DEVELOPING A SUSTAINABILITY RATING TOOL FOR WASTEWATER SYSTEMS

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ABSTRACT

As part of a growing trend towards integrated economic, social, and environmental sustainability, there is interest in wastewater treatment systems that use less energy (or even produce energy), allow for the elimination or beneficial reuse of biosolids, and restore natural nutrient cycles.

A sustainability rating system specifically designed for use by wastewater utilities can serve as an industry benchmark for environmental considerations and will be of practical use to utilities. Such a tool would complement other research, decision analysis techniques, and environmental management systems being used to develop sustainability indicators for projects, industries, and geographic areas.

This concept is inspired by the successful "Leadership in Energy and Environmental Design" (LEED™) Green Building Rating System(s) developed by the U.S. Green Building Council, which provides national standards for what constitutes a "green building."

KEYWORDS

Sustainability; Wastewater; LEED; Energy; Resources

INTRODUCTION

While today's wastewater management systems are a foundation of modern public health and environmental protection, is a new interest within the wastewater management community to establish best practices and industry benchmarking to encourage broader and more meaningful sustainability. The intent of a more sustainable wastewater management system is to use less energy (or possibly produce energy), allow for the elimination or beneficial reuse of biosolids, and restore natural nutrient cycles. (Daigger, 2005) Following are some of the drivers that are prompting the industry to consider integrating sustainability into their wastewater solutions.

- Belief or culture that it is the "right thing to do"
- Local and state requirements or policies to incorporate sustainability
- Operational efficiencies
- Cost reduction in operations and maintenance (O&M) (e.g., lower energy cost)
- Lower risk (e.g., less management of toxic chemicals)
- Public acceptance of a more "green" system
- Improved regulatory relationships

This paper presents an overview of a practical toolkit for the planning, design, construction, and operations of sustainable wastewater treatment systems. Following are positive outcomes that may arise from the use of this toolkit.

- A mechanism for the wastewater treatment industry to quantify and set criteria for what constitutes an energy efficient and environmentally responsible "green" treatment system—it can be used to guide planning, design, and public outreach to help utilities achieve their goals.
- A means to promote the achievement of green treatment processes and increased awareness of the benefits of incorporating sustainability principles in wastewater solutions.
- Future adaptation for drinking water treatment and other types of industrial processes.
- Future adaptation to include formal social credit ratings (this version includes opportunities for social credits as "innovation" credits).

CREDIT STRUCTURE

The credit structure is inspired by the "Leadership in Energy and Environmental Design" (LEED™) Green Building Rating System(s)™ developed by the U.S. Green Building Council (USGBC), which provides national standards for what constitutes a "green building." The Wastewater Sustainability Rating Tool (WWSRT) borrows the credit numbering structure of the USGBC LEED™ family of products with some modifications. The intent of the WWSRT is to complement but not overlap with existing LEED™ products. For example, a wastewater treatment plant (WWTP) would ideally incorporate LEED™ for the buildings and WWSRT for the treatment process. In addition, LEED™ is developing a product for laboratories, so wastewater laboratory operations are not included in this tool.

This ranking has been aligned with LEED™ because LEED™ is a familiar and effective tool being used by a rapidly growing sector of design, construction, operations, and maintenance industry professionals. For example, the Green Guide for Health Care™ (GGHC, Version 2.1 Pilot) is a LEED™-based best practices guide for use in health care design, construction, and facilities management. The GGHC takes a comprehensive view of design and operations, and is also used as a significant reference.

Some credits directly incorporate the language of the corresponding LEED™ or GGHC credit; however, other credits have been modified or added to reflect the unique nature of wastewater process activities.

This article includes a list of credits; each credit includes a brief description, intent, and discussion, if needed. A definition of each is provided below.

- **Intent** summarizes the goal of the credit.
- **Requirements** suggest documentation and steps to achieve the credit.
- **Discussion** provides additional clarification and notes for certain credits. (GGHC, 2005)

Because this tool is still in development and has not been released for piloting, some credits are more developed and detailed than others.

CATEGORIES AND POINT SUMMARY

Table 1 provides a summary of the categories and points in the WWSRT, as described in this paper. This version of the WWSRT development includes three major categories. The "General" category applies to all wastewater utility efforts toward sustainability, and should be considered in conjunction with the other two categories. The second category applies to planning, design, construction, and start-up for new construction or major upgrades.

The third category separates the operations, maintenance, and management elements. Any existing utility can consider applying the "General" and "Operations" categories to their wastewater system.

