King County

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Addendum to SEPA Checklist
Bow Lake Recycling and Transfer Station

July 21, 2008

Description of Proposal: The King County Solid Waste Division (KCSWD) is proposing to replace and expand the existing Bow Lake Recycling and Transfer Station. The proposed project involves an 8.9-acre expansion to the north of the existing station on adjacent property currently owned by Washington State Department of Transportation (WSDOT). The County is currently finalizing acquisition of this surplus right-of-way. The proposed project will involve demolition of existing structures and site work. New structures will include a transfer building, transfer trailer yard, recycling and yard waste facilities, internal roadways and parking areas, and associated utilities.

This project is detailed in the *2006 Facility Master Plan Update, Bow Lake Recycling and Transfer Station Update (FMP)*. The Master Plan was prepared to provide a blueprint for expanding the existing Bow Lake Recycling and Transfer Station. This expansion is necessary because of the station's important role within the County's solid waste management system, including improved operational efficiency, compliance with current building and environmental standards, enhanced customer service, customer and employee safety improvements, and preparation for eventual out-of-county waste export.

Proponent and Lead Agency: King County
Department of Natural Resources and Parks
Solid Waste Division
201 S. Jackson Street, Suite 701
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Location of Proposal: The location of the project is the existing Bow Lake Recycling and Transfer Station in south Tukwila near the intersection of Orillia Road South and South 188th Street, just east of Interstate 5 (I-5). The project will also involve a parcel of land directly north of the Bow Lake Recycling and Transfer Station, currently owned by WSDOT.

Environmental Documentation: KCSWD issued a SEPA Environmental Checklist (EC) and Mitigated Determination of Non-Significance (MDNS) for the project on December 21, 2006. The lead agency for this proposal determined that it did not have a significant adverse impact on the environment. A number of mitigation measures intended to minimize potentially adverse impacts were described. The lead agency determined that an Environmental Impact Statement (EIS) was not required under Chapter 20.44 County Environmental Procedures and RCW 43.21C.030(2)©. The decision was made after a review of the completed Environmental Checklist.

As design of the project has progressed, there have been a number of modifications to the project as previously described in the 2006 Environmental Checklist. In some areas (e.g. stormwater system), design has progressed to a point where more detail is now available. In other areas, new regulations (e.g. climate change) are now in place, which require additional evaluation. For these reasons, an Addendum to the 2006 Environmental Checklist has been prepared. Specific issues that are addressed in the Addendum include: site footprint, construction schedule, solid waste processing capability, stormwater handling during construction, construction traffic, additional geotechnical studies, long-term stormwater handling, climate change, and noise from operations.

Conclusion: The results of evaluation of potential impacts resulting from modifications to the project do not change the analysis of significant impacts in the 2006 Environmental Checklist and no new probable significant environmental impacts are expected. This SEPA Addendum is issued in accordance with Chapter 20.44 KCC and WAC 197-11-350.

Information used in support of the SEPA Addendum is on file with the lead agency. This information is available to the public on request for a nominal photocopying fee.

Responsible Official: Kevin E. Kiernan, P.E.

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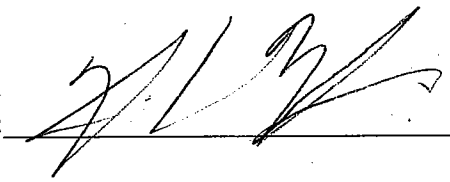
Date: 07-22-08 **Signature:** 

The SEPA Addendum is available on the following project Web site:

http://www.metrokc.gov/dnrp/swd/facilities/bowlake/index.asp

ADDENDUM TO

2006 Environmental Checklist
State Environmental Policy Act

2006 Facility Master Plan Update
Bow Lake Transfer/Recycling Station

July 2008

King County
Department of
Natural Resources and Parks
Solid Waste Division

Addendum to

Environmental Checklist
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Introduction

In 2005 and 2006, King County Solid Waste Division (KCSWD) initiated a series of engineering and environmental studies intended to determine the best means for expanding the Bow Lake Transfer/Recycling Station and to identify potential environmental impacts associated with expansion. In late summer 2006, KCSWD, acting as lead agency, prepared a State Environmental Policy Act Environmental Checklist (SEPA Checklist) for the project, *Environmental Checklist, State Environmental Policy Act: 2006 Facility Master Plan Update, Bow Lake Transfer/Recycling Station* (KCSWD, 2006). KCSWD issued a Mitigated Determination of Non-Significance (MDNS) on August 30, 2006. The lead agency determined that the proposed project did not have a significant adverse impact on the environment and that an Environmental Impact Statement (EIS) was not required under Chapter 20.44 County Environmental Procedures and RCW 43.21C.030(2)(c). The SEPA Checklist was circulated to interested residents, adjacent landowners, municipalities, and government agencies and a public meeting was held on September 14, 2006. Responses to the SEPA Checklist were obtained from two municipalities and one private developer.

Following review of comments received on the SEPA Checklist, KCSWD determined that it was desirable to provide additional information on environmental issues associated with the project and decided to temporarily withdraw the SEPA Checklist. Additional information was incorporated into a revised SEPA Checklist. Minor modifications to the Facility Master Plan (FMP) were also made in response to the new information. The revised SEPA Checklist was then recirculated and the MDNS reissued on December 21, 2006.

Reason for Addendum

There are several reasons that have led KCSWD to prepare this Addendum to the December 2006 SEPA Checklist. As design of the project has progressed, there have been a number of modifications to the project as previously described in the 2006 SEPA Checklist. In some areas (e.g. stormwater system), design has progressed to a point where more detail is now available. In other areas, new regulations (e.g. climate change) are now in place that require additional evaluation of the project.

Specific issues that will be addressed in this Addendum are listed below:

1. Site Footprint. The site footprint has changed slightly from that shown in the 2006 SEPA Checklist.
2. Construction Schedule. A more specific timetable for proposed construction activities has now been developed.
3. Processing. Since the SEPA Checklist was issued in 2006, KCSWD has added additional solid waste processing capability to the project.
4. Stormwater During Construction. In accordance with applicable requirements, more details about potential methods for handling stormwater during construction have now been developed.

5. Construction Traffic. Progress on the design of the facility has resulted in changes in estimates of the volumes of material and required truck trips required to haul material to and from the site.

6. Geotechnical Studies. There have been additional geotechnical studies since the SEPA Checklist was issued.

7. Stormwater System. KCSWD has determined that directing stormwater to Stream E at the base of the slope east of the site is the most desirable means of discharge. Design details have now been developed and are being reviewed by the City of Tukwila.

8. Climate Change. Since the SEPA Checklist was issued in December 2006, King County has developed SEPA requirements associated with effects of the proposed station on climate change.

This Addendum to the 2006 SEPA Checklist has been prepared in accordance with King County Code (KCC), Chapter 20.44 that adopts SEPA Administrative Rules, Washington Administrative Code (WAC), Chapter 197-11. Specifically, this Addendum follows WAC 197-11-625 Addenda Procedures and WAC 197-11-706 Addendum, which defines the purpose and nature of an Addendum.

Modifications to the Project

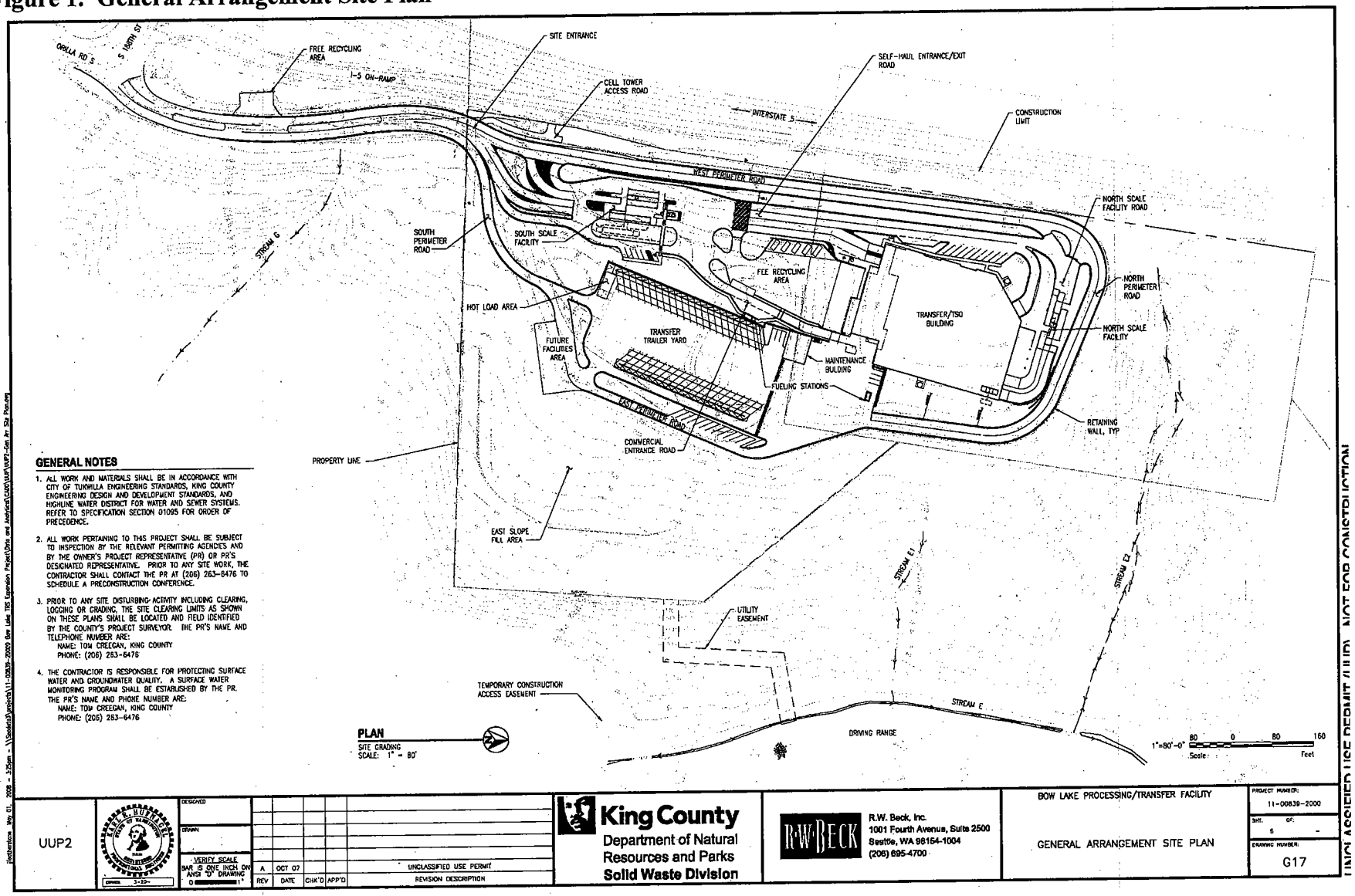
Site Plan

The updated Site Plan is provided in Figure 1. Slight modifications have been made to the size and layout of the Transfer Building in the northern portion of the site. Minor changes to the recycling and yard waste areas on the south side of the Transfer Building have also been made. The offsite easement for the stormwater and sewer pipelines adjacent to the eastern boundary or the site is in the process of being negotiated and acquired.

