Turbidity and TSS Removal with BioSwale® Technology

Project Location: Shepherd Research Facility, Montana, USA

This case study demonstrates the ability of Elevated BioSwale® technology to clean irrigation ditch water by substantially reducing turbidity and related total suspended solids (TSS). The BioSwale technology is protected by U.S. Patent No. 8,287,728.

Overview

Field-scale tests were conducted at the Floating Island International Research Station at Shepherd, Montana. This report covers measurements taken during the period July 24 through August 13, 2014. The system comprised a 4300-ft section of irrigation ditch with two BioSwale filters placed in series (50 feet apart) within the ditch channel at the lower end of the study section.

Location	Shepherd, MT, USA
Parameters Studied	Turbidity, Total Suspended Solids (TSS)
Environment	Privately-owned irrigation ditch
BioSwale Size	Two BioSwales in series, each having an approx. volume of 40 cf. Dimensions: 4ft wide x 2 ft tall x 6 ft long each.
Water Source	Yellowstone River plus agricultural irrigation return
Installation Date	2010
Flow Rate	Varied from 5 to 360 gpm. Average 195 gpm.
Water Depth	Water depth in ditch - average 1 ft.
BioSwale Avg. Turbidity In/Out	15.4 FAU / 11.0 FAU
BioSwale Estimated TSS In/Out	56.6 mg/L / 49.9 mg/L
BioSwale Avg. Turbidity Removal	29%
BioSwale Estimated TSS Removal	12%

The BioSwales were installed in the ditch approximately four years prior to the field test, and had mature annual and perennial plant growth along their top surfaces, with plant roots extending an unknown distance into the interior regions. Visual observations indicated that the BioSwales backed-up water upstream from each BioSwale during normal flows. Water overtopping the BioSwales was observed occasionally during exceptionally high flows, and was associated with significantly increased water backup upstream from the BioSwales.

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Turbidity was measured with a Hach 890 colorimeter instrument that was calibrated in FAU (formazin attenuation units). TSS was estimated from turbidity by collecting three split samples (low, medium, and high turbidity), analyzing the samples for both TSS (at a commercial laboratory) and for turbidity, and developing a calibration curve[1] to correlate the TSS and turbidity measurements. Measurements were typically taken two to three times per day, and measurements were made in the field immediately after each sample was collected. Measurements were made at four locations along the ditch as follows: 1) at the upstream entrance to the ditch, 2) at the approximate midpoint of the study section (2062 ft below the inlet), 3) just upstream of the BioSwales (4244 feet below the inlet), and 4) just downstream of the BioSwales (4304 feet below the inlet). The reported results were the mean values from 19 sets of measurements.

The ditch had significant growth of green riparian plants along the sides and bottom along the entire study section, and these plants provided significant filtration that resulted in a removal of about 76% of the influent turbidity (64.2 to 15.4 FAU) and 57% of the TSS (130.9 to 56.6 mg/L) prior to the water reaching the BioSwales.

The average turbidities upstream and downstream from the BioSwales were 15.4 FAU and 11.0 FAU, respectively, for a calculated BioSwale removal of 29%. The corresponding reduction in TSS (56.6 to 49.9 mg/l) is a removal of 12%. Removal is believed to be caused by a combination of settling (directly upstream and downstream from each BioSwale) and trapping of particles by filtration within each BioSwale.

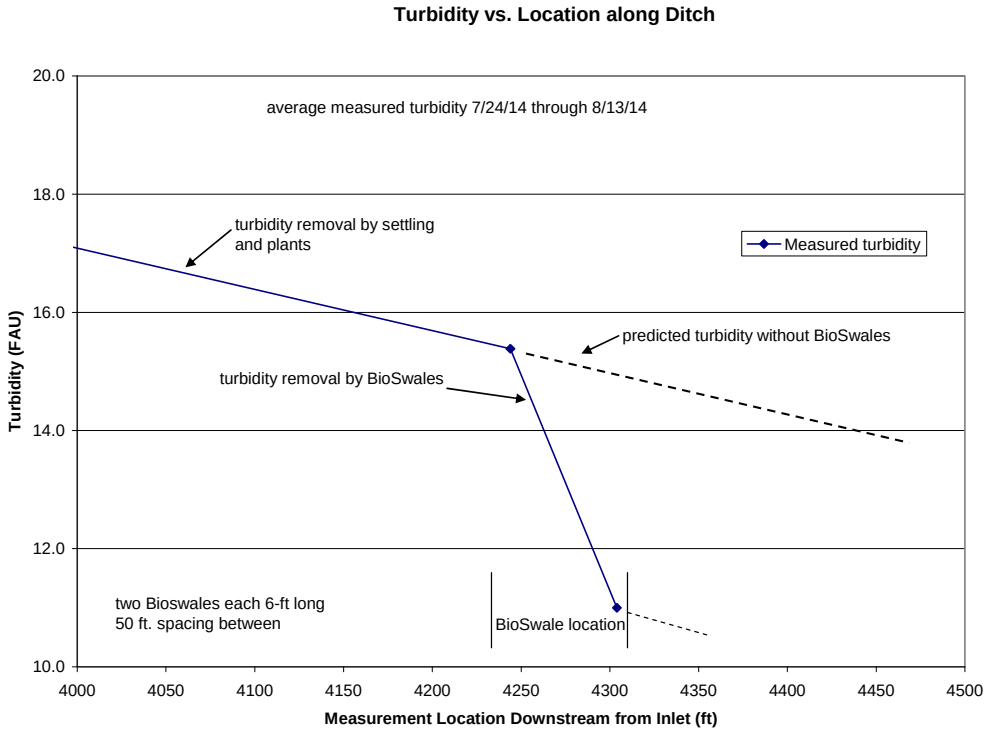
Conclusions

The BioSwale technology significantly removed turbidity and TSS in this field-scale application. Since influent concentrations were relatively low at this site compared to other potential applications such as stormwater runoff, additional tests will be conducted to confirm the efficacy of the BioSwale technology with higher turbidity. We anticipate that the products will perform well under more challenging conditions.

