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Permeable Heavy Use Area for Livestock Farms

Presentation for Kitsap County DCD,
September 28th, 2006,
Lab Test Findings and Calculated
Storm Water Performance of a
Permeable HUA

Agenda

- Description of the proposed Permeable HUA surface
- Photos and documentation of lab testing
- Description and supporting calculations for application on the Hyatt Property in the Burley Area

Reasons to build a HUA

- Livestock farms have areas where animals concentrate for watering, feeding, bedding, and other purposes.

- In wet weather, livestock will tear up cover vegetation and create deep mud. During storm events, this increases storm runoff laden with fine sediments. It is also a hazard to livestock health.

Typical HUA Description

- A best management practice to eliminate these problems is to construct a livestock heavy use area.
- Typical construction is a soil separation geotextile overlaid by a 4” layer of 2.5” clean rock for bearing strength, and topped with 4” to 12” layer of 5/8”-minus rock, sand, or wood chips (hog fuel) to cushion the animal’s hooves.
- The surfacing usually includes fines, and usually cannot be considered to be permeable.

Permeable HUA

- The proposed HUA surface will be constructed like a permeable pavement, with a permeable soil separation geotextile, a 6” (min.) layer of 2.5” clean rock, and topped with a 6” (min.) layer of 5/8” clean crushed rock.

- This surface may either be sloped to allow drainage, or installed flat with an engineered discharge outlet to act as a detention pond.

Lab Testing

- The following photo series shows a lab test to determine the water volume capacity and the rainfall permeability for this proposed surface.
- The gravel used is a 2.5”-minus clean rock and 1”-minus clean rock taken directly from a local quarry’s stockpile.

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Gravel and Test Buckets marked at 6” and 12” depth

* * 0

Gravel bucket filled slightly over 6” with 2.5” rock and compacted, Water bucket filled to 6”

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Water level = 3-5/8” after filling 2.5” Gravel Bucket to 6” line - Water capacity = 39.6%

* * 0

2.5” Gravel & Water Buckets after filling Gravel Bucket with water to 6” line

* * 0

2.5” Gravel placed loose in Orange Bucket after test – Notice additional rock volume w/o compaction

* * 0

Gravel bucket filled slightly over 6” with 1”-Minus and compacted, Water bucket filled to 6”

* * 0

Water level = 3-1/2” after filling 1”-minus Gravel Bucket to 6” line – Water capacity = 41.7%

* * 0

1”-minus Gravel placed loose in Orange Bucket after test – Notice additional rock volume w/o compaction

* * 0

2.5” rock placed and compacted to slightly below 6” level

* * 0

1”-minus placed on top and compacted to slightly over 12”, water bucket filled to 12” – See note (next) -

Note on Rock Levels and Placement

2.5” gravel was placed and compacted at lower than 6”, and then 1”-minus was placed. This was to allow for the maximum effect of “chinking”, or allowing the 1”- minus to fill as much of the void space on the surface of the 2.5” material as possible.

This was done to simulate a sub-optimal construction for a conservative water volume measurement.

* * 0

Water level = 7-7/8” after filling Permeable HUA Gravel Bucket to 12” line - Water capacity = 34.4%

* * 0

2.5” & 1”-minus Gravel placed loose in Orange Bucket after test – Notice additional rock volume w/o compaction

Proposed Hyatt HUA

- Existing area measures 2295 sf, or 0.053 acres.
- Kitsap silt loam has slow permeability (0.06”-0.20”/hour), and high water holding capacity.
- Pasture is modeled as a short grass area in good condition with a class D soil (SCS Curve Number=80).
- Constructed Surface is modeled as an impermeable surface (SCS Curve Number = 98) flowing into a detention pond.

24 Hr Storm Event:	2 yr	10 yr	100 yr
Rainfall:	3.0”	4.0”	6.0”

Proposed Hyatt HUA

- Proposed HUA surface will have a minimum 6” base layer of 2.5” clean rock and a minimum 6” top layer of 1” or 5/8” clean rock.

- Site will be dug down 1.0’, graded level, and covered with permeable soil separation geotextile. This will allow it to hold water like a detention pond during rain events.

Proposed Hyatt HUA

- A native soil margin will be maintained between the HUA and the existing sub-drain running along the downstream side of the HUA.
- An engineered notch control weir will be installed to allow storm water to flow out of the HUA to the sub-drain during storm events.

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Storm Runoff Table, Before and after construction

Peak Runoff Rates	Before Construction	After Construction
2 Yr Storm:	0.06 cfs	0.14 cfs
10 Yr Storm:	0.10 cfs	0.19 cfs
100 Yr Storm:	0.19 cfs	0.29 cfs

* * 0

Storm Runoff Table, Before and After Construction

Peak Runoff Volumes	Before Construction	After Construction
2 Yr Storm:	240 cf	533 cf
10 Yr Storm:	393 cf	724 cf
100 Yr Storm:	727 cf	1109 cf

Simulation with WaterWorks

- Heavy Use Area measures 2295 sf, 1’ deep, with a water holding capacity of 34.4%
- Water holding capacity simulated using a pond with infiltration rate of 0.06”/hour and a total volume of 788 cubic feet at 1.0’ depth (V = 2295 sf x 1 ft x 34.4%)
- Control Notch Weir measures 0.4’ wide, 0.6” high, bottom elevation = 0.4’ above bottom of HUA.

Level Pool Routing Results:

Description	Match Peak	Inflow Peak	Peak Stage	Peak Outflow
HUA @ 2yr Storm	0.06 cfs	0.14 cfs	0.44’	0.02 cfs
HUA @ 10yr Storm	0.10 cfs	0.19 cfs	0.54’	0.07 cfs
HUA @ 100yr Storm	0.19 cfs	0.29 cfs	0.67’	0.17 cfs

Conclusion:

- This Permeable Heavy Use Area will satisfactorily meet Kitsap County Stormwater Criteria as an engineered detention facility.
- This Permeable HUA will perform well if maintained by collecting animal manure and removing any accumulation of fine gravels near field entrances.