George's Report For 2008-07-21 Meeting
What Should We Do To Significantly Improve The Quality of The Water Discharged Into The Anchorage Canal?

Water Quality of Storm Water Discharge Into The Anchorage Canal

Evaluation of Current Sediment Control Forebay

Where Do We Go From Here?

Agenda – Summary

- Water Quality Monitoring Pre Forebay
- DelDOT Installs Forebay In Early 2004
- Evaluation of The Current Sediment Control Forebay
- Suggestions For Making Significant Improvement To The Water Quality That Enters The Anchorage Canal
  1. Sand Filter
  2. Artificial wetland
  3. Pipe to Ocean
  4. EcoSolutions Advanced Wetland Stormwater Filter
  5. Pipe to Sanitary Sewer
- Where Do We Go From Here?

1996 Lagoon Water Quality/Rainfall Study

by Jack Pingree, Division of Water Resources, DNREC

- Water Quality (Enterococcus Level) was measured 34 times between April 22, 1996 and August 28, 1996 at 4 sites. Swimming standard at the time was 156 cfu/100ml

1. Anchorage & Rt. 1
   Exceeded standard 20 times
   Maximum measured 3,000 cfu/100ml
2. Anchorage & O'Connor home
   Exceeded standard 11 times
   Maximum measured 3,000 cfu/100ml
3. Petherton & Rt. 1
   Exceeded standard 20 times
   Maximum measured 2,200 cfu/100ml
4. Anchorage & Petherton
   Exceeded standard 7 times
   Maximum measured 2,166 cfu/100ml

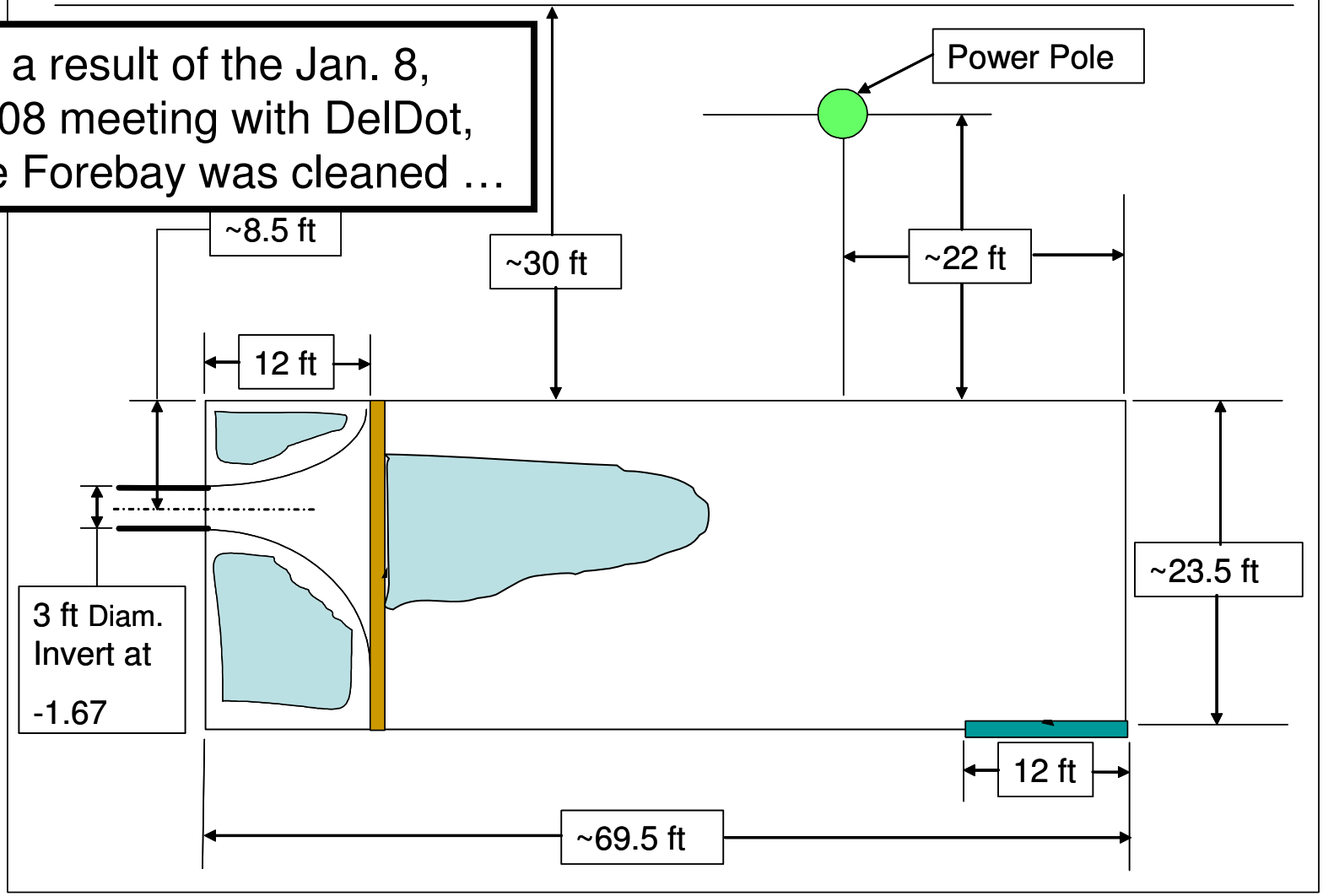
The January 2001 Report Characterized Storm Water Discharge Into The Anchorage Canal

- The study report documents that for each rainfall of about ½ inch during 1998 and 1999
  - About 360,000 gallons of stormwater were dumped into the Anchorage Canal.
  - During each event this stormwater contained
    - 6 pounds of Nitrogen
    - ½ pound of Phosphorous
    - 90 pounds of Chemical Oxygen Demand (COD) material
    - 10,000 to 100,000 colony forming units of fecal coliforms per 100ml of stormwater
- Previous Studies in the 1990s Documented oil slicks, heavy algae growths, foul odors, diminished water clarity and deposition of large amounts of silt.

