

WEATHERFORD PLACE ECOCRAFT HYBRID™ COMMUNITY OF LEED PLATINUM HOMES

Simone du Boise¹

INTRODUCTION

“Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it is the only thing that ever has.” —Margaret Mead

My partner, Denise Donahue, and I, Simone du Boise, AIA, LEED AP, NCARB are, in essence, environmentalists. As licensed architects, certified general contractors, and LEED Accredited Professionals, we co-founded Cadmus Environmental Design-Build in spite of our belief that the world doesn't really need another developer, builder, or architect, but rather because it most certainly needs environmental stewards. We also believe we have both a personal and professional responsibility to utilize our abilities and expertise to “Build A Better Environment.”

Our Weatherford Place Community is a living expression of that commitment to comprehensive energy and water conservation, coupled with contributory assets that demand less and deliver more as a community. Our signature solution, the EcoCraft Hybrid™ Home, provides a prescriptive method towards Net Zero Energy results. Our formula factors efficiency, conservation, and CARE (Clean, Alternative, Renewable, Energy) toward a result of zero demand. Synergistic systems and innovations that include passive solar, active solar PV, and solar thermal are key to measurable results and LEED Platinum Certifications.

The EcoCraft Hybrid™ Home evolves around a holistic approach that includes: low impact design; utilitarian driven and directed by the local vernacular; passive and active solar integration; engineered systems to enhance conservation measures; and in-situ analysis that integrates the past with the present. Energy efficiency, water conservation, and environmental care inform the design and construction of an artistic, comfortable, easy to care for, and healthy home that enables universal access and age-in-place abilities. Following our specific design and construction directives, all of this is achievable at price points comparable to conventional construction.

KEYWORDS

LEED for Homes, LEED for Neighborhood Development, low impact development, stormwater management, Eco Craft Hybrid™ Home, stream restoration, monitoring and energy management tools, alternative energy systems, net-zero energy homes

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FIGURE 1. Entrance to Weatherford Place features brick and stone walls. The stone was “in situ” and stockpiled during excavation. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



LEED FOR HOMES PROJECT CHECKLIST

The Weatherford Place (WP) community's first three homes have received LEED for Homes Platinum Certification. The fourth home is under construction and also on track for Platinum Level certification. The most recent certification is the largest home in the WP portfolio of plans. With 5,016 heated and cooled square feet it was challenged for its size but with the integration of engineered efficiencies was still able to achieve Platinum certification. As per LEED criteria, the home needed to achieve 102.5 points and we were successful in achieving 104.5 points.

[LL] :: Location and Linkages (10 of 10 points)

LEED encourages and rewards sites that continue to develop or re-develop inside the urban fabric where all the supporting infrastructure is in place versus growth into the suburban fabric where the cost of land may be less expensive but the environmental impact is high. Cadmus completely embraces and applauds the USGBC in their recognition of our effect on the environmental fabric and how we choose to develop, grow, and strengthen our built environment. It is our intent to participate in the LEED for Neighborhood Development certification at a Platinum level.

The site selection was a fundamental foundation of the project. Site selection is driven by an assessment of environmental impacts, infrastructure availability, and integration with the existing urban fabric. The north side of the property is bounded by Crossville Creek, a tremendous asset to the community and tributary to the Chattahoochee River, a water resource

that serves four million Georgians who depend on it for drinking water, electricity, and recreation. With a healthy slope downward from the southern street side to the northern stream side, the topography had adversely impacted and continued to challenge the health of the stream. This crucial resource demanded our attention and protection.

Not only did we perform stream testing prior to development, we also tested the stream during development. With a complete 200' stream buffer restoration, test results have shown that the health of the stream actually improved during construction. Cadmus sponsors Crossville Creek in the Adopt-A-Stream Program and together with the WP HOA continues to monitor the stream monthly.

