NAGS HEAD
WATER SYSTEM NEEDS ASSESSMENT

For the

TOWN OF NAGS HEAD
DARE COUNTY, NORTH CAROLINA

April 2005

Prepared by:

CAVANAUGH

Solutions through integrity and partnership

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DARE COUNTY, NORTH CAROLINA

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Prepared for:

Town of Nags Head

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Nags Head Water System Needs Assessment

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EXECUTIVE SUMMARY

The Town of Nags Head is located in northeast Dare County. The Town has a permanent population of approximately 2,900 (2003) and a seasonal population of 38,353 (June-August in 2002). The Town of Nags Head purchases water from Dare County. During the summer peak season, when the population increases, Nags Head operates a treatment plant located beside Fresh Pond which has a rated capacity of 1.5 MGD of treated drinking water.

The Town of Nags Head is concerned about the Fresh Pond Facility's capability of meeting the near-future drinking water standards for turbidity, total organic carbon (TOC), and disinfection by-products. The applicable regulations are the Interim Enhanced Surface Water Treatment Rule (IESWTR), the Long Term 1 Enhanced Surface Water Treatment Rule (LT1SWTR) and the Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR).

The Town of Nags Head requested that Cavanaugh & Associates, P.A. provide a Water System Needs Assessment. Cavanaugh & Associates analyzed the Fresh Pond Water Treatment Facility in regards to the above concerns and drinking water standards. The finished report presents findings about the current treatment process and alternatives to address the Town's concerns and to assist with compliance with the above-stated drinking water standards and rules.

Because the Fresh Pond safe yield is limited, the recommended alternative is for the Town of Nags Head to purchase additional capacity from Dare County. The recommended additional capacity to purchase is 1.0 MGD, which will bring the Town's total contractual capacity to 4.0 MGD without relying on the Fresh Pond Plant. This capacity will satisfy projected demand until nearly year 2010. The Fresh Pond Plant can, thus, be taken out of service once the additional capacity is actually available from the Dare County System. The preliminary opinion of probable cost for the infrastructure to provide this additional capacity is nearly $1.2 million. Since these modifications will take a significant amount of time, the Fresh Pond Plant will be needed to help provide water to Nags Head for at least the next peak demand period.

The decision to close the Fresh Pond Plant and purchase all water from Dare County will directly affect the Water Contract with Dare County and Kill Devil Hills. The allotted water each currently receives is dependent partly on the production of water by the Fresh Pond Plant. The three parties are each currently entitled to 0.5 MGD (1.5 MGD total) of water from the Fresh Pond Plant according to the Water Contract. Taking the Fresh Pond Plant out of service will reduce the total available allotment of water by 1.5 MGD. Presumably, each

partner's allocation will decrease by 0.5 MGD, but this issue should be referred to the Town's attorney for guidance.

Concerns over the Fresh Pond Plant's ability to comply with the LT1SWTR and the Stage 1 DBPR remain during the recommended interim operation period, particularly during peak flow periods. To ensure consistent compliance with these rules, recommended improvements at the Fresh Pond Plant include new media for the filters, a new flocculation basin, and conversion of the existing sedimentation/flocculation basin to a sedimentation basin. The total costs for these improvements are projected to exceed $200,000.00, and all of the improvements can likely not be achieved before the next peak demand period. The Town should discuss the feasibility and costs versus the benefits with the state Public Water Supply Section (PWS). Based on those discussions, the Town may elect to implement some portion of these temporary improvements, such as filter media replacement.

Now is also the time to begin planning for additional capacity needed for 2010 and beyond, since seasonal demand already exceeds 80% of available capacity. Because of the significant time required for planning, design and construction of the facilities necessary for capacity expansion, immediate action is necessary to avoid an actual water shortage.

SECTION 1

INTRODUCTION

1.1 Background

The Town of Nags Head is located on Bodie Island in the northeast section of North Carolina in Dare County. Bodie Island is part of the barrier island system known as North Carolina's "Outer Banks." The Town of Nags Head has a permanent population of approximately 2,900 according to 2003 statistics. The Town's seasonal population swelled to approximately 38,353 during the months of June through August 2002. These population numbers were derived from the state of North Carolina State Demographic homepage and from the Town's 2002 Local Water Supply Plan (LWSP).

The Town of Nags Head is bounded by Kill Devil Hills to the north, the Atlantic Ocean to the east, the Cape Hatteras National Seashore Park to the south, and the Albermarle and Roanoke Sounds to the west.

The Town of Nags Head owns and operates the potable water system that serves the Town, with a Public Works Department managing the system. The Town is also party to a 40-year contract (Water Contract) with Kill Devil Hills and Dare County that governs water production and distribution in the region. The Town of Nags Head entered this contract on June 30, 1996. The Dare County Regional System's water comes from the Roanoke Island Water Treatment Plant, which is owned and operated by Dare County, the Reverse Osmosis (RO) plant at Kill Devil Hills, which is also owned and operated by Dare County, and from the Fresh Pond Water Treatment Plant, which is owned and operated by the Town of Nags Head. The Fresh Pond Water Treatment Plant is typically operated only from July through September to accommodate the seasonal population.

An initial Water System Master Plan (Master Plan) was completed in 1986 for the Town of Nags Head by the firm of Black & Veatch. (Town of Nags Head Water System Master Plan, 2004) Cavanaugh & Associates, P.A. completed an update of the Master Plan in 2004. The 2000 and 2004 updates are used for a reference to obtain some of the demographic and water use information for the Town of Nags Head for this Water System Needs Assessment.

1.2 Purpose and Scope

This Water Treatment System Needs Assessment is developed at the request of J. Webb Fuller, Town Manager, Town of Nags Head, and Dave Clark, P.E., Public Works Director, under the direction and guidance of the Town of Nags Head Town Council, and Mayor Robert W. Muller, in order to provide the Town with a thorough engineering evaluation as to the manner in which the existing drinking water treatment system may be optimized to efficiently serve the Town's needs and meet the current and near-future drinking water regulations for turbidity and total organic carbon (TOC). The Town of Nags Head selected Cavanaugh & Associates, P.A. to perform this assessment and report findings to the Town for review and consideration.

1.3 Regulatory Agency Requirements

The two specific regulations of interest for the Town of Nags Head are the Interim Enhanced Surface Water Treatment Rule (IESWTR) and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1SWTR). The turbidity and total organic carbon (TOC) standards established for the treated drinking water are of particular concern to the Town. Another regulation related to the reduction of TOC is the Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR).

- Interim Enhanced Surface Water Treatment Rule (IESWTR) – The purpose of this rule is to help control microbial contaminants when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule, with a focus on Cryptosporidium. The major provisions of this rule set contaminant removal standards for Cryptosporidium along with turbidity performance standards and monitoring requirements.
- Long Term 1 Enhanced Surface Water Treatment Rule (LT1SWTR) – This rule is very similar to IESWTR, but it is for systems serving <10,000 people. The purpose of this rule is to help control microbial contaminants when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule, with a focus on Cryptosporidium. The major provisions of this rule are based on control of Cryptosporidium and combined filter effluent (CFE) turbidity performance standards.
- Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR) – The purpose of this rule is to limit the exposure to disinfection byproducts (DBPs), since studies have shown that some disinfection byproducts can lead to cancer and other health concerns.

The quick reference guide for each rule, published by the Environmental Protection Agency (EPA), is provided in the appendix. These documents provide a more detailed description of each of the regulations mentioned above.

SECTION 2

CURRENT SITUATION

2.1 General

Drinking water treatment is crucial to minimize public health risks associated with public water supplies. Treating the source water improves the quality of the water, promoting good health of the users and providing an aesthetically pleasing drinking source. Increased research in recent years has resulted in the classification of a large number of contaminants and a stricter limit on the presence or quantity of these contaminants allowed in water produced for consumption. Below is a list of types of contaminants that may be found in drinking water along with some potential sources for each contaminant group.

- Microbial Contaminants
  - Consist of bacteria and viruses
  - Main Sources
    - Discharges from sewage treatment plants
    - Urban stormwater runoff
    - Agricultural livestock operations
    - Wildlife
- Inorganic Contaminants
  - Consist of salts and metals
  - Sources
    - Urban stormwater runoff
    - Industrial and domestic wastewater discharges
    - Oil and gas production
    - Mining
    - Farming
- Pesticides and Herbicides
  - Sources
    - Agriculture
    - Urban stormwater and residential uses
    - Golf courses
- Organic Chemical Contaminants
  - Consist of synthetic and volatile organic chemicals
  - Sources
    - Byproducts of industrial processes and petroleum production
    - Gas stations
    - Urban stormwater runoff
    - Septic systems

- Radioactive Contaminants
  - Can occur naturally or from manmade processes

2.2 Existing System

The Dare County Water System includes three different water treatment plants. These plants are the Skyco Water Treatment Plant in Skyco, the Reverse Osmosis (RO) Plant in Kill Devil Hills, and the Fresh Pond Treatment Plant in Nags Head. The first two treatment plants are owned and operated by Dare County, while the latter is owned and operated by the Town of Nags Head. Dare County, Kill Devil Hills and Nags Head have entered into a contract (Water Contract) specifying the quantity of water that each entity is allocated, the quantity each plant is required to produce and how the water is sold. More specific information on the Water Contract can be found in the actual contract. (A copy is included in the appendix.)

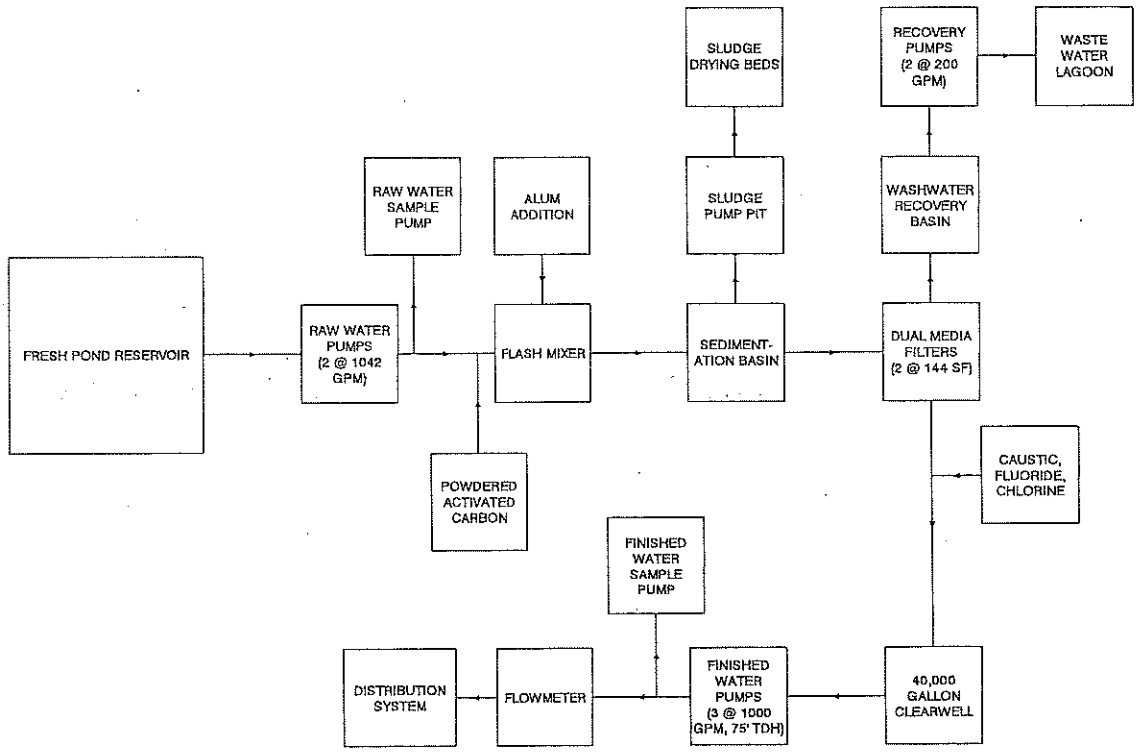
The Town of Nags Head drinking water treatment plant was originally constructed in 1964 beside the Fresh Pond, where it is currently located. Improvements and modifications to the treatment plant were completed in 1970 and 1985. The current treatment plant has an ultimate design capacity of 1.5 MGD (million gallons per day). Safe summer yield of the facility is estimated to be only 0.9 MGD, which was determined in a previous study and cited in the 2004 Water System Master Plan Update. The safe summer yield of 0.9 MGD is based on Fresh Pond capacity and recharge rate according to the plant operator. Below is a list of the major components of the current treatment plant, and figure 2.1 provides a schematic diagram.

- Components and Description
  - Fresh Pond Reservoir – Raw water storage
  - Raw Water Pumps (2 Pumps @ 1042 GPM)
  - Raw Water Sample Pump
  - Powdered Activated Carbon – Removes contaminants through filtration
  - Alum Addition – Coagulant to aid in settling
  - Flash Mixer – Mixes water and added chemicals for enhanced settling and treatment
  - Clarifier/Sedimentation Basin – Provides quiescent area for settling
    - Sludge Pump Pit – Contains pumps that remove sludge from the clarifier/sedimentation basin
    - Sludge Drying Beds – Dries sludge generated during water treatment
    - Dual Media Filters (2 @ 144 SF)
    - Washwater Recovery Basin

  - Recovery Pumps (2 @ 200 GPM)
  - Wastewater Lagoon – Where filter backwash water is pumped
- Caustic, Fluoride, Chlorine
  - Caustic Soda (NaOH)– Adjustment of final pH
  - Fluoride – Helps prevent tooth decay
  - Chlorine – Provides disinfection
- 40,000 Gallon Clearwell
- Finished Water Pumps (3 @ 1000 GPM, 75' TDH)
- Finished Water Sample Pump
- Flowmeter

The Nags Head Drinking Water Treatment Plant is only operated during the summer months to help meet peak demand. For the rest of the year, the Town of Nags Head is supplied drinking water solely from the Dare County Water System.

Figure 2.1 Diagram of Existing Nags Head Drinking Water Treatment Facility



2.3 Water System Treatment Problems

The current water treatment system for the Town of Nags Head is working well and is meeting the current requirements of the North Carolina Department of Environment and Natural Resources (DENR) Public Water Supply regulations. The operator of the Nags Head Treatment Plant has expressed concern about the treatment plant being able to continue to meet the drinking water standards, particularly the near-future water treatment quality standards relating to turbidity, TOC concentrations and disinfection byproducts.

The only violations received for exceeding standards in the past couple of years (2002 and 2003) have been due to arsenic levels greater than the Maximum Contaminant Level (MCL). These violations are attributed to water produced by Dare County, not water produced by the Town of Nags Head. The arsenic was present in the water produced by the Dare County Water Treatment System, which the Town of Nags Head purchases and this issue has been addressed by Dare County.

