Final White Paper

Metro Solid Waste Transportation Study

Prepared for

METRO
PEOPLE PLACES • OPEN SPACES

May 2007

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SECTION 1

Introduction

1.1 Background

Metro is interested in investigating multi-modal transportation options available for transporting waste from their two transfer stations; Metro Central, located in northwest Portland and Metro South, located near Oregon City, to the Columbia Ridge Landfill (CRL), owned by Waste Management, Inc., located in Gilliam County, Oregon. Metro's current solid waste transportation contract expires in December, 2009. The disposal agreement with CRL expires in 2014, with the possibility that it would be extended to 2019. Any new transportation contract must anticipate those dates because an RFP for disposal services will most likely be issued at that time.

Currently, Metro has an efficient long-haul transportation system that results in low-cost trucking operations. During the procurement process for its next long-haul transportation contract, Metro is interested in investigating alternative modes that have different costs, but that could result in fewer emissions of greenhouse gases and other air pollutants and provide other benefits compared to trucking. The results of this study will help inform the RFP that Metro is preparing to ensure that it results in a transportation system that best meets Metro's objectives.

1.2 Contents

This white paper includes a summary of the results of interviews with barge, rail, truck, and terminal operators about a series of procurement and operations issues relevant to Metro's upcoming procurement process. It also provides an analysis of key issues; analyzes the cost, fuel use, emissions, and other factors of a set of eight transportation scenarios, and discusses a set of policy issues related to Metro's upcoming procurement.

Appendix A presents the results of interviews with six comparable jurisdictions that have recently procured, or will soon be procuring long distance transportation and/or disposal service.

SECTION 2

Industry Research and Interviews

The CH2M HILL project team conducted a series of interviews and meetings with transportation service providers from each of the transportation modes: barge, rail, and truck. The purpose of these interviews was to obtain information about the companies, understand their ideas and preferences about transporting Metro's solid waste, and discuss their perception of the opportunities and constraints that Metro faces in preparing for its upcoming solid waste transportation procurement.

The interviews were conducted with companies that had expressed interest and/or have experience in transporting solid waste. While originally only barge, rail, and truck service providers were considered, another category emerged and became part of the industry research and interviews: terminal operations and operators. These companies are fairly independent of any specific transportation company and either own an intermodal facility or have the ability to operate an intermodal facility either on the waterways for barge access and/or for managing private railroad tracks at their facility for access to the railroad's main line infrastructure. Some operators such as the Port of Portland, have access to both transportation modes; barge and rail.

The companies interviewed for this study are identified in Exhibit 2-1 (listed in alphabetical order) by transportation mode.

EXHIBIT 2-1
Transportation Companies Interviewed[a]

Trucking Companies	Railroad Companies	Tug and Barging Companies	Terminal Operations & Operators
Blue Line Trans. Co.	BNSF Railway	Bernert Barge Lines	Kinder Morgan
GTI – Gordon Trucking	Union Pacific	Foss Maritime	NW Container Services
JB Hunt		Shaver Trans. Co.	Port of Portland
Lynden Transport		Tidewater Barge	SSA America
Puget Sound/NPE			Willow Creek – Gene Leverton
Walsh Trucking			

[a]In addition, operations staff from Waste Management's Columbia Ridge Landfill were interviewed about landfill operational issues related to the different transport modes.

Prior to the interviews, each company was provided a list of the procurement and operating issues that it would be asked about in its interview. A list of the issues that were discussed during these interviews is provided in Exhibit 2-2.

EXHIBIT 2-2
Procurement and Operating Issues Discussed During Industry Interviews

Issue
1. Mobilization Time Line
2. Desired Contract Length
3. Other Desired Specific Contract Terms and Conditions
4. Constraints associated with the potential for the destination landfill to change in 2019
5. Payload Capability Per Container or Truckload
6. The Feasibility of Backhaul Opportunities
7. Ideas to Ensure Smooth Transition from Current Trucking Service Provider
8. Ability to Assist in Transition in the Event Current Contractor Services Become Unsatisfactory
9. Methods and Ideas to Ensure Smooth Interface at Metro's Two Transfer Stations
10. Effects on Regional Freight Mobility (i.e., how does your mode affect regional traffic congestion)
11. Transportation Contract Service Performance Guarantees
12. Feasibility of a Regional Multimodal Freight Hub (Transload Facility) with Solid Waste Being One of the Key Commodities
13. Emissions Impact of Your Transportation Mode
14. Using Alternative Fuels
15. Consistency with Metro's Regional Transportation Plan Policies and Regional Framework
16. Creative Ideas for to the Procurement Process
17. General Level of Risk Associated with Your Transportation Mode Relative to Other Modes
18. Contingency Plans in the Event of Lock Closures, Rail Line Blockage or Other Natural Disasters or Emergencies to Ensure No Service Interruption Occurs to Metro's Solid Waste Transportation and Two Transfer Stations

The CH2M HILL team informed each company that some of the issues discussed in the interview could involve proprietary information. In response, each company was assured that no individual company information would be included in the report. Thus, this report contains summary information of interview responses.

A summary of industry responses to the procurement and operating issues discussed in the interviews is included in Exhibit 2-3. Input received from terminal operators is included in the railroad portion of the exhibit.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
	1. Mobilization Time Line
Barge	In order to transport waste from Metro's transfer stations to CRL, barging requires four key components:
	Tractor/Chassis: Equipment build times are between 3 and 6 months. The tractors and chassis are not specialty items.
	Barge Depot: Assuming a new dock would need to be built, the biggest challenge with a new depot is usually permitting for construction. Depending on the location and requirements, there may be issues that must be mitigated to address impacts to fisheries, shorelines and other factors. Thus, an industry projection is a minimum of 6 months to one year to permit a new site. Construction of a barge dock and crane erection would take approximately 3 to 6 months and could be constructed concurrent with the development of the site. The lead time for a custom built barge crane or a rated duty cycle container crane is 6 to 10 months. Thus total depot development time would likely to range between 9 and 18 months.
	Barge Construction: Many of the tugboat operators on the Columbia River have several barges that can be used on a short-term basis, but they would eventually need to build additional ones to accommodate Metro's needs. Barges typically require 2 to 3 months of engineering, a 2 to 3 week bid process and a 4 to 6 month build time once awarded and a date for starting construction (i.e., a construction slot) is agreed to. Usually, while negotiations are going on, the construction slot is reserved immediately at a shipyard because this process, from start to finish will take 18 to 24 months, much of which is based on the number of orders currently in place at the shipyard.
	Container Fabrication: Similar to barge construction, the number of orders in place at the container fabricator will affect the speed with which containers can be obtained. The large quantity of containers needed for the barge cycles (over 400) will require up to six months including delivery.
	Total implementation time for a barge transport system is likely to range from 9 to 18 months.
Rail	The most critical component for rail is locating an intermodal ramp in the Portland area for loading and unloading the intermodal containers into rail cars. At present, the UPRR is the only railroad that can serve the Columbia Ridge landfill. This requires that a UPRR served or "reciprocally served" site located at or near the Metro transfer stations be identified at the origin. New rail cars are expected to take 6-9 months to obtain.
	Total implementation time for a rail transport system is likely to range from 12 to 18 months.
Truck	New tractors and tippers would be available in 6 to 9 months from the date of contract award. Trailers would be available in stages, the first allotment available in 6 months, and the complete order within twelve months of date of contract award.
	The local truck terminals and maintenance infrastructure required to operate this type of equipment is already in place, and companies anticipate using the same facility CSU is leasing at the CRL to perform equipment maintenance. If the facility at the landfill is not available through Waste Management (and Waste Management has stated that it will not be available), some carriers are willing to building a new facility. The shuttle tractors (yard goats) for the two transfer stations are available on short notice. For drivers, most carriers anticipate being in a position to offer CSU's employees an opportunity to work for them.
	Total implementation time for a truck transport system is likely to be approximately 12 months.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
	2. Desired Contract Length
Barge	Barging companies interviewed generally prefer at least a 10-year contract and most stated that ideally a 15- to 20-year agreement could be executed with Metro. They stated that a longer term agreement would result in lower rates to Metro because they could depreciate their barges over a longer period of time. Waste volumes and the length of the contract are critical for their business, which has relatively high capital costs and relatively low operating costs compared to competing transport modes.
Rail	The rail companies were somewhat non committal about contract length and prefer short-term contracts. A five year contract term would probably be acceptable.
Truck	Most trucking companies (motor carriers) stated that they depreciate their equipment between 5 and 10 years; 5 years for truck-tractors and 7 years for trailers. An initial 10-year term is ideal to coincide with the landfill disposal agreement. Trucking companies would like the contract to include a 5 to 10 year extension option (e.g., if Metro was pleased with the service and waste continues to be transported via truck to CRL). In the event a new landfill location is selected, ideally Metro would allow the contracted carrier to offer a proposal first before a new procurement was developed.
	3. Other Desired Specific Contract Terms and Conditions
Barge	Fuel Escalators (depending on whether Metro provides the fuel).
	COLA – Provisions for Wage & Fringe annual increases over the contract term.
	Subcontracting flexibility that would allow the contractor to substitute another qualified subcontractor, with Metro approval, in the remote case that they are not meeting the contracted company's or Metro standards, in the case of the truck drayage of containers to and from the docks.
Rail	Fuel surcharge.
	Annual CPI increases.
Truck	Metro continues to purchase fuel.
	CPI increase as part of the bid.
	Pricing is best done on a per load basis (rather than a per ton basis).
	Insurance requirements should be considered carefully. After 9/11, costs have increased substantially. $5 million total coverage may be adequate protection for Metro.
	Metro should commit to a minimum annual tonnage guarantee (i.e., put or pay provision).
	The selection process should recognize that trucking will provide more family wage jobs than other modes that require more investment in infrastructure and assets.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
	4. Constraints associated with the potential for the destination landfill to change in 2019
Barge	Companies stated this is not an issue for the barge mode as long as the destination (disposal site) is in the same proximity as present with the following conditions: • The Roosevelt regional landfill, owned and operated by Allied/Rabanco, would need a dock facility (marine terminal). An issue would arise if the barge contractor were to be required to capitalize the dock unless the contracts can be extended and reopened to ensure that they can be compensated appropriately. • Finley Buttes landfill near Boardman (the Port of Morrow) is further and may or may not affect the rates depending on what other business opportunities exist and the operational logistics involved. • The new Arlington Terminal (Willow Creek) will serve CRL. If the transportation contract is to end in 2019, facilities and equipment would have to be depreciated over a 10-year period. It's likely that some CSU employees would be hired to staff the Willow Creek terminal operations.
Rail	None mentioned.
Truck	None mentioned.
	5. Payload Capability Per Container or Truckload
Barge	Barge companies commented that they have no payload restrictions on the water, however rated container capacity, chassis type and road weight restrictions are likely to limit payloads to 30.5 to 32 tons.
Rail	Rail carriers anticipate a payload capacity range between 30 and 32 tons, based on the highway restrictions for containers on chassis and the use of "Husky" double stack well cars capable of transporting two 40' to 48' long intermodal containers stacked two high in the well cars.
Truck	Carriers anticipate a payload capacity range between 32 and 34 tons per load, using a modified 53-foot trailer, with the total combination having eight axles. There is engineering work still to be completed with the compactor and trailer manufacturers to determine the exact capacity, thus the 34 ton estimate could increase or be slightly less. One carrier suggested they could envision a configuration that could achieve a 35-ton average payload. Note: actual payloads will also depend on the compaction capability of the transfer station compactors, the composition of the incoming waste, and the need to maintain efficient transfer operations. This will be considered during subsequent analysis.
	6. The Feasibility of Backhaul Opportunities
Barge	Barge companies agree that backhaul of other commodities in other barges or containers can be achieved; however waste would make up a small portion of an existing tow (e.g., Metro waste from North and South moved 3 days per week in 2010 would be approximately 40 percent of a tow). They are already moving freight westbound and the addition of waste to the tow does not provide any inherent backhaul opportunity that would lower Metro's total transportation cost. Some companies suggested it might be worth including a shared benefit clause in the contract with no obligation. Then, if a backhaul could be developed that is unique and related to Metro, any cost savings would be shared between Metro and the barge company. However, most companies agree that backhauling is not likely to result in substantial long-term reductions in the rate charged to Metro.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
Rail	The railroads stated that the potential for backhauls and related cost mitigation will require substantial research, but that it is an on-going item of interest for them and they will continue to explore it. Potentially some rail cars, loaded with export containers, could be "tagged" (connected) to the returning waste train and delivered to the Metro region for transfer to large ships for export.
Truck	Carriers stated that these avenues require substantial research, but that it is an on-going item of interest for carriers and they will continue to explore it. The primary concern is that the solid top trailers typically used for solid waste shipments greatly limit the type of bulk commodities available for a backhaul. A rear-loading conveyor method would be needed for loading and these methods don't work well typically with end-load containers. In addition, the potential for contamination from transporting solid waste further limits those options. Depending upon the load time and location, the possibility of a substantial rate reduction is minimal, however better backhauling could have a favorable impact environmentally by reducing trips on the road and emissions.
7. Ideas to Ensure Smooth Transition from Current Trucking Service Provider	
Barge	Barge companies stated that it would be important to refine the differences inherent in loading containers and chassis instead of trailers at the transfer station(s). During mobilization it would be important to establish operating procedures with Metro that ensure operational excellence, safety and quality and clarify expectations about paperwork and inspections.
Rail	The railroads and potential intermodal terminal operators stated they plan on speaking with CSU management, and if awarded the Metro contract, would anticipate some of their employees joining their company as shuttle tractor and container drayage drivers.
Truck	Several of the carriers have acquired other transportation companies over the years and are very experienced at combining operations while seamlessly servicing the customer at the levels expected during transition. One carrier has met with CSU management and anticipates a high percentage of their employees joining their company if awarded the Metro contract. All carriers understand that they will be required to provide new equipment, competitive wages and benefits. Most of the carriers the CH2M HILL team interviewed would be able to offer Metro an existing local base of operations and a long local history in the industry.
8. Ability to Assist in Transition in the Event Current Contractor Services Become Unsatisfactory	
Barge	During transition, services could be performed from a port facility that is currently operational such as terminal two at the Port of Portland and at the terminal in Boardman, OR. It is anticipated that operating costs would likely be different however. Proper solid waste intermodal containers may be a challenge to secure, however barge companies think they should be able to acquire them and phase them in within a two to four month period. Most have some current barge capacity on the river with existing fleet, but might be stressed because of other customer obligations and commitments with their barges.
Rail	They offered to work with Metro to make every effort to assist Metro on a short-term basis.
Truck	Carriers commented they would make every effort to assist Metro on a short-term basis, possibly leasing equipment to supplement current inventory, making their maintenance facilities available to perform maintenance on the tractors and trailers, and supplying management as needed. One carrier offered to partner with Metro for a long-term solution if the renewal date for a new contract could be moved forward. If a long-term agreement could be moved forward, the carrier could provide new equipment which would ensure continuity of service and increase the likelihood of being able to retain the current CSU employees**.**

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
	9. Methods and Ideas to Ensure Smooth Interface at Metro's Two Transfer Stations
Barge	Barge companies offered to work with Metro to establish loading operating hours at the Metro South transfer station to avoid peak traffic periods and consider a night truck transfer of containers to minimize traffic impact during peak times. However, space constraints at the station(s) may eliminate this as an option, assuming it may be a problem for the transfer station to stack, stage and store empty and loaded intermodal containers.
Rail	One intermodal ramp (terminal) operator presented the idea of providing rail service from their existing yard located in Northwest Portland and providing direct rail service off of a UPRR mainline adjacent to the Metro South transfer station, basically eliminating the need for a truck drayage of the containers. They anticipate this would offer a smoother transition than more remote facilities that would require an over the road truck dray, at least for Metro South.
Truck	Most carriers have local operations and some regional carriers are headquartered locally within the Metro region boundaries, including management that would be responsible for interacting with Metro's transfer station operations contractor. Some carriers interviewed have experience transporting various items from both transfer facilities in the past. Most carriers have or currently transport solid waste for Waste Management and Allied locally, and have good working relationships with both facilities**.** They proposed maintaining lead drivers on site and dedicated dispatchers for each transfer station. A senior management person would maintain the relationship with the facility managers.
	10. Effects on Regional Freight Mobility (i.e., how does your mode affect regional traffic congestion)
Barge	Barging companies report that they anticipate eliminating much I-84 traffic and road wear from heavy loads and possibly reducing solid waste transfer trucks by half or greater, depending on the location of the barge terminal. For barges, a short dray of approximately 20 miles would still be required from the new Willow Creek terminal in Arlington to transport the containers to the landfill.
Rail	Impacts on regional traffic congestion could be avoided for both facilities (South and Central transfer stations) by co-locating the rail intermodal ramp at Metro South and by loading intermodal containers during the day at Metro Central and draying them to the NW Portland intermodal ramp during non-peak traffic hours (night).
Truck	Trucking offers the highest payload and with new fleet technology, they anticipate being able to increase payloads over current averages which will reduce the number of trips required to transport the solid waste. Specifically they anticipate a 7 to 10% increase in payload, which will reduce the number of trips that must be made to the landfill. In addition, some carriers proposed dispatching trucks so that the majority of the trips through Portland will be during off-peak hours. Regardless of the transportation mode selected, the loads will start on a truck and have to be transported around the Portland Metropolitan area. Carriers believe they will have the least impact on regional traffic congestion, particularly at peak hours, as trucking is a direct mode that operates on a 24-hour clock.
	11. Transportation Contract Service Performance Guarantees
Barge	Collective input from barging companies stated that performance bonds add cost to the project. They are able to provide them, however they come with a price. They would prefer to see that the contractor be required in their response, to provide company background, relative job "demonstrated" experience, capabilities to qualify for work of this magnitude, financial strength or capabilities and short biographies to be part of the RFP – basically legitimate job performance references. Rather than performance bonds, they preferred having strict performance clauses and performance or default resolution guidelines written in the contract. They perform risk assessments for contracts the size of Metro's and factor (add in) the necessary costs in accordingly.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
Rail	At this time, while the railroads understand Metro's desire for protection, there is a limit to what is economically feasible for them to offer in terms of guaranteed performance and/or on time delivery of Metro's waste to the landfill.
Truck	At this time it appears a performance bond could be available for a reasonable price. Carriers stated that a bond valued at $2,000,000 should be sufficient. As a reminder, events such as 9/11 have had a serious adverse effect on the price and availability of these bonds. Carriers commented that they hope that the performance of the current contractor does not put an undo burden on the future transporter. While they understand Metro's desire for protection, there is a limit to what is economically feasible.
12. Feasibility of a Regional Multimodal Freight Hub (Transload Facility) with Solid Waste Being One of the Key Commodities	
Barge	Companies stated that the hub concept is definitely feasible and likely can provide some synergies for labor & possibly even equipment. The limiting factor is realistically what freight, aside from aggregate, could be reloaded into the solid waste containers and that is available to haul on a fairly large scale basis. Export containers, petroleum, grain and wood residuals are also possibilities that would need to be explored more thoroughly and could be loaded into other barges and placed in tow with returning solid waste barges loaded with empty containers.
Rail	The railroads understand this concept, but do not anticipate being able to participate in such a facility. One of the intermodal ramp (terminal) operators offered that it might be possible to semi "host" an intermodal hub at their NW Portland location; however the idea would require further details and refinement.
Truck	In general, carriers offered to participate, but not necessarily host a facility of this type for Metro. Because trucks move commodities direct from one point to another, adding stops at a regional hub is viewed as unnecessary and costly.
13. Emissions Impact of Your Transportation Mode	
Barge	Barge companies offered that engine manufacturers' specifications will be provided. Some of the tug and barge companies are retrofitting their barges with newer engines, however none at the time of the interviews were able to provide a dedicated fleet for Metro with completely retrofitted new "clean" burning or "green" engines. One suggested that Metro consider requiring companies to use a higher grade and environmentally friendly hydraulic fluids such as bio-degradable or Clairion oil for their hydraulic systems also.
Rail	At present, some locomotives (nine in the UPRR's entire system) are being "tested" with alternative engine technology and diesel particulate devices, however the railroads cannot guarantee or offer dedicated "green" locomotives to Metro if a waste train were to be developed. Additionally, the EPA does not currently mandate or require specific reduced emissions or alternative fuel engine for the railroads and their locomotives.
Truck	New federal emissions standards for the 2007 model year will require 100 percent of on-road diesel HDEs use diesel particulate filters, and 50 percent of the engines must use NOx exhaust control technology; beginning with the 2010 model year, 100 percent of the on-road heavy-duty diesel engines will require NOx exhaust control technology.
14. Using Alternative Fuels	
Barge	Biodiesel or alternative mix is an option for tugboats. This may or may not require different injectors for the engine. The engine manufacturer and some company's port engineers will need to review this issue prior to submitting a proposal to Metro.
Rail	No information provided.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
Truck	Carriers offered to assess the maximum amount of bio-fuel that can be mixed with diesel to achieve optimum operating and clean air efficiencies. They also will evaluate the opportunity to use alternative fuels such as propane or LNG for the loaders at the transfer stations and landfill. Additionally they will investigate technical advances for lightweight aerodynamic tractors and trailers.
15. Consistency with Metro's Regional Transportation Plan Policies and Regional Framework	
Barge	Fuel efficiencies, performance issues, sustainability and reliability, emissions, and road wear will all improve over current practices through the use of tugs and barges.
Rail	The railroads would contemplate the plan and try to modify their operations to align it with Metro's plans and policies.
Truck	Carriers expressed a willingness to consider limiting peak time trips through Portland; reducing the number of trips by increasing payloads; and researching the feasibility of increased utilization by backhauling commodities which would reduce total trips even further. Most carriers have years of experience working with their current shippers to be creative in routing and timing to reduce congestion and maximize the efficiency of loads moved.
16. Creative Ideas for to the Procurement Process	
Barge	One company suggested having Metro qualify the respective companies and invite one or two companies from each transport mode to work directly with Metro prior to issuing the RFP. Metro should feel confident that they have chosen a quality contractor that can perform for the entire service period and have the financial strength and resources to back it up. Most companies think Metro would appreciate a responsible and hassle free "partner" that they have confidence in day in and day out on performance.
Rail	No information was provided.
Truck	No information was provided.
17. General Level of Risk Associated with Your Transportation Mode Relative to Other Modes	
Barge	Low to moderate risk level. Barge incidents have been minimal along the Columbia River and Willamette waterways according to all barge companies that were interviewed.
Rail	Risk level for rail is low to moderate. Railroad risk is largely dependent on whether a derailment occurs that could likely scatter several rail cars and loaded or empty containers (depending on the direction of the train – east or west) and spillage of waste could occur. This varies from a potential truck spillage incident where typically only one truckload, not numerous, would be involved in spilling significantly less waste than that of a loaded waste train with 80 to 100 intermodal containers.
Truck	Compared to the other modes, trucks transport each load independently, thus the consequences of an accident would be less than the other modes. Trucks have a good safety record: CSU's history of 17 years with minimal problems is testimony to this statement. Trucking also offers the ability to still transport via its mode if a road is closed by using an alternate route. Rail and barge will likely look to trucking as a back-up if the railroad is washed out or the locks are closed.
18. Contingency Plans in the Event of Lock Closures, Rail Line Blockage or Other Natural Disasters or Emergencies to Ensure No Service Interruption Occurs to Metro's Solid Waste Operations	
Barge	Annual navigation lock maintenance closures are known approximately 3 months in advance and should be addressed in the RFP. The expenses for truck hauling during lock closures could be factored in to the total annual per ton rate, or could be paid for on a spot basis during the closure period. Much of the fleet used to dray trucks, containers and chassis during normal operations could be used to go straight to the CRL during the lock closure period.