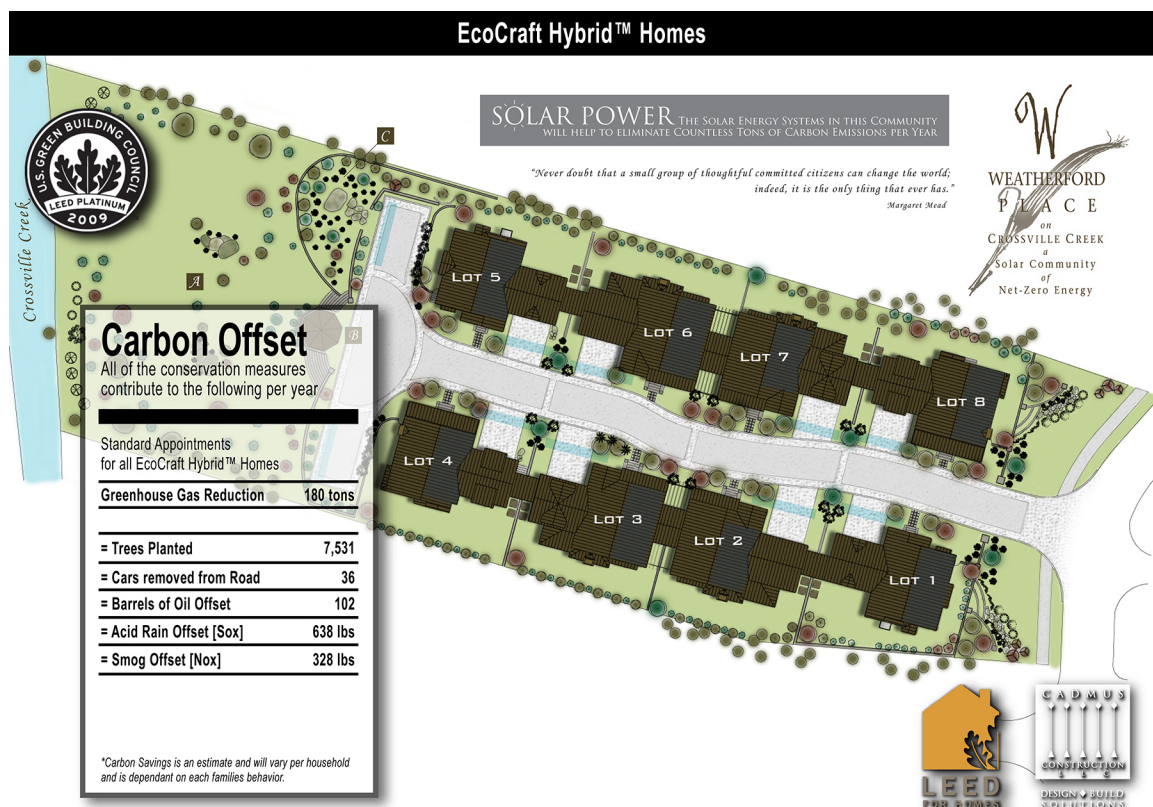
An archeological survey was required by the municipality which we completed to ensure that there were no artifacts along the stream bed. Not surprisingly, nothing was discovered since the entire area had been previously disturbed many years ago for the installation of sewer lines by the county. Consequently, if there were any artifacts in the area, they had long since been displaced and/or destroyed.

The WP parcel was previously owned by Mr. Louie Weatherford and, hence, so dedicated. As part of a much larger tract of land, over many years parcels were sectioned off and sold as the City of Roswell grew. At the time we purchased the property, it was about 1.8 acres

FIGURE 2. Existing site with house, barn, existing paving [indicated in grey] and plowed garden area. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



FIGURE 3. Carbon offset calculations. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



and contained the original barn and homestead. The property has townhome projects on the east and west sides, office professional on the south side, and residential on the other (north) side of the creek.

The WP site had access to existing utility services (water, sewer, gas, and electric). The property is within walking distance to offices, schools, parks, library, religious, and various community centers. Just one block from the City of Roswell Historic District a diverse collection of restaurants, boutiques, antique shops, art galleries, and other amenities, services, and events are all within a short stroll with a dog park and soccer fields at the corner. The City of Roswell has a nationally recognized parks system and expanding network of dedicated bike lanes.

The WP development has its own private park with nature trails that has recently received its Wildlife Habitat Certification. In brief, the certification criteria are to provide food, water, and cover for wildlife to raise their young.

[LID] :: Low Impact Development

Cadmus, as developer, architectural firm, and general contractor for Weatherford Place, was positioned to make an unwavering commitment to create a Low Impact Development (LID). The EPA describes LID as an “approach to land development (or re-development) that works with nature to manage storm water as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats storm water as a resource rather than a waste product. There are many practices that have been used to adhere to these principles such as bio-retention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed’s hydrologic and ecological functions. The Water Environment Research Foundation and others have characterized LID as a sustainable storm-water practice. Cadmus’ commitment to LID practices led to innovations that contributed to the award of 10 points under Innovation & Design Process [ID] and 20 points under LEED for Homes Sustainable Sites sections [SS2] Landscaping, [SS4] Surface Water Management, and [SS6] Compact Development. The details are described in each respective section.

