Advanced Treatment Wetlands

Benefits and Challenges of Constructed Treatment Wetlands

Dan Leemon – Teton Conservation District

Agenda

- Background on Advanced Treatment Wetlands
- Treatment Wetlands in Teton County; Karns Meadow Stormwater Wetland & Residential RVF Wetlands
- Additional Potential Uses of Treatment Wetlands for Water Quality Improvement
- Advantages of Treatment Wetlands.
- Disadvantages of Treatment Wetlands
- References

Introduction

- Engineered or constructed wetlands utilize natural processes involving wetland vegetation, soils, and their associated microbial assemblages to assist, at least partially, in treating an effluent or other water source.
- Free water surface (FWS) type (also known as surface flow, SF)—Configuration similar to natural wetland, with soil bed, emergent vegetation, and water exposed to atmosphere.
- Vegetated submerged bed (VSB) type (also known as subsurface flow, SSF)—Bed of media (e.g., stones, gravel, sand, soil), often linear, planted with wetland plants but with water level below media surface.

Introduction

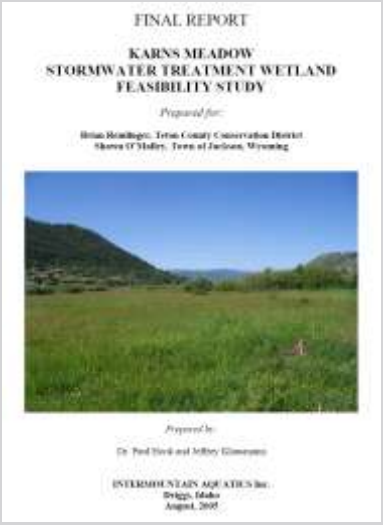
- Designing and building wetlands to treat wastewater is not a new concept. As many as 5,000 constructed wetlands have been built in Europe and about 1,000 are currently in operation in the United States.
- The performance of these systems is influenced by their area, length to width ratio, water depth, rate of wastewater loading and the time for it to pass through the wetland.
- For the removal of disease-causing microorganisms, an efficiency above 90% is normally achieved, for organic material and suspended solids 80% removal may be expected but nutrient removal efficiency is normally below 60%.

Karns Meadow Stormwater Wetland

- Located near Flat Creek in the center of Jackson, WY.
- Flat Creek was added to the 303(d) List in 2000.
- Flat Creek's ability to meet its aquatic life other than fish use is threatened, primarily by urban runoff, which contributes excess sediment to the stream and limits aquatic habitat.

Feasibility Study

- Provided an independent evaluation of the feasibility of constructing a stormwater retention wetland on the Karns Meadow property, with primary emphasis on treating sediment and enhancing wildlife habitat.
- Developed a design concept embodying a practical approach to constructing a stormwater retention wetland given hydrology, water quality, and site characteristics.


FINAL REPORT

KARNS MEADOW
STORMWATER TREATMENT WETLAND
FEASIBILITY STUDY

Prepared for:

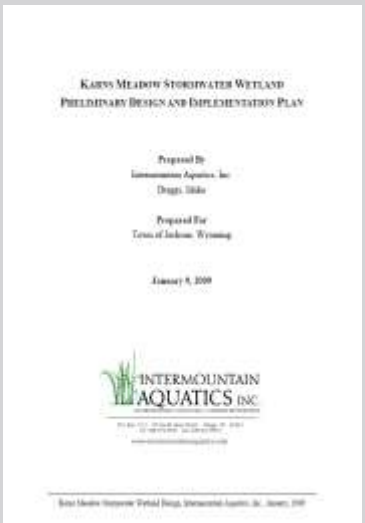
Prepared by:

INTERMOUNTAIN AQUATICS Inc.
Driggs, Idaho
August, 2005

Partnerships and Funding

- Wyoming Department of Environmental Quality Non-Point Source 319 Grant.
- Numerous local funding partners.
- Outreach was key to public acceptance.

