

## **Appendix F – Water Resources**

- Conceptual Stormwater Management Plan (2006)
- Leachate Memorandum (2006)

# Conceptual Stormwater Management Plan

## INTRODUCTION

This memorandum describes the existing drainage system at the Bow Lake Transfer/Recycling Station, identifies applicable design criteria and regulatory requirements, and presents a conceptual stormwater management system that would be used to control and treat stormwater at the site. For the purpose of this memorandum, "site" refers to the area within the limits of the proposed Bow Lake station project boundary. The site is located along the east side of Interstate 5, just north of its intersection with Orillia Road and South 188th Street. The majority of the site is located within the City of Tukwila (the City). A small portion is located in unincorporated King County. The total developed site area is approximately 12 acres, 4.4 of which will be new impervious surface. Site improvements include demolition of all existing on site facilities and construction of two scale facilities, a transfer building, fee and free recycling areas, and other equipment and operator facilities. The surface water management facilities required for these improvements include:

- Stormwater quantity control (detention) facilities,
- Stormwater quality control facilities,
- Conveyance system including piping, curb and gutter and or ditches,
- Temporary erosion and sediment control and water quality source control during construction,
- Permanent water quality source controls.

This memorandum is divided into three sections: 1) a description of the existing affected environment in the vicinity of the project site and the downstream system, 2) a description of stormwater control design criteria and regulatory requirements, 3) a description of the conceptual design of stormwater management and impact mitigation facilities.

## EXISTING DRAINAGE SYSTEM

The existing Bow Lake Transfer/Recycling Station was built almost 30 years ago on the site of a closed landfill. The area immediately north of the existing Transfer Station site is mostly undeveloped and is owned by WSDOT. This area includes a large stockpiled mound of fill. The portion of the WSDOT property closest to Interstate 5 (I-5) is used as a construction laydown yard for work along the I-5 corridor. The Bow Lake site is generally flat in the area of the existing facilities with a moderately steep down slope to the east.

Information about the existing site and downstream drainage system has been obtained from construction plans and site visits, through meetings with City staff,

and through research of the Tukwila South Project Draft Environmental Impact Statement (DEIS) prepared for a private development in the area.

The Transfer Station site includes approximately 4 acres of impervious area consisting of roads, trailer parking areas, and the roof of the transfer station building. Stormwater runoff from most of the site is collected in catch basins and trench drains and conveyed to one of four piped discharges along the top of the slope along the east site boundary. Runoff from the trailer parking and pit areas where stormwater has a greater potential to come into contact with solid waste operations is collected separately and routed to a retention vault. Vault contents are pumped out and trucked off site as wastewater. This portion of the runoff was separated from the stormwater collection system as part of site improvements made in 1991. Prior to these improvements, runoff from the entire site was discharged to the east slope.

Discharged stormwater travels down the slope either as surface flow in indistinct drainage swales or as groundwater that has infiltrated along the hillside. At the toe of the slope approximately 700 feet east of the transfer station, surface water and any re-emergent groundwater discharge to an existing ditch. The ditch, referred to as "Ditch E" in the proposed Tukwila South Project DEIS, flows to the north adjacent to a driving range and continues across pasture land before connecting to a culvert system along South Center Parkway that conveys flow north to the South 180<sup>th</sup> Street pump station where it is pumped into the Green River.

There are no known erosion or slope stability problems resulting from the concentrated discharges that have been occurring since the site was initially developed nearly 30 years ago.

The DEIS states that no fish sightings in Ditch E have been recorded during habitat surveys. However, it conservatively assumes that fish could be present in the stream. Because the pump station downstream at the Green River acts as a barrier, there are no anadromous fish in the stream.

Hydrologic Analysis of Existing Conditions

A King County Runoff Time Series (KCRTS) hydrologic model was developed to estimate existing runoff rates from the site. A summary of the analysis follows in Table 1. Model output is included in Attachment F1. Although some of the impervious area at the existing site is conveyed to the sanitary sewer system, it was assumed that all runoff enters the storm drain system.

**Table 1  
Hydrologic Results – Existing Conditions**

Impervious Area (acres)	4.3
Till Grass Area (acres)	2.5
Till Forest Area (acres)	4.7
Total Area (acres)	11.5
Peak Flow (cfs)	

2-year	2.3
10-year	4.1
25-year	5.6
100-year	8.9

## DESIGN CRITERIA AND REGULATORY REQUIREMENTS

The regulatory requirements governing this project were reviewed to determine the likely design criteria that would apply. The applications for permits for the project will likely be submitted sometime in late 2007. This section identifies permits that will likely be required for the project and describes the design criteria used to develop the conceptual stormwater management system and the required stormwater controls during construction.

Federal, state and local agencies may require permits for work related to stormwater associated with the transfer station improvements. A National Pollutant Discharge Elimination System (NPDES) permit, which would include a Stormwater Pollution Prevention Plan, will likely be required by the State Department of Ecology for construction activities including clearing, grading and excavation.

Per Tukwila Municipal code 14.30.070, the City has adopted the 1998 *King County Surface Water Design Manual* (KCSWDM, or Manual) except as amended by the City of Tukwila Public Works Development Guidelines and Design and Construction Standards. The City is currently considering adopting the 2005 Manual.. Because the City will likely have adopted the 2005 Manual prior to submission of permit applications for the Bow Lake Transfer/Recycling Station Improvement project, surface water facilities will be designed to follow the 2005 Manual guidelines and requirements. The 2005 manual guidelines are also appropriate because the project is being constructed by a King County agency that designs to the higher established standards.

