

# Introduction to Constructed Wetlands

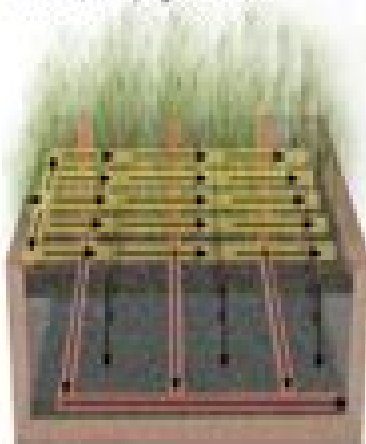
## Wetland Types & Plant Species

### Types of Constructed Wetlands?

#### Sub-Surface Flow (SSF)

- Enhanced removal of nitrogen and pathogens<sup>10</sup>
- Reduced odor, vectors, and contact with wastewater
- Space efficient

Vertical Sub-Surface Flow (vSSF)  
Aerobic, nitrifying conditions

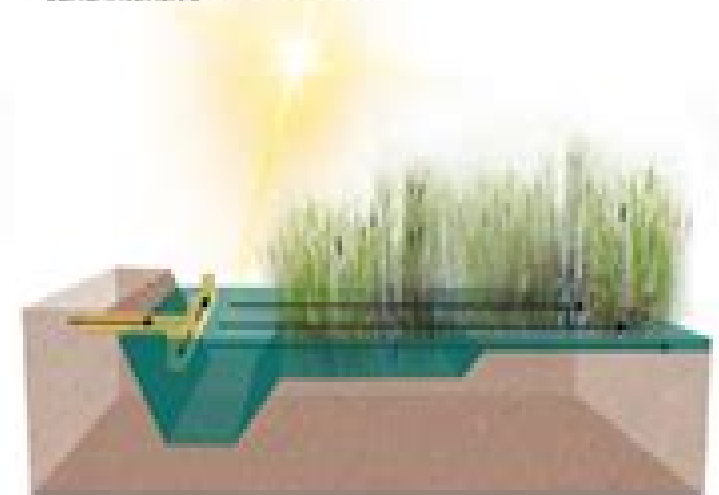


Horizontal Sub-Surface Flow (hSSF)  
Anaerobic, denitrifying conditions



#### Free Water Surface (FWS)

- Vegetation distributes and reduces water current
- UV radiation kills off pathogens
- Most similar to natural wetlands
- Land intensive



### A Selection of Plant Species for Constructed Wetlands in Idaho

#### Emergent Plants<sup>7</sup>



**Broadleaf Cattail**  
*Typha latifolia*

**Soft-stem Bulrush**  
*Scheuchzeria  
lanceolata*



#### Submerged Plants<sup>7,18</sup>

**Cook's Tail**  
*Ceratophyllum demersum*



**Leafy Pondweed**  
*Potamogeton foliosus*



#### Floating Plants<sup>7,18</sup>

**Common duckweed**  
*Lemna minor*



**Rocky Mountain Pond Lily**  
*Najas lutea* spp. polytricha



For more information on native Idaho wetland plants: <https://idfg.idaho.gov/species/interior/wetland/Plants/UCJNARW000000.pdf>

# **Constructed Wetlands For Water Quality Improvement**

**CH2M Gore & Storrie Limited, Alberta.  
Environmental Sciences Division.  
Municipal Program Development  
Branch**

## **Constructed Wetlands For Water Quality Improvement:**

**Constructed Wetlands for Water Quality Improvement** Gerald A. Moshiri, 1993-10-25 Constructed Wetlands for Water Quality Improvement is a virtual encyclopedia of state of the art information on the use of constructed wetlands for improving water quality Well organized and easy to use this book features contributions from prominent scientists and provides important case studies It is ideal for anyone involved in the application of constructed wetlands in treating municipal and industrial wastewater mine drainage and non point source pollution Constructed Wetlands for Water Quality Improvement is a must for industrial and municipal water treatment professionals consulting engineers federal and state regulators wetland scientists and professionals ecologists environmental health professionals planners and industrial environmental managers

