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American Recovery and Reinvestment Act (ARRA)
Federal Energy Management Program
Technical Assistance Project 281

Solar Hot Water Application Assessment for U.S. Army IMCOM-Southeast Region

BJ Russo
WD Chvala

September 2010

Pacific Northwest
NATIONAL LABORATORY

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Richland, Washington 99352

Executive Summary

The Energy Independence and Security Act of 2007 (EISA) requires installations to install solar systems of sufficient capacity to provide 30% of domestic hot water in new construction and renovations where cost-effective. However, installations are struggling with how to implement solar hot water, and while several installations are installing solar hot water on a limited basis, paybacks remain long. Pacific Northwest National Laboratory (PNNL) was tasked to address this issue to help determine how best to implement solar hot water projects. PNNL selected nine buildings in which to monitor the domestic hot water consumption patterns at Fort Campbell from December 2009 through July 2010. These consumption patterns and other building-specific parameters were then entered into TSOL, a solar hot water analysis program, to determine system parameters (such as collector size) and system performance (such as efficiency and solar fraction). Each building type was then analyzed for each of the climate zones that span Installation Management Command Southeast (IMCOM-Southeast). Next, an economic analysis was performed for major military installations across IMCOM-Southeast. Savings-to-investment ratios (SIRs) were calculated and reported using current Energy Conservation Investment Program (ECIP) guidance. Lastly, a sensitivity analysis of system and energy cost was performed across all climate zones considered.

The analysis revealed that solar hot water systems are a relatively expensive form of domestic hot water heating that is currently cost-effective under a somewhat narrow set of circumstances. A handful of locations including Fort Buchanan, MOT (Military Ocean Terminal) Sunny Point, U.S. Army Garrison (USAG) Miami, and Anniston Army Depot might be currently suitable for cost-effective solar hot water installation. Projects may have savings-to-investment (SIR) ratios in excess of 2.0 for the best locations and building types. These locations are suitable primarily because of the high cost of water heating energy at these sites. The Federal government should initially focus on these sites for cost-effective solar hot water development. If energy costs continue to increase at levels similar to the previous decade, additional sites such as Fort Gordon, Fort Stewart, Fort Jackson, Blue Grass Army Depot, Fort Campbell, Redstone Arsenal, Fort Rucker, and Fort Bragg may also be suitable. However, currently these locations tend to have SIRs in the range of 0.5 to 1.1. The Federal government should consider these sites as a secondary priority for cost-effective solar hot water development. Sites with exceptionally low cost energy, such as Fort Polk, Fort McPherson, Pine Bluff Arsenal, and Fort Knox, may not be suitable for solar hot water systems unless exceptional increases in energy and/or drops in system costs occur as the SIRs are currently less than 0.5 for most building types, and can be as low as 0.20.

Although certain locations are more suitable for solar hot water systems, specific buildings are also more suitable for these systems. Table ES.1 lists the building characteristics that tend to enhance or suppress solar hot water system economics.

Table ES.1. Characteristics that Indicate Solar Hot Water System Economics

Characteristics that improve solar hot water project economics
High levels of makeup water heating and low levels of water reheating
Occupied 7 days per week
Inefficient existing hot water systems
Consistent and regular water draws throughout the day
Large amounts of food processing
The presence of year-round use pools
Low domestic hot water temperature setpoint (e.g., 120 ^{o}F)
Characteristics that degrade solar hot water project economics
High levels of water reheating
High hot water peak demand relative to the average demand
Oversized hot water systems
Buildings that have been heavily repurposed

The sensitivity analysis revealed that substantial changes in energy costs, system prices, or both would need to occur for cost-effective solar water development to be widespread. In addition, the analysis further emphasized that at this time, system economics are more dependent upon the value of the displaced fuel, and, to a lesser extent, building use type than insolation.

Lastly, based on the average building performance across all climate zones, if solar hot water systems meeting the 30% solar fraction goal were installed on all nine of the buildings analyzed in this report, it would result in 133,372 lb (66 metric tons) of CO_2e emission savings per year, 1,127 MMBtu per year of energy savings, and 3.0 full time employment opportunities. If a suitable building from each of building types identified could be developed at all 17 sites considered, it would result in 2.2 million lbs (1,100 metric tons) of CO_2e emission savings per year, 19,160 MMBtu per year of energy savings, and 51 full time employment opportunities. Note, however, that this is a conservative estimate as large sites may have dozens of suitable buildings.

Acknowledgments

The authors wish to acknowledge the support of Mr. Dewayne Smith at Fort Campbell, Kentucky, who graciously allowed the team to study water usage patterns in buildings at the fort. This project was co-funded by Paul Volkman of the Army Installation Management Command (IMCOM) with support from IMCOM-Southeast Region Energy Manager, Manette Messenger, and with additional funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA).

Acronyms and Abbreviations

AEWRS	Army Energy and Water Reporting System
ARRA	American Recovery and Reinvestment Act of 2009
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
DFAC	dining facility
ECIP	Energy Conservation Investment Program
EISA	Energy Independence and Security Act
EO	Executive Order
FEDS	Facility Energy Decision System
FTE	full-time employment
ICS	integrated collector storage
IMCOM	Installation Management Command
MOT	Military Ocean Terminal
O&M	operations and maintenance
PNNL	Pacific Northwest National Laboratory
REC	renewable energy credit
RPS	Renewable Portfolio Standard
SDHW	solar domestic hot water
SIR	savings-to-investment ratio
UFC	Unified Facilities Code
UFGS	Unified Facilities Guide Specifications
USAG	U.S. Army Garrison

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1.0 Introduction

The Energy Independence and Security Act of 2007 (EISA) requires installations to install solar systems to provide 30% of domestic hot water in new construction and renovations where cost-effective. However, installations in Installation Management Command-Southeast Region (IMCOM-Southeast) are struggling with how to implement solar hot water projects. Several installations are installing solar hot water systems on a limited basis, but paybacks remain long. Consequently, installations would benefit from detailed guidance on how and where to install solar hot water systems that provide the quickest payback.

Pacific Northwest National Laboratory (PNNL) was tasked to help installations in IMCOM-Southeast determine how best to implement solar hot water projects. The first part of this assessment includes a survey of system types to evaluate current equipment options. Secondly, PNNL sought to understand hot water usage patterns in typical buildings found on an Army installation by installing monitoring equipment in nine representative buildings commonly found on Army installations. The metered data were used to analyze the performance of a solar hot water system at these buildings. Finally, PNNL has an extensive database of utility rate information and complete Facility Energy Decision System (FEDS)[1] energy models for IMCOM-Southeast installations. These were used to generalize the metered results to buildings located in all parts of IMCOM-Southeast and perform economic analyses for each retrofit project.

This report documents the results of the assessment and presents a strategy for IMCOM-Southeast installations to follow for the further implementation of solar hot water projects.

[1] www.pnl.gov/feds

2.0 Solar Hot Water Technologies

Solar domestic hot water (SDHW) heating is a flexible and versatile technology that has been used in locations as far north as the city of Whitehorse in Canada's Yukon Territory. While contemporary SDHW systems have been available since the 1960s, these systems only became popular in the United States during the various energy crises. These systems became unpopular when energy prices declined, although increasing concern over climate change and dwindling energy supplies has spurred supportive legislation and renewed interest in these systems. However, despite these incentives, large-scale use of solar hot water heating systems on Army facilities is limited, and therefore, there is a lack of experience and knowledge within the Army construction community.

2.1 Applicable Policy

EISA requires new or renovated Federal buildings to use solar energy for 30% of their domestic water heating energy needs, if cost-effective. Executive Order (EO) 13423 mandates that by 2013, 7.5% of the total electric energy consumed by an installation originate from renewable resources. EO 13423 allows thermal technologies to count towards the renewable energy goal. Lastly, the National Defense Authorization Act codifies the Department of Defense's voluntary goal of 25% by 2025. Renewable thermal energy counts toward this renewable goal.

2.2 The Solar Energy Resource

Solar hot water systems harvest solar radiation (i.e., insolation) in the form of thermal energy to heat water. Insolation is commonly measured in units of energy delivered to an area over a period of time, and is most frequently described in $kWh/m^2/day$. Insolation is frequently expressed as the amount of sunlight that strikes a collector, and insolation levels are higher on surfaces angled to face the sun than on the ground. Insolation levels are typically higher in the summer because the sun is higher in the sky (which means there is less atmosphere through which sunlight must travel) and the number of daylight hours is greater. Local factors such as cloudiness, dust, and shadow-casting features (such as mountains or trees) also affect insolation.

Care must be taken when describing the angle at which a panel is tilted because the angle can dramatically influence the insolation intensity. A common angle used to express insolation is 0^o, which represents a collector flat on the ground. This is also known as the global insolation. Another common angle used to express insolation is a latitude-tilted collector, where the collector angle is equal to the latitude of the site of interest. Latitude-tilted surfaces typically optimize the amount of sunlight collected throughout the year by a fixed-angle collector. The closer a site is to the equator, the closer the latitude-tilted insolation value will equal the global insolation value (because the latitude of an equatorial site is 0°). Figure 2.1 shows the insolation on a latitude-tilted surface across the United States. In the southeastern region of the United States, insolation ranges from 4.0 to 5.5, with the low occurring in Kentucky and the high in southern Florida.

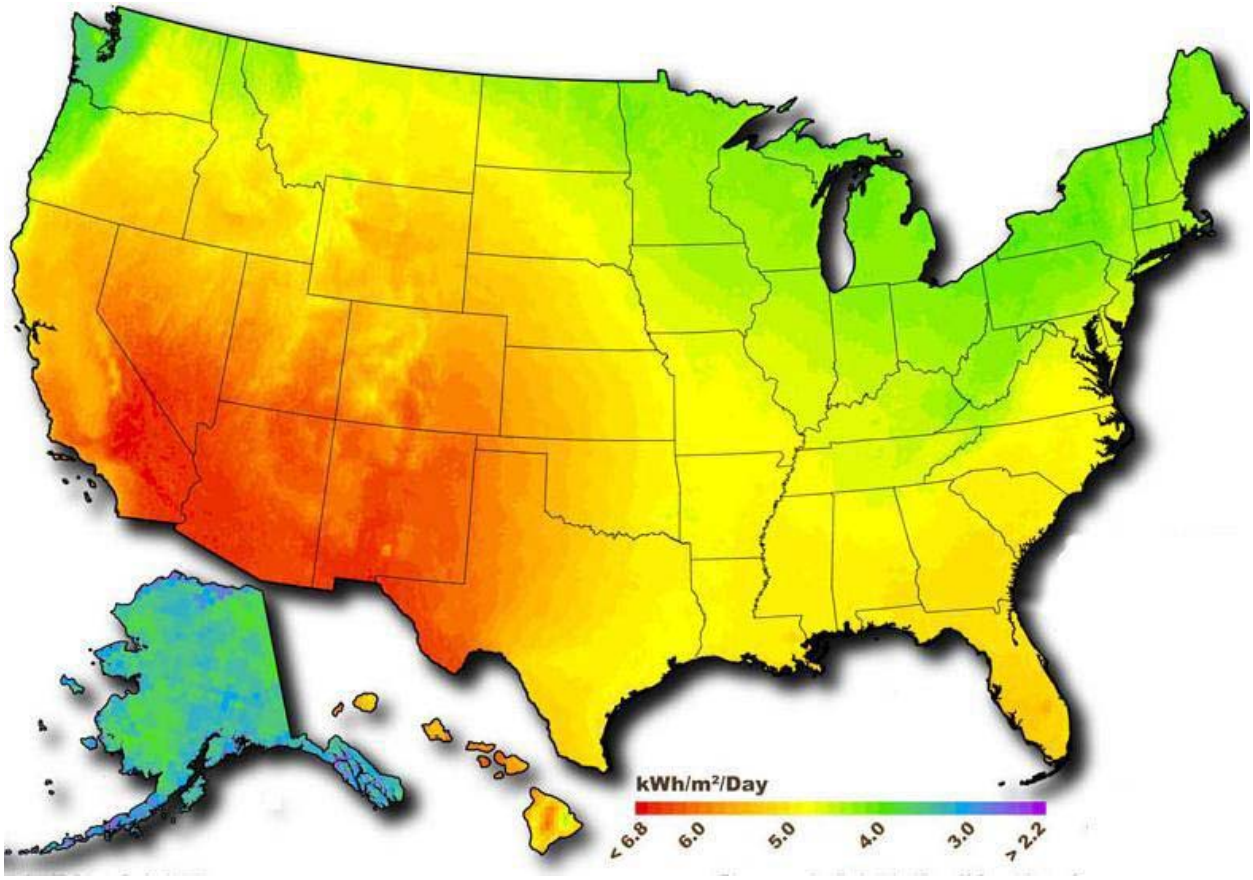

Figure 2.1. Solar Insolation Levels across the United States on a Latitude Tilted Surface (NREL 2008)

2.3 Solar Hot Water Heating Technologies

SDHW systems are simple in theory; heat is collected from the solar resource by the collector panels and stored in water tanks for when the hot water is needed. There are several benefits to solar water heating:

- Use of a well-understood and studied renewable resource,
- Relatively predictable annual energy output,
- Ability to scale the collectors and storage system to a wide range of existing needs,
- Free energy source,
- High efficiency relative to other renewable energy systems,
- Recognizable and highly visible technology.

SDHW heating has a number of drawbacks as well, such as:

- Inability to provide 100% of hot water demand (which requires the need to have a backup heater),
- Relatively high initial cost compared to standard water heating technologies,
- Added complexity that requires additional maintenance,

- Institutional resistance because of historic maintenance issues and perceived unreliability.

2.4 Collector Types

There is a wide variety of collectors and system designs available for solar water heating. Collector types include glazed solar collectors, unglazed solar collectors, and evacuated tube solar collectors. Systems are either direct or indirect, and may employ either an antifreeze solution or a drainback tank for freeze and overheat protection.

Glazed solar collectors are the most common type of collector used for small and medium water heating applications. They are able to achieve water temperatures up to 160°F and are well suited to domestic hot water production. These collector systems are typically the default collectors for most solar domestic water heating. The panel efficiency, amount of solar insolation received by the panels, and size of panel area directly relate to how much energy is delivered.

Unglazed collectors are only used in low-temperature applications such as pool heating and were not considered in this analysis. Evacuated tube solar collectors are most often used in high-temperature (>150°F) applications, where roof or mounting space is limited, or in cold climate/low light situations, where heat loss needs to be minimized to achieve useful output temperatures. These systems are more expensive and fragile, and there is considerably less experience with the operation and maintenance (O&M) of these collectors in the United States. Furthermore, when only moderately hot water is necessary (<150°F), evacuated tube systems can be just as, and sometimes less, efficient than glazed solar collectors. Therefore, evacuated tube systems were also not included in this analysis.

2.4.1 Indirect/direct Systems

In indirect systems, a heat exchanger is used to isolate the potable water from the working (heat transfer) fluid. This allows antifreeze to be used in the heat transfer fluid. In some instances, an indirect system is used even if antifreeze is not used because purified, deionized water can be used in the loop instead. This is generally to protect against issues arising from hard water, and will extend the life of the solar collectors and the water heating system.

In direct systems, potable water is circulated directly through the solar collector, thereby avoiding the need for heat exchangers. Direct systems are between 5 and 10% more efficient than indirect systems when using pure water as the working fluid. In locations where freezing occurs, direct systems are not allowed (UFC Active Solar Preheat Section, Section 22 33 30.00 10) except in cases where a drainback system is implemented (Section 48 14 13.00 20 2.11). In addition to freezing issues, direct systems can also have scaling problems and should only be used where water quality issues are minimal.

2.4.2 Drainback Systems

Drainback tanks are a useful component to many solar hot water systems that allow them to cope with drastic changes in weather or hot water consumption patterns. Specifically, drainback systems can provide adequate freeze and overheat protection during seasonal extremes. Moreover, these systems address the problem of buildings that may be unoccupied for prolonged periods of time, such as barracks during deployments. A system with a drainback tank can be offline for prolonged periods of time and the

solar fluid can be stored in the drainback tank. By draining back into the drainback tank, the solar fluid is not exposed to excessively high temperatures, which can reduce the life of the fluid and system.

Drainback systems are slightly more efficient when water is used in the loop because water has a higher thermal capacity than a glycol/water mixture. Using water also extends the life and helps avoid additional maintenance requirements that a drainback system using a glycol-water working fluid would need.

Indirect systems that forgo a drainback system can also be considered, if precautions are taken to prevent freezing and overheating. The glycol antifreeze mix can be tailored to protect the system from even the worst freezing conditions. To prevent overheating, the panels can be tilted, rotated, or covered to decrease the insolation experienced during the most intense portion of the day and year.

2.4.3 Storage

A SDHW system should have its own storage tank to take full advantage of the freely available solar energy. When the solar hot water system shares a tank with the backup heating system, the backup system will operate more often than required, reducing the renewable energy used for hot water heating. In new construction projects, the backup system storage can be properly sized to account for the additional solar system storage tank; in retrofit projects, the existing tank can remain in use and an additional tank can be installed as the solar hot water storage tank.

It is critical to properly size the storage system to assure high system performance and functionality. Unified Facilities Guide Specifications (UFGS)-48-14-13.00-20 recommends that a SDHW system has between 1.5 to 2.0 gallons of hot water storage per square foot of collector. This is a wide range and will generally be adequate for most applications. Under-sizing the storage system may lead the tank to reach its maximum temperature too quickly. In the case of a drainback system, the working fluid would be drained, and the system would stop operating and reduce the project's economics. In the case of an indirect system without a drainback tank, the excess heat must be absorbed by the system, which may lead to system damage if it cannot be diverted to a shunt load.

A frequent concern is that hot water consumption may be mismatched to the peak periods of SDHW production. This could be the case in a barracks, where a substantial amount of hot water is used in the morning and a smaller quantity in afternoons and evenings, when insolation is strongest. Modern hot water storage tanks are well insulated and have relatively small standby losses, which is a few percent per hour for most systems. It is feasible for a SDHW system to produce hot water during the day and have the backup heater maintain that temperature. While this will consume more backup energy than if the solar-heated hot water was consumed during the day, the system will still deliver a substantial quantity of solar-heated water.

If the building has a recirculation loop, as is the case for many larger buildings, a significant quantity of heat is lost to the environment as the water circulates through the building. This lost heat is a natural consequence of looped systems that cannot be avoided. Solar hot water heating systems will offset some of this lost heat with solar-derived heat as opposed to fossil-derived heat. When sizing a solar hot water system, this heat loss must be accounted for, especially when there is a solar fraction target.

2.5 Energy Savings Potential of Solar Hot Water Systems

When considering a specific project, the savings potential is influenced by a wide variety of factors. One of the key design considerations is ensuring that the produced hot water has a corresponding demand. For example, if two typical large administration buildings are outfitted with two different systems, one that provides 30% of total hot water needs and one that provides 70%, the larger of the systems can have a payback period that is 50% longer than the smaller system. The rationale behind this trend is rooted in heat transfer efficiency; the greater the temperature difference between two objects, the greater the thermodynamic drive for heat to move from the hot object to the cold object. When a solar hot water heating system accepts relatively cold water as an input at the heat exchanger, a great deal of heat is able to be transferred from the system to the cold water. This mode of operation is typical of smaller systems that act as a domestic hot water preheater. Larger systems, however, will both preheat and, to a larger extent, reheat cooled water more than a small system solar hot water system. Consequently, the larger solar hot water system has to deliver heat to an already warm fluid, which affects the heat transfer efficiency and results in a smaller quantity of renewable energy being delivered.

Other factors that affect the savings potential of a solar hot water system include occupancy, the domestic hot water distribution configuration (i.e., distributed or recirculating), insulation levels, and the efficiency of the supplemental water heater. Occupancy patterns naturally influence savings because more heavily occupied buildings tend to consume greater volumes of hot water. The hot water distribution configuration affects savings because recirculating systems can lose substantial amounts of energy through the hot water distribution loop. Insulation will help retain heat within the hot water system and is especially critical in recirculating hot water systems. Lastly, the efficiency of the supplemental water heater must be accounted for since each unit of energy delivered by the solar hot water system will displace a larger amount of fuel after accounting for the supplemental heater system efficiency.

2.6 Factors in Solar Hot Water Project Economics

Undoubtedly, the current limitation to widespread SDHW deployment is poor project economics. The economics of SDHW heating systems are influenced by five primary factors:

- The value of the displaced energy,
- System cost,
- The quantity of renewable energy delivered,
- The quantity of hot water demanded, and
- Government or utility assistance/rebate programs.

The value of the displaced energy can be the single largest factor that may affect a SDHW project's feasibility. The expense of hot water heating can vary dramatically based on the energy source. For instance, applications that heat water with electricity that is twice as expensive as natural gas will find that supplementing an electric system with a solar water heating system can result in over twice the dollar savings, compared to replacing a similarly-sized natural gas system.

At this time, SDHW systems are affordable, although still relatively expensive compared to conventional water heating technologies. System costs vary according to the options and specific design, but are typically between $90 and $120 per square foot for conventional glazed collectors.

The quantity of energy delivered will naturally affect solar hot water system economics. For a system of a given size, the more energy the system produces, the most cost-effective the system will be compared to a system that produces less energy. Factors such as building occupancy, service water temperatures, insulation levels of the hot water system, and hot water recirculation will affect the quantity of energy delivered for any given solar hot water system.

The quantity of hot water demand typically correlates with the fraction of energy needed for makeup water heating instead of water reheating. Systems that principally perform makeup water heating tend to be more efficient, and thus cost-effective, than systems that perform substantial amounts of water reheating.

Lastly, utility or government incentives, such Florida's sales tax exemption for solar hot water systems, can reduce system capital costs, which will improve system economics. Occasionally, renewable energy credits (RECs) can be sold for renewable energy systems that produce thermal energy. RECs represent the property rights to the positive qualities of renewable electricity generation. A REC and its positive qualities can be sold separately from the physical electricity associated with a renewable-based generation source. For example, North Carolina has provisions in their Renewable Portfolio Standard (RPS) legislation that allow for solar thermal hot water systems to generate RECs. These RECs could be sold or swapped to improve project economics.

2.7 Operation and Maintenance

SDHW systems are traditionally thought to be operations and maintenance (O&M)-intensive. While they are more complex than traditional water heaters, their reliability has improved since the late 1970s and early 1980s, when the last energy crisis initially sparked widespread manufacture and use of these systems. Nevertheless, solar hot water systems are more O&M-intensive than their traditional counterparts.

O&M for solar hot water systems is mostly required for temperature sensors and controls, expansion tanks, pump motor winding, general leaks, valve failures, and collector defects. Basic preventative maintenance activities include checking glycol levels, insulation, and pumps twice a year. These steps can take about 1 hour for a small system (6 collectors), and up to half a day for large systems (100 or more collectors). The glycol working fluid will also need to be replaced approximately every 3 years. Beyond basic maintenance, the variety of system types, sizes, and complexities can result in highly variable O&M costs and issues. Annual O&M costs are frequently expressed as a percentage of the total capital cost. The DOD UFC 3-440-04N guide suggests using 3% to 4% (and generally no more than 8%) of the capital cost per year for a glazed collector system (WBDG 2010a).

3.0 Data Collection

Solar hot water system analysis is typically limited by access to accurate data. Frequently, American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) values and other rules of thumb are used to estimate daily hot water loads. These values, typically used by designers, are presented in Table 3.1.

Table 3.1. ASHRAE Domestic Hot Water Consumption (from ASHRAE 2007)

Building Type	Per Capita Hot Water Consumption (gallons/person/day)
Administration	1.0
Barracks (men's dormitories)	13.1
Dining	7.2
Health	18.4
Lodging	14.0
School	1.8

Unfortunately, these values are not always completely germane to the building types encountered at many Army facilities and do not address water usage profiles throughout a typical day. To facilitate more accurate solar hot water analyses, PNNL metered the domestic hot water consumption of several buildings at Fort Campbell, Kentucky.

3.1 Hot Water Metered Data

Hot water consumption and building occupancy patterns can greatly influence the effectiveness of solar hot water systems. To best make recommendations about which buildings the Army should focus on for solar hot water system installation, several buildings were monitored to determine their hot water consumption, temperature setpoints, and in some cases, natural gas consumption for heating domestic water.

3.2 Building Selection

Based on PNNL's previous site visits to Fort Campbell, PNNL selected nine buildings in which to monitor the domestic hot water consumption patterns. These buildings were chosen because they are standard types encountered at most Army facilities and are expected to be economic choices for solar water heating. Monitoring occurred from December 2009 through July 2010. Table 3.2 describes the buildings that were selected for this study. Appendix A provides additional details for each of the selected buildings.

Table 3.2. Selected Buildings and Building Details

Building Number	Building Description	Year of Construction	Metered Quantities
1610	Golf course clubhouse, which included locker rooms, banquet facilities, and luncheonette	2003	Makeup water, supply and return temperature
2191	Indoor pool showering facilities	1948	Makeup water, natural gas, supply temperature
3069	Child development center	1993	Makeup water, supply and return temperature
3211	Hammerhead barracks with dining hall	1954	Makeup water, supply and return temperature
3217	Hammerhead barracks with administrative spaces	1952	Makeup water, supply and return temperature
7037	Physical fitness center	1997	Makeup water, supply and return temperature
7044	2002-vintage modern barracks	2002	Makeup water, supply and return temperature
7048	Dining facility	2002	Makeup water, natural gas, supply and return temperature
7075	2002-vintage administrative building	2002	Makeup water, supply and return temperature

3.2.1 Golf Clubhouse Metered Data

Figure 3.1 displays the water consumption pattern for building 1610, the golf course clubhouse, which includes locker rooms, shower rooms, dining and banquet facilities, and a luncheonette. The hot water system experiences its greatest loads during the weekday and particularly during the early afternoon when dishwashing is at its peak. A smaller breakfast dishwashing peak can also be seen at 0900. Weekend consumption is relatively minimal, although there appears to be a regular peak at 1700 on Saturdays, which may be associated with dinner patrons.

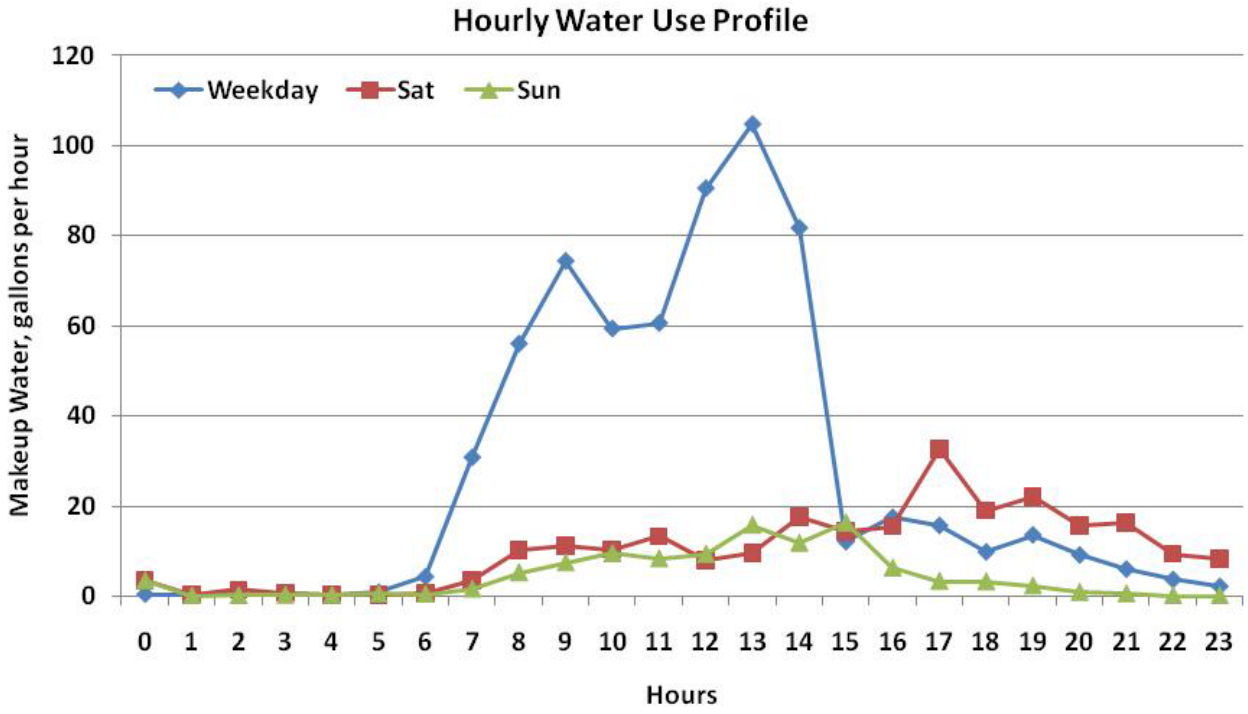

Figure 3.1. Average Makeup Water Consumption Profile for the Golf Clubhouse

Figure 3.2 displays the average supply and return temperature for the recirculating hot water system. The water supply and return temperatures are maintained with a relatively narrow range, and the large hot water consumption peaks after 0800 and 1300 can be clearly correlated to the drops in temperature that occur slightly after the consumption peaks.

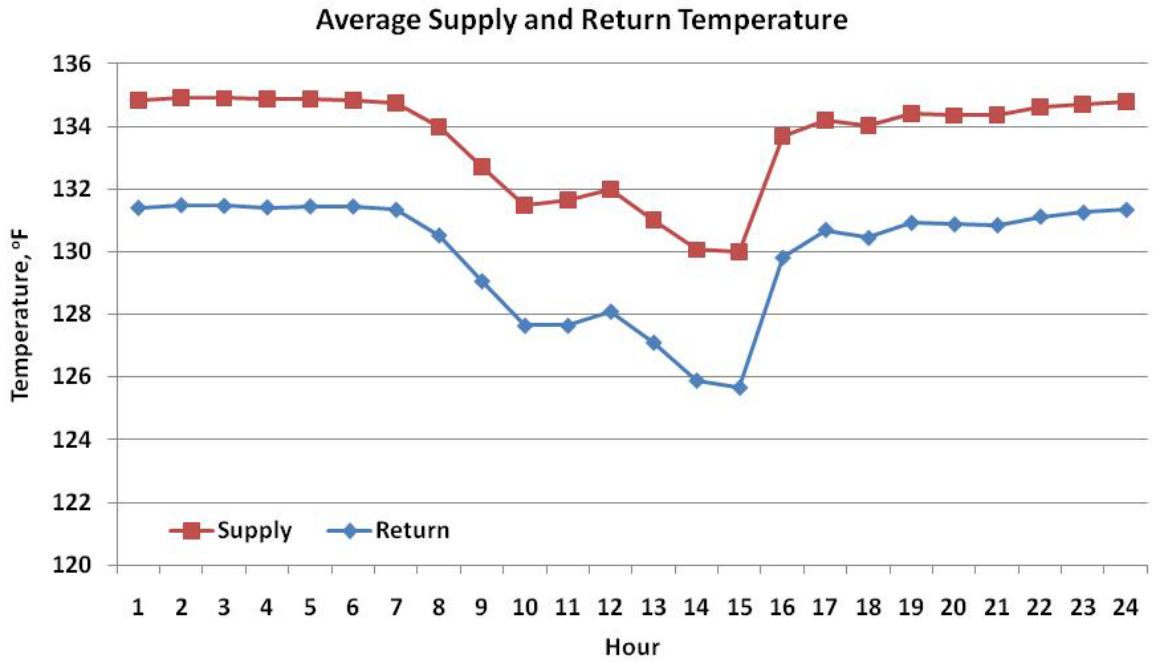

Figure 3.2. Supply and Return Temperature for the Golf Clubhouse

3.2.2 Pool Shower Facility Metered Data

Building 2191 is connected to an indoor pool and is mostly comprised of two locker and shower rooms in addition to a small amount of storage space and an unconditioned mechanical room for the domestic hot water system. Figure 3.3 displays the water consumption pattern for the pool shower facility. The water consumption pattern varies drastically throughout the day and week. The building clearly experiences several weekday peaks correlating with morning exercise, late morning exercise, and an evening exercise period. Hot water consumption is somewhat level between the hours of 1200 and 1900. Saturday and Sunday afternoon swims are also clearly popular.

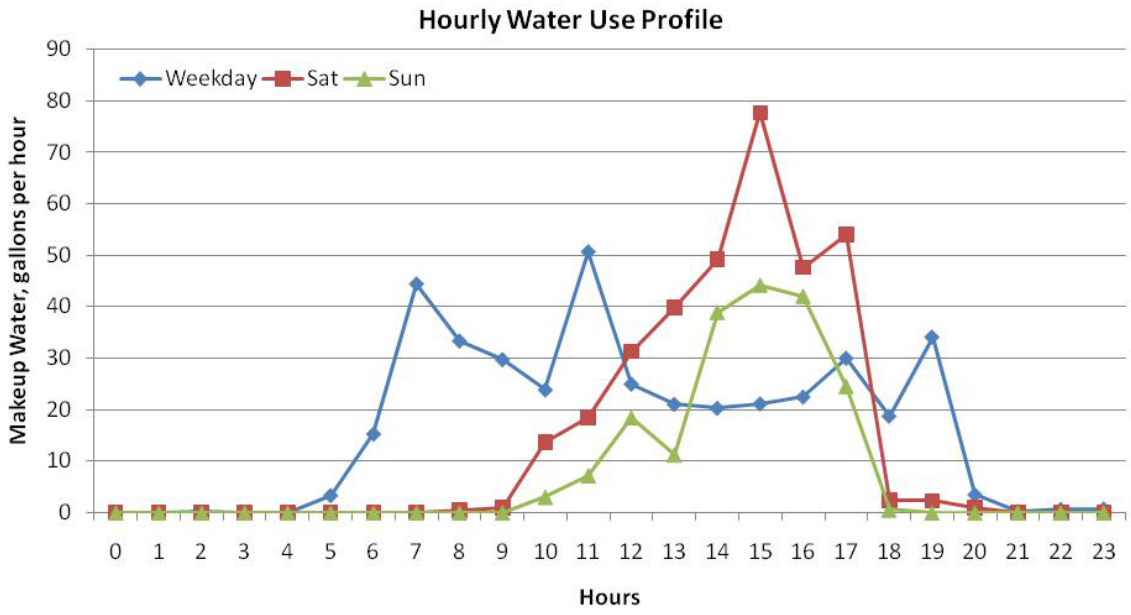

Figure 3.3. Average Makeup Water Consumption Profile for the Pool Shower Facility

Figure 3.4 displays the average supply temperature for the distributed hot water system. The pool shower facility was the only building visited with a distributed hot water system, and the hot water metering point was located on a portion of the supply line immediately after the tank outlet. From the data collected from 1200 to 1800, the tank temperature is near 120°F, while during the early mornings, the water temperature in the pipe drops to a low of 65°F during the early mornings because of minimal hot water use between the hours of 2300 and 0500.

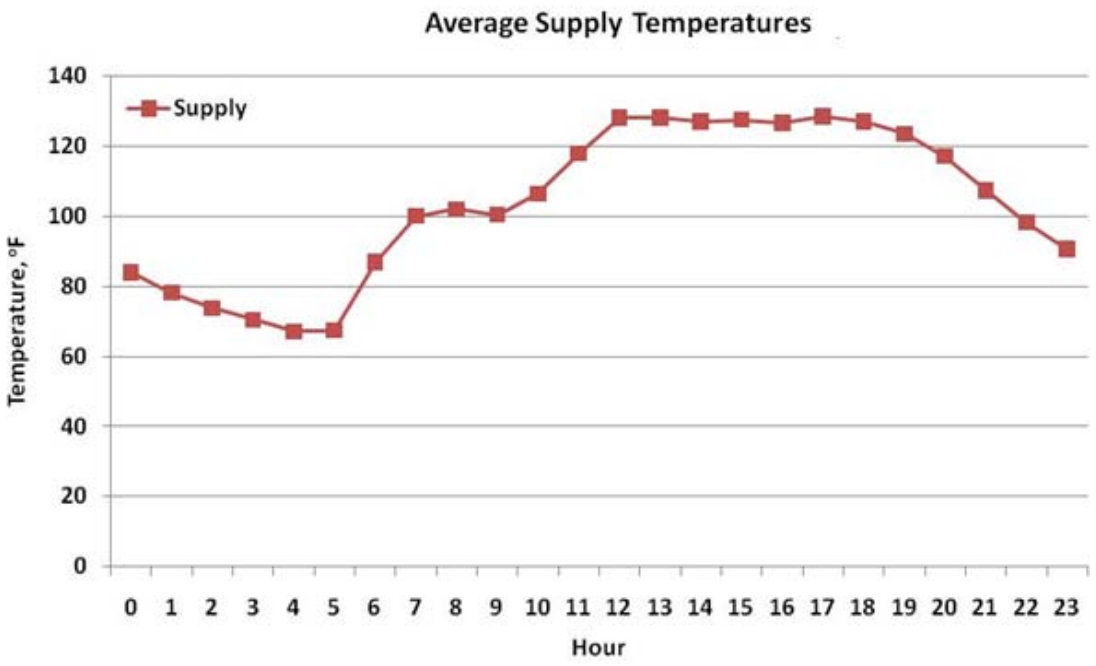

Figure 3.4. Supply Temperature for the Pool Shower Facility

3.2.3 Child Development Center Metered Data

Figure 3.5 displays the water consumption pattern for building 3069, a child development center, which is comprised of a variety of classrooms for students of various ages, administrative offices, and a dining facility. Like the golf clubhouse, the hot water consumption primarily occurs during the weekday and peaks during the breakfast preparation and dishwashing period at 0800. Hot water consumption is sustained mostly because of food preparation and dishwashing for lunch and dinner, with three smaller peaks occurring at 1100, 1400, and 1900. A similar consumption pattern occurs Saturday, although the magnitude is smaller because of lower occupancy rates. The breakfast peak is less pronounced than other meal times, possibly because of a greater diversity of child drop-off times and the relatively lower energy intensity of breakfast preparation.

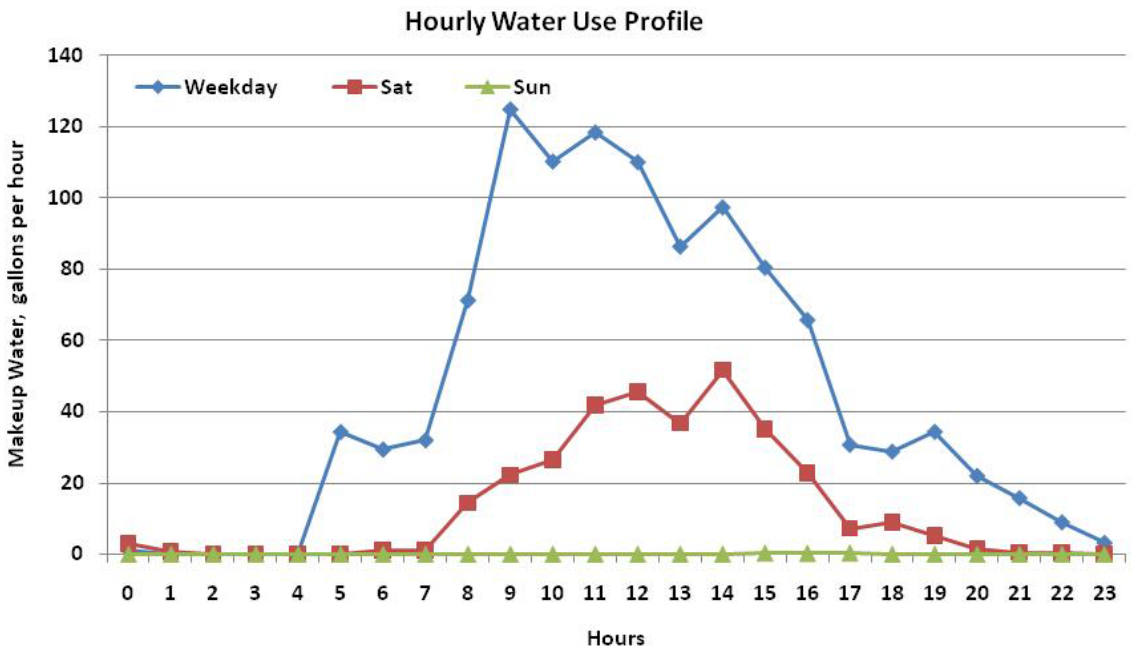

Figure 3.5. Average Makeup Water Consumption Profile for the Child Development Center

Figure 3.6 displays the average supply and return temperature for the recirculating hot water system. The difference between the supply and return temperatures are somewhat steady and the changes associated with the arrival of employees for breakfast preparation can be identified. In addition, there are periods of time where the supply temperature is increasing while the return temperature decreases. These events are likely due to the large water draws that occur which require the water heating system to possibly operate at, or nearly at, full capacity, which causes the tank temperature to spike above the setpoint. At the same time, the recirculation pipes are still relatively cool, which results in a decreasing return water temperature.

