



*The Bear Creek Parkway &
161st Avenue NE Improvement Project
Phase 1*

Final Drainage Report



June 2008

KPG

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1. Project Overview

The Bear Creek Parkway & 161st Avenue NE Roadway Improvements Project - Phase I (BC Parkway Project) proposes roadway improvements for Bear Creek Parkway (BCP) from NE Redmond Way and 159th Place NE, on the west, to 160 ft south of the NE 74th Street intersection along the existing BCP. The improvements include a new alignment that goes through the Leary Way shop site and avoids the site previously known as the heron rookery, connecting Redmond Way NE to Leary Way and the existing BCP. Improvements to 161st Avenue NE are isolated to the new intersection with Bear Creek Parkway within the Leary Way Shop site.

The basin areas for this project are based on City of Redmond (City) GIS Watershed boundaries with minor adjustments. Basins were adjusted per the proposed storm drainage routing, field review and review of record drawings. The basin areas for both the roadway limits and the contributing watershed are shown on the Proposed Basin Map, included in Appendix A.

The Soil Survey of King County shows the soils within the project limits as predominately Everett gravelly sandy loam. The Soil Survey is included in Appendix B. This type of soil is classified as having a Hydrologic Soil Group Type A with low runoff potential and high infiltration rates. A small portion of the project, at the northern and southern boundaries, is shown as Earlmont Silt loam which is listed as Type C soil with moderately high runoff potential and slow infiltration rates.

This project was analyzed as a single threshold discharge area per the City Technical Notebook 2007 requirements. Based on a single project area the proposed roadway improvements add greater than 5000 square feet of New Impervious Area, thus requiring evaluation of all Stormwater Management Minimum Requirements. Per the Technical Notebook, discharge into the Sammamish River does not require flow control. The project is creating more than 5000 square feet of new Pollution Generating Impervious Surface area requiring water quality treatment facilities which will meet the Enhanced Treatment level goals based on projected traffic use along BCP.

A regional treatment vault system has been constructed for Basin A to handle the drainage areas for this project and a regional Stormwater Treatment Wetland (STW) is proposed for Basin B. The Basin A regional treatment system has been constructed under separate contract, prior to the completion of the BC Parkway Project to provide a treatment connection for an adjacent private development. The proposed STW facility for Basin B will provide treatment for the entire basin area contributing to this outfall. No proposed water quality facility will be constructed in Basin C or D, which only have minor improvements and are outfalling to current or future water quality treatment facilities. The roadway project area in Basin C will continue to drain to the existing wetvault and the project area within Basin D will be addressed by a proposed regional facility for the entire 209 acre basin being analyzed separately by the City.

2. Existing Condition Summary

This project is located within the City Center Drainage Basin per the City of Redmond Stormwater System Map, dated April 2005. Within the City Center Basin, the project extends through four City Watersheds, numbers 500, 510, 540 and 550 per the City of Redmond GIS Watershed Map, dated April 2005.

The area within the BC Parkway Project areas previously discharged through three existing outfall pipes at separate locations into the Sammamish River. Basin A and D previously outfalled through a single 30-inch pipe along the north side of NE Redmond Way at the Sammamish River crossing. Basin A has been rerouted to a previously abandoned outfall at the south side of the NE Redmond Way bridge as part of recently constructed McRedmond Regional Water Quality Project, but the remaining basin discharge locations will remain unchanged. For Basin B, runoff drained through the existing Leary Way Bioswale Facility before discharging into the Sammamish River near the Leary Way Bridge. The runoff from the BC Parkway Project improvements within Basin C outfall through an existing 54-inch pipe adjacent to the Redmond Town Center private ponds, directly south of the Basin B outfall.

The project basins generally match the City of Redmond Watershed areas. The project basin boundaries were adjusted from the Watershed boundary locations based on new survey data, record drawing information and the proposed drainage system layout for the BC Parkway Project. The City Watershed areas show the entire railroad right-of-way draining towards Basin B and the NE Redmond Way system. However the railroad track appears to be the basin boundary with the north portion of the right-of-way draining into Basin D. The surveyed high points of streets and drainage ditches were also used to adjust the basin boundaries.