The 2005 King County Manual uses thresholds to define the type of drainage review required for different sizes and types of projects. The type of drainage review generally defines which requirements apply. The manual applies eight “Core Requirements” plus “Special Requirements”. Core Requirements apply to all projects meeting certain thresholds. Special Requirements also apply depending on the project location or site specific characteristics.

The Bow Lake Transfer/Recycling Station project will create more than 2,000 square feet of new impervious surface and will require a Full Drainage Review. As such, it will be required to meet all eight of the Core Requirements as follows. Further explanation of how the stormwater facilities will meet these requirements is included in the conceptual design discussion of this memorandum.

1. **Discharging surface water at the natural location.** Natural drainage patterns are to be maintained and discharges from the project site shall occur at the natural locations, to the maximum extent practicable.

2. **Providing an off-site analysis.** All projects must submit an offsite analysis report that assesses potential offsite drainage impacts associated with development of the project site and propose appropriate mitigation of those impacts. The objective of the requirement is to identify and evaluate offsite drainage problems that may be created or aggravated by the proposed project and to determine appropriate measures for preventing aggravation of those projects.
3. **Providing flow control.** All projects, including redevelopment projects such as the Transfer Station Improvement Project, must provide onsite flow control facilities or flow control BMPs or both to mitigate the impacts of storm and surface water runoff generated by new impervious surface, new pervious surface and replaced impervious surface. The transfer station project is within a “Basic Flow Control” area and requires detention such that outflows match the 2-and 10-year flows for existing conditions.
4. **Providing a conveyance system.** All engineered conveyance system elements for projects must be analyzed, designed and constructed to provide a minimal level of protection against overtopping, flooding, erosion, and structural failure. The conveyance system will be sized to handle 25-year peak flows calculated using 15-minute time steps in the King County Backwater Model (KCBW).
5. **Providing erosion and sediment control measures.** All projects that will clear, grade, or otherwise disturb the site must provide erosion and sediment controls to prevent, to the maximum extent practicable, the transportation of sediment and other construction–related pollutants from the project site to downstream drainage facilities, water resources, and adjacent properties.
6. **Maintaining and operating the surface water facilities.** The objective of this requirement is to ensure that the drainage facilities will be properly maintained and operated in perpetuity.
7. **Complying with financial guarantees.** Project proponents must comply with the financial guarantee requirements in King County Ordinance 12020 and the liability requirements of King County Code 9.04.100. Because the County is a government agency, the City of Tukwila will not likely require these financial guarantees.
8. **Providing water quality treatment.** All projects, including redevelopment projects, must provide water quality facilities to treat the runoff from those new and replaced pollution-generating impervious surfaces and new pollution-generating pervious surfaces targeted for treatment. For water quality treatment facilities upstream of detention facilities, the water quality treatment design flow is based on 60% of the developed 2-year peak flow as determined using the KCRTS model. Downstream of detention, the water quality treatment design flow is equal to the full 2-year release rate. The water

quality treatment volume is a minimum of 95% of the average annual runoff volume in the time series as determined by the KCRTS model.

In addition to the Core Requirements, the project would be required to meet all applicable Special Requirements. Of the Special Requirements, the only one that would apply is Special Requirement 4, Source Controls. This requirement would be triggered because the project will require a commercial site development permit. Water quality source controls will be required to prevent rainfall and runoff water from coming into contact with pollutants, thereby reducing the likelihood that pollutants will enter public waterways and violate water quality standards.

Projects subject to a Full Drainage Review are required to submit a Technical Information Report (TIR), stamped and dated by a Washington State licensed professional civil engineer. The TIR will include the drainage design plus supporting calculations as well as the proposed erosion and sediment control (ESC) plan.

In addition to meeting the local requirements in the 2005 Manual, an NPDES permit for construction will also be required. This permit, which is administered by the Department of Ecology, is required for projects that will create land disturbing activities in excess of 1 acre. For this permit a Storm Water Pollution Prevention Plan (SWPPP) must be prepared. Most of the requirements of the SWPPP are similar to the requirements of the Full Drainage Review.

The Green River Flood Control Zone District is a quasi-municipal corporation of the State of Washington that is primarily responsible for maintaining and operating flood protection facilities on the lower Green River within its boundaries. Discharges to the Green River in the Cities of Auburn, Kent, Renton, and Tukwila and in King County are regulated by the Green River Pump Operations Procedures Plan. The plan establishes guidelines for the design and operation of pumped and gravity outfalls to the Green River. Flood protection measures include limiting pump station operating hours and providing storage for the 100-year 7-day rainfall event. Because stormwater from the Bow Lake facility will be conveyed to an existing pump station, the requirements of this document do not apply.

Washington state law requires that any construction activity that will use, divert, obstruct, or change the bed or flow of state waters must do so under the terms of a Hydraulic Project Approval (HPA) permit issued by the Washington State Department of Fish and Wildlife. If site runoff is conveyed to Ditch E, the outfall may include construction at Ditch E, and the possible requirement of a Hydraulic Project Approval (HPA), issued by the Washington State Department of Fish and Wildlife. HPA permits typically require that the project comply with the provisions of the Washington State Department of Ecology (Ecology) 2005 Stormwater Management Manual for Western Washington. The Ecology manual's standard flow control requirement is more stringent than that of the 2005 King County manual. Stormwater discharges must meet pre-developed

durations for discharge rates from 50% of the 2-year peak flow up to the 50-year peak flow. The pre-developed condition would likely be forested land cover unless an exception is approved.

