Going Green in the Water & Wastewater Industry: How Design-Build Can Facilitate the Certainty of LEED™ Certification

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This article describes the driving forces for green building practices, challenges encountered in certifying buildings at water and wastewater plants, and the way that alternative delivery methods, specifically design-build, facilitates and increases the certainty of certification. A project highlight describes the process used to evaluate a project and leverage integrated design and construction input to increase the certainty of certification from initial conception to final construction.

The Greening of America

Over the past 10 years, green design and construction have become the fastest-growing initiatives in the architectural engineering and construction (AE&C) industry. They can be defined as environmental conscious attitudes, values and principles combined with science technology, engineering practices, and low-impact construction aimed at improving our local and global environmental quality.

With unprecedented governmental initiatives and funding, public acceptance and public-policy advocates, development of sustainable materials and a push for energy and cost saving, owners are requiring that projects achieve some level of sustainable design. Drivers that persuade owners to "go green" include building impacts to the environment that consist of approximately 39 percent of the total primary energy consumption, as shown in Figure 1 (U.S. Department of Energy (DOE), 2008), and more than 60 percent of the electricity used in the United States (Energy Information Association, EIA 2010). Combined residential and commercial buildings make up approximately 7.9 percent of carbon dioxide emissions globally (Intergovernmental Panel on Climate Change, IPCC 2007) and 39 percent of the total United States carbon dioxide emissions (Pew Center on Global Climate Change).

This impact is linked directly with our natural environment, economy, health, and productivity. As a result of these demands and as a response to the need for energy efficiencies, the United States Green Building Council (USGBC) was founded. This nonprofit organization was organized in 1993 to establish green building practices committed to cost-efficient and energy-saving initiatives for future generations.

One of the first initiatives was the development of a rating system to define and measure green buildings. The first LEED™ Green Building Rating System came out of that initiative in 1998. Today LEED not only focuses on building operation and maintenance, but also includes building types and project scopes. LEED is an internationally recognized green building certification system providing third-party verification that a building has been designed and constructed using sustainable design and construction strategies and principles aimed at improving the building's energy performance.

LEED Certification Challenges in Water & Wastewater

The LEED rating system was developed as an assessment tool for evaluating the performance of design and construction from a standpoint of sustainability. Even with all its modifications and improvements, LEED focuses primarily on inhabited commercial, industrial, and residential buildings. That poses challenges to owners, water and wastewater professionals, and constructors wanting to LEED-certify water and wastewater facilities.

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Some of these challenges may include 1) limited site availability, 2) geographic location, 3) non-applicable zoning requirements or land uses, 4) unavailable alternative transportation services, 5) vehicular loading requirements that prohibit alternative impervious surfaces, 6) conflicting stormwater design requirements, and 7) conflicting client-developed design and material standards.

Overcoming these challenges requires that the owner, design professionals, and constructors develop a culture of open, participatory communication. Advanced planning and

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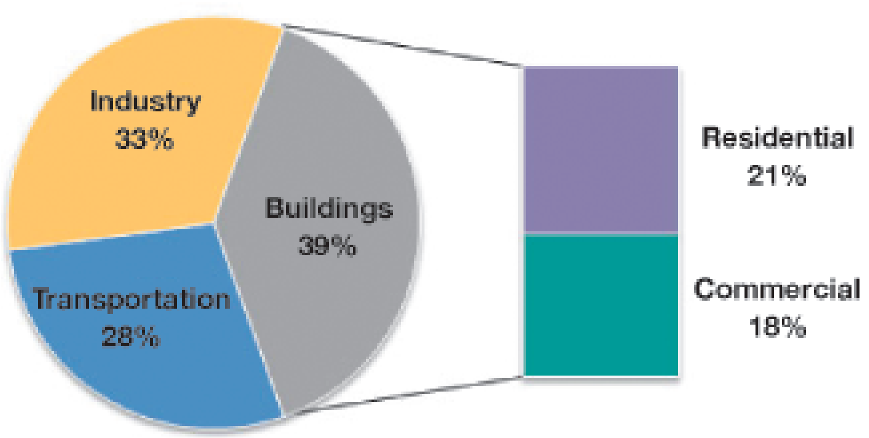
Figure 1: Buildings' Share of U.S. Primary Energy Consumption (2006)



Source: U.S. Department of Energy (DOE), 2008 Buildings Energy Data Book, Section 1.1.1, 2008.

