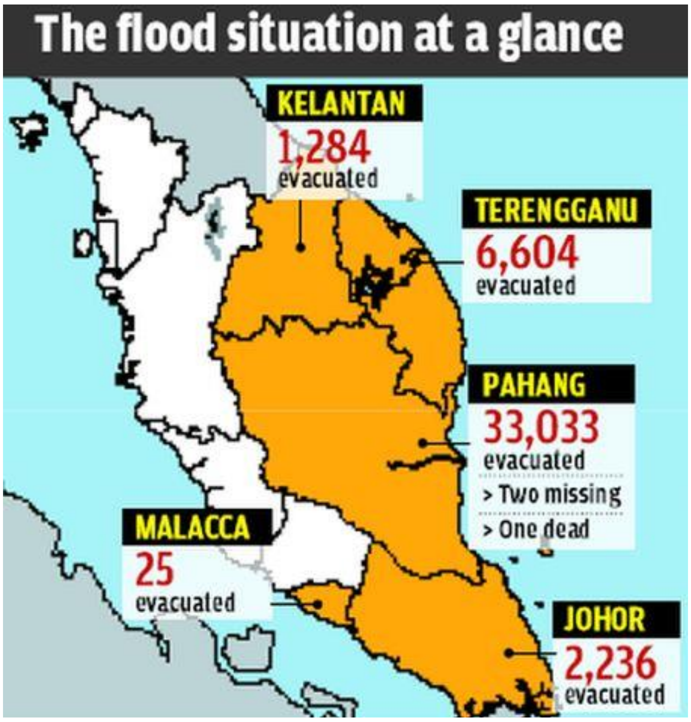

Floods chaos

By SANDEEP SINGH GREWAL

BAHRAIN descended into chaos yesterday as heavy showers flooded several areas overnight, disrupting traffic and damaging homes.

■ A tanker drains water from King Hamad Highway leading towards Durrat Al Bahrain



FLOOD

A DISASTER OR A CHALLENGE

Flood

Abstract

Flood can be defined as a body of water, which overflowed from the river, lake or drainage system caused by heavy rains, melting ice, tides, and obstruction of the duct.

Flooding occurs when a river's discharge exceeds its channel's volume causing the river to overflow onto the area surrounding the channel known as the floodplain. The increase in discharge can be triggered by several events. The most common cause of flooding is prolonged rainfall. If it rains for a long time, the ground will become saturated and the soil will no longer be able to store water leading to increased surface runoff. Rainwater will enter the river much faster than it would if the ground wasn't saturated leading to higher discharge levels and floods.

As well as prolonged rainfall, brief periods of heavy rain can also lead to floods. If there's a sudden "burst" of heavy rain, the rainwater won't be able to infiltrate fast enough and the water will instead enter the river via surface runoff. This leads to a sudden and large increase in the river's discharge which can result in a flash flood.

Flood had been the main problem in Malaysia which is position in the tropics typically and receive high rainfall. The average annual rainfall is 2,500 mm to 3,500 mm. However, there are instances where it rains too heavily on a point that can cause flooding.

This paper is to study and discuss on how the flood occurs and to find and discuss the solution for flood prevention especially for Environmental or Landscaping Practices. Sample of Environmental or Landscaping Practices are Storm water Pond, Storm water Wetland, Rain Garden, Green Roof, Permeable Paving's, Rain Water Harvesting. Detailing of this design will be included in this paper.

Flash flood occurs on 4^{th}. September 2012 in Serdang area and it is the worst flood ever in 17 years. Therefore this area will be a case study for this paper in explaining why and what causes flood happen.

TABLE OF CONTENT **Pages**

1. Introduction

Definition of Flood

Flood can be defined as a body of water, rising, swelling and which overflowed from the river, lake or drainage system caused by heavy rains, melting ice, tides, and obstruction of the duct.

2. Types and Nature of Flood

There are no formal categorizations of floods in Malaysia but is often broadly categorised as monsoonal due to months of heavy rain such as September to February. However floods can be classified based on its location, characteristics, the cause, the timing as to when it occurs and its duration. In this paper floods are categorised on it characteristic as below:

1) Flash Flood
   In areas with steep slopes, heavy rain can cause a riverbed that held very little or no water at first, to suddenly brim with fast flowing water. The rain water is collected on the slopes, then flows downhill gathering speed and all the water comes together in the river bed. The water level rises fast. The water flows over the river banks and floods the area. Speed is the keyword. It all happens fast, it rains heavily. The water flows at high speed. This type of flood is commonly happen in most of areas in Malaysia.

2) Coastal flood
   A coastal flood is when the coast is flooded by the sea. The cause of such a surge is a severe storm. The storm wind pushes the water up and creates high waves. A flood starts when waves move inland on an undefended coast or overtop or breach the coastal defence works like dunes and dikes. The waves attack the shore time and again. When it is a sandy coast, each wave in a storm will take sand away. Eventually a dune may collapse that way.

3) Urban Flood
   Flooding in urban areas can be caused by flash floods, or coastal floods, or river floods, but there is also a specific flood type that is called urban flooding.

Urban flooding is specific in the fact that the cause is a lack of drainage in an urban area. As there is little open soil that can be used for water storage nearly all the precipitation needs to be transport to surface water or the sewage system. High intensity rainfall can cause flooding when the city sewage system and draining canals do not have the necessary capacity to drain away the amounts of rain that are falling. Water may even enter the sewage system in one place and then get deposited somewhere else in the city on the streets. Sometimes you see dancing drain covers.

4) River Flood

Rainfall over an extended period and an extended area can cause major rivers to overflow their banks. The water can cover enormous areas. Downstream areas may be affected, even when they didn't receive much rain themselves. The area that is flooded can be huge. Villages surrounded by large stretches of water were cattle would normally graze. Whole communities can become isolated from the rest of the world as roads are blocked and communications are down.

When a dike or a dam breaks and a lot of water is released suddenly, the speed of the water at the breach can be compared with the speed of a flash flood. As a larger area gets covered the speed will be reduced. The water spreads out as much as possible flowing to the lower lying areas before slowly rising. A breach is very dangerous for the people living close to it. The strength of the water may carry cars, trees and even houses away and cause loss of live. If you want to study the details of breach growth, go here. This type of flood happened in Cameroon Highland on 23rd. Oktober 2013 which had killed 3 people.

5) Ponding (or pluvial floods)

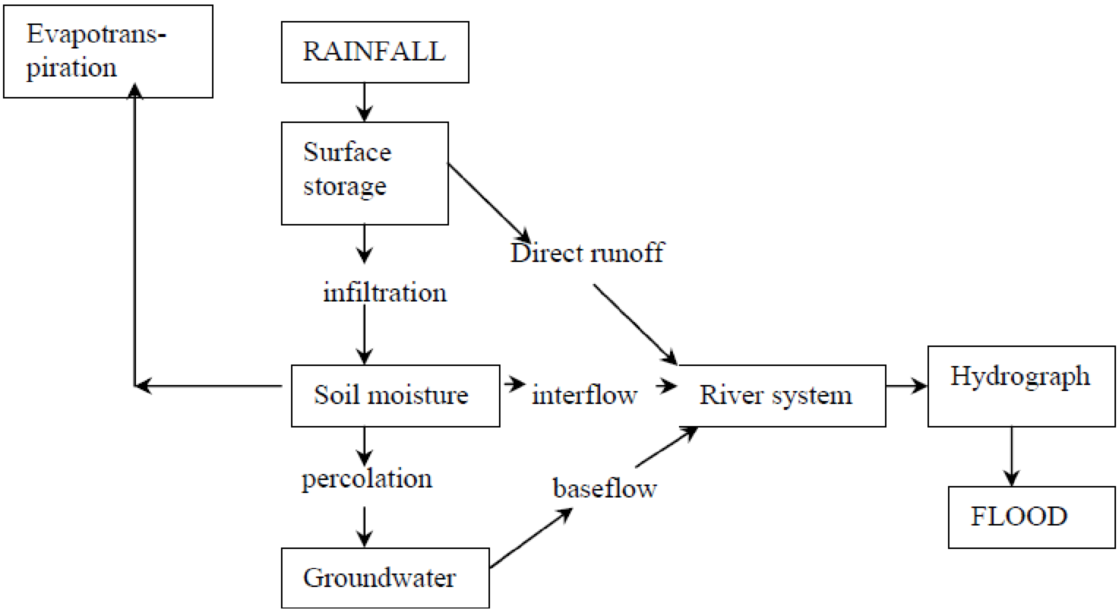
Ponding is a type of flooding that can happen in relatively flat areas. Rain water falling in an area is normally stored in the ground, in canals or lakes, or is drained away, or pumped out. When more rainwater enters a water system than can be stored, or can leave the system, flooding occurs. In this case, rain is the source of the flood: not water coming from a river, but water on its way to the river. That's why it is also called "pluvial flood".

Puddles and ponds develop on the land, canals are filled to brim and spill over; gradually a layer of water covers the land. It is like urban flooding, but without the sewage systems and in more rural areas.

3. Causes of Flood

Catchment System and flood Occurrence

The hydrograph of a stream flow from a catchment is the overall continuing response of that catchment to the previous history of rainfall and evaporation over the catchment. It is simplified as in flow diagram below. Flood is defined as the discharge that may be expected from most severe combination of meteorological and hydrologic conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combination (Linsley and Franzni,1979)



1) Rapid development

Trees as one of the source that absorb water being cut down and surfaces of land covered with concrete blocked water from penetrating into the ground.

