Water Management Plan

United States Environmental Protection Agency
National Health Environmental Effects Research Laboratory
Human Studies Facility
104 Mason Farm Road
Chapel Hill, North Carolina 27599

2 February 2009

Point of Contact:
Mr. Sam Pagan
Energy Manager
919-541-5001

EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
HUMAN STUDIES DIVISION LABORATORY

WATER MANAGEMENT PLAN

Reviewed by:

Stephen Jackson, Laboratory Facility Manager — 2/19/09 Date

Tim McClellan, Facilities Operations Branch Chief — 2-11-09 Date

Peter Schubert, OARM EMS Coordinator — 4 FEB 2009 Date

Sam Pagán, Energy Manager — 4 Feb '09 Date

Approved by:

Alex Montilla, Director, Facility Management Support Division — 4 Feb 2009 Date

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

1.0 EPA'S STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes wise, efficient use of water, is essential to achieve these objectives.

Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important. Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can prevent pollution by reducing wastewater flows, recycling process water, reclaiming wastewater, and using less energy. As municipalities and regions deal with chronic drinking water shortages due to drought and changes in climate patterns, water conservation becomes even more important to the sustainability of our mission.

EPA recognizes that regional, state, and local differences exist regarding water quality, quantity, and use. Differences in climate, geography, and local requirements influence the water efficiency programs applicable to specific facilities. Therefore, EPA is establishing facility-specific Water Management Plans to promote the efficient use of water and meet the water conservation requirements under Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.

This Water Management Plan has been established to document and promote the efficient use of water at the National Health and Environmental Effects Research Laboratory (NHEERL) Human Studies Division Laboratory in Chapel Hill, North Carolina. The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning guidance under Executive Order 13423.

This plan has also been developed in recognition of, and consistent with, the Long Term Water Efficiency Plan for University of North Carolina at Chapel Hill (25 July 2004). That plan is provided for reference in Appendix A.

2.0 FACILITY DESCRIPTION

The six-story Human Studies Facility (HSF), located on the medical campus of the University of North Carolina (UNC) at Chapel Hill, houses unique research facilities that EPA and non-EPA scientists use to investigate the potential health effects of pollutants on human populations. At the HSF, EPA scientists associated with NHEERL Human Studies Division (HSD) conduct a coordinated research program that integrates epidemiological, clinical, and laboratory based studies of human health. UNC’s Center for Environmental Medicine, Asthma, and Lung Biology has a cooperative use agreement with EPA, conducts research programs closely related to the HSD research programs, and is co-located at the HSF. The HSF is owned by UNC, and leased by EPA under the cooperative use agreement that ends in 2015.

HSD conducts clinical studies for research questions which are best approached experimentally by monitoring or administering exposures under highly controlled laboratory settings, or where

the evaluation of effects requires complex laboratory procedures. The HSF contains 136,786 square feet of conditioned space and is equipped with state-of-art human exposure systems capable of delivering aerosols, gases, particulates, and organic vapors to human subjects in specially controlled test chambers. The facility also houses laboratory space featuring capabilities in pulmonary function testing, light and electron microscopy, flow cytometry, molecular biology, analytical chemistry, and geographic information systems. In addition, the HSF contains medical facilities and a subject recruitment office to support the ongoing research programs.

3.0 FACILITY WATER MANAGEMENT GOALS

The water management goals of the HSF are achieved through the implementation of the EPA Research Triangle Park (RTP) Environmental Management System (EMS). The EMS is established and implemented consistent with RTP's Comprehensive EMS Implementation Policy. The EPA-RTP EMS policy statement and water management objectives and targets are provided in the following sections.

Environmental Management Policy

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and safeguard the natural environment. The Agency accomplishes this mission by setting standards for environmental protection, assisting others in reducing and preventing pollution, conducting research, sharing information and enforcing environmental standards.

It is a core value of EPA at Research Triangle Park (EPA-RTP) to serve as a model enterprise for environmental stewardship. To accomplish this, and to support the Agency's mission, we must properly manage the environmental impacts of our own operations and facilities.

EPA-RTP is the Agency's largest field operation. As such, we recognize our obligation and opportunity to provide leadership in protecting the environment, addressing emerging environmental issues, advancing the science and technology of risk assessment and risk management, and promoting environmental education.

We commit to reduce the environmental impacts of our operations and limit our natural resource consumption. Our comprehensive EMS framework will address the following goals:

- Develop a collaborative EMS that covers the EPA organizations in RTP;
- Comply with relevant environmental laws, regulations and other requirements which we subscribe;
- Seek to continually reduce the environmental impacts of EPA-RTP activities;
- Consider environmental impacts in planning, constructing and operating facilities;
- Incorporate source reduction and pollution prevention into research activities;
- Establish, track and review environmental performance goals associated with significant environmental aspects of day-to-day operations;
- Educate our employees about the EMS, seek their participation and involve them in making environmental improvements;
- Share information about our EMS with interested parties; and
- Strive to continually improve EPA-RTP's collective environmental performance.

Objectives and Targets

To fulfill this environmental policy, EPA-RTP has identified water consumption as a significant environmental aspect and has established reduction of water consumption intensity (measured on a gallon/square foot basis from a FY 2007 baseline) as an objective under its Water Management Environmental Management Program (EMP). The Water Management EMP Lead is the Facility Energy Manager. With respect to this objective, EPA-RTP has established a target to reduce water use by 2 percent annually through the end of FY 2015, for a total reduction of 16 percent. As required under EO 13423 and the RTP EMP, this plan provides the FY 2007 baseline in Table 1.