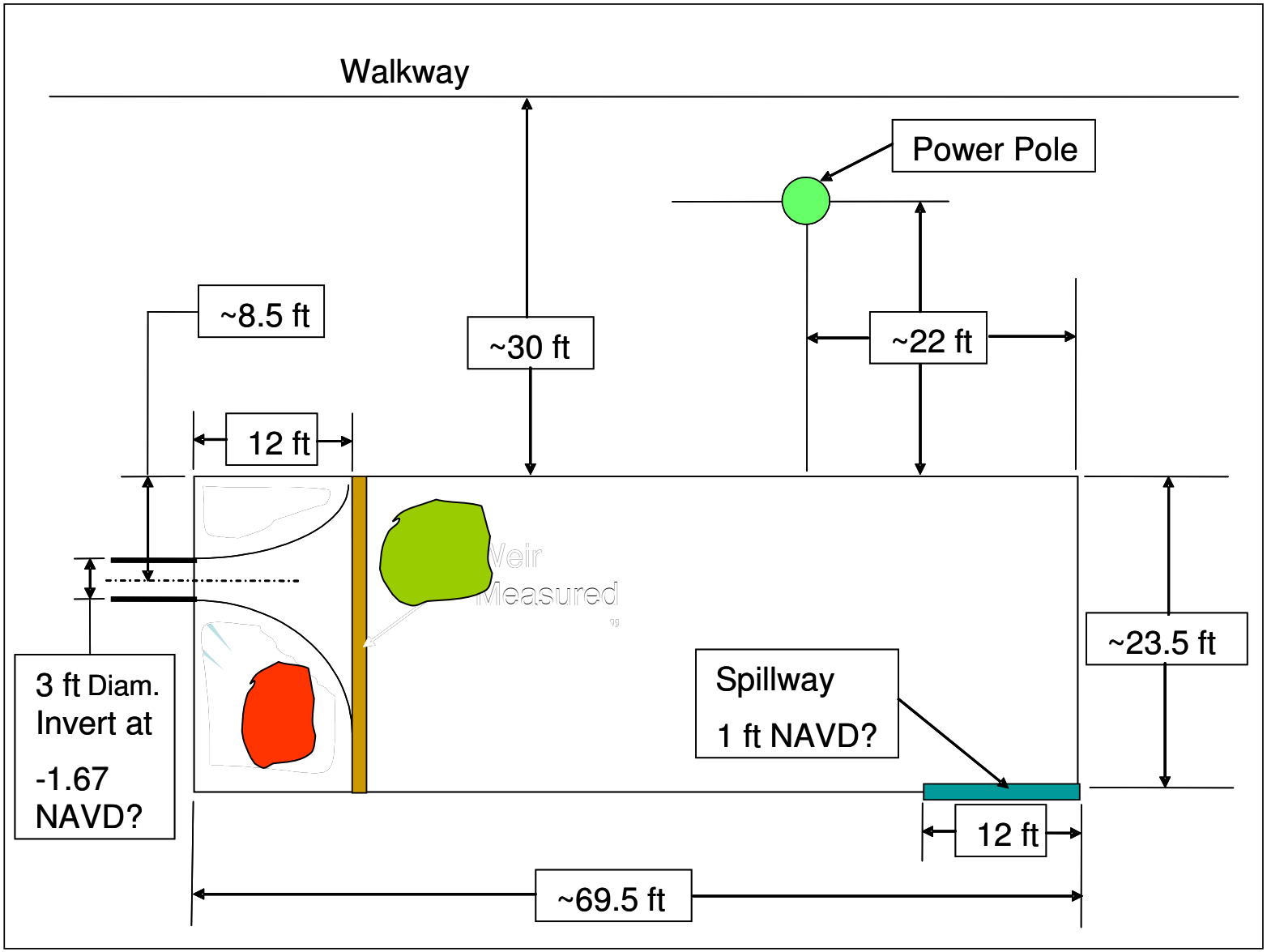
In Early 2004 DelDOT Installed the Current Sediment Control Forebay at the Easterly End of the Anchorage Canal

Our Inspection Shows Significant Sedimentation. (Pre-Weir), ~20” Deep in The Blue Area, ~7” Deep Around It, ~1” Deep Where The Water Exits The Pipe. (Post Weir), ~20 Deep In Blue Area Decreasing to Just A Few Inches.

As a result of the Jan. 8, 2008 meeting with DelDot, the Forebay was cleaned …



Our May 2008 Inspection After DelDOT Cleaning Shows Significant Sediment Still Remains. Red is 12” to 22” Deep. Green is 4” to 10” Deep



Even With Appropriate Cleaning The Efficiency of The Stormwater Sediment Control Forebay Is Only ~28%

Summary August 2005 DNREC Report

The forebay captured a substantial amount of the storm water sediments that were destined for Anchorage Canal. Sediment capture efficiencies of forebays are typically from 50 to 90 % (USEPA, 1999), however these are based on designs for systems that have much longer residence times (24 hrs) and larger surface areas in relation to drainage area. Based on the small size of the forebay and minimal retention time the Anchorage Canal forebay performed as well as could be expected with an overall efficiency of 28 % based on volume.