Because Ditch E is tributary to a pump station and there is minimal potential for fish access, Ecology's level of flow control may not be required. Based on discussion with Tukwila City staff, recent development in this drainage basin requiring an HPA has not been held to the Ecology flow control standard. If an HPA is required, the applicability of Ecology standards will be discussed with WDFW during the project design phase.

The hydrologic analysis and conceptual design presented in this memorandum assume that the project will be required to meet King County requirements. Where appropriate, a brief discussion identifies the potential impacts to design if the Ecology Manual must be adhered to.

## **CONCEPTUAL STORMWATER MANAGEMENT DESIGN AND MITIGATION APPROACH**

This section describes a conceptual level approach for providing a drainage system for the proposed Transfer Station that meets the 2005 KCSWDM requirements. To meet the core requirements, the project will include both permanent storm water facilities as well as temporary measures for erosion and sediment control during construction. The permanent storm drainage system will include piping, detention vaults and stormwater quality treatment. Stormwater in areas with higher potential for pollution will be isolated and conveyed to the sanitary sewer system. A conceptual layout of the permanent facilities is shown in Figure 1.

### *Mitigation during Construction*

The Bow Lake Transfer station will be constructed in phases. Throughout construction, temporary drainage and erosion control facilities and source controls will be provided. Erosion and sediment control measures may include:

- Providing temporary cover over exposed soils and stockpiles,
- Using silt fencing between construction activities and downstream water courses,
- Installing check dams along existing and temporary ditches,
- Directing runoff to temporary sediment traps or portable treatment tanks for treatment prior to discharge to the downstream system,
- Preventing track off of sediment onto offsite roadways,
- Installing permanent cover measures as soon as possible after construction is complete.

- Providing water quality source controls during construction to prevent pollutants from coming into contact with stormwater. Source control measures could include safe handling of petroleum products including proper storage and maintenance of vehicles and equipment.
- Implementing measures to minimize leachate generation during construction. The potential for leachate generation is discussed in a memorandum by R.W. Beck dated October 12, 2006 with the subject *Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Evaluation of Potential for Leachate Generation at the Project Site During Construction and During Operation of the Completed Facility*.

Permanent Facilities

**Hydrologic Analysis of Developed Conditions**

The KCRTS model was used to evaluate the potential increase in runoff from the recycling and transfer station development at the Bow Lake site. The hydrologic model was used to estimate future runoff rates for the improved site conditions. Table 2 provides a summary of model input and results. Note that approximately 0.4 acres of impervious area will be conveyed to the sanitary sewer.

**Table 2  
Hydrologic Results – Developed Conditions**

Impervious Area (acres)	8.8
Till Grass Area (acres)	2.3
Diverted to Sanitary Sewer (acres)	0.4
Total Area (acres)	11.5
Peak Flow (cfs)	
2-year	4.4
10-year	7.5
25-year	9.7
100-year	14.1

**Conveyance**

Core Requirement number four requires a conveyance system that provides minimal protection against overtopping, flooding, erosion and structural failure. The systems must be designed to convey the 25-year peak flow. Conceptual collection and conveyance systems for the Bow Lake Transfer/Recycling Station are shown schematically on Figure 1. A rainwater harvesting system will be in place to collect roof runoff for use in transfer station operations. The approximate roof area to be included is 1.5 acres. Roof drains will also be provided for use in the event that the harvesting system is taken off-line. A rough estimate is that up to one-half of the precipitation collected could be used for solid waste operations and then be discharged to the sanitary sewer system.

All paved surfaces including building roofs will be conveyed by 12 to 24-inch-diameter storm drain pipes. These pipe sizes are preliminary and will be

confirmed by detailed hydraulic analysis during final design. The conveyance system will collect runoff from the site and direct it to an underground detention vault or vaults. Detained flows would flow to a water quality treatment system and then discharged down the eastern slope.

Flows will be discharged down the slope by one of two alternatives; a piped (tightline) system down the slope or a flow spreading and dispersion system. The tightline alternative would include piping flow down the slope to Ditch E in a pipe sized to convey the 100-year peak flow (likely a 24-inch-diameter pipe). Construction of this pipeline would require a drainage easement from the adjacent property owner.

The second alternative would be to discharge flows to the downstream drainage system by overland flow along the eastern slope. This option would consist of an engineered flow spreading and dispersion system(s) that would discharge flows along the eastern property line located on a bench further down the slope or higher up along the slope. Selection of a location for the discharge spreader(s) would give careful consideration of the issues of slope stability and leachate generation. The system would be designed to minimize erosion and mimic the current dispersed stormwater discharge conditions at the site.

Decisions about the discharge method and details will be made during development of the TIR and during design based on input from the City of Tukwila and other agencies having regulatory or oversight responsibilities and on the possibility of obtaining an easement from the adjacent property owner. The dispersion option will only be considered feasible if slope stability analysis by a licensed geotechnical engineer shows that discharge flows will not create or make worse any existing erosion problems downstream of the project site. If a dispersion option were implemented along the top of the slope, consideration would be given to planting high water consumption trees on the un-forested downhill slope as an additional means of taking up ground water to reduce the volume of site runoff. Consideration may also be given to increasing the volume of detention storage to further reduce peak flows leaving the site. As previously indicated, an HPA may be required for discharge to Ditch E.

### **Detention Facilities**

A vault (or vaults) was selected to detain runoff rather than an open pond or infiltration facility due to the lack of space available to provide an open pond, soil conditions, and to avoid permanent open water at the site which might possibly attract waterfowl and birds to the site. Per the City of Tukwila Public Works Development Guidelines and Design and Construction Standards, the site is within a "Basic Flow Control Area" and therefore, the Level 1 flow control standard applies, which requires matching the existing site conditions 2- and 10-year peak flows. If during the downstream analysis, a Type 2 drainage problem (severe erosion) is identified, additional flow control may be required. The downstream analysis will be performed during the project design phase. Runoff will be discharged in a manner that does not cause or make worse any downstream erosion problems.