2) Land clearing / unplanned development
3) Poor drainage system
4) Soil Erosion
5) River shallow
6) Heavy Rainfall.

Annual Maximum Rainfall Intensity in Malaysia.

Duration	1970 – 1980	2000 - 2007	% Increased
1 -hr	96 mm/hr	112 mm/hr	+ 17 %
3 -hrs	111 mm/hr	133 mm/hr	+ 29 %
6 -hrs	111 mm/hr	145 mm/hr	+ 31 %

4. Impact of Flood

Positive:

Sustaining, enriching and rejuvenating certain sector of biodiversity in the floodplains, replenishes the land with nutrient rich soils and therefore good for agriculture and natural vegetation, clear debris as well as remove sediments from the flooded area, recharges groundwater storage

Negative socio-economic Impacts of Floods

1) Loss of lives and property

Immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, non-functioning of infrastructure facilities and deterioration of health condition owing to waterborne diseases. Flash floods, with little or no warning time, cause more deaths than slow-rising riverine floods. In monetary terms, the extent of damages caused by floods is on the one hand dependent on the extent, depth and duration of flooding, and the velocities of flows in the flooded areas. On the other hand it is dependent on the vulnerabilities of economic activities and communities.

2) Loss of livelihoods:

As communication links and infrastructure such as power plants, roads and bridges are damaged and disrupted, economic activities come to a standstill, resulting in dislocation and the dysfunction of normal life for a period much beyond the duration of the flooding. Similarly, the direct effect on production assets be it in agriculture or industry, can inhibit regularly activity and lead to loss of livelihoods. The spill over effects of the loss of livelihoods can be felt in business and commercial activities even in adjacent non-flooded areas

3) Decreased purchasing and production power:

Damage to infrastructure also causes long-term impacts, such as disruptions of clean water and electricity supply, transport, communication, education and health care. Loss of livelihoods, reduction in purchasing power and loss of land value in the flood plains lead to increased vulnerabilities of communities living in the area. The additional cost of rehabilitation, relocation of people and removal of property from flood-affected areas can divert the capital required for maintaining production.

4) Mass migration:

Frequent flooding, resulting in loss of livelihoods, production and other prolonged economic impacts and types of suffering can trigger mass migration or population displacement. Migration to developed urban areas contributes to the overcrowding in the cities. These migrants swell the ranks of the urban poor and end up living in marginal lands or informal settlements that are prone to floods or other risks. Selective out-migration of the workforce sometimes creates complex social problems.

5) Psychosocial effects:

The huge psycho-social effects on flood victims and their families can traumatize them for long periods of time. The loss of loved ones can generate deep impacts, especially on children. Displacement from one’s home, loss of property, loss of memorabilia and livelihoods, decreased levels of security in the aftermath of floods and in temporary shelters, and disruption to business and social affairs can cause stress. The stress of overcoming these losses can be overwhelming and produce lasting psychological impacts.

6) Hindering economic growth and development:

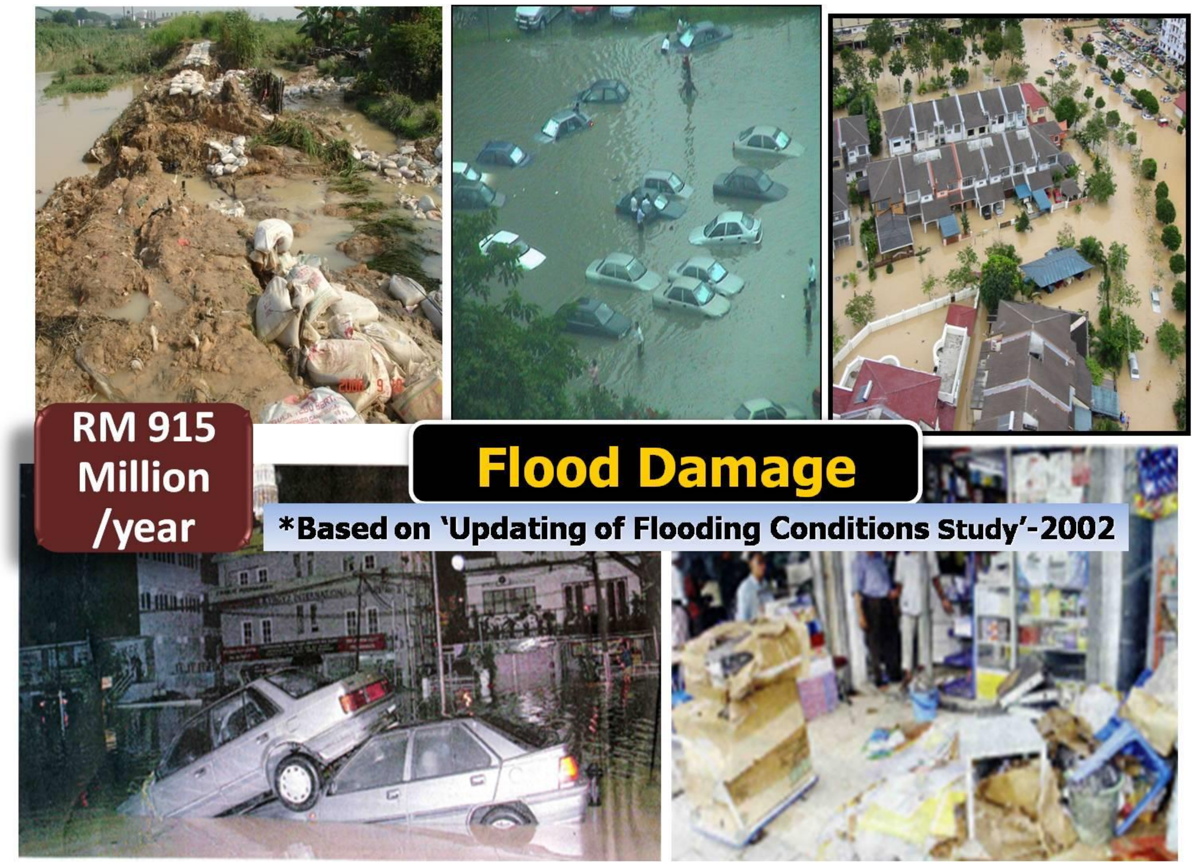
The high cost of relief and recovery may adversely impact investment in infrastructure and other development activities in the area and in certain cases may cripple the frail economy of the region. Recurrent flooding in a region may discourage long-term investments by the government and private sector alike. Lack of livelihoods, combined with migration of skilled labour and inflation may have a negative impact on a region's economic growth. Loss of resources can lead to high costs of goods and services, delaying its development programmes.

7) Political implications:

Ineffective flood response and relief operations during major flood events regularly lead to public discontent or loss of trust in the authorities or the state and national governments. Lack of development in flood-prone areas may cause social inequity and even social unrest posing threat to peace and stability in the region.

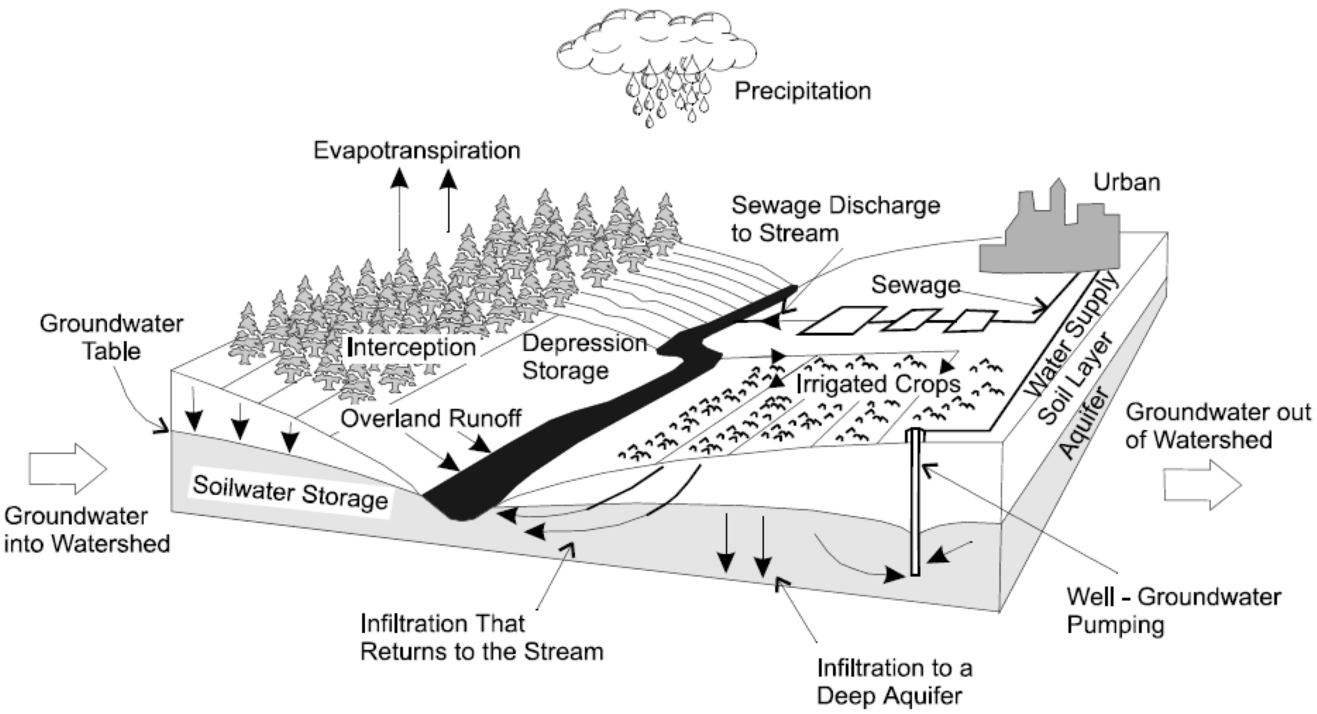
8) Disease

Flooding usually brings infectious diseases, e.g. military fever, pneumonic plague, dermatopathia, dysentery, common cold (type A), break bone fever, etc. And for those areas which have no electric supply due to flooding, food poisoning may occur as food may not be properly frozen.

