HSU Forestry Parking Lot

Sediment Runoff Assessment

Patrick Murphy

Michael Nystrom

Augustine Sughrua

Environmental Science Practicum

Fall 2012

Table of Contents

Problem Statement

Humboldt State University's main stormwater infrastructure directs surface runoff into nearby streams, and ultimately into Humboldt Bay. The current infrastructure fails to address pollutant levels, especially sediment, that is transported into nearby natural systems. Although effective at reducing flooding and ponding on campus, the system is not all encompassing and certain areas on campus are more prone to increase sediment levels within nearby watersheds through both improper infrastructural design and improper use. Improper use on campus conflicts with current Clean Water Act Regulations that state non-treated stormwater must be reduced to the "Maximum Extent Practicable".

Problem Background

When analyzing the widespread influence of stormwater, it is important to compare the path discharge takes in both natural and man-made systems. In natural systems, stormwater from precipitation events slowly percolate back into the ground where it becomes purified before reentering the hydrologic cycle. In contrast, man-made systems tend to collect the water and move it off site as quickly as possible. As the water runs over impervious surfaces, it speeds up and collects sediment and pollutants, and is then directed directly into oceans, other waterways, or collected and transported to a large treatment facility.

The release of untreated water has many detrimental effects on immediate watersheds, including: downstream flooding, stream bank erosion, increased turbidity (muddiness created by stirred up sediment) from erosion, habitat destruction, changes in the stream flow hydrograph (a graph that displays the flow rate of a stream over a period of time), combined sewer overflows, infrastructure damage, and contaminated streams, rivers, and coastal water (EPA, 2011).

In regards to human health, stormwater pollution can contain bacteria and chemical pollutants dangerous to humans-- making swimming in infected water dangerous after heavy rains. Both the "gross pollution" (litter such as cigarette butts) and the muddiness caused by increased turbidity negatively impact the visual aesthetics of our surrounding waters.

Stormwater may also be polluted with nutrients from farming practices. Fertilizer containing phosphorus and nitrogen leach out of the soil and into nearby waterways during times of high rainfall or increased irrigation. Massive algal blooms are caused by excess nutrients entering the waterway, ultimately decreasing the amount of available oxygen within the ecosystem. These algal blooms can severely alter the structure of the ecosystem if they become more common or longer lasting (Roberts, 2007).

Traditionally, water pollution has been addressed through managing point sources of pollution. The new paradigm of Low Impact Development design recognizes more significant impacts of various non-point sources. Low impact development, or redevelopment, focuses on aligning stormwater management with close-proximity sources. Low Impact Development (LID) is a relatively cheap alternative which can help to improve the health and vitality of communities. LID design elements include bioretention and rain gardens, rooftop gardens, sidewalk storage, vegetated swales, buffers and strips, tree preservation, roof leader disconnection, rain barrels and cisterns, permeable pavers, soil amendments, and impervious surface reduction and disconnection (Elliot, 2007).

LID and Best Management Practices (BMP) are considered in CEQA and NEPA documents, but this section could be improved considerably. The Humboldt Bay Marsh treatment of sewer water project has been studied and replicated across the country and world. With an increased emphasis on LID, Humboldt County could become a leader in the management of stormwater as well.

There have been efforts to reduce runoff and stormwater pollution at other California State Universities. Cal Poly San Luis Obispo has created preserves and lagoons to meet their standards of their developed Water Quality Management and Stormwater Pollution Prevention Program. San Francisco State has also made efforts by creating a rain harvest system that collects 12,000 gallons of water each year. This reduces the amount of stormwater runoff and eases the impact of sewer systems for that community.

In order for a radical shift in stormwater infrastructure to occur, changes would need to take place on the federal level through changing the NEPA process. If NEPA projects were held to the same stringent standards as CEQA documents, by requiring mitigation measures to be adopted, the process would be much more effective. On the State Level the Water Board could improve regulations and strengthen the stormwater treatment practices. To change practices in Humboldt County alone, the jurisdiction would lie with the North Coast Water Quality Control Board.

The North Coast Water Quality Control Board (NCWQCB) has suggested new restrictions on water runoff. On February 22nd 2011, The North Coast Regional Water

Quality Control Board announced that it is developing a water quality compliance program for discharges from irrigated lands in certain watersheds, including along the Klamath, Scott and Shasta rivers.

Managing stormwater in ways that mimic natural processes is a relatively new idea, and city development has not usually taken it into account. With new technologies and a greater understanding on stormwater systems, it is inexpensive to incorporate these methods into new developments. The major interest group for LID in Humboldt County is the North Coast Stormwater Coalition. By altering large bureaucracy and ending the conventional way cities and towns plan their stormwater infrastructure, there is great potential to positively shift inertia to change our system (Brown, 2005).

Emphasizing the importance of LID technologies in Humboldt County and ultimately Humboldt State, could potentially result in a greater opportunity for growth, increased new jobs, possibilities for retraining for unemployed and underemployed residents, and improve the overall quality of our beautiful bay and rivers.

In the Humboldt Bay area, the stormwater management system is separate from our sewer system. Polluted stormwater is released into the sensitive bay ecosystem without treatment (North Coast Storm water Coalition). This system is not working effectively, since the Mad River is listed as impaired due to altered temperature, sediment, turbidity and siltation regimes. Humboldt Bay, which receives Arcata's runoff, is listed as "impaired" by the State of California and is being considered for listing as threatened due to the high level sediment input. Until recently sedimentation effects were largely ignored, sedimentation in small streams affects biotic communities, reduces diversity of fish and other animal communities, and lowers the productivity of aquatic populations (Waters, 1995).

In 2008 The Clean Water Act instated phase II of stormwater management requirements and these new regulations require the regulating of stormwater for municipalities with populations under 100,000 persons. These new rules were included in the updated stormwater management plan for Arcata, California. Municipal Phase II stormwater programs are composed of six minimum control measures, including:

- Public education and outreach;
- Public involvement and participation;
- Illicit discharge detection and elimination;
- Construction site storm water runoff control;
- Post-construction storm water management; and
- Pollution prevention, or "good housekeeping," for municipal operations.

Illicit discharge refers to any water not 100% attributable to precipitation events, and according to the EPA fact sheet, approximately 40% of discharge was not from such precipitation events. This discharge is difficult to manage because it is a non point source pollutant and management is complicated and multifaceted. The EPA suggests a reactive and proactive anti-illicit discharge program— meaning proactive integrated stormwater management planning during construction and identifying sources of illicit discharge from current infrastructure in a reactive manner.

Less obvious, however (and until recently largely ignored), is sedimentation in small streams that affects biotic communities, reduces diversity of fish and other animal communities, and lowers the productivity of aquatic populations (Waters, 1995).

History of Jolly Giant Creek and Campbell Creek Watersheds

The Jolly Giant Creek rises in the 690-acre watershed in the Arcata Community Forest and flows six miles to the Pacific, passing through Humboldt State University's campus and downtown Arcata on its way into Humboldt Bay. Much of the creek from the campus to downtown was culverted and channelized as the area developed, then neglected after the lumber mills located there shutdown in the 1960s and 1970s (Pinkham, 2000). Several restoration projects are underway in an attempt to daylight certain portions of the creek and increase fish and wildlife habitats.

Campbell Creek is a portion of the watercourse that encompasses lower Beith Creek, Campbell Creek, and Gannon Slough. It is located at the north end of Arcata Bay, within the City of Arcata. Similar to the Jolly Giant Creek, Campbell Creek is severely disrupted and altered and several restoration processes are underway to help bring its reaches to working order. A 910-foot reach of Campbell Creek was authorized to be relocated away from its current location immediately adjacent to Highway 101 to develop a more natural channel and riparian area. The creek is being fenced to exclude livestock and revegetated with native trees and shrubs (CCC, 2006).