Most of the existing roads within the project area have piped conveyance systems. The adjacent properties to the proposed roadway improvements are mostly developed commercial sites, except within Basin B which has significant open space areas. The forested area in Basin B, previously identified as a heron rookery, is lower in elevation than the surrounding roads and appears to be an isolated low-point which does not contribute overland flow to the roadway conveyance systems, but infiltrates most of the rainfall. The soils in this area are classified as Type A Hydrologic Soils with high infiltration rates. For these reasons, this heron rookery area is not included in the Basin B hydrologic and hydraulic analysis.

The sensitive areas adjacent to this project include the City Wellhead Projection Zones, a potential heron rookery open space, and the Sammamish River. The majority of this project is within Wellhead Protection Zone 3 with a small area on the fringe in Zone 2, as shown on the Wellhead Sensitive Area Map included in Appendix B. The forested area, south of the proposed BCP extension between 159th Place NE and Leary Way, was identified as a heron rookery for great blue herons per the heron monitoring report by Norman Wildlife Consulting completed early 2006. However, herons apparently have not returned to the nest area for the past several years. The Sammamish River buffer is

classified as a shoreline protected area by the City. In the Stream Classification Critical Areas Map, dated August 2005, the Sammamish River is shown as a Class I stream with riparian habitats of local importance.

3. Offsite Analysis

For the offsite analysis, a qualitative level evaluation was performed. There are no landslide hazard areas identified within the project limits. The three existing project outfall locations and the previously abandoned outfall location into the Sammamish River were reviewed in the field and are summarized below with findings for each basin.

Basin A

The outfall from Basin A, until the complete of the McRedmond Regional Water Quality Project, connected to the existing NE Redmond Way drainage system, Basin D, which has been identified by the City as having inadequate capacity during large storm events. The McRedmond Regional Water Quality Treatment Vault system, construction in 2007, connects Basin A to the existing previously abandoned outfall along the south side of NE Redmond Way. The storm pipe connecting Basin A to this abandoned outfall was apparently plugged many years ago during the construction of the NE Redmond Way bridge. Local drainage from the City park and trail, adjacent to the river, remained connected to the outfall downstream of the blockage. The outfall into the river was reconnected with the new conveyance system through the McRedmond Landing Park.

Basin B

Drainage from Basin B uses the existing outfall from the Leary Way Bioswale into the Sammamish River. The 15-inch concrete pipe from the existing Bioswale facility has a concrete headwall and riprap protection at the river's edge, which appears to be in stable condition. The existing 12-inch pipe along Leary Way was evaluated for adequate capacity using XP-STORM, a proprietary computer model interface of the Environmental Protection Agency's Stormwater Management Model (SWMM), with the output results included in Appendix A.

Basin C

The project area within this basin drains to the existing 54-inch storm drainage pipe from the Redmond Town Center properties. Runoff from the project within this Basin will continue to drain to the existing Wetvault prior to outfalling through the existing 54-inch pipe. There are no known capacity problems with this outfall pipe. The outfall at the Sammamish River is controlled by a flap gate with a concrete headwall and riprap protection which did not appear to have any maintenance issues.

Basin D

Drainage from Basin D connects to the Sammamish River at the north side of the Redmond Way Bridge. Basin A previously connected to this same outfall, but has been routed to the previously abandoned outfall on the south side of the bridge during the

construction the McRedmond Regional Water Quality Project in the summer of 2007. The existing Basin D outfall has been identified by the City as having flow capacity issues during the large storm events. The City is evaluating capacity improvement options for this system, such as slip-lining or pipe replacement, separate from this project.

4. Permanent Stormwater Control Plan

4.1. Existing Site Hydrology

The project basins, A through D, generally match the City of Redmond Watershed Map dated April 2005. The basin boundaries were adjusted from the Watershed boundary locations based on new survey data, review of record drawings and the proposed drainage layout for the BC Parkway Project. The Soil Survey of King County Report, issued November 1973 by the Soil Conservation Service, shows the soils within the BC Parkway Project as predominately Everett gravelly sandy loam. This type of soil is classified as Type A Hydrologic Soils with low runoff potential and high infiltration rates. A small portion of the project, at the northern and southern boundaries, is shown as Earlmont Silt loam which is listed as Type C soil with moderately high runoff potential and slow infiltration rates. The Soil Survey Map of the project vicinity is included in Appendix B.