5.0 Flood Prevention

5.1 Storm Water Management and maintenance.



There are five (5) types of Storm Water Management and Maintenance. These practises are commonly used in most of country.

Table 3.3 Stormwater Management Practices Acceptable for Water Quality

Group	Practice	Description
Pond	Micropool Extended Detention Pond (P-1)	Pond that treats the majority of the water quality volume through extended detention, and incorporates a micropool at the outlet of the pond to prevent sediment resuspension.
	Wet Pond (P-2)	Pond that provides storage for the entire water quality volume in the permanent pool.
	Wet Extended Detention Pond (P-3)	Pond that treats a portion of the water quality volume by detaining storm flows above a permanent pool for a specified minimum detention time.
	Multiple Pond System (P-4)	A group of ponds that collectively treat the water quality volume.
	Pocket Pond (P-5)	A stormwater wetland design adapted for the treatment of runoff from small drainage areas that has little or no baseflow available to maintain water elevations and relies on ground water to maintain a permanent pool.
Wetland	Shallow Wetland (W-1)	A wetland that provides water quality treatment entirely in a wet shallow marsh.
	Extended Detention Wetland (W-2)	A wetland system that provides some fraction of the water quality volume by detaining storm flows above the marsh surface.
	Pond/ Wetland System (W-3)	A wetland system that provides a portion of the water quality volume in the permanent pool of a wet pond that precedes the marsh for a specified minimum detention time.
	Pocket Wetland (W-4)	A shallow wetland design adapted for the treatment of runoff from small drainage areas that has variable water levels and relies on groundwater for its permanent pool.
Infiltration	Infiltration Trench (I-1)	An infiltration practice that stores the water quality volume in the void spaces of a gravel trench before it is infiltrated into the ground.
	Infiltration Basin (I-2)	An infiltration practice that stores the water quality volume in a shallow depression, before it is infiltrated it into the ground.
	Dry Well (I-3)	An infiltration practice similar in design to the infiltration trench, and best suited for treatment of rooftop runoff.
Filtering Practices	Surface Sand Filter (F-1)	A filtering practice that treats stormwater by settling out larger particles in a sediment chamber, and then filtering stormwater through a sand matrix.
	Underground Sand Filter (F-2)	A filtering practice that treats stormwater as it flows through underground settling and filtering chambers.
	Perimeter Sand Filter (F-3)	A filter that incorporates a sediment chamber and filer bed as parallel vaults adjacent to a parking lot.
	Organic Filter (F-4)	A filtering practice that uses an organic medium such as compost in the filter, in the place of sand.
	Bioretention (F-5)	A shallow depression that treats stormwater as it flows through a soil matrix, and is returned to the storm drain system.
Open Channels	Dry Swale (O-1)	An open drainage channel or depression explicitly designed to detain and promote the filtration of stormwater runoff into the soil media.
	Wet Swale (O-2)	An open drainage channel or depression designed to retain water or intercept groundwater for water quality treatment.

5.1.1 Stormwater Ponds

Constructed storm water retention basin that has a permanent pool (or micro pool). Runoff from each rain event is detained and treated in the pool through settling and biological uptake mechanisms. There are five design options.

i. Micro pool Extended Detention (P-1)

ii. Wet Pond (P-2)

iii. Wet Extended Detention (P-3)

iv. Multiple Pond (P-4)

v. Pocket Pond (P-5)

Treatment Suitability:

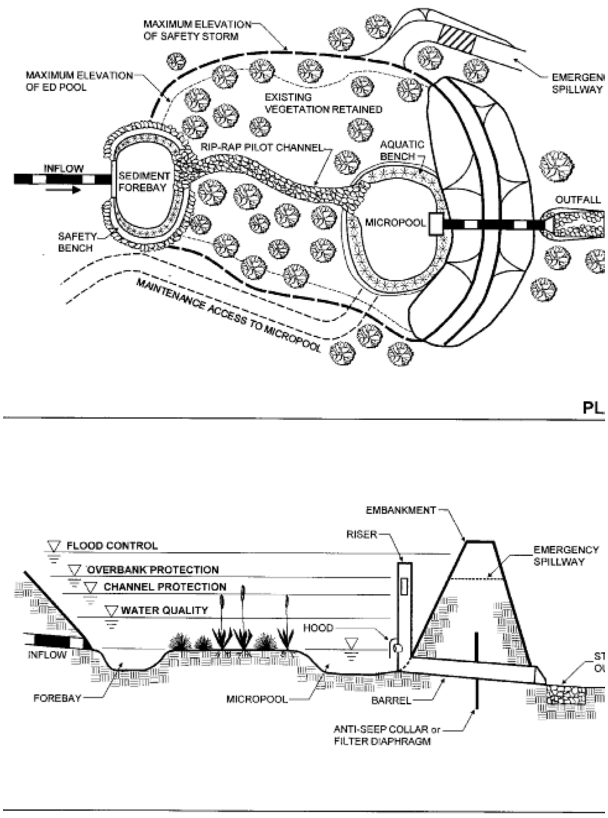
Dry extended detention ponds without a permanent pool are not considered an acceptable option for meeting water quality treatment goals. Each of the five storm water pond designs can be used to provide channel protection volume as well as overbank and extreme flood attenuation. The term "pocket" refers to a pond or wetland that has such a small contributing drainage area that little or no base flow is available to sustain water elevations during dry weather. Instead, water elevations are heavily influenced, and in some cases maintained, by a locally high water table.

IMPORTANT NOTES:

WHILE THE STORMWATER PONDS DESIGNED ACCORDING TO THIS GUIDANCE MAY ACT AS A COMMUNITY AMMENITY, AND MAY PROVIDE SOME HABITAT VALUE, THEY CANNOT BE ANTICIPATED TO FUNCTION AS NATURAL LAKES OR PONDS

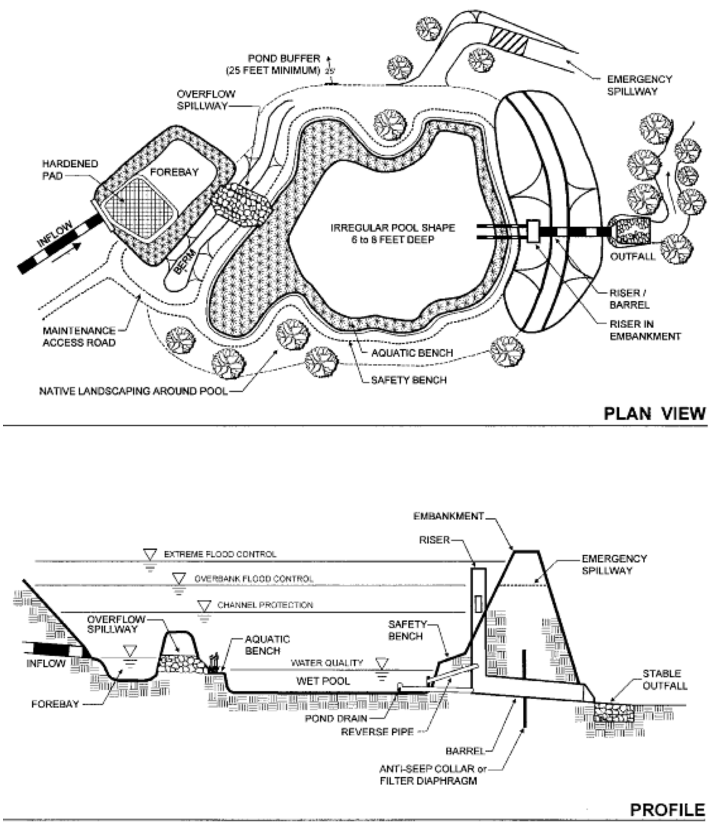
i) Micro pool Extended Detention Pond(P-1)

Figure 6.1 Micropool Extended Detention Pond (P-1)



