Sustainable Design for Water Pollution Engineering
Part I: An Introduction

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The following is the first part of a three part series developed by the Sustainable Water Pollution Engineering Subcommittee. Here, in Part I, the concepts of Sustainable Design are introduced. In Part II, Bill Heasom discusses why it's necessary for the water pollution engineers to integrate natural ecosystem models into water pollution engineering designs. In Part III, Robert Roseen describes the nuts and bolts of sustainable design for the water pollution engineer.

The practice of sustainability is often described as a fundamental responsibility for all professional engineers and scientists, regardless of their particular discipline. Designing systems that meet current and future societal needs, while at the same time protecting and minimizing the current and future consumption of natural resources, is an ethical responsibility of all practicing professionals. The need for sustainable design is well documented in our undergraduate engineering ethics texts and in our professional journals and newsletters. However the practice of sustainable design remains an area that deserves better description.

In some regards, sustainable design is a new term created to describe an already existing practice. For example, in the 1990s the term Urban Redevelopment was replaced with the term Brownfields Redevelopment. While brownfield sites may have the added twist of needing to meet "innovative" environmental thresholds, the term urban redevelopment has essentially been removed from the common vernacular. In "terms" of sustainable design, civil engineers have always assumed moral and ethical responsibilities for their projects. In fact, pollution engineering is a field created to solve sustainability challenges. However, the term ***sustainable design*** obliges the engineer to meet specific ethical criteria that were not necessarily spelled out in the past. These criteria specify that the engineer consider the conservation and protection of natural resources in designing systems intended to meet societal needs.

Sustainable design challenges our profession to question current practices in water pollution engineering. This challenge is difficult, especially when our profession's intent is to design systems that protect natural resources and human health. However difficult it may be for us to see, the very systems we design to provide clean water and healthy environments, may, in turn, ***create*** adverse impacts to the environment and may not efficiently conserve natural resources. Sometimes, these impacts are outside of the envelope of the design. Sometimes, these impacts go unmeasured. Undoubtedly, there are improvements in the efficiencies of how we design water pollution control systems that can be identified and shared with our peers for the common good.

Sustainable designs minimize resource depletion and maintain the economic and environmental systems needed for a sustainable future. As civil engineers, the guiding light for doing the right thing is spelled out in our Code of Ethics. Canon 1 of the ASCE's Code of Ethics states: *"Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of* ***sustainable development*** *in the performance of their professional duties."* In ASCE Policy Statement #418, ASCE defines sustainable development: "**Sustainable Development** is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development."

This policy also outlines the implementation strategies to achieve the objectives of sustainable development:

- *Promote broad understanding of political, economic, social and technical issues and processes as related to sustainable development.*
- *Advance the skills, knowledge and information to facilitate a sustainable future, including habitats, natural systems, system flows, and the effects of all phases of the life cycle of projects on the ecosystem.*
- *Advocate economic approaches that recognize natural resources and our environment as capital assets.*
- *Promote multidisciplinary, whole system, integrated and multi-objective goals in all phases of project planning, design, construction, operations, and decommissioning.*
- *Consider reduction of vulnerability to natural, accidental, and willful hazards to be part of sustainable development.*
- *Promote performance based standards and guidelines as bases for voluntary actions and for regulations, in sustainable development for new and existing infrastructure.*

To apply these concepts to water pollution engineering, an operational definition of the field is needed. Water Pollution Engineering encompasses the design, treatment, management and stewardship of water and water resource systems to control and/or prevent water pollution impacts to human health and the environment.

Relating the strategies of sustainable development to sustainable design in water pollution engineering is rather straightforward. In addition to creating designs that meet client needs, regulatory requirements, economic constraints and ethical obligations, designs of the future will also incorporate the following:

Evaluation of the life-cycle of materials used in the construction process - We will evaluate alternative construction materials not only for their utility in system construction, but also for the costs they incur and natural resources they affect before they arrive to the construction site.

Evaluation of the life-cycle of the facility - We will evaluate construction means and methods, facility infrastructure impacts and operation, and recycle/reuse/disposal implications once a facility is decommissioned.

Evaluation of the life-cycle of energy and materials consumed during facility operation - We will evaluate the sustained availability of natural resources consumed during facility operations as well as the anticipated impacts of chemicals and other materials to natural resources beyond the boundaries of the facility.

Life-cycle evaluation (or assessment) means tracking the flows of energy, materials and waste streams required in the manufacture, use and disposal of products. With these "additional" considerations, engineers will be better prepared to evaluate the feasibility of alternative technologies, the use of renewable materials, innovative construction means and methods, the value of energy conservation and efficiency, pollution prevention, and other sustainable issues when creating water pollution engineering designs.

Consistent with Policy Statement #418, ASCE recognizes its responsibility to take a leadership role in promoting sustainable design practices. This subcommittee will work to link sustainable design concepts with practicing professionals, civil engineering students and the general public.

Our approach will be to publicize our work, support technical sessions at professional meetings, promote training sessions and undergraduate engineering outreach, and develop, collect and disseminate case-studies in sustainable design for water pollution engineering.

Perhaps more so than any other profession, practicing water pollution engineers are prepared to embrace sustainable design concepts. We need to look no further than a "typical" POTW to see many sustainable design concepts in practice. Though not without concerns (not all wastes are recyclable and there are ongoing disputes about the use of chlorine for disinfection and the reuse of biosolids), a POTW creates billions of gallons of a precious, renewable resource annually, i.e., water. We engineers recognize that it's worth our time and effort to find improvements in any process, and that is what our subcommittee is committed to helping us all do.

For more information about the Sustainable Water Pollution Engineering Subcommittee, contact Helene Hilger, Subcommittee Chair at hhilger@uncc.edu .