Water Management Plan

Revision 1

U.S. Environmental Protection Agency
National Air and Radiation Environmental Laboratory
540 South Morris Avenue
Montgomery, Alabama 36115

10 June 2010

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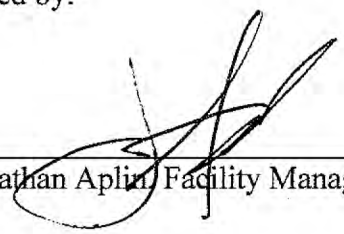
EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY
MONTGOMERY, ALABAMA

WATER MANAGEMENT PLAN

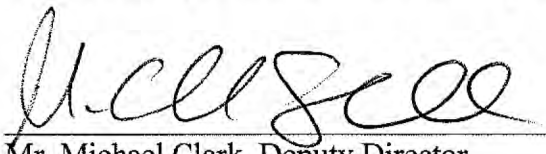
Approved by:



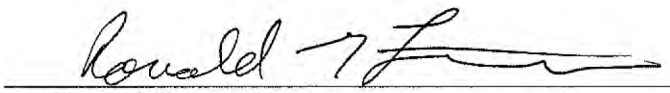
Mr. Jonathan Aplin, Facility Manager — 02 June 10 — Date

Vicki Lloyd — 10 June 2010

Ms. Vicki Lloyd, Environmental Management System Coordinator — Date



Mr. Michael Clark, Deputy Director — 5/26/2010 — Date



Mr. Ronald Fraass, Director — 25 May 2010 — Date

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1.0 EPA'S STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

To meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water resources 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 the country faces 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 EPA's 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 (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management,* and EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance.*

This Water Management Plan has been established to document and promote the efficient use of water at EPA's National Air and Radiation Environmental Laboratory (NAREL) located in Montgomery, Alabama. The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning Guidelines.

2.0 FACILITY DESCRIPTION

NAREL is a comprehensive environmental laboratory located on the Gunter Annex of Maxwell Air Force Base in Montgomery, Alabama. NAREL incorporates state-of-the-art laboratory equipment to analyze environmental samples for radioactivity and other hazardous characteristics. NAREL provides laboratory services to a wide range of clients, including other EPA offices and federal and state agencies. In addition to its onsite work, NAREL supports the deployment of emergency teams that respond to nuclear emergencies with a mobile radiological laboratory.

The original laboratory building was constructed in 1990 and an additional wing dedicated to the analysis of mixed waste samples was added in 2000. The main laboratory houses both physics and chemistry labs and administrative offices. A central plant building that houses upgraded mechanical systems came online in 2007, and an emergency response field asset warehouse (ER Building) used to prepare, house, and stage emergency response equipment was occupied in 2008. NAREL consists of 71,656 square feet of conditioned space. It is owned and operated by EPA on land leased from the U.S. Air Force (USAF).

3.0 FACILITY WATER MANAGEMENT GOALS

The resource conservation goals of NAREL are achieved through the implementation of an Environmental Management System (EMS). NAREL's Environmental Management Policy (signed on 5 May 2005) and February 2010 water conservation goals are provided below.

Environmental Management Policy

NAREL is a program laboratory for EPA's Office of Air and Radiation. The management and staff at NAREL are committed to the Agency mission of protecting the public health and environment. In order to accomplish that mission, we recognize that it is essential that Agency facilities set an example of environmental stewardship. NAREL has an excellent record for identifying and implementing state-of-the-art procedures and equipment at the laboratory to minimize our impact on the environment. We pledge to continue seeking and implementing methods to improve our environmental management by establishing an EMS. In support of this effort we have identified the following goals for the laboratory's EMS:

- Meet or exceed all applicable legal and other environmental requirements – *Full compliance will be encouraged through periodic internal reviews and external audits of the NAREL environmental programs.*

- Continually improve environmental performance for both regulated and unregulated environmental impacts – *Laboratory personnel are empowered to review all aspects of laboratory operation and make recommendations on improvements to the environmental controls.*

- Employ source reduction and other pollution prevention approaches whenever practicable – *NAREL has changed analytical processes to those which have less impact on the environment. We will continue to look for similar steps that will result in reducing resource burdens and pollution from the laboratory.*

- Environmental factors will be considered when making planning, purchasing and operating decisions – *All laboratory operations will be reviewed annually with regard to lessening environmental impact.*

