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# **2012 Post Construction Monitoring Report King County Multiple Stormwater Facility Retrofits**

**DOE Stormwater Retrofit Grant  
Grant Agreement Number G1100216**

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## **Introduction**

King County received a grant from the State of Washington Department of Ecology to retrofit stormwater facilities owned and operated by King County. These retrofit projects address identified facility performance deficiencies. These facilities include a mix of stormwater detention and treatment facilities, nearly all of which were constructed by past subdivision development projects to mitigate the flow and water quality impacts of land development.

King County constructed fifteen stormwater facility retrofit projects in 2011. These facilities have gone through one wet season of operation. This report includes the photographs and summary of field check of each retrofit site to evaluate the success of the retrofit improvement. The field checks also note any continuing physical defects and recommend corrective action. The summary of field checks and photographs for each facility are shown below in order of wet biofiltration swales (bioswales), then basic bioswales, then non-bioswale improvements.

## **Wet Biofiltration Swales (bioswale)**

Five of the retrofit projects are wet biofiltration swales (bioswales), planted with wet tolerant plant species per Table 6.3.2.A, page 6-57, of the 2009 King County Surface Water Design Manual. The projects monitoring reports are shown below.

### **Woodbrook D92670**

The Woodbrook D92670 project was field checked by Cody Toal, Environmental Scientist, on June 13, 2012. The project is located on King County Parcel Number 9510930600, at the 28200 block of 55<sup>th</sup> Avenue S, Auburn, WA. The project constructed a new gravel access driveway for the bioswale, constructed a new emergency overflow spillway, improved the berm between the bioswale and the road with low permeable soil, and regraded and replanted the bioswale with wet tolerant species.

This bioswale was planted with a total of 4006 emergent plugs including 6 different species. Plant survival is over 85%. In the first two cells closest to inlet, survival and cover is close to 100%. In the 3<sup>rd</sup> and 4<sup>th</sup> cells, survival and cover is not quite as high. The outside of the bends are drier and not as many plants have survived. The plants that have survived in the drier areas have not spread as rapidly. Due to slight imperfections in grading the water tends to hug the inner part of the bends. A few small rivulets have formed channeling the water. These could be fixed with a few yards of compost and the planting of approximately 100 additional emergent plugs. Some clover has moved in and become established in the lower cells. Both inlet and outlet are clear.

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Woodbrook Upper Cells



Woodbrook Middle Cells with Clover





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Woodbrook Channelization



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## Woodlands D92432

The Woodlands D92432 project was field checked by Cody Toal, Environmental Scientist, on June 13, 2012. The project is located on King County Parcel Number 11250691, at the 25800 block of NE 70<sup>th</sup> Street Redmond, WA. The project regraded a bioswale, installed an energy dissipater at the bioswale inlet, and installed a level flow spreader at the bioswale outfall.

This bioswale was planted with a total of 1250 emergent plugs including 5 different species. Plant survival is over 90% and cover is very good in most areas. A few areas have a small channel path moving through it. These could be fixed by planting approximately 100 additional emergent plugs to fill the channel or it just may fill in on its own. No additional compost would be needed in the supplemental planting. Both inlet and outlet are clear.

### Woodlands Bioswale





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Woodlands Channel Path



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**Swan Lake Estates Bioswale 1 D92637**

The Swan Lake Estates Bioswale 1 D92637 project was field checked by Cody Toal, Environmental Scientist, on June 13, 2012. The project is located at 23925 NE 69<sup>th</sup> Place Redmond, WA. The project converted an existing bioswale into a wet bioswale.

This bioswale was planted with a total of 765 emergent plugs including 3 different species. This swale is very shady and it is hard to find species that can tolerate almost 100% shade. Plant survival is over 85% but cover is significantly less than that due to a low rate of growth in the plants. The mannagrass appears to have outperformed the Scirpus and Carex. A few small rivulets have formed but not much water is moving through them due to very low flow in the swale. Cover could be increased by planting approximately 300 additional emergent plugs to fill the channel or it may just slowly fill in on its own. Increased cover will take some time due to shady conditions. No additional compost would be needed in the supplemental planting. Both inlet and outlet are clear.

Swan Lake Estates Bioswale 1 Vegetation





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**Swan Lake Estates Bioswale 2 D92623**

The Swan Lake Estates Bioswale 2 D92623 project was field checked by Cody Toal, Environmental Scientist, on June 13, 2012. The project is located at 6423 240<sup>th</sup> Way NE Redmond, WA. The project converted an existing bioswale into a wet bioswale.