Project Schedule

The Environmental Checklist described a project schedule consisting of three phases, beginning in April 2008. Construction was to be completed in June 2011. Since the Environmental Checklist was issued in December 2006, the overall construction process has been described and the project schedule refined. The facility will be constructed under two general construction contracts. Bulk excavation and grading of the site areas outside the existing station footprint and some site utility work will be conducted under the **Site Preparation** contract. The Site Preparation contract will be a conventional design-bid-build contract.

Figure 1. General Arrangement Site Plan



The Site Preparation contract is now expected to run from October 2008 through October 2009. The remainder of the facility construction, including demolition of the existing structures, will be conducted under the **Site Facilities** contract. The Site Facilities contract is now scheduled to commence November 2009 and continue through Summer 2012.

In order to expedite construction, the Bow Lake Transfer/Recycling Station will be closed to self-haul traffic during contractor work hours on weekdays under both the Site Preparation and Site Facilities contracts. Self-haul traffic on weekdays will utilize other solid waste facilities in south King County (e.g. Renton, Algona) and may, at times, be allowed in after construction work hours on weekdays. The Bow Lake facility will continue to serve all commercial and account-holding customers.

Processing

A limited amount of processing is currently conducted at the existing Bow Lake Transfer/Recycling Station. Processing takes place primarily at the Free Recycling area south of the Scale Facility and at the Paid Recycling area south of the existing Transfer Building.

As described in the 2006 SEPA Checklist, the proposed project may expand processing at the site through the addition of a Yard Waste Tipping Area and compaction of Municipal Solid Waste (MSW). Yard waste and other woody waste may be chipped and ground into a compostable material. This material would then be placed in trailers for transport to a compost facility. Within the Transfer Building, two stationary, preload compactors will compress MSW prior to loading into containers to be hauled from the site. Compaction of MSW will maximize truck payloads and reduce the number of haul trips.

Since the 2006 SEPA Checklist was issued, KCSWD has further expanded future processing capability at the site. Design of the new Transfer Building will allow space for separation of specific materials (i.e. cardboard, paper, wood, metal, plastic) from the general MSW stream. All recyclable materials except wood and metal will be baled on site. A summary of materials processing activities is provided in Table 1. Note that expanded processing activities are shown in bold.

Table 1. Material Processing Bow Lake Recycling & Transfer Station

Facility Area	*Materials Processed*	*Process*	*Type of "Solid Waste Processing" as defined in WAC 173-350-01 or WAC 173-304-100*
Fee Recycling Area	Metal Appliances Fluorescent tubes Household batteries E-Waste	Collect and consolidate by material type	Operation to prepare a material for reuse, recycling or disposal
Yard Waste Tipping Area	Woody waste Yard waste	Collection and consolidation of woody waste and non-ground yard waste in trailers for transport to a composting facility	One part of an operation to convert a material into a useful product
Building Tipping Floor and Lower Level	**Cardboard** **Paper** **Wood** **Metal** **Film plastic**	**Separation from the general Municipal Solid Waste (MSW) waste stream and consolidate by material type** **Bale all recyclable materials except wood and metal including material collected at the free recycle area**	**Operations to prepare a material for reuse or recycling**
	MSW	Compact MSW in two stationary, preload compactors prior to loading into containers to maximize payloads and minimize hauling traffic and costs	Operation to prepare solid waste for disposal
Possible Future Facility Enhancements	Wood waste chipping. Vactor decant facility	Chipping and grinding of woody waste into a compostable material Dewater grit removed from storm sewers and roads and streets	One part of an operation to convert a material into a useful product. Operation to prepare solid waste for disposal

The addition of processing capability within the proposed Transfer Building required several design modifications to the interior of the structure but did not alter the overall building footprint or height.

Separation and baling of selected materials from the MSW stream will reduce the volume of waste to be hauled from the site. The types of trucks used to haul separated and baled waste may be different than those used for hauling compacted waste in containers, however, the number of truck trips required is not expected to change.

WSDOT Right-of-Way

King County has been working cooperatively with WSDOT to address right-of-way issues since an early point in the planning process. As design has progressed, more detailed information has become available regarding potential impacts on the WSDOT right-of-way, adjacent to the project site's western boundary. Construction of the retaining wall near the project site's western boundary will require clearing and grading activity within the WSDOT right-of-way. In addition, a portion of the Highline Water District water main that serves the Bow Lake Transfer/Recycling Station lies within the right-of-way. The project will include upgrading this pipeline. Both of these activities are temporary in nature. The duration of construction is estimated to range from six to nine months. Neither activity will involve disruption of the on-ramp to I-5. No significant impacts are anticipated. WSDOT has prepared a Categorical Exclusion (CE) for the right-of-way work as part of compliance with the National Environmental Policy Act (NEPA) 23 CFR 771.117.

Analyses

Construction Traffic

Construction traffic was first described in Section 14. f. of the 2006 SEPA Checklist for the Site Preparation and Site Facilities contracts. As design has progressed further, estimates of excavation and fill requirements have been refined and volumes of material to be exported modified. The schedules for the Site Preparation and Site Facilities contracts have also been developed in more detail.

For these reasons, KCSWD has developed more detailed information concerning construction traffic and potential impacts on adjacent roadways. Additional analyses of potential construction traffic have been conducted and are summarized in this section of the Addendum. These analyses include a trip generation analysis and comparison of construction traffic with expected self-haul operations. For more detail, refer to "Bow Lake Transfer Station – Construction Impacts" in Appendix A.

As described previously in the Addendum, construction activity will occur under two contracts. Under the Site Preparation contract, it is expected that site work will be conducted between October 2008 and October 2009. It is likely that most site work and heaviest traffic will occur during dry periods within this time frame. During the Site Preparation contract, construction traffic will include trucks associated with soil delivery, material export, piling and concrete, as well as worker vehicles and miscellaneous vehicle trips (e.g. deliveries, vendor visits, inspectors, etc.). In order to facilitate construction, the station will be closed to self-haul traffic during contractor work hours on weekdays under both Site Preparation and Site Facilities contracts.

The Site Facilities phase will occur after completion of the Site Preparation contract. It is tentatively scheduled to occur between November 2009 and summer 2012. Construction

traffic during this contract is expected to include trucks associated with material removal, material and equipment import, worker vehicles, and miscellaneous trips.

Daily trip generation estimates for both contracts of construction are based on information provided in "Memorandum: Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast" prepared in spring 2008. (See Appendix B.) Estimates for typical and peak conditions during the more active dry seasons are shown in Table 2. Weekday PM peak hour traffic generation for trucks and miscellaneous vehicle trips are estimated using specific amount of work hours per day. Estimates for 8-hour and 10-hour workdays are provided to demonstrate the effect of workday length on PM peak hour trip generation. Finally, weekday PM peak hour trips generated by workers are based on the expected number of workers and trip generation rates from *Trip Generation, 7th Edition* (Institute of Transportation Engineers (ITE), 2004). Specifically, a trip rate of 0.42 weekday PM peak hour trips per worker is used based on the General Light Industrial land use category.

Table 2. Estimates of Construction Period Trip Generation

Land Use	Average "Dry" Season Conditions			Peak "Dry" Season Conditions		
	Weekday Daily Trips	Weekday PM Peak Hour Trips		Weekday Daily Trips	Weekday PM Peak Hour Trips	
		10-Hour Workday	8-Hour Workday		10-Hour Workday	8-Hour Workday
Site Preparation[1]						
Soil Removal Trucks[2]	80	8	10	200	20	25
Imported Material Trucks[2]	20	2	3	20	2	3
Concrete Trucks[2]	20	2	3	20	2	3
Workers[3]	90	13	13	150	21	21
Other[2]	50	5	6	60	6	8
Total	**260**	**30**	**35**	**450**	**51**	**60**
Site Facilities[1]						
Material Removal Trucks[2]	56	6	7	56	6	7
Imported Material Trucks[2]	14	1	2	60	6	8
Workers[3]	150	21	21	450	63	63
Other[2]	60	6	8	80	8	10
Total	**280**	**34**	**38**	**646**	**83**	**88**
Existing Operations						
Transfer Trailer Trucks[4]	116	12	15	116	12	15
Commercial Haul Trucks[4]	468	8	8	468	8	8
Self-Haul Vehicles[4]	456	34	34	456	34	34
Total	**1040**	**54**	**57**	**1040**	**54**	**57**

1. Daily trip generation based on estimates provided in *Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast* (R.W. Beck, 2008).
2. Weekday PM peak hour estimates for soil removal trucks, imported material trucks, material removal trucks, and other vehicles based on daily estimates and the number of hours in a typical workday.
3. Weekday PM peak hours estimates for workers during Site Preparation and Site Facilties contracts based on the estimated number of workers and the trip rate per employee taken from *Trip Generation*, 7th Edition, 2003 (ITE, 2003).
4. Estimates of daily and weekday PM peak hour traffic associated with the Self-Haul Operations are based on the existing data and transaction forecasts provided by King County.

Self-haul traffic at the recycling and transfer station consists of passenger vehicles and small trucks. It does not include trucks used to haul solid waste from the processing/transfer facility.

In Table 2, estimates of traffic associated with each self-haul operation have been calculated based on historical data and projections over the four-year construction period. Daily trip generation for the transfer trailer trucks was obtained from existing data provided by KCSWD. Weekday PM peak hour trip generation was calculated based on 8-hour and 10-hour workdays.

For commercial and self-haul operations, future estimates of transactions over the period 2008 through 2012 have been provided based on existing data and historical growth. To determine the number of daily trips associated with these operations during the construction period, the August 2010 estimate of transactions provided by KCSWD were used. This estimate of approximately 18,000 monthly transactions is expected to represent an average number of transactions during the "dry" portion of the construction period. Of the total number of transactions, approximately 68 percent are associated with self-haul operations while the remaining 32 percent are tied to the commercial haul operations. Applying this breakdown, approximately 12,300 self-haul transactions and 5,700 commercial haul transactions are expected.

The resulting daily and weekday PM peak hour trip generation expected during the two construction phases and the self-haul operations are summarized in Table 2. As shown in the table, during the dry season, the Site Preparation phase is expected to generate approximately 260 daily trips with approximately 30 to 35 of these trips occurring during the weekday PM peak hour. During the Site Facilities phase (dry season), construction is expected to generate a slightly higher number of trips, approximately 280 trips on a daily basis. Of these, approximately 34 to 38 trips are likely to occur during the weekday PM peak hour. During peak conditions, likely to be infrequent, construction activity may generate up to approximately 650 daily trips and 90 weekday PM peak hour trips.