Goals

1. Reduce the annual sediment yields of HSU's forestry tool cleaning area as much as it is technically feasible
2. Devise ways to eliminate sediment runoff from the forestry building parking lot into campus runoff by devising a new infrastructure

Objectives

1. Reduce annual sediment discharge from tool cleaning area from HSU's forestry parking lot by 90%.
2. Increase infiltration levels of tool cleaning area by 90%

Weighing Alternatives

Alternatives

A. Install sediment trap and receptacle for excess soil next to tool cleaning station and allow groundwater percolation/drainage through use of permeable surfaces

B. Move tool-cleaning station to adjacent, unpaved parcel behind the fence and outfit with water fixture

C. Install filtering technology on the storm drain on the corner of 17th Street and B Street.

D. Install removable/replaceable filter socks around tool cleaning area

Alternative	Cost (Labor/Supplies)	Effectiveness	Maintenance	Aesthetics	Timeliness	**Total Score**
A	4	17	7	8	5	**41**
B	7	9	6	8	7	**37**
C	6	8	3	7	7	**31**
D	8	7	3	3	8	**29**

Table 1. *Weighing alternatives. All alternatives (A-D) were rated on a relative scale of 1-10 based on Cost, Maintenance, Aesthetics, and Timeliness, with ten being most appropriate. Effectiveness was rated on a relative scale of 1-20, with twenty being most appropriate.*

Explanation of Ratings

A. Although not having the highest total score out of the four alternatives, installing a sediment trap and receptacle for excess soil next to the tool cleaning station in the forestry parking lot will be the most effective in preventing sediment from entering the waterways. It will take the longest and cost the most to install, but the immediate proximity to the affected area and lack of maintenance make it a fitting solution. The addition of gravel and cement curbs will change little aesthetically because the existing infrastructure is only asphalt. Concerning projects where all solutions are relatively inexpensive, effectiveness becomes the most important parameter.

B. Moving the tool cleaning station to the adjacent, unpaved parcel, was rated second in terms of overall score among the four alternatives. Some maintenance is needed in order to upkeep the site (grade soil, clean area, fix fixtures, etc.). Aesthetics are hardly affected because the area is behind a wooden gate—although people who use the nearby picnic table may be impacted. The time frame would be relatively short because only water fixtures need to be installed, and the table needs to be moved from the south end of the parking lot to behind the gate. This alternative may be costly only due to whether or not accessing water lines is difficult. Based on HSU utilities infrastructure map, waterlines run through the parcel. The main concern with moving the tool cleaning operation behind the fence is the overall effectiveness. High-pressure hoses are used to blast soil from shovels, buckets, boots, etc, and multiple hits with high pressure on bare soil will displace, create surface flow, and ultimately increase the levels of soil erosion. Also, multiple entries and exits with muddy boots may make the problem even worse.

C. Installing filtering technology on the storm drains along the southern side of 17th Street was rated third in overall feasibility. It is a relatively cheap option, but the storm drain filters will have to be replaced yearly ($376 total for all five mats) (Appendix D). If implemented, this alternative will utilize three Ultra-Inlet Guard Plus storm drain filters—three of which are curb style for combination drains (PART #9165) with overflow ports, and two are for classic flat drain filters with overflow ports (PART #9162 & 9161). The effectiveness was rated as low, since large storm flows, student foot traffic, and car traffic will damage or move the mats. Because of these disturbances there will be a high level of maintenance where the school will have to pay an employee to constantly check and adjust the filters. Even though the filters are cost and labor intensive, they can be installed quickly and they have an overall low impact on aesthetics.

D. Installing removable filter socks around tool cleaning area was rated last in overall feasibility. Even though it is the most cost effective alternative over the short term period (3 filter socks @ $70.00 each), the alternative has a general low effectiveness. The socks are not failsafe, and the sediment has to dry before sediment can be removed. This alternative, similar to the storm drain filters, requires a high level of maintenance. The lack of structural permanence means there will be maintenance issues and require constant monitoring. There will be a large impact on aesthetics because three sediment tubes will be laid out around the previously empty, forestry parking lot. This alternative has a quick implementation, since the tubes are simply lad out and connected. The filter socks are specifically tailored for sediment issues (Appendix C).

Design strategies for Alternative A

In order to determine the appropriate size of the sediment catchment, daily rainfall amounts, lab water usage, and soil infiltration rates were taken into account. With infiltration rates being the limiting factor, the catchment had to be designed large enough to handle the rainfall and water spigot flows.

By making sure extremes were accounted for, the data we used in the analysis utilized the largest numbers from each of the categories. For rainfall, we used a rate of 2 inches per 24 hours, and for lab water consumption we used 31.169 gallons per lab (based on highest spigot flow @ 1 Gallon per 11.55 seconds). The recorded infiltration rates of a nearby exposed soil of the same series (recorded with infiltrometer, Silt Loam @ 0.5 cm suction rate = 7.2) averaged 0.023611 mL per second—ultimately equating to 3.21165 cubic centimeters per 230 seconds. The rainfall rate of 2 inches per 24 hours translated to 0.000058796 cm per second (Appendix I). Overhung rooftops limit the amount of runoff percolating into proposed drainage area to only direct rainfall and spigot flow.

Based on 6'x6' pit, infiltration rate, rainfall patterns, and lab use from information above, the catchment can handle 0.0423940 gal per min or 61.0416 gallons per day. This is more than enough to handle the most demanding lab at HSU along with other smaller labs on the same day. This infiltration rate does not include the 5 feet of filtering sand and drainage rock about the natural soil.

As mentioned, the sediment catchment will physically be 6' by 6' across and 5' deep. Filtration layers (from bottom to top) are drainage rock, pea gravel and sand. A replaceable catchment layer will be placed on top of the sand layer to remove trapped sediment, leaves and increase percolation (Figure 4, Appendix A). Above this, a rubber mat with holes will be installed in order to prevent disruption of the sand layer and eliminate any sediment or sand from spraying out of the pit. Around three of the sides of the pit, a 4" by 4" curb will be constructed in order to contain the sand and sediment, and the fourth side will utilize the curb already installed in the forestry parking lot. A nearby receptacle for excess soil will be adjacent to the catchment, where students can scrape excess soil off boots and tools before entering the pit. Based on these dimensions and materials needed, area of the curb and layers within the pit was calculated and the corresponding cost per unit was calculated (Appendix I).

Interpretive signage listing impacts of sediment runoff will be installed on the nearby building along will a phone number for maintenance issues.

General Timeline for Implementation

This project requires the approval of many different Humboldt State University departments. There is a specific timeline that must be completed in order for full implementation. The project must first have funding, and a possible funding source which has expressed interest in completing this project is the Environmental Health and Safety office. The Environmental Health and Safety office (EHS) is the drafter of the Humboldt State Storm Water Management Plan (HSSWMP). They are currently drafting an updated SWMP for Humboldt State which will be compliant to the revised standards of the updated clean water act. The EHS office compiles annual reports regarding storm water management on campus and new point sources of illicit discharge. Staff of the EHS department has been contacted about the sediment runoff from the Forestry building, Sabrina Boyd a member of the staff has committed to including this source of discharge in the revised SWMP. This commitment and inclusion in the updated report is an opportunity for funding of this project.

Utility maps were provided by Caryle K. Bradford in the Plant Operation plan room and the EHS office. Based on these maps, no utility lines are in the vicinity of the catchment system planning area—thus eliminating an implementation obstacle related to rerouting electrical and gas lines.

When funding is secured to build the sediment containment system there will be two main personnel that will be vital to the implementation of this project: Mark Baker the Director of Plant Operations/Deputy Building Official, and Traci Ferdolage the Senior Director at the Department of Planning, Design & Transportation Management. The following steps for implementation are based on multiple in person conversations and email correspondence with Mr. Baker and Ms. Ferdolage.

The following steps will need to be completed for construction to begin:

The first step is identifying and receiving an estimate for the construction of the catchment system. This estimate would include planning drawings which would be submitted to Ms. Ferdolage who will work with Mr. Brenner to finalize approval of these plans. In this step there is a possibility for revision based on input from Planning and Operations personnel. Once the planning documents have been approved by Mr. Baker and Ms. Ferdolage, Mr. Baker will issue a building permit and construction can begin.

Monitoring and Evaluation

Once the catchment system is installed, the overall effectiveness will be evaluated. The main focus of installing the catchment is to reduce the amount of sediment that is released into the storm water system. By measuring the amount of sediment that is released into the sewer system via the drains on 17th street, we can determine whether or not the catchment is fulfilling its purpose. Aspects of the proposed project under evaluation include: the reduction of sediment through use of the catchment, the overall stability of the catchment during use, and whether the catchment materials withstand high student traffic. The catchment's ability to drain water during heavy use and seasonal storm surges without excess water pooling will also be evaluated. To assure new students are using the system, George Pease, HSU's Foresty Stockroom Manager, will instruct all professors on how to use the system for their lab courses. Professors will then relay this information to students and enforce its use.