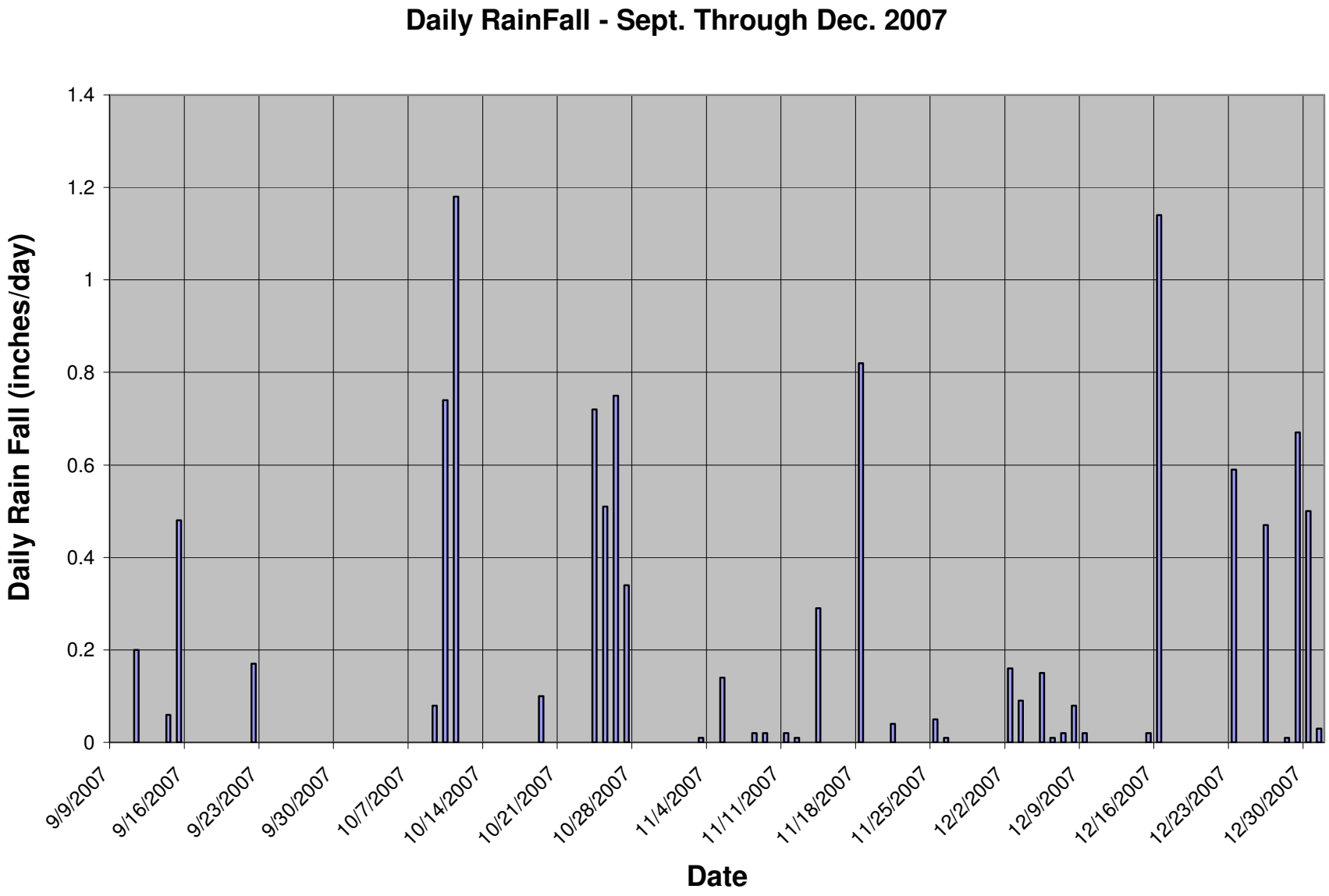
The outflow design of the forebay needs modification as evidenced by the severe scour at the outfall. The outfall weir should either be widened to decrease outflow velocity and/or the canal bottom should be hardened to prevent erosion.

The evaluation year was completed without the occurrence of a major storm event. The largest storm monitored (7.59 cm, 3.0 in) was the equivalent of a 2-year return frequency 12-hour storm (Bonnin, et al., 2004). The ability of the forebay to trap the sediment in runoff from larger storm events can not accurately be estimated. Two factors will affect efficiency as storm water flow increases; at one point the overland flow will increase to a sufficient velocity to erode the sandy soil and transport it into the drainage system, substantially increasing the forebay loading rate. In addition, the higher velocity water flow through the forebay might re-suspend trapped sediments and flush them into the canal.