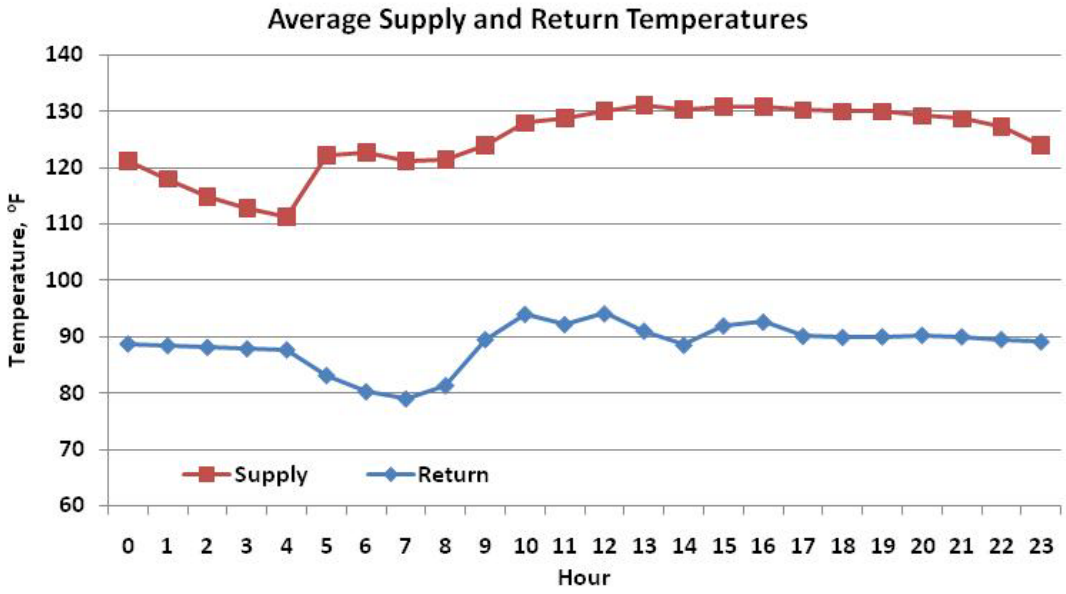

Figure 3.6. Supply and Return Temperature for the Child Development Center

3.2.4 Hammerhead Barracks 1 Metered Data

Figure 3.7 displays the water consumption pattern for building 3211, a 1950s vintage hammerhead barracks that currently is used for administrative and storage spaces. This facility also has a dining facility, although it is no longer used for food preparation. The baseline consumption is notably high, at approximately 37 gallons per hour. This is likely associated with a large leak in the hot water distribution system. A clear weekday peak at 0800 is likely because of the arrival of administrative staff. Consumption above the leak baseline is minimal on weekends because of minimal weekend occupancy. When conducting the solar hot water system analysis, the leak was removed from the consumption pattern.

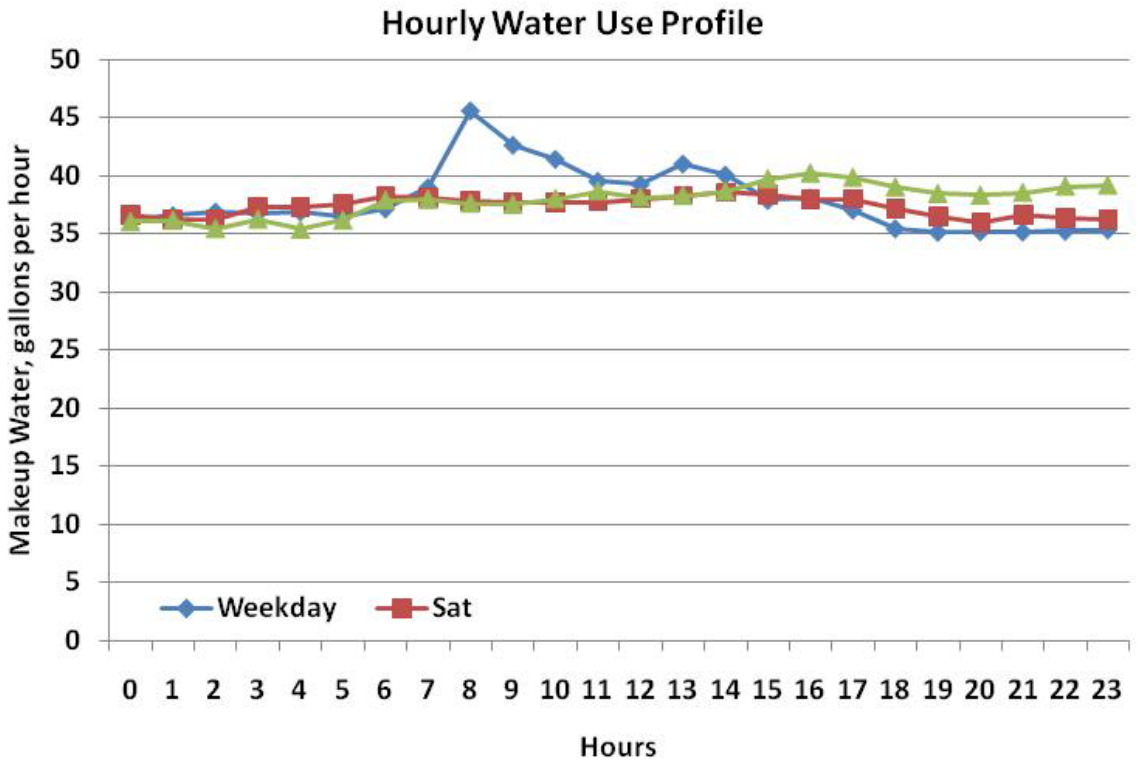

Figure 3.7. Average Makeup Water Consumption Profile for Hammerhead Barracks 1

Figure 3.8 displays the average supply and return temperature for the recirculating hot water system. To some extent, the relatively large difference in supply and return temperatures, the profiles appear relatively flat. In addition, due to the minimal water draws that occur, the pipes are able to maintain relatively steady temperatures. The large difference is indicative of minimal or failed insulation on the hot water distribution pipes, which is to be expected given the age of the building.

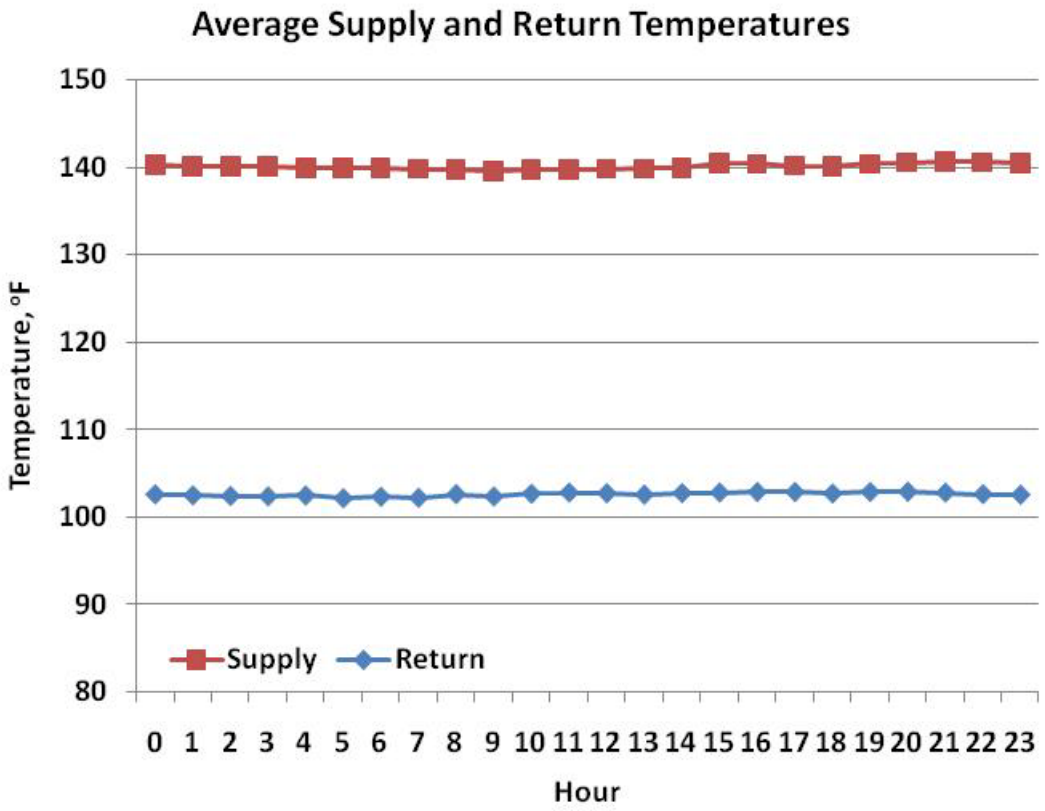

Figure 3.8. Supply and Return Temperature for Building Hammerhead Barracks 1

3.2.5 Hammerhead Barracks 2 Metered Data

Figure 3.9 displays the water consumption pattern for building 3217, a hammerhead barracks that has been converted to temporary lodging and administrative spaces. The baseline consumption is notably high here as well, at approximately 35 gallons per hour. This is likely associated with the relatively large leak in the hot water tank. A clear weekday peak at 0700 is likely the result of showers. A similarly sized peak on Sunday is also likely because of showers occurring later in the day. Saturday water consumption patterns are likely less structured, which leads to an absence of consumption peaks. When conducting the solar hot water system analysis, the leak was removed from the consumption pattern.

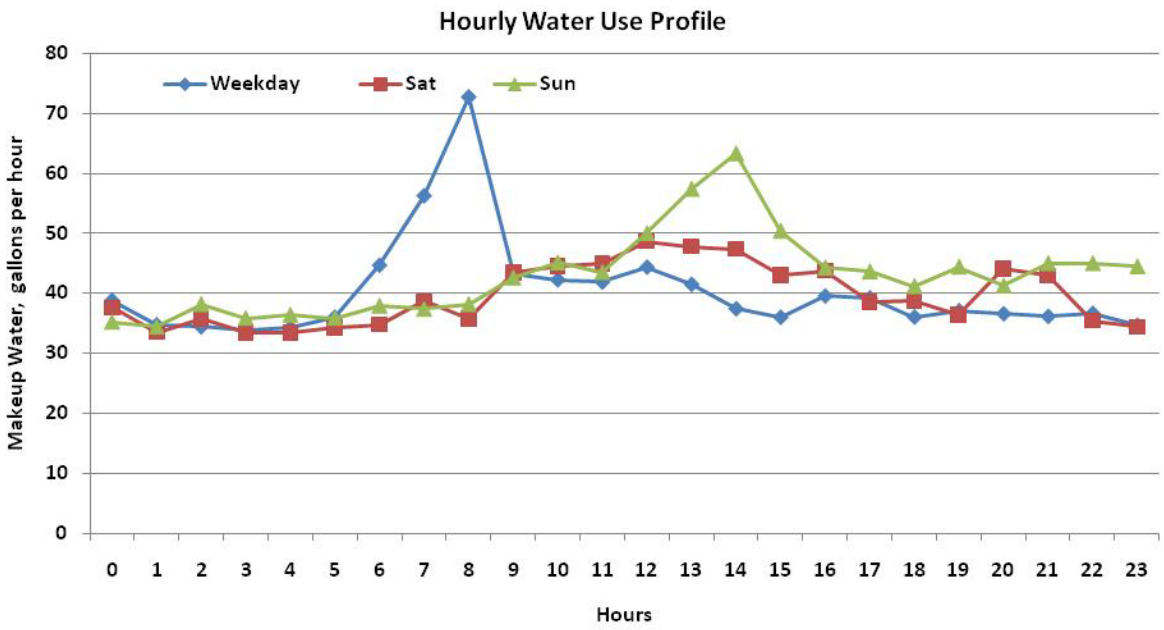

Figure 3.9. Average Makeup Water Consumption Profile for Hammerhead Barracks 2

Figure 3.10 displays the average supply and return temperature for the recirculating hot water system. To some extent, the relatively large difference in supply and return temperatures, the profiles appear relatively flat. In addition, due to the minimal water draws that occur, the pipes are able to maintain relatively steady temperatures. The large difference is indicative of minimal or failed insulation on the hot water distribution pipes, which is to be expected given the age of the building.

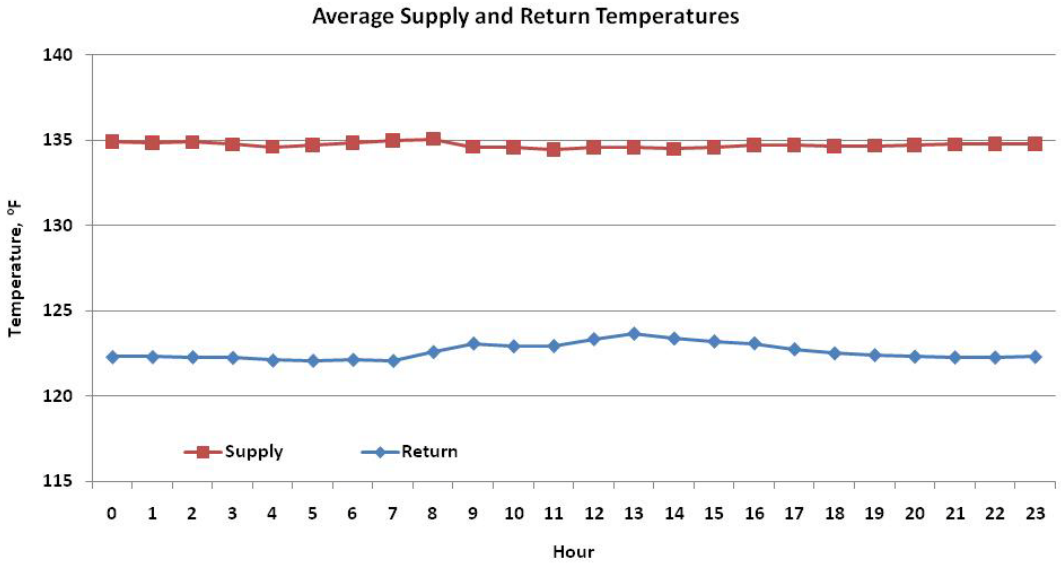

Figure 3.10. Supply and Return Temperature for Hammerhead Barracks 2

3.2.6 Physical Fitness Center Metered Data

Figure 3.11 displays the water consumption pattern for building 7037, a large, modern physical fitness center that serves a significant portion of the installation. A large hot water consumption peak occurs at 0800 as facility users conclude their physical training regiment and take showers. Hot water consumption is sustained throughout the day as other patrons use the facilities, and subsequently shower, in addition to hot water used for laundry services. This fitness center is also open during the weekend, although it experiences considerably less traffic and less hot water is needed for showers and laundry.

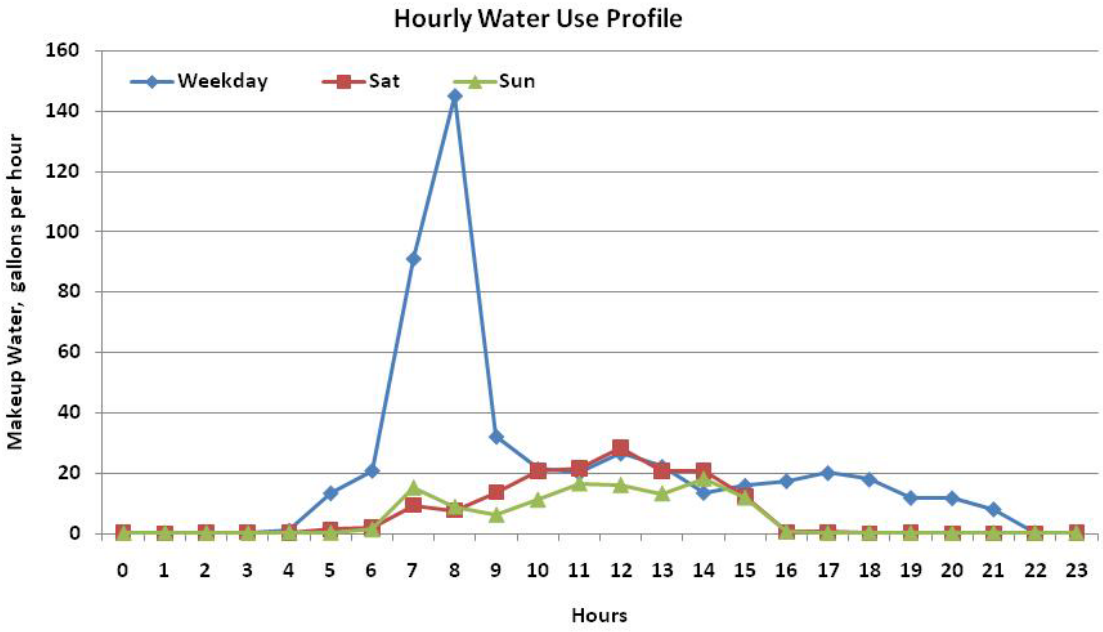

Figure 3.11. Average Makeup Water Consumption Profile for the Physical Fitness Center

Figure 3.12 displays the average supply and return temperature for the recirculating hot water system. To some extent, the relatively large difference in supply and return temperatures, the profiles appear relatively flat. In addition, due to the minimal water draws that occur, the pipes are able to maintain relatively steady temperatures. The large difference is indicative of minimal or failed insulation on the hot water distribution pipes, which is to be expected given the age of the building.

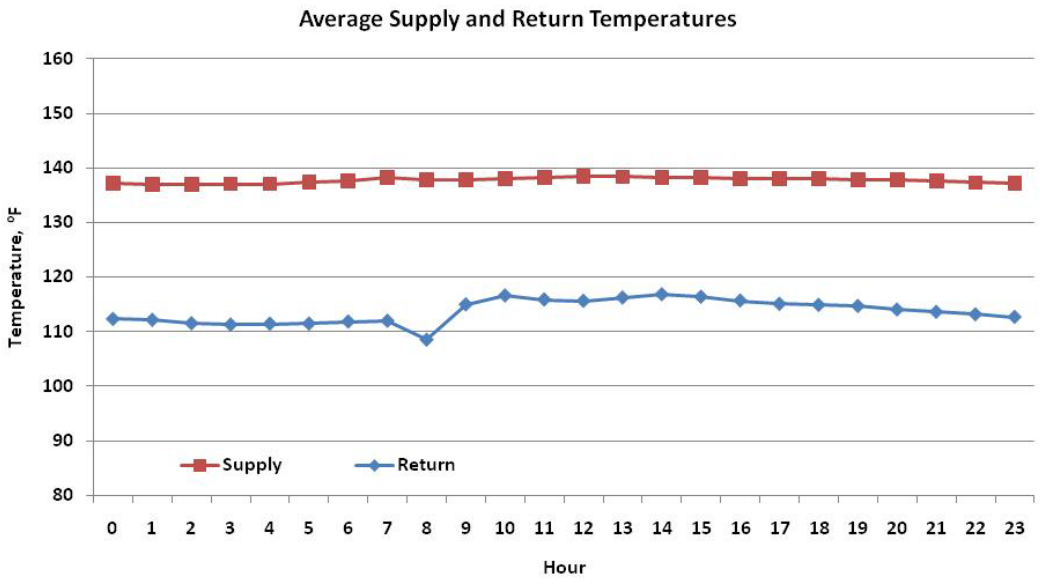

Figure 3.12. Supply and Return Temperature for the Physical Fitness Center

3.2.7 2002-Vintage Barracks Metered Data

Figure 3.13 displays the water consumption pattern for building 7044, a large 2002-vintage barracks. There are several distinct peaks in hot water consumption, which primarily occur in the morning. An initial peak occurs at 0500 as the first wave of occupant showers occur. At 0800, a larger consumption peak occurs most likely because soldiers are returning to the barracks after their physical fitness regime. Additional showering and various domestic needs such as hand washing, cleaning, etc., are the likely cause of sustained hot water consumption throughout the day. A smaller peak occurs in the evening between 1700 and 1800 as personnel return to the barracks. The weekend consumption is notably steadier between the hours of 0800 and 1900. A relatively shallow peak occurs Sunday evening because occupants are likely showering in preparation for Monday.

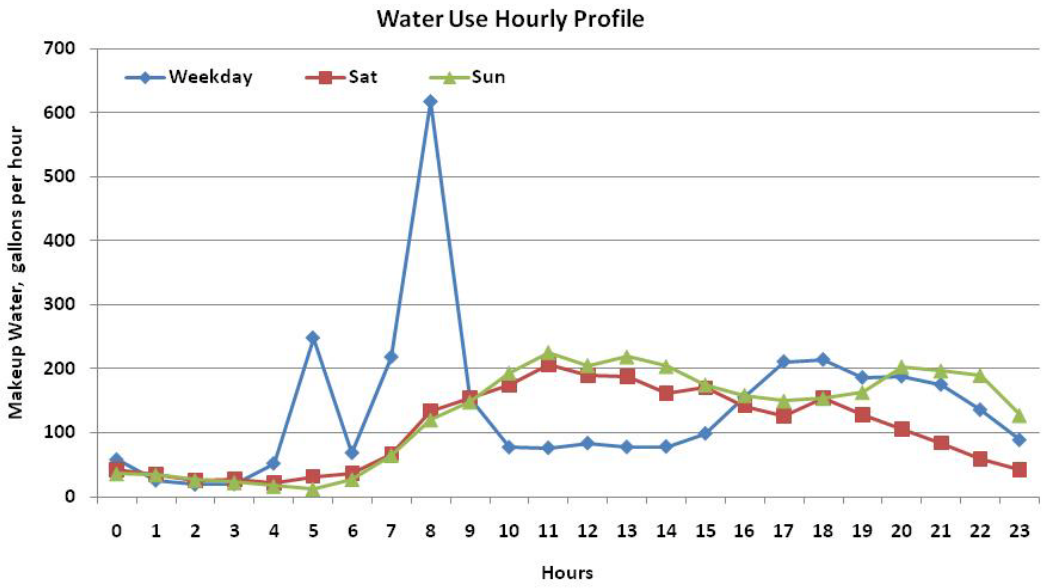

Figure 3.13. Average Makeup Water Consumption Profile for a 2002-Vintage Barracks

Figure 3.14 displays the average supply and return temperature for the recirculating hot water system. Because of the relatively consistent hot water consumption in the afternoon and evening, the profiles appear relatively flat with the exception of the temperature drop that occurs between 0800 and 0900 caused by the large water draw in the morning. The moderate difference in temperatures seen during all other hours may be indicative of minimal or failed insulation on the hot water distribution loop. The temperature differential may also be accentuated by the long pipe runs that are necessary for this large and tall structure.

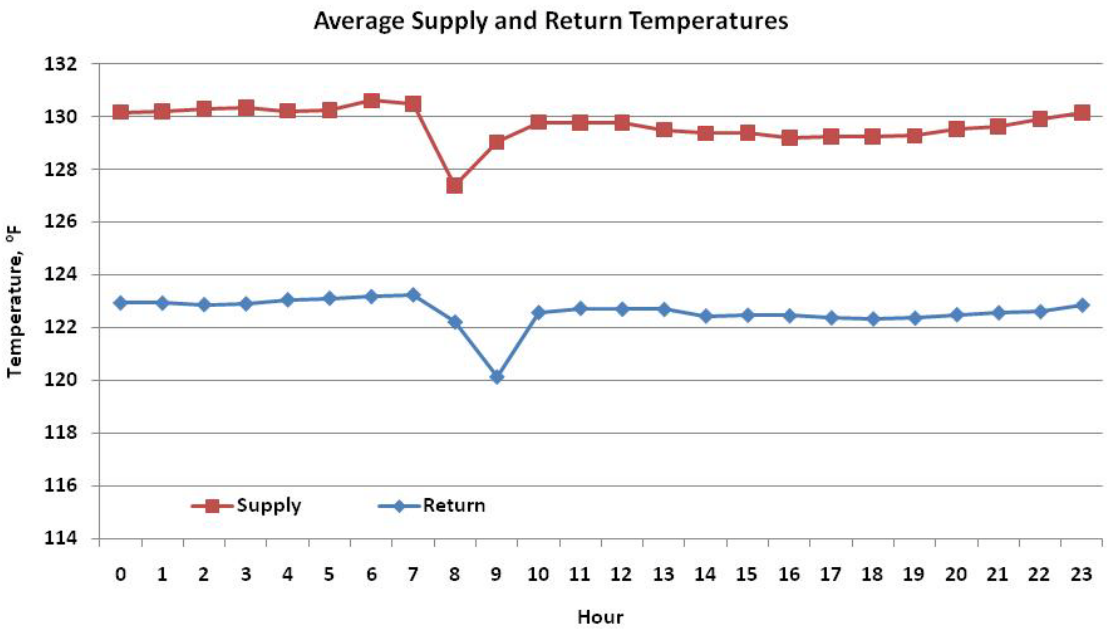

Figure 3.14. Supply and Return Temperature for a 2002-Vintage Barracks

3.2.8 Dining Facility Metered Data

Error! Reference source not found. displays the water consumption pattern for building 7048, a large, modern dining facility (DFAC). During the weekday, three clearly identifiable peaks can be connected to the breakfast, lunch, and dinner preparation and cleaning. These peaks can also be identified on Saturday and Sunday to a lesser extent. In addition, the dinner peak during the weekend is larger than the breakfast or lunch peak, which is the reverse of the weekday consumption.

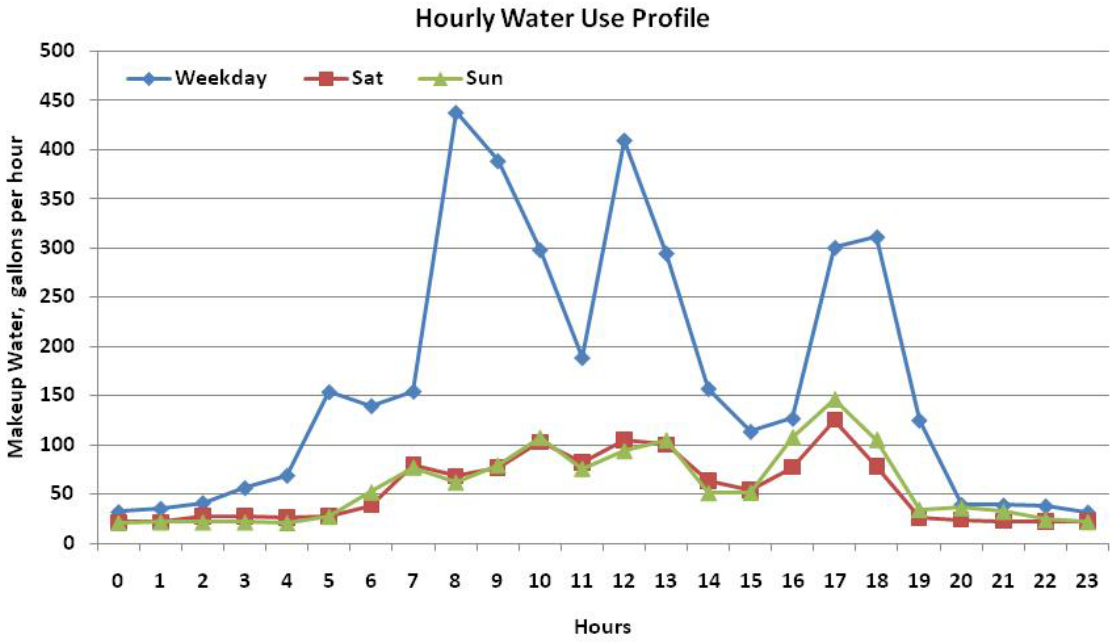

Figure 3.15. Average Makeup Water Consumption Profile for the Dining Facility

Figure 3.16 displays the average supply and return temperature for the recirculating hot water system. The three peaks associated with the meal preparation and dishwashing can also be clearly identified. The relatively small difference between the supply and return temperatures is likely because of the short pipe runs for this compact facility.

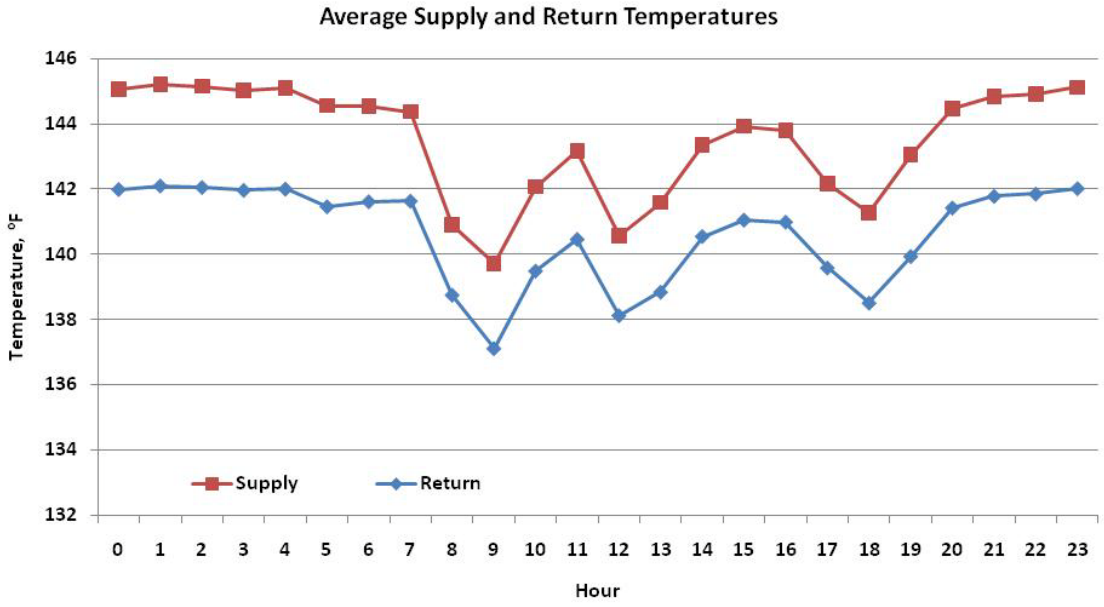

Figure 3.16. Supply and Return Temperature for the Dining Facility

3.2.9 2002-Vintage Administrative Building Metered Data

Figure 3.17 displays the water consumption pattern for building 7075, which is a large 2002-vintage administrative facility that includes a storage area and loading facility. During the weekdays, a clear peak at 0800 can be identified as personnel arrive at the building and take a limited number of showers. Hot water consumption sharply drops off until 1400, when another substantially smaller peak occurs after lunch. Hot water consumption also occurs on weekends but is insignificant compared to weekday consumption.

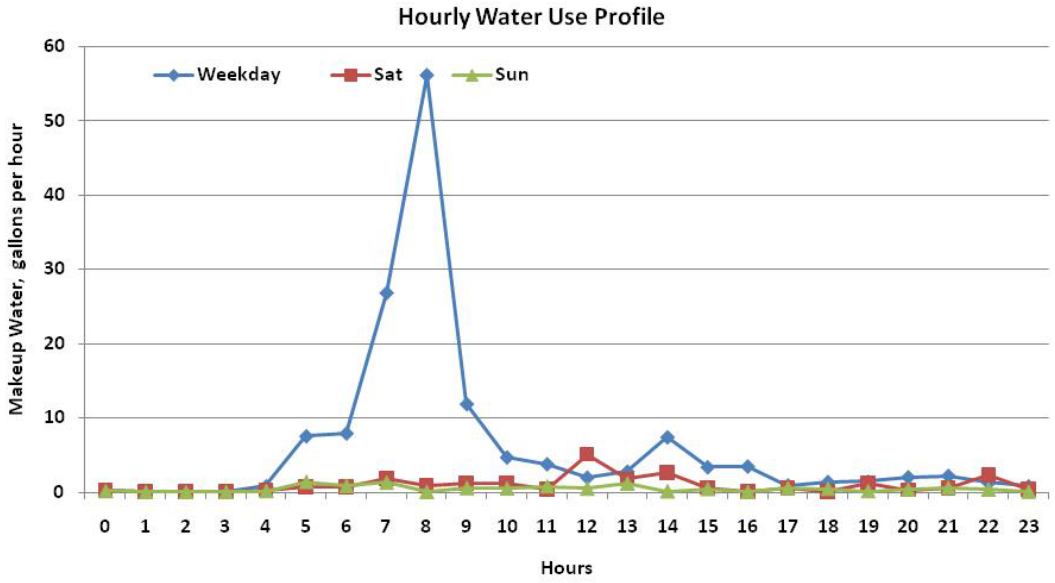

Figure 3.17. Average Makeup Water Consumption Profile for the 2002-Vintage Administrative Building

Figure 3.18 displays the average supply and return temperature for the recirculating hot water system. There is a notably small difference between the supply and return temperatures, which indicates that insulation has been installed on the circulation pipes. In addition, the relatively low temperature setpoint prevents the heat loss that would occur with a higher setpoint.

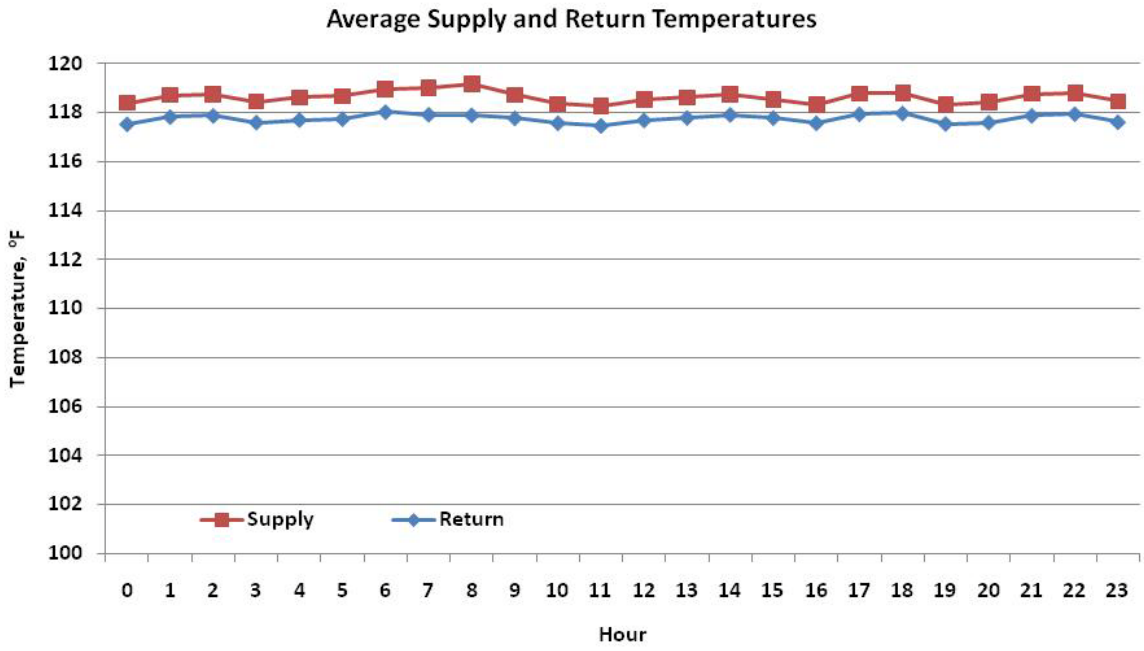

Figure 3.18. Supply and Return Temperature for the 2002-Vintage Administrative Building

4.0 Solar Hot Water Collector Performance

This section contains the analysis and results for a solar hot water system installed in a wide variety of locations in the IMCOM-Southeast region.

4.1 Solar Hot Water Performance Metrics

Solar hot water system performance can be measured with several different metrics. The most well understood metric, and the metric used by EISA, is the solar fraction, which represents what fraction (typically as a percentage) of the gross hot water energy load is satisfied by the solar hot water system. Solar fractions typically range from as little as 20% to as high as 70%. Values exceeding 70% are uncommon because it may lead to excessive heat collection during summer months, which can lead to system damage.

Another common performance metric of solar hot water systems is system efficiency. The efficiency of a solar hot water system is defined to be the ratio of the renewable energy delivered by the collector to the domestic hot water system to the total solar radiation incident on the collectors. Efficiency values typically range from 30% to 60%, although the system efficiency can be highly influenced by several factors. One of the single largest factors that can affect solar hot water system efficiency is the type of domestic hot water system with which it is incorporated. In the case of distributed systems, the majority of the hot water heating energy load is for makeup water heating, or in other words, the heating that occurs to bring city water up to the desired hot water temperature (e.g. 140^{o}F). In addition to this makeup water heating, the system occasionally has to reheat the water because of heat losses through the skin of the storage tank. Except for distributed systems that experience very little use, the energy required to compensate for skin losses is relatively small compared to the energy required for makeup water heating.

In loop/recirculated systems, substantial amounts of heat loss can occur as the hot water travels through the loop. This is particularly true when the recirculation loop is poorly insulated or uninsulated. When the makeup water heating energy is approximately equal to or less than the reheating energy load, the efficiency of the solar hot water system can be reduced because the solar hot water system is primarily reheating water. Under these conditions, the temperature difference over the heat exchanger or collector tubes is smaller than when the system is heating water from the groundwater temperatures. This smaller temperature difference results in lower efficiency.

As noted earlier, occupancy patterns also affect the system's efficiency. Naturally, buildings occupied 5 days a week will require less hot water than a similar building occupied all week. During unoccupied days, the solar hot water system can only serve to reheat water, which, as established above, reduces the system's efficiency. A building's water consumption patterns also have an effect on the system's efficiency. Depending on the specifics of the hot water storage tank design (e.g., single tank versus multi-tank arrangement, circulation between the solar hot water tank and the supplemental hot water tank), occupancy patterns can greatly impact system efficiency because the major water consumption periods may not be aligned with the peak insolation hours. The non-alignment of these peaks may lead to lower efficiency because the solar hot water system may only principally be available for water reheating.

The last metric this report will consider is the renewable energy delivered by the system. This quantity is typically reported in MMBtu and is a measure of renewable energy delivered to the existing hot water system. It is a function of available insolation and system efficiency.

4.2 Solar Hot Water Analysis by Site

IMCOM-Southeast spans four main climate zones (Figure 4.1) and so one point for each of the climate zones was selected to perform the solar hot water system performance analysis for each of the buildings metered at fort Campbell. Each installation was then mapped to a climate zone and an economic analysis of the solar hot water systems was performed at each site with the site's current energy costs. This approach is justifiable because solar insolation levels do not vary greatly within each climate zone in the Southeast. However, such an approach would not be valid for sites located in the southwest or the mountain states because the climate zones do not correlate as strongly to latitude.

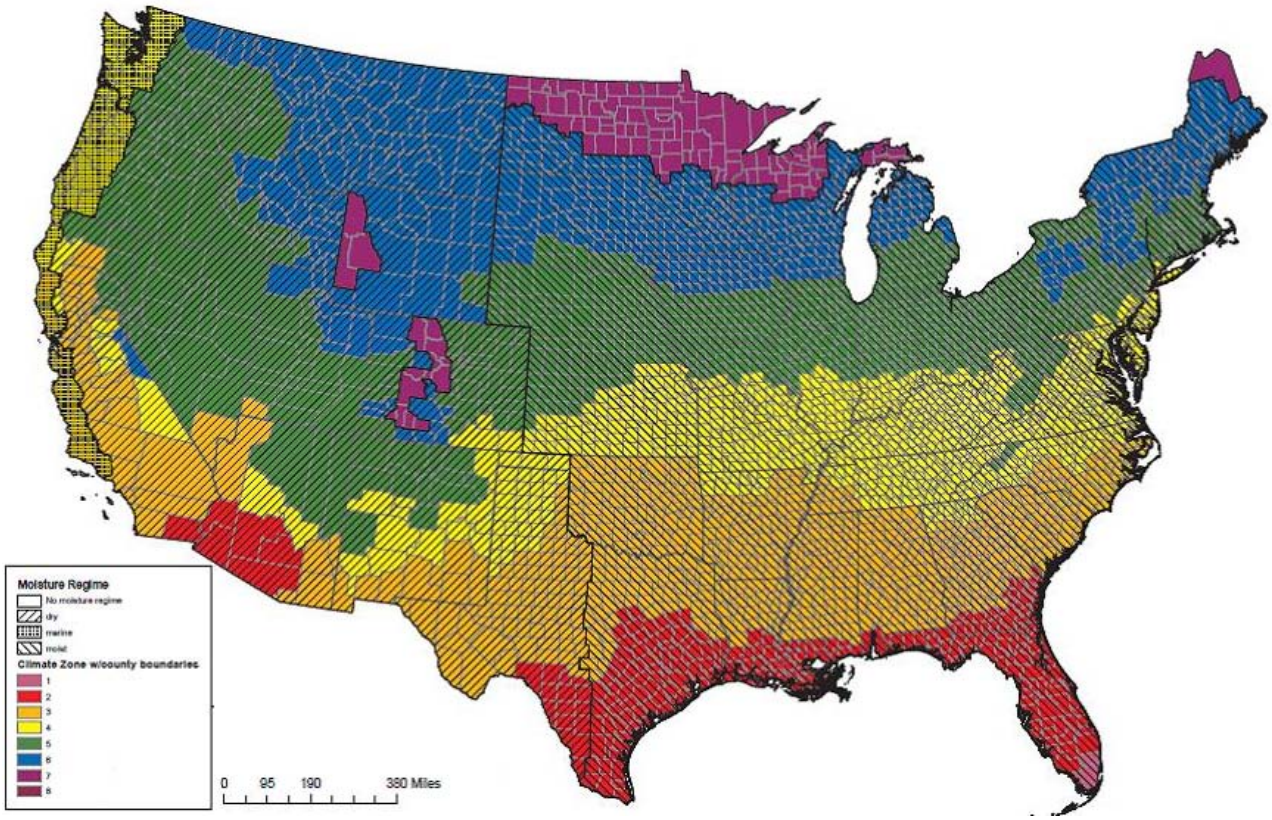

Figure 4.1. Climate Zones Across the Continental United States

Table 4.1 provides additional relevant details about these climate zones. Average electric and natural gas rates are displayed for all major installations within IMCOM-Southeast in each climate zone. Details for each site can be found in Appendix A. Note that two of the installations included in this analysis, Fort Buchanan and Military Ocean Terminal (MOT) Sunny Point, do not have natural gas, so electricity was assumed to be the water heating energy source.

