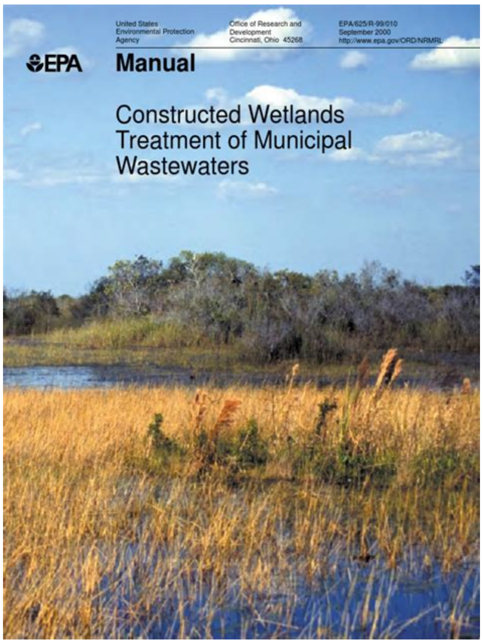
constructed wetland design manual for individual residences



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Book Descriptions:

constructed wetland design manual for individual residences

Residence Wastewater Wetland Construction in Indiana Department of Health as part of the onsite wastewater disposal project. Extension paper coming soon. Information, Images They may be appropriate for environmentally sensitive Pretreatment eases the This guide is designed to Wetland Provide temporary fences or barriers If it is necessary to Fill soil should be free of rocks, plants, Compact fill to the required elevations, filling in any disrupted or lowlying This sizing refers to the area between the inlet and If multiple systems are to be built, conduct a void ratio Lengths to width For example, a two bedroom home would require 300 A constructed Sizing generally Details on sizing a range of systems can be found However, the possibility of downsizing is Wetland The tank should be polyethylene, reinforced concrete or fiberglass capable of If using an existing septic tank, It should be a minimum of 1,000 gallons with The tank must hold water Utilize gravity flow whenever possible. If a pump Pumps should be equipped with automatic restart. Protect the pumps against Make sure that surface water is diverted around One to two inches of Indiana. The insulation will help stabilize the wetland during freezing and Liner is usually 2030 mil depending upon It is important that the liner is sunlight and weather It should be free of Check the liner for holes before placement and leaks after Leave this water in the cell to protect Before placing the liner, Clean all joints and openings prior to Do not glue the vertical riser on the outlet end of the wetland figure 4 within the water level control sump. This should be removable so that the wetland can be completely drained if Gravel should be screened and washed. Gravel with excessive fines is likely to cause plugging and subsequent failure The 1 3 inch rock should be placed first The lined basin should be filled with Finish grade must be level.http://www.mohini.cn/fckeditor/editor/filemanager/connectors/php/fckeditor/upload/202009/98-ranger-manual-hub-conversion.xml

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Again, filling the basin with water to a depth of 24 Fill in low places where water is Locate the wetland where it Consult your extension botanist, horticulturist, or Select two to five different Use locally grown and adapted plants If these plants Plants should be inserted into the pea gravel bed to a Roots must be placed in Rows may be 18 inches apart and staggered 9 inches. Rows should be perpendicular Planting should be completed before August 24 Northern Indiana or September 1 Select mulch that will not contaminate the wetland The mulch can be covered with a woven Prior to mulching, place a The mulch will help insulate the bed to prevent freezing during the winter. Do not let the These wells consist of PVC pipe with Monitoring However, they The most common maintenance activities are Other maintenance The need to control turtles and Do not mow The gravel at the Another management Simply unplug the wetland, allow it to This also encourages root penetration Indiana. The Indiana State Department of Health may require monitoring. It would Therefore, Information Edition, S.C. Reed, R.W. Crites, and E.J. Middlebrooks. 1995, McGraw. Hill. Users including Individual Residences. Second Edition. G.R. Steiner, J.T. Watson. 1993. Tennessee Valley Authority, Water Management Resources Group. General Design, Construction, and Operation Guidelines, Publication WWBLDM65. Virginia University, P.O. Box 6064, Morgantown, West Virginia 265066064. Engineering, Purdue University; Michael Ogden, Southwest Wetlands