Table 1 – Wastewater Sustainability Rating System Overview

Category	Total Achievable Points
General	
1.0 Chartering	2
2.0 Innovation	4
Planning, Design, Construction, and Start-up for New Construction and Major Upgrades	
3.0 Collection Systems (Pipeline Networks)	6
4.0 Watershed Management	10
5.0 Energy and Atmosphere	9
6. 0 Materials and Resources	13
Operations for All Wastewater Utilities	
7.0 Utility Management	27

Points can be used to establish threshold levels in an official certification system; however, this tool currently focuses on a voluntary educational approach for early adopters of sustainability to develop and document their sustainability approaches. (GGHC, 2005)

GENERAL

1.0 Chartering

Credit 1.1 Integrated Planning and Implementation (1 point)

Intent: Achieve an effective collaborative process throughout any phase of work—planning, design, construction, start-up, or operations and maintenance—by engaging multiple technical disciplines, as well as owners, users, constructors, managers, and operations personnel. (GGHC, 2005)

Requirements: The owners work with the involved parties to develop and endorse a charter that includes goals and measures of success. Collaborate with designers, constructors, managers, operations personnel, and community stakeholders. Recharter as needed throughout the life of the project (for example, when moving into a significant new phase or managing a change in key staff or stakeholders). Measure success on a regular basis. (CH2M HILL, 2001)

Discussion: Identify strategies and tools that will be used during the project. Involve community as required as part of a permitting or approval process; the project charter can specify additional community involvement beyond requirements. Consider safe and environmentally sensitive operations and a commitment to continuous improvement.

Credit 1.2 Sustainability Mission Statement and Program (1 Point)

Intent: Establish sustainability goals and use as a basis for selection and implementation of future planning, design, construction, and operational strategies. Demonstrate a cross-discipline approach in decision-making to ensure safe, healthy, and environmentally sensitive methods and materials.

Requirements: Develop a mission statement and program that includes goals for enhancing the local and global environment as well as the work environment for operations personnel. This shall be the guiding document for decision-making. (GGHC, 2005)

2.0 Innovation

Credit 2.1 Innovation (1-4 Points)

Intent: Provide an opportunity to award projects points for exceptional performance above the requirements set by this rating system and/or innovative performance in green engineering categories not specifically addressed.

Requirements: For each point, identify the goal of the innovation credit, the requirement for compliance, the deliverables to demonstrate compliance, and the design approach (strategies) that are being considered to meet the requirement.

Discussion: These credits can apply to outstanding social or community efforts such as the following:

- Community involvement
- Education programs
- Community development achievements
- Demonstrated social equity measures (e.g., is the WWTP located in a privileged rather than a disadvantaged area)
- Cost to community (e.g., are rate increases or community indebtedness avoided?)

In addition, consider life cycle analysis of components or research the undocumented benefits of sustainability. (USGBC, 2005)

PLANNING, DESIGN, CONSTRUCTION, AND START-UP FOR NEW CONSTRUCTION AND MAJOR UPGRADES

3.0 Collection Systems (Pipeline Networks)

Credit 3.1 Erosion and Sedimentation Control (1 Point)

Intent: Control erosion to reduce negative impacts on air and water quality.

Requirements: Prepare and implement an erosion control plan for any construction relating to the collection system. The plan must conform to the latest U.S. Environmental Protection Agency (EPA) guidelines for stormwater management during construction or local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authority.

Credit 3.2 Route Selection (1 Point)

Intent: Avoid disturbance of sensitive areas and reduce environmental impacts from the location of a pipeline through a sensitive area.

Requirements: No collection system extension shall be placed in any of the following areas.

- Prime farmland as defined by the U.S. Department of Agriculture
- Within 5 feet of the 100-year floodplain as defined by the Federal Emergency Management Agency
- Threatened and endangered species habitat as defined by federal and state authorities
- Within 100 feet (or more stringent per locally applicable regulations) of waterways, wetlands, and areas of special concern identified by federal, state, and local requirements
- Public parkland

Credit 3.3 Development Density (1–2 Points)

Intent: Channel development to urban areas, protect greenfields, and preserve habitat and natural resources.

Requirements: Provide new pipeline infrastructure only within areas planned and zoned for minimum development density based on square foot of building space per acre of land (sf/ac):

- 30,000 sf/ac 1 point
- 60,000 sf/ac 2 points
  (two story downtown development)

Credit 3.4 Brownfield Redevelopment (1 Point)

Intent: Enable the rehabilitation of damaged sites where development is complicated by real or perceived environmental contamination, reducing the pressure on undeveloped land during the planning stages of the project.

Requirements: Provide service connections to brownfield sites as documented by a federal, state, or local government agency.

Credit 3.5 Reduced Disturbance (1 Point)

Intent: Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirements: Use of trenchless technologies or limitation of site disturbance to within 5 feet of trench or paved area. (USGBC, 2005)

4.0 Watershed Management

Credit 4.1 Water Reclamation and Reuse (1-4 Points)

Intent: Limit or eliminate the amount of water discharged as a point source. Reduce generation of wastewater and potable water demand, while increasing local aquifer recharge.

Requirements: Implement a water reclamation/reuse plan that results in at least a 25 percent discharge in rate and quantity of point source discharge. (USGBC, 2005)

- 25% Reduction 1 point
- 50% 2 points
- 75% 3 points
- 100% (no point discharge) 4 points

Discussion: In many cases, municipal wastewater is conveyed away from the original source such that the discharge of the treated effluent does not serve to replenish local water resources. Water management should now consider alternatives to this approach. Consideration should be given to groundwater discharge, implementation of natural treatment systems (e.g., constructed treatment wetlands) or decentralized treatment systems that eliminate point source discharge.