- Establish, track and review specific environmental performance goals – *An Environmental Systems Coordinator and alternate have been identified that will work with management and staff at NAREL to establish, track and review specific environmental performance goals.*

- Information on environmental performance that is identified through the EMS program at NAREL will be shared with other agencies and with the public to encourage acceptance of improvements. *NAREL will strive to make this information available through reports that are presented at scientific or public meetings, publications in open literature and through the EPA Web site.*

Environmental Management System Aspects, Objectives and Targets

In view of this environmental management policy, NAREL has reviewed its water consumption. In 2005, NAREL identified water consumption and conservation as a significant environmental aspect. Through the Energy and Water Management Environmental Management Program (EMP), NAREL established the following objectives related to this aspect:

- Continue to comply with the requirements of applicable energy management laws, regulations, and EOs.

- Reduce water consumption-related energy use.

To meet these objectives, NAREL established a specific target to reduce total water use in fiscal year (FY) 2010 by 2 percent compared to an FY 2007 baseline, with a long term goal of reducing total water use 16 percent by FY 2015. To achieve this target, NAREL plans to implement candidate water conservation projects from the Water Management Plan, Revision 1.

In addition, the Green Procurement EMP sets a target to ensure procurement of water-efficient products, though WaterSense® labeled products are not officially designated. Under this plan, facility staff will consider WaterSense labeled products when making purchases.

EMPs, objectives, targets, and tasks are reviewed annually as part of the EMS goal of continual improvement. During the next annual review, NAREL will consider incorporating new EO 13514 requirements in the appropriate EMPs.

EO 13514 Goals and ConservW Targets

NAREL strives to achieve the water use intensity reduction goal set forth in EO 13514. Therefore, NAREL has set a goal of reducing its water use intensity (in gallons per gross square foot (gal/GSF)) by 2 percent per year from an FY 2007 baseline through FY 2020, for a total reduction in water use intensity of 26 percent.

To continue progress toward meeting EO requirements, NAREL will strive to meet annual facility-specific goals set by EPA's Sustainable Facilities Practices Branch under its ConservW program. These ConservW goals are calculated for each EPA facility based on the facility's previous water use reduction and its potential identified projects.

4.0 UTILITY INFORMATION

Rate Schedule and Contact Information

Potable water supply and sewer service are provided by the USAF at a flat rate of $47.12 per month. The charges are based on an assumed usage of 14,200 gallons per month at a rate of $3.32 per 1000 gallons. The water utilities contact at USAF's Gunter Annex is:

Al Riley, Contractor
42 CES/CER
334-953-3951

Water is provided to the Gunter Annex by the City of Montgomery.

Payment Office

A NAREL employee approves payments. His contact information is:

Charles Petko
USEPA NAREL
540 South Morris Avenue
Montgomery, Alabama 36115

334-270-3411

5.0 FACILITY WATER USE INFORMATION

The main building contains a mix of laboratory and office space. The laboratory space is configured for bench scale analyses of samples for radioactivity and other hazardous characteristics. In the main building, water is used for sanitary needs, building mechanical systems, fume hood exhaust scrubbing and internal washdown, and laboratory processes. The ER Building houses vehicles, mobile laboratories, and other equipment to support NAREL's radiological and emergency response and preparedness mission. Water is used for sanitary needs and vehicle washing in the ER Building. Additional details on NAREL's water use are provided in the following sections.

Major Water Using Processes

Average water use in FY 2009 by major process is shown in Table 1.

Table 1. Major Water-Using Processes, NAREL

Major Process	FY 2009 Annual Consumption (gallons)	Percent of Total Water Use	Comments
Sanitary water (main building) [a]	280,000	5.7	Engineering estimate
Sanitary and vehicle wash water (ER Building)	9,750	0.2	Metered
Penthouse scrubber water recirculation tank overflow on units 24 and 28	53,000	1.1	Engineering estimate
Vacuum pump recirculation tank overflow	187,000	3.8	Engineering estimate
Reverse osmosis system [b]	119,360	2.4	Metered
Cooling tower make-up water	3,382,880	68.8	Metered
Laboratory fume hood internal washdown, other miscellaneous laboratory water uses	902,360	18.1	Calculated by difference from annual total
Total water use	**4,934,350**	**100.0**	**FY 2009 total reported water use**

[a] In early December 2009, water-efficient toilets, urinals, and faucets were installed throughout the building. FY 2010 sanitary water use is expected to decrease significantly due to these retrofits.
[b] The reverse osmosis system was replaced in August 2009. Water use increased significantly after the replacement.