4.0 UTILITY INFORMATION

Contact Information

Potable water and sewer service is supplied by Orange Water and Sewer Authority. These services, as well as all other utilities, are billed on a single statement from the University of North Carolina to EPA under the current lease agreement. The billing agency is:

UNC Energy Services Accounting
CB#1855 – 925 Branch Street
Chapel Hill, NC 27599

Phone: 919-962-1158

Rate Schedule

As of June 2008, water supply was billed by UNC as follows:

1. A water use rate of $6.14/1,000 gallons, applicable July to October;

2. A water use rate of $3.71/1,000 gallons, applicable November to May;

3. A water use rate of $7.04/1,000 gallons, applicable in June;

4. A service fee of $256.04/month for water supplied through a 4-inch metered service line; and

5. A service fee of $68.92/month for a 1.5-inch metered service line for irrigation water (not used at this time).

There is no additional charge for water to hydrants and the fire protection system.

As of June 2008, sewer service was billed by UNC as follows:

1. A use rate of $4.37/1,000 gallons of supplied water, applicable July to October;

2. A use rate of $7.30/1,000 gallons of supplied water, applicable November to June; and

3. A service fee of $112.04/month.

Payment Office

Glen Lowery
Facility Management Support Division
US EPA, C604-01
Research Triangle Park, NC 27711

Phone: 919-541-0914

5.0 FACILITY INFORMATION

The HSF was constructed in 1991, and occupied beginning in 1995. The building is constructed in two distinct areas: a six-story tower housing offices and 42 research laboratories, and a research wing housing specialized atmospheric inhalation exposure test chambers. All building utilities, including potable water, chilled water, and steam are supplied by UNC. Building systems are maintained by EPA's facility operations and maintenance contractor, Call Henry, Inc. (CHI). Specialized services for the inhalation test chambers, including HVAC and Reverse Osmosis systems supplying those chambers, are provided under a contract for "Operation, Maintenance, and Modification of Human Studies Facility" that HSD holds with TRC Environmental Corporation.

High pressure and low pressure steam is supplied by UNC. Steam is used for space heating and direct humidification. Steam condensate is captured and returned to the UNC central utility plant. Chilled water at 45°F is supplied by UNC and circulated through air handler coils for space cooling, and provides non- contact cooling for air compressors. Chilled water is returned to the UNC central utility plant. Potable water is used for sanitary needs, laboratory processes such as glassware washing, steam sterilization, humidity control on experimental equipment, and production of deionized water. Additional details on facility potable water use are provided in the following sections.

Major Water Using Processes

Estimates of potable water consumption by major use area are provided in Table 1. These data reflect average facility water use in FY 2007 and represent the FY2007 HSF baseline.

Table 1. Major Potable Water Using Processes

Major Process	Annual Consumption (gallons)	Percent of Total	Comments
Sanitary	650,000	32.5	Engineering estimate (see App. B)
Steam sterilizer drain trap cooling water	270,000	13.5	Engineering estimate based on literature data
Vacuum pump cooling water in Room 89	182,000	9.1	Engineering estimate
Laboratory processes, including reverse osmosis, and other uses.	896,000	44.9	Engineering estimate, by difference. Major components of flow are RO water used for test chamber humidification, and RO reject water.
TOTAL	**1,998,000** **14.61 gal/ft^2**	**100.0**	**Metered**

Note that steam for direct humidification of laboratory space other than test chambers is supplied separately as steam and is not included in the above total. Chilled water is supplied by and returned to the UNC central utility plant and is not included in the above total. No make-up water to the UNC chilled water and steam systems are supplied by the HSF.

A chart showing trends in water use, based on monthly usage data for FY 2007, is provided in Appendix B. Additional detail on assumptions and calculations supporting these water use estimates are also provided in Appendix B.

Measurement Devices

Potable water supply to the building is provided through a metered 4-inch line. Grounds maintenance, including irrigation, is provided separately by the university. The meter is located in a below grade meter box located on the southeast side of the building. Meter reading is performed monthly by an Orange Water and Sewer Authority (OWASA) meter reader. The metered data are reported to UNC, and ultimately supplied by UNC to EPA. OWASA tests and calibrates the meter every four years under a utility-wide meter testing and repair program. The meter on the 4-inch line was last tested by OWASA on December 8, 2005 and found to be in compliance with American Water Works Association recommendations. The meter records water use in units of 1,000 gallons.

Shut-off Valves

The main potable water shut-off valve is located the HSF basement mechanical room.

Occupancy and Operating Schedules

Approximately 130 staff work at the HSF. The facility operates on a flex time schedule and is typically occupied between 8:00 a.m. and 6:00 p.m., Monday through Friday.