Hypothetically, in the absence of construction activities, self-haul operations are projected to generate approximately 1,040 daily trips on an average weekday over the next four years. During weekday PM peak hour, approximately 54 to 57 trips would likely occur.

A comparison of construction-related trips with self-haul trips in the absence of construction indicates that trip generation associated with construction activity will be substantially less than would normally occur at the site during self-haul operations. Although weekday PM peak hour traffic during peak conditions of the Site Facilities phase of construction is expected to exceed typical self-haul trip generation by approximately 30 trips, this condition is expected to occur infrequently. Overall, with the facility closed to self-haul traffic during contractor work hours, off-site impacts to the adjacent roadway network during construction are generally expected to be within the boundaries of traffic impacts during normal operations of the processing/transfer facility.

Several mitigation measures are intended to reduce or eliminate potential impacts associated with haul truck traffic to and from the site.

- Construction documents will require all truck traffic to enter the site with a right-turn only movement. Similarly, truck traffic leaving the site will be required to exit with a right-turn only movement. This will reduce potential impacts at the Orillia Road S.W./ S.W. 188th Street intersection near the entrance to the site.
- Signage will be provided as needed to alert drivers to construction activity and to facilitate vehicle movement through construction areas and vehicle access locations.
- Flaggers will be utilized as needed, particularly during peak hour periods, to expedite vehicle movements through potentially congested areas.

Stormwater Management During Construction

The 2006 SEPA Checklist (Section 3) described surface waters in the vicinity of the project, potential impacts on water quality associated with construction and operation of the new facility, and mitigation measures that would be used to reduce or eliminate potential impacts. The SEPA Checklist also described applicable state and local regulations that will apply to stormwater management during construction.

Since the SEPA Checklist was issued, additional design work has been conducted on the proposed stormwater discharge system as well as stormwater management during construction. Similar to the operational stormwater system, design work for stormwater management during construction has been developed in accordance with provisions of the *King County Surface Water Design Manual* (King County, 1998), as amended by the Tukwila Public Works Development Guidelines and Design and Construction Standards (Tukwila Municipal Code [TMC] 14.30.070).

In order to meet City of Tukwila and Ecology regulations, KCSWD will prepare and implement a Temporary Erosion and Sedimentation Control (TESC) Plan. A Stormwater Pollution Prevention Plan (SWPPP) will be developed as part of NPDES Permit conditions. An Environmental Protection Plan (EPP) will be developed that will describe procedures for managing and monitoring excavation activities, including procedures for identifying, testing, and handling of contaminated materials should they be encountered during site work. Each of these plans has specific measures, including Best Management Practices (BMPs), intended to reduce or eliminate potential stormwater impacts during construction.

Although design is not yet complete, the elements are now available and can be used to assist regulators in refining the design to minimize potential impacts and ensure that stormwater quality meets applicable standards. Stormwater generated on the site during construction will be intercepted and conveyed to a temporary detention pond located east of the facility. Flow from the pond will be directed to a chitosan-enhanced sand filtration (CESF) treatment system with chemical treatment for suspended solids. Following

treatment, stormwater will be pumped to a newly-constructed pipeline to an outfall that discharges to Stream E.

All construction-related stormwater will be directed to the detention pond until the permanent stormwater vaults are installed. These vaults will then provide stormwater treatment for suspended solids and will also discharge through the new stormwater pipeline to Stream E. Both the pond and vaults will remain available for construction stormwater treatment until the project can transition to sole use of the vaults. Note that any stormwater that comes into contact with burn fill or refuse material will be considered contaminated stormwater (CSW) and will be collected and hauled offsite independent of the pond or vault systems.

In the event that there is a temporary delay in construction of the stormwater discharge line to Stream E (the County is in the process of obtaining an easement), on-site stormwater would be collected, treated as necessary in ponds and/or vaults to meet applicable water quality requirements and then discharged through spreaders along the upper slopes on the east side of the site. Discharged stormwater would then percolate into the soil on the vegetated hillside before infiltrating into the groundwater system. (This system is very similar to that which exists at the present time.) The temporary detention and treatment pond system would meter out flows to the spreader system.

During major storm events, runoff quantities may occasionally exceed the capacities of the pond and spreader system. When this occurs, the contractor would be required to pump excess flows into portable tanks and haul the water off-site for approved disposal.

In order to estimate potential truck trips resulting from major storm events, a 10-year, 72-hour storm event was assumed. Based on projected stormwater volumes, detention pond storage volumes, and projected spreader rates, excess volumes of treated stormwater to be hauled were calculated. Assuming a tank truck with 8,000 gallons capacity, peak and average truck trips are calculated to be 3.6 and 1.6 trips per hour, with a total of 114 trips over the course of 72 hours. See Appendix C for more detail. During peak storm conditions, truck haul trips would be a small percentage of daily construction traffic and are not considered a significant traffic impact. Most storm events would be considerably less than a 10-year event and the required truck trips correspondingly less. See Construction Traffic Section above.

Geotechnical Studies

Following issuance of the 2006 SEPA Checklist, additional geotechnical investigations have been conducted in support of overall project design. These provide useful information on potential geotechnical impacts of the project, recommended design elements, and mitigation measures to reduce or eliminate potential impacts.

The *Geotechnical Report: Slope Pipelines, Bow Lake Processing/Transfer Facility, King County Solid Waste Division, Tukwila, Washington* (HWA Geosciences, Inc., 2008)

examined geotechnical issues associated with the proposed construction of stormwater and sanitary sewer pipelines from the project site east to the valley floor. Work included a combined geotechnical and environmental subsurface exploratory program; analytical laboratory testing; and geotechnical laboratory testing and engineering analyses.

The study found "...no signs of either incipient or on-going slides..." along the proposed pipeline alignment although steep gradient cuts are present on the lower slopes. The study determined that "...the proposed pipelines can be installed as planned when the engineering recommendations as presented herein are adhered to."(HWA Geosciences, Inc., 2008). These recommendations addressed various methods of pile support in refuse and non-refuse areas, use of spread footings, use of shallow auger piles and/or pin-piles, regarding of slopes in selected areas, and buttress fill at the toe of steep slopes.

The study also analyzed soil samples along the alignment for contamination associated with refuse material. Toxicity Characteristic Leaching Procedure (TCLP) and total metals analyses were performed to assess offsite disposal options for excess or unsuitable soils. TCLP analysis involves evaluation of a leached extract to determine the tested material's Hazardous Waste ("Dangerous Waste" in the State of Washington) classification for regulatory compliance and disposal purposes. Total metals analyses measure all of the selected metals in a sample. The results of these analyses indicated elevated petroleum hydrocarbon and metals concentrations near the top of the slope within the proposed pipeline alignment.

The study recommended a number of measures that should be implemented during construction. These include:

- Construction bid documents should include all analytical results and requirements for handling of contaminated soil and refuse, treatment/disposal requirements and health and safety requirements.
- During excavation and soils handling, soils should be field screened for staining and/or odors. Prior to export, stockpiled soils should be sampled for potential contamination as required by the disposal facility.
- All geotechnical studies and environmental analyses of soils should be made available to the receiving facility for review.
- The contractor should be required to notify the Owner's Project Representative of suspected contaminated materials.
- Contract specifications should contain provisions for testing, segregating and stockpiling materials, decontamination, and standby time for delays due to testing.
- The contractor should be required to submit waste characterization, waste management, spill prevention/control, and health and safety plans.

The geotechnical reports and accompanying analytical data will be made available to the Contractor. Required measures for identifying and handling contaminated materials will be incorporated into the Environmental Protection Plan (EPP) and Contract Documents.

The *Final Geotechnical Report: Bow Lake Processing/Transfer Facility, King County Solid Waste Division, Tukwila, Washington* (HWA Geosciences, Inc., 2008) is a design level geotechnical engineering study that provides recommendations for site work and construction of the new facility. The investigation examined the existing transfer station site and the WSDOT site to the north, which King County is in the process of acquiring. The work included a combined geotechnical and environmental subsurface exploratory program; analytical laboratory testing; and geotechnical laboratory testing and engineering analyses. Based on subsurface explorations, detailed cross-sections were developed throughout the site.

The information generated in this study substantially increased the level of information available beyond that described in previous studies and summarized in the 2006 Environmental Checklist. More detailed information was provided on engineering properties of soils, seismicity, refuse extent and characteristics and probable settlement. This information led to development of design recommendations for specific elements of the project including the Transfer Building, the Scale Facilities, various retaining walls, the stormwater detention vaults and wastewater holding tank, and the maintenance building.

A number of geotechnical measures have been incorporated into the design in order to minimize or eliminate potential geotechnical impacts related to seismicity, slope stability, and settlement. These include:

- Design of structures according to International Building Code (IBC) seismic criteria.
- Use of preloading methods to compress soils subject to settlement.
- Use of structural fill and compaction.
- Use of cast-in-place concrete, soldier pile, or mechanically-stabilized earth (MSE) designs for retaining walls.
- Use of pile foundations.
- Over-excavation of refuse and unsuitable soils.
- Provision of landfill gas-venting systems for all buildings and vaults.

In spring 2008, the *Final Slope Stability Report Bow Lake Recycling and Transfer Station, King County Solid Waste Division, Tukwila, Washington* (HWA Geosciences, Inc., 2008) was prepared. The document provides an evaluation of the stability of eastern and southern slopes, slope stability along the northern perimeter road, Wall E design and construction considerations, and fill handling and disposal. The scope of work included a geotechnical subsurface exploration program, slope stability analyses, engineering analyses for wall design, and design and construction recommendations. These recommendations indicate that significant slope stability impacts can be avoided using generally-accepted engineering methods.

Stormwater Discharge

The SEPA Checklist issued in December 2006 described proposed collection and treatment of stormwater generated on the project site. The SEPA Checklist also described how the stormwater system would meet all applicable requirements, specifically, the *King County Surface Water Design Manual* (King County, 1998) as amended by the Tukwila Public Works Development Guidelines and Design and Construction Standards (Tukwila Municipal Code [TMC] 14.30.070).

The December 2006 SEPA Checklist described two possible methods for disposing of stormwater following collection and treatment, one, a pipeline down the slope east of the site with a discharge to Stream E, and two, an engineered spreader for distributing stormwater on-site near the top of the slope. More detailed analyses of these options were conducted in spring 2007. A Sensitive Area Study of Wetland and Watercourses was conducted in accordance with TMC Chapter 18.45 Environmentally Sensitive Areas. Wetlands and portions of Stream E likely to be affected by the project were surveyed and an inventory of trees on the project site was conducted in accordance with TMC Chapter 18.54 Tree Regulations.

These analyses further confirmed that the preferred method for disposing of stormwater was the pipeline to Stream E, as originally described in the 2006 SEPA Checklist. Stream E is a fish-bearing watercourse that discharges to the Green River via a pump station and flow control structure referred to as the S. 180th Pump Station. Note that collection and treatment of stormwater on the project site remains the same as described in the SEPA Checklist.