To size the detention facilities, the Manual requires the use of the KCRTS hydrologic model. Preliminary sizing suggests that an 18'x50'x11' vault will be required to meet Level 1 flow control requirements. Release of stormwater from the vault will be controlled with a multiple orifice outlet control structure. Table 3 presents the mitigated outflows from the site.

**Table 3  
Hydrologic Results – Mitigated Peak Outflows (cfs)**

2-year	2.27
10-year	4.15
25-year	6.49
100-year	11.05

If the project is subject to the requirements of the Ecology Manual, the required detention volume would be significantly greater.

### **Water Quality Treatment Facilities**

The transfer station is not located in a drainage basin having sensitive lakes or sphagnum bog wetlands and therefore only requires basic water quality treatment. However, the Manual requires that certain land uses that generate high concentrations of metals in stormwater runoff provide Enhanced Basic Treatment. Defined thresholds for requiring Enhanced Basic Treatment are if 50% or more of the area draining to a treatment facility is industrial or multifamily development, if the project is a commercial development with an expected average daily traffic (ADT) count of 100 or more vehicles per 1,000 square feet of gross building area, or if the project is a commercial development involved with vehicle repair maintenance or sales.

Specific water quality measures (described below) will be applied to areas of the site with “industrial” type activities such as the recycle areas, the transfer station floor, and vehicle queuing areas. Expected ADT in the year 2030 is expected to be less than 20 vehicles per 1,000 square foot of building. Because the project will be below the threshold ADT and because special treatment / disposal will be provided for those areas having greater risk of pollution, Basic Treatment will be provided for the remainder of the site. This will be confirmed during development of the TIR and during design based on input from the City of Tukwila.

The Manual offers a menu of several different types of water quality treatment Best Management Practices (BMPs) for selection appropriate for the site conditions. Bioswales and wetponds are not feasible at the site due to lack of space for such facilities. Water quality could potentially be provided in a wet vault within the detention vault. “StormFilter” systems by Stormwater Management 360 are another potential method of providing water quality treatment. A StormFilter system is a media filtration system that consists of media-filled cartridges that can be installed in a manhole or vault depending on the number of cartridges required to treat the flow. The StormFilter cartridges can be filled with a various types of media, selected to treat the specific pollutant

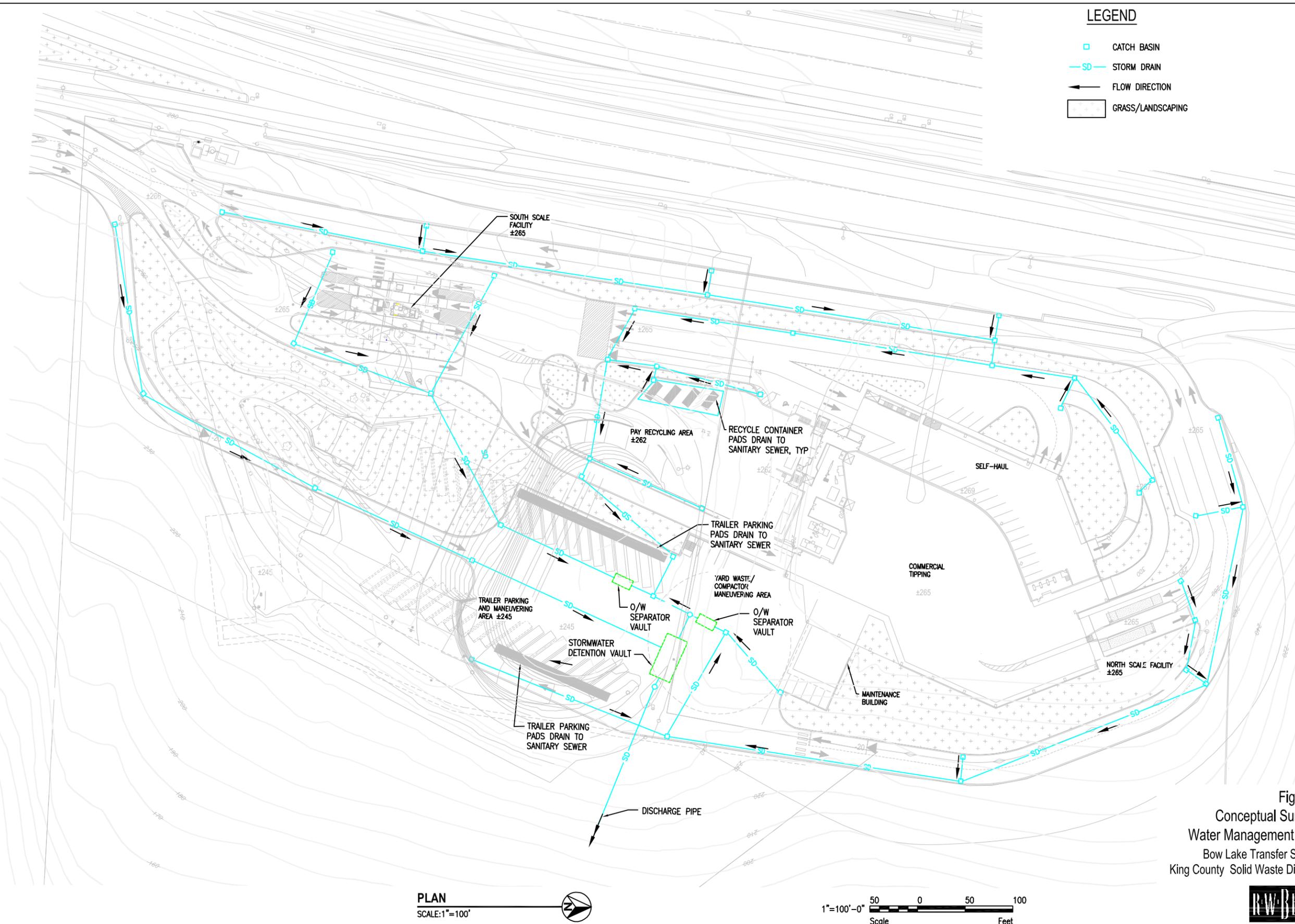
loadings at each site. Since this site is only required to provide basic treatment, the media would be selected primarily to remove sediment. As shown on Figure 1, The StormFilters, if used, will be located on the downstream side of the detention facility. The StormFilter systems typically require 2.3 feet of head differential between the inlet and the outlet. The StormFilter cartridges will need to be contained in vaults due to the anticipated large number of filter cartridges required. If selected as the preferred method of water quality treatment, sizing of the vaults will be done as part of final design based on discharge rates from the detention vault. Because the Basic Flow Control detention requirement in the KSCWDM is not as stringent as the Ecology Manual, discharges from the vault will be higher. Over-detention of stormwater runoff may be considered as a way to reduce discharges from the detention vault, thus reducing the size of the StormFilter vault.