6.0 BEST MANAGEMENT PRACTICE SUMMARY AND STATUS

The President has established Water Reduction Goals under Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management. Under the Executive Order, Agencies must establish a FY 2007 water use baseline, and then reduce water use intensity by 2 percent annually through the end of FY 2015, for a total reduction of 16 percent. This target is incorporated into the EPA-RTP Water Management EMP as noted above. Facilities should implement Best Management Practices (BMPs) related to water use, considering life-cycle cost effectiveness, to achieve these water reduction goals. The Federal Energy Management Program (FEMP) has identified BMPs in 14 possible areas to help facilities identify and target water use reductions The Human Studies Facility has adopted BMPs in five of the areas, as checked below:

☑ Water Management Planning
☑ Information and Education Programs
☑ Distribution System Audits, Leak Detection and Repair
NA Water Efficient Landscaping
NA Water Efficient Irrigation
☐ Toilets and Urinals
☐ Faucets and Showerheads
☑ Boiler/Steam Systems
☑ Single-Pass Cooling Equipment
NA Cooling Tower Management
NA Commercial Kitchen Equipment
☐ Laboratory/Medical Equipment
☐ Other Water Use
☐ Alternate Water Sources

NA – Not applicable.

See http://www1.eere.energy.gov/femp/water/water_bmp.html for additional information regarding FEMP recommended best management practices.

Water Management Planning

This plan addresses the recommended elements of a water management plan and satisfies best management practice related to water management planning.

Information and Education Programs

Employees have been educated on water and other resource conservation topics through implementation of the EPA-RTP EMS. Water consumption is identified as a significant environmental aspect, operational controls are implemented, objectives and targets are established and communicated to employees. Posters are used throughout the EPA-RTP facilities to call employee attention to the importance of water conservation. Annual training of employees related to Environmental Management Programs under the EMS is conducted. Use of the EMS to educate employees and communicate progress toward water conservation objectives and targets is considered a best management practice and credit is claimed in this area.

Distribution System Audits, Leak Detection and Repair

Potable water to the building is supplied through a single metered supply line, and then dispersed through the building in exposed, accessible service piping. The on-site operations and maintenance (O&M) contractor performs a daily walk through inspection of all mechanical spaces. Any leaks or other problems identified are corrected immediately.

Facility staff are trained to report leaks and malfunctioning water using equipment to a central facility maintenance call-in Help Desk. Reported problems are assigned a Service Call or Work Order, which is completed by the facility O&M contractor. Repairs are tracked through completion and close-out by the O&M contractor and the O&M Project Officer.

Under this plan, trends in monthly water use also will be monitored by the Energy Manager and changes that are not understood or expected will be investigated and resolved. BMP status is achieved in this area.

Water Efficient Landscape

UNC has designed, installed and maintains the landscaping surrounding the HSF; as EPA is not responsible for landscaping. BMP status is not applicable in this area.

Water Efficient Irrigation

UNC maintains and irrigates the landscaping surrounding the HSF; as EPA is not responsible for landscape irrigation. BMP status is not applicable in this area.

Toilets and Urinals

Building construction was initiated in 1991, prior to the implementation of current standards for water efficient sanitary fixtures. Therefore, toilets operate at 3.5 gallons per flush (gpf) and urinals operate at 1.5 gpf, rather than the current 1992 Energy Policy Act (EPAct) requirements of 1.6 and 1.0 gpf, respectively. A full inventory of sanitary fixtures is provided in Table 2.

Table 2. Sanitary Fixture Inventory

Fixture	Quantity	Flow Rate
Toilets	46	3.5 gpf
Urinals	14	1.5 gpf
Lavatory Sink Faucets	46	2.2 gpm
Showers	7	2.5 gpm

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facility maintenance help desk, which are immediately corrected.

Since the toilets and urinals do not operate at current design standards, BMP credit for toilets and urinals is not claimed at this time. It may be possible to upgrade toilets and urinals to water efficient design standards quite cost effectively by replacing the flush valve diaphragms with

more efficient models (1.6 gpf for toilets and 0.5 gpf for urinals). This retrofit is currently being tested on one toilet to evaluate if performance deteriorates when a lower flow rated diaphragm valve is installed on a standard design fixture. If performance is satisfactory, this retrofit can be implemented more broadly without changing the porcelain fixtures or valve bodies themselves. If performance does deteriorate, both the valve bodies and fixtures would need to be replaced to achieve the EPAct design standard. This option is discussed further in section 9.0.

Faucets and Showerheads

EPAct compliant showerheads are used throughout the facility, as shown on the inventory of sanitary fixtures provided in Table 2. However, more efficient showerheads (1.5 gpm) are readily available at low cost. The showerheads should be replaced to achieve BMP status in this area.

Lavatory sink faucets are compliant with EPAct water efficiency requirements (2.2 gallons per minute for faucets). However, the American Society of Mechanical Engineers has established a standard for lavatory faucets in public use (essentially all applications but domestic residences) with a maximum flow rate of 0.5 gpm (ASME A112.18.1). This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings.

Janitorial staff and employees are trained to report leaks or other maintenance problems to the facility maintenance help desk, which are immediately corrected. System pressure is maintained at 64 psi, within the range recommend for optimum system performance.

No BMP credit is claimed in this area, pending replacement of existing faucets or faucet aerators with products that have a maximum flow of 0.5 gpm and showerheads with products that flow at 1.5 gpm. These options are discussed in section 9.0.