From the proposed stormwater treatment vaults, flows will be directed down steep slopes east of the site via pipeline (See Figure 1.). This pipe will terminate in an energy dissipating catch basin and rock-lined channel that will discharge directly into Stream E, a City of Tukwila Type 2 watercourse (See Figures 2 and 3.). More detailed information is available in *Preliminary Surface Water Technical Information Report, Bow Lake Recycling and Transfer Station Project, King County* (R.W. Beck, May, 2008).

A sanitary sewer line will also be constructed within the pipeline corridor. Use of this pipeline will await connection with a new sewer line to be constructed on the valley floor at an undetermined future date. For the foreseeable future, sanitary flows generated at the facility will be conveyed to an on-site holding tank. Periodically, these sanitary flows will be pumped from the holding tank, trucked to the KCSWD's Cedar Hills Regional Landfill for pre-treatment in that facility's leachate ponds, and then discharged to the Metro sewer.

The proposed action will have minor impacts on two wetlands along the pipeline alignment and on Stream E. Temporary wetland and stream impacts are calculated to be 948 and 280 square feet, respectively. Temporary wetland and stream buffer impacts are expected to be approximately 12,200 square feet. Permanent wetland impacts are expected to be 110 square feet. Mitigation for these impacts on wetlands and the stream

will be provided on-site in accordance with the requirements of Tukwila Municipal Code (TMC) Chapter 18.45 – Environmentally Sensitive Areas. Design of mitigation site(s) for the project is now underway and will be submitted to the City of Tukwila for approval.

In addition, the project will have to meet state and federal requirements regarding impacts to wetlands and streams. A Joint Aquatic Resource Permit Application (JARPA) was submitted on January 11, 2008 for review by state and federal agencies. Subsequently, an Hydraulic Project Approval (HPA) was issued on January 28, 2008 by the Washington State Department of Fish and Wildlife (WSDFW). It included standard conditions for construction of the discharge structure to Stream E.

The JARPA was also reviewed by the U.S. Army Corps of Engineers (Army Corps). The Army Corps issued a Nationwide 12 Permit on March 24, 2008. The Army Corps also concurred with the assessment of "no effect" to listed species under the Endangered Species Act. The 401 Water Quality Certification and Coastal Zone Management (CZM) consistency approvals were obtained on April 3, 2008 from the Washington Department of Ecology (Ecology) in conjunction with the Nationwide 12 permit.

Climate Change

The proposed Bow Lake Recycling & Transfer Facility will generate short-term emissions from construction/redevelopment of the existing facility and long-term emissions during operation of the upgraded facility. Both short-term and long-term emissions were addressed in the 2006 SEPA Checklist, including an air quality evaluation provided in Appendix E of that document.

Subsequent to issuance of the SEPA Checklist in December 2006, King County issued an Executive Order on September 1, 2007, which required King County departments to evaluate the impacts on climate of actions being evaluated under authority of SEPA. These impacts included those relating to greenhouse gas emissions. Although the SEPA Checklist for the Bow Lake Processing/Transfer Facility was issued prior to this Executive Order, KCSWD determined that it was desirable to include a climate change analysis in this SEPA Addendum.

Analysis of greenhouse gas (GHG) emissions for the proposed facility has utilized the SEPA GHG Emissions Worksheet (Version 1.7 12/26/2007) developed by King County Department of Development and Environmental Services (DDES). This worksheet identifies multiple sources of GHG emissions associated with development including:

- The extraction, processing, transportation, construction and disposal of materials and landscape disturbance (Embodied Emissions);
- Energy demands created by the development after it is completed (Energy Emissions); and
- Transportation demands created by the development after it is completed (Transportation Demands).

The worksheet is intended to provide estimates of GHG emissions that will be generated over the life span of a project. This includes emissions associated with obtaining construction materials, fuel used during construction, energy consumed during operation, and transportation by building occupants. See Appendix C.

For the proposed Bow Lake Processing/Transfer Facility, a lifespan of 50 years is assumed. The standard of measure used in the worksheet is carbon dioxide equivalent ($CO2_e$) since CO2 is typically the most common component of GHG emissions.

Using the SEPA GHG Emissions Worksheet, the total $CO2_e$ generated by construction and operation of the proposed facility over a 50-year lifespan is estimated to be 91,581 metric tons $CO2_e$ ($MTCO2_e$). This total includes 26,918 $MTCO2_e$ based on building size (i.e. square footage), 16,500 $MTCO2_e$ based on amount of pavement (i.e. square footage), and 48,163 $MTCO2_e$ based on operation of heavy equipment within the facility.

Embodied emissions included the cumulative footprints of all site structures, a total of approximately 83,400 square feet. Although use of some recycled materials (e.g. concrete, asphalt) are likely to be used for construction of the new facility, these were not included in the analysis of embodied emissions.

Energy emissions were based on an energy consumption model for the proposed Transfer Building. This included a base 1,389,000,000 btu/year regulated load (e.g. lighting, heat, ventilation) and a 1,413,000,000 btu/year process load (e.g. compactor, grinder). The regulated load was applied to the remaining site buildings as a square footage ratio that resulted in 54,000,000 btu/year of energy consumption for the remainder of the site. The site will also produce approximately 38,000,000 btu/year of renewable energy from a photovoltaic solar array on the roof of the Transfer Building. The cumulative energy consumption will be 2,818,000,000 btu/year. This estimate includes heat energy recovery from the compactor equipment.

Transportation emissions included a total of 25 on-site operational personnel over all shifts at the 24-hour facility. Haulers were not included because of the variability of the operations and the different sites involved.

Equipment emissions were not accounted for in the original worksheet and have been added to account for the biodiesel-powered heavy equipment to be used for on-site operations. It was assumed that there will be one full and one half time front end loader (4.5 gallons per hour); one full and one half time piece of small equipment (1.5 gallons per hour); and one full time yard tractor operating on-site at the 24-hour facility. The resulting estimate of fuel usage was 100,000 gallons per year. The facility equipment currently operates on a fuel mixture of 20 percent biofuel and 80 percent diesel fuel.

It is also important to note that the analysis applies solely to the proposed facility; no adjustment is made for replacing GHG emissions from the existing facility. To obtain incremental GHG emissions for the project, GHG emissions for the existing facility

would have to be subtracted from the GHG emissions for the proposed facility. Although this was not done in this evaluation, it is likely that the increment of additional GHG emissions at this location would be substantially lower than the GHG figure developed for the proposed new facility.

Noise from Yard Waste/Wood Waste Grinder

As discussed above, KCSWD has expanded processing capabilities at the proposed facility since the SEPA Checklist was issued in December 2006. This has included possible use of a portable grinder for yard waste and wood waste. The grinder reduces the volume of yard and wood waste, thereby reducing the number of haul truck trips from the facility. Further, grinding is one of the first steps in reprocessing of yard and wood waste into useable materials.

The grinder would be located near the southwest corner of the new Transfer Building. It would be partially-enclosed within a u-shaped wall approximately 8 feet in height. Although a specific grinder has yet to be selected, KCSWD determined that it would be desirable to assess potential noise impacts from grinder operations. A noise consultant was retained by KCSWD to evaluate potential noise impact on users of the facility and the nearest residential properties. See Appendix D.

This evaluation utilized representative equipment (i.e. Morbark Woodhog 2600), which the manufacturer indicated produced a noise level of 82 dBA at a distance of 100 feet at full power. Sound levels generated by grinder operations were modeled at the nearest residential properties to the transfer facility. As with previous analyses conducted for the SEPA Checklist, the Cadna/A model was used to predict potential sound levels. Projected sound levels for grinder operations were added to sound levels of other on-site equipment considered previously in the SEPA Checklist. The evaluation included both daytime and nighttime operations.

Daytime noise levels at the nearest residential properties were modeled for a yard waste/wood waste grinder at the proposed facility. Noise levels ranging from 49 to 53 dBA were predicted for the residences located to the west across Interstate 5 (I-5) and at the La Pianta property line to the north. Existing background sound levels (L_{90S}) during the day range from 68 to 71 dBA and are at least 15 dBA higher than the predicted facility sound levels at these nearest residential locations. As a result, even with the inclusion of a waste grinder at the new facility, noise from I-5 would obscure noise from daytime facility operations. Therefore, it is unlikely that noise from the facility would be audible except during rare lulls in I-5 traffic, and no adverse noise impacts are expected.

For nighttime operations, inclusion of the yard waste/wood waste grinder would result in noise levels ranging from 48 to 53 dBA at the nearest residential properties. Sound levels greater than 50 dBA would not comply with the nighttime noise limit. For this reason, KCSWD does not intend to operate the waste grinder at night.

Conclusion

A number of modifications to the Bow Lake Recycling and Transfer Station project have been made since the 2006 Checklist was issued by KCSWD. The results of evaluation of potential impacts resulting from these modifications do not change the analysis of significant impacts in the 2006 SEPA Checklist and no new probable significant environmental impacts would result.

Signature

The above statements are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make their decision.

Signature: _____
Name (print): KEVIN E KIERNAN
Title: DIVISION DIRECTOR
Date Submitted: 07-22-08

REFERENCES

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R.W. Beck. 2008. Technical Memorandum: Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast. From K. Hufnagel to S. Bingham (ESA Adolfson) and K. Gahnberg (The Transpo Group). October 16, 2006. Revised March 27, 2008. 4p.

The Transpo Group. 2008. Memorandum: Bow Lake Transfer Station – Construction Impacts. From K. Gahnberg and B. Przybyl (The Transpo Group) to K. Hufnagel (R.W. Beck). Kirkland, Washington. April 22, 2008. 4p.

APPENDIX A

Construction Traffic Impacts

The Transpo Group

MEMORANDUM

Date:	May 2, 2008	**TG:** 02150.00
To:	Karl R. Hufnagel, P.E. - RW Beck	
From:	Kurt Gahnberg - The Transpo Group Bart Przybyl, P.E., PTOE - The Transpo Group	
Subject:	Bow Lake Transfer Station - Construction Impacts	

This memorandum may serve as an addendum to the *Bow Lake Recycling/Transfer Station Traffic Impact Analysis* (TIA) prepared by Transpo in December 2006. Its purpose is to address the potential impacts of changed construction activity levels. A trip generation analysis was undertaken to estimate the number of trips that will be generated during the construction phase of the Bow Lake Recycling/Transfer Station expansion project. The estimates of construction traffic are then compared to the trips that are typically generated by the self-haul operations at the site to determine if construction traffic will now exceed typical self-haul traffic generation which will be curtailed during construction and therefore result in additional impacts to the surrounding roadway network. The following summarizes our analysis.

Trip Generation Estimates

Construction Traffic

Construction activity at the site will be performed in two phases. The Site Preparation will be done first and is scheduled to occur between August 2008 and October 2009. During this phase, construction traffic will include trucks associated with soil export, material import, concrete, as well as worker and miscellaneous (deliveries, vendor visits, etc.) trips. The Site Facilities construction phase will be done after the Site Preparation is complete and is scheduled to occur from November 2009 to Summer of 2012. Construction traffic for the Site Facilities phase will include trucks associated with material export, material and equipment import, as well as worker and miscellaneous trips.