This bioswale was planted with a total of 650 emergent plugs including 4 different species. This swale is very sunny. Plant survival and cover is close to 100%. No rivulets formed and water is ponded or very low flow in the swale. No supplemental planting needed. Some watercress has mixed in with the native plants in the swale and there is blackberry, grasses, Salmonberry and other weeds growing around the perimeter that will need to be maintained. Both inlet and outlet are clear.

Swan Lake Estates Bioswale 2





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## **Willowbrook D92342**

The Willowbrook D92342 project was field checked by Cody Toal, Environmental Scientist, on June 13, 2012. The project is located at 6423 240<sup>th</sup> Way NE Redmond, WA. The project converted an existing bioswale into a wet bioswale.

This bioswale was planted with a total of 765 emergent plugs including 5 different species. This swale is in almost full sun. Plant survival and cover is close to 85%. Swale was recently maintained so it is hard to tell exactly how some of the native species are performing. Some watercress and exotic grasses have mixed in with the native plants. Swale appears to be functioning normally. No channelization is occurring and water is at a very low flow in the swale. No supplemental planting needed. Both inlet and outlet are clear.

### **Willowbrook Bioswale**





## Basic Biofiltration Swales (bioswale)

Six of the retrofit projects are basic biofiltration swales (bioswales), planted with grass seed mix suitable for bioswales per Table 6.3.2.1.C, page 6-48 of the 2009 King County Surface Water Design Manual. The projects monitoring reports are shown below.

### Forest Hills Estates D92062

The Forest Hills Estates D92062 project was field checked by Chris Gallagher, Engineer, on October 16, 2012. The project is located on King County parcel 2595650760, the 5200 block of South 279<sup>th</sup> Street Auburn, WA. The project regraded a bioswale, and installed an energy dissipater at the bioswale inlet.

This bioswale was reseeded with bioswale grass seed mixture per Table 6.3.1.C of the 2009 King County Surface Water Design Manual. The bioswale is horseshoe shaped. It appears that a majority of the grass has survived. There were no visible spots where the plastic liner was exposed. There does not appear to be any channelization occurring in the bioswale. Some standing water is present in the bioswale due to the bioswale's shallow slope and accumulated grass clippings. The standing water occurs near the bend in the bioswale. All three inlets and the outlet are clear.

Forest Hills Estates Bioswale – Looking from inlet towards bend.





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Forest Hills Estates Bioswale – Standing water near bend in bioswale.



Forest Hills Estates Bioswale – Looking from bend towards outlet.





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**Webster Lake Estates Tract I D92339**

The Webster Lake Estates Tract I D92339 project was field checked by Eric Bosserman, Engineer, on October 16, 2012. The project is located on King County parcel 9206700300, 18100 244<sup>th</sup> Ave SE Maple Valley, WA. The project regraded a bioswale, and removed rock check dams to correct standing water issues.

The bioswale was planted with bioswale grass seed mixture per Table 6.3.1.C of the 2009 King County Surface Water Design Manual. Plant survival is over 95%. Due to imperfections in the grading water slight pools or goes dry in places. Both inlet and outlet are clear. No modifications or maintenance required.

Webster Lake Estates Tract I



Vigorous growth can be seen throughout bioswale.



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Webster Lake Estates Tract I



Outlet and inlet are clear.



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### **Webster Lake Estates Tract G D92336**

The Webster Lake Estates Tract G D92336 project was field checked by Eric Bosserman, Engineer, on October 16, 2012. The project is located on King County parcel 9206700280, 18399 244<sup>th</sup> Ave SE Maple Valley, WA. The project regraded a bioswale, installed a level flow spreader at the inlet to the bioswale, installed a flow divider down the center of the bioswale, moved the bioswale outlet pipe to increase the length of the bioswale, and installed an emergency spillway from the bioswale into the detention pond.

The bioswale was planted with bioswale grass seed mixture per Table 6.3.1.C of the 2009 King County Surface Water Design Manual. Plant survival is over 65%. In the middle third of the bioswale the survival rate and coverage is close to 80%. In the first and last fifths of the bioswale grass survival and cover is less than 10%. The end of the bioswale is under up to four inches of water partial due to a reverse slope in the outlet pipe discovered during construction and some settling of the soils. Due to slight imperfections in the grading water pools or goes dry in places. These could be fixed with a few yards of soil and the planting of similar grass. Both inlet and outlet are clear.

#### **Webster Lake Estates Tract G**



The flow spreader and the flow divider both appear to be functioning as designed. More trimming may be warranted here.