Additional water quality measures will be considered for areas with higher potential for pollution. As a method of source control, areas close to transfer station operations, including full trailer parking areas and the fee recycling area will be isolated, and the stormwater will either be routed to the storm or sanitary sewer system depending on operating conditions. Automatic wheel washes and track-off grates will be provided at receiving floor exit to prevent commercial customer vehicles from tracking out waste to outside pavement areas. In addition, although not required by the Manual, the trailer parking areas, scale facility areas, and queuing areas will be drained to one or more coalescing plate oil/water separators for additional treatment prior to release to the site drainage system. These areas are indicated on Figure 1.

Although the final facility design may include rainwater harvesting from the transfer building roof for non-potable uses within the building, to be conservative the conceptual drainage plan assumes that all roof runoff will be collected and treated. The roofs of the new buildings will include coatings so that they will not be pollution-generating surfaces due to leaching of metals such as zinc, and therefore the roof runoff should not require treatment. However, because roof runoff is required to be detained, and it is not likely to be practical to keep this runoff separated from the runoff from the rest of the site, it will also be treated for water quality.

**LEGEND**

- CATCH BASIN
- SD— STORM DRAIN
- FLOW DIRECTION
- + GRASS/LANDSCAPING



**PLAN**  
SCALE: 1" = 100'



1" = 100'-0"  
Scale      50      0      50      100  
Feet

Figure 1  
Conceptual Surface  
Water Management Plan  
Bow Lake Transfer Station  
King County Solid Waste Division



**ATTACHMENT F1**  
**HYDROLOGIC MODELING RESULTS**

Bow Lake Transfer Station  
Preferred Site Plan  
Land Use  
5/1/2006

	<b>Existing</b>	<b>Developed</b>
<b>Forest</b>	4.7	0
<b>Grass</b>	2.5	2.32
<b>Impervious</b>	4.34	8.78
<b>Sewer</b>	0	0.45

# PRE-DEVELOPED PEAK FLOW

11-BLPreDev.pks

Flow Frequency Analysis  
 Time Series File: 11-blpredev.tsf  
 Project Location: Sea-Tac

LogPearson III Coefficients  
 Mean= 0.396 StdDev= 0.164  
 Skew= 1.556

---Annual Peak Flow Rates---  
 Flow Rate Rank Time of Peak

-----Flow Frequency Analysis-----  
 - - Peaks - - Rank Return Prob

Flow Rate (CFS)	Rank	Time of Peak
3.45	9	2/16/49 17:45
4.82	4	3/03/50 15:00
2.03	35	8/27/51 18:00
2.31	28	10/17/51 7:15
1.70	44	9/30/53 3:00
1.97	38	12/19/53 17:30
1.66	46	7/30/55 21:15
2.50	19	10/04/55 10:00
2.38	24	12/09/56 12:45
2.21	33	1/16/58 10:00
2.76	13	10/18/58 19:45
2.74	14	10/10/59 22:00
2.40	22	2/14/61 20:15
2.00	36	8/04/62 13:15
1.95	39	12/01/62 20:15
1.52	49	6/05/64 15:00
2.23	30	4/20/65 19:30
1.55	48	1/05/66 15:00
2.51	18	11/13/66 17:45
5.06	3	8/24/68 15:00
2.27	29	10/20/68 12:00
1.42	50	1/13/70 20:45
1.72	43	12/06/70 7:00
3.58	7	12/08/71 17:15
1.99	37	4/18/73 9:30
2.38	26	11/28/73 8:00
2.59	17	8/17/75 23:00
1.76	42	10/29/75 7:00
1.63	47	8/23/77 14:30
2.88	11	9/17/78 1:00
3.96	6	9/08/79 13:45
2.80	12	12/14/79 20:00
2.70	15	9/21/81 8:00
5.63	2	10/05/81 22:15
2.36	27	10/28/82 16:00
1.86	40	1/02/84 23:30
1.68	45	6/06/85 21:15
2.49	20	10/27/85 10:45
2.92	10	10/25/86 22:45
2.38	25	5/13/88 17:30
2.21	32	8/21/89 16:00
3.48	8	1/09/90 5:30
2.40	23	4/03/91 20:15
1.86	41	1/27/92 15:00
2.22	31	6/09/93 12:15
2.11	34	11/17/93 16:45
2.49	21	6/05/95 17:00
2.63	16	7/19/96 19:30
10.79	1	12/29/96 11:45
4.58	5	10/04/97 14:15