Group, 901 W. San Mateo, Suite M, Santa Fe, NM 87505; and Alan Dunn, Indiana State Department. Monitoring data from the assembled smallscale wetland database was used to develop sizing criteria for FWS and VSB wetlands. Loading rates and corresponding effluent quality were developed for BOD, TSS, TKN, phosphorus, and fecal coliform bacteria. Where there was adequate data, the variation in monthly vs.http://www.kk-gorenjska.si/uporabnik/file/98-pontiac-transport-service-manual.xml

Information on internal processes, hydraulic design, operation, maintenance, cost, and industrial applications of constructed wetlands is also presented in this report. This title belongs to WERF Research Report Series ISBN 9781843397281 Print ISBN 9781780403991 eBook Please click on the PDF icon to access. By continuing to use our website, you are agreeing to our privacy policy. Discharge water from the wetland system will be used as irrigation water for the agricultural crop area, thus ensuring complete recycling and utilization of nutrients. Many of its construction requirements can eventually be met with use of insitu materials, such as gravel from the Mars surface. Because the technology requires little machinery and no chemicals, and relies more on natural ecological mechanisms microbial and plant metabolism, maintenance requirements are minimized, and systems can be expected to have long operating lifetimes. Research needs include suitability of Martian soil and gravel for wetland systems, system sealing and liner options in a Mars Base, and wetland water quality efficiency under varying temperature and light regimes. Recommended articles No articles found. Citing articles Article Metrics View article metrics About ScienceDirect Remote access Shopping cart Advertise Contact and support Terms and conditions Privacy policy We use cookies to help provide and enhance our service and tailor content and ads. By continuing you agree to the use of cookies. They are designed to recreate the structure and function of a natural wetland, to act as a filter or purifier. In this selfsustaining system, abiotic physical and chemical and biotic microbial and phytological mechanisms can act alone, sequentially or simultaneously on pathogenic contaminants or microorganisms. Examples of effluents that can be treated using this technology include runoff water, mine drainage water and municipal, industrial or agricultural wastewater.

Some contaminants are converted into less harmful or dangerous substances, while others are transported, immobilized or concentrated in the substrate. When designing an artificial marsh, it is possible to optimize the parameters in order to enhance the mechanisms needed to treat specific contaminants.They consist of shallow basins in the ground, or any other support capable of supporting the roots of plants. They generally consist of a base made of soil and an emergent vegetation. Surface water is exposed to the atmosphere and moves through the wetland containing a substrate consisting of soils, gravels, sediments, etc. at low speeds. The plants in this system are adapted to aquatic environments and able to withstand continuously saturated soil conditions, as well as anaerobic conditions that can be encountered below the surface of the water and in sediments at the bottom of the wetland.These wetlands can be designed for horizontal or vertical flow, allowing water to flow through permeable root media below the soil surface.The main materials to consider for the construction of an artificial marsh areSome residues such as sludge and solids can accumulate during this treatment.The nature of these discharges will have to be determined in order to make an adequate disposition.The nature of these discharges will have to be determined in order to make an adequate disposition.It must meet the criteria applicable to the point of exit of the wetland. Otherwise, in the presence of byproducts or an unacceptable pH that may pose danger to the receptors, the water must be pumped and appropriately disposed.In addition, the system cannot be used during the winter months if the temperatures are too low. The recommendations for a more efficient system in a northern region areIn this case, analyses must be carried out to determine how the residues will be managed, in order to dispose of them appropriately, depending on the concentrations of contaminants present.