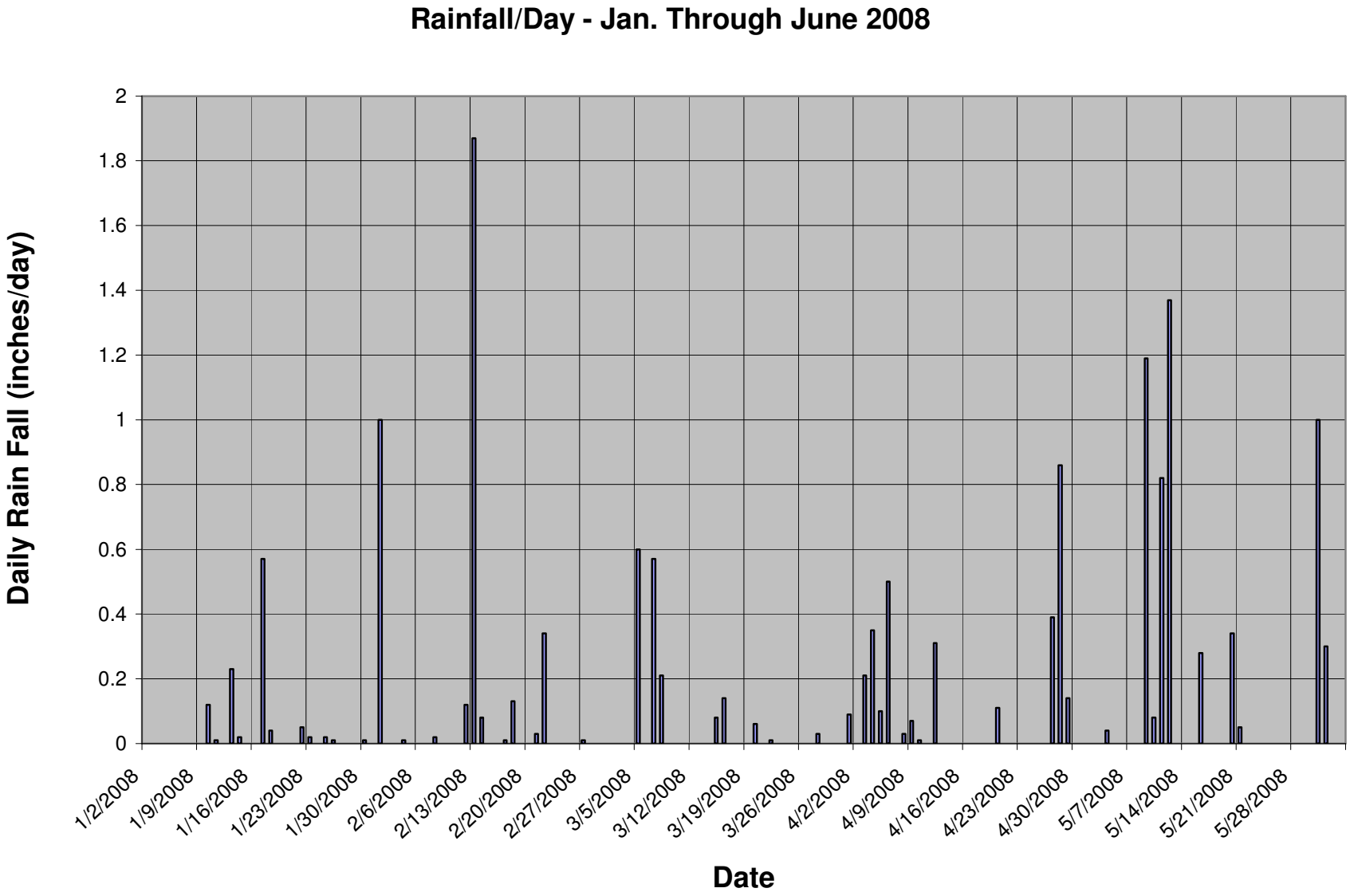
Where Do We Go From Here?

- Need to understand the “volume” of the problem
  - Need to know the volume of water that must be handled
  - The current forebay is too small to handle it
  - Rain gage data together with chart from 2001 Characteristics Report show the volume of water that must be handled. See next three charts

Rain Gage Data From 2007



Rain Gage Data For 2008



May 1998 through September 1999 is depicted in Figure 2.