[SS] Sustainable Sites (20 of 22 points)

[SS1] Site Stewardship

Cadmus’ first priority in the site development was the site stabilization, specifically and foremost along the stream buffer. The local codes asked for a stream bank restoration and a 150 foot stream buffer. Cadmus implemented a full 200 foot stream buffer restoration because the site had been previously plowed into the stream bank. There was absolutely no vegetation within the 150 foot stream buffer. Step one was to install a series of erosion and sediment control measures. The E+SC measures were staged to allow the for:

1. Protection of the stream
2. Stabilization of the stream bank
3. Installation of water management system
4. Revegetation of the stream buffer

The protection of the stream along with the stabilization and restoration [with native vegetation] of the entire stream buffer was paramount. Because of our commitment to the stream buffer stabilization, Cadmus, as the developer, did not pursue a variance which would have allowed for an additional two homes to be constructed.

[SS2] Landscaping

The first step in addressing our vegetative resources was to identify a certified arborist, landscape architect, and horticulturalist who shared our level of commitment.

A tree survey was completed and tree save program implemented. Only two distressed trees were recommended for removal. The remainders were carefully limbed and root pruned near disturbance areas and treated with vitamin supplements to bolster their health. The careful removal of privet along the stream bank was done under the direction of our project botanist. The privet was removed in such a manner to maintain shaded areas for native dart fish. The next step was to revegetate the entire 200-foot stream buffer. Cadmus worked closely with our local Pike Family Nursery to ensure that native, drought-tolerant species were chosen. We chose not to use any turf grass but rather return the area in the park to a more natural state. Since the stream buffer stabilization and development of the nature preserve, wildlife, including avian and aquatic populations, has flourished.

The entrance area utilized a drought-tolerant Mondo grass instead of turf grass and incorporated rain gardens on the east and west side. Each home's entrance is landscaped with drought-tolerant vegetation and irrigated with captured rain water via a drip irrigation system. We worked closely with our landscape architect and horticulturalist to reduce the outdoor water demand by 80%. We were awarded 6 points for SS 2.5, 4 points for WE 2.3, and 4 exemplary points for ID 3.

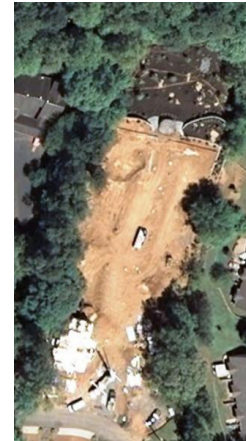
Prior to any homesite excavation, the arborist performed root pruning and injected the trees with supplements. During the construction of each home, the sheetrock [gypsum] was ground and used as a soil amendment. The wood waste was also chipped and used as mulch around each home as an erosion and sediment control measure.

[SS3] Local Heat Island Effects

Cadmus chose to use both vegetation and a light-colored, high-albedo engineered road, sidewalk, and driveway to reduce local heat island effects. During the permitting process, Cadmus applied for a variance to reduce the width of the roadway and asked for the sidewalk to be incorporated into the road. We were required to accommodate Roswell's largest firetruck and outriggers but were able to demonstrate compliance. The scale of the reduced roadway has an effect on both the walkability of the neighborhood and reduces the heat island effect.

The sidewalk and driveways are made of stamped, pigmented concrete and the roadway itself is a combination of locally quarried #56 stone and crimson rock. Understory shade trees [crepe myrtles and redbud trees] are incorporated along the sidewalk. The bronze metal roofs are "cool roofs" with an SRI > 29.

FIGURE 4.
Stabilization
of the stream
bank. ©2014
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[SS4] Surface Water Management (4 of 4 points)

Surface water management was achieved through the innovative and award winning engineered sidewalk and pervious road integration for enhanced storm water attenuation, rain water harvesting, and water quality management. The fundamentals of the system are illustrated in Figure 5—two rain gardens at the entrance, gutters and cisterns at each home, pervious roadway, two cisterns at hammerhead, and a bio-retention area.

Each home is designed with custom gutters and downspouts (see Figure 6) that are engineered to capture 90% of the rainwater [based on the 500-year storm event]. The water is directed through below grade drain tiles and collected in an 1,880 gallon custom cistern that is located below each home's driveway. The rainwater collected at each home is used for irrigation, car washing, and other miscellaneous outdoor uses. Each drip irrigation system has a timer that operates a dirty water pump that is accessible for maintenance thru a portal located beside the driveway.