Depending on the water flow to be treated, the space required can be important. A constructed wetland may be joined in series to various processes such as settling ponds, oil and water separators and physical filtration, etc. and chemical chemical addition for phosphorus reduction, etc. treatment methods. Constructed wetlands can be used as a polishing process for ex situ treatments.Constructed wetland systems can significantly reduce biological oxygen demand, total suspended solids, nitrogen and metal concentrations, trace of organic content and presence of microbial pathogens. Although removal rates are highly variable and site dependent, removal efficiency observed for biochemical oxygen demand and suspended solids usually range from 70 to 90%; for nitrogen, from 60 to 86%; and between 97 and 99% for copper, zinc and cadmium. Constructed wetlands show longterm performance with low maintenance and modifications, and consequently low operation costs.CRC Press, ISBN1566703425. 281p Environmental Protection Agency EPA. A handbook of constructed wetlands A guide to creating wetlands for agricultural wastewater, domestic wastewater, coal mine drainage, stormwater, in the midAtlantic region. Volume 1 General considerations.CRC Press, ISBN9781566705264, 1048p. Constructed wetlands are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality. These systems can be used commercially for efficient biological treatment of wastewater, and it will also act as a better ecofriendly method when compared with other conventional treatment methods. A constructed wetland pilot scale unit was constructed in the SRM University campus which was allowed to treat wastewater from the sewage treatment plant III. The pilot scale unit was designed based on EPA and CPCB guidelines. The dimension of the constructed wetland was 250 150 80 cm with a slope of 0.01 1 %. The design is as per Darcy’s law.

http://erptrends.com/images/canon-eos-5d-instruction-manual.pdf

The retention time provided for the unit was 24, 48, 72, 96, and 120 h. Phragmites australis also known as common reed was the wetland plant species planted in the unit. Six field trials were carried out during the project and with average removal efficiencies of 75.99 % for BOD, 76.16 % for COD, 57.34 % for TDS, 62.08 % for Nitrate, 58.03 % for Phosphate, 57.83 % for Potassium. While not all constructed wetlands CWs replicate natural ones, it makes sense to construct wetlands that improve water quality and support wildlife habitat EPA Manual 2004; Sudharsan et al. 2014 . CWs can also be a costeffective and technically feasible approach to treating wastewater. Wetlands are often less expensive to build than traditional wastewater treatment options, have low operating and maintenance expenses, and can handle fluctuating water levels. Additionally, they are esthetically pleasing and can reduce or eliminate odors associated with wastewater. CWs are generally built on uplands and outside floodplains or floodways in order to avoid damage to natural wetlands and other aquatic resources. Wetlands are frequently constructed by excavating, backfilling, grading, diking, and installing water control structures to establish desired hydraulic flow patterns. If the site has highly permeable soils, an impervious, compacted clay liner is usually installed and the original soil placed over the liner. Wetland vegetation is then planted or allowed to establish naturally EPA Manual 2004 . Constructed wetlands A constructed wetland is a shallow basin filled with some sort of filter material substrate, usually sand or gravel, and planted with vegetation tolerant of saturated conditions. Wastewater is introduced into the basin and flows over the surface or through the substrate, and is discharged out of the basin through a structure which controls the depth of the wastewater in the wetland CN Manual 2008 .

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A constructed wetland comprises the following five major components This project work attempts to put the proper perspective on appropriate use of CWs. For some applications, these are best options because they are low in cost, maintenance requirements, offer good performance, and provide a natural appearance and more ecological benefits. They are well suited for wastewater treatment in small communities where inexpensive land is available and skilled operators are hard to find. Constructed wetland systems can be used commercially for efficient biological treatment of waste water. It is a better ecofriendly method than other conventional treatment methods. Materials and methods Natural wetlands, marshes, swamps, and bogs play an important role in protecting water quality. Constructed or artificial wetland systems mimic the treatment that occurs in natural wetlands by relying on plants and a combination of naturally occurring biological, chemical, and physical processes to remove pollutants from the water. Because constructed wetland systems are designed specifically for wastewater treatment, they typically work more efficiently than natural wetlands. Some constructed wetland system designs can closely resemble natural wetlands enough to provide additional habitat areas for many birds, animals, and insects that thrive in wetland environments. Study area The wastewater for project work was taken from the Sewage treatment plant STP III located at the SRM University Campus. The University is located along NH 45, about 40 km way from Chennai city. Sample collection points Wastewater sampling was performed by one of the two methods, grab sampling, and composite sampling. Composite sampling was the type of sampling that has been used in the collection of wastewater. Composite sampling consists of a collection of numerous individual discrete samples taken at regular intervals over a period of time, usually 24 h.

