite dispersal systems are operated by private developments or businesses in the County. On US Hwy. 421, BASF currently operates an onsite WWTP with a NPDES direct discharge permit. Surf City owns a small WWTP with secondary treatment and spray irrigation system for dispersal of the treated wastewater. The Town of Burgaw operates a wastewater collection system and WWTP that has a current treatment capacity of 750,000 gpd. In Duplin County, north of Pender County, the Town of Wallace currently has a 1 MGD tertiary WWTP that discharges to a tributary of the Northeast Cape Fear River. The Town also has a WWTP with a permitted capacity of 4.0 MGD (construction

upgrade to start late 2006). Pender County has been allocated 2.0 MGD of the 4.0 MGD capacity when construction is completed.

D. Projected Wastewater Flows

Projected wastewater flows have been developed for each of the townships designated to be serviced via the County's regional systems through 2030. Table I-1 below provides a summary of the projected wastewater flows for each township in 5-year increments for the project planning period:

Table I-1 – Summary of Total Wastewater Flows by Township (MGD)

Township	2010	2015	2020	2025	2030
Burgaw	0.10	0.23	0.30	0.41	0.63
Caswell	0.00	0.01	0.02	0.02	0.03
Union	0.20	0.39	0.51	0.73	1.14
Topsail	1.73	2.32	2.92	3.59	4.01
Rocky Point	0.59	1.32	2.41	2.95	3.51
Long Creek	0.00	0.10	0.23	0.53	0.70
Grady	0.00	0.23	0.59	1.03	1.43
COUNTY TOTAL	**2.62**	**4.60**	**6.97**	**9.27**	**11.44**

It is noted that the projected wastewater flows for 2030 are nearly 12 MGD. These result from a combination of predominantly new growth in the residential, commercial, and industrial sectors, as well as a contribution of service for existing systems as they fail or wish to connect to the system. It is proposed in the Wastewater Master Plan that wastewater system improvements be made in phases to meet the growing needs throughout the planning period. As indicated in the report, two regional Wastewater Reclamation Facilities (WWRFs) are recommended to service the projected wastewater needs. Current plans are to construct each plant in three phases. Wastewater pumping stations conveying flow to the WWRFs will also be phased as wastewater flows develop in each township.

E. Alternatives Evaluation

Multiple options and alternatives were considered for treatment and dispersal of the collected wastewater. These included:

- Collaborative efforts with:
  - New Hanover County and City of Wilmington
  - Town of Wallace

- Town of Burgaw
- Town of Surf City

- Stand-Alone efforts:

  - Single Central system vs Multiple Decentralized Systems
  - Secondary Treatment vs Advanced Treatment
  - Surface Discharge vs Land-based Non-discharge
  - Dedicated land-based dispersal vs Non-dedicated Unrestricted Reuse
  - Dispersal by Irrigation vs Infiltration

- Various combinations of several of these options

F. Wastewater Conveyance Treatment and Dispersal Systems

Conveyance

The proposed concept for wastewater conveyance throughout the study area includes regional wastewater pumping stations in each of the townships. The townships of Caswell, Grady, Long Creek and Rocky Point are recommended to have centrally located regional pump stations that would convey flow to the proposed West Regional Wastewater Reclamation Facility for treatment. On the east side of the County, the County wants to provide wastewater collection along NC Highway 17 in the Topsail Township. Therefore, a series of wastewater pumping stations with a manifolded force main layout are proposed along NC Highway 17. Gravity sewer lines would be extended from each station along NC-17 for wastewater collection. The gravity sewer would be designed to cover the majority of road frontage along NC-17 providing a nearly "gap free" sewer service coverage area. The pump stations would convey flow through the force main to the proposed East Regional Wastewater Reclamation Facility for treatment.

Treatment

In aggregate, a large proportion of the total County growth and wastewater demand is located in the southern tier of Townships. In addition, the most viable treatment and dispersal options present themselves in these general areas of the County. It is recommended that the County construct two new wastewater reclamation facilities on the southern end of the County to provide wastewater treatment through 2030. Tertiary treatment would be accomplished, producing reclaimed water that could be used for beneficial reuse and reduce dispersal limitations. The facilities are referred to as the West and East Regional Wastewater Reclamation Facilities (WWRF) in the Master Plan. It is recommended that the West WWRF be co-located with the new water treatment

plant along US-421. Significant savings will be realized by shared facilities on a co-located site (such as administration and maintenance facilities, and residuals processing). The County currently plans to locate the East WWRF in the Scott Hills District on the Sidbury Property indicated in the Wastewater Master Plan. For phasing purposes, construction of the WWRFs was evaluated in three phases. The first phase (Phase IA - 1.0 MGD at each facility) is anticipated to be partly funded by developers requiring immediate allocation. Phases IB and II would possibly involve the County upgrading each facility to handle 3.0 MGD and 6.0 MGD, respectively.

Co-location of the Water Treatment Plant and the West Regional WWRF will allow for implementation of a residuals treatment process to develop a commercially viable Class A product. It is suggested that initial residuals processing at the East Regional WWRF be limited to thickening and that the County contract with a local waste management company to collect the residuals and perform further treatment off-site. As flows and waste volumes increase, it may be beneficial to either transport to the West WWRF for final processing or implement additional biosolids treatment at the East WWRF.

Dispersal

Correspondence with the Division of Water Quality regarding new direct discharges at the proposed Wastewater Reclamation Facilities indicated that the Division is currently in the process of developing a watershed model for the Cape Fear estuary. The modeling will allow the Division to subsequently develop a Total Maximum Daily Load (TMDL) for the estuary. The Division expects to complete the TMDL process by September 2006. Allocations for new and existing discharges will not be established until the modeling and TMDL development is completed. Therefore, the chance of the County getting approved for direct discharges at the proposed WWRFs is uncertain and other dispersal options must be evaluated. McKim & Creed has located several parcels within close proximity (0-10 miles) of the proposed Wastewater Reclamation Facilities that appear to have soils suitable for accepting wastewater treated to reclaimed water standards.

It is proposed that the County construct dispersal facilities including so-called Infiltration Ponds – these are below grade earthen ponds that would accept treated wastewater from the WWRFs. The ponds would be constructed in soils and to depths that would allow the treated wastewater to infiltrate at a moderate rate (1.0 gpd/sf) through the subsurface and eventually outlet to nearby surface waters or aquifers. The ponds provide for a low cost and low maintenance solution for treated wastewater dispersal when compared to large drip or spray irrigation systems.

G. Implementation Plan

Phase IA, to be constructed by the end of the year 2010, consists of two new wastewater reclamation facilities, multiple pump stations, gravity sewer and force main in the Topsail Township, a reclaimed water transmission line and infiltration ponds at a total project cost of approximately $95,676,000. In the East Region of the County, Phase IA will be divided in two sections, IA1 and IA2. Phase IA1 will include construction of the initial convenience system components along NC Highway 17. Construction of these initial pump stations and force main will put in place the "downstream" section of the convenience system needed to service the lower half of the Topsail Township along NC Highway 17. Treatment will be provided by a 0.5 MGD allocation in a WWTP to be privately built; which will later potentially form a basis for the East Regional WWTP. It is anticipated that approximately 36 months will be required to complete Phase IA.

Phase IB, to be constructed between the years of 2011 and 2016, involves upgrading the two WWRFs to 3 million gallons per day, constructing additional pump stations, gravity sewer and force main in Topsail Township, constructing pump stations and force main within the four townships of the west region and expanding the infiltration pond systems to accept 3.0 MGD from each WWRF. The total project cost for Phase I B is $127,643,648.

Phase II, to be constructed by the Year 2021, involves a 3 million gallons per day upgrade to the Phase IB plant designs (for total facility capacities of 6 million gallons per day each), upgrade of the west region township pump stations and expansion of the infiltration pond systems to accept a total reclaimed water volume of 12 MGD at a total project cost of $140,437,530.

Since these facilities are largely dedicated to serving new development in the area, the magnitude and timing of the phases may be adjusted somewhat to better coincide with the timing of that development.

Wastewater generated in the Union and Central districts would be conveyed and treated through interlocal agreement with the Towns of Burgaw and/or Wallace. In the near term, additional demands in a large portion of Union and Central districts can be met through continued use of decentralized systems.

H. Opinions of Probable Cost

McKim & Creed developed construction cost and total project cost opinions for the recommended implementation plan. Tables I-2 and I-3 show the cost opinions for each phase of the west and east regional wastewater systems.

Table I-2 – West Region Project Cost

	Phase IA (2006 - 2010)	Phase IB (2011 - 2020)	Phase II (2021 - 2030)
Wastewater Pump Stations and Force Mains			
Caswell	$0	$3,127,000	$0
Grady	$0	$5,610,000	$435,000
Rocky Point	$0	$6,869,000	$651,000
Long Creek	$0	$11,185,000	$735,000
Subtotal	**$0**	**$26,791,000**	**$1,821,000**
West Regional WWTP	$21,000,000	$12,000,000	$33,000,000
Reclaimed Water Pumping Station and Transmission Lines	$5,400,000	$0	$1,475,000
Reclaimed Water Dispersal System (Infiltration Ponds.)	$5,767,000	$11,533,000	$21,625,000
Total Construction Cost	**$32,167,000**	**$50,324,000**	**$57,921,000**
Contingencies	$6,433,400	$10,064,800	$11,584,200
Planning, Design, Bidding and Construction Services	$5,790,060	$9,058,320	$10,425,780
Administrative and Legal Services	$1,608,350	$2,516,200	$2,896,050
Land Acquisition, Total Net Ac Req'd (80 + 70 + 105)	$1,600,000	$1,400,000	$2,100,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$47,598,810**	**$73,363,320**	**$84,927,030**

Table I-3 – East Region Project Cost

	Phase I A1[1] (NC Hwy. 17 Initial Conveyance)	Phase I A2 (2006-2009)	Phase I B (2010 - 2020)	Phase II (2021 - 2080)
Topsail Collection Systems (Gravity Lines and/or Pump Stations)				
Service Area #1		$1,600,000	$0	$0
Service Area #2	$455,000	$1,540,000	$0	$0
Service Area #3	$455,000	$1,966,000	$0	$0
Service Area #4	$455,000	$1,816,000	$0	$0
Service Area #5	$455,000	$0	$3,363,930	$0
Service Area #6		$0	$2,786,850	$0
Service Area #7		$0	$1,527,470	$0
Subtotal	**$1,820,000**	**$6,922,000**	**$7,678,250**	**$0**
Topsail Force Main System	$5,825,000	$0.00	$4,151,000	$0.00
East Regional WWTP w/Biosolids Thickening	$0	$6,250,000	$12,500,000	$18,750,000
Reclaimed Water Pumping Station and Transmission Lines	$0	$5,475,000	$650,000	$600,000
Reclaimed Water Disposal System (Infiltration Ponds)	$0	$6,000,000	$12,000,000	$18,000,000
Total Construction Cost	**$7,645,000**	**$24,647,000**	**$36,979,250**	**$37,350,000**
Contingencies	$1,529,000	$4,929,400	$7,395,850	$7,470,000
Planning, Design, Bidding and Construction Services	$1,376,100	$4,436,460	$6,656,265	$6,723,000
Administrative and Legal Services	$382,250	$1,232,350	$1,848,963	$1,867,500
Land Acquisition, Total Net Ac Reqd (15+65+70+105)	$300,000	$1,300,000	$1,400,000	$2,100,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$11,232,350**	**$36,845,210**	**$54,280,328**	**$55,510,500**

[1] Phase I A1 includes construction of four pump stations and force mains along NC Highway 70. See Exhibit 6A in Appendix A for locations and sizes.

I. Recommendations

Based on the findings of the Wastewater Master Plan and recent private development interest in the County, it is recommended that the County enter into agreements with selected developers to fund the design and construction of two new Wastewater Reclamation Facilities as an initial phase to the overall implementation plan. It is anticipated with the projected growth in the proposed service areas that the County will need to upgrade the initial WWRFs and construct new conveyance systems throughout the southern half and in selected portions of the northern half of the County. For the ultimate planning period design (year 2030) it is projected that the County will need to operate two 6.0 MGD WWRFs along with multiple regional wastewater pumping stations and infiltration ponds, and conveyance systems to the Town of Wallace. It is recommended that the County begin detailed planning for implementation of the Phase IA improvements as described in the Wastewater Master Plan.

II. Population Projections

A. Purpose

This Section details the methodology used to estimate the population throughout the County for the 25-year study period. The input of the Pender County staff and other project team members was crucial in the development of this document. This information serves as the basis for all proceeding work recommended for the Pender County Wastewater Master Plan.

B. Population Projections

Historical and Current Population

Pender County's population has grown to 2½ times its original size over the past 25 years. The County is listed as one of the fastest growing counties in North Carolina. Historically it has been a rural county with modest coastal area development. In recent is years it has attracted significant development in the coastal areas and along the I-40/117 corridor. Census data shows that Pender County has grown from 18,850 in 1960 to 41,082 in 2000.

Pender County is bordered by counties exhibiting a wide range of growth profiles. To the south, New Hanover County and Brunswick County have experienced significant growth surrounding their coastal areas and the City of Wilmington. Both Sampson and Duplin Counties to the north have experienced modest growth. Yet both Bladen and Columbus Counties to the west have exhibited low growth profiles and Onslow County to the northeast has experienced a decrease in population.

In order to estimate the growth for the last five years, interim population data were gathered and correlated to the increase in school enrollment and housing permits. It was found that growth in population in 2001 through 2005 varied between 1.5% and 3.4% per year.