An immediate observation of merit is that the average insolation levels vary relatively little from site to site and that all sites are within 7% of the average value. However, electricity and natural gas prices vary, on average, by substantially greater levels than insolation.

Table 4.1. Analysis Details across Climate Zones

Climate Zone	Average, Latitude, (deg)	Electricity Rate, $/MMBtu	Electricity Rate Deviation from Average, %	Natural Gas Rate, $/MMBtu	Natural Gas Deviation from Average, %	Average Insolation, kWh/m^2/day *	Insolation Deviation from Average, %
1	25	$28.52	23.23%	$13.86	35.65%	5.01	5.20%
2	31	$25.30	9.31%	$7.56	-26.02%	4.83	1.42%
3	33	$15.46	-33.20%	$11.93	16.75%	4.76	-0.05%
4	37	$23.30	0.66%	$7.52	-26.38%	4.45	-6.56%
Average		$25.60	n/a	$8.90	n/a	4.76	n/a
*Insolation on a latitude-tilted surface rotated to face south							

4.3 Solar Hot Water System Specification and Performance

For each of the buildings considered, solar hot water systems were designed to satisfy the 30% solar fraction goal outlined in EISA. In addition, systems were designed to comply with UFC 3-440-01, which prescribes that systems should have 1.5 to 2.0 gallons of supplemental storage per square foot of collector area (WBDG 2010b). Occasionally, the solar fraction is several percentage points higher than 30%. This is typically true of smaller systems where the removal of one module would result in a system with a solar fraction less than 30%. All systems were modeled using a 30% glycol working fluid for freeze protection and all systems were assumed to have an 80% efficient natural gas supplemental boiler or 100% efficient electric supplemental boiler (where applicable). In addition, the systems have a >91% glaze transmittance, and the heat loss coefficients, k1 and k2, are 2.41 W/m^{2}K and 0.015 W/m^{2}K^2, respectively. These coefficients indicate the amount of heat the collectors lose to the environment based on the average collector temperature and the outdoor temperature. These coefficients are used to calculate system efficiency. Lastly, systems were assumed to cost $100 per square foot of collector, which includes capital costs for all equipment (e.g., tanks, piping, collector, etc.) and installation.

4.3.1 Golf Clubhouse Solar Hot Water Feasibility and Performance

The golf clubhouse includes locker rooms, shower rooms, dining and banquet facilities, and a luncheonette. Table 4.2 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.2. System Specifications and Performance for the Golf Clubhouse

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	261	9	450	1.73	32.2%	62%	89.12
2	261	9	450	1.73	30.4%	60%	84.48
3	290	10	520	1.79	32.3%	58%	90.01
4	319	11	520	1.63	31.2%	56%	86.80

Table 4.3 displays the economic results of these systems for the major IMCOM-Southeast installations. Fort Buchanan and MOT Sunny Point both perform well because these locations do not have natural gas and as a result, the systems were assumed to displace electricity. U.S. Army Garrison (USAG) Miami has particularly expensive natural gas and a high solar resource, which allows for cost-effective solar hot water projects. The remaining sites, which include Fort Gordon, Anniston Army Depot, Blue Grass Army Depot and Fort Rucker, also have relatively expensive natural gas and consequently have relatively good system economics despite being in areas that receive less insolation than a site such as Fort Polk.

Table 4.3. Economic Performance for the Golf Clubhouse

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	3.1	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.1	MOT Sunny Point	3	$21.53	1.2
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.6	Redstone Arsenal	3	$6.38	0.5
Fort Stewart	2	$6.31	0.5	Blue Grass Army Depot	4	$9.18	0.6
Anniston Army Depot	3	$11.33	0.8	Fort Bragg	4	$7.43	0.5
Fort Benning	3	$6.41	0.5	Fort Campbell	4	$7.52	0.5
Fort Gordon	3	$11.93	0.8	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.5				

4.3.2 Pool Shower Facility Solar Hot Water Feasibility and Performance

The pool shower facility is for patrons of an indoor pool that is used year-round. Table 4.4 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.4. System Specifications and Performance for the Pool Shower Facility

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	58	2	100	1.72	32.6%	80%	25.39
2	58	2	100	1.72	30.4%	76%	23.54
3	58	2	100	1.72	30.2%	75%	23.37
4	87	3	150	1.72	38.3%	72%	29.17

Table 4.5 displays the economic results of these systems for the major IMCOM-Southeast installations. As before, Fort Buchanan and MOT Sunny Point both perform well because these locations do not have natural gas and as a result, the systems were assumed to displace electricity. USAG Miami has particularly expensive natural gas and a high solar resource, which allows for cost-effective solar hot water projects. The remaining sites, which include Fort Gordon, Anniston Army Depot, Blue Grass Army Depot, and Fort Rucker, also have relatively expensive natural gas and consequently have relatively good economics, because the average system efficiency is relatively high across all climate zones.

Table 4.5. Economic Performance for the Pool Shower Facility

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	3.2	Fort McPherson	3	$5.47	0.5
USAG Miami	1	$13.86	1.4	MOT Sunny Point	3	$21.53	1.3
Fort Polk	2	$5.88	0.5	Pine Bluff Arsenal	3	$4.22	0.4
Fort Rucker	2	$7.56	0.7	Redstone Arsenal	3	$6.38	0.6
Fort Stewart	2	$6.31	0.6	Blue Grass Army Depot	4	$9.18	0.7
Anniston Army Depot	3	$11.33	1.0	Fort Bragg	4	$7.43	0.6
Fort Benning	3	$6.41	0.6	Fort Campbell	4	$7.52	0.6
Fort Gordon	3	$11.93	1.1	Fort Knox	4	$6.62	0.5
Fort Jackson	3	$6.67	0.6				

4.3.3 Child Development Center Solar Hot Water Feasibility and Performance

The child development center is comprised of a wide variety of classrooms for students of various ages, administrative offices, and a dining facility. Table 4.6 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.6. System Specifications and Performance for the Child Development Center

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	232	8	400	1.73	32.8%	61%	77.62
2	232	8	400	1.73	30.9%	59%	73.12
3	232	8	400	1.73	30.4%	58%	71.92
4	261	9	425	1.63	30.0%	56%	70.76

Table 4.7 displays the economic results of these systems for the major IMCOM-Southeast installations. The economics trend between sites largely follows the same pattern from the previous buildings for similar reasons. The child development center is not as economic as the clubhouse and pool facility

because the solar hot water system has a lower efficiency, which is largely a function of the lower weekend occupancy.

Table 4.7. Economic Performance for the Child Development Center

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	2.5	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.1	MOT Sunny Point	3	$21.53	1.0
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.5	Redstone Arsenal	3	$6.38	0.5
Fort Stewart	2	$6.31	0.5	Blue Grass Army Depot	4	$9.18	0.6
Anniston Army Depot	3	$11.33	0.8	Fort Bragg	4	$7.43	0.5
Fort Benning	3	$6.41	0.5	Fort Campbell	4	$7.52	0.5
Fort Gordon	3	$11.93	0.8	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.5				

4.3.4 Hammerhead Barracks 1 Solar Hot Water Feasibility and Performance

The first hammerhead barracks examined currently is used for administrative and storage spaces. Table 4.8 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.8. System Specifications and Performance for Hammerhead Barracks 1

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	174	6	300	1.73	32.0%	35%	33.30
2	174	6	300	1.73	31.8%	35%	32.99
3	174	6	300	1.73	31.8%	35%	32.89
4	203	7	350	1.72	30.0%	32%	31.39

Table 4.9 displays the economic results of these systems for the major IMCOM-Southeast installations. In this case, only Fort Buchanan has an SIR greater than 1.0. Because this building has an excessively large hot water tank for its current use, minimal amounts of insulation, and substantial standby losses, a large proportion of the available solar energy is required just to maintain tank temperature. Consequently, the system efficiency is low, as seen in Table 4.9. A natural result of this outcome is that only locations with expensive water heating energy sources and an above average level of insolation will have cost-effective solar energy projects.

Table 4.9. Economic Performance for Hammerhead Barracks 1

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	1.4	Fort McPherson	3	$5.47	0.2
USAG Miami	1	$13.86	0.6	MOT Sunny Point	3	$21.53	0.6
Fort Polk	2	$5.88	0.3	Pine Bluff Arsenal	3	$4.22	0.2
Fort Rucker	2	$7.56	0.3	Redstone Arsenal	3	$6.38	0.3
Fort Stewart	2	$6.31	0.3	Blue Grass Army Depot	4	$9.18	0.3
Anniston Army Depot	3	$11.33	0.5	Fort Bragg	4	$7.43	0.3
Fort Benning	3	$6.41	0.3	Fort Campbell	4	$7.52	0.3
Fort Gordon	3	$11.93	0.5	Fort Knox	4	$6.62	0.2
Fort Jackson	3	$6.67	0.3				

4.3.5 Hammerhead Barracks 2 Solar Hot Water Feasibility and Performance

The second hammerhead barracks considered in this analysis has been converted to temporary lodging and administrative spaces. Table 4.10 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.10. System Specifications and Performance for Hammerhead Barracks 2

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	145	5	275	1.90	30.7%	61%	49.00
2	174	6	300	1.73	33.2%	57%	53.12
3	174	6	300	1.73	33.0%	57%	52.82
4	203	7	350	1.73	32.9%	54%	52.68

Table 4.11 displays the economic results of these systems for the major IMCOM-Southeast installations. As with the previous cases, Fort Buchanan, MOT Sunny Point, USAG Miami perform particularly well. Of the remaining sites, only Fort Gordon and Anniston Army Depot have nearly economic projects. Like with hammerhead barracks 1, the hot water tank is vastly oversized given this building's current hot water consumption. However, because this building does have full-time residents, the system efficiency is slightly higher and as a result, the project economics are slightly superior to building hammerhead barracks 1.

Table 4.11. Economic Performance for Hammerhead Barracks 2

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	2.5	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.1	MOT Sunny Point	3	$21.53	1.0
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.5	Redstone Arsenal	3	$6.38	0.4
Fort Stewart	2	$6.31	0.4	Blue Grass Army Depot	4	$9.18	0.5
Anniston Army Depot	3	$11.33	0.8	Fort Bragg	4	$7.43	0.4
Fort Benning	3	$6.41	0.4	Fort Campbell	4	$7.52	0.4
Fort Gordon	3	$11.93	0.8	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.5				

4.3.6 Physical Fitness Center Solar Hot Water Feasibility and Performance

The large, modern physical fitness center considered in this analysis serves a large portion of the site 7 days per week. Table 4.12 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.12. System Specifications and Performance for the Physical Fitness Center

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	232	8	450	1.90	30.5%	61%	77.79
2	261	9	450	1.73	31.4%	57%	80.15
3	261	9	450	1.73	31.3%	57%	80.11
4	290	10	500	1.73	30.2%	55%	77.08

Table 4.13 displays the economic results of these systems for the major IMCOM-Southeast installations. The economics trend between sites largely follows the same pattern of the golf clubhouse and CDC buildings for similar reasons. The system efficiency is somewhat low for this building because there are long periods of the day with minimal hot water draws, which results in relatively high standby losses. Moreover, the temperature setpoint for this building is high, which requires a greater number of panels to provide a 30% solar fraction and is a detriment to the system efficiency.

Table 4.13. Economic Performance for the Physical Fitness Center

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	2.5	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.1	MOT Sunny Point	3	$21.53	1.0
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.5	Redstone Arsenal	3	$6.38	0.4
Fort Stewart	2	$6.31	0.4	Blue Grass Army Depot	4	$9.18	0.6
Anniston Army Depot	3	$11.33	0.8	Fort Bragg	4	$7.43	0.4
Fort Benning	3	$6.41	0.5	Fort Campbell	4	$7.52	0.5
Fort Gordon	3	$11.93	0.8	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.5				

4.3.7 2002 Barracks Solar Hot Water Feasibility and Performance

This 2002-vintage barracks is a large, modern barracks that houses approximately 350 soldiers. Table 4.14 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.14. System Specifications and Performance for the 2002-Vintage Barracks

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	637	22	1,200	1.88	30.0%	78%	272.18
2	724	25	1,300	1.80	30.6%	71%	278.01
3	724	25	1,300	1.80	30.5%	71%	276.82
4	840	29	1,500	1.79	30.8%	72%	279.65

Table 4.15 displays the economic results of these systems for the major IMCOM-Southeast installations. The economics trend between sites largely follows the same pattern of the golf clubhouse and CDC buildings for similar reasons. The system efficiency is high for this building because there are substantial water draws that allow the system to preheat large quantities of water relative to the energy needed to reheat the recirculation water.

Table 4.15. Economic Performance for the 2002-Vintage Barracks

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	3.1	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.1	MOT Sunny Point	3	$21.53	1.2
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.5	Redstone Arsenal	3	$6.38	0.4
Fort Stewart	2	$6.31	0.4	Blue Grass Army Depot	4	$9.18	0.6
Anniston Army Depot	3	$11.33	0.8	Fort Bragg	4	$7.43	0.5
Fort Benning	3	$6.41	0.4	Fort Campbell	4	$7.52	0.5
Fort Gordon	3	$11.93	0.8	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.5				

4.3.8 Dining Facility Solar Hot Water Feasibility and Performance

This large, modern dining facility (DFAC) serves approximately 500 patrons per day. Table 4.16 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.16. System Specifications and Performance for the DFAC

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	550	19	1,000	1.82	30.7%	79%	240.58
2	608	21	1,100	1.81	30.9%	74%	242.39
3	608	21	1,100	1.81	30.8%	74%	240.72
4	695	24	1,200	1.73	30.6%	71%	240.10

Table 4.17 displays the economic results of these systems for the major IMCOM-Southeast installations. The economics trend between sites largely follows the same pattern of the previous buildings for similar reasons. The system efficiency is high for this building because there are substantial water draws over nearly all daylight hours, which allows the system to preheat relatively large quantities of water relative to the energy needed to reheat the recirculation water.

Table 4.17. Economic Performance for the DFAC

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	3.2	Fort McPherson	3	$5.47	0.5
USAG Miami	1	$13.86	1.4	MOT Sunny Point	3	$21.53	1.3
Fort Polk	2	$5.88	0.5	Pine Bluff Arsenal	3	$4.22	0.4
Fort Rucker	2	$7.56	0.7	Redstone Arsenal	3	$6.38	0.6
Fort Stewart	2	$6.31	0.6	Blue Grass Army Depot	4	$9.18	0.7
Anniston Army Depot	3	$11.33	1.0	Fort Bragg	4	$7.43	0.6
Fort Benning	3	$6.41	0.6	Fort Campbell	4	$7.52	0.6
Fort Gordon	3	$11.93	1.1	Fort Knox	4	$6.62	0.5
Fort Jackson	3	$6.67	0.6				

4.3.9 2002-Vintage Administrative Building Solar Hot Water Feasibility and Performance

This large, modern administrative facility includes offices, storage areas, and a loading facility. Table 4.18 displays the details of a solar hot water system for this building over each of the four climate zones considered.

Table 4.18. System Specifications and Performance for the 2002-Vintage Administrative Building

Climate Zone	Collector Area, sf	Number of Collectors	Storage, gal	Storage to Collector Area Ratio, gal/sf	Solar Fraction, %	System Efficiency, %	Renewable Energy Delivered, MMBtu/year
1	116	4	200	1.73	33.0%	55%	35.01
2	116	4	200	1.73	30.9%	53%	32.79
3	116	4	200	1.73	31.0%	53%	32.86
4	145	5	250	1.73	32.1%	49%	34.19

Table 4.19 displays the economic results of these systems for the major IMCOM-Southeast installations. The economics trend between sites largely follows the same pattern of the previous buildings for similar reasons. The system efficiency is somewhat low for this building because there are long periods of the day with minimal hot water draws, which results in higher standby losses.

Table 4.19. Economic Performance for the 2002-Vintage Administrative Building

Site	Climate Zone	Fuel, $/MMBtu	SIR	Site	Climate Zone	Fuel, $/MMBtu	SIR
Fort Buchanan	1	$49.04	2.2	Fort McPherson	3	$5.47	0.4
USAG Miami	1	$13.86	1.0	MOT Sunny Point	3	$21.53	0.9
Fort Polk	2	$5.88	0.4	Pine Bluff Arsenal	3	$4.22	0.3
Fort Rucker	2	$7.56	0.5	Redstone Arsenal	3	$6.38	0.4
Fort Stewart	2	$6.31	0.4	Blue Grass Army Depot	4	$9.18	0.5
Anniston Army Depot	3	$11.33	0.7	Fort Bragg	4	$7.43	0.4
Fort Benning	3	$6.41	0.4	Fort Campbell	4	$7.52	0.4
Fort Gordon	3	$11.93	0.08	Fort Knox	4	$6.62	0.4
Fort Jackson	3	$6.67	0.4				

4.4 Solar Hot Water Analyses Building and Site Comparison

Several obvious factors strongly affect solar hot water project economics including the value of the displaced heating energy, solar insolation levels, and system capital costs. However, there are many more subtle factors that also affect project economics including the water consumption profile, the level of makeup water heating compared to water reheating, and groundwater temperatures. Table 4.20 displays the SIR as a function of the climate zone and the building type at current energy costs.

Table 4.20. SIR as a Function of Location and Building

Building Type	Across All Zones	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4
Pool Shower Facility	0.88	2.30	0.61	0.77	0.59
DFAC	0.87	2.29	0.60	0.75	0.61
2002-Vintage Barracks	0.73	2.10	0.46	0.61	0.47
Golf Clubhouse	0.69	1.79	0.49	0.59	0.48
Child Development Center (CDC)	0.68	1.76	0.48	0.59	0.48
Hammerhead Barracks 2	0.67	1.77	0.46	0.58	0.46
Fitness center	0.67	1.76	0.46	0.58	0.47
2002-Vintage Administration	0.61	1.58	0.43	0.54	0.42
Hammerhead Barracks 1	0.40	1.00	0.29	0.36	0.27

When examining the results across all zones, the analysis shows that the DFAC and the pool shower facility had, on average, the best economics.

The DFAC requires a relatively large amount of makeup water consumption on a daily basis throughout the entire week. As a result, to a greater extent than most of the other buildings, the amount of heat lost because of recirculation is minimal compared to energy needed to heat makeup water. This allows the solar hot water system to operate more efficiently (an average of 74%) because it is performing makeup water heating, as opposed to reheating. Systems operate more efficiently under this mode because the average tank temperature of the solar hot water storage tank is lower, and as a result, the heat transfer over the heat exchanger is higher for a given working fluid temperature. Moreover, the makeup water consumption occurs throughout the day, which minimizes standby losses of solar thermal energy.

The pool shower facility does not experience water draws as large as the DFAC, although the water draws are still large and consistent throughout the day and the entire week. As a result, the average efficiency of this system is relatively high at 76%, and the system economics are correspondingly high.

The economic performance of the solar hot water system for the 2002-vintage barracks is lower than the previous two buildings, although it is still somewhat promising because it has a system efficiency of 73% across the four climate zones. The 2002-vintage barracks is a large, modern barracks and experiences a relatively high water draw, although the consumption is bimodal, with the first peak in the morning and the second peak in the evening. The evening peak occurs somewhat late in the day, and the solar hot water system is not likely able to begin heating this volume of water until the next day. However, there is a second large water draw early the next morning, again before the peak insolation period. As a result, much of the solar water heating must occur between the peaks. To accomplish this while maintaining a solar fraction of 30%, the system must be sized slightly larger than a building with more regular water draws. This results in slightly lower system efficiency than compared to other buildings, such as the DFAC, with similarly large water draws but more appropriate consumption profiles for solar hot water heating applications.

The solar hot water systems analyzed for the golf clubhouse, the CDC, hammerhead barracks 2, and the 2002-vintage administrative building had similar levels of economic performance. The golf clubhouse and the CDC both have kitchen facilities, and the golf clubhouse also has some limited shower facilities, which leads to high levels of water consumption. However, both of these buildings have sporadic weekend occupancy levels, which results in a drop in overall system efficiency, and as a result, system economics.

The physical fitness center also has marginal economic performance principally because the weekend consumption is relatively minor compared to the weekday consumption. As a result, the solar hot water system operates relatively inefficiently during weekend periods. In addition, the water temperature setpoint of this building is high, which requires a relatively large solar hot water system to maintain a 30% solar fraction. Reducing the temperature setpoint would help improve solar hot water system performance and economics. Also, many fitness centers, such as the SFC Paul R Smith Fitness Center at Fort Benning, have a pool and are used by family members on weekdays and weekends, which will increase the number of showers taken. These factors would likely improve system performance and economics.

Hammerhead barracks 2, which is a repurposed hammerhead barracks, continues to experience a moderate water draw relative to the storage tank volume, although the consumption is somewhat sporadic over the weekends. This slightly decreases the system efficiency and economics. However, this building is relatively old and the hot water piping insulation is minimal or possibly absent. As a result, the return water temperature is nearly 40°F lower than the setpoint temperature. Because of this large energy loss, the solar hot water system is capable of more efficiently reheating the return water, which results in more positive economics than if the distribution system were well insulated.

The 2002-vintage administrative building is a large administrative building that experiences a large water draw in the morning, and relatively little draw throughout the rest of the day. In addition, this building consumes almost no hot water during the weekends. As a result, the system efficiency is 53%, on average, which results in lackluster system economics.

Hammerhead barracks 1, another repurposed hammerhead barracks, has administrative and storage spaces and always performs the worst of all the buildings considered. This is principally because the hot water tank is substantially oversized given the building's current hot water needs. This oversized system results in considerable thermal losses, which requires substantial amounts of water reheating. The system efficiency averaged 34% across all climate zones because solar hot water systems are less efficient at hot water reheating. As with hammerhead barracks 2, the hot water pipe insulation is poor, which results in a large temperature difference of 10°F between the supply and return temperature. Had the pipes been better insulated, the system efficiency and economics would have been considerably lower.

In summary, the pool shower facility and the dining facility are the top two performing buildings because of their high and regular hot water demands. Similarly, the 2002-vintage administrative building and hammerhead barracks 1 are always the two worst performing buildings caused by either intermittent occupancy, in the case of the 2002 administrative building, or excessive thermal losses, in the case of hammerhead barracks 1, which results in high levels of water reheating and low system efficiency. For the remaining buildings, factors such as the conformity of water consumption patterns to insolation levels, other weather factors such as yearly wind patterns (which can affect the efficiency of the solar collectors), and the groundwater temperature are likely contributors to shifts in rankings between zones. Nevertheless, certain buildings, such as the 2002-vintage barracks, the golf clubhouse, and the CDC, typically have better economic performance than hammerhead barracks 1 and the fitness center.

Table 4.20 also allows for comparisons across climate zones. Installations located in climate zone 1 always have superior project economics. Although it is tempting to ascribe this result to the higher availability of the solar resource, Table 4.9 indicates that the insolation is only 5% greater than the other locations. Instead, the nature of the superior economics for installations located in climate zone 1 are related to the high value of the displaced energy. Moreover, Fort Buchanan does not have access to natural gas, which is typically the lowest cost heating fuel. USAG Miami does have access to natural gas, but its natural gas costs nearly $14/MMBtu, which is well above the average rate across all installations.

Of the remaining climate zones considered, installations located in climate zone 3 tend to perform better than those in zone 2 or zone 4. This is principally because these sites have slightly greater insolation and because a handful of sites, such as Fort Gordon and Anniston Army Depot, have high natural gas rates, and because MOT Sunny Point does not have natural gas, electricity was assumed to be the water heating energy source. When these three sites are removed from the aggregated SIR calculations, installations in zone 3 have the lowest average economic performance, thus highlighting the importance of the value of the displaced fuel over most other factors explored.

Installations located in climate zone 4 tended to have slightly more expensive natural gas rates than those located in zone 2. Despite receiving slightly less insolation, the higher value of the displaced fuel allows systems to perform more economically.

Table 4.21 reorganizes the data seen in Table 4.20 to more plainly indicate trends in the economic performance of the buildings. Cells with values above 1.0 are colored green and cells with values between 0.8 and 1.0 are colored yellow.

Table 4.21. Relative Economic Performance (in SIR) for all Buildings Across all Climate Zones Considered

	Climate Zone	Building Types*								
		GCH[1]	PSF[2]	CDC[3]	HHB1[4]	HHB2[5]	PFC[6]	MB[7]	DFAC[8]	ADMIN[9]
Fort Buchanan	1	2.50	3.21	2.45	1.40	2.47	2.46	3.12	3.20	2.21
USAG Miami	1	1.09	1.39	1.06	0.61	1.07	1.07	1.08	1.39	0.96
Fort Polk	2	0.44	0.55	0.42	0.26	0.41	0.41	0.41	0.54	0.38
Fort Rucker	2	0.56	0.70	0.55	0.33	0.53	0.53	0.53	0.69	0.49
Fort Stewart	2	0.47	0.59	0.46	0.27	0.44	0.44	0.44	0.58	0.41
Anniston Army Arsenal	3	0.81	1.05	0.81	0.49	0.79	0.80	0.79	1.03	0.74
Fort Benning	3	0.46	0.59	0.46	0.28	0.45	0.45	0.45	0.58	0.42
Fort Gordon	3	0.85	1.10	0.85	0.52	0.83	0.84	0.84	1.08	0.77
Fort Jackson	3	0.47	0.62	0.47	0.29	0.46	0.47	0.47	0.60	0.43
Fort McPherson	3	0.39	0.51	0.39	0.24	0.38	0.39	0.38	0.50	0.36
MOT Sunny Point	3	1.00	1.30	1.00	0.61	0.98	0.99	1.23	1.27	0.91
Pine Bluff Arsenal	3	0.30	0.39	0.30	0.18	0.29	0.30	0.30	0.38	0.27
Redstone Arsenal	3	0.45	0.59	0.45	0.28	0.44	0.45	0.45	0.58	0.41
Blue Grass Army Depot	4	0.57	0.71	0.57	0.33	0.55	0.56	0.56	0.73	0.50
Fort Bragg	4	0.46	0.57	0.46	0.26	0.44	0.45	0.45	0.59	0.40
Fort Campbell	4	0.47	0.58	0.47	0.27	0.45	0.46	0.46	0.59	0.41
Fort Knox	4	0.41	0.51	0.41	0.23	0.39	0.40	0.40	0.52	0.36

* Cells with values above 1.0 are colored green and cells with values between 0.8 and 1.0 are colored yellow.
1 – golf clubhouse, 2 – pool shower facility, 3 - child development center, 4 – hammerhead barracks 1, 5 – hammerhead barracks 2, 6 – physical fitness center, 7 – 2002-vintage barracks, 8 – dining facility, 9 – administrative building

The most important conclusion to be drawn from Table 4.21 is that solar hot water feasibility is highly site-sensitive and that the value of the displaced fuel has the largest affect on project economics. For example, Fort Buchanan and USAG Miami both perform well because of the high value of the displaced energy. Also, despite being located in areas with less insolation than climate zone 2, MOT Sunny Point, Anniston Army Depot, and Fort Gordon are also suitable locations to consider solar hot water systems. Note that Redstone Arsenal also purchases relatively expensive steam from an off-site producer. Displacing this steam is likely to result in projects with notably better system economics.

4.5 Solar Hot Water Sensitivity Analysis

The economic results for most of the sites analyzed were marginal because of high capital costs and low displaced fuel values. To explore the impact of decreasing system prices and increasing fuel costs (which is more likely to occur), a sensitivity analysis was performed for these two variables across the four climate zones considered. Table 4.22 shows the SIR as a function of increases in energy costs and decreases in system costs.

Table 4.22. SIR Sensitivity Analysis across all Climate Zones*

Increases in Energy Costs	*Decreases* in System Cost					
	0%	-10%	-20%	-30%	-40%	-50%
0%	0.70	0.78	0.88	1.00	1.17	1.41
10%	0.77	0.86	0.97	1.10	1.29	1.55
20%	0.84	0.94	1.05	1.20	1.41	1.69
30%	0.91	1.02	1.14	1.31	1.52	1.83
40%	0.98	1.09	1.23	1.41	1.64	1.97
50%	1.05	1.17	1.32	1.51	1.76	2.11

* Cells with values above 1.0 are colored green and cells with values between 0.8 and 1.0 are colored yellow.

The SIRs represent the average value across all buildings and sites for all climate zones. For example, for the 0% change in system costs and 0% change in fuel costs cell, the SIR across all buildings and sites was 0.70. While this average SIR is not strictly meaningful (as the relative performance between buildings cannot be ascertained), it does serve as a useful indicator when performing a sensitivity analysis. As can be seen, a percentage change in the system cost results in greater impact than a percentage change in the fuel cost. However, system costs are not expected to change drastically in the future because many developments in solar hot water systems have focused on space saving, durability, and marginal improvements in efficiency that typically are not economically justifiable at current energy costs. On the other hand, fuel costs are expected to change in the near and mid future. Between 2000 and 2008, the average price of natural gas sold to commercial consumers nearly doubled (EIA 2010). Although gas prices have retreated over the last 2 years, gas prices remain volatile and are expected to increase again. For instance, a price increase of 40% results in an average SIR of 0.98, which is nearly cost-effective. Table 4.23 displays the SIRs for each building at each installation assuming a 40% increase in energy prices. Cells with values above 1.0 are colored green and cells with values between 0.8 and 1.0 are colored yellow.

From Table 4.23, it is evident that approximately half of the buildings examined would have cost-effective or nearly cost-effective projects. With a 40% increase in energy prices, sites that might be suitable for solar hot water projects include Fort Buchanan, USAG Miami, Fort Rucker, Fort Stewart, Anniston Army Arsenal, Fort Benning, Fort Gordon, Fort Jackson, MOT Sunny Point, Redstone Arsenal, Blue Grass Army Depot, Fort Bragg, and Fort Campbell. However, these cost-effective projects tend to occur at installations that already had expensive energy rates prior to the energy rate escalation.

Table 4.23. Economic Performance of Solar Hot Water Systems Organized by Installation with a 40% Energy Escalation

	Climate Zone	Building Types*								
		GCH 1	PSF 2	CDC 3	HHB1 4	HHB2 5	PFC 6	MB 7	DFAC 8	ADMIN 9
Fort Buchanan	1	3.50	4.49	3.43	1.96	3.46	3.44	4.37	4.48	3.09
USAG Miami	1	1.52	1.95	1.49	0.85	1.50	1.49	1.90	1.94	1.34
Fort Polk	2	0.61	0.77	0.59	0.36	0.58	0.58	0.72	0.75	0.53
Fort Rucker	2	0.79	0.98	0.76	0.46	0.74	0.75	0.93	0.97	0.69
Fort Stewart	2	0.66	0.82	0.64	0.38	0.62	0.62	0.78	0.81	0.57
Anniston Army Arsenal	3	1.13	1.47	1.13	0.69	1.10	1.12	1.39	1.44	1.03
Fort Benning	3	0.64	0.83	0.64	0.39	0.62	0.63	0.79	0.81	0.58
Fort Gordon	3	1.19	1.54	1.19	0.72	1.16	1.18	1.46	1.51	1.08
Fort Jackson	3	0.66	0.86	0.66	0.41	0.65	0.66	0.82	0.85	0.61
Fort McPherson	3	0.55	0.71	0.54	0.33	0.53	0.54	0.67	0.69	0.50
MOT Sunny Point	3	1.40	1.81	1.40	0.85	1.37	1.38	1.72	1.78	1.27
Pine Bluff Arsenal	3	0.42	0.55	0.42	0.26	0.41	0.42	0.52	0.54	0.38
Redstone Arsenal	3	0.64	0.82	0.63	0.39	0.62	0.63	0.78	0.81	0.58
Blue Grass Army Depot	4	0.80	0.99	0.80	0.46	0.76	0.78	0.98	1.02	0.69
Fort Bragg	4	0.65	0.80	0.65	0.37	0.62	0.63	0.79	0.82	0.56
Fort Campbell	4	0.66	0.81	0.65	0.37	0.63	0.64	0.80	0.83	0.57
Fort Knox	4	0.58	0.71	0.58	0.33	0.55	0.57	0.71	0.73	0.50

* Cells with values above 1.0 are colored green and cells with values between 0.8 and 1.0 are colored yellow.
1 – golf clubhouse, 2 – pool shower facility, 3 - child development center, 4 – hammerhead barracks 1, 5 – hammerhead barracks 2, 6 – physical fitness center, 7 – 2002-vintage barracks, 8 – dining facility, 9 – administrative building

Figures 4.2 and 4.3 present contour plots that display the SIR as a function of both system costs and fuel costs (natural gas and electricity, respectively) for all buildings analyzed across all climate zones. The bottom left hand corner represents the original system cost, which was $100/sf. The y-axis (i.e., the vertical line) represents decreases in system costs on a percentage scale. The x-axis represents energy costs in $/MMBtu.

The semi-vertical lines that originate on the x-axis and cross the plot are contour lines. Contour lines represent combinations of system cost decreases and fuel costs that result in equivalent SIR values. For example, the first contour line after the y-axis represents an SIR equal to 1.0. All combinations of system cost decreases and fuel costs that result in an SIR of 1.0 lay on this line. The next contour line indicates SIRs equal to 2.0. All combinations of system cost decreases and fuel cost increases that lay between the SIR-1.0 and SIR-2.0 lines have SIRs between 1.0 and 2.0.

The verticality of the contour line indicates the sensitivity of the SIR to the two variables explored. A line that is dominantly vertical suggests that changes in system cost are relatively insensitive at a given fuel cost. For example, at approximately $7/MMBtu, even dramatic changes in system cost do not result in large changes in the SIR. However, at more expensive energy rates, such as $40/MMBtu, relatively small changes in system costs can greatly affect the SIR. In other words, at $40/MMBtu, system economics cross nearly four different SIR ranges, while at $10/MMBtu, only one contour line is crossed. This is true for both electricity and natural gas.

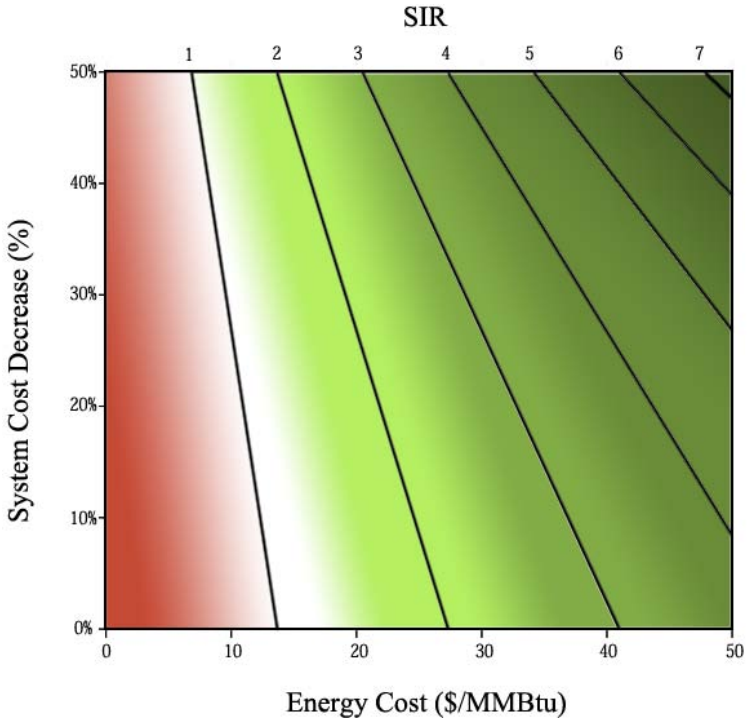

Figure 4.2. SIR Contour Plot for Natural Gas

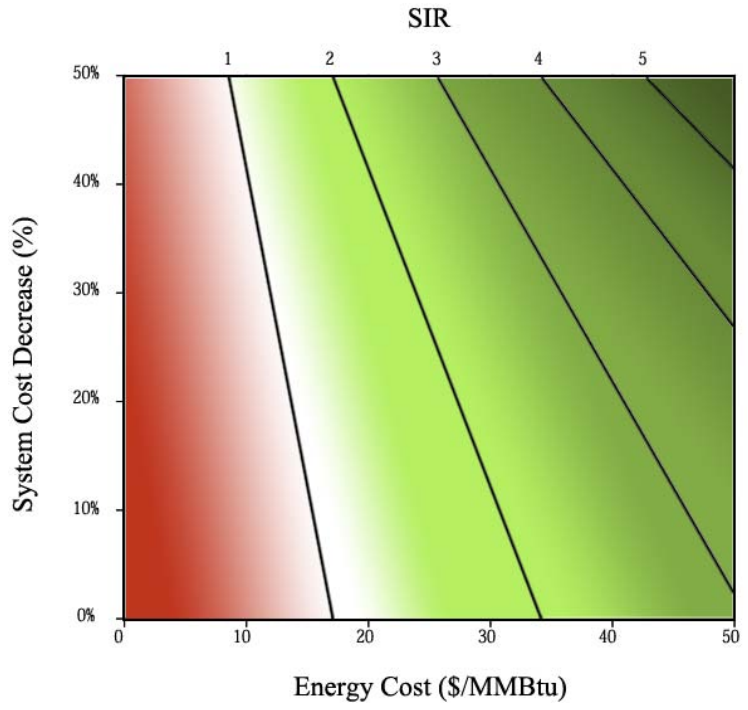

Figure 4.3. SIR Contour Plot for Electricity

5.0 Greenhouse Gas Emissions Reduction and Job Creation

The implementation of these renewable energy projects would help reduce the nation's greenhouse gas emissions and would create additional employment opportunities. Table 5.1 documents the greenhouse gas reduction estimates and full-time employment (FTE) opportunities that would be generated if solar hot water projects were implemented at all 9 building types at a single site. To generate the greenhouse gas reduction estimates, the renewable energy delivered for each building was averaged across all sites and it was assumed that the solar hot water systems would displace natural gas. This analysis used the AP-42 (EPA 1997) emission factors for the external combustion of natural gas. In addition, this analysis assumed that the global warming potentials of CH_4 and N_2O were 21 and 310, respectively, as per the guidance of the Federal Greenhouse Gas Accounting and Reporting Guidance (White House 2010a). Note that global warming potential is a measure of the global warming potential of a gas relative to CO_2. For example, one unit of CH_4 has the global warming potential of 21 units of CO_2. Lastly, the number of FTE opportunities was estimated using the guidance of the Council of Economic Advisors to the White House, which estimates $92,136 of spending is needed to create one job-year (White House 2010b). Based on the average building performance across all climate zones, if a solar hot water system was installed on each of the nine buildings considered at one site, it would result in 133,372 lb (66 metric tons) of CO_2e emission savings and 3.0 FTE opportunities.

Table 5.1. Estimates of Greenhouse Gas Reduction and Job Creation for Solar Thermal Projects

Building Description	Total Investment, $	Gas Consumption Reduction, MMBtu	Greenhouse Gas Emission Reduction, lbs of CO_2e (metric tons)	FTE Opportunities Created
2002-Vintage Barracks	$74,847	346	41,015 (20)	0.81
DFAC	$62,786	301	35,644 (18)	0.68
Golf Clubhouse	$29,118	110	13,049 (7)	0.32
Physical Fitness Center	$26,706	99	11,711 (6)	0.29
CDC	$24,121	91	10,734 (5)	0.26
Hammerhead Barracks 1	$18,263	41	4,823 (2)	0.20
Hammerhead Barracks 2	$17,919	65	7,753 (4)	0.19
2002-Vintage Administration	$12,405	42	4,945 (2)	0.13
Pool Shower Facility	$6,547	31	3,700 (2)	0.07
Total	**$272,712**	**1,126**	**133,372**	**3.0**

If a suitable building from each of building types identified could be developed at all 17 sites considered, it would result in 2.2 million lbs (1,100 metric tons) of CO_2e emission savings per year, 19,160 MMBtu per year of energy savings, and 51 full time employment opportunities. Note, however, that this is a conservative estimate as large sites may have dozens of suitable buildings.

