

## **SECTION I. EXECUTIVE SUMMARY**

This is a technical assessment of constructed wetlands for wastewater treatment in the Midwest focusing on Iowa that has been conducted to assess the viability of these treatment systems as an energy and cost efficient treatment alternative for pretreated wastewater. To place this study in context, a literature review of wetland design and treatment capability in the U.S. and other countries has been included. NPDES (National Pollutant Discharge Elimination System)-permitted wetland systems for which information has been summarized was based on site visits, interviews with managers and engineering design documents. This information includes: wastewater system design, vegetation characteristics, operation, and maintenance requirements including energy costs, operator management and satisfaction with the wetlands, construction costs, and treatment efficiency.

### **Wetland Design**

Fifteen of the twenty wetlands were designed as surface flow. All are preceded by lagoons that may be aerated or non-aerated. One system has surface and subsurface flow wetlands. The four other wetlands are subsurface flow wetlands, all are preceded by a septic tank with the exception of two systems one is preceded by a sand filter after the septic tank and the other is preceded by a multi-flow system. Cattails (*Typha*) are the predominant vegetation at most sites with some bulrush (*Scirpus*), iris (*Iris*), and sedges (*Carex*). Wetlands were designed as fully vegetated, vegetated with open water, and open water with some vegetation. The sizes of the communities served by treatment systems with wetlands ranges from 100 to 996. Some of the smaller facilities with wetlands have small staffs but frequently have large groups of 75 or so people.

### **Energy and Operation and Maintenance Requirements, Construction Costs**

The wetlands currently used in Iowa require no electrical energy. However, the pretreatment systems such as aerated lagoons require energy. Wetlands have low operation and maintenance requirements compared to mechanical systems. Some of the later designed surface flow systems that have liners have more difficulties in maintaining healthy stands of vegetation compared to the earlier surface flow wetland designs that are unlined. Construction costs vary due to the variations in system sizes and configurations as do the reasons for selecting a wetland system. The most significant cost often is land acquisition. For most of the larger municipal systems the wetland was the most cost effective way to provide additional CBOD (carbonaceous biochemical oxygen demand) and TSS (total suspended solids) removal prior to final discharge. Most of the managers of the smaller wetland facilities with subsurface wetlands preferred a wetland treatment system to other treatment options. Some facilities were used for outdoor education purposes and they wanted the public to be able to observe a treatment system that blended in with the natural landscape. Another site had restricting soils where a typical drain field would not work.

### **Treatment Efficiency**

The efficiency of wetlands alone at removing wastewater contaminants could not be evaluated due to the lack of sampling data. Removal of CBOD and TSS occurs in the

pretreatment system and the wetlands serve as a final polishing area or buffer for unexpected pretreatment system overloads. Removals for CBOD and TSS were determined for only five of the 20 treatment systems that included wetlands because most systems don't monitor influent quality. Treatment systems with wetlands were efficient at removing CBOD and TSS. Seasonal fluctuations in CBOD and TSS concentrations occur in wetland systems. Ammonia removal does occur in some treatment systems with wetlands but is inconsistent among sites and is limited during the winter months. Not all sites are required to monitor ammonia in effluent. Ammonia concentrations at some sites periodically exceed permit limits. It is believed that the current designs in wetlands used in Iowa are not a reliable method for ammonia removal especially during the winter months.

### **Additional Wetland Benefits**

Wetlands have the added benefits of providing habitat for wildlife such as songbirds, waterfowl, turtles, and frogs. Several sites use their wetlands for educational purposes as a type of wastewater treatment system that blends in more naturally with the surroundings.

### **Advantages of Using Constructed Wetlands for Wastewater Treatment**

- Wetlands provide low cost, energy efficient treatment for communities with populations less than 1000 when land is available and affordable
- Wetland operation requires fewer skills compared with mechanical treatment systems
- Wetlands can be used in place of a drain field in areas with restricting soil and geologic features
- Wetland treatment systems are effective at removing TSS and CBOD
- Wetlands provide a buffer to the receiving stream if the pretreatment system malfunctions
- Wetlands provide habitat for wildlife that is an important feature especially when considering the dramatic loss of natural wetlands in Iowa
- Wetlands are aesthetically pleasing and are used for outdoor educational purposes

### **Disadvantages of Using Constructed Wetlands for Wastewater Treatment**

- The wastewater facility must have a pretreatment system and available and affordable land in order to consider using wetlands technology
- Wetlands (designs currently used in Iowa) are not a reliable treatment method for ammonia removal especially during the winter months
- Wetlands require water level management in order to sustain vegetation
- Some wildlife management is required such as muskrat control especially for surface flow wetlands

- Wetlands require weed and sapling management especially during system start-up; it may take several years to develop a sustainable stand of vegetation
- Wetland treatment is considered innovative so there are no specific codes for design criteria and permit guidelines for wetlands in Iowa

There are several steps that could be initiated to promote more widespread use of this energy efficient land treatment system. Design criteria and permit guidelines could be developed in Iowa for constructed wetlands. Further studies of wetlands in Iowa could be conducted to monitor their performance, improve ammonia removal, and identify appropriate vegetation and water level management. Workshops and conferences could be organized for individuals in Iowa that are involved with this technology. A network of individuals in Iowa that are involved with constructed wetlands for wastewater treatment could be developed for information exchange and support. A brochure could be developed to address constructed wetlands for wastewater treatment technology and be distributed throughout Iowa.

The information that was gathered for this assessment indicates that constructed wetlands for wastewater treatment in Iowa are an energy and cost efficient land treatment method with the added benefit of providing wildlife habitat. This technology in Iowa can be considered as being in a developing stage. Efforts need to be made to further develop this technology in Iowa.