**Constructed Wetlands for Water Quality Improvement in Surface Water Discharges to the Everglades** Wossenu Abtew, Tracey Piccone, Kathleen Pietro, 2007 Everglades Stormwater Treatment Areas STAs are constructed freshwater wetlands designed for reducing phosphorus concentration and load from drainage waters that flow into the Everglades Currently six stormwater treatment areas with a total effective treatment area of 16 098 ha are under operation Operation of the STAs started in 1994 with a 1 544 ha prototype constructed wetland the Everglades Nutrient Removal Project and additional STAs were constructed over the following years For the period of operation of the STAs the average total phosphorus TP concentration was 140 ppb in the inflow and 43 ppb in the outflow The average phosphorus load reduction was about 70 percent Hydraulic loading rate TP loading rate and hydraulic retention time are recognized as factors that affect TP removal efficiency Since the start of operation of the Everglades Nutrient Removal Project and the subsequently constructed additional stormwater treatment areas about 826 540 ha m of water has been treated and 810 3 mt of total phosphorus have been removed An additional expansion of the STA treatment system by another 2 389 ha is currently in progress

**Constructed Wetlands for Pollution Control** Robert H. Kadlec, R. Knight, J. Vymazal, H. Brix, P. Cooper, R. Haberl, 2000-03-31 The book presents a comprehensive up to date survey of wetland design techniques and operational experience from treatment wetlands This book is the first and only global synthesis of information related to constructed treatment wetlands Types of constructed wetlands major design parameters role of vegetation hydraulic patterns loadings treatment efficiency construction operation and maintenance costs are discussed in depth History of the use of constructed wetlands and case studies from various parts of the world are included as well Constructed Wetlands for Pollution Control will be indispensable for wastewater treatment researchers and designers decision makers in public authorities wetland engineers environmentalists and landscape ecologists Contents Biological methods for the treatment of wastewaters Types of constructed wetland Applications of the technology Framework for interpreting and predicting water quality improvement Mechanisms and results for water quality improvement Design Plants and planting System start up Economics Case studies Scientific and Technical Report No 8

Wetlands for Tropical Applications Norio Tanaka, Wun Jern Ng, K. B. S. N.

Jinadasa,2011 This book provides a systematic exposition of the design features of constructed wetlands and their management in terms of siting physical maintenance and operation Only very few books or chapters have been published on constructed wetlands in tropical conditions and none are current The selection of plant species managing their growth and harvesting cycles and the impact these have on the attenuation of organic and inorganic pollutants nutrients and pathogens would be of interest to students and practitioners of the art working under tropical conditions The potential of constructed wetlands as a low cost intervention for developing countries in tropical regions that faced water pollution problems in particular deserves to be explored systematically

**Guidelines for the Approval and Design of Natural and Constructed Treatment Wetlands for Water Quality Improvement** CH2M Gore & Storrie Limited,Alberta.

Environmental Sciences Division. Municipal Program Development Branch,2000 **Artificial or Constructed Wetlands**

María del Carmen Durán-Domínguez-de-Bazúa,Amado Enrique Navarro-Frómata,Josep M. Bayona,2018-06-15 Artificial or constructed wetlands are an emerging technology particularly for tropical areas with water scarcity For big cities the sustainable management of water resources taking into account proper use is always challenging The book presents case studies illustrating the above As plants and microorganisms are a fundamental part of the correct functioning of these systems their contribution to the degradation of the organic matter and to the removal and transformation of the pollutant compounds present in the wastewaters is also a highlight of this book **Treatment Wetlands** Robert H. Kadlec,Scott Wallace,2008-07-22 Completely revised and updated Treatment Wetlands Second Edition is still the most comprehensive resource available for planning designing and operating wetland treatment systems It provides engineers and scientists with a complete reference source that includes detailed information on wetland ecology design for consistent performance site specific studies estimated costs construction guidance and operational control through effective monitoring Case histories of operational wetland treatment systems illustrate the variety of design approaches presented allowing readers to tailor them to the needs of their projects *Using Constructed Wetlands to Improve Water Quality* James Allan Moore,1992