In the event that the rain water collected exceeds the tank's capacity of 1,880 gallons, an overflow orifice has been engineered to control the velocity from each tank. The overflow for all eight cisterns [one per home] is directed via the development's storm water lines into two additional tanks for the common areas then to an outfall that diverts the water into a bio-retention area. The water is filtered through the bio-retention area and any excess is discharged through a second headwall located in the park. We have not witnessed rainfall leaving this outfall even though the area has seen a 500-year storm event.

The rain water from the engineered roadway is filtered through layers of various sized rock, geo-textile fabric, and collected/directed through both perforated and solid drain pipe, thus meeting the EPA's Phase I storm water requirements. Surface water is directed into the roadway from the sidewalks, driveways, and surface area from each home. The sidewalks also act as a means to lock-in the engineered rock. The surface water from the roadway is then directed and collected in two 1,880 gallon custom cisterns that are located below the roadway

FIGURE 5. Graphic Illustration: ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



in front of the gazebo. Each of these two cisterns has a pump connected to a drip irrigation system that is automated with a timer. The collected water is used to irrigate both the park [a full 200' stream buffer restoration] and the bio-retention area. The community as a whole is able to accommodate 18,800 gallons of storm water attenuation in the rain tanks alone. The engineered system did not require a bio-retention area, but at the time of permitting, the local municipality did not recognize the system innovation and required the redundancy of the bio-retention area. Even though we were told that the required bio-retention area negated the need for the rain harvesting system, we chose to bear the additional expense to prove the concept. The city has since recognized the innovation and encourages similar systems. We have also been recognized by the City of Roswell for exemplary Storm Water Management and have contributed to the City receiving the "Water First Community Certification" and "Wildlife Habitat City Certification."

As with most municipalities, personnel turnover makes it difficult to maintain relationships of trust. When presenting innovative solutions or even those proven yet not locally deployed, we continue to face challenges with community development departments, city engineers, and building inspectors who seem reluctant to consider alternative solutions.

FIGURE 7. Gazebo and private park area. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



FIGURE 6. Custom gutters and downspouts for each home. We have observed the collection of condensate during the summer months when we have had no rain fall. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



FIGURE 8. Crossville Creek, located on the north side of the property. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



[EA] Energy and Atmosphere (32 of 38 points)

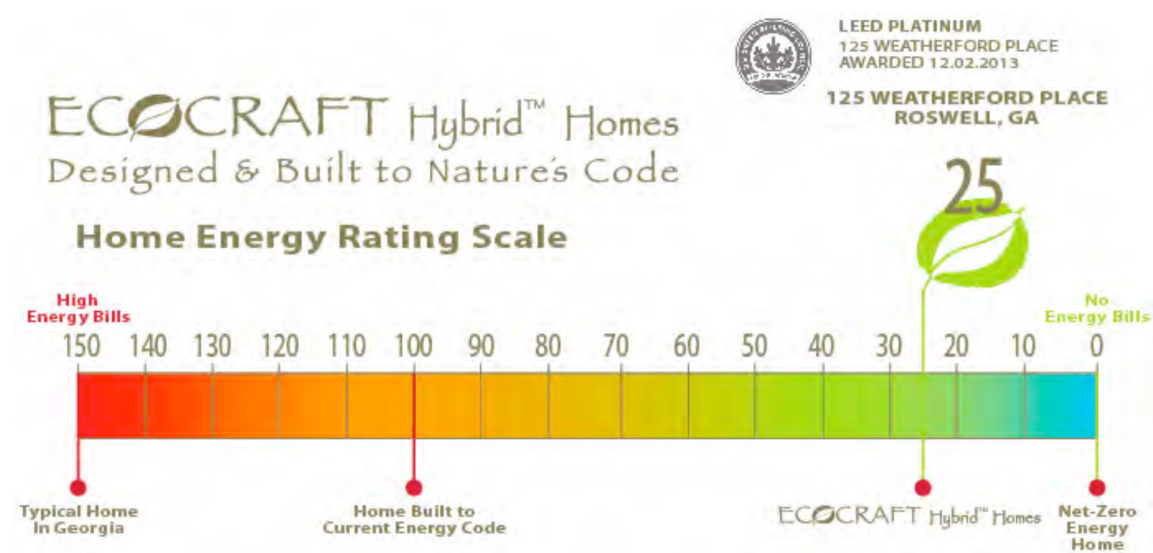
HERS [Home Energy Rating System] Index

The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET)* in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home and the less energy the home will use.

Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home. Thus a home with a HERS Index of 85 is 15% more energy efficient than the HERS Reference Home and a home with a HERS Index of 80 is 20% more energy efficient.