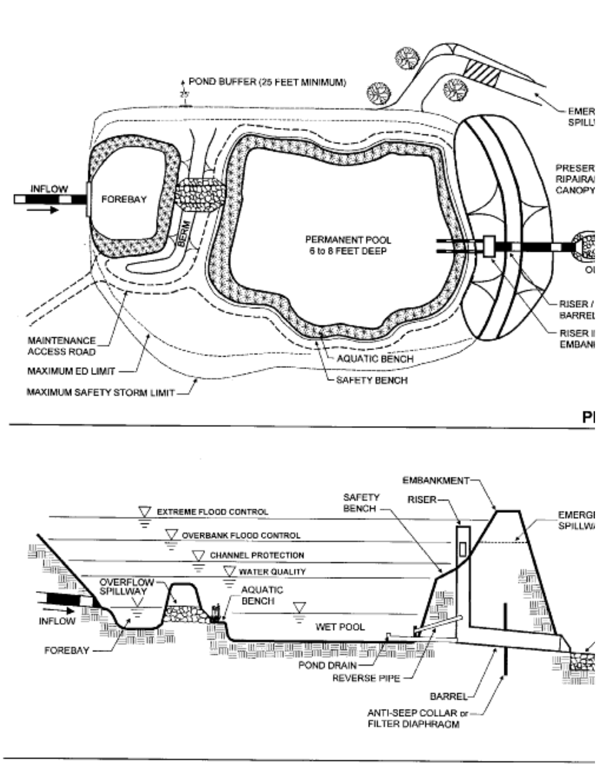
ii) Wet Pond (P-2)

Figure 6.2 Wet Pond (P-2)



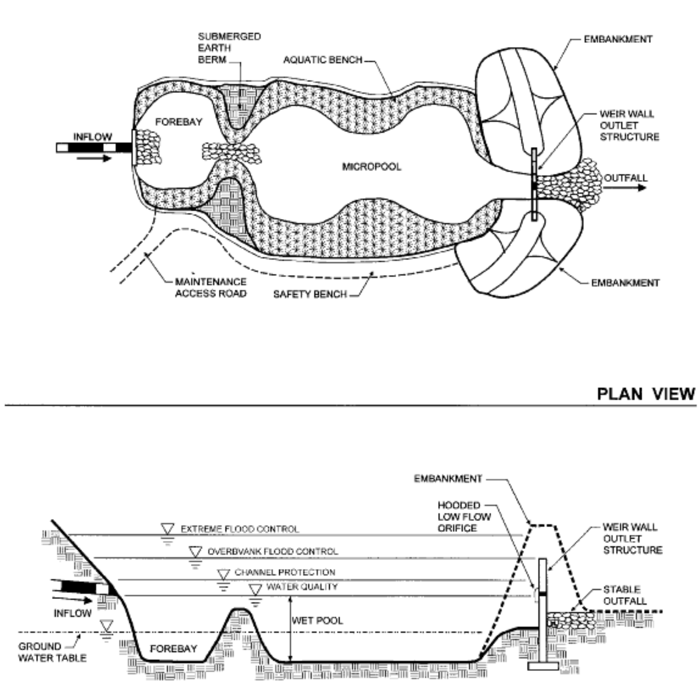
iii) Wet Extended Detention Pond (P-3)

Figure 6.3 Wet Extended Detention Pond (P-3)



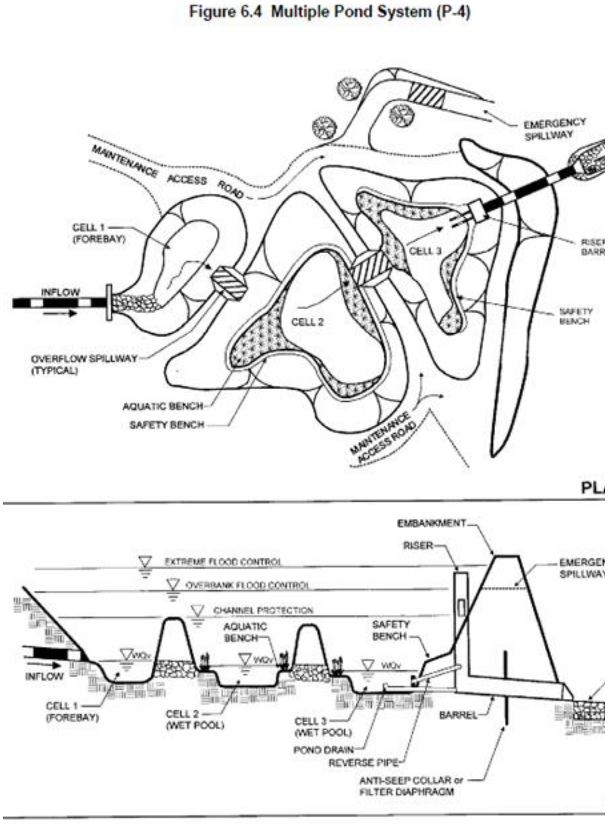
v) Pocket Pond (P-5)

Figure 6.5 Pocket Pond (P-5)



iv) Multiple Pond System (P-4)

Figure 6.4 Multiple Pond System (P-4)



Required Elements

• Storm water ponds shall not be located within jurisdictional waters, including wetlands.

• Evaluate the site to determine the Hazard Class, and to determine what design elements are required to ensure dam safety (see Guidelines for Design of Dams).

• Avoid direction of hotspot runoff to design P-5.

• Provide a 2’ minimum separation between the pond bottom and groundwater in sole source aquifer recharge areas.

5.1.2 Storm water Wetland

Description: Storm water wetlands (a.k.a. constructed wetlands) are structural practices that incorporate wetland plants into the design to both store and treat runoff. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the practice.

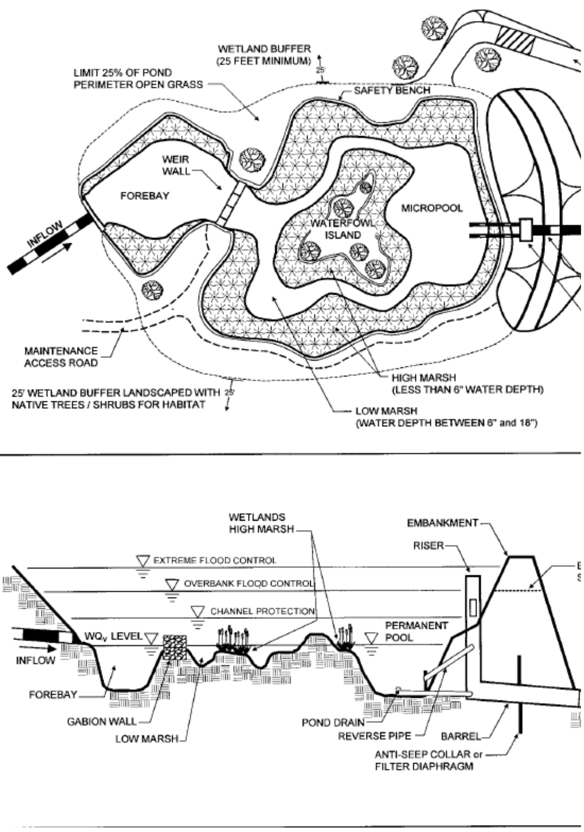
Storm water wetlands are practices that create shallow marsh areas to treat urban storm water and often incorporate small permanent pools and/or extended detention storage to achieve the full WQv. Design variants include:

1) W-1 Shallow Wetland.
2) W-2 Extended Detention Shallow Wetland.
3) W-3 Pond/Wetland System.
4) W-4 Pocket Wetland.

Wetland designs W-1 through W-4 can be used to provide Channel Protection volume as well as Overbank and Extreme Flood attenuation. In these design variations, the permanent pool is stored in a depression excavated into the ground surface. Wetland plants are planted at the wetland bottom, particularly in the shallow regions.

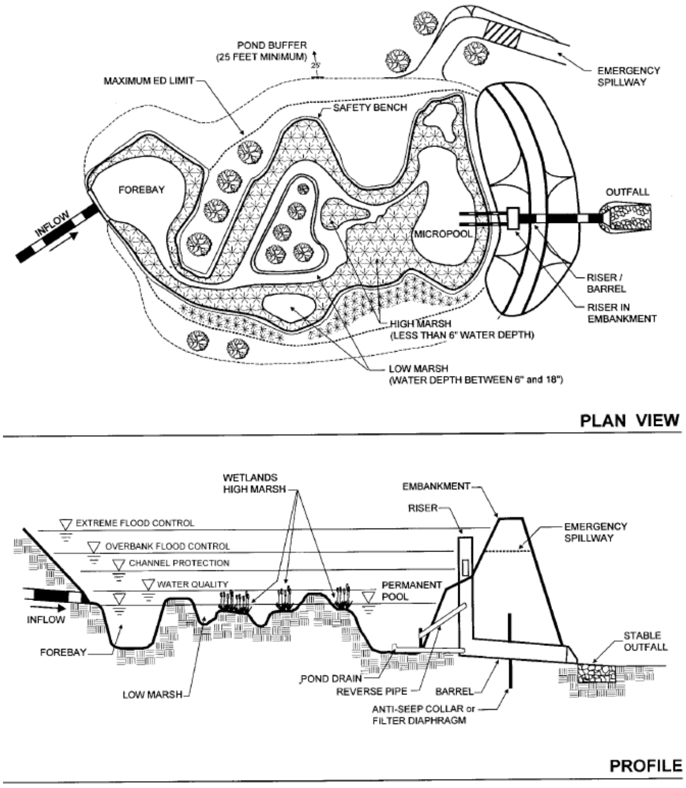
1) Shallow Wetland (W-1)

Figure 6.7 Shallow Wetland (W-1)