The area within the BC Parkway Project previously discharged through three existing outfall pipes at separate locations in the Sammamish River. Basin A and D previously both outfalled through a single 30-inch pipe along the north side of NE Redmond Way, at the Sammamish River crossing. With the construction the McRedmond Regional Water Quality Project in the summer of 2007, Basin A has been rerouted to a separate outfall on the south side of the NE Redmond Way bridge which was previously been abandoned, except for local park drainage connections along the river front trail. Runoff from Basin B drains through the existing Leary Way Bioswale Facility before discharging into the Sammamish River near the Leary Way Bridge. The runoff from the BC Parkway Project improvements within Basin C outfalls through an existing 54-inch pipe near the Redmond Town Center private ponds, directly south of the Basin B outfall.

The proposed BCP extension will connect the roadway between Leary Way and 159th Place through the abandoned Leary Way shop site, which has recently been demolished. A separate environmental cleanup project was undertaken by the City for this shop site. The environmental cleanup project was completed in 2007.

Per the City Technical Notebook, the pre-developed conditions for this area along the valley floor are modeled as pasture cover. However, since Flow Control is not required the existing flows and durations were not analyzed. The existing impervious and pervious areas have been evaluated within the proposed roadway right-of-way limits to provide a comparison between the existing and proposed conditions and evaluate the Water Quality treatment requirements.

Existing Conditions within the Proposed Roadway Limits						
Drainage Basin	Total Area in ROW		Impervious Area		Pervious Area	
	(sf)	(acre)	(sf)	(acre)	(sf)	(acre)
Ap	88,900	2.04	61,600	1.41	27,300	0.63
Bp	202,700	4.65	148,100	3.40	54,600	1.25
Cp	52,200	1.20	36,100	0.83	16,100	0.37
Dp	49,100	1.13	42,500	0.98	6,600	0.15
Project Total	392,900	9.02	288,300	6.62	104,600	2.40

4.2. Developed Site Hydrology

The developed site hydrology is similar to the existing conditions, which are mostly impervious commercial and roadway areas. Only Basin B has a significant amount of open space. Most of area for the proposed roadway extensions is over existing, highly impervious, commercial properties with some existing landscaped areas. There are also several existing impervious areas that are proposed to be re-landscaped with this project. Since Flow Control is not required, the runoff flow durations and discharge rates were not evaluated for the pre-developed conditions. The discharge rates of the Developed Conditions were calculated for pipe capacity design. The overall proposed roadway improvements will increase the impervious area by approximately 20,100 sf (0.46acres), including converted gravel areas; see the Drainage Area Summary in Appendix A.

For the proposed site hydrology, the portion of the Leary Way Shops site north of the proposed BCP is modeled as commercial property with 85% impervious area per the City of Redmond Neighborhood Zoning for commercial land use designation in City Code 20C.50.25-020. The Leary Way Shop site south of the BCP is included as landscaped area with pedestrian sidewalks per the proposed plaza and open space improvements with this project. The existing commercial properties within the basins were analyzed with a 91% impervious land cover per estimates based on the existing sites from survey data and aerial photography evaluation.

Proposed Conditions within the Proposed Roadway Limits						
Drainage Basin	Total Area in ROW		Impervious Area		Pervious Area	
	(sf)	(acre)	(sf)	(acre)	(sf)	(acre)
Ap	88,900	2.04	69,800	1.60	19,100	0.44
Bp	202,700	4.65	149,000	3.42	53,700	1.23
Cp	52,200	1.20	35,700	0.82	16,500	0.38
Dp	49,100	1.13	45,900	1.05	3,200	0.07
Project Total	392,900	9.02	300,400	6.90	92,500	2.12