We have compared the five-month energy consumption of a new conventionally built home [built by a premier builder in the same area and with similar features] with no HERS Index and the new EcoCraft Hybrid™ Home with a HERS Index of 25. The five-month total for the conventionally built home was \$3,332.15. The five-month total for the EcoCraft Hybrid™ Home was \$720.42. The conventionally built home uses 4.6 times more energy than the EcoCraft Hybrid™ Home.

FIGURE 9. Graphic Illustration: ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



*The Residential Energy Services Network's (RESNET®) mission is to ensure the success of the building energy performance certification industry, set the standards of quality, and increase the opportunity for ownership of high performance buildings. RESNET is a membership 501-C-3 nonprofit organization. RESNET's standards are officially recognized by the U.S. mortgage industry for capitalizing a building's energy performance in the mortgage loan, certification of "White Tags" for private financial investors, and by the federal government for verification of building energy performance for such programs as federal tax incentives, the Environmental Protection Agency's ENERGY STAR program, and the U.S. Department of Energy's Building America Program.

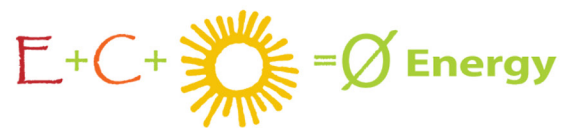
HERS Score of 25

EcoCraft Hybrid™ Homes are energy efficient buildings requiring less than 25% and in some cases 100% less energy than that of a typical home. Once we have designed the most energy efficient building, we then reach for the Net-Zero Energy Goal by supplementing that efficiency with an EcoCraft Hybrid™ Alternative Energy System. Our Integrated Passive Solar Design, coupled with Solar PV and Solar Thermal Systems, provide FREE Hot Water meeting at least 50% of your hot water needs (our monitoring is proving more than 80%) and enough solar electric power to reduce the building's electricity demand to Net or Near Zero. Consequently, the building saves tons of carbon emissions and in some cases could actually eliminate the carbon footprint of operations and/or occupants.

NET-ZERO ENERGY

What Is It and How Do We Achieve It?

Net Zero Energy means a zero net energy consumption and zero carbon emissions annually. We achieve Net Zero through a holistic approach to efficiency, conservation, and CARE* [Clean Alternative Renewable Energy].



Efficiency + Conservation + Solar = Net-Zero Energy

Efficiency

Design and **Build** the most efficient buildings in the most efficient manner

Design > to standard material sizes that minimize waste > calculate ideal ratio of conditioned space to building envelope variables [doors/access, windows/views, natural light harvesting > provide building envelope integrity with comprehensive insulation/air seal > study and apply geo-thermal dynamics passive/active > design structured mechanical/electrical/plumbing/monitoring and management systems > specify the most energy efficient **HVAC/ Lighting/Appliances & Systems** based on performance modeling > simplify custom architectural details to reduce fabrication energy demand > select materials/finishes/treatments [exterior/interior] for low maintenance/durability > integrate high performance renewable energy system(s) > think in terms of lifecycle costs/performance.

Build > to construction docs/specs > train trades/crews > manage waste > recycle

*Solar power is generally one of our best renewable energy resources.

Conservation

Conservation = Monitoring, Management and The Human Factor

Without Conservation - Efficiency literally flies out the window

Save Energy>>>Save Water * Save Water>>>Save Energy

Monitoring and Management systems educate, encourage and enable Conservation and can reduce Energy demand by 15%

* Some of our coal-fired power plants can use up to 45 MGD with 98% consumption

FIGURE 10. Low flow fixtures.
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30075.