Monitoring, through regular upkeep and maintenance, will be essential to assure continued use and functionality. The plant operation maintenance crew will conduct system maintenance twice yearly (once a semester). If any problems occur between the biannual service, the individual can report the issue to the plant operations work request line—located on the informational signage adjacent to the catchment (Appedix H). The catchment must be able to maintain its structure and composition by resisting compression from student weight and movement and the catchment materials need to stay within the set borders. Monitoring will help to establish the rate of deterioration on the components of the system and refine the estimates of the timeframe needed to replace catchment materials. The biannual checks will include monitoring of any structural damage to the weed mat to evaluate whether it should be replaced prior to the proposed two-year replacement.

By understanding the impacts of the proposed sediment catchment, the level of success of this project will help others who are interested in conducting a similar project. Discovering and improvements to the structure during its implementation will also help those who want to create a similar catchment.

Looking Back

If we were to repeat this project we would do a few things differently. Because the realm of stormwater is so broad, there are many different options to focus on. We spent weeks finding documents and information about the Arcata stormwater system, and we then spent another couple weeks researching HSU school documents. With the intentions of evaluating Humboldt State University's stormwater system, it wasn't until about halfway through the semester that we came across the idea of creating a catchment system for the forestry parking lot. Looking back, it would of been very helpful to have identified our main project focus within the first couple weeks.

If we were to do the project again we would have made a couple changes to our evaluation of the catchment. After present information in front of our peers, we received helpful criticisms that should have been included in our project. One observation that we missed was taking in to account the compaction of the soil beneath the asphalt of the parking lot. Since it is paved, we do not know how much compaction occurred while the forestry building was being constructed. There could have been heavy machinery used to move the soil around or compact the soil to create a sturdy foundation for the structure. We would of also looked into the amount of money it would cost for the labor and construction of the catchment. We would have had to contacted local contractors and find out if Plant Operations has a list of prioritized contracts. For the limited time we had we felt we had few regrets and felt we, overall, did a thorough job.

Works Cited

A.H. Elliott, S.A. Trowsdale, A review of models for low impact urban stormwater drainage, Environmental Modelling Software, Volume 22, Issue 3, March 2007, Pages 394-405.

Brown, Rebekah. Impediments to Integrated Urban Stormwater Management: The Need for Institutional Reform, Environmental Management, Volume 36, Issue 3, September 2005, Pages 455-468.

California Coastal Commission. North Coast District Office. *F9a Staff Report: Permit Amendment*. By Jim Baskin. City of Arcata--Environmental Services Department. July 27, 2006. United States. Print.

Morison, Peter J. (2010) Avoiding the presumptive policy errors of intergovernmental environmental planning programmes: a case analysis of urban stormwater management planning. *Journal of Environmental Planning and Management* 53(2)

Pinkham, Richard. *Daylighting: new life for buried streams*. Rocky Mountain Institute, 2000.

Roberts, David A. (2007) MBACI sampling of an episodic disturbance: Stormwater effects on algal epifauna. *Marine Environmental Research* 64(4)

Waters, Thomas F. "Sediment in streams. Sources, biological effects, and control." *American Fisheries Society Monograph. 1995.* (1995).

<u>**Appendices**</u>

Appendix A: Pictures

Figure 1: *Jacoby Creek outlet into the Pacific Ocean. Humboldt County, California.*

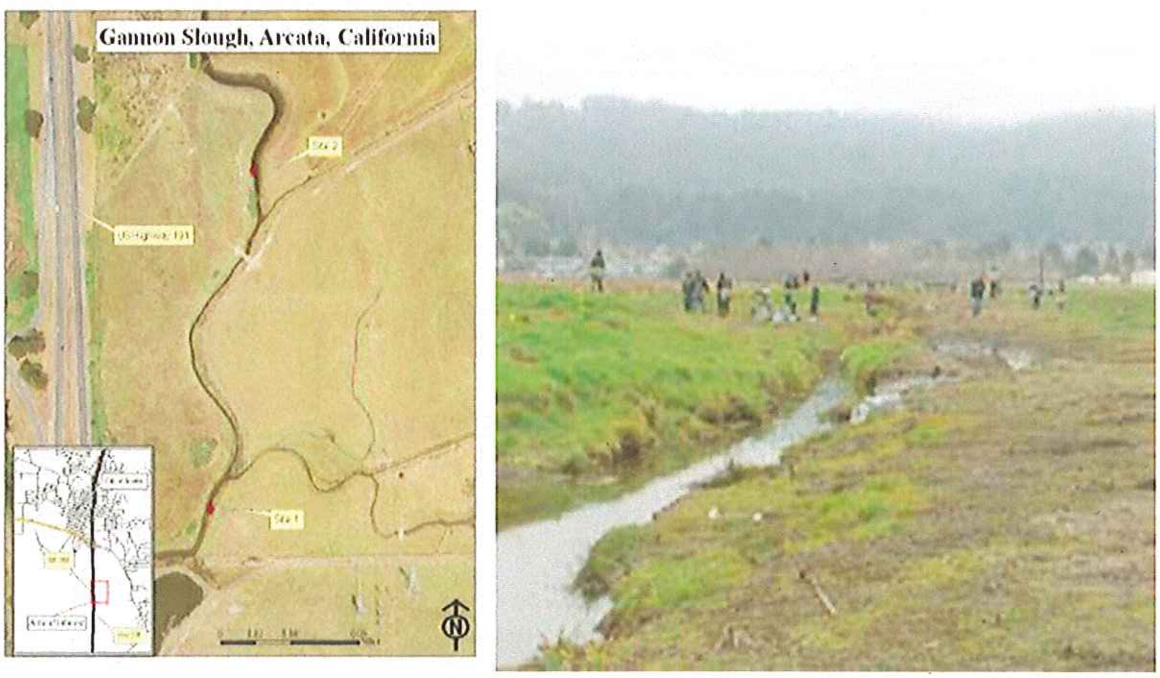


Figure 2-3: *Aerial and ground level view of Campbell Creek and Gannon Slough. Arcata, Humboldt County, California.*

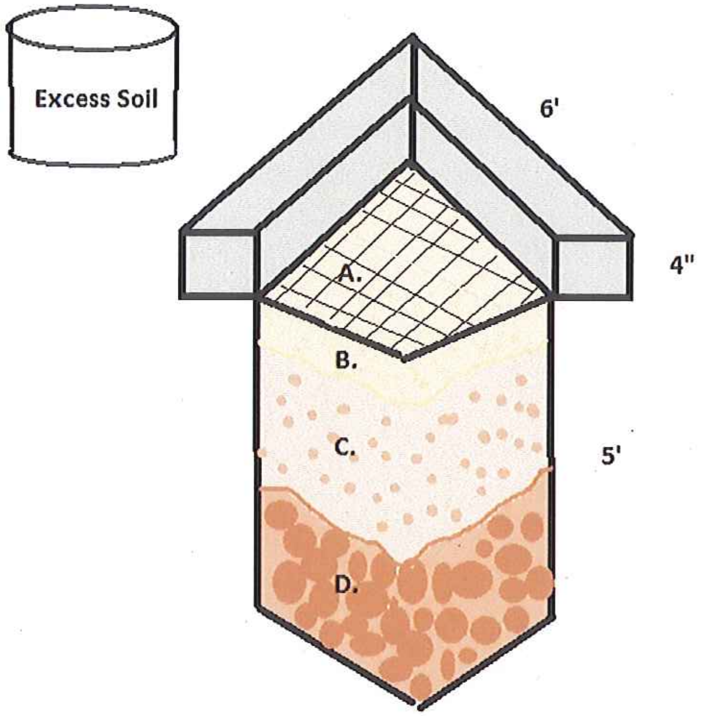


Figure 4: Cross Section drawing of proposed catchment basin.