Population Growth

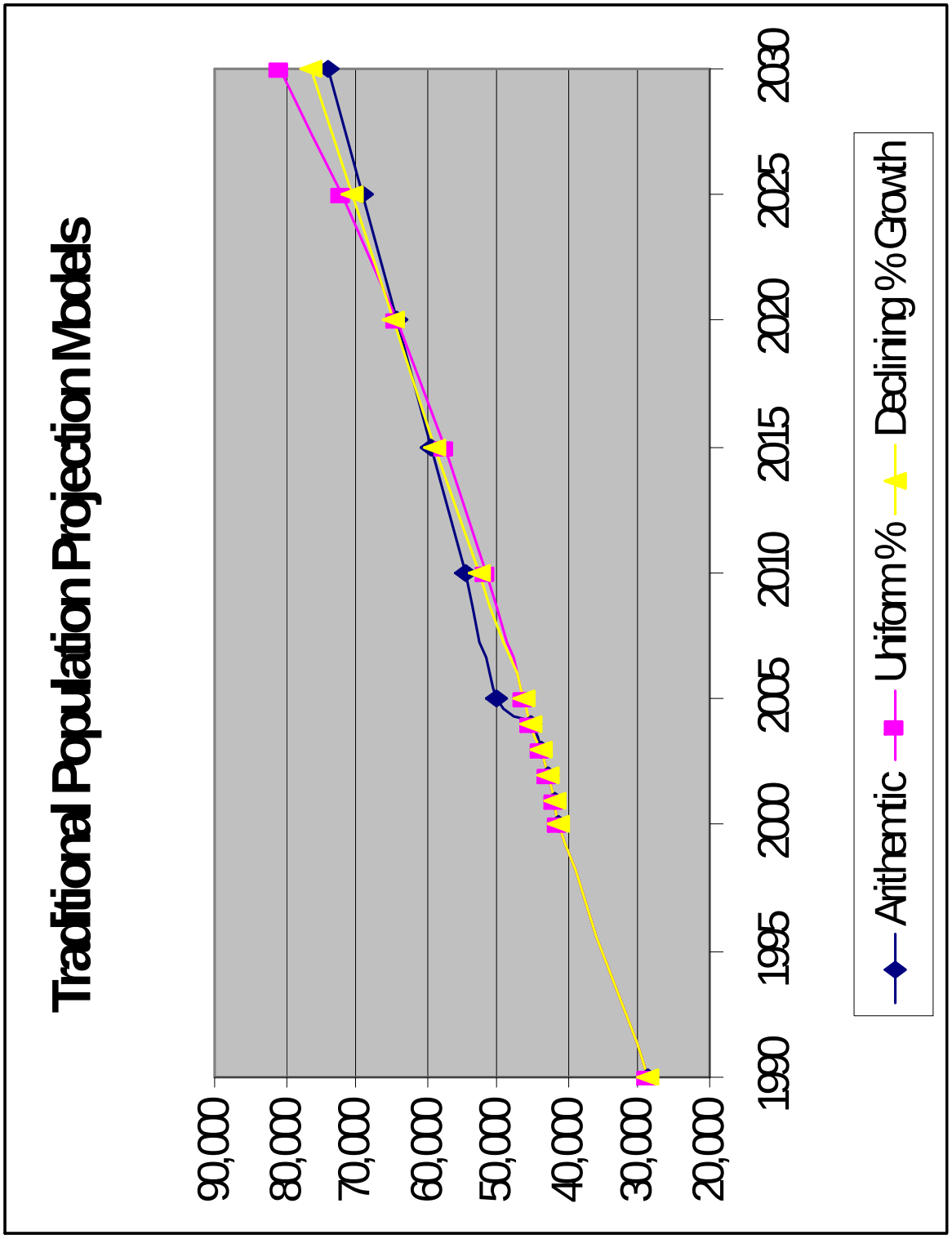
North Carolina is growing at an above average rate. The coastal areas of the state are attracting an increasing number of retirement communities and vacation home developments. In addition, the growth of the City of Wilmington is beginning to expand into Pender County. Due to easy access to major transportation routes, coastal resources and affordable land, many new homeowners are choosing to live in Pender County and commute to work in Wilmington. It is expected that growth in these two sectors will continue.

Just how fast that growth occurs and to what extent depends upon the policy makers of the Pender County government. By providing infrastructure such as public water and sewer and using sound development strategies, the County is expected to experience a significant growth rate. With public water and sewer available, industrial and commercial recruitment will increase, followed by an increased demand for housing and amenities.

In order to predict what level of growth the County can expect in an increased growth rate environment, the populations of several analogous high growth areas were examined. Each one of these counties has experienced significant growth in recent years, with each having a different set of pressures driving that growth.

As a first step in predicting future growth within the County, previous census data were applied to several traditional population growth models. These include arithmetic, uniform percentage, and declining percentage growth models. These models are based upon the assumption the historical growth trend will continue into the future. All of these methods yielded a similar result with the County's population reaching between 75,000 and 81,000 by 2030.

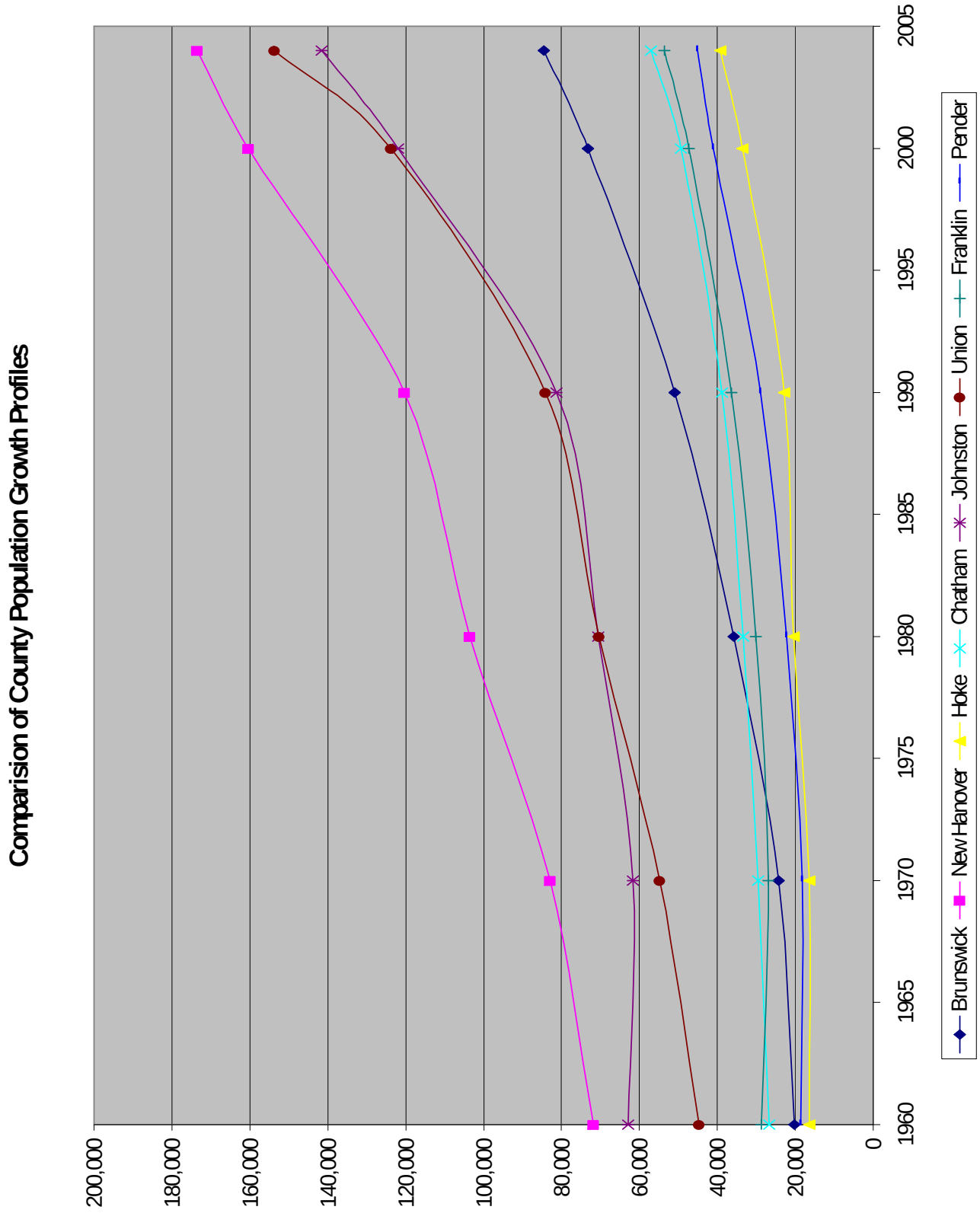
Figure No. II-1-Traditional Growth Models for Pender County Population



After further analysis and discussion with the County about these predictive models, an issue was raised concerning traditional modeling techniques and their inability to predict the often extraordinary population growth rate changes that occur with the available water and wastewater infrastructure. The challenge was tailoring these more traditional growth models to improve such prediction capabilities. Subsequently, the models were modified based on surrounding Counties that have experienced "infrastructure driven" growth, as well as an analysis of timing for Pender County's future infrastructure improvements.

For comparison purposes, the populations of several other high growth Counties were examined, again with each having a different set of pressures driving growth.

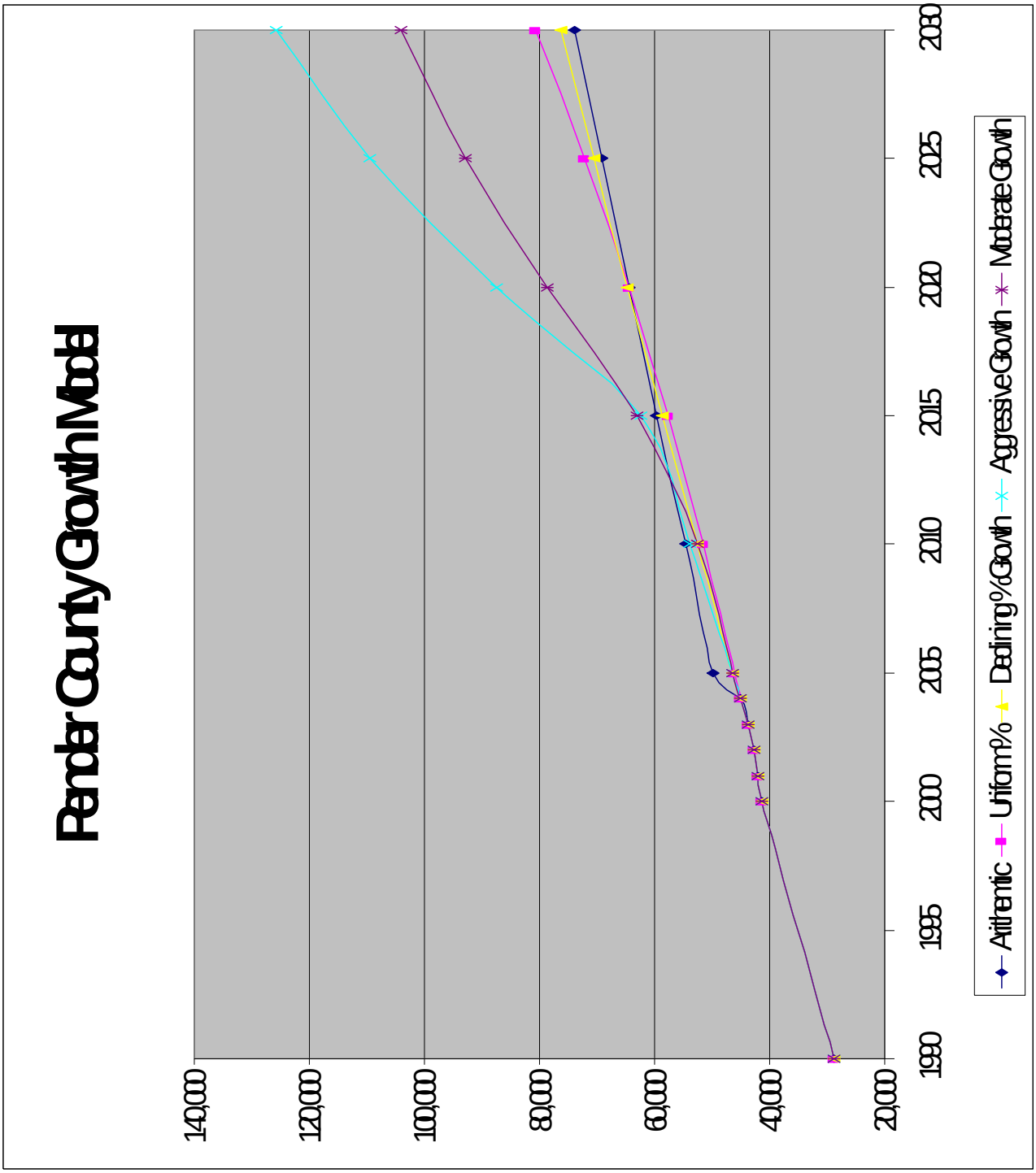
Figure No. II-2 – Comparison of County Population Growth Profiles



Of the counties considered, Brunswick County has the most in common with Pender County. Like Pender County, Brunswick County is also a coastal county that is experiencing the pressure from the outward growth of New Hanover County. Brunswick County's recent growth profile was used to create an aggressive growth model for Pender County. The aggressive growth model shown in Figure No. II-2 predicted an increase of Pender County's population of over 300% between 2000 and 2030. While this kind of growth profile is possible, it is expected that a more moderate growth increase is more probable.

Another model was created using a more moderate growth rate as seen in Brunswick County between 1984 and 2004. In 1984, Brunswick County's population was roughly equal to Pender County's current population. This moderate growth model predicts that Pender County's population will grow to 104,000 by 2030. After further discussion and consultation with County staff, the moderate growth model was chosen as the basis for population growth predictions noted in this study.

Figure No. II-3 – Growth Models for Pender County



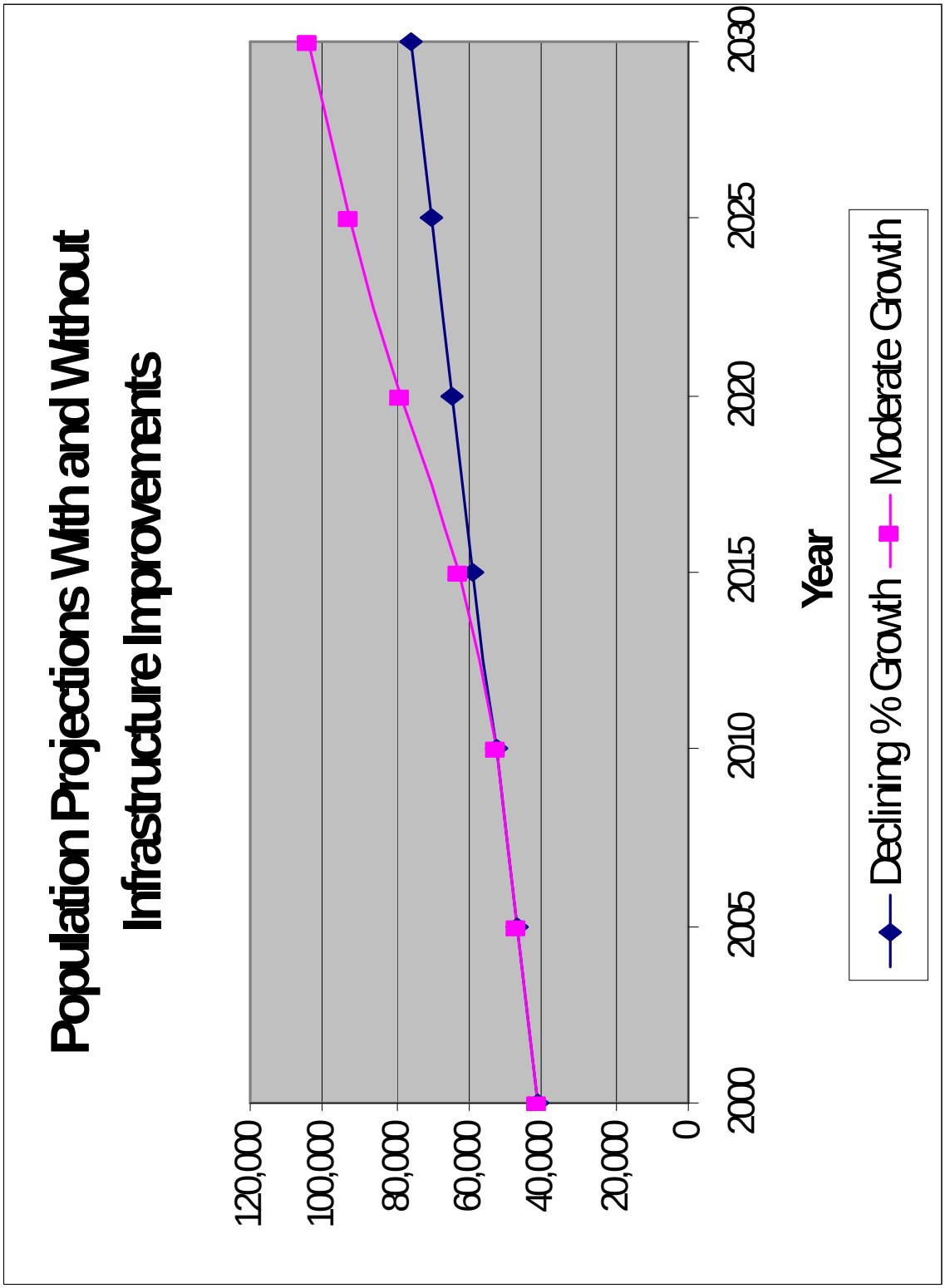
Population by Township

All areas of Pender County are not growing uniformly. The coastal areas, the I-40/117 corridor, and the area bordering New Hanover County are growing rapidly, while other areas in the County are growing at a modest pace. Therefore, each township within the County was evaluated as a separate growth area in the analysis utilizing census data that are available for each township and for incorporated areas within the County. Based upon discussions with the County, incorporated towns were excluded from the analysis as they will not be served by the County's water and sewer systems. Exhibit 1 in Appendix A shows the 2030 projected populations for each delineated township within Pender County.

