**REPORT for OBJ2.TASK 2: DIFFERENTIATING FILTRATION, INFILTRATION, BIORETENTION**

To: MPCA

From: The Kestrel Design Group Team (The Kestrel Design Group Inc, with Dr. William Hunt, PE, Ryan Winston, PE, Dwayne Stenlund – Minnesota Department of Transportation, Dr. John Gulliver, PE – University of Minnesota)

Date: July 29, 2013

Re: Contract CR5332 Objective 2 Task 2

**SCOPE**

**Obj2.Task 2: Differentiating Filtration, Infiltration, Bioretention:**

1. Review literature and new research on bioretention, infiltration and filtration BMPs. Included in this is a review of case studies that differentiate infiltration, bioretention, and filtration BMPs as well as subsets of these BMPs (e.g. infiltration trenches and infiltration basins for infiltration BMPs, rain gardens with and without an underdrain for bioretention BMPs, etc.).
2. Prepare and submit a Technical memo that includes definitions, examples and graphics that differentiate filtration, bioretention and infiltration BMPs and different types of filtration, bioretention and infiltration BMPs.
3. Prepare and submit a report, including examples and graphics, containing definitions that differentiate filtration, bioretention and infiltration BMPs and different types of filtration, bioretention and infiltration BMPs.

**NEXT STEPS REQUESTED BY MIKE TROJAN 3/4/2013, AFTER FEBRUARY WORKSHOPS:**

* To complete task 2, I recommend building on the table that Barr produced in their March 11, 2011 memo.  Incorporate recommended changes from the workshop (see the workshop notes I distributed).  Submit this as a final product.
* Have you looked into the graphics portion of this task?  There are graphics in the current manual.  No need to be redundant if they are acceptable. Photos, if available, would be useful.

**MIKE TROJAN’S MEETING MINUTES FROM FEBRUARY WORKSHOPS:**

* 1. Nathalie went through definitions in draft document prepared by kestrel
	2. Question about 2 acre minimum – general agreement these systems can accommodate larger areas
	3. Restrictions may be a function of seasonal high water table (3 feet separation required in Minnesota), with or without underdrains
	4. The calculator will likely incorporate recommendations for the Manual
	5. There are no permit requirements for contributing area – just recommendations
	6. Decision – change language to “typically 5 acres or less”
	7. Rationale – there is no reason these systems cannot accommodate larger areas provided they are properly designed, constructed and maintained. A number of these systems with contributing areas greater than 5 acres have been built. As a system increases in size, pre-treatment becomes more important.
	8. In the Manual, will have BMPs identified as Infiltration Practices or Filtration practices. There may be some redundancy between sections within these two but that is acceptable. Examples of Infiltration practices include Bioinfiltration, Infiltration trench, and infiltration basin. Examples of filtration BMPs are Biofiltration, Swales, Sand filter.
	9. Keep bioretention as part of heading for bioinfiltration and filtration because people are used to the terms.
	10. Bioinfiltration vs. biofiltration: no underdrains vs. underdrains
	11. Manual will provide clear definitions for these, including a table so people can compare the different BMPs
	12. Strike maximum impervious from the definition
	13. Need to make sure we explain the difference between bioretention and infiltration systems because some infiltration systems have plants. Bio has design media, infiltration does not. Also differ in max ponding depth, where they sit in treatment train (infiltration is at the end of the train while bio can be in different locations)

**LIST OF FIGURES**

Figure 2.1: Bioinfiltration

Figure 2.2: Biofiltration with underdrain at bottom

Figure 2.3: Biofiltration with elevated underdrain

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Table 2: Types of bioretention basins

**DEFINITIONS REPORT**

**Infiltration basins** and **bioretention basins** are terrestrial-based (up-land as opposed to wetland-based), water quality and water quantity control treatment practices with a required drawdown time of 48 hours or less.  For basins within trout stream watersheds, the drawdown time is 24 hours or less due to the need to reduce discharge temperatures.

Table 1 shows how to differentiate between **infiltration basins** and **bioretention basins**.

Table 2 shows how to further differentiate **bioretention basins** into:

* Bioinfiltration basin (See Figure 2.1)
* Biofiltration basin with underdrain at bottom (See Figure 2.2)
* Biofiltration basin with elevated underdrain (See Figure 2.3)
* Biofiltration basin with internal water storage layer (IWS) (See Figure 2.4)
* Biofiltration basin with liner (See Figure 2.5)

Bioinfiltration basin

Biofiltration basin with underdrain at bottom

Infiltration Basin

Infiltration Basin

Bioretention Basin

**Table 1**

Biofiltration basin with elevated underdrain

**Table 2**

Bioretention Basin

Biofiltration basin with internal water storage

Biofiltration basin with liner

Table 1: Differences between infiltration basins and bioretention basins

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BMP** | **Typical Position in Watershed** | **Treatment Scale** | **Typical Storm Sizes**  | **Maximum Drainage Area Guidelines\*** | **Maximum Ponding Depth Guidelines\*** | **Growing Medium\*** |
| Infiltration Basin | Typically downgradient of other water quantity and water quality control practices | Development or regional scale control | Less frequent large storm events that exceed the capacity of upgradient practices | 50 acres | 4 feet | Native soil |
| Bioretention Basin | Located throughout watershed | Site scale control | Small storms(water quality events) | Typically 5 acres | Ideally 12”, can be up to 18” with appropriate design and plant selection | Engineered growing medium  |

\* See Task 8 for more detailed guidance regarding maximum drainage area, maximum depth, and growing medium (hyperlink).