The wastewater samples were taken using a gouge from a depth of 10 cm. The domestic wastewater was collected and pumped from the preaeration tank of sewage treatment plant in the university and was discharged into the wetland unit. Wastewater sampling and analysis The sewage to be treated and reused in the campus was subjected to characteristic study. The following parameters were determined based on standard methods APHA 1998 pH, specific conductivity SC, biochemical oxygen demand BOD, chemical oxygen demand COD, total dissolved solids TDS, nitrate, phosphate, and potassium. The analysis was done immediately after sample collection, otherwise were properly stored. Waste water samples were taken using a gouge from the depth 10 cm. The retention time provided was 24, 48, 72, 96, and 120 h. The wetland media consisted of a gravel bed underlain on an impermeable concrete surface. The bed was filled to a height of 50 cm with coarse rock, medium gravel, fine gravel, gravelly sand, and coarse sand. The top portion of the wetland unit was filled with local sandy clay loam soil to support vegetation. This process depicted in Fig. 1. Fig. 1 Experimental setup Top view Full size image The plants were collected from a nearby lake and planted in the wetland unit 3 months before the commencement of treatment. The vegetation was planted by hand and normal water was used to grow plants. These plants increase the residence time of water by reducing velocity and increase sedimentation of the suspended particles. They also add oxygen and provide a physical site for microbial bioremediation. The plants have been used to remove suspended solids, nutrients, heavy metals, toxic organic compounds, and bacteria Deepak et al. 2012 . Maintenance The system was inspected on a weekly basis concerning the overall functioning. Major attention was given to the inlet flow, which was checked twice a week, as clogging may occur due to the presence of suspended solids.

Results and discussion The raw wastewater in the treatment plant mainly comes from hostels, canteens, bathrooms, washing areas, laundry services in the campus. The wastewater after treatment is mainly used for gardening and rest of the water is sent to the lakes in the premises. The Domestic wastewater from The preaeration tank of SRM Sewage treatment plant III was sent to the constructed wetland unit which was constructed near the treatment plant. The pilot scale unit created was a concrete tank of capacity 3 m 3 with soil and vegetation in it. The vegetation planted was Phragmites australis common reed. A total of six trials were carried out with a detention time of 5 days. The reduction pattern in each of the trials is obtained. Data representation and statistical analysis was done using error graphs and t test. Field trial I The subsurface integrated flow constructed wetland was constructed and proper setting of the unit was done. The commencement of functioning of the pilot scale unit began on January 2014. Figure 2 a, b shows the reduction in concentration of various parameters with respect to time. As the detention time increases, the reduction percentage is also increased, a detention period of 5 days is given for the constructed wetland. The removal efficiencies of various parameters after 5th day were 63.16 % for BOD, 62.96 % for COD, 52.63 % for TDS, 64.29 % for Nitrate, 46.60 % for Phosphate, 44.27 % for Potassium. Fig. 2 Reduction in concentration from influent and effluent of waste water.As the detention time increases the reduction percentage is also increased; a detention period of 5 days is given for the constructed wetland. The various removal efficiencies were 60 % for BOD, 60.48 % for COD, 60 % for TDS, 60.53 % for Nitrate, 53.27 % for Phosphate, and 50 % for Potassium. Fig. 3 Reduction in concentration from influent and effluent of waste water.

As the detention time increases the reduction percentage is also increased; a detention period of 5 days is given for the constructed wetland. The reduction percentages obtained for various parameters were 82.61 % for BOD, 82.69 for COD, 57.89 % for TDS, 62.86 % for Nitrate, 47.37 % for Phosphate, and 73.33 % for Potassium. Fig. 4 Reduction in concentration from influent and effluent of waste water.As the detention time increases the reduction percentage is also increased; a detention period of 5 days is given for the constructed wetland. The reduction percentages obtained were 79.49 % for BOD, 81.45 % for COD, 59.17 % for TDS, 65.22 % for Nitrate, 74.82 % for Phosphate, and 64.17 % for Potassium. Fig. 5 Removal of concentration from influent and effluent of waste water.As the detention time increases the reduction percentage is also increased; a detention period of 5 days is given for the constructed wetland. The various removal efficiencies observed during trial V were 84.44 % for BOD, 84.92 % for COD, 58.33 % for TDS, 58.06 % for Nitrate, 63.77 % for Phosphate, and 52.73 % for Potassium. Fig. 6 Reduction of concentrations from waste water.As the detention time increases the reduction percentage is also increased; a detention period of 5 days is given for the constructed wetland. The various reduction efficiencies observed were 86.22 % for BOD, 84.44 % for COD, 56 % for TDS, 61.54 % for Nitrate, 62.32 % for Phosphate, and 62.5 % for Potassium. The various forms of nitrogen are continually involved in chemical transformations from inorganic to organic compounds and back from organic to inorganic. Some of these processes require energy typically derived from an organic carbon source to proceed, and others release energy, which is used by organisms for growth and survival.