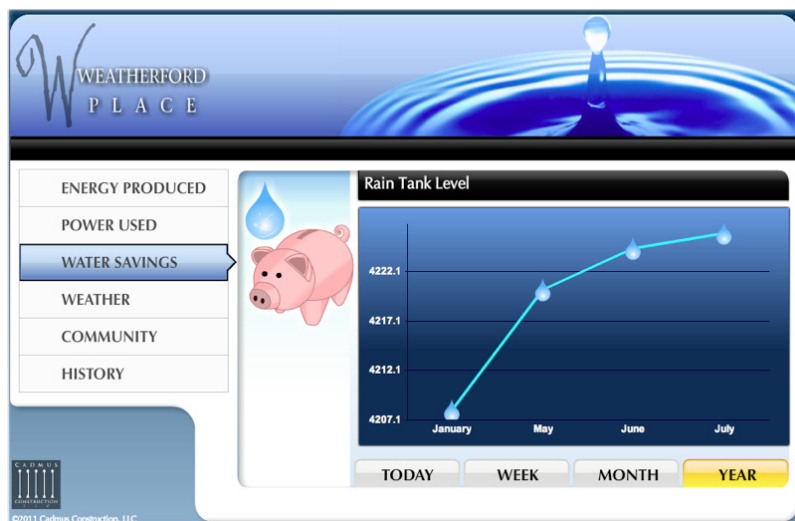
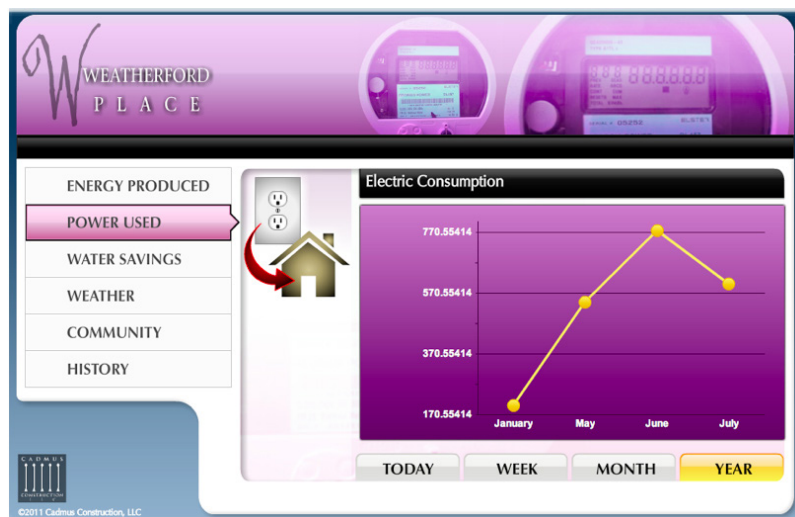
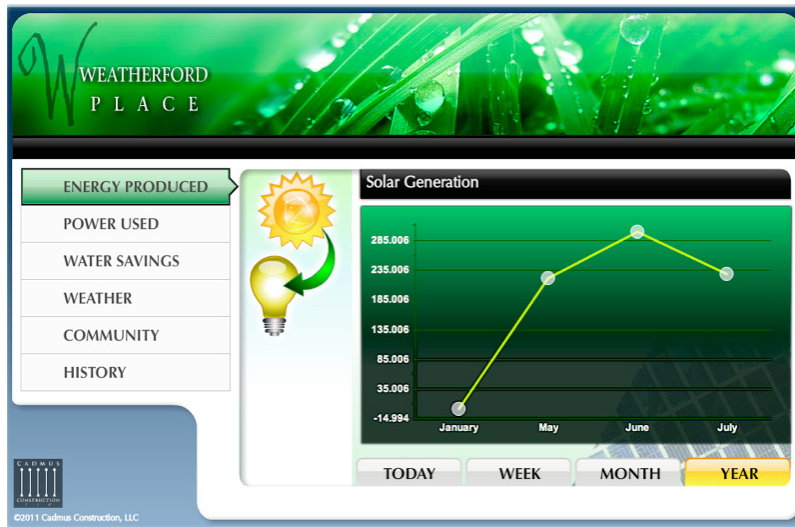
Monitoring and Energy Management Tools

At the time of the project's inception, an off-the-shelf monitoring solution did not exist. Cadmus embedded numerous devices to monitor and sensor temperature and relative humidity for laminate schedules at varying layers to determine the "real world" success of various construction methodologies compared to computer modeling. CTs were also used in conjunction with data loggers to monitor KW consumption and production.

Our mission, to provide the best possible solutions in energy efficient and environmentally responsible living environments, led Cadmus to meet with Lawrence Peterson (Ph.D., Dean, College of Science & Mathematics, Kennesaw State University) and Matthew Laposata (Ph.D., Professor, Environmental Science, Kennesaw State University) in order to share common interests with regard to the implementation of alternative energy resources and Cadmus Construction's environmental design/build initiatives.

Both Dr. Peterson and Dr. Laposata had agreed that our Weatherford Place Project would be an excellent opportunity to gather data on a household's energy collection and consumption. Committed to Leadership in Energy & Environmental Design (LEED) Certification, and with a goal of Platinum Level, this project is designed to meet or exceed all the LEED requirements and incorporate water reclamation and reuse, solar/photovoltaic/hot water, and recycle/reuse systems.