It was determined that townships experiencing modest growth will most likely remain rural throughout the study period. In these areas it will not be economically feasible to provide conveyance and treatment capacity to serve the communities, due to the low population, densities, and remote locations. Therefore, for the purposes of this study, Canetuck, Caswell, Columbia, and Holly Townships were assumed to remain rural in character and maintain modest growth.

In townships where water and sewer are expected to be in place, growth is anticipated to accelerate. The amount of growth in these areas is equal to the difference between the Countywide Moderate Growth curve and the Declining Percentage Growth curve (Figure II-1). As previously stated, the accelerated growth is a direct result of the addition of wastewater infrastructure. Without this infrastructure it is assumed that the township's population would continue to grow as predicted in the declining percentage growth model. Therefore the population represented by the area between the two curves (Figure No. II-4) was added to the townships' populations in accordance with the development timeline.

Figure No. II-4 – Population Projections



The number of household to be served during the study period was determined for each township. The person per household ratio (as reported in the 2000 census) was used to make the conversion from predicted population to predicted number households. For the purposes of this study, the person per household ratio for each township was held constant. A breakdown of the historical population growth and number of households, as taken from US census data, for each township is shown in Table I-1 as follows:.

Table No. II-1 - Existing Data on Population by Township

	1990 Pop	1990 Housing Units	1990 People /home	2000 Pop	2000 Housing Units	2000 People / Home	Housing Units per Sq Mile	% Change in Pop	% Change in Housing Units	Change in Pop	% Total Growth in Pop	Change in Housing Units	% Total Growth in Housing Units
Burgaw	5,515	2,036	2.71	7,474	2,876	2.60	35.5	135.52%	141.26%	1,959	16.02%	840	45.33%
Town	1,807	702	2.57	3,337	1,051	3.18	306.0	184.67%	149.72%	1,530	12.51%	349	18.83%
St. Helena Village	321	145	2.21	395	175	2.26	31.0	123.05%	120.69%	74	0.61%	30	1.62%
Remainder	3,387	1,189	2.85	3,742	1,650	2.27	23.0	110.48%	138.77%	355	2.90%	461	24.88%
Canetuck	369	148	2.49	361	210	1.72	4.7	97.83%	141.89%	-8	-0.07%	62	3.35%
Caswell	1,016	398	2.55	1,172	601	1.95	12.2	115.35%	151.01%	156	1.28%	203	10.96%
Atkinson	275	141	1.95	236	117	2.02	127.6	85.82%	82.98%	-39	-0.32%	-24	-1.30%
Remainder	741	257	2.88	936	484	1.93	10.0	126.32%	188.33%	195	1.59%	227	12.25%
Columbia	1,790	626	2.86	2,179	904	2.41	9.2	121.73%	144.41%	389	3.18%	278	15.00%
Atkinson	0	0	0.00	0	0	0.00	0.0	0.00%	0.00%	0	0.00%	0	0.00%
Remainder	1,790	626	2.86	2,179	904	2.41	9.2	121.73%	144.41%	389	3.18%	278	15.00%
Grady	1,725	599	2.88	2,192	962	2.28	18.6	127.07%	160.60%	467	3.82%	363	19.59%
Holly	2,095	743	2.82	2,263	1,137	1.99	5.5	108.02%	153.03%	168	1.37%	394	21.26%
Long Creek	1,280	494	2.59	1,854	798	2.32	19.7	144.84%	161.54%	574	4.69%	304	16.41%
Rocky Point	3,377	1,295	2.61	5,786	2,370	2.44	44.4	171.34%	183.01%	2,409	19.70%	1,075	58.01%
Topsail	8,403	3,510	2.39	13,806	9,190	1.50	58.3	164.30%	261.82%	5,403	44.19%	5,680	306.53%
Surf City	970	*660*	1.47	1,101	1,929	0.57	507.6	113.51%	292.27%	131	1.07%	1,269	68.48%
Topsail Beach	346	998	0.35	471	1,149	0.41	262.8	136.13%	115.13%	125	1.02%	151	8.15%
Remainder	7,087	1,852	3.83	12,234	6,112	2.00	40.9	172.63%	330.02%	5,147	42.10%	4,260	229.90%
Union	3,285	1,263	2.60	3,995	1,750	2.28	19.6	121.61%	138.56%	710	5.81%	487	26.28%
Wallace	*15*	*6*	2.50	18	7	2.57	25.4	120.00%	116.67%	3	0.02%	1	0.05%
Watha	99	41	2.41	151	71	2.13	77.9	152.53%	173.17%	52	0.43%	30	1.62%
Remainder	3,171	1,216		3,826	1,672	2.29	19.0			655	5.36%	456	24.61%
TOTAL	28,855	18,945	1.52	41,082	20,798	1.98	23.9	142.37%	109.78%	12,227	100.00%	1,853	100.00%

Numbers in italics were estimated based upon census data.

By applying the previously discussed growth model to the available data on existing population, population and households were projected by township. Tables II-2 and II-3 provide a summation of these projections:

Table No. II-2 – Projected Population by Township

		2000	2005	2010	2015	2020	2025	2030
Burgaw		7,474	8,337	9,305	10,273	11,241	13,409	15,827
	Town	3,337	4,011	4,767	5,523	6,279	7,035	7,791
	St. Helena Village	395	428	465	502	539	576	613
	Remainder	3,742	3,898	4,073	4,248	4,423	4,598	4,773
Canetuck		361	357	353	349	345	341	337
Caswell		1,172	1,241	1,318	1,395	1,472	1,549	1,626
	Atkinson	236	219	200	181	162	143	124
	Remainder	936	1,022	1,118	1,214	1,310	1,406	1,502
Columbia		2,179	2,350	2,542	2,734	2,926	3,118	3,310
	Atkinson		0	0	0	0	0	0
	Remainder	2,179	2,350	2,542	2,734	2,926	3,118	3,310
Grady		2,192	2,398	2,629	2,860	3,091	5,122	6,853
Holly		2,263	2,337	2,420	2,503	2,586	2,669	2,752
Long Creek		1,854	2,107	2,391	2,675	3,959	7,243	9,027
Rocky Point		5,786	6,848	8,038	10,028	16,018	19,008	20,498
Topsail		13,806	16,188	18,857	25,126	31,615	34,484	37,379
	Surf City	1,101	1,160	1,625	2,190	2,775	3,380	3,985
	Topsail Beach	471	526	588	800	1,012	1,224	1,436
	Remainder	12,234	14,503	17,046	19,589	22,132	24,675	27,218
Union		3,995	4,308	4,659	5,071	5,515	6,003	6,491
	Wallace	18	19	20	21	22	23	24
	Watha	151	174	200	226	252	278	304
	Remainder	3,826	4,115	4,439	4,763	5,087	5,411	5,735
TOTAL		41,082	46471	52512	63014	78768	92946	104100

Table No. II-3 – Estimated Number of Housing Units by Township

		2000	2005	2010	2015	2020	2025	2030
Burgaw		2,876	3,208	3,581	3,953	4,326	5,160	6,090
	Town	1,051	1,263	1,501	1,739	1,978	2,216	2,454
	St. Helena Village	175	190	206	222	239	255	272
	Remainder	1,650	1,719	1,796	1,873	1,950	2,027	2,105
Canetuck		210	208	205	203	201	198	196
Caswell		601	636	676	715	755	794	834
	Atkinson	117	109	99	90	80	71	61
	Remainder	484	528	578	628	677	727	777
Columbia		904	975	1,055	1,134	1,214	1,294	1,373
	Atkinson	0	0	0	0	0	0	0
	Remainder	904	975	1,055	1,134	1,214	1,294	1,373
Grady		962	1,052	1,154	1,255	1,357	2,248	3,008
Holly		1,137	1,174	1,216	1,258	1,299	1,341	1,383
Long Creek		798	907	1,029	1,151	1,704	3,118	3,885
Rocky Point		2,370	2,805	3,292	4,108	6,561	7,786	8,396
Topsail		9,190	10,776	12,552	16,725	21,045	22,954	24,881
	Surf City	1,929	2,032	2,847	3,837	4,862	5,922	6,982
	Topsail Beach	1,149	1,283	1,434	1,952	2,469	2,986	3,503
	Remainder	6,112	7,246	8,516	9,786	11,057	12,327	13,598
Union		1,750	1,887	2,041	2,221	2,416	2,630	2,843
	Wallace	7	7	8	8	9	9	9
	Watha	71	82	94	106	118	131	143
	Remainder	1,672	1,798	1,940	2,081	2,223	2,365	2,506
TOTAL		20,798	23,628	26,801	32,724	40,876	47,522	52,890

Exhibit 1 in Appendix shows the total estimated 2030 populations for each township.

Population by Water and Sewer District

Pender County has successfully used the "Water and Sewer District" model for expanding infrastructure in recent years and is expected to continue with this model as a basis for infrastructure development. Accordingly, the County has delineated proposed Water and Sewer Districts for this purpose.

Each Township falls partly or entirely with a District. In order to estimate the population by District the following percentages were used.

Table No. II-4 – Percentage of Land Area per District

DISTRICT	Topsail	Rocky Point	Holly	Grady	Long Creek	Caswell	Canetuck	Columbia	Burgaw	Union
Rocky Pt/Topsail	94.89%	97.39%	12.28%		42.64%				15.45%	
Scott's Hill	5.11%									
Moore's Creek				100.00%	52.76%	100.00%	100.00%	5.08%	1.01%	
Central		2.61%	87.72%		4.60%				83.54%	
Columbia/Union								94.92%		100.00%

The percentages above (Table II-4) were applied to the population estimated by township. For the purposes of this study all incorporated areas such as the Town of Burgaw were excluded from the calculations. The result is the following population figures (Table No II-5).

Table No. II-5 – Population Projections by District

DISTRICT	2000	2005	2010	2015	2020	2025	2030
Rocky Pt/Topsail	18,890	22,219	25,949	30,459	39,290	46,053	50,715
Scott's Hill	625	741	871	1,001	1,131	1,261	1,391
Moore's Creek	4,616	5,047	5,532	6,016	7,028	10,895	13,671
Central	5,347	5,582	5,845	6,129	6,564	7,012	7,352
Columbia/Union	5,894	6,346	6,852	7,358	7,864	8,371	8,877
TOTAL	**35,373**	**39,935**	**45,049**	**50,963**	**61,877**	**73,591**	**82,005**

When the same percentages are applied to the number of housing units estimated per Township, again excluding incorporated areas, the result is the following estimate of housing units per District (Table No. II-6).

Table No. II-6 – Housing Unit Projections by District

DISTRICT	2000	2005	2010	2015	2020	2025	2030
Rocky Pt/Topsail	8,843	10,404	12,153	14,222	18,069	21,087	23,232
Scott's Hill	312	370	435	500	565	630	695
Moore's Creek	2,140	2,334	2,552	2,770	3,215	4,904	6,121
Central	2,474	2,581	2,700	2,828	3,019	3,217	3,369
Columbia/Union	2,530	2,724	2,941	3,158	3,375	3,593	3,810
TOTAL	**16,299**	**18,412**	**20,781**	**23,478**	**28,243**	**33,431**	**37,227**

These estimates of District population and housing units are intended to by rough guidelines for planning purposes only. As each District develops and begins planning for the construction of water and wastewater infrastructure, a more detailed analysis of population and housing units is required.

III. Wastewater Flow Projections

A. Purpose

This section details the methodology used in and results obtained from wastewater flow prediction modeling for Pender County. The modeling effort is based upon the population projections outlined in Section III, as well as an analysis of the commercial and industrial growth expected in the County. The input of the Pender County staff and other project team members was crucial in the development of this section.

B. Residential Wastewater Projections

Residential wastewater projections were first stratified by township and then later applied to a water and sewer district model. In all cases the incorporated areas of the County were excluded from consideration.

Several assumptions were made about projected regional sewer use. Townships experiencing only modest growth will most likely remain rural throughout the study period. In these areas it will not be economically feasible to provide conveyance and treatment capacity to serve the communities because of low densities which will not support or cannot afford to pay for the high construction and operation and maintenance costs. Therefore, for the purposes of this study, Canetuck, Caswell (a portion of), Columbia, and Holly Townships were not included in our analysis for centralized treatment options, but will be discussed as potential areas of decentralized County and non-County maintained wastewater service later in Section V.