Basin A

Basin A has 17.03 acres within the City Watershed #540 and includes mostly commercial and industrial areas under existing conditions. This basin includes the area of the Luke McRedmond Park adjacent to the Sammamish River which is downstream of the BC Parkway Project drainage system. With the reconnection to the abandoned outfall, on the south side of the Redmond Way Bridge, the Luke McRedmond Park drainage has been connected to the new conveyance system recently installed under the separate McRedmond Regional Water Quality Treatment Project contract. The basin boundary has been adjusted near the intersection of 159th Place NE and NE Redmond Way to differentiate the area draining to the reconnected outfall on the south side of the Redmond Way Bridge from the flow that continues to the outfall on the north side. 15.01 acres, from Basin A, flows to the McRedmond Water Quality facility and the remaining basin area connects downstream of the facility. Within this basin, the proposed BC Parkway Project extends along the existing 159th Place NE roadway from the junction with NE Redmond Way to the location where 159th Place NE bends south towards Leary Way. From this roadway bend, the proposed Bear Creek Parkway roadway continues east through existing commercial sites and into the recently demolished Leary Way shop site. The area within the proposed project improvements limits, Basin Ap, is 2.04 acres with 1.60 acres of impervious and 0.44 acres of landscaped area.

Basin B

Basin B, with 17.60 acres, generally matches the City Watershed #510. The Basin boundaries were adjusted along the north side of the basin to follow the center of the existing railroad track adjacent to the Leary Way Shops site and adjusted along the river to include only the area draining to the existing stormwater outfall. In addition, the proposed Bear Creek Parkway drainage system has been designed to direct new roadway runoff from most of the abandoned Leary Way shop site to the proposed Stormwater Treatment Wetland (STW) within this basin. Most of Leary Way shop site previously drained to Basin A. A STW is less expensive to build and maintain than the underground vault facility proposed for Basin A. A STW requires more land area dedicated to the treatment facility, but the STW be constructed on the footprint of the Biofiltration facility with additional area from the Redmond Town Center open space. The City has requested the existing Bioswale be replacement with a new treatment facility due to concerns about the ineffectiveness of this facility.

Basin B contains a large forested area in the center of the basin, with 4.49 acres, previously identified as a heron rookery. The forested area is not included in the runoff treatment facility, sized for 13.11 acres, because it appears to be an isolated low area and protected from future development. This forested area is on Type A soils which has high infiltration and low runoff potential. The 13.11 acres within Basin B drain south along Leary Way and 159th Place towards the existing Bioswale facility on the southeast side of the Leary Way Bridge. The contributing area from the proposed project improvements, Basin Bp, is 4.65 acres with 3.42 acres of impervious and 1.23 acres of landscaped area.

Basin C

Basin C is within the City Watershed #500 which has approximately 106 acres. The majority of area in Basin C is associated with the existing Redmond Town Center Commercial areas where the runoff is directed into a series of three existing stormwater ponds. The level of treatment provided by these three ponds and the design standards implemented by these facilities was not investigated by this project because the proposed project area does not drain to these existing facilities. The majority of the existing Bear Creek Parkway, south of the Redmond Town Center and outside of the BC Parkway Project limits drains to existing infiltration ponds along Bear Creek.

The BC Parkway Project proposes shifting the intersection of BCP at Leary Way north to avoid the forested parcel previously identified as a heron rookery. The Bear Creek Parkway existing impervious area at the previous intersection location will be converted to landscaped area. With the proposed conveyance system, a portion of the Bear Creek Parkway southeast of the Leary Way intersection is redirected from Basin C to the proposed STW facility within Basin B. By redirecting the runoff to Basin B a shorter length of new conveyance pipe is required within Basin C and an additional area of approximately 0.34 acres, southeast of the intersection along BCP, will be treated within the Leary Way STW. The remaining new roadway area within Basin C, designated as Basin Cp, will continue to flow south along BCP through the existing Wetvault and to the existing 54" stormwater pipe outfall. Proposed Basin Cp contains 1.20 acres with 0.82 acres of impervious area and 0.38 acres of landscaped area. Due to the proposed landscaping improvements at the relocated intersection and the redirection of flow to Basin B, Basin C has a net decrease in overall impervious area within the project limits.

A new pedestrian trail will be constructed from the BCP intersection with 161st Ave NE along the west edge of the heron rookery area to the intersection of Leary Way and 159th Place. This trail will be non-pollution generating, without vehicle access, with sheet flow dispersion into the open space area.