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team integration are necessary to identify areas of conflict and develop solutions to obtain certification.

Permitting agency requirements should be considered early in the process to avoid conflicting interests and requirements. Site planning and management to best utilize the available area and early design and construction coordination are essential for efficient utilization of green construction practices, procurement, and use of sustainable materials and resources.

Choosing a Delivery Method

Project delivery methods are a way that designers, contractors, subconsultants, and construction trade subcontractors provide various services to the owner of a project. The three major delivery methods typically used include traditional Design-Bid-Build (DBB), Construction Manager at Risk (CMAR), and Design-Build (D-B), as shown in Figure 2.

Studies show that project delivery methods directly influence budget, schedule, and construction quality. These studies point out how key indicators are influenced by the degree of team integration and delivery method. Specifically, these studies show that integrated delivery methods such as D-B and CMAR promote team integration and have a higher success rate in meeting budget, schedule, and quality goals than does DBB (Konchar and Sanvido 1998, Ling, et al. 2004, Hale, et al. 2009).

Similarly, studies show that team integration also influences the success of delivering a high-performance sustainable building and LEED certification (Charles Pankow Foundation, 2009). These studies point out that traditional DBB, and to some extent CMAR, can limit the contractor's participation and ability to contribute to sustainable objectives based on procurement procedures and payment provisions (Lapinski, et al. 2006, Riley et al., 2003).

Using the traditional delivery method of DBB requires two separate procurement phases: acquisition of the design team and acquisition of the contractor. Usually procurement of the design team is based on qualifications, while payment typically is fixed lump-sum price or cost plus fee. The contractor normally is selected upon completion of design on low-bid and paid by a fixed lump-sum price.

A recent study showed that projects seeking LEED certification using DBB tend to have a lower success rate of achieving LEED certifications because the guarantee to deliver a certified project does not reside with the engineer, but with the contractor; therefore, the guarantee to deliver a certified building is later with DBB than any other delivery method.

CMAR requires the owner to retain a designer for design services and retain a construction manager to build the project, while guaranteeing the cost and schedule. Payment for the designer is normally fixed lump-sum price or cost plus fee, while payment to the construction manager is typically cost plus fee, not to exceed a guaranteed maximum price (GMP).

The value of this delivery method is that the construction manager is involved with the project early. The CMAR becomes an integrated part of the project team providing preconstruction services, cost estimating, scheduling, constructability reviews, and value engineering studies. This arrangement allows the LEED certification guarantee to be determined at the time of the GMP, which could be as early as 30 percent or as late as 100 percent in the design process as specified by the owner.

D-B is a project delivery method in which the owner retains both design and construction services in the same contract from a single legal entity referred to as the D-B builder. The D-B builder is selected either by a competitive proposal process or a qualifications-based process. The D-B warrants the design and is responsible for the cost of any errors or omissions caused by the designer.

Payment to a design builder is through either a fixed lump-sum price or a cost plus fee not to exceed a GMP. This delivery method allows the builder to be involved early in providing constructability reviews, cost estimates, schedule adjustments and value-added design input. Under this project delivery method, the LEED certification guarantee is determined at the end of the conceptual design and prior to the design-builder providing a fixed lump-sum price or at the time of GMP.

Since both design and construction points are needed to obtain LEED certification, an integrated delivery method is best suited to achieve this goal. Under traditional DBB, and to some extent CMAR, the engineer can not guarantee certification but can design with green building and LEED principles. Under those delivery methods, the contractor is responsible for the construction of the facility as designed by the engineer. Changes to or errors in the design during construction are the responsibility of the owner.

The D-B delivery method creates a way for the owner to put the liability of design, construction, and certification contractually onto a signal source. A single source of responsibility promotes collaboration between the designer and contractor, increasing the certainty of certification.