In addition, the level of wastewater treatment required to protect public health and the environment often results in an effluent with quality suitable for reuse. In some instances, water resources will be in sufficiently short supply that additional treatment to enable reuse of effluent will be cost effective. (Daigger, 2005) Consideration should be given to reuse for non-potable applications such as landscape irrigation, toilet and urinal flushing, and custodial uses. (USGBC, 2005) Synergy with nearby industrial or manufacturing, such as cooling water requirements, should be reviewed.

Credit 4.2 Stormwater (1 Point)

Intent: Limit disruption and pollution of natural water flows by integrating the management of stormwater and wastewater flows.

Requirements: The impact of stormwater on the wastewater collection and treatment system must be managed to avoid contamination of waterways. Combined sewer systems must have approved plans in place to minimize combined sewer overflows (CSOs). Separate sewer sewers must also have approved plans in place to mitigate the negative impact of increased inflow/infiltration during storm events.

Discussion: Combined systems can provide additional benefit of storing stormwater for treatment and discharge after the storm event is over. This can moderate high peak flows in waterways (caused by runoff from impervious services) and improve water quality (by treating contaminated stormwater runoff). Regardless of the type of wastewater system, consider that any stormwater volumes that cannot be handled with stormwater best management practices (BMPs) can be integrated into the wastewater treatment process to eliminate contamination before reuse or discharge.

Credit 4.3 Surface Water (1 Point)

Intent: Maintain or improve water quality and quantity in surface water.

Requirements: Design a management plan that addresses surface water impacts. The plan must conform to the latest federal and local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authorities. This credit may include National Pollution Discharge Elimination System (NPDES) permitting for point source discharge, interbasin transfer approvals, and others.

Discussion: Perform site studies or surveys to identify site elements and adopt a master plan that includes mitigation or avoidance of negative surface water impacts. (USGBC, 2005) Smaller treatment facilities that produce high-quality effluents and allow for local discharge to eliminate the public health necessity to remove the wastewater from the populated area must also be considered. A hybrid system could use a centralized system supplemented with decentralized systems. (Daigger, 2005) For example, if individual on-site treatment systems are appropriate in some areas, the need to convey the wastewater is minimized, the volume being discharged at the centralized WWTP is reduced, and contributions are made to water resources in the localized area. In cases where the WWTP is in another watershed, local on-site systems can reduce interbasin transfer.

Credit 4.4 Groundwater (1 Point)

Intent: Maintain or improve water quality and quantity in groundwater.

Requirements: Design a management plan that addresses groundwater impacts. The plan must conform to the latest federal and local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authorities. In addition to the related regulatory requirements listed for Credit 4.3, this credit may also include groundwater discharge permits.

Discussion: See discussion for Credit 4.3 and apply to groundwater impacts.

Credit 4.5 Aquatic Habitat (1 Point)

Intent: Ensure that water withdrawals and wastewater discharges do not threaten aquatic ecosystems, biodiversity, or individual species.

Requirements: Design a management plan that addresses aquatic habitat impacts. The plan must conform to the latest federal and local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authorities.

Discussion: Perform site studies or surveys to identify site elements and adopt a master plan that includes mitigation or avoidance of negative aquatic habitat impacts. (USGBC, 2005)

Credit 4.6 Terrestrial Habitat (1 Point)

Intent: Ensure that water withdrawals and wastewater discharges do not threaten land-based eco-systems, biodiversity, or individual species.

Requirements: Design a management plan that addresses terrestrial habitat impacts. The plan must conform to the latest federal and local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authorities.

Discussion: Perform site studies or surveys to identify site elements and adopt a master plan that includes mitigation or avoidance of negative terrestrial habitat impacts. (USGBC, 2005)

Credit 4.7 Soil Quality (1 Point)

Intent: Eliminate deterioration of soil quality by discharges of wastewater through salt accumulation, pH alteration, or plugging with bioslimes. (Daigger, 2005)

Requirements: Design a management plan that addresses soil quality impacts. The plan must conform to the latest federal and local/state requirements, whichever are more stringent. The plan must be approved by the appropriate authorities.

Discussion: Perform site studies or surveys to identify site elements and adopt a master plan that includes mitigation or avoidance of negative soil quality impacts. (USGBC, 2005)

5.0 Energy and Atmosphere

Credit 5.1 Optimize Energy Performance (1-4 Points)

Intent: Reduce environmental impacts associated with energy use.

Requirements: Points are based on ranges on a kilowatt-hour per 1,000 gallons basis in design, including pumping and treatment systems.

- 1.5 < 2.0 kWh per kgal 1 point
- 1.0 < 1.5 2 points
- 0.5 < 1.0 3 points
- < 0.5 4 points

Discussion: Taken together, water and wastewater utilities comprise up to 3 percent of the nation's energy use. Selection of process treatment technology will dictate the range of energy use. Consider design strategies to minimize the use of motors and optimize energy use through computerized supervisory control and data acquisition (SCADA) capabilities. (EPRI, 1996)

Credit 5.2 Onsite Renewable Energy (1-4 Points)

Intent: Encourage and recognize increasing levels of onsite renewable energy self-supply in order to reduce environmental impacts associated with fossil fuel energy use.