Daily trip generation associated with the two phases of construction is based on information provided in *Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast* prepared by Karl Hufnagel, P.E., in March 2008. Estimates for typical and peak conditions during the more active "dry" season are shown. Weekday PM peak hour traffic generation for the various trucks and miscellaneous trips were estimated assuming a specific amount of work hours per day. Estimates for 8-hour and 10-hour workdays are provided to demonstrate the effect of the workday length on PM peak hour trip generation. Finally, weekday PM peak hour trips generated by the workers is based on the expected number of workers and trip generation rates from *Trip Generation*, 7th Edition, 2004, published by the Institute of Transportation Engineers (ITE). Specifically, a trip rate of 0.42 weekday

PM peak hour trips per worker was used and is based on the General Light Industrial land use.

Self-Haul Traffic

Self-haul traffic at the site is comprised of transfer trailer trucks, commercial haul trucks, and passenger/small trucks associated with self-haul operations. Estimates of the traffic associated with each self-haul operation were calculated based on historical data and projections into the four-year construction period.

Daily trip generation for the transfer trailer trucks was obtained from existing data provided by the County. Weekday PM peak hour trip generation was calculated assuming a specific amount of work hours per day. Estimates for 8-hour and 10-hour workdays are provided.

For commercial haul and self-haul operations, future estimates of transactions from 2008 and 2012 were provided based on existing data and historical growth. To determine the number of daily trips associated with these operations during the construction period, the August 2010 estimate of transactions provided by the County were used. This estimate of approximately 18,000 monthly transactions is expected to represent an average number of transactions during the "dry" season of the construction period. Of the total number of transactions, approximately 68 percent are associated with self-haul operations while the remaining 32 percent are tied to the commercial haul operations. Applying this breakdown, approximately 12,300 self-haul transactions and 5,700 commercial haul transactions are expected.

The total transaction count for each type of operation was then divided between weekday and weekend using historical data. Specifically, for commercial haul operations, approximately 91 percent of transactions occur during weekdays with the remaining 9 percent occurring on weekends. For self-haul operations, approximately 41 percent of transactions occur during the weekdays with the remaining 59 percent occurring during on weekends. Finally, the total number of weekday transactions was divided by 22 weekdays during August 2010 to achieve an estimate of the number of daily transactions.

Weekday PM peak hour trips associated with commercial haul and self-haul operations were obtained by utilizing historical hourly transaction data to determine the percentage of daily trips that occur during the weekday PM peak hour. The results indicate that approximately 1.5 percent of daily commercial haul trips and approximately 7.4 percent of daily self-haul trips occur during the weekday PM peak hour.

The resulting daily and weekday PM peak hour trip generation expected during the two construction phases and the self-haul operations are summarized in Table 1.

Table 1. Estimates of Construction Period Trip Generation[1]

Land Use	Average "Dry" Season Conditions: Weekday Daily Trips	Average "Dry" Season Conditions: Weekday PM Peak Hour Trips 10-Hour Workday	Average "Dry" Season Conditions: Weekday PM Peak Hour Trips 8-Hour Workday	Peak "Dry" Season Conditions: Weekday Daily Trips	Peak "Dry" Season Conditions: Weekday PM Peak Hour Trips 10-Hour Workday	Peak "Dry" Season Conditions: Weekday PM Peak Hour Trips 8-Hour Workday
Site Preparation[1]						
Soil Removal Trucks[2]	80	8	10	200	20	25
Imported Material Trucks[2]	20	2	3	20	2	3
Concrete Trucks[2]	20	2	3	20	2	3
Workers[3]	90	13	13	150	21	21
Other[2]	50	5	6	60	6	8
Total	**260**	**30**	**35**	**450**	**51**	**60**
Site Facilities[1]						
Material Removal Trucks[2]	56	6	7	56	6	7
Imported Material Trucks[2]	14	1	2	60	6	8
Workers[3]	150	21	21	450	63	63
Other[2]	60	6	8	80	8	10
Total	**280**	**34**	**38**	**646**	**83**	**88**
Self-Haul Operations						
Transfer Trailer Trucks[4]	116	12	15	116	12	15
Commercial Haul Trucks[4]	468	8	8	468	8	8
Self-Haul Vehicles[4]	456	34	34	456	34	34
Total	**1,040**	**54**	**57**	**1,040**	**54**	**57**

1. Daily trip generation based on estimates provided in *Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast* by Karl Hufnagel, P.E. dated March 27, 2008.
2. Weekday PM peak hour estimates for soil removal trucks, imported material trucks, material removal trucks, and other vehicles based on daily estimates and the number of hours in a typical workday.
3. Weekday PM peak hour estimates for workers during Site Preparation and Site Facilities based on the estimated number of workers and the trip rate per employee taken from *Trip Generation*, 7th Edition, 2003, published by the Institute of Transportation Engineers (ITE) for the General Light Industrial land use.
4. Estimates of daily and weekday PM peak hour traffic associated with the Self-Haul Operations are based on existing data and transaction forecasts provided by the client.

As shown, the Site Preparation phase of construction during the dry season is expected to generate approximately 260 daily trips with approximately 30 to 35 of those occurring during the weekday PM peak hour. The Site Facilities phase is expected to generate a higher number of trips with a total of approximately 280 trips expected on a daily basis. Of those, approximately 34 to 38 are expected to occur during the weekday PM peak hour. During peak conditions, which are expected to occur infrequently, construction activity may generate up to approximately 650 daily trips and 90 weekday PM peak hour trips.

Assuming that construction did not occur at the site and self-haul operations continued through the construction period, it is estimated that approximately 1,040 daily trips would be expected on an average weekday. During the weekday PM peak hour, approximately 54 to 57 trips would typically be expected. Comparing these estimates to the estimates of traffic during construction, it is expected that trip

generation associated with the construction activity will generally be significantly less than would normally occur at the site during self-haul operations. Although weekday PM peak hour traffic during peak conditions of the Site Facilities phase of construction is expected to exceed typical self-haul trip generation by approximately 30 trips, this is expected to occur infrequently. As a result, off-site impacts to the nearby roadway network during construction are generally expected to be within the boundaries of traffic impacts during normal operations and no additional analysis or mitigation will be required.

APPENDIX B

Construction Traffic Forecast

October 16, 2006
Revised March 27, 2008

Technical Memorandum

From: Karl Hufnagel, P.E.

To: Steve Bingham, ESA Adolfson
Kurt Gahnberg, The Transpo Group

Subject: Bow Lake Transfer/Recycling Station Facility Master Plan Update and Implementation – Construction Traffic Forecast

Background

The purpose of this memorandum is to provide an estimate of the construction traffic traveling to and from the project site during the approximately four years that construction will be in progress at the site. As currently envisioned, the site construction will take place under two consecutive contracts: a Site Preparation contract scheduled to run from August 1, 2008 through October 31, 2009, and a Site Facilities contract scheduled to run from November 1, 2009 through Summer/Fall 2012. Note that periods of heavy traffic will likely be within the Dry Season (April 30 – October 1) of each year.

Site Preparation Contract

This is primarily an earthworks contract with some retaining wall and stormwater system construction. At the completion of this construction the site will be "winterized" to protect it from stormwater erosion during the winter months of 2009/2010.

Soil Removal:

Based on preliminary estimates there is expected to be approximately 167,000 cubic yards of material excavated and removed from site. At 20 cubic yards per dump truck and pup trailer, this material will require around 8,350 round trip truck trips to/from the site over an estimated thirteen month period. Assuming that the work is carried out only on weekdays, this would be 280 hauling days or an average of 30 truck trips per day. The Dry Season will be more conducive to earthworks and will result in more truck trips, while the Wet Season will limit truck trips. It's expected that there will be 130 days of Dry Season hauling and 150 days on Wet Season hauling. Assuming twice the production in the Dry Season as the Wet Season, results in an average 20 truck trips per day in the Wet Season and 40 truck trips per day in the Dry Season.

The peak truck trips per day are expected to occur in the Dry Season at approximately 100 truck trips per day.

Imported Materials:

It is estimated that there will be around 20,000 of earthwork material brought in to the site over a period of five months. At 20 cubic yards per dump truck and pup trailer, this material will require about 1,000 round trip truck trips. Assuming the work is carried out on weekdays, this would be around 108 hauling days or an average of 10 truck trips per day. These trips are expected to coincide with the soil removal trips.

Concrete:

It is estimated that there will be around 1,000 cubic yards of concrete brought to the site during the site preparation work, primarily for retaining walls. At 10 cubic yards per truck, this would require 100 truck trips. It is expected that concrete will be delivered and placed at an average rate of around 100 cubic yards per day, which equates to 10 truck trips per day. These trips are expected to coincide with the soil removal and soil import trips.

Workers:

The average workforce during the site preparation work is expected to be around 30 with a peak work force of 50. These workers are expected to park on site and to make an average of 1.5 round trips to the site each day. The peak workforce days are expected to coincide with the soil removal, import material and the concrete delivery trips.

Other:

It is expected that there will be other miscellaneous materials deliveries, vendor visits, labor union visits, contractor home office visits and County and consultant daily visits or between 25 and 30 per day throughout the life of the construction.

Total:

Wet Season average daily traffic is expected to be around 110 trips. Dry Season average daily traffic is expected to be approximately 130 trips. Peak daily traffic in the Dry Season is expected to be 225 trips.

Site Facilities Contract

This is primarily a building, pavement and utilities contract with some additional earthwork, and site retaining wall construction.

Material Removal:

An estimated 20,000 cubic yards of rubble from the demolition of the existing transfer building and pavements and 27,000 cubic yards of refuse will be removed during Phase 2

of this contract. At an average load of 20 cubic yards, this equates to 2,400 truck trips over a four month period, or around 28 trips per day.

Imported Materials:

The estimated material types, quantities, load size and number trips are provided in the following table:

Material Type	Estimated Quantity	Average Load Size	Number of Trips
Concrete	7,700 CY	10 CY	770
Road Aggregates	13,000 CY	20 CY	650
Structural Fill, Drain Rock	38,000 CY	20 CY	1,900
Hot Mix Asphalt	4,000 CY	20 CY	200
Roadway Appurtenances	---	---	20
Topsoil & Amendments	4,000 CY	20 CY	200
4" and larger Utility Pipe	15,000 LF	2,000 LF	8
Manholes/CBs	80 EA	6 EA	14
Metal Building	---	---	50
Electrical Equipment	---	---	50
Plumbing Pipe & Fixtures	---	---	20
Compactors	---	---	10
Industrial Wastewater Treatment System	---	---	20
Miscellaneous	---	---	1000
Total			**4,912**

These material delivery trips are expected to occur on weekday over the full 32 month construction period (695 weekdays). The average daily trips would therefore be around 7. It is estimated that a peak day for this category could be 30 trips.