Project Highlight

Recently the U.S. Navy selected the Haskell D-B team, consisting of Haskell as the design-builder and guarantor, Brown and Caldwell as the process designer, Haskell AE as the building designer, and Haskell as the general contractor, to design and construct several new facilities and improvements to an existing wastewater treatment plant located in Indian Head, Maryland. The criteria package required

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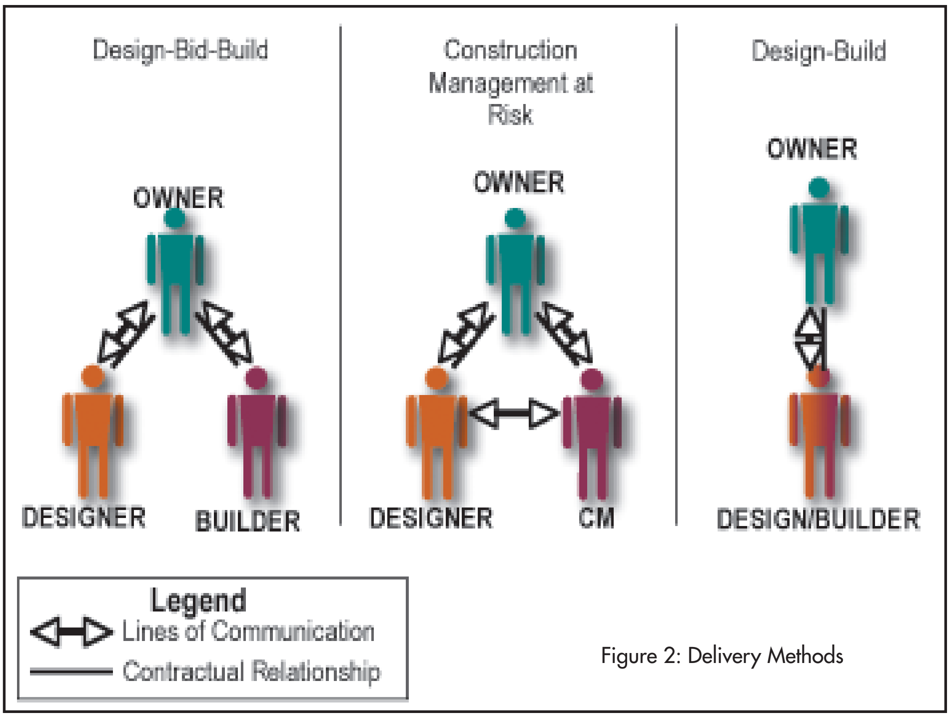
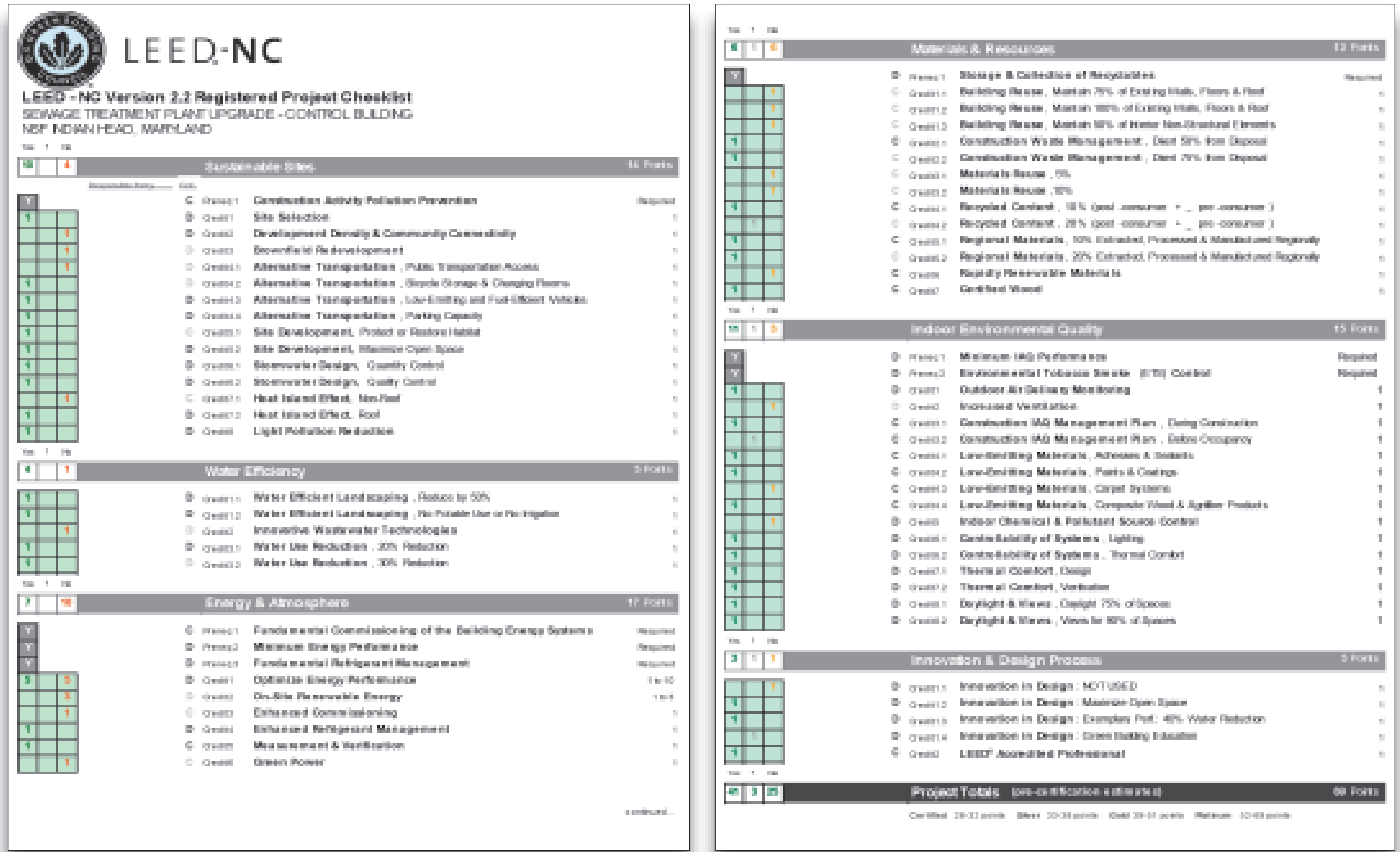


