1. **Purpose**

Stellenbosch University established this Storm Water Management Plan to ensure that the site and hard surfaces are managed to control stormwater runoff and filter litter or pollutants to reduce peak flows, erosion and contamination of groundwater, streams and rivers.

1. **Scope**

This Storm Water Management Plan identifies the following in order to limit the disruption of natural hydrology, minimise pollution and deterioration of the site:

* Built environment and natural environmental elements with their associated constraints and problems.
* On-going operational targets: short-term solutions and longer-term solutions to be implemented over a few years.
* Issues and causes of peak flows, erosion, pollution etc.
* Implementation of source control thereby reducing the generation of increased run-off.
* Implementation of repairs, maintenance and stabilisation.

1. **Storm Water Problems**

Storm water in practice is channeled away from sites as rapidly as possible to the nearest watercourse, wetland or coastline without much consideration for quality. Storm water runoff impacts both water quality and water quantity by increasing erosion and flooding and decreasing groundwater infiltration, as well as increasing many pollutants, such as nutrients, sediment, pathogens, organic materials, toxic contaminants, and debris. In addition, it increases the temperature of streams receiving the runoff which affects the ecosystem and can cause death to many organisms.

Storm Water Quantity:

In its natural state, an undeveloped landscape will absorb the rainwater from normal rainfall and minor storm events but during heavier or longer rainfall events the rainwater begins to soak into the soil. The remaining water not lost by evaporation and transpiration will continue to seep into the water table. The groundwater, once it reaches an impermeable layer, will slowly and continuously discharge into the watercourse. The vegetation along the watercourses which protects the soil against erosion has adapted to these conditions. Only after several showers in close succession or a period of extended rainfall will the soil reach saturation point, and excess rainfall will move across the surface as runoff.

In developed areas however, the scenario changes. Rainfall is collected on impervious surfaces, roofs, roads and parking areas and immediately concentrated into storm water pipes or surface channels. There is no vegetation to absorb the light showers, the surface is impermeable and there is no infiltration into the soil. Runoff is channeled to the nearest watercourse in a concentrated stream of high energy water. This means that every rainfall event results in a flood which results in damage to vegetation along the watercourse and soil erosion. Since every rainfall event results in a damaging flood within the watercourse, there is no time for vegetation to recover and it is systematically removed and the exposed soil is eroded.

Storm Water Quality:

The contaminants mostly found in storm water can be grouped according to their water quality impacts:

* Oils, grease and surfactants: Rubber from tyres and oil and grease washed from road surfaces, domestic and industrial sites, plus surfactants from detergents used for washing vehicles, materials or surfaces are common sources of toxic pollutants in stormwater.
* Litter: This includes organic waste matter, paper, cigarette buds, plastics, glass, metal and other packaging materials from paved areas in urban catchments.
* Total Suspended solids: Suspended solids have two main constituents: organic, primarily from sewage, and inorganic, primarily from surface runoff. Turbidity from suspended solids reduces light penetration in water, affecting the growth of aquatic plants. When silts and clays settle, they may smother bottom-dwelling organisms and disrupt their habitats. Since metals, phosphorus and various organics are adsorbed and transported with these particles, sediment deposits may lead to a slow release of toxins and nutrients in the waterway.
* Nutrients: Potential sources of nutrients are:
  + Sewage overflows;
  + Industrial discharges;
  + Animal wastes;
  + Fertilisers;
  + Domestic detergents; and
  + Septic tank seepage.

Excessive amounts of nutrients, such as nitrogen and phosphorus, can promote rapid growth of aquatic plants, including toxic and non-toxic algae. This excessive growth and oxygen depletion can cause fish and aquatic organisms to die.

The necessity to deal with both the quantity and quality of runoff is recognised through the encouragement of groundwater recharge through infiltration, and for storage and reuse of runoff.

1. **Goals and Rules**

The goal of this Storm Water Management Plan is to ensure that the site and hard surfaces are managed by infiltration, collecting and reusing stormwater runoff of the precipitation falling on site (including the roof area) as well as filtering pollutants to reduce or eliminate contamination of groundwater, streams and rivers.

To limit disruption of natural hydrology by reducing impervious cover, increasing on-site Infiltration, reducing or eliminating pollution from stormwater runoff and eliminating contaminants, the following could be practical sequencing of interventions:

* Firstly, preserve and restore elements of Storm Water System: natural channels, eroded vegetation embankments
* Secondly, manage the quantity and quality of stormwater near the source
* Thirdly, install new treatment measures or rainwater harvesting-, attenuation-, filtration- or other systems as intervention retrofits.