One concern is related to maintenance with the sedimentation/clarifier basin. Cleaning this basin is a very labor intensive process. The operator is required to first remove the sludge generated from the water treatment process. Currently, to accomplish this removal, the water must be drained from the basin. The staff must then don appropriate attire and climb into the basin. The staff must scrape and wash the sludge to the drain where the sludge can then be pumped out of the basin. This basin might be considered a confined space, which presents potential hazards and requires the operator to follow proper protocol after training. Increased costs are associated with the equipment and training required to meet OSHA regulations. Another primary concern is the fact that the treatment plant must be shut down in order to clean the basin. Cleaning is required about every two to three months, which may present a problem should demand increase beyond what Dare County can supply. In addition, if cleaning is required during a peak time, the plant will not be able to produce water for a day or more.

Another concern is algae in Fresh Pond. Algae is always a potential issue when using surface water as a raw water source. Currently algaecide (Earth Tech) is used to treat the algae and is said to be effective according to the operator of the treatment plant. Algaecide can cause the membranes of the algae to rupture, however, which can compromise the source water quality. Ruptured algae membranes can allow toxins to be released to the water that may affect its taste and odor. Toxins (or their effects) are generally not removed through the

conventional water treatment process. As a result, the aesthetics of the finished water may be adversely affected, which may result in unsatisfied consumers.

The relatively high concentration of organics in the Fresh Pond's waters presents another concern. The dissolved organics can react with the disinfection process to form disinfection byproducts. The removal of organics from the raw water is crucial to ensure that the finished water is able to meet current and near-future standards for disinfection byproducts. Two primary areas contributing organic matter to Fresh Pond are runoff from the wooded areas around Fresh Pond and the willows that surround the pond. Additionally, aquatic wildlife and aquatic flora and fauna also contribute organic matter.

SECTION 3

DEMOGRAPHICS AND WATER REQUIREMENTS

3.1 Existing Demographics

3.1.1 General

Areas of potential growth have been identified in the Town of Nags Head Official Zoning Map. Population data and projections for each land use type provided by the Planning Department were used in determining future population and water demands. This same data were used for present population. The basis for these projections is the computer modeling conducted by the Planning Department.

3.1.2 Present

The 2003 permanent population was estimated to be 2,900, and the seasonal population from June-August was 38,353. Tables 3.1 and 3.2 show present and future development by zone:

Table 3.1 Present Development by Zone in Nags Head

Land areas by acres for all zoning districts.						
District	**Acres Undeveloped**	**Acres Developed**	**Total Acres**	**Percent Developed**	**Total ROW**	**Total District**
R-1	64.27	75.48	139.76	54.00	8.47	148.23
R-2	873.37	636.95	1510.32	42.17	182.13	1692.45
R-3	38.9	70.93	109.83	64.58	27.3	137.13
CR	124.35	198.28	322.63	61.46	31.69	354.32
C-2	132.77	322.68	455.45	70.85	154.47	609.92
C-3	9.33	20.15	29.48	68.35	4.63	34.11
C-4	2.6	3.13	5.73	54.62	0.5	6.23
SPD-C	57.55	313.77	371.32	84.50	72	443.32
SPD-20	121.2	400.64	521.84	76.77	33.78	555.62
SED-80	5736.53	476.64	6213.17	0.07	1.01	6214.18
Total	**7160.87**	**2518.65**	**9679.53**	**26.02**	**515.98**	**10195.51**

Source: Town of Nags Head Planning Department (2003 data)

- R-1 = low density residential
- R-2 = medium density residential
- R-3 = high density residential
- CR = commercial/residential
- C = commercial
- SPD = special planned district
- SED = special environmental district

Table 3.2 Lots available for Future Development

Lots available for development				
District	**Undeveloped Parcels**	**Developed Lots**	**Total Lots**	**Percent Developed**
R-1	29	109	138	78.99
R-2	540	1929	2469	78.13
R-3	96	388	484	80.17
CR	71	311	382	81.41
C-2	244	593	837	70.85
C-3	5	11	16	68.75
C-4	5	9	14	64.29
SPD-C	140	577	717	80.47
SPD-20	72	177	249	71.08
SED-80	31	15	46	32.61
Total	**1233**	**4119**	**5352**	**76.96**

Source: Town of Nags Head Planning Department (2003 data)

3.1.3 Future

The peak population by the year 2010 is projected to be 3,198 for permanent population and 43,570 for seasonal population, as referenced from the LWSP (2003). The 2020 population is expected to be 3,737 for permanent and 50,342 for seasonal.

3.2 WATER REQUIREMENTS

3.2.1 General

Water usage rates vary during different times of the day (diurnal demand fluctuation) and different times of the year (seasonal demand fluctuation). Demand rates are defined by the following terms:

- Annual Average Daily = $\frac{\text{Yearly total quantity of water distributed}}{\text{Number of days in the year}}$
- Maximum Daily = the maximum quantity of water used in any 24-hour period during the year; it is used to size water production and treatment facilities
- Maximum Hourly = the maximum amount of water required during any 60-minute period of the year

The Maximum Hourly demand is generally the critical condition that results in minimum residual pressures within the distribution system. This demand rate determines the size and location of distribution and storage facilities. In addition, municipal distribution facilities are designed to safely deliver fire flows. Fire flows will often determine the size of the distribution mains in areas where large fire flows are required.

The state requires that the residual pressure in a water main for average daily flow is 30 pounds per square inch (psi), and 20 psi for peak flow (such as fire flow).

3.2.2 Water Demand Projections

According to historical data, the Town of Nags Head experiences peak water demand during the months of June, July and August. (See Figure 3.1) Maximum Hourly demands are assumed to be twice those of the Maximum Daily.

Figure 3.1, on the following page, shows graphically the average daily and maximum daily demand over a 9 month period. (*Source: Town of Nags Head Water System Master Plan, October 2004*)

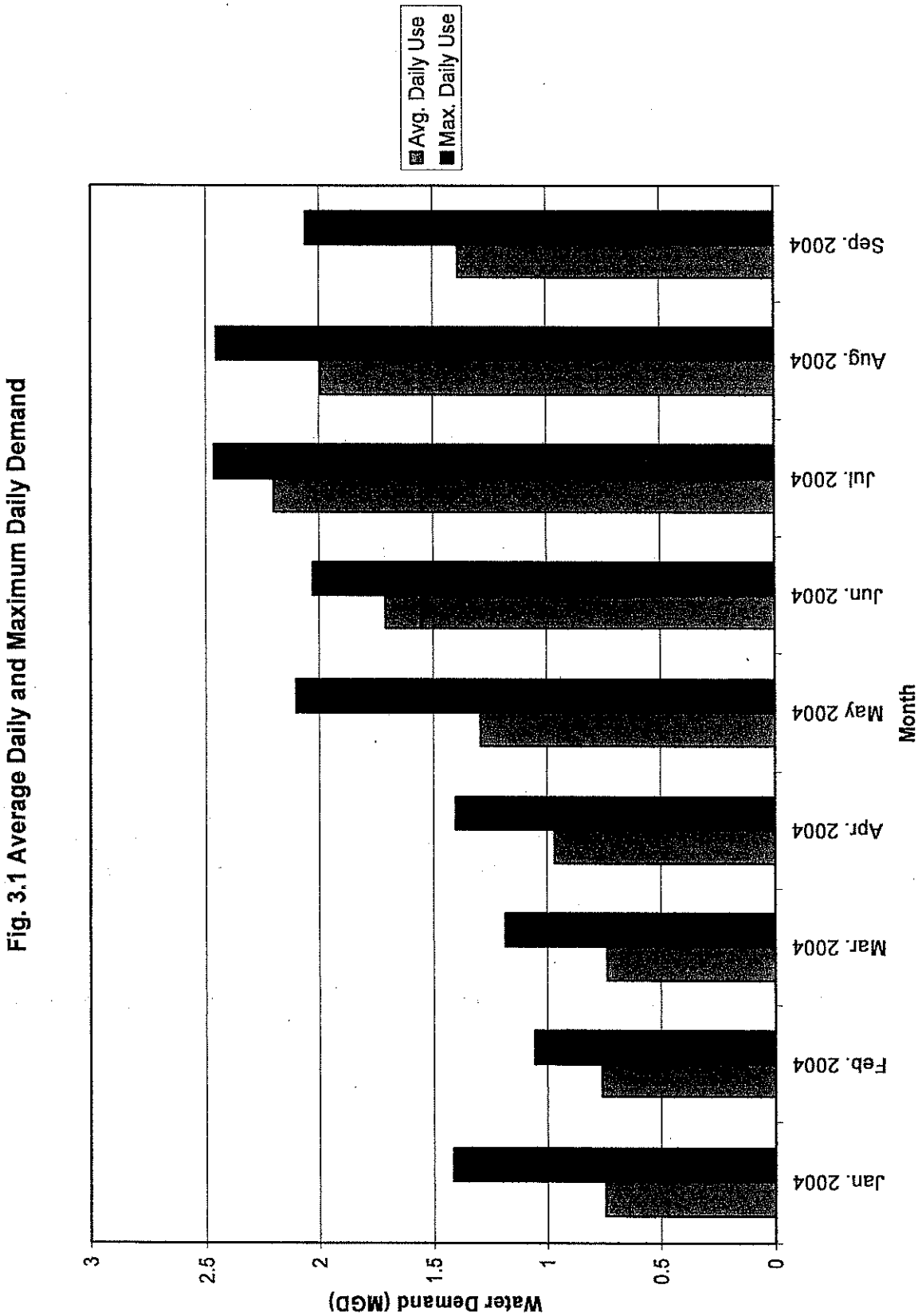


Fig. 3.1 Average Daily and Maximum Daily Demand

3.2.3 Water Supply

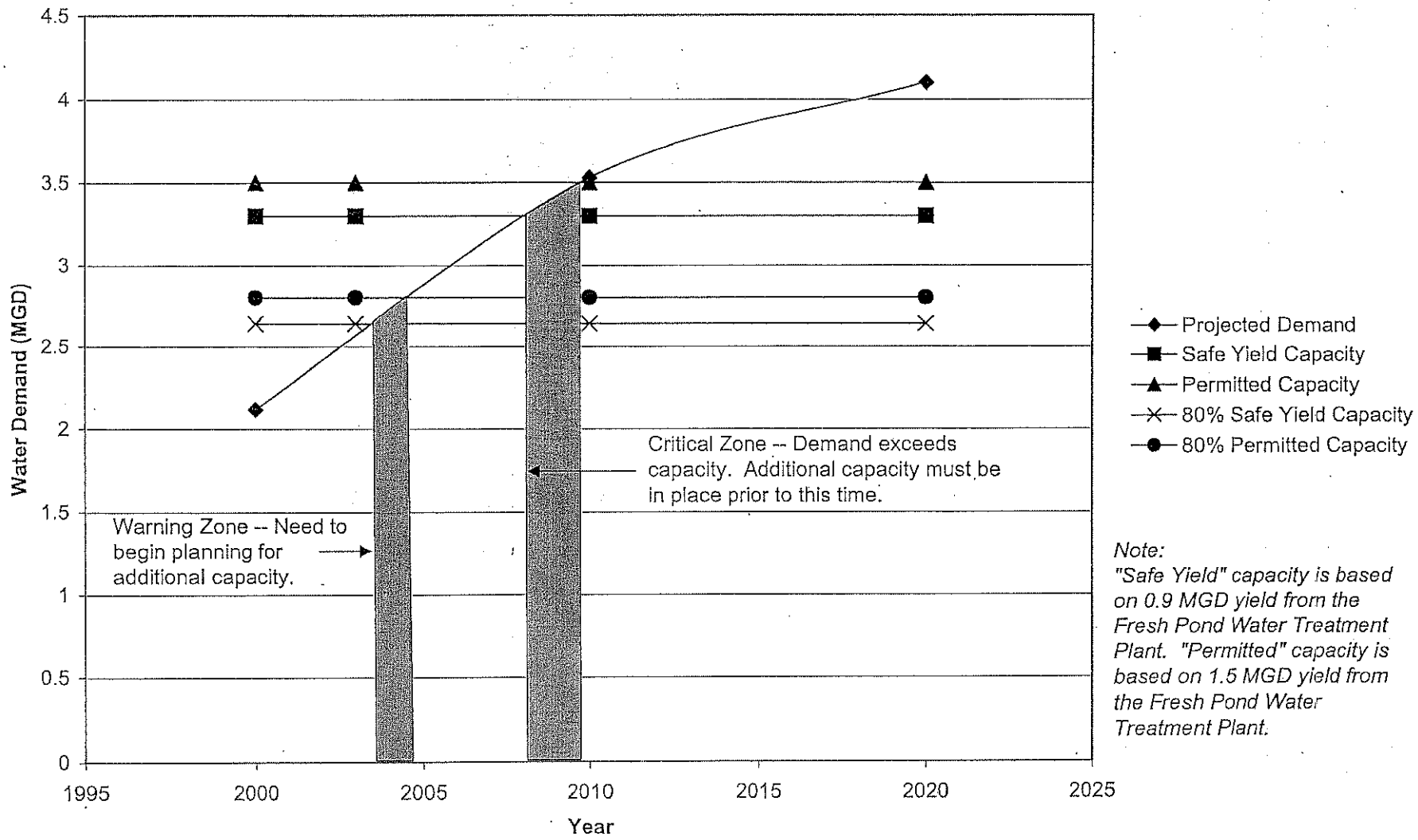
The Dare County Regional Water System is the water provider for Nags Head. This system's water comes from the Roanoke Island Water Treatment Plant, which is owned and operated by Dare County, and the RO Plant in Kill Devil Hills, which is owned by Dare County. Both plants are outside the scope of the study. Water is also supplied from the Fresh Pond Water Treatment Plant which is owned and operated by the Town of Nags Head.

The Fresh Pond Plant was originally constructed in 1964, with improvements made in 1970 and 1985. The plant was not in operation from 1980-1985. The rated plant capacity is 1.5 MGD. However, due to limitations on the yield of the Fresh Pond, the safe yield for the summer months from this treatment plant is projected to be 0.9 MGD. The plant operator indicates that the limiting factor is the recharge rate of Fresh Pond, a groundwater fed surface water body.

Water received from the Dare County water system is distributed to participating area water systems based upon previous contractual agreements with the County. Nags Head's share of water produced at the Roanoke Island Water Treatment Plant is 2.0 MGD and they receive 1.0 MGD from the RO Plant in Kill Devil Hills. The Town produces an additional 0.50 MGD from the Fresh Pond Water Treatment Plant. Thus, the total supply currently available to the Town is 3.50 MGD. (Town of Nags Head Water System Master Plan Update, 2004) The anticipated peak day demand is 3.53 million gallons (MG) in 2010 and 4.10 MG in 2020, see Figure 3.2. (Water System Master Plan Update, 2000)

Figure 3.2 shows the projected demands along with current supply capacity with Fresh Pond yielding 0.9 MGD and 1.5 MGD respectively. Also shown are indicators for 80% capacity, at which point planning for additional capacity should already have begun. The figure indicates that projected demand will actually exceed available supply as early as the year 2008.