Additional details on assumptions and calculations supporting these water use estimates are provided in Appendix A. Monthly total water use and cooling tower make-up water use in FY 2009 is provided in Appendix B.

Measurement Devices

Two domestic water meters measure all onsite city water used in the main NAREL building and the ER Building. The incoming water line to the main building is equipped with a 4-inch Sensus compound flow meter. The meter is located in the main mechanical room. The incoming water line to the ER building is equipped with a Siemens water meter. The meter is located in the mechanical room adjacent to the break room.

Flow totalizing submeters are also installed on the cooling tower make-up water line and the reverse osmosis (RO) system. Cooling tower make-up water use is tracked using the facility's advanced metering system. RO system water use is tracked in a daily log book manually.

Facility staff monitors the onsite city water use readings using their advanced metering system. The monthly water use data is reviewed by the Facility Manager. Under this plan, water use trends will be monitored on an ongoing basis and unexpected changes in water use will be investigated and resolved.

Shut-off Valves

The main shut-off valve is located adjacent to the main water meter in the main mechanical room. The shut-off valve for ER Building water line is located near the water meter in the ER Building mechanical room. Shut-off valves for the chilled and hot water lines that supply the air handling units are located just inside the main entrance to the ER building.

Occupancy and Operating Schedules

Approximately 56 people work at NAREL. The facility operates on a flex time schedule, one shift per day, Monday through Friday.

6.0 BEST MANAGEMENT PRACTICE SUMMARY AND STATUS

EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, signed in January 2007, calls for federal agencies to reduce water use intensity by 2 percent per year between FY 2007 and FY 2015, for a total reduction of 16 percent. This goal was extended by EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, signed in October 2009. EO 13514 calls for reducing potable water consumption intensity by 2 percent annually through the end of FY 2020, for a total reduction of 26 percent. Facilities should implement best management practices (BMPs) related to water use, considering life-cycle cost effectiveness, to achieve this water reduction goal. FEMP has identified BMPs in 14 areas to help facilities identify and target water use reductions. NAREL has adopted BMPs in 10 of the areas, designated by checkmarks in the list below. Three other areas are deemed inapplicable for NAREL, designated by "NA" in the list below. The status of each BMP at NAREL is as follows:

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

Information and Education Programs

NAREL currently tracks water use on a monthly basis and is in the process of updating its EMS targets and objectives for FY 2010 to reflect EO 13514's requirements. EO 13423's requirements are currently reflected in NAREL's Energy and Water Management EMP.

NAREL calls an all-hands meeting every two months. At each meeting, one EMP is highlighted. In addition, NAREL Net, which serves as each employee's Web homepage, highlights one EMP per month. NAREL uses these mechanisms to raise employee awareness regarding its water use reduction targets and objectives. NAREL has achieved BMP status in this area.

Distribution System Audits, Leak Detection and Repair

An EPA employee, working under the Facility Manager, performs a daily walk-through of the facility, including mechanical spaces, to identify malfunctioning equipment or other problems. Facility staff are trained to report leaks and malfunctioning water-using equipment to the Facility Manager. Janitors report any observed problems to the Facility Manager.

Reported maintenance problems are assigned a work order and addressed as they arise. Significant maintenance issues or repairs are brought to the attention of an on call operations and maintenance (O&M) contractor. The O&M contractor operates under a work order system; work orders are tracked until the job is completed and the work request closed out.

Under this plan, the Facility Manager will monitor trends in monthly water use. Changes that are not understood or expected will be investigated and resolved. NAREL has achieved BMP status in this area.

Water-Efficient Landscaping

Grasses and shrubs are climate-appropriate and survive on natural rainfall. NAREL has achieved BMP status in this area.

Water-Efficient Irrigation

NAREL does not use landscape irrigation water. NAREL has achieved BMP status in this area.

Toilets and Urinals

All sanitary fixtures in the main building were replaced with high-efficiency models in December 2009, and all fixtures installed in the ER Building during initial construction were high-efficiency models. Table 2 presents an inventory of sanitary fixtures.

Janitorial staff and employees report leaks or other maintenance problems to the Facility Manager, which are immediately corrected by on-call O&M staff.

NAREL has achieved BMP status in this area.