Boiler/Steam Systems

The HSF is provided with steam from the UNC central utility plant. The steam is used directly for building humidification and also supplies heat exchangers that maintain a 180°F recirculating heating hot water loop and a 180°F recirculating glycol heating loop. The heating water loop serves the terminal reheat coils for supply air. The glycol heating loop serves the laboratory, air handler preheat coils, and the exposure chamber air handler reheat coils. The two heating loops are closed systems and require very little potable make-up water. Domestic hot water is provided by steam heat exchangers.

BMP status is claimed in this area as condensate from the heat exchangers is collected and returned to the central utility plant to conserve water and energy. The heat exchangers and condensate return system is inspected visually each day by the on-site O&M contractor for proper operation.

Note that steam consumed for direct humidification is supplied separately from potable water and is not included in the water balance presented on Table 1.

Single Pass Cooling Equipment

Single pass cooling was used to cool vacuum pumps in Room 89. These vacuum pumps were replaced with a rotary screw pump in 2008 that does not use cooling water (the water cooled pumps are kept in emergency reserve and exercised for approximately 15 minutes each week) Currently, no other single pass cooling equipment is used. All cooling needs are provided by recirculated chilled water provided by the UNC central utility plant. After heat exchange, chilled water is returned to the central utility plant. As laboratory equipment use changes over time, NHEERL laboratory managers should annually examine and verify that single pass water is not used for equipment cooling. EPA has a policy to maintain best management practice in this area and not cool equipment with single pass cooling water.

Cooling Tower Management

All cooling needs are supplied by chilled water supplied by and returned to the UNC central utility plant. BMP status is not applicable in this area.

Commercial Kitchen Equipment

HSF does not operate commercial kitchen equipment. BMP status is not applicable in this area.

Laboratory/Medical Equipment

The laboratory operates and maintains two reverse osmosis (RO) systems; both are supplied with potable water. The larger system of the two is operated by HSD's technical support contractor, TRC. This system primarily supplies purified water for humidification of air supplied to the exposure test chambers. In addition to water used for humidification, purified water is converted to steam in a steam to steam heat exchanger and this "pure" steam is used to maintain temperature on the heating water jackets of the humidification units on each of the eight test chambers. Steam condensate from six of these eight units is recycled to the steam condensate return system for the UNC central utility plant. Condensate on the other two units is discharged to the sanitary sewer. Operation of this RO system can be highly variable, depending on test chamber utilization, and historical flow data are not available. The RO reject water is discharged directly to the sanitary sewer.

The building O&M contractor operates a second RO water treatment system that supplies purified water for laboratories located in the six-story tower. The system consists of a multimedia filter, activated carbon filter, and RO membranes. RO permeate is supplied to a 1,000 gallon holding tank that is recirculated through the supply and return header systems to and from the laboratories. This RO system has a nominal design capacity of 1,200 gallons per day. Historical use data for the system are not available. This RO system is significantly smaller than the system described above. The RO reject water is discharged directly to the sanitary sewer.

For each RO system, consumption and reject water generation should be metered and a trend analysis performed monthly by the respective system operators (TRC and building O&M contractor). The membranes should be cleaned and maintained when trend data indicate system performance has dropped below acceptable limits. System performance limits should be defined

in conjunction with the RO system vendors. Conservation measures and reject water reuse alternatives should be considered and implemented before BMP credit can be claimed in this area. One potential conservation option is recirculating reject water to a feed tank with a bleed stream rather than discharging it directly to the sewer. Consideration should also be given to consolidating the operations of the two systems into a single system to maximize utilization and system efficiency. Best management practice can be achieved in this area pending evaluation and implementation of measures to reduce or reuse RO reject water.

The laboratory is equipped with five steam sterilizers, listed in Table 3. The units in Rooms 409, 417 and 533 have a continuous flow of tempering water to the drain while the unit is in standby mode. Literature data indicates this flow can be 1 gpm or greater. Retrofit kits are available to eliminate this flow except for times when condensate is being discharged above 140^{o}F. Best management practice can be achieved by installing retrofit kits to eliminate the continuous flow of tempering water. This retrofit is discussed further in Section 9.0.

Table 3 – HSF Steam Sterilizers

Room	Model	Continuous Tempering Water Flow?
311	Amsco SV120	No – Only when needed
409	Amsco 3011	Yes – In standby mode
417	Amsco 3000SL	Yes – In standby mode
417	Amsco 3000SL	Yes – In standby mode
533	Amsco 3000SL	Yes – In standby mode

Other Water Use

Water is used as necessary in individual laboratories for bench scale experimentation and glassware preparation. No specific BMP credit is claimed in this area.

Alternate Water Sources

Air handler condensate and RO system reject water both provide sources of relatively high quality graywater that are available for reuse. A preliminary estimate of the RO reject water quantity indicates that several hundred thousand gallons per year may be available for reuse. This estimate should be verified by metering RO system consumption and reject water quantities (discussed further in Secton 9.0 below). RO system water use efficiency can be improved by recycling the reject water to a RO system feed tank, coupled with a bleed stream to remove dissolved solids. This approach could be investigated as a potential recycle alternative, but RO system water quality requirements would need to be confirmed before this approach is implemented.

A preliminary estimate of air handler condensate indicates that approximately 500,000 gallons per year of condensate are generated and discharged to the sewer. This estimate should be verified by direct measurement before a project using this water is developed. Toilet and urinal flushing is a potential reuse option for this water, although this would take a significant amount

of plumbing modification to be achieved. This reuse option could be evaluated after water conserving BMPs for toilet flushing have been fully explored and implemented.

