

## **SECTION VII. WETLAND FEASIBILITY, BARRIERS, AND FUTURE ACTIONS**

### **System Feasibility in Iowa**

The following can be used as guidance for small communities and facilities in Iowa or other states that might be considering using constructed wetlands as a treatment method after some sort of pretreatment. The information is based on the Iowa inventory of constructed wetlands for wastewater treatment.

#### **Wetland Energy Requirements**

- One of the most obvious advantages of using constructed wetlands for wastewater treatment is that there are typically no electrical energy requirements unless aeration systems are used for advanced ammonia removal. Less skilled operators are needed due to the non-mechanized nature of these treatment systems.

#### **Types of Facilities that could use Constructed Wetlands in Iowa**

- Wetlands can be used by small communities, parks, public and private facilities, and businesses (including industries if proper pretreatment is used), the land area is available, the influent quality is applicable to this type of treatment technology, and the effluent quality meets the requirements for the receiving stream.
- Constructed wetlands are typically used by communities with populations less than 1,000 that do not have major industries.
- In small communities, wetlands work well as an accompaniment to a lagoon system that is close to or actually experiencing TSS and CBOD permit violations. They can also be used for additional polishing of wastewater after activated sludge treatment. Small facilities can use a wetland after a septic tank in place of a drainfield.

#### **Types of Pretreatment**

- Pretreatment prior to wetlands that can be used includes: septic tanks and sand filters for subsurface flow wetlands, and aerated lagoons, facultative lagoons, sequencing batch reactors, and activated sludge for surface flow wetlands.

#### **Wetland Designs**

- The hydraulics of surface flow systems are easier to monitor and control, compared with subsurface flow systems, since surface flow systems are larger for a given influent flow rate, than subsurface systems.
- More of the successful surface flow wetlands designs appear to be the earlier designs that were not lined with clay or other impervious material that was later

required to meet IDNR requirements. Many of the sealed wetland systems experience difficulty in maintaining a healthy stand of vegetation.

- Subsurface systems can be used by very small communities and small facilities. Iowa has limited experience with wetland technology especially with subsurface wetlands. There are scaling-up concerns from small facilities (populations <50) to small communities (populations >100-6,000 or more) especially with the hydraulics of subsurface systems. This is because there is more hydraulic control required with larger subsurface systems. If wetlands are loaded too heavily, solids will build up and effluent will pond on the surface and result in hydraulic failure. Small subsurface systems have fewer site separation distance requirements to such features as wells and human habitation.

### **Vegetation Types and Designs**

- Surface flow wetlands can be designed as open, vegetated, and open and vegetated. The preferred design is a combination of open and vegetated areas. The open areas would be deeper areas that help equalize flow, provide a change in habitat for wildlife and may assist with ammonia removal. The unlined wetlands appear to have healthier stands of vegetation..
- Subsurface flow wetlands are designed as vegetated only.
- Vegetation can be a combination of *Typha* (cattail), *Scirpus* (bulrush), *Carex* (sedges), and *Iris* (iris) and also include wet-prairie vegetation.

### **Number of Wetland Cells and Size**

- Wetlands should have at least two cells. The extra cell can be used when another cell is being serviced and backup if there are failures with the pretreatment system.
- Wetland sizes ranges can range from 0.07 to greater than 10 acres. The largest surface flow wetland system in the Midwest at Columbia, Missouri is 90 acres following an activated sludge system.
- Cell sizes vary depending on the volume of effluent and treatment objectives. Cell shapes can be rectangular, kidney-shaped, or sinuous. The preferred design is one that is not rectangular and that has a sinuous flow path that would provide additional retention time and wildlife habitat.

### **Wetland Construction Costs**

- Wetland costs may include: design by engineer, construction of wetland by contractor, clay or synthetic liner, soil, media, and plants
- Wetland construction costs vary with the size of the wetland and the availability of on-site materials. Costs will be less if clay soils that can be adequately compacted are available on-site for the wetland liner. Costs can be high if clay has to be delivered from far distances or synthetic liners are used.
- Plant costs can be minimized if they are available locally.

### **Expected Spring/Summer Maintenance**

- Most systems require mowing/grazing around the edge of the wetland, tree and weed removal, muskrat removal, and water level management. If either subsurface or surface wetland cells are allowed to dry out for too long the wetland vegetation will die and have to be replanted.
- If cells are used for storage and water levels are too high in early spring when plants start growing, vegetation may die out and have to be replanted.

### **Expected Fall/Winter Maintenance**

- Most surface flow systems might require water level management, muskrat removal, and mulching, trimming or burning of vegetation if wetland vegetation is well established. Periodic wetland management may enhance nutrient removal. Reseeding may be done when wetland vegetation releases seeds.
- Subsurface systems have not been in existence in Iowa long enough to know when or if vegetation should be trimmed, mulched, or burned. Periodic vegetation management might be used to enhance nutrient removal.

### **Special Considerations**

- There are some management situations that are unique to specific sites and could occur at constructed wetland sites. These include: keeping wetland vegetation established in wetlands with clay liners, deer browsing of wetland vegetation, odors, cattail seed dispersal, jetting, algal buildup at outfall in the flow measuring device, biomass accumulation on the gravel surface of a subsurface system, and potential damage to synthetic liners caused by muskrats and root penetration.