Requirements: Points based on percent of process energy use incorporated in design through use of onsite renewable energy.

- 1% Renewable 1 point
- 2% 2 points
- 5% 3 points
- 10% 4 points

Discussion: Assess the potential for non-polluting and renewable energy sources including solar, wind, geothermal, low-impact hydroelectric, biomass, and bio-gas (e.g., digester gas recovery to run a turbine) strategies. When applying these strategies, take advantage of net metering with the local utility. (USGBC, 2005) This can be accomplished as part of a bundled program for multiple uses.

Credit 5.3 Air Quality (1 Point)

Intent: Establish minimum air quality and odor control performance for site and neighbors.

Requirements: Meet the minimum requirements of federal, state, and local laws and regulations for design and construction.

6.0 Materials and Resources

Credit 6.1 Structural Reuse (1-2 Points)

Intent: Extend the life of existing structures, conserve resources, reduce waste, and reduce environmental impacts of new construction as they relate to materials manufacturing and transport.

Requirements: Points based on a percent of existing non-occupancy structures (e.g., tankage) reused versus demolished, excluding mechanical systems or other elements that may be outdated or present risk. (USGBC, 2005)

- 50% Reuse 1 point
- 75% 2 points

Credit 6.2 Process Footprint (1 Point)

Intent: Reduce use of new construction material and conserve resources by limiting process area required, and reduce heat island effect (thermal gradients) for areas not inside a building.

Requirements: Employ strategies, materials, and landscaping techniques to reduce heat absorption of exterior materials. Shade constructed areas with landscape features (native or non-invasive, climate-tolerant species) and minimize the overall process footprint.

Discussion: Mitigating the heat island effect results in lowering ground surface temperatures and reducing conditions favorable for ground-level ozone formation. In addition, vegetation moderates the microclimate on the site, which reduces the heating and cooling loads. Reducing the process footprint leaves more site area as open space, habitat, etc. (GGHC, 2005)

Credit 6.3 Recycled Content (1 Point)

Intent: Increase demand for building materials that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

Requirements: Specify cement used in constructing pumping and process areas with at least 10 percent recycled content and document the installation.

Discussion: Acceptable recycled-content cements used as substitutes for Portland cement include the following:

- Fly ash generated as a coal combustion by-product or ground granulated blast furnace slag as a by-product of pig-iron production (only with documentation that the plant was not co-fired with hazardous waste, medical waste, or tire-derived fuels and with verified mercury content <2 parts per billion [ppb]).
- Rice husk ash.

Fly ash generated from municipal solid waste incinerators is not acceptable for this credit. In addition, mechanical and electrical components are not included. (GGHC, 2005)

Credit 6.4 Dioxins in Materials (1 Point)

Intent: Reduce the release of persistent bioaccumulative toxic chemicals (PBTs) associated with the life cycle of pumping and process materials.

Requirements: Specify no use of cement from kilns fired with hazardous waste. Specify no use of materials in mechanical/electrical systems (piping, conduit, and boxes) containing virgin or recycled chlorinated compounds including the following:

- Chlorinated polyethylene (CPE) (e.g., wire and cable jacketing)
- Chlorinated polyvinyl chloride (CPVC) (e.g., water pipes)
- Chlorosulfonated polyethylene (CSPE) (e.g., electrical connectors)
- Neoprene (e.g., seals, gaskets, and adhesives)
- Polyvinyl chloride (PVC) (e.g., pipes and conduit, wire, and cable sheathing)

Exception can be made for minor parts, such as tracks, gaskets, and seals, as long as a chlorinated compound is not one of the primary materials of the frame or body of the product. However, specifiers are encouraged to seek ethylene propylene diene monomer (EPDM) and silicone or other non-chlorinated alternative seals and other minor parts where possible.

Discussion: Because of their toxicity, persistence, and bioaccumulative characteristics, even very small, difficult to detect releases can lead to harmful exposures. This credit is intended to eliminate materials that either contain this PBT or are associated with the PBT release at one or more stages in its life cycle. Alternatives may include polyethylene for wiring and copper, cast iron, steel, concrete, clay, polypropylene, and high density polyethylene (HDPE) for piping. Fluoropolymers as substitutions for wiring should be avoided. (GGHC, 2005)

Credit 6.5 Mercury Use in Equipment (1 Point)

Intent: Reduce the release of PBTs associated with the life cycle of materials.

Requirements: Specify control systems and other large electrical project and/or systems that are free of mercury switches (tilt, float, pressure, and temperature) and mercury relays. This credit includes pumps and other process-related fluid control systems.

Discussion: Mercury is a potent neurotoxin. See additional discussion under Credit 6.4. *(GGHC 2005)*

Credit 6.6 Lead and Cadmium in Materials (1 Point)

Intent: Reduce the release of PBTs associated with the life cycle of materials.