EXHIBIT 2-3
Summary Comparison of Industry Responses to Procurement and Operating Issues by Mode

Mode	Issue
Rail	If the main rail line is blocked, trucks can be used and waste would be transported over alternate routes. If I-84 is also out, alternate truck routes are available such as Highway 14 in Washington or Highway 26 over Mt. Hood to Highway 35. There are also alternative landfills available, such as Riverbend and Coffin Butte in case of emergency.
Truck	As discussed above for rail, alternative routes are available if I-84 is closed due to slides or inclement weather, such as Highway 14 in Washington or Highway 26 over Mt. Hood to Highway 35. There are also alternative landfills available, such as Riverbend and Coffin Butte in case of emergency.

SECTION 3

Evaluation of Key Issues

Section 2 presented the results of industry interviews, and as such, represents a summary of the opinions of potential transportation service providers. This section uses information received from the industry interviews and the combined experience of the CH2M HILL project team to evaluate a series of issues that will help Metro prepare its procurement documents. The issues evaluated include:

- Strategies to ensure competition among modes
- Transportation mode impact on Metro's solid waste system or regional freight mobility
- Feasibility of the hub concept and facilitating backhaul opportunities
- Transfer station interface and scheduling
- Expected payloads
- Preferred contract term

3.1 Strategies to Ensure Competition Among Modes

Metro is in a rare position of having access to three possible modes for solid waste transport. Thus, there is the potential to foster competition not only between companies within a mode, but between companies using different modes of transport. This section identifies some strategies for consideration that may help foster competition to achieve Metro's objectives. Outside of just preparing a well-thought out procurement document, creating competition among the various modes requires the shipper, i.e. Metro, to become creative in developing scenarios where the modes can become competitive. This can be achieved in a variety of ways; however each one comes with a price tag to Metro.

3.1.1 Developing a Terminal Served by Barge and Rail

One of the most effective ways for any shipper to ensure competition among the transportation modes is to secure or make available the necessary facilities and infrastructure needed for each of the modes to compete. In this case, securing a facility such as the Port of Portland Terminal Two (T-2) would increase competition with respect to both rail and barging. Not having this type of facility available to potential service providers, forces them to identify their own intermodal container handling facilities. Such facilities are risky and costly to develop, and few feasible sites are available in the Metro region.

Another advantage of this strategy is that it places Metro in a good position when its disposal contract is up for re-bidding in 2014 or 2019. Having control of a terminal that can serve multiple transport modes and send waste to multiple landfills would help maintain competition for both transportation and disposal.

An example of this type of strategy is the City of New York, which is building four marine waste transfer station terminals in and around the city. The terminals will be owned by the City and operations and marine transportation will be subcontracted to private companies. Another example is Los Angeles County Sanitation Districts (LACSD), which is developing

a WastebyRail program and securing land adjacent to its Puente Hills Material Recovery Facility (MRF) to design and build an intermodal ramp for handling rail cars and transloading intermodal containers loaded with solid waste. In yet another example, King County, Washington, in an effort to control its own destiny, purchased a former grain mill that is located on the water in Elliot Bay that also has rail access, allowing them multimodal transportation options.

3.1.2 Equipment Ownership

Another way to increase competition is for Metro to purchase transfer trailers (in the case of trucking) and/or the intermodal containers (in the case of rail or barge) and possibly even the chassis. As trailers and containers are expensive depreciable items, removing this cost element from the procurement process will make it easier for some smaller, local firms that are less capitalized to compete for the business. It would also have the advantage of lowering Metro's total costs, because the private sector would not receive a profit margin on this equipment and Metro's cost of capital are lower than that available to the private sector. Further, should a provider go out of business for some reason, it would be more feasible for Metro to simply hire another transportation company (with drivers and tractors) for emergency service than having to completely rebid solid waste transportation services.

There are some disadvantages to this approach as well. First, damage to equipment could prove to be an issue. Quite often in other situations where subcontracted transportation companies do not own the trailers or container and damage occurs, it becomes a finger-pointing issue of which entity's employees caused the damage and who is responsible for the cost of the repairs. Second, fleet management and maintenance of both containers and trailers can become a full time job and would require someone who specializes in fleet maintenance and management on Metro's staff. Interfacing with the subcontracted transportation company regularly will be a requirement of this staff position and will most likely consume most of their time. Third, there have been instances in which tire theft by subcontractors has become a significant challenge, particularly in less supervised situations. As the cost for new tires, and even recapped tires have increased, along with all other costs associated with transportation, Class 8 vehicle tires have become a sometimes "hot" commodity, especially in larger metropolitan areas.

3.1.3 Capital Advance/Financing

Another potential opportunity for Metro to ensure competition among the transportation modes is to provide a $5-10 million payment to the successful private transportation company to be used specifically for capital purchasing of new equipment or infrastructure for exclusive use in Metro's solid waste transportation. Again, the strategy here would be to level the playing field among contenders, allowing all players the means to secure new equipment and participate in the procurement process, and provide lower cost capital that would lower Metro's total cost of transportation services.

3.1.4 Fuel Provision

Currently, Metro provides the fuel to the truck transportation service provider. Metro saves federal excise tax on the fuel it purchases. If Metro were to continue this practice and offer it in the next procurement cycle, all modes would develop cost models for their services

reflective of this savings and it would be passed onto Metro in the transportation rates they propose to Metro.

3.2 Transportation Mode Impact on Metro Solid Waste System and/or Regional Freight Mobility

The three transportation modes will have somewhat different impacts on both Metro's solid waste system and/or on the region's freight mobility. This section highlights some of the advantages, opportunities, and disadvantages associated with each mode.

3.2.1 Barge

Advantages/Opportunities:

- Consumes the least amount of fuel: including truck drayage on each end, a barge-based system would consume about half the fuel of Metro's current all-truck transportation system.
- Has a greater fixed cost and if volumes increase the average price per unit decreases, alternatively, if volumes decrease their price per unit increases.
- Significant payload capability per barge tow. Each barge will hold—theoretically—80 containers: 4 across x 5 long x 4 thick, but for stability reasons on the way up, they put two center rows on the 4th level. An optimal tow is 4-barges for a maximum capacity of approximately 280 containers. In 2010, Metro's waste three days per week would be about 40 percent of a 4-barge tow; thus each tow would include containers from Metro and cargo from some other customer. An 8-hour shift would be needed to load/unload each barge.
- If a barging facility is located near or adjacent to Metro's transfer stations (specifically Metro Central), a reduction in some local truck traffic could be realized thereby promoting regional freight mobility. However, this effect would be minor because the current transport system generates a total of about 160 truck trips (80 full and 80 empty) on an average day, which is small relative to the total number of vehicles on the roads waste is transported on.
- Can serve any of the three main regional landfills that are anticipated to be competing for Metro's waste in 2019 – Roosevelt, Columbia Ridge and Finley Buttes.
- Would significantly reduce Metro's waste truck traffic on I-84 through the Columbia River Gorge Scenic Area.
- Reduced interface with motoring public.

Disadvantages:

- While an EPA rule has been proposed, no current Federal or EPA mandates on emissions standards of alternative fuel usage exist. Thus significant reductions in PM and NOx will not be required as soon as they will be for trucks.

- Requires large section of land for centralizing the loading and unloading of intermodal containers.
- The price of new assets (barges and tugs) manufactured from steel and other raw materials have risen significantly in price. New tow barges, depending on their specifications can range from between $3 and $5 million to design and construct.
- Barge manufacturers are booked out about 1.5 to 2 years.
- Annual lock and dam closures would require waste to be trucked to CRL for 4-6 weeks annually. This presents some operational challenges and may have some transitory effects on operations at Metro's transfer stations.
- Increasing in-stream flows for salmon lower water levels up river, which reduces the draft, which in turn reduces the maximum load a barge can carry up river. While this is not a constraint today, should conditions change in the future, it is possible that fewer containers could be carried on each barge, thereby increasing barge operating costs.
- Barges must pay a user fee to Corps of Engineers on fuel used above Bonneville Dam (for dredging).
- Barging to Willow Creek will take 18-20-hours (a barge company would probably "budget" 24 hours just in case). Thus, barge requires the most containers of any mode.
- Barge terminal on waterways – If a current site is not available or selected, developing a new site could be an issue requiring approximately 18 months to develop and mobilize.
- New tugboat engines are more sensitive to alternate fuels and as the processing standards of these new fuels are not very high, the fuel injectors are known to build up deposits from biofuels. Engine failure from mandating biofuels or others types needs to be carefully considered as engine failure on a tug enroute pulling a load could have catastrophic consequences.
- Some possibility of improving regional freight mobility and spurring economic development if a terminal can be developed for materials that would move along the Columbia River using barges rather than truck.

3.2.2 Rail

Advantages/Opportunities:

- Would significantly reduce Metro's waste truck traffic on I-84 through the Columbia River Gorge Scenic Area.
- If a rail loading facility is located near or adjacent to Metro's transfer stations (specifically Metro South), a reduction in some local truck traffic could be realized thereby promoting regional freight mobility. Again, any such improvement in regional mobility is likely to be minor.
- Less fuel consumption and emissions than Metro's current transportation system, but more than barge.

- Reduced interface with motoring public.
- Some possibility of improving regional freight mobility and spurring economic development if a terminal can be developed for materials that would move by rail rather than by truck.

Disadvantages:

- While an EPA rule has been proposed, no current Federal or EPA mandates on emissions standards of alternative fuel usage exist. Thus significant reductions in PM and NOx will not be required as soon as they will be for trucks.
- Requires large section of land for centralizing the loading and unloading of intermodal containers.
- Typically want 5 year or less contract length.
- Rarely, if ever, offer liquidated damages or agree to service performance criteria.
- At present, railroad traffic is highly congested in and around the greater Portland area and the railroads are limited in what they can offer Metro for intermodal service and yard space for building trains. Thus it is likely that an independent terminal operator, or Metro, would need to provide the railroad a facility with rail access to connect and transport loaded railroad cars to the landfill.
- "Captive shipper" landfills are only served by one railroad (Allied/Rabanco is only served by the BNSF; WMI and Finley Buttes are only served by the UPRR) so changing to another landfill in a longer term contract when the disposal agreement expires is problematic.
- In recent years, rail traffic on the west coast and in the Portland area has increased substantially in response to domestic demand and increased container traffic from Asia. Many local shippers have complained about service delays and poor customer service from the railroads[1]. It is possible that this could add to costs or affect operations at Metro's transfer stations.

3.2.3 Truck

Advantages/Opportunities:

- Most rapid mobilization of the modes.
- Simplest transition and implementation of the modes.
- Can offer work to Gilliam County drivers.
- Less container or trailer handling than other modes which reduces operational complexity and cost i.e., simplest means of transportation: direct from transfer stations to landfill.

[1] See for example, Isbell, Monica. *Testimony before the Oregon House Transportation Committee Rail Hearing*, February 7, 2007.

- Most responsive, versatile and flexible mode relative to change operational needs and waste volumes or other schedules.
- More flexibility than other modes to respond in case of an emergency that eliminates the main transportation route.
- EPA rule for road diesel engines (trucks) will likely result in dramatic reductions in PM and NOx occurring more rapidly than will the proposed rule currently under consideration for marine and locomotive diesels.

Disadvantages:

- Highest fuel consumption and greenhouse gas emissions per ton-mile of cargo transported.
- Truck costs are the most price-sensitive of the three modes to changes in fuel costs and wages.
- Highest amount of visibility and accident risk in community with residents.
- Greatest negative impact on regional freight mobility – which has a minor effect on traffic congestion in the region.
- Labor is a higher proportion of total costs than the other modes, and a current shortage of truck drivers in the region increases the risk of cost increases and may make staff more difficult to retain.

3.3 Feasibility of the Hub Concept and Facilitating Backhaul Opportunities

The development of a regional freight hub and a backhaul scenario are linked. Some type of hub would be necessary to implement a backhaul, and a hub would be more effective if handled freight flowing in both eastward and westward directions. Identifying a backhaul from the east to replace the hauling of otherwise empty equipment would reduce fuel use, emissions, and truck traffic, and might possibly lower Metro's total transportation costs.

3.3.1 Regional Freight Hub

A regional freight hub would consist of a central intermodal yard and/or a backhaul stockpile facility. In the freight business, each "shipment" of a specific "commodity" requires very specific time and location logistics. In practice, public facility "hubs" are rarely viable unless they are subsidizing a transportation mode or backhaul commodity (such as aggregate to wood residuals) that is already relatively cost effective.

As an example, assuming a wood residual backhaul could be developed returning on either of the three transportation modes, a central location for stockpiling the commodity would need to be developed. This is needed to minimize the cycle times of the intermodal containers or trailers that would be used for both "head hauling" Metro's solid waste to the landfill and backhauling the other commodity.

There are a few ways that Metro could pursue the hub concept:

A. Suggest that proposers provide a hub and see if a feasible proposal is received – Under this option, the RFP would identify the hub concept and pose it as an option for proposers to develop. However, without specific requirements in the RFP, it is likely that proposers would focus on the main procurement and Metro might not receive any proposals on this option.

B. Require a specific number of acres of an intermodal site available for loading other freight – This option would somewhat restrict the firms able to respond to the RFP in general as given the site requirements, only larger, well capitalized corporations will be able to meet the requirements. This may substantially reduce the number of transportation firms developing proposals to Metro's RFP. It is also likely to increase the cost of transportation, particularly if the other freight opportunities are not particularly lucrative.

C. Metro purchase a site with a specific number of acres made available for loading other freight – Metro would secure the site, either by purchasing or leasing it and make it available to the successful transportation contractor for use. This would allow smaller companies to participate, and could instill competition between rail and barge if the site had access for both modes. This would result in some economic risk to Metro because it could end up making payments for land and equipment that is underutilized.

D. Develop hub later – The potential exists to identify the hub concept in the RFP, and have Metro and the contractor develop the hub as a public-private partnership after the main operations are working smoothly. This might require Metro to provide the terminal site, or agree to make lease payments to the contractor for the excess property that exists prior to the hub's development.

3.3.2 Backhaul Opportunities

Five primary commodities have been identified for potential backhaul opportunities. They are depicted in Exhibit 3-1 for each mode. The possibility of lower rates for Metro's waste transportation depends on the amount of loading time, the location of the loading yard, and market conditions for the material. If a backhaul could be developed it would help reduce fuel usage and emissions assuming the backhauled commodity wouldn't otherwise have been provided close to the Metro region.

Based on our conversations with industry and a general knowledge of market conditions, the likelihood of a substantial reduction in the price paid by Metro is small. One reason for this conclusion is that backhauls require additional labor and equipment time to load, and to transport and deliver the backhauls to their destination. Quite often in a travel distance as short as the one between Metro's transfer stations the extra time spent loading and delivering the materials is enough to counteract any savings realized by sharing the rolling stock.

EXHIBIT 3-1
Potential Backhaul Opportunities by Mode

	Grain	Wood Residuals	Aggregate	Export Containers	Bulk Petroleum
Barge	✓	✓	✓	✓	✓
Rail			✓	✓	
Truck		✓	✓		

If material is transported in solid top trailers, the list of prospective bulk commodities available for backhauling is limited. Conveyor loading methods could be performed, but they are not particularly efficient both in terms of throughput in number of trailers or containers to be loaded in given timeframe and the actual time it takes to load a single container or trailer.

An alternative would be to transport waste in open top trailers or containers. This would allow for more efficient loading. It would also result in added costs for operating and maintaining tarps, and Metro would need to implement a rigorous maintenance and inspection program to ensure that litter doesn't escape from trailers in transit.

A final constraint is the potential for contamination from transporting commodities in trailers or containers that have carried solid waste. This further limits the commodities that could be part of a backhaul opportunity.

If Metro wants to encourage backhauls, it could structure its RFP with options with and without backhauls. For the with backhaul option, proposers would need to specify the nature of the arrangements for backhauled commodities, equipment, hub location, and added labor and equipment costs. Metro could then evaluate whether or not it wanted to select the backhaul option or the no backhaul option.

3.4 Transfer Station Interface and Scheduling

Each of the three modes requires trucking in some capacity or another for loading and unloading the containers or trailers. For barge and rail, a truck/container "drayage" is typically required where the intermodal container is placed on a chassis connected to a tractor, which is then transported to a Metro transfer station for loading. The same is true on the receiving end at the landfill where a chassis connected to a truck is loaded with an intermodal container and drayed to the tipper at the landfill for disposal.

The loading/unloading operation varies somewhat at the rail and barge terminal, but at the transfer station the operation is essentially identical. Further, once equipment is properly specified, there should be no substantial difference at the transfer station between loading chassis and containers (barge and rail) or trailers (truck).

Because truck has the fastest cycle time, fewer trailers are required than containers in barge or rail. For truck haul, a pool of trailers would be staged in a yard adjacent to the Metro Transfer stations, as is currently done, and a shuttle tractor drays the trailers to the

compactors for loading and once loaded the are restaged in the adjacent yard for eventual delivery to the landfill for disposal. A barge and rail system would require a larger staging pool of stacked containers at the terminal and/or near the transfer stations than would a truck system.

In summary, outside of the increased number of containers required for barge and rail options, all three options should have a similar interface with station operations at the Metro transfer stations.

3.5 Expected Payloads

Metro's current operation does well in maximizing payloads considering that the equipment and associated engineering technology is almost 20 years old. As outlined in the summary of responses from the various transportation modes, all stated that higher payloads could be achieved than the current average. Barge and rail operators stated that 31-32 ton payloads were possible, and truck operators stated that payloads of 32-34 tons were possible, or perhaps as high as 35 tons. Barge and rail cannot achieve the same payloads as trucking because those modes must use containers on chassis which are considerably heavier than an integrated, light-weight trailer. On the other hand, many more containers would be transported on a rail or barge trip than on a truck trip.

3.6 Preferred Contract Term

As noted in Section 2, Metro's existing disposal contract expires in 2014 with a possible extension to 2019. Because the destination landfill may change at that time, a ten-year contract term with a buy-out option at five years is a logical contract term for this procurement. Under most circumstances, trailers and containers have a useful economic life of about ten years. The life of the equipment can be extended, however the maintenance costs begin to exceed the equipment's salvage value. Also, maintenance repairs in later years can add significant weight (welded and replaced parts) so payload capacity begins to decrease.