Table 2. Inventory of Sanitary Fixtures, NAREL

Fixture Type	Flow Rate	Total Number
Toilets	1.28 gallons per flush (gpf)	11
	Dual flush: 1.6 and 1.1 gpf	4
Urinals	0.5 gpf	2
Lavatory faucets	0.5 gallons per minute (gpm)	11
	1.5 gpm, metered	4
Showerheads	2.5 gpm	7

Faucets and Showerheads

High-efficiency lavatory faucets (0.5 gpm) have been installed to conserve water throughout the main building. The ER Building's 1.5 gpm metered faucets dispense a maximum of 0.25 gpm.

Energy Policy Act of 1992 (EPAct 1992)-compliant showerheads (2.5 gpm) are installed in all seven shower stalls. System pressure is maintained between 20 to 80 pounds per square inch.

Table 2 presents a complete inventory of faucets and showerheads.

Janitorial staff and employees report leaks or other maintenance problems to the Facility Manager, which are immediately corrected by on-call O&M staff.

NAREL has achieved BMP status in this area.

Boiler/Steam Systems

NAREL does not operate a steam boiler. BMP status is not applicable in this area.

Single-Pass Cooling Equipment

NAREL has eliminated all forms of single-pass equipment cooling. BMP status is not applicable in this area.

Cooling Tower Management

NAREL operates a two-cell cooling tower. One cell operates at 300 tons and the other at 150 tons. The cooling tower is maintained by a cooling tower maintenance contractor that performs monthly quality, performance, and water chemistry reviews of cooling tower operation. Chemical treatment is provided to control scale and corrosion. A conductivity meter set between 600 and 650 microSiemens per centimeter (*u*S/cm) is used to control blowdown.

In December 2009, the cooling tower was not operating correctly, causing it to waste water. A recurring problem related to the condenser water loop and associated blowdown control appeared to have been responsible. Air was frequently entrained into the blowdown line; therefore, the tower did not blowdown even when the blowdown valve was actuated by the conductivity controller. To either reduce the tendency to entrain air or to achieve some level of blowdown, operating staff raised the water level in the cooling tower basin to just above the overflow drain. This caused water to drain continuously from the tower and the level control switch not to cut off cleanly.

In early 2010, the blowdown line was moved so air no longer becomes entrained in the line. The blowdown control system can now routinely control the cooling tower at the selected conductivity control point. In addition, NAREL extended the drains inside the cooling tower by 3 inches to ensure that the level in the tower allows the float control to cut off cleanly. This change ensures that water is not released through the basin overflow drain during normal operation.

Because these operational issues were corrected, NAREL has achieved BMP status in this area.

Commercial Kitchen Equipment

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

Laboratory/Medical Equipment

Laboratory fume hoods are equipped with a scrubber system to capture the acid gas fumes that can be generated during sample digestions. Each of 27 fume hoods is equipped with a scrubber system. Each scrubber system contains two primary components that use water. First, as exhaust air is vented through the scrubber unit, it passes through a wetted, packed bed to control acid gas. The packed bed is wetted by water recirculated from a small sump. The recirculation pump is controlled by an on-off switch operated by the analyst at the fume hood opening. The water level in the sump is maintained by a float switch. The second use of water is to flush down the interior surfaces of the duct work leading from the research bench to the scrubber unit. When an analyst finishes a task that can generate acid gas, he or she opens a flow control valve which activates water sprayers in the duct work. After approximately one to two minutes, the flow valve is shut and the flushing sequence is completed. Flushing water drains from the duct work to the acid sewer.

A liquid ring vacuum pump located in the mechanical room generates vacuum supplied to laboratory spaces throughout the building. A recirculation tank supplies water to provide the liquid ring seal. The water level in the recirculation tank is maintained by a float-operated switch. NAREL replaced the float-operated switch in early 2010 because the system previously operated with a constant overflow of water though the tank, indicating that the float-operated switch was not operating properly.

Under this plan, NAREL will maintain a daily inspection routine for the scrubber systems and vacuum pump to ensure that the float switches are operating properly and the respective recirculation tanks do not continuously overflow.

Purified water for laboratory use is generated by RO. The purified water is fed to a holding tank, from which it is pumped to individual laboratory spaces throughout the building. The system was not equipped with any type of control over the generation rate, so purified water was generated continuously and overflowed the top of the holding tank. In early 2010, new pressurized tanks were installed on the purified water line. When the pressurized tanks are full, the back pressure triggers a shut-off valve that stops the continuous flow of water. The RO system is equipped with a flow meter and readings are recorded daily.