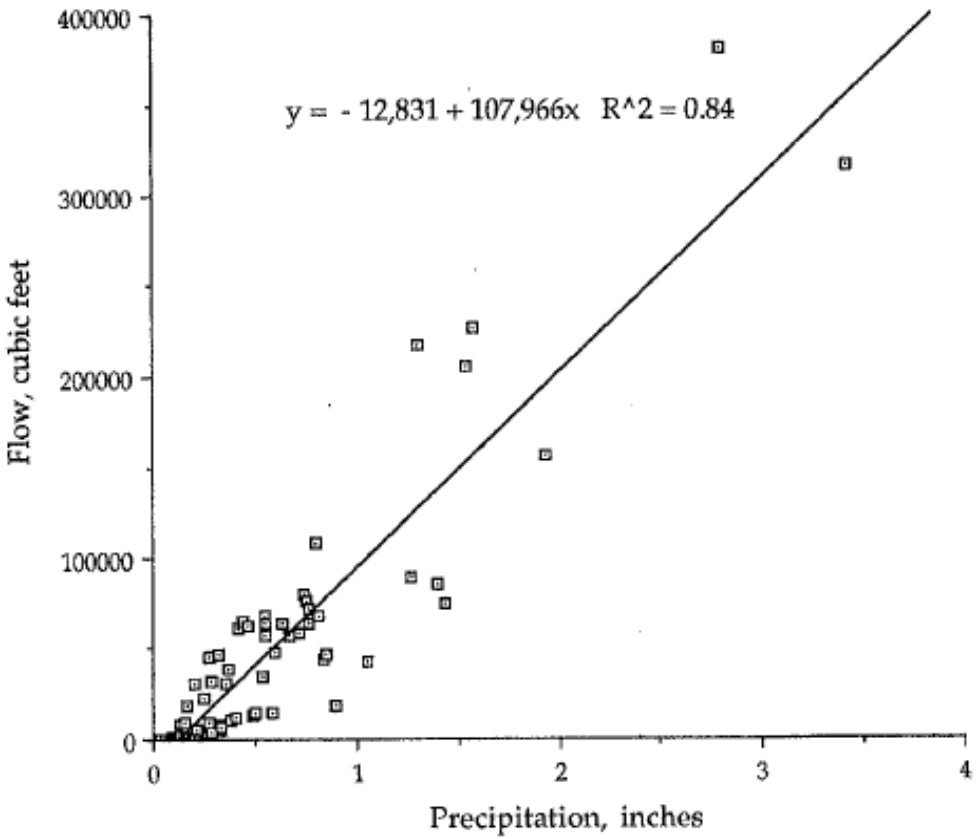


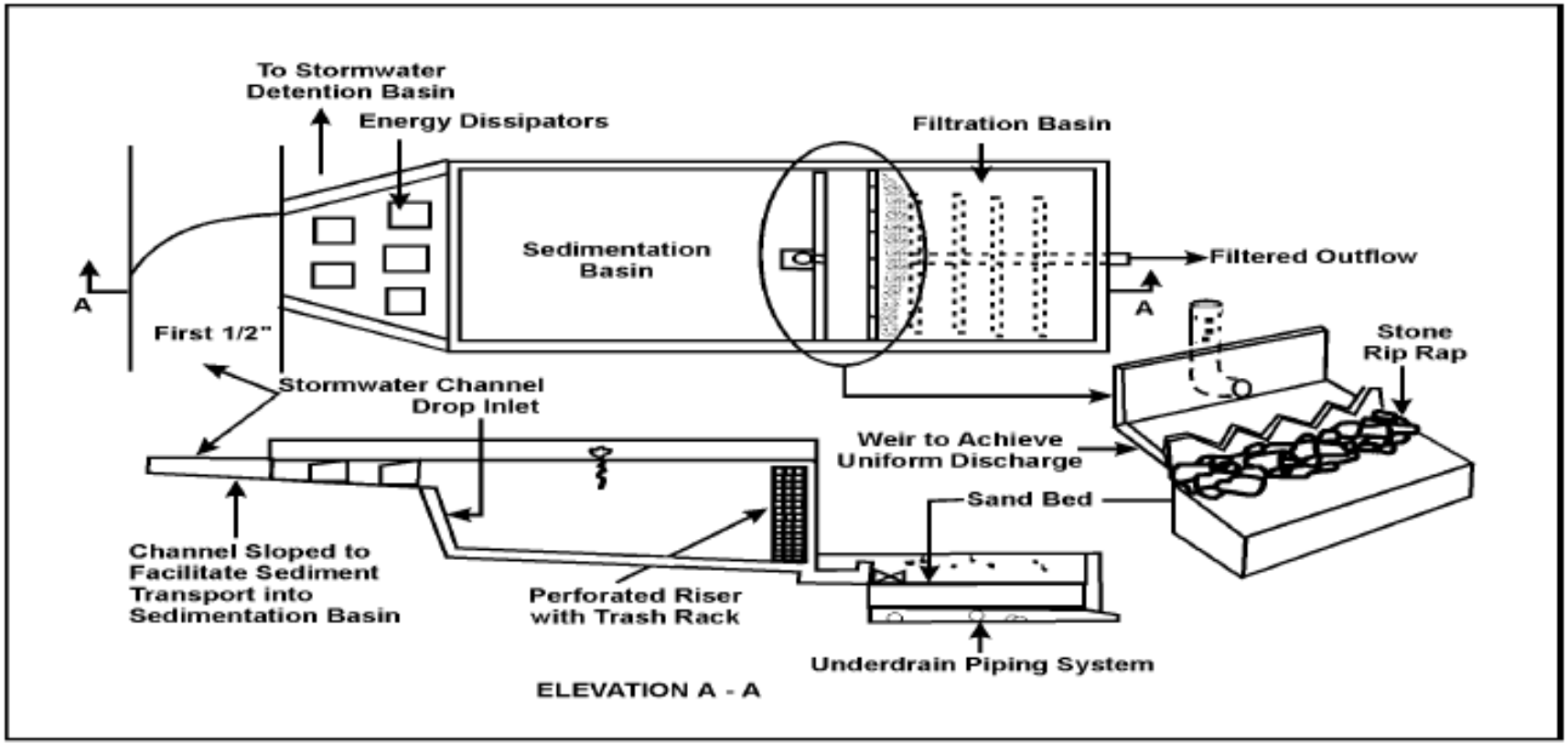
Figure 2. Observed relationship between precipitation and runoff for the Town of South Bethany Anchorage Canal catchment.

Details Of Significantly Different Suggestions For BMPs That Would Significantly Improve The Quality of The Water Discharged Into The Anchorage Canal

1. Sand Filter
2. Artificial wetland
3. Pipe to Ocean
4. EcoSolutions Advanced Wetland Stormwater Filter
5. Pipe to Sanitary Sewer – Probably a non starter

1. Sand Filter – There is Zero Head Room Available For A Typical BMP at Anchorage

An Austin Sand Filter Which Can Accommodate Stormwater Run Off From Over 50 Acres <u>Requires Over 6' of head.</u>

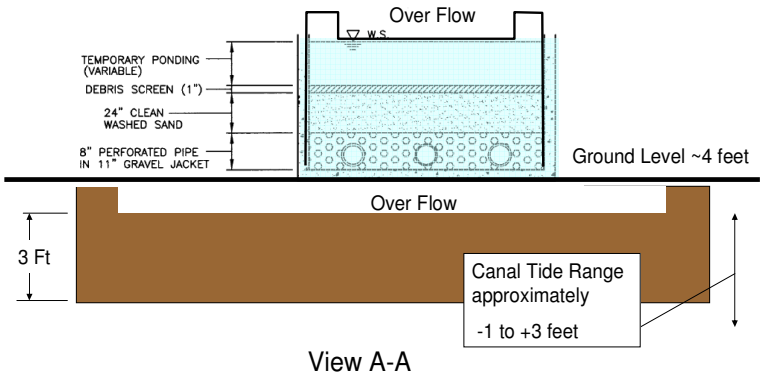


Source: Schueler, 1992.

FIGURE 1 TYPICAL AUSTIN SAND FILTER DESIGN

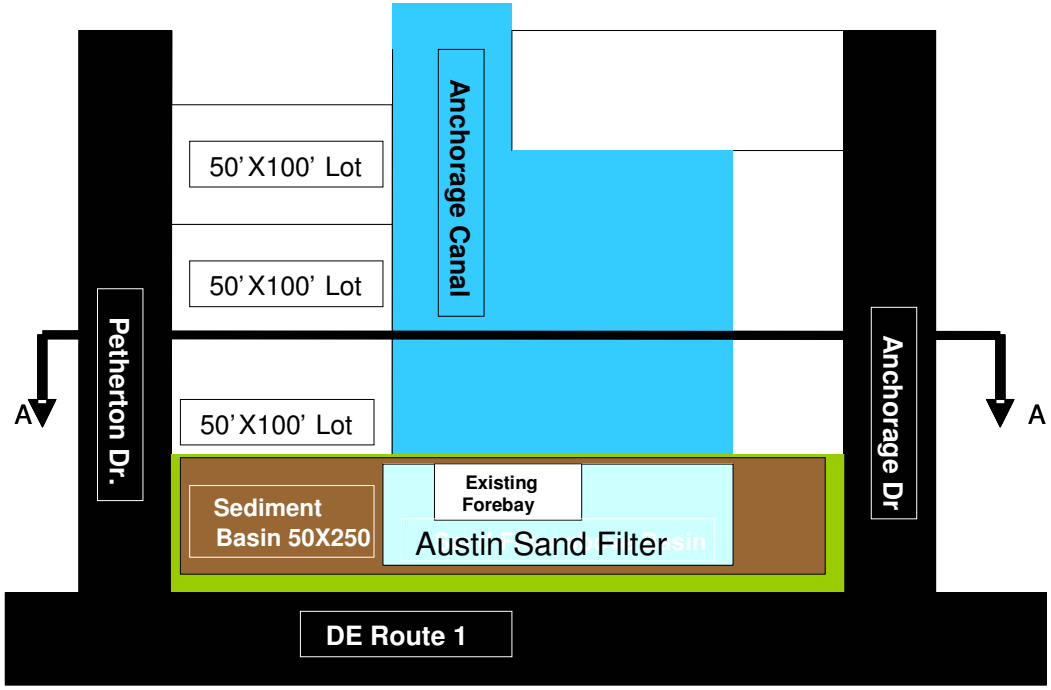
EPA 832-F-99-007, Sept.,1999, Stormwater Technology Fact Sheet – Sand Filters