Basin D

Basin D is within the City Watershed Number #550 which has approximately 209 acres. The BC Parkway Project has limited impact to this basin through the proposed improvement at the 159th Place NE intersection with Redmond Way NE. The proposed roadway improvements within this basin, Basin Dp, accounts for approximately 1.13 acres of total area, which is mostly existing roadway and sidewalk area under existing conditions. The proposed improvements within Basin Dp include 1.05 acres of impervious area and 0.07 acres of landscaped area. Due to the small change in Pollution-Generation Impervious Area of 1380 sf mostly attributed to the new turn lane from Redmond Way NE onto BCP, no water quality improvements are proposed for this basin. Most of the new impervious area for this basin, approximately 3400 sf, is associated with sidewalk improvements. The City is analyzing a regional treatment facility for the entire 209 acres separate from this project.

4.3. Performance Standards and Goals

The stormwater treatment requirements for the BC Parkway Project are based on the City of Redmond Clearing, Grading and Stormwater Management Technical Notebook (Technical Notebook), update January 2007. This Technical Notebook defines how the 2005 Washington Department of Ecology’s Stormwater Management Manual for Western Washington (2005 DOE Manual) will be implemented within the City.

The entire project limits were considered as a single threshold discharge area per the City’s Technical Notebook which does not allow project areas to be separated even if outfall locations are greater than one-quarter mile apart. The BC Parkway Project has been analyzed as a “New Development” project at the request of the City as the proposed improvements will be of equal or greater value than the existing improvements. Based on a single project area the total “New” Impervious Area within the project limits is 20,100 sf. Per the DOE Manuals, the conversion of gravel to paved surface is considered new impervious area for threshold requirements. The change in impervious area within the project limits, including existing gravel as existing impervious surface, is 12,100 sf. Area comparisons shown in the table below and are included in the Drainage Area Summary in Appendix A. Since more than 5000 sf of new impervious surface area is being created by this project, regardless of the gravel classification, all of the Minimum Stormwater Requirements must be evaluated. Per the Technical Notebook discharge into Sammamish River does not require flow control because all of the project discharge locations connect to the Sammamish River.

Impervious Area Summary within the Proposed Roadway Limits						
Drainage Basin	Total Area in ROW	Existing Imp Area	Proposed Imp Area	Increase in Imp Area	New Imp from Gravel	Total New Impervious
	(sf)	(sf)	(sf)	(sf)	(sf)	(sf)
Ap	88,900	61,600	69,800	8,200	2,200	10,400
Bp	202,700	148,100	149,000	900	5,800	6,700
Cp	52,200	36,100	35,700	-400	0	-400
Dp	49,100	42,500	45,900	3,400	0	3,400
Project Total	392,900	288,300	300,400	12,100	8,000	20,100

Based on the 2005 DOE Manual, an oil control facility is not required for the BC Parkway Project. The Average Daily Traffic for the proposed BC Parkway Project is less than the 25,000 minimum through the year 2020, per the Mirai traffic study performed in conjunction with the BC Parkway Project. Commercial properties are required to install oil control facilities if the expected average daily traffic is greater than 100 vehicles per 1000 square feet of building area or if specific materials are stored on-site. If required, redeveloped commercial properties adjacent to the project would need to provide oil control facilities before connecting to the BCP drainage system. Per the Technical Notebook, Phosphorus control is required for areas within the Lake Sammamish Basin.

The BC Parkway Project discharges to the Sammamish River downstream of the lake, therefore no Phosphorus control facilities are proposed.

The Pollution Generation Impervious Surface (PGIS) summary provides a conservative estimate of the new PGIS areas within the proposed roadway corridor. The PGIS areas are not directly linked to changes in impervious areas. For example, when a roof area is converted to a roadway surface there is no change in impervious area, but the area is now considered pollution-generating due to motorized vehicle access to runoff water. Conversely, when a sidewalk is added over a previously paved driving surface the impervious area does not change, but the PGIS area is decreased. Per the City's request, an estimate of the net change in PGIS was calculated to account for the existing PGIS areas that will be converted to non-PGIS surfaces. The new PGIS areas (56,000 sf) and the areas converted to non-PGIS areas (53,5000 sf) are shown in the Pollution Generating Impervious Surface Area Summary in Appendix A. Based on the area within the roadway corridor, generally following the proposed roadway right-of-way, the overall PGIS area would increase by approximately 2500 sf. This includes the area within the Leary Way Shop, south of the proposed BCP, which is a proposed landscaped area. This estimate of PGIS converted areas does not include the portion of the Leary Way Shops site north of Bear Creek Parkway, which is assumed to be redeveloped as commercial property at a later date. The existing conditions PGIS reference point for the area within Leary Way Shops site was based on the survey and aerial photo data prior to the site demolition since it is difficult to classify which areas may be considered PGIS with ongoing construction activity. Water quality treatment facilities are required per the 2005 DOE Manuals for projects that add 5000 sf or more of new PGIS areas, without credit for converted areas. Adding water quality treatment for the entire City Center Watershed matches the City's intent to improve the overall stormwater water quality discharge to the river.