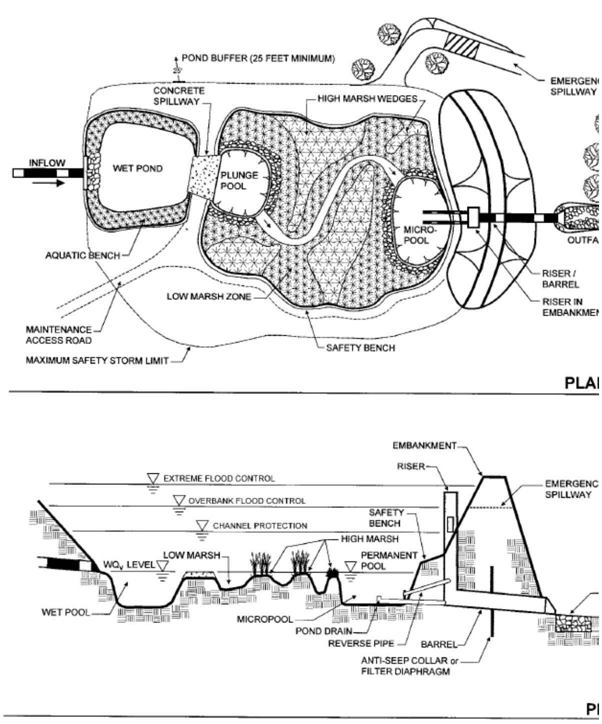
2) Extended Detention Shallow Wetland (W-2)

Figure 6.8 Extended Detention Shallow Wetland (W-2)



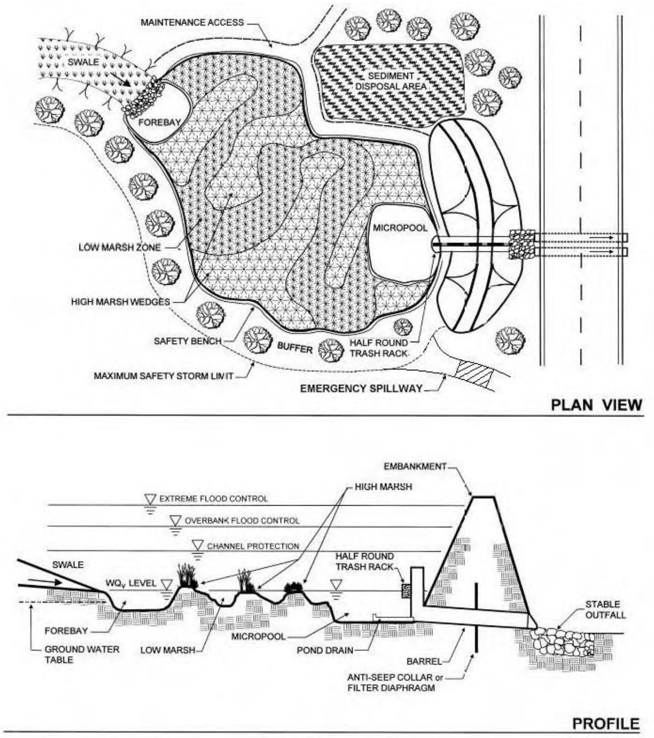
3) Pond/Wetland System (W-3)

Figure 6.9 Pond/Wetland System (W-3)



4) 10 Pocket Wetland (W-4)

Figure 6.10 Pocket Wetland (W-4)



5.1.3 Storm water Infiltration

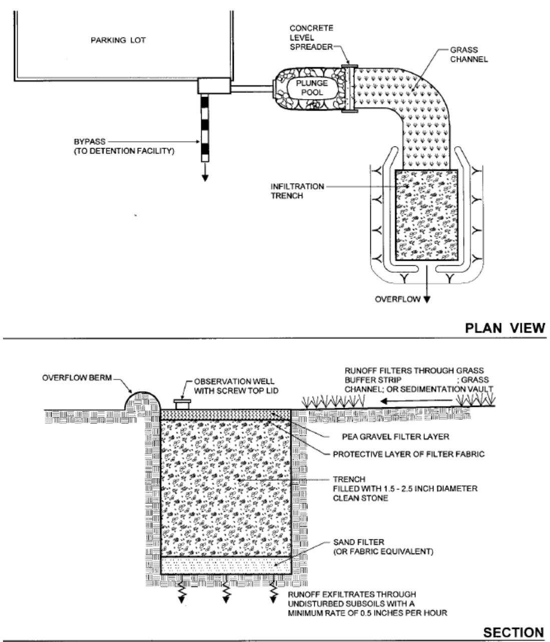
Description: Excavated trench or basin used to capture and allow infiltration of storm water runoff into the surrounding soils from the bottom and sides of the basin or trench.

Design Options:

1) Infiltration Trench.
2) Infiltration Basin.
3) Dry Well.

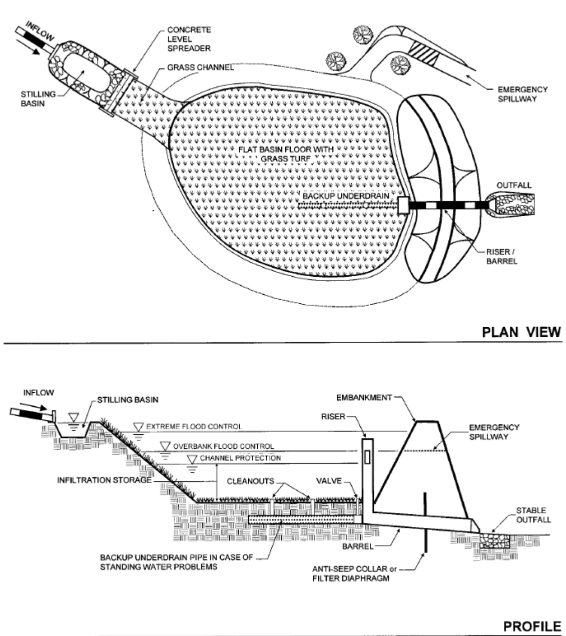
1) Infiltration Trench (I-1)

Figure 6.11 Infiltration Trench (I-1)

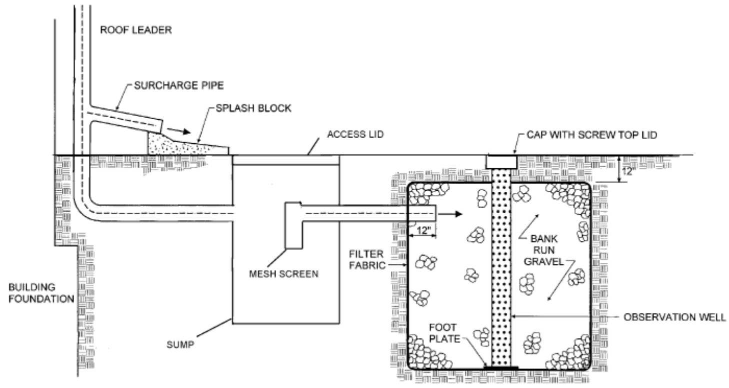


2) Infiltration Basin (I-2)

Figure 6.12 Infiltration Basin (I-2)



3) Dry Well (I-3)



5.1.4 Storm water Filtering System Section

Storm water filtering systems capture and temporarily store the WQv and pass it through a filter bed of sand, organic matter, or soil. Filtered runoff may be collected and returned to the conveyance system, or allowed to partially infiltrated into the soil.

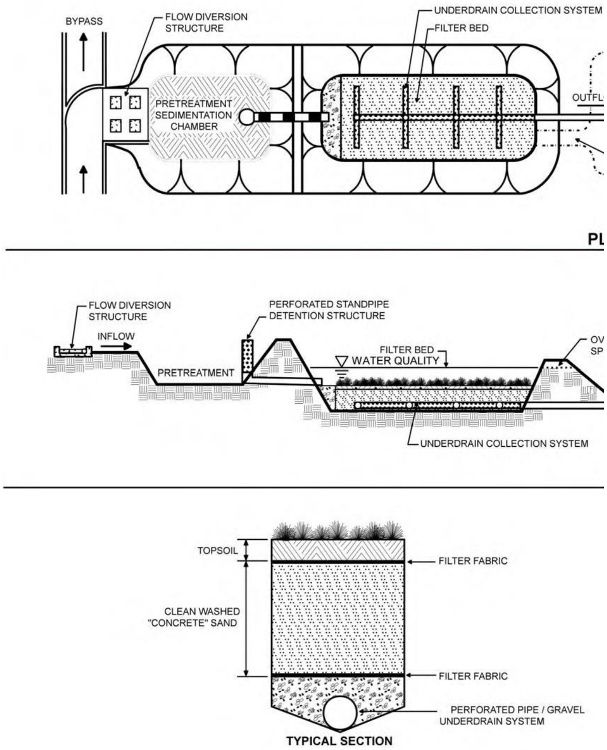
Sand/ Organic Filters

Multi-chamber structure designed to treat storm water runoff through filtration, using a sediment fore bay, a primary filter media and, typically, an under drain collection system.