Workers:

The average workforce during the site facilities work is expected to be around 50 with a peak work force of 150. These workers are expected to park on site and to make an average of 1.5 round trips to the site each day.

Other:

It is expected that there will be other miscellaneous materials deliveries, vendor visits, labor union visits, contractor home office visits and County and consultant daily visits or between 30 and 40 per day throughout the life of the construction.

Total:

Disregarding the months when soil is being removed from site, the average daily traffic is expected to be around 112 trips. The peak daily traffic is expected to be around 300 trips.

APPENDIX C

Stormwater Truck Haul Analysis

CONSTRUCTION RUNOFF: ON-SITE DISPERSION & TRUCKING ANALYSIS (7/15/08)

Duration (hr)	Tributary Areas (ac)		Volume Factors (ac-ft)		Volume (ac-ft)		Total Volume (cf)	Treatment or Haul Design Rate (gph)	Treatment or Haul Volume (cf)	Storage Volume (cf)	Storage Volume (gal)	Required Haul Rate (gph)	Load equivalent (#)	Duration (hrs)	Loads per time step (#)
	Impervious	Soil	Impervious	Soil	Impervious	Soil									
1	6.6	5.7	0.04	0.02	0.3	0.1	16466	0	0	16466	123,163	0	0	0	0
2	6.6	5.7	0.06	0.03	0.4	0.2	24699	50000	6684	18014	134,745	28500	3.5625	1	3.5625
3	6.6	5.7	0.08	0.04	0.5	0.2	32931	50000	13369	19562	146,327	28500	3.5625	1	3.5625
4	6.6	5.7	0.09	0.04	0.6	0.2	35806	50000	20053	15753	117,831	28500	3.5625	1	3.5625
5	6.6	5.7	0.10	0.05	0.7	0.3	41164	50000	26738	14426	107,908	28500	3.5625	1	3.5625
6	6.6	5.7	0.11	0.06	0.7	0.3	46522	50000	33422	13100	97,985	28500	3.5625	3	10.6875
9	6.6	5.7	0.16	0.09	1.1	0.5	68346	50000	53476	14870	111,225	28500	3.5625	3	10.6875
12	6.6	5.7	0.18	0.10	1.2	0.6	76578	40000	58824	17755	132,807	18500	2.3125	6	13.875
18	6.6	5.7	0.23	0.14	1.5	0.8	100885	40000	90909	9976	74,620	18500	2.3125	6	13.875
24	6.6	5.7	0.27	0.18	1.8	1.0	122316	35000	107620	14696	109,927	13500	1.6875	24	40.5
48	6.6	5.7	0.36	0.25	2.4	1.4	165572	25000	157086	8486	63,475	3500	0.4375	24	10.5
72	6.6	5.7	0.41	0.28	2.7	1.6	187395	20000	189840	-2444	(18,285)	-1500	0	24	0

Storage Volume Required[7]: 19562 cf
146,327 gal

Add 20% to Required Storage 23475 cf

Total truck loads---> 114

NOTES:

1 Assumes 4 on-site dispersion trenches able to discharge at a total flow rate of 0.8 cfs (=21,500 gph)
2 Assumes 2 Baker Tanks on-site with a total storage volume of 5,610 cf (=42,000 gallons)
3 Total live storage is TESC Storage Pond + 2 Baker Tanks = 23,500 cf
4 Therefore, need a peak truck haul rate for the 10-year, 72-hour event of 28,500 gph
5 If assume a tank truck with 8,000 gallons capacity then 3.6 truck loads per hour (about 1 truck every 15 to 20 minutes leaving and entering the site)
6 The basin is the same as assumed for the CESF system plus 1 additional acre of impervious to be conservative (total = 12.3 ac)
7 Assumes a 1-hr ramp up time where no flows are released or hauled (see first time step)

APPENDIX D

GHG Emission Worksheet

Geomatrix

Memorandum

TO:	Steve Bingham, ESA Adolfson	**DATE:**	February 26, 2008
FROM:	Kristen Wallace	**PROJ. NO.:**	12209.000.0
CC:	Karl Hufnagel, R.W. Beck	**PROJ. NAME:**	Bow Lake Transfer/Recycling Station Upgrade

SUBJECT: **Noise Assessment of the Proposed Yard Waste/Wood Waste Grinder**

As part of the proposed upgrade of the Bowlake Transfer/Recycling Station, King County is proposing to install a yard waste/wood waste grinder at the new transfer building. Geomatrix Consultants, Inc. (Geomatrix) was asked to assess whether the addition of the grinder would result in any additional noise impacts when compared to the SEPA documentation. The results of our analysis follow.

The yard waste/wood waste grinder would be located near the southwest corner of the new transfer building, partially surrounded by a u-shaped wall approximately 8 feet in height. The specific grinder proposed for the site had not been identified at the time of this analysis, so Geomatrix used the sound level of a Morbark Woodhog 2600 as a representative piece of equipment, which the manufacturer identified as 82 dBA at a distance of 100 feet with the unit running at full power.

To estimate the additional noise expected from the grinder, Geomatrix modeled the sound levels of the grinder at the nearest residential properties to the transfer facility. As with the assessment conducted for the SEPA checklist, Geomatrix used the Cadna/A noise model to predict future sound levels from the grinder. The projected sound levels of the proposed grinder were added to the sound levels of the other on-site equipment considered previously for the SEPA evaluation.

Daytime Operation

Inclusion of a yard waste/wood waste grinder in addition to the equipment specified in the SEPA checklist results in predicted daytime sound levels ranging from 49 to 53 dBA at the nearest residences on the hill to the west and at the Pianta property line north of the site. The existing background sound levels (L_{90}s) during the day range from 68 to 71 dBA and are at least 15 dBA higher than the predicted facility sound levels at these nearest residential locations. Consequently, even with inclusion of a grinder at the transfer facility, noise from the freeway would obscure noise from the facility operations. Therefore, it is unlikely that noise from the facility would be audible except during rare lulls in I-5 traffic, and no adverse noise impacts are anticipated.

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www.geomatrix.com

Nighttime Operation

For nighttime operations, inclusion of the yard waste/wood waste grinder in the modeling results in predicted overall sound levels ranging from 48 to 53 dBA at the nearest residential properties. Sound levels greater than 50 dBA would not comply with the nighttime noise limit. Therefore, we recommend that the grinder only be operated during daytime hours (i.e., between 7 a.m. to 10 p.m.).

Conclusion

During daytime operations, predicted noise levels from the upgraded Bowlake Transfer/Recycling Station with inclusion of the yard waste/wood waste grinder would easily comply with the daytime noise limit at the nearest residential properties, are at least 15 dBA lower than the existing background sound levels (primarily from the adjacent freeway), and are not be expected to result in any adverse noise impacts.

During nighttime operations, predicted sound levels with the grinder are greater than 50 dBA at residential locations on the hillside west of the facility and would not comply with the nighttime noise limits. Therefore, operation of the grinder should be restricted to daytime hours only.

APPENDIX E

Noise Assessment
Yard Waste/Wood Waste Grinder

King County Department of Development and Environmental Services
SEPA GHG Emissions Worksheet
Version 1.7 12/26/07

Introduction

The Washington State Environmental Policy Act (SEPA) requires environmental review of development proposals that may have a significant adverse impact on the environment. If a proposed development is subject to SEPA, the project proponent is required to complete the SEPA Checklist. The Checklist includes questions relating to the development's air emissions. The emissions that have traditionally been considered cover smoke, dust, and industrial and automobile emissions. With our understanding of the climate change impacts of GHG emissions, King County requires the applicant to also estimate these emissions.

Emissions created by Development

GHG emissions associated with development come from multiple sources:

- The extraction, processing, transportation, construction and disposal of materials and landscape disturbance (Embodied Emissions)
- Energy demands created by the development after it is completed (Energy Emissions)
- Transportation demands created by the development after it is completed (Transportation Emissions)

GHG Emissions Worksheet

King County has developed a GHG Emissions Worksheet that can assist applicants in answering the SEPA Checklist question relating to GHG emissions.

The SEPA GHG Emissions worksheet estimates all GHG emissions that will be created over the life span of a project. This includes emissions associated with obtaining construction materials, fuel used during construction, energy consumed during a buildings operation, and transportation by building occupants.

Using the Worksheet

1. Descriptions of the different residential and commercial building types can be found on the second tabbed worksheet ("Definition of Building Types"). If a development proposal consists of multiple projects, e.g. both single family and multi-family residential structures or a commercial development that consists of more than on type of commercial activity, the appropriate information should be estimated for each type of building or activity.

2. For paving, estimate the total amount of paving (in thousands of square feet) of the project.

3. The Worksheet will calculate the amount of GHG emissions associated with the project and display the amount in the "Total Emissions" column on the worksheet. The applicant should use this information when completing the SEPA checklist.

4. The last three worksheets in the Excel file provide the background information that is used to calculate the total GHG emissions.

5. The methodology of creating the estimates is transparent; if there is reason to believe that a better estimate can be obtained by changing specific values, this can and should be done. Changes to the values should be documented with an explanation of why and the sources relied upon.

6. Print out the "Total Emissions" worksheet and attach it to the SEPA checklist. If the applicant has made changes to the calculations or the values, the documentation supporting those changes should also be attached to the SEPA checklist.

Section I: Buildings

Type (Residential) or Principal Activity (Commercial)	# Units	Square Feet (in thousands of square feet)	Emissions Per Unit or Per Thousand Square Feet (MTCO2e) Embodied	Energy	Transportation	Lifespan Emissions (MTCO2e)
Single-Family Home	0		98	672	792	0
Multi-Family Unit in Large Building	0		33	357	766	0
Multi-Family Unit in Small Building	0		54	681	766	0
Mobile Home	0		41	475	709	0
Education		0.0	39	646	361	0
Food Sales		0.0	39	1,541	282	0
Food Service		0.0	39	1,994	561	0
Health Care Inpatient		0.0	39	1,938	582	0
Health Care Outpatient		0.0	39	737	571	0
Lodging		0.0	39	777	117	0
Retail (Other Than Mall)		0.0	39	577	247	0
Office		0.0	39	723	588	0
Public Assembly		0.0	39	733	150	0
Public Order and Safety		0.0	39	899	374	0
Religious Worship		0.0	39	339	129	0
Service		0.0	39	599	266	0
Warehouse and Storage		0.0	39	352	181	0
Other		83.4	39	210	74	26918
Vacant		0.0	39	162	47	0