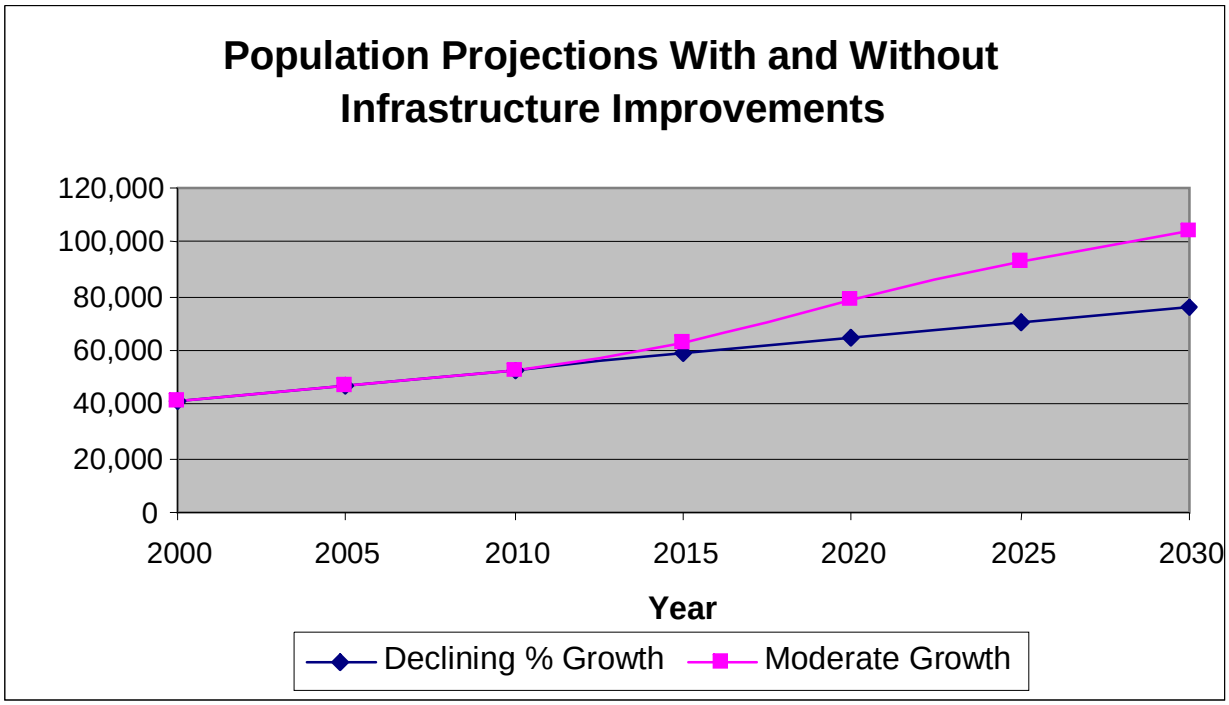
In more densely populated townships, construction of wastewater conveyance and treatment facilities were estimated to be completed in accordance with the following timeline.

Table No. III-1 – Timeline for Wastewater Infrastructure Development

Time Period	Infrastructure Development
2005-2010	Planning/Construction for Topsail Township Service Area, Service area from Wallace Constructed (Union Township), Service to the Industrial Area of Long Creek/Grady Constructed (US 421 Area)
2010-2015	Topsail Township WW Service in Place, Planning/Construction for Rocky Point Service Area
2015-2020	Rocky Point WW Service in Place, Planning/Construction for Long Creek/Grady Residential/ Commercial Service Area
2020-2025	Long Creek/Grady Service In Place, Burgaw Area Expanded
2025-2030	Continued Growth

In townships where water and sewer are expected to be in place, growth will likely accelerate. The amount of growth in these areas is equal to the difference between the Countywide Moderate Growth curve and the Declining Percentage Growth curve. As previously stated, the accelerated growth is a direct result of the addition of wastewater infrastructure. Without this infrastructure it is assumed that the township's population would continue to grow as predicted in the declining percentage growth model. Therefore the population represented by the area between the two curves (Figure No. III-1 below) was added to the townships' populations in accordance with the development timeline.

Figure No. III-1 – Population Projections



Although a basic "backbone" sewer system is expected to be constructed in a township, it will not be feasible to serve all households within that township. Some areas will be too sparsely populated to ever have community sewer service. Based upon our discussion with Pender County staff, in areas where sewer service is available, the majority of new development is expected to be served. Connection to the sewer system by existing homes will be voluntary. Due to the cost involved to homeowners, only a small percentage of existing residences are expected to become sewer customers.

With that in mind, each township was assigned a percentage of existing residential development to be served and a percentage of new development to be served. Table No III-2 below provides a breakdown of the percentages used in our flow calculations.

Table No. III-2 – Percentages of Residential Areas Served

Township	Existing Residential Homes	New Residential Development
Burgaw	10%	50%
Union	10%	50%
Topsail	40%	90%
Rocky Point	20%	60%
Long Creek/Grady	20%	60%

Residential flow calculations by township were based upon the previously outlined parameters. In each township, growth was assumed to be the same as the previous year's percentage until sewer infrastructure was in place. Then an accelerated growth rate was superimposed to account for increased densities and the conversion of land not suitable for on-site disposal systems.

Population projections are converted into flow by applying the person per house density (equal to the 2000 census density) for each township and 120 gallons per day (gpd) per bedroom per home, as an assumption. This number was then multiplied by the percentage of residential areas served in each township. The flow of 120 gpd per bedroom is based upon North Carolina's Department of Environment and Natural Resources' required design flow. The results are shown in Table No III-3 as follows:

Table No. III-3 – Residential Wastewater Flow (MGD)

Township	2010	2015	2020	2025	2030
Burgaw	0.00	0.08	0.09	0.11	0.12
Grady	0.00	0.10	0.13	0.32	0.48
Caswell	0.00	0.01	0.02	0.02	0.03
Long Creek	0.00	0.10	0.22	0.53	0.69
Rocky Point	0.31	0.48	1.01	1.28	1.41
Topsail	1.45	1.87	2.28	2.69	3.10
Union	0.00	0.10	0.12	0.15	0.17
TOTAL	**1.76**	**2.74**	**3.87**	**5.09**	**6.01**

C. Commercial Wastewater Projections

Commercial Growth

According to Pender County staff there is a "penned-up" demand for commercial, office, and light industrial development. There are three interchanges along the I-40 corridor within the County that carry significant traffic to the coastal areas, yet minimal services or amenities are at any of them. This is largely due to the lack of wastewater facilities.

The County is planning to provide the "backbone" of a collection and conveyance system to serve these commercial areas. They will ask developers to build the infrastructure to connect to this backbone. This will likely spur additional growth along the highways/corridors in these areas.

Commercial wastewater demand was calculated by determining the amount of available land. The County's zoning map was used to determine the acreage available within each township. Floodplains, municipal planning boundaries (ETJ's), undrained wetlands, and water features were excluded from our analysis.

The rate of development of commercial land was determined by the predicted time table of sewer availability and perceived demand. Areas of high demand were assumed to be the I-40 interchange areas and along NC Highway 17 in Topsail Township.

Table No. III-4 - Amount of Land Developed for Commercial Uses (Ac)

Township	Land Zoned B-1, B-2, B-3 Available	2010	2015	2020	2025	2030
Burgaw	506.9	50.7	76.0	101.4	152.1	253.5
Canetuck	0.0	0.0	0.0	0.0	0.0	0.0
Caswell	0.0	0.0	0.0	0.0	0.0	0.0
Columbia	51.12	0.0	5.1	6.1	12.8	17.9
Grady	44.83	0.0	4.5	5.4	11.2	15.7
Holly	18.59	0.0	0.0	0.0	0.0	0.0
Long Creek	0.0	0.0	0.0	0.0	0.0	0.0
Rocky Point	353.63	35.4	106.1	176.8	212.2	265.2
Topsail	471.42	141.4	235.7	330.0	466.7	471.4
Union	1060.01	106.0	159.0	212.0	318.0	530.0
TOTAL	2506.5	333.5	586.4	831.7	1,172.9	1,553.7

Commercial Flow Predictions

Two different flow profiles were used to predict wastewater flow. One for interchange areas where several fast food restaurants are grouped together and another for more varied services or retail oriented commercial development. A flow of 3,550 gallons per acre was used for interchange areas, while a flow of only 1,500 gallons per acre was used for suburban retail development. Again, each township was assigned a different ratio of interchange to retail development based upon perceived demand based on the percentages provided in Table No. III-5.

Table No. III-5-Percentage of Commercial Development Type By Township

	Interchange (3,550 gal/ac)	Retail (1,500 gal/ac)
Burgaw	25%	75%
Columbia	15%	85%
Grady	15%	85%
Rocky Point	20%	80%
Topsail	20%	80%
Union	15%	85%

Applying these factors to the amount of anticipated land development, wastewater flows can be predicted (see Table No. III-6).

Table No. III-6 – Commercial Wastewater Flow (MGD)

Township	2010	2015	2020	2025	2030
Burgaw	0.10	0.15	0.20	0.31	0.51
Canetuck	0.00	0.00	0.00	0.00	0.00
Caswell	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.01	0.01	0.02	0.03
Grady	0.00	0.01	0.01	0.02	0.03
Holly	0.00	0.00	0.00	0.00	0.00
Long Creek	0.00	0.00	0.00	0.00	0.00
Rocky Point	0.07	0.20	0.34	0.41	0.51
Topsail	0.27	0.45	0.63	0.89	0.90
Union	0.19	0.29	0.38	0.57	0.96
TOTAL	**0.63**	**1.11**	**1.58**	**2.22**	**2.94**

D. Industrial Wastewater Projections

If the necessary water and wastewater infrastructure is in place, Pender County is poised to attract industrial development. Its proximity to Wilmington and major transportation routes make it a favorable place for industries to locate. According to our discussions with industrial development representatives for this area, the current economic market favors light industrial applications such as distribution centers, computer processing centers, and office buildings. These representatives also indicated that Pender County will most likely see the same kind of light industry growth occurring in Wilmington.

Industrial wastewater demand was determined by the amount of land currently planned for industrial uses. The amount of land was calculated by taking the acreage of land zoned for industrial use and subtracting the floodplain, undrained wetland, and municipal planning areas. In order to determine the estimated flow per acre, industrial wastewater billing records from the City of Wilmington were reviewed. This review yielded an estimated 1,000 gallons per day per acre in wastewater flow. This estimated flow per acre was used to determine the flow expected within each township throughout the planning period (see Table No. III-7 and Table No. III-8).

Table No. III-7 – Industrial Growth by Land Area (Ac)

Township	Total Amount Of Land Zoned I-1, I-2 Available	2010	2015	2020	2025	2030
Burgaw	0.01	0.0	0.0	0.0	0.0	0.0
Canetuck	0	0.0	0.0	0.0	0.0	0.0
Caswell	0	0.0	0.0	0.0	0.0	0.0
Columbia	0	0.0	0.0	0.0	0.0	0.0
Grady	1143.45	114.3	285.9	457.4	686.1	914.8
Holly	485.62	0.0	0.0	0.0	0.0	0.0
Long Creek	7.58	1.9	3.8	7.6	7.6	7.6
Rocky Point	2118.39	211.8	635.5	1,059.2	1,271.0	1,588.8
Topsail	11.38	3.4	5.7	8.0	11.3	11.4
Union	9.11	0.0	9.1	9.1	9.1	9.1
TOTAL	**3,775.5**	**331.5**	**940.0**	**1,541.2**	**1,985.1**	**2,531.6**

Table No. III-8 – Industrial Flow By Land Area (MGD)

Township	Amount of Flow Generated				
	2010	2015	2020	2025	2030
Burgaw	0.00	0.00	0.00	0.00	0.00
Canetuck	0.00	0.00	0.00	0.00	0.00
Caswell	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.00	0.00	0.00	0.00
Grady	0.00	0.11	0.46	0.69	0.91
Holly	0.00	0.00	0.00	0.00	0.00
Long Creek	0.00	0.00	0.01	0.01	0.01
Rocky Point	0.21	0.64	1.06	1.27	1.59
Topsail	0.00	0.01	0.01	0.01	0.01
Union	0.00	0.01	0.01	0.01	0.01
TOTAL	**0.22**	**0.76**	**1.54**	**1.99**	**2.53**

The timing and magnitude of actual industrial growth often varies significantly from projection. The projections included herein may be accelerated with the development of an industrial park that may include high process water usage facilities.

E. Summary of Needs by Township

A summary of the County's wastewater treatment needs by 2030 is shown in Table No. III-9 below.

Table No. III-9 – Summary of Wastewater Needs by 2030 (MGD)

Township	Residential	Commercial	Industrial	TOTAL FLOW
Burgaw	0.12	0.51	0.00	0.63
Caswell	0.03	0.00	0.00	0.03
Union	0.17	0.96	0.01	1.14
Topsail	3.10	0.90	0.01	4.01
Rocky Point	1.41	0.51	1.59	3.51
Long Creek	0.69	0.00	0.01	0.70
Grady	0.48	0.03	0.91	1.43
COUNTY TOTAL	**6.01**	**2.90**	**2.53**	**11.44**

The estimated amount of wastewater treatment capacity required in Pender County was determined for each township in 5 year increments. Within the

25 year planning period the estimated timing of the construction of this capacity is provided in Table No. III-10:

Table No. III-10 – Summary of Wastewater Needs by Township (MGD)

Township	2010	2015	2020	2025	2030
Burgaw	0.10	0.23	0.30	0.41	0.63
Caswell	0.00	0.01	0.02	0.02	0.03
Union	0.20	0.39	0.51	0.73	1.14
Topsail	1.73	2.32	2.92	3.59	4.01
Rocky Point	0.59	1.32	2.41	2.95	3.51
Long Creek	0.00	0.10	0.23	0.53	0.70
Grady	0.00	0.23	0.59	1.03	1.43
COUNTY TOTAL	**2.62**	**4.60**	**6.97**	**9.27**	**11.44**

Exhibit 2 in Appendix A shows the 2030 wastewater flow projections for each township.

F. Wastewater Needs by Water & Sewer District

Pender County's wastewater needs can also be stratified by proposed Water & Sewer Districts. The County has created several new Water & Sewer Districts in addition to the existing Districts: Rocky Point/Topsail Water & Sewer District and Maple Hill Water & Sewer District. The Districts were presented in Section III - Predicting Population. While some townships are wholly contained within a single water and sewer district, others may be partially within two or three different districts.

Using the percentages of each township that is in each proposed District, the flows can be converted to a summary of projected flow by District. The percentages used in these calculations are shown in Table No. III-11 below.

Table No. III-11 – Percentage of Land Area Per District
Established Townships

Water and Sewer Districts	Topsail	Rocky Point	Holly	Grady	Long Creek	Caswell	Canetuck	Columbia	Burgaw	Union
Rocky Pt/Topsail	94.89%	97.39%	12.28%		42.64%				15.45%	
Scott's Hill	5.11%									
Moore's Creek				100.00%	52.76%	100.00%	100.00%	5.08%	1.01%	
Central		2.61%	87.72%		4.60%				83.54%	
Columbia/Union								94.92%		100.00%

Note: Table III-11 establishes the percent (of land area) of each township contained within the County's individual Water and Sewer Districts.

Using the percentages in Table No. III-11, the total wastewater treatment capacity needed by 2030 for each District broken down by category is shown below.

Table No. III-12 – Summary of Wastewater Needs By District By Category (MGD)

DISTRICT	Residential	Commercial	Industrial	TOTAL FLOW
Rocky Pt/Topsail	4.63	1.43	1.56	7.62
Scott's Hill	0.16	0.05	0.00	0.21
Moore's Creek	0.88	0.03	0.92	1.83
Central	0.17	0.44	0.04	0.65
Columbia/Union	0.17	0.96	0.01	1.14
COUNTY TOTAL	**6.01**	**2.90**	**2.53**	**11.44**

The timeline for the sum of these needs is outlined in Table No. III-13.