Fig. 3.2 Projected Water Demand



Note:
"Safe Yield" capacity is based on 0.9 MGD yield from the Fresh Pond Water Treatment Plant. "Permitted" capacity is based on 1.5 MGD yield from the Fresh Pond Water Treatment Plant.

SECTION 4

ALTERNATIVES ANALYSIS

4.1 General

The Nags Head Water Treatment Facility must be able to accommodate the existing and future drinking water demands and to meet state drinking water standards. Careful analysis and evaluation of alternatives that will allow Nags Head to meet these requirements are warranted. Each option must be evaluated objectively and equitably.

4.2 Water Supply Approaches

Water providers should always utilize the best quality raw water source that can be acquired economically. Environmental Protection Agency's (EPA) National Interim Primary Drinking Water Regulations (Environmental Protection Agency, 1976) states, "Production of water that poses no threat to the consumer's health depends on continuous protection. Because of human frailties associated with protection, priority should be given to selection of the purest source."

4.3 Alternative Sources

The feasibility of alternative sources should be considered when contemplating a major capacity expansion for an existing plant, construction of a new treatment plant, or if a different and more expensive treatment approach is being analyzed. Some examples of alternative source scenarios follow:

- Groundwater versus surface water
- Different groundwater source or surface water source
- River bank infiltration versus surface water withdrawal

It is also important to consider the economic feasibility of the different options and the size of the municipal system. (Water Quality and Treatment, 1999)

4.4 Alternatives to Construction of New Treatment Facilities

Several alternatives should be considered that do not require expansion of the treatment system:

- Purchasing water from another utility
- Universal Metering
- Leak Prevention and Repair

Purchasing water from another utility allows the system to obtain water that has already been treated. This alternative might be used when regulations become stricter, making treatment with the existing treatment facility too expensive. This is only an option if the other municipality has surplus capacity and is willing to sell it. Analysis of the waters from the different systems is important to check for source and disinfection compatibility between the different water sources.

With universal metering, each user is metered for the exact volume of water used. The use of universal metering is only an alternative to treatment if the existing water system is able to meet current and future drinking water treatment regulations. This option gives the users an economic incentive to be more conservative with their water use. Each user is metered for the exact volume of water used. There is still the increased cost of installing the meters instead of the cost of expanding treatment capacity. Dare County currently employs a universal metering policy.

There is also the alternative of preventing leaks and repairing water lines. This again is an alternative that requires the existing treatment facility to be able to meet current and future drinking water treatment standards. This option requires the water lines to be properly maintained, leaking lines repaired and other problems with the water system corrected. This option would have the cost of servicing the lines and allows for the possibility to increase supply without increased production. A municipality should be continuously involved in leak prevention and repair. Stopping the loss of unaccounted water from leaks may be able to delay expansion of a municipality's water treatment facility.

4.5 Process Selection Factors

Multiple factors influence proper treatment process selection. Some process selection factors are as follows:

Contaminant Removal

Contaminant removal is the primary purpose of drinking water treatment. Primary contaminants are contaminants that cause health risk/threat to the consumers. Proposed drinking water standards should be carefully analyzed in addition to current regulations. The selected process should be able to meet the current and future standards or allow modifications to be made to satisfy future requirements. Maximum Contaminant Levels (MCL) should not be reached or even approached if utility customers and utility management are interested in emphasizing water of excellent quality.

Aesthetics

Aesthetics of water in a water system are as important, if not more, than being under the MCL limits. Below are some of the secondary contaminants of drinking water, which produce aesthetic effects, but are not associated with any known health risk:

- Color
- Odor
- Taste
- Hardness
- Mineral Content
- Iron
- Manganese

Even if the treated water is in compliance with the regulations, if something makes the consumer feel it is not safe, the perception will be that the water is not safe.

Source Water Quality

The quality of the source water may ultimately determine the selected treatment process. An analysis of the watershed will help determine possible areas that could cause contamination. These areas may occur naturally or they may be manmade. The treatment plant must receive water of a quality that it can effectively treat.

Reliability

The reliability of each treatment process must be known to determine if each process is acceptable for its intended application. For example, disinfection is mandatory and should, therefore, be practically free of failure. If the disinfection process fails, the water provider must issue a boil-water notice or stop distribution until the problem is fixed. Neither option is very popular with the consumer. Treatment processes must be designed to have the lowest practicable potential for failure and to operate effectively.

Some factors that influence the reliability of the drinking water treatment process (Water Quality and Treatment, 1999):

- Water quality of the source water as compared to the range of quality the treatment plant can effectively treat
- Rate of change in water source quality
- Degree of experience and training of the operators
- Operation - Intermittent or Continuous
  - Constant rate of flow or varied depending on demand
- Whether personnel are intermittent in shifts or 24 hours per day
- Instrumentation quality
- Upkeep of instruments and proper calibration
- Reliability of electrical supply
- Ability to limit or prevent deterioration of source water quality in the distribution system

Existing Conditions

The existing processes or equipment may also influence the choice of which processes to add. This might include site constraints, such as space limitations. Hydraulic constraints are also important to consider. For example, booster pumps may be required to satisfy head requirements for certain treatment processes. Higher capital and Operation & Maintenance (O&M) costs may be associated with the pumps.

Process Flexibility

It is quite advantageous for a treatment plant to be capable of allowing process changes in order to meet future regulations or to accommodate changes in source water quality. More regulations that result in further treatment processes and require a higher degree of water quality will likely be implemented in the future. It is beneficial for the treatment plant to be designed with a degree of flexibility with future requirements in mind.

Utility Capabilities

For the water treatment plant to provide the desired finished water quality, the utility must have the proper number of staff with sufficient experience to provide effective operation. The management of the utility must be progressive and realize the importance of properly trained staff, the proper equipment, and other resources required to operate and maintain the plant effectively.

The adaptation of a SCADA (Supervisory Control and Data Acquisition) system can be important no matter what the size of the treatment system. The SCADA system can allow every process of the treatment process to be monitored, make the treatment system more efficient and notify the operator of possible problems.

Costs

The cost associated with the various process options can make evaluation of the alternatives complicated. Different processes may have different capabilities and may result in different finished water quality. Sometimes a process that can do more than meet minimum requirements may not be justified. In other scenarios, it could be beneficial to have those extra treatment features if, for instance, they will help satisfy future requirements. It is also necessary to consider the total lifespan of the process or equipment, rather than simply the initial capital costs. O&M costs may be quite significant, particularly over time, but they are sometimes difficult to estimate. Small systems in particular must consider the cost of having spare parts for the different process components on hand and the skill level required to maintain and install the parts.

Environmental Compatibility

Increasingly strict environmental regulations make the potential for environmental impacts an important area for consideration when evaluating alternatives. The waste management of residuals must be addressed. The disposal of water wasted from the treatment processes (i.e. backwashing of filters) must also be considered. In addition, the energy requirements of the different processes necessary to protect the environment must also be taken into account.

Distribution Water Quality

Attention must be given to portions of the distribution system that may cause or allow deterioration of finished water quality prior to delivery to consumers. An example is certain areas within the distribution network that are not looped and have "dead ends." Internal corrosion and deposition within the pipe network are additional distribution system concerns. The goal is for finished water to be chemically and biologically stable with minimal DBP's within the distribution system. More complex water systems may also be concerned with the compatibility of finished waters from multiple treatment facilities and source waters.

Summary of Evaluation Criteria for Process Options

Below is a summary of the primary considerations for selecting treatment options (Water Quality and Treatment, 1999):

- Regulatory Requirements:
  - Total Coliform Rule (TCR)
  - Surface Water Treatment Rule (SWTR)
  - Total Trihalomethane Rule (TTHM)
  - Information Collection Rule (ICR)
  - Stage 1 Disinfectant/Disinfection Byproduct Rule (Stage 1 DBPR)
  - Interim Enhanced Surface Water Treatment Rule (IESWTR)
  - Expected Long-term Enhanced Surface Water Treatment Rule (LTESWTR)
  - Expected Stage 2 Disinfectant/Disinfection Byproduct Rule (Stage 2 DBPR)
  - Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)
- Coping with spills in the water supply watershed
- Experience of staff with operating the process
- Capability of the process to treat variable raw water quality versus expected raw water quality
- Operator certification level required
- Complexity and reliability of process
- Monitoring needed and ability of staff needed for monitoring
- Viability in Long-Term
- Acceptance by customers
- Ability to meet constraints of the site
- Energy Requirements
- Capital Costs
- O&M Costs

4.6 Alternatives Analysis

4.6.1 Alternative 1 – No Action

The decrease in allowable turbidity and TOC levels and the projected increase in water demand make regulatory compliance for the Town of Nags Head very difficult to almost impossible without action. In addition, the ultimate safe yield capacity for Fresh Pond is not sufficient to meet the increase in water demand in the near future. These requirements make this alternative infeasible, and it is eliminated from further consideration.

4.6.2 Alternative 2 – Upgrade the Treatment at the Fresh Pond Plant

This option consists of improving the Fresh Pond Plant to meet current and near-future water quality requirements producing up to 0.9 MGD from Fresh Pond, which is considered the safe yield from Fresh Pond by a previous study. To meet these requirements, the following bulleted items need to be addressed, with some having several alternatives for meeting each need. Recommended alternatives for this option are included after the list of considerations.

- Install real-time turbidity monitors on each filter effluent line plus combined turbidity monitoring
- Possible filter-based modifications
    - Media replacement
        - Change sand characteristics: grain size (D_{10}) and increase bed depth
        - Change anthracite (type of filter media) characteristic: increase bed depth
    - Additional media: add additional layer (e.g. garnet)
    - Filter more post-backwash water to waste, i.e. allow filter to ripen longer
- Possible coagulation/flocculation/sedimentation modifications
    - Modification to existing basin
        - Dual train: add capacity to increase retention time and efficiency
        - Baffles or related internal modifications to increase efficiency
        - Construction of new basin
    - Modification to treatment chemistry
        - Additional/different coagulant
        - Additional/different polymer aid
        - Powdered Activated Carbon (PAC) adjustment

  - Flocculation followed by ultrafiltration/microfiltration membranes added to treatment train in place of filters(removal of existing filter beds)
    - Enhanced coagulation
    - PAC (Powdered Activated Carbon) and regular coagulation (This option may/may not require sedimentation basin modifications. It would also be good for algae removal.)
- Possible changes to disinfection practices
  - Change primary/secondary disinfectant (i.e. use UV for primary and lower chlorine amount as secondary disinfectant)
  - Real time disinfectant monitoring in the system to allow optimal (lowest) disinfectant dose

  (Monitoring requirements are established in LT1SWTR and Stage 1 DBPR rules.)

The following actions are recommended for this alternative:

Item 1

The operator of the Fresh Pond Water Treatment Plant has expressed the need for a particle counter to monitor the combined effluent. The particle counter, which is projected to cost approximately $8,000, is also necessary for measurements that will soon be required from near-future regulations. The Town of Nags Head should already have all the necessary equipment and software that is needed to operate the additional particle counter. Nags Head may need additional counters in the future, but there should at least be one for each filter and one for a blended measurement. These particle counters are not required by the current regulations, but they can be very useful tools for the operators of the treatment facility.

Item 2

The treatment facility should be able to meet the required turbidity requirements with some sand media modification and filtering more water to waste after each backwash cycle. The proper grade of sand for the filter beds should cost about $7,500. The existing sand media must be disposed of properly (in a landfill). The use of additional filter water to waste should not present a capital cost issue, relating to being able to use the produced water for wasting.

Item 3

Because OSHA has classified the existing sedimentation/flocculation basin as a non-permitted confined space, and the basin may not be sufficient for enhanced coagulation, the recommendation is to replace the existing basin. The projected construction cost for a new flocculation basin is approximately $135,000. The existing flocculation/sedimentation basin can then be turned into a sedimentation basin at an approximate cost of $50,000. The conversion to a sedimentation basin should only require the top of the existing basin to be removed, since the existing flocculation/sedimentation basin is currently used for sedimentation.

Table 4.1 Estimated Costs to Meet Regulations Treating 0.9 MGD

Item	Preliminary Opinion of Probable Cost
Particle Counter for Combined Effluent	$8,000.00
New Media for Filters	$7,500.00
New Flocculation Basin	$135,000.00
Conversion of Existing Basin	$50,000.00
Total Cost	**$200,500.00**

* Note: Costs do not include contingency, engineering fees, construction costs or land costs.

4.6.3 Alternative 3 – Upgrade Treatment at Fresh Pond Plant and Purchase Additional Capacity from Dare County

This option requires the treatment capacity of the Fresh Pond Plant to be expanded to 1.5 MGD. Although the treatment plant is currently designed to treat this volume, two things make upgrades to the current treatment facility necessary. First, the current and near-future drinking water standards require stricter limits than the existing treatment facility was originally designed to meet. Second, the ultimate safe dry weather yield for Fresh Pond is 0.9 MGD or less according to the plant operator. The latter issue necessitates consideration of alternate or supplemental water sources.

Since this alternative involves upgrades to the existing water treatment plant, the upgrades listed in Alternative 2 and the projected costs in Table 4.1 are required to bring the treatment capacity to 0.9 MGD. The Water Contract with Dare County specifies that should Nags Head purchase additional capacity, the incremental increase must be 1.0 MGD, with a maximum increase of 2.0 MGD. The projected costs associated with this alternative are shown in Table 4.2. The costs include the improvements described in Alternative 2 and anticipated

improvements to the Dare County Water System necessary to provide additional capacity to Nags Head.

Table 4.2 Estimated Costs to Upgrade Fresh Pond Plant and Purchase Additional Capacity from Dare County

Preliminary Opinion of Probable Cost

Description			Total
Particle Counter for Combined Effluent			$8,000.00
New Media for Filters			$7,500.00
New Flocculation Basin			$135,000.00
Conversion of Existing Basin			$50,000.00
		Subtotal=	$200,500.00

Description	Quantity	Cost	Total
RO Train (1.0 MGD Capacity)	1	$800,000.00	$800,000.00
Well Improvements	1	$72,000.00	$72,000.00
Pumps	2	$14,000.00	$28,000.00
Chemical Feed Pumps	1	$3,000.00	$3,000.00
Water Transmission Improvements	1	$100,000.00	$100,000.00
Misc. Costs and Equipment	1	$150,000.00	$150,000.00
		Subtotal=	$1,153,000.00

Total Estimated Cost **$1,353,500.00**

Assumptions:

Existing wells have suitable safe yield capacity to satisfy additional projected demands with pumping modifications.

Improvements to Dare County's facilities are based on Cavanaugh & Associates' interpretation of available documents. Cavanaugh & Associates has not formally evaluated Dare County's facilities and can make no definitive representations as to the capabilities thereof.

Expansion of buildings and wastestream facilities are not included in this cost estimate.

As a result, this alternative will provide a total quantity of 1.9 MGD for Nags Head. The potential water that can be produced by this alternative makes this a possible alternative for the Town of Nags Head.