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Webster Lake Estates Tract G middle with small pools



Webster Lake Estates Tract G last fifth with four inches of standing water



As a maintenance item soil should be used to fill this area up to outlet pipe and re-planted



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Webster Lake Estates Tract G



Webster Lake Estates Tract G.



A new overflow was built into the access road to keep a bioswale overflow within the facility.



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Webster Lake Estates Tract G



The emergency bioswale overflow has not been utilized but appears to be in good shape.

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Webster Lake Estates Tract G.



The first 15' of tree branches on conifers were removed. Additional sun on grass can be seen in previous photos.



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### Canterbury South D92453

The Canterbury South D92453 project was field checked by Alex Jones, Engineer, on October 4, 2012. The project is located on King County Parcel number 1330850150 at the southeast corner of NE 39<sup>th</sup> Way and 224<sup>th</sup> Ave NE intersection Redmond, WA. The project installed a low permeability soil in the presettling pond, regraded the existing bioswale, and installed a level flow spreader at the inlet to the bioswale.

The bioswale was regraded and reseeded with a grass seed mix in Table 6.3.1.C of the 2009 King County Surface Water Design Manual. Plant survival is over 80%. The first half of the swale shows close to a 100% survival rate for bioswale grass and coverage. The final half shows bioswale grass survival and cover of about 70%. No rills or eroded channels were observed in the graded swale channel bottom. It is expected that the swale grass in the final half of the cell will fill in as precipitation increases and the swale experiences more flow. No further action is recommended.

Canterbury South first half of swale. The swale grass cover is very good and close to 100% survival.





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Canterbury South last half of swale.



Canterbury South newly-installed flow spreader between the presettling cell and the swale channel.





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The presettling cell area was modified by replacing the soils in bottom and sidewalls with low-permeability material. Site visits throughout the year indicated that this appeared effective in retaining water. Overflow over the new flow spreader into the swale channel has not been observed since completing the retrofit. The presettling cell is overgrown with vegetation and the inlet pipe invert is slightly below ground surface. This could be fixed by clearing the vegetation out of the cell and removing a small amount of material from the area of the pipe inlet during standard maintenance activity.

Canterbury South overgrown presettling cell looking toward the inlet pipe. The vegetation and invert clearing can be addressed during standard facility maintenance.



Canterbury South view of the overgrown presettling cell from the inlet pipe looking toward the beginning of the swale.



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### **Tuscany Tract B D91824**

The Tuscany Tract B D91824 project was field checked by Scott Miller, Engineer, on June 22, 2012. The project is located on King County Parcel number 7701990780 adjacent to 12217 198<sup>th</sup> Ave NE Woodinville, WA. The project regraded a bioswale and installed flow spreaders.

A bioswale seed mix was planted to complete the construction. Grass grew in 2011, and the performance of the bioswale was good. Through the winter, however, watercress became the dominant plant. The watercress has grown between flow spreader notches, concentrating flow more in some places than in others.

This bioswale can be replanted. It appears to be wet enough to plant with wet bioswale plants, despite having a steeper grade than what is specified in the 2009 King County Surface Water Design Manual.



Tuscany Tract B Upstream end of bioswale, looking downstream.



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Tuscany Tract B Middle section of bioswale, looking upstream.



Tuscany Tract B Downstream end of bioswale, looking downstream.



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Tuscany Tract B Detail of flow spreader notch, watercress pulled back.



### **Swan Lake Estates #3, D92636**

The Swan Lake Estates #3 project was field checked by Chris Gallagher, Engineer, on November 26, 2012. The project is located at 6414 238<sup>th</sup> Avenue Northeast, Redmond, WA. The project removed existing vegetation and sediment in the bioswale and reseeded with bioswale grass seed mixture per Table 6.3.1.C of the 2009 King County Stormwater Design Manual. The bioswale is straight. It appears that a majority of the grass has survived. There does not appear to be any channelization occurring in the bioswale. Some standing water is present in the bioswale due to the bioswale's shallow slope. The inlet and outlets are clear. No modifications or maintenance required.



## Non Biofiltration Swale Improvements

Four of the retrofit projects are not biofiltration swale improvements. The projects monitoring reports are shown below.

### Sunrise Ridge D90926

The Sunrise Ridge D90926 project was field checked by Eric Bosserman, Engineer, on October 10, 2012. The project is located on King County parcel 8123550270, 12417 169<sup>th</sup> Ave NE Redmond, WA. The project replaced a 12-inch diameter corrugated metal pipe with a 24-inch corrugated polyethylene pipe and replaced a lid on the last downstream catch basin with a bird cage style debris barrier.