Requirements: Specify substitutes for materials manufactured with lead and cadmium, when cost-effective alternatives that meet or exceed performance standards are available. This includes lead-free solder, lead-free insulated jacketing of electrical wire and cable that meets or exceeds performance requirements, and paints that do not include cadmium or lead. Paints meeting Green Seal criteria exclude metals including cadmium, lead, mercury, antimony, and hexavalent chromium.

Discussion: Lead is a potent neurotoxin and cadmium is a carcinogen. See additional discussion of Credit 6.4. Green Seal information can be found at www.greenseal.org. Consider products such as silver and other lead-free solder, solderless copper connectors, polyethylene piping, and Green Seal-compliant paints. Note that some PVC products contain lead or cadmium as stabilizers. For example, lead remains the primary stabilizer in PVC insulation for electrical wire and cable. Specifying no PVC products as per Credit 6.4 will help ensure greater elimination of potential lead and cadmium sources. (GGHC, 2005)

Credit 6.7 Low-Emitting Materials (1 Point)

Intent: Reduce the quantity of indoor air contaminants that are odorous, potentially irritating, and/or harmful to comfort and well being of installers and operators.

Requirements: Due diligence in considering alternatives to materials containing volatile organic compounds (VOCs).

Discussion: Specify low-VOC materials (adhesives, sealants, paints, and coatings) in construction documents. Ensure that VOC limitations are clearly stated in each section where these items are addressed. (USGBC, 2005) Because of corrosion issues on plant sites, exterior and interior materials can often not meet the low-emission criteria.

Credit 6.8 Toxic Pollution Prevention (1 Point)

Intent: Avoid potentially hazardous chemicals that may adversely affect operators or the environment. In addition to Credits 6.4 through 6.7, consider other potentially toxic elements, including the design of the treatment process.

Requirements: Use treatment systems that do not require substances with toxicity to humans or the environment. (USGBC, 2005)

Discussion: This credit should be based on the 12 principles of green chemistry, the risk management analysis outlined in EPA's Green Engineering program, or similar. (EPA, 2005) Also note that the initial selection of the process is critical: a biological secondary or tertiary treatment system uses a renewable population of microbes, whereas a physical/chemical system uses non-renewable chemicals and sometimes more energy. Consider alternatives to chlorine products that may produce dioxin by-products whenever feasible.

Credit 6.9 Construction Waste Management (1-2 Points)

Intent: Divert construction, demolition, and land-clearing debris from landfill disposal. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites.

Requirements: Develop and implement a waste management plan, quantifying material diversion goals. Recycle and/or salvage at least 50 percent of construction, demolition, and land clearing waste associated with the wastewater process. Calculations can be made by weight or volume, but must be consistent throughout.

- 50% Diversion 1 point
- 75% 2 points

Discussion: Provide tabulation of the total waste material, quantities diverted, and the means by which diverted. Designate a specific area onsite for reuse and recycling and track progress throughout construction. Identify haulers and recyclers to handle the designated materials. Salvage may include donation of materials to charitable organizations or reuse of salvaged materials onsite.

Credit 6.10 Construction Management—Temporary Facilities and Equipment (1 Point)

Intent: Implement site and materials management during construction to minimize adverse impacts on staff and neighbors. Reduce air and noise pollution from construction equipment. Implement conservation and efficiency practices for temporary facilities.

Requirements: Develop and implement a Construction Practices Environmental Management System (EMS), which can include the following.

- Develop site plan including temporary facilities, designated staging areas, access roads, and construction parking. The plan should focus on reducing site disturbance.
- Use approved measures to protect sensitive areas of the site, including prohibiting staging, stockpiling, and soil compaction. Prevent disturbance to natural resources, protected wetlands, and endangered species.
- Use high-efficiency equipment for temporary heating and cooling. Make all temporary facilities weathertight.
- Store materials in a clean, dry location to prevent soiling and moisture.
- Prevent fuels, waste oils, washdown water, and other hazardous or undesirable material from entering sensitive areas, waterways, and sanitary or stormwater facilities.

- Use salvaged or refurbished materials for construction of temporary facilities, excluding pressure-treated wood, wood treated with arsenic and chromium, and wood with lead paint.
- Control particulate discharge and dust.
- Use energy-efficient lighting and control light pollution in temporary lighting. Shut off temporary lighting during non-work hours, except for emergency and security needs.
- Control water during construction as approved by local or state authorities.
- Use alternative-fueled vehicles for on-road construction vehicles to provide 50 percent of the projects vehicular transportation needs (as measured by total miles logged).
- Reduce air emissions from construction equipment and other non-road engines by using low-sulfur diesel fuel, biodiesel, or natural gas.
- Reduce noise emissions from construction equipment and other engines by using low-noise alternatives.
- Use electric-powered cranes, compressors, and other equipment when feasible.
- Demonstrate efforts to establish carpooling or alternative transportation programs for construction personnel.
- Appoint an Environmental Manager onsite to oversee the environmental goals for the project.
- Provide training to construction personnel on environmental issues and site-specific requirements. (GGHC, 2005)

Credit 6.11 Fundamental O&M Requirements (1 Point)

Intent: Verify and ensure that the entire system is designed, constructed, and calibrated to operate as intended.