4.6.4 Alternative 4 – Decommission Fresh Pond Plant and Purchase All Capacity from Dare County

Closing the Fresh Pond Plant appears to reduce the current water capacity allotment to Nags Head by 0.5 MGD according to the Water Contract. The Town attorney's guidance should be sought to determine the exact terms and ramifications of Fresh Pond Plant closure. The Water Contract indicates that expanded capacity is only available in 1.0 MGD increments. Adding 1.0 MGD of additional capacity in place of the 0.5 MGD lost by closing the Fresh Pond Plant will give Nags Head 4.0 MGD of capacity, which will satisfy projected near-future demands. Taking the Fresh Pond Water Treatment Plant out of service eliminates the annual O&M costs associated with its operation. Additionally, the limited supply from Fresh Pond and the potential vulnerability of that source to contamination are no longer an issue. Open reservoirs are subject to potential contamination from human activities, wildlife, storm events such as hurricanes, etc. The projected cost for this alternative is $1,153,000. A detailed list of items for this alternative is the same as part of Alternative 3 and can be seen in Table 4.3. This alternative is a feasible option for the Town of Nags Head.

Table 4.3 Preliminary Opinion of Probable Cost to Purchase an Additional 1.0 MGD Capacity from Dare County

Preliminary Opinion of Probable Cost

Description	Quantity	Cost	Total
RO Train (1.0 MGD Capacity)	1	$800,000.00	$800,000.00
Well Installation	1	$72,000.00	$72,000.00
Pumps	2	$14,000.00	$28,000.00
Chemical Feed Pumps	1	$3,000.00	$3,000.00
Water Transmission Improvements	1	$100,000.00	$100,000.00
Misc. Costs and Equipment	1	$150,000.00	$150,000.00
Total Estimated Cost			$1,153,000.00

Assumptions:

Existing wells have suitable safe yield capacity to satisfy additional projected demands with pumping modifications.

Improvements to Dare County's facilities are based on Cavanaugh & Associates' interpretation of available documents. Cavanaugh & Associates has not formally evaluated Dare County's facilities and can make no definitive representations as to the capabilities thereof.

Expansion of buildings and wastestream facilities are not included in this cost estimate.

4.6.5 Alternative 5 – Install Wells and Convert Fresh Pond Plant to a RO Plant

The option of installing wells and connecting the Fresh Pond Plant to an RO Facility will allow the Town of Nags Head to use the existing treatment plant building and some of the existing equipment. This alternative includes separation from the Dare County System, although contractual ramifications are not considered here. The cost of this option is projected be similar to the alternative of purchasing the capacity from Dare County with the additional costs of purchasing additional equipment and wells. In this scenario, the Town of Nags Head will still be responsible for operation and maintenance, and associated costs. Another key issue is that in the Water Contract, Nags Head agrees to not do anything that might jeopardize or affect the existing Dare County System. New wells installed by Nags Head could compete with Dare County wells, with the potential to modify water quality, for example increased salinity and/or decreased yield. Establishing new wells with suitable source quality can be challenging in this region. In fact, no one can guarantee that such sources are available at a feasible cost. The additional anticipated costs and risks associated with this alternative, and the requirement for additional — perhaps extensive — investigation to identify suitable sources render this alternative infeasible.

SECTION 5

RECOMMENDED ALTERNATIVE

5.1 General

The Fresh Pond has been an important part of the history and growth of the Town of Nags Head. In recent years water from Fresh Pond has been withdrawn during the summer to help offset the increase in water demand. As the popularity of this historic and scenic area has grown, the water demand continues to increase. Nags Head's water demand is projected to exceed what is currently available, even with augmentation from Fresh Pond, around the year 2010 – perhaps as early as the year 2008. This potential water shortage makes it necessary for the Town to find additional water to meet the demands of the growing seasonal population as soon as possible.

The following recommendations are based on analysis of the projected future water demand, the current and near-future drinking water standards and the projected costs associated with the various alternatives evaluated to provide the needed quantity and quality of water for the Town of Nags Head.

5.2 Recommendation

The recommended alternative is Alternative 4. This alternative calls for the Town of Nags Head to begin the process of purchasing additional capacity from Dare County. This process, along with required system modifications will take some time to complete. The Town, along with the Town's attorney, will need to meet with Dare County and Kill Devil Hills to make sure this process proceeds in a prudent manner and in accordance with the Water Contract. The Town will need to meet with Dare County to begin negotiations concerning cost and scheduling for purchasing the desired capacity increase. Starting the process as quickly as possible is necessary to avoid an actual water shortage.

The recommended additional capacity to purchase is 1.0 MGD, which will bring the Town's total contractual capacity to 4.0 MGD without relying on the Fresh Pond Plant. This capacity will satisfy projected demand until nearly year 2010. The Fresh Pond Plant can, thus, be taken out of service once the additional capacity is actually available from the Dare County System. Now is the time to begin planning for additional capacity needed for 2010 and beyond, since seasonal demand already exceeds 80% of available capacity. Since these modifications will take a significant amount of time, the Fresh Pond Plant will be needed to help provide water to Nags Head for at least the next peak demand period.

Table 5.1 Estimated Costs to Purchase an Additional 1.0 MGD Capacity from Dare County

Preliminary Opinion of Probable Cost

Description	Quantity	Cost	Total
RO Train (1.0 MGD Capacity)	1	$800,000.00	$800,000.00
Well Installation	1	$72,000.00	$72,000.00
Pumps	2	$14,000.00	$28,000.00
Chemical Feed Pumps	1	$3,000.00	$3,000.00
Water Transmission Improvements	1	$100,000.00	$100,000.00
Misc. Costs and Equipment	1	$150,000.00	$150,000.00
Total Estimated Cost			$1,153,000.00

Assumptions:

Existing wells have suitable safe yield capacity to satisfy additional projected demands with pumping modifications.

Improvements to Dare County's facilities are based on Cavanaugh & Associates' interpretation of available documents. Cavanaugh & Associates has not formally evaluated Dare County's facilities and can make no definitive representations as to the capabilities thereof.

Expansion of buildings and wastestream facilities are not included in this cost estimate.

The cost of purchasing the additional capacity, as shown in Figure 5.1, is projected to be approximately 1.2 million dollars. This cost includes the Reverse Osmosis (RO) Train that must be added to the Dare County System, well improvements, and the other necessary appurtenances required for transmission and treatment of the source water. The cost of purchasing the water from Dare County is not included in the $1.2 million. Currently, the Dare County wholesale water rate (DCWWR) is calculated by adding the cost of purchasing water from Nags Head. By shutting down the Fresh Pond Plant, the factor associated with the plant will be removed from the DCWWR. The O&M costs associated with Fresh Pond Plant operation will also be removed for the Town of Nags Head. The money currently budgeted against these operational costs can be applied toward the debt service resulting from the purchase of the increased capacity. These assumptions are based on Cavanaugh & Associates' interpretation of the Water Contract. The Town's attorney should be consulted for confirmation or correction of these assumptions.

The decision to close the Fresh Pond Plant and purchase all water from Dare County will directly affect the Water Contract with Dare County and Kill Devil Hills. The allotted water each currently receives is dependent partly on the production of water by the Fresh Pond Plant. The three parties are currently entitled to 0.5 MGD (1.5 MGD total) of water from the Fresh Pond Plant according to the Water Contract. Taking the Fresh Pond Plant out of service will reduce the total available allotment of water by 1.5 MGD. Presumably, each partner's allocation will decrease by 0.5 MGD, but this issue should be referred to the Town's attorney for guidance.

The Town of Nags Head also needs to meet with the Public Water Supply (PWS) Section to inform them about the Town's decision to close the Fresh Pond Drinking Water Treatment Plant. This meeting should address the existing drinking water treatment plant's ability to comply with current and near-future drinking water standards.

Potential Temporary Improvements

Several improvements previously identified in Alternative 2 will help the Fresh Pond Plant comply with the new drinking water standards. These improvements include replacing the filter media, implementing enhanced coagulation, modifying the existing sedimentation basin and changing the disinfection method. These items focus on removal of organics and other settleable contaminants. All of the improvements can likely not be achieved before the next peak demand period. The associated costs are significant. The Town should discuss the feasibility and costs versus the benefits with PWS. Based on those discussions, the Town may elect to implement some portion of these temporary improvements, such as filter media replacement.

In following the recommended alternative, the Fresh Pond Treatment Plant must remain in operation for some time since the well and transmission improvements necessary for increasing capacity in the Dare County system will likely not be complete before the next peak seasonal demand. Depending on budget constraints and other capital improvements deemed necessary by the Town of Nags Head, the temporary recommendations or some portion thereof can be put in place as Phase I, with the complete process recommended above of purchasing the capacity from Dare County following as Phase II.

For this scenario, Table 5.2 shows the projected costs associated with Phase I.

Table 5.2 Opinion of Probable Costs to Meet Regulations Treating 0.9 MGD

Phase I (Temporary) Improvements

Item	Preliminary Opinion of Probable Cost
Particle Counter for Combined Effluent	$8,000.00
New Media for Filters	$7,500.00
New Flocculation Basin	$135,000.00
Conversion of Existing Basin	$50,000.00
Total Cost	**$200,500.00**

5.3 Fresh Pond Alternatives

The closing of the Fresh Pond Treatment Plant raises the question of what should be done with Fresh Pond and the treatment facilities. Should the Town decide to permanently close the plant, the existing equipment may be sold to generate additional revenue. The Fresh Pond area could be transformed into a recreational park. The Fresh Pond could provide water activities and the surrounding area could be used for walking trails, picnic areas, etc. The creation of a park may also allow the Town of Nags Head to qualify for grant monies to help pay for this conversion.

5.4 Recommended Next Steps

- Begin discussion with Dare County to purchase additional capacity of 1.0 MGD from the Dare County Water System.
- Begin discussion with the PWS regarding decommissioning the Fresh Pond Plant and relying solely on water from Dare County.
- Begin discussion with PWS regarding interim compliance with surface water standards in light of plans to decommission Fresh Pond Plant.
- Maintain the Fresh Pond Plant to allow operation for the upcoming 2005 operating season.
- Begin discussion with Dare County and Kill Devil Hills about closing the Fresh Pond Treatment Plant.
- Begin immediate planning and discussions to prepare for meeting demands beyond year 2010.

Sources

Town of Nags Head Water System Master Plan (Update). 2004
Cavanaugh & Associates, P.A.

Town of Nags Head Water System Master Plan (Update). 2000
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Town of Nags Head Land and Water Use Plan 2000.
Town of Nags Head Planning Department

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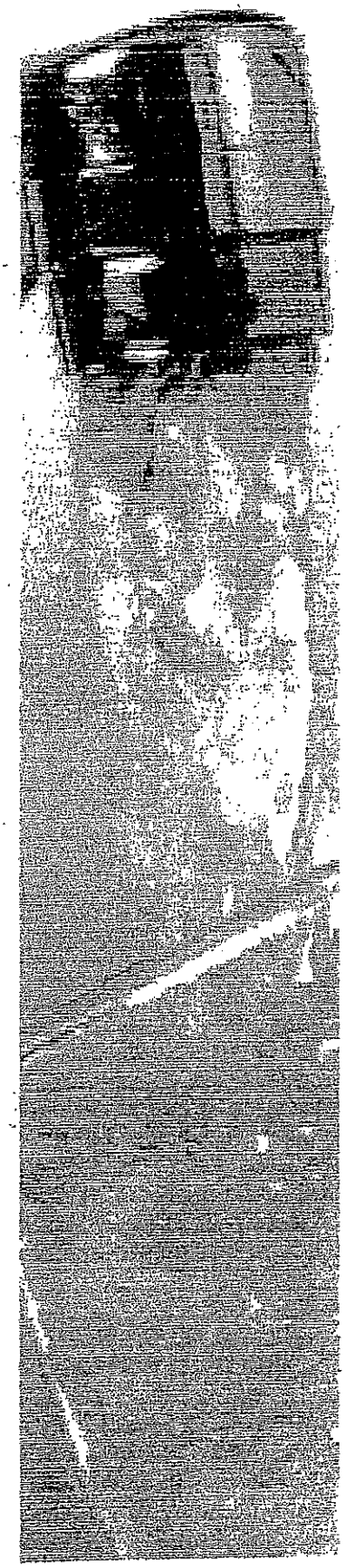
APPENDIX

United States Environmental Protection Agency | Office of Water (4606) | EPA 816-F-01-011 May 2001 www.epa.gov/safewater

EPA



Interim Enhanced Surface Water Treatment Rule: A Quick Reference Guide

Overview of the Rule

Title	Interim Enhanced Surface Water Treatment Rule (IESWTR) 63 FR 69478 - 69521, December 16, 1998, Vol. 63, No. 241 Revisions to the Interim Enhanced Surface Water Treatment Rule (IESWTR), the Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR), and Revisions to State Primacy Requirements to Implement the Safe Drinking Water Act (SDWA) Amendments 66 FR 3770, January 16, 2001, Vol 66, No. 29
Purpose	Improve public health control of microbial contaminants, particularly *Cryptosporidium*. Prevent significant increases in microbial risk that might otherwise occur when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.
General Description	Builds upon treatment technique approach and requirements of the 1989 Surface Water Treatment Rule. Relies on existing technologies currently in use at water treatment plants.
Utilities Covered	Sanitary survey requirements apply to all public water systems using surface water or ground water under the direct influence of surface water, regardless of size. All remaining requirements apply to public water systems that use surface water or ground water under the direct influence of surface water and serve 10,000 or more people.

Major Provisions

Regulated Contaminants

Cryptosporidium	▸ Maximum contaminant level goal (MCLG) of zero. ▸ 99 percent (2-log) physical removal for systems that filter. ▸ Include in watershed control program for unfiltered systems.
Turbidity Performance Standards	Conventional and direct filtration combined filter effluent: ▸ ≤ 0.3 nephelometric turbidity units (NTU) in at least 95 percent of measurements taken each month. ▸ Maximum level of 1 NTU.

Turbidity Monitoring Requirements (Conventional and Direct Filtration)

Combined Filter Effluent	▸ Performed every 4 hours to ensure compliance with turbidity performance standards.
Individual Filter Effluent	▸ Performed continuously (every 15 minutes) to assist treatment plant operators in understanding and assessing filter performance.