The timing of a tractor replacement for most applications ranges between 4 and 6 years. Thus, Metro could require phased tractor replacement within that time window, and at the end of a 10-year contract the tractors would be nearing the end of their useful economic life.

Most all potential service providers felt that a 10-year contract would be acceptable and that it makes sense to link the expiration of the transportation agreement to the expiration of the landfill agreement. Rail was the one mode that desired a shorter contract term. To have a transportation contract life longer than the disposal contract expirations may require significant capital investmen``t if the destination landfill location is changed, depending on whether a longer or short distance to the new landfill is required.

Having a contract less than ten years would not allow transportation firms to adequately amortize and depreciate their trailer or container fleet. Consequently, the contractor would need to build in higher costs for the shorter contract life. This would increase the cost to Metro because the contracted transportation firm would most likely depreciate the equipment over the exact length of the contract.

It is recommended that Metro establish a 10-year contract term in which the transportation contract is structured to expire in 2019 with a buy-out provision for 2014 in case the disposal contract is not extended and it is advantageous for Metro to end the transportation contract at that time as well.

SECTION 4

Analysis of Transportation Scenarios

This section presents the results of an analysis of transportation scenarios. These scenarios represent feasible combinations of modes and terminals developed as a result of the industry research summarized in Section 3. They do not represent a complete universe of possible options available to Metro, but are intended to give a broad set of insights into the cost, environmental, socioeconomic, and operational aspects of different transportation arrangements.

The analysis of scenarios includes estimates of fuel use, emissions, and costs by mode. Those estimates plus other risks were evaluated in a value modeling analysis for each scenario.

4.1 Scenario Definition and Common Assumptions

The following eight scenarios are analyzed in this section:

1a. Barge with intermodal loading at Terminal 2 (west) and Willow Creek (east)

1b. Barge with intermodal loading at a northern Portland facility (west) and Willow Creek (east)

2a. Rail with intermodal loading at Terminal 2 (west) and Columbia Ridge Landfill (east)

2b. Rail with intermodal loading at Terminal 2 (west) and Port of Morrow (east)

2c. Rail with intermodal loading at Portland rail yard and Metro South (west) and Columbia Ridge Landfill (east)

3. Truck haul similar to current system

4a. Barge for Central (Terminal 2-Willow Creek); Truck from South

4b. Rail for Central (Terminal 2-Columbia Ridge Landfill); Truck from South

Fuel use and emissions estimates for each scenario are also compared to those of Metro's existing system in 2006.

Diagrams that show the mix of modes and terminal locations for each scenario are shown in Exhibit 4-1.

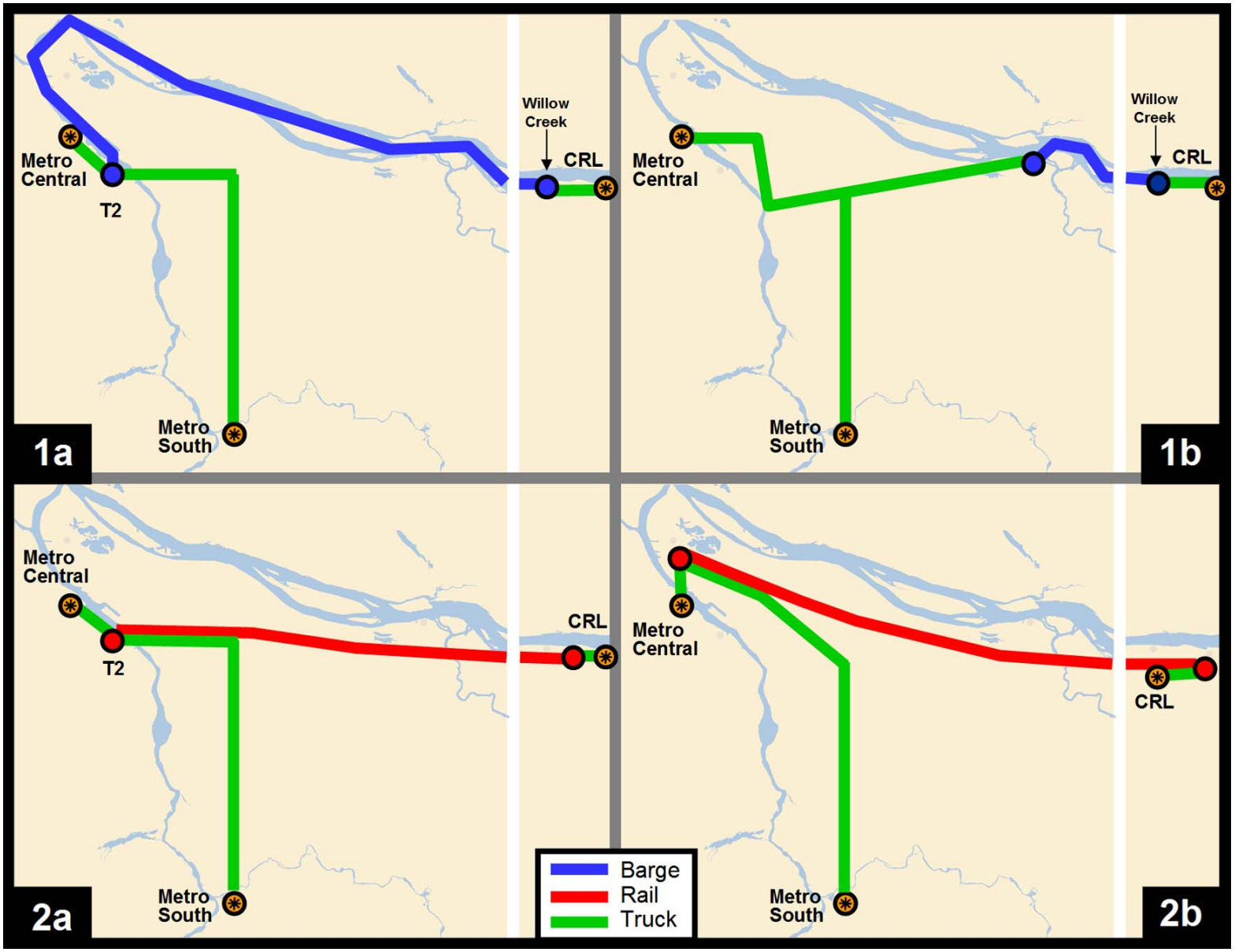

EXHIBIT 4-1
Transportation Scenarios

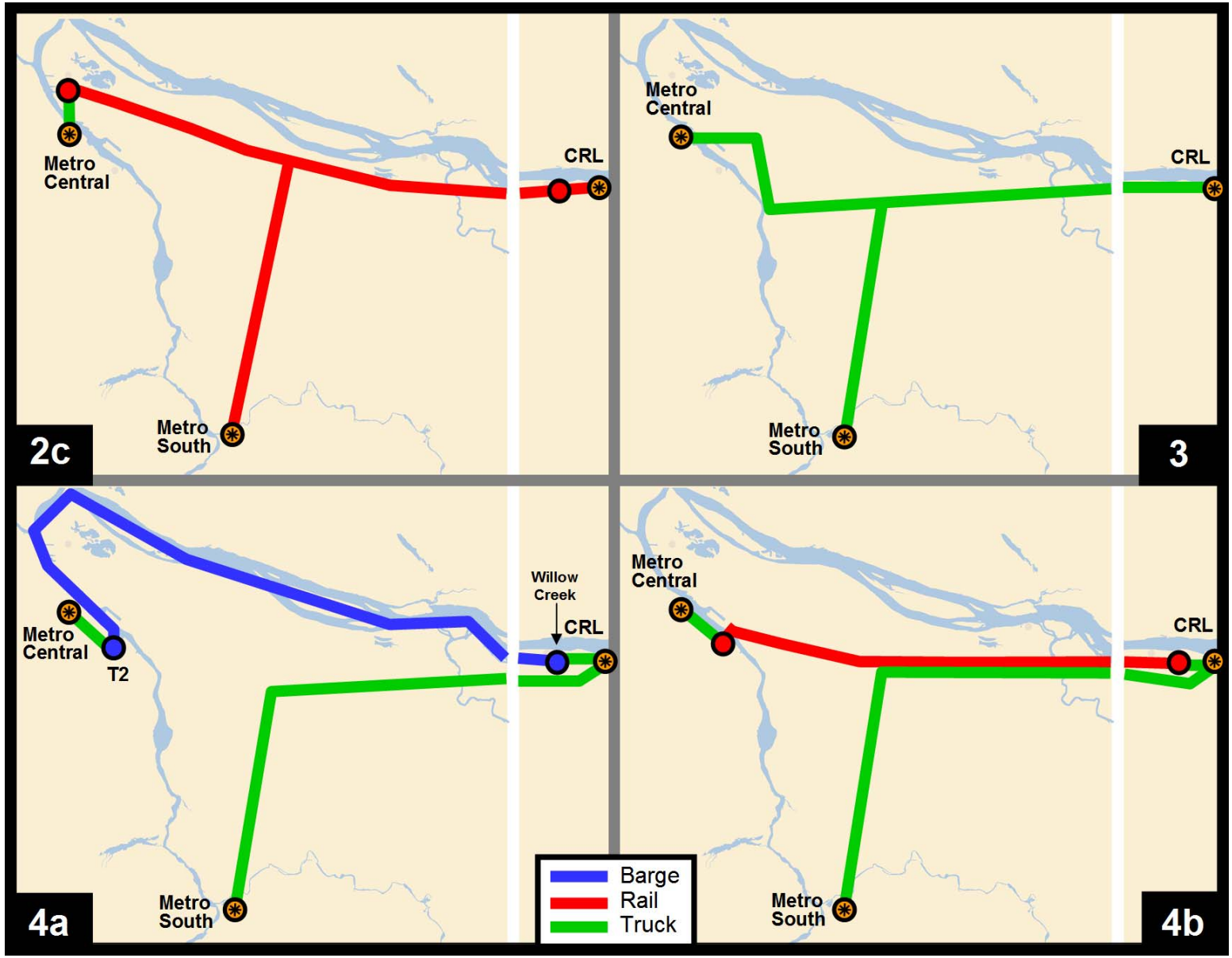

EXHIBIT 4-1 (Continued)
Transportation Scenarios

Assumptions common to all scenarios or to a particular mode include:

- Contract term: 10 years
- 2010 Tons from Central: 260,809; from South 256,823
- 2019 Tons from Central: 337,579; from South 322,766
- Average payload 33 tons for new long-haul trailers, 31 tons for containers drayed to a terminal
- In the barge scenarios (1a, 1b, 4a), lock closures will require trucking during 3 weeks each year.
- Trailer/container storage adjacent to Central and at South remains at current levels (i.e., containers cannot be stored on site and moved at night).
- All trucks (excepting contract trucking during lock closures) will be new and will meet 2007 EPA emissions requirements.
- Emissions estimates do not include emissions that would occur at terminals.
- Real discount rate: 3 percent
- CRL operating hours remain 7 a.m. to 4 p.m.

4.2 Cost Estimates

4.2.1 Methodology

Planning-level cost estimates were prepared for each scenario using data from a variety of sources, published rates, rates provided by service providers, and a proprietary trucking cost model. Costs were prepared in 2007 dollars for the first year of service, 2010. Thereafter, Metro's contract would most likely be structured so that costs would increase at some multiple of a published price index.

Costs have been developed for each mode of transport and include the cost of shuttle operations at Metro transfer stations, drayage (short-haul transportation) from Metro stations to terminals, line-haul, and terminal operations. It is assumed that the transportation contractor will own or lease all components of the transportation system including containers, chassis, trailers, tractors, tugs, barges, locomotives, rail cars, and terminal facilities.

4.2.2 Cost Estimates

The estimated cost of the transportation scenarios is shown in Exhibits 4-2, 4-3, and 4-4. Exhibits 4-2 and 4-3 are graphic representations of costs in total dollars and on a per-ton basis, respectively. Exhibit 4-4 is a table that reports estimated costs for each link of the system in total dollars and in cost per ton. Actual total costs incurred by Metro for solid waste transportation in 2006 (including fuel, shuttle operations, and other costs) are included for reference purposes. A few observations about the cost estimates follow:

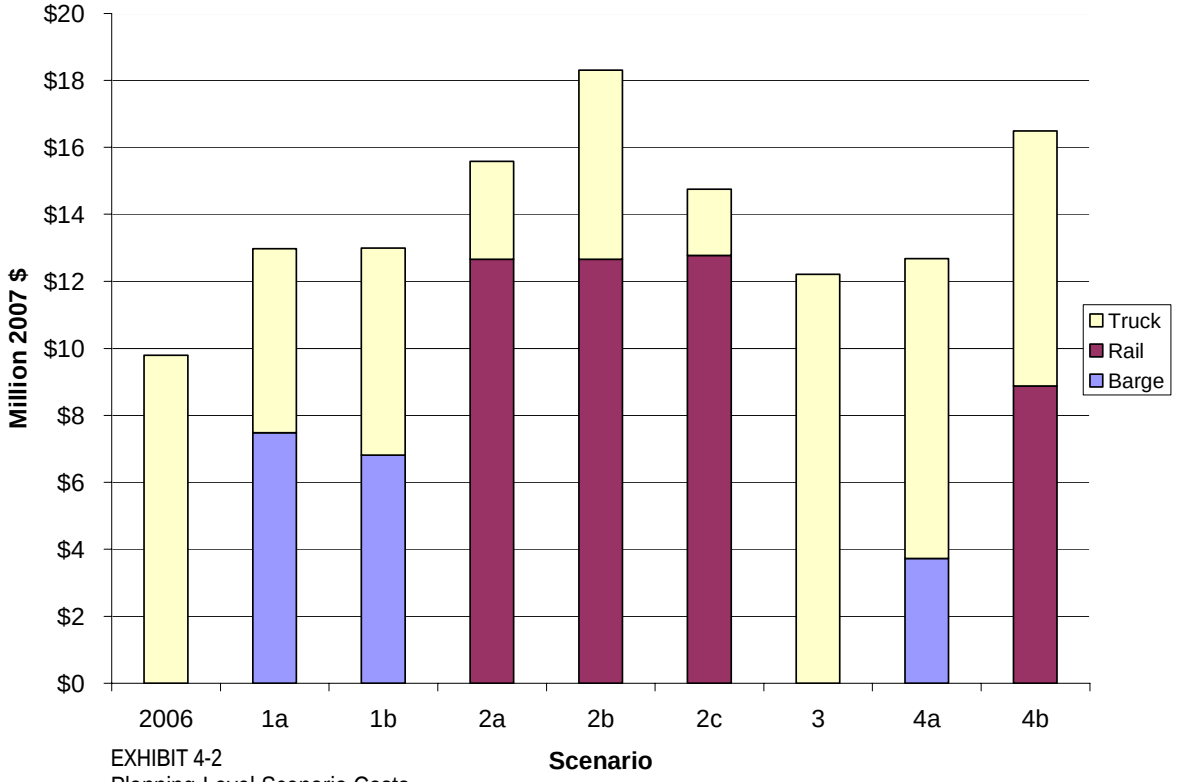

EXHIBIT 4-2
Planning-Level Scenario Costs
2010 tons and Millions of 2007$

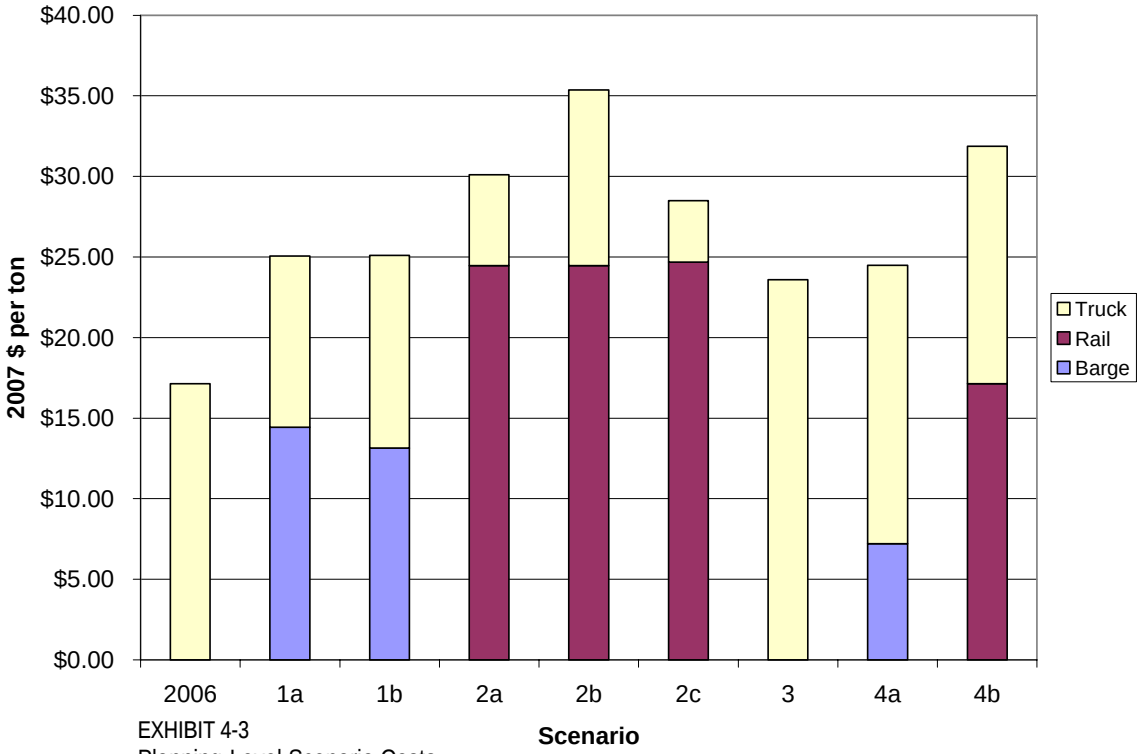

EXHIBIT 4-3
Planning-Level Scenario Costs
2010 tons and 2007$

EXHIBIT 4-4
Planning-Level Scenario Costs

Scenario	2010 Tons and 2007 Dollars Annual Cost	Cost per Ton
Scenario 1a		
Drayage		
Metro Central to T2	$678,361	$2.60
Metro South to T2	$1,500,986	$5.84
Willow Creek to CRL	$2,455,864	$4.74
To CRL during lock closure	$880,623	$29.49
Barge (line-haul, containers, loading)	$7,475,408	$14.44
Scenario 1a Total	**$12,991,242**	**$25.10**
Scenario 1b		
Drayage		
Metro Central to North Portland	$1,435,271	$5.50
Metro South to North Portland	$1,417,301	$5.52
Willow Creek to CRL	$2,455,864	$4.74
To CRL during lock closure	$880,623	$29.49
Barge (line-haul, containers, loading)	$6,807,496	$13.15
Scenario 1b Total	**$12,996,555**	**$25.11**
Scenario 2a		
Drayage		
Metro Central to T2	$678,361	$2.60
Metro South to T2	$1,500,986	$5.84
Arlington to CRL	$763,035	$1.47
Rail (line-haul, containers, loading)	$12,663,055	$24.46
Scenario 2a Total	**$15,605,437**	**$30.15**
Scenario 2b		
Drayage		
Metro Central to T2	$678,361	$2.60
Metro South to T2	$1,500,986	$5.84
Port of Morrow to CRL	$3,480,005	$6.72
Rail (line-haul, containers, loading)	$12,663,055	$24.46
Scenario 2b Total	**$18,322,407**	**$35.40**
Scenario 2c		
Drayage		
Metro Central to Northwest Portland	$714,733	$2.74
Metro South to Adjacent Yard	$534,343	$2.08
Arlington to CRL	$763,035	$1.47
Rail (line-haul, containers, loading)	$12,774,243	$24.68
Scenario 2c Total	**$14,786,354**	**$28.57**
Scenario 3		
Truck to CRL	$12,211,305	$23.59
Scenario 3 Total	**$12,211,305**	**$23.59**
Scenario 4a		
Drayage		
Metro Central to T2	$678,361	$1.31
Willow Creek to CRL	$1,272,732	$2.46
Metro South to CRL	$6,539,717	$25.07
To CRL during lock closure	$471,614	$31.34
Barge (line-haul, containers, loading)	$3,727,065	$7.20
Scenario 4a Total	**$12,689,489**	**$24.51**
Scenario 4b		
Drayage		
Metro Central to T2	$678,361	$1.31
Arlington to CRL	$420,686	$0.81
Metro South to CRL	$6,539,717	$12.63
Rail (line-haul, containers, loading)	$8,868,752	$17.13
Scenario 4b Total	**$16,507,516**	**$31.89**

- As shown, all eight scenarios are much higher than Metro's current system. This is anticipated because Metro's is currently at the end of a 10-year contract in which it is receiving below market rates.
- Transportation by barge and truck appear to be relatively close in cost, whereas rail appears more costly.
- Barge and rail scenarios are sensitive to the length of drayage that must occur on either end of the line-haul.