Table No. III-13 – Summary of Wastewater Needs By District By Time Period (MGD)

DISTRICT	2010	2015	2020	2025	2030
Rocky Pt/Topsail	2.23	3.57	5.26	6.58	7.62
Scott's Hill	0.09	0.12	0.15	0.18	0.21
Moore's Creek	0.00	0.29	0.73	1.34	1.83
Central	0.10	0.23	0.32	0.45	0.65
Columbia/Union	0.20	0.39	0.51	0.73	1.14
COUNTY TOTAL	**2.62**	**4.60**	**6.97**	**9.27**	**11.44**

IV. Wastewater Treatment and Dispersal

A. Purpose

This section details the wastewater treatment and dispersal system options considered for Pender County under this Master Plan. The section will provide discussion of the advantages and disadvantages of each option, including relative capital costs and regulatory compliance issues.

B. General Wastewater Treatment Considerations

Historically, Pender County and virtually all rural areas of the United States have relied on individual on-site septic "tank" systems for wastewater treatment. With the advent of the Clean Water Act in the early 1970's, there was a tremendous increase in the creation of centralized sewage collection and treatment systems. These two treatment strategies occupy the extremes of the continuum of potential wastewater treatment approaches. Over time more and more on-site systems have been shown to experience failure of some sort, and development has occurred in areas not practically suitable for onsite systems. Concurrently, the costs of extremely centralized collection and treatment have increased substantively, and the capability of the environment to absorb large point discharges has diminished. Currently, the large gulf between the black and white extremes of totally onsite systems and a single centralized sewer system is occupied by a broad range of gray – decentralized wastewater systems. These consist of a blend or combination of onsite or small clustered systems, and larger (but possibly not single unique) collection and treatment systems.

This plan will discuss the applicability of this range of options

C. Existing Wastewater Treatment Facilities

Pender County has long relied on individual wastewater systems to effectively treat the domestic and commercial wastewater generated in the County. The majority of current Pender County residents and businesses depend on decentralized wastewater treatment systems (onsite septic "tank" systems or small packaged treatment systems). Pender County currently owns and operates several wastewater pumping stations including the Del Labs, Cape Fear Middle School, Heidi Trask Senior High School, and NC133/US117 Regional Pump Station. All four stations convey flow to New Hanover County for treatment at the Wilmington Northside WWTP. Pender County currently has a 75,000 gpd wastewater allocation from the City of Wilmington. Several package treatment plants and onsite dispersal systems are operated by private developments or businesses in the County. On US Highway 421, BASF currently operates an

onsite WWTP with a NPDES direct discharge permit to the Cape Fear River. Surf City owns a small WWTP with secondary treatment and spray irrigation system for dispersal of the treated wastewater. The Town of Burgaw operates a wastewater collection system and WWTP that has a current treatment capacity of 750,000 gpd, and discharges to a tributary of the Northeast Cape Fear River. The Town of Wallace currently has a 1.0 MGD tertiary WWTP that discharges to a tributary of the Northeast Cape Fear River. The Town also has a WWTP which has a permitted capacity of 4.0 MGD, currently not in operation which will also discharge to a tributary of the Northeast Cape Fear River. Construction for the plant is to start late 2006. Pender County has been allocated 2.0 MGD of discharge to the 4.0 MGD capacity at completion of construction.

D. Individual On-site Systems

Other than the municipal concentrations and isolated industrial uses described above, the County relies on individual systems. Heretofore, the relatively sparse density, large lot sizes, and available economical land have lent themselves to this application. Among other factors, increased residential growth will now support increased commercial and industrial activity – activities which traditionally (even under ideal conditions) are harder to accommodate by individual on-site systems. At the same time, as more is known about requisite conditions for sustainable individual systems, it is found that more and more areas receiving pressure for this development exhibit characteristics less than ideal for installation of these conventional onsite systems. Therefore, continued reliance on these systems to serve the majority of residences and businesses in the County is not feasible. That is not to say that there is not a place for the continued use of well-managed individual on site systems. Areas of the County which still exhibit light development density - particularly of the commercial and industrial uses – and which contain favorable natural conditions for these systems – should continue to manage wastewater by this method. Areas which exhibit conditions contrary to the foregoing must incorporate some form of more centralized wastewater management.

E. Centralized Systems

1. Treatment Alternatives Evaluation

The concept or process of wastewater treatment really consists of two separate elements - treatment and dispersal. Just as effective planning of any sort requires us to begin with the end in mind; it is in fact the downstream considerations that are the most significant drivers in evaluating the feasibility of wastewater treatment options. The method

of dispersing the treated effluent typically will control the selection of the upstream treatment processes.

2. Dispersal Discussion

Treatment processes themselves neither create nor destroy the wastewater. They merely purify the water. The water must then be disposed or dispersed in an acceptable manner. The term dispersal is used to describe the ultimate disposition of the treated effluent. Generally, there are two broad categories of dispersal. Surface discharge is a direct connection to a surface water body – such as a river or a lake. So-called "non-discharge" implies a land-based dispersal which does not result in any direct surface discharge.

As more and more pollutants are being released to our surface waters - whether by defined point sources or by non-point source runoff - the ability of the water bodies to assimilate these pollutants without significant negative consequences to environmental health has been reduced. This has resulted in the imposition of more restrictive treatment requirements, or in the outright denial or prohibition of new and/or expanded point discharges. Concurrently, land-based treatment and dispersal options of various descriptions have become more commonplace.

Theoretically, there is potential for variations of each of these categories of dispersal in Pender County.

3. Surface Discharge

Despite the fact that there are several, admittedly small, surface discharges present in the County, and much larger existing ones in neighboring and adjoining downstream communities, the State's regulating agencies are concerned about the existing health and potentially limited additional assimilative capacity of the Lower Cape Fear River. Correspondence with the Division of Water Quality regarding new direct discharges for any proposed new or expanded wastewater reclamation facilities indicated that the Division is currently in the process of developing a watershed model for the Cape Fear estuary. The modeling will allow the Division to subsequently develop a Total Maximum Daily Load (TMDL) for the estuary. The Division expects to complete the TMDL process by late 2006. Allocations for new and existing discharges will not be established until the modeling and TMDL development is completed. Therefore, the chance of the County

getting approved for direct discharges for any proposed WWRFs is uncertain and other dispersal options must be evaluated.

Nonetheless, this option should be kept in view and considered for pursuit when appropriate. Even if relatively strict treated effluent limitations are imposed, they are likely to be not significantly more stringent than those required preceding land-based dispersal strategy, and therefore the total treatment system cost should be significantly more economical.

4. Collaborative Efforts

As discussed, there are four existing municipalities which may offer opportunities for collaboration with Pender County for all or a portion of its projected wastewater needs.

Town of Surf City

Surf City owns and operates a treatment and dispersal system which utilizes secondary treatment and a dispersal site with dedicated spray irrigation. Inquiries indicated that they are pursuing potential expansion for their own needs, and as with all dedicated land-based systems, the availability of sufficient and affordable land area is of concern. Given the magnitude of the County's projected needs, it does not appear that there is a collaborative scenario which is of sufficient positive benefit to both the County and the Town.

Town of Burgaw

Burgaw operates a relatively small (0.75 MGD) treatment and surface discharge system. They too are in need of expansion for their internal needs. Due to the sensitive nature of their receiving water and limited assimilative capacity, any potential expansion will, at a minimum, necessitate extension of the discharge directly to the Northeast Cape Fear River. It most likely will also require compliance with more stringent effluent limitations than currently in effect. For the same reasons stipulated above, planning for any significant expansion of this facility of a magnitude consistent with any significant portion of the County's projected needs will need to be deferred and pursued after the State's TMDL work is complete.

However, as a general statement of feasibility, it becomes progressively less feasible to permit an increased discharge as one proceeds progressively further upstream toward reaches of the river with lower

base flows, lower assimilative capacities, and perhaps more sensitive environments. The Town is now studying its options to serve the Town's potential growth. Under serious consideration is directing all or a portion of its flow northward and collaborating with Pender County and the Town of Wallace to utilize a portion of Pender County's allocation in the Town's treatment system.

Town of Wallace

Wallace acquired ownership of the 4.0 MGD wastewater treatment and discharge facility serving the now-defunct Steveco-knit factory. Wallace has been in pursuit of an improvement project to this plant in order to take advantage of more than 3.0 MGD of excess capacity present. During the course of preparation of this plan, and with recommendation and concurrence, the County has pursued and intends to consummate the purchase of 2.0 MGD of this capacity for future use. While this will not accommodate all the County's needs as a single central facility, it can serve as an important element in an overall somewhat decentralized approach – serving the north-central portions of the County, including the upper I-40 interchanges. Also during report preparation, and also with recommendation and concurrence, the County intends to contract with the Town of Burgaw to allow the Town to avail themselves of a significant portion of this capacity for their expansion needs. Therefore, this capacity and the facilities which will convey wastewater to it will function as a regional cooperative decentralized solution for a significant portion of the County.

City of Wilmington/New Hanover County

The City of Wilmington owns and operates an 8.0 MGD treatment and discharge facility. In cooperation with New Hanover County, the City is in the midst of an expansion which will take it to 16 MGD capacity. However, this expansion does not accommodate all the forecast needs from the City and NEW HANOVER COUNTY for a reasonable planning period. Therefore, inquiries have indicated that capacity to serve all or a majority of Pender County's needs is not available. Further, while Pender County had a current allocation of 0.75 MGD to this facility, its conveyance facilities inside Pender County are very limited – having been built originally to accommodate flow from Del Labs, and subsequently expanded to accommodate the new Trask high School. Once in New Hanover County, facilities conveying flow from Castle Hayne to the Ogden Interceptor and on to the Northside plant are also limited, and would require significant expansion to accommodate significant

additional flow from Pender County. Pender County has a contract in place to purchase 1.0 MGD of capacity from New Hanover in 250,000 GPD implements, after the Northside upgrade.

Rather than conveying flow all the way to an expanded Northside plant, another collaborative option explored was participating with New Hanover County in a new plant in the vicinity of either the Pender/New Hanover border, or in the vicinity of New Hanover County landfill. This plant would be sized for 4.0 MGD, with each County allocated 50% or 2.0 MGD. This capacity corresponds to an existing (soon to expire) NPDES permit obtained some years ago when New Hanover County was pursuing the development of its own treatment plant. Subsequently the county elected to participate with the City of Wilmington in the now-current Northside plant expansion. New Hanover County is pursuing the possibility of retaining and renewing said NPDES permit. It is unknown how the State will react to that request. Cost opinions for various iterations and participation levels of this option are present in Table IV-1.

5. Non-Discharge Alternatives

In evaluating non-discharge based options the central question is the whether receiver sites will be managed as dedicated (with associated restrictions) or non-dedicated (with attendant relaxed restrictions). The degree of treatment provided prior to dispersal will drive which of these choices is available for use, as it will potentially drive the method of application (various forms of irrigation versus infiltration) and their attendant advantages and disadvantages.

Dedicated dispersal sites may use treatment as secondary levels, but must be controlled and managed much more restrictively due to the increased risk of pollution from a poorly managed operation. The treatment plant itself provides some degree of removal of certain pollutants, and the dispersal site itself may be relied upon for further treatment prior to the point at which the effluent has migrated to either surface or ground waters.

Non-dedicated dispersal sites rely on much more advanced treatment, complying with standards for reclaimed water at a minimum, and enjoying the benefits of fairly unrestricted access and relaxed monitoring and operational requirements – owing to the greatly reduced or eliminated risk of pollution from its operation.

Table IV-2 illustrates representative treatment requirements for dedicated versus non-dedicated facilities. A complete description of applicability and design and operational requirements can be found in the so called '2T' rules (15 NCAC 2T), recently revised from the previous 2H.0200 rules and adopted but not effective until later this year. (Included as Exhibit 7)

Table No. IV-1 – Comparing Secondary With Reclaimed

Parameter	Conventional Secondary Standard	Reclaimed Water Standard
BOD	<30 mg/l	<10 mg/l
TSS	<30 mg/l	<5 mg/l
NH3	no limit	<4 mg/l
Turbidity	no limit	<10 NTU
Fecal Coliform	<200 CFU/100 ml	<14 CFU/100 ml

a. Secondary Systems

As can be seen from the table, treatment requirements for secondary levels versus reclaimed water levels are significantly different (and perhaps less costly). However, the requirements for the land dispersal system are much more severe. Since secondary effluent requires final treatment in the land dispersal system, application rates must be limited to those which allow for the soil and vegetation systems to make use of the remaining constituents in the effluent before it eventually migrates into ground or surface waters. This results in required land areas much larger than would be the case with reclaimed water systems, which (typically) would only be limited hydraulically (how much water can successfully infiltrate the soil without direct runoff into surface waters). When combined with buffers and setbacks, and allowing for inclusions of wetlands and unsuitable soils contained within most large tracts of land, the resulting required tract size for a significant wastewater disposal system can be quite large. For example, assuming average allowable application rate of 1.0 inch per week and a net useable area of 50%, a 1.0 MGD facility would require a dispersal site of over 500 acres. The availability of such tracts – with contiguous acquirable parcels exhibiting favorable soil and topographical conditions, within reasonable distances of the point of origin of the wastewater, and at an affordable price – are fairly limited in Pender County.

An additional item of concern relevant to the use of secondary systems, and perhaps dedicated reclaimed systems as well, is the potential for application rates becoming phosphorus-limited. This has heretofore been a very uncommon, if not unprecedented, situation. Nutrient management strategies promulgated by the USDA Natural Resources Conservation Service include possible limitations in order to minimize the risk of off-site phosphorus transport. This is of particular concern in areas of prior agricultural and silvicultrual production, where soils are likely to exhibit an elevated Phosphorus Index.

Additionally, when considering whether to implement a secondary treatment system, one must consider the additional risk of maintaining compliance, the regulating communities inexorable march toward ever more restrictive effluent limitations (the new 2T rules impose more stringent limitations on secondary systems), and the degree of public acceptance for such a system. These factors all conspire against such a system – with its only favorable advantage as lower cost of construction and operation – and that only valid if land is available at reasonable cost. It is for these reasons that we seldom see the implementation of new secondary systems, and in fact often see the movement toward upgrading those existing secondary systems to reclaimed water standards.

b. Reclaimed Systems

Standard Reclaimed Water

An effluent compliant with reclaimed water standards may be provided for a multitude of beneficial uses including:

- Agricultural, Horticultural, and Forestry
- Industrial Process Water
- Land Enhancement
  - Recreational Lands – Park, Athletic Field, and Golf Courses
  - Highway Medians
  - Commercial, Industrial and Residential Irrigation
- Wetland Restoration

Some of these are provided with virtually unrestricted public access (save for appropriate signage and identification). However, in cases such as provision of reclaimed water for lawn irrigation, the County has little control over how much and how

frequently the homeowners will avail themselves of this service, and therefore how much dispersal can be relied upon. For this reason, in the early stages of a reclaimed water system (before utilization patterns can reliably be predicted), the system must include dispersal options which are managed and controlled by the County or some other entity such that the required volume of dispersal is reliably achieved. These may still fall into areas of beneficial reuse and public access – such as recreational facilities, greenways, athletic fields, road medians and rights-of-way – or may be dedicated sites such as sod farms, silviculture (tree farms) and the like. Such sites are required to apply at agronomic rates, and ensure there is no direct runoff to surface waters. Application rates may be higher than secondary systems, application protocols may be easier to manage, and land areas may be reduced through these factors and reduced or eliminated buffers and setbacks.