An Innovative Approach Would Use A Low Flow Rate (200 GPM) Pump To Overcome The Zero Head Room Issue

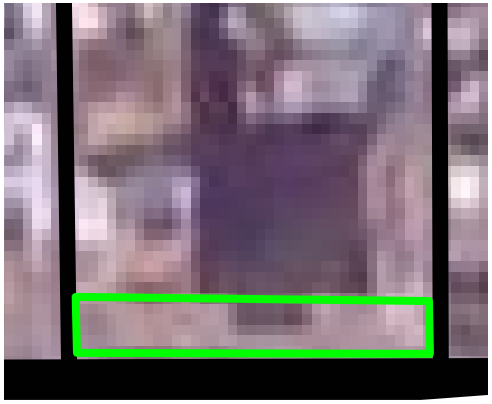


In this innovative approach

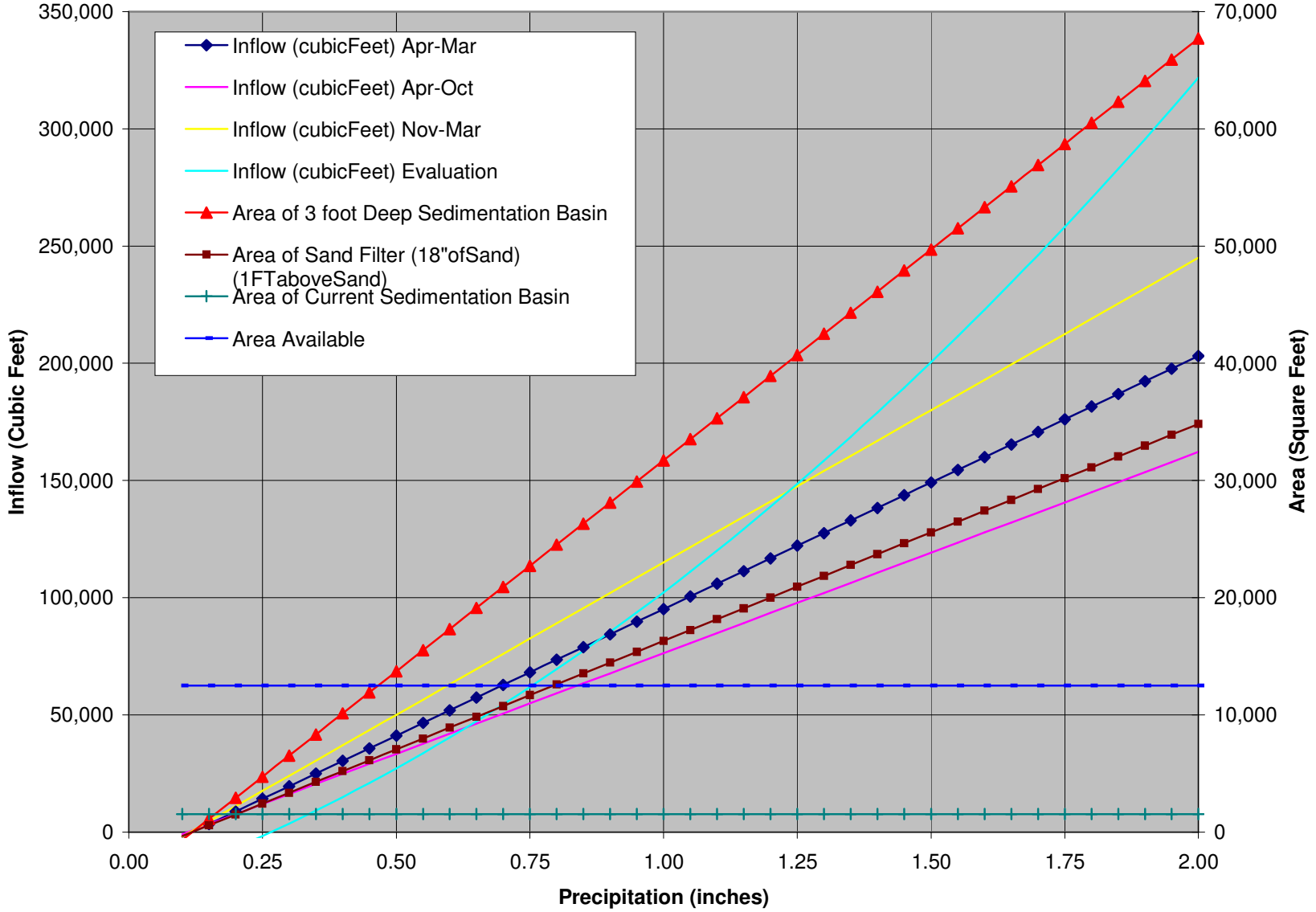
- The sand filter is above the sediment basin
- A low volume pump empties the sediment basin into the sand filter over a 24 hour period



Note: The sedimentation filter, designed per EPA 832-F-99-007 is significantly larger than the existing forebay



The Space Available In The Right Away Provides Enough Volume To Handle A 0.75" Rain Event Every 24 Hours



What Would A Sand Filter Do For Us?