Requirements: Implement or have a contract in place to implement the following fundamental best practices.

- Engage a review team that does not include individuals directly responsible for the project design or construction management
- Review the design intent and the basis of design documentation
- Incorporate start-up and O&M requirements into the construction documents
- Develop and use a start-up and O&M plan
- Verify installation, functional performance, training, and O&M documentation
- Complete a start-up and O&M report

Discussion: The activities discussed above are generally expected as part of a typical start-up and are an essential function; however, the following activities should be given consideration.

- An independent review team other than the design team should be engaged early in the design phase.
- The independent review team conducts a review of the design prior to the construction documents phase.
- The independent review team conducts a review of the construction documents near completion of the construction document development and prior to issuing the contract documents for construction.
- The independent review team reviews the contractor submittals relative to the systems in the start-up phase.
- The owner receives a single manual that contains the information required for reviewing O&M.
- A contract is developed and in place to review O&M with staff, including a plan for resolution of outstanding issues within 1 year after construction completion date. (USGBC, 2005)

OPERATIONS FOR ALL WASTEWATER UTILITIES

Credit 7.0 Utility Management

Credit 7.1 Measurement and Verification (1 point)

Intent: Provide for the ongoing accountability and optimization of performance over time.

Requirements: Monitor and analyze the collection system, watershed management, energy and atmosphere, and utility management performance over time.

Discussion: Use models to predict savings. Design with equipment to measure performance. Draft a measurement and verification plan to apply during operation that compares predicted savings to those actually achieved. (USGBC, 2005)

Credit 7.2 Environmental Management System (1 point)

Intent: Provide for continuous improvement of environmental performance.

Requirements: Implement voluntary EMS(s) based on ISO 14001.

Discussion: Document and report the costs and benefits of the sustainability program annually to build the business case for sustainability. Consider the triple bottom line: economic, social, and environmental elements.

Credit 7.3 Staff Education (1 Point)

Intent: Support training of staff to ensure they can deliver the goals of the sustainability program.

Requirements: Establish a staff education program that includes both primary job responsibilities and sustainability. Target an average of 24 hours of job training (or more if needed to meet the requirements of an external licensing or certification program) and 8 hours of sustainability education. (GGHC, 2005)

Credit 7.4 Alternative Fuel Vehicles (1-2 Points)

Intent: Reduce pollution and land development impacts from local emissions of fossil-fuel combustion powered vehicles.

Requirements: Use alternative fuel fleet vehicles. Points based on percent of fleet mileage driven annually:

- 50% of total mileage 1 point
- 100% 2 points

Discussion: Acceptable fuel types include biodiesel, low-sulfur diesel, hydrogen, compressed natural gas, hybrid, all electric, or energy derived from reuse of wastewater treatment by-products. (GGHC, 2005)

Credit 7.5 Energy Efficiency (1 Point)

Intent: Reduce energy consumption by using energy-efficient equipment.

Requirements: Purchase 90 percent of administrative equipment that is EnergySTAR® qualified or in the top 25 percent for energy consumption for that class of equipment. For process equipment, demonstrate that 75 percent of new equipment is in the top 25 percent of its category for energy performance. Demonstrate that replacement equipment reduces energy demand by 10 percent or is in the top 25 percent of its category for energy performance. (GGHC, 2005)

Discussion: EPA has an ongoing initiative called the Energy Star Industrial Water and Wastewater Focus. With participation from more than 20 organizations, EPA is developing an energy performance rating system, information on energy efficiency opportunities, strategies for energy management, and information on financing energy-efficient projects. EPA states that drinking water and wastewater systems spend $4 billion dollars per year on energy to pump, treat, deliver, collect, and clean water. The energy costs to operate drinking water and wastewater systems can represent as much as one-third of a municipality's energy bill. If drinking water and wastewater systems can effectively reduce energy use by 10 percent, collectively that would result in $400 million and 5 billion kWh in annual savings. The initiative is scheduled for completion by the end of 2006. (EPA 2006)

Credit 7.6 Renewable Energy (1-4 Points)

Intent: Encourage the development and use of both onsite and grid-source, renewable energy technologies on a net zero pollution basis.

Requirements: Provide at least 5 percent of the process electricity from renewable sources. The sources can be on-site renewable technologies (See Credit 5.2) or a renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

- 5% total energy 1 point
- 10% 2 points
- 25% 3 points

- 50% 4 points

Discussion: See on-site renewables discussion in Credit 5.2. For grid-source renewable energy, determine the energy needs of the facilities and investigate opportunities to engage in a green power contract with the local utility. Green power is derived from solar, wind, geothermal, biomass, or low-impact hydro sources. Green Power may be procured from a Green-e certified power marketer, a Green-e accredited utility program, through Green-e certified Tradable Renewable Certificates, or from a supply that meets the Green-e renewable power definition. For details about the Green-e program, visit www.green-e.org. This can be accomplished as part of a bundled program of green power for multiple uses. (USGBC, 2005)

Credit 7.7 Airborne Releases (1 Point)

Intent: Establish minimum air quality and odor control performance for site and neighbors. Control or reduce odors and emissions of biosolids and toxic compounds.