6.0 Conclusions

Solar hot water systems are a relatively expensive form of domestic hot water heating that is currently cost-effective under a somewhat narrow set of circumstances. Locations that currently appear to be suitable for cost-effective solar hot water projects include:

- Fort Buchanan,
- MOT Sunny Point,
- USAG Miami, and
- Anniston Army Depot.

These locations are suitable primarily because of the high cost of water heating energy at these sites. If energy costs continue to increase at levels similar to the previous decade, the following sites should also be considered for cost-effective solar hot water projects:

- Fort Rucker,
- Fort Stewart,
- Fort Benning,
- Fort Gordon,
- Fort Jackson
- Redstone Arsenal,
- Blue Grass Army Depot,
- Fort Campbell, and
- Fort Bragg.

Sites with exceptionally low-cost energy, such as Fort Polk, Fort McPherson, Pine Bluff Arsenal, and Fort Knox, may not be suitable for solar hot water systems unless exceptional increases in energy and/or drops in system costs occur. Alternatively, if a site uses another, more expensive fuel to heat domestic water in any of their buildings, solar hot water could be considered.

Although certain sites are more suitable for solar hot water systems, certain buildings are also more suitable for these systems. Because of their high and regular water consumption profile that allows solar hot water systems to operate efficiently, the following building types tend to perform well:

- Shower facilities associated with indoor pools, and
- Dining facilities.

Although the lack of full-time weekend occupancy, variable consumption patterns, or large thermal losses from hot water recirculation tended to result in slightly lower economic performance, the following building types also perform well:

- Child development centers,
- Physical fitness centers, and
- Highly occupied barracks.

Administrative buildings and repurposed hammerhead barracks that do not have substantial weekend occupancy or have been heavily repurposed are not ideal candidates because heat losses from hot water recirculation dominate the heating energy needs of the hot water system, which results in inefficient solar

hot water systems. However, it should be emphasized that sufficiently high-cost energy can allow solar hot water systems to be cost-effective even for the most unsuitable buildings.

Although this study focused on specific buildings, there are several general building characteristics that can be distilled to help determine whether any building might be particularly suitable (or unsuitable) for solar hot water heating. The characteristics that tend to improve solar hot water project economics include:

- **High levels of makeup water heating and low levels of water reheating.** When the system is heating cold groundwater, it is performing makeup water heating. When systems reheat water that has lost heat from skin losses through the tank or recirculation losses, it is performing water reheating. Solar hot water systems are more efficient at makeup water heating than water reheating (for a given system and consumption profile). Buildings such as the pool shower facility, the dining facility, and the 2002-vintage barracks consume large quantities of water and must perform high quantities of makeup water heating. Hot water systems at buildings such as the hammerhead barracks 1and the 2002-vintage administrative building dominantly reheat water.

- **Occupied 7 days per week.** Buildings that are occupied 7 days per week will utilize a solar hot water systems more frequently, which allows them to be more cost-effective. This also allows the systems to operate more efficiently because the solar hot water system is required to perform less water reheating than if the system was installed on a building that was occupied for fewer days per week.

- **Inefficient existing hot water systems**. Solar hot water systems displace hot water that would have been produced by the conventional hot water system. When the existing, conventional hot water system is inefficient, each unit of energy the solar hot water system provides saves a greater quantity of energy than if the supplemental system was highly efficient.

- **Consistent and regular water draws throughout the day.** Consistent water draws throughout the day allow the solar hot water system to supply heat that is used relatively quickly, which minimizes standby heat losses that occur through the tank skin or losses from water recirculation, which therefore minimizes water reheating by the solar hot water system.

- **Large amounts of food processing.** Food processing facilities are a good indicator of buildings with large and consistent hot water demands. Food processing facilities also tend to perform a large amount of makeup water heating relative to water reheating, which indicates potential for higher solar hot water system efficiency.

- **The presence of year-round use pools.** Buildings with pools that are used year round, such as indoor pools or fitness centers, tend to be heated and use large amounts of hot water. As a result, these facilities also tend to have a high makeup water heating to reheating ratio, which indicates potential for high solar hot water system efficiency, if the building is used 7 days per week.

- **Low domestic hot water temperature setpoint (e.g., 120^{o}F).** Low domestic hot water temperatures allow solar hot water systems to operate more efficiently and therefore more cost-effectively, and allow for smaller solar hot water systems to be installed. Relatively low temperature setpoints allow solar hot water systems to maintain greater temperature differences

between the working fluid and the fluid in the tank because less reheating is required to maintain the high water temperature, which improves heat transfer and thus system efficiency. High temperature setpoints also require a greater number of panels to be installed. Note that lowering setpoint temperatures will allow any hot water system to operate more economically. However, high temperature setpoints may be necessary for specific applications (e.g., dish or clothes washing).

Likewise, several characteristics tend to degrade solar hot water project economics:

- **High levels of water reheating.** Domestic hot water systems with high levels of water reheating tend to be poor candidates for solar hot water systems. There are many situations where high levels of water reheating may occur including:
    - Low/sporadic occupancy levels
    - Long pipe runs, but minimal water draws
    - Low/intermittent hot water consumption
    - The lack of insulation on hot water distribution piping or storage tanks
    - Tanks with high temperature setpoints (e.g., 180^{o}F).
- **Buildings with a high hot water peak demand relative to the average demand.** Most buildings have a peak hot water demand associated with a certain time of day or activity. However, some buildings' peak hot water demand is substantially larger than the average demand, such as physical fitness centers or barracks that experience a morning rush. As a result, storage tanks and hot water recirculation piping must be sized to accommodate this peak load. However, during non-peak load times (which is the majority of the day), these large tanks and pipes lose substantial amounts of heat relative to the makeup water heating needs. This lost heat must be compensated for by reheating the water in the circulation loop and tank, and results in substantial amounts of energy dedicated to water reheating. Pairing a solar hot water system to such a system will require the solar hot water to also perform substantial amounts of water reheating, and results in lower solar hot water system efficiency.
- **Buildings with oversized hot water systems**. Buildings that have oversized hot water systems to meet their needs may not result in cost-effective solar hot water systems. These systems must perform disproportionately more water reheating than a smaller system meeting the same load, and lowers the performance of the solar hot water system.
- **Buildings that have been heavily repurposed.** There are many older buildings at Army installations across the U.S. that have been repurposed and are no longer occupied in the manner that was originally intended. However, although buildings may be repurposed, the domestic hot water systems are rarely overhauled to match the new use. As a result, many buildings, such as the hammerhead barracks monitored for this analysis, have mis-sized domestic hot water systems, which can be an impediment to cost-effective solar hot water system deployment.

Table 6.1 lists the summary of characteristics that tend to enhance or suppress solar hot water project economics.

Table 6.1. Buildings Characteristics that Indicate Solar Hot Water System Economics

Characteristics that improve solar hot water project economics
High levels of makeup water heating and low levels of water reheating
Occupied seven days per week
Inefficient existing hot water systems
Consistent and regular water draws throughout the day
Large amounts of food processing
The presence of year-round use pools
Low domestic hot water temperature setpoint (e.g., 120 ^{o}F)
Characteristics that degrade solar hot water project economics
High levels of water reheating
Buildings with a high hot water peak demand relative to the average demand
Buildings with oversized hot water systems
Buildings that have been heavily repurposed

Lastly, the sensitivity analysis revealed that substantial changes in energy costs, system prices, or both would need to occur for the development of cost-effective solar hot water projects across IMCOM-Southeast. In addition, the analysis further emphasized that at this time, system economics are more dependent upon the value of the displaced fuel, and, to a lesser extent, building use type than insolation. The analysis determined that at locations with high energy costs (e.g., Fort Buchanan), nearly all buildings would have positive economics.

7.0 Next Steps

Although the analysis concluded that a majority of the building types and locations were not suitable for solar hot water systems, approximately one-quarter of the scenarios considered are promising candidates. IMCOM-Southeast should explore solar hot water feasibility at the sites with promising economics. Specifically, Fort Buchanan, MOT Sunny Point, USAG Miami, and Anniston Army Depot might be currently suitable for solar hot water projects. With a 40% energy price increase, sites such as Fort Gordon, Fort Stewart, Fort Polk, Fort Jackson, Pine Bluff Arsenal, Blue Grass Army Depot, Fort Campbell, and Fort Bragg may also be suitable. Further feasibility studies would involve sending subject matter experts to the sites to conduct building surveys. These surveys should document the building use type, occupancy patterns, hot water system parameters, and a thorough documentation of the roof type, slope, and orientation. Building drawings are also useful to determine loop lengths, the mass flow of the water, and insulation levels. After a site visit, systems could be specified and submitted to ECIP or other similar funding avenues if they prove to be cost-effective.

To facilitate these next steps, PNNL has surveyed all the real property data within its possession for SERO installations. A list of buildings that may be suitable for solar hot water systems is provided in Appendix C. Note that this is intended to be a preliminary screening of potential candidate buildings based on real property data inputs. Some real property data is somewhat out of date and may not reflect recent new construction and demolitions.

Beyond site visit and project development for glazed solar hot water heaters, IMCOM-Southeast should consider conducting a similar study for applications that may be appropriate for evacuated tube collector systems. Applications include laundry facilities, manufacturing plants that consume large quantities of high temperature water, and hot water central energy plants that could supplement their existing hot water production with solar hot water. In addition, a similar study should be focused on solar hot water heating for pools because these can be cost-effective even when domestic solar hot water heating is not. Lastly, a handful of locales, such as USAG Miami and Fort Buchanan, may be positioned to use thermosiphon or integrated collector storage systems, which can only be used in areas that do not experience freezing. These systems are considerably less costly than glazed collector systems.

8.0 References

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Appendix A

Methodology

Appendix A

Methodology

This report involved two major efforts. The first was to meter and log hot water consumption data for several buildings at Fort Campbell. The second step was to process and organize the data for use in TSOL solar hot water system models.

A.1 Data Collection Methodology

PNNL utilized Campbell Scientific CR800 and CR1000[2] multi-channel data loggers for data collection. Data was logged at 5-minute intervals and downloaded periodically. Neptune water meters with pulse output modules were installed on the makeup water line for the domestic hot water system and connected to the data loggers. On select systems, dedicated natural gas meters were installed on the gas line serving the hot water boiler. Likewise, these meters had pulse output modules installed and were connected to the data loggers.

Temperature sensors, thermistors and thermocouples were installed at a variety of locations. One temperature sensor was installed on city water supply to measure out-of-the ground temperature of supply water. On distributed hot water systems, only the supply temperature was monitored. For those systems with a circulation loop, supply and return temperatures were both monitored.

In each building, the goal was to capture the energy consumption of the domestic hot water systems on a time-of-day basis. In the case of natural gas meters, this was measured directly and the makeup water and temperature sensors aided in modeling the system. In other buildings, a combination of water consumption, supply/return temperatures, and pump flow characteristics were used to calculate the energy use patterns.

A.2 System Performance Analysis Methodology

To evaluate the performance of the solar hot water system for each building, Valentine Software's TSOL Pro solar thermal modeling software was selected because of its ability to handle hot water load schedules and a wide variety of system configurations. Observations from the site visit and the schedules determined by the data logging were used to model the performance of the systems.

After establishing the model inputs, a solar hot water system was modeled for each building and then simulated using the environmental characteristics of the four different climate zones that cover the southeast region. The performance of a given solar hot water system was then assigned to an installation based upon the climate zone of that installation.

Next, natural gas prices were obtained from the AEWRS database for each of the IMCOM-Southeast installations being investigated. Lastly, the DOD's Energy Conservation Investment Program (ECIP)

[2] Indications of specific trade names and equipment are for research purposes only and does not constitute as an endorsement.

life-cycle cost approach was used to determine the cost-effectiveness of the solar hot water systems. The ECIP approach was used because this is the most likely approach for sites to fund projects at the scale of a typical solar hot water system.

A.3 Building Details

While onsite in December 2009, PNNL collected and documented a wide range of information for the buildings selected for this study. Naturally, given the nature of this analysis, the domestic hot water system was documented in detail. Note that while the burner efficiency of the domestic hot water heaters was documented, the solar hot water analysis assumed all burners were 80% efficient so that a meaningful comparison between buildings could be conducted.

A.3.1 Building 1610

Building 1610 is a large golf clubhouse located at Fort Campbell's expansive golf course (Figure A.1).

Figure A.1. Building 1610 Aerial View (Bing 2010)

This building is approximately 34,364 sf and has a wide variety of use areas including administrative offices, food preparation facilities, banquet halls, locker and shower rooms, a small luncheonette /sandwich shop, retail shops, and a maintenance bay for golf carts. Table A.1 displays several relevant parameters for building 1610.

Table A.1. Building 1610 Parameters of Interest

Parameter	Quantity/Description
Size	34,364 sf
Number of Floors	Two
Year of Construction	2003
Construction	Masonry building constructed on slab with pitched, standing seam metal roof
Hours of Occupancy	M–F: 1100–2100 Sat: intermittent

	Sun: intermittent
Typical Daily Occupancy	330 persons
Heating and Cooling Technology	Natural gas heating, split system electric cooling
Hot Water Heating Capacity	250,000 Btu/h

Building 1610 has a recirculating hot water system with approximately 750 ft of piping. The system is comprised of a single 500-gallon storage tank that is plumbed to a smaller unitary 98-gallon tank with a natural gas boiler. The unitary system is an AO Smith GWT500ASV0N0 with an 83% efficient burner. Figure A.2 schematically describes the domestic hot water heating system of building 1610.

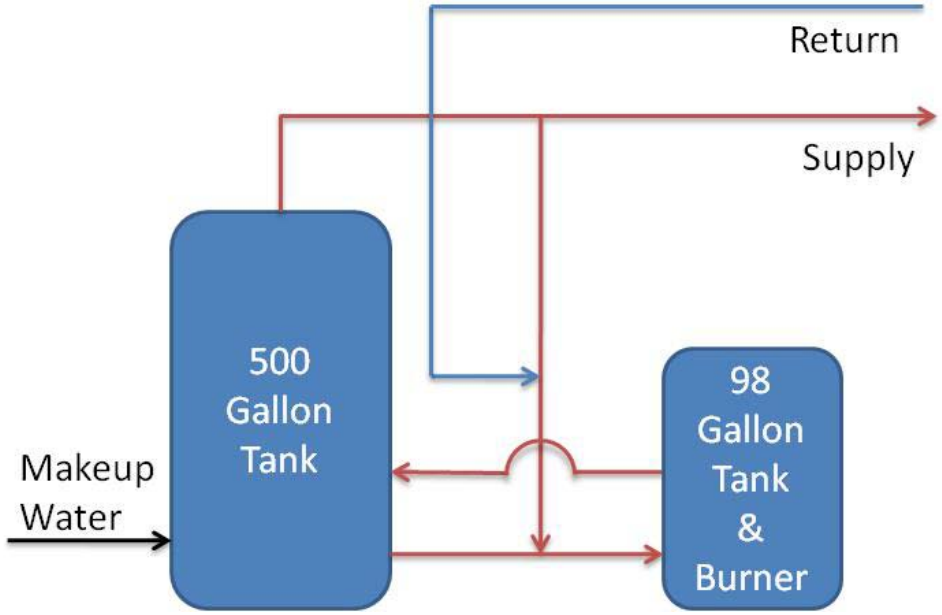

Figure A.2. 1610 Domestic Hot Water System

A.3.2 Building 2193

Building 2193 is a small building that abuts the south side of the indoor pool, which is located in building 2191(Figure A.3).

Figure A.3. Building 2193 and 2191 Aerial View (Bing 2010)

This building is approximately 950 sf, and is mostly comprised of two locker and shower rooms in addition to a small amount of storage space and an unconditioned mechanical room for the domestic hot water system. Table A.2 displays several relevant parameters for building 1610.

Table A.2. Building 2193 Parameters of Interest

Parameter	Quantity/Description
Size	950 sf
Number of Floors	One
Year of Construction	1948
Construction	Masonry building constructed on slab with a wooden, shingle roof
Hours of Occupancy	M–F: 0530–2100 Sat: 1100–1800 Sun: 1100–1800
Typical Daily Occupancy	150 persons
Heating and Cooling Technology	PoolPak natural gas heating, split system electric cooling
Hot Water Heating Capacity	250,000 Btu/h

Building 2193 has a distributed hot water system. The system is a unitary 100-gallon tank with a natural gas boiler. The unitary system is a Lochinvar CNR250-100-DF9 with an 80% efficient burner. Figure A.4 schematically describes the domestic hot water heating system of building 2193.

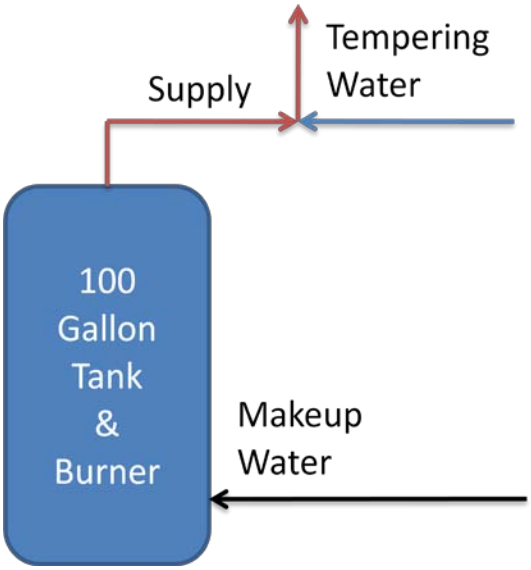

Figure A. 4. 2193 Domestic Hot Water System

A.3.3 Building 3069

Building 3069 is one of the child development centers (CDC) located on post (Figure A.5).

Figure A.5. Building 3069 Aerial View (Bing 2010)

This building is approximately 24,245 sf, and is comprised a wide variety of classrooms for students of various ages, administrative offices, and a dining facility. Table A.3 displays several relevant parameters for building 1610.

Table A.3. Building 3069 Parameters of Interest

Parameter	Quantity/Description
Size	24,245 sf
Number of Floors	One
Year of Construction	1993
Construction	Masonry building constructed on slab with a wooden, shingle roof
Hours of Occupancy	M–F: 0530–2100 Sat: 0800–1700 (every other weekend) Sun: closed
Typical Daily Occupancy	100 persons
Heating and Cooling Technology	Natural gas boiler and split A/C units connected to air handling units
Hot Water Heating Capacity Unit 1	540,000 Btu/h
Hot Water Heating Capacity Unit 2	149,000 Btu/h

Building 3069 has a semi-complex hot water system consisting of one recirculating system interconnected with one distributed system. The system is comprised of two unitary 140-gallon tanks with natural gas boilers. The right-most tank (see Figure A.6) is set at a relatively low setpoint to prevent burns, and is the only portion of the system that recirculates water. The burner is an AO Smith BTD140-149000. The second unitary system also has a 140-gallon storage tank, but the burner is an AO Smith BTP140-540000 and the temperature setpoint is 140°F. Furthermore, this system has a supplemental 119-gallon storage tank. These two tanks serve the kitchen, which requires higher temperature water. During the tour of the building, the purpose of the tempered supply water could not be determined, although it may serve the limited laundry facilities located at the building. Figure A.6 schematically describes the domestic hot water heating system of building 3069.

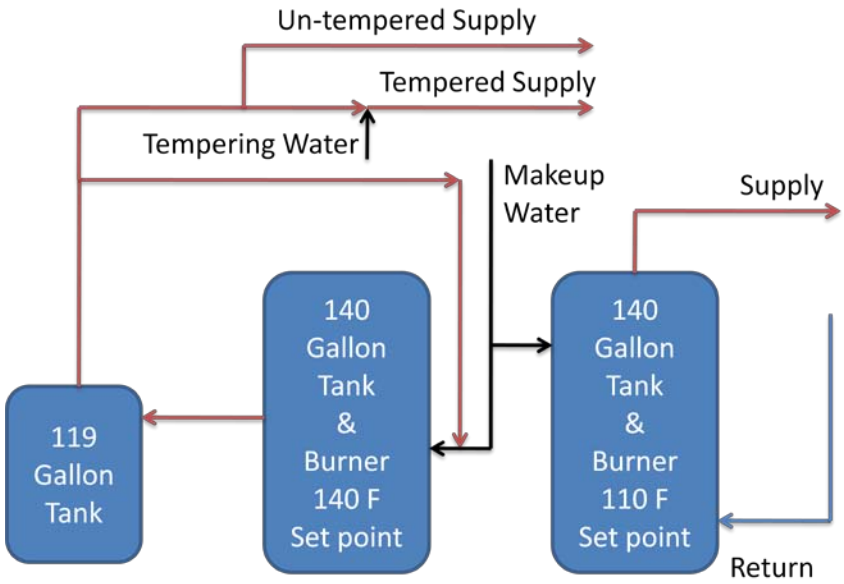

Figure A.6. 3069 Domestic Hot Water System

A.3.4 Building 3211

Building 3211 is an older hammerhead barracks found at Army facilities across the United States (Figure A.7).

Figure A.7. Building 3211 Aerial View (Bing 2010)

This building is approximately 37,809 sf, and was formerly used as a barracks. However, currently the building is dominantly used as administrative and storage spaces. This facility also has a dining facility, although it is no longer used for food preparation. Table A.4 displays several relevant parameters for building 3211.

Table A.4. Building 3211 Parameters of Interest

Parameter	Quantity/Description
Size	37,809 sf
Number of Floors	Three-stories
Year of Construction	1954
Construction	Masonry building constructed on slab with a flat, built up roof
Hours of Occupancy	M–F: 0800–1700 Sat: intermittent Sun: intermittent
Typical Daily Occupancy	20–30 persons
Heating and Cooling Technology	District steam heating, no cooling
Hot Water Heating Capacity	Heat exchanger capacity unknown

Building 3211 has a recirculating hot water system designed to serve a barracks. The system is comprised of a single 500-gallon storage tank, and the water is heated by district steam via an older tube-and-shell heat exchanger. **Error! Reference source not found.** schematically describes the domestic hot water heating system of building 3211.

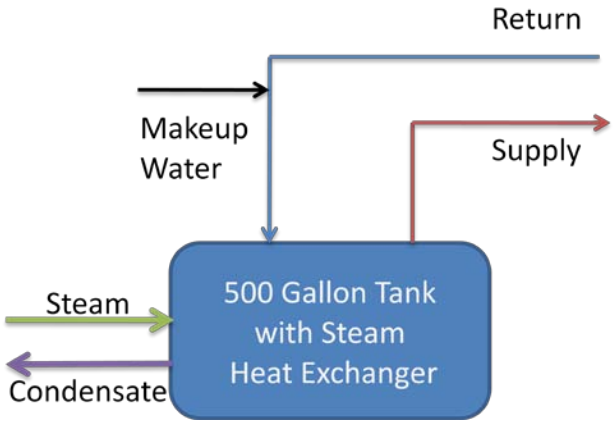

Figure A.8. 3211 Domestic Hot Water System

A.3.5 Building 3217

Building 3217 is an older hammerhead barracks found at Army facilities across the United States (Figure A.9).

Figure A.9. Building 3217 Aerial View (Bing 2010)

This building is approximately 37,795 sf, and was formerly used as a barracks. However, upon touring the building, it became clear that this building is approximately one-third administrative space and two-thirds short-term lodging. Table A.5 displays several relevant parameters for building 3217.

Table A.5. Building 3217 Parameters of Interest

Parameter	Quantity/Description
Size	37,795 sf
Number of Floors	Three-stories
Year of Construction	1952
Construction	Masonry building constructed on slab with a flat, built up roof
Hours of Occupancy (Administrative section)	M – F: 0800 – 1700 Sat: intermittent Sun: intermittent
Hours of Occupancy (Temporary housing)	M–F: 1600–0530 Sat: 1600–0530 Sun: 1600–0530
Typical Daily Occupancy	20-30 persons
Heating and Cooling Technology	District steam heating, no cooling
Hot Water Heating Capacity	Heat exchanger capacity unknown

Building 3217 has a recirculating hot water system designed to serve a barracks. The system is comprised of a single 500-gallon storage tank, and the water is heated by district steam via an older tube-and-shell heat exchanger. Figure A.10 schematically describes the domestic hot water heating system of building 3217.

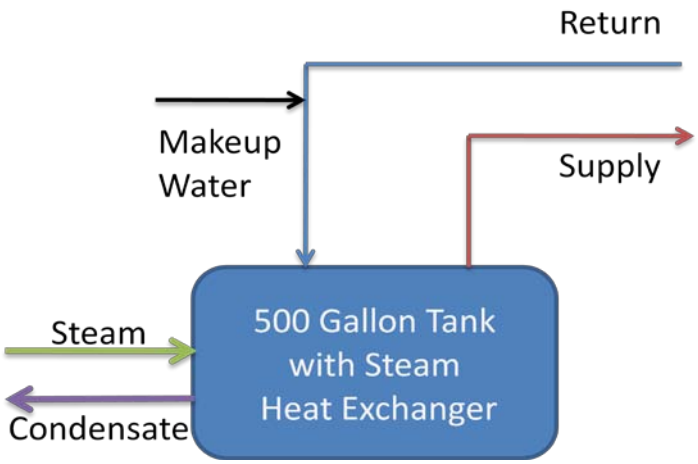

Figure A.10. 3217 Domestic Hot Water System

A.3.6 Building 7037

Building 7037 is a modern, large physical fitness center that serves a large portion of the site (Figure A.11).

Figure A.11. Building 7037 Aerial View (Bing 2010)

This building is approximately 37,458 sf, and is an active and heavily used physical fitness center. It features two basketball courts, and a series of large, expansive weight rooms. Table A.6 displays several relevant parameters for building 7037.

Table A.6. Building 7037 Parameters of Interest

Parameter	Quantity/Description
Size	37,458 sf
Number of Floors	One
Year of Construction	1997
Construction	Masonry building constructed on slab with a sloped, standing seam metal roof
Hours of Occupancy	M–F: 0500–2100 Sat: 0500–1800 Sun: 0500–1500
Typical Daily Occupancy	300 persons
Heating and Cooling Technology	AHU served by a natural gas boiler, and a screw chiller for cooling
Hot Water Heating Capacity	986,000 Btu/h

Building 7037 has a recirculating hot water system. The system is comprised of a single 250-gallon storage tank, and the hot water is heated by an independent natural gas boiler. The gas boiler is a Lochinvar CWN0986PM and has an 81% efficient burner. Figure A.12 schematically describes the domestic hot water heating system of building 7037.

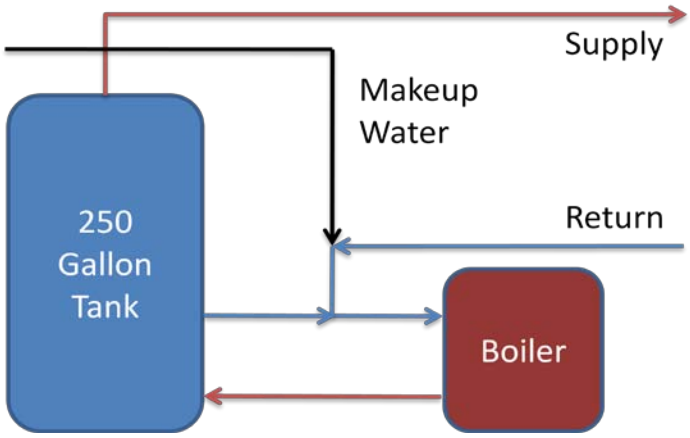

Figure A.12. 7037 Domestic Hot Water System

A.3.7 Building 7044

Building 7044 is a large, modern barracks with two identical wings and a common area between the two wings (Figure A.13).

Figure A.13. Building 7044 Aerial View (Bing 2010)

This building is approximately 126,841 sf, and is densely occupied. It features two, three-story wings and a large, single-story central administrative space and common area. Table A.7 displays several relevant parameters for building 7044.

Table A.7. Building 7044 Parameters of Interest

Parameter	Quantity/Description
Size	126,841 sf
Number of Floors	Three
Year of Construction	2002
Construction	Masonry building constructed on slab with a pitched, standing seam metal roof
Hours of Occupancy	M–F: 1600–0530 Sat: intermittent Sun: intermittent
Typical Daily Occupancy	350 persons
Heating and Cooling Technology	AHU served by a natural gas boiler, and a reciprocating chiller for cooling
Hot Water Heating Capacity (per boiler)	994,000 Btu/h

Building 7044 has a recirculating hot water system. The system is comprised of a single 1000-gallon storage tank, and the hot water is heated by two independent natural gas boilers. The gas boilers are HESco HNS-700 and have 80% efficient burners. Figure A.14 schematically describes the domestic hot water heating system of building 7044.

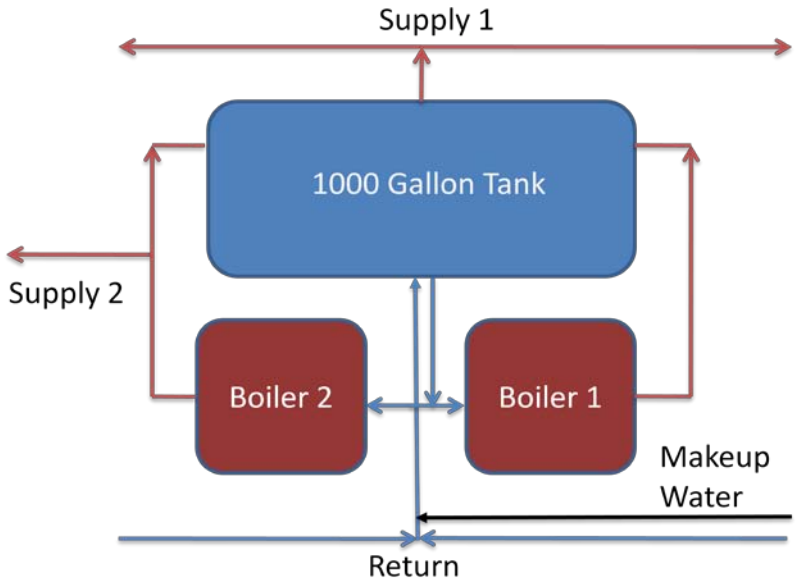

Figure A.14. 7044 Domestic Hot Water System for Both Wings

A.3.8 Building 7048

Building 7048 is a large, modern dining facility that services several barracks, administrative buildings, and shops in the immediate area (Figure A.15).

Figure A.15. Building 7048 Aerial View (Bing 2010)

The building is approximately 20,601 sf, and is a heavily utilized facility that serves breakfast, lunch, and dinner 7 days per week. It features a full kitchen and several dining areas. Table A.8 displays several relevant parameters for building 7048.

Table A.8. Building 7048 Parameters of Interest

Parameter	Quantity/Description
Size	20,601 sf
Number of Floors	One
Year of Construction	2002
Construction	Masonry building constructed on slab with a pitched, standing seam metal roof
Hours of Occupancy	M–F: 0600–2000 Sat: 0600–2000 Sun: 0600–2000
Typical Daily Occupancy	500 patrons
Heating and Cooling Technology	AHU served by a natural gas boiler, and a standard chiller for cooling
Hot Water Heating Capacity	700,000 Btu/h

Building 7048 has a recirculating hot water system. The system is comprised of a single 450-gallon storage tank, and the hot water is heated by an independent natural gas boiler. The gas boiler is a HESco HNS-700 and has an 80% efficient burner. Figure A.16 schematically describes the domestic hot water heating system of building 7048.

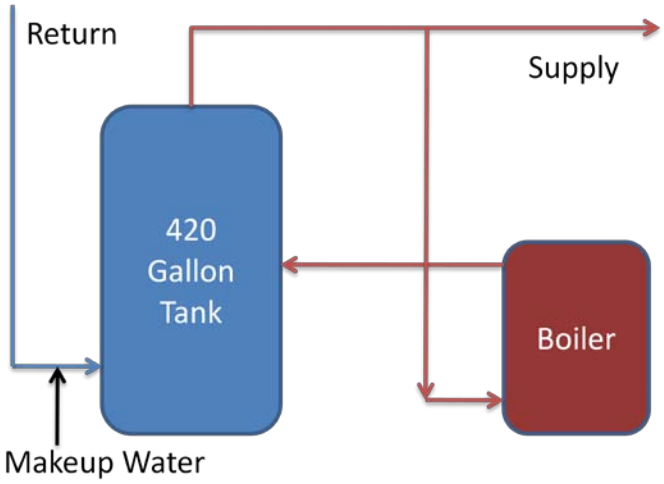

Figure A.16. 7048 Domestic Hot Water System

A.3.9 Building 7075

Building 7075 is a large, modern administrative facility that includes a storage area and loading facility (Figure A.17). The building is approximately 61,419 sf.

Figure A.17. Building 7075 Aerial View (Bing 2010)

The building is approximately 62,000 sf and is typically occupied five days per week. Table A.9 displays several relevant parameters for building 7075.

Table A.9. Building 7075 Parameters of Interest

Parameter	Quantity/Description
Size	61,419 sf
Number of Floors	Three
Year of Construction	2002
Construction	Masonry building constructed on slab with a pitched, standing seam metal roof
Hours of Occupancy	M–F: 0800–1700 Sat: intermittent Sun: intermittent
Typical Daily Occupancy	100 persons
Heating and Cooling Technology	AHU served by a natural gas boiler, and a standard chiller for cooling
Hot Water Heating Capacity	600,000 Btu/h

Building 7075 has a recirculating hot water system. The system is comprised of a single AO Smith BTP200-600 unitary 200-gallon storage tank with an 80% efficient burner. Figure A.18 schematically describes the domestic hot water heating system of building 7075.

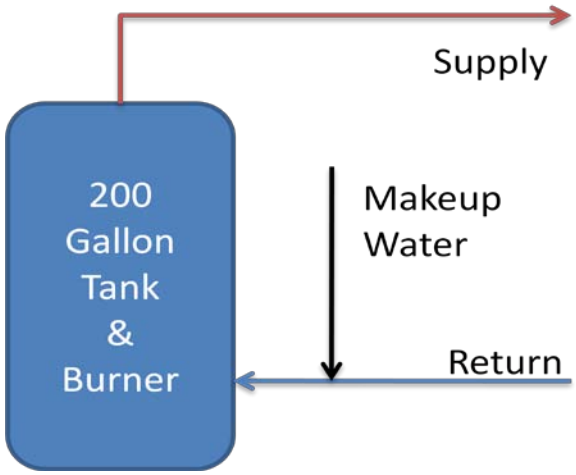

Figure A.18. 7075 Domestic Hot Water System

Appendix B

Building-Specific Makeup Water Metered Data

Appendix B

Building-Specific Makeup Water Metered Data

Appendix B contains the processed data collected from the data loggers that was used to construct the TSOL models. It is presented in a series of tables, two for each building to show average hourly water consumption by month and by day.

Table B.1. Building 1610 Average Water Consumption by Month

Raw data collected: 12/17/2009 13:35–7/29/2010 3:50

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.1	0.5	3.2	0.2	1.5	3.9	0.3	0.6	1.3
1	0.1	0.1	0.1	0.1	0.1	0.8	0.3	0.2	0.2
2	0.1	0.9	0.5	0.6	0.2	1.1	0.3	0.2	0.5
3	0.2	0.1	0.0	0.5	1.0	1.9	0.1	0.3	0.5
4	0.1	0.1	0.0	0.2	0.2	1.2	0.1	0.3	0.3
5	0.1	0.3	0.0	2.3	0.7	1.5	0.3	0.5	0.7
6	0.1	4.2	1.5	4.7	3.8	4.3	3.1	2.6	3.0
7	1.7	19.5	16.9	26.5	31.6	26.6	25.0	22.1	21.2
8	10.6	42.6	29.6	57.9	40.0	39.8	44.9	54.6	40.0
9	15.1	51.1	44.4	72.7	56.5	61.8	58.3	62.8	52.8
10	5.0	47.8	49.7	42.5	51.2	42.0	48.5	54.1	42.6
11	16.4	45.6	48.5	46.8	50.8	49.5	49.2	47.7	44.3
12	10.5	54.3	58.9	72.0	88.6	67.4	86.7	66.8	63.2
13	8.4	70.7	65.5	90.3	102.6	79.2	91.3	79.8	73.5
14	14.7	50.4	50.5	67.2	88.8	70.0	77.7	53.2	59.1
15	6.8	9.6	14.6	7.3	15.1	23.5	11.9	12.5	12.7
16	23.7	9.5	12.6	6.1	20.3	25.3	15.5	15.9	16.1
17	20.1	6.8	16.7	12.1	23.4	30.5	13.3	9.4	16.5
18	18.0	5.8	8.1	7.9	11.8	18.5	9.7	5.3	10.6
19	14.3	14.6	10.7	12.5	16.8	21.8	10.6	4.0	13.2
20	5.9	6.1	11.5	7.9	10.6	18.3	5.7	3.5	8.7
21	0.2	5.5	12.1	4.9	8.1	10.4	5.4	3.9	6.3
22	0.0	3.3	7.6	1.8	1.9	9.3	3.7	2.7	3.8
23	0.0	1.4	6.9	2.0	1.4	5.0	2.7	1.8	2.6

Table B.2. Building 1610 Average Water Consumption by Day

Raw data collected: 12/17/2009 13:35–7/29/2010 3:50

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	0.1	0.2	0.4	0.2	1.6	3.6	3.4	1.4
1	0.3	0.4	0.5	0.1	0.1	0.2	0.1	0.2
2	0.2	0.4	0.5	0.2	0.7	1.5	0.2	0.5
3	0.7	0.3	1.3	0.2	0.4	0.8	0.2	0.5
4	0.3	0.4	0.5	0.1	0.2	0.2	0.3	0.3
5	0.1	0.6	1.0	0.9	2.1	0.3	0.5	0.8
6	1.3	3.0	8.1	5.1	4.3	0.7	0.4	3.3
7	30.1	32.1	27.1	32.7	32.0	3.6	1.6	22.7
8	63.4	45.8	61.2	57.9	51.8	10.4	5.2	42.2
9	71.9	63.6	77.0	85.0	74.4	11.1	7.4	55.8
10	49.6	55.3	70.2	59.5	62.1	10.4	9.5	45.2
11	36.5	68.1	69.9	68.5	60.1	13.3	8.4	46.4
12	55.8	98.9	95.8	107.4	94.8	7.9	9.3	67.1
13	76.3	112.4	112.3	122.0	100.7	9.6	15.8	78.5
14	37.1	83.4	76.5	100.4	111.5	17.6	11.8	62.6
15	3.5	5.7	11.8	26.0	13.8	14.5	16.3	13.1
16	6.4	3.9	17.7	24.7	34.8	15.5	6.3	15.6
17	4.6	10.2	15.2	23.9	24.4	32.6	3.3	16.3
18	3.7	5.0	10.6	14.2	15.8	19.1	3.2	10.2
19	1.3	3.9	11.5	27.3	24.0	22.1	2.3	13.2
20	1.7	4.7	7.2	15.4	16.8	15.6	0.9	8.9
21	1.1	3.0	4.6	9.3	12.1	16.3	0.5	6.7
22	1.0	2.4	1.6	4.2	9.4	9.4	0.2	4.0
23	0.3	0.3	0.0	2.0	8.3	8.4	0.1	2.8

Table B.3. Building 2191 Average Water Consumption by Month

Raw data collected: 12/17/2009 10:35–12/17/2009 13:55
12/25/2009 4:00–3/3/2010 12:00
Gaps indicate missing data because of power outage because of building renovation.