All of these transformations are necessary for wetland ecosystems to function successfully, and most chemical changes are controlled through the production of enzymes and catalysts by the living organisms they benefit Vymazal and Krasa 2003 . Fig. 7 Reduction of concentrations from waste water.Implementing this wastewater treatment system in SRM university campus can create awareness on environmental consciousness to the students, staff, and other residents of the township. Statistical analysis of concentration reductions in the domestic wastewater treatment using CWs was compared using t test. Statistical analysis using t test A t test compares the means of two groups. For example, we compare whether systolic blood pressure differs between a control and treated group, between men and women, or any other two groups. Here, we have compared the means of different parameters like BOD, COD, TDS, Nitrate, Phosphate, and Potassium before and after treatment. The processes that affect removal and retention of nitrogen during wastewater treatment in CWs are manifold and include NH 3 volatilization, nitrification, denitrification, nitrogen fixation, plant and microbial uptake, mineralization ammonification, nitrate reduction to ammonium nitrateammonification, anaerobic ammonia oxidation ANAMMOX, fragmentation, sorption, desorption, burial, and leaching. However, only few processes ultimately remove total nitrogen from the wastewater while most processes just convert nitrogen to its various forms Vymazal 2007 . The unpaired t test compares the means of two groups. The most useful result is the confidence interval for the difference between the means. If the assumptions of the analysis are true, we can be 95 % sure that the 95 % confidence interval contains the true difference between the means. The point of the experiment was to see how far apart the two means are. The confidence interval tells us how precisely we know that difference.

For many purposes, this confidence interval is all you need. The P value was used to ask whether the difference between the mean of two groups is likely to be due to chance. It is traditional, but not necessary and often not useful, to use the P value to make a simple statement about whether or not the difference is “statistically significant.” We will interpret the results differently depending on whether the P value is small or large. Table 1 shows the BOD, COD, Total dissolved solids, Nitrate, Phosphate, and Potassium value comparison of raw and treated wastewater analysis using t test. The table shows comparison of mean, Standard deviation, Standard error mean. The twotailed P value equals 0.0029. By conventional criteria, this difference is considered to be very statistically significant.Nitrification and denitrification are the main processes for nitrogen removal from wastewater. Denitrification is an anaerobic heterotrophic microbial process often limited by the presence of oxygen O 2 and the availability of labile carbon substrates. Nitrification is an aerobic chemoautotrophic process Ong et al. 2011 . The major processes responsible for phosphorus removal in SFWC are typically by adsorption, precipitation, and plant uptake rates. The frequent filtration materials used in SFCW are gravel, which is commonly good in absorption compared to the plant roots Vymazal 2004 . Phosphorus is an important nutrient required for plant growth and is usually act as a limiting factor for vegetative productivity. Phosphorus is transformed in the wetland by a complicated biogeochemical cycle. Accordingly, most of the researchers claimed that wetlands are not efficient in phosphorus reduction Kadlec and Knight 1996; Adeniran et al. 2012; Akratos et al. 2008 .