Design Variations:

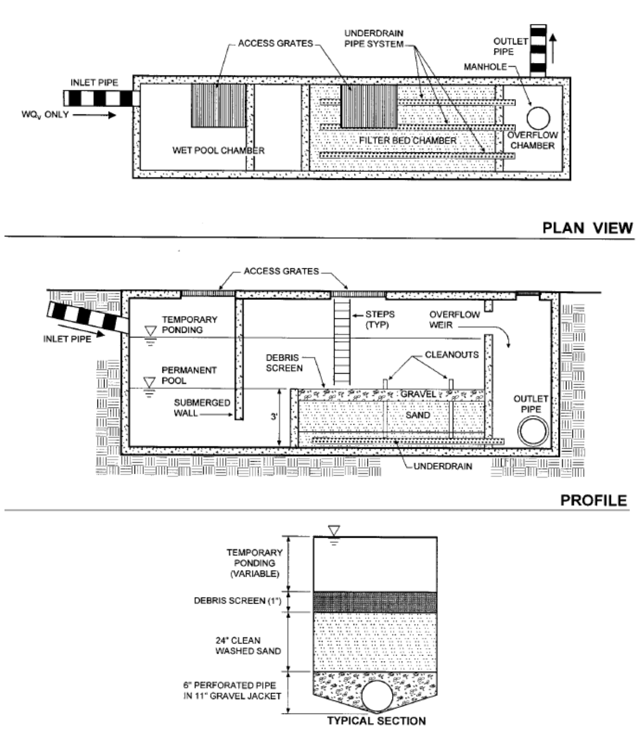
1) Surface Sand Filter (F-1),
2) Underground Sand Filter (F-2),
3) Perimeter Sand Filter (F-3),
4) Organic Sand Filter (F-4)

1) Surface Sand Filter (F-1)



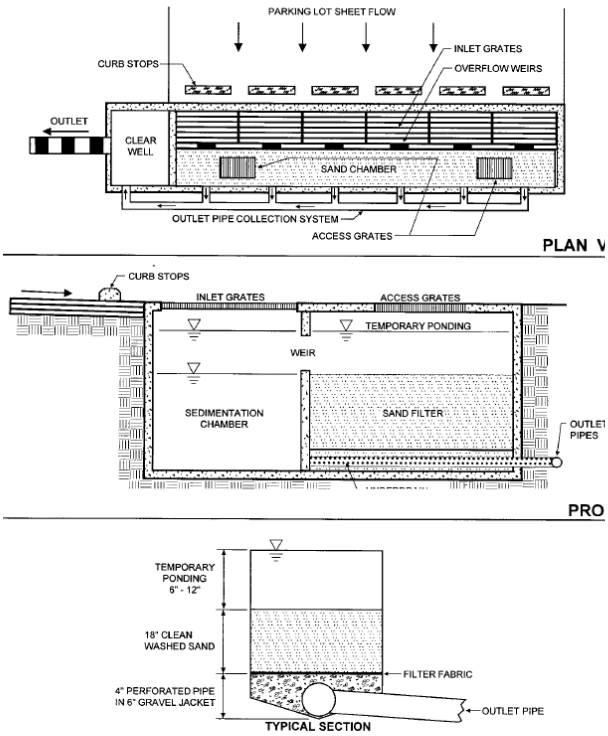
2) Underground Sand Filter (F-2)

Figure 6.16 Underground Sand Filter (F-2)

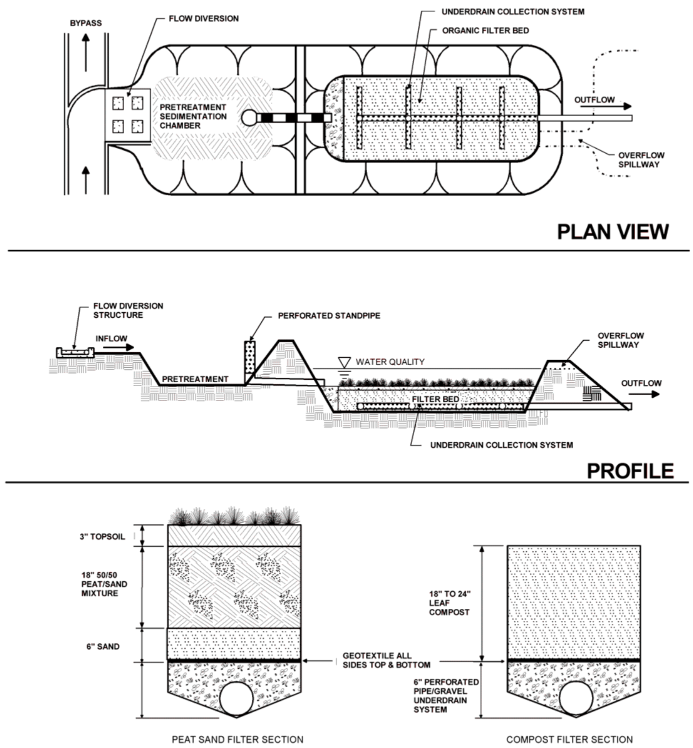


3) Perimeter Sand Filter (F-3)

Figure 6.17 Perimeter Sand Filter (F-3)



4) Organic Filter (F- 4)



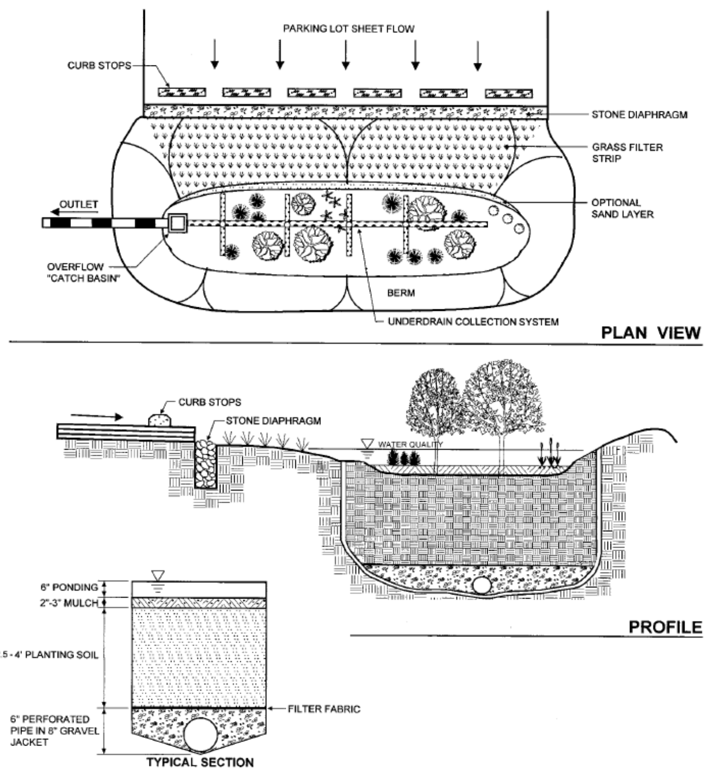
Bioretention Areas (F-5)

Description: Shallow storm water basin or landscaped area which utilizes engineered soils and vegetation to capture and treat runoff. The practice is often located in parking lot islands, and can also be used to treat residential areas.

mulch layer, sized based on the methodologies described in Section 6.4.2.

Bioretention (F-5)

Figure 6.19 Bioretention (F-5)



5.1.5 Open Channels

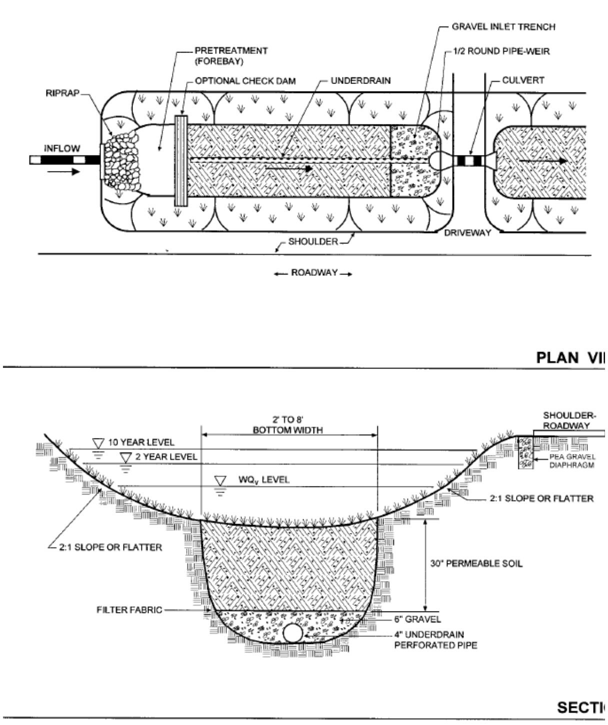
Description: Vegetated channels that are explicitly designed and constructed to capture and treat storm water runoff within dry or wet cells formed by check dams or other means. Open channel systems are vegetated open channels that are explicitly designed to capture and treat the full WQv within dry or wet cells formed by check dams or other means. Design variants include:

1) O-1 Dry Swale (Figure 6.20)
2) O-2 Wet Swale (Figure 6.21)

Treatment Suitability: Open Channel Systems can meet water quality treatment goals only, and are not appropriate for Cpv or Qp.