### **Life Expectancy of Wetlands in Iowa**

- The oldest existing engineered constructed wetland in Iowa has been used to polish pretreated wastewater for at least 15 years. Surface flow systems if managed properly and site conditions are favorable could last this long. Wetlands could last 20 or more years, based on some of the older existing surface flow systems in the U.S. (Kadlec and Knight, 1996). Additional wetland cells may have to be constructed along with expansion of the pretreatment system if the population of a community is increasing. Wetlands, like all wastewater treatment systems, must be maintained properly and operated according to design criteria.
- Subsurface flow wetlands have been in existence for 10 or more years (Kadlec and Knight, 1996). The maximum life expectancy is not known at this time. Research suggests that these types of systems might experience solids buildup and thus increased hydraulic resistance near the inflow and would require solids management, media replacement or be allowed to rest or not be loaded for an extended period.

- The long-term performance of the wetland depends on maintaining vegetation, repairing synthetic or clay liners that may be damaged by plant roots or muskrats, and repairing washout areas after system over-loads.

### **Barriers to Adopting Wetland Technology in Iowa**

- As water quality standards become more stringent, system upgrades may be necessary. All wastewater treatment systems including those with wetlands may require additional treatment to meet water quality standards such as ammonia.
- The Iowa Department of Natural Resources (IDNR) currently has no specific design guidelines for wetlands for municipal wastewater treatment. Wetland systems are considered innovative technology and would not be classified as conventional treatment until further studies are conducted on existing and experimental systems and design criteria and permit guidelines are available. The Department does however have 20 years experience in reviewing the proposals for wetland systems and providing design information and guidance.
- Delays in the design review process and permit review process for wetlands may be caused by the lack of design criteria, permit guidelines, and permit forms. However, some may argue that design standards may limit wetland innovation.
- One of the IDNR concerns with these systems is with seasonal changes in ammonia concentrations in effluent, especially during some winter and summer months. There are a few sites where there may be periodic seasonal concerns over ammonia concentrations. Additional research needs to be conducted to refine the ammonia limit-setting process to adjust to site-specific conditions.
- IDNR staff and consulting engineers in Iowa are not as familiar with the latest developments in subsurface wetland systems that include aeration so they be might be more hesitant to approve and suggest these technologies. Iowa communities need to be aware of this treatment technology and where and when it can be used following pretreatment.

### **Future Actions**

#### **Design Criteria and Permit Guidelines**

- Design criteria and permit guidelines for constructed wetlands for municipal wastewater treatment must be developed in Iowa. Wetland systems are considered innovative technology and would not be classified as conventional treatment until further studies are conducted on existing and experimental systems and design criteria and permit guidelines are available.
- IDNR staff, Iowa consulting engineers, and other professionals and communities in Iowa that could use this technology need to be involved in the development of design criteria and permit guidelines.

#### **Further Studies**

- Further studies of constructed wetlands in Iowa are needed to monitor the performance of these systems especially considering the number of systems used in Iowa and the lack of research studies in Iowa on constructed wetlands. The analysis of monitoring data from Iowa wetland sites indicated that none of the systems monitor the entire wastewater stream, especially prior to the wetlands. For this reason an accurate assessment of wetland performance cannot be made at this time. Most systems monitor effluent only. Removal efficiencies can be determined for only a few wetland systems where influent and effluent quality is monitored. None of the wetland systems monitor ammonia-nitrogen in influent.
- A thorough study of selected wetland systems is recommended and should include monitoring the entire wastewater stream before and after the wetlands. Typical wastewater parameters should be used as indicators of performance.
- Studies should also be done to determine new wetland designs suitable for Iowa conditions to improve such performance as ammonia removal and other nutrient removals.
- An evaluation should be made to determine the effectiveness of wetlands for pathogen removal as an alternative to costly disinfection.
- An evaluation should be made of the potential for using harvested wetland vegetation as a source of bio-fuel.

### **Workshops and Conferences**

- Workshops and conferences on constructed wetlands for wastewater and wastes (leachate, animal waste) should be organized for individuals involved in all aspects of wetlands in Iowa, in order to increase awareness of the use of the technology.
- These events would focus on a range of issues such as performance of wetland systems and advances in the technology, system configurations and pretreatment and post treatment energy efficient alternatives, wetland water level and vegetation management, and assessing the quality of wetland habitat for attracting wildlife.
- The workshops and conferences should be held in Iowa and include neighboring states.
- They should be directed towards managers and operators of wastewater treatment plants, researchers, engineers, consultants, regulators, contractors that construct wetlands, and any individuals or groups interested in this wastewater technology.

### **Networking and Operator Training**

- A network of individuals in Iowa that are involved with constructed wetlands for wastewater treatment should be developed for information exchange and support.
- Most operators during site visits mentioned that they felt that there was a lack of information exchanged on constructed wetland technology in Iowa.
- The network should focus on operator training issues such as determining adequate vegetation and water level management strategies. Operators need to be

aware that wetland vegetation is sensitive to water level. They need to maintain their systems to mimic natural fluctuations in water level seasonally.

### **Brochure**

- A brochure should be developed to address constructed wetlands for wastewater treatment technology and be distributed throughout Iowa.
- The brochure would describe the types of constructed wetlands and system configurations, expectations of wetlands at removing wastewater contaminants, and estimated costs.
- It should focus on the application of this treatment for small communities and small flow facilities such as parks, training centers, businesses, and in some cases industries.

### **References**

Kadlec, R.H. and R.L. Knight. 1996. *Treatment Wetlands*. CRC Press LLC, Boca Raton, FL.