No BMP credit is claimed in this area at this time, pending further engineering evaluation of these reuse options.

The Orange Water and Sewer Authority (OWASA) has initiated a project with UNC to build a wastewater reclaimation system that will supply the UNC main campus with highly treated non-potable water from OSAWA's Mason Farm Wastewater Treatment Plant. As this reclaimed water becomes available on campus, as early as April or May 2009, it may present additional opportunities for non-potable water reuse. At a minimum, this reclaimed water will be used by UNC in the central utility plants that supply chilled water and steam to HSF. While the current master plan depicts the reclaimed water distribution system piping terminating less than 1000 feet from the HSF, there are currently no plans to extend the piping to the building. Point of contact for planning is Margaret (Meg) Holton with UNC Energy Services, MDHolton@energy.unc.edu, 919-843-0364. Point of contact for construction is Bob Beke with UNC Facilities Planning & Construction, BOBB@fac.unc.edu, 919- 962-9010.

7.0 DROUGHT CONTINGENCY PLAN

The HSF will follow the Orange Water and Sewer Authority Water Conservation Standards and Regulations. A summary of the major drought response levels are provided below:

Year Round Conservation

- Spray irrigation limited to 3 days per week, between 8 PM and 9 AM
- All irrigation limited to 1 inch per week
- Automatic controllers and moisture sensors required on all irrigation systems
- Shut-off nozzles required on all hoses
- Wasteful water use prohibited
- Leaks must be repaired within 10 days
- Use of reclaimed or harvested water strongly encouraged
- Use of water saving fixtures strongly encouraged

Water Supply Advisory

- Public alert about potential shortage
- Targeted conservation education and awareness campaign (communications could be coordinated through outreach and education initiatives at UNC. See: http://sustainability.unc.edu/default.aspx?tabid=65)

Stage One Shortage (10 percent reduction goal)

- Spray irrigation limited to 1 day per week
- All irrigation limited to ½ inch per week
- No water used for cleaning of paved surfaces

Stage Two Shortage (15 percent reduction goal)

- No spray irrigation
- Irrigation by drip irrigation and hand-held hoses permitted, but limited to ½ inch per week
- No vehicle washing
- No water used for exterior building washing or cleaning of paved surfaces

Stage Three Shortage (20 percent reduction goal)

- No irrigation, except by hand-held hoses or watering cans
- No outdoor water use, except to maintain public health, safety or welfare
- Water for heating and cooling to be reduced to the maximum extent allowable

Water Supply Emergency (20+ percent reduction goal)

- No outdoor water use, except to maintain public health, safety or welfare
- Water for heating and cooling to be reduced to the maximum extent allowable

The complete ordinance is available at www.owasa.org/pages/watconsord03.asp .

8.0 COMPREHENSIVE PLANNING

The Laboratory Director, Facility Manager, and Energy Manager will ensure that water supply, wastewater generation, and water efficiency BMPs are taken into account during the initial stages of planning and design for any facility renovations or new construction. These factors will also be considered by the Laboratory Director, laboratory managers, the facilities operations branch, and purchasing agents prior to the purchase and installation of any equipment that would measurably change facility water consumption. Where applicable, WaterSense® labeled products will be purchased.

9.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

The HSF is considering the following projects to achieve additional reductions in water use:

1. **Upgrade Toilets and Urinals.** Completely upgrading toilets and urinals to low flow design standards by replacing fixtures and flush valves is estimated to have a 20 year payback, and is not deemed cost effective. However, depending on the fixture design, it may be possible to replace the flush valve diaphragms with those rated 1.6 gpf for toilets and 0.5 gpf for urinals, without replacing the fixture and valve body. This can be done at fairly minimal cost as a maintenance activity. When a different rating diaphragm is used, without changing the fixture, performance may degrade. Therefore, this option should only be tried on a few units at first to make sure performance is satisfactory. If this modification can be implemented satisfactorily on all toilets and urinals, approximately 210,000 gallons and $2,300 can be saved annually at minimal cost. This opportunity will be evaluated by OARM-ASD.

2. **Retrofit Lavatory Faucets with 0.5 gpm Flow Controllers.** FMSD will replace originally installed faucet flow controllers with water efficient models. Faucets can be

retrofit with 0.5 gpm flow controllers at a nominal cost of $10 to 15 each. Resulting savings are estimated to be 37,000 gallons and $410 per year.

3. **Retrofit Showers with 1.5 gpm Showerheads.** FMSD will replace originally installed showerheads with water efficient models. Showers can be retrofit with 1.5 gpm showerheads at a nominal cost of $25 each, or less. Resulting savings are estimated to be 52,000 gallons and $580 per year.

4. **Meter and Track RO Water Use.** RO system water consumption and reject water production will be metered, the use will be documented at least monthly, and usage trends analyzed. Opportunities to conserve RO water or reuse reject water will be evaluated once trend data are available. This opportunity will be implemented by NHEERL and OARM-FMSD.