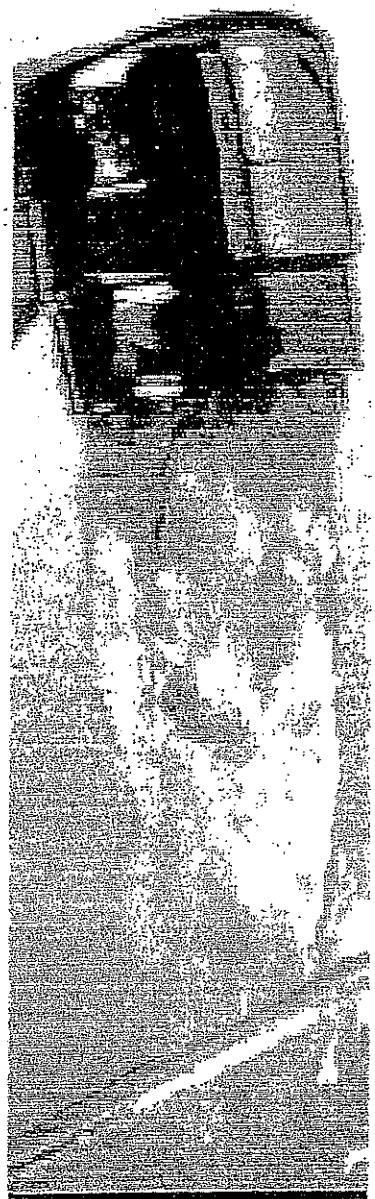
Additional Requirements

- Disinfection profiling and benchmarking.
- Construction of new uncovered finished water storage facilities prohibited.
- Sanitary surveys, conducted by the state, for all surface water and ground water under the direct influence of surface water systems regardless of size (every 3 years for community water systems and every 5 years for noncommunity water systems).

Profiling and Benchmarking

Public water systems must evaluate impacts on microbial risk before changing disinfection practices to ensure adequate protection is maintained. The three major steps are:

- Determine if a public water system needs to profile based on TTHM and HAA5 levels (applicability monitoring)
- Develop a disinfection profile that reflects daily *Giardia lamblia* inactivation for at least a year (systems using ozone or chloramines must also calculate inactivation of viruses)
- Calculate a disinfection benchmark (lowest monthly inactivation) based on the profile and consult with the state prior to making a significant change to disinfection practices



Critical Deadlines and Requirements

For Drinking Water Systems	
February 16, 1999	Construction of uncovered finished water reservoirs is prohibited.
March 1999	Public water systems lacking ICR or other occurrence data begin 4 quarters of applicability monitoring for TTHM and HAA5 to determine if disinfection profiling is necessary.
April 16, 1999	Systems that have 4 consecutive quarters of HAA5 occurrence data that meet the TTHM monitoring requirements must submit data to the state to determine if disinfection profiling is necessary.
December 31, 1999	Public water systems with ICR data must submit it to states to determine if disinfection profiling is necessary.
April 1, 2000	Public water systems must begin developing a disinfection profile if their annual average (based on 4 quarters of data) for TTHM is greater than or equal to 0.064 mg/L or HAA5 is greater than or equal to 0.048 mg/L.
March 31, 2001	Disinfection profile must be complete.
January 1, 2002	Surface water systems or ground water under the direct influence of surface water systems serving 10,000 or more people must comply with all IESWTR provisions (e.g., turbidity standards, individual filter monitoring).
For States	
December 16, 2000	States submit IESWTR primacy revision applications to EPA (triggers interim primacy).
January 2002	States begin first round of sanitary surveys.
December 16, 2002	Primacy extension deadline - all states with an extension must submit primacy revision applications to EPA.
December 2004	States must complete first round of sanitary surveys for community water systems.
December 2006	States must complete first round of sanitary surveys for noncommunity water systems.

Public Health Benefits

Implementation of the IESWTR will result in . . .	▸ Increased protection against gastrointestinal illnesses from *Cryptosporidium* and other pathogens through improvements in filtration. ▸ Reduced likelihood of endemic illness from *Cryptosporidium* by 110,000 to 463,000 cases annually. ▸ Reduced likelihood of outbreaks of cryptosporidiosis.
Estimated impacts of the IESWTR include . . .	▸ National total annualized cost: $307 million ▸ 92 percent of households will incur an increase of less than $1 per month. ▸ Less than 1 percent of households will incur an increase of more than $5 per month (about $8 per month).

For additional information on the IESWTR:

Call the Safe Drinking Water Hotline at 1-800-426-4791, visit the EPA web site at www.epa.gov/safewater, or contact your State drinking water representative.

Additional material is available at www.epa.gov/safewater/mdbp/implementation.html.

EPA
United States
Environmental Protection
Agency

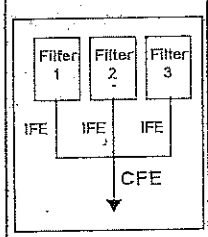
Long Term 1 Enhanced Surface Water Treatment Rule: A Quick Reference Guide

Overview of the Rule

Title	Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) 67 FR 1812, January 14, 2002, Vol. 67, No. 9
Purpose	Improve public health protection through the control of microbial contaminants, particularly *Cryptosporidium*. Prevent significant increases in microbial risk that might otherwise occur when systems implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.
General Description	Builds upon the requirements of the 1989 Surface Water Treatment Rule (SWTR). Smaller system counterpart of the Interim Enhanced Surface Water Treatment Rule (IESWTR).
Utilities Covered	Public water systems that use surface water or ground water under the direct influence of surface water (GWUDI) and serve fewer than 10,000 people.

Major Provisions

Control of *Cryptosporidium*	▸ The maximum contaminant level goal (MCLG) is set at zero. ▸ Filtered systems must physically remove 99% (2-log) of *Cryptosporidium*. ▸ Unfiltered systems must update their watershed control programs to minimize the potential for contamination by *Cryptosporidium* oocysts. ▸ *Cryptosporidium* is included as an indicator of GWUDI.
Combined Filter Effluent (CFE) Turbidity Performance Standards	*Specific CFE turbidity requirements depend on the type of filtration used by the system.* <u>Conventional and direct filtration:</u> ▸ ≤ 0.3 nephelometric turbidity units (NTU) in at least 95% of measurements taken each month. ▸ Maximum level of turbidity: 1 NTU. <u>Slow sand and diatomaceous earth (DE) filtration:</u> ▸ Continue to meet CFE turbidity limits specified in the SWTR: • 1 NTU in at least 95% of measurements taken each month. • Maximum level of turbidity: 5 NTU. <u>Alternative technologies (other than conventional, direct, slow sand, or DE):</u> ▸ Turbidity levels are established by the State based on filter demonstration data submitted by the system. • State-set limits must not exceed 1 NTU (in at least 95% of measurements) or 5 NTU (maximum).



Turbidity Monitoring Requirements

Combined Filter Effluent	▸ Performed at least every 4 hours to ensure compliance with CFE turbidity performance standards.[1]
Individual Filter Effluent (IFE) (for systems using conventional and direct filtration only)	*Since the CFE may meet regulatory requirements even though one filter is producing high turbidity water, the IFE is measured to assist conventional and direct filtration treatment plant operators in understanding and assessing individual filter performance.* ▸ Performed continuously (recorded at least every 15 minutes). ▸ Systems with two or fewer filters may conduct continuous monitoring of CFE turbidity in place of individual filter effluent turbidity monitoring. ▸ Certain follow-up actions are required if the IFE turbidity (or CFE for systems with two filters) exceeds 1.0 NTU in 2 consecutive readings or more (i.e., additional reporting, filter self-assessments, and/or comprehensive performance evaluations (CPEs)).

For additional information on the LT1ESWTR

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA web site at www.epa.gov/safewater/mdbp/lt1eswtr.html; or contact your State drinking water representative.

[1] This frequency may be reduced by the State to once per day for systems using slow sand/alternative filtration or for systems serving 500 persons or fewer regardless of the type of filtration used.

Disinfection Profiling and Benchmarking Requirements

Community and non-transient non-community public water systems must evaluate impacts on microbial risk before changing disinfection practices to ensure adequate microbial protection is maintained. This is accomplished through a process called disinfection profiling and benchmarking.

What are the disinfection profiling and benchmarking requirements?

- Systems must develop a disinfection profile, which is a graphical compilation of weekly inactivation of *Giardia lamblia*, taken on the same calendar day each week over 12 consecutive months. (Systems using chloramines, ozone, or chlorine dioxide for primary disinfection must also calculate inactivation of viruses). Results must be available for review by the State during sanitary surveys.
- A State may deem a profile unnecessary if the system has sample data collected after January 1, 1998–during the month of warmest water temperature and at maximum residence time in the distribution system–indicating TTHM levels are below 0.064 mg/L and HAA5 levels are below 0.048 mg/L.
- Prior to making a significant change to disinfection practices, systems required to develop a profile must calculate a disinfection benchmark and consult with the State. The benchmark is the calculation of the lowest monthly average of inactivation based on the disinfection profile.

Additional Requirements

- Construction of new uncovered finished water reservoirs is prohibited.

Critical Deadlines and Requirements

For Drinking Water Systems

March 15, 2002	Construction of uncovered finished reservoirs is prohibited.
July 1, 2003	No later than this date, systems serving between 500-9,999 persons must report to the State: ▸ Results of optional monitoring which show levels of TTHM < 0.064 mg/L and HAA5 < 0.048 mg/L, OR ▸ System has started profiling.
January 1, 2004	No later than this date, systems serving fewer than 500 persons must report to the State: ▸ Results of optional monitoring which show levels of TTHM < 0.064 mg/L and HAA5 < 0.048 mg/L, OR ▸ System has started profiling.
June 30, 2004	Systems serving between 500 and 9,999 persons must complete their disinfection profile unless the State has determined it is unnecessary.
December 31, 2004	Systems serving fewer than 500 persons must complete their disinfection profile unless the State has determined it is unnecessary.
January 14, 2005	Surface water systems or GWUDI systems serving fewer than 10,000 people must comply with the applicable LT1ESWTR provisions (e.g., turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).

For States

January 2002	As per the IESWTR, States begin first round of sanitary surveys (at least every 3 years for community water systems and every 5 years for non-community water systems).
October 14, 2003	States are encouraged to submit final primacy applications to EPA.
January 14, 2004	Final primacy applications must be submitted to EPA unless granted an extension.
December 2004	States must complete first round of sanitary surveys for community water systems (as per the IESWTR).
January 14, 2006	Final primacy revision applications from States with approved 2-year extension agreements must be submitted to EPA.
December 2006	States must complete first round of sanitary surveys for non-community water systems (as per the IESWTR).

Public Health Benefits

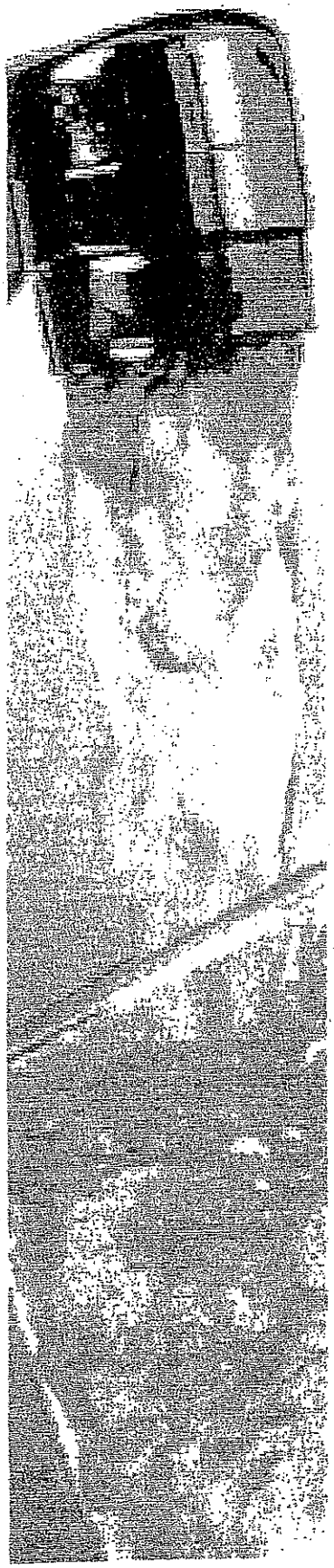
Implementation of the LT1ESWTR will result in . . .	▸ Increased protection against gastrointestinal illnesses from *Cryptosporidium* and other pathogens through improvements in filtration. ▸ Reduced likelihood of endemic illness from *Cryptosporidium* by an estimated 12,000 to 41,000 cases annually. ▸ Reduced likelihood of outbreaks of cryptosporidiosis.
Estimated impacts of the LT1ESWTR include . . .	▸ National total annualized cost: $39.5 million. ▸ 90% of affected households will incur an increase of less than $1.25 per month. ▸ One percent of affected households are likely to incur an increase of more than $10 per month.

United States Environmental Protection Agency

Office of Water (4606)

EPA 816-F-01-010
May 2001
www.epa.gov/safewater

EPA



Stage 1 Disinfectants and Disinfection Byproducts Rule: A Quick Reference Guide

Overview of the Rule

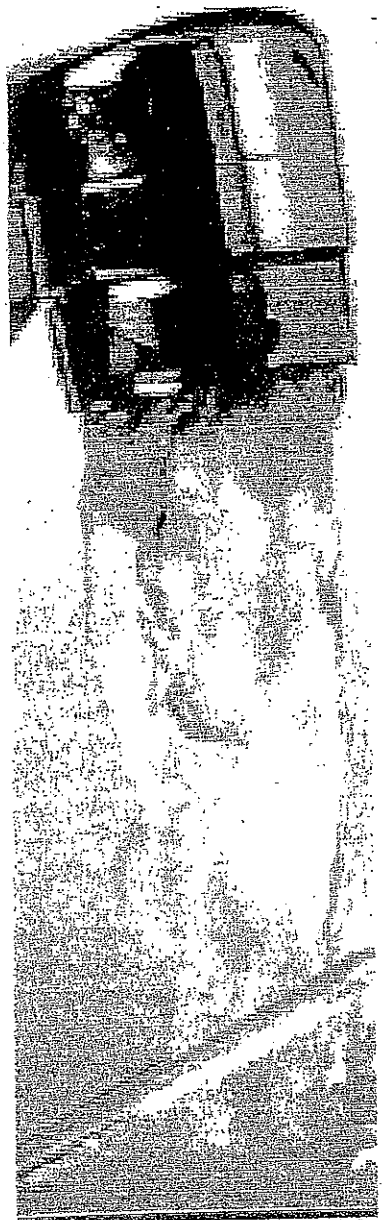
Title	Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR) 63 FR 69390 - 69476, December 16, 1998, Vol. 63, No. 241 Revisions to the Interim Enhanced Surface Water Treatment Rule (IESWTR), the Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR), and Revisions to State Primacy Requirements to Implement the Safe Drinking Water Act (SDWA) Amendments 66 FR 3770, January 16, 2001, Vol 66, No. 29
Purpose	Improve public health protection by reducing exposure to disinfection byproducts. Some disinfectants and disinfection byproducts (DBPs) have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans.
General Description	The Stage 1 DBPR is the first of a staged set of rules that will reduce the allowable levels of DBPs in drinking water. The new rule establishes seven new standards and a treatment technique of enhanced coagulation or enhanced softening to further reduce DBP exposure. The rule is designed to limit capital investments and avoid major shifts in disinfection technologies until additional information is available on the occurrence and health effects of DBPs.
Utilities Covered	The Stage 1 DBPR applies to all sizes of community water systems and nontransient noncommunity water systems that add a disinfectant to the drinking water during any part of the treatment process and transient noncommunity water systems that use chlorine dioxide.