4.3 Fuel Use and Emissions Estimates

4.3.1 Methodology

Different approaches were used to estimate emissions for each mode. Modeling emissions is complex and depends on a host of variables that cannot easily be specified in a planning-level analysis. For this study, modeling approaches that were used that were flexible enough to address the many combinations of modes, locations, and distances in the scenarios, yet rigorous enough to give good, planning-level estimates.

A discussion of the models used to estimate emissions for each mode follows.

Barge Fuel Use and Emissions

Fuel Use. Fuel use for barges was based on input from industry representatives and was assumed to be 75 gallons per hour. Metro was assigned a percent share of that fuel use based on its share of the cargo carried on that trip, which in 2010 was 41 percent for Scenarios 1a and 1b, and 20 percent for 1c. This percentage increases in future years proportional to increases in tonnage.

CO_2 Emissions. Information provided in *Emissions Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel*, EPA420-F-05-001, February 2005, was used to calculate carbon dioxide (CO_2) emissions of 10,084 grams per gallon of diesel fuel burned. This factor was used for both tugs and locomotives.

NO_x and PM Emissions. Nitrogen oxides (NO_x) and particulate matter (PM) emissions in grams per mile were calculated using the methodology from *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data,* EPA420-00-002, February 2000. (EPA Emissions Study). In this document, an emission rate in grams per kilowatt-hour (g/kW-hr) is calculated using the fractional load and defined coefficients shown in equation 1:

$$\text{Emission rate (ER)} = a\,(\text{Fractional Load})^{-x} + b \qquad (1)$$

To determine emissions in grams per mile, the emission rate is multiplied by mode specific power and the annual hours of travel then divided by the annual miles as in equation 2.

$$\text{Emissions} = \text{ER} * \text{Mode specific (kW)} * \text{Time (hours)} / \text{Distance traveled (miles)} * \text{Metro share of tow (41\% in Scenario 1a in 2010)} \qquad (2)$$

Mode specific power is the rated horsepower in kilowatts of the tug multiplied by the fractional load the tug is operating. In the SR 47 document, cruising is defined as 80% load; slow cruising is defined as 40% load.

Estimated NOx and PM emissions in grams per mile from the EPA Emissions Study (calculated for Scenario 1a) are shown below.

Mode of Operation	NO_x (grams/mile)	PM (grams/mile)
EPA Commercial Marine Cruise	1,100	27
EPA Commercial Marine Slow Cruise	566	14

The CH2M HILL project team estimates that barge operations could be characterized as 90 percent "Marine Cruise" and 10 percent as "Slow Cruise". This results in NOx emissions of 1,047 g/mile and PM emissions of 26 g/mile.

On May 10, 2004, EPA finalized the Clean Air Nonroad Diesel Rule. This rule requires the sulfur content of marine diesel and locomotive fuel to drop from its current level of approximately 3,000ppm to 500ppm (low sulfur diesel) in June 2007 and 15ppm (ultra low sulfur diesel, ULSD) in June 2012. The reduction in sulfur levels will reduce PM and NOx emissions from diesel engines currently in operation. EPA estimates that low sulfur diesel will result in a 10-15% reduction in PM emissions compared to existing non-road diesel fuel, and using ULSD will result in an additional 5-10% reduction in PM emissions[2]. For the purposes of this study, the midpoints of these ranges are used, and the phase-in to ULSD is assumed to begin in 2013 (i.e., rounding to the first full year of operation).

Reducing the sulfur content of fuel will also reduce NO_x emissions somewhat. There is less information available about the relationship between sulfur in fuel and NO_x emissions. Based on a review of available literature[3], this study assumes that using low sulfur diesel will result in a 10% reduction in NO_x emissions, and using ULSD will result in an additional 5% reduction in NO_x emissions.

These adjustments are made to both marine and locomotive diesel consumption estimates. The emissions estimates used in this study for the barge mode for various time periods follow.

Mode of Operation	NO_x (grams/mile)	PM (grams/mile)
2010-2012 (Low Sulfur Diesel)	916	23
2013-2019 (Ultra Low Sulfur Diesel)	847	22

Additional calculations used to prepare these emission rates are shown in Appendix C.

[2] *Finding Strategies that Work: Advanced Pollution Controls for Commuter Locomotives.* Lucy Edmonton, EPA New England. January 26, 2006.

[3] See for example the London and California examples in*: International Experience On Ultra Low Sulfur Diesel and Biodiesel.* Michael P. Walsh. Hong Kong Environmental Protection Department Motor Vehicles Emissions Group. January 24, 2000; and *Diesel Health Impacts and Recent Comparisons to Other Fuels.* Diane Bailey, Natural Resources Defense Council, DEER Conference, San Diego, CA, August 2002.

Proposed EPA Rule[4]. EPA is proposing to adopt more stringent standards for marine diesel engines and locomotives that would have three main effects. First, existing locomotive engines would be affected when they are remanufactured. These standards would take effect as soon as certified remanufacture systems are available (as early as 2008), but no later than 2010 (2013 for Tier 2 locomotives). EPA is also requesting comment on similar requirements for certain existing marine diesel engines when they are remanufactured.

Second, EPA is proposing near-term emission standards, referred to as Tier 3 standards, for newly-built locomotive and marine engines. These standards would reflect the application of technologies to reduce engine-out PM and NOx emissions and would phase in starting in 2009.

Third, EPA is proposing long-term emissions standards, referred to as Tier 4, for newly-built locomotives and marine diesel engines. These standards are based on the application of high-efficiency catalytic after treatment technology and would phase in beginning in 2014 for marine diesel engines and 2015 for locomotives. These standards are enabled by the ULSD that is required to be made available to non-road shippers beginning in 2012. These marine Tier 4 engine standards would apply to commercial marine diesel engines above 800 hp and recreational marine diesel engines above 2,000 hp. The proposal would result in PM reductions of about 90 percent and NO_x reductions of about 80 percent from engines meeting these standards, compared to engines meeting the current standards. The proposed standards would also yield sizeable reductions in emissions of HC, CO, and other air toxics.

Rail Fuel Use and Emissions

Based on input from industry representatives, rail fuel use was assumed to be 6,000 gallons total for three locomotives per round trip for a 6,000 foot train. Fuel use was adjusted so that every 1 percent reduction in tonnage results in a 0.33 percent reduction in fuel use.

NO_x and PM emissions from the use of locomotives were calculated using the methodology from EPA's *Technical Highlights, Emission Factors for Locomotives,* EPA420-F-97-051*, December 1997*. Emission factors vary according to the age of the locomotive with Tier 0 standards applying to locomotives originally manufactured between 1973 and 2001, Tier 1 standards applying to locomotives manufactured from 2002 through 2004 and Tier 2 standards applying to locomotives manufactured in 2005 and later.

The average age of the locomotives was assumed to be 10 years each year of the 2010-2019 project. Therefore, Tier 0 standards were used for the first year of the project; Tier 1 standards were used for the years 2011 through 2013 and Tier 2 standards were used for the remaining years.

Equation 3 presents the calculation of NO_x and PM emissions in grams per mile:

$$\text{Emissions } (NO_x \text{ and PM}) = F \times EF \ / \ M \qquad (3)$$

Where

F = annual fuel consumption, gallons

[4] http://www.epa.gov/otaq/regs/nonroad/420f07015.htm

EF = Emission factor (gram per gallon, g/gal)

M = annual miles traveled

As discussed above for barge emissions, a reduction in emissions from the use of low sulfur diesel and ultra low sulfur diesel was applied. The low sulfur diesel adjustment was applied to Tier 0 and Tier 1, and the ultra low sulfur diesel adjustment was applied to Tier 2. Emission factors are presented in Exhibit 4-5.

EXHIBIT 4-5
Locomotive Emission Factors – Grams Per Gallon

Tier	NO_x	PM
0	155.8	6.0
1	121.6	6.0
2	83.4	3.1

Truck Fuel Use and Emissions

Based on the project team's knowledge of trucking operations and information about Metro's existing system, the following fuel economy was assumed for different types of trucks:

- Long-haul with new engines: 5.5 mpg
- Drayage with new engines: 4.5 mpg
- Leased trucks during lock closures: 5.0 mpg

NO_x, PM and CO_2 emissions from the use of trucks were calculated using the Freight Logistics Environmental and Energy Tracking Performance Model (FLEET). The model is available at http://www.epa.gov/smartway/smartway_fleets_software.htm. Inputs included number of trucks, payload, vehicle class, fuel consumption and idling hours.

The FLEET model accounts for the mandated changes in truck technology and for the use of ultra-low sulfur diesel in 2007. Additional inputs include truck model year and the year emissions are to be calculated. The model does not account for upgrades to engines in 2010. These upgrades affect NO_x emissions. NO_x emissions were reduced by 80 percent consistent with EPA estimates.

4.3.2 Fuel Use and Emissions Results

Emissions in Grams per Mile

Emissions in grams per mile for all transportation links in the scenarios are shown in Exhibit 4-6. (This exhibit and all subsequent exhibits are shown at the end of this section.)

Total Fuel Use and Emissions, 2010-2019

Estimated fuel use and emissions for each scenario are shown graphically in Exhibits 4-7 to 4-10, and in tabular form in Exhibit 4-11. As shown, the scenarios with a barge line-haul (1a, 1b, 4a) have significantly lower fuel and CO2 emissions compared to the other

scenarios. The all truck scenario, Scenario 3 would result in the lowest PM and NO_x emissions.

Emissions in the Columbia River Gorge Scenic Area

As discussed in a variety of publications including the *Columbia River Gorge Visibility Project, 2006 Annual Report*, Oregon Department of Environmental Quality, Southwest Clean Air Agency, September 12, 2006, there is heightened sensitivity about air pollution that is causing visibility and other concerns in the Columbia River Gorge Scenic Area. In response, diesel fuel use and NO_x emissions in the Scenic Area were estimated for the scenarios as shown in Exhibit 4-12. Because of a lack of available emissions data, diesel fuel use was used as a proxy for SO_x emissions.

Likely Effects from EPA Proposed Marine Diesel and Locomotive Standards

Should they be adopted as law, the proposed EPA marine diesel and locomotive standards would result in a phase in of much cleaner operating diesel engines. As discussed above, remanufactured engines would be required to have improved emissions performance at some point between 2008 and 2010, and after 2014 (marine diesel) and 2015 (locomotive), all new engines would be required to include emissions reduction technologies similar to those about to take effect on trucks that would result in a projected reduction of 90 percent of PM emissions and 80 percent of NO_x emissions. Thus, there would be some potential for regulatory action or the initiative of barge and rail companies that would result in a substantial improvement in emissions performance during the life of the Metro contract.

PM and NOx emissions estimates using marine diesel and locomotive engines that meet the emissions performance outlined in the proposed EPA standards are shown in Exhibits 4-13 and 4-14. Under these circumstances, barge and truck would have similar PM emissions, but the all-truck scenario (Scenario 3) would still have substantially lower NOx emissions than the other scenarios.

Uncertainty Associated with Emissions Estimates

Considerably more research has been done to model emissions from trucks than has been done for barge and rail. In addition, emissions are inherently difficult to estimate because they depend on many factors such as fuel sulfur content, engine loading, wind, currents, tare weights, and aerodynamic drag. Specifically, in the case of barging, water depth, engine power, and draft all have unique effects on emissions. Additionally EPA standards for emissions for trucks are much more stringent than that for the barge and railroad industry. These uncertainties should be recognized when making conclusions made based on the estimates provided in this report.

EXHIBIT 4-6
Emissions Outputs

Truck Movement	Scenario	Engine Year	Grams per Mile CO2	PM	NOx
1. Truck - Current System	0	2002	1,900	0.26	11.17
2. Truck - Current System in Gorge	0	2002	1,900	0.26	11.17
3. Truck - drayage, new with 2007 compliant engines	1a	2010	2,238	0.08	0.69
4. Truck - drayage trucks, lock closure (new engines)	1a	2010	2,014	0.08	0.73
5. Truck - leased fleet trucks during lock closure	1a	2004	2,014	0.25	7.00
6. Truck - leased fleet trucks during lock closure	1a	2013	2,014	0.08	0.73
7. Trucks Through Gorge - drayage trucks, lock closure	1a	2010	2,014	0.08	0.73
8. Trucks Through Gorge - leased fleet trucks, lock closure	1a	2004	2,014	0.25	7.00
9. Trucks Through Gorge - leased fleet trucks, lock closure	1a	2013	2,014	0.08	0.73
10. Tugs 2010-12	1a	Age 20	43,754	23.13	915.78
10A. Tugs 2013-19	1a	Age 20	43,754	21.97	847.09
11. Tugs	1a	New 2014	43,754	2.31	183.16
12. Truck - drayage, new with 2007 compliant engines	1b	2010	2,238	0.08	0.73
13. Truck - drayage trucks, lock closure (new engines)	1b	2010	2,014	0.08	0.73
14. Truck - leased fleet trucks during lock closure	1b	2004	2,014	0.25	7.00
15. Truck - leased fleet trucks during lock closure	1b	2013	2,014	0.08	0.73
16. Tugs 2010-12	1b	Age 20	46,281	24.71	968.36
16A. Tugs 2013-19	1b	Age 20	46,281	23.47	895.73
17. Tugs	1b	New 2014	46,281	2.47	193.67
18. Truck - drayage, new with 2007 compliant engines	2a	2010	2,238	0.08	0.73
19. Locomotives - Tier 0, 2010	2a	Age 10	188,571	110.00	2,996.00
19. Locomotives - Tier 1, 2011-13	2a	Age 10	188,571	110.00	2,339.00
19. Locomotives - Tier 2, 2014-19	2a	Age 10	188,571	58.00	1,724.00
20. Locomotives	2a	New 2015	188,571	11.00	599.20
21. Truck - drayage, new with 2007 compliant engines	2b	2010	2,238	0.08	0.73
22. Locomotives - Tier 0, 2010	2b	Age 10	188,571	110.00	2,996.00
22. Locomotives - Tier 1, 2011-13	2b	Age 10	188,571	110.00	2,339.00
22. Locomotives - Tier 2, 2014-19	2b	Age 10	188,571	58.00	1,724.00
23. Locomotives	2b	New 2015	188,571	11.00	599.20
24. Truck - drayage, new with 2007 compliant engines	2c	2010	2,238	0.08	0.73
25. Locomotives - Tier 0, 2010	2c	Age 10	165,378	96.00	2,627.00
25. Locomotives - Tier 1, 2011-13	2c	Age 10	165,378	96.00	2,052.00
25. Locomotives - Tier 2, 2014-19	2c	Age 10	165,378	51.00	1,512.00
26. Locomotives	2c	New 2015	165,378	9.60	525.40
27. Truck - long-haul, new with 2007 compliant engines	3	2010	1,831	0.08	0.73
28. Truck Through Gorge - long-haul, new engines	3	2010	1,831	0.08	0.73
29. Truck - drayage, new with 2007 compliant engines	4a	2010	2,238	0.08	0.73
30. Truck - long-haul, new with 2007 compliant engines	4a	2010	1,831	0.08	0.73
31. Truck - drayage trucks, lock closure (new engines)	4a	2010	2,014	0.08	0.73
32. Truck - leased fleet trucks during lock closure	4a	2004	2,014	0.25	7.00
33. Truck - leased fleet trucks during lock closure	4a	2013	2,014	0.08	0.73
34. Tugs 2010-12	4a	Age 20	21,343	11.39	446.58
34A. Tugs 2013-19	4a	Age 20	21,343	10.82	413.09
35. Tugs	4a	New 2014	21,343	1.14	89.32
36. Truck - drayage, new with 2007 compliant engines	4b	2010	2,238	0.08	0.73
37. Truck - long-haul, new with 2007 compliant engines	4b	2010	1,831	0.08	0.73
38. Locomotives - Tier 0, 2010	4b	Age 10	161,344	94.00	2,563.00
38. Locomotives - Tier 1, 2011-13	4b	Age 10	161,344	94.00	2,002.00
38. Locomotives - Tier 2, 2014-19	4b	Age 10	161,344	50.00	1,475.00
39. Locomotives	4b	New 2015	161,344	9.40	512.60