FIGURE 11. Screen captures of custom dashboard: Energy Consumption, Energy Generation, Water Conservation. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



A monitoring system integrated with data collection/management software and accessible via a website for real time energy analysis created a uniquely powerful tool with tremendous value. With multi-tiered and password-protected access, it served a broad and diverse audience. This data collection/management system coupled with internet access offered:

- *Academia*—A broad scope of educational and research applications for students, faculty, and the general public, as well as utilities and industry. Kennesaw State University used the anonymous data from Weatherford Place as part of a required course for all non-science majors. The data was integrated into a website [<http://ihome21.kennesaw.edu>] and developed into K-12 lesson plans for teachers.
- *Homeowners*—The advantage of studying their individual home's energy demands and costs.
- *Environmental Organizations*—A valuable tool for research, educational outreach, and environmental advocacy.
- *Confirmation of Construction Methodologies*—Data can be collected and compared over time to determine if the laminate schedules produced the expected results projected by computer modeling.

Data Monitoring Result to Date

We have been monitoring one home's solar energy production and whole house [3,860 h/c sq. ft] energy consumption since 2007 and have found that annual energy production has exceeded projections. The energy bills during the first year for 105 Weatherford Place were approximately \$150. During that time, the home located at 115 Weatherford Place was constructed using the energy from 105.

We have also discovered that the basic functions of this home [domestic hot water, HVAC, two Energy Star refrigerators, and basic lighting] require an average of 11 kWh per day [4015 kWh annually]. The balance of the load is created by optional devices [flat screen TVs, routers, computers, espresso/coffee machines, hairdryers, iron, etc.] controlled by the occupants and varies per household.

Making the homeowner aware of their energy consumption and the areas of highest use will help them control, and hopefully reduce, their energy consumption.

Old Weatherford Barn Carefully Documented & Deconstructed

The barn wood was re-used and recycled into custom shutters, gazebo benches, and other interior accents. Even the sawdust from the planed wood was used as ground cover for the solar staging area. Some of the cobblestones were re-used at the entrance as granite curb stones and some of the larger pieces were made into benches around a fire pit in the community park.

The old barn was originally constructed of felled trees from the site and salvaged wood from the bleachers of Roswell's first

FIGURE 12. Reclaimed barn wood shutters. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.





FIGURE 13. Old barn prior to deconstruction; sawdust from planing barn wood [used as ground cover for solar staging area]; barn wood shutters; wood chips [used for site stabilization]. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.

ball field by Louie Weatherford and his father. The foundation was made from stacked field stone that was collected from the site and cobblestones that were salvaged from old Decatur Street in Atlanta.

BUILDING INTEGRATED ALTERNATIVE ENERGY SOLUTIONS

EcoCraft Hybrid™ Homes are designed with CARE [Clean Renewable Alternative Energy]. Geographic location, site characteristics, energy models, and economics are a few of the factors considered in determining the most effective alternative energy solution.

- *Passive Solar*—Optimum orientation, roof pitch, placement and sizing of windows/doors w/ solar/uv glazing and overhangs for solar shading.
- *Solar PV*—Thin-film integrated into standing seam metal roof.
- *Solar Thermal*—Co-generation in same area under metal roof for hot water and synergistic results.

Solar

Passive Solar

Solar PV

Solar Thermal

Co-Generation/Hybrid Systems

Building Integrated > Roof Mounted > Other Surface / Ground Mounted
New Technologies / Coatings / Nano and more

Enough Solar Energy hits the earth in one hour to power our entire planet's current energy demand for one year.

Passive Solar Design

A commitment to design a neighborhood community of near/net-zero homes was made during the design concept stage for Weatherford Place in 2005. Denise Donahue directed the visionary approach to prove that sustainable building with a keen focus on water and energy conservation was both environmentally and economically rewarding. Save water—save energy. Save energy—save water.

The state of Georgia generates the majority of energy from coal-burning power plants that use in excess of 500 millions of gallons of water per day [as cited in “Water Vulnerabilities for existing Coal Fired Power Plant,” published in 2010 by National Energy Technology Laboratory]. Reducing the energy required by each homeowner reduces both water demand—an ever-diminishing resource—and electric power demand. Donahue’s futuristic concepts required that each home’s design begin with passive solar.

The existing site had an established tree line that bordered the east and west property lines. The site grade diminished from the south to the north. Each building was designed to optimize building integrated alternative energy systems; specifically solar photovoltaic and solar thermal [98% exposure], natural light harvesting [located on the north side of the roofs], and minimal solar heat gain from fenestration.