5. **Install Water Conservation Kits for Steam Sterilizer Trap Cooling.** The laboratory is equipped with four steam sterilizers that discharge a constant steam of cooling water to drain while the equipment is in standby mode. Retrofit kits can be installed for approximately $2,500 each that significantly reduce the use of this tempering water by controlling the application of tempering water to only those times when condensate is being discharged to drain at above 140^{o}F. This modification is estimated to save approximately 230,000 gallons and $2,500 per year. The payback period for this retrofit is estimated to be approximately four years. This opportunity will be implemented by OARM-FMSD.

6. **Investigate the Feasibility of Capturing Humidification Steam Condensate.** Steam is used to maintain the temperature on the heating water jackets on the humidification units on each of the eight test chambers at HSF. Steam condensate from six of the eight units is recovered and recycled to the steam condensate return system for the UNC central utility plant. Condensate from the other two units is discharged to the sanitary sewer. OARM-FMSD will investigate the feasibility of capturing the recycling the condensate from these remaining tow units.

Appendix A

LONG TERM WATER EFFICIENCY PLAN
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
(http://sustainability.unc.edu/Portals/0/Documents/UNC%20Water%20Efficiency%20Plan%20-%207.28.04.doc**)**

7/28/04
Long Term Water Efficiency Plan
University of North Carolina at Chapel Hill

A. Commitment

UNC Chapel Hill has an active sustainability program that addresses long term water conservation. State Executive Order 26 and House Bill 1215 further reinforce this concern. State Executive Order 26 requires state agencies and universities to evaluate non-essential water use, set baselines for water use and identify potential water savings. House Bill 1215 declares that all North Carolina state agencies must reduce water consumption by 10 percent.

Additionally, sustainable water use is an important part of the UNC Development Plan. Two positions were created to identify, develop and implement water sustainability measures. These positions are the UNC Sustainability Coordinator and the UNC Water, Wastewater and Stormwater Manager. Both positions have both been filled and staff are working on these issues.

B. Scope of Plan

This water efficiency plan focuses on the UNC Chapel Hill Campus.

C. Baseline Water Consumption

The following numbers are based on UNC Chapel Hill size and population in FY 1999-2000. This baseline was selected as it was pre-drought. UNC Chapel Hill is growing in size and population. This baseline is relative to the square footage and population in FY 1999-2000.

Functional Area	Baseline Usage
Academic Affairs	197,905,000 gallons/year
Athletics	19,258,000 gallons/year
Commercial	34,072,000 gallons/year
Enterprise	156,264,000 gallons/year
General Administration	2,588,000 gallons/year
Health Affairs	252,080,000 gallons/year
Housing	101,814,000 gallons/year

The University of North Carolina at Chapel Hill receives its water from the Orange Water and Sewer Authority: OWASA: (919) 968-4421.

D. Previous Water Conservation Measures

1. Reviewed water consumption on campus and identified potential areas to maximize results of conservation efforts.
2. Reviewed cooling and temperatures required. Adjusted to minimize excess water usage.
3. Reviewed heating and temperatures required. Adjusted to minimize excess water usage.
4. Reviewed preventive maintenance with additional emphasis on water savings.
5. Studied possibility of recycling cooling tower blow-down water.
6. Studied waste stream reuse at Cogeneration Facility.
7. Conducted joint study with OWASA to evaluate use of wastewater treatment plant effluent for cooling towers and irrigation re-use.
8. Conducted joint study with OWASA to evaluate use of water treatment plant process water waste for Cogeneration Facility re-use.
9. Revised building design standards to maximize water conservation. Researched the most efficient fixtures.
10. Requested campus community to report leaks, drips or water running in storm drains.

11. Conducted water use audits for Cogeneration Facility and Chilled Water Facilities.
12. Conducted annual sustainability awareness/education outreach to student population with Green Games.
13. Held "Water Wars" competition between residential housing groups to increase awareness for water conservation needs.
14. Revised outdoor planting time to seasons which allow for best establishment of plantings with less water usage. Mid-Fall to Late-Winter identified as optimum seasons for the majority of plantings.
15. Restricted watering of athletic fields and turf areas to amount needed for turf, but not excessive. Identified alternate water sources where possible.
16. Installed rain sensors so irrigation systems allow for precipitation as part of irrigation.
17. Adjusted toilet and urinal flush valves to use 1.6 or less gallons per flush.
18. Installed low flow shower heads in all student housing.
19. Placed plastic bottles in toilets with tanks to reduce volume per flush.
20. Changed out equipment requiring high amounts of water for more efficient equipment (including, but not limited to: ice machines, stills, chillers).
21. Changed laboratory cooling system at the Cogeneration Facility to recycle cooling water.
22. Optimized condensing operation at the Cogeneration Facility.
23. Implemented aggressive program to cycle HVAC systems off during periods that buildings or spaces were not occupied.
24. Discontinued use of water based heat pumps.
25. Upgraded hot water loops to reduce leakage and diminish run time.
26. Repaired identified water leaks in water system, chilled water system, and steam system.
27. Purchased 300 waterfree urinals, began installation and offered for installation in new state supported buildings. Approximately 200 have been installed to date.
28. Repiped stills in five laboratory buildings to install closed loop cooling systems.
29. Constructed rainwater reuse cistern under intramural field for irrigation water.
30. Converted land cover to reduce landscaping water needs and increase water infiltration back into aquifers.
31. Discontinued washing dishes at dining halls during drought and used disposable dishware and utensils.
32. Discontinued washing of state-owned vehicles during drought conditions.
33. Discontinued use of water for washing hard outdoor surfaces.
34. Turned off all decorative outdoor fountains using domestic water during drought conditions.
35. Preventative Maintenance Work Orders issued in 2003 on equipment related to water efficiency.