Figure 2: Delivery Methods



LEED-NC

LEED - NC Version 2.2 Registered Project Checklist
SEWAGE TREATMENT PLANT UPGRADE - CONTROL BUILDING
NSF INDIAN HEAD, MARYLAND

Sustainable Sites

Water Efficiency

Energy & Atmosphere

Materials & Resources

Indoor Environmental Quality

Innovation & Design Process

Project Totals (pre-certification estimates)

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that the facility achieve Version 2.2 LEED-NC Silver Certification. The team worked closely with the Navy to meet the goals and standards while designing a facility with LEED design principles that could be constructed to meet LEED Silver Certification requirements.

This portion of the article describes the process used to evaluate the project and determine if the required certification level could be obtained by applying green building and LEED design practices, as well as managing resource recovery, reuse, and purchasing practices during construction. The integrated nature of D-B permitted the team to assess the requirements, make adjustments in design, and have early contractor input for constructability and cost estimating. The following paragraphs describe in detail the process used to apply for LEED Silver Certification.

Evaluating the Project for Certification

During the proposal phase, Haskell evaluated the project and its elements to determine if the contract requirements of a LEED Silver Certification could be achieved. The team utilized the information provided in the criteria package and the LEED project checklist as a guide to evaluate the project. The site and each of the facilities were evaluated alongside the LEED requirements to determine possible points.

Based on the evaluation, it was determined that several of the buildings could not meet the requirements necessary to achieve enough points to be Silver Certified; therefore, the entire project could not be certified. It was determined that the administration building could be silver certified as a stand-alone building on the project because of its commercial and institutional nature. As a result, Haskell proposed to achieve LEED Silver Certification for the administration building.

Out of a possible 69 points, the building was pre-qualified for 41 points (see the checklist). If the building qualifies for all of the 41 points requested, it will qualify for a higher Gold Certification; however, typically some requested points are not achieved, so having more points than required for certification is in the best interest of the project.