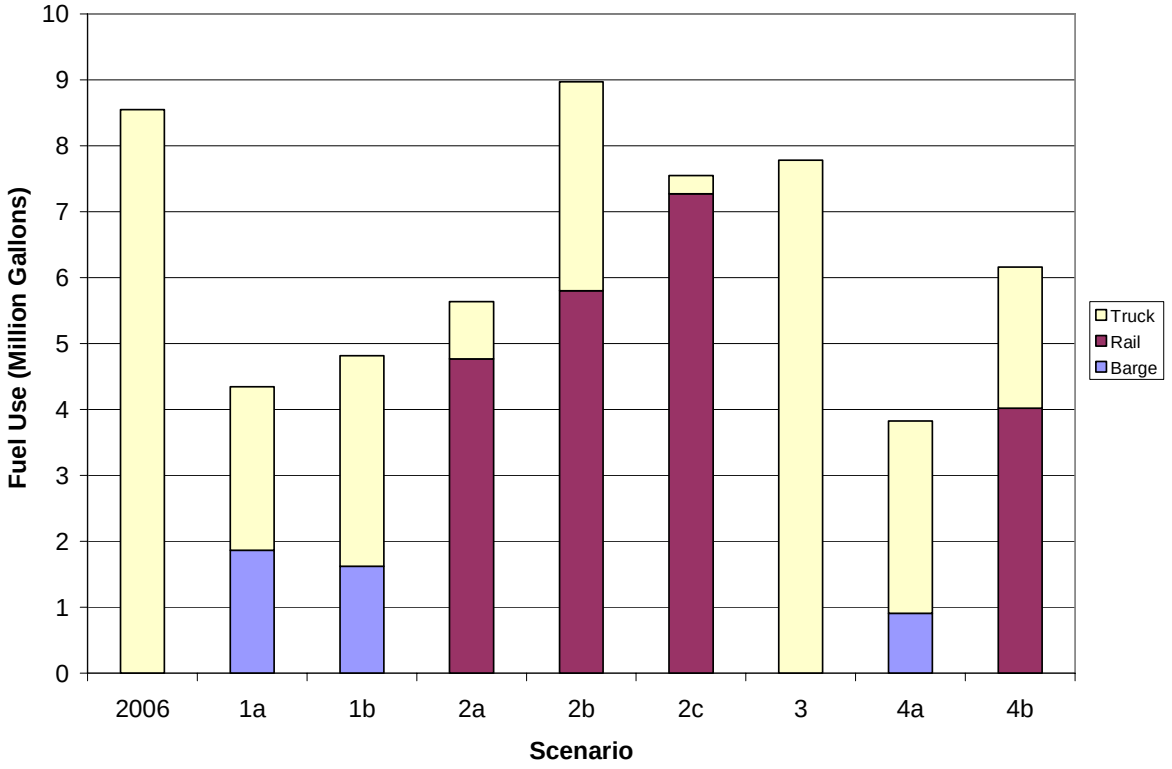

EXHIBIT 4-7
Estimated Fuel Use (mgal)
PV2010-2019

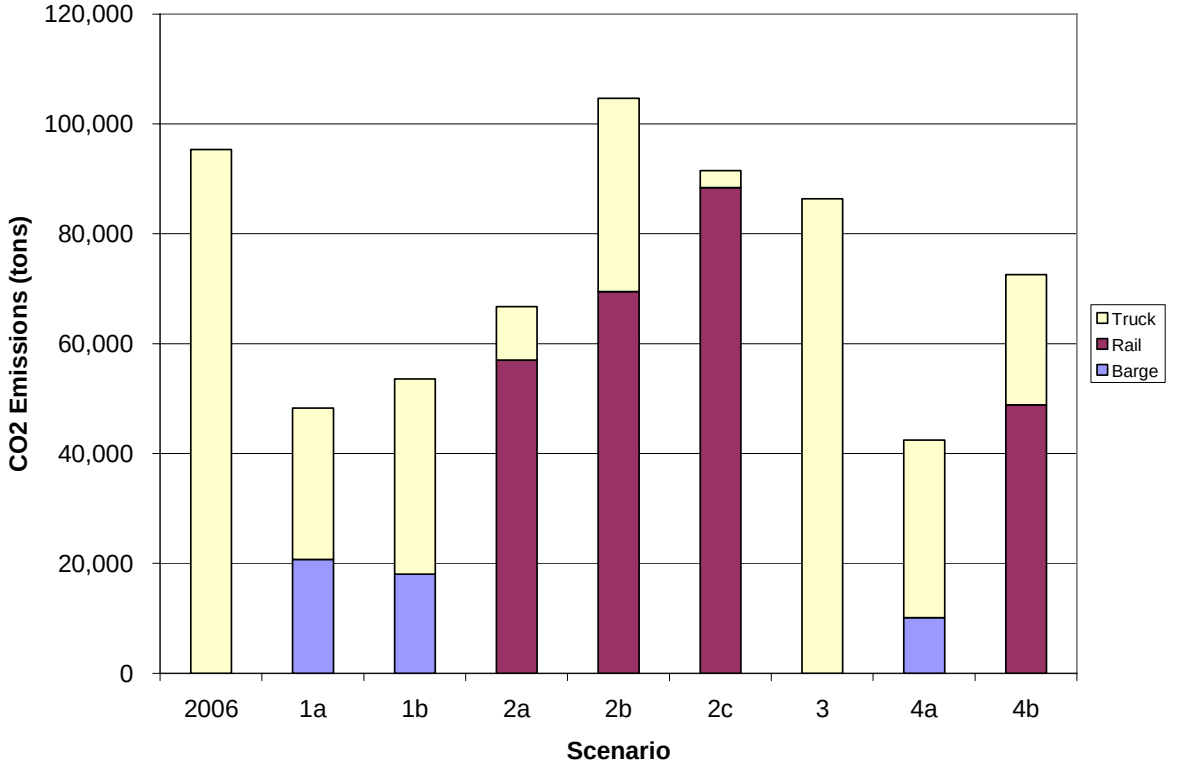

EXHIBIT 4-8
Estimated CO_2 Emissions (tons)
PV 2010-2019

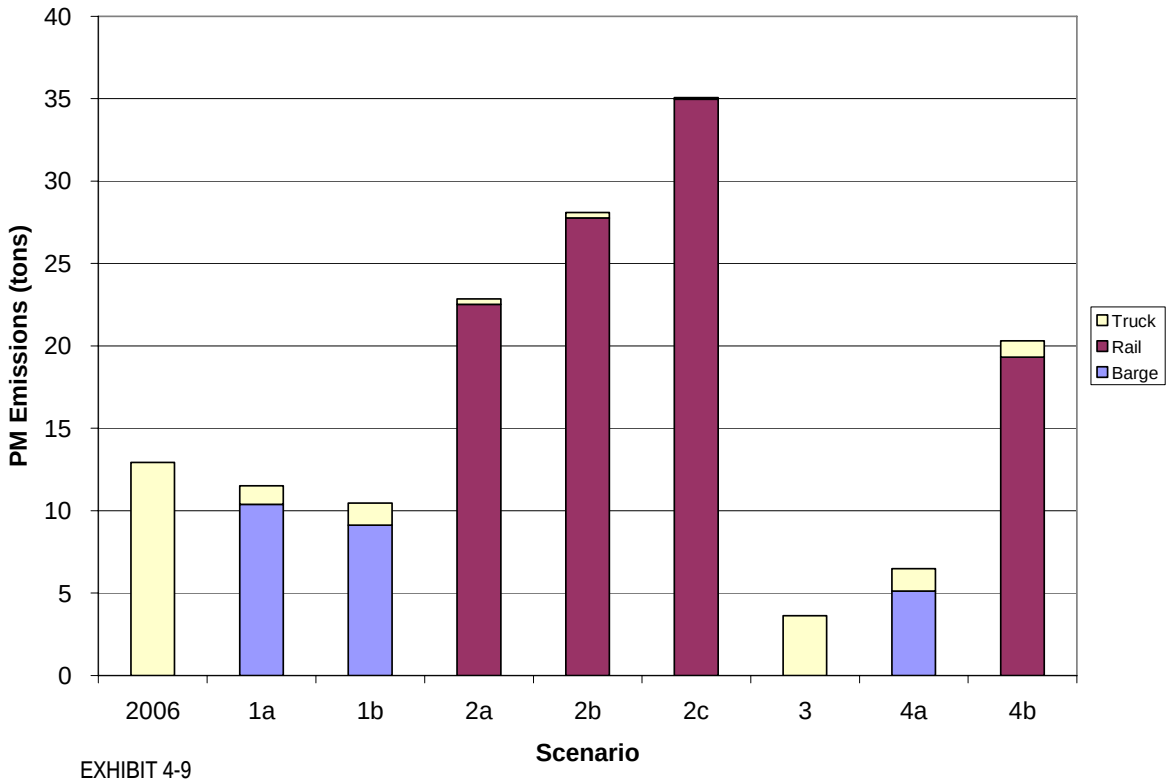

EXHIBIT 4-9
Estimated PM Emissions (tons)
PV 2010-2019

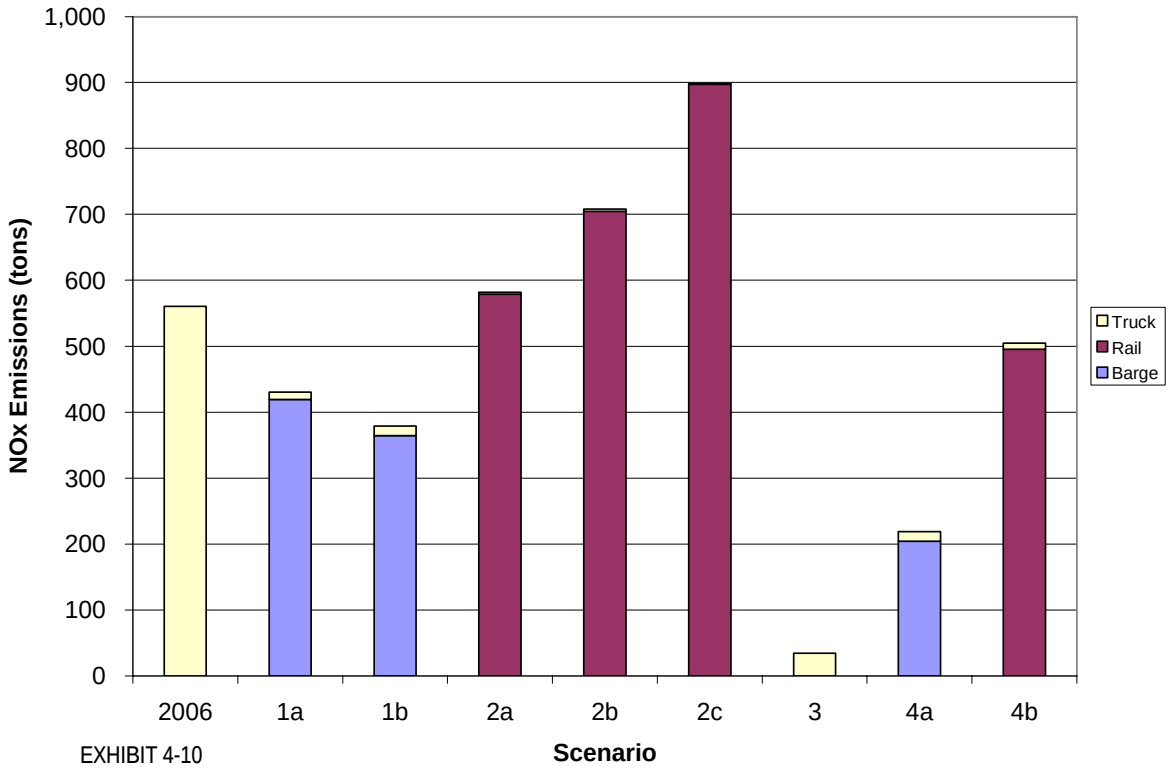

EXHIBIT 4-10
Estimated NO_x Emissions (tons)
PV 2010-2019

EXHIBIT 4-11
Fuel Use and Emissions Summary

	Present Value, Operations from 2010-2019			
	Fuel	Emissions (tons)		
Total	(Gallons)	CO2	PM	NOx
Current System	8,549,621	95,347	12.9	560.6
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	4,343,051	48,237	11.5	430.5
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	4,817,262	53,561	10.5	378.7
Scenario 2a - Rail: T2 (west) and CRL (east)	5,634,355	66,709	22.9	582.1
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	8,969,528	104,636	27.8	708.1
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	7,548,842	91,478	34.9	898.1
Scenario 3 - Truck Haul Similar to Current System	7,780,479	86,364	3.6	34.5
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	3,823,356	42,454	6.5	218.8
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	6,159,217	72,542	20.3	504.7
Barge				
Current System	0	0	0.0	0.0
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	1,866,350	20,746	10.4	419.0
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	1,622,913	18,040	9.1	364.3
Scenario 2a - Rail: T2 (west) and CRL (east)	0	0	0.0	0.0
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	0	0	0.0	0.0
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	0	0	0.0	0.0
Scenario 3 - Truck Haul Similar to Current System	0	0	0.0	0.0
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	910,415	10,120	5.1	204.3
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	0	0	0.0	0.0
Rail				
Current System	0	0	0.0	0.0
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	0	0	0.0	0.0
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	0	0	0.0	0.0
Scenario 2a - Rail: T2 (west) and CRL (east)	4,763,950	57,047	22.5	578.9
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	5,801,001	69,465	27.8	704.9
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	7,270,774	88,391	34.9	897.1
Scenario 3 - Truck Haul Similar to Current System	0	0	0.0	0.0
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	0	0	0.0	0.0
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	4,021,263	48,810	19.3	495.3
Truck				
Current System	8,549,621	95,347	12.9	560.6
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	2,476,701	27,492	1.1	11.5
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	3,194,348	35,521	1.3	14.5
Scenario 2a - Rail: T2 (west) and CRL (east)	870,405	9,662	0.3	3.2
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	3,168,527	35,171	0.3	3.2
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	278,068	3,087	0.1	1.0
Scenario 3 - Truck Haul Similar to Current System	7,780,479	86,364	3.6	34.5
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	2,912,941	32,334	1.4	14.5
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	2,137,954	23,732	1.0	9.3

EXHIBIT 4-12
Summary of Fuel Use and Emissions in the Columbia River Gorge Scenic Area

	Present Value, Operations from 2010-2019	
	Fuel	Emissions
Total	(Gallons)	NOx
Current System	4,668,543	306.1
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	3,482,960	223.6
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	3,870,355	238.0
Scenario 2a - Rail: T2 (west) and CRL (east)	4,763,950	326.9
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	5,801,001	326.9
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	4,077,529	503.1
Scenario 3 - Truck Haul Similar to Current System	4,249,379	18.8
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	2,750,924	114.3
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	5,963,181	288.3
Barge		
Current System	0	0.0
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	3,212,451	221.1
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	3,397,985	233.8
Scenario 2a - Rail: T2 (west) and CRL (east)	0	0.0
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	0	0.0
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	0	0.0
Scenario 3 - Truck Haul Similar to Current System	0	0.0
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	1,567,049	107.8
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	0	0.0
Rail		
Current System	0	0.0
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	0	0.0
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	0	0.0
Scenario 2a - Rail: T2 (west) and CRL (east)	4,763,950	326.9
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	5,801,001	326.9
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	4,077,529	503.1
Scenario 3 - Truck Haul Similar to Current System	0	0.0
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	0	0.0
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	4,021,263	279.7
Truck		
Current System	4,668,543	306.1
Scenario 1a - Barge:T2 (west) and Willow Creek (east)	270,509	2.5
Scenario 1b - Barge Northern Portland (west) and Willow Creek (east)	472,370	4.2
Scenario 2a - Rail: T2 (west) and CRL (east)	0	0.0
Scenario 2b - Rail: T2 (west) and Port of Morrow (east)	0	0.0
Scenario 2c - Rail: Portland Rail Yard and Metro South (west) and CRL (east)	0	0.0
Scenario 3 - Truck Haul Similar to Current System	4,249,379	18.8
Scenario 4a - Barge from Central (T2-Willow Creek) and Truck from South	1,183,875	6.4
Scenario 4b - Rail from Central (T2-CRL) and Truck from South	1,941,918	8.6

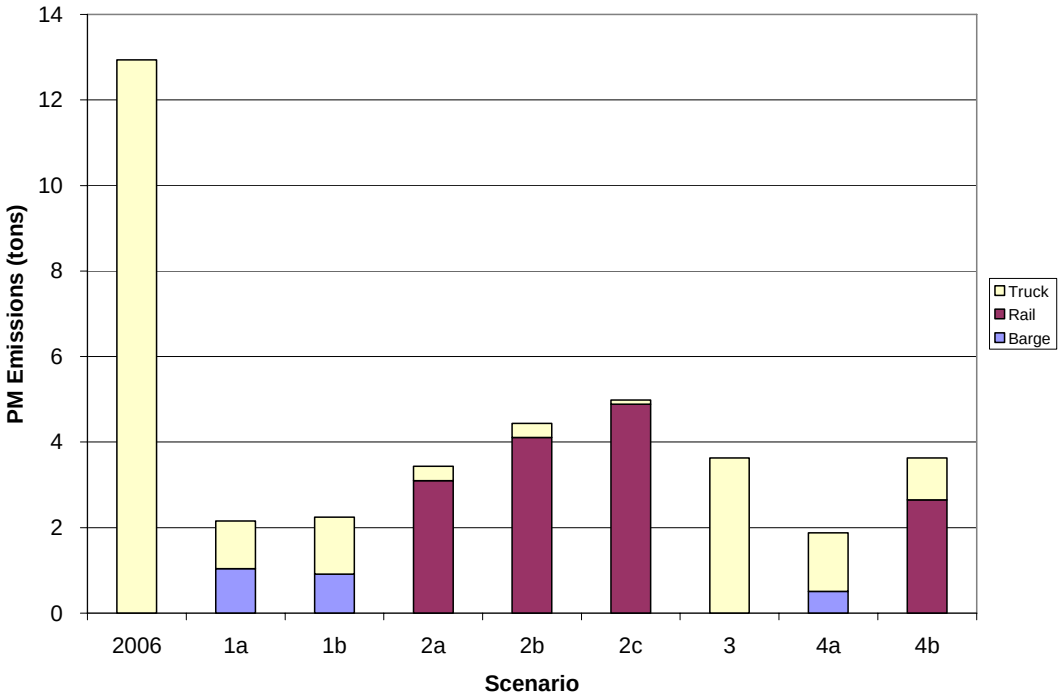

EXHIBIT 4-13
Estimated PM Emissions under Proposed EPA Marine Diesel and Locomotive Standards (tons)
PV 2010-2019

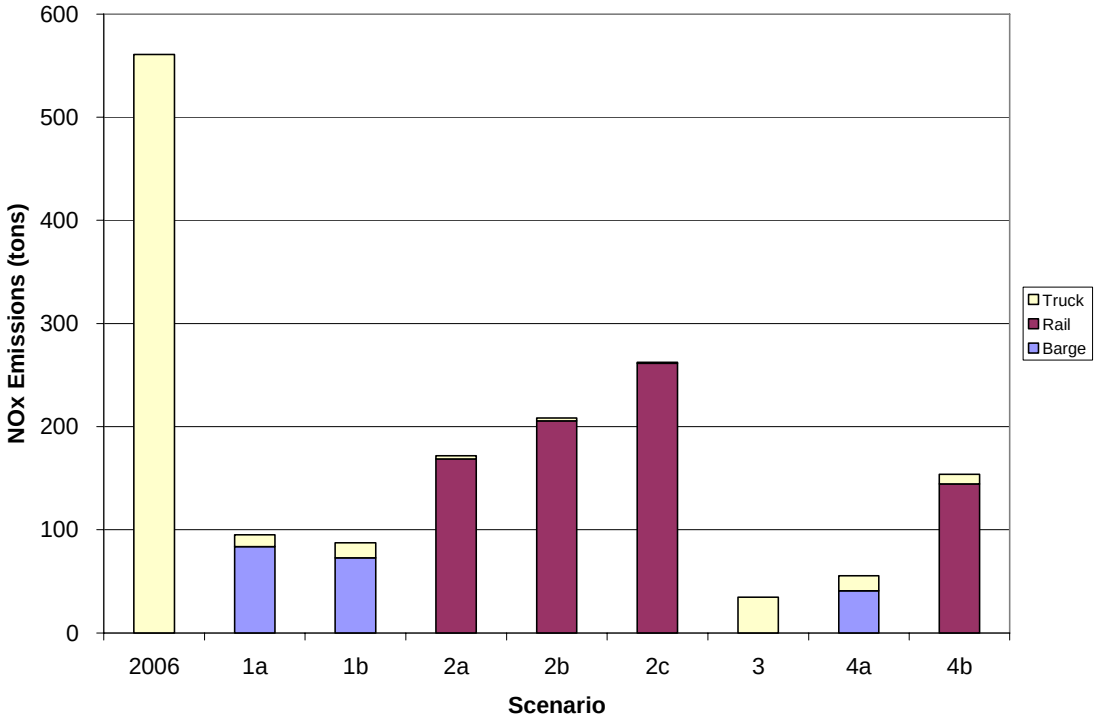

EXHIBIT 4-14
Estimated NO_x Emissions under Proposed EPA Marine Diesel and Locomotive Standards (tons)
PV 2010-2019

SECTION 5

Value Modeling of Scenarios

A value modeling methodology (multi-criteria decision analysis) was used to evaluate the cost, environmental, socioeconomic, and operational aspects of each scenario. Value modeling is a method of evaluating how well a series of options rate against a chosen set of objectives. It is a particularly useful tool when important non-monetary values and objectives exist, stakeholder input must be considered, and clear documentation of methods and results is important. The value modeling approach consists of the following six elements:

- Establish the decision goal
- Identify and specify fundamental objectives
- Develop performance measures to assess project performance against objectives
- Add technical detail to the performance measures, and assign scores to the performance measures
- Assign weights to the objectives
- Calculate value scores and conduct sensitivity analysis

5.1 Council Values and Objectives Hierarchy

In establishing the objectives for this analysis, Metro Council Goals and Objectives and Critical Success Factors and the values established for the Metro disposal system were reviewed. The following were thought to be particularly relevant to this analysis:

Goal and Objective 2. Environmental Health

2.3 The region's waste stream is reduced, recovered, and returned to productive use, and the remainder has a minimal impact on the environment

2.4 Metro is a model for sustainable business practices

Metro Critical Success Factors

1. Metro sets a standard of fiscal prudence, integrity, transparency and accountability that is emulated by others

1.3 Metro programs are sustainably supported at an appropriate level and are right-sized in relation to their benefits

Disposal System Values

Environmental sustainability

Ensure reasonable, affordable rates

The project team worked with Metro staff and developed a hierarchy of objectives that forms the foundation of the value modeling approach. Exhibit 5-1 presents the objectives hierarchy used in this analysis. As shown there are various "levels" in the hierarchy in which lower levels help define or describe the meaning of the upper level objectives. The two first level, or fundamental objectives are Metro's cost values and its non-cost values. The next level under non-cost values includes three second-level objectives: environmental, socioeconomic, and operations; there are no second-level objectives associated with cost. Also listed are various third and fourth level objectives that clarify Metro's objectives further.

EXHIBIT 5-1
Objectives Hierarchy

Decision Context: Evaluate various transportation scenarios to provide insight into ways of structuring Metro's pending procurement process for solid waste transportation services.

1. Metro Cost Values (Minimize long-term life-cycle cost)
2. Metro Non-Cost Values
    - 2.1 Environmental
        - 2.1.1 Minimize use of non-renewable fuel and harmful air emissions
            - PM
            - NOx
            - Greenhouse gases (CO_2)
        - 2.1.2 Minimize impacts in CR Gorge National Scenic Area
            - Non-renewable fuel (proxy for SO_x)
            - NO_x
            - Potential for impacts other than emissions
    - 2.2 Socioeconomic
        - 2.2.1 Minimize impacts to neighborhoods
            - Facility proximity effects (noise, traffic)
            - Traffic and associated emissions
        - 2.2.2 Enhance regional freight movement
            - Likelihood of a regional freight hub or terminal that leads to economic growth
            - Minimizes truck trips in congested roadways in Metro Area during peak traffic periods
        - 2.2.3 Enhance relationships with Gilliam County partners
            - Provides jobs
            - Supports development of transportation infrastructure
    - 2.3 Operations (Flexibility, Reliability, Risk)
        - 2.3.1 Has flexibility to respond to future changes in disposal and transfer
            - Metro South
            - Attract new wastes
            - Respond to new fuels and/or emission technologies
        - 2.3.2 Reliable, consistent, timely service throughout contract
        - 2.3.3 Manages risk that can not be mitigated
            - Likelihood of waste release to environment
            - Consequence of waste release to environment
            - Ability to provide backup service during emergency outage
            - Not influenced by potential fishery and dam issues
            - Relatively insensitive to fuel price increases

5.2 Performance Measures and Scoring

Performance measures were developed for each objective that was identified by the project team for measurement. The performance measures and descriptions of constructed scales are shown in Exhibit 5-2. The constructed scales are qualitative measures in which the best feasible outcome rates a 5, and the worst conceivable outcome rates a 1.