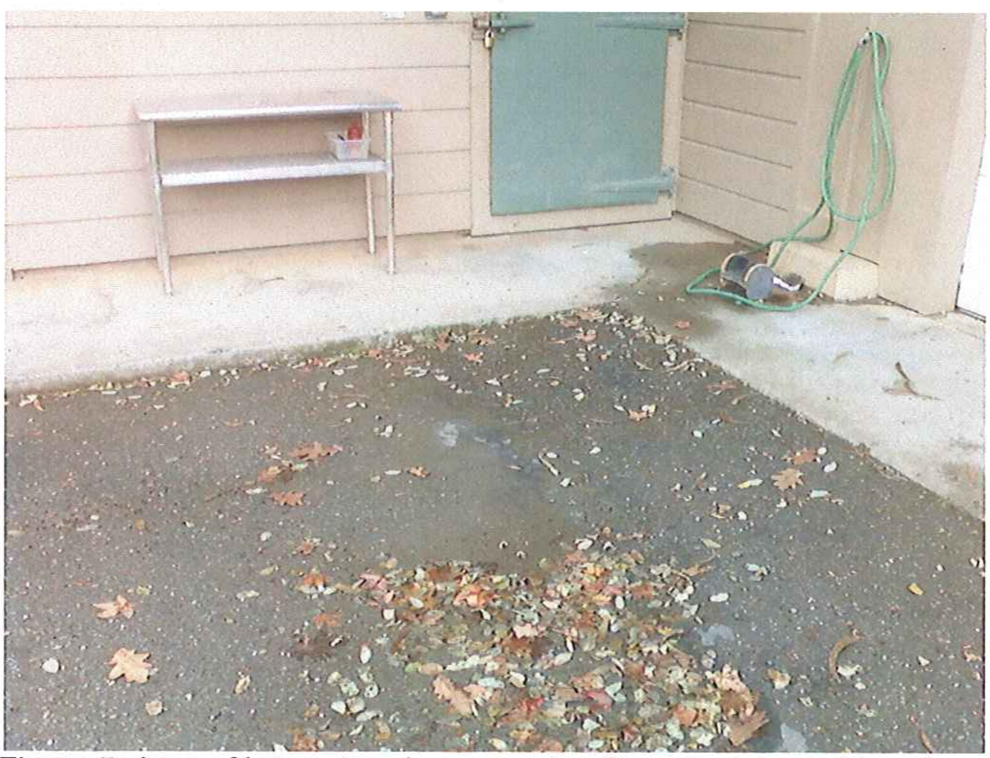
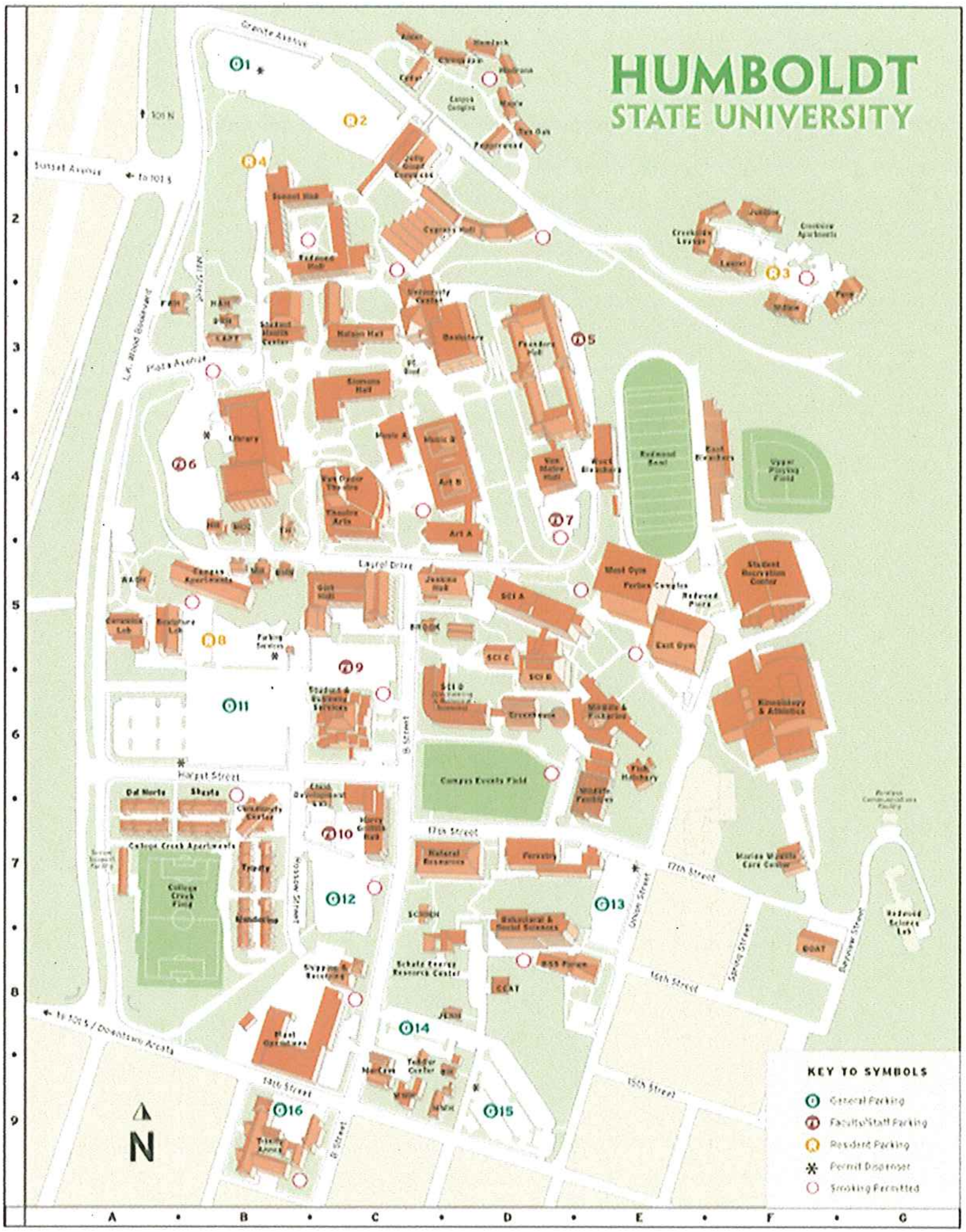


Figure 5: Area of Interest and proposed sediment catchment location.

Appendix B: Campus Map



Appendix C: Ultra-Filter Sock Specifications (Sediment Removal)

Ultra-Filter Sock ®

Stop Harmful Substances From Entering The Stormwater System

- Use in front of storm drains, around downspouts,in gullies and ditches, or anywhere there is potential for harmful stormwater runoff.
- Woven polymer casing allows water to pass through quickly while filtration media inside removes pollutants.
- Available in 9-foot lengths. Units can be overlapped for longer coverage.
- Looped ends allow units to be staked in place and also assist in transport.
- Available with different types of media depending on which pollutant is present.*
- Option for heavy-metal removal available.



ULTRA-FILTER SOCK ®			
Part#	**Description**	**Dimensions** in (mm)	**Weight** lbs. (kg)
9453	Activated Carbon	108 x 7 x 4 (2,743 x 178 x 102)	40.0 (18.0)
9455	Sorb 44	108 x 7 x 4 (2,743 x 178 x 102)	15.0 (7.0)
9457	Sediment Removal	108 x 7 x 4 (2,743 x 178 x 102)	40.0 (18.0)
9456	Phos Filter	108 x 7 x 4 (2,743 x 178 x 102)	66.0 (30.0)
9454	Heavy Metal Removal	108 x 7 x 4 (2,743 x 178 x 102)	35.0 (16.0)

* Multiple Ultra-Filter Socks can be used in a "treatment train" if the potential for more than one contaminant or a large quantity of a single contaminant is present.