Green Building & LEED Design Practices

During the design phase, the project checklist developed during the project evaluation process was used to form a strategy to meet the requirements of each LEED category. Both the design and construction teams worked to develop these strategies.

The use of an integrated team to develop the strategies expedited the design process by reducing the uncertainties of constructability and cost. It also increased confidence in obtaining points for each credit and allowed the design team to make early changes to the design to satisfy the requirements as issues became known. The following design principles and credits were used to attain the necessary points for certification.

- ***Sustainable Sites***
  - Site Selection: previously developed, that meets all credit requirements.
  - Alternative Transportation: providing bicycle storage, changing rooms and fuel-efficient vehicle spaces.
  - Stormwater Design: site design that meets post-development peak runoff rate and quantity that is not more than pre-development.
  - Building Roof Design: use of lighter colored roofing materials.
  - Reduction of Light Pollution: reduction of exterior lighting power densities and use of automatically controlled interior lighting.
- ***Water Efficiency***
  - Water Efficient Landscaping: elimination of turf grass, no potable water use and no irrigation system.
  - Water Use Reduction: by the use of high-efficiency fixtures, and occupant sensors.
- ***Energy & Atmosphere***
  - Optimizing Energy Performance: by percent improvement in building performance rating compared to the baseline building performance.
  - Enhanced Refrigerant Management: use

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of alternatives to chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants.
- Development of a Measurement and Verification Plan: a plan that involves recording actual energy use over the course of occupancy and comparing it with estimated energy used in design.

Indoor Environmental Quality
- Indoor Environmental Quality: use of outdoor air measuring devices.
- Increase Ventilation: mechanical ventilation that increases breathing zone outdoor air ventilation rates.
- Construction Indoor Air Quality Management Plan: management of indoor air quality during construction.
- Low-Emitting Materials: use of adhesives and sealants that meet volatile organic compound limits.
- Low-Emitting Materials: use of paints and coatings that meet volatile organic compound limits.
- Low-Emitting Materials: use of composite wood and agrifiber products requirements.
- Controllability of Systems: indoor individual lighting controls.
- Controllability of Systems: indoor individual comfort controls.
- Thermal Comfort: HVAC systems designed to meet the requirements of ASHRAE-55 for air temperature, radiant temperature, humidity, and air speed.
- Thermal Comfort: comfort verification through a survey of the building occupants.
- Daylight and Views: provide daylight to at least 75 percent of the regularly occupied spaces.
- Daylight and Views: provide views to at least 90 percent of the regularly occupied spaces.

Innovation & Design Process
- Innovation in Design: provide green building education.
- Innovation in Design: 40-percent water reduction.
- LEED Accredited Professionals on the project team.

Resource Recovery & Reuse of Materials

The D-B delivery method allowed early contractor input as facilities were being evaluated for demolition. An early site visit by the contractor helped identify the materials of these facilities and the possibility of material recovery, reuse, and landfill diversion. Having this information helped the design team identify the LEED credits under the category of Materials & Resources that could be obtained. The following LEED credits are being utilized to meet these goals.

Material & Resources
- Diversion of a Minimum Construction Waste: diversion of up to 75 percent of the construction waste from landfills by recycling, onsite reuse, or resale.
- Specifying Materials with Recycled Content: at least 10 percent of recycled content from the site.

Local Sustainable Materials

With early contractor input, identifying local material manufactures and suppliers of materials that could be readily purchased and shipped to the job site from within a 500-mile radius was expedited and known prior to design completion, allowing the design team to be sure of obtaining materials that met the requirements of regional materials. The following LEED credits were utilized because of early input by the contractor to help meet the required points for Silver Certification.

Material & Resources
- Regional Materials: 20 percent of materials will be locally extracted, harvested, and recovered.

Use of Wood-Based Products: use of Forest Stewardship Council (FSC)-certified wood products.

Conclusions

Currently the construction of this project is approximately 25-percent complete. An assessment indicates that the utilization of D-B has resulted in optimal performance and early team involvement that has facilitated the certainty of obtaining the points necessary for LEEDTM Silver Certification.

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