**Constructed Wetlands for Ground Water Quality Improvement** Ryan C. Molsee,2002 **Constructed Wetlands for Wastewater Treatment** Donald A. Hammer,2019-12 Both practical and theoretical this book provides the basic principles of soil chemistry hydrology wetland ecology microbiology vegetation and wildlife as a sound introduction to this innovative technology to treat toxic wastewaters and sludges The use of wetlands for acid mine drainage and metals removal in municipal urban runoff and industrial systems is discussed Case histories are also presented demonstrating specific types of constructed wetlands and applications to municipal wastewater home sites coal and non coal mining coal fired electric power plants chemical and pulp industry agriculture landfill leachate and urban stormwater Construction and management guidelines are clearly explained providing information on applicable policies and regulations siting and construction and operations and monitoring of constructed wetlands treatment systems Recent theoretical and empirical results from

operating systems and research facilities including such new applications as nutrient removal from eutrophic lakes and urban stormwater treatment within highway rights of way are included This book is an ideal resource for wastewater treatment plants consulting engineers federal and state regulators industrial environmental managers municipalities environmental health professionals and ecologists

**A Pilot Study on Municipal Wastewater Treatment Using a Constructed Wetland in Uganda** Tom Okia Okurut,2000-01-01 This study investigates the use of constructed wetlands as a cheaper and more effective alternative method of treating domestic wastewater in tropical environments This book determines the technical viability of the model with respect to treatment performance under different operating conditions and the economic competitiveness of technology in Uganda and across the region The Pilot Constructed Wetland investigated in this study was situated at the National Water and Sewerage Corporation s Jinja Sewage Works at Kirinya Uganda The study revealed the economic viability of constructed wetland systems in the tropical regions These could be established at competitive costs with waste stabilisation ponds

Guidelines for the Approval and Design of Natural and Constructed Treatment Wetlands for Water Quality Improvement ,2000

**Arizona Guidance Manual for Constructed Wetlands for Water Quality Improvement** Robert Lee Knight,1995

**Constructed Wetlands in Water Pollution Control** Paul F. Cooper,B. C. Findlater,1990

**Natural Wastewater Treatment Systems, Second Edition** Ronald W. Crites,E. Joe Middlebrooks,Robert K. Bastian,2014-03-14 Calling for ecologically and economically sound wastewater treatment systems the authors of Natural Wastewater Treatment Systems explore the use of wetlands sprinkler or deep irrigation groundwater recharge and other natural systems as sustainable methods for the treatment and management of wastewater Based on work by prominent experts in natural waste treatment this text provides a thorough explanation on how soil and plants can successfully sustain microbial populations in the treatment of wastewater Determining that natural systems cost less to construct and operate and require less energy than mechanical treatment alternatives this book also explains how these processes produce lower amounts of residual solids and use little or no chemicals What s New in the Second Edition This revised edition includes current design and regulatory and operational developments in the natural wastewater treatment field It provides detailed examples and analyses along with significant operational data in each chapter It also considers how processes provide passive treatment with a minimum of mechanical elements and describes new approaches to partially mixed ponds including dual powered aeration ponds Introduces the planning procedures and treatment mechanisms responsible for treatment in ponds wetlands land application and soil absorption systems Provides new case studies of constructed wetlands and water reuse systems Presents design criteria and methods of pond treatment and pond effluent upgrading Describes constructed wetlands design procedures process applications treatment performance data and land treatment concepts and design equations Includes information on constituents of emerging concern CEC and their fate in natural systems The text discusses wastewater pond systems free water surface constructed wetlands subsurface and

vertical flow constructed wetlands land treatment sludge management and onsite wastewater systems It describes residuals and biosolids management including nitrogen removal pretreatment methods and uses U S customary and metric units in all chapters It presents case studies of new applications of natural systems and includes worked examples of design equations for ponds and land treatment It also provides a biosolids regulatory update from a top EPA scientist and algae reduction technologies for ponds and wetlands Designed for practicing wastewater engineers and scientists involved in the planning design and operation of ponds wetlands land treatment biosolids and onsite soil based treatment systems the book integrates many natural treatment systems into one single source      **Wetlands for Water Pollution Control** Miklas