6. Infiltration

A variant of reclaimed water systems becoming increasingly popular is the use of reclaimed water as the source water for infiltration ponds. These ponds are perennially wet basins, excavated so that the bottom is below the typical surficial water table (and thus always with a depth of water. Reclaimed water is added to the ponds, and migrates out into the surrounding surficial water table and eventually serving to recharge nearby streams and surface waters. Since the effluent is brought into immediate contact with essentially groundwater, the effluent is required to be treated to somewhat more stringent standards, ensuring it complies with groundwater quality standards (the so-called '2L' rules) prior to dispersal. For systems treating predominantly domestic wastewater, the main differences are in the levels of the nutrients of nitrogen and phosphorus. Since typical reclaimed water systems incorporating irrigation have agronomic uses for these nutrients, they are not required to be removed, but merely converted to an acceptable form (nitrification is required to convert ammonia to nitrate and nitrite, which is available to plants for their own metabolism). In the case of infiltration ponds, no further renovation or uptake of these nutrients is possible, so the effluent must be limited in nitrate/nitrite content and phosphorus so that it will not negatively impact receiving surface waters. Table IV-3 illustrates required and recommended effluent standards for reclaimed water destined for infiltration ponds in comparison to the basic reclaimed water standards. Exhibit 7 in Appendix A shows potentially suitable soils in the southern half of Pender County and areas selected for the recommended dispersal sites.

Table No. IV-2 – Reclaimed Water Design Criteria to Accomplish Objectives

Effluent Parameters	**Recommended Requirements for Infiltration Pond Systems**	**Minimum NCDENR Reclaimed Water Requirements**
CBOD		
Concentration	< 5 mg/l	< 10 mg/l
TSS		
Concentration	< 5 mg/l	< 5 mg/l
TN		
Concentration	< 10 mg/l	None
NH3-N		
Concentration	< 1 mg/l	< 4 mg/l
TP		
Concentration	< 2 mg/l	None
Turbidity	< 0.2 NTU	< 0.2 NTU
Fecal Coliform	Non-Detect	14/100

Just as for secondary and reclaimed systems, the additional complexity and cost of the more advanced treatment systems can be offset by the more advantageous requirements and basis of design for the infiltration ponds. As opposed to the irrigation rates of approximately 1 inch/week, infiltration rates would be measured in gallons per day per square foot, with a 1.0 gpd/sf rate being fairly conservative. Since infiltration is governed by the hydraulics of the basin and hydrogeology, it functions consistently year-round, and does not require any wet-weather storage ponds as does secondary and irrigation-based reclaimed water systems. In combination with savings in setbacks and buffers, and the ability to 'shrink-wrap' a site to be acquired around the ponds needed, the site acquisition requirements are an order of magnitude lower than for dedicated irrigation systems. Often, these ponds can be incorporated into development land planning as aesthetic amenities, with beneficial impact to the development, and may not require "major" investment in land acquisition by the County.

F. Alternatives Summary

From the foregoing discussion and evaluation, a number of conclusions can be reached:

1. Onsite Systems

Onsite systems can continue to play an important role in overall wastewater management in the county. Much of the County is and will remain (for the foreseeable future) fairly sparsely populated with large expanses of land suitable for conventional individual on-site septic systems to support the nature of the development expected. The County may consider some form of improved centralized management of these systems, without actually centralizing the collection, treatment, and dispersal functions.

2. Collaborative Efforts

Collaborative efforts (at least in terms of combining resources and expanding upon the other entities wastewater systems is not feasible in some cases (such as Surf City and Burgaw) due to the relative small size of these existing facilities, existing need for expansion of those facilities for their current service areas, and the expected challenges – technical, economic, and environmental - of effecting significant expansions of those facilities. As discussed and shown in Section IV.E.4 and Table IV-1, collaborative efforts with New Hanover County and the City of

Wilmington may be dismissed since the economics of participating in the a joint facility could not compare favorably with any other of the multiple variations of a facility located locally. Finally, in order to collaborate with the Town of Wallace, a tremendous investment would be required in conveyance facilities to reach their facility. Given the relatively small amount of ultimate flow (2 MGD) available at their facility, and the location and timing of the development requiring service, this does not appear to be a reasonable first phase opportunity. During the discussion of participation with the Town of Burgaw, it became apparent that perhaps the best use of this opportunity would be to benefit the Town's own expansion needs, and additionally provide service to the extreme northern part of the County – initially the area surrounding the two I-40 interchanges – and longer term development forecast for the surrounding areas.

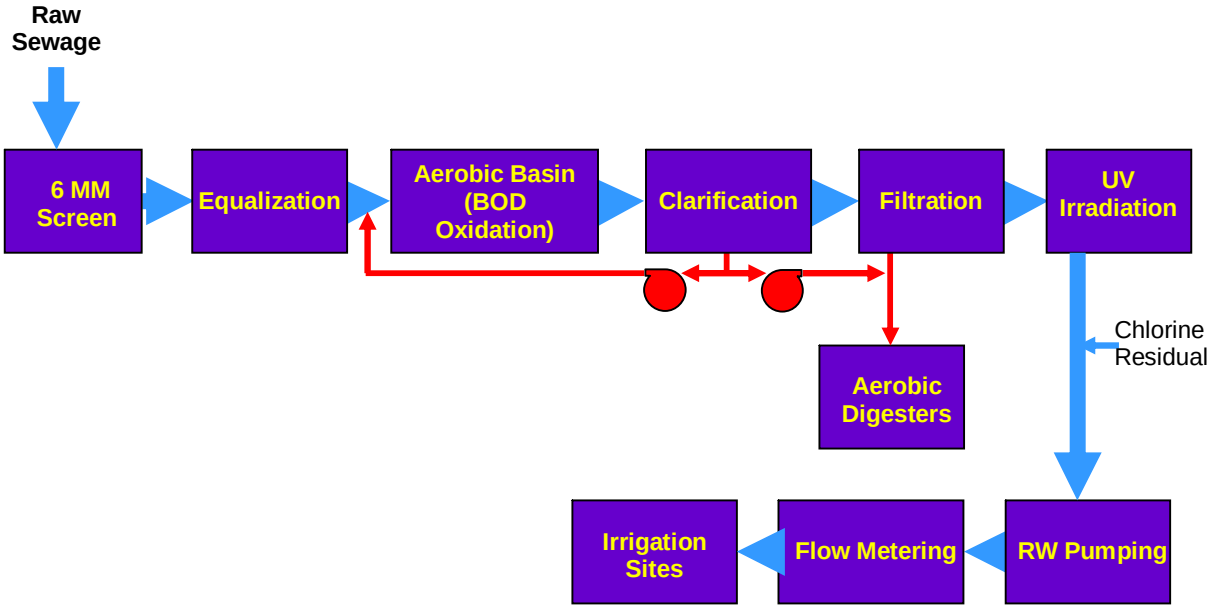
3. Discharge System

Unquestionably, if the County can be successful in acquiring a permit for a surface discharge it will be the most economical solution possible. In fact, since it will obviate the need for significant cost for dispersal facilities, it is the only alternative which may lend itself to a single centralized treatment option. Conversely, since the only feasible discharge point will be in the western portion of the County, if there is a dual treatment system scenario involving discharge it will be utilizing surface discharge in the west, but still relying on a non-discharge option in the east. As previously discussed, a discharge permit is speculative at this point, but given recent and current NPDES activity in adjoining communities (New Hanover County, City of Wilmington, and Brunswick County) it would be prudent to forecast an alternative incorporating surface discharge, and continue to pursue this in whole or in part as soon as practical. Alternative 1 consists of a single centralized treatment facility serving the entire defined County service areas/Townships previously identified. Wastewater flow from the townships included would be treated by a West Regional Wastewater Reclamation Facility (WWRF). The County could locate the WWRF near the Pender/New Hanover County line along 421 on a tract of land presently owned by the German manufacturer, BASF. Flow from both the east and west regions would be pumped to the WWRF via a conveyance system described in Section V. The County would like to co-locate a Water Treatment Plant (WTP) at the BASF property as well so that biosolid processing facilities could be combined for an economical approach. The reclamation facility would include screening, grit removal, an activated sludge process (including secondary sedimentation), return activated sludge pumping,

disinfection, and tertiary filtration. The tertiary treatment processes would produce an effluent stream that would approximate the most recent permit expansion for the City of Wilmington's Northside WWTP. Biosolids processing would include stabilization, dewatering and conditioning for production of Class A material. This processed material could be provided to the local community for beneficial reuse. Often the material could be sold at a marketable price to generate income to partially offset the operating cost of the facilities. It is assumed that any current and future industrial users must comply with a County-wide pretreatment standard which will required dischargers to pretreat their waste stream to reduce solids and organic loadings to a point at or below normal domestic sewage loadings. Figure IV-1 illustrates a general schematic of the treatment process.

Figure IV-1
Reclaimed Treatment Process Units

(Basic Reclaimed Standards for Irrigation and Surface Discharge)



It is worth noting that the aforementioned BASF facility is currently permitted for NPDES direct discharge into the Cape Fear River. The direct discharge is regulated by mass loading limits established under the permit. Based on the projected quality of the effluent stream produced by the proposed West Regional WWRF, the permit limits would allow the County to discharge approximately 1.0 MGD. The County has had

discussions with NCDENR about acquiring the permit and therefore having rights to the mass loading allocation. As with any other aspect of a new or expanded discharge, DENR would prefer to defer discussion of this until the TMDL work is complete. In the overall magnitude of the County's future needs, this is a minor portion. However, it could be a significant impact on a first phase of the West Regional system, and should be kept in a prominent position in the implementation plan to pursue to resolution.

4. Non-Discharge System

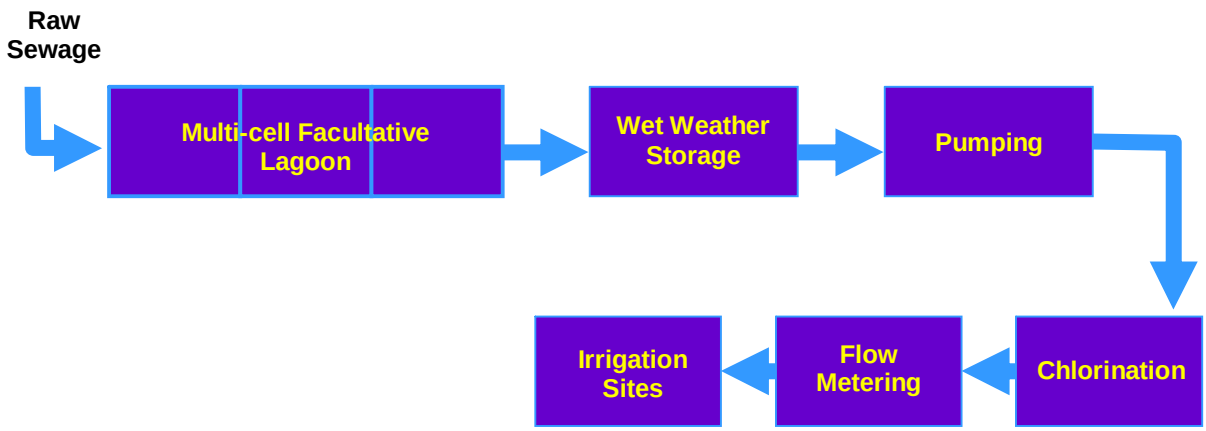
In parallel with pursuit of a discharge-based alternative, all remaining alternatives to be considered include some form of a non-discharge system.

a. Secondary System

In previous discussion regarding Secondary systems, it was discussed that for a host of reasons – large land requirement, increased risk of environmental degradation, increased risk of regulatory non-compliance, and prospect of forced upgrades to comply with ever-tightening regulatory standards – options including secondary treatment do not appear terribly feasible. Nevertheless, at this point in time, they are technically an available option. Therefore Alternative 2 has been compiled to illustrate a dual east-west system incorporating two secondary treatment facilities with attendant dedicated irrigation dispersal. As it illustrates, the extreme amount of suitable contiguous land required - and its attendant cost - alone makes this theoretical option probably not practically feasible. Figure IV-2 illustrates a general schematic of the treatment process.

Figure IV-2
Secondary Treatment Process Units

(for Dedicated Irrigation)



b. Reclaimed Water Systems

The remaining two alternatives compiled include dual east-west systems incorporating treatment to at least reclaimed water standards. Alternative 3 presumes dispersal by dedicated irrigation as illustrated in Figure IV-2. Alternative 4 presumes dispersal by dedicated infiltration with two alternative technologies to accomplish this, as illustrated in Figures IV-3 and IV-4. The increased application rates and reduced land area requirements of Alternative 4 result in a significant cost advantage. It should be cautioned that the extreme amount of land required for Alternative 3 may be difficult to locate and acquire, making the practicality of this option questionable until further investigation is performed. In both alternatives, reclaimed water is then made available for future non-dedicated and unrestricted access uses, such as residential and recreational irrigation (and other uses set forth in Section IV.E.5.b). Development of these uses can mitigate the costs of future expansions.