Conclusion The treatment of domestic wastewater from sewage treatment plant III in integrated subsurface flow constructed wetland vegetated with Phragmites australis is working well in degradation of high concentration of wastes. The average removal efficiencies obtained for the respective constructed wetland were 75.99 % for BOD, 76.16 % for COD, 57.34 % for TDS, 62.08 % for Nitrate, 58.03 % for Phosphate, and 57.83 % for Potassium, and thus the organic loading removal efficiency of the CW unit was identified. The wastewater treatment system on the SRM university campus using CWs has created awareness on environmental consciousness to the students, staff, and other residents of the township. The treated effluent values obtained were convenient with current Central Pollution Control Board regulations for domestic wastewater discharge. Implementing the constructed wetland technology is suitable for decentralized domestic wastewater treatment. The Integrated surface flow constructed wetland system by using Phragmites australis seems to be viable alternative for reducing the organic matter content from an institutional complex. CWs act like primarily biological filters and are very effective in removing BOD, COD, TSS, and organic nitrogen. When comparing performance of wetlands, the comparison should be based on the performance of complete systems remembering that wetlands are only one part of a multipart system. Accessed Sept 2004 Deepak M, Sudarasan JS, Deeptha VT, Baskar G 2012 Low cost dairy wastewater treatment using constructed wetland.Lewis Publishers, London. See COVID19 initiatives on Appropedia for more information. These systems mimic marshes with aquatic plants, soil, and associated microorganisms but take advantage of a controlled environment to treat wastewater. Wetlands have shown the ability to meet this goal in an aesthetic, sustainable, and economical manner.

However, they require large areas of land, consistent maintenance, and technical operational knowledge.Once their ability to treat water was discovered, as early as the 1950s, early research efforts to use and assess constructed wetlands were begun. Dr. Kathe Seidel at the Max Planck Institute in Plon, Germany, tested the ability of bulrushes to treat wastewater. Her discoveries led to the first subsurface CW for municipal wastewater treatment in 1974 in the community of LiebenburgOthfresen, Germany. The first free water surface CW was implemented in The Netherlands in 1967.Both subsurface types of horizontal HF or vertical flow VF involve a flat bed of permeable soil covered with macrophytes. For HF systems, the influent enters in the bed subsurface at the beginning of the wetland cell and flows through horizontally using pressure and gravity forces. Advantages to a subsurface wetland include a minimized risk of odors or insect vectors. In addition, the SSF media provides a greater surface area for contaminant filtration and treatment and allows for greater thermal protection in colder environments.The depth of the system is important not just in treatment efficiency but also in safety.Flow conditions can be calculated so that the entire wetland is effective in nutrient removal.The influent of the CW has normally undergone primary treatment. This entails a removal of large solid waste, a settling of heavy suspended solids, and an equalization of wastewater flow and quality.Typically for FWS wetlands, silt clay or loam soils are preferable. The inlet and outlet of a CW system contains some soils and rocks that act as distribution medium to evenly distribute and collect the influent and effluent. The distribution medium is usually coarse drainfield rock. In contrast with natural wetlands, vegetation in CW must be able to survive in waters with high concentrations of pollutants. Macrophytes can be freefloating, emergent, or submerged.

However, they enhance nutrient removal, although mostly through indirect means. Unless nutrient loadings are very low, net removal by direct plant uptake is generally a small proportion of total removal.Inlet structures for FWS or HF SSF wetlands include perforated or slotted PVC pipe or open trenches perpendicular to the direction of the flow, and the influent is released onto the distribution medium for further dispersion and velocity reduction, creating uniform flow throughout the width of the wetland cell. In VF SSF wetlands, a grid of pipes or trenches is laid over the bed, and influent is released down into the substrate. The medium will assist in the spreading of the water throughout the bed, but it is important for the inlet grid to be as uniformly distributed as possible.In FWS or HF SSF wetlands, most systems have a perpendicular perforated or slotted pipe enclosed in drainfield rock. A sump can be positioned downstream of the outlet to control the water level. In VF SSF systems, the collection system can be a grid network of pipes in drainfield rock.If the soil is clayey and impermeable, a liner may not be needed. There are a few options for lining the system.Further, these berms are important because they are designed in an effort to prevent flooding of dangerous wastewater. The berms usually contain about 0.6 to 0.9 meters of freeboard above the surface of the water. On either side of the berms, there is a grassed slope that sits on top of a sturdy soil like clay. On the top of the berm, there is often times a gravel path that is about three meters wide. The ratio for the grassed slopes should be greater than 31. Within, the berm, the PVC liner is usually tucked in to prevent any wastewater from leaking out of the constructed wetlands.The first zone is shallow and heavily vegetated to remove suspended solids and BOD. The second zone is deeper with open water to allow aeration and nitrification.