Because the RO system was modified to only generate RO when it is needed and a new float-operated switch was installed on the vacuum pump recirculation tank, NAREL has achieved BMP status in this area.

Other Water Use

Approximately four times per year, emergency response vehicles are washed in the parking lot using a high pressure washer supplied with city water. Two tractors, one trailer, and four large vehicles are washed during this time. Once every one to two years, the exterior of the building is pressure washed using potable water. NAREL has achieved BMP status in this area because high pressure, low flow washers are used to minimize water consumption.

Alternative Water Sources

NAREL plans to collect air handler condensate from air handling units in its mechanical spaces to use as cooling tower make-up water.

NAREL is evaluating whether it is cost-effective to also route RO reject water to the cooling tower for reuse rather than to drain. Since new pressurized tanks were installed on the RO system in early 2010, total RO water use, and thus the quantity of RO reject generated, should decrease. NAREL will evaluate the total quantity of RO reject water generated annually to determine if it is cost effective to reroute this water to the cooling tower.

NAREL can claim BMP status in this area once the air handler condensate project has been completed and the RO reject reuse project has been evaluated.

7.0 DROUGHT CONTINGENCY PLAN

The City of Montgomery Water Works and Sanitary Sewer Board does not have a permanent drought management plan. The Board may institute voluntary or mandatory restrictions, consistent with the Alabama Drought Management Plan (22 April 2004). The Alabama Drought Management Plan is available from the Alabama Department of Economic Development and Community Affairs at:
www.adeca.state.al.us/C12/Alabama%20Drought%20Management%20Pla/default.aspx

In the event the Water Works and Sanitary Sewer Board institutes voluntary or mandatory water conservation reductions, NAREL will form a task force of facility and operating personnel to identify and implement modifications to facility operations to achieve additional specified reductions in water consumption.

8.0 COMPREHENSIVE PLANNING

The Facility Manager will ensure the 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 prior to the purchase and installation of any equipment that would measurably change facility water consumption. Where available, NAREL will purchase or specify WaterSense labeled products (www.epa.gov/watersense).

9.0 STATUS UNDER GUIDING PRINCIPLES FOR HIGH PERFORMANCE AND SUSTAINABLE BUILDINGS

The Interagency Sustainability Working Group (ISWG), formed as a subcommittee of the EO 13423 Steering Committee, has established guiding principles to assist agencies in meeting the high performance and sustainable buildings goals of EO 13423, section 2(f). The 1 December 2008, version of the ISWG's *Guiding Principles for Sustainable Existing Buildings* established six supporting principles for protecting and conserving water. NAREL's status toward achieving the supporting principles for protecting and conserving water at existing buildings is documented in Table 3.

Table 3. Status of Guiding Principle to Protect and Conserve Water

Topic	Status
Indoor Water	Option 1: Comparison to 2006 Plumbing Codes In December 2009, all older, higher-flow style sanitary fixtures in the main building were replaced with 1.28 gpf toilets, 0.5 gpf urinals, and 0.5 gpm faucet fixtures. The ER Building is equipped with dual-flush toilets offering 1.6 and 1.1 gpf flushing options and 1.5 gpm, metered faucets. Because of the installation of water-efficient fixtures at NAREL, potable water use in FY 2010 is expected to be approximately 33 percent less than the calculated water use baseline. The baseline for the facility was established as 120 percent of the Uniform Plumbing Code 2006 under the *Guiding Principles*, Indoor Water Option 1. Option 2: Comparison to FY 2003 or year thereafter: Because of a lack of sufficient historical data, the *Guiding Principles* Indoor Water Option 2 cannot be evaluated for this facility at this time. Water use intensity data was not available until FY 2006, and accurate data was not available in FY 2006, FY 2007, or FY 2008. Reported water use intensity varied widely during this time. In FY 2009, data was reported from the new advanced metering system, providing the best baseline water data available for NAREL to date. NAREL used 68.86 gallons/GSF in FY 2009.
Outdoor Water	The facility does not have a permanent irrigation system. It does not use potable water for irrigation. New plantings are not watered. Grasses and shrubs are climate appropriate and survive on natural rainfall.
Water Metering	Two domestic water meters measure all onsite city water used in the main NAREL building and the ER Building. Flow totalizing submeters are also installed on the cooling tower make-up water line and the reverse osmosis system. NAREL has advanced metering of electricity, natural gas, and water.
Stormwater Management	Stormwater runoff from the site is collected by both an underground storm sewer system and ditches. Runoff collected by the storm sewer system is conveyed to Three Mile Branch Creek. Stormwater runoff from the main building is collected in roof drains connected to the storm sewer system. Stormwater runoff from the ER Building is collected in roof downspouts and is directed to vegetated areas. An engineered grassed swale, located near the western edge of the site, manages a portion of stormwater runoff from the site. NAREL is working with Auburn University to install two rain gardens on either side of the elevated entrance walkway into the main building where large underground storm drains are located. This project is in the preliminary design phase.
Process Water	NAREL does not use potable water to improve its energy efficiency at the expense of water efficiency.
Water-Efficient Products	The Green Procurement EMP sets a target to ensure procurement of water-efficient products, though it does not officially designate WaterSense labeled products. Under this plan, facility staff will consider WaterSense labeled products when making purchases. All sanitary fixtures in the main building were replaced with high-efficiency models in December 2009, and all fixtures installed in the ER Building are high-efficiency models from original construction. Acquisition personnel are trained in the procurement of WaterSense labeled and water-efficient products, but bank card holders are not.