The stormwater treatment facilities for the BC Parkway Project are designed to meet Enhanced Treatment standards per the 2005 DOE Manual since the 7500 Annual Average Daily Traffic count requirement of the 2005 DOE Manual will be exceeded for new BCP roadway per the March 2006 Marai Traffic Analysis Report. Due to maintenance and groundwater concerns Infiltration and Sand Filtration systems were not investigated as Enhanced Treatment options. Stormwater Treatment Wetlands and a treatment train facility with a Media Filter are the remaining choices for regional scale facilities. The 2005 DOE Manual also allows Bioretention and Biofiltration Facilities with compost-amended soils as Enhanced Treatment alternatives, which are generally applicable for small sites.

4.4. Flow Control System

Per the City's Technical Notebook, discharge into the Sammamish River does not require flow control. Even though the total effective impervious area is 6.68 acres with a net increase of 12,100 sf of impervious area, flow control is not proposed because all three of the project outfalls discharge directly into the Sammamish River.

Due to the possible conveyance capacity issue within the existing storm system downstream of Basins A and D, Basin A has been redirected to the abandoned 30-inch concrete outfall on the south side of the Redmond Way Bridge. The connection from the abandoned outfall through the Luke McRedmond Park, including installation of the new water quality treatment vault system, has been constructed under a separate contract completed in 2007. Basin B flowing through the previously abandoned outfall has been verified to have adequate capacity to convey the 50 year reoccurrence storm event.

4.5. Water Quality System

The 2005 DOE Manuals rank infiltration as the first priority for stormwater treatment. However per the Technical Notebook, infiltration is not approved for stormwater treatment. The project is within Wellhead Projection Zone 3 so infiltration is not allowed. Therefore, treatment vaults are used for Basin A, with a Stormwater Treatment Wetland (STW) is proposed for Basin B.

The water quality facilities are sized using the DOE Western Washington Hydrology Model (WWHM) based on the site parameters listed in Appendix A. The water quality vaults are sized to treat all of the runoff within the contributing basin area since the flows from the PGIS areas are mixed with the runoff from the non-PGIS landscaped and sidewalk areas. A regional water quality facility is proposed for Basin B as part of this project. The regional water quality treatment vault system for Basin A has been constructed under a separate contract.

Basin A

The location of the treatment train vaults for Basin A is outside of the 159th Place roadway area because of potential conflicts with the existing underground utilities near the intersection at NE Redmond Way. These treatment vaults, installed in 2007, are within the existing parking lot for the Luke McRedmond Landing Park, southeast of the NE Redmond Way and BCP intersection.

The water quality design treatment flow for the area within the project limits of Basin A, Subbasin Ap, is estimated at 0.15 cfs, based on the WWHM model for an offline system with a 15 minute time step adjustment. The comparable treatment flow for the entire basin is 1.19 cfs.

Basin B

Basin B has ample open space to construct an above ground Stormwater Treatment Wetland (STW). STW facilities are less expensive to build and maintain, but require a larger surface area because the average treatment water depth is only 3 feet. The most suitable location for the STW is in the vicinity of the existing Leary Way Bioswale facility. This location would allow the existing Bioswale, which has questionable performance and aesthetics, to be replaced with a facility that provides Enhanced Treatment for the entire contributing basin. The majority of the existing Bioswale appears to be within the 150 foot stream buffer and a Shoreline Permit will be required

for the construction of the STW. By constructing the new STW in the same location, the existing Bioswale can be removed and the new facility can be better positioned on the existing facility easement. The area outside of the existing Bioswale is within the Redmond Town Center Open Space parcel and an agreement to build the facility on this land will be required. No changes are proposed for the outlet pipe into the Sammamish River. The rock outfall pad will be fortified and approximately 150 ft along the river bank, above the Ordinary High Water Mark, will be replanted with native species as part of this project.