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.0	0.0	0.0	0.0	-	-	-	-	0.0
1	0.0	0.0	0.0	0.0	-	-	-	-	0.0
2	0.0	0.3	0.0	0.0	-	-	-	-	0.1
3	0.0	0.0	0.0	0.0	-	-	-	-	0.0
4	0.0	0.0	0.0	0.0	-	-	-	-	0.0
5	0.1	1.4	3.6	5.3	-	-	-	-	2.6
6	7.3	8.4	12.9	24.9	-	-	-	-	13.4
7	8.2	20.4	40.0	121.2	-	-	-	-	47.4
8	4.6	15.6	32.1	74.0	-	-	-	-	31.6
9	2.5	7.3	34.4	87.6	-	-	-	-	33.0
10	11.9	16.2	25.1	17.0	-	-	-	-	17.5
11	17.4	25.1	61.5	43.4	-	-	-	-	36.8
12	12.7	21.3	31.9	31.0	-	-	-	-	24.2
13	7.1	10.8	38.8	34.0	-	-	-	-	22.7
14	11.0	17.1	43.8	15.6	-	-	-	-	21.9
15	14.7	18.5	53.4	36.9	-	-	-	-	30.9
16	11.5	17.3	46.3	18.4	-	-	-	-	23.4
17	14.5	23.1	47.7	35.7	-	-	-	-	30.3
18	17.6	10.0	16.7	19.8	-	-	-	-	16.0
19	10.1	16.7	36.9	26.7	-	-	-	-	22.6
20	0.6	2.3	3.7	0.2	-	-	-	-	1.7
21	0.0	0.5	0.0	0.0	-	-	-	-	0.1
22	0.0	1.1	0.0	0.0	-	-	-	-	0.3
23	0.0	0.0	1.3	0.0	-	-	-	-	0.3

Table B.4. Building 2191 Average Water Consumption by Day

Raw data collected: 12/17/2009 10:35–12/17/2009 13:55
12/25/2009 4:00–3/3/2010 12:00

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.9	3.8	7.4	1.3	2.9	0.0	0.0	2.3
6	7.3	20.9	18.9	16.3	12.3	0.0	0.0	10.8
7	30.2	38.4	68.7	64.9	20.6	0.1	0.0	31.8
8	20.0	41.6	31.2	59.7	15.5	0.4	0.0	24.1
9	12.7	43.4	31.1	44.1	17.1	0.8	0.1	21.3
10	17.3	34.2	32.2	17.3	16.9	13.7	3.0	19.2
11	39.3	37.7	71.4	62.8	42.2	18.4	7.2	39.9
12	26.3	26.4	30.1	26.4	15.9	31.3	18.5	25.0
13	10.4	43.3	21.5	20.9	8.1	39.8	11.3	22.2
14	15.1	21.0	33.3	23.3	9.4	49.2	38.9	27.2
15	20.1	37.9	15.1	20.5	11.4	77.7	44.2	32.4
16	16.0	19.1	47.7	22.3	9.8	47.6	42.0	29.2
17	23.1	24.0	52.0	21.1	31.2	54.0	24.6	32.9
18	15.3	20.3	32.7	10.0	16.1	2.4	0.6	13.9
19	25.1	35.7	54.3	42.9	15.5	2.2	0.0	25.1
20	5.9	3.3	3.2	1.7	3.3	0.8	0.0	2.6
21	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.2
22	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.5
23	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.5

Table B.5. Building 3069 Average Water Consumption by Month

Raw data collected: 12/17/2009 9:10–6/8/2010 8:25
6/10/2010 13:45–7/29/2010 4:25

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	1.1	4.3	2.9	2.4	0.8	0.1	0.0	-	1.7
1	0.0	0.3	0.9	0.1	0.0	0.0	0.0	-	0.2
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
4	0.6	0.0	0.0	0.0	0.0	0.2	0.0	-	0.1
5	20.0	31.0	36.3	36.2	34.9	19.4	14.6	-	27.5
6	16.4	29.1	34.4	39.1	30.5	16.6	3.7	-	24.2
7	13.3	30.3	31.3	39.3	35.1	24.4	5.3	-	25.6
8	30.5	65.7	74.5	81.0	72.7	58.9	19.1	-	57.5
9	50.5	101.5	128.7	128.3	113.2	98.1	52.9	-	96.2
10	43.5	92.4	109.2	114.1	99.6	90.3	46.1	-	85.0
11	58.2	98.1	116.2	124.4	118.2	100.0	51.1	-	95.2
12	49.8	85.2	92.2	110.5	105.4	95.8	59.1	-	85.4
13	35.5	69.1	82.4	88.8	83.3	73.4	47.9	-	68.6
14	47.2	78.3	107.4	121.1	102.3	81.6	29.4	-	81.0
15	42.4	67.6	88.3	86.5	75.1	61.7	27.6	-	64.2
16	24.4	58.2	73.8	74.5	62.7	48.7	27.2	-	52.8
17	9.2	29.1	33.8	39.7	34.2	30.1	6.4	-	26.1
18	18.8	31.4	38.3	27.0	21.7	21.0	6.1	-	23.5
19	15.8	29.2	44.2	34.4	25.1	20.8	9.1	-	25.5
20	9.4	15.4	19.3	17.3	15.3	8.7	17.6	-	14.7
21	6.8	13.4	19.6	19.0	16.2	7.5	6.4	-	12.7
22	2.2	9.3	12.0	15.0	8.3	4.5	1.5	-	7.5
23	1.4	2.8	4.1	7.0	2.4	1.2	0.2	-	2.7

Table B.6. Building 3069 Average Water Consumption by Day

Raw data collected: 12/17/2009 9:10–6/8/2010 8:25
6/10/2010 13:45–7/29/2010 4:25

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	0.0	1.0	2.0	1.9	1.5	3.1	0.0	1.3
1	0.0	0.0	0.2	0.1	0.0	0.7	0.0	0.1
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1
5	32.4	36.3	36.3	34.3	32.7	0.0	0.0	24.6
6	26.1	30.8	33.6	28.7	28.2	1.1	0.0	21.2
7	28.9	30.9	35.3	33.5	31.9	1.1	0.0	23.1
8	63.1	73.9	80.5	70.4	69.2	14.4	0.0	53.1
9	114.2	135.4	135.3	124.8	115.5	22.3	0.0	92.5
10	105.5	108.5	127.9	107.8	102.6	26.6	0.0	82.7
11	102.3	124.4	127.0	117.8	121.6	41.8	0.0	90.7
12	104.8	112.1	101.8	118.0	113.9	45.7	0.0	85.2
13	84.0	90.3	88.6	87.7	82.0	36.8	0.0	67.1
14	84.9	91.5	113.3	102.8	95.6	51.7	0.0	77.1
15	71.8	75.7	92.5	85.3	77.9	35.1	0.3	62.6
16	57.0	71.8	73.2	66.8	61.1	22.8	0.3	50.4
17	33.0	29.6	33.0	31.4	27.0	7.3	0.3	23.1
18	29.1	22.9	26.3	25.4	40.2	9.0	0.0	21.9
19	34.6	26.2	29.3	31.7	49.8	5.2	0.0	25.3
20	17.7	13.1	24.3	22.5	32.5	1.7	0.0	16.0
21	15.6	16.7	14.1	14.5	18.2	0.6	0.0	11.4
22	7.2	8.9	5.5	8.5	14.9	0.4	0.0	6.5
23	1.6	2.8	2.7	3.2	5.9	0.0	0.0	2.3

Table B.7. Building 3211 Average Water Consumption by Month

Raw data collected: 12/15/2009 12:55–7/19/2010 5:00

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.7	13.8	46.9	73.9	84.9	8.7	18.1	0.6	31.0
1	0.6	13.7	46.9	74.1	86.0	9.0	18.3	0.6	31.2
2	0.7	13.7	47.2	74.4	86.0	9.2	18.4	0.6	31.3
3	0.6	13.9	47.5	74.7	87.5	9.4	18.6	0.7	31.6
4	0.8	13.9	47.9	74.8	87.8	9.6	18.6	0.7	31.7
5	0.8	14.1	48.0	74.5	85.8	9.5	18.4	0.6	31.5
6	1.1	14.5	48.1	75.7	88.9	9.8	18.9	0.8	32.2
7	1.1	17.9	49.2	76.7	90.3	11.2	20.0	1.0	33.4
8	1.5	29.3	58.9	84.3	93.8	11.2	19.7	0.8	37.5
9	3.6	26.0	51.4	78.3	94.5	12.4	17.8	2.0	35.7
10	16.9	19.0	50.9	75.8	94.5	11.2	17.4	0.7	35.8
11	6.5	17.2	49.5	77.7	89.7	11.2	18.3	1.7	34.0
12	9.1	16.7	47.9	78.5	89.2	10.9	17.5	1.0	33.9
13	16.2	16.2	47.8	78.6	96.4	10.5	16.7	1.4	35.5
14	2.3	16.2	47.8	76.8	99.0	10.5	19.5	1.0	34.1
15	2.8	15.5	48.4	76.5	88.2	10.1	19.0	2.9	32.9
16	8.0	15.4	48.9	76.7	88.8	10.0	18.5	0.8	33.4
17	3.2	15.2	47.8	76.5	87.5	9.5	18.2	0.8	32.3
18	2.3	15.1	48.0	75.1	81.7	9.0	17.6	0.7	31.2
19	1.7	14.7	47.4	75.0	79.8	9.3	17.7	0.7	30.8
20	3.4	14.6	47.2	74.1	80.0	9.3	17.8	0.6	30.9
21	1.5	15.1	47.3	73.7	80.9	9.1	17.7	0.7	30.8
22	0.8	15.3	47.2	73.8	81.7	9.0	17.7	0.7	30.8
23	0.7	14.7	47.5	74.2	82.4	9.0	17.5	0.5	30.8

Table B.8. Building 3211 Average Water Consumption by Day

Raw data collected: 12/15/2009 12:55–7/19/2010 5:00

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	39.2	38.7	34.4	33.9	34.8	36.6	36.0	36.2
1	39.7	39.1	34.4	34.6	35.2	36.3	36.2	36.5
2	39.9	39.3	35.0	35.0	35.4	36.3	35.5	36.6
3	39.1	39.2	35.4	35.0	35.2	37.4	36.3	36.8
4	38.9	39.1	36.1	35.3	35.2	37.3	35.4	36.8
5	38.3	38.5	35.7	34.7	35.1	37.6	36.2	36.6
6	38.9	40.3	35.7	35.3	35.7	38.2	37.9	37.4
7	41.7	41.0	38.9	35.8	37.6	38.1	38.0	38.7
8	50.5	49.3	48.4	39.0	40.7	37.8	37.6	43.3
9	45.2	45.6	41.6	42.5	38.4	37.7	37.5	41.2
10	41.0	39.0	45.7	42.8	38.7	37.7	38.0	40.4
11	42.6	39.2	39.9	37.6	38.5	37.8	38.7	39.2
12	40.8	39.6	41.8	37.1	37.0	38.0	38.1	38.9
13	40.3	40.2	44.0	44.2	36.4	38.3	38.3	40.2
14	40.3	38.2	36.0	46.7	39.2	38.6	38.7	39.7
15	40.3	37.5	36.8	37.3	37.8	38.3	39.7	38.2
16	40.5	38.9	37.8	35.4	38.0	38.0	40.2	38.4
17	39.9	37.5	35.1	35.2	37.8	38.0	39.8	37.6
18	38.1	35.4	32.5	34.6	36.7	37.2	39.0	36.2
19	37.8	34.8	32.0	34.8	36.5	36.5	38.4	35.8
20	38.5	34.5	32.5	34.3	36.3	36.0	38.3	35.8
21	37.8	34.6	33.2	33.8	36.6	36.6	38.5	35.9
22	38.3	34.4	32.9	34.5	36.1	36.4	39.1	36.0
23	38.7	34.2	33.6	33.8	36.5	36.2	39.2	36.0

Table B.9. Building 3217 Average Water Consumption by Month

Raw data collected: 12/17/2009 8:30–6/8/2010 8:55
6/17/2010 13:25–7/29/2010 5:20

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	47.3	24.3	27.1	20.5	25.4	133.8	22.6	-	43.0
1	45.3	17.7	22.0	16.2	16.0	134.2	22.9	-	39.2
2	45.9	15.8	21.8	20.8	14.5	137.0	23.0	-	39.8
3	46.1	15.9	22.0	13.3	13.6	137.3	23.1	-	38.8
4	45.9	15.2	22.0	15.0	14.5	137.6	23.3	-	39.1
5	46.4	21.1	21.4	18.1	14.1	138.8	23.5	-	40.5
6	51.8	26.1	34.3	25.9	28.9	142.8	23.5	-	47.6
7	63.9	39.7	65.9	40.4	28.5	141.7	23.5	-	57.7
8	60.9	55.1	78.2	62.4	52.2	149.2	23.5	-	68.8
9	58.2	32.4	37.1	22.1	25.3	142.9	23.3	-	48.8
10	56.7	32.8	33.9	28.2	20.5	144.1	22.6	-	48.4
11	55.1	27.4	37.1	23.5	23.3	146.1	22.7	-	47.9
12	55.2	38.4	34.4	26.9	34.9	144.0	23.7	-	51.1
13	50.5	27.7	48.5	22.0	32.9	143.6	23.5	-	49.8
14	49.4	29.5	46.9	20.3	21.2	149.2	12.8	-	47.0
15	47.6	25.7	43.1	22.8	17.6	142.4	0.0	-	42.7
16	46.6	29.8	48.6	22.3	20.2	144.5	0.0	-	44.6
17	47.3	20.7	40.8	27.2	21.8	147.0	0.0	-	43.5
18	47.3	21.4	28.5	16.9	26.4	145.3	0.0	-	40.8
19	45.4	29.0	30.5	17.0	20.6	148.4	0.0	-	41.6
20	45.0	26.6	35.4	19.3	18.2	148.6	0.0	-	41.9
21	49.3	25.1	36.3	16.6	20.6	148.0	0.0	-	42.3
22	49.6	23.4	31.4	19.8	18.9	147.5	0.0	-	41.5
23	44.9	18.7	31.7	15.9	18.5	147.2	0.0	-	39.5

Table B.10. Building 3217 Average Water Consumption by Day

Raw data collected: 12/17/2009 8:30–6/8/2010 8:55
6/17/2010 13:25–7/29/2010 5:20

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	43.6	47.1	34.5	36.2	32.5	37.6	35.2	38.1
1	37.7	43.0	27.6	30.7	34.4	33.5	34.4	34.5
2	39.8	41.6	28.4	32.8	29.1	35.8	38.2	35.1
3	38.3	42.2	28.3	31.0	28.9	33.5	35.8	34.0
4	40.3	43.8	27.7	30.2	29.0	33.4	36.4	34.4
5	42.7	45.8	29.0	32.2	30.1	34.3	35.9	35.7
6	45.8	56.8	44.0	38.7	37.8	34.8	37.9	42.3
7	49.1	67.8	60.3	54.1	49.9	38.7	37.4	51.0
8	60.4	89.4	78.6	77.1	58.6	35.7	38.2	62.6
9	42.9	51.0	37.0	40.6	43.7	43.5	42.6	43.1
10	48.5	47.9	36.2	38.0	40.2	44.5	45.1	42.9
11	48.9	47.3	33.4	34.8	44.4	45.0	43.5	42.5
12	56.5	49.2	33.7	39.3	42.6	48.7	50.0	45.7
13	51.9	48.1	31.5	35.2	40.3	47.8	57.3	44.6
14	42.9	40.4	31.1	35.4	37.1	47.4	63.3	42.5
15	44.1	30.2	32.2	37.7	35.5	43.1	50.4	39.0
16	45.9	38.9	32.2	39.1	41.3	43.7	44.2	40.8
17	46.9	33.0	40.1	39.6	36.3	38.5	43.6	39.7
18	42.8	34.1	29.5	36.5	37.0	38.8	41.2	37.1
19	44.4	36.4	32.0	36.0	36.4	36.5	44.4	38.0
20	48.7	33.2	35.2	31.8	33.7	44.1	41.2	38.3
21	45.4	35.7	34.9	32.3	32.3	42.9	45.0	38.4
22	47.8	34.4	32.0	31.8	37.1	35.4	45.0	37.6
23	43.0	31.9	28.9	36.8	32.5	34.4	44.5	36.0

Table B.11. Building 7037 Average Water Consumption by Month

Raw data collected: 12/17/2009 8:40–7/29/2010 8:05

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.1	0.0	0.8	0.2	0.1	0.3	0.4	0.3	0.3
1	0.0	0.1	0.7	0.2	0.2	0.3	0.4	0.2	0.3
2	0.3	0.2	0.7	0.1	0.1	0.4	0.4	0.2	0.3
3	0.2	0.0	0.8	0.2	0.2	0.6	0.5	0.4	0.4
4	0.0	0.8	0.6	0.8	0.1	0.8	2.4	1.1	0.8
5	14.4	16.7	12.7	18.4	3.8	3.8	3.2	2.6	9.5
6	14.1	21.8	18.5	23.0	13.3	8.0	9.6	9.4	14.7
7	52.1	91.4	77.2	79.1	67.4	49.1	58.6	56.0	66.4
8	68.0	138.2	126.7	124.1	108.7	66.2	85.9	94.8	101.6
9	12.5	28.9	33.1	28.7	26.9	17.2	23.2	26.4	24.6
10	19.6	18.6	16.5	24.3	17.7	16.3	24.0	19.1	19.5
11	23.6	18.1	21.1	24.6	17.2	17.2	16.9	18.8	19.7
12	20.8	24.1	27.8	35.4	23.7	22.1	22.1	18.6	24.3
13	16.2	20.2	20.8	26.3	18.5	20.5	18.6	19.2	20.1
14	15.2	17.5	19.0	14.9	12.1	11.9	14.0	17.8	15.3
15	9.9	9.9	15.4	18.4	14.8	12.7	16.5	16.6	14.3
16	9.9	11.2	13.7	14.6	11.6	8.5	12.5	16.2	12.3
17	6.5	13.0	15.3	18.4	11.5	8.5	16.0	20.4	13.7
18	8.9	9.5	9.2	19.0	11.8	11.2	12.9	15.0	12.2
19	4.1	8.2	8.7	9.9	6.3	6.3	8.4	13.6	8.2
20	4.3	6.2	5.9	10.2	7.8	8.4	11.9	10.0	8.1
21	2.3	2.8	5.5	7.8	8.6	6.0	4.9	6.0	5.5
22	0.0	0.1	0.9	0.4	0.1	0.1	0.4	0.2	0.3
23	0.0	0.1	0.7	0.2	0.1	0.3	0.4	0.2	0.2

Table B.12. Building 7037 Average Water Consumption by Day

Raw data collected: 12/17/2009 8:40–7/29/2010 8:05

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	0.2	0.1	0.4	0.2	0.7	0.2	0.1	0.3
1	0.3	0.3	0.3	0.1	0.6	0.1	0.2	0.3
2	0.2	0.2	0.4	0.1	0.8	0.3	0.1	0.3
3	0.2	0.2	0.6	0.3	0.8	0.4	0.2	0.4
4	0.4	1.6	1.3	0.9	1.3	0.3	0.4	0.9
5	13.2	14.2	16.5	12.0	11.3	1.3	0.2	9.8
6	19.6	22.4	24.1	18.3	20.3	2.0	1.3	15.4
7	84.9	94.5	106.7	96.0	73.9	9.4	15.2	68.6
8	133.3	152.4	171.6	141.3	127.1	7.7	8.8	106.0
9	32.9	31.5	31.0	34.7	30.7	13.6	6.2	25.8
10	17.2	24.3	22.6	24.8	18.2	20.8	11.1	19.9
11	16.4	19.4	23.5	21.6	19.6	21.4	16.5	19.8
12	29.2	29.0	29.2	25.2	20.4	28.5	16.0	25.4
13	22.7	23.6	25.8	18.7	20.4	20.8	13.2	20.7
14	11.7	14.0	15.4	15.1	11.7	20.9	18.1	15.3
15	17.1	14.9	15.2	20.5	11.8	12.1	11.8	14.8
16	16.3	17.1	19.9	19.6	14.3	0.5	0.5	12.6
17	22.6	20.4	23.2	20.8	13.6	0.4	0.1	14.5
18	18.9	21.4	21.4	18.9	9.3	0.1	0.2	12.9
19	14.5	12.8	17.2	14.4	0.9	0.2	0.1	8.6
20	13.4	15.7	16.5	13.6	0.1	0.1	0.2	8.5
21	7.7	10.4	11.2	11.3	0.3	0.0	0.3	5.9
22	0.5	0.3	0.3	0.7	0.1	0.1	0.2	0.3
23	0.2	0.3	0.2	0.7	0.1	0.1	0.2	0.3

Table B.13. Building 7044 Average Water Consumption by Month

Raw data collected: 12/17/2009 8:15–7/29/2010 6:20

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	28.5	53.6	85.1	81.8	50.5	22.2	38.2	-	51.4
1	12.5	30.9	38.3	42.6	19.9	14.7	28.8	-	26.8
2	6.2	27.0	34.9	34.9	13.8	10.2	13.1	-	20.0
3	23.8	22.9	33.6	36.0	12.2	8.5	22.4	-	22.8
4	28.1	33.2	37.2	72.4	49.1	11.7	39.8	-	38.8
5	76.7	143.8	184.5	234.2	284.0	58.6	187.3	-	167.0
6	44.3	30.0	50.4	57.9	64.1	72.7	69.3	-	55.5
7	86.8	124.8	190.5	165.5	196.7	131.3	218.9	-	159.2
8	171.3	388.4	603.1	630.7	701.6	202.2	473.1	-	452.9
9	54.2	132.4	193.7	189.3	226.8	133.1	138.9	-	152.6
10	127.5	97.0	117.7	105.0	113.2	126.6	95.7	-	111.8
11	71.1	97.8	145.1	147.9	129.5	99.2	119.6	-	115.8
12	114.2	120.0	144.7	154.9	117.0	87.7	97.5	-	119.4
13	95.8	107.1	132.5	174.3	96.4	83.4	112.3	-	114.5
14	76.6	114.2	109.3	146.8	107.5	85.6	109.4	-	107.1
15	65.8	112.3	127.0	152.6	119.9	99.6	116.6	-	113.4
16	95.3	118.6	168.8	189.8	140.9	134.0	143.3	-	141.5
17	83.3	210.7	261.8	221.2	178.0	122.4	170.3	-	178.2
18	88.2	194.8	269.6	266.5	242.6	90.8	170.8	-	189.0
19	85.3	195.1	224.0	222.8	214.7	73.2	164.3	-	168.5
20	79.4	164.6	237.3	225.5	211.2	78.9	189.3	-	169.5
21	70.7	185.3	210.6	217.4	219.9	58.9	150.5	-	159.0
22	71.2	147.9	160.5	165.4	171.4	57.8	131.0	-	129.3
23	43.1	102.1	143.8	108.5	101.1	37.2	71.1	-	86.7

Table B.14. Building 7044 Average Water Consumption by Day

Raw data collected: 12/17/2009 8:15–7/29/2010 6:20

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	73.6	49.4	60.4	56.2	50.9	41.5	36.6	52.7
1	39.1	29.7	22.2	17.1	20.0	34.7	34.8	28.2
2	20.3	33.8	16.3	8.6	17.3	24.9	26.4	21.1
3	22.7	28.4	16.5	18.4	13.4	26.7	22.8	21.3
4	57.7	63.4	51.5	57.9	29.8	21.5	17.2	42.7
5	276.6	220.9	282.0	244.3	217.3	31.5	12.7	183.6
6	83.6	56.5	69.1	67.5	66.7	35.9	27.8	58.2
7	194.2	232.3	230.2	239.9	195.3	67.2	65.3	174.9
8	509.1	558.2	684.3	658.0	675.8	134.4	120.4	477.2
9	164.0	124.4	160.3	165.7	159.1	155.0	148.6	153.9
10	107.6	69.0	62.5	73.5	74.2	173.9	193.8	107.8
11	117.1	73.8	54.1	63.3	74.0	206.1	225.7	116.3
12	106.4	81.6	46.9	69.5	114.4	189.6	205.4	116.3
13	98.3	75.5	34.0	58.2	123.1	188.3	218.8	113.7
14	68.9	70.8	59.9	59.9	133.5	161.0	203.9	108.3
15	70.9	91.1	97.2	76.8	159.7	170.3	175.1	120.1
16	112.3	128.9	132.5	180.6	221.7	141.9	158.8	153.8
17	175.3	186.4	210.0	263.8	220.0	126.2	149.9	190.2
18	184.3	214.6	240.8	226.9	205.0	154.3	154.0	197.1
19	186.2	191.2	197.0	187.5	169.1	127.8	163.2	174.6
20	208.7	224.4	202.7	187.7	117.2	105.6	203.5	178.5
21	178.9	215.5	203.1	184.8	94.1	83.9	196.9	165.3
22	167.5	175.4	136.1	144.7	55.5	59.5	189.8	132.6
23	96.2	102.0	93.2	113.3	39.1	41.5	127.4	87.5

Table B.15. Building 7048 Average Water Consumption by Month

Raw data collected: 12/17/2009 9:20–7/29/2010 6:50

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.0	22.7	3.9	35.2	41.5	31.4	26.1	-	23.0
1	0.0	26.7	13.6	39.5	42.5	31.3	26.3	-	25.7
2	0.3	22.2	12.0	83.5	39.3	31.7	26.4	-	30.8
3	0.4	45.0	39.8	93.9	56.1	32.4	27.2	-	42.1
4	5.6	22.4	64.9	98.0	97.3	35.0	29.4	-	50.4
5	20.5	91.2	76.8	140.0	133.4	127.2	120.2	-	101.3
6	31.1	74.3	93.8	129.0	136.9	99.4	129.7	-	99.2
7	20.4	87.1	124.1	158.8	177.3	105.4	148.8	-	117.4
8	85.2	287.2	317.2	391.2	425.1	252.6	361.1	-	302.8
9	82.9	252.0	289.9	428.2	399.5	217.4	298.6	-	281.2
10	75.1	167.6	226.8	327.2	296.1	203.8	274.2	-	224.4
11	27.3	124.5	143.0	233.8	201.7	115.2	154.3	-	142.8
12	45.7	293.5	289.3	345.1	420.4	256.0	366.9	-	288.1
13	49.0	191.0	236.3	277.6	278.4	226.9	286.3	-	220.8
14	29.9	125.2	105.3	171.4	141.2	111.4	138.5	-	117.5
15	18.6	74.2	69.9	130.3	107.1	118.5	99.8	-	88.3
16	22.3	100.9	108.6	137.5	139.3	117.1	112.5	-	105.4
17	34.0	209.3	225.5	305.6	273.6	222.5	322.7	-	227.6
18	30.0	225.7	264.8	285.6	240.7	262.6	274.5	-	226.3
19	0.4	70.9	86.8	145.5	88.1	99.2	111.6	-	86.1
20	0.4	18.2	19.1	66.4	34.3	38.1	42.0	-	31.2
21	0.0	17.3	8.5	68.7	37.9	40.7	34.4	-	29.6
22	0.4	7.1	21.2	55.0	44.3	34.8	35.1	-	28.3
23	0.3	8.4	8.7	40.4	41.8	33.9	27.9	-	23.1

Table B.16. Building 7048 Average Water Consumption by Day

Raw data collected: 12/17/2009 9:20–7/29/2010 6:50

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	22.6	31.8	33.9	49.2	22.7	21.4	21.2	29.0
1	25.8	35.3	40.0	49.9	26.1	21.6	22.0	31.5
2	30.4	50.0	49.0	54.0	23.0	27.0	21.8	36.5
3	70.5	47.9	53.0	65.8	45.1	27.1	21.8	47.3
4	74.9	56.1	71.4	96.9	46.3	25.9	21.1	56.1
5	134.7	169.5	176.4	182.5	107.2	27.2	27.6	117.9
6	130.3	122.1	158.2	162.6	125.8	38.6	52.1	112.8
7	149.1	145.3	177.2	178.2	123.6	79.7	77.3	132.9
8	370.8	423.1	504.2	503.8	386.6	68.1	61.8	331.2
9	315.4	367.9	432.3	424.8	400.7	76.7	79.1	299.6
10	238.2	292.3	325.6	338.9	295.7	103.0	107.1	243.0
11	143.9	191.6	219.8	203.7	184.5	82.1	75.9	157.4
12	336.5	420.4	479.3	435.7	376.4	104.8	93.8	321.0
13	246.0	289.8	326.2	322.1	289.3	100.3	104.6	239.8
14	135.2	158.1	171.1	169.0	153.1	63.3	51.3	128.7
15	95.1	137.3	128.2	114.5	93.8	54.2	51.7	96.4
16	137.5	125.1	158.7	129.4	85.6	77.3	107.6	117.3
17	327.4	372.5	368.2	290.9	149.0	125.4	145.9	254.2
18	322.0	370.9	412.2	294.9	161.8	78.0	105.1	249.3
19	135.6	120.0	187.3	137.6	47.6	26.4	34.5	98.4
20	31.2	42.1	70.2	31.2	23.2	23.9	36.1	36.8
21	32.1	47.2	55.0	36.7	23.4	22.6	32.4	35.6
22	32.6	40.2	55.5	32.9	29.3	22.1	24.2	33.8
23	28.3	32.3	51.8	24.6	21.6	21.7	22.2	28.9

Table B.17. Building 7075 Average Water Consumption by Month

Raw data collected: 12/17/2009 8:00–6/8/2010 9:15
6/10/2010 16:50–7/29/2010 7:25

Averaged Water Usage (gallons/hour)									
Hour	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Average**
0	0.0	0.3	0.2	1.2	0.0	0.1	0.0	-	0.3
1	0.0	0.0	0.1	0.4	0.0	0.1	0.0	-	0.1
2	0.0	0.0	0.5	0.3	0.0	0.2	0.0	-	0.1
3	0.0	0.0	0.1	0.2	0.0	0.3	0.0	-	0.1
4	0.1	0.0	0.4	3.7	0.2	0.4	0.1	-	0.7
5	0.0	9.7	10.5	16.8	3.9	0.4	0.7	-	6.0
6	0.4	5.5	8.4	20.9	5.9	0.9	1.6	-	6.2
7	6.9	24.8	28.0	45.1	32.3	4.1	7.0	-	21.2
8	16.3	65.9	47.4	77.3	73.6	5.3	18.9	-	43.5
9	1.5	8.7	7.1	15.3	15.2	15.1	1.7	-	9.2
10	10.1	4.4	5.7	4.5	3.4	3.0	0.9	-	4.6
11	2.9	3.1	5.5	6.1	3.5	1.1	0.5	-	3.3
12	0.8	1.8	1.6	9.5	1.8	0.5	0.7	-	2.4
13	0.2	2.2	3.6	7.5	2.8	1.3	0.4	-	2.6
14	0.1	2.4	5.8	5.8	3.7	23.2	0.1	-	5.9
15	1.9	3.1	3.8	6.8	2.2	0.9	1.2	-	2.8
16	1.3	2.9	2.5	8.4	2.5	1.1	0.1	-	2.7
17	0.0	1.2	1.4	2.8	0.7	0.0	0.0	-	0.9
18	0.0	2.2	1.0	4.1	0.6	0.0	0.0	-	1.1
19	0.4	2.6	1.6	3.2	1.2	0.0	0.0	-	1.3
20	0.0	0.5	2.5	7.0	1.2	0.2	0.0	-	1.6
21	0.0	0.3	1.8	10.1	0.6	0.1	0.0	-	1.8
22	0.0	1.0	1.5	6.8	0.2	0.0	0.0	-	1.4
23	0.0	0.9	0.8	2.9	0.2	0.1	0.0	-	0.7

Table B.18. Building 7075 Average Water Consumption by Day

Raw data collected: 12/17/2009 8:00–6/8/2010 9:15
6/10/2010 16:50–7/29/2010 7:25

Averaged Water Usage (gallons/hour)								
Hour	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Average**
0	0.1	0.3	0.4	0.7	0.1	0.2	0.2	0.3
1	0.0	0.0	0.2	0.3	0.0	0.1	0.0	0.1
2	0.3	0.1	0.4	0.0	0.0	0.1	0.0	0.1
3	0.2	0.0	0.2	0.0	0.0	0.1	0.0	0.1
4	0.6	1.7	0.4	1.0	0.4	0.3	0.2	0.7
5	2.8	10.1	10.5	9.6	5.0	0.8	1.4	5.7
6	3.4	8.6	11.5	9.9	6.4	0.7	0.9	5.9
7	17.1	29.6	36.6	29.2	21.9	1.8	1.3	19.7
8	41.7	58.1	72.6	61.2	47.6	0.9	0.1	40.3
9	4.3	8.6	13.7	24.1	9.1	1.2	0.6	8.8
10	2.4	2.6	5.2	7.6	5.9	1.3	0.5	3.6
11	1.5	2.4	7.2	3.8	4.1	0.4	0.8	2.9
12	1.4	1.4	4.0	1.8	1.5	5.1	0.5	2.2
13	1.3	3.4	3.6	2.8	3.0	1.8	1.2	2.4
14	1.3	7.1	4.2	20.0	4.8	2.7	0.1	5.7
15	1.9	4.0	5.6	4.1	1.5	0.6	0.4	2.6
16	3.6	3.0	6.2	4.0	0.8	0.1	0.0	2.5
17	1.0	0.8	0.9	1.6	0.5	0.6	0.6	0.8
18	0.9	1.3	2.0	2.0	0.9	0.0	0.5	1.1
19	1.0	2.0	2.7	0.6	1.0	1.2	0.1	1.2
20	1.5	2.4	1.9	4.0	0.5	0.3	0.4	1.6
21	2.1	5.3	2.9	0.8	0.3	0.5	0.6	1.8
22	1.5	2.2	1.3	1.3	0.3	2.3	0.4	1.3
23	1.0	1.0	1.6	0.4	0.1	0.4	0.1	0.7

Appendix C

Site-Specific Buildings to Consider for Solar Hot Water Heating Systems

Appendix C

Site-Specific Buildings to Consider for Solar Hot Water Heating Systems

Appendix C contains buildings that might be suitable for solar hot water system consideration. Note that not all sites considered in the main body of the report are present because PNNL did not have access to the entire real property database. Therefore, PNNL analyzed the buildings for all real property data for datasets already in PNNL's possession.

Table C.1. Buildings to Consider for Solar Hot Water Heating Systems at Fort Campbell

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
39	GP ADMIN BLDG	Administration	7148	LARGE UNIT HQ	Administration
43	GP ADMIN BLDG	Administration	7157	LARGE UNIT HQ	Administration
82	GP ADMIN BLDG	Administration	7159	LARGE UNIT HQ	Administration
125	GP ADMIN BLDG	Administration	7163	AVN OPNS BLDG	Administration
127	GP ADMIN BLDG	Administration	7170	GP ADMIN BLDG	Administration
232	GP ADMIN BLDG	Administration	7184	GP ADMIN BLDG	Administration
234	GP ADMIN BLDG	Administration	7185	SMALL UNIT HQ	Administration
602	GP ADMIN BLDG	Administration	7186	SMALL UNIT HQ	Administration
723	GP ADMIN BLDG	Administration	7200	SMALL UNIT HQ	Administration
734	GP ADMIN BLDG	Administration	7211	SMALL UNIT HQ	Administration
750	GP ADMIN BLDG	Administration	7242	AVN OPNS BLDG	Administration
843	TNG AIDS BLDG	Administration	7259	SMALL UNIT HQ	Administration
845	TNG AIDS BLDG	Administration	7265	AVN OPNS BLDG	Administration
847	TNG AIDS BLDG	Administration	7275	SMALL UNIT HQ	Administration
849	GP ADMIN BLDG	Administration	7276	LARGE UNIT HQ	Administration
850	GP ADMIN BLDG	Administration	7277	LARGE UNIT HQ	Administration
865	GP ADMIN BLDG	Administration	7278	LARGE UNIT HQ	Administration
869	GP ADMIN BLDG	Administration	7280	LARGE UNIT HQ	Administration

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
871	GP ADMIN BLDG	Administration	7282	LARGE UNIT HQ	Administration
873	GP ADMIN BLDG	Administration	7283	GP ADMIN BLDG	Administration
875	GP ADMIN BLDG	Administration	7298	LARGE UNIT HQ	Administration
907	GP ADMIN BLDG	Administration	7502	SMALL UNIT HQ	Administration
2110	GP ADMIN BLDG	Administration	7504	SMALL UNIT HQ	Administration
2112	GEN INSTN BLDG	Administration	7510	LARGE UNIT HQ	Administration
2152	GP ADMIN BLDG	Administration	7562	SMALL UNIT HQ	Administration
2159	GP ADMIN BLDG	Administration	7565	SMALL UNIT HQ	Administration
2170	GP ADMIN BLDG	Administration	7604	GP ADMIN BLDG	Administration
2172	GP ADMIN BLDG	Administration	7609	GP ADMIN BLDG	Administration
2174	GP ADMIN BLDG	Administration	7811	GP ADMIN BLDG	Administration
2176	GP ADMIN BLDG	Administration	7830	GP ADMIN BLDG	Administration
2178	GP ADMIN BLDG	Administration	7855	GP ADMIN BLDG	Administration
2182	GP ADMIN BLDG	Administration	7871	SMALL UNIT HQ	Administration
2186	GP ADMIN BLDG	Administration	7873	GEN INSTN BLDG	Administration
2188	GP ADMIN BLDG	Administration	7882	GEN INSTN BLDG	Administration
2203	GP ADMIN BLDG	Administration	71002	LARGE UNIT HQ	Administration
2204	GP ADMIN BLDG	Administration	71003	LARGE UNIT HQ	Administration
2205	GP ADMIN BLDG	Administration	71010	LARGE UNIT HQ	Administration
2206	GP ADMIN BLDG	Administration	A6924	LARGE UNIT HQ	Administration
2209	GP ADMIN BLDG	Administration	B6080	TNG AIDS BLDG	Administration
2250	GP ADMIN BLDG	Administration	B6628	SMALL UNIT HQ	Administration
2259	GP ADMIN BLDG	Administration	C6080	TNG AIDS BLDG	Administration
2267	GP ADMIN BLDG	Administration	D2195	SMALL UNIT HQ	Administration
2269	GP ADMIN BLDG	Administration	D4003	SMALL UNIT HQ	Administration
2301	GP ADMIN BLDG	Administration	D6080	TNG AIDS BLDG	Administration