Properly managed stormwater flows can prevent the increase in flood risk and watercourse erosion typically caused by urbanisation and provide important flow return to streams, offsetting the environmental impact of upstream water supply diversions and reducing the need for costly in-ground stormwater infrastructure.

The following additional stormwater management interventions could have further benefits to the building’s environmental impact:

* Water reclamation/ rainwater harvesting can reduce potable water demand considerably;
* Soak-away comprises an underground storage area packed with coarse aggregate or other porous media that gradually discharges storm water to the surrounding soil. Multiple soak-away elements can be put in the flow-path of peak run-off.
* The enhanced use of natural drainage corridors and depressions can provide open space, landscaped and recreational areas and conservation benefits increasing the amenity of new urban developments (multiple use corridors)
* Treatment of stormwater closer to source minimises uncontrolled discharge of water containing high suspended solids, nutrients and organic material
* Grids to screen reception of storm water to filter rubble or litter or plastic shopping bags from the storm water system
* Permeable paving materials, such as porous asphalt or porous concrete, or modular paving blocks with openings filled with grass or gravel are surfaces that mimic natural infiltration.
* Infiltration trenches are excavated trenches filled with rock or relatively large granular material and can be effective in removing sediment, metals, bacteria and organic material.

Permeable surfaces can also be designed with a turf cell reinforcement structure or open-celled pavers, and concrete or plastic grids with voids that are filled with topsoil, growing medium or aggregate to ensure that vehicle or foot traffic can still use the area securely whilst surfaces remain permeable.

Landscaping also plays an integral role in the design of most stormwater treatment systems, offering opportunities for their aesthetic incorporation in the surrounding area. The use of particular plant species is important since some species will be more effective in treating stormwater and better suited for surviving the ambient conditions. Coordination between storm water engineers, landscapers and nurseries/growers is advised to ensure that the required plants are available for planting at the correct stage in the season and during the performance period.

1. **On-going Operational Targets**

One of the goals of Stellenbosch University’s Storm Water Program is to minimise adverse impacts on water quality that result from pollutants that are discharged from structures and drainage ways or that have run off from surrounding land and buildings.

The following targets have been put in place:

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| --- | --- |
| **Short Term Targets** | **Target / Initiative** |
| Total Suspended Solids (TSS) | Maintain minimum erosion |
| Litter | Remain at 0% |
| Nutrients, oils, grease and surfactants | Change over to organic cleaning products |

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| --- | --- | --- |
| **Long Term Targets** | **Target / Initiative** | **Date** |
| Maintain and improve system performance | Implement an annual inspection programme of all stormwater management facilities to ensure continued performance | Annual basis |
| Peak flows | Perform calculations and disclosure of peak flows on an annual basis | Annual basis |

**Source Control**

Stellenbosch University Source Control:

* Litter: The building is swept every morning and cleaners are based on site who keep the grounds tidy and free of litter. All waste is to be removed from the campus on a daily basis. All litter shall be removed from sidewalks, gutters, and all planted areas each week. Sweep or blow-off all walks, curbs, and gutters weekly. All trash, litter, leaves, etc. shall be collected, hauled away, and disposed of legally.
* Landscaping: Environmental policies such as promoting the use of vegetation and planting programmes have been put in place which will reduce the long-term effects of storm water run-off at Stellenbosch University.
* Sewage overflow: Sewage drains are jetted before winter to clear any blockages and prevent flow.
* Drainage channels and storm water channels are cleaned regularly to avoid flooding in the winter.
* Cleaning detergents: Only sustainable cleaning products are used in the common areas on site. Further to this, pouring such products down the drain is avoided.
* Waste: An operational waste management plan is in place and proper waste collection and disposal procedures are in place.

1. **Implementation of Repairs, Maintenance and Stabilisation**

An annual inspection programme of all stormwater management facilities shall be carried out to confirm continued performance. The body responsible for this audit shall maintain documentation of inspection, including identification of areas of erosion, maintenance needs and repairs. All routine maintenance shall be performed and necessary repairs or stabilisation within 60 days of inspection.

1. **Responsibilities and Accountability**

The operation and maintenance of the stormwater system rests with the local authority and Stellenbosch University’s facilities’ management team. The facilities manager shall undertake an annual inspection programme of all stormwater management facilities to confirm continued performance.

The inspection shall be carried out by the body responsible for the functioning of the storm water system and monitoring will be based on the stormwater plan.

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| --- | --- | --- |
| **Title** | **Contact Person** | **Email Address** |
| Facilities Manager |  |  |

1. **Time Period**

This plan will remain in effect going forward from inception date, (insert date), and is applicable to Stellenbosch University indefinitely or until replaced by an updated version.