Public Health Benefits

Implementation of the Stage 1 DBPR will result in . . .	▸ As many as 140 million people receiving increased protection from DBPs. ▸ 24 percent average reduction nationally in trihalomethane levels. ▸ Reduction in exposure to the major DBPs from use of ozone (DBP = bromate) and chlorine dioxide (DBP = chlorite).
Estimated impacts of the Stage 1 DBPR include . . .	▸ National capital costs: $2.3 billion ▸ National total annualized costs to utilities: $684 million ▸ 95 percent of households will incur an increase of less than $1 per month. ▸ 4 percent of households will incur an increase of $1-10 per month. ▸ <1 percent of households will incur an increase of $10-33 per month.

Critical Deadlines and Requirements

For Drinking Water Systems	
January 1, 2002	Surface water systems and ground water systems under the direct influence of surface water serving ≥ 10,000 people must comply with the Stage 1 DBPR requirements.
January 1, 2004	Surface water systems and ground water systems under the direct influence of surface water serving < 10,000, and all ground water systems must comply with the Stage 1 DBPR requirements.
For States	
December 16, 2000	States submit Stage 1 DBPR primacy revision applications to EPA (triggers interim primacy).
December 16, 2002	Primacy extension deadline - all states with an extension must submit primacy revision applications to EPA.



For additional information on the Stage 1 DBPR

Call the Safe Drinking Water Hotline at 1-800-426-4791, visit the EPA web site at www.epa.gov/safewater, or contact your State drinking water representative.

Additional material is available at www.epa.gov/safewater/mdbp/implement.html.

Regulated Contaminants/Disinfectants

Regulated Contaminants	MCL (mg/L)	MCLG (mg/L)
Total Trihalomethanes (TTHM)	0.080	
Chloroform		-
Bromodichloromethane		zero
Dibromochloromethane		0.06
Bromoform		zero
Five Haloacetic Acids (HAA5)	0.060	
Monochloroacetic acid		-
Dichloroacetic acid		zero
Trichloroacetic acid		0.3
Bromoacetic acid		-
Dibromoacetic acid		-
Bromate (plants that use ozone)	0.010	zero
Chlorite (plants that use chlorine dioxide)	1.0	0.8

Regulated Disinfectants	MRDL (mg/L)	MRDLG (mg/L)
Chlorine	4.0 as Cl_2	4
Chloramines	4.0 as Cl_2	4
Chlorine dioxide	0.8	0.8

*Stage 1 DBPR includes maximum residual disinfectant levels (MRDLs) and maximum residual disinfectant level goals (MRDLGs) which are similar to MCLs and MCLGs, but for disinfectants.

Treatment Technique
Enhanced coagulation/enhanced softening to improve removal of DBP precursors (See Step 1 TOC Table) for systems using conventional filtration treatment.

Step 1 TOC Table - Required % Removal of TOC

Source Water TOC (mg/L)	Source Water Alkalinity, mg/L as $CaCO_3$		
	0-60	> 60-120	> 120
> 2.0 to 4.0	35.0%	25.0%	15.0%
> 4.0 to 8.0	45.0%	35.0%	25.0%
> 8.0	50.0%	40.0%	30.0%

[1] Systems meeting at least one of the alternative compliance criteria in the rule are not required to meet the removals in this table.

[2] Systems practicing softening must meet the TOC removal requirements in the last column to the right

Routine Monitoring Requirements

	Coverage	Monitoring Frequency	Compliance
TTHM/HAA5	Surface and ground water under the direct influence of surface water serving ≥ 10,000	4/plant/quarter	Running annual average
	Surface and ground water under the direct influence of surface water serving 500 - 9,999	1/plant/quarter	Running annual average
	Surface and ground water under the direct influence of surface water serving < 500	1/plant/year in month of warmest water temperature**	Running annual average of increased monitoring
	Ground water serving ≥ 10,000	1/plant/quarter	Running annual average
	Ground water serving < 10,000	1/plant/year in month of warmest water temperature**	Running annual average of increased monitoring
Bromate	Ozone plants	Monthly	Running annual average
Chlorite	Chlorine dioxide plants	Daily at entrance to distribution system; monthly in distribution system	Daily/follow-up monitoring
Chlorine dioxide	Chlorine dioxide plants	Daily at entrance to distribution system	Daily/follow-up monitoring
Chlorine/Chloramines	All systems	Same location and frequency as TCR sampling	Running annual average
DBP precursors	Conventional filtration	Monthly for total organic carbon and alkalinity	Running annual average

** System must increase monitoring to 1 sample per plant per quarter if an MCL is exceeded.

ADDENDUM NO. 1

THIS ADDENDUM made and entered into this the 10th day of October, 1997, by and between THE TOWN OF NAGS HEAD, a body politic; THE TOWN OF KILL DEVIL HILLS, a body politic; and THE COUNTY OF DARE, a body politic.

NOTWITHSTANDING the provisions of the first paragraph of Section 18 of that certain Agreement between the above named parties dated June 30, 1996, Dare County is allowed to sell emergency water outside the boundaries of Dare County under the following conditions:

(1) The purchasing system as comprised at the time of the emergency request is able to certify that regardless of cause it is unable to provide to its users 100% of its maximum production as determined by the peak production day from the prior year. The prior year's peak production day less the amount the purchasing system is capable of supplying per day to its customers shall determine the maximum amount of emergency water Dare County can sell per day to the purchasing system.

(2) That the Towns of Nags Head and Kill Devil Hills be notified within 30 days of any such sales, the amount of water being sold, the cause of the purchasing system's shortfall, and the total amount of water being supplied to customers of the purchasing system.

(3) That no sales of water by Dare County outside the County will be allowed if water restrictions are in place due to an emergency or seasonal variation as specified in the above referenced Agreement or if Dare County has reduced, for any reason, its system capacity as defined in the above referenced Agreement.

(4) Any emergency water sold under the provisions of this Addendum shall be sold at no less than the Dare County retail rate.

(5) Dare County shall, within twelve (12) months of the date of this amendment, have conducted and completed, by a qualified hydrogeologist or hydrogeologic firm, a study showing that there is sufficient raw water available from the sources now supplying raw water under the tri-party agreement with Dare County. The costs of such study shall not be reflected in the costs of water to Nags Head or Kill Devil Hills.

(6) This Addendum shall become null and void upon the completion of the above-referenced study and its presentation to the Dare County Board of Commissioners at a public meeting.

This Addendum shall be executed in three counterparts with each of the parties retaining an executed counterpart.

IN WITNESS WHEREOF, the parties hereto have set their hands and seals the day and year first written above.

COUNTY OF DARE

By: _____
Chairperson
Board of Commissioners

ATTEST:

_____
Clerk

TOWN OF NAGS HEAD

By: _____
Mayor

ATTEST:

_____
Clerk

TOWN OF KILL DEVIL HILLS

By: _____
Mayor

ATTEST:

_____
Clerk

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NORTH CAROLINA
DARE COUNTY

THIS AGREEMENT made and entered into this the 30th day of June, 1996, by and between The Town of Nags Head, a body politic, (hereinafter NH); The Town of Kill Devil Hills, a body politic, (hereinafter KDH); and The County of Dare, a body politic, (hereinafter DC).

W I T N E S S E T H :

WHEREAS, the parties hereto have previously entered into certain oral and written agreements concerning the construction, operation, maintenance, expansion, and ownership of certain water production facilities located within the corporate boundaries of the parties, and have entered certain oral and written agreements concerning the production, allocation, pricing formulas and supply of water to and within each of the entities; and

WHEREAS, disagreements between the parties have arisen as to the interpretation of such previous agreements; and

WHEREAS, the parties now desire to enter into a new agreement, superseding and replacing all previous agreements between the parties concerning the matters referred to above.

NOW, THEREFORE, in consideration of the mutual terms and conditions contained herein, the parties enter into the following agreement:

1. SCOPE OF AGREEMENT: This agreement is the sole agreement among the parties concerning the construction, operation, maintenance, expansion, and ownership of the water production facilities and their appurtenances. This agreement is also the sole agreement among the parties concerning the allocation of certain water resources within the entities and the sale and use of treated water by the parties. This agreement is also the sole agreement among the parties concerning the allocation of the raw water resources set forth below. This agreement supersedes and replaces all other agreements between the parties, whether written or oral, concerning such matters. The water production facilities which are the subject of this agreement are commonly known as: (a) the Reverse Osmosis Plant in Kill Devil Hills (hereinafter RO Plant), (b) the water production plant located in Skyco (hereinafter Skyco Plant), and (c) the Fresh Pond water production facility located in Nags Head (hereinafter Fresh Pond Plant), including the real property upon which such facilities lie, and all appurtenances including, but not limited to buildings, wells,

pumps, storage tanks, pipelines, vehicles, tools, equipment, chemicals and all other personal property associated with the

facilities or the operation, maintenance, production and supply of water from such facilities. The raw water resources which are the subject of this agreement are: (a) the Fresh Pond located in NH and KDH, (b) the aquifer from which the Skyco Plant withdraws water, and (c) the aquifer from which the RO Plant withdraws water. This agreement specifically excludes the Rodanthe RO Plant as well as any other water production facility or water resource which is not set forth above.

2. EFFECT ON PAST AGREEMENTS: Unless otherwise provided herein, upon execution of this agreement, all obligations or liabilities of the parties pursuant to any previous written or oral agreement, concerning the matters and things which are the subject of this agreement, shall become null and void.

3. OWNERSHIP SKYCO PLANT: The Skyco Plant and its appurtenances as described in paragraph 1 above, together with the real property upon which the plant and its appurtenances lie, including, but not limited to, all wells used to withdraw water for the Skyco Plant, together with all pumps, pipelines, and other fixtures necessary to withdraw water from such wells and transport it to the Skyco Plant, shall be the sole property of DC. NH and KDH agree to execute such documents, if any, that may be reasonably necessary, in the opinion of the DC attorney, to vest legal title to such property in DC. Except as otherwise provided in this agreement, DC shall be responsible for all costs, expenses and liabilities necessary to operate, maintain and repair such property as well as any and all other obligations or liabilities associated with such property and agrees to forever indemnify and hold harmless the other parties from payment of the same.

4. OWNERSHIP FRESH POND PLANT: The Fresh Pond Plant and its appurtenances as described in Paragraph 1 above, together with the real property upon which the plant and its appurtenances lie, shall be the sole property of NH. DC and KDH agree to execute such documents, if any, that may be reasonably necessary, in the opinion of the NH attorney, to vest legal title to such property in NH. The real property upon which the Fresh Pond lies shall remain the property of NH and KDH respectively, as their interests shall appear. Except as otherwise provided in this agreement, NH shall be responsible for all costs, expenses and liabilities necessary to operate, maintain and repair such plant as well as any and all other obligations or liabilities associated with such plant and agrees to forever indemnify and hold harmless the other parties from payment of the same

5. OWNERSHIP RO PLANT: The RO plant and its appurtenances as described in Paragraph 1 above, together with the real property

upon which the plant and its appurtenances lie, including, but not limited to, all wells and well sites used to withdraw water for the RO Plant, (excluding the well sites leased pursuant to Paragraph 8 below) together with all pumps, pipelines, and other fixtures necessary to withdraw water from all wells (whether leased or owned by DC) and transport it to the RO and Skyco Plants, shall be the sole property of DC. NH and KDH agree to execute such documents as may be reasonably necessary, in the opinion of the DC attorney, to vest legal title to such property unto DC. Except as otherwise provided in this agreement, DC shall be responsible for all costs, expenses and liabilities necessary to operate, maintain and repair such property as well as any and all other obligations or liabilities associated with such property and agrees to forever indemnify and hold harmless the other parties from payment of the same.

6. OWNERSHIP DISTRIBUTION SYSTEMS: The water distribution system used by each of the parties to distribute water to its customers shall be the sole property of that party. The water distribution system of each party means all property, real or personal, associated with the distribution of water to customers of the parties and includes, but is not limited to, all water storage tanks, pipelines, pumps, vehicles, tools, fixtures, and equipment associated with the distribution of water by the parties to this agreement.

7. COSTS AND EXPENSES ASSOCIATED WITH DISTRIBUTION SYSTEMS: Each of the parties shall be responsible for all costs, expenses or liabilities necessary to, or associated with, the operation, maintenance, replacement, upgrade and repair to its respective distribution system and shall forever indemnify and hold harmless the other parties from payment of the same.

8. OWNERSHIP AND LEASE OF CURRENT WELL SITES: All well sites (for both production wells and monitoring wells) currently in use and located upon property owned by NH or KDH shall remain the property of NH or KDH. (All pumps, pipes, equipment and other personal property or fixtures located upon such well sites shall be the property of DC). Such well sites shall be leased by NH and KDH to DC for an annual lease payment of one dollar per year, for a term equal to the length of this agreement plus any renewals, plus five years. DC shall be responsible for the operation, maintenance and repair of such wells and well sites. NH and KDH agree to grant unto DC such easements as may be reasonably necessary, across properties owned by NH or KDH, to allow DC access to such well sites for the operation, maintenance and repair; and also for the purpose of transporting water from the well sites to the production facilities set forth above. All well sites (for both production wells and monitoring wells) located upon property owned by DC or by anyone other than NH or KDH shall be the property of DC.

9. OWNERSHIP OF OTHER PROPERTY: All other pipelines, pumps, fixtures, equipment, tools, chemicals, inventory, or other personal property, tangible or intangible, not otherwise provided for in this agreement, which are a part of or used in connection with, the water withdrawal, production or supply systems and which are not a part of the distribution system of any of the parties hereto or a part of the Fresh Pond Plant, shall be the property of DC.

10. PRODUCTION OF WATER: DC shall be solely responsible for the production of water to be supplied to KDH and NH. DC shall be responsible for all costs of production and shall pay the costs of all labor, equipment, material, or other expenses associated with the production of water (except for the production of water from the Fresh Pond Plant which shall be the responsibility of NH) unless otherwise provided in this agreement. NH shall be responsible for the production of water from the Fresh Pond and shall sell such water produced to DC upon the terms and conditions set forth in this agreement. NH shall be responsible for the cost of all labor, materials, equipment, or other expenses associated with the production of water from the Fresh Pond, unless otherwise provided in this agreement.

11. OBLIGATION TO SUPPLY WATER: DC shall supply water to NH and KDH, in the quantities, at the price, and upon the terms set forth in this agreement. NH shall supply water only to DC from the Fresh Pond, in the quantities, at the price and upon the terms set forth in this agreement.

12. DC SOLE SUPPLIER OF WATER: The parties acknowledge and agree that DC is the sole supplier of water from the resources which are the subject matter of this agreement and that NH and KDH shall not be allowed to supply water to any entity outside their municipal boundaries, except those customers who, as of the date of this agreement are outside those boundaries and are receiving water from NH or KDH.