Flow Rate (CFS)	Rank	Return Period	Prob
10.79	1	89.50	0.989
5.63	2	32.13	0.969
5.06	3	19.58	0.949
4.82	4	14.08	0.929
4.58	5	10.99	0.909
3.96	6	9.01	0.889
3.58	7	7.64	0.869
3.48	8	6.63	0.849
3.45	9	5.86	0.829
2.92	10	5.24	0.809
2.88	11	4.75	0.789
2.80	12	4.34	0.769
2.76	13	3.99	0.749
2.74	14	3.70	0.729
2.70	15	3.44	0.709
2.63	16	3.22	0.690
2.59	17	3.03	0.670
2.51	18	2.85	0.650
2.50	19	2.70	0.630
2.49	20	2.56	0.610
2.49	21	2.44	0.590
2.40	22	2.32	0.570
2.40	23	2.22	0.550
2.38	24	2.13	0.530
2.38	25	2.04	0.510
2.38	26	1.96	0.490
2.36	27	1.89	0.470
2.31	28	1.82	0.450
2.27	29	1.75	0.430
2.23	30	1.70	0.410
2.22	31	1.64	0.390
2.21	32	1.59	0.370
2.21	33	1.54	0.350
2.11	34	1.49	0.330
2.03	35	1.45	0.310
2.00	36	1.41	0.291
1.99	37	1.37	0.271
1.97	38	1.33	0.251
1.95	39	1.30	0.231
1.86	40	1.27	0.211
1.86	41	1.24	0.191
1.76	42	1.21	0.171
1.72	43	1.18	0.151
1.70	44	1.15	0.131
1.68	45	1.12	0.111
1.66	46	1.10	0.091
1.63	47	1.08	0.071
1.55	48	1.05	0.051
1.52	49	1.03	0.031
1.42	50	1.01	0.011

Computed Peaks  
 Computed Peaks  
 Computed Peaks  
 Computed Peaks  
 Computed Peaks  
 Computed Peaks  
 Computed Peaks

8.86	100.00	0.990
7.07	50.00	0.980
5.62	25.00	0.960
<u>4.11</u>	<u>10.00</u>	0.900
3.87	8.00	0.875
3.22	5.00	0.800
<u>2.27</u>	<u>2.00</u>	0.500
1.87	1.30	0.231

MATCH 2&10 for Level 1 flow control



# VAULT DISCHARGE PEAKS.

Flow Frequency Analysis  
 Time Series File: rdout.tsf  
 Project Location: Sea-Tac

rdout.pks  
 LogPearson III Coefficients  
 Mean= 0.435 StdDev= 0.171  
 Skew= 1.921

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-----				
Flow Rate (CFS)	Peak Rank	Time of Peak		Peaks (CFS)	Rank	Return Period	Prob	
3.12	13	2/16/49 18:00		13.88	9.19	1	89.50	0.989
5.57	3	3/03/50 15:30		6.10	8.25	2	32.13	0.969
2.22	33	2/09/51 1:30		5.57	8.21	3	19.58	0.949
1.86	49	10/15/51 12:15		5.50	8.20	4	14.08	0.929
2.04	39	9/30/53 3:45		5.39	8.19	5	10.99	0.909
2.23	30	12/19/53 18:00		4.11	8.00	6	9.01	0.889
2.23	31	11/25/54 1:15		3.93	7.61	7	7.64	0.869
2.27	26	11/18/55 15:15		3.85	7.44	8	6.63	0.849
3.23	12	12/09/56 13:00		3.60	6.93	9	5.86	0.829
2.31	24	12/25/57 15:15		3.53	6.80	10	5.24	0.809
2.08	36	10/18/58 20:00		3.43	6.64	11	4.75	0.789
2.23	32	11/20/59 3:45		3.23	6.30	12	4.34	0.769
2.04	38	2/14/61 20:30		3.12	6.15	13	3.99	0.749
2.13	34	8/04/62 13:45		3.10	6.13	14	3.70	0.729
2.02	40	12/15/62 1:30		3.02	6.02	15	3.44	0.709
2.25	27	12/31/63 22:15		3.01	6.00	16	3.22	0.690
2.00	43	4/20/65 19:45		3.00	5.99	17	3.03	0.670
1.89	48	1/05/66 15:15		2.92	5.89	18	2.85	0.650
3.53	10	11/13/66 18:00		2.91	5.88	19	2.70	0.630
5.39	5	8/24/68 15:15		2.83	5.84	20	2.56	0.610
2.24	29	12/03/68 15:45		2.81	5.84	21	2.44	0.590
2.01	41	1/13/70 21:45		2.48	5.70	22	2.32	0.570
1.98	44	12/05/70 8:45		2.47	5.69	23	2.22	0.550
3.43	11	12/08/71 17:30		2.31	5.42	24	2.13	0.530
2.06	37	6/24/73 12:45		2.28	5.29	25	2.04	0.510
2.48	22	11/28/73 8:30		2.27	5.23	26	1.96	0.490
2.92	18	12/26/74 22:15		2.25	5.14	27	1.89	0.470
1.77	50	12/02/75 19:30		2.24	5.12	28	1.82	0.450
2.24	28	8/26/77 1:15		2.24	5.10	29	1.75	0.430
3.93	7	9/17/78 1:15		2.23	5.07	30	1.70	0.410
3.85	8	9/08/79 14:00		2.23	5.07	31	1.64	0.390
3.10	14	12/14/79 20:15		2.23	5.07	32	1.59	0.370
2.83	20	11/21/80 10:30		2.22	5.04	33	1.54	0.350
6.10	2	10/06/81 14:15		2.13	4.62	34	1.49	0.330
3.00	17	10/28/82 16:15		2.11	4.54	35	1.45	0.310
2.11	35	1/03/84 0:00		2.08	4.42	36	1.41	0.291
1.98	45	6/06/85 22:15		2.06	4.34	37	1.37	0.271
3.02	15	10/27/85 11:00		2.04	4.28	38	1.33	0.251
3.60	9	10/25/86 23:00		2.04	4.26	39	1.30	0.231
2.00	42	5/13/88 18:00		2.02	4.18	40	1.27	0.211
2.91	19	8/21/89 16:30		2.01	4.11	41	1.24	0.191
5.50	4	1/09/90 5:15		2.00	4.09	42	1.21	0.171
2.81	21	4/03/91 20:30		2.00	4.07	43	1.18	0.151
2.28	25	1/27/92 15:45		1.98	4.00	44	1.15	0.131
1.97	46	12/10/92 20:30		1.98	3.99	45	1.12	0.111
1.96	47	11/17/93 17:00		1.97	3.95	46	1.10	0.091
2.47	23	11/30/94 5:00		1.96	3.93	47	1.08	0.071
3.01	16	7/19/96 20:00		1.89	3.66	48	1.05	0.051
13.88	1	12/29/96 12:00		1.86	3.55	49	1.03	0.031
4.11	6	10/04/97 14:30		1.77	3.19	50	1.01	0.011
Computed Peaks				11.05	8.62	100.00	0.990	
Computed Peaks				8.47	8.43	50.00	0.980	
Computed Peaks				6.49	8.29	25.00	0.960	
Computed Peaks				4.15	8.09	10.00	0.900	
Computed Peaks				3.97	8.03	8.00	0.875	
Computed Peaks				3.18	6.71	5.00	0.800	
Computed Peaks				2.27	5.65	2.00	0.500	
Computed Peaks				1.96	4.24	1.30	0.231	