Implementation and Construction



Implementation and Construction

August 2010

August 2011

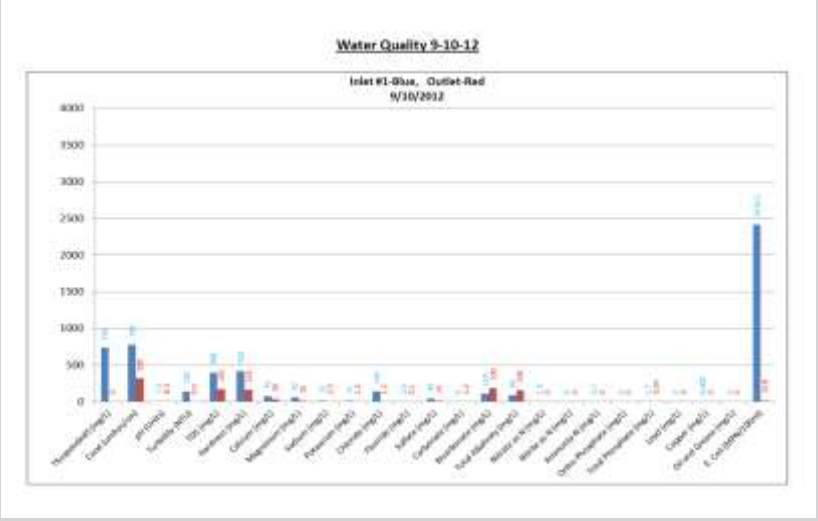
Implementation and Construction

September 2010

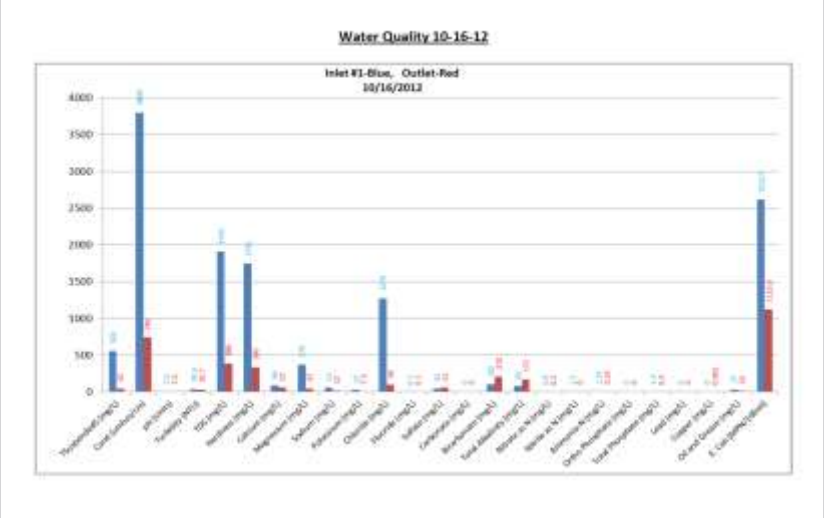
Late August 2011

Monitoring

Results



Results

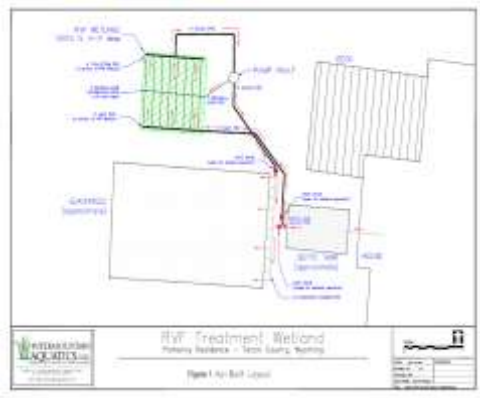


RVF Residential Treatment Wetland

- Problem: Traditional septic systems are not providing adequate water quality protection in areas of high groundwater and/or permeable soils.
- Potential solution: Recirculating vertical flow wetlands that work with an existing septic tank and leach field.

RVF Residential Treatment Wetland

- Residential treatment wetlands have been used successfully throughout Europe and some parts of the U.S. for several decades and are an accepted technology in many locations.
- Use of residential treatment wetlands remains limited in the northern Rocky Mountain region due to lack of regulatory approval.
- Studies in Minnesota and Indiana indicate that treatment wetlands can function well in cold climates.
- Rigorous tests of year round performance have not been conducted in the northern Rocky Mountain region



RVF Residential Treatment Wetland

Excavation of RVF wetland cell. Groundwater level is at base of cell (center right). Pump vault is large vertical pipe at right.

Frame for RVF wetland cell liner.

RVF Residential Treatment Wetland

Filling lined RVF wetland cell with gravel. Gravel size is graded vertically from a coarse base to a fine root zone.

Influent distribution pipe (partially covered). Pipe from septic tank enters at bottom left.

RVF Residential Treatment Wetland

Recirculation distribution pipes installed at 6 inch depth. Pipe from pump is at bottom center.

RVF wetland filled with gravel. Pipe at bottom is overflow from pump vault to leachfield.

RVF Residential Treatment Wetland

Final grading

Pipe to RVF wetland (top) from septic tank (right). Preexisting pipe from septic tank to leachfield runs from right to left.