13. WATER QUALITY: Water supplied to NH and KDH by DC shall be potable and shall meet all State, Federal or other governmental water quality requirements at the point where the water leaves the DC water supply system. DC agrees that it will cooperate with NH and KDH to deliver a mix of RO water and non-RO water to allow KDH and NH to meet all State, Federal or other governmental water quality regulations at the tap, so long as such mix can be safely maintained without damage to the water supply sources or production equipment (as determined by DC) and does not increase the wholesale water rate set forth below by more than five per cent within any annual rate cycle. In addition, DC shall not otherwise change the mix of RO and non RO water such that the DCWWR shall increase by more than five per cent in any annual rate cycle, unless (a) the change in such mix is necessary to provide potable water to all of the parties to this agreement, (b) is necessary to protect or prevent damage to any of the raw water sources which are the

subject matter of this agreement, or (c) is necessary to provide any of the parties to this agreement their allocated amounts of water. The average mix of RO and non-RO water for the twelve month period prior to the date of this agreement shall be the base from which changes in the mix shall be initially calculated. Except as provided herein, the mix of RO and non-RO water shall be in the discretion of DC. Except as provided in this paragraph, DC shall have no responsibility for water quality at the "tap" of any customers of NH and KDH, and NH and KDH shall hold DC harmless from such liability. Water supplied to DC by NH shall be potable and shall meet all State, Federal or other governmental water quality requirements at the point where the water leaves the NH water supply system and enters the DC supply systems.

14. DELIVERY OF WATER TO TOWNS: DC agrees to deliver water to NH and KDH at a flow adequate to deliver each town's allocated amount of water. DC shall have no responsibility or liability for maintaining water pressure within NH or KDH.

15. SYSTEM CAPACITY: System capacity shall mean the amount of water that the system can safely produce on peak days, as determined by DC, but shall not be less than nine million five hundred thousand gallons per day so long as the raw water sources which are the subject matter of this agreement can be safely pumped to produce sufficient raw water to provide such capacity. The parties acknowledge and agree that the water supply system which is the subject of this agreement consists of the Skyco Plant, the RO Plant and the Fresh Pond Plant. The parties further acknowledge and agree that the peak system capacity to produce water, without further improvements, at the time of execution of this agreement, is nine million five hundred thousand gallons per day. (1.5 million gallons per day from the Fresh Pond Plant, 3 million gallons per day from the RO Plant and 5 million gallons per day from the Skyco Plant).

16. WATER ALLOCATION: NH shall be allocated three million five hundred thousand gallons per day of the system capacity. KDH shall be allocated three million gallons per day of the system capacity. Such allocations may be increased or decreased only pursuant to other provisions of this agreement.

17. OBLIGATION TO SUPPLY ALLOCATED WATER: DC shall provide to NH and KDH, at the point of connection with DC, their respective allocated water, upon demand. It shall be the responsibility and duty of DC to produce sufficient potable water, so long as suitable raw water supplies are available, and to provide NH and KDH their allocation of water as calculated by the terms of this agreement, and DC shall bear all costs associated with the production and delivery of such water, except as otherwise provided in this agreement.

18. DC USE OF ALLOCATED OR UNALLOCATED WATER: Except as otherwise provided in this agreement, all water produced and unused, whether allocated to NH and KDH or not, may be used in any manner and for any purpose by DC. DC may not sell or supply water outside the boundaries of Dare County, unless it is scientifically determined by a qualified hydrogeologist or hydrogeologic firm, that there is sufficient raw water available, from the sources now supplying raw water or from such other sources as may become available in the future, to meet the unused portion of NH's and KDH's maximum expansion capacity as defined in Paragraph 19.

Except as otherwise provided in this agreement, in the event that the demand for water from the system by all of the parties hereto exceeds the system capacity and NH and/or KDH have not exceeded their allocation of water as set forth in this agreement, DC shall have the obligation to either expand the system capacity, at its own cost, to meet the system demand, or to reduce its consumption of water such that the total demand of the parties does not exceed the system capacity and the Towns can receive their allocated amounts of water.

19. EXPANSION OF PRODUCTION FACILITIES: Except as otherwise provided in this agreement, in the event that the system is producing at ninety percent of its capacity on 2 consecutive days in the previous twelve months, DC shall immediately begin work to expand the production system, in not less than one million gallon per day increments. If either KDH or NH have exceeded their allocated amount of water on two consecutive days in the previous twelve month period, then, except as provided in this paragraph and in Paragraph 34, the Town or Towns which exceeded their allocated amount shall pay unto DC all costs and expenses associated with such expansion as they become due.

DC may on its own, and shall, upon request of either town or upon a required expansion as provided above, expand the RO water production system, in not less than 1 million gallon per day increments, such expansions not to exceed 2 million gallons per day in capacity for NH and 1 million gallons per day in capacity for KDH. NH shall not be permitted to expand the system by greater than 2 million gallons per day and KDH shall not be permitted to expand the system by more than 1 million gallons per day. DC shall not be allowed to expand the system by more than 2 million gallons per day without first determining, by a qualified hydrologist or engineering firm qualified in hydrology, that upon such expansion there shall remain sufficient raw water available, from the sources now supplying raw water or from such other sources as may become available in the future, to meet the unused portion of NH's and KDH's maximum expansion capacity as defined herein.

DC shall pay all costs of any expansion not requested or required by either NH or KDH. The town requesting or requiring the additional expansion shall bear all costs and expenses associated

with such expansion. In lieu of expanding the RO production facilities as provided above, DC shall have the option to provide water from other sources, to the town or towns, in an amount equal to the amount of water which would be received by the town if the expansion of the RO production facilities were completed. If DC elects not to expand the RO production facilities, but to provide water from another source, the town or towns requesting or requiring such expansion shall pay the cost and expenses associated with procuring water from such other source, up to and not in excess of the costs to expand had DC elected to expand the RO production facilities. In the event the cost of expansion using such other sources is less than the cost of expanding the RO production facilities, the town or towns requesting or requiring expansion shall pay the lesser cost.

Upon the completion of the expansion, the system capacity and the water allocation of the party which paid for the expansion shall be increased by the number of gallons the system was expanded. In the event that more than one of the parties contributed to the expansion costs, their respective water allocation shall be increased by the percentage of the costs paid by each party times the number of gallons added to the system by the expansion.

Not withstanding the foregoing, if any expansion required or requested under this paragraph requires DC to expand the building housing the RO Plant, the cost of expanding the building shall be borne by DC.

20. TOWNS USE OF UNUSED BUT ALLOCATED WATER: In the event that either NH or KDH is using less than its allocation of water as provided herein, and the other has demand for more than its allocation of water, the town with excess demand may use the unused allocation of the other town, so long as the combined use to NH and KDH does not exceed the combined allocation of water to NH and KDH. This paragraph shall not exempt any of the parties hereto from the expansion requirements set forth in Paragraph 19 above.

21. NON SEASONAL REDUCTION IN RAW WATER SUPPLY: In the event that the raw water supply available to the three plants specified above shall, for any reason other than seasonal variations, be reduced such that the production capacity of the system on its peak day is less than the design capacity of the system at the time of such reduction, the allocation of water to KDH and NH shall be reduced by a percentage equal to the particular Town's percentage allocation of the system capacity multiplied by the number of gallons that the production capacity of the system is diminished as a result of the reduction in raw water supply. For example, if the production capacity of the system is reduced by 100,000 gallons per day, and KDH's allocation equals 31.6 per cent of the system capacity, KDH's allocation of water shall be reduced by 31,600 gallons per day (31.6% x 100,000 = 31,600).

22. REALLOCATION FROM INCREASE IN PRODUCTION CAPACITY: In the event that the production capacity of the system is increased due to any of the factors used to compute the DC Wholesale Water Rate, (including the membrane reserve fund) and not including "other capital" as defined in Paragraph 33, NH and KDH shall be entitled to a percentage of the increase equal to their percentage allocated prior to the increase in capacity. For example, if the production capacity of the system increases by 100,000 gallons per day, and KDH's allocation equals 31.6 per cent of the system capacity, KDH would be entitled to 31,600 gallons per day of the increased capacity (31.6% x 100,000 = 31,600).

23. INSUFFICIENT RAW WATER FOR EXPANSION: In the event that expansion of the production system is required or is requested as provided in this agreement, and there is, for any reason, insufficient raw water available from the current sources of raw water or any source identified as a source under the expansion guarantees provided in Paragraphs 18 and 19, to meet the expansion requirements, or if governmental regulations prevent such expansion, DC shall not be required to expand the production facility. In such event, NH and KDH shall be entitled to receive up to their allocated amounts of water and any entity that is consuming water in excess of its allocated amount shall reduce its consumption such that upon demand NH and KDH can consume their desired quantity of water up to the amounts of water allocated to NH and KDH. In the event that such reduction does not allow NH and KDH to receive their allocated amount of water, DC shall reduce its consumption such that upon demand NH and KDH can consume their desired quantity of water up to the amounts of water allocated to NH and KDH.

24. SUFFICIENT RAW WATER FOR PARTIAL EXPANSION: In the event that expansion is required or requested as provided in this agreement, and there is, for any reason, sufficient raw water from any source identified as a source under the expansion guarantees provided in Paragraphs 18 and 19 to allow only a portion of the expansion required or requested, or if governmental regulations permit only such partial expansion, then DC shall complete the partial expansion only if such partial expansion is of at least one million gallons per day in capacity or increments of one million gallons per day. Upon completion of such partial expansion the water available to the towns from the partial expansion shall be reallocated, 36.8% to NH, 31.6% to KDH and the balance to DC so long as each entity, at the completion of the expansion has paid a proportional share of the expansion costs. If NH or KDH, at the time of completion of the expansion, has not paid its proportional share of the expansion costs in full, then it shall not be entitled to any additional allocation of water created by the partial expansion, and such additional allocation shall be allocated to the other entity or entities, in proportion to the costs paid.

25. LEASE OR PURCHASE OF FUTURE WELL SITES: The parties acknowledge and agree that there are, at the time of the execution of this agreement, water supply wells located upon lands owned by NH and KDH and that additional RO wells and monitoring wells will be needed for any future expansion of the system. There are currently two or more well sites identified along Well Field Road in Nags Head for such future wells and there may be other sites for future wells located in NH and KDH. NH and KDH agree that they will lease to DC, the existing well sites located in NH or KDH, and NH and KDH agree that they will lease to DC such future well sites identified and located upon property owned by them, (together with any necessary easements along the Town's roads to deliver water from the leased well sites to the production system and to permit access for construction, operation, maintenance or repair to the wells or their appurtenances).

The leases set forth above shall be for a term equal to the term of this agreement plus any renewal periods plus five years, and at a rental rate of one dollar per year. DC may withdraw water from the leased wells during the term of the lease so long as the withdrawal of water from such wells does not have a significant negative impact upon the surficial aquifer of the Nags Head Woods Maritime Forest.

In addition, the parties hereto will cooperate and work together to identify and purchase as many additional RO well sites as may be available within NH or KDH, (not to exceed the number of wells necessary to safely withdraw a sufficient amount of raw water to produce 8 million gallons per day of finished (potable) RO water).

The purchase of such future well sites shall be at a price and upon purchase conditions satisfactory to the parties. In the event that the parties cannot agree upon a purchase price, the purchase price shall be determined in the same manner as if DC were condemning the property, with the purchase price being equal to the amount which would be deposited if DC condemned the property. In the event the owner of a well site and the parties hereto cannot reach an agreement for the purchase and sale of a well site, DC may, at its option, condemn the well site, and the actual amount paid by DC at the completion of the condemnation shall be the purchase price of the property.

Upon purchase of such well sites, legal title to the well sites shall be conveyed to DC. The parties agree that as of June 30, 1995 there is $248,513.00 paid into the water fund existing prior to this agreement and being held by DC. This sum shall be adjusted to reflect the balance as of June 30, 1996 and such balance, as adjusted, shall be used by DC to apply to the purchase or lease price and the closing costs associated with the wells to be acquired pursuant to this paragraph. All costs (including all costs of procurement such as engineering, surveys, scientific

analysis and ~~any other costs necessary to determine the suitability~~ of a site for wells) above such amounts shall be paid equally by the parties.

Notwithstanding the foregoing, DC may at any time, at its own cost, purchase such other well sites as it may deem appropriate.

26. USE OF FUTURE WELLS TO REPLACE LOST CAPACITY: In the event that the pumping capacity of a well in operation on the date of this agreement is reduced for any reason, DC shall be allowed to use future well sites to replace such lost capacity and in such event, DC shall not be required to reimburse NH and KDH for their portion of the purchase price for each future well used and the parties hereto shall each be responsible for and pay one third of the costs associated with the installation of the replacement well.

27. NO IMPEDIMENTS TO ACCESS OR WATER WITHDRAWAL: Except as otherwise provided in this agreement, NH and KDH further agree that they shall take no action to impede access to or withdrawal of water from wells which may be located, now or in the future, within NH or KDH.

28. SEASONAL VARIATIONS IN RAW WATER SUPPLY: In the event of a seasonal variation in the raw water supply due to drought or other seasonal factor, which temporarily reduces the supply of raw water below ninety per cent of system capacity or below the amount produced on the peak day in the prior twelve months, whichever is less, each of the parties shall impose water use restrictions which shall reduce water consumption within the distribution system of each of the parties. The total of the consumption reductions in all of the entities shall equal the reduced capacity of the system. The water use restrictions within the water distribution system of each of the parties shall reduce consumption within that parties water distribution system by an amount equal to the average daily consumption of that parties water distribution system during the peak consumption month of the previous twelve months, divided by the production capacity of the system, multiplied by the number of gallons the systems production capacity is reduced due to the seasonal factor. For the purpose of calculating the water restriction in this provision, and for no other purpose, DC shall be deemed to be allocated the difference between the sum of KDH and NH allocations and the system capacity. DC as the operator shall determine whether a seasonal variation has occurred and whether the water restrictions set forth in this paragraph shall be imposed.

29. DC WHOLESALE WATER RATE: DC shall supply water to NH and KDH in the quantities set forth above. The cost of water to NH and KDH shall be the DC Wholesale Water Rate (DCWWR) times each thousand gallons (rounded to the nearest thousand gallons) delivered by DC from the production system to the distribution system of the respective town. DC shall bill NH and KDH on a monthly basis and such bill shall be due and payable within thirty

days from mailing by DC. Except as provided in DC's contract in effect with the Town of Manteo on the date of this agreement, DC shall not provide water to any entity not a part of the DC distribution system, at a rate less than the DCWWR.

30. CALCULATION DCWWR: Standard rates (all are per thousand gallons) to be used as the DCWWR shall be the previous fiscal year's actual costs divided by the total number of gallons distributed to the distribution systems of the parties using the eligible costs as defined below.

A reconciliation under the terms of Paragraph 32 below shall be performed to reconcile the amounts paid through the use of the above standard rates with the actual costs for the fiscal year for which the standard rates were used.