Exhibit 5-3 shows how well each scenario was judged to meet each objective. Results reported in Section 4 were used to score cost and emissions measures, and the project team met to assign scores to the constructed scales. The rationale for the constructed scale scores for each scenario is documented in Appendix D.

5.3 Weighting

CH2M HILL and a Metro staff working group prepared an initial assessment of the relative importance of each objective in accordance with the Metro Council's stated values. The initial objectives hierarchy and weights were presented to the Metro Council Liaison's for this project, then to the full Council at a study session on March 20, 2007. In response to feedback from the Council, the hierarchy and weights were revised to reflect the weights shown in Exhibit 5-4.

During the work session it was agreed that the sensitivity of the results should be tested for relative weights on cost of 30, 60, and 90.

EXHIBIT 5-2
Performance Scales

				Description of 1-5 Performance Scales				
Objectives Hierarchy	**Performance Measure**	**Best**	**Worst**	**5**	**4**	**3**	**2**	**1**
1. Metro Cost Values	Planning-level 2010 Costs in million 2007$	$10.0	$20.0	Estimated Costs				
2. Metro Non-Cost Values								
2.1 Environmental								
2.1.1 Minimize use of non-renewable fuel and harmful air emissions								
PM10	Tons	3.5	40.0	Estimated PM Emissions				
NOx	Tons	30	950	Estimated NOx Emissions				
Greenhouse gases (CO2)	Tons	40,000	110,000	Estimated CO2 Emissions				
2.1.2 Minimize impacts in CR Gorge National Scenic Area								
Non-renewable fuel (proxy for SO2)	million gallons			Estimated Fuel Use				
NOx	Tons			Estimated NOx Emissions				
Potential for impacts other than emissions	1-5 scale	5	1	Few issues of concern		Some issues of concern		A number of issues of concern
2.2 Socioeconomic								
2.2.1 Minimize impacts to neighborhoods	1-5 scale	5	1	All truck travel is on routes currently used by Metro transportation contractor	New facility in industrial zone and/or some new truck travel on routes that pass by properties zoned industrial or commercial; impact of additional truck traffic on those streets is small			New facility likely to result in organized opposition and/or some new truck travel on routes that are zoned commercial or residential; impact of additional truck traffic on those streets is noticeable and mitigation may be required
2.2.2 Enhance regional freight movement	1-5 scale	5	1	Scenario includes a terminal with barge and rail access; no increase in truck trips on congested roadways during peak traffic periods	Scenario includes a terminal with barge or rail access; no increase in truck trips on congested roadways during peak traffic periods	Scenario includes a terminal with barge or rail access; some increase in truck trips on congested roadways during peak traffic periods	Part of Metro's waste would be handled at a multi-modal terminal with some increase in truck trips on congested roadways during peak traffic periods, or no change from current system	No multi-modal terminal and an increase in truck trips on congested roadways during peak traffic periods
2.2.3 Enhance relationships with Gilliam County partners	1-5 scale	5	1	Employment for Gilliam County workers likely to be similar or greater than in current contract		Employment for Gilliam County workers likely to be noticeably less, but contract supports development of new infrastructure in Gilliam County		Few opportunities for Gilliam County infrastructure or jobs
2.3 Operations (Flexibility, Reliability, Risk)								
2.3.1 Has flexibility to respond to future changes in disposal and transfer	1-5 scale	5	1	Maximum possible flexibility for foreseeable future changes				Very inflexible for one or more potential future changes
2.3.2 Reliable, consistent, timely service throughou	1-5 scale	5	1	Track record of reliable, consistent, and timely service in region and no major constraints to this continuing throughout the contract	Track record of reliable, consistent, and timely service in region, but some challenges related to potential service interruption throughout the contract			Concerns exist with current and likely future operations that could result in noticeable increased cost to Metro, challenges to staff and/or impacts to customers at transfer stations
2.3.3 Manages risk that can not be mitigated	1-5 scale	5	1	Not highly exposed to listed unmitigable risks		A moderate level of exposure to unmitigable risks exists		A relatively high level of exposure to unmitigable risks exists

EXHIBIT 5-3

Decision Scores

Objectives Hierarchy	Scale	Decision Scores							
		Scenario							
		1a	1b	2a	2b	2c	3	4a	4b
1. Metro Cost Values	2010 in mill. 2007$	$13.0	$13.0	$15.6	$18.3	$14.8	$12.2	$12.7	$16.5
2. Metro Non-Cost Values									
2.1 Environmental									
2.1.1 Minimize use of non-renewable fuel and harmful air emissions									
PM	PV 2010-19, tons	11.4	10.6	22.9	27.8	34.9	3.6	6.3	20.3
NOx	PV 2010-19, tons	430.6	378.6	582.1	708.1	898.1	34.5	219.0	504.7
Greenhouse gases (CO2)	PV 2010-19, tons	48,237	53,561	66,709	104,636	91,478	86,364	42,454	72,542
2.1.2 Minimize impacts in CR Gorge National Scenic Area									
Non-renewable fuel	PV 2010-19, mgal.	3.5	3.9	4.8	5.8	4.1	4.2	2.8	6.0
NOx	PV 2010-19, tons	223.7	237.9	326.9	326.9	503.1	18.8	114.4	288.3
Potential for impacts other than emissions in Columbia River Gorge National Scenic Area	1-5 scale	3.5	3.5	3.5	3.5	3.5	2.0	3.0	3.0
2.2 Socioeconomic									
2.2.1 Minimize impacts to neighborhoods	1-5 scale	4.0	4.0	4.0	4.0	2.0	5.0	4.5	4.5
2.2.2 Enhance regional freight movement	1-5 scale	4.0	4.5	3.0	3.0	2.5	2.0	3.5	2.5
2.2.3 Enhance relationships with Gilliam County partners	1-5 scale	3.5	3.0	1.0	2.5	1.0	5.0	4.0	3.0
2.3 Operations (Flexibility, Reliability, Risk)									
2.3.1 Has flexibility to respond to future changes in disposal and transfer	1-5 scale	3.0	3.0	3.0	3.0	2.0	4.0	3.5	3.5
2.3.2 Reliable, consistent, timely service throughout contract	1-5 scale	3.0	3.0	2.0	2.0	2.0	5.0	4.0	3.0
2.3.3 Manages risk that can not be mitigated	1-5 scale	2.0	2.0	3.0	3.0	3.0	4.0	3.0	3.5

EXHIBIT 5-4

Weights Assigned to Objectives

Objectives Hierarchy	Weights				Percent Weight[a]
	Level 1	Level 2	Level 3	Level 4	
1. Metro Cost Values	60%				60.0%
2. Metro Non-Cost Values	40%				
2.1 Environmental		40%			
2.1.1 Minimize use of non-renewable fuel and harmful air emissions			70%		
PM				50%	5.6%
NOx				25%	2.8%
Greenhouse gases (CO2)				25%	2.8%
2.1.2 Minimize impacts in CR Gorge National Scenic Area			30%		
Non-renewable fuel (proxy for SO2)				55%	2.6%
NOx				35%	1.7%
Potential for impacts other than emissions				10%	0.5%
2.2 Socioeconomic		10%			
2.2.1 Minimize impacts to neighborhoods			50%		2.0%
2.2.2 Enhance regional freight movement			25%		1.0%
2.2.3 Enhance relationships with Gilliam County partners			25%		1.0%
2.3 Operations (Flexibility, Reliability, Risk)		50%			
2.3.1 Has flexibility to respond to future changes in disposal and transfer			25%		5.0%
2.3.2 Reliable, consistent, timely service throughout contract			60%		12.0%
2.3.3 Manages risk that can not be mitigated			15%		3.0%

[a]The percent weights are applied to the scores (Exhibit 5-3) in a weighted averaging process. An example calculation of the percent weights follows: PM weight is 5.6%, which is 40% * 40% * 70% * 50%

5.4 Results

The performance scales and weights were entered into Criterium Decision Plus software to compile the results. The results of the value model analysis are shown in Exhibit 5-5. As shown, Scenarios 3 (trucking with new, low emission engines) and 4a (barge from Central and truck from South) are the scenarios that best meet this representation of Metro's values. The other two barge scenarios, 1a and 1b, also score relatively high.

Exhibit 5-5 also provides some insight into the reasons for this result. Scenarios 3 and 4a perform well on all the main cost and non-cost values, in particular Scenario 3 scores best in operations performance and is similar in cost to Scenarios 4a, 1a, and 1b. Most scenarios are fairly similar in environmental performance.

Exhibit 5-6 provides an additional view of how the scenarios scored on the sub-elements of the three non-cost values.

Exhibits 5-7 to 5-9 show how the scenarios perform as the relative weight assigned to cost changes from 30 percent to 60 percent to 90 percent. As shown, the rank ordering of scenarios is quite stable regardless of the weight assigned to cost: there is no change in the ordering of the four highest rated scenarios. The only changes in rank order occur between the rail options (2a, 2b, 2c, 4b): Scenario 4b scores best when cost is assigned a 30 percent weight and Scenario 2c scores best when cost is assigned a 90 percent weight.

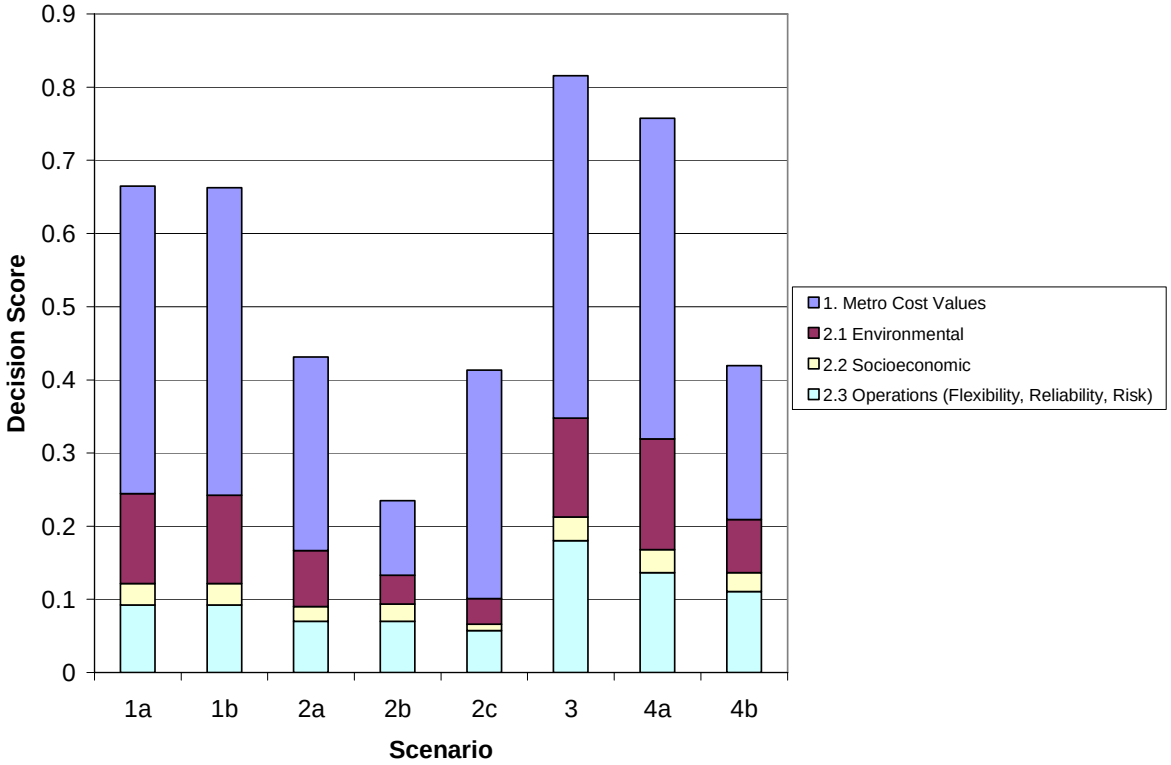

EXHIBIT 5-5
Value Model Results

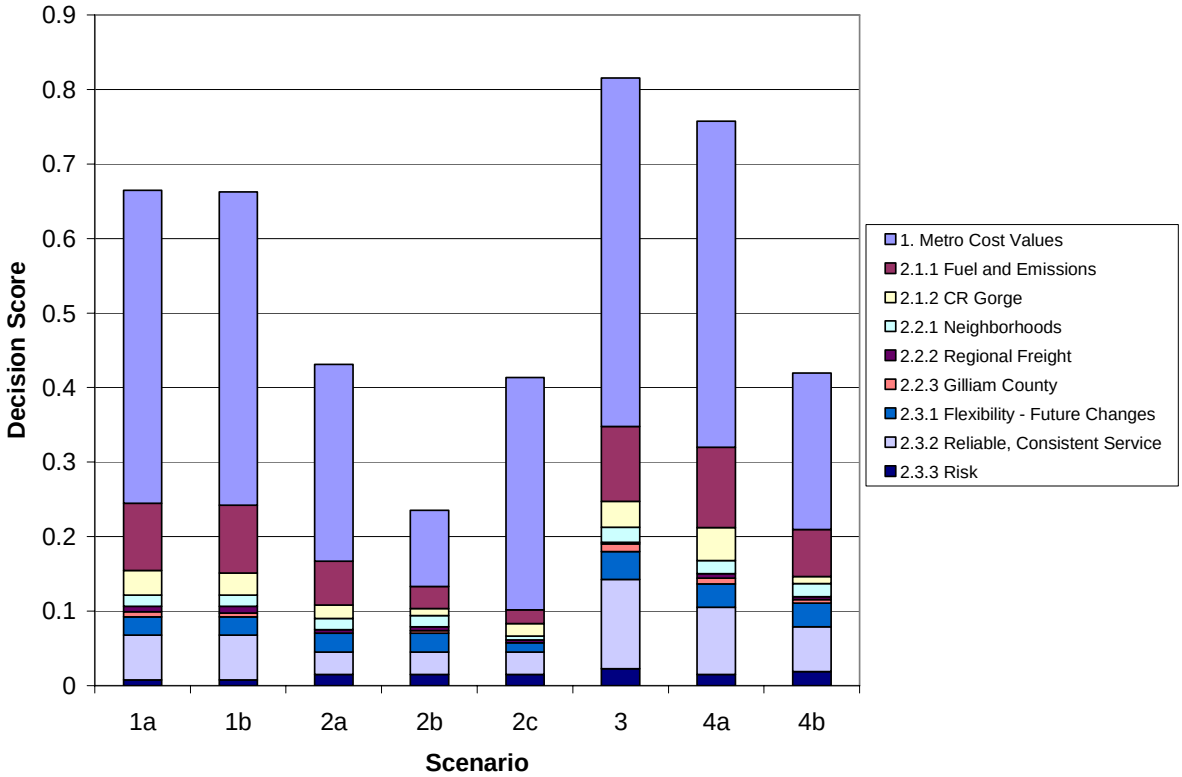

EXHIBIT 5-6
Additional Value Model Results

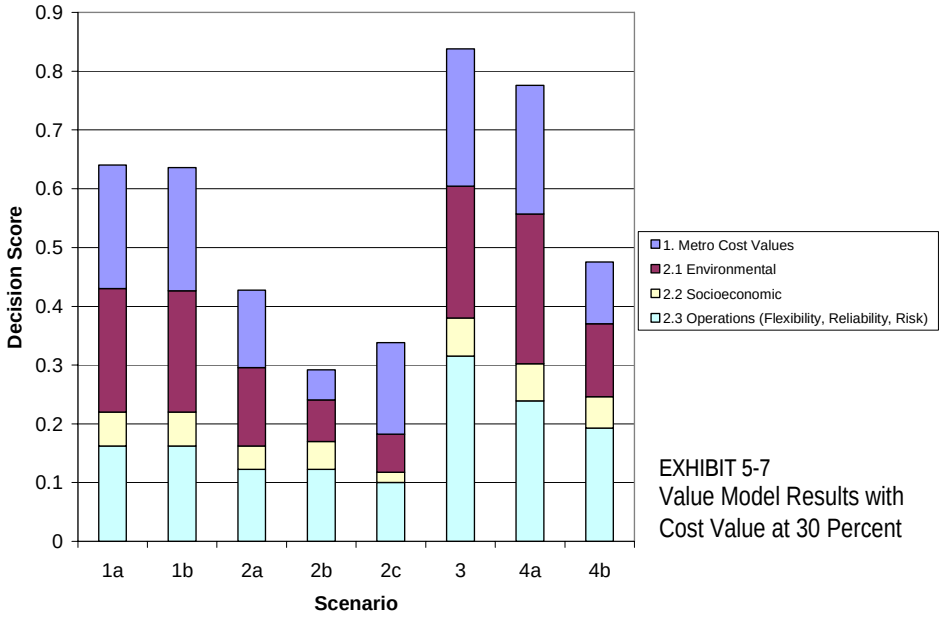

EXHIBIT 5-7
Value Model Results with Cost Value at 30 Percent

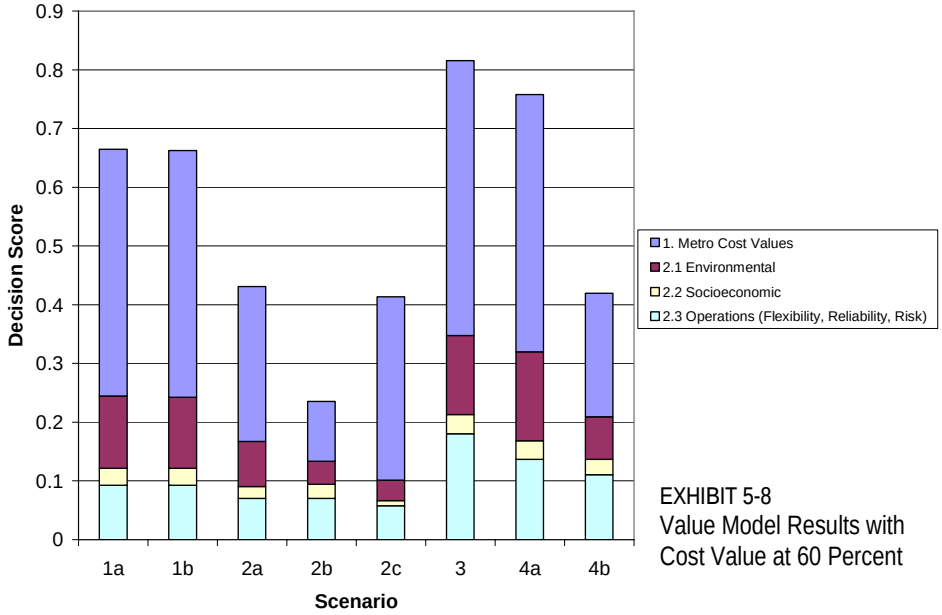

EXHIBIT 5-8
Value Model Results with Cost Value at 60 Percent

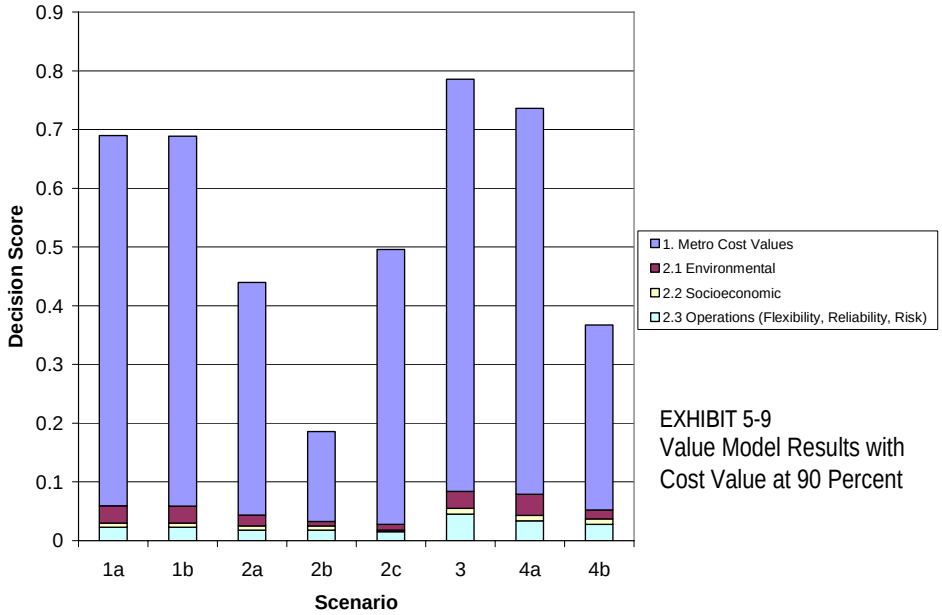

EXHIBIT 5-9
Value Model Results with Cost Value at 90 Percent

SECTION 6

Analysis of Policy Issues

There are a number of policy issues that the Metro Council will need to address in order to shape the upcoming transportation procurement in a way that best reflects its values and objectives. This section provides the consulting team's recommendations about those issues based on the results of the industry research and the value modeling analysis.