A comprehensive solar shading analysis was taken on the east and west sides of Lot 1, 2, 3, and 4. Even though the east and west sides provide the majority of fenestration, solar shading devices such as deep overhangs, cantilevers and porches, light ledges, along with a dense tree line and additional Weatherford Place Homes across the street, provide shading to minimize solar heat gain but maximize diffused natural light. The solar shading analysis demonstrated the success of the approach.

It is imperative that the “real world conditions” are taken into account when determining passive solar attributes. Failure in passive solar design may certainly be assured if “rule of thumb” scenarios or a “text book” assessment is used without considering in-situ conditions. We are continuing our dialogue with the USGBC on the subject of criteria for achieving credit ID1.5. The criteria for awarding the Passive Solar point are predicated by meeting four requirements [A, B, C and D]. Currently requirement A is met by simply counting the fenestration on the north and south side as compared to the east and west side. If one isolates each home at Weatherford Place—or any building for that matter—and removes in-situ characteristics (site

FIGURE 14. Southern Facing Elevation features: integrated solar pv & thermal system, deep overhangs and cantilevers that are strategically placed to act as solar shading devices. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



conditions, natural vegetation, and adjacent building/structures), then the home does not achieve criteria “A” for the passive solar credit. Clearly, that was not the approach used when planning the community, nor does it reflect the high performance results we see in real world field analysis.

Building Integrated Solar PV and Thermal System

The USGBC LEED for Homes program (even at the Platinum Level) does not require the integration of alternative energy systems. However, the deployment of these systems is certainly in the spirit of the program and has proven to have significantly contributed to lowering the HERS index and carbon footprint, as well as energy costs. We decided to take advantage of the HERS and apply that to achieving additional points under Energy and Atmosphere [EA].

Each WP EcoCraft Hybrid™ Home has a solar thermal system that provides approximately 80% of the domestic hot water load. The building integrated solar system provides a synergistic solution that wicks heat away from the solar photovoltaic system, transfers the energy into another heat sink (water), creating another alternative energy that is used to reduce the domestic hot water load and cool the photovoltaic panels (PV), thus increasing the amount of energy produced by the solar PV panels. Research has shown:

- solar thermal can reduce PV temperatures up to 37°F
- 1–2% increase in PV efficiency for every 10°F drop in temperature
- 5% increase in PV efficiency at 85°F ambient temperature

Given the goal of producing 50% of its energy demands, each home was designed with a 3.88 kW DC Solar PV system. We used PVwatts to determine the annual energy production. Although the numbers are conservative, PVwatts is a standard tool provided by NREL. The Derate factor was adjusted for the amorphous thin film panels. The results yielded 5,773 kWh annually. A more in-depth analysis revealed that shifting each building slightly east produced slightly more energy.

FIGURE 15. Deep overhangs and balcony [used as a solar shading device]. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



FIGURE 16. Installing the building integrated solar photovoltaic and solar thermal system. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



FIGURE 17. Streetscape at Weatherford Place. ©2014 CCLLC, Cadmus Construction LLC, Roswell, GA 30075.



The amorphous thin film panels, at Weatherford Place, were the first of their type to be installed in the Southeast. Following extensive research, including personal interviews and project consultations with solar engineers, industry patent holders, technology leaders, and authors of white papers published specific to the study of real world performance of these technologies based on over 10 years of proven performance, Cadmus identified amorphous thin film as the best panel for the following reasons:

- Amorphous thin film panels are virtually indestructible.
- 1/5 the weight of ballasted crystalline panels.
- Less than 1/2 the weight of mechanically fastened crystalline panels.
- Require no roof penetrations, unlike most crystalline panels which require multiple roof penetrations.
- Amorphous thin film does not require annual cleaning as do crystalline panels.
- Amorphous thin film outperforms crystalline panels in “real world” conditions.

EcoCraft Hybrid™ Building Solutions

A prescriptive method for high performance/low impact development with design-build solutions at or below construction costs associated with conventional building. All the benefits of design-build, including site evaluation tools and design methodologies, materials, systems and technologies that embody the EcoCraft Hybrid™ Building Solution holistic approach to site development, architectural design, and construction management for residential, commercial, and mixed use.

Highlights include: Innovative Alternative Energy Systems, Rainwater Harvesting and Irrigation, Award Winning Storm Water Management, Age-In-Place Design, Monitoring, Measurement and Management Tools.

Embracing the spirit of USGBC and the LEED Program by reaching beyond requirements to fully integrate efficiency, conservation and renewable energy towards NZE performance goals generating innovative solutions for healthy, age-in-place, universal access, affordable and sustainable environments.

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