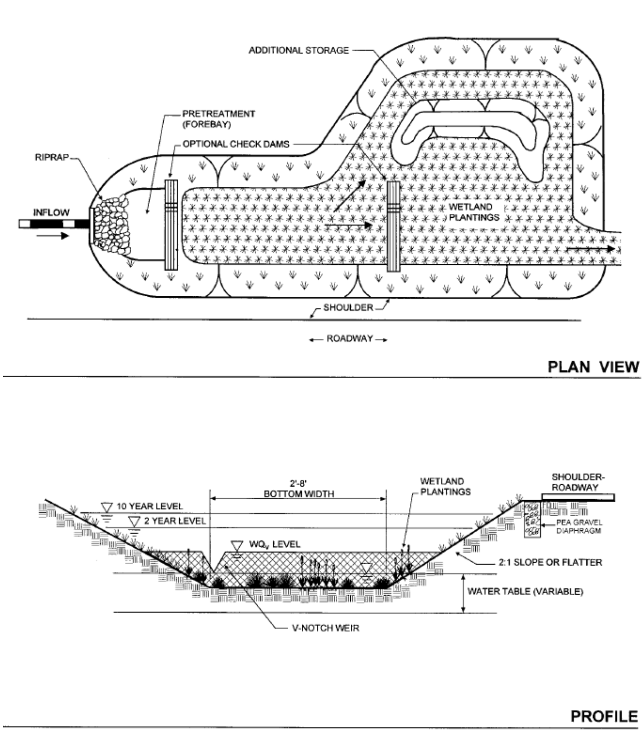
1) Dry Swale (O-1)

Figure 6.20 Dry Swale (O-1)



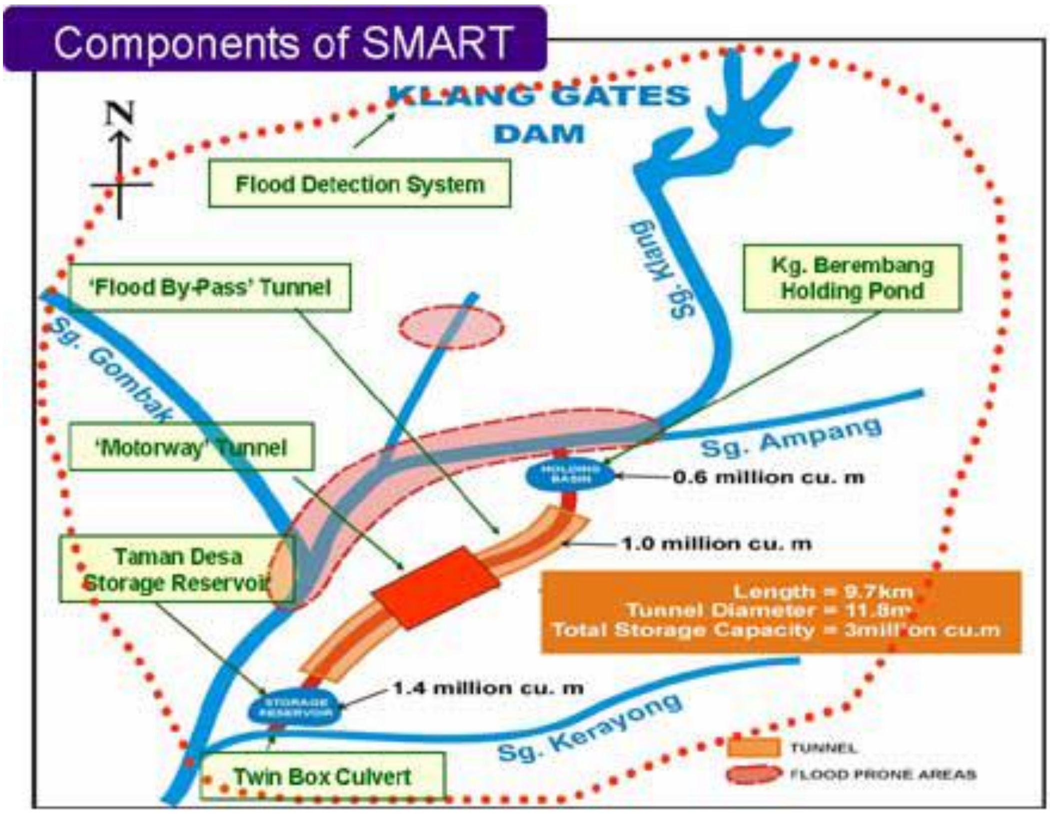
2) Wet Swale (O-2)

Figure 6.21 Wet Swale (O-2)



5.1.6 SMART Tunnel Project

SMART is an acronym for Storm water Management and Road Tunnel. It is an innovative project of the Government of Malaysia to solve flooding problem in the City Centre of Kuala Lumpur. Also serve to ease the traffic congestion problem between Kuala Lumpur City Centre and Southern gateway. The Unique feature of SMART is the 3 km double-deck motorway within the 9.7 km tunnel Objectives; Primary: To alleviate flooding problem at the Kuala Lumpur city centre due to storm water from the Klang-Ampang catchment. Added benefit: To ease traffic congestion at the southern main gateway (TUDM at Sungai Besi) to the city centre.



5.2 Environmental / Landscape Solution and Benefits

As cities and suburbs grow and replace forests and agricultural land, increased storm water runoff from impervious surfaces becomes a problem. Storm water runoff from developed areas increases flooding; carries pollutants from streets, parking lots and even lawns into local streams and lakes; and leads to costly municipal improvements in storm water treatment structures.

5.2.1 Rain Garden

By reducing storm water runoff, rain gardens can be a valuable part of changing these trends. While an individual rain garden may seem like a small thing, collectively they produce substantial neighbourhood and community environmental benefits. Benefits of Rain gardens work for us in several ways:

1. Increasing the amount of water that filters into the ground, which recharges local and regional aquifers;
2. Helping protect communities from flooding and drainage problems;
3. Helping protect streams and lakes from pollutants carried by urban storm water – lawn fertilizers and pesticides, oil and other fluids that leak from cars, and numerous harmful substances that wash off roofs and paved areas;

4. Enhancing the beauty of yards and neighbourhood's
5. Providing valuable habitat for birds, butterflies and many beneficial insects.

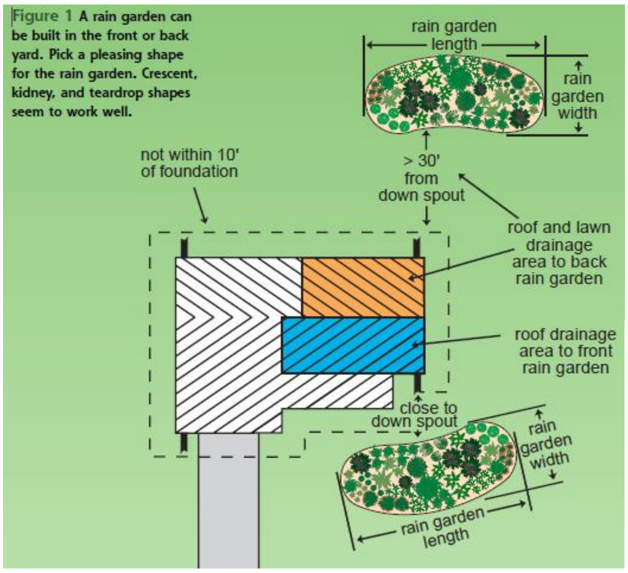


Figure 1 A rain garden can be built in the front or back yard. Pick a pleasing shape for the rain garden. Crescent, kidney, and teardrop shapes seem to work well.

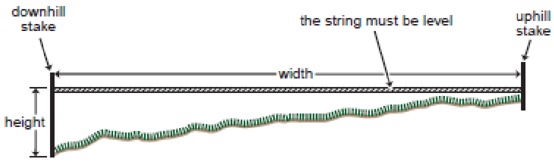


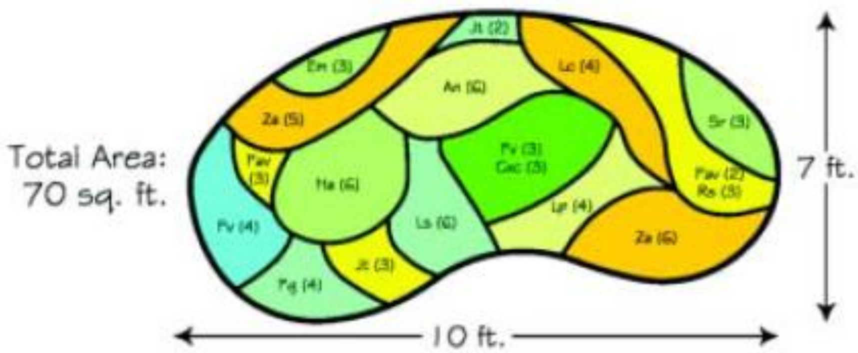
Figure 3 The string should be tied to the base of the uphill stake, then tied to the downhill stake at the same level.

Todd measures the length of the string between the stakes; it is 180 inches long. The height is 9 inches. He divides the height by the width to find his lawn's percent slope.

$$\frac{\text{height}}{\text{width}} \times 100 = \%\ \text{slope} \qquad \frac{9\ \text{inches}}{180\ \text{inches}} \times 100 = 5\%\ \text{slope}$$

With a 5% slope, Todd should build a 6 inch deep rain garden.

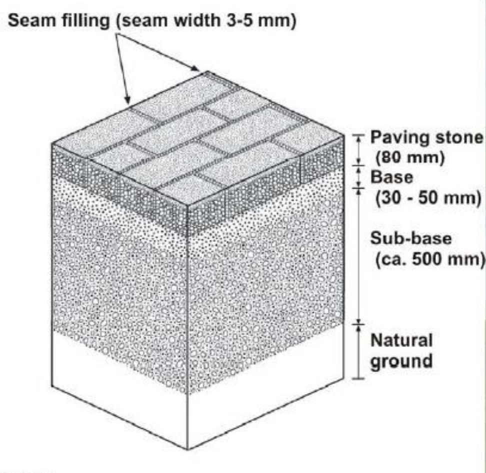
10 feet wide; full to partial sun with silt and sandy soils



5.2.2 Green Roof

Green Roof in Portland Oregon USA retain 60% of rainfall on average preventing sewer overflows into the Willamette River

5.2.3 Permeable Pavements



Testfield Coesfeld, Germany

The rainwater run-off of about 80 houses with a paved area of 1.1 hectares will be disconnected from the wastewater system and the storm water will be utilised to create a new area of biodiversity.