October 12, 2006

## **Technical Memorandum**

From: Karl Hufnagel, P.E.

To: Steve Bingham, ESA Adolfson

Subject: Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Evaluation of Potential for Leachate Generation at the Project Site During Construction and During Operation of the Completed Facility

The purpose of this memorandum is to address in both a qualitative and quantitative way the potential for leachate generation during reconstruction of the site facilities and in the operational period following completion of construction. In addition, it discusses measures that will be taken to reduce or eliminate the potential for leachate generation. Leachate as used in this memorandum refers to any water regardless of its source that comes in contact with municipal solid waste and that therefore is considered potentially contaminated.

### **Leachate from Old Refuse:**

Portions of the existing Bow Lake Transfer/Recycling station are constructed over an old municipal waste landfill that was operated at the site from the 1940's and 1950's. Refer to the Seattle-King County Department of Public Health's April 30, 1985 *Abandoned Landfill Study in King County* for more information about the history of the Bow Lake site. When landfilling stopped in 1961, the area was capped with soil and a transfer station was constructed on top of the soil cap. The current transfer building is supported on timber piles that penetrate through the old waste layer. The current stormwater management system consists primarily of surface sheet flow and some local piped flow to the eastern perimeter of the developed site and to a lesser extent to landscaped areas in the interior of the site where the flow dissipates through infiltration and down slope surface flow. It can be assumed that a significant portion of this runoff becomes groundwater and that part of this flow is reaching the old waste deposits which results in leachate generation. In the attached supporting technical memorandum, it is estimated that the new facility has the potential to reduce the groundwater flow due to precipitation infiltration by approximately 8.4 millions gallons per year. This could significantly reduce the potential for leachate generation at the site. This reduction is premised on the collected stormwater flow being discharged to Stream E at the bottom of the eastern slope via a tight line or being discharged through a dispersal system at locations on site where the flow would be away from old refuse deposits. Either of these discharge options also has the potential to reduce the possibility of groundwater exacerbated slope instability. The following paragraphs discuss the basis for this reduction in more detail.

During the reconstruction of the transfer station, the old structures and pavements will be demolished, the site will be regraded, and new, much more extensive structures and pavements will be constructed. Once construction is completed, large areas of the old landfill site will be covered with highly impervious construction including concrete and asphalt paving and concrete and steel buildings. This new construction will provide an effective cap over much of the old refuse deposits. In addition, an extensive permanent surface water management system will intercept, collect and direct surface water runoff to a new stormwater detention and treatment system. The preferred discharge from this system will be by tight line down the eastern slope of the site to the stormwater system located near the Southcenter Parkway. If this pipeline is not constructed, the system discharge will be dissipated as surface flow through a spreader system designed in accordance with the requirements of the *King County Surface Water Design Manual (2005)*.

Landscaped areas within the developed area of the site and located above known or suspected waste deposit areas will be sloped to drain to the stormwater collection system rather than to encourage infiltration. Where appropriate, a subsurface drain system consisting of a dense, semi-impervious soil layer topped by a porous drain layer and perforated pipe collection system may be placed below the vegetative support layers of soil in landscaped areas to intercept infiltrated flow. This flow will be directed to the stormwater system.