Figure IV-3
Reclaimed Treatment Process Units

(Conventional BNR for Infiltration)

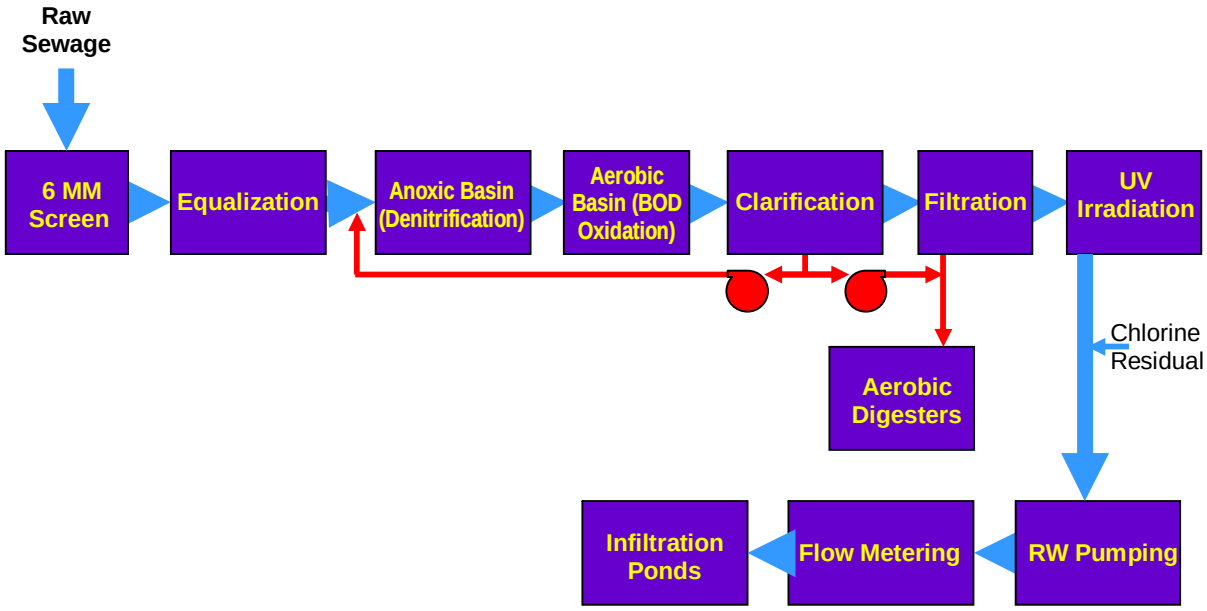
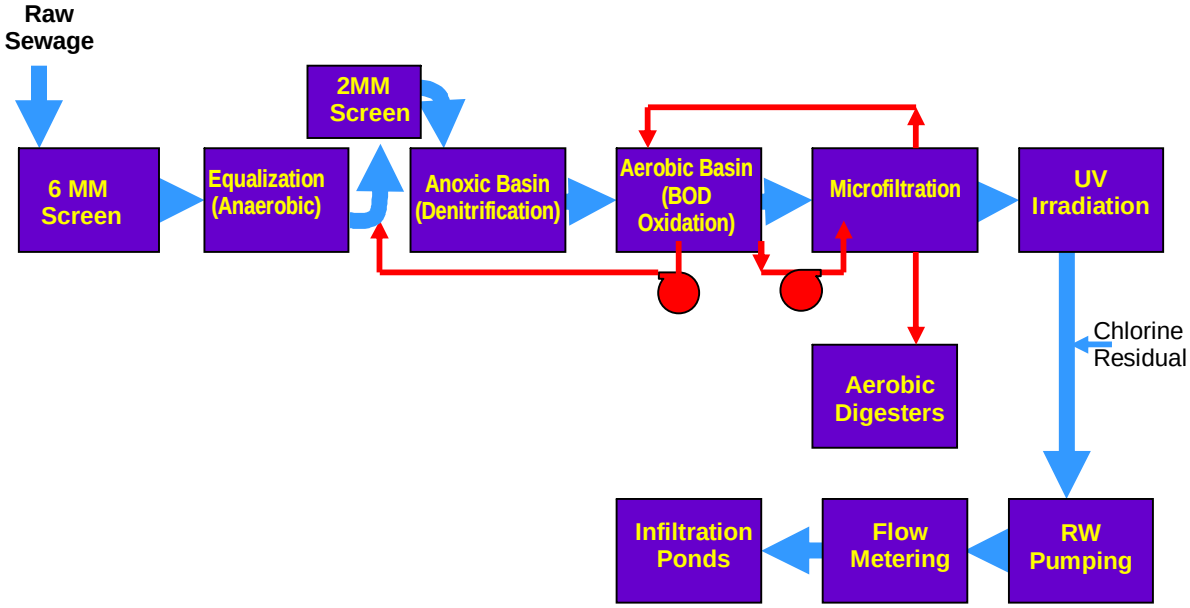


Figure IV-4
Reclaimed Treatment Process Units

(MBR/Microfiltration for Infiltration)



V. Wastewater Conveyance

A. Purpose

This section details the wastewater conveyance alternatives developed for Pender County under this Master Plan. The section will provide discussion of how the alternatives were developed, advantages and disadvantages of each and associated capital cost.

B. Conveyance System Alternatives

1. Introduction

As discussed in earlier sections of the Master Plan, the wastewater system improvements are being evaluated for the southern half of the County where the majority of growth is expected to occur in the County through the planning period (2030). The West Region includes the townships of Grady, a portion of Caswell, Long Creek and Rocky Point (west of I-40). The East Region includes the townships of Rocky Point (east of I-40) and Topsail. The two regions are divided by the I-40 corridor that runs north to south through the center of the County.

With the magnitude of the proposed improvements required to service the 2030 wastewater needs under the regional approach, it was anticipated that the improvements would need to be phased. Phasing the improvements would help to spread the capital cost more evenly through the planning period and avoid oversizing infrastructures for wastewater needs in the early years of the planning period. Therefore, the improvements were proposed to occur in two phases, Phase I and Phase II. Phase I improvements would designed to meet the 2020 wastewater needs in general and the Phase II improvements would expand the Phase I improvements to meet the 2030 wastewater needs.

Due to the topography of Pender County it would be infeasible to consider conveying wastewater over a long distance via a gravity sewer system alone. Therefore, the conveyance system options for serving Pender County would need to include pumping station and force mains in order to convey wastewater to the regional treatment facility location(s). There are various options for how the individual pump stations and force mains could be linked as part of a regional conveyance system. These options could include pumping from one station to another in a 'piggy-back' manner of conveyance or could include

connecting multiple pump station force mains into a common force main that would serve as a manifold to convey all flow to the treatment facility.

It is anticipated that a multitude of collection system options could be utilized to collect flow being tributary to the pump stations. These options could include localized gravity sewer lines, low pressure sewer, vacuum sewer, or a combination of these. It is anticipated that a regional low pressure sewer or vacuum sewer system for the County would be infeasible. It is anticipated that these systems would be used in localize regions within the townships to convey flow to the County pump stations.

For developing the regional conveyance alternatives, conveyance was evaluated for each individual township. The County wanted McKim & Creed to take the approach of having centralized pump stations within each township that would collect flow from gravity and low-pressure sewer collection systems and other smaller pump stations within the regional collection system(s). Collection lines were not included in the Master Plan for the townships in the west region of the County, but were included for the east region (Topsail Township). The County anticipates that developers will be largely involved in extending sewer collection lines as developments occur.

McKim & Creed evaluated the individual townships and natural drainage basins within each township to determine feasible locations for the pump stations. Pump Stations were also located near or along major roadways such that main collection lines could be easily routed along road right-of-way. The recommended pump station locations are displayed on Exhibits 4 and 5 in Appendix A. Preliminary design of the stations was based on the wastewater flow projections provided herein. Each station was sized to pump a projected peak hourly flow rate for the township it would service. The peak hourly flow rates were calculated by assigning a peak factor to the actual average daily water usage rate for each area. Based on the calculated pumping rates, force mains were sized to achieve a minimum velocity of 2 feet per second (required by the State of North Carolina for scouring velocities). Force mains were located within existing road right-of-way along state roads whenever possible. Due to the long distances spanning between some townships, a few of the pump station force mains were designed to discharge into another township pump station. Otherwise, the longer force main lengths would result in excessive friction loss that would require economically infeasible pump designs.

The pump stations were preliminarily designed as conventional submersible wastewater pump stations with below grade concrete wet wells and valve vaults. Each station would be equipped with an emergency generator, remote telemetry, electrical equipment, site fencing and associated appurtenances. It was planned that the pump station improvements would be made in two phases.

The purpose of the County's conveyance system would be to deliver the County's wastewater to the appropriate treatment facility location. The appropriate treatment facility should be the facility that has adequate treatment capacity to handle the conveyed flow and be located nearest to the downstream end of the conveyance system in order to keep final conveyance cost at a minimum.

The alternatives discussed in Section V – Wastewater Treatment and Dispersal include two general layouts for location of the County's future regional wastewater treatment facilities. Alternative 1 included a single Regional WWRF located along the southern end of Highway 421 near the County line. Alternatives 2, 3 and 4 included two Regional WWRF's, an East and West Regional Facility. Therefore, there is logically two conveyance alternatives to be derived based on the Treatment and Dispersal alternative layouts.

2. Alternatives

The first conveyance alternative would correspond with the Treatment and Dispersal Alternatives No. 2-4. Under this alternative the conveyance system would be designed such that the wastewater in the West Region of the County would be conveyed to the West Regional WWRF and the wastewater in the East Region of the County would be conveyed to the East Regional WWRF. Therefore this would result in an east and west regional conveyance system dedicated to conveying flow to the appropriate treatment facility. The second conveyance alternative would correspond with the first Treatment and Dispersal Alternative (No. 1), such that the conveyance system would be designed to convey the wastewater collected in the East and West Regions of the County to the single Regional WWRF along Highway 421.

For the purposes of evaluating the two conveyance system alternatives, the pump stations design flows were determined for each township first. Then it was determined how the pump stations and force mains should be designed to minimum conveyance cost required for conveying flow to the nearest possible treatment facility. Therefore, Conveyance

Alternative No. 1 was first evaluated to determine how each regional conveyance (and collection for the east region) system(s) should be designed for the minimal cost. Alternative No. 2 was expanded to account for having to pump the wastewater collected in the east region to West Regional WWRF along Highway 421. Obviously, the conveyance cost in Alternative No. 2 would be greater than Alternative No. 1 because the east regional flow would have to be pumped much further and require connection (relifting) to the proposed west regional pump stations in order to generate enough energy (pump head) to convey the flow to the West Regional Treatment Facility.

Alternative No. 1

For discussion of Alternative No. 1, the conveyance system designs are separated for the east and west regions.

West Region

The projected average daily wastewater flows for the West Region townships are displayed in Table V-1.

Table No. V-1 – West Region
Summary of Wastewater Needs by Township (MGD)

Township	**2010**	**2015**	**2020**	**2025**	**2030**
Caswell	0.00	0.01	0.02	0.02	0.03
Rocky Point*	0.59	1.32	2.41	2.95	3.51
Long Creek	0.00	0.10	0.23	0.53	0.70
Grady	0.00	0.23	0.59	1.03	1.43
REGION TOTAL	**0.59**	**1.66**	**3.25**	**4.53**	**5.67**

*For the purpose of dividing wastewater flows, all of the Rocky Point Township was included in the West Region.

The proposed conveyance system improvements for each of the townships in the West Region are described in detail in the following paragraphs.

The Caswell Township, the western most township in the region, would have a new wastewater pump station located along NC Highway 210 at the Big Branch of the Cape Fear River. The station would be designed to pump 180 gpm to service the southeastern portion of the Caswell Township. This flow rate would be in excess of the rate required to

service the flow calculated for this portion of the township. The station would be designed with additional capacity to handle future build-out in the local area that is not anticipated in the 2030 planning period. This station would convey flow through a new 6" force main eastward along NC-210 to the Grady Township where the force main would discharge into the proposed Grady Township Pump Station. The force main would be approximately 31,000 linear feet in length.

The Grady Township would be serviced by a new pump station located near the intersection of NC-210 with US-421. The pump station would be designed to collect the entire projected wastewater flow from the Township in conjunction with flow from the proposed Caswell Pump Station as mentioned earlier. The station would be ultimately sized for a firm capacity of 2900 gpm. The station would initially pump 1600 gpm to meet the 2020 wastewater needs as part of the Phase I improvements and then upsized to deliver 2900 gpm to meet the 2030 needs. The station would be constructed with a new 18" force main extending from the station to the proposed West Regional Wastewater Reclamation Facility (WWRF) site located near the Pender/New Haven County line along US-421. The force main would be approximately 44,000 linear feet in length running within the US-421 road right-of-way.

The Rocky Point Township abuts the Long Creek Township on the west and is bound by the Northeast Cape Fear River on the east. I-40 dissects the township traveling north to south across the County. It is proposed that a centralized wastewater pumping station be located within the township along NC-210 near the intersection with NC-117. This station would service the entire township and would be sized for an ultimate capacity of 6200 gpm. Initially the station would be sized to deliver 4400 gpm. The pump station would pump through a new 24" force main routed along NC-210. The force main would discharge into the proposed Long Creek Township Pump Station. The new 24" force main would be approximately 38,000 linear feet in length.

The Long Creek Township would be serviced by a new pump station located along NC-210 near Mill Creek. The station would collect flow from the Rocky Point Pump Station and the entire Long Creek Township. The station would be designed for an ultimate pumping rate of 7000 gpm but would initially be designed to deliver 4800 gpm. The station would pump through a new 24" force main routed along NC-210 and US-421 to the proposed West Regional WWRF.

East Region

The projected average daily wastewater flows for the East Region are displayed in Table V-2. The Topsail Township comprises the wastewater flows for the East Region.

Table No. V-2 – East Region
Summary of Wastewater Needs by Township (MGD)

Township	2010	2015	2020	2025	2030
Topsail	1.73	2.32	2.92	3.59	4.01
Rocky Point*	0.00	0.00	0.00	0.00	0.00
Topsail Beach					
REGION TOTAL	**1.73**	**2.32**	**2.92**	**3.59**	**4.01**

*Rocky Point flows were accounted for in the West Region projections.

As in the Western Region of the County, the topography limits the extent to which gravity sewer can be used to convey wastewater over long distances. Therefore, the conveyance system options for the East Region are essentially the same as those for the West Region. In general, pump stations and force mains would serve as the regional conveyance system that would deliver flow to the regional treatment facility. It is anticipated as with the East Region, that gravity sewer, low pressure sewer and possibly vacuum sewer would be utilized for wastewater collection, conveying flow to the pump stations.

A part of the wastewater conveyance system within the Topsail Township, the County wants to make wastewater collection available along the entire stretch of NC-17. A collection system layout involving multiple pump stations and gravity collection system lines was developed for this area. For the layout, gravity sewer would be extended in sub-basin areas along NC-17 collecting flow from future connections. The gravity sewer would feed pump stations within each sub-basin located near NC-17. The stations would pump into a common manifolded force main located along NC-17. The common force main would increase in diameter directly downstream of each additional pump station connection. Eventually the force main would reach 30” in diameter and would convey all flow from the stations to the treatment facility serving the East Region. The proposed conveyance and collection systems for the Topsail Township consist of seven wastewater pumping stations ranging in capacity of 500 gpm (0.72 MGD) to 1400 gpm (2.0 MGD), approximately 144,800 LF of 8” and 12” gravity sewer (located on

both sides of NC-17) and approximately 91,700 LF of 8", 16", 20", 24" and 30" force main. The proposed collection system is displayed on Exhibit 5 of Appendix A.

The County plans to construct the pump stations and force mains in sequence with the local development. The County is planning to have developers share in the cost of constructing the pump stations and force mains. The most downstream force main (30") will have to be constructed to the proposed reclamation facility, before the upstream stations are built. This will be a major factor in the cost sharing for the initial contributing developers. Also, developers will be required to pay for extending sewer from their developments to the main collection system along NC-17.

It was anticipated for planning purposes and for developing phased construction cost that pump stations #1-4 and the associated gravity sewer and force main would be constructed in an initial phase. The remaining stations (#5-7), gravity sewer and force main would to be constructed in a second phase. It is proposed that the stations would be designed and constructed for the 2030 design condition and therefore would not be phased.