The proposed STW has been set at minimum depth to match the existing inverts into the Bioswale facility and minimize the extent of grading and the top footprint area of the STW. The proposed top area of this STW is approximately 41,000 sf, 0.94 acres. The proposed location of the STW has also been chosen to limit the impact to existing trees in the Redmond Town Center Open Space. A liner has been included in the design of the STW due to the presence of Everett Gravelly Sandy Loam Type A soils, which would not allow a permanent pool at the bottom of the pond.

A backflow preventer is not recommended for the outfall from the STW to the Sammamish River. Due to the Type A Hydrologic Soils, with high infiltration rates, the elevation of the groundwater should be close to the water surface elevation in the river. A backflow prevention valve on the outfall pipe could allow the groundwater to rise higher than the water elevations in the pond during high river flows and low inflow to the pond. A condition where the groundwater is higher than the water elevations in the pond could cause the pond liner to lift once the buoyancy of the pond liner soil and liner are offset. The proposed outfall does not have a backflow prevention valve so water elevations in the pond should remain relatively balanced with those of the groundwater by their interconnectedness with the river.

The estimated cost for the regional STW is \$570,000. This includes excavation, pond liner, top soil, wetland plants, river bank revegetation, access road, outfall pad and a portion of the general lump sum construction items (12.3% per land area impacted for items such as mobilization, TESC, etc.). These subcomponents are listed in the detailed Stormwater Treatment Wetland Cost Estimated, included in Appendix A. The cost for the STW does not include property acquisition costs.

The water quality design treatment flow for the area within the project limits of Basin B, Subbasin Bp, is estimated at 0.55 cfs, based on the WWHM model for an online system with a 15 minute time step adjustment. The comparable treatment flow for the entire basin is 1.36 cfs.

Basin C

No new water quality facilities are proposed for Basin C because a portion of the new roadway area within this basin is redirected to the proposed STW in Basin B and the remaining roadway project area, Basin Cp, will drain to the existing wetvault facility. Approximately 0.34 acres of new roadway area, directly southeast of the intersection along BCP, will be conveyed through the new storm pipes to the proposed Leary Way

STW within Basin B. This roadway area southeast of the existing BCP and Leary Way intersection used to drain to the existing wetvault. The remaining improvements in Basin C also create a net decrease in impervious area of approximately 400 sf. The wetvault for the existing Bear Creek Parkway roadway was installed per the 1995 Bear Creek Parkway plan number 95-2220. The existing 12 ft by 26 ft wetvault connects to the existing 54" outfall pipe that discharges to the Sammamish River near the Leary Way Bioswale in Basin B. The roadway area south of Leary Way, approximately 1.2 acres, will continue to flow through the existing wetvault and received basic water quality treatment.

The water quality design treatment flow for the area within the project limits of Basin C, Subbasin Cp, is estimated at 0.13 cfs, based on the WWHM model for an offline system with a 15 minute time step adjustment. The existing water quality vault as-built plans show an offline system with a bypass pipe. Treatment flows for Basin C, with approximately 106 acres, were not calculated.

Basin D

The area of proposed improvements, with this phase of the BC Parkway Project, is limited to the intersection of Redmond Way NE and the new BCP. The new PGIS surface within this basin is approximately 2220 sf with 2250 sf of PGIS being removed. The overall net decrease in impervious area of 30 sf in PGIS area is due to the proposed landscaping and realigned intersection at NE Redmond Way. No water quality facility is proposed for this basin.

The water quality design treatment flow for the area within the project limits of Basin D, Subbasin Dp, is estimated at 0.09 cfs, based on the WWHM model for an offline system with a 15 minute time step adjustment. Treatment flows for Basin D, with approximately 209 acres, were not calculated. A future water quality facility for the entire Basin D area is being evaluated separately by the City.