Requirements: Meet the minimum requirements of federal, state, and local laws and regulations during operation. Develop an odor control master plan, risk management plan, and/or emergency response plan (if required) to address potential impacts on neighbors.

Discussion: Consider emissions from equipment that burns fossil fuels.

Credit 7.8 Leaks and Spills (1 Point)

Intent: Prevent releases of hazardous process chemicals and fuels into the environment.

Requirements*:* Prepare a *Stormwater Pollution Prevention Plan* (SWPPP) and *Spill Prevention, Control, and Containment Plan* (SPCC) for treatment facility process areas in accordance with EPA and state regulations, whichever are more stringent.

Credit 7.9 Chemical Management and Minimization (1 Point)

Intent: Prevent exposure from hazardous chemicals to staff and the community.

Requirements: Develop a comprehensive chemical management policy with processes for receiving, handling, storing, and disposing of all hazardous chemicals that specifically includes the following processes.

- A purchasing policy that includes standards for evaluating chemicals prior to purchase with preference for less hazardous alternatives when possible
- Proper OSHA labeling
- Appropriate disposal practice guidelines
- Pretreatment program for industrial users
- Approved SWPPP and risk management plan in accordance with Credits 7.7 and 7.8
- Hazardous materials management plan including material safety data sheets (MSDS) management, staff training, inventory of all hazardous materials, usage guidance, safety and environmental precautions, waste disposal requirements, and monitoring requirements

- Indoor Air Quality Plan (IAQ) indicating routine review of indoor pollutant sources
- Lowest-available mercury alternatives, including any fluorescent lamps or task lighting, consider using new light-emitting diode (LED) alternatives

Discussion: Minimize use of chlorine for disinfection, consider a chemical recycling plan when feasible, and consider the following elements of operational support.

- Integrated pest management to reduce pesticide use: consider non-toxic good housekeeping and preventive policies as well as methods when treatment is required.
- Environmentally preferable cleaning policy, to reduce hazardous chemicals: use Green Seal GS-37 standards for industrial and institutional cleaners. Consider non-toxic good housekeeping and preventive polices as well as methods and products for cleaning. Both maintenance and emergency cleaning should be considered. (GGHC, 2005)

Credit 7.10 Janitorial Equipment and Products (1 Point)

Intent: Ensure that the cleaning program addresses safety and environmental impacts.

Requirements: Vacuum cleaners must meet the requirements of the Carpet and Rug institute Green Label Program for particulate capture and sounds levels. Deep-cleaned carpets (e.g., in administrative areas) shall be dried within 24 hours. Other powered floor maintenance equipment must meet similar requirements. Any powered cleaning equipment shall be ergonomically designed to minimize vibration, noise, and user fatigue. Such equipment shall also be high-efficiency, low-emission, and optimize use of cleaning products.

Credit 7.11 Paper Products (1 Point)

Intent: Reduce use of virgin wood pulp paper resources.

Requirements:

- Use products that meet the most current EPA Comprehensive Procurement Guidelines for recycled content. Give preference to chlorine-free products and janitorial paper dispensers that limit paper portions.
- Use strategies such as digital data storage, double-sided copying, and Internet written communication. (GGHC, 2005)
- Consider tree-free paper products that come from rapidly renewable resources.
- Include these elements in the purchasing policy.

Credit 7.12 Resource Reuse in Administrative Furniture (1 Point)

Intent: Reduce environmental impacts from the manufacture, use, and disposal of furniture needed for administrative support.

Requirements: Purchase salvaged, refurbished, or used furniture for a minimum 20 percent of the total furnishings budget, including seating, filing systems, tables, stools, carts, etc.

Discussion: This credit helps save energy and other resources by reducing shipping and creation of new products using virgin materials. (GGHC, 2005)

Credit 7.13 Materials, Transport, and Emissions in Administrative Furniture (1-7 Points)

Intent: Reduce the environmental impacts from the manufacture, use, and disposal of furniture. Reduce use of furniture that may release indoor air contaminants that are odorous or potentially irritating and may be deleterious to installer and staff health, comfort, and well-being.

Requirement: One point for each credit below, measured by 40 percent of furniture purchased by cost.