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
2304	GEN INSTN BLDG	Administration	D6647	GEN INSTN BLDG	Administration
2332	GP ADMIN BLDG	Administration	D6800	SMALL UNIT HQ	Administration
2334	GP ADMIN BLDG	Administration	F3900	SMALL UNIT HQ	Administration
2401	GP ADMIN BLDG	Administration	F4000	SMALL UNIT HQ	Administration
2402	GP ADMIN BLDG	Administration	F5982	SMALL UNIT HQ	Administration
2432	GP ADMIN BLDG	Administration	F7135	SMALL UNIT HQ	Administration
2435	GEN INSTN BLDG	Administration	H2194	SMALL UNIT HQ	Administration
2436	GP ADMIN BLDG	Administration	H3904	SMALL UNIT HQ	Administration
2577	GP ADMIN BLDG	Administration	J6820	SMALL UNIT HQ	Administration
2601	GP ADMIN BLDG	Administration	N7000	SMALL UNIT HQ	Administration
2603	GP ADMIN BLDG	Administration	83	TRANSIENT LODGING	Barracks
2605	GP ADMIN BLDG	Administration	652	TRANSIENT LODGING	Barracks
2699	GP ADMIN BLDG	Administration	1581	TRANSIENT LODGING	Barracks
2700	GP ADMIN BLDG	Administration	1582	TRANSIENT LODGING	Barracks
2703	GP ADMIN BLDG	Administration	1583	TRANSIENT LODGING	Barracks
2745	MISC OPNS SUPT BLDG	Administration	1584	TRANSIENT LODGING	Barracks
2950	GP ADMIN BLDG	Administration	1585	TRANSIENT LODGING	Barracks
3101	GP ADMIN BLDG	Administration	1595	TRANSIENT LODGING	Barracks
3202	BAND TNG FAC	Administration	2255	STUDENT BARRACKS	Barracks
3207	SMALL UNIT HQ	Administration	2257	STUDENT BARRACKS	Barracks
3209	GP ADMIN BLDG	Administration	2310	STUDENT BARRACKS	Barracks
3210	LARGE UNIT HQ	Administration	2312	STUDENT BARRACKS	Barracks
3211	GP ADMIN BLDG	Administration	2316	STUDENT BARRACKS	Barracks
3212	GP ADMIN BLDG	Administration	2318	STUDENT BARRACKS	Barracks
3215	SMALL UNIT HQ	Administration	2320	STUDENT BARRACKS	Barracks
3216	SMALL UNIT HQ	Administration	2322	STUDENT BARRACKS	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
3218	GP ADMIN BLDG	Administration	2324	STUDENT BARRACKS	Barracks
3306	LARGE UNIT HQ	Administration	2326	STUDENT BARRACKS	Barracks
3672	SMALL UNIT HQ	Administration	2330	STUDENT BARRACKS	Barracks
3680	SMALL UNIT HQ	Administration	2989	ENLISTED UPH	Barracks
3686	SMALL UNIT HQ	Administration	2990	ENLISTED UPH	Barracks
3721	LARGE UNIT HQ	Administration	2992	ENLISTED UPH	Barracks
3755	SMALL UNIT HQ	Administration	2993	ENLISTED UPH	Barracks
3759	SMALL UNIT HQ	Administration	2994	ENLISTED UPH	Barracks
3763	LARGE UNIT HQ	Administration	2995	ENLISTED UPH	Barracks
3765	LARGE UNIT HQ	Administration	2996	ENLISTED UPH	Barracks
3767	SMALL UNIT HQ	Administration	2997	ENLISTED UPH	Barracks
3780	LARGE UNIT HQ	Administration	3213	ENLISTED UPH	Barracks
3962	LARGE UNIT HQ	Administration	3214	ENLISTED UPH	Barracks
3968	LARGE UNIT HQ	Administration	3217	ENLISTED UPH	Barracks
4013	SMALL UNIT HQ	Administration	3713	ENLISTED UPH	Barracks
4017	SMALL UNIT HQ	Administration	3725	ENLISTED UPH	Barracks
4021	SMALL UNIT HQ	Administration	3730	ENLISTED UPH	Barracks
4025	LARGE UNIT HQ	Administration	3731	ENLISTED UPH	Barracks
4029	SMALL UNIT HQ	Administration	3748	ENLISTED UPH	Barracks
4054	SMALL UNIT HQ	Administration	3750	ENLISTED UPH	Barracks
4062	SMALL UNIT HQ	Administration	3754	ENLISTED UPH	Barracks
4068	SMALL UNIT HQ	Administration	3766	ENLISTED UPH	Barracks
5134	GP ADMIN BLDG	Administration	4024	ENLISTED UPH	Barracks
5663	GP ADMIN BLDG	Administration	4028	ENLISTED UPH	Barracks
5668	GP ADMIN BLDG	Administration	4033	ENLISTED UPH	Barracks
5711	GP ADMIN BLDG	Administration	4038	ENLISTED UPH	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
5740	EOC/SCIF	Administration	4039	ENLISTED UPH	Barracks
6050	GP ADMIN BLDG	Administration	4044	ENLISTED UPH	Barracks
6080	TNG AIDS BLDG	Administration	4053	ENLISTED UPH	Barracks
6082	TNG AIDS BLDG	Administration	4057	ENLISTED UPH	Barracks
6101	LARGE UNIT HQ	Administration	4067	ENLISTED UPH	Barracks
6102	LARGE UNIT HQ	Administration	6730	ENLISTED UPH	Barracks
6254	LARGE UNIT HQ	Administration	6731	ENLISTED UPH	Barracks
6302	SMALL UNIT HQ	Administration	6732	ENLISTED UPH	Barracks
6304	SMALL UNIT HQ	Administration	6733	ENLISTED UPH	Barracks
6306	LARGE UNIT HQ	Administration	6752	ENLISTED UPH	Barracks
6308	LARGE UNIT HQ	Administration	6753	ENLISTED UPH	Barracks
6390	LARGE UNIT HQ	Administration	6754	ENLISTED UPH	Barracks
6502	SMALL UNIT HQ	Administration	6756	ENLISTED UPH	Barracks
6504	LARGE UNIT HQ	Administration	6762	ENLISTED UPH	Barracks
6506	LARGE UNIT HQ	Administration	6763	ENLISTED UPH	Barracks
6508	LARGE UNIT HQ	Administration	6764	ENLISTED UPH	Barracks
6603	GP ADMIN BLDG	Administration	6771	ENLISTED UPH	Barracks
6639	AVN OPNS BLDG	Administration	6772	ENLISTED UPH	Barracks
6729	SMALL UNIT HQ	Administration	6773	ENLISTED UPH	Barracks
6734	SMALL UNIT HQ	Administration	6909	ENLISTED UPH	Barracks
6735	SMALL UNIT HQ	Administration	6910	ENLISTED UPH	Barracks
6736	SMALL UNIT HQ	Administration	6911	ENLISTED UPH	Barracks
6741	LARGE UNIT HQ	Administration	6912	ENLISTED UPH	Barracks
6742	LARGE UNIT HQ	Administration	6917	ENLISTED UPH	Barracks
6743	SMALL UNIT HQ	Administration	6918	ENLISTED UPH	Barracks
6744	SMALL UNIT HQ	Administration	6919	ENLISTED UPH	Barracks
6745	LARGE	Administration	6920	ENLISTED UPH	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
	UNIT HQ				
6746	LARGE UNIT HQ	Administration	6921	ENLISTED UPH	Barracks
6747	SMALL UNIT HQ	Administration	6922	ENLISTED UPH	Barracks
6748	SMALL UNIT HQ	Administration	6923	ENLISTED UPH	Barracks
6749	LARGE UNIT HQ	Administration	6927	ENLISTED UPH	Barracks
6750	SMALL UNIT HQ	Administration	6928	ENLISTED UPH	Barracks
6751	SMALL UNIT HQ	Administration	6929	ENLISTED UPH	Barracks
6759	SMALL UNIT HQ	Administration	6930	ENLISTED UPH	Barracks
6760	LARGE UNIT HQ	Administration	6931	ENLISTED UPH	Barracks
6765	LARGE UNIT HQ	Administration	6936	ENLISTED UPH	Barracks
6766	SMALL UNIT HQ	Administration	6937	ENLISTED UPH	Barracks
6767	LARGE UNIT HQ	Administration	6938	ENLISTED UPH	Barracks
6768	SMALL UNIT HQ	Administration	6939	ENLISTED UPH	Barracks
6769	LARGE UNIT HQ	Administration	6940	ENLISTED UPH	Barracks
6770	SMALL UNIT HQ	Administration	6942	ENLISTED UPH	Barracks
6801	LARGE UNIT HQ	Administration	6943	ENLISTED UPH	Barracks
6852	GP ADMIN BLDG	Administration	6944	ENLISTED UPH	Barracks
6855	GP ADMIN BLDG	Administration	6945	ENLISTED UPH	Barracks
6883	GEN INSTN BLDG	Administration	7034	ENLISTED UPH	Barracks
6901	GP ADMIN BLDG	Administration	7038	ENLISTED UPH	Barracks
6904	GP ADMIN BLDG	Administration	7039	ENLISTED UPH	Barracks
6905	GP ADMIN BLDG	Administration	7044	ENLISTED UPH	Barracks
6906	GP ADMIN BLDG	Administration	7094	ENLISTED UPH	Barracks
6907	LARGE UNIT HQ	Administration	7096	ENLISTED UPH	Barracks
6908	LARGE UNIT HQ	Administration	7110	ENLISTED UPH	Barracks
6913	GP ADMIN BLDG	Administration	7112	ENLISTED UPH	Barracks
6914	GP ADMIN	Administration	7118	ENLISTED UPH	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
	BLDG				
6915	LARGE UNIT HQ	Administration	7120	ENLISTED UPH	Barracks
6916	SMALL UNIT HQ	Administration	7520	ENLISTED UPH	Barracks
6924	LARGE UNIT HQ	Administration	7523	ENLISTED UPH	Barracks
6925	LARGE UNIT HQ	Administration	7580	ENLISTED UPH	Barracks
6926	LARGE UNIT HQ	Administration	Q6647	AT/MOB BARRACKS	Barracks
6932	LARGE UNIT HQ	Administration	R6647	AT/MOB BARRACKS	Barracks
6933	LARGE UNIT HQ	Administration	3066	NURSERY/CHILD CARE	Child Development Center
6934	LARGE UNIT HQ	Administration	3067	NURSERY/CHILD CARE	Child Development Center
6935	LARGE UNIT HQ	Administration	3068	NURSERY/CHILD CARE	Child Development Center
6991	LARGE UNIT HQ	Administration	3069	NURSERY/CHILD CARE	Child Development Center
6995	GP ADMIN BLDG	Administration	3071	NURSERY/CHILD CARE	Child Development Center
6997	LARGE UNIT HQ	Administration	3612	NURSERY/CHILD CARE	Child Development Center
7035	SMALL UNIT HQ	Administration	2261	DINING FACILITY	Dining Facility
7069	SMALL UNIT HQ	Administration	2991	DINING FACILITY	Dining Facility
7071	LARGE UNIT HQ	Administration	3717	DINING FACILITY	Dining Facility
7073	GP ADMIN BLDG	Administration	4061	DINING FACILITY	Dining Facility
7075	SMALL UNIT HQ	Administration	6755	DINING FACILITY	Dining Facility
7076	LARGE UNIT HQ	Administration	6761	DINING FACILITY	Dining Facility
7077	LARGE UNIT HQ	Administration	7048	DINING FACILITY	Dining Facility
7078	LARGE UNIT HQ	Administration	7095	DINING FACILITY	Dining Facility
7079	SMALL UNIT HQ	Administration	A6647	DINING FACILITY	Dining Facility
7081	LARGE UNIT HQ	Administration	1610	OPEN MESS/CLUB FAC	Golf Club House
7082	SMALL UNIT HQ	Administration	2193	MISC MWR SUPT FAC	Golf Club House
7084	LARGE UNIT HQ	Administration	2570	MISC MWR SUPT FAC	Golf Club House
7086	SMALL UNIT HQ	Administration	3065	MISC MWR FAC	Golf Club House
7097	LARGE	Administration	6633	OPEN MESS/CLUB FAC	Golf Club House

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
	UNIT HQ				
7098	LARGE UNIT HQ	Administration	7121	OPEN MESS/CLUB FAC	Golf Club House
7099	LARGE UNIT HQ	Administration	7546	MISC MWR SUPT FAC	Golf Club House
7106	LARGE UNIT HQ	Administration	80	RECREATION CTR	Physical Fitness Center
7107	LARGE UNIT HQ	Administration	2270	INDOOR FITNESS FAC	Physical Fitness Center
7111	SMALL UNIT HQ	Administration	3610	INDOOR FITNESS FAC	Physical Fitness Center
7113	SMALL UNIT HQ	Administration	3932	INDOOR FITNESS FAC	Physical Fitness Center
7114	GP ADMIN BLDG	Administration	6145	RECREATION CTR	Physical Fitness Center
7116	SMALL UNIT HQ	Administration	6990	INDOOR FITNESS FAC	Physical Fitness Center
7117	SMALL UNIT HQ	Administration	6992	INDOOR FITNESS FAC	Physical Fitness Center
7119	LARGE UNIT HQ	Administration	7037	INDOOR FITNESS FAC	Physical Fitness Center
7123	SMALL UNIT HQ	Administration	7246	INDOOR FITNESS FAC	Physical Fitness Center
7124	SMALL UNIT HQ	Administration	7540	INDOOR FITNESS FAC	Physical Fitness Center
7125	LARGE UNIT HQ	Administration	1567	RESTROOM/SHOWER	Pool Shower Building
7126	LARGE UNIT HQ	Administration	2191	INDOOR SWM POOL	Pool Shower Building
7127	LARGE UNIT HQ	Administration	2192	RESTROOM/SHOWER	Pool Shower Building
7131	SMALL UNIT HQ	Administration	2572	RESTROOM/SHOWER	Pool Shower Building
7133	LARGE UNIT HQ	Administration	2573	RESTROOM/SHOWER	Pool Shower Building
7138	GP ADMIN BLDG	Administration	6142	RESTROOM/SHOWER	Pool Shower Building
7145	SMALL UNIT HQ	Administration	6621	RESTROOM/SHOWER	Pool Shower Building
7146	GP ADMIN BLDG	Administration	6879	RESTROOM/SHOWER	Pool Shower Building
7147	GP ADMIN BLDG	Administration	7542	RESTROOM/SHOWER	Pool Shower Building
			C6647	RESTROOM/SHOWER	Pool Shower Building

Table C.2. Buildings to Consider for Solar Hot Water Heating Systems at Red Stone Arsenal

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
111	ADMIN FACS	Administration	7019	GEN INST BLDG	Administration
112	ADMIN FACS	Administration	7020	GEN INST BLDG	Administration
113	ADMIN FACS	Administration	7021	GEN INST BLDG	Administration
118	ADMIN FACS	Administration	7030	GEN INST BLDG	Administration
1200	RELIG ED FACS	Administration	7031	GEN INST BLDG	Administration
1500	ADMIN FACS	Administration	7032	GEN INST BLDG	Administration
2565	GEN INST BLDGS	Administration	7033	GEN INST BLDG	Administration
2575	GEN INST BLDGS	Administration	7035	GEN INST BLDG	Administration
2576	GEN INST BLDGS	Administration	7040	GEN INST BLDG	Administration
2592	GEN INST BLDGS	Administration	7050	GEN INST BLDG	Administration
3197	ADMIN FACS	Administration	7051	GEN INST BLDG	Administration
3200	GEN INST BLDGS	Administration	7052	GEN INST BLDG	Administration
3202	ADMIN FACS	Administration	7053	GEN INST BLDG	Administration
3203	ADMIN FACS	Administration	7060	GEN INST BLDG	Administration
3205	ADMIN FACS	Administration	7070	GEN INST BLDG	Administration
3206	ADMIN FACS	Administration	7072	GEN INST BLDG	Administration
3207	ADMIN FACS	Administration	7080	GEN INST BLDG	Administration
3208	ADMIN FACS	Administration	7082	GEN INST BLDG	Administration
3210	GEN INST BLDGS	Administration	7083	GEN INST BLDG	Administration
3211	ADMIN FACS	Administration	7084	GEN INST BLDG	Administration
3212	ADMIN FACS	Administration	7085	GEN INST BLDG	Administration
3213	ADMIN FACS	Administration	7086	GEN INST BLDG	Administration
3214	HQ BLDG, CO	Administration	7088	GEN INST BLDG	Administration
3215	ADMIN FACS	Administration	7090	GEN INST BLDG	Administration
3216	ADMIN FACS	Administration	7109	ADMIN FACS	Administration
3217	ADMIN FACS	Administration	7113	ADMIN FACS	Administration
3218	GEN INST BLDGS	Administration	7134	ADMIN FACS	Administration
3222	ACES FACS	Administration	7408	ADMIN FACS	Administration
3300	ADMIN FACS	Administration	7437	ADMIN FACS	Administration
3301	ADMIN FACS	Administration	7446	ADMIN FACS	Administration
3303	GEN INST BLDGS	Administration	7471	ADMIN FACS	Administration
3304	GEN INST BLDGS	Administration	7571	ADMIN FACS	Administration
3315	ADMIN FACS	Administration	7611	ADMIN FACS	Administration
3318	ADMIN FACS	Administration	7612	ADMIN FACS	Administration
3323	LIBRARY FACS	Administration	7613	ADMIN FACS	Administration
3324	ADMIN FACS	Administration	7650	ADMIN FACS	Administration
3328	GEN INST BLDGS	Administration	7770	ADMIN FACS	Administration
3329	GEN INST BLDGS	Administration	7884	ADMIN GEN PURP	Administration

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
3334	ADMIN FACS	Administration	8001	GEN INST BLDGS	Administration
3340	GEN INST BLDGS	Administration	8003	GEN INST BLDG	Administration
3341	GEN INST BLDGS	Administration	8714	ADMIN FACS	Administration
3345	ADMIN FACS	Administration	8715	ADMIN FACS	Administration
3421	ADMIN FACS	Administration	8716	ADMIN FACS	Administration
3435	HQ BLDG, BDE	Administration	8973	ADMIN FACS	Administration
3437	HQ BLDG, CO	Administration	8976	GEN INST BLDGS	Administration
3440	HQ BLDG, CO	Administration	50	ARMY LODGING	Barracks
3450	GEN INST BLDGS	Administration	55	ARMY LODGING	Barracks
3453	ADMIN FACS	Administration	56	ARMY LODGING	Barracks
3457	ADMIN FACS	Administration	58	ARMY LODGING	Barracks
3458	ADMIN FACS	Administration	60	ARMY LODGING	Barracks
3466	ADMIN FACS	Administration	62	ARMY LODGING	Barracks
3467	ADMIN FACS	Administration	131	ARMY LODGING	Barracks
3489	ADMIN FACS	Administration	133	ARMY LODGING	Barracks
3495	GEN INST BLDGS	Administration	134	UPH OFFICER FAC	Barracks
3534	GEN INST BLDGS	Administration	135	ARMY LODGING	Barracks
3545	GEN INST BLDG	Administration	244	ARMY LODGING	Barracks
3619	ADMIN FACS	Administration	1400	ARMY LODGING	Barracks
3623	ADMIN FACS	Administration	1401	UPH, ENL FACS	Barracks
3644	ADMIN FACS	Administration	1402	UPH, ENL FACS	Barracks
3646	ADMIN FACS	Administration	1403	UPH, ENL FACS	Barracks
3651	ADMIN FACS	Administration	1404	UPH, ENL FACS	Barracks
3661	ADMIN FACS	Administration	1405	UPH, ENL FACS	Barracks
3687	ADMIN FACS	Administration	1406	UPH, ENL FACS	Barracks
3708	ADMIN FACS	Administration	1407	UPH, ENL FACS	Barracks
3710	ADMIN FACS	Administration	1416	ARMY LODGING	Barracks
3760	GEN INST BLDGS	Administration	1417	ARMY LODGING	Barracks
3793	HQ BLDG, BN	Administration	1418	ARMY LODGING	Barracks
3794	HQ BLDG, CO	Administration	1419	ARMY LODGING	Barracks
4122	ADMIN GEN PURP	Administration	1420	ARMY LODGING	Barracks
4381	ADMIN FACS	Administration	1421	ARMY LODGING	Barracks
4484	ADMIN FACS	Administration	1422	ARMY LODGING	Barracks
4488	ADMIN FACS	Administration	1423	ARMY LODGING	Barracks
4497	ADMIN FACS	Administration	1424	ARMY LODGING	Barracks
4545	ADMIN FACS	Administration	1426	ARMY LODGING	Barracks
4808	OPS BDGS AFLD	Administration	1427	ARMY LODGING	Barracks
4835	ADMIN GEN PURP	Administration	1428	ARMY LODGING	Barracks
5105	OPS SPT BLDGS	Administration	1429	ARMY LODGING	Barracks
5208	ADMIN GEN PURP	Administration	1430	ARMY LODGING	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
5250	ADMIN FACS	Administration	1433	ARMY LODGING	Barracks
5300	ADMIN FACS	Administration	1434	ARMY LODGING	Barracks
5301	ADMIN FACS	Administration	1435	ARMY LODGING	Barracks
5302	ADMIN FACS	Administration	1436	ARMY LODGING	Barracks
5303	ADMIN FACS	Administration	1437	ARMY LODGING	Barracks
5304	GEN INST BLDGS	Administration	3410	UPH, ENL STU	Barracks
5307	ADMIN FACS	Administration	3411	UPH, ENL STU	Barracks
5308	ADMIN FACS	Administration	3412	UPH, ENL STU	Barracks
5309	ADMIN FACS	Administration	3413	UPH, ENL STU	Barracks
5411	ADMIN FACS	Administration	3436	UPH, ENL FACS	Barracks
5414	ADMIN FACS	Administration	3496	UPH, ENL FACS	Barracks
5419	OPS SPT BLDGS	Administration	3497	UPH, ENL FACS	Barracks
5420	ADMIN FACS	Administration	3498	UPH, ENL FACS	Barracks
5425	ADMIN FACS	Administration	3499	UPH, ENL FACS	Barracks
5429	ADMIN FACS	Administration	3140	CHILD DEV CTRS	Child Development Center
5436	ADMIN FACS	Administration	3145	CHILD DEV CTRS	Child Development Center
5464	ADMIN FACS	Administration	3400	CHILD DEV CTRS	Child Development Center
5662	ADMIN FACS	Administration	130	OPEN DINING	Dining Facility
5664	ADMIN FACS	Administration	3438	UPH DINING FACS	Dining Facility
5678	ADMIN FACS	Administration	3443	UPH DINING FACS	Dining Facility
5681	ADMIN FACS	Administration	3463	PVT/ORG CLB BLD	Golf Club House
5683	ADMIN FACS	Administration	3559	PVT/ORG CLB BLD	Golf Club House
5687	ADMIN FACS	Administration	4828	PVT/ORG CLB BLD	Golf Club House
6320	ADMIN GEN PURP	Administration	5132	PVT/ORG CLB BLD	Golf Club House
7010	GEN INST BLDG	Administration	3474	FITNESS FACS	Physical Fitness Center
7011	GEN INST BLDG	Administration	3705	FITNESS FACS	Physical Fitness Center
7012	GEN INST BLDG	Administration	4460	FITNESS FACS	Physical Fitness Center
7019	GEN INST BLDG	Administration	126	SEP TOIL/SHOWER	Pool Shower Building
7020	GEN INST BLDG	Administration	1501	SEP TOIL/SHOWER	Pool Shower Building
			3469	SEP TOIL/SHOWER	Pool Shower Building
			3795	SEP TOIL/SHOWER	Pool Shower Building

Table C.3. Buildings to Consider for Solar Hot Water Heating Systems at Sunny Point MOT

Building Number	Real Property Facility Title	Building Type	Building Number	Building Number	Real Property Facility Title
1	OPS SPT BLDGS	Administration	18	EATING FACS	Dining Facility
3	OPS SPT BLDGS	Administration	22	EATING FACS	Dining Facility
5	HAZ STOR INST	Administration	23	EATING FACS	Dining Facility
139	OPS SPT BLDGS	Administration	24	EATING FACS	Dining Facility
220	UPH SR NCO FACS	Administration	29	EATING FACS	Dining Facility
249	DEP AMMO MNT	Administration	30	EATING FACS	Dining Facility
279	OPS BLDG, SHIP	Administration	32	EATING FACS	Dining Facility
281	OPS BLDG, SHIP	Administration	35	EATING FACS	Dining Facility
290	ENCL STOR INST	Administration	36	EATING FACS	Dining Facility

Table C.4. Buildings to Consider for Solar Hot Water Heating Systems at Fort Polk

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
14	ADMIN FACS	Administration	1154	UPH, ENL FACS	Barracks
205	ADMIN FACS	Administration	1156	UPH, ENL FACS	Barracks
350	ADMIN FACS	Administration	1266	UPH, ENL FACS	Barracks
401	ADMIN FACS	Administration	1268	UPH, ENL FACS	Barracks
403	ADMIN FACS	Administration	1344	UPH, ENL FACS	Barracks
404	ADMIN FACS	Administration	1346	UPH, ENL FACS	Barracks
406	ADMIN FACS	Administration	1348	UPH, ENL FACS	Barracks
407	ADMIN FACS	Administration	1566	UPH, ENL FACS	Barracks
411	ADMIN FACS	Administration	1567	UPH, ENL FACS	Barracks
412	ADMIN FACS	Administration	1568	UPH, ENL FACS	Barracks
414	ADMIN FACS	Administration	1631	ARMY LODGING	Barracks
417	ADMIN FACS	Administration	1634	ARMY LODGING	Barracks
418	ADMIN FACS	Administration	1635	ARMY LODGING	Barracks
419	ADMIN FACS	Administration	1945	UPH, ENL FACS	Barracks
421	ADMIN FACS	Administration	1948	AT/MOB BARRACKS	Barracks
422	GEN INST BLDGS	Administration	1949	UPH, ENL FACS	Barracks
423	ADMIN FACS	Administration	1950	AT/MOB BARRACKS	Barracks
667	ADMIN FACS	Administration	2042	UPH, ENL FACS	Barracks
911	ADMIN FACS	Administration	2043	UPH, ENL FACS	Barracks
920	ADMIN FACS	Administration	2044	UPH, ENL FACS	Barracks
1052	HQ BLDG, CO	Administration	2045	UPH, ENL FACS	Barracks
1053	HQ BLDG, CO	Administration	2272	UPH, ENL FACS	Barracks
1056	HQ BLDG, BN	Administration	2273	UPH, ENL FACS	Barracks
1070	HQ BLDG, BN	Administration	2274	UPH, ENL FACS	Barracks
1072	HQ BLDG, BN	Administration	2277	UPH, ENL FACS	Barracks
1158	HQ BLDG, CO	Administration	2278	UPH, ENL FACS	Barracks
1160	HQ BLDG, CO	Administration	2279	UPH, ENL FACS	Barracks
1164	ADMIN FACS	Administration	2386	UPH, ENL AST	Barracks
1166	HQ BLDG, BDE	Administration	2387	UPH, ENL FACS	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
1264	HQ BLDG, BN	Administration	2389	UPH, ENL FACS	Barracks
1270	HQ BLDG, CO	Administration	7127	AT/MOB BARRACKS	Barracks
1272	HQ BLDG, CO	Administration	7128	AT/MOB BARRACKS	Barracks
1352	HQ BLDG, BN	Administration	7130	AT/MOB BARRACKS	Barracks
1355	HQ BLDG, CO	Administration	7131	AT/MOB BARRACKS	Barracks
1456	GEN INST BLDGS	Administration	7132	AT/MOB BARRACKS	Barracks
1501	ADMIN FACS	Administration	7134	AT/MOB BARRACKS	Barracks
1562	ADMIN FACS	Administration	7135	AT/MOB BARRACKS	Barracks
1563	ADMIN FACS	Administration	7137	AT/MOB BARRACKS	Barracks
1564	ADMIN FACS	Administration	7161	AT/MOB BARRACKS	Barracks
1565	ADMIN FACS	Administration	7162	AT/MOB BARRACKS	Barracks
1569	ADMIN FACS	Administration	7163	AT/MOB BARRACKS	Barracks
1613	HQ BLDG, BDE	Administration	7164	AT/MOB BARRACKS	Barracks
1629	ADMIN FACS	Administration	7166	AT/MOB BARRACKS	Barracks
1630	ADMIN FACS	Administration	7167	AT/MOB BARRACKS	Barracks
1633	HQ BLDG, CO	Administration	7168	AT/MOB BARRACKS	Barracks
1650	ADMIN FACS	Administration	7170	AT/MOB BARRACKS	Barracks
1651	ADMIN FACS	Administration	7174	AT/MOB BARRACKS	Barracks
1652	ADMIN FACS	Administration	7177	AT/MOB BARRACKS	Barracks
1713	HQ BLDG, BDE	Administration	7208	AT/MOB BARRACKS	Barracks
1714	HQ BLDG, BDE	Administration	7209	AT/MOB BARRACKS	Barracks
1715	ADMIN FACS	Administration	7210	AT/MOB BARRACKS	Barracks
1830	ADMIN FACS	Administration	7213	AT/MOB BARRACKS	Barracks
1831	ADMIN FACS	Administration	7478	AT/MOB BARRACKS	Barracks
1942	ADMIN FACS	Administration	7602	AT/MOB BARRACKS	Barracks
1943	ADMIN FACS	Administration	7604	AT/MOB BARRACKS	Barracks
1944	ADMIN FACS	Administration	7606	AT/MOB BARRACKS	Barracks
1946	ADMIN FACS	Administration	7607	AT/MOB BARRACKS	Barracks
1947	ADMIN FACS	Administration	7608	AT/MOB BARRACKS	Barracks
2041	HQ BLDG, CO	Administration	7609	AT/MOB BARRACKS	Barracks
2046	HQ BLDG, BN	Administration	7641	AT/MOB BARRACKS	Barracks
2047	HQ BLDG, BN	Administration	7642	AT/MOB BARRACKS	Barracks
2155	HQ BLDG, CO	Administration	7643	AT/MOB BARRACKS	Barracks
2201	ADMIN FACS	Administration	7644	AT/MOB BARRACKS	Barracks
2250	ADMIN FACS	Administration	7645	AT/MOB BARRACKS	Barracks
2254	HQ BLDG, BN	Administration	7646	AT/MOB BARRACKS	Barracks
2256	HQ BLDG, CO	Administration	7647	AT/MOB BARRACKS	Barracks
2262	HQ BLDG, BN	Administration	7666	AT/MOB BARRACKS	Barracks
2263	HQ BLDG, BDE	Administration	7667	AT/MOB BARRACKS	Barracks
2264	HQ BLDG, CO	Administration	7668	AT/MOB BARRACKS	Barracks
2266	HQ BLDG, BDE	Administration	7669	AT/MOB BARRACKS	Barracks
2268	HQ BLDG, CO	Administration	7670	AT/MOB BARRACKS	Barracks
2380	ADMIN FACS	Administration	8010	AT/MOB BARRACKS	Barracks
2391	HQ BLDG, CO	Administration	8012	AT/MOB BARRACKS	Barracks
2392	HQ BLDG, CO	Administration	8013	AT/MOB BARRACKS	Barracks
2394	ADMIN FACS	Administration	8014	AT/MOB BARRACKS	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
2395	HQ BLDG, BN	Administration	8015	AT/MOB BARRACKS	Barracks
2430	ADMIN FACS	Administration	8016	AT/MOB BARRACKS	Barracks
2446	ADMIN FACS	Administration	8017	AT/MOB BARRACKS	Barracks
2501	ADMIN FACS	Administration	8018	AT/MOB BARRACKS	Barracks
2502	ADMIN FACS	Administration	8019	AT/MOB BARRACKS	Barracks
2503	ADMIN FACS	Administration	8054	AT/MOB BARRACKS	Barracks
2504	ADMIN FACS	Administration	8055	AT/MOB BARRACKS	Barracks
2505	HQ BLDG, CO	Administration	8056	AT/MOB BARRACKS	Barracks
2506	HQ BLDG, CO	Administration	8057	AT/MOB BARRACKS	Barracks
2507	ADMIN FACS	Administration	8058	AT/MOB BARRACKS	Barracks
2508	ADMIN FACS	Administration	8060	AT/MOB BARRACKS	Barracks
2512	ADMIN FACS	Administration	8061	AT/MOB BARRACKS	Barracks
2515	ADMIN FACS	Administration	8062	AT/MOB BARRACKS	Barracks
2516	ADMIN FACS	Administration	8063	AT/MOB BARRACKS	Barracks
2521	GEN INST BLDGS	Administration	8066	AT/MOB BARRACKS	Barracks
2522	ADMIN FACS	Administration	8067	AT/MOB BARRACKS	Barracks
2524	ADMIN FACS	Administration	8068	AT/MOB BARRACKS	Barracks
2529	ADMIN FACS	Administration	8069	AT/MOB BARRACKS	Barracks
2530	ADMIN FACS	Administration	8070	AT/MOB BARRACKS	Barracks
2531	ADMIN FACS	Administration	8072	AT/MOB BARRACKS	Barracks
2537	ADMIN FACS	Administration	8073	AT/MOB BARRACKS	Barracks
2538	ADMIN FACS	Administration	8074	AT/MOB BARRACKS	Barracks
2539	ADMIN FACS	Administration	8075	AT/MOB BARRACKS	Barracks
2541	ADMIN FACS	Administration	8201	AT/MOB BARRACKS	Barracks
2543	ADMIN FACS	Administration	8203	AT/MOB BARRACKS	Barracks
2625	ADMIN FACS	Administration	8207	AT/MOB BARRACKS	Barracks
3304	ADMIN FACS	Administration	8209	AT/MOB BARRACKS	Barracks
3305	ADMIN FACS	Administration	8213	AT/MOB BARRACKS	Barracks
3327	ADMIN FACS	Administration	8217	AT/MOB BARRACKS	Barracks
3409	ADMIN FACS	Administration	8221	AT/MOB BARRACKS	Barracks
3602	ADMIN FACS	Administration	8223	AT/MOB BARRACKS	Barracks
4209	HQ BLDG, CO	Administration	8252	AT/MOB BARRACKS	Barracks
4210	HQ BLDG, CO	Administration	8253	AT/MOB BARRACKS	Barracks
4213	GEN INST BLDGS	Administration	8254	AT/MOB BARRACKS	Barracks
4217	GEN INST BLDGS	Administration	8255	AT/MOB BARRACKS	Barracks
4275	HQ BLDG, BN	Administration	8256	AT/MOB BARRACKS	Barracks
4276	ADMIN FACS	Administration	8258	AT/MOB BARRACKS	Barracks
4370	ADMIN FACS	Administration	8259	AT/MOB BARRACKS	Barracks
4507	ADMIN FACS	Administration	8260	AT/MOB BARRACKS	Barracks
4740	ADMIN FACS	Administration	8261	AT/MOB BARRACKS	Barracks
6528	ADMIN FACS	Administration	8262	AT/MOB BARRACKS	Barracks
7010	ADMIN FACS	Administration	8263	AT/MOB BARRACKS	Barracks
7018	ADMIN FACS	Administration	8423	AT/MOB BARRACKS	Barracks
7026	ADMIN FACS	Administration	8424	AT/MOB BARRACKS	Barracks

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
7103	CO HQ, TRANS	Administration	8426	AT/MOB BARRACKS	Barracks
7154	BN HQ, TRANS	Administration	8427	AT/MOB BARRACKS	Barracks
7155	ADMIN FACS	Administration	8428	AT/MOB BARRACKS	Barracks
7205	ADMIN FACS	Administration	8429	AT/MOB BARRACKS	Barracks
7305	ADMIN FACS	Administration	8430	AT/MOB BARRACKS	Barracks
7307	ADMIN FACS	Administration	8431	AT/MOB BARRACKS	Barracks
7458	ADMIN FACS	Administration	8432	AT/MOB BARRACKS	Barracks
7474	ADMIN FACS	Administration	8433	AT/MOB BARRACKS	Barracks
7475	ADMIN FACS	Administration	8435	AT/MOB BARRACKS	Barracks
7477	ADMIN FACS	Administration	8437	AT/MOB BARRACKS	Barracks
7523	GEN INST BLDGS	Administration	8439	AT/MOB BARRACKS	Barracks
7615	CO HQ, TRANS	Administration	8441	AT/MOB BARRACKS	Barracks
7616	CO HQ, TRANS	Administration	8445	AT/MOB BARRACKS	Barracks
7617	CO HQ, TRANS	Administration	8458	AT/MOB BARRACKS	Barracks
7618	CO HQ, TRANS	Administration	8459	AT/MOB BARRACKS	Barracks
7619	CO HQ, TRANS	Administration	8460	AT/MOB BARRACKS	Barracks
7621	CO HQ, TRANS	Administration	8461	AT/MOB BARRACKS	Barracks
7630	CO HQ, TRANS	Administration	8463	AT/MOB BARRACKS	Barracks
7634	CO HQ, TRANS	Administration	8536	AT/MOB BARRACKS	Barracks
7635	CO HQ, TRANS	Administration	8541	AT/MOB BARRACKS	Barracks
7636	CO HQ, TRANS	Administration	8542	AT/MOB BARRACKS	Barracks
7653	ADMIN FACS	Administration	8543	AT/MOB BARRACKS	Barracks
7654	HQ BLDG, CO	Administration	8545	AT/MOB BARRACKS	Barracks
7801	ACES FACS	Administration	8546	AT/MOB BARRACKS	Barracks
7818	ADMIN FACS	Administration	8547	AT/MOB BARRACKS	Barracks
8004	CO HQ, TRANS	Administration	8548	AT/MOB BARRACKS	Barracks
8005	HQ BLDG, BDE	Administration	8549	AT/MOB BARRACKS	Barracks
8011	CO HQ, TRANS	Administration	M0108	AT/MOB BARRACKS	Barracks
8042	CO HQ, TRANS	Administration	744	CHILD DEV CTRS	Child Development Center
8045	CO HQ, TRANS	Administration	1162	UPH DINING FACS	Dining Facility
8046	CO HQ, TRANS	Administration	1260	UPH DINING FACS	Dining Facility
8049	CO HQ, TRANS	Administration	1632	UPH DINING FACS	Dining Facility
8081	CO HQ, TRANS	Administration	2382	UPH DINING FACS	Dining Facility
8085	CO HQ, TRANS	Administration	3224	EATING FACS	Dining Facility
8086	CO HQ, TRANS	Administration	7125	DINING FAC TRAN	Dining Facility
8205	BN HQ, TRANS	Administration	7139	DINING FAC TRAN	Dining Facility
8219	BN HQ, TRANS	Administration	7142	DINING FAC TRAN	Dining Facility
8230	CO HQ, TRANS	Administration	7143	DINING FAC TRAN	Dining Facility
8241	CO HQ, TRANS	Administration	7153	DINING FAC TRAN	Dining Facility
8242	CO HQ, TRANS	Administration	7179	DINING FAC TRAN	Dining Facility
8245	CO HQ, TRANS	Administration	7180	DINING FAC TRAN	Dining Facility
8246	CO HQ, TRANS	Administration	7614	DINING FAC TRAN	Dining Facility
8249	CO HQ, TRANS	Administration	7632	DINING FAC TRAN	Dining Facility
8250	CO HQ, TRANS	Administration	8009	DINING FAC TRAN	Dining Facility
8405	BN HQ, TRANS	Administration	8024	DINING FAC TRAN	Dining Facility

Building Number	Real Property Facility Title	Building Type	Building Number	Real Property Facility Title	Building Type
8447	BN HQ, TRANS	Administration	8043	UPH DINING FACS	Dining Facility
8502	BN HQ, TRANS	Administration	8047	DINING FAC TRAN	Dining Facility
8590	ADMIN FACS	Administration	8048	DINING FAC TRAN	Dining Facility
9806	GEN INST BLDGS	Administration	8051	DINING FAC TRAN	Dining Facility
14030	ADMIN FACS	Administration	8080	DINING FAC TRAN	Dining Facility
M0101	ADMIN FACS	Administration	8239	DINING FAC TRAN	Dining Facility
R0451	GEN INST BLDGS	Administration	8244	DINING FAC TRAN	Dining Facility
11	ARMY LODGING	Barracks	8247	DINING FAC TRAN	Dining Facility
12	ARMY LODGING	Barracks	8248	DINING FAC TRAN	Dining Facility
13	ARMY LODGING	Barracks	8401	DINING FAC TRAN	Dining Facility
293	UPH, ENL FACS	Barracks	8403	DINING FAC TRAN	Dining Facility
331	ARMY LODGING	Barracks	8411	DINING FAC TRAN	Dining Facility
332	ARMY LODGING	Barracks	8533	DINING FAC TRAN	Dining Facility
426	ARMY LODGING	Barracks	8538	DINING FAC TRAN	Dining Facility
522	ARMY LODGING	Barracks	M0107	DINING FAC TRAN	Dining Facility
1054	UPH, ENL FACS	Barracks	2532	PVT/ORG CLB BLD	Golf Club House
1150	UPH, ENL FACS	Barracks	4713	PVT/ORG CLB BLD	Golf Club House
1152	UPH, ENL FACS	Barracks	1262	FITNESS FACS	Physical Fitness Center
3350	FITNESS FACS	Physical Fitness Center	2070	FITNESS FACS	Physical Fitness Center
272	REC SPT FAC	Pool Shower Building	2276	FITNESS FACS	Physical Fitness Center

Table C.5. Buildings to Consider for Solar Hot Water Heating Systems at Fort Benning