MATERIAL SAFETY DATA SHEET

UltraTech International, Inc.
11542 Davis Creek Court
Jacksonville, FL 32256
(904) 292-1611 FAX (904) 292-1325

PRODUCT IDENTIFICATION/CHEMICAL & PHYSICAL CHARACTERISTICS

PRODUCT NAME: Sediment Removal Media
APPEARANCE: 1/4" & Larger Pieces
SPECIFIC GRAVITY: 1.04 - 1.16
VAPOR PRESSURE: N/A
EVAPORATION RATE N/A

SOLUBILITY IN WATER: Insoluble
ODOR: Slight smell of vulcanized rubber
MELTING POINT: N/A
VAPOR DENSITY: N/A
BOILING POINT: N/A

HAZARDOUS INGREDIENTS

MATERIAL (CAS)	WT%	OSHA PEL	(ACGIH TLV)
VULCANIZED RUBBER COMPOUND	Approx. 99%	N/A	N/A
Talc, (Hydrous Magnesium Silicate) (14807-96-6) Respirable Dust	Less than 4%	2.0 mg/m3	(2.0 mg/m3)

FLASH POINT: Ignition Temperature of dust cloud 320°C (608°F) approximately.

FLAMMABLE LIMITS: N/A

FIRE AND EXPLOSION HAZARD DATA

LEL: .025 OZ/CU FT*

UEL N/A

EXTINGUISHING MEDIA: Water, foam, dry powder. Encapsulating fire suppressant (DO NOT USE HIGH PRESSURE WATER)

SPECIAL FIRE FIGHTING PROCEDURES: Noxious gases may be formed under fire conditions, wear NIOSH approved self contained apparatus.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Dust may be explosive if mixed with air in critical proportions and in the presence of an ignition source. The hazard is similar to that of many organic solids.

*Estimate based on data for 200 mesh synthetic and crude hard rubber dust as contained in the NFPA Fire Protection Handbook.

REACTIVITY DATA

STABLE: Yes	CONDITIONS TO AVOID: Conditions that would cause burning.
INCOMPATIBILITY (Materials to Avoid):	Avoid strong oxidizing agents.
HAZARDOUS DECOMPOSITION OF BYPRODUCTS:	Thermal decomposition may produce carbon monoxide, carbon dioxide, zinc oxide fume/dust sulfer dioxide, liquid and gaseous hydrocarbons.
HAZARDOUS POLYMERIZATION Will not occur	CONDITIONS TO AVOID: Do not store hot material in hoppers due to possibility of spontaneous combustion.
ROUTES OF ENTRY:	Inhalation
HEALTH HAZARDS (Acute and Chronic):	The product can contain fine fibers that may cause itching. Otherwise not known.

HEALTH HAZARD DATA

CARCINOGENICITY:	Rubber is not listed as a carcinogen.
SIGNS AND SYMPTOMS OF EXPOSURE:	None
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:	Not known
EMERGENCY AND FIRST AID PROCEDURES:	Normal washing of skin with soap and water. Ordinary means of personal hygiene are adequate.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Sweep up or vacuum into disposal containers.
WASTE DISPOSAL METHOD:	Product not defined as hazardous waste. Dispose of in accordance with federal, state, and local regulations.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:	Do not store near flame or ignition source. Do not store hot material in tubs or containers where spontaneous combustion could occur.
OTHER PRECAUTIONS:	If material burns, oils will be released. These must be disposed of in accordance with federal, state, and local regulations.
RESPIRATORY PROTECTION:	Not required

CONTROL MEASURES

VENTILATION:	LOCAL EXHAUST: Yes, if dusty conditions occur.
SPECIAL:	MECHANICAL (General): Dust collector and exhaust fans.
PROTECTIVE GLOVES: Recommended. Not required	EYE PROTECTION: Not required
OTHER PROTECTIVE CLOTHING OR EQUIPMENT:	None
WORK/HYGENE PRACTICES:	Good personal hygiene, frequent washing with soap and water of exposed areas, remove and clean soiled clothing

The information contained in this MSDS is consistent with the U.S. department of Labor OSHA Form OMB No. 1218-0072. Consult OSHA Hazard Communication Standard 29 CFR 1910.1200 for additional information. To fully understand the use of any material, the user should avail themselves of reference material and expert consultation in the fields of fire prevention, ventilation and toxicology.

Ultra-Filter Sock

INSTRUCTIONS FOR USE

The Ultra-Filter Sock is designed to help remove pollutants from stormwater. Please follow the instructions below for best results.

Step 1: Remove sock from plastic cover and empty any dust or fines generated by the Filter Sock during transport according to local, state or federal regulations.

Step 2: Due to the nature of the filter media, fine dust and powder will occur during transport. For best results, rinse the Ultra-Filter Socks with a hose on grass or a vegetated area prior to use. This will allow most of the fines to be removed and captured away from any catch basin. Hose the sock off for 1 minute for every 1 ½ linear feet of filter sock (6 minutes for a 9' sock). Use care in handling the Ultra-Filter Socks to minimize further development of fines prior to placement for use.

Step 3: Place the Ultra-Filter Sock across the opening of a curb style catch basin or in front of a grated catch basin where stormwater flows into the catch basin. Use the Ultra-Filter Sock to intercept the stormwater flowing into the catch basin and allow the stormwater to flow through the sock's filter media to help remove the heavy metal pollutants.

Step 4: You can use one sock in front of the grate with the sock formed into a concave shape to allow the incoming stormwater to collect in front of the Ultra-Filter Sock and slowly percolate through the sock. You can also use two or more Ultra-Filter Socks to form a donut around a grate to allow stormwater coming from any direction to have to pass through the Filter Sock before entering the catch basin. Be sure to overlaps the ends of the Filter Socks to prevent any paths where stormwater could pass through untreated.

Step 5: While each site has different rainfall events and other variables, we suggest, at a minimum, to rotate the Filter Socks ¼ of a turn every week when there has been a significant rain event to allow full use of the media in the Filter Sock. If it has not rained much or at all, there is no need to rotate the Filter Sock. The Filter Sock should be replaced after the sock has been fully rotated back to where it first started. If you are testing the effluent passing through the Filter Sock, you will be able to better determine when the useful life of the Filter Sock has ended and a replacement is needed.

Step 6: Dispose of used Ultra-Filter Socks according to local, state or federal regulations.

Replacements: Contact your local distributor for replacement Ultra-Filter Socks.

Questions: Contact UltraTech at 800-353-1611 (904-292-1611) with any questions. You can also visit our website at www.StormwaterProducts.com.

Ultra-Filter Sock Specifications

Material Specifications		
Properties	**ASTM Test**	**Value**
Material: High Density Polyethylene (HDPE), Woven Geotextile	----	----
Grab Tensile (MD/TD)	D 4632	326 / 216 lbs
Trapezoid Tear (MD/TD)	D 4533	141 / 70 lbs
Puncture	D 4833	109 lbs
Mullen Burst	D 3786	376 psi
UV Resistance (2000 hours)	D 4355	> 70%

Media Specifications	
Media Type	**Capacity Information***
Activated Carbon	• Each Filter Sock is filled with granular activated carbon. This media is an excellent polishing filter, due to its immense surface area and the wide range of components it is capable of absorbing. Helps with removing odors. • Dry Filter Sock Weight of approximately 36 lbs
Heavy Metal Removal Media	• Each Filter Sock can remove up to 1145 grams of heavy metals • Removal rates up to 50% per Filter Sock • See Heavy Metal Removal Data Sheet for more information • Dry Filter Sock Weight is approximately 32.5 lbs
Sorb 44	• Each Filter Sock can absorb up to 5.33 gallons (20 liters) of hydrocarbon • Dry Filter Sock Weight is approximately 9 lbs
PhosFilter	• Each Filter Sock can remove up to 26 lbs of phosphorus with up to 95% efficiency • Dry Filter Sock Weight is approximately 50 lbs
Sediment Removal Media	• Recycled rubber material keeps unit in place and allows for maximum water flow • Dry Filter Sock Weight is approximately 40 lbs

* Note – All information is based on a standard 9-foot long Ultra-Filter Sock

07/12/2011

11542 Davis Creek Court • Jacksonville, FL 32256 • 904.292.1611 • 800.353.1611 • Fax 904.292.1325
E-mail: info@stormwaterproducts.com • www.stormwaterproducts.com

Appendix D: Ultra-Inlet Guard Plus Specifications

Ultra-Inlet Guard and Inlet Guard Plus ®

Protect Drains And Inlets WITHOUT Lifting Any Grates.