10.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

NAREL is pursuing the following projects to achieve additional reductions in water use:

1) **Pursue corrective action on the cooling tower's blowdown control system and level control.** NAREL completed a project in early 2010 to ensure that the blowdown control system routinely controls at the selected conductivity control point. NAREL also extended the drains inside the cooling tower by 3 inches to ensure that the level in the tower allows the float control to cut off cleanly. This change ensures that water is not released through the basin overflow drain during normal operation. Performing these corrective actions to ensure that the cooling tower is operating and being controlled correctly is estimated to save NAREL 1,000,000 gallons per year.

2) **Capture and Reuse Air Handler Condensate.** NAREL will capture air handler condensate and route it to the cooling tower. Initial engineering evaluation indicates that it may be possible to capture up to 730,000 gallons per year. This water will significantly offset the consumption of potable water for cooling tower make-up.

3) **Improve preventative maintenance procedures on float-operated switch associated with vacuum pump.** In early 2010, NAREL completed a project to install a new float-operated switch used to control water flow into the basement vacuum pump because it was not operating properly. Under this plan, NAREL will improve preventative maintenance on this device to assure that it is not constantly flowing to drain. Installation of the new float-operated switch is estimated to save approximately 140,000 gallons per year.

4) **Improve Operation of RO System.** In early 2010, NAREL modified the RO system so that it only runs when there is a demand for purified water, rather than overflowing the holding tank. NAREL modified the system by installing new pressurized tanks on the purified water line, and when the tanks are full the back pressure triggers a shut-off valve that stops the continuous flow of water. By improving the operation of the RO system, NAREL may save an estimated 200,000 gallons of water per year.

5) **Track the Quantity of RO Reject Water to Evaluate if Reuse Opportunity Exists.** NAREL is considering rerouting RO reject water to the cooling tower to be used as make-up water instead of sending it to drain. Before initiating this project, NAREL will monitor the quantity of RO reject generated. Since new pressurized tanks were installed on the RO system in early 2010 (per project #4 above), total RO water use, and thus the quantity of RO reject generated, should decrease. NAREL will evaluate if it is cost-effective to reroute the RO reject water to the cooling tower for reuse after further evaluating the total quantity of RO reject water generated annually.

Appendix A

WATER BALANCE SUPPORTING CALCULATIONS

Table A-1. Water Balance Supporting Calculations – FY 2009, NAREL, Montgomery, Alabama

Major Process	Annual Consumption (gallons)	Supporting Calculations and Source Documentation
Main building sanitary	280,000	Engineering estimate based on 56 people using 20 gallons/day, 250 days per year. 56 people × 20 gallons / person / day × 250 days / year = 280,000 gallons / year. This estimate is based on older, higher flow fixtures which were in place during FY 2009. In early FY 2010, new high-efficiency fixtures were installed, which will result in decreased water use in FY 2010.
ER Building sanitary and vehicle washing	9,750	Monthly meter readings (FY 2009)
Penthouse scrubber water recirculation tank overflow on units 24 and 28	53,000	Engineering estimate based on observed flow rate of approximately 0.1 gpm continuous flow. 0.1 gpm × 60 minutes / hour × 24 hour / day × 365 days / year = 52,560 gallons / year.
Vacuum pump recirculation tank overflow	187,000	Engineering estimate based on measured flow rate of approximately 22.45 milliliters (mL) / second continuous flow. 22.45 mL / second × 1 gallon / 3,785.41178 mL × 60 seconds / minute × 60 minutes / hour × 24 hours / day × 365 days / year = 187,029 gallons / year.
Reverse osmosis system use	119,360	Meter readings from 1 October 2008 through 30 September 2009 = 119,360 gallons / year.
Cooling tower make up water	3,382,880	Monthly meter readings (FY 2009)
Laboratory fume hood internal washdown, other miscellaneous laboratory water uses	902,360	Calculated by difference from total water use
Total water use	**4,934,350**	**Total reported FY 2009 water use**