4.6. Conveyance System Analysis

The proposed drainage layout with connections to the existing conveyance system is shown on sheets 33 through 43 with profiles on sheets 44 through 52, submitted separately as part of the Bid Document Plans for the BCP & 161st Avenue NE Roadway Improvement Project. To verify the feasibility of connecting to the existing drainage pipes within Basins A and B, the capacity of the existing conveyance system was evaluated using XP-Storm, a proprietary computer model interface of the Environmental Protection Agency's Stormwater Management Model (SWMM). The flows modeled in XP-Storm are based the Santa Barbara Urban Hydrograph method (SBUH) with Type 1A storm routed from each subbasin. The City Technical Notebook requires that the conveyance system has greater than 1-ft of freeboard during the 10 year storm event, 6"

of freeboard during the 25 year event, and the flows estimated for the 50 year event do not overtop the grate of any structure.

The downstream capacity of Basins C and D was not evaluated. Basin C has a net decrease in impervious area due to the redirection of flow near the new BCP and Leary Way intersection and the proposed landscaping. Basin D used to be connected to most of the roadway and commercial areas within Basin B. With the recent connection of Basin B to the previously abandoned outfall within the Luke McRedmond Park, Basin B longer connects to the same outfall as Basin B thus removing approximately 15 acres from Basin D.

A new conveyance system within the roadway limits is proposed for Basin A. The existing system was too shallow and did not have adequate capacity to meet the requirements of the Technical Notebook. The new conveyance system, including the new connection to the abandoned outfall through the Luke McRedmond Park, was modeled using XP-Storm. The model output for this system is included in Appendix A.

The limiting capacity in the existing Leary Way storm system is a 12" pipe at 0.38% slope. The full flow capacity of this limiting pipe segment is estimated at 2.2 cfs, based on Manning's Equation. The proposed 50 year flow, based on the XP-Storm Model is 3.73 cfs, thus a backwater analysis was required. The backwater analysis performed using XP-Storm determined that the existing drainage pipe meets the freeboard requirements of the Technical Notebook because the existing system is greater than 8 ft deep and thus has adequate capacity for the proposed project runoff. The model output for Basin B is included in Appendix A.

5. Construction Stormwater Pollution Prevention Plan

A Draft Construction Stormwater Pollution Prevention Plan (SWPPP) is included with the Project Specifications. Prior to construction, the awarded contractor will be required to finalize the SWPPP and Erosion and Sedimentation Control (ESC) plans in accordance with this report, the Contract Plans, and City requirements.

The ESC plans will need to include a variety of Best Management Practices (BMPs) to prevent the transport of sediment from the project site to downstream drainage facilities, water resources, and adjacent properties. These BMPs may include a variety of temporary and permanent measures, including:

- Clearing Limits
- Stabilize Soils
- Perimeter and Slope Protection
- Drainage Inlets Protection
- Traffic Area Stabilization
- Sediment Retention
- Surface Water Controls

- Dust Control
- Pollutant Control

6. Special Reports

The following special reports have also been prepared for this project:

- Traffic Analysis Report, Marai, March 2006
- Heron Colony Monitoring Report, Norman Wildlife Consulting, March 2006
- Stormwater Treatment Alternatives, KPG, February 2006
- McRedmond Regional Water Quality Facility Design Report, KPG, December 2006
- Leary Way Bioswale Drainage Complaint, City of Redmond, February 2004
- City Center Basin Planning – Regional Water Quality, City of Redmond, on going

7. Other Permits

The following permits are identified as required, or anticipated to be required, for this project:

- Shoreline Permit
- City of Redmond Clear & Grading Permit
- Construction Stormwater General Permit

8. Operations & Maintenance Manual

The proposed public drainage facilities will be maintained by the City of Redmond, per their maintenance standards and schedules.

9. Bond Quantities, Facility Summaries & Declaration of Covenant

The roadway extension project is proposed by the City of Redmond within the public streets, and will not require any bonding or covenants. The private open space parcels with existing covenants are not anticipated to require updating for the proposed Stormwater Treatment facility. The easement and acquisition options for this land have been addressed separately by the City.

APPENDIX A

- Proposed Basin Map
- Pollution Generating Impervious Area Summary Map
- Drainage Area Summary
- Stormwater Treatment Wetland Design
- Western Washington Hydrology Model Output
- Subbasin Design Parameters
- XP-Storm Model Output
- Stormwater Treatment Wetland Cost Estimate

APPENDIX B

- Redmond Wellhead Protection Zones Map
- King County Soils Map
- King County Floodway Boundaries