Alternative No. 2

Alternative No. 2 would be developed as an alteration of Alternative No. 1 such that the West Regional conveyance system would be expanded to accept wastewater from the East Regional conveyance system. The expanded conveyance system would convey the combined regional flows to the West Regional WWRF.

The Topsail Township conveyance system (comprises the East Regional conveyance system) would also be expanded to deliver flow to the proposed Rocky Point Township Pump Station. The expansion would include the extension of an additional 61,000 LF of 30" force main (in addition to the amount required under Alternative No. 1) along NC-210.

To accommodate additional wastewater flow from the east region the Rock Point and Long Creek Pump Stations would need to be upsized. Additionally, the force mains from each pump station would need to be upsized to convey the total wastewater flows to the West Regional Treatment Facility. The Rocky Point Pump Station would be upsized for an ultimate pumping capacity of 12,050 gpm. The force main from this station to the Long Creek Pump Station would need to be upsized from 24" (under Alternative No. 1) to 30". The Long Creek Pump Station

would need to be upsized for an ultimate pumping capacity of 12,850 gpm and the force main to the West Regional Treatment Facility would need to be upsized from 30” to 36”.

VI. Alternative Selection and Conceptual Design

A. Purpose

This section will compile and compare feasible combinations of treatment, dispersal, and conveyance, so as to select the recommended alternative for Pender County to pursue. It will then discuss planning for its implementation - including phasing, schedule, and funding.

B. Alternative Selection

In order to accommodate projected wastewater demands in 2030, and in accordance with the foregoing discussion and evaluations, the principal combination alternatives considered were:

Alternative 1 – Single West Regional 12.0 MGD treatment facility with dispersal via surface discharge to the Cape Fear River. Incorporates conveyance system alternative 2.

Alternative 2 – Dual East and West Regional 6.0 MGD treatment facilities incorporating secondary treatment and dispersal via dedicated irrigation. Incorporates conveyance system alternative 1.

Alternative 3 – Dual East and West Regional 6.0 MGD reclaimed water treatment facilities with dispersal via dedicated irrigation. Incorporates conveyance system alternative 1.

Alternative 4 - Dual East and West Regional 6.0 MGD reclaimed water treatment facilities with dispersal via dedicated infiltration. Incorporates conveyance system alternative 1.

Cost opinions for these combinations are present as Tables VI-1 through VI-4. Project unit cost assumptions for the individual construction components and other associated project costs are presented in Exhibit 3.

Table No. VI-1 – Alternative No. 1 Project Cost Summary

	Costs
Conveyance System Construction Cost	$67,753,000
Treatment System Construction Cost	$90,000,000
Dispersal System Construction Cost	840,.000
Total Wastewater System Construction Cost	**$158,593,000**
Contingencies (20%)	$31,718,600
Planning, Design, Bidding and Construction Services (18%)	$28,546,740
Administrative and Legal Services (5%)	$7,929,650
Land Acquisition, Total Net Ac Req'd (30)	$600,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$227,387,990**

Table No. VI-2 – Alternative No. 2 Project Cost Summary

	Costs
Conveyance System Construction Cost	$56,464,000
Treatment System Construction Cost	$52,800,000
Dispersal System Construction Cost	$60,200,000
Total Wastewater System Construction Cost	**$169,464,000**
Contingencies (20%)	$33,892,800
Planning, Design, Bidding and Construction Services (18%)	$30,503,520
Administrative and Legal Services (5%)	$8,473,200
Land Acquisition, Total Net Ac Req'd (7,200)	$144,000,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$386,333,520**

Table No. VI-3 – Alternative No.3 Project Cost Summary

	Costs
Conveyance System Construction Cost	$56,464,000
Treatment System Construction Cost	$90,000,000
Dispersal System Construction Cost	$62,700.000
Total Wastewater System Construction Cost	**$209,164,000**
Contingencies (20%)	$41,832,800
Planning, Design, Bidding and Construction Services (18%)	$37,649,520
Administrative and Legal Services (5%)	$10,458,200
Land Acquisition, Total Net Ac Req'd (5,800)	$116,000,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$415,103,720**

Table No. VI-4 – Alternative No. 4 Project Cost Summary

	Costs
Conveyance System Construction Cost	$56,464,000
Treatment System Construction Cost	$103,500,000
Dispersal System Construction Cost	$88,525,000
Total Wastewater System Construction Cost	**$248,489,000**
Contingencies (20%)	$49,697,800
Planning, Design, Bidding and Construction Services (18%)	$44,728,000
Administrative and Legal Services (5%)	$12,424,450
Land Acquisition, Total Net Ac Req'd (510)	$10,200.000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$365,539.250**

Evaluation of these options yields fairly clear conclusions:

In addition to utilizing technically obsolete technology and carrying the greatest risk of near term forced upgrades resulting form tightening regulatory standards, it is also the most expensive option resulting from its land-intensive nature) and should be discarded.

A surface discharge (Alternative 1) will be the most economical alternative, even supporting the extra cost of conveying wastewater generated in the east side of the County. It should be pursued in whatever form is possible consistent with constraints of timing to provide service in the short term.

It may not be possible to delay all activity while waiting for the regulatory landscape to clear and determine if a discharge is truly achievable. In the interim, development of dual regional facilities relying on infiltration to the maximum extent practical (Alternative 4) is the most economical option. It also provides a source of high quality reclaimed water for future beneficial uses, thus being perhaps the most environmentally sound option. Ultimately – as sources for quality drinking water diminish and costs for compliance with wastewater discharges increase – it may prove to be the most economical and sustainable approach overall.

Therefore, it is recommended that the County pursue Alternative 4 – separate East and West Regional Reclaimed Water Reclamation Facilities with dispersal by infiltration to the maximum extent practical. Upon additional detailed hydrogeological investigations and pursuit of permitting of these, supplemental dedicated irrigation may be substituted for a portion of the infiltration capacity. Further, the County should pursue the acquisition of a surface discharge permit for the West Regional facility, through acquisition and future expansion of the BASF facility permit. Additionally, the County should facilitate the creation of a reclaimed water distribution system and encourage beneficial use of this high quality resource. Finally, the County should continue the use of individual on-site wastewater systems where appropriate, and should consider the facilitation and institution of a more comprehensive and centralized management approach to those systems.

C. Implementation

1. Phasing and Schedule

The proposed improvements are intended to meet the County's 2030 wastewater needs based on the flow projections. The infrastructure improvements associated with the 2030 design conditions are very extensive and will require large amounts of capital expenditure. For

planning purposes it is proposed that the improvements be implemented in phases that correspond with the incremental wastewater flow projections provided in Section IV.

Three separate phases were proposed for the improvements. These phases were developed with input from the County Manager regarding upcoming development plans and available funding. The overall design capacity for 2030 was projected to be approximately 12 MGD with 6 MGD capacity at each proposed WWRF. The phased improvements for the WWRF's and other wastewater system components would need to be done in a manner that would allow for easy expansion.

For preliminary implementation purposes, an abbreviated desktop and filed investigation was conducted to ascertain the feasibility of suitable alternative dispersal options within a reasonable distance of the proposed treatment facilities. From these investigations it was determined that there are several nearby tracts of land (within 5 miles) that have soils suitable for on-site dispersal through "non-discharge" applications. The principal location for the West region is an area south of NC 210 in Long Creek Township, nearly adjacent to the Grady Township border. In the East region, the principal areas are on either side of the Northeast Cape Fear River, south of NC 210. These areas have a high concentration of the soils most suited for infiltration ponds, exhibit a good gross-to-net soil usability ratio, and are in reasonable proximity to significant drainage features – enhancing lateral transmissivity and attendant allowable application rates on the sites.

Based on the County's input, the first construction phase (Phase IA) would include improvements at both WWRF's, providing 1.0 MGD capacity at the West Regional Facility and 0.75 MGD at the East Regional Facility. The County anticipates this volume being sufficient to service currently planned developments while providing some reserve capacity. The County plans on developers sharing much of the initial capital cost for these improvements. It is anticipated that four of the seven proposed pump stations in the Topsail Township of the East Region would be constructed in Phase IA along with the associated force mains and gravity sewer. None of the proposed Regional Pump Stations in the West Region are expected to be constructed in Phase IA. For the wastewater dispersal improvements it is proposed that initial infiltration ponds sized for 1.0 MGD capacity be constructed for each region. The reclamation pump stations and force mains would be constructed to the initial basins as part of Phase IA. Implementation of the Phase IA planning and design is

estimated to begin in 2006 with construction of the improvements completed by the end of 2009.

Phase IB would consist of improvements at the WWRF's to provide 3.0 MGD capacity at each facility for a total capacity of 6.0 MGD (half the 2030 design capacity). In Phase IB, the West Regional pump stations would be constructed. The proposed Caswell Pump Station would be sized to meet the 2030 design condition while the other three stations would initially be sized for a pumping rate less than the projected 2030 design conditions. These three stations would later be expanded to full capacity. It is proposed that single force mains capable of conveying the 2030 design flow be designed and constructed for each of the West Regional pump stations in Phase IB. No parallel force mains are proposed. In the East Region it is anticipated that the remaining three proposed pump stations and associated force mains and gravity sewer would be constructed. In addition to the pumping and treatment system improvements included in Phase IB, the dispersal systems would need to be expanded to accommodate increase capacities from each WWRF. Therefore, a second phase of basins and transmission lines would be constructed to handle an additional 2.0 MGD in wastewater dispersal at each region. Implementation of the Phase IB planning and design is estimated to begin in 2010 with construction of the improvements completed by the end of 2013.

For the final implementation phase (Phase II), the WWRF's would be expanded to their full design capacity of 6.0 MGD each. The three West Regional Pump Stations (Grady, Long Creek and Rocky Point) would be expanded to their full design capacity as well. Additional infiltration ponds and associated transmission lines would be constructed in each region to provide a total of 12.0 MGD capacity. Implementation of the Phase II planning and design is estimated to begin in 2020 with construction of the improvements completed by the end of 2023.

Tables VI-5 and VI-6 present the phased implementation costs of the West and East Regional Systems of the selected Alternative 4. Additional cost detail for the selected alternative is present in Appendix B. Exhibit 6 is an illustration of the comprehensive recommended system.

Table No. VI-5 –Selected Alternative West Regional Total Project Cost

	Phase IA (2006 - 2010)	Phase IB (2011 - 2020)	Phase II (2021 - 2030)
Wastewater Pump Stations and Force Mains			
Caswell	$0.00	$3,127,000.00	$0.00
Grady	$0.00	$5,610,000.00	$435,000.00
Rocky Point	$0.00	$6,869,000.00	$651,000.00
Long Creek	$0.00	$11,185,000.00	$735,000.00
Subtotal	**$0.00**	**$26,791,000.00**	**$1,821,000.00**
West Regional WWTP	$21,000,000.00	$12,000,000.00	$33,000,000.00
Reclaimed Water Pumping Station and Transmission Lines	$5,400,000.00	$0.00	$1,475,000.00
Reclaimed Water Dispersal System (Infiltration Ponds.)	$5,767,000.00	$11,533,000.00	$21,625,000.00
Total Construction Cost	**$32,167,000.00**	**$50,324,000.00**	**$57,921,000.00**
Contingencies	$6,433,400.00	$10,064,800.00	$11,584,200.00
Planning, Design, Bidding and Construction Services	$5,790,060.00	$9,058,320.00	$10,425,780.00
Administrative and Legal Services	$1,608,350.00	$2,516,200.00	$2,896,050.00
Land Acquisition, Total Net Ac Req'd (80 + 70 + 105)	$1,600,000.00	$1,400,000.00	$2,100,000.00
WASTEWATER SYSTEM TOTAL PROJECT COST	**$47,598,810.00**	**$73,363,320.00**	**$84,927,030.00**

Table No. VI-6 – Selected Alternative East Regional Total Project Cost

	Phase IA1[1)] (NC Hwy. 17 Initial Conveyance)	Phase IA2 (2006-2009)	Phase IB (2010 - 2020)	Phase II (2021 - 2030)
Topsail Collection Systems (Gravity Lines and/or Pump Stations)				
Service Area #1		$1,600,000	$0	$0
Service Area #2	$455,000	$1,540,000	$0	$0
Service Area #3	$455,000	$1,966,000	$0	$0
Service Area #4	$455,000	$1,816,000	$0	$0
Service Area #5	$455,000	$0	$3,363,930	$0
Service Area #6		$0	$2,786,850	$0
Service Area #7		$0	$1,527,470	$0
Subtotal	**$1,820,000**	**$6,922,000**	**$7,678,250**	**$0**
Topsail Force Main System	$5,825,000	$0.00	$ 4,151,000	$0.00
East Regional WWTP w/Biosolids Thickening	$0	$6,250,000	$12,500,000	$18,750,000
Reclaimed Water Pumping Station and Transmission Lines	$0	$5,475,000	$650,000	$600,000
Reclaimed Water Dispersal System (Infiltration Ponds)	$0	$6,000,000	$12,000,000	$18,000,000
Total Construction Cost	**$7,645,000**	**$24,647,000**	**$36,979,250**	**$37,350,000**
Contingencies	$1,529,000	$4,929,400	$7,395,850	$7,470,000
Planning, Design, Bidding and Construction Services	$1,376,100	$4,436,460	$6,656,265	$6,723,000
Administrative and Legal Services	$382,250	$1,232,350	$1,848,963	$1,867,500
Land Acquisition, Total Net Ac Req'd (15 + 65 + 70 + 105)	$300,000	$1,300,000	$1,400,000	$2,100,000
WASTEWATER SYSTEM TOTAL PROJECT COST	**$11,232,350**	**$36,845,210**	**$54,280,328**	**$55,510,500**

[1)]Phase IA1 includes construction of four pump stations and force mains along NC Highway 70. See Exhibit 6A in Appendix A for locations and sizes.

2. Funding

Certainly, generating sufficient capital to implement these improvements, while maintaining user rates at acceptable levels will be a challenge.

The largest portion of these funds will of necessity be generated by the users of the system. Since the vast majority of the projected demand is from new development, capacity/impact fees will need to be set to recover a significant portion of the costs. Various forms of connection and tap fees will be instituted. Once actual users are connected to the system, a portion of the monthly usage charge could be dedicated to debt service.

Over the past decade, traditional sources of grant funds have diminished and gotten more competitive. Nonetheless, there remain sources of funds for which all or a portion of these future projects may be eligible. Many of these sources have been utilized successfully on past water and wastewater projects in Pender County. They include: Federal funding agencies (such as USDA Rural Development, USEPA, and US Department of Commerce), State funding agencies (such as Rural Center and Clean Water Management Trust Fund), and special appropriations at both the State and Federal levels. Both USDA and USEPA (through DENR) operate funding programs featuring subsidized interest rates or extended terms.

Finally, conventional debt instruments (such as general obligation bonds, revenue bonds, certificates of participation, and installment purchase contracts may be required.