6.1 Feasibility of Developing a Hub or other New Facility to Spur Economic Development and Possibly Lower Costs

Some interest had been expressed about using this project to promote regional freight flows and economic development. Some issues associated with this concept are discussed in Section 3.

Based on initial opinions about the relative importance of various Council values expressed by Council members at the March 20, 2007 work session, the hub concept, while important does not appear to be a driving factor for this procurement. The industry research indicated that it would be difficult for Metro to proactively use this procurement process to drive other economic development goals: Spin-off economic development from this project may occur, but it can probably be done more effectively through other, targeted initiatives.

Thus, it is recommended that Metro give a small consideration in its evaluation process to proposals that would include a terminal that may have a synergistic effect on regional freight and economic development.

6.2 Should Metro Actively Seek a Backhaul in this Procurement?

While not unprecedented, backhauls are difficult to achieve in solid waste transportation projects. If a proposer can develop a backhaul and lower its price and air emissions, it will do so. Metro could allow proposals with open-top trailers/containers, which would increase the opportunity for backhauls; however this would raise concerns about blowing litter locally and through the Gorge, as well as long-term equipment maintenance. Considering the Council values of sustainability and reducing impacts in the Columbia Gorge National Scenic Area, it is recommended that Metro insist on enclosed trailers/containers. Further, any backhaul proposal that is linked to a price reduction to Metro should be scrutinized carefully to ensure that the backhaul is likely to be viable throughout the life of the contract.

6.3 How Should Metro Address Emission Reductions and Alternative Fuels in this Procurement?

The first recommendation is that Metro require that all tractors used for drayage or long-hauling have new engines that are compliant with the EPA's new 2007 emission standards for heavy-duty engines and diesel fuel regulations. These new engines would then use ultra low sulfur diesel (ULSD) and would result in a sizeable reduction in PM and NO_x emissions from trucks currently being used in Metro's solid waste transportation system.

Lowering emissions for rail and barge modes is more complex. As discussed in Section 4, EPA has a proposed rule that would require the phasing in of requirements that marine diesel and locomotives run on ULSD with emission technology similar to the new truck engine requirements. It would be difficult for Metro to require the use of ULSD and low-emission engine technology for barge and rail because those engines are not yet readily available. Various tests are being conducted and there are a few such engines in use around the country, but a strict requirement may make it so that barge or rail either could not respond to Metro's RFP, or could do so only at a price premium. It may be more feasible to require new engines by, say, the mid-point of the contract (end-2015) or somewhat earlier. Metro should be aware that the nation's refiners are not required to have ULSD available for marine and rail use prior to 2012 (ULSD is required for many of the emission-reduction technologies to be effective). Thus, it is recommended that Metro consider requiring new clean-burning marine diesel or locomotive engines at some time during the contract (at risk of a financial penalty).

One of the evaluation criteria in Metro's request for proposals should examine the use of non-renewable fuel and emissions for each proposer. One way to evaluate this would be for Metro to require that proposers provide estimated fuel use and emissions for each mode for the initial year. Proposers would be required to document the basis for the calculations, which could be verified by Metro.

6.4 Should Metro Provide Fuel?

Under its current transportation contract, Metro purchases the fuel and makes it available for the contractor. Metro saves federal excise tax on the fuel it purchases, resulting in a cost savings to its ratepayers. Current federal excise taxes on diesel fuel are $0.201 for barge and $0.244 for rail and truck, but on the Columbia River system, fuel excise taxes for barge transport apply only to the portion of the barge haul east of the Dalles[5].

The tax regulations for barge travel state that "if a private party is contracted to haul for a State or local government, the vessel is not ''being used by a State or local government.'" (48.4042-3, pg 77) and is therefore not tax exempt. Thus, there is some question as to whether or not Metro could extend its current practice of saving federal excise taxes to a barge or rail operation. It is recommended that Metro seek an opinion from a qualified tax advisor about this issue. If Metro can save federal excise taxes on fuel for all modes, it is

[5] See http://thismatter.com/Money/Tax/IRS/p510/1-Fuel-Taxes.htm#title; and http://www.access.gpo.gov/nara/cfr/waisidx_06/26cfr48_06.html

recommended that Metro make that an assumption in its procurement document. If it can for some modes but not for all, Metro's procurement document should take the potential for this cost savings into account in its evaluation of proposals.

If Metro does not end up purchasing fuel, it is recommended that the procurement document include a fuel price escalation clause that is separate from an escalation clause that would be applied to other cost elements (such as labor, equipment, and parts).

6.5 Metro Role in Financing and/or Ownership

Metro could lower its overall cost by providing capital because its cost of capital is typically less than that of the private sector, and it would not pay a profit margin on the use of that capital. As discussed in Section 3, Metro could own trailers and/or containers and chassis, but there are a series of disadvantages associated with ownership of rolling stock. After reflecting on comments from industry, it is not recommended that Metro own trailers, containers, or chassis during its next transportation contract.

Another approach would be for Metro to make a sizeable one-time, up-front payment to the contractor of $5 million or more that it could use to purchase rolling stock or other items. Any such payment would need to be accompanied by a provision in which Metro was reimbursed for part of that up-front payment in the event of contractor default (likely in accordance with some type of amortization schedule) The obvious question is whether or not Metro could successfully recover this payment in such a circumstance. Another method for recovering the payment is through a contract provision allowing transfer of ownership of the equipment to Metro in the event of default by the contractor. It is recommended that Metro explore these approaches further with its financial and risk advisors to see if an acceptable risk management plan could be developed for this type of payment plan.

APPENDIX A

Case Studies of Procurements from Other Jurisdictions

APPENDIX A

Case Studies of Procurements from Other Jurisdictions

Six other jurisdictions were contacted about recent or pending solid waste procurement processes they have been involved with: Clark County, WA.; New York City, NY.; Kitsap County, WA.; Seattle, WA.; Phoenix, AZ.; Los Angeles, CA. Procurement documents were obtained from each jurisdiction, and a series of questions were asked of knowledgeable staff to obtain general information about each procurement. A summary of each of these procurements follows.

Clark County, Washington

Contact

Jim Mansfield
360-397-6118 x.4920

Description of long-haul operation

Clark County currently has a contract with Columbia Resource Company to barge waste from 2 transfer stations to the Finley Buttes Landfill in eastern Oregon.

Annual tons transported

280,000 tons 2006.

When last contracted

Original contract was signed in 1992, and recently extended to 2016.

Criteria used to select your contractor

Price was the biggest factor, but the contractor was also required to build the current transfer stations and new ones as needed.

Aspects of your system that are working particularly well

Overall system is working well.

Aspects of your system that could be improved upon

The long-haul part of the contract is working well. They would like to improve C&D processing and introduce food composting at the transfer stations.

New York City, NY.

Contact

Harry Szarpanski
Asst. Commissioner
917-237-5501

Describe your long-haul operation

Landfill on Staten Island closed in 2001. Currently, they transport waste by truck from marine transfer stations to New Jersey, then by rail to South Carolina. Once new system is implemented, they'll rail directly from transfer stations to South Carolina.

Annual tons transported

3.4 million tons per year

When last contracted

2001

Contract Term

Since 2001 they've been using an interim contract until new stations are available.

Criteria used to select your contractor

Details in RFP.

Aspects of your system that are working particularly well

Works fine right now and will have more direct route to South Carolina when new contract set up.

Aspects of your system that could be improved upon

With this new contract they will eliminate truck traffic through the city to NJ because waste will be railed to South Carolina from transfer stations. This is an improvement from the previous contract.

Kitsap County, WA.

Contact

Dean Boening
360-337-5784

Describe your long-haul operation

Waste is loaded by pre-load compactor into containers at transfer station, then loaded on-site into double-stack well cars. Cars are pulled by shortline railroad to the UP main line, then transported to Columbia Ridge Landfill.

Annual tons transported

215,000 tons per year of MSW plus contaminated soils.

When last contracted

2000.

Contract Term

Contract is for 20-years with various buy-out options.

Criteria used to select your contractor

Prequalification based on experience, then evaluated proposers based on price, management qualifications, demonstrated ability to process and handle similar waste stream, and the technical proposal.

Aspects of your system that are working particularly well

The system generally works very well. Rate is good and they have a pretty good working relationship with contractor.

Aspects of your system that could be improved upon

The County has had a series of challenges related to inconsistent rail service. More containers were added to the system, which helped, but recently containers are arriving in an inconsistent manner. Their contractor is considering adding an area for container storage at the transfer station to help solve this issue.

Seattle, WA.

Contact

George Sidles
206-233-7903

Describe your long-haul operation

Waste is loaded by pre-load compactor into containers at transfer station, drayed to an intermodal yard, then loaded on-site into double-stack well cars. Cars are pulled by UPRR to the Columbia Ridge Landfill.

Annual tons transported

Approximately 438,000 tons per year of MSW in 2006. This is combined with waste from private C&D transfer stations and waste from other jurisdictions.

When last contracted

1988

Contract Term

Original contract is for 20-years, but has been extended a few times. Contract will be rebid some time between 2011-2013.

Criteria used to select your contractor

Evaluated proposers based on price and experience. It was specified that no waste would be transported through the Columbia Gorge National Scenic Area by truck.

Aspects of your system that are working particularly well

The system generally works well.

Aspects of your system that could be improved upon

The City has had a series of challenges related to inconsistent rail service. More containers were added to the system, which helped, but recently containers are arriving in an inconsistent manner. Their contractor added an area near the existing intermodal yard for additional container storage.

Phoenix, AZ.

Contact

Joe Giudice
Deputy Public Works Director
602-256-5621

Describe your long-haul operation

Truck transfer mode from two City owned transfer stations (27th Avenue and North Gateway) and one City owned landfill (SR 85 landfill). 27th Avenue is 55 miles one way and N. Gateway is 65 miles one way from the landfill. Trailer types are open top tipper style transfer trailers transport MSW from the two transfer stations to the SR 85 landfill and are tipped with carrier owned tippers.

Annual tons transported

1,000,000 tons/year between 2 transfer stations (65% of volume is from 27th Avenue T/S and 35% from North Gateway T/S)

When last contracted

Awarded in summer of 2005 and carriers started providing services in January 2006.

Contract Term

Five years with two one-year renewal options designed around the life cycle of a Class 8 tractor.

Criteria used to select your contractor

MSW transportation experience, existing client references, reasonableness and thoroughness of their proposals, longevity in business, financial strength, perceived value of their proposal, maintenance records, however price also played a fairly large part.

Aspects of your system that are working particularly well

The two transfer volumes were split among two motor carriers and the respective contracts were designed so that the two carriers could back each other up at the other transfer station which has proven to work well in the busy months in the summer.

Aspects of your system that could be improved upon

Tipper ownership and fuel: The City does not own the tippers, instead each of the carriers owns one and it has proven to be challenging to manage. The City would now prefer to own the tippers themselves to maintain control. Fuel is costly and in hindsight the City should have offered to provide the fuel and save any markup from the carrier as well as having to pay the F.E.T. on it.

City of Los Angeles, CA.

Contact

Enrique Zalidar
Solid Resources Management Executive Officer
213- 485-2210

Describe your long-haul operation

Last bid was for both transportation and disposal for approximately 50% of the City's total volume of waste generated annually. All waste is transported by truck from three of the City's six wastesheds to El Sobrante Landfill in Riverside County. The trailer fleet is a mix of trailers between 48' and 51' in length and is made up of both walking floor and tipper style trailers, depending on the destination disposal site. El Sobrante has tippers so the recent contract they awarded all have 51' long tipper style transfer trailers.

Annual tons transported

1,000,000 tons/year, however only 500,000 tpy was bid last time (2005).

When last contracted

2005 and service began December of 2006

Contract Term

Five year with three five-year options.

Criteria used to select your contractor

The proposer's financial stability, OSHA and safety compliance, experience in the industry, client references and an evaluation of their proposed contingency plan for disposal. Since the RFP was for combined transportation and disposal, the vicinity to the City's wastesheds and the associated combined transportation and disposal costs were also key. Project Proposal Price was the most heavily weighted item in the City's evaluation criteria.

Aspects of your system that are working particularly well

The tipper style trailers are lighter weight than the walking floor trailers and greater payload can be achieved, which is especially important since California is restricted to 80,000 lbs. gross legal vehicle weight ratings.

Aspects of your system that could be improved upon

Not much at present. The City is fairly pleased with both the trucking and disposal service providers selected. An annual renewal performance bond is in place in the event of non-performance.

APPENDIX B

Transportation Cost Calculations

Exhibit B-1

Barge Cost Estimates (Excluding drayage)

Barge Line-haul	
Cost per container (round trip)	$200
Containers per year 1a, 1b	16,698
Containers per year 4a	8,285
Total line haul cost 1a, 1b	$3,339,561
Total line haul cost 4a	$1,656,923
Containers - 1a, 1b	
Number of Containers	440
Unit Life in Years	10
Interest rate	9%
Salvage Percentage	10%
Price	$11,500
Federal Excise Tax	$1,380
Sales Tax	$0
Container Cost	$12,880
Interest Expense @ 10 years	$1,581
Total Container Financed Cost	$14,461
Total Container Cost	$6,362,853
per year cost	$636,285
per ton cost	$1.23
Containers - 4a	
Number of Containers	230
Unit Life in Years	10
Interest rate	9%
Salvage Percentage	10%
Price	$11,500
Federal Excise Tax	$1,380
Sales Tax	$0
Container Cost	$12,880
Interest Expense @ 10 years	$1,581
Total Container Financed Cost	$14,461
Total Container Cost	$3,326,037
per year cost	$332,604
per ton cost	$1.28
Container Loading	
No. of Containers per year 1a, 1b	16,698
No. of Containers per year 4a	8,285
Container Loading Cost west terminal - T2	$120
Container Loading Cost west terminal - other	$80
Container Loading Cost east terminal	$80
Per year 1a	$3,339,561
Per year 1b	$2,671,649
Per year 4a	$1,656,923
Per ton 1a	$6.45
Per ton 1b	$5.16
Per ton 4a	$6.35
Container Maintenance	
$1000/yr/cont.	$320,000
5 years	$1,600,000
Per year 1a, 1b	$160,000
Per year 4a	$80,616
Per ton 1a, 1b	$0.31
Per ton 4a	$0.31
Total Annual Cost	
1a	$7,475,408
1b	$6,807,496
4a	$3,727,065

Exhibit B-2

Rail Cost Estimates (Excluding drayage)

Line Haul	
2a, 2b, 2c Terminal 2 or North Portland to CRL	
Tons per year	517,632
Per-ton price (with fuel surcharge)	$16.25
Annual Cost	$8,411,520
2b North Portland and Metro South to CRL	
Tons per year	517,632
Per-ton price (with fuel surcharge)	$17.88
Annual Cost	$9,252,672
4b Terminal 2 to CRL	
Tons per year	260,808
Per-ton price (with fuel surcharge)	$16.25
Annual Cost	$4,238,130
Containers - 2a, 2b, 2c	
Number of Containers	340
Unit Life in Years	10
Interest rate	9%
Salvage Percentage	10%
Price	$11,500
Federal Excise Tax	$1,380
Sales Tax	$0
Container Cost	$12,880
Interest Expense @ 10 years	$1,581
Total Container Financed Cost	$14,461
Total Container Cost	$4,916,750
per year cost	$491,675
per ton cost	$0.95
Containers - 4b	
Number of Containers	180
Unit Life in Years	10
Interest rate	9%
Salvage Percentage	10%
Price	$11,500
Federal Excise Tax	$1,380
Sales Tax	$0
Container Cost	$12,880
Interest Expense @ 10 years	$1,581
Total Container Cost	$14,461
Total Annual Container Cost	$2,602,985
per year cost	$260,299
per ton cost	$1.00
Container Loading	
No. of Containers per year 2a, 2b, 2c	16,698
No. of Containers per year 4b	8,413
Site development cost 2c	$5,000,000
Annualized site development cost (9%, 10 yrs)	$779,100
Container Loading Cost west terminal - T2	$120
Container Loading Cost west terminal - other	$80
Container Loading Cost east terminal	$80
Per year 2a, 2b	$3,339,561
Per year 2c	$3,450,749
Per year 4b	$1,682,632
Per ton 2a, 2b	$6.45
Per ton 2c	$6.67
Per ton 4b	$6.45
Container Maintenance	
$1000/yr/cont. 2a, 2b, 2c	$320,000
5 years	$1,600,000
Per year 2a, 2b, 2c	$160,000
Per year 4a	$84,706
Per ton 2a, 2b, 2c	$0.31
Per ton 4b	$0.32
Total Annual Cost	
2a	$12,663,055
2b	$12,663,055
2c	$12,774,243
4b	$8,868,752

Exhibit B-3

Transportation Cost Calculations

Barge Drayage, Central to T2. Scenarios 1a, 4a

Origin Location	Metro Central
Destination	T-2
Miles (one way)	2.7
Average Miles per Hour	20
Workdays per Week	5
Annual Workdays	245
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.27
Total Time per Trip	0.94
Loads per day	34
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	35
Hostler hours per day	16
Total hours per day	51
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	4.0
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	12
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	528,142
Total Container Expense	603,591
Total Capital Expense	1,131,733
Required Truck Quantity	4.0
Required Trailer Quantity	12
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$46,514	$0.18	$2.05
Chassis	$4,630	$55,559	$0.21	$2.45
Labor		$311,562	$1.19	$13.72
Fuel		$30,287	$0.12	$1.33
R&M		$11,812	$0.05	$0.52
Insurance		$56,000	$0.21	$2.47
License & Fees		$20,033	$0.08	$0.88
G&A		$58,494	$0.22	$2.58
Profit		$70,831	$0.27	$3.12
Total		$661,093	$2.53	$29.10

Exhibit B-4

Transportation Cost Calculations

Rail Drayage, Central to T2. Scenarios 2a, 2b

Origin Location	Metro Central
Destination	T-2
Miles (one way)	2.7
Average Miles per Hour	20
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.27
Total Time per Trip	0.94
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	33
Hostler hours per day	16
Total hours per day	49
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	4.0
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	12
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	528,142
Total Container Expense	603,591
Total Capital Expense	1,131,733
Required Truck Quantity	4.0
Required Trailer Quantity	12
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$46,514	$0.18	$2.05
Chassis	$4,630	$55,559	$0.21	$2.45
Labor		$317,502	$1.22	$13.98
Fuel		$30,287	$0.12	$1.33
R&M		$11,812	$0.05	$0.52
Insurance		$56,000	$0.21	$2.47
License & Fees		$20,033	$0.08	$0.88
G&A		$59,148	$0.23	$2.60
Profit		$71,623	$0.27	$3.15
Total		$668,478	$2.56	$29.43

Exhibit B-5

Transportation Cost Calculations

Barge Drayage, South to T2. Scenario 1a

Origin Location	Metro Central
Destination	T-2
Miles (one way)	20.7
Average Miles per Hour	30
Workdays per Week	5
Annual Workdays	245
Monthly Tons through the T/S	21,402
Annual Trips	8,285
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.38
Total Time per Trip	2.05
Loads per day	34
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	76
Hostler hours per day	16
Total hours per day	92
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	7.5
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	19
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	990,266
Total Container Expense	955,685
Total Capital Expense	1,945,951
Required Truck Quantity	7.5
Required Trailer Quantity	19
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$87,214	$0.34	$0.51
Chassis	$4,630	$87,969	$0.34	$0.51
Labor		$558,643	$2.18	$3.26
Fuel		$228,655	$0.89	$1.33
R&M		$89,176	$0.35	$0.52
Insurance		$80,500	$0.31	$0.47
License & Fees		$75,201	$0.29	$0.44
G&A		$132,809	$0.52	$0.77
Profit		$160,820	$0.63	$0.94
Total		$1,500,986	$5.84	$8.75

Exhibit B-6

Transportation Cost Calculations

Rail Drayage, South to T2. Scenarios 2a, 2b

Origin Location	Metro Central
Destination	T-2
Miles (one way)	20.7
Average Miles per Hour	30
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,402
Annual Trips	8,285
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.38
Total Time per Trip	2.05
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	72
Hostler hours per day	16
Total hours per day	88
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	7.5
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	19
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	990,266
Total Container Expense	955,685
Total Capital Expense	1,945,951
Required Truck Quantity	7.5
Required Trailer Quantity	19
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$87,214	$0.34	$0.51
Chassis	$4,630	$87,969	$0.34	$0.51
Labor		$564,583	$2.20	$3.29
Fuel		$228,655	$0.89	$1.33
R&M		$89,176	$0.35	$0.52
Insurance		$80,500	$0.31	$0.47
License & Fees		$75,201	$0.29	$0.44
G&A		$133,463	$0.52	$0.78
Profit		$161,611	$0.63	$0.94
Total		$1,508,371	$5.87	$8.80