- No PBTs in material manufacture—mercury, cadmium, lead, or chlorinated compounds (including PVC) in furniture components, textiles, finishes, or dyes
- No chrome-plated finishes
- All wood components from Forest Stewardship Council (FSC) Certified Wood
- Locally and/or regionally assembled within 300 miles if transported primarily by truck or 1,000 miles if shipped primarily by rail or water
- Packaging that is reused, recycled, or composted; including packaging that is taken back by the manufacturer for reuse
- Designed for disassembly, recycling, biodegrading, or is part of a "take-back" program
- Does not contain three out of four of the following: polybrominated diphenyl ethers (PBDE), perfluorooctanoic acid (PFOA), urea formaldehyde, or phthalate plasticizers

Discussion: The brominated fire retardants are rarely listed on material sheets. Along with PBDE there are also tetrabromobisphenol A (TBBPA), hexabromocyclododecane (HBCD), and others. One potential strategy is to specify seating with mesh and no foam. Perfluorocarbons (PFCs) are a product of the process and do not appear as a final ingredient. PFCs are used most commonly in stain and non-stick treatments. Consider GreenGuard (www.greenguard.org) as a resource. (GGHC, 2005)

Credit 7.14 Reduce Waste Stream (1-3 Points)

Intent: Establish minimum source reduction and recycling program elements and monitor waste stream production volume. Reduce waste disposal in landfills and incinerators through reduction reuse, recycling, and composting.

Requirements: Conduct an audit to establish a baseline of the ongoing waste stream, including types and amounts of waste stream constituents. Include costs for handling and disposal or final use. This includes process by-products and residuals, hazardous waste, solid waste, and recyclables.

Reduce waste to landfill or incinerator by:

- 15% total volume 1 point
- 25% 2 points

- 35% 3 points

Discussion: Operate a procurement and waste reduction policy including purchasing strategies and staff education. The focus should be on source reduction, reuse, and recycling when possible. Consideration should be given to the following measures.

- Avoid waste by modifying a process or procedure (electronic versus paper)
- Buy products with recyclable materials, durability, reusability, and less packaging
- Recycle, including 95 percent of batteries and fluorescent lamps
- Implement composting processes
- Identify markets for waste products (GGHC, 2005)
- Include all waste generated, even if from a specific renovation or repair
- Include beneficial reuse of biosolids

Credit 7.15 Electronics Purchasing and End-of-Life Management (1 Point)

Intent: Require take-back and management services for end-of-life electronic products to safely manage hazardous compounds.

Requirements: Establish an IT/Telecom Environmental Management Plan that includes procurement, reduction, reuse, and recycling in compliance with federal and state solid waste and hazardous waste disposal regulations. Require manufacturer or vendor take-back guarantee. Ensure that recyclers verify that they do not export hazardous waste. (GGHC, 2005)

CONCLUSION

Although this article focuses on the potential benefits of a sustainability rating tool for wastewater systems, the tool must undergo additional review, revision, and piloting to refine the concept, and, as such, the tool will be updated to incorporate new strategies as they evolve.

Point-based rating tools that reduce complex circumstances down to a "score" can be popular and useful because they are easy for a wide audience to understand. At their best, such programs serve as education, guidance, and catalysts for change. However, since each point in the system represents a great deal of information, the entire rating program must be carefully calibrated and updated over time to ensure the desired results. Programs that are too easy, too difficult, or improperly balanced will not gain the credibility or the popularity needed.

Popular rating systems can become influential, and critics often single out examples of manipulation, which in some cases may be the perception of imbalance. In other cases there may be examples of achieving points by means that do not meet the overall intent.

Some initial feedback has been incorporated and includes the following future revisions of the tool.

- Improvements in the credits and overall calibration of the points for each
- Streamlined documentation approaches that would minimize effort and expense in using the

tool

- Evaluation of minimum scores in multiple categories or other means that would encourage broad improvements in sustainability
- Further exploration of incentives, such as grant funding opportunities or formal regulatory programs

The early stages of planning and selection of technologies is at the heart of the overall sustainability of the system. For example, the selection of the type of treatment process will dictate energy usage (due to equipment size and complexity) and chemical usage.

It is important to remember that universally ideal water management approaches and wastewater treatment systems do not exist. Each community has different resources, needs, and values, which will dictate the optimal approaches. This paper focuses on the development of a rating system that can serve as a reference and tool for making decisions about trade-offs regarding sustainability. The following are two different approaches.

- Water reclamation plants can reduce point-source discharges and provide important opportunities for water reuse, but these plants typically have higher capital cost, high power demands, and may rely on chemical addition for optimal effectiveness. These impacts must be balanced against such opportunities as reduced footprints that could minimize impact on local lands and habitats and the availability of green power supplies.
- Natural treatment systems (e.g., constructed wetlands) require more land and can generate odor and vector nuisances if not properly designed and maintained. Thus, siting may be difficult, particularly in light of smart-growth initiatives that promote more dense population areas. However, natural treatment systems can serve in conjunction with recreational, wildlife habitat, and open-space initiatives. They are also mechanically simple, require less energy, and do not typically rely on chemical addition. (Daigger, 2005)

These examples in no way describe the detailed and complex needs of evaluating water management and treatment approaches, but do illustrate that there is no single solution for every community. The further development and testing of the Wastewater Sustainability Rating Tool proposed in this paper can help communities and designers understand the value of sustainability goals and evaluate ways to offset impacts.

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