In addition, old refuse will be removed under selected new structures to eliminate concerns about settlement and its effect on structures. Removal of refuse will reduce the site's potential for generating leachate.

Precipitation falling on the 1.5 acre roof of the transfer building will be diverted to a rainwater harvesting detention system. This water will be used for washdown of the transfer station floors and, as explained below, will therefore be diverted to the sanitary sewer system with excess amounts sent to the stormwater system. Consequently, a rainfall on approximately 10% of the developed site will be prevented from ever coming in contact with the old refuse deposits under the developed site. As indicated in the attached memorandum, approximately 8.2 acres (roughly 50%) of the developed site will be impervious surfaces (roof areas and pavement) with the precipitation from these surfaces diverted either to the stormwater system or to the sanitary sewer system.

While construction is in progress, areas stripped of their natural or man-made cover and underlain by old refuse may be temporarily more susceptible to water infiltration from precipitation and surface runoff. In order to minimize the risk of leachate generation, the following measures will be taken:

1. The majority of the earthwork (excavation and grading) will be scheduled for the drier months of the year (April through October) under a separate site preparation contract

2. The permanent stormwater detention and treatment system will be installed and made operational during the site preparation construction
3. Following completion of the site preparation work, the site will be “winterized” using temporary erosion and sediment control best practices measures including temporary covers over exposed soil, such as plastic sheeting and PAM (drinking water grade polyacrylamide monomer), and by compacting and sloping the finished subgrade to encourage runoff to flow to the surface water management system rather than into the subsurface soils
4. The site preparation contractor will be required to inspect and maintain the wet weather protection system and responsibility for maintaining this system will pass to the site facilities contractor
5. Subsequent facility construction under a separate construction contract will be scheduled to start at the beginning of the next dry period and any remaining earthwork will be undertaken during this or subsequent dry periods
6. Site winterization will continue for each wet period until the facility construction is complete
7. Throughout the construction an extensive temporary surface water collection system will be constructed to collect surface water and direct it away from sensitive areas where infiltration is not desirable, including excavations into or above old refuse, and two the permanent detention and treatment facilities noted in item 2

Following reconstruction of the transfer station, leachate generation from the old refuse is expected to be less than from existing conditions, due to decreased stormwater infiltration and a slight reduction in refuse quantity.

### **Leachate from Waste Handling Operations**

Once the transfer station is in operation, leachate will be generated from washdown water used inside the transfer building to clean floors and other surfaces that come in contact with refuse. It may also be generated as water draining from refuse after it is placed inside trailers and intermodal containers and parked temporarily on the site if the trailer and container door seals are not watertight. To eliminate the possibility of this leachate migrating into the environment, all floor areas within the transfer building will drain to the sanitary sewer system. In addition, the parking areas for all loaded waste trailers/containers and any outdoor areas where open top bins for recyclable materials are placed will be constructed with concrete paving, sloped so that the drip areas at the rear of the trailers/containers and under bins and drop boxes drain to an inlet and thence to the sanitary sewer system. This collected wastewater will be hauled to an approved

treatment facility after first being pretreated in a wastewater treatment facility that is part of the proposed facility.

Attachment: December 12 , 2006 Technical Memorandum

December 12, 2006

## **Technical Memorandum**

From: Ian Sutton, P.E.

To: Steve Bingham, ESA Adolfson

Subject: Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Quantitative Evaluation of Potential for Leachate Generation at the Project Site

The purpose of this memorandum is to quantitatively address the potential for leachate generation at the Bow Lake Transfer/Recycling Station (Bow Lake TS) site. Leachate is any water, regardless of its source, that comes in contact with municipal solid waste (MSW) and that therefore is considered potentially contaminated. This quantitative analysis is focused on potential leachate generation as a result of precipitation.

### **Reduction of Available Precipitation:**

The Bow Lake TS site is at an existing landfill. Precipitation that falls on-site has the potential to infiltrate into the existing landfill, contact MSW, and become leachate.

Clean surface water runoff from impervious site surfaces is routed east of the facility and dispersed down the eastern slope. Some of this water has the potential to infiltrate into the ground, contact MSW contained within the existing landfill, and become leachate. Only precipitation falling on the trailer parking area is considered contaminated and is therefore collected and removed from site in the wastewater system. This collection area is approximately 54,000-ft<sup>2</sup> and is shown in Attachment 1.

As part of the Bow Lake TS Expansion Project, precipitation falling onto impervious site surfaces will be collected and either removed from site or dispersed to another area of the site. This precipitation will not have the opportunity to infiltrate into the existing landfill if it is routed off-site by tight-line or if it is discharged away from the landfill deposits. The impervious surface area for the expanded facility is approximately 410,000-ft<sup>2</sup> and is shown in Attachment 2.

The Bow Lake TS Expansion Project provides an increased run-off collection area of 356,000-ft<sup>2</sup> over that of the existing Bow Lake TS. The site location receives an annual rainfall of 38-in, as shown in Attachment 3. The resultant volume of precipitation is 1.13x10<sup>6</sup>-ft<sup>3</sup>, or 8.4-million gallons. Disregarding evaporation and transpiration, the Bow Lake TS Expansion Project has the potential to redirect approximately 8.4-million gallons of water each year away from landfill deposit areas. This would significantly reduce the potential for leachate generation at the site.

Site wide reduction of potential leachate can also be considered. The combined original King County property and acquired WSDOT property has an approximate 889,000-ft<sup>2</sup> area. The increased impervious surface collection area for the Bow Lake TS Expansion Project will be approximately 356,000-ft<sup>2</sup>. This will result in a potential 40% reduction in available surface water that could become leachate.