TABLE 2 TYPICAL POLLUTANT REMOVAL EFFICIENCY

Pollutant	Percent Removal
Fecal Coliform	76
Biochemical Oxygen Demand (BOD)	70
Total Suspended Solids (TSS)	70
Total Organic Carbon (TOC)	48
Total Nitrogen (TN)	21
Total Kjeldahl Nitrogen (TKN)	46
Nitrate as Nitrogen (NO_3-N)	0
Total Phosphorus (TP)	33
Iron (Fe)	45
Lead (Pb)	45
Zinc (Zn)	45

Source: Galli, 1990

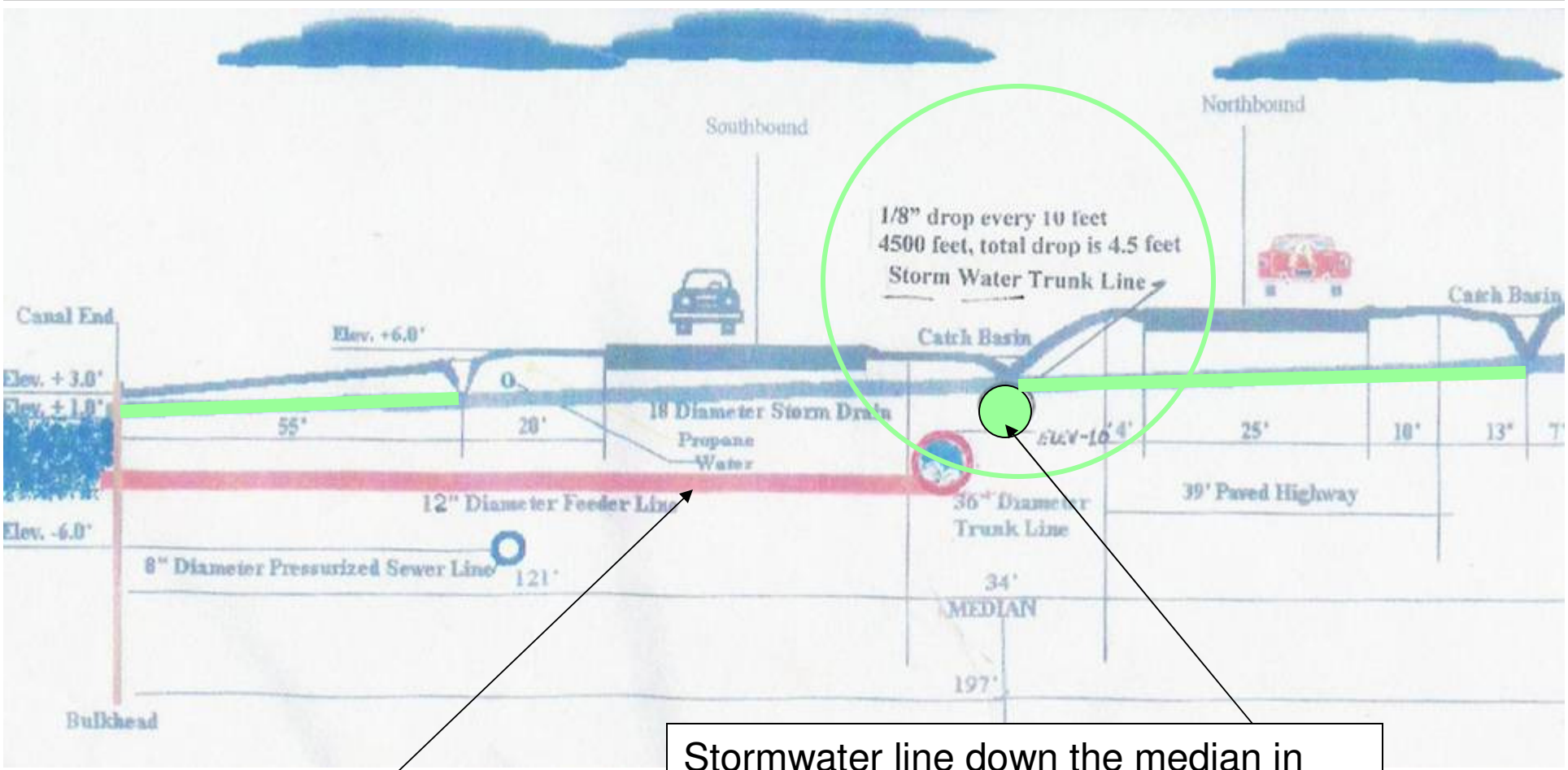
EPA 832-F-99-007, Sept.,1999, Stormwater Technology Fact Sheet – Sand Filters

Table 1. Sand Filter Data

Pollutant	Austin sand filter	Delaware sand filter
Fecal Coliform	76 %	not measured
Total Suspended Solids (TSS)	70 %	80-83%
Biochemical Oxygen Demand (BOD)	70 %	77.5%
Total Organic Carbon (TOC)	48 %	65.9%
Total Kjeldahl Nitrogen (TKN)	46 %	70.6%
Iron (Fe)	45%	not measured
Lead (Pb)	45 %	not measured
Zinc (Zn)	45 %	81.6%
Total Phosphorous (TP)	33 %	72.3%
Total Nitrogen	21 %	47.2%
Nitrate as Nitrogen (NO_3--N)	0 %	62.7%