Appendix B

MONTHLY WATER USE IN FY 2009

Table B-1. Monthly Water Use in FY 2009, NAREL, Alabama

Month Year	Cooling Tower Make-Up Water (gallons)	Total Water Use (gallons)
October 2008	176,570	316,460
November 2008	109,710	245,710
December 2008	378,890	413,340
January 2009	332,450	479,900
February 2009	324,410	419,910
March 2009	197,550	303,850
April 2009	215,270	388,970
May 2009	288,230	397,230
June 2009	378,890	497,190
July 2009	354,000	512,430
August 2009	317,630	485,830
September 2009	309,280	473,530
Total water use	**3,382,880**	**4,934,350**

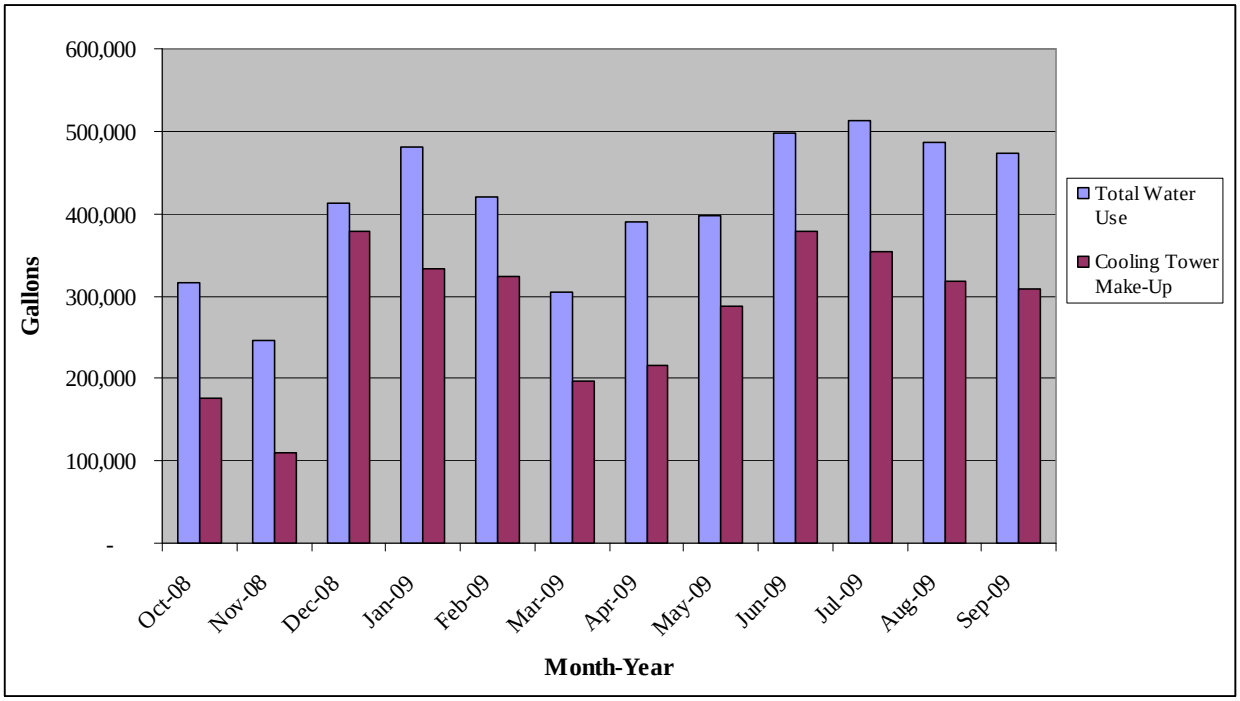

Figure B-1. Monthly Total Water Use and Cooling Tower Make-Up Water in FY 2009, NAREL, Montgomery, Alabama