Scholz,2023-11-08 Wetlands for Water Pollution Control is the third edition of the reputable reference guide by Miklas Scholz formerly known as Wetland Systems to Control Urban Runoff The book covers broad water and environmental engineering aspects relevant for the drainage and treatment of storm water and wastewater providing a descriptive overview of complex black box treatment systems and general design issues involved The fundamental science and engineering principles will be explained to address the student and professional market Standard and novel design recommendations for predominantly constructed wetlands and related sustainable drainage systems will also be provided to account for the interests of the professional engineers and environmental scientists Latest research findings in wastewater treatment and runoff control will be discussed to attract academics and senior consultants who should recommend the proposed textbook to final year and postgraduate students and graduate engineers respectively Includes twelve new chapters with a broad overview of water and environmental engineering aspects relevant for the drainage and treatment of stormwater and wastewater Contains case study topics covering wetlands including natural wetlands and constructed treatment wetlands sustainable water management including sustainable drainage systems and specific applications such as wetlands treating hydrocarbon greywater and piggery dye wastewater Captures the latest findings in wastewater treatment with chapters focusing on practical applications and field studies      **Wetland Systems to Control Urban Runoff** Miklas Scholz,2015-10-22 Wetlands

for Water Pollution Control Second Edition covers the fundamental science and engineering principles relevant to the drainage and treatment of both storm and wastewater Standard and novel design recommendations for predominantly constructed wetlands and related sustainable drainage systems are also provided to account for the interests of professional engineers and environmental scientists This revised edition deals with the design operation maintenance and water quality monitoring of traditional and novel wetland systems but also provides information on the analysis of asset performance and modeling of treatment processes along with performances of existing infrastructures in predominantly developed but also developing countries and the sustainability and economic issues involved This new edition contains 10 new chapters along with multidisciplinary experimental and modeling orientated case study topics that include natural wetlands constructed treatment wetlands for pollution control sustainable drainage systems and specific applications such as wetlands treating

hydrocarbon and ammonia as well as ecological sanitation systems recycling treated Contains a broad overview of water and environmental engineering aspects relevant for the drainage and treatment of storm water and wastewater respectively Includes standard and novel design operation monitoring and maintenance recommendations for predominantly constructed wetlands and related sustainable drainage systems Provides detailed solutions to pressing water quality challenges associated with constructed treatment wetlands integrated constructed wetlands sustainable flood retention basins farm constructed wetlands and storm water ponds and other sustainable biological filtration and treatment technologies linked to public health engineering

Treatment Marshes for Runoff and Polishing Robert H. Kadlec, 2019-07-09 Treatment Marshes for Runoff and Polishing represents the most comprehensive and up to date resource for the design construction and operation of marsh treatment systems This new edition represents a complete rewrite of the surface flow sections of previous editions of Treatment Wetlands It is based on the performance hundreds of treatment marshes over the past 40 years Treatment Marshes focuses on urban and agricultural runoff river and lake water improvement and highly treated municipal effluents New information from the past dozen years is used to improve data interpretation and design concepts Topics included in this book are Diversity of marsh vegetation Analyses of the human use of treatment marshes New concepts of underground processes and functions Spectrum of marsh values spanning mitigation restoration enhancement and water quality improvement Improved methods for calculation of evapotranspiration and wetland water temperatures Hydraulics of surface and subsurface flows in marshes Analysis of long track records for deterministic and probabilistic behavior Consideration of integrated microbial and vegetative contaminant removals via mass balances Uptake and emission of gases Performance of urban and agricultural wetlands Design procedures for urban and agricultural wetlands Reduction of trace metals pesticides pharmaceuticals endocrine disruptors and trace organics Updated capital and O M economics and valuation of ancillary benefits An updated list of over 1900 references

**Water and Nutrient Management in Natural and Constructed Wetlands** Jan Vymazal, 2010-09-23 Natural and constructed wetlands play a very important role within the landscape and their ecological services are highly valuable Water management including flood water retention biomass production carbon sequestration wastewater treatment and as a biodiversity source are among the most important ecological services of wetlands In order to provide these services wetlands need to be properly evaluated protected and maintained This book provides results of the latest research in wetland science around the world Chapters deal with such topics as the use of constructed wetlands for treatment of various types of wastewater use of constructed wetlands in agroforestry wetland hydrology and evapotranspiration the effect of wetlands on landscape temperature and chemical properties of wetland soils

Wetland Systems for Water Pollution Control 1994 Robert H. Kadlec, H. Brix, 1995-05-31 Proceedings of the 4th International Conference on Wetland Systems for Water Pollution Control held in Guangzhou China 6 10 November 1994

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