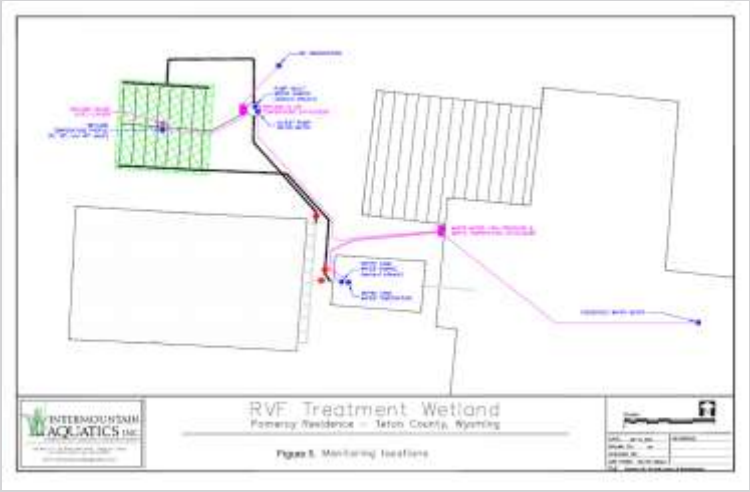
RVF Residential Treatment Wetland

Planting completed May 26, 2010

September 1, 2010

RVF Residential Treatment Wetland

Monitoring



RVF Residential Treatment Wetland

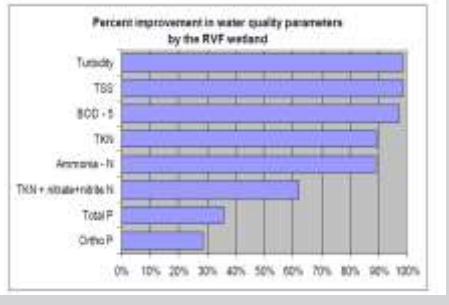
Results

Table 2. Baseline wetland water quality prior to introducing septic tank effluent.

pH	Conductivity (umhos/cm)	BOD$_5$ (mg/L)	TSS (mg/L)	Nitrate + Nitrite N (mg/L)	Ammonia N (mg/L)	TKN (mg/L)	Ortho P (mg/L)	Total P (mg/L)	Turbidity NTU
7.5	433	0.85	5.7	0.19	<0.1	<0.1	<0.1	0.05	13.5

Table 3. Average water quality entering and leaving the wetland (septic tank and pump vault, respectively).

	pH	Conductivity (umhos/cm)	BOD$_5$ (mg/L)	TSS (mg/L)	Nitrate + Nitrite N (mg/L)	Ammonia N (mg/L)	TKN (mg/L)	Ortho P (mg/L)	Total P (mg/L)	Turbidity NTU
Septic tank	6.64	668	128.6	76.1	0.0	62.2	81.0	6.8	7.8	161.1
Pump vault	6.74	660	5.8	1.0	16.8	5.8	6.7	2.8	5.8	1.8
Percent reduction	NA	4.5%	97.1%	98.4%	NA	90.8%	92.1%	58.4%	55.7%	98.9%
Quantity removed (mg/L)	NA	NA	124.1	77.8	-16.8	47.1	64.6	1.8	2.8	NA



Additional Potential Uses of Treatment Wetlands for Water Quality Improvement

- Domestic Wastewater Treatment
  - Treatment of primary settled and secondary treated sewage
  - Tertiary effluent polishing
  - Disinfection
- Agricultural Wastewater
  - Establishment of wetland plants in irrigation ditches for the reduction of e-coli and nutrients
- Urban and Rural Stormwater Runoff
- Landfill and Mining Leachate Treatment
- Industrial Effluent Treatment
- Enhancement of in-stream nutrient and e-coli assimilation
- Nutrient Removal via Biomass Production and Export

Advanced Treatment Wetlands: Advantages

- Wetlands can be less expensive to build than other treatment options.
- Operation and maintenance expenses (energy and supplies) are low.
- Operation and maintenance require only periodic, rather than continuous, on-site labor.
- Wetlands are able to tolerate fluctuations in flow.
- Facilitate water reuse and recycling.
- They provide habitat for many wetland organisms.
- They can be built to fit harmoniously into the landscape.
- They provide numerous benefits in addition to water quality. improvement, such as wildlife habitat and the aesthetic enhancement of open spaces.
- They are an environmentally-sensitive approach that is viewed with favor by the general public.

Advanced Treatment Wetlands Disadvantages

- They generally require larger land areas than do conventional wastewater treatment systems. Wetland treatment may be economical relative to other options only where land is available and affordable.
- Performance may be less consistent than in conventional treatment.
  - Wetland treatment efficiencies may vary 'seasonally in response to changing environmental conditions, including rainfall and drought.
  - While the average performance over the year may be acceptable, wetland treatment cannot be relied upon if effluent quality must meet stringent discharge standards at all times.
- The biological components are sensitive to toxic chemicals, such as ammonia and pesticides.
- Flushes of pollutants or surges in water flow may temporarily reduce treatment effectiveness.
- They require a minimum of water if they are to survive.
  - While wetlands can survive temporary drawdowns they cannot withstand complete drying.

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