Sunrise Ridge



Vigorous growth can be seen across site, emergency overflow has not yet been utilized.





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**Park Avenue D92106**

The Park Avenue D92106 project was field checked by Lica Dulan, Engineer, on October 24, 2012. The project is located on at 13410 179<sup>th</sup> Ave NE Redmond, WA. The project raised the spill way and berm elevation of the detention pond to maximize the design storage.

The spillway was built in accordance with the design plans, 0.5 FT depth and 6:1 side slopes and appears to be in good condition (see Picture 1).

The berm has been raised to the designed elevation, leveled with 1-2" of topsoil and planted with grass. It appears to be in good condition, with no signs of erosion and 100% covered with grass (see Picture 2).

No significant storm event has occurred since this facility has been retrofitted. No further actions are recommended.

Park Avenue Picture 1: Post Construction Spillway





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Park Avenue Picture 2: Post Construction Berm



Park Avenue Picture 3: Pond Outlet





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**Reintree D90709**

The Reintree D90709 project was field checked by Alex Jones, Engineer, on October 4, 2012. The project is located at the 19400 block of NE 202<sup>nd</sup> Place Woodinville, WA. The project installed a rolled asphalt berm around the catch basin lid, added erosion protection and energy dissipation at the outfall from the catch basin, and improved the downstream system to accommodate overflow from the high surface flows that bypass the D90709 pond.

These modifications were intended to reduce the risk of road overflows into a ravine and causing erosion that could impact Paradise Lake. Both the berm and emergency overflow area were in good condition. There was minimal sediment collection and it did not appear that the structure had experienced overflows since the retrofit was performed. No further actions are recommended.

Reintree - Inlet structure with low-profile berm directing emergency overflows to the roadside ditch system.



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Reintree - Area of previously-reported overflows across the road into a ravine. No recent evidence of overflows.



Reintree - Erosion protection at emergency overflow area.





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**Quail Creek No. 2 and 3 D92446**

The Quail Creek No. 2 and 3 D92446 project was field checked by Scott Miller, Engineer, on June 15, 2012. The project is located on King County Parcel number 6979910150 across the street from 27910 NE 18<sup>th</sup> Court Redmond, WA. The project converted a detention pond to a combination detention / wet pond.

Upon post construction inspection, the dead storage was ponded with low or no flow into it. There was algal growth in the pond, which may have been caused by phosphorous, newly exposed by excavation. This nutrient source may be depleted over time. No further actions are recommended.



Quail Creek No. 2 and 3 View of tail end of pond from south.



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Quail Creek No. 2 and 3 View of middle section of pond, where filter berm was removed, from south.



Quail Creek No. 2 and 3 View of head end of pond, from southwest.



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## Summary

King County constructed fifteen stormwater facility retrofit projects in 2011. Overall, the retrofit facilities are functioning well. All of the facilities had clear inlets and outlet pipes.

Five of the retrofit projects are wet biofiltration swales (bioswales), planted with wet tolerant plant species per Table 6.3.2.A, page 6-48 of the 2009 King County Surface Water Design Manual. Three of the wet bioswales (Woodbrook D92670, Woodlands D92432, and Swan Lake Estates Bioswale 1 D92637) recommended more planting to cover areas where small rivulets have formed channeling the water. Woodbrook D92670 plant survival rate was 97.5%. Woodlands D92432 plant survival rates was over 90%. Swan Lake Estates Bioswale 1 D92637 plant survival rate was 85%. Two of the wet bioswales (Swan Lake Estates Bioswale 2 D92623 and Willowbrook D92342) recommended no further action because the plant survival and cover is close to 100%.

Six of the retrofit projects are basic bioswales, planted with grass seed mix per Table 6.3.1C, page 6-57 of the 2009 King County Surface Water Design Manual. Four of the basic bioswales (Forest Hills Estates D92062, Webster Lake Estates Tract I D92339, Canterbury South D92453, and Swan Lake #3 D92636) recommended no further action because the plant survival and cover is close to 100%. Webster Lake Estates Tract G D92336 Plant survival is over 65%. Due to slight imperfections in the grading water pools or goes dry in places. These could be fixed with a few yards of soil and the planting of similar grass. Tuscany Tract B D91824 appears to be wet enough to plant with wet bioswale plants, despite having a steeper grade than what is specified in the 2009 King County Surface Water Design Manual.

Four of the retrofit projects were not a bioswale improvement (Sunrise Ridge D90926, Park Avenue D92106, Reintree D90709, and Quail Creek No. 2 and 3 D92446). These projects are functioning well and no further action is recommended.