Table 2: Types of bioretention basins

|  |  |  |  |
| --- | --- | --- | --- |
| **BMP**  | **Typical Uses; Advantages (see 2008 manual performance types for more detail)** | **Relative amount of runoff abstracted from storm sewer system**  | **2008 manual terminology** |
| Bioinfiltration basin  | Abstracts all runoff captured in the basin that does not leave through overflow | **All** runoff that flows into the basin and does not overflow into an overflow structure is abstracted from the stormsewer system through infiltration or evapotranspiration. | Infiltration / recharge facility |
| Biofiltration basin with underdrain at bottom  | Allows for a small amount of infiltration, at a rate compatible with underlying soils, but carries away excess waterthrough the underdrain after it has been filtered through the basin | **A small amount** of therunoff that flows into the basin and does not overflow into an overflow structure is abstracted from the stormsewer system through infiltration or evapotranspiration; the remainder is filtered by the growing medium but then leaves via an underdrain. | Filtration/Partial recharge |
| Biofiltration basin with internal water storage (IWS) | Allows for more infiltration, at a rate compatible with underlying soils, but carries away excess water through the underdrain after it has been filtered through the basin; Internal Water Storage Zone (IWS) (1) allows for more infiltration and evaporation compared to bioretention with underdrain at the bottom; (2) improves **thermal pollution abatement** and **nitrogen removal** (longer retention time allows runoff to cool more before discharge and allows denitrification to occur under anoxic condition). | **More** of therunoff that flows into the basin and does not overflow into an overflow structure is abstracted from the stormsewer system through infiltration or evapotranspiration compared to bioretention with an underdrain at the bottom of the basin without an upturned elbow, because the upturned elbow increases hydraulic retention time; the remainder is filtered by the growing medium but then leaves via an underdrain with an upturned elbow.  | Not included |
| **BMP**  | **Typical Uses; Advantages (see 2008 manual performance types for more detail)** | **Relative amount of runoff abstracted from storm sewer system**  | **2008 manual terminology** |
| Biofiltration basin with elevated underdrain | Allows for more infiltration, at a rate compatible with underlying soils, but carries away excess water through the underdrain after it has been filtered through the basin; elevating underdrain (1) allows for more infiltration and evaporation compared to bioretention with underdrain at the bottom (2) improves **thermal pollution abatement** and **nitrogen removal** (longer retention time allows runoff to cool more before discharge and allows denitrification to occur under anoxic condition). | **More** of therunoff that flows into the basin and does not overflow into an overflow structure is abstracted from the stormsewer system through infiltration or evapotranspiration compared to bioretention with an underdrain at the bottom of the basin, because the elevated underdrain increases hydraulic retention time; the remainder is filtered by the growing medium but then leaves via an elevated underdrain. | Infiltration/filtration/ recharge |
| Biofiltration basin with liner | Impervious liner reduces or eliminates possibility of groundwater contamination; underdrain can be blocked and objectionable materials siphoned through an observation well and safely contained; often used in areas of potential stormwater “hot-spots” (e.g., gas stations, transfer sites, transportation depots,industrial complexes etc.), or areas where groundwater recharge is undesirable | **None** of the runoff that flows into the basin is abstracted from the stormsewer system through infiltration but some is abstracted through evapotranspiration; i.e. allof therunoff that flows into the basin without flowing into an overflow structure, and is not evapotranspired, is filtered by the growing medium but then leaves via an underdrain. | Filtration only |

**Other Terminology options:**

Bioretention Basin Types:

* Bioinfiltration Basin
* Biofiltration Basin with limited infiltration: underdrain at bottom
* Biofiltration Basin with limited infiltration: elevated underdrain
* Biofiltration Basin with limited infiltration: internal water storage layer (IWS)
* Biofiltration Basin with liner

OR:

The option below highlights the fact that all bioretention basins (except with liner) have some infiltration and some filtration:

* Bioretention basin without underdrain
* Bioretention basin with underdrain at bottom
* Bioretention basin with elevated underdrain
* Bioretention basin with internal water storage
* Bioretention basin with liner

OR

The option below calls all bioretention basins (including the one without an underdrain) biofiltration basins, to highlight that the bioretention basins all infiltrate less volume than infiltration basins:

Bioretention Basin Types:

* Biofiltration Basin without underdrain
* Biofiltration Basin with underdrain at bottom
* Biofiltration Basin with elevated underdrain
* Biofiltration Basin with internal water storage layer (IWS)
* Biofiltration Basin with liner