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
4	GEN INST BLDGS	Administration	9154	HQ BLDG, CO	Administration
5	ADMIN FACS	Administration	9155	HQ BLDG, CO	Administration
6	ADMIN FACS	Administration	9156	HQ BLDG, CO	Administration
8	ADMIN FACS	Administration	9160	HQ BLDG, BN	Administration
16	ADMIN FACS	Administration	9161	HQ BLDG, BN	Administration
18	ADMIN FACS	Administration	9170	HQ BLDG, BN	Administration
19	ADMIN FACS	Administration	9171	HQ BLDG, BN	Administration
35	GEN INST BLDGS	Administration	9173	HQ BLDG, CO	Administration
65	ADMIN FACS	Administration	9174	HQ BLDG, CO	Administration
66	ADMIN FACS	Administration	9184	HQ BLDG, CO	Administration
71	ADMIN FACS	Administration	9185	HQ BLDG, CO	Administration
74	HQ BLDG, BN	Administration	9186	HQ BLDG, CO	Administration
76	HQ BLDG, BN	Administration	9198	ADMIN FACS	Administration
85	ADMIN FACS	Administration	9199	ADMIN FACS	Administration
89	ADMIN FACS	Administration	9203	ADMIN FACS	Administration
122	ADMIN FACS	Administration	9204	ADMIN FACS	Administration
147	GEN INST BLDGS	Administration	9205	ADMIN FACS	Administration
214	HQ BLDG, CO	Administration	17	UPH, ENL AST	Barracks
235	ADMIN FACS	Administration	36	ARMY LODGING	Barracks
241	ADMIN FACS	Administration	37	ARMY LODGING	Barracks
243	ADMIN FACS	Administration	38	ARMY LODGING	Barracks
245	ADMIN FACS	Administration	73	UPH, ENL AST	Barracks
322	ADMIN FACS	Administration	75	ARMY LODGING	Barracks
324	ADMIN FACS	Administration	83	ARMY LODGING	Barracks
468	ADMIN FACS	Administration	96	ARMY LODGING	Barracks
470	ADMIN FACS	Administration	365	ARMY LODGING	Barracks
482	ADMIN FACS	Administration	367	ARMY LODGING	Barracks
880	GEN INST BLDGS	Administration	369	ARMY LODGING	Barracks
1367	ADMIN FACS	Administration	371	ARMY LODGING	Barracks
1369	ADMIN FACS	Administration	373	ARMY LODGING	Barracks
1370	HQ BLDG, CO	Administration	399	ARMY LODGING	Barracks
1697	ADMIN FACS	Administration	791	ARMY LODGING	Barracks
1707	ADMIN FACS	Administration	972	UPH OFFICER FAC	Barracks
1836	ADMIN FACS	Administration	973	UPH OFFICER FAC	Barracks
2288	ADMIN FACS	Administration	974	UPH OFFICER FAC	Barracks
2293	HQ BLDG, CO	Administration	975	UPH OFFICER FAC	Barracks
2294	ADMIN FACS	Administration	976	UPH OFFICER FAC	Barracks
2295	ADMIN FACS	Administration	2510	UPH, ENL AST	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
2297	ADMIN FACS	Administration	2747	UPH, ENL AST	Barracks
2401	GEN INST BLDGS	Administration	2752	UPH, ENL AST	Barracks
2485	OPS BDGS AFLD	Administration	2753	UPH, ENL AST	Barracks
2506	GEN INST BLDGS	Administration	2754	UPH, ENL AST	Barracks
2507	ADMIN FACS	Administration	2755	UPH, ENL AST	Barracks
2509	ADMIN FACS	Administration	2756	UPH, ENL AST	Barracks
2575	ADMIN FACS	Administration	2760	UPH, ENL AST	Barracks
2580	ADMIN FACS	Administration	2761	UPH, ENL AST	Barracks
2602	ADMIN FACS	Administration	2762	UPH, ENL AST	Barracks
2603	ADMIN FACS	Administration	2816	AT/MOB BARRACKS	Barracks
2604	ADMIN FACS	Administration	2819	UPH, ENL AST	Barracks
2605	ADMIN FACS	Administration	2831	UPH, ENL FACS	Barracks
2607	ADMIN FACS	Administration	2832	UPH, ENL FACS	Barracks
2608	ADMIN FACS	Administration	2833	UPH, ENL FACS	Barracks
2609	ADMIN FACS	Administration	2834	UPH, ENL FACS	Barracks
2610	ADMIN FACS	Administration	2836	UPH, ENL FACS	Barracks
2611	ADMIN FACS	Administration	2837	UPH, ENL FACS	Barracks
2612	ADMIN FACS	Administration	2838	UPH, ENL FACS	Barracks
2613	ADMIN FACS	Administration	2839	UPH, ENL FACS	Barracks
2614	ADMIN FACS	Administration	2887	UPH, ENL FACS	Barracks
2616	ADMIN FACS	Administration	2888	UPH, ENL FACS	Barracks
2617	ADMIN FACS	Administration	2889	UPH, ENL FACS	Barracks
2618	ADMIN FACS	Administration	2890	DET MISC FACS	Barracks
2619	ADMIN FACS	Administration	2896	DET MISC FACS	Barracks
2620	ADMIN FACS	Administration	2897	UPH, ENL FACS	Barracks
2621	ADMIN FACS	Administration	2898	UPH, ENL FACS	Barracks
2622	ADMIN FACS	Administration	2934	UPH, ENL FACS	Barracks
2624	ADMIN FACS	Administration	2935	UPH, ENL FACS	Barracks
2626	ADMIN FACS	Administration	2936	UPH, ENL FACS	Barracks
2627	ADMIN FACS	Administration	2937	UPH, ENL FACS	Barracks
2632	ADMIN FACS	Administration	2938	UPH, ENL FACS	Barracks
2633	ADMIN FACS	Administration	2939	UPH, ENL FACS	Barracks
2635	ADMIN FACS	Administration	2940	UPH, ENL FACS	Barracks
2637	ADMIN FACS	Administration	2941	DET MISC FACS	Barracks
2638	ADMIN FACS	Administration	2942	DET MISC FACS	Barracks
2670	ADMIN FACS	Administration	3035	BT BARRACKS	Barracks
2672	OPS SPT BLDGS	Administration	3105	BT BARRACKS	Barracks
2748	ADMIN FACS	Administration	3210	BT BARRACKS	Barracks
2749	HQ BLDG, BDE	Administration	3240	BT BARRACKS	Barracks
2751	ADMIN FACS	Administration	3245	BT BARRACKS	Barracks
2757	HQ BLDG, BN	Administration	3305	BT BARRACKS	Barracks
2758	HQ BLDG, BN	Administration	3335	BT BARRACKS	Barracks
2759	ADMIN FACS	Administration	3405	BT BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
2768	HQ BLDG, BN	Administration	3425	BT BARRACKS	Barracks
2815	HQ BLDG, BN	Administration	4700	UPH, ENL FACS	Barracks
2826	ADMIN FACS	Administration	4701	UPH, ENL FACS	Barracks
2827	HQ BLDG, BDE	Administration	4704	UPH, ENL FACS	Barracks
2830	HQ BLDG, BN	Administration	4705	UPH, ENL FACS	Barracks
2835	HQ BLDG, BN	Administration	4706	UPH, ENL FACS	Barracks
2850	ADMIN FACS	Administration	4707	UPH, ENL FACS	Barracks
2880	HQ BLDG, CO	Administration	4710	UPH, ENL FACS	Barracks
2881	HQ BLDG, CO	Administration	4711	UPH, ENL FACS	Barracks
2882	HQ BLDG, CO	Administration	5001	UPH, ENL AST	Barracks
2883	HQ BLDG, CO	Administration	5004	UPH, ENL AST	Barracks
2884	HQ BLDG, CO	Administration	5005	UPH, ENL AST	Barracks
2885	HQ BLDG, BN	Administration	5008	UPH, ENL AST	Barracks
2886	HQ BLDG, CO	Administration	5009	UPH, ENL AST	Barracks
2903	ADMIN FACS	Administration	5013	DET MISC FACS	Barracks
2904	ADMIN FACS	Administration	5016	UPH, ENL AST	Barracks
2905	ADMIN FACS	Administration	5017	UPH, ENL AST	Barracks
2908	ADMIN FACS	Administration	5018	UPH, ENL AST	Barracks
2930	HQ BLDG, BDE	Administration	5034	UPH, ENL FACS	Barracks
2931	HQ BLDG, BDE	Administration	9012	UPH, ENL FACS	Barracks
2932	HQ BLDG, CO	Administration	9013	UPH, ENL FACS	Barracks
2933	HQ BLDG, CO	Administration	9014	UPH, ENL FACS	Barracks
2944	HQ BLDG, CO	Administration	9015	UPH, ENL FACS	Barracks
2945	HQ BLDG, CO	Administration	9018	UPH, ENL FACS	Barracks
2946	HQ BLDG, BN	Administration	9021	UPH, ENL FACS	Barracks
3205	ADMIN FACS	Administration	9022	UPH, ENL FACS	Barracks
3215	HQ BLDG, BDE	Administration	9053	UPH, ENL FACS	Barracks
3254	ADMIN FACS	Administration	9140	DET MISC FACS	Barracks
3354	HQ BLDG, CO	Administration	9141	UPH, ENL FACS	Barracks
3410	HQ BLDG, BDE	Administration	9142	UPH, ENL FACS	Barracks
4155	ADMIN FACS	Administration	9143	UPH, ENL FACS	Barracks
4628	HQ BLDG, BN	Administration	9145	DET MISC FACS	Barracks
4679	HQ BLDG, CO	Administration	9146	UPH, ENL FACS	Barracks
4695	GEN INST BLDGS	Administration	9147	UPH, ENL FACS	Barracks
4703	HQ BLDG, CO	Administration	9148	UPH, ENL FACS	Barracks
4712	HQ BLDG, CO	Administration	9180	DET MISC FACS	Barracks
4713	HQ BLDG, CO	Administration	9181	UPH, ENL FACS	Barracks
4714	HQ BLDG, CO	Administration	9182	UPH, ENL FACS	Barracks
4883	GEN INST BLDGS	Administration	9183	UPH, ENL FACS	Barracks
4884	HQ BLDG, BN	Administration	9188	UPH, ENL FACS	Barracks
4964	HQ BLDG, BN	Administration	9189	UPH, ENL FACS	Barracks
4965	HQ BLDG, CO	Administration	7	CHILD DEV CTRS	Child Development Center
4966	HQ BLDG, BN	Administration	1051	CHILD DEV CTRS	Child Development Center

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
5012	ADMIN FACS	Administration	1366	CHILD DEV CTRS	Child Development Center
5015	ADMIN FACS	Administration	2682	CHILD DEV CTRS	Child Development Center
5019	ADMIN FACS	Administration	9242	CHILD DEV CTRS	Child Development Center
5020	ADMIN FACS	Administration	11304	CHILD DEV CTRS	Child Development Center
5023	ADMIN FACS	Administration	128	OPEN DINING	Dining Facility
5024	HQ BLDG, BN	Administration	129	OPEN DINING	Dining Facility
5242	ADMIN FACS	Administration	2396	OPEN DINING	Dining Facility
5504	GEN INST BLDGS	Administration	2502	OPEN DINING	Dining Facility
5884	ADMIN FACS	Administration	2784	OPEN DINING	Dining Facility
5887	ADMIN FACS	Administration	2895	UPH DINING FACS	Dining Facility
5888	ADMIN FACS	Administration	2943	UPH DINING FACS	Dining Facility
6000	ADMIN FACS	Administration	3025	UPH DINING FACS	Dining Facility
8538	GEN INST BLDGS	Administration	3270	OPEN DINING	Dining Facility
8539	GEN INST BLDGS	Administration	4702	UPH DINING FACS	Dining Facility
8540	GEN INST BLDGS	Administration	5021	UPH DINING FACS	Dining Facility
8541	GEN INST BLDGS	Administration	5022	UPH DINING FACS	Dining Facility
8766	GEN INST BLDGS	Administration	9139	UPH DINING FACS	Dining Facility
8769	GEN INST BLDGS	Administration	80	PVT/ORG CLB BLD	Golf Club House
8780	ADMIN FACS	Administration	229	PVT/ORG CLB BLD	Golf Club House
8781	ADMIN FACS	Administration	390	PRO SHOP/GOLF	Golf Club House
8847	GEN INST BLDGS	Administration	5972	CONFERENCE CTRS	Golf Club House
9000	HQ BLDG, BDE	Administration	5990	CONFERENCE CTRS	Golf Club House
9003	HQ BLDG, BN	Administration	M6257	CONFERENCE CTRS	Golf Club House
9004	HQ BLDG, BN	Administration	933	FITNESS FACS	Physical Fitness Center
9016	HQ BLDG, BN	Administration	1055	FITNESS FACS	Physical Fitness Center
9019	HQ BLDG, BN	Administration	2818	FITNESS FACS	Physical Fitness Center
9025	ADMIN FACS	Administration	3021	FITNESS FACS	Physical Fitness Center
9026	HQ BLDG, CO	Administration	3350	FITNESS FACS	Physical Fitness Center
9027	HQ BLDG, CO	Administration	9001	FITNESS FACS	Physical Fitness

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
					Center
9036	HQ BLDG, CO	Administration	17	SEP TOIL/SHOWER	Pool Shower Building
9044	HQ BLDG, CO	Administration	374	SEP TOIL/SHOWER	Pool Shower Building
9050	HQ BLDG, BDE	Administration	2681	SEP TOIL/SHOWER	Pool Shower Building
9073	HQ BLDG, CO	Administration	2770	SEP TOIL/SHOWER	Pool Shower Building
9075	HQ BLDG, BN	Administration	2865	SEP TOIL/SHOWER	Pool Shower Building
9105	ADMIN FACS	Administration	2869	SEP TOIL/SHOWER	Pool Shower Building
9149	HQ BLDG, CO	Administration	2872	SEP TOIL/SHOWER	Pool Shower Building
9152	HQ BLDG, CO	Administration	3819	SEP TOIL/SHOWER	Pool Shower Building
9153	HQ BLDG, CO	Administration	5081	SEP TOIL/SHOWER	Pool Shower Building
			8767	SEP TOIL/SHOWER	Pool Shower Building
			9080	SEP TOIL/SHOWER	Pool Shower Building

Table C.6. Buildings to Consider for Solar Hot Water Heating Systems at Fort Bragg

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
11139	ADMIN FACS	Administration	M2343	HQ BLDG, CO	Administration
11202	ADMIN FACS	Administration	M2346	HQ BLDG, BN	Administration
11242	HQ BLDG, CO	Administration	M2348	HQ BLDG, CO	Administration
11326	ADMIN FACS	Administration	M2350	ADMIN FACS	Administration
11333	ADMIN FACS	Administration	M2351	ADMIN FACS	Administration
11621	ADMIN FACS	Administration	M2353	HQ BLDG, CO	Administration
11833	ADMIN FACS	Administration	M2356	ADMIN FACS	Administration
12336	ADMIN FACS	Administration	M2357	ADMIN FACS	Administration
12532	HQ BLDG, BDE	Administration	M2359	ADMIN FACS	Administration
12732	HQ BLDG, BDE	Administration	M2360	ADMIN FACS	Administration
14827	ADMIN FACS	Administration	M2513	HQ BLDG, CO	Administration
21105	ADMIN FACS	Administration	M2640	ADMIN FACS	Administration
21114	ADMIN FACS	Administration	M2643	HQ BLDG, CO	Administration
21120	ADMIN FACS	Administration	M2645	ADMIN FACS	Administration
21133	ADMIN FACS	Administration	M2646	ADMIN FACS	Administration
21138	ADMIN FACS	Administration	M2650	ADMIN FACS	Administration
21145	HQ BLDG, BN	Administration	M2651	ADMIN FACS	Administration
21256	HQ BLDG, BN	Administration	M2653	ADMIN FACS	Administration
21343	ADMIN FACS	Administration	M5010	HQ BLDG, BDE	Administration
21361	HQ BLDG, BDE	Administration	M5015	HQ BLDG, BN	Administration
21414	ADMIN FACS	Administration	M5019	HQ BLDG, BN	Administration
21515	ADMIN FACS	Administration	M5022	HQ BLDG, BN	Administration
21653	ADMIN FACS	Administration	M5026	HQ BLDG, BDE	Administration
21731	HQ BLDG, CO	Administration	M5035	HQ BLDG, BDE	Administration
21817	ADMIN FACS	Administration	M5040	HQ BLDG, BN	Administration
22015	ADMIN FACS	Administration	M5044	HQ BLDG, BN	Administration
22017	GEN INST BLDGS	Administration	M5051	HQ BLDG, BDE	Administration
22053	ADMIN FACS	Administration	M5708	ADMIN FACS	Administration
22205	ADMIN FACS	Administration	M5814	HQ BLDG, BN	Administration
22211	ADMIN FACS	Administration	M6133	HQ BLDG, BDE	Administration
22409	ADMIN FACS	Administration	M6140	HQ BLDG, BDE	Administration
23116	ADMIN FACS	Administration	M6142	HQ BLDG, BDE	Administration
23227	ADMIN FACS	Administration	M6143	HQ BLDG, BDE	Administration
23602	ADMIN FACS	Administration	M6146	HQ BLDG, BN	Administration
24227	HQ BLDG, BN	Administration	M6148	HQ BLDG, BN	Administration
24515	HQ BLDG, CO	Administration	M6151	HQ BLDG, CO	Administration
24518	HQ BLDG, CO	Administration	M6153	HQ BLDG, CO	Administration
24528	HQ BLDG, BDE	Administration	M6433	ADMIN FACS	Administration
24815	HQ BLDG, CO	Administration	M6438	HQ BLDG, BDE	Administration
24818	HQ BLDG, CO	Administration	M6440	HQ BLDG, BDE	Administration
24827	HQ BLDG, BN	Administration	M6443	HQ BLDG, BN	Administration
24953	ADMIN FACS	Administration	M6445	ADMIN FACS	Administration
25155	ADMIN FACS	Administration	M6446	HQ BLDG, BN	Administration
25517	ADMIN FACS	Administration	M6450	ADMIN FACS	Administration

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
25935	ADMIN FACS	Administration	M6453	HQ BLDG, CO	Administration
31333	ADMIN FACS	Administration	M6733	HQ BLDG, BDE	Administration
31631	ADMIN FACS	Administration	M6740	HQ BLDG, CO	Administration
31632	ADMIN FACS	Administration	M6746	HQ BLDG, BN	Administration
31634	ADMIN FACS	Administration	M6748	ADMIN FACS	Administration
31832	ADMIN FACS	Administration	M6751	HQ BLDG, CO	Administration
31933	ADMIN FACS	Administration	M6753	HQ BLDG, CO	Administration
31947	ADMIN FACS	Administration	M6943	HQ BLDG, CO	Administration
32033	ADMIN FACS	Administration	M6950	ADMIN FACS	Administration
32048	ADMIN FACS	Administration	M6951	ADMIN FACS	Administration
32245	ADMIN FACS	Administration	M6953	HQ BLDG, CO	Administration
32448	ADMIN FACS	Administration	M7033	HQ BLDG, BDE	Administration
32631	HQ BLDG, CO	Administration	M7240	HQ BLDG, CO	Administration
32647	ADMIN FACS	Administration	M7243	HQ BLDG, BN	Administration
32951	ADMIN FACS	Administration	M7250	HQ BLDG, CO	Administration
33045	ADMIN FACS	Administration	M7253	ADMIN FACS	Administration
33050	ADMIN FACS	Administration	M8456	HQ BLDG, BDE	Administration
33052	ADMIN FACS	Administration	O9007	ADMIN FACS	Administration
33242	HQ BLDG, BDE	Administration	O9062	ADMIN FACS	Administration
34533	HQ BLDG, BDE	Administration	O9125	ADMIN FACS	Administration
34735	HQ BLDG, BN	Administration	O9131	GEN INST BLDGS	Administration
41367	ADMIN FACS	Administration	OH050	ADMIN FACS	Administration
41437	HQ BLDG, CO	Administration	P1455	HQ BLDG, CO	Administration
41467	ADMIN FACS	Administration	P1551	HQ BLDG, CO	Administration
41469	ADMIN FACS	Administration	P1559	HQ BLDG, CO	Administration
41567	ADMIN FACS	Administration	P2352	ADMIN FACS	Administration
41571	HQ BLDG, BN	Administration	P2455	HQ BLDG, BDE	Administration
41768	ADMIN FACS	Administration	P2457	GEN INST BLDGS	Administration
42032	HQ BLDG, BDE	Administration	P3839	ADMIN FACS	Administration
42101	ADMIN FACS	Administration	P3956	HQ BLDG, BN	Administration
42102	ADMIN FACS	Administration	P4544	ADMIN FACS	Administration
42145	ADMIN FACS	Administration	R2965	ADMIN FACS	Administration
42843	ADMIN FACS	Administration	R5556	ADMIN FACS	Administration
42848	ADMIN FACS	Administration	SPGLK	UPH SR NCO FACS	Administration
42948	HQ BLDG, CO	Administration	X5381	ADMIN FACS	Administration
56110	HQ BLDG, CO	Administration	X5779	ADMIN FACS	Administration
69357	ADMIN FACS	Administration	X5878	ADMIN FACS	Administration
69673	GEN INST BLDGS	Administration	X5880	ADMIN FACS	Administration
81703	ADMIN FACS	Administration	Y7603	ADMIN FACS	Administration
82105	ADMIN FACS	Administration	11938	UPH, ENL FACS	Barracks
83022	ADMIN FACS	Administration	11939	ARMY LODGING	Barracks
83749	ADMIN FACS	Administration	12334	UPH, ENL FACS	Barracks
83846	HQ BLDG, CO	Administration	14425	ARMY LODGING	Barracks
84807	ADMIN FACS	Administration	14428	ARMY LODGING	Barracks
5611O	ADMIN FACS	Administration	24208	UPH, ENL FACS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
A1624	ADMIN FACS	Administration	24708	UPH, ENL FACS	Barracks
A1917	GEN INST BLDGS	Administration	41137	UPH, ENL FACS	Barracks
A2544	ADMIN FACS	Administration	41238	UPH, ENL FACS	Barracks
A3280	HQ BLDG, BN	Administration	43539	UPH, ENL FACS	Barracks
A3527	HQ BLDG, BN	Administration	55047	ARMY LODGING	Barracks
A3726	HQ BLDG, BDE	Administration	83575	ARMY LODGING	Barracks
A3728	ADMIN FACS	Administration	A3875	AT/MOB BARRACKS	Barracks
A3730	ADMIN FACS	Administration	A3923	AT/MOB BARRACKS	Barracks
A3734	ADMIN FACS	Administration	A4598	AT/MOB BARRACKS	Barracks
A3736	ADMIN FACS	Administration	A4599	AT/MOB BARRACKS	Barracks
A3872	ADMIN FACS	Administration	A4697	AT/MOB BARRACKS	Barracks
A3877	TNG CTRS-RESERV	Administration	A4799	AT/MOB BARRACKS	Barracks
A3879	ADMIN FACS	Administration	A5020	AT/MOB BARRACKS	Barracks
A3881	ADMIN FACS	Administration	A5021	AT/MOB BARRACKS	Barracks
A3925	HQ BLDG, BN	Administration	A5022	AT/MOB BARRACKS	Barracks
A3928	HQ BLDG, BN	Administration	A5023	AT/MOB BARRACKS	Barracks
A3934	ADMIN FACS	Administration	A5024	AT/MOB BARRACKS	Barracks
A3949	ADMIN FACS	Administration	A5028	AT/MOB BARRACKS	Barracks
A3956	ADMIN FACS	Administration	A5032	AT/MOB BARRACKS	Barracks
A4595	GEN INST BLDGS	Administration	A5046	AT/MOB BARRACKS	Barracks
A4620	HQ BLDG, CO	Administration	A5047	AT/MOB BARRACKS	Barracks
A4626	ADMIN FACS	Administration	A5048	AT/MOB BARRACKS	Barracks
A4634	TNG CTRS-NG/AR	Administration	A5049	AT/MOB BARRACKS	Barracks
A4638	HQ BLDG, CO	Administration	A5050	AT/MOB BARRACKS	Barracks
A4649	ADMIN FACS	Administration	A5051	AT/MOB BARRACKS	Barracks
A4662	ADMIN FACS	Administration	A5077	AT/MOB BARRACKS	Barracks
A4683	HQ BLDG, CO	Administration	A5078	AT/MOB BARRACKS	Barracks
A4687	GEN INST BLDGS	Administration	A5080	AT/MOB BARRACKS	Barracks
A4846	TNG CTRS-	Administration	A5083	DET MISC FACS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
	NG/AR				
A4847	TNG CTRS-NG/AR	Administration	A5084	AT/MOB BARRACKS	Barracks
A4848	TNG CTRS-NG/AR	Administration	A5085	AT/MOB BARRACKS	Barracks
A4849	TNG CTRS-NG/AR	Administration	A5220	AT/MOB BARRACKS	Barracks
A4850	TNG CTRS-NG/AR	Administration	A5221	AT/MOB BARRACKS	Barracks
A4851	TNG CTRS-NG/AR	Administration	A5222	AT/MOB BARRACKS	Barracks
A4887	GEN INST BLDGS	Administration	A5224	AT/MOB BARRACKS	Barracks
A4965	GEN INST BLDGS	Administration	A5232	AT/MOB BARRACKS	Barracks
A4966	GEN INST BLDGS	Administration	A5233	AT/MOB BARRACKS	Barracks
A5025	ADMIN FACS	Administration	A5234	AT/MOB BARRACKS	Barracks
A5030	ADMIN FACS	Administration	A5246	AT/MOB BARRACKS	Barracks
A5031	ADMIN FACS	Administration	A5247	AT/MOB BARRACKS	Barracks
A5033	ADMIN FACS	Administration	A5249	AT/MOB BARRACKS	Barracks
A5035	ADMIN FACS	Administration	A5250	AT/MOB BARRACKS	Barracks
A5087	GEN INST BLDGS	Administration	A5251	AT/MOB BARRACKS	Barracks
A5225	ADMIN FACS	Administration	A5277	AT/MOB BARRACKS	Barracks
A5230	HQ BLDG, CO	Administration	A5280	AT/MOB BARRACKS	Barracks
A5231	HQ BLDG, CO	Administration	A5284	AT/MOB BARRACKS	Barracks
A5283	ADMIN FACS	Administration	A5377	AT/MOB BARRACKS	Barracks
A5287	GEN INST BLDGS	Administration	A5378	AT/MOB BARRACKS	Barracks
A5387	GEN INST BLDGS	Administration	A5380	AT/MOB BARRACKS	Barracks
A5424	HQ BLDG, BDE	Administration	A5381	AT/MOB BARRACKS	Barracks
A5426	HQ BLDG, CO	Administration	A5383	AT/MOB BARRACKS	Barracks
A5427	ADMIN FACS	Administration	A5385	AT/MOB BARRACKS	Barracks
A5428	ADMIN FACS	Administration	A5386	AT/MOB BARRACKS	Barracks
A5430	HQ BLDG, CO	Administration	A5420	AT/MOB BARRACKS	Barracks
A5431	HQ BLDG, CO	Administration	A5421	AT/MOB	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
				BARRACKS	
A5432	HQ BLDG, CO	Administration	A5434	AT/MOB BARRACKS	Barracks
A5433	HQ BLDG, CO	Administration	A5446	AT/MOB BARRACKS	Barracks
A5435	HQ BLDG, BN	Administration	A5448	AT/MOB BARRACKS	Barracks
A5436	HQ BLDG, BDE	Administration	A5449	AT/MOB BARRACKS	Barracks
A5620	HQ BLDG, CO	Administration	A5450	AT/MOB BARRACKS	Barracks
A5624	HQ BLDG, BDE	Administration	A5451	AT/MOB BARRACKS	Barracks
A5628	HQ BLDG, BDE	Administration	A5562	AT/MOB BARRACKS	Barracks
A5630	HQ BLDG, BN	Administration	A5583	AT/MOB BARRACKS	Barracks
A5631	HQ BLDG, BN	Administration	A5586	UPH, ENL AST	Barracks
A5632	HQ BLDG, BN	Administration	A5587	UPH, ENL AST	Barracks
A5635	HQ BLDG, CO	Administration	A5621	AT/MOB BARRACKS	Barracks
A5636	ADMIN FACS	Administration	A5622	AT/MOB BARRACKS	Barracks
A5720	HQ BLDG, CO	Administration	A5626	AT/MOB BARRACKS	Barracks
A5721	HQ BLDG, CO	Administration	A5627	AT/MOB BARRACKS	Barracks
A5722	HQ BLDG, CO	Administration	A5646	AT/MOB BARRACKS	Barracks
A5723	HQ BLDG, CO	Administration	A5647	AT/MOB BARRACKS	Barracks
A5724	HQ BLDG, CO	Administration	A5648	AT/MOB BARRACKS	Barracks
A5725	HQ BLDG, CO	Administration	A5649	AT/MOB BARRACKS	Barracks
A5727	HQ BLDG, CO	Administration	A5650	AT/MOB BARRACKS	Barracks
A5728	HQ BLDG, CO	Administration	A5651	AT/MOB BARRACKS	Barracks
A5730	HQ BLDG, CO	Administration	C1244	UPH, ENL FACS	Barracks
A5731	HQ BLDG, CO	Administration	C1647	UPH, ENL FACS	Barracks
A5732	HQ BLDG, CO	Administration	C1943	UPH, ENL FACS	Barracks
A5746	HQ BLDG, CO	Administration	C2920	UPH, ENL FACS	Barracks
A5747	HQ BLDG, CO	Administration	C2925	UPH, ENL FACS	Barracks
A5748	HQ BLDG, CO	Administration	C2927	UPH, ENL FACS	Barracks
A5749	HQ BLDG, CO	Administration	C3019	UPH, ENL FACS	Barracks
A5750	HQ BLDG, CO	Administration	C3120	UPH, ENL FACS	Barracks
A5751	HQ BLDG, CO	Administration	C3125	UPH, ENL FACS	Barracks
A5762	HQ BLDG, BDE	Administration	C3321	UPH, ENL FACS	Barracks
A5783	HQ BLDG, CO	Administration	C3324	UPH, ENL FACS	Barracks
A5785	ADMIN FACS	Administration	C3421	UPH, ENL FACS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
A5957	HQ BLDG, CO	Administration	C3522	UPH, ENL FACS	Barracks
A6003	GEN INST BLDGS	Administration	C4120	UPH, ENL FACS	Barracks
A6005	GEN INST BLDGS	Administration	C4122	UPH, ENL FACS	Barracks
A6292	TNG CTRS-RESERV	Administration	C4123	UPH, ENL FACS	Barracks
B6837	ADMIN FACS	Administration	C4125	UPH, ENL FACS	Barracks
C1135	HQ BLDG, CO	Administration	C4420	UPH, ENL FACS	Barracks
C1137	HQ BLDG, CO	Administration	C4422	UPH, ENL FACS	Barracks
C1138	HQ BLDG, CO	Administration	C4424	UPH, ENL FACS	Barracks
C1140	HQ BLDG, BDE	Administration	C4426	UPH, ENL FACS	Barracks
C1235	HQ BLDG, CO	Administration	C4428	UPH, ENL FACS	Barracks
C1238	HQ BLDG, CO	Administration	C5225	UPH, ENL FACS	Barracks
C1435	HQ BLDG, CO	Administration	C5227	UPH, ENL FACS	Barracks
C1536	HQ BLDG, BN	Administration	C5322	UPH, ENL FACS	Barracks
C1539	HQ BLDG, BN	Administration	C5324	UPH, ENL FACS	Barracks
C1736	HQ BLDG, BN	Administration	C5528	UPH, ENL FACS	Barracks
C1739	HQ BLDG, BN	Administration	C5626	UPH, ENL FACS	Barracks
C1936	HQ BLDG, CO	Administration	C5725	UPH, ENL FACS	Barracks
C1937	HQ BLDG, CO	Administration	C5823	UPH, ENL FACS	Barracks
C1938	HQ BLDG, CO	Administration	C6231	UPH, ENL FACS	Barracks
C2219	HQ BLDG, CO	Administration	C6329	UPH, ENL FACS	Barracks
C2221	HQ BLDG, CO	Administration	C6427	UPH, ENL FACS	Barracks
C2225	HQ BLDG, CO	Administration	C6432	UPH, ENL FACS	Barracks
C2227	HQ BLDG, CO	Administration	C6530	UPH, ENL FACS	Barracks
C2519	HQ BLDG, CO	Administration	C6628	UPH, ENL FACS	Barracks
C2521	HQ BLDG, CO	Administration	C6726	UPH, ENL FACS	Barracks
C2525	HQ BLDG, CO	Administration	C7236	UPH, ENL FACS	Barracks
C2527	HQ BLDG, CO	Administration	C7334	UPH, ENL FACS	Barracks
C2729	HQ BLDG, BDE	Administration	C7433	UPH, ENL FACS	Barracks
C2931	HQ BLDG, BN	Administration	C7437	UPH, ENL FACS	Barracks
C3031	HQ BLDG, BN	Administration	C7531	UPH, ENL FACS	Barracks
C3331	HQ BLDG, BN	Administration	C7535	UPH, ENL FACS	Barracks
C3609	ADMIN FACS	Administration	C7634	UPH, ENL FACS	Barracks
C3731	HQ BLDG, BDE	Administration	C7732	UPH, ENL FACS	Barracks
C3821	HQ BLDG, CO	Administration	C8142	UPH, ENL FACS	Barracks
C3831	HQ BLDG, BN	Administration	C8241	UPH, ENL FACS	Barracks
C3927	HQ BLDG, BN	Administration	C8339	UPH, ENL FACS	Barracks
C4127	HQ BLDG, BN	Administration	C8344	UPH, ENL FACS	Barracks
C4229	HQ BLDG, BDE	Administration	C8438	UPH, ENL FACS	Barracks
C4329	HQ BLDG, BDE	Administration	C8442	UPH, ENL FACS	Barracks
C4823	HQ BLDG, CO	Administration	C8541	UPH, ENL FACS	Barracks
C5333	HQ BLDG, BN	Administration	C8640	UPH, ENL FACS	Barracks
C5430	HQ BLDG, BN	Administration	C8750	UPH, ENL FACS	Barracks
C5535	ADMIN FACS	Administration	C8948	UPH, ENL FACS	Barracks
C5630	HQ BLDG, BN	Administration	C9055	UPH, ENL FACS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
C5635	HQ BLDG, BDE	Administration	C9349	UPH, ENL FACS	Barracks
C5826	HQ BLDG, CO	Administration	C9354	UPH, ENL FACS	Barracks
C6032	HQ BLDG, BN	Administration	D2004	UPH, ENL FACS	Barracks
C6132	HQ BLDG, BN	Administration	D2007	UPH, ENL FACS	Barracks
C6525	HQ BLDG, BN	Administration	D2420	UPH, ENL FACS	Barracks
C6533	GEN INST BLDGS	Administration	D2617	UPH, ENL AST	Barracks
C6931	HQ BLDG, CO	Administration	D2723	UPH, ENL FACS	Barracks
C7037	ADMIN FACS	Administration	D2729	UPH, ENL FACS	Barracks
C7137	ADMIN FACS	Administration	D2822	UPH, ENL FACS	Barracks
C7339	HQ BLDG, BN	Administration	D2826	UPH, ENL FACS	Barracks
C7342	HQ BLDG, BDE	Administration	D3026	UPH, ENL FACS	Barracks
C7417	ADMIN FACS	Administration	D3142	UPH, ENL FACS	Barracks
C7444	HQ BLDG, BDE	Administration	D3151	UPH, ENL FACS	Barracks
C7540	HQ BLDG, BN	Administration	D3238	UPH, ENL FACS	Barracks
C7620	ADMIN FACS	Administration	D3255	UPH, ENL FACS	Barracks
C7842	HQ BLDG, BN	Administration	D3345	UPH, ENL FACS	Barracks
C7845	HQ BLDG, BN	Administration	D3348	UPH, ENL FACS	Barracks
C7943	HQ BLDG, BN	Administration	D3355	UPH, ENL FACS	Barracks
C8145	HQ BLDG, BN	Administration	D3438	UPH, ENL FACS	Barracks
C8246	HQ BLDG, BN	Administration	D3545	UPH, ENL FACS	Barracks
C8448	HQ BLDG, BN	Administration	D3548	UPH, ENL FACS	Barracks
C8548	HQ BLDG, BN	Administration	D3601	ARMY LODGING	Barracks
C8858	HQ BLDG, BN	Administration	D3705	ARMY LODGING	Barracks
C8960	HQ BLDG, BDE	Administration	D4215	ARMY LODGING	Barracks
C9157	ADMIN FACS	Administration	E4728	UPH, ENL FACS	Barracks
D1004	ADMIN FACS	Administration	E4824	UPH, ENL FACS	Barracks
D1305	GEN INST BLDGS	Administration	H3229	UPH, ENL FACS	Barracks
D1405	GEN INST BLDGS	Administration	H3526	UPH, ENL FACS	Barracks
D1705	ADMIN FACS	Administration	H3829	UPH, ENL FACS	Barracks
D1713	ADMIN FACS	Administration	H4350	UPH, ENL FACS	Barracks
D1911	HQ BLDG, BDE	Administration	H4445	UPH, ENL FACS	Barracks
D1966	ADMIN FACS	Administration	H4654	UPH, ENL FACS	Barracks
D2105	GEN INST BLDGS	Administration	H4812	UPH, ENL FACS	Barracks
D2111	HQ BLDG, BDE	Administration	H4817	UPH, ENL FACS	Barracks
D2113	ADMIN FACS	Administration	H4822	UPH, ENL FACS	Barracks
D2212	GEN INST BLDGS	Administration	H4952	UPH, ENL FACS	Barracks
D2307	HQ BLDG, CO	Administration	H5117	UPH, ENL FACS	Barracks
D2311	ADMIN FACS	Administration	H5122	UPH, ENL FACS	Barracks
D2317	ADMIN FACS	Administration	H5214	UPH, ENL FACS	Barracks
D2410	GEN INST BLDGS	Administration	H5245	UPH, ENL FACS	Barracks
D2507	HQ BLDG, BDE	Administration	H5412	UPH, ENL FACS	Barracks
D2509	ADMIN FACS	Administration	H5448	UPH, ENL FACS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
D2517	GEN INST BLDGS	Administration	H5454	UPH, ENL FACS	Barracks
D2524	ADMIN FACS	Administration	H5748	UPH, ENL FACS	Barracks
D2609	HQ BLDG, BN	Administration	H5752	UPH, ENL FACS	Barracks
D2612	ADMIN FACS	Administration	H5812	UPH, ENL FACS	Barracks
D2719	ADMIN FACS	Administration	H6428	UPH, ENL STU	Barracks
D2815	HQ BLDG, CO	Administration	H6432	UPH, ENL STU	Barracks
D2919	HQ BLDG, BDE	Administration	M2364	AT/MOB BARRACKS	Barracks
D3004	ADMIN FACS	Administration	M2366	AT/MOB BARRACKS	Barracks
D3022	HQ BLDG, CO	Administration	M2367	AT/MOB BARRACKS	Barracks
D3029	GEN INST BLDGS	Administration	M2369	AT/MOB BARRACKS	Barracks
D3145	HQ BLDG, BN	Administration	M2964	AT/MOB BARRACKS	Barracks
D3148	HQ BLDG, BN	Administration	M3019	UPH, ENL FACS	Barracks
D3206	ADMIN FACS	Administration	M3040	UPH, ENL FACS	Barracks
D3225	HQ BLDG, CO	Administration	M3213	UPH, ENL FACS	Barracks
D3404	ADMIN FACS	Administration	M3226	UPH, ENL FACS	Barracks
D3534	HQ BLDG, BN	Administration	M3233	UPH, ENL FACS	Barracks
D3555	HQ BLDG, CO	Administration	M3346	UPH, ENL FACS	Barracks
D3637	HQ BLDG, CO	Administration	M3519	UPH, ENL FACS	Barracks
D3745	HQ BLDG, CO	Administration	M3540	UPH, ENL FACS	Barracks
D3748	HQ BLDG, CO	Administration	M4020	UPH, ENL FACS	Barracks
D3915	GEN INST BLDGS	Administration	M4040	UPH, ENL FACS	Barracks
D3941	HQ BLDG, BN	Administration	M4313	UPH, ENL FACS	Barracks
D3947	HQ BLDG, BDE	Administration	M4346	UPH, ENL FACS	Barracks
D3952	HQ BLDG, BN	Administration	M4520	UPH, ENL FACS	Barracks
D4052	HQ BLDG, CO	Administration	M4540	UPH, ENL FACS	Barracks
E1351	HQ BLDG, CO	Administration	O9071	UPH OFFICER FAC	Barracks
E1541	HQ BLDG, BN	Administration	O9072	UPH, ENL STU	Barracks
E1646	HQ BLDG, CO	Administration	RVEDG	UPH, ENL AST	Barracks
E1650	HQ BLDG, CO	Administration	14157	CHILD DEV CTRS	Child Development Center
E1733	HQ BLDG, CO	Administration	16067	CHILD DEV CTRS	Child Development Center
E1739	HQ BLDG, BN	Administration	83684	CHILD DEV CTRS	Child Development Center
E1743	HQ BLDG, BN	Administration	B7033	CHILD DEV CTRS	Child Development Center
E1745	GEN INST BLDGS	Administration	F1243	CHILD DEV CTRS	Child Development Center
E1930	HQ BLDG, CO	Administration	14930	OPEN DINING	Dining Facility
E1935	HQ BLDG, BN	Administration	25112	UPH DINING FACS	Dining Facility
E1952	HQ BLDG, CO	Administration	32102	OPEN DINING	Dining Facility

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
E2040	HQ BLDG, BDE	Administration	55353	OPEN DINING	Dining Facility
E2048	HQ BLDG, CO	Administration	A4622	UPH DINING FACS	Dining Facility
E2333	HQ BLDG, BN	Administration	A4632	UPH DINING FACS	Dining Facility
E2375	ADMIN FACS	Administration	A4635	UPH DINING FACS	Dining Facility
E2431	HQ BLDG, BN	Administration	A4646	UPH DINING FACS	Dining Facility
E2535	HQ BLDG, CO	Administration	A4647	UPH DINING FACS	Dining Facility
E2633	HQ BLDG, CO	Administration	A4648	UPH DINING FACS	Dining Facility
E2929	ADMIN FACS	Administration	A4650	UPH DINING FACS	Dining Facility
E3323	HQ BLDG, BN	Administration	A4651	UPH DINING FACS	Dining Facility
E3428	HQ BLDG, BDE	Administration	A4684	UPH DINING FACS	Dining Facility
E3622	HQ BLDG, BN	Administration	A4685	UPH DINING FACS	Dining Facility
E3825	ADMIN FACS	Administration	A4686	UPH DINING FACS	Dining Facility
E3928	HQ BLDG, CO	Administration	C2040	UPH DINING FACS	Dining Facility
E4025	ADMIN FACS	Administration	C2523	UPH DINING FACS	Dining Facility
E4068	HQ BLDG, CO	Administration	D3039	UPH DINING FACS	Dining Facility
F4208	ADMIN FACS	Administration	D3055	UPH DINING FACS	Dining Facility
H2614	GEN INST BLDGS	Administration	E4325	UPH DINING FACS	Dining Facility
H2639	HQ BLDG, CO	Administration	H3237	OPEN DINING	Dining Facility
H2908	HQ BLDG, CO	Administration	H3606	OPEN DINING	Dining Facility
H2919	HQ BLDG, CO	Administration	H4842	UPH DINING FACS	Dining Facility
H3014	HQ BLDG, BN	Administration	M2167	UPH DINING FACS	Dining Facility
H3654	ADMIN FACS	Administration	M4234	UPH DINING FACS	Dining Facility
H3743	HQ BLDG, CO	Administration	O8402	UPH DINING FACS	Dining Facility
H3849	HQ BLDG, CO	Administration	O8404	UPH DINING FACS	Dining Facility
H4235	HQ BLDG, BN	Administration	O9073	UPH DINING FACS	Dining Facility
H4358	HQ BLDG, BN	Administration	22414	PVT/ORG CLB BLD	Golf Club House
H4440	HQ BLDG, CO	Administration	N4116	PVT/ORG CLB BLD	Golf Club House
H4786	ADMIN FACS	Administration	O9034	PVT/ORG CLB	Golf Club House