- Keeps dirt, sand, sediment, trash and debris out of drains.
- Quick and easy installation using built-in magnets — no more lifting of heavy catch basin grates.
- Available in several sizes for street drains, combination drains and trench drains. Custom sizes also available.
- Heavy-duty, reinforced material (non-woven, polyester spun) allows up to 192 gal/ft2/min. through drains.
- Low profile design can be driven over and is unobtrusive to traffic and personnel.
- Ultra-Inlet Guard Plus also available. Includes built-in overflow port to help prevent flooding and/or ponding during heavy rainfall.
- Geotextile material helps remove oil and other hydrocarbons from stormwater flow.
- Helps comply with NPDES, 40 CFR 122.26 (1999) and TMDL requirements.

ULTRA - INLET GUARD PLUS (INCLUDES BUILT-IN OVERFLOW PORT)
Part# : 9160 **Dimensions:** 24" x 24" (610 mm x 610 mm)
Part# : 9161 **Dimensions:** 24" x 36" (610 mm x 915 mm)
Part# : 9162 **Dimensions:** 24" x 48" (610 mm x 1,220 mm)
Part# : 9163 **Dimensions:** Curb-Style (for combination drains) 24" x 24" (610 mm x 610 mm)
Part# : 9164 **Dimensions:** Curb-Style (for combination drains) 24" x 36" (610 mm x 915 mm)
Part# : 9165
Dimensions: Curb-Style (for combination drains) 24" x 48" (610 mm x 1,220 mm)

Ultra-Inlet Guard® Specifications

Minimum Average Fabric Values

Properties	ASTM Test	Value
Mass per Unit Area (oz/yd^2)	D-3776	5.2
Grab Tensile Strength, MD x CD (lbs)	D 4632	297 x 223
Grab Elongation, MD x CD (%)	D 4632	58 / 59
Trapezoid Tear, MD x CD (lbs)	D 4533	81 x 75
Puncture (lbs)	D 4833	99
Burst Strength (psi)	D 3786	340
Permittivity (sec-1)	D 4491	2.60
A.O.S. (U.S. sieve – (mm)	D 4751	60
Water Flow Rate (gpm/ft^2)	D-4491	192

Revised 08.21.07

11542 Davis Creek Court • Jacksonville, FL 32256 • 800-353-1611
www.Stormwater-Products.com • E-mail: info@stormwater- products.com

Appendix E: Infiltration Figures and Tables

Time	MiniDisk Volume	Midpoint of Time Interval	Time Interval	Volume infiltrated	Infilt. Rate
s	ml		s	ml	ml/s
0	64		0		
30	62	15	30	2	0.066667
60	61	45	30	1	0.033333
90	60	75	30	1	0.033333
120	59	105	30	1	0.033333
150	58	135	30	1	0.033333
180	57	165	30	1	0.033333
210	56	195	30	1	0.033333
240	55	225	30	1	0.033333
270	54.5	255	30	0.5	0.016667
300	54	285	30	0.5	0.016667
330	53.5	315	30	0.5	0.016667
360	53	345	30	0.5	0.016667
390	52.5	375	30	0.5	0.016667
420	52	405	30	0.5	0.016667
450	51.5	435	30	0.5	0.016667
480	51	465	30	0.5	0.016667
510	50.5	495	30	0.5	0.016667
540	50	525	30	0.5	0.016667
570	49.5	555	30	0.5	0.016667
600	49	585	30	0.5	0.016667
630	48.5	615	30	0.5	0.016667
660	48	645	30	0.5	0.016667
690	47.5	675	30	0.5	0.016667
720	47	705	30	0.5	0.016667
750	47	735	30	0	0
780	46.5	765	30	0.5	0.016667
810	46.5	795	30	0	0
840	46	825	30	0.5	0.016667
870	46	855	30	0	0

Table 1: Time versus infiltration rate (ml/s) for representative soil

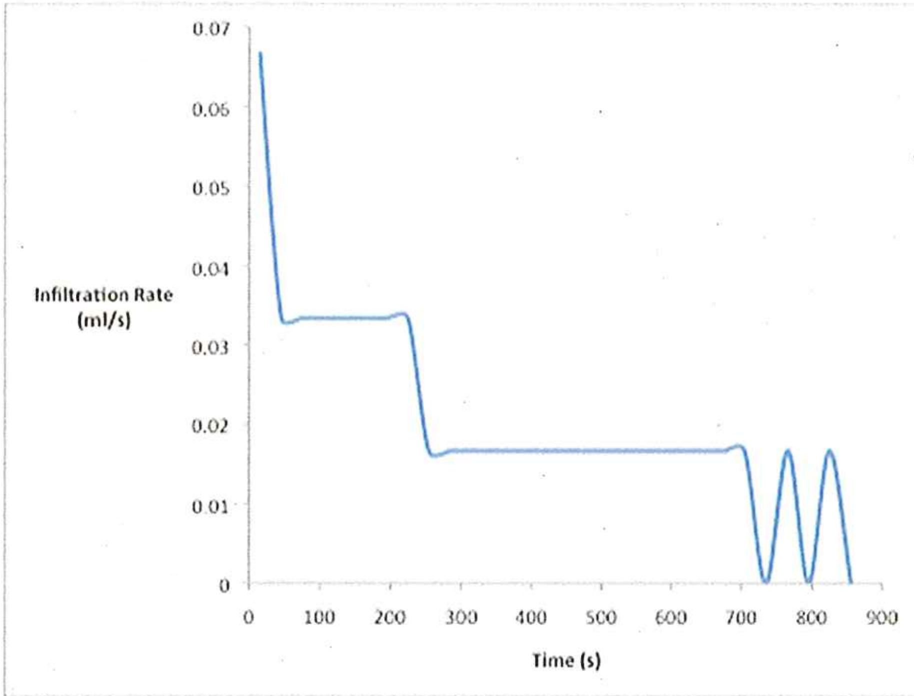


Figure 4: Time versus infiltration rate (ml/s) for representative soil

Time (s)	sqrt (t)	Volume (mL)	Infilt (cm)
0		64	0.00
30	5.48	62	0.13
60	7.75	61	0.19
90	9.49	60	0.25
120	10.95	59	0.31
150	12.25	58	0.38
180	13.42	57	0.44
210	14.49	56	0.50
240	15.49	55	0.57
270	16.43	54.5	0.60
300	17.32	54	0.63
330	18.17	53.5	0.66
360	18.97	53	0.69
390	19.75	52.5	0.72
420	20.49	52	0.75
450	21.21	51.5	0.79
480	21.91	51	0.82
510	22.58	50.5	0.85
540	23.24	50	0.88
570	23.87	49.5	0.91
600	24.49	49	0.94
630	25.10	48.5	0.97
660	25.69	48	1.01

Table 2: Square root of time versus cumulative infiltration for representative soil