E. Conservation Opportunities

The UNC Chapel Hill program emphasizes:

1. Long-Term Conservation and Sustainability
2. Education and Increased Sustainability Awareness
3. Evaluation and Identification of Specific Functional Areas that Offer Potential for Reduced Water Use.
4. Identification of Major Facilities Groups and Specific Facilities for Water Savings Measures
5. Evaluation of Non-essential Water Use

Under these general areas the following implementation items have been identified.

1. Long Term Conservation and Sustainability
   Sustainability coordinator to spearhead identification of conservation opportunities as well as public education opportunities.

2. Education and Increased Sustainability Awareness
Notify all University groups about water sustainability and conservation concerns by e-mail, handouts, published articles, and other methods, such as: stickers, buttons, and posters. A Conservation Awareness Team has been created to focus on disseminating information about the importance of water conservation.

3. Evaluation and Identification of Specific Functional Areas that Offer Potential for Reduced Water Use.
   a. Conduct audits to determine how water is currently used.
   b. Identify potential areas for reduced use and best practices to replicate.

4. Identification of Major Facilities Groups and Specific Facilities for Water Savings Measures.
Break down of major groups into Utilities, Laboratories, Classrooms, Residential, and Other.

5. Evaluation of Non-essential Water Use
See D. Previous Water Conservation Measures, above, for list.

F. Target Reduction Goal:
Reduce water use by 10% or more relative to 1999-2000 baseline for square footage and population of facilities.

G. Selected Actions and Timelines
1. Jointly evaluating with OWASA the feasibility of reusing wastewater effluent for cooling towers and irrigation. If feasible, the timeline is July 2007 for system to be on-line.
2. Install waterless urinals, where feasible, in new men's restrooms.
3. Capture and store rainwater for reuse in irrigation, where feasible.
4. Continue education and awareness measures.
5. Continue requirement for low water use fixtures in restrooms.
6. Continue requirement for water efficient equipment.

H. Employee Education and Awareness Program
UNC Chapel Hill Conservation Awareness Team was created to focus on the dissemination of the importance of water conservation and the education of the University community in the need to conserve water. UNC will provide notification across University to all groups of water sustainability and conservation concerns by e-mail, handouts, published articles, and other materials such as: stickers, buttons, and posters.

I. Maintenance Program
UNC Chapel Hill staff have a high awareness of water conservation concerns and the individual facility maintenance personnel are alerted to the need for quick response to reporting of leaks. Facilities Services has an active preventive maintenance program that includes regular routine checks of water consuming equipment to minimize waste.
Through the University, the Main Response is the UNC Work Management system, which is available by telephone, or on-line:

Work Management Work Request Line: (919)962-3456
On-line Work Request: http://www.fac.unc.edu/CustomerService/workReq.asp

J. Important Contacts

Main Water Sustainability Contacts:

UNC Sustainability Coordinator:
Cindy Pollock Shea
cpshea@fac.unc.edu (919)843-5251

UNC Water, Wastewater and Stormwater Manager:
Margaret D. Holton
mdholton@energy.unc.edu (919)843-0364

Facilities Services Contacts:

Director of Building Services
Steve Copeland
(919)962-4633
stevec@fac.unc.edu

Lab Mechanic II
Durwood House
(919)201-7757
dhouse@fac.unc.edu

Preventive Maintenance, Work Management:
Donnie Apple
(919)962-4616

K. Essential Water Uses

Bathrooms	Food Services
Chilled Water System	Housekeeping
Classrooms	Irrigation
Cogeneration Facilities	Laboratories
Drinking Fountains	Patient Care Facilities

L. Continuous Improvement

For FY 2004-2005, designated key members of UNC Chapel Hill including: EHS, Energy Services, Facilities Services, Grounds, Housekeeping, Sustainability, and Water, Wastewater and Stormwater will semiannually evaluate progress on specific actions, communicate successes, and designate new targets as necessary. This will be facilitated by the Water, Wastewater and Stormwater Manager. At the beginning of each subsequent fiscal year, the team will meet to reevaluate water conservation at UNC facilities, analyze progress and identify new targets for water efficiency. UNC will also review drought stages for the area and maintain awareness of drought status and any local regulatory changes affecting water use.

In the event of a projected water shortage, UNC will follow the OWASA guidelines and restrictions, plus additional restrictions as noted in this plan.

Implemented this 28th day of July, 2004.

Director, Energy Services	Director, Facilities Services	Associate Vice Chancellor, Campus Services

This document serves as a Memorandum of Agreement to support Water Efficiency Planning for state government.