5.2.4 Permeable Parking Lots.

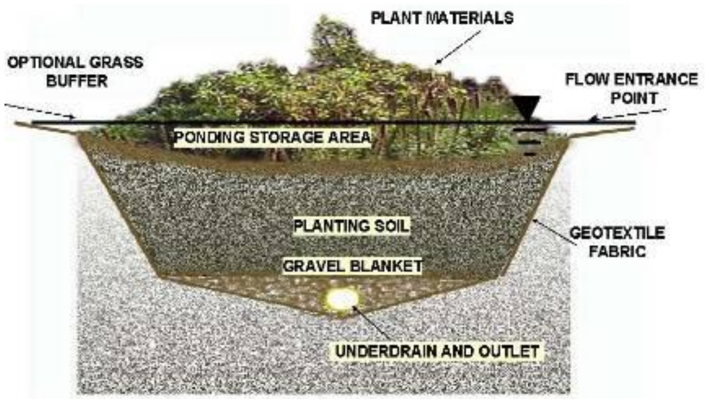
Bordeaux is located in a low lying area and is particularly prone to flood water damage so permeable pavements are now required on all new developments.

Benefits of permeable paving

1) Reduced flood risk
2) Reduced demand for irrigation
3) Benefits for tree roots
4) Reduced urban heat island effects

5.2.5 Green and Blue Corridors

Rerouting storm water from houses to then be utilized in creating "green and blue corridors" in the suburbs.



5.2.6 Rain Water Harvesting

Rainwater harvesting is now seen as a means of reducing mains water consumption, something that we are now all under strong official pressure to do. It is also now recognized that rainwater harvesting can at the same time contribute to attenuating flood water flow, i.e. holding some storm water that comes off the roof and letting it flow at a controlled, slower, rate to the drain or soak away.

The application of allotment-scale rainwater harvesting can moderately reduce flood risk whilst assisting in the protection of urban stream health. It should be one of the suites of tools used to reduce the flooding and ecological impacts of urban storm water. The water from rainwater storage are usually used as cleaning, watering garden and flushing toilets.

6.0 Case Study - Serdang

Causes of Flood in Serdang

1) Rapid development

Most of developers only thinking of profits than impact of the development being done.

2) Land clearing / unplanned development

Existing site normally full with plants and natural surface water runoff for water to absorb to ground. After develop natural surface water runoff placed with concrete paving and plants that being chop off are not being replaced as much as the existing condition.

3) Poor drainage system

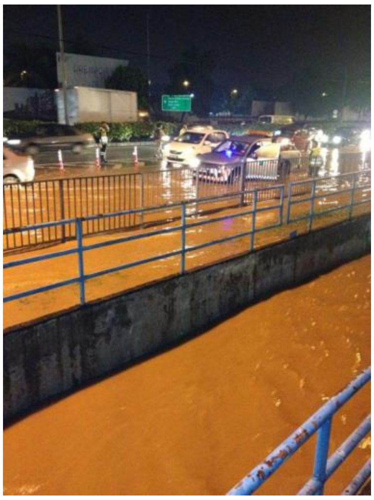
4) Soil Erosion

Failure in solid waste management, solid waste are thrown into the river and clogging the water flow. When water flow blocked water will be over flow to the river bank affecting flood to surroundings

Development on or near hill side without proper planning affecting soil erosion and this soil which carried by water to river will create river shallow.

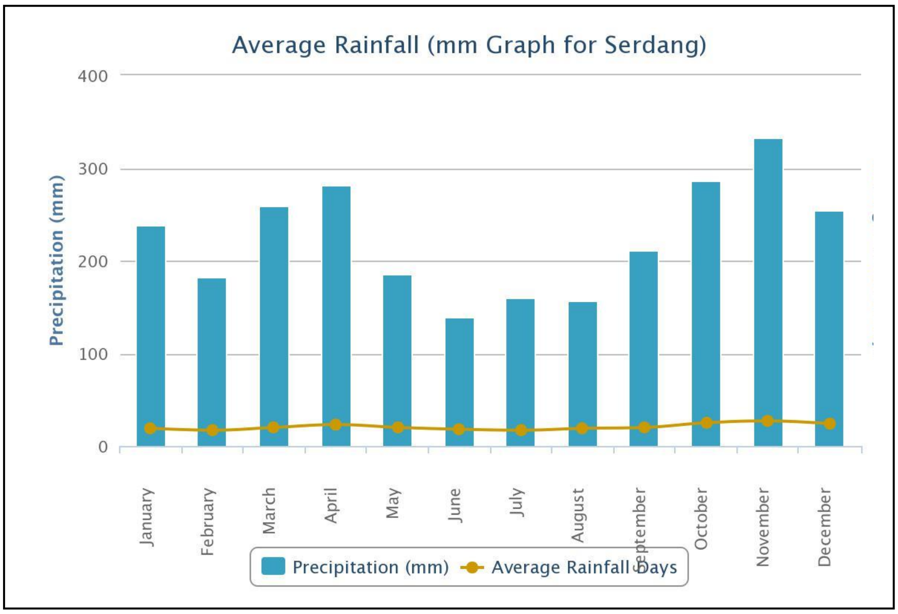
5) River shallow

When the river bed become shallow and the water clogged with solid waste, during the heavy rain the river and the drainage failed to flow the water out from Serdang area causing Flash Flood towards road and highway as well as 600 residents.



9. Rainfall.

The average total annual rainfall for Serdang for the period 1985-2003 was 2426.4 mm. Generally, there would be two periods of heavy rainfall (about 300-500 mm month-1) in a year at March-April and October-December



There was a general increase in total annual rainfall in Serdang for the period 1985-2003. Generally, total annual rainfall would increase by 26 mm every year; this indicated that Serdang was experiencing a general increase in wet weather for the past 19 years.

The recent flooding in Serdang on Sept 4 as an example of heavy rain causing rivers and retention ponds in areas next to the highway to overflow, resulting in flooding. Heavy rain has led to flash floods at several sections of the highway.

Caused of flood in Serdang area can be defined as combination of Flash flood and Pluvial flood.





Proposal to prevent Flood in Serdang

FRSB and Engineering Faculty are the lowest ground in Serdang area. Most of water from surroundings areas flow to the Existing Wetland located at Engineering Faculty. This area is suitable for storm water management to overcome flood that occur in Serdang.

This proposal considered two practises to overcome flood in this area.

1) To reduce water surface runoff by using building with Green Roof, Rain Garden, Natural Swale and Green and Blue Corridors. This created to ensure 40% – 60% of surface water runoof absorb into ground or evaporated into atmosphere.

2) Collecting Storm water using Constructed Wetland and blocking water from over flows to the road using Riparian Buffer.

7.0 Conclusion

Malaysians should be very grateful as our country is blessed with lot of rainfall throughout the year. That means Malaysia is full with fresh water resources. Freshwater is needed for drinking, farming, and washing. Without water, life as we know it would not exist. However this phenomenon had created a problem to Malaysian, especially during monsoon season in September to February where Malaysia is pouring with heavy rainfall. This heavy rainfall failed to infiltrate fast enough and the water will instead enter the river via surface runoff. This leads to a sudden and large increase in the river's discharge which can result in a flash flood. In reality heavy rainfall is not a problem because it is a natural phenomenon happen in Malaysia every year since the beginning.

Therefore the real problem is the development that done by human. Most of the development did not consider the impact of this phenomenon. This paper is to inform and create awareness that flood which is a natural phenomenon has become a big problem to Malaysia especially in urban areas where most of development being done by human. The causes of flood are the main issues in urban areas since developers and designers who are the real person that creates flood in urban areas. Designers such as Landscape Architects, Architects and Engineers should advise to the developers on the impacts of the development they are creating. Proper analyses of the site they are designing are required prior to the future impact.

There are many more ways to overcome flood. This paper only discussed on storm water management and water surface runoff which is considered important for the knowledge as a Landscape Architect. The suitable practises to overcome the flood problem need to be analysing by the designers in the beginning of the planning stages of any development. Developers normally dislike this solution as they do not get any profit and normally flood did not occur at the development site but at the lowest point of the surroundings area. Therefore the solution of this problem depends on the creativity of the designer to change the problem become the profit and benefits to the developer and the surrounding communities.

References :

1) **New York State Storm water Management Design Manual August 2010
Prepared by: Center for Watershed Protection, 8391 Main Street, Ellicott City, MD 21043**
2) **Rain Garden Manual - Wisconsin Department of Natural Resources.**
3) **Flood Management – www.water.gov.my**
4) **The star online.**
5) **REGIONAL WORKSHOP ON CLIMATE CHANGE AND URBAN FLOODING MANAGEMENT 19 – 20 March 2013 DAEGU, KOREA by
MOHD FAUZI MOHAMAD
National Hydraulic Research Institute of Malaysia (NAHRIM)
Ministry of Natural Resources & Environment (NRE)**
6) **Stormwater management around the world Lessons from Novatech 2010
By : Dennis Corbett and Marion Urrutiaguer**