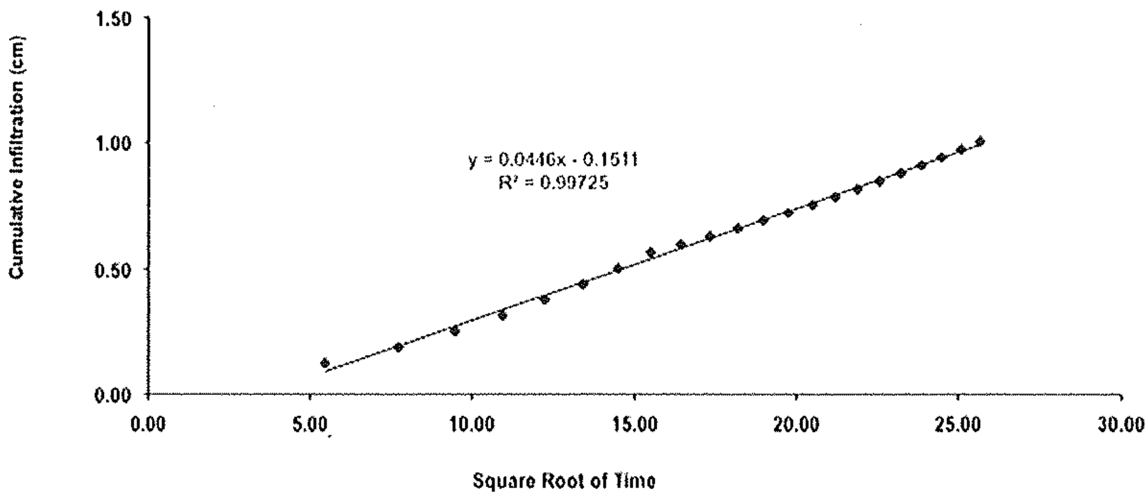
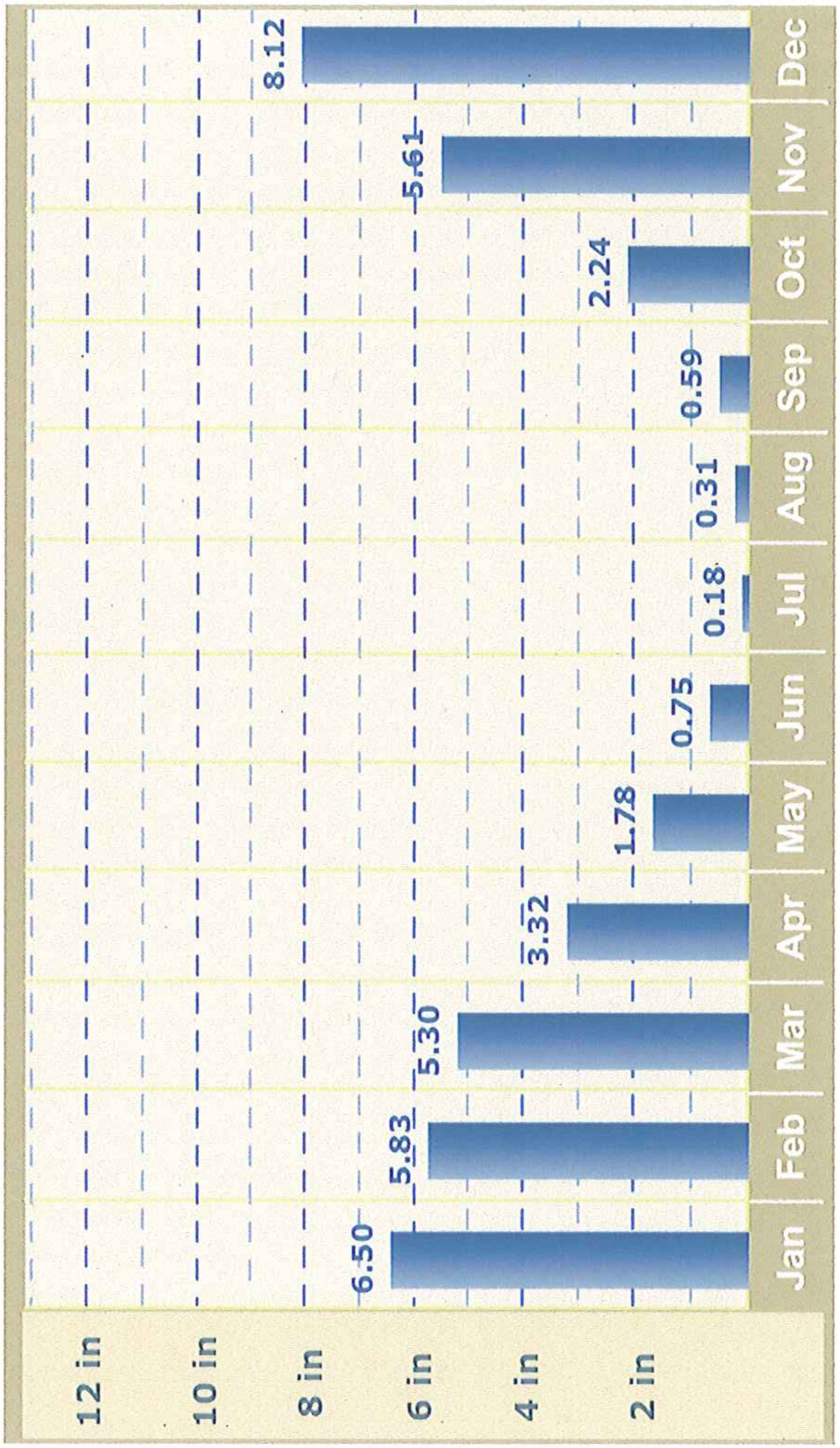


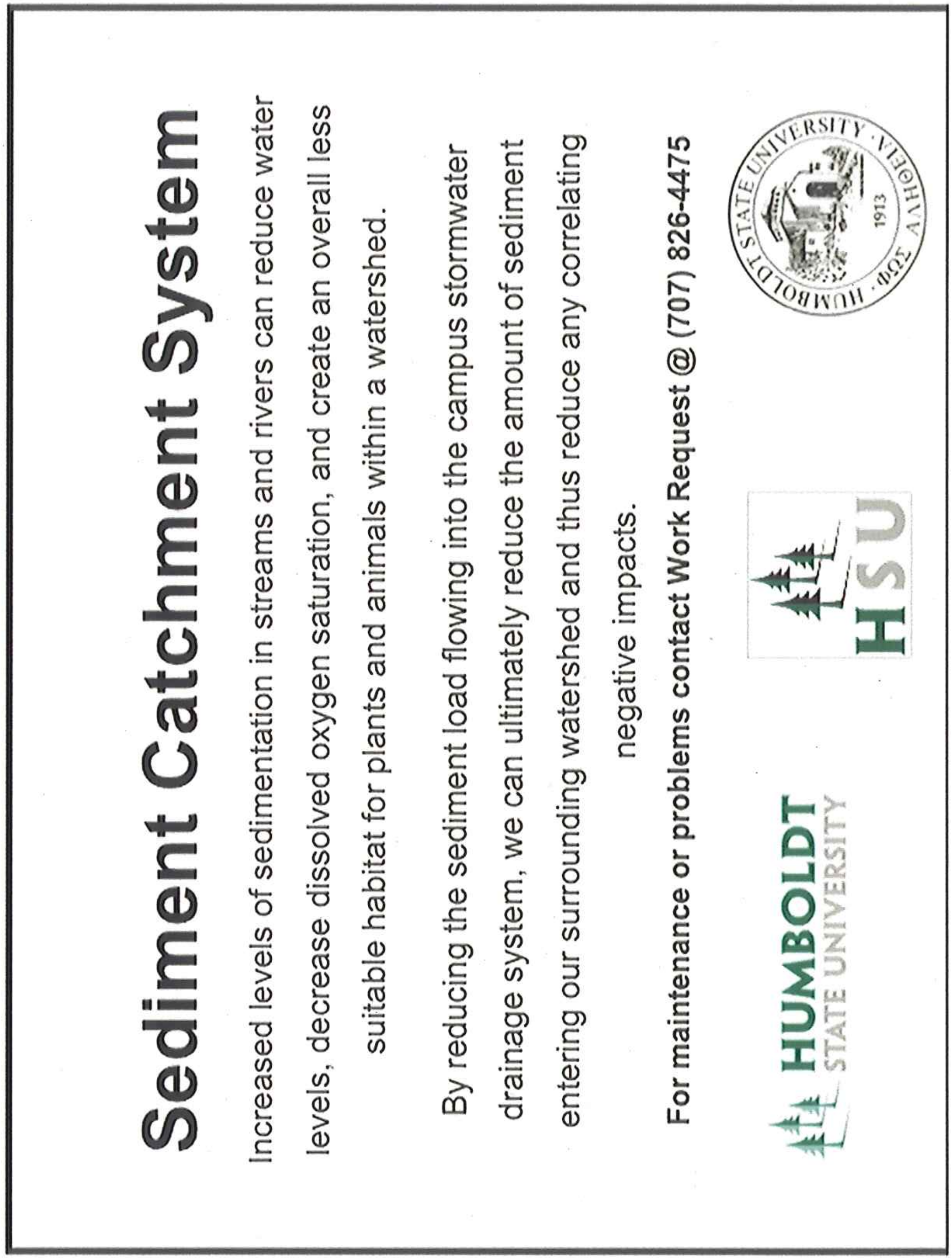
Figure 5: Square root of time versus cumulative infiltration for representative soil