The BioSwale zone can be considered to be a “point-source collection site”. We envision that solids taken out of suspension by BioSwales can be permanently removed from the system in two ways: 1) removal of settled particles by shovel, backhoe, etc., or 2) removal of trapped particles by temporarily removing the BioSwales from the ditch and spraying them with a high-pressure rinse hose.

1) TSS (mg/l) = (1.5225 FAU) + 33.145

A Newly Installed BioSwale



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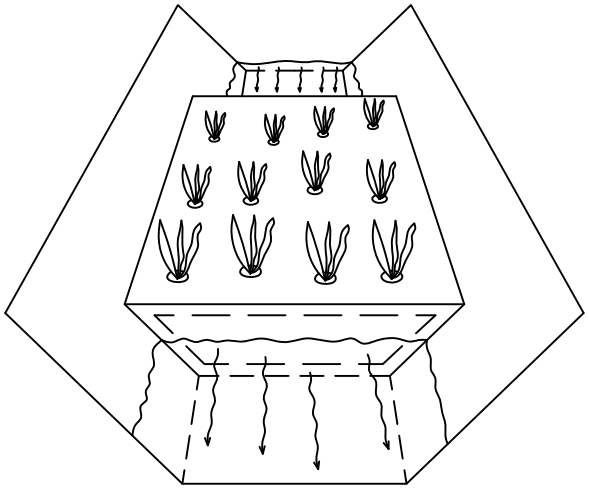
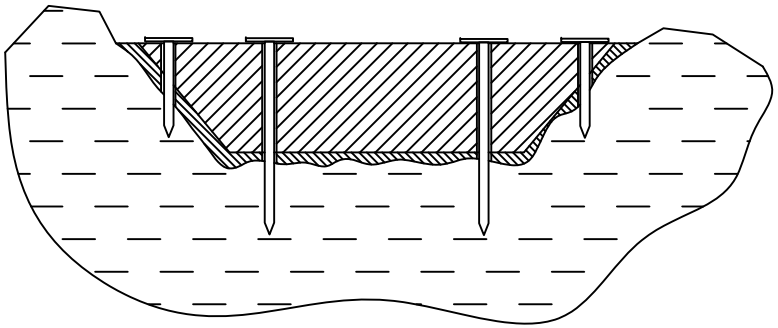
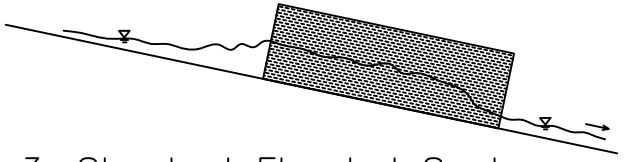
Simplified Side Views



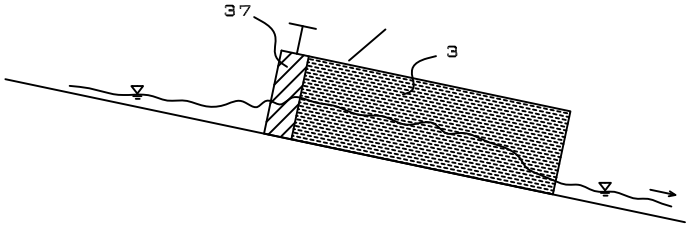
1. Standard Elevated Swale with plants.



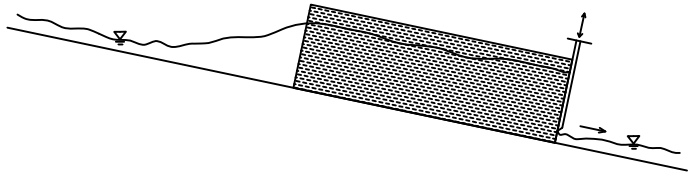
2. Elevated swale with a form–fitting outer shell and attachment spikes



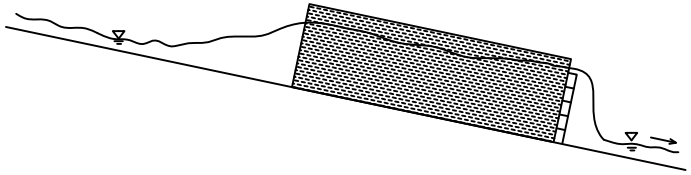
3. Standard Elevated Swale



4. Elevated Swale with a prefilter



5. Elevated swale with an underflow gate



6. Elevated swale with an overflow weir

Itemref	Quantity				Article No./Reference	
Designed by BK		Drawn by FS	Approved by - date	File name 071312A	Date 07–13–12	Scale none
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