Section II: Pavement

Pavement		330.00				16500

Section III: Facility Equipment

Equipment Emmissions (MTCO2e)						48163

Project Emissions: 91581

Definition of Building Types

Type (Residential) or Principal Activity (Commercial)	Description
Single-Family Home	Unless otherwise specified, this includes both attached and detached buildings
Multi-Family Unit in Large Building	Apartments in buildings with more than 5 units
Multi-Family Unit in Small Building	Apartments in building with 2-4 units
Mobile Home	
Education	Buildings used for academic or technical classroom instruction, such as elementary, middle, or high schools, and classroom buildings on college or university campuses. Buildings on education campuses for which the main use is not classroom are included in the category relating to their use. For example, administration buildings are part of "Office," dormitories are "Lodging," and libraries are "Public Assembly."
Food Sales	Buildings used for retail or wholesale of food.
Food Service	Buildings used for preparation and sale of food and beverages for consumption.
Health Care Inpatient	Buildings used as diagnostic and treatment facilities for inpatient care.
Health Care Outpatient	Buildings used as diagnostic and treatment facilities for outpatient care. Doctor's or dentist's office are included here if they use any type of diagnostic medical equipment (if they do not, they are categorized as an office building).
Lodging	Buildings used to offer multiple accommodations for short-term or long-term residents, including skilled nursing and other residential care buildings.
Retail (Other Than Mall)	Buildings used for the sale and display of goods other than food.
Office	Buildings used for general office space, professional office, or administrative offices. Doctor's or dentist's office are included here if they do not use any type of diagnostic medical equipment (if they do, they are categorized as an outpatient health care building).
Public Assembly	Buildings in which people gather for social or recreational activities, whether in private or non-private meeting halls.
Public Order and Safety	Buildings used for the preservation of law and order or public safety.
Religious Worship	Buildings in which people gather for religious activities, (such as chapels, churches, mosques, synagogues, and temples).
Service	Buildings in which some type of service is provided, other than food service or retail sales of goods
Warehouse and Storage	Buildings used to store goods, manufactured products, merchandise, raw materials, or personal belongings (such as self-storage).
Other	Buildings that are industrial or agricultural with some retail space; buildings having several different commercial activities that, together, comprise 50 percent or more of the floorspace, but whose largest single activity is agricultural, industrial/ manufacturing, or residential; and all other miscellaneous buildings that do not fit into any other category.
Vacant	Buildings in which more floorspace was vacant than was used for any single commercial activity at the time of interview. Therefore, a vacant building may have some occupied floorspace.

Sources:

Residential — 2001 Residential Energy Consumption Survey
Square footage measurements and comparisons
http://www.eia.doe.gov/emeu/recs/sqft-measure.html

Commercial — Commercial Buildings Energy Consumption Survey (CBECS),
Description of CBECS Building Types
http://www.eia.doe.gov/emeu/cbecs/pba99/bldgtypes.html

Embodied Emissions Worksheet

Section I: Buildings

Type (Residential) or Principal Activity (Commercial)	# thousand sq feet/ unit or building	Life span related embodied GHG missions (MTCO2e/ unit)	Life span related embodied GHG missions (MTCO2e/ thousand square feet) - See calculations in table below
Single-Family Home	2.53	98	39
Multi-Family Unit in Large Building	0.85	33	39
Multi-Family Unit in Small Building	1.39	54	39
Mobile Home	1.06	41	39
Education	25.6	991	39
Food Sales	5.6	217	39
Food Service	5.6	217	39
Health Care Inpatient	241.4	9,346	39
Health Care Outpatient	10.4	403	39
Lodging	35.8	1,386	39
Retail (Other Than Mall)	9.7	376	39
Office	14.8	573	39
Public Assembly	14.2	550	39
Public Order and Safety	15.5	600	39
Religious Worship	10.1	391	39
Service	6.5	252	39
Warehouse and Storage	16.9	654	39
Other	83.4	3,229	39
Vacant	14.1	546	39

Section II: Pavement

All Types of Pavement	50

	Columns and Beams	Intermediate Floors	Exterior Walls	Windows	Interior Walls	Roofs		
Average GWP (lbs CO2e/sq ft): Vancouver, Low Rise Building	5.3	7.8	19.1	51.2	5.7	21.3		
Average Materials in a 2,272-square foot single family home	0.0	2269.0	3206.0	285.0	6050.0	3103.0	Total Embodied Emissions (MTCO2e)	Total Embodied Emissions (MTCO2e/ thousand sq feet)
MTCO2e	0.0	8.0	27.8	6.6	15.6	30.0	88.0	38.7

Sources

All data in black text
King County, DNRP. Contact: Matt Kuharic, matt.kuharic@kingcounty.gov

Residential floorspace per unit
2001 Residential Energy Consumption Survey (National Average, 2001)
Square footage measurements and comparisons
http://www.eia.doe.gov/emeu/recs/sqft-measure.html

Floorspace per building
EIA, 2003 Commercial Buildings Energy Consumption Survey (National Average, 2003)
Table C3. Consumption and Gross Energy Intensity for Sum of Major Fuels for Non-Mall Buildings, 2003
http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set9/2003excel/c3.xls

Average GWP (lbs CO2e/sq ft): Vancouver, Low Rise Building
Athena EcoCalculator
Athena Assembly Evaluation Tool v2.3- Vancouver Low Rise Building
Assembly Average GWP (kg) per square meter
http://www.athenasml.ca/tools/ecoCalculator/index.html
Lbs per kg 2.20
Square feet per square meter 10.76

Average Materials in a 2,272-square foot single family home
Buildings Energy Data Book: 7.3 Typical/Average Household
Materials Used in the Construction of a 2,272-Square-Foot Single-Family Home, 2000
http://buildingsdatabook.eren.doe.gov/?id=view_book_table&TableID=2036&t=xls
See also: NAHB, 2004 Housing Facts, Figures and Trends, Feb. 2004, p. 7.

Average window size
Energy Information Administration/Housing Characteristics 1993
Appendix B, Quality of the Data. Pg. 5.
ftp://ftp.eia.doe.gov/pub/consumption/residential/rx93hcl.pdf

Pavement Emissions Factors
MTCO2e/thousand square feet of asphalt
or concrete pavement 50 (see below)

Embodied GHG Emissions.....Worksheet Background Information

Buildings
Embodied GHG emissions are emissions that are created through the extraction, processing, transportation, construction and disposal of building materials as well as emissions created through landscape disturbance (by both soil disturbance and changes in above ground biomass).

Estimating embodied GHG emissions is new f eld of analysis; the estimates are rapidly improving and becoming more inclusive of all elements of construction and development.

The estimate included in this worksheet is calculated using average values for the main construction materials that are used to create a typical family home. In 2004, the National Association of Home Builders calculated the average materials that are used in a typical 2,272 square foot single-family household. The quantity of materials used is then multiplied by the average GHG emissions associated with the life-cycle GHG emissions for each material.

This estimate is a rough and conservative estimate; the actual embodied emissions for a project are likely to be higher. For example, at this stage, due to a lack of comprehensive data, the estimate does not include important factors such as landscape disturbance or the emissions associated with the interior components of a building (such as furniture).

King County realizes that the calculations for embodied emissions in this worksheet are rough. For example, the emissions associated with building 1,000 square feet of a residential building will not be the same as 1,000 square feet of a commercial building. However, discussions with the construction community indicate that while there are significant differences between the different types of structures, this method of estimation is reasonable; it will be improved as more data become available.

Additionally, if more specific information about the project is known, King County recommends two online embodied emissions calculators that can be used to obtain a more tailored estimate for embodied emissions: www.buildcarbonneutral.org and www.athenasmi.ca/tools/ecoCalculator/.

Pavement
Four recent life cycle assessments of the environmental impacts of roads form the basis for the per unit embodied emissions of pavement. Each study is constructed in slightly different ways; however, the aggregate results of the reports represent a reasonable estimate of the GHG emissions that are created from the manufacture of paving materials, construction related emissions, and maintenance of the pavement over its expected life cycle. For specifics, see the worksheet.

Special Section: Estimating the Embodied Emissions for Pavement

Four recent life cycle assessments of the environmental impacts of roads form the basis for the per unit embodied emissions of pavement. Each study is constructed in slightly different ways; however, the aggregate results of the reports represent a reasonable estimate of the GHG emissions that are created from the manufacture of paving materials, construction related emissions, and maintenance of the pavement over its expected life cycle.

The results of the studies are presented in different units and measures; considerable effort was undertaken to be able to compare the results of the studies in a reasonable way. For more details about the below methodology, contact matt.kuharic@kingcounty.gov.

The four studies, Meil (2001), Park (2003), Stripple (2001) and Treolar (2001) produced total GHG emissions of 4-34 MTCO2e per thousand square feet of finished paving (for similar asphalt and concrete based pavements). This estimate does not including downstream maintenance and repair of the highway. The average (for all concrete and asphalt pavements in the studies, assuming each study gets one data point) is ~17 MTCO2e/thousand square feet.

Three of the studies attempted to thoroughly account for the emissions associated with long term maintenance (40 years) of the roads. Stripple (2001), Park et al. (2003) and Treolar (2001) report 17, 81, and 68 MTCO2e/thousand square feet, respectively, after accounting for maintenance of the roads.

Based on the above discussion, King County makes the conservative estimate that 50 MTCO2e/thousand square feet of pavement (over the development's life cycle) will be used as the embodied emission factor for pavement until better estimates can be obtained. This is roughly equivalent to 3,500 MTCO2e per lane mile of road (assuming the lane is 13 feet wide).

It is important to note that these studies estimate the embodied emissions for roads. Paving that does not need to stand up to the rigors of heavy use (such as parking lots or driveways) would likely use less materials and hence have lower embodied emissions.

Sources:

Meil, J. A Life Cycle Perspective on Concrete and Asphalt Roadways: Embodied Primary Energy and Global Warming Potential. 2006. Available: http://www.cement.ca/cement.nsf/eee9ec7bbd63C126852566c40052107b/6ec79dc8ae03a782852572b90061b914/$FILE/ATTK0WE3/athena%20report%20Feb.%202%202007.pdf

Park, K, Hwang, Y., Seo, S., M.ASCE, and Seo, H. , "Quantitative Assessment of Environmental Impacts on Life Cycle of Highways," Journal of Construction Engineering and Management , Vol 129, January/February 2003, pp 25-31, (DOI: 10.1061/(ASCE)0733-9364(2003)129:1(25)).

Stripple, H. Life Cycle Assessment of Road. A Pilot Study for Inventory Analysis. Second Revised Edition. IVL Swedish Environmental Research Institute Ltd. 2001. Available: http://www.ivl.se/rapporter/pdf/B1210E.pdf

Treloar, G., Love, P.E.D., and Crawford, R.H. Hybrid Life-Cycle Inventory for Road Construction and Use. Journal of Construction Engineering and Management. P. 43-49. January/February 2004.