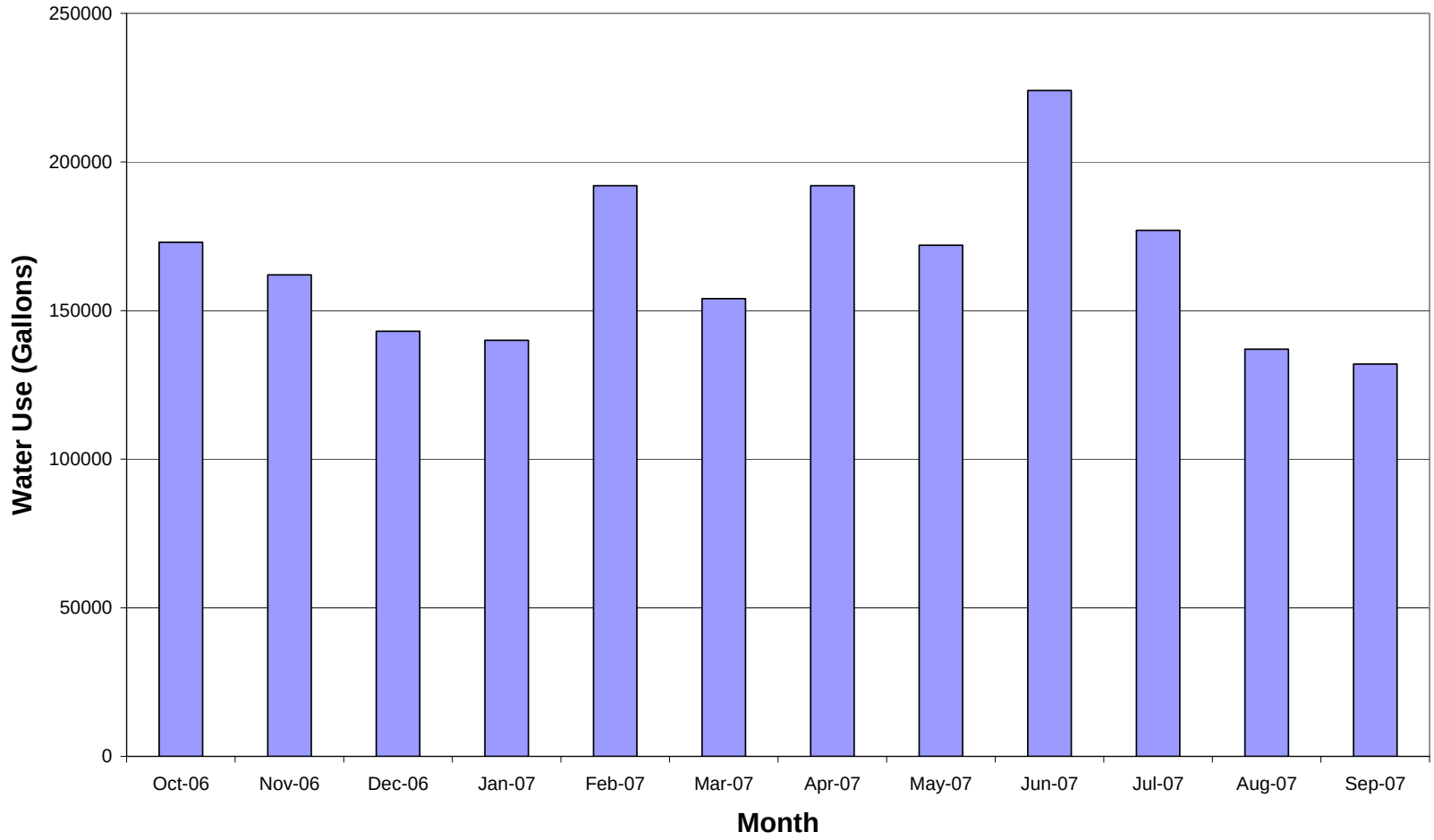
Director, State Energy Office	Date

Appendix B

WATER USE - SUPPORTING INFORMATION

EPA Human Studies Facility
Chapel Hill, North Carolina

Water Use (Gallons)
October 2006 to September 2007



EPA Human Studies Facility
Chapel Hill, North Carolina

Water Use (1000 Gallons)
FY 2007

Month	Water Consumption 1000s of Gallons
Oct-06	173
Nov-06	162
Dec-06	143
Jan-07	140
Feb-07	192
Mar-07	154
Apr-07	192
May-07	172
Jun-07	224
Jul-07	177
Aug-07	137
Sep-07	132
TOTAL	**1,998**

Water Balance Supporting Calculations
Human Studies Facility
Chapel Hill, North Carolina

Major Process	Annual Consumption (gallons)	Supporting Calculations
Sanitary	650,000	Engineering estimate based on 130 people × 20 gallons per person per day × 250 days per year
Steam sterilizer drain trap cooling water	270,000	Assume 2 of 4 sterilizers are operational on each work day. Assume 1 gallon/minute flow at each of two sterilizers for 9 hours per day while in standby mode. Based on data presented by van Gelder at 2004 Austin AWWA Conference. 2 units × 1 gallon/minute × 60 minutes/hr × 9 hrs/day × 250 days/year = 270,000 gallons
Vacuum pump cooling water in Room 89	182,000	Engineering estimate based on difference in metered water use between FY 2008 and FY 2007. Pump was replaced in 2008. 1,998,000 – 1,816,000 = 182,000 gallons
Laboratory processes, including reverse osmosis, and other uses.	896,000	Engineering estimate, by difference: 1,998,000 - 650,000 – 270,000- 182,000 = 896,000. Major components of flow are RO water used for test chamber humidification, and RO reject water.
TOTAL	**1,998,000**	**Based on metered potable water use in FY 2007: 1,998,000 gallons.**