SAND FILTER FOR TREATING STORM WATER RUNOFF

2. Capture Route 1 Stormwater and Pipe South – in the Route 1 Median, To a Constructed Wetland in the State Park



Proposed Tidal Pump Lines in Red

Stormwater line down the median in DE Route 1

A pump and an equalization basin would probably be required

An Artificial Wetland at Georgetown Industrial Park is One of the CIB Action Plan Demonstration Projects

United States Environmental Protection Agency

Office of Water (4504F)

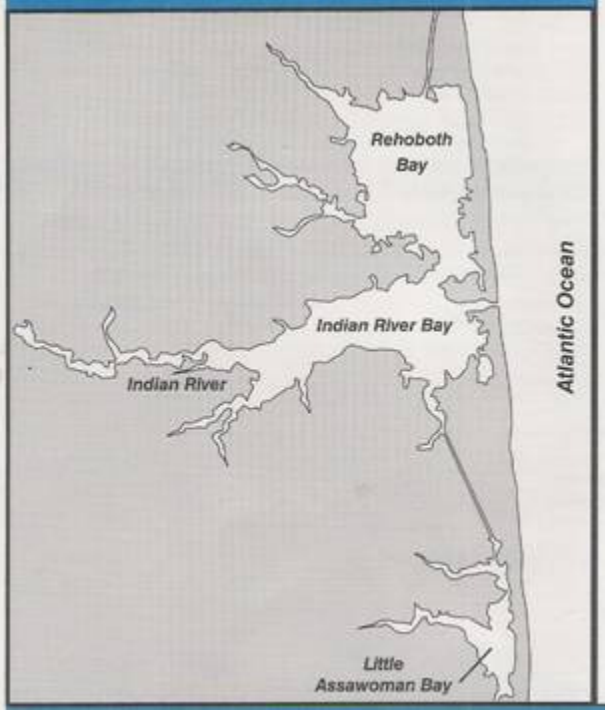
EPA 842-F-95-001C September 1995

EPA

Georgetown Stormwater Management Project

Demonstrating Practical Tools For Watershed Management Through The National Estuary Program

Delaware Inland Bays, Delaware



Characteristics:

- The Delaware Inland Bays consist of Rehoboth, Little Assawoman, and Indian River Bays.
- The Bays and their tributaries stretch across about 32 square miles and drain a 182 square mile watershed.
- About 120,000 people live in the Bay watershed.
- Approximately 75 square miles of the watershed are used as farmland, 3 square miles are urban, and the rest is mainly open space and forest.

The Problem: The overloading of nutrients in the Bay from point and nonpoint sources has resulted in decreased water quality and loss of habitat.

- Submerged aquatic vegetation beds once thrived in the Bays; however, excessive nutrient levels have suppressed their growth.
- Soft clam, oyster, and bay scallop fisheries are essentially extinct.
- Nonpoint sources, especially stormwater runoff, are the primary source of nutrient loading in the Bays.

The Project: The Georgetown Stormwater Management Demonstration Project was designed to construct an artificial freshwater wetland for stormwater control and habitat creation in an urban area, the Georgetown Industrial Park.

3. Pipe to the Ocean – Rehoboth Beach Has 5 Stormwater Outfalls into the Ocean

Pipes are 30” to 36” HDPE, supported and held down with timber piles every 6’

The outfalls run from the boardwalk out to an invert at the mean low water based on the restored beach. The following pictures are at Maryland Ave. were the outfall is exposed due to erosion of the restored beach.

Outfalls are located at Grenoble Pl., Maryland Ave., Rehoboth Ave., Delaware Ave., and Laurel St.

Our application would require a high volume pump or an equalization basin couple with a low volume pump

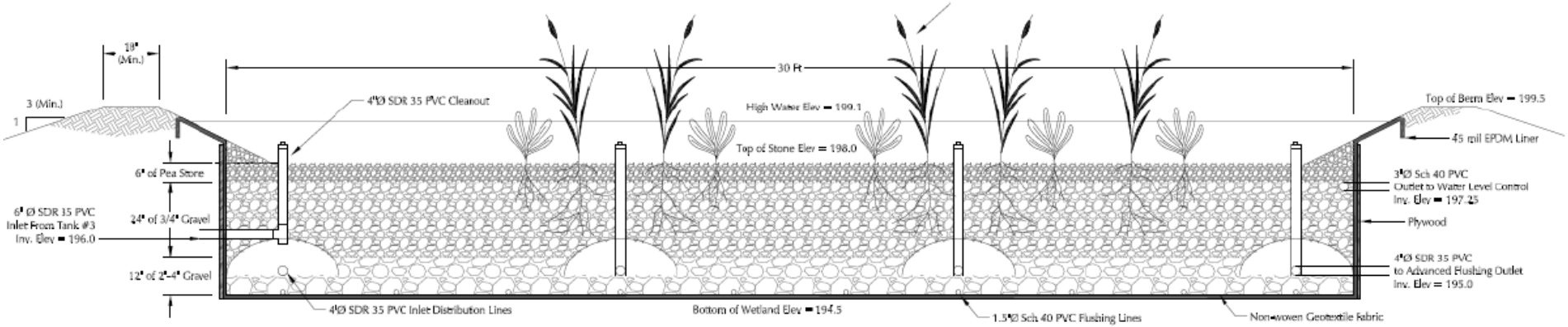
4. EcoSolutions Advanced Wetland Stormwater Filter – Need to Learn How This Works With Zero Head Available And How It Handles Excess Volume

Advanced Wetland Stormwater Filter

Farrell Park, South Burlington, Vermont

ecoSolutions LLC
www.ecosoldesigns.com

Fitzgerald Environmental Associates, LLC.
www.fitzgeraldenvironmental.com



Advanced Wetland Stormwater Filter (AWSF) - Section View
Not To Scale

- Summary
  - The current forebay is not designed for the volume of water that is discharged into it.
  - The current forebay is not designed to effectively remove
    - Fecal Coliform
    - Nitrogen
    - Phosphorus
- Where Do We Go From Here?
- How Do We Decide Which Is The “Best” BMP For The Anchorage Canal?