Energy Emissions Worksheet

Type (Residential) or Principal Activity (Commercial)	Energy consumption per building per year (million Btu)	Carbon Coefficient for Buildings	MTCO2e per building per year	Floorspace per Building (thousand square feet)	MTCE per thousand square feet per year	MTCO2e per thousand square feet per year	Average Building Life Span	Lifespan Energy Related MTCO2e emissions per unit	Lifespan Energy Related MTCO2e emissions per thousand square feet
Single-Family Home	107.3	0.108	11.61	2.53	4.6	16.8	57.9	672	266
Multi-Family Unit in Large Building	41.0	0.108	4.44	0.85	5.2	19.2	80.5	357	422
Multi-Family Unit in Small Building	78.1	0.108	8.45	1.39	6.1	22.2	80.5	681	489
Mobile Home	75.9	0.108	8.21	1.06	7.7	28.4	57.9	475	448
Education	2,125.0	0.124	264.2	25.6	10.3	37.8	62.5	16,526	646
Food Sales	1,110.0	0.124	138.0	5.6	24.6	90.4	62.5	8,632	1,541
Food Service	1,436.0	0.124	178.5	5.6	31.9	116.9	62.5	11,168	1,994
Health Care Inpatient	60,152.0	0.124	7,479.1	241.4	31.0	113.6	62.5	467,794	1,938
Health Care Outpatient	985.0	0.124	122.5	10.4	11.8	43.2	62.5	7,660	737
Lodging	3,578.0	0.124	444.9	35.8	12.4	45.6	62.5	27,826	777
Retail (Other Than Mall)	720.0	0.124	89.5	9.7	9.2	33.8	62.5	5,599	577
Office	1,376.0	0.124	171.1	14.8	11.6	42.4	62.5	10,701	723
Public Assembly	1,338.0	0.124	166.4	14.2	11.7	43.0	62.5	10,405	733
Public Order and Safety	1,791.0	0.124	222.7	15.5	14.4	52.7	62.5	13,928	899
Religious Worship	440.0	0.124	54.7	10.1	5.4	19.9	62.5	3,422	339
Service	501.0	0.124	62.3	6.5	9.6	35.1	62.5	3,896	599
Warehouse and Storage	764.0	0.124	95.0	16.9	5.6	20.6	62.5	5,942	352
Other	2,818.0	0.124	350.4	83.4	4.2	15.4	50.0	17,519	210
Vacant	294.0	0.124	36.6	14.1	2.6	9.5	62.5	2,286	162

Sources

All data in black text — King County, DNRP. Contact: Matt Kuharic, matt.kuharic@kingcounty.gov

Energy consumption for residential buildings

2007 Buildings Energy Data Book: 6.1 Quad Definitions and Comparisons (National Average, 2001)
Table 6.1.4: Average Annual Carbon Dioxide Emissions for Various Functions
http://buildingsdatabook.eren.doe.gov/
Data also at: http://www.eia.doe.gov/emeu/recs/recs2001_ce/ce1-4c_housingunits2001.html

Energy consumption for commercial buildings
and
Floorspace per building

EIA, 2003 Commercial Buildings Energy Consumption Survey (National Average, 2003)
Table C3. Consumption and Gross Energy Intensity for Sum of Major Fuels for Non-Mall Buildings, 2003
http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set9/2003excel/c3.xls

Note: Data in plum color is found in both of the above sources (buildings energy data book and commercial buildings energy consumption survey).

Carbon Coefficient for Buildings

Buildings Energy Data Book (National average, 2005)
Table 3.1.7. 2005 Carbon Dioxide Emission Coefficients for Buildings (MMTCE per Quadrillion Btu)
http://buildingsdatabook.eere.energy.gov/?id=view_book_table&TableID=2057
Note: Carbon coefficient in the Energy Data book is in MTCE per Quadrillion Btu.
To convert to MTCO2e per million Btu, this factor was divided by 1000 and multiplied by 44/12.

Residential floorspace per unit

2001 Residential Energy Consumption Survey (National Average, 2001)
Square footage measurements and comparisons
http://www.eia.doe.gov/emeu/recs/sqft-measure.html

average lief span of buildings,
estimated by replacement time method

	Single Family Homes	Multi-Family Units in Large and Small Buildings	All Residential Buildings
New Housing Construction, 2001	1,273,000	329,000	1,602,000
Existing Housing Stock, 2001	73,700,000	26,500,000	100,200,000
Replacement time:	57.9	80.5	62.5

(national average, 2001)

Note: Single family homes calculation is used for mobile homes as a best estimate life span.
Note: At this time, KC staff could find no reliable data for the average life span of commercial buildings.
Therefore, the average life span of residential buildings is being used until a better approximation can be ascertained.

Sources:

New Housing Construction, 2001 Quarterly Starts and Completions by Purpose and Design - US and Regions (Excel)
http://www.census.gov/const/quarterly_starts_completions_cust.xls
See also: http://www.census.gov/const/www/newresconstindex.html

Existing Housing Stock, 2001 Residential Energy Consumption Survey (RECS) 2001
Tables HC1:Housing Unit Characteristics, Million U.S. Households 2001
Table HC1-4a. Housing Unit Characteristics by Type of Housing Unit, Million U.S. Households, 2001
Million U.S. Households, 2001
http://www.eia.doe.gov/emeu/recs/recs2001/hc_pdf/housunits/hc1-4a_housingunits2001.pdf

Transportation Emissions Worksheet

Type (Residential) or Principal Activity (Commercial)	# people/ unit or building	# thousand sq feet/ unit or building	# people or employees/ thousand square feet	vehicle related GHG emissions (metric tonnes CO2e per person per year)	MTCO2e/ year/ unit	MTCO2e/ year/ thousand square feet	Average Building Life Span	Life span transportation related GHG emissions (MTCO2e/ per unit)	Life span transportation related GHG emissions (MTCO2e/ thousand sq feet)	Biodiesel Used to Operate Equiment at Facility gal/year	Life span equipment operation related GHG emissions (MTCO2e)
Single-Family Home	2.8	2.53	1.1	4.9	13.7	5.4	57.9	792	313		
Multi-Family Unit in Large Building	1.9	0.85	2.3	4.9	9.5	11.2	80.5	766	904		
Multi-Family Unit in Small Building	1.9	1.39	1.4	4.9	9.5	6.8	80.5	766	550		
Mobile Home	2.5	1.06	2.3	4.9	12.2	11.5	57.9	709	668		
Education	30.0	25.6	1.2	4.9	147.8	5.8	62.5	9247	361		
Food Sales	5.1	5.6	0.9	4.9	25.2	4.5	62.5	1579	282		
Food Service	10.2	5.6	1.8	4.9	50.2	9.0	62.5	3141	561		
Health Care Inpatient	455.5	241.4	1.9	4.9	2246.4	9.3	62.5	140506	582		
Health Care Outpatient	19.3	10.4	1.9	4.9	95.0	9.1	62.5	5941	571		
Lodging	13.6	35.8	0.4	4.9	67.1	1.9	62.5	4194	117		
Retail (Other Than Mall)	7.8	9.7	0.8	4.9	38.3	3.9	62.5	2394	247		
Office	28.2	14.8	1.9	4.9	139.0	9.4	62.5	8696	588		
Public Assembly	6.9	14.2	0.5	4.9	34.2	2.4	62.5	2137	150		
Public Order and Safety	18.8	15.5	1.2	4.9	92.7	6.0	62.5	5796	374		
Religious Worship	4.2	10.1	0.4	4.9	20.8	2.1	62.5	1298	129		
Service	5.6	6.5	0.9	4.9	27.6	4.3	62.5	1729	266		
Warehouse and Storage	9.9	16.9	0.6	4.9	49.0	2.9	62.5	3067	181		
Other	25.0	83.4	0.3	4.9	123.4	1.5	50.0	6170	74	100,000	48163
Vacant	2.1	14.1	0.2	4.9	10.5	0.7	62.5	657	47		

Sources

All data in black text — King County, DNRP. Contact: Matt Kuharic, matt.kuharic@kingcounty.gov

people/ unit — Estimating Household Size for Use in Population Estimates (WA state, 2000 average)
Washington State Office of Financial Management
Kimpel, T. and Lowe, T. Research Brief No. 47. August 2007
http://www.ofm.wa.gov/researchbriefs/brief047.pdf
Note: This analysis combines Multi Unit Structures in both large and small units into one category; the average is used in this case although there is likely a difference

Residential floorspace per unit — 2001 Residential Energy Consumption Survey (National Average, 2001)
Square footage measurements and comparisons
http://www.eia.doe.gov/emeu/recs/sqft-measure.html

employees/thousand square feet — Commercial Buildings Energy Consumption Survey commercial energy uses and costs (National Median, 2003)
Table B2 Totals and Medians of Floorspace, Number of Workers, and Hours of Operation for Non-Mall Buildings, 2003
http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set1/2003excel/b2.xls

Note: Data for # employees/thousand square feet is presented by CBECS as square feet/employee.
In this analysis employees/thousand square feet is calculated by taking the inverse of the CBECS number and multiplying by 1000.

vehicle related GHG emissions

Estimate calculated as follows (Washington state, 2006)_

56,531,930,000	2006 Annual WA State Vehicle Miles Traveled
	Data was daily VMT. Annual VMT was 365*daily VMT.
	http://www.wsdot.wa.gov/mapsdata/tdo/annualmileage.htm
6,395,798	2006 WA state population
	http://quickfacts.census.gov/qfd/states/53000.html
8839	vehicle miles per person per year
0.0506	gallon gasoline/mile
	This is the weighted national average fuel efficiency for all cars and 2 axle, 4 wheel light trucks in 2005. This includes pickup trucks, vans and SUVs. The 0.051 gallons/mile used here is the inverse of the more commonly known term "miles/per gallon" (which is 19.75 for these cars and light trucks).
	Transportation Energy Data Book. 26th Edition. 2006. Chapter 4: Light Vehicles and Characteristics. Calculations based on weighted average MPG efficiency of cars and light trucks.
	http://cta.ornl.gov/data/tedb26/Edition26_Chapter04.pdf
	Note: This report states that in 2005, 92.3% of all highway VMT were driven by the above described vehicles.
	http://cta.ornl.gov/data/tedb26/Spreadsheets/Table3_04.xls
24.3	lbs CO2e/gallon gasoline
	The CO2 emissions estimates for gasoline and diesel include the extraction, transport, and refinement of petroleum as well as their combustion.
	Life-Cycle CO2 Emissions for Various New Vehicles. RENew Northfield.
	Available: http://renewnorthfield.org/wpcontent/uploads/2006/04/CO2%20emissions.pdf
	Note: This is a conservative estimate of emissions by fuel consumption because diesel fuel,
2205	lbs/metric tonne with a emissions factor of 26.55 lbs CO2e/gallon was not estimated.
4.93	vehicle related GHG emissions (metric tonnes CO2e per person per year)
0.20	Asssume a 20% reduction in CO2e for using biofuel

average lief span of buildings, estimated by replacement time method	See Energy Emissions Worksheet for Calculations
Commercial floorspace per unit	EIA, 2003 Commercial Buildings Energy Consumption Survey (National Average, 2003) Table C3. Consumption and Gross Energy Intensity for Sum of Major Fuels for Non-Mall Buildings, 2003 http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set9/2003excel/c3.xls

Transportation.....Worksheet Background Information

This section helps estimate the emissions associated with transportation of building occupants. At this time, it is based on average vehicle miles traveled by the average Washington State citizen.