Appendix F: Monthly Rainfall Averages for Arcata, California



Appendix G: Campus Utilities Map

Appendix H: Interpretive Signage



Appendix I: Lab water consumption (per lab, per semester) and calculations

	Heaviest Users	Class Title	Students Enrolled	# of Dirty Labs
	WSHD 310	Hydrology & Watershed Mgmt	46	5
	FOR 230	Dendrology	72	5
	FOR 432	Silviculture	36	5
	FOR 431	Forest Restoration	40	5
	FOR 210	Forest Measurements	28	5
	FOR 311	Forest Mensuration and Growth	25	5
	ENVS 450	Applied Ecological Restoration	24	5
	ENVS 230	Environmental Problem Solving	48	5

	water used (s) per lab	water used (s) per semester	water used (gal) per lab	water used (gal) per semester
	230	1150	19.91341991	99.56709957
	360	1800	31.16883117	155.8441558
	180	900	15.58441558	77.92207792
	200	1000	17.31601732	86.58008658
	140	700	12.12121212	60.60606061
	125	625	10.82251082	54.11255411
	120	600	10.38961039	51.94805195
	240	1200	20.77922078	103.8961039
Total	**1595**	**7975**	**138.0952381**	**690.4761905**

water used (s) per lab: half of students enrolled multiplied by 10 sec of water use each
water used (s) per semester: multiply water used (s) per lab by # of dirty labs
water used (gal) per lab: multiply water used (s) per lab by spigot flow (1 gal. per 11.55 sec.)
water used (gal) per semester: multiply water used (s) per semester by spigot flow (1 gal. per 11.55 sec.)

Rainfall			**Rainfall @ 6'x6' pit**
2 inches per 24 hours	= 0.000023148 inches per second	= 0.000058796 cm per second	452.58 cm3 per 230 sec
Highest Class Usage			
31.169 gallons	= 117987.5 cm3 per 230 sec		
Infiltration Rate	(Averaged over 720 seconds)		**Infiltration Rate @ 6'x6' pit**
mL per second	0.023611		3.21165 cm3 per 230 sec
cm3 per second	0.023611		
Based on 6'x6' pit, infiltration rate, rainfall patterns, and lab use from information above, the catchment can handle:			
0.0423940 gal per min	= 61.0416 gallons per day		

Appendix J: Materials and Costs

Material	Area Needed	Amount per Unit	Cost Per Unit	Amount needed	Total Price
Quikrete Premium 50 lbs Play Sand	5"x72"x72" =15 cu ft	1 bag= 0.5 cu ft	1 bag= $4.57	**30 bags**	**$137.10**
Rapid Set 60 lbs Concrete Mix	4"x4"x"72" x3sides= 2 cu ft	1 bag= 0.5 cu ft	1 bag= $11.69	**4 bags**	**$46.76**
Kolor Scape Drainage Rock	27.5"x72"x72" =82.5 cu ft	1 bag= 0.5 cu ft	1 bag= $4.10	**165 bags**	**$676.50**
Pea Pebbles	27.5"x72"x72" =82.5 cu ft	1 bag= 0.5 cu ft	1 bag= $3.68	**165 bags**	**$607.20**
Drainage Modular Mat	6'x6'= 36 sq ft	3'x3'= 9 sq ft	1 mat= $53.00	**4 mats**	**$212.00**
Professional Landscape Fabric	6'x6'= 36 sq ft	400 sq ft	1 roll= $39.98	**1 roll**	**$39.98**
5 gallon bucket	N/A	N/A	1 bucket= $3.97	**1 bucket**	**$3.97**
				TOTAL	**$1723.51**

Encore Plastics 5-Gallon Food Grade Bucket
Item #: 356492 | Model #: 51640

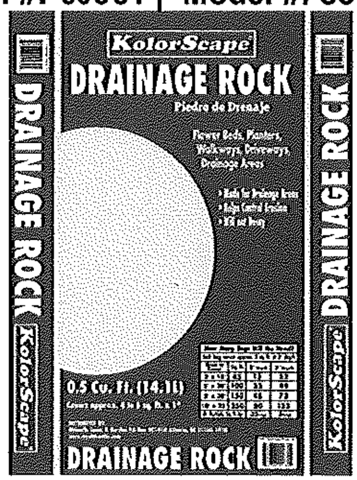
Type	General bucket
Unit of Measure	Gallon(s)
Unit of Measure Quantity	5.0
Bucket Tub Material	Polyethylene
Handle Material	Wire
Classification	Industrial
Wheels	No
Color/Finish Family	White

Greenscapes 400 sq ft Professional Landscape Fabric
Item #: 63064 | Model #: 208414

Series Name	N/A
Square Foot Coverage	400.0
Length (Feet)	100.0
Width (Feet)	4.0
Grade	Professional

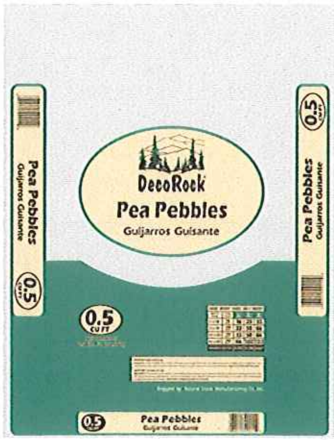
Material	Spun-bond material
UV Resistant	Yes
Ideal for Annual Flower Gardening	No
Ideal for Annual Vegetable Gardening	No
Ideal for Perennial Beds and Shrubs	Yes
Ideal for Patio/Playground Underlayment	Yes

Kolor Scape 0.5 cu ft Drainage Rock
Item #: 60061 | Model #: 337500075



Bag Capacity Quantity by Dry Volume	0.5
Bag Capacity Unit of Measure	Cubic feet
Rock Type	Drainage rock
Rock Color Family	White/Black
Sq. Ft. Coverage at 2-Inch Depth	3.0

0.5 cu ft Pea Pebbles
Item #: 385078 | Model #: R1PGG12L



Bag Capacity Quantity by Dry Volume	0.5
Bag Capacity Unit of Measure	Cubic feet
Rock Type	Pea pebbles
Rock Color Family	Brown
Sq. Ft. Coverage at 2-Inch Depth	3.0

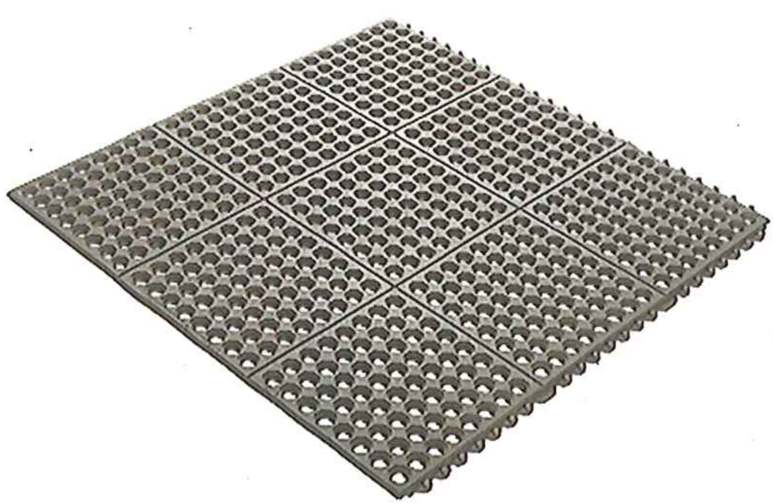
QUIKRETE 50 lbs Play Sand
Item #: 10392 | Model #: 111351

Sand Type	Play Sand
Bag Weight (lbs.)	50.0
Sand Coverage (Cu. Feet)	0.5

Rapid Set 60 lb. Concrete Mix
Model # 03010060 Store SKU # 383937

Assembled Depth (in.)	14 in	Assembled Height (in.)	5 in
Assembled Width (in.)	22 in	Color Family	Grays
Compression strength (psi)	6000	Manufacturer Warranty	1 Year Limited Warranty
Product Weight (lb.)	60 lb	Vertical/overhead use	Yes
Working time (min.)	15		

3 x 3' Modular Mat - Drainage



Custom-fit your mat around any workstation or production machine.
Strong interlocking system securely connects tiles.
Ideal in dirty or slippery areas
100% rubber for comfort. Reduces fatigue.
Optional Beveled Edges for easy access on and off mat.