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
				BLD	
H5057	HQ BLDG, CO	Administration	21705	FITNESS FACS	Physical Fitness Center
H5086	ADMIN FACS	Administration	31602	FITNESS FACS	Physical Fitness Center
H5240	HQ BLDG, CO	Administration	31604	FITNESS FACS	Physical Fitness Center
H5332	HQ BLDG, BN	Administration	31851	FITNESS FACS	Physical Fitness Center
H5626	HQ BLDG, BN	Administration	C2015	FITNESS FACS	Physical Fitness Center
H5757	HQ BLDG, CO	Administration	C5032	FITNESS FACS	Physical Fitness Center
H5777	HQ BLDG, CO	Administration	C5838	FITNESS FACS	Physical Fitness Center
H5834	HQ BLDG, BDE	Administration	C7215	FITNESS FACS	Physical Fitness Center
H5923	HQ BLDG, BN	Administration	D3856	FITNESS FACS	Physical Fitness Center
H5927	HQ BLDG, BN	Administration	H4630	FITNESS FACS	Physical Fitness Center
H5955	HQ BLDG, BN	Administration	H5718	FITNESS FACS	Physical Fitness Center
H6262	HQ BLDG, CO	Administration	M4161	FITNESS FACS	Physical Fitness Center
H6308	HQ BLDG, CO	Administration	M4226	FITNESS FACS	Physical Fitness Center
H6418	HQ BLDG, CO	Administration	15631	SEP TOIL/SHOWER	Pool Shower Building
H6612	HQ BLDG, CO	Administration	55250	SEP TOIL/SHOWER	Pool Shower Building
H6715	HQ BLDG, CO	Administration	C5040	SEP TOIL/SHOWER	Pool Shower Building
J2144	ADMIN FACS	Administration	C7018	SEP TOIL/SHOWER	Pool Shower Building
M2059	ADMIN FACS	Administration	C7116	SEP TOIL/SHOWER	Pool Shower Building
M2114	HQ BLDG, BN	Administration	D4050	SEP TOIL/SHOWER	Pool Shower Building
M2340	ADMIN FACS	Administration	M5868	SEP TOIL/SHOWER	Pool Shower Building
M2342	HQ BLDG, CO	Administration	O9051	SEP TOIL/SHOWER	Pool Shower Building

Table C.7. Buildings to Consider for Solar Hot Water Heating Systems at Fort Buchannan

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
23	ADMIN FACS	Administration	1106	ADMIN FACS	Administration
67	ADMIN FACS	Administration	1140	ADMIN FACS	Administration
136	ADMIN FACS	Administration	1141	ADMIN FACS	Administration
152	ADMIN FACS	Administration	1142	ADMIN FACS	Administration
176	ADMIN FACS	Administration	1143	ADMIN FACS	Administration
192	ADMIN FACS	Administration	1144	ADMIN FACS	Administration
193	ADMIN FACS	Administration	1145	ADMIN FACS	Administration
202	ADMIN FACS	Administration	1146	ADMIN FACS	Administration
203	ADMIN FACS	Administration	1147	ADMIN FACS	Administration
204	ADMIN FACS	Administration	1302	HQ BLDG, BN	Administration
206	ADMIN FACS	Administration	1303	ADMIN FACS	Administration
212	ADMIN FACS	Administration	1304	ADMIN FACS	Administration
214	ADMIN FACS	Administration	1305	TNG CTRS-RESERV	Administration
218	ADMIN FACS	Administration	1306	TNG CTRS-RESERV	Administration
219	ADMIN FACS	Administration	1307	TNG CTRS-RESERV	Administration
220	ADMIN FACS	Administration	1308	TNG CTRS-RESERV	Administration
223	ADMIN FACS	Administration	1310	TNG CTRS-RESERV	Administration
224	ADMIN FACS	Administration	1311	TNG CTRS-RESERV	Administration
225	ADMIN FACS	Administration	1312	TNG CTRS-RESERV	Administration
227	ADMIN FACS	Administration	1313	ADMIN FACS	Administration
228	ADMIN FACS	Administration	1314	ADMIN FACS	Administration
231	ADMIN FACS	Administration	1316	TNG CTRS-RESERV	Administration
390	ADMIN FACS	Administration	1317	HQ BLDG, CO	Administration
399	ADMIN FACS	Administration	1318	TNG CTRS-RESERV	Administration
504	ADMIN FACS	Administration	1319	TNG CTRS-RESERV	Administration
507	TNG CTRS-RESERV	Administration	1320	TNG CTRS-RESERV	Administration
509	ADMIN FACS	Administration	1322	TNG CTRS-RESERV	Administration
512	ADMIN FACS	Administration	1323	TNG CTRS-RESERV	Administration
514	ADMIN FACS	Administration	1324	TNG CTRS-RESERV	Administration
522	TNG CTRS-RESERV	Administration	119	UPH, ENL FACS	Barracks
523	TNG CTRS-RESERV	Administration	678	ARMY LODGING	Barracks
525	TNG CTRS-RESERV	Administration	679	ARMY LODGING	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
527	HQ BLDG, BN	Administration	680	ARMY LODGING	Barracks
540	ADMIN FACS	Administration	681	ARMY LODGING	Barracks
556	ADMIN FACS	Administration	801	ARMY LODGING	Barracks
576	ADMIN FACS	Administration	802	ARMY LODGING	Barracks
607	TASC	Administration	1300	UPH, ENL FACS	Barracks
1017	ADMIN FACS	Administration	1301	UPH, ENL FACS	Barracks
1018	ADMIN FACS	Administration	1315	UPH, ENL FACS	Barracks
1020	ADMIN FACS	Administration	348	CHILD DEV CTRS	Child Development Center
1021	ADMIN FACS	Administration	660	OPEN DINING	Dining Facility
1022	ADMIN FACS	Administration	1309	UPH DINING FACS	Dining Facility
1101	ADMIN FACS	Administration	167	FITNESS FACS	Physical Fitness Center
1102	ADMIN FACS	Administration	181	SEP TOIL/SHOWER	Pool Shower Building
1104	ADMIN FACS	Administration			

Table C.8. Buildings to Consider for Solar Hot Water Heating Systems at Fort Gordon

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
23	ADMIN FACS	Administration	41202	GEN INST BLDGS	Administration
308	ADMIN FACS	Administration	41203	GEN INST BLDGS	Administration
319	HQ BLDG, CO	Administration	41204	ADMIN FACS	Administration
357	GEN INST BLDGS	Administration	D2054	ADMIN FACS	Administration
402	ADMIN FACS	Administration	OT011	GEN INST BLDGS	Administration
458	ADMIN FACS	Administration	OT014	GEN INST BLDGS	Administration
508	ADMIN FACS	Administration	OT017	GEN INST BLDGS	Administration
510	GEN INST BLDGS	Administration	OT029	GEN INST BLDGS	Administration
511	GEN INST BLDGS	Administration	OT048	GEN INST BLDGS	Administration
520	ADMIN FACS	Administration	OT053	GEN INST BLDGS	Administration
961	TASC	Administration	OT054	GEN INST BLDGS	Administration
962	TASC	Administration	6	ARMY LODGING	Barracks
964	TASC	Administration	104	REC BILLETS	Barracks
994	ADMIN FACS	Administration	106	REC BILLETS	Barracks
2133	ADMIN FACS	Administration	250	ARMY LODGING	Barracks
11307	GEN INST BLDGS	Administration	315	UPH, ENL STU	Barracks
13302	GEN INST BLDGS	Administration	317	UPH, ENL FACS	Barracks
13804	CNT WASH BLDGS	Administration	18404	ARMY LODGING	Barracks
14401	TNG CTRS-RESERV	Administration	19730	DET MISC FACS	Barracks
14500	ADMIN FACS	Administration	19731	UPH, ENL FACS	Barracks
21304	ADMIN FACS	Administration	19733	UPH, ENL FACS	Barracks
21305	GEN INST BLDGS	Administration	19735	UPH, ENL FACS	Barracks
21604	HQ BLDG, BN	Administration	19737	UPH, ENL FACS	Barracks
21605	HQ BLDG, BN	Administration	19750	DET MISC FACS	Barracks
21706	HQ BLDG, CO	Administration	19751	UPH, ENL FACS	Barracks
21710	HQ BLDG, BDE	Administration	19753	UPH, ENL FACS	Barracks
21714	HQ BLDG, CO	Administration	19755	UPH, ENL FACS	Barracks
21717	HQ BLDG, BN	Administration	19757	UPH, ENL FACS	Barracks
21718	HQ BLDG, CO	Administration	21707	AT/MOB BARRACKS	Barracks
21719	HQ BLDG, CO	Administration	21708	AT/MOB BARRACKS	Barracks
21722	HQ BLDG, BN	Administration	21715	AT/MOB BARRACKS	Barracks
24402	HQ BLDG, BN	Administration	21716	AT/MOB BARRACKS	Barracks
24403	HQ BLDG, CO	Administration	21720	AT/MOB BARRACKS	Barracks
24408	HQ BLDG, CO	Administration	24401	ARMY LODGING	Barracks
24409	HQ BLDG, CO	Administration	24404	UPH, ENL AST	Barracks
24410	HQ BLDG, CO	Administration	24405	ARMY LODGING	Barracks
24411	HQ BLDG, CO	Administration	24406	UPH, ENL AST	Barracks
25114	GEN INST BLDGS	Administration	24407	UPH, ENL STU	Barracks
25423	HQ BLDG, CO	Administration	24412	UPH, ENL STU	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
25424	HQ BLDG, CO	Administration	24413	UPH, ENL STU	Barracks
25525	HQ BLDG, BN	Administration	25410	UPH, ENL FACS	Barracks
25526	HQ BLDG, BDE	Administration	25411	UPH, ENL FACS	Barracks
25601	HQ BLDG, BN	Administration	25412	UPH, ENL FACS	Barracks
25602	ADMIN FACS	Administration	25413	UPH, ENL FACS	Barracks
25604	HQ BLDG, BN	Administration	25416	UPH, ENL FACS	Barracks
25605	HQ BLDG, BN	Administration	25420	UPH, ENL FACS	Barracks
25701	HQ BLDG, CO	Administration	25421	UPH, ENL FACS	Barracks
25706	HQ BLDG, CO	Administration	25425	UPH, ENL STU	Barracks
25710	HQ BLDG, BDE	Administration	25427	UPH, ENL FACS	Barracks
25714	HQ BLDG, CO	Administration	25428	UPH, ENL FACS	Barracks
25719	HQ BLDG, CO	Administration	25430	UPH, ENL STU	Barracks
25810	GEN INST BLDGS	Administration	25702	UPH, ENL AST	Barracks
26309	ADMIN FACS	Administration	25703	UPH, ENL STU	Barracks
28412	ADMIN FACS	Administration	25705	UPH, ENL STU	Barracks
28423	HQ BLDG, BN	Administration	25707	UPH, ENL STU	Barracks
28424	HQ BLDG, CO	Administration	25708	UPH, ENL STU	Barracks
28431	ADMIN FACS	Administration	25715	UPH, ENL STU	Barracks
28510	HQ BLDG, BN	Administration	25716	UPH, ENL STU	Barracks
29601	ADMIN FACS	Administration	25718	UPH, ENL STU	Barracks
29602	HQ BLDG, BN	Administration	25720	UPH, ENL STU	Barracks
29603	ADMIN FACS	Administration	25721	UPH, ENL STU	Barracks
29701	HQ BLDG, CO	Administration	28410	UPH, ENL FACS	Barracks
29706	HQ BLDG, CO	Administration	28411	UPH, ENL FACS	Barracks
29714	HQ BLDG, CO	Administration	28413	UPH, ENL FACS	Barracks
29718	ADMIN FACS	Administration	28417	UPH, ENL FACS	Barracks
29719	ADMIN FACS	Administration	28425	UPH, ENL FACS	Barracks
29803	ADMIN FACS	Administration	28426	UPH, ENL FACS	Barracks
29808	ADMIN FACS	Administration	28430	UPH, ENL FACS	Barracks
29809	GEN INST BLDGS	Administration	28432	UPH, ENL FACS	Barracks
29811	GEN INST BLDGS	Administration	28433	UPH, ENL FACS	Barracks
32503	ADMIN FACS	Administration	28435	UPH, ENL FACS	Barracks
33412	CIDC FACS	Administration	29702	UPH, ENL STU	Barracks
33512	ADMIN FACS	Administration	29703	UPH, ENL STU	Barracks
33720	ADMIN FACS	Administration	29705	UPH, ENL STU	Barracks
33800	ADMIN FACS	Administration	29707	UPH, ENL AST	Barracks
34509	ADMIN FACS	Administration	29708	UPH, ENL STU	Barracks
38702	ADMIN FACS	Administration	29715	UPH, ENL STU	Barracks
38707	GEN INST BLDGS	Administration	29716	UPH, ENL STU	Barracks
38709	ADMIN FACS	Administration	29720	UPH, ENL STU	Barracks
38711	ADMIN FACS	Administration	29721	UPH, ENL STU	Barracks
38715	GEN INST BLDGS	Administration	34506	ARMY LODGING	Barracks
38717	ADMIN FACS	Administration	36700	ARMY LODGING	Barracks
38801	ADMIN FACS	Administration	37300	ARMY LODGING	Barracks
38802	ADMIN FACS	Administration	37302	ARMY LODGING	Barracks
38803	ADMIN FACS	Administration	39005	AT/MOB BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
39006	ADMIN FACS	Administration	39010	AT/MOB BARRACKS	Barracks
39107	ADMIN FACS	Administration	40005	AT/MOB BARRACKS	Barracks
39110	GEN INST BLDGS	Administration	40121	AT/MOB BARRACKS	Barracks
39111	ADMIN FACS	Administration	40122	AT/MOB BARRACKS	Barracks
39113	GEN INST BLDGS	Administration	40123	AT/MOB BARRACKS	Barracks
39114	GEN INST BLDGS	Administration	44401	CHILD DEV CTRS	Child Development Center
39115	GEN INST BLDGS	Administration	102	UPH DINING FACS	Dining Facility
39119	GEN INST BLDGS	Administration	18400	OPEN DINING	Dining Facility
39121	GEN INST BLDGS	Administration	18402	OPEN DINING	Dining Facility
39122	GEN INST BLDGS	Administration	21709	UPH DINING FACS	Dining Facility
39123	GEN INST BLDGS	Administration	24414	UPH DINING FACS	Dining Facility
39124	GEN INST BLDGS	Administration	25704	UPH DINING FACS	Dining Facility
39125	GEN INST BLDGS	Administration	25717	UPH DINING FACS	Dining Facility
39211	ADMIN FACS	Administration	29704	UPH DINING FACS	Dining Facility
39702	GEN INST BLDGS	Administration	29722	UPH DINING FACS	Dining Facility
39706	ADMIN FACS	Administration	36708	OPEN DINING	Dining Facility
39708	ADMIN FACS	Administration	39105	UPH DINING FACS	Dining Facility
39718	ADMIN FACS	Administration	39117	UPH DINING FACS	Dining Facility
39719	ADMIN FACS	Administration	40127	UPH DINING FACS	Dining Facility
39720	ADMIN FACS	Administration	537	PRO SHOP/GOLF	Golf Club House
39801	ADMIN FACS	Administration	39101	PVT/ORG CLB BLD	Golf Club House
40101	GEN INST BLDGS	Administration	19140	FITNESS FACS	Physical Fitness Center
40109	GEN INST BLDGS	Administration	21713	FITNESS FACS	Physical Fitness Center
40110	GEN INST BLDGS	Administration	25510	FITNESS FACS	Physical Fitness Center
40200	ADMIN FACS	Administration	25713	FITNESS FACS	Physical Fitness Center
40202	GEN INST BLDGS	Administration	29607	FITNESS FACS	Physical Fitness Center
40203	ADMIN FACS	Administration	40119	FITNESS FACS	Physical Fitness Center
40705	GEN INST BLDGS	Administration	15	SEP TOIL/SHOWER	Pool Shower Building
40707	ADMIN FACS	Administration	513	SEP TOIL/SHOWER	Pool Shower Building
40709	ADMIN FACS	Administration	19230	SEP TOIL/SHOWER	Pool Shower Building
40711	GEN INST BLDGS	Administration	21608	INDOR SWIM	Pool Shower Building

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
				POOL	
41101	GEN INST BLDGS	Administration	25101	SEP TOIL/SHOWER	Pool Shower Building
41102	GEN INST BLDGS	Administration	36710	SEP TOIL/SHOWER	Pool Shower Building
41201	GEN INST BLDGS	Administration	OT012	SEP TOIL/SHOWER	Pool Shower Building
			OT050	SEP TOIL/SHOWER	Pool Shower Building

Table C.9. Buildings to Consider for Solar Hot Water Heating Systems at Fort Jackson

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
1525	TNG CTRS-RESERV	Administration	2463	DET MISC FACS	Barracks
1727	HQ BLDG, BN	Administration	2464	ARMY LODGING	Barracks
1765	GEN INST BLDGS	Administration	2467	UPH, ENL FACS	Barracks
1895	HQ BLDG, BN	Administration	2468	UPH, ENL FACS	Barracks
2310	HQ BLDG, BN	Administration	2785	ARMY LODGING	Barracks
2320	HQ BLDG, BN	Administration	3205	BT BARRACKS	Barracks
2340	HQ BLDG, BDE	Administration	3215	ARMY LODGING	Barracks
2360	HQ BLDG, BN	Administration	3216	BT BARRACKS	Barracks
2370	HQ BLDG, BN	Administration	3225	AT/MOB BARRACKS	Barracks
2400	GEN INST BLDGS	Administration	3235	ARMY LODGING	Barracks
2435	ADMIN FACS	Administration	3265	ARMY LODGING	Barracks
2441	ADMIN FACS	Administration	3275	ARMY LODGING	Barracks
2466	UPH SR NCO FACS	Administration	3276	ARMY LODGING	Barracks
2563	ADMIN FACS	Administration	3285	BT BARRACKS	Barracks
2567	ADMIN FACS	Administration	3295	BT BARRACKS	Barracks
2606	ADMIN FACS	Administration	3640	ARMY LODGING	Barracks
2620	TNG CTRS-RESERV	Administration	3641	ARMY LODGING	Barracks
3058	HQ BLDG, CO	Administration	3642	ARMY LODGING	Barracks
3220	HQ BLDG, BDE	Administration	3643	ARMY LODGING	Barracks
3230	HQ BLDG, CO	Administration	3644	ARMY LODGING	Barracks
3233	GEN INST BLDGS	Administration	3645	ARMY LODGING	Barracks
3255	HQ BLDG, CO	Administration	3750	ARMY LODGING	Barracks
3290	HQ BLDG, BN	Administration	3751	ARMY LODGING	Barracks
3330	HQ BLDG, BDE	Administration	3752	ARMY LODGING	Barracks
3360	HQ BLDG, BN	Administration	3754	ARMY LODGING	Barracks
3390	INFO PROC CTR	Administration	3770	ARMY LODGING	Barracks
3499	ADMIN FACS	Administration	3771	ARMY LODGING	Barracks
3903	CO HQ, TRANS	Administration	3772	ARMY LODGING	Barracks
3908	BN HQ, TRANS	Administration	3773	ARMY LODGING	Barracks
3909	BN HQ, TRANS	Administration	3774	ARMY LODGING	Barracks
3910	GEN INST BLDGS	Administration	3850	ARMY LODGING	Barracks
3911	GEN INST BLDGS	Administration	3917	ARMY LODGING	Barracks
3912	GEN INST BLDGS	Administration	3918	UPH OFFICER FAC	Barracks
3914	GEN INST BLDGS	Administration	3964	ARMY LODGING	Barracks
3915	GEN INST BLDGS	Administration	4205	BT BARRACKS	Barracks
3916	GEN INST BLDGS	Administration	4215	BT BARRACKS	Barracks
3924	ADMIN FACS	Administration	4225	BT BARRACKS	Barracks
4200	HQ BLDG, CO	Administration	4235	BT BARRACKS	Barracks
4204	GEN INST BLDGS	Administration	4243	BT BARRACKS	Barracks
4220	HQ BLDG, CO	Administration	4255	BT BARRACKS	Barracks
4230	GEN INST BLDGS	Administration	4265	BT BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
4266	GEN INST BLDGS	Administration	4275	BT BARRACKS	Barracks
4282	INFO SYS FACS	Administration	4285	BT BARRACKS	Barracks
4310	HQ BLDG, BDE	Administration	4295	BT BARRACKS	Barracks
4325	ADMIN FACS	Administration	4416	ARMY LODGING	Barracks
4330	HQ BLDG, BN	Administration	4420	BT BARRACKS	Barracks
4338	ADMIN FACS	Administration	5422	BT BARRACKS	Barracks
4340	ADMIN FACS	Administration	5482	BT BARRACKS	Barracks
4350	ADMIN FACS	Administration	5500	BT BARRACKS	Barracks
4354	ADMIN FACS	Administration	6000	ARMY LODGING	Barracks
4356	HQ BLDG, BDE	Administration	10300	ARMY LODGING	Barracks
4394	ADMIN FACS	Administration	10402	BT BARRACKS	Barracks
4404	ADMIN FACS	Administration	10404	BT BARRACKS	Barracks
4405	ADMIN FACS	Administration	10405	BT BARRACKS	Barracks
4406	ADMIN FACS	Administration	10406	BT BARRACKS	Barracks
4407	ADMIN FACS	Administration	10407	BT BARRACKS	Barracks
4461	EOC/SCIF FACS	Administration	11000	BT BARRACKS	Barracks
4475	ADMIN FACS	Administration	12000	BT BARRACKS	Barracks
4514	GEN INST BLDGS	Administration	S3852	UPH OFFICER FAC	Barracks
5385	HQ BLDG, BDE	Administration	S3870	UPH OFFICER FAC	Barracks
5432	HQ BLDG, CO	Administration	S3872	UPH OFFICER FAC	Barracks
5450	ADMIN FACS	Administration	S3919	AT/MOB BARRACKS	Barracks
5483	CIDC FACS	Administration	S3920	AT/MOB BARRACKS	Barracks
5615	ADMIN FACS	Administration	S3921	DET MISC FACS	Barracks
7533	GEN INST BLDGS	Administration	S3940	AT/MOB BARRACKS	Barracks
7541	C-E RDT&E FACS	Administration	S3941	AT/MOB BARRACKS	Barracks
7542	GEN INST BLDGS	Administration	S3947	AT/MOB BARRACKS	Barracks
9400	GEN INST BLDGS	Administration	S3960	ARMY LODGING	Barracks
9475	ADMIN FACS	Administration	S3963	AT/MOB BARRACKS	Barracks
9810	TNG CTRS-RESERV	Administration	W3210	UPH OFFICER FAC	Barracks
10000	GEN INST BLDGS	Administration	W3220	ARMY LODGING	Barracks
10100	GEN INST BLDGS	Administration	W3501	AT/MOB BARRACKS	Barracks
10400	HQ BLDG, BN	Administration	W3510	AT/MOB BARRACKS	Barracks
12600	TASC	Administration	W3511	AT/MOB BARRACKS	Barracks
12625	TASC	Administration	W3934	AT/MOB BARRACKS	Barracks
12630	TASC	Administration	W3935	AT/MOB BARRACKS	Barracks
12650	TASC	Administration	W3936	AT/MOB BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
12656	TASC	Administration	W3938	AT/MOB BARRACKS	Barracks
13000	TNG CTRS-RESERV	Administration	W3939	AT/MOB BARRACKS	Barracks
D0007	GEN INST BLDGS	Administration	W3942	AT/MOB BARRACKS	Barracks
D0056	GEN INST BLDGS	Administration	W3943	AT/MOB BARRACKS	Barracks
D6271	TNG CTRS-RESERV	Administration	W3944	AT/MOB BARRACKS	Barracks
F5400	GEN INST BLDGS	Administration	W3945	AT/MOB BARRACKS	Barracks
K5510	ADMIN FACS	Administration	4581	CHILD DEV CTRS	Child Development Center
K5531	ADMIN FACS	Administration	4585	CHILD DEV CTRS	Child Development Center
S3800	GEN INST BLDGS	Administration	5953	CHILD DEV CTRS	Child Development Center
S3891	GEN INST BLDGS	Administration	5955	CHILD DEV CTRS	Child Development Center
S3892	ADMIN FACS	Administration	5957	CHILD DEV CTRS	Child Development Center
S3907	GEN INST BLDGS	Administration	5975	CHILD DEV CTRS	Child Development Center
S3910	GEN INST BLDGS	Administration	1875	UPH DINING FACS	Dining Facility
S3962	ADMIN FACS	Administration	2230	UPH DINING FACS	Dining Facility
W3430	ADMIN FACS	Administration	2260	UPH DINING FACS	Dining Facility
W3432	ADMIN FACS	Administration	3210	UPH DINING FACS	Dining Facility
W3810	GEN INST BLDGS	Administration	3232	DINING FAC TRAN	Dining Facility
1872	BT BARRACKS	Barracks	3305	OPEN DINING	Dining Facility
1880	BT BARRACKS	Barracks	3505	DINING FAC TRAN	Dining Facility
1892	BT BARRACKS	Barracks	3965	UPH DINING FACS	Dining Facility
1897	BT BARRACKS	Barracks	4210	UPH DINING FACS	Dining Facility
2205	BT BARRACKS	Barracks	4270	UPH DINING FACS	Dining Facility
2215	BT BARRACKS	Barracks	10401	UPH DINING FACS	Dining Facility
2235	BT BARRACKS	Barracks	W3933	UPH DINING FACS	Dining Facility
2253	BT BARRACKS	Barracks	W3937	UPH DINING FACS	Dining Facility
2255	BT BARRACKS	Barracks	W3946	UPH DINING FACS	Dining Facility
2265	BT BARRACKS	Barracks	3652	PRO SHOP/GOLF	Golf Club House
2275	BT BARRACKS	Barracks	6510	MISC MWR BLDG	Golf Club House
2285	BT BARRACKS	Barracks	2009	FITNESS FACS	Physical Fitness Center
2442	UPH, ENL FACS	Barracks	4149	FITNESS FACS	Physical Fitness Center
2446	UPH, ENL FACS	Barracks	4482	FITNESS FACS	Physical Fitness Center
2447	DET MISC FACS	Barracks	2760	SEP TOIL/SHOWER	Pool Shower Building
2449	UPH, ENL FACS	Barracks	3296	INDOR SWIM POOL	Pool Shower Building
2453	UPH, ENL FACS	Barracks	J8473	SEP TOIL/SHOWER	Pool Shower Building

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
2460	UPH, ENL FACS	Barracks	J8477	SEP TOIL/SHOWER	Pool Shower Building
2461	UPH, ENL FACS	Barracks	M2645	SEP TOIL/SHOWER	Pool Shower Building

Table C.10. Buildings to Consider for Solar Hot Water Heating Systems at Fort Knox

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
39	ADMIN FACS	Administration	2815	UPH, ENL FACS	Barracks
81	ADMIN FACS	Administration	2816	UPH, ENL FACS	Barracks
122	ADMIN FACS	Administration	2817	DET MISC FACS	Barracks
203	ADMIN FACS	Administration	2818	UPH, ENL FACS	Barracks
299	ADMIN FACS	Administration	2819	UPH, ENL FACS	Barracks
474	ADMIN FACS	Administration	4016	ARMY LODGING	Barracks
483	TASC	Administration	4770	ARMY LODGING	Barracks
484	TASC	Administration	5916	BT BARRACKS	Barracks
485	TASC	Administration	5919	BT BARRACKS	Barracks
488	CIDC FACS	Administration	5920	BT BARRACKS	Barracks
614	ADMIN FACS	Administration	5921	BT BARRACKS	Barracks
1001	ADMIN FACS	Administration	5922	BT BARRACKS	Barracks
1002	ADMIN FACS	Administration	5936	BT BARRACKS	Barracks
1049	ADMIN FACS	Administration	5937	BT BARRACKS	Barracks
1101	ADMIN FACS	Administration	5938	BT BARRACKS	Barracks
1109	ADMIN FACS	Administration	5939	BT BARRACKS	Barracks
1110	ADMIN FACS	Administration	5941	BT BARRACKS	Barracks
1307	ADMIN FACS	Administration	6010	UPH, ENL STU	Barracks
1310	ADMIN FACS	Administration	6011	UPH, ENL STU	Barracks
1373	ADMIN FACS	Administration	6015	UPH, ENL STU	Barracks
1375	ADMIN FACS	Administration	6017	UPH, ENL STU	Barracks
1382	ADMIN FACS	Administration	6539	BT BARRACKS	Barracks
1383	ADMIN FACS	Administration	6541	BT BARRACKS	Barracks
1384	ADMIN FACS	Administration	6542	BT BARRACKS	Barracks
1467	TNG CTRS-RESERV	Administration	6543	BT BARRACKS	Barracks
1468	HQ BLDG, BDE	Administration	6544	BT BARRACKS	Barracks
1477	HQ BLDG, BN	Administration	6545	BT BARRACKS	Barracks
1478	HQ BLDG, BN	Administration	6546	BT BARRACKS	Barracks
1487	ADMIN FACS	Administration	6547	BT BARRACKS	Barracks
1996	GEN INST BLDGS	Administration	6548	BT BARRACKS	Barracks
1997	ADMIN FACS	Administration	6550	BT BARRACKS	Barracks
2000	HQ BLDG, CO	Administration	6551	BT BARRACKS	Barracks
2010	GEN INST BLDGS	Administration	6552	BT BARRACKS	Barracks
2197	ADMIN FACS	Administration	6553	BT BARRACKS	Barracks
2316	ADMIN FACS	Administration	6554	BT BARRACKS	Barracks
2317	ADMIN FACS	Administration	6555	BT BARRACKS	Barracks
2323	TNG CTRS-RESERV	Administration	6556	BT BARRACKS	Barracks
2324	TNG CTRS-RESERV	Administration	6557	BT BARRACKS	Barracks
2339	HQ BLDG, CO	Administration	6558	BT BARRACKS	Barracks
2350	ADMIN FACS	Administration	6578	BT BARRACKS	Barracks
2368	GEN INST BLDGS	Administration	6597	UPH, ENL FACS	Barracks
2369	ADMIN FACS	Administration	6804	AT/MOB BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
2372	HQ BLDG, BN	Administration	6807	AT/MOB BARRACKS	Barracks
2373	TNG CTRS-RESERV	Administration	6808	AT/MOB BARRACKS	Barracks
2374	ADMIN FACS	Administration	6811	AT/MOB BARRACKS	Barracks
2375	TNG CTRS-RESERV	Administration	6812	AT/MOB BARRACKS	Barracks
2382	HQ BLDG, BN	Administration	6814	AT/MOB BARRACKS	Barracks
2389	HQ BLDG, BN	Administration	6815	AT/MOB BARRACKS	Barracks
2421	GEN INST BLDGS	Administration	6816	AT/MOB BARRACKS	Barracks
2422	ADMIN FACS	Administration	6817	AT/MOB BARRACKS	Barracks
2423	ADMIN FACS	Administration	6820	AT/MOB BARRACKS	Barracks
2424	GEN INST BLDGS	Administration	6821	AT/MOB BARRACKS	Barracks
2425	GEN INST BLDGS	Administration	6822	AT/MOB BARRACKS	Barracks
2426	ADMIN FACS	Administration	6823	AT/MOB BARRACKS	Barracks
2601	UPH SR NCO FACS	Administration	6825	AT/MOB BARRACKS	Barracks
2962	ADMIN FACS	Administration	6826	AT/MOB BARRACKS	Barracks
4248	ADMIN FACS	Administration	6829	AT/MOB BARRACKS	Barracks
5101	ADMIN FACS	Administration	6830	AT/MOB BARRACKS	Barracks
5217	TNG CTRS-RESERV	Administration	6840	AT/MOB BARRACKS	Barracks
5923	HQ BLDG, CO	Administration	6843	AT/MOB BARRACKS	Barracks
5926	HQ BLDG, CO	Administration	6844	AT/MOB BARRACKS	Barracks
5930	HQ BLDG, CO	Administration	6848	AT/MOB BARRACKS	Barracks
5931	HQ BLDG, BDE	Administration	6852	AT/MOB BARRACKS	Barracks
5932	HQ BLDG, CO	Administration	6859	AT/MOB BARRACKS	Barracks
5935	HQ BLDG, CO	Administration	6860	AT/MOB BARRACKS	Barracks
5950	HQ BLDG, CO	Administration	6871	AT/MOB BARRACKS	Barracks
5951	HQ BLDG, CO	Administration	6875	AT/MOB BARRACKS	Barracks
6007	HQ BLDG, CO	Administration	6876	AT/MOB BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
6335	GEN INST BLDGS	Administration	6879	AT/MOB BARRACKS	Barracks
6535	GEN INST BLDGS	Administration	6880	AT/MOB BARRACKS	Barracks
6536	GEN INST BLDGS	Administration	6881	AT/MOB BARRACKS	Barracks
6537	GEN INST BLDGS	Administration	6884	AT/MOB BARRACKS	Barracks
6538	HQ BLDG, BDE	Administration	6885	AT/MOB BARRACKS	Barracks
6540	HQ BLDG, BN	Administration	6892	AT/MOB BARRACKS	Barracks
6549	HQ BLDG, BN	Administration	7007	AT/MOB BARRACKS	Barracks
6559	HQ BLDG, BN	Administration	7008	AT/MOB BARRACKS	Barracks
6571	GEN INST BLDGS	Administration	7011	AT/MOB BARRACKS	Barracks
6573	GEN INST BLDGS	Administration	7012	AT/MOB BARRACKS	Barracks
6574	GEN INST BLDGS	Administration	7014	AT/MOB BARRACKS	Barracks
6579	ADMIN FACS	Administration	7015	AT/MOB BARRACKS	Barracks
6580	ADMIN FACS	Administration	7016	AT/MOB BARRACKS	Barracks
6581	ADMIN FACS	Administration	7020	AT/MOB BARRACKS	Barracks
6583	HQ BLDG, BN	Administration	7021	AT/MOB BARRACKS	Barracks
6584	HQ BLDG, BN	Administration	7022	AT/MOB BARRACKS	Barracks
6590	ADMIN FACS	Administration	7024	AT/MOB BARRACKS	Barracks
6616	TASC	Administration	7025	AT/MOB BARRACKS	Barracks
6617	TASC	Administration	7028	AT/MOB BARRACKS	Barracks
6803	ADMIN FACS	Administration	7038	AT/MOB BARRACKS	Barracks
6845	HQ BLDG, BN	Administration	7039	AT/MOB BARRACKS	Barracks
6850	HQ BLDG, BN	Administration	7043	AT/MOB BARRACKS	Barracks
6862	HQ BLDG, BN	Administration	7044	AT/MOB BARRACKS	Barracks
6893	HQ BLDG, CO	Administration	7050	AT/MOB BARRACKS	Barracks
7004	HQ BLDG, BN	Administration	7054	AT/MOB BARRACKS	Barracks
7032	HQ BLDG, BN	Administration	7055	AT/MOB BARRACKS	Barracks

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
7037	HQ BLDG, BN	Administration	7057	AT/MOB BARRACKS	Barracks
7040	HQ BLDG, BN	Administration	7058	AT/MOB BARRACKS	Barracks
7052	HQ BLDG, BN	Administration	7067	AT/MOB BARRACKS	Barracks
7064	HQ BLDG, BN	Administration	7068	AT/MOB BARRACKS	Barracks
7069	HQ BLDG, BN	Administration	7070	AT/MOB BARRACKS	Barracks
7096	HQ BLDG, BN	Administration	7071	AT/MOB BARRACKS	Barracks
7097	HQ BLDG, BN	Administration	7074	AT/MOB BARRACKS	Barracks
7099	HQ BLDG, BDE	Administration	7075	AT/MOB BARRACKS	Barracks
7104	CIDC FACS	Administration	7087	AT/MOB BARRACKS	Barracks
7203	TASC	Administration	7088	AT/MOB BARRACKS	Barracks
7241	TNG CTRS-RESERV	Administration	7091	AT/MOB BARRACKS	Barracks
9183	GEN INST BLDGS	Administration	7092	AT/MOB BARRACKS	Barracks
9261	GEN INST BLDGS	Administration	7094	AT/MOB BARRACKS	Barracks
9298	GEN INST BLDGS	Administration	7095	AT/MOB BARRACKS	Barracks
9306	GEN INST BLDGS	Administration	7961	ARMY LODGING	Barracks
9307	GEN INST BLDGS	Administration	4249	CHILD DEV CTRS	Child Development Center
9308	GEN INST BLDGS	Administration	4250	CHILD DEV CTRS	Child Development Center
297	AT/MOB BARRACKS	Barracks	4765	CHILD DEV CTRS	Child Development Center
298	UPH, ENL FACS	Barracks	4768	CHILD DEV CTRS	Child Development Center
853	UPH, ENL FACS	Barracks	1118	OPEN DINING	Dining Facility
855	UPH OFFICER FAC	Barracks	1491	UPH DINING FACS	Dining Facility
856	ARMY LODGING	Barracks	2723	OPEN DINING	Dining Facility
857	ARMY LODGING	Barracks	2968	OPEN DINING	Dining Facility
1004	ARMY LODGING	Barracks	4555	OPEN DINING	Dining Facility
1117	ARMY LODGING	Barracks	5915	UPH DINING FACS	Dining Facility
1120	ARMY LODGING	Barracks	5917	UPH DINING FACS	Dining Facility
1391	AT/MOB BARRACKS	Barracks	5940	UPH DINING FACS	Dining Facility
1392	AT/MOB BARRACKS	Barracks	6012	UPH DINING FACS	Dining Facility
1393	AT/MOB	Barracks	6018	UPH DINING	Dining Facility

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
	BARRACKS			FACS	
1394	AT/MOB BARRACKS	Barracks	6818	UPH DINING FACS	Dining Facility
1474	AT/MOB BARRACKS	Barracks	6824	UPH DINING FACS	Dining Facility
1475	AT/MOB BARRACKS	Barracks	6827	UPH DINING FACS	Dining Facility
1476	UPH, ENL FACS	Barracks	6853	UPH DINING FACS	Dining Facility
1479	AT/MOB BARRACKS	Barracks	6857	UPH DINING FACS	Dining Facility
1480	AT/MOB BARRACKS	Barracks	6869	UPH DINING FACS	Dining Facility
1482	UPH, ENL FACS	Barracks	6872	UPH DINING FACS	Dining Facility
1483	UPH, ENL FACS	Barracks	6878	UPH DINING FACS	Dining Facility
1484	UPH, ENL FACS	Barracks	6887	UPH DINING FACS	Dining Facility
1485	UPH, ENL FACS	Barracks	6891	UPH DINING FACS	Dining Facility
1486	UPH, ENL FACS	Barracks	7023	UPH DINING FACS	Dining Facility
2378	AT/MOB BARRACKS	Barracks	7027	UPH DINING FACS	Dining Facility
2379	UPH, ENL AST	Barracks	7053	UPH DINING FACS	Dining Facility
2380	UPH, ENL AST	Barracks	7089	UPH DINING FACS	Dining Facility
2381	UPH, ENL AST	Barracks	7959	OPEN DINING	Dining Facility
2441	ARMY LODGING	Barracks	4022	PVT/ORG CLB BLD	Golf Club House
2443	ARMY LODGING	Barracks	850	FITNESS FACS	Physical Fitness Center
2444	ARMY LODGING	Barracks	2341	FITNESS FACS	Physical Fitness Center
2445	ARMY LODGING	Barracks	5927	FITNESS FACS	Physical Fitness Center
2446	ARMY LODGING	Barracks	6591	FITNESS FACS	Physical Fitness Center
2447	ARMY LODGING	Barracks	1138	SEP TOIL/SHOWER	Pool Shower Building
2448	ARMY LODGING	Barracks	1144	REC SPT FAC	Pool Shower Building
2449	ARMY LODGING	Barracks	1308	SEP TOIL/SHOWER	Pool Shower Building
2602	ARMY LODGING	Barracks	2679	REC SPT FAC	Pool Shower Building
2603	ARMY LODGING	Barracks	2680	SEP TOIL/SHOWER	Pool Shower Building
2604	ARMY LODGING	Barracks	5539	SEP TOIL/SHOWER	Pool Shower Building
2605	ARMY LODGING	Barracks	7700	SEP TOIL/SHOWER	Pool Shower Building
2606	ARMY LODGING	Barracks	7962	REC SPT FAC	Pool Shower Building
2607	ARMY LODGING	Barracks	9804	SEP TOIL/SHOWER	Pool Shower Building

Building Number	OSD FAC Title	Building Type	Building Number	OSD FAC Title	Building Type
2814	UPH, ENL FACS	Barracks			

Pacific Northwest
NATIONAL LABORATORY

U.S. DEPARTMENT OF
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