The costs used to calculate the DCWWR shall be: operating and maintenance costs for the RO Plant Fund (RO Production Plant located in KDH) and the Skyco Production Fund, reasonably related to the production of potable water under this contract; plus administrative overhead for each of those plants as determined by an annual Cost Allocation Plan, calculated by a third party per the requirements of OMB Circular A-87 or its successor and accepted by the North Carolina Department of Human Resources or its successor; plus the annual requirement for membrane reserve for the RO Production Plant, as calculated in Paragraph 31 below; plus the amount for other capital replacement as provided in Paragraph 33 below. Operating and maintenance costs for the Skyco Plant Fund shall include the cost to DC to purchase water from the NH Fresh Pond Plant. Operating and maintenance costs for both the RO Plant Fund and the Skyco Plant Fund shall include capital items which do not meet the definition of "Other Capital Replacement" set forth in Paragraph 33 below.

31. MEMBRANE RESERVE FUND: The annual sum to be paid into the membrane reserve fund by the parties shall be determined by DC as follows: (a) the estimated number of years until membrane replacement will be required; (b) the estimated total future cost of membrane replacement; (c) the amount held as membrane reserve will be deducted from the total estimated future replacement cost (item (b)); and (d) the result from the calculation in (c) shall be divided by (a) to determine the total annual membrane reserve fund (total costs captured divided by years remaining until replacement). The amount held as membrane reserve as of the date of this agreement is $343,357.00. This sum shall be adjusted to reflect the balance as of June 30, 1996.

32. RECONCILIATION OF DCWWR: At the end of the DC fiscal year, and no later than November 15th, actual expenditures shall be reconciled against amounts provided by the standard rates set forth above. (For the purpose of this paragraph, actual expenditures shall mean the actual amount of money spent by DC for the eligible costs plus other allowable cost items as provided in Paragraph 30

above) In the event that the DCWWR using actual expenditures is greater than the DCWWR using the standard rates set forth above, the difference between what the Towns actually paid DC for water during the previous fiscal year and the DCWWR calculated using actual expenditures and applied to the water received by the Towns in the previous fiscal year, shall be due and owing from the Towns to DC. DC shall bill the Towns for such sums and such bill shall be due 30 days from mailing. In the event that DCWWR calculated using actual expenditures is less than the DCWWR using the standard rates set forth above, the difference between DCWWR using actual expenditures and applied to the water received by the Towns during the previous fiscal year, and the amount paid to DC by the Towns in the previous fiscal year, shall be due and owing from DC to the Towns within 30 days from the date the financial information necessary to recalculate the DCWWR is received by the Towns. Interest shall accrue on all receivables due to the Towns or to DC at a rate equal to the seven day yield offered by the North Carolina Capital Management Trust Cash Portfolio, or its successor, as of July 1st of the fiscal year which is ending. Such interest shall be calculated on such receivables from the preceding January 1st until paid. Prior to mailing a bill or statement, DC shall make its records used in calculating the DCWWR available to NH and KDH, in order for NH and KDH to verify such figures and calculations.

33. OTHER CAPITAL REPLACEMENT: The term "Other Capital Replacement" used in the calculation of DCWWR shall mean any equipment, fixtures, machinery, tools or other personal property or real property improvements, whether purchased or leased, which have a useful life greater than five years or which costs ten thousand dollars or more. The ten thousand dollar limitation set forth in this paragraph shall be adjusted annually for inflation by the percentage increase or decrease in the Consumer Price Index for the Southeastern Region on the first day of each fiscal year. The increased or decreased amount shall be the threshold for that fiscal year. The value for "Other Capital Replacement" to be used in the calculation of the DCWWR shall be $335,000.00.

MISCELLANEOUS

34. EMERGENCIES: The parties acknowledge that emergency situations, such as fires, water line breaks, tornadoes, hurricanes and other such unanticipated short term events, may occur from time to time. When such events occur, the distribution system or systems in which the emergency occurred shall be allowed to exceed their allocated water amounts in order to meet the emergency needs. The excess use of water during the emergency shall not count as a "consecutive day" or a "peak use day" and shall not trigger the required expansion set forth in Paragraph 19 above. The distribution system or systems in which the emergency occurs shall take reasonable efforts to conserve water and to isolate and repair water line breaks as quickly as possible. In such emergency

situations, if DC determines that the supply of water does not meet the demand for water in all distribution systems, DC may in its discretion declare such event a "Seasonal Variation" and water restrictions shall be imposed in all distribution systems of the parties hereto as provided in Paragraph 28 above.

35. TERM: This agreement shall remain in effect for a period forty years from the date hereof. At the end of the forty year term or any renewals, this agreement shall renew for additional twenty year terms. Either of the Towns may elect to withdraw from this agreement at the end of the initial term or at the end of any renewal term, provided the Town gives DC and the other Town written notice of its intent to withdraw from the contract five years before the expiration of the initial term or any renewal term. Upon withdrawal from this agreement, no sums paid pursuant to this agreement shall be refunded to the withdrawing Town except any refunds due to a Town from the reconciliation of the wholesale water rate as set forth in Paragraph 32 above , and all property, real or personal, tangible or intangible owned by any of the entities shall remain the property of that entity.

36. EXISTING OBLIGATIONS OF TOWNS: NH and KDH each agree to make their five remaining annual payments to DC of $76,231.00 each, on the 31st day of December each year through and including the 31st day of December, 2001. These sums represent the remaining payments due for the water rights and allocations provided under the terms of this agreement.

37. FRESH POND WHOLESALE WATER RATE: NH shall sell unto DC, water from its Fresh Pond Plant. Such water shall be potable and shall meet all state, federal or other governmental water quality requirements for potable water. DC shall be allowed to purchase as much water as the Fresh Pond Plant can safely produce, and a minimum of 1.5 million gallons per day, so long as sufficient raw water can be safely withdrawn from the fresh pond. The cost of such water to DC shall be the Fresh Pond Wholesale Water Rate (FPWWR) times each one thousand gallons of water, rounded to the nearest one thousand gallons, delivered to DC. The FPWWR shall be calculated using the same formula used to calculate the DCWWR in Paragraph 30 above, except that (a) the Fresh Pond Plant shall be substituted for the RO and Skyco Plants, (b) all records used in calculating the formula shall be the records of NH related to the Fresh Pond Plant, (c) no factor for membrane replacement shall be used, (d) no factor for the cost of Fresh Pond water shall be used, and (e) the cost for "other capital replacement" shall be paid as provided in Paragraph 38 below and shall not be used as a factor in computing FPWWR.

38. NH CAPITAL REPLACEMENT ITEMS: The parties agree that there is currently $146,809.00 being held by NH in the Fresh Pond Fund. This sum shall be adjusted to reflect the balance as of June 30, 1996. The costs of "Other Capital Replacement", as defined in

Paragraph 33 above, for the Fresh Pond Plant, shall be paid first with the proceeds of the Fresh Pond Fund. Thereafter, (a) if the cost of Other Capital Replacement is less than $100,000.00 in any calendar year, such cost shall be paid one third by NH, one third by DC and one third by KDH, as they become due, (b) if the cost of Other Capital Replacement is greater than $100,000.00, DC and KDH shall not be obligated to contribute to such costs in any calendar year, without their consent. If DC or KDH shall elect not to pay such costs in excess of $100,000.00, the 1.5 million capacity of the Fresh Pond Plant shall be allocated to the party or parties who paid such costs in a percentage equal to the amount paid for such costs and the overall allocation of water to the parties as provided in this agreement shall be adjusted accordingly for so long as the Fresh Pond Plant is producing water. Not withstanding other provisions of this agreement, if the Fresh Pond Plant is closed permanently, the allocation of water to all the parties, prior to any adjustments as provided in this paragraph, shall be reduced by one third of the Fresh Pond capacity (as defined in Paragraph 15 above).

39. RECONCILIATION OF FPWWR: At the end of the NH fiscal year, and no later than October 15th, actual expenditures shall be reconciled against standard rates, using the same method set forth in Paragraph 32 above. If actual expenditures are greater than standard rates, DC shall pay NH, within 30 days from the mailing of a bill, the difference between the FPWWR calculated using actual expenditures and applied to water received by DC from NH during the previous fiscal year and the amount paid by DC to NH during the previous fiscal year. If actual expenditures are less than the standard rates, NH shall pay DC, within 30 days from NH receipt of the financial information necessary to perform such reconciliation, the difference between the FPWWR calculated using actual expenditures applied to the quantity of water received by DC during the previous fiscal year and the amount paid to NH by DC for water during the previous fiscal year. Not less than 30 days prior to the date that DC is required to make its records used in calculating the DCWWR available to NH and KDH, NH shall make all records, used to determine the figures to be inserted in the foregoing formula, and used in the year end reconciliation available to DC and KDH in order for DC and KDH to verify such figures and calculations. Interest shall accrue on all receivables due to the NH or to DC at a rate equal to the seven day yield offered by the North Carolina Capital Management Trust Cash Portfolio as of July 1st of each year. Such interest shall be calculated on such receivables from the preceding January 1st until paid.

40. EXECUTION OF DOCUMENTS: All parties agree to execute such other documents as may be reasonably necessary by the attorney for any of the parties to facilitate and accomplish the matters and things set forth herein.

41. ENTIRE UNDERSTANDING OF PARTIES: This agreement contains the entire understanding of the parties concerning the matters set forth herein and there are no representations, warranties, covenants or undertakings, oral or written, other than those expressly set forth herein. This agreement may only be modified or amended by express written agreement, executed by all the parties.

42. NH AND KDH DEPOSIT OF FUNDS IN EVENT OF DISPUTE: In the event of a dispute in the payment of any sums due from NH or KDH to DC pursuant to the terms of this agreement, NH and KDH shall, on or before the due date for payment of such sums, deposit the disputed amount in an interest bearing account until the dispute is resolved under the dispute resolution process set forth in Paragraph 44 below or is resolved by agreement of the parties to the dispute. The terms of the dispute resolution process shall then determine who is entitled to the deposited funds including all accrued interest. In the event that NH or KDH fail to deposit such sums within the time set forth above, all damages or awards recovered by DC under the provisions of Paragraph 44 below shall be trebled. This remedy shall be in addition to and without prejudice to all other remedies available to DC

43. DC DEPOSIT OF FUNDS IN EVENT OF DISPUTE: In the event of a dispute in the payment of any sums due from DC to NH or KDH pursuant to the terms of this agreement, DC, on or before the due date for payment of such sums, shall deposit the disputed amount in an interest bearing account until the dispute is resolved under the dispute resolution process set forth in Paragraph 44 below or is resolved by agreement of the parties to the dispute. The terms of the dispute resolution process shall then determine who is entitled to the deposited funds including all accrued interest. In the event that DC fails to deposit such sums within the time set forth above, all damages or awards recovered by NH or KDH under the provisions of Paragraph 44 below shall be trebled. This remedy shall be in addition to and without prejudice to all other remedies available to NH or KDH.

44. DISPUTE RESOLUTION PROCESS: In the event of any dispute, controversy or claim arising out of or relating to this contract, or the breach thereof, the parties hereto shall use their best efforts to settle the dispute, controversy, claim or breach. To this effect, they shall consult and negotiate with each other in good faith and, recognizing their mutual interests, attempt to reach a just and equitable solution satisfactory to the parties. If they do not reach such solution within sixty days, then upon notice by any of the parties, the dispute, controversy, claim or breach shall be settled by arbitration administered by the American Arbitration Association in accordance with its commercial rules and judgement may be entered in any Court having jurisdiction thereof.

Any of the parties to the dispute may apply to the court having jurisdiction hereof and seek injunctive relief, under the

applicable Rules of Civil Procedure, to maintain the status quo or to protect the rights of the parties until the arbitration tribunal's determination on the merits.

Except as provided in this agreement, the arbitrators shall have no authority to award punitive damages or other damages not measured by the prevailing party's actual damages and may not, in any event, make any ruling, finding, or award that does not conform to the terms and conditions of this agreement. Except as provided in this paragraph, the arbitrators shall have the authority to award any remedy or relief that a court of the State of North Carolina could order or grant.

The arbitrators shall award to the prevailing party, if any, all of its costs and fees. "Costs and fees" shall mean all reasonable preaward expenses of the arbitration, including the arbitrators' fees, administrative fees, witness fees, deposition costs, court costs, attorneys fees and other out of pocket costs of the prevailing party.

The arbitrators' decision shall be in writing and shall contain specific and detailed findings of fact and conclusions of law. Either of the parties to the arbitration may, within 30 days of receipt of the written arbitrators decision, appeal the decision to Dare County Superior Court. The court shall sit as an appellate court and shall be bound by the findings of fact determined by the arbitrators, if such facts are supported by substantial evidence. The Court may reverse or modify the arbitrators decision if the substantial rights of the appealing party have been prejudiced because the arbitrators findings, inferences, conclusions or decisions are: (a) in violation of constitutional provisions; (b) affected by an error of law; (c) failed to follow the procedure agreed upon by the parties; (d) in excess of the authority of the arbitrators as provided in this agreement; (e) unsupported by substantial evidence admissible under the rules of the American Arbitration Association; (f) arbitrary or capricious. In addition to the "costs and fees" set forth above, the prevailing party shall be awarded all out of pocket costs, including attorneys fees, associated with the appeal of the arbitrators' decision. The decision of the Superior Court shall be final and binding upon the parties.

45. RIGHT TO TRANSFER ALLOCATION BETWEEN PARTIES: NH, KDH and DC shall, among themselves, be allowed to sell and transfer water allocations to each other. Upon such transfer, all parties shall be notified of the change in allocation and all allocated amounts of water set forth in other provisions of this agreement shall be adjusted accordingly to reflect the transferred allocation.

46. CALIBRATION OF METERS: NH and KDH shall allow DC access to all meters used to calculate the quantity of water being supplied to the distribution systems of the towns from DC for the

purpose of calibrating such meters to reflect a correct measurement of the quantity of water supplied. DC shall allow NH access to all meters used to calculate the quantity of water being supplied to DC from the Fresh Pond Plant for the purpose of calibrating such meters to reflect a correct measurement of the quantity of water supplied. DC shall allow NH or KDH access to all meters used to calculate the quantity of water being supplied to the distribution system of DC for the purpose of calibrating such meters to reflect a correct measurement of the quantity of water supplied.

47. NOTICE OF ACTION AFFECTING PARTIES: Except with regard to emergencies and seasonal variations as defined in Paragraphs 28 and 34, when a change of the existing conditions with respect to the obligations of each of the parties to this agreement occurs, the movant of the change of conditions shall supply notice of such change, at least 30 days in advance of the proposed action, to the respective parties as follows: Terry Wheeler, County Manager, Dare County, or his successor; Webb Fuller, Town Manager, Nags Head, or his successor; Debbie Diaz, Town Manager, Kill Devil Hills, or her successor.

48. COUNTERPARTS: This agreement shall be executed in three counterparts with each of the parties retaining an executed counterpart.

IN WITNESS WHEREOF, the parties hereto have set their hand and seals the day and year first above written.

County of Dare

By: _____ (SEAL)

Attest:

_____
Clerk

Town of Nags Head

By: _____ (SEAL)

Attest:

_____
Clerk

Town of Kill Devil Hills

By: _____ (SEAL)

Attest:

_____
Clerk