Exhibit B-7

Transportation Cost Calculations

Drayage, Central to North Portland Yard: Scenarios 1b, 4b

Origin Location	Metro Central
Destination	N Portland
Miles (one way)	23.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.02
Total Time per Trip	1.69
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	60
Hostler hours per day	16
Total hours per day	76
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	6.5
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	17
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	858,231
Total Container Expense	855,087
Total Capital Expense	1,713,318
Required Truck Quantity	6.5
Required Trailer Quantity	17
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$75,586	$0.29	$0.39
Chassis	$4,630	$78,709	$0.30	$0.41
Labor		$489,799	$1.88	$2.53
Fuel		$258,005	$0.99	$1.33
R&M		$100,622	$0.39	$0.52
Insurance		$73,500	$0.28	$0.38
License & Fees		$78,278	$0.30	$0.40
G&A		$126,995	$0.49	$0.66
Profit		$153,779	$0.59	$0.79
Total		$1,435,271	$5.50	$7.42

Exhibit B-8

Transportation Cost Calculations

Drayage, South to North Portland Yard: Scenario 1b

Origin Location	Metro South
Destination	N Portland
Miles (one way)	23.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,402
Annual Trips	8,285
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.02
Total Time per Trip	1.69
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	59
Hostler hours per day	16
Total hours per day	75
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	6.4
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	17
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	845,027
Total Container Expense	855,087
Total Capital Expense	1,700,114
Required Truck Quantity	6.4
Required Trailer Quantity	17
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$74,423	$0.29	$0.39
Chassis	$4,630	$78,709	$0.31	$0.41
Labor		$483,887	$1.88	$2.54
Fuel		$254,061	$0.99	$1.33
R&M		$99,084	$0.39	$0.52
Insurance		$72,800	$0.28	$0.38
License & Fees		$77,079	$0.30	$0.40
G&A		$125,405	$0.49	$0.66
Profit		$151,854	$0.59	$0.80
Total		$1,417,301	$5.52	$7.44

Exhibit B-9

Transportation Cost Calculations

Drayage, Central to Northwest Portland Yard: Scenario 2c

Origin Location	Metro Central
Destination	NW Portland
Miles (one way)	4.3
Average Miles per Hour	35
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.25
Total Time per Trip	0.91
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	32
Hostler hours per day	16
Total hours per day	48
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	4.0
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	12
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	528,142
Total Container Expense	603,591
Total Capital Expense	1,131,733
Required Truck Quantity	4.0
Required Trailer Quantity	12
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$46,514	$0.18	$1.29
Chassis	$4,630	$55,559	$0.21	$1.54
Labor		$311,940	$1.20	$8.62
Fuel		$48,236	$0.18	$1.33
R&M		$18,812	$0.07	$0.52
Insurance		$56,000	$0.21	$1.55
License & Fees		$23,964	$0.09	$0.66
G&A		$61,713	$0.24	$1.71
Profit		$74,728	$0.29	$2.07
Total		$697,466	$2.67	$19.28

Exhibit B-10

Transportation Cost Calculations

Drayage, Yard Adjacent to Metro South: Scenario 2c

Origin Location	Metro South
Destination	Yard near South
Miles (one way)	0.5
Average Miles per Hour	20
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,402
Annual Trips	8,285
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.05
Total Time per Trip	0.72
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	25
Hostler hours per day	16
Total hours per day	41
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	3.1
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	10
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	409,310
Total Container Expense	502,992
Total Capital Expense	912,302
Required Truck Quantity	3.1
Required Trailer Quantity	10
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$36,048	$0.14	$8.70
Chassis	$4,630	$46,299	$0.18	$11.18
Labor		$264,603	$1.03	$63.88
Fuel		$5,523	$0.02	$1.33
R&M		$2,154	$0.01	$0.52
Insurance		$49,700	$0.19	$12.00
License & Fees		$11,595	$0.05	$2.80
G&A		$45,751	$0.18	$11.04
Profit		$55,401	$0.22	$13.37
Total		$517,075	$2.01	$124.83

Exhibit B-11

Transportation Cost Calculations

Long-Haul Trucking: Scenario 3

Origin Location	Metro TSs
Destination	CRL
Miles (one way)	152.0
Average Miles per Hour	55
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	43,136
Annual Trips	15,686
Average Tons per Trip	33
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	5.53
Total Time per Trip	6.19
Loads per day	60
Labor Assumptions	
Non-driving percent	0%
Driver hours per day	374
Hostle/Shuttle hours/day	32
Total hours per day	406
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	5.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Trailer Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	34.3
Unit Life in Years	5
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 5 years	28,871
Total Truck Financed Cost	146,471
Note: Tipper included in truck capital	
Trailers	Quad Axle Trailer
Number of Trailers in the Fleet	135
Unit Life in Years	10
Salvage Percentage	10%
Price	$ 85,000
Federal Excise Tax	4,800
Sales Tax	0
Trailer Cost	89,800
Interest Expense @ 5 years	22,046
Total Trailer Financed Cost	111,846
Total Truck Expense	5,023,954
Total Trailer Expense	15,099,212
Total Capital Expense	20,123,166
Required Truck Quantity	34.3
Required Trailer Quantity	135
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$26,144	$896,746	$1.73	$0.38
Chassis	$10,335	$1,395,171	$2.70	$0.59
Labor		$2,610,556	$5.04	$1.09
Fuel		$2,600,994	$5.02	$1.09
R&M		$1,239,807	$2.40	$0.52
Insurance		$268,100	$0.52	$0.11
License & Fees		$811,104	$1.57	$0.34
G&A		$1,080,473	$2.09	$0.45
Profit		$1,308,354	$2.53	$0.55
Total		$12,211,305	$23.59	$5.12

Exhibit B-12

Transportation Cost Calculations

Drayage, Willow Creek to Columbia Ridge Landfill: Scenarios 1a, 1b

Origin Location	Willow Creek
Destination	CRL
Miles (one way)	23.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	245
Monthly Tons through the T/S	43,136
Annual Trips	16,698
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.02
Total Time per Trip	1.69
Loads per day	68
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	127
Hostler hours per day	0
Total hours per day	127
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	12.3
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	18
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	1,624,036
Total Container Expense	928,021
Total Capital Expense	2,552,057
Required Truck Quantity	12.3
Required Trailer Quantity	18
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$143,031	$0.28	$0.37
Chassis	$4,630	$85,422	$0.17	$0.22
Labor		$767,765	$1.48	$2.00
Fuel		$512,066	$0.99	$1.33
R&M		$199,706	$0.39	$0.52
Insurance		$114,100	$0.22	$0.30
License & Fees		$153,347	$0.30	$0.40
G&A		$217,298	$0.42	$0.57
Profit		$263,128	$0.51	$0.69
Total		$2,455,864	$4.74	$6.39

Exhibit B-13

Transportation Cost Calculations

Drayage, Arlington Railhead to Columbia Ridge Landfill: Scenarios 2a, 2c

Origin Location	Arlington Rail
Destination	CRL
Miles (one way)	2.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	43,136
Annual Trips	16,698
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.09
Total Time per Trip	0.76
Loads per day	64
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	53
Hostler hours per day	0
Total hours per day	53
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	5.9
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	9
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	779,009
Total Container Expense	445,148
Total Capital Expense	1,224,157
Required Truck Quantity	5.9
Required Trailer Quantity	9
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$68,608	$0.13	$2.05
Chassis	$4,630	$40,975	$0.08	$1.23
Labor		$343,474	$0.66	$10.29
Fuel		$44,527	$0.09	$1.33
R&M		$17,366	$0.03	$0.52
Insurance		$69,300	$0.13	$2.08
License & Fees		$29,517	$0.06	$0.88
G&A		$67,514	$0.13	$2.02
Profit		$81,754	$0.16	$2.45
Total		$763,035	$1.47	$22.85

Exhibit B-14

Transportation Cost Calculations

Drayage, Port of Morrow to Columbia Ridge Landfill: Scenario 2b

Origin Location	Port of Morrow
Destination	CRL
Miles (one way)	36.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	43,136
Annual Trips	16,698
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.60
Total Time per Trip	2.27
Loads per day	64
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	160
Hostler hours per day	0
Total hours per day	160
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	15.6
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	23
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	2,059,753
Total Container Expense	1,177,002
Total Capital Expense	3,236,755
Required Truck Quantity	15.6
Required Trailer Quantity	23
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$181,405	$0.35	$0.30
Chassis	$4,630	$108,340	$0.21	$0.18
Labor		$1,030,422	$1.99	$1.71
Fuel		$801,495	$1.55	$1.33
R&M		$312,583	$0.60	$0.52
Insurance		$137,200	$0.27	$0.23
License & Fees		$227,787	$0.44	$0.38
G&A		$307,916	$0.59	$0.51
Profit		$372,858	$0.72	$0.62
Total		$3,480,005	$6.72	$5.79

Exhibit B-15

Transportation Cost Calculations

Drayage, Willow Creek to Columbia Ridge Landfill: Scenario 4a

Origin Location	Willow Creek
Destination	CRL
Miles (one way)	23.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	245
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	1.02
Total Time per Trip	1.69
Loads per day	34
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	64
Hostler hours per day	0
Total hours per day	64
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	6.7
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	10
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	884,638
Total Container Expense	505,507
Total Capital Expense	1,390,145
Required Truck Quantity	6.7
Required Trailer Quantity	10
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$77,911	$0.30	$0.40
Chassis	$4,630	$46,531	$0.18	$0.24
Labor		$386,839	$1.48	$2.00
Fuel		$258,005	$0.99	$1.33
R&M		$100,622	$0.39	$0.52
Insurance		$74,900	$0.29	$0.39
License & Fees		$78,948	$0.30	$0.41
G&A		$112,613	$0.43	$0.58
Profit		$136,364	$0.52	$0.70
Total		$1,272,732	$4.88	$6.58

Exhibit B-16

Transportation Cost Calculations

Drayage, Arlington Railhead to Columbia Ridge Landfill: Scenario 4b

Origin Location	Arlington Rail
Destination	CRL
Miles (one way)	2.0
Average Miles per Hour	45
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,734
Annual Trips	8,413
Average Tons per Trip	31
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	0.09
Total Time per Trip	0.76
Loads per day	32
Labor Assumptions	
Non-driving percent	10%
Driver hours per day	27
Hostler hours per day	0
Total hours per day	27
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	3.5
Unit Life in Years	10
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 10 years	14,435
Total Truck Financed Cost	132,035
Chassis	
Number of Chassis in the Fleet	5
Unit Life in Years	10
Salvage Percentage	10%
Price	40,000
Federal Excise Tax	4,800
Sales Tax	0
Chassis Cost	44,800
Interest Expense @ 10 years	5,499
Total Trailer Financed Cost	50,299
Total Truck Expense	462,124
Total Container Expense	264,071
Total Capital Expense	726,195
Required Truck Quantity	3.5
Required Trailer Quantity	5
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$11,629	$40,700	$0.16	$2.42
Chassis	$4,630	$24,307	$0.09	$1.44
Labor		$173,059	$0.66	$10.29
Fuel		$22,435	$0.09	$1.33
R&M		$8,750	$0.03	$0.52
Insurance		$52,500	$0.20	$3.12
License & Fees		$16,638	$0.06	$0.99
G&A		$37,223	$0.14	$2.21
Profit		$45,073	$0.17	$2.68
Total		$420,686	$1.61	$25.00

Exhibit B-17

Transportation Cost Calculations

Long-Haul Trucking from Metro South: Scenarios 4a, 4b

Origin Location	Metro South
Destination	CRL
Miles (one way)	152.0
Average Miles per Hour	55
Workdays per Week	5
Annual Workdays	260
Monthly Tons through the T/S	21,402
Annual Trips	7,783
Average Tons per Trip	33
Compacted / Uncompacted Loads	Compacted
Average Loading Time	20
Average Unloading Time	20
Average Roundtrip Time	5.53
Total Time per Trip	6.19
Loads per day	30
Labor Assumptions	
Non-driving percent	0%
Driver hours per day	185
Hostler hours per day	16
Total hours per day	201
Driver Annual Wage	$39,000
Loaded Driver Percentage	32%
Operational Assumptions	
SG&A Overhead Percentage	11%
(SG&A is Sales / Mgmt / Admin / Dispatch)	
Profit Margin Percentage	12%
Interest Rate	9.00%
Fuel Cost	
Fuel MPG	4.5
Diesel Cost per Gallon	$3.00
Repair & Maintenance	
Truck Cost per Mile	$0.15
Chassis Cost per Mile	$0.11

Equipment Cost	
Tractor Make and Model	Quad Axle Truck
Number of Trucks in the Fleet	18.5
Unit Life in Years	5
Salvage Percentage	15%
Price	105,000
Federal Excise Tax	12,600
Sales Tax (None in OR)	0
Vehicle Cost	117,600
Interest Expense @ 5 years	28,871
Total Truck Financed Cost	146,471
Trailers	Quad Axle Trailer
Number of Trailers in the Fleet	70
Unit Life in Years	10
Salvage Percentage	10%
Price	$ 85,000
Federal Excise Tax	4,800
Sales Tax	0
Trailer Cost	89,800
Interest Expense @ 5 years	22,046
Total Trailer Financed Cost	111,846
Total Truck Expense	2,709,713
Total Container Expense	7,829,221
Total Capital Expense	10,538,934
Required Truck Quantity	18.5
Required Trailer Quantity	70
Licenses & Taxes	
State Highway Use Tax	
State	Oregon
Rate per mile	$0.146
State An. Registration (per truck)	$2,800
Federal Hwy Use Tax (per truck)	$550
Insurance (per truck per year)	$7,000
Annual Insurance	$28,000

	Annual Cost per Truck	Annual Trucking Costs	Cost per Ton	Cost per Mile
Truck	$26,144	$483,668	$1.88	$0.41
Chassis	$10,335	$723,422	$2.82	$0.61
Labor		$1,296,020	$5.05	$1.10
Fuel		$1,577,256	$6.14	$1.33
R&M		$615,130	$2.40	$0.52
Insurance		$157,500	$0.61	$0.13
License & Fees		$407,394	$1.59	$0.34
G&A		$578,643	$2.25	$0.49
Profit		$700,684	$2.73	$0.59
Total		$6,539,717	$25.46	$5.53

APPENDIX C

Calculation of Emissions from Barge Operation

EXHIBIT C-1
Calculation of Emissions from Barge Operation

	Engine hp	Annual Hours Used	Miles Travelled Annually	2010 % of Trip to Metro	Metro Share of Annual Miles	Gal. Used per Hour	Metro Fuel Use	CO2 Emission Factor (g/gal)	CO2 Metro Emissions (g/mile)	NOx Metro Emissions (g/mile)	PM Metro Emissions (g/mile)
1a	3,000	6,762	47,922	41%	19,648	75	207,932	10,084	43,754	1,100	27
1b	3,000	5,880	39,396	41%	16,152	75	180,810	10,084	46,281	1,163	29
4a	3,000	6,762	47,922	20%	9,584	75	101,430	10,084	21,343	536	13

CO2 emission factor calculation reference: Average CO2 Emissions Resulting from Gasoline and Diesel
Emission Factor (g/mile) = (EFg/gal)(gal/hr)(Hours)(P)/(Miles Traveled)

Consumption Data, (EPA, Feb. 2000)
Emission Factor (g/mile) = a (Load Factor)-x + b

	Emission Calculation Factor			Activity Load factor	non-ocean going ships slow cruise 0.4	non-ocean going ships cruise 0.8
	x	b	a		g/kw-hr	(g/kw-hr)
PM 10	1.5	0.2551	0.0059	Emission factor	0.278	0.263
NOx	1.5	10.4496	0.1225		10.934	10.621

EXHIBIT C-2
Barge NOx and PM Emissions with Sulfur Adjustment

	Scenario 1a		Scenario 1b		Scenario 4a	
	NO_x	**PM**	**NO_x**	**PM**	**NO_x**	**PM**
Cruise	1,100	27	1,163	29	536	13
Slow Cruise	566	14	599	15	276	7
Combined	1,047	26	1,107	27	510	13
Adjustment for reduced diesel sulfur content						
2010-12	12.5%	10.0%	12.5%	10.0%	12.5%	10.0%
2013-19	7.5%	5.0%	7.5%	5.0%	7.5%	5.0%
Emissions Estimates						
2010-12	916	23	968	25	447	11
2013-19	847	22	896	23	413	11

APPENDIX D

Explanation of Scoring Used for Constructed Scales

EXHIBIT D-1
Explanation of Scoring Used for Constructed (1-5) Scales

Decision Context: Evaluate various transportation scenarios to provide insight into ways of structuring Metro's pending procurement process for solid waste transportation services.

Objectives Hierarchy	Scale	Scores: Scenario 1a	1b	2a	2b	2c	3	4a	4b	Explanation of Scoring Used for Constructed (1-5) Scales: Scenario 1a: Barge, T2-Willow Creek	1b: Barge, North Portland to Willow Creek	2a: Rail, T2 to CRL	2b: Rail, T2 to Port of Morrow	2c: Rail, Portland Rail Yard and Metro South to CRL	3: Truck	4a: Split: Central = Barge to Willow Creek; South = Truck to CRL	4b: Split: Central + Rail to CRL; South = Truck to CRL
1. Metro Cost Values	2010 in mill. 2007$	$13.0	$13.0	$15.6	$18.3	$14.8	$12.2	$12.7	$16.5								
2. Metro Non-Cost Values																	
2.1 Environmental																	
2.1.1 Minimize use of non-renewable fuel and harmful air emissions																	
Non-renewable fuel	PV 2010-19, mgal.	4.3	4.8	5.6	9.0	7.5	7.8	3.8	6.2								
PM	PV 2010-19, tons	11.4	10.6	22.9	27.8	34.9	3.6	6.3	20.3								
NOx	PV 2010-19, tons	430.6	378.6	582.1	708.1	898.1	34.5	219.0	504.7								
Greenhouse gases (CO2)	PV 2010-19, tons	48,237	53,561	66,709	104,636	91,478	86,364	42,454	72,542								
2.1.2 Minimize impacts in CR Gorge National Scenic Area																	
Non-renewable fuel	PV 2010-19, mgal.	3.5	3.9	4.8	5.8	4.1	4.2	2.8	6.0								
NOx	PV 2010-19, tons	223.7	237.9	326.9	326.9	503.1	18.8	114.4	288.3								
Potential for impacts other than emissions in Columbia River Gorge National Scenic Area	1-5 scale	3.5	3.5	3.5	3.5	3.5	2	3	3	Some concern about adding to traffic on river; conflicts with wind surfers; potential for accident.	Some concern about adding to traffic on river; conflicts with wind surfers; potential for accident.	Relatively low impact; some concerns with noise and accident potential.	Relatively low impact; some concerns with noise and accident potential.	Relatively low impact; some concerns with noise and accident potential.	Highest probability of accident (though relatively low consequence); Some noise and visual concerns	Mixes attributes of Scenarios 1a and 3	Mixes attributes of Scenarios 2a and 3
2.2 Socioeconomic																	
2.2.1 Minimize impacts to neighborhoods	1-5 scale	4	4	4	4	2	5	4.5	4.5	Waste to terminal in industrial area. Truck travel on routes where impacts will be small.	Waste to terminal in industrial area. Truck travel on routes where impacts will be small.	Waste to terminal in industrial area. Truck travel on routes where impacts will be small.	Waste to terminal in industrial area. Truck travel on routes where impacts will be small.	Trucks must pass through St. Johns neighborhood.	No new facilities or truck routes.	No new facilities or truck routes from South; New truck routing from Cental through an industrial area will have little impact.	No new facilities or truck routes from South; New truck routing from Cental through an industrial area will have little impact.
Facility proximity effects (noise, traffic)																	
Traffic and associated emissions																	
2.2.2 Enhance regional freight movement	1-5 scale	4	4.5	4	4	2.5	2	3	3	Multi-modal terminal with potential for attracting new waste, but increased travel on congested roadways	Barge terminal with potential for attracting new waste, but increased travel on congested roadways	Multi-modal terminal with potential for attracting new waste, but increased travel on congested roadways	Multi-modal terminal with potential for attracting new waste, but increased travel on congested roadways	Rail terminal, and some added travel on congested roadways	No change from current system - little opportunity for regional freight enhancement	Multi-modal terminal for some waste and some added travel on congested roadways.	Multi-modal terminal for some waste and some added travel on congested roadways.
Likelihood of a regional freight hub or terminal that leads to economic growth																	
Minimizes truck trips in congested roadways in Metro Area during peak traffic periods																	
Potential for attracting added solid waste from inside or outside Metro																	
2.2.3 Enhance relationships with Gilliam County partners	1-5 scale	3.5	3	1	2.5	1	5	4	3	Fewer trucking jobs, but anchor tenant for Willow Creek facility	Fewer trucking jobs, but anchor tenant for Willow Creek facility	Very few jobs available for trucking from CRL rail yard to landfill	Some jobs available for trucking from Port of Morrow to landfill	Very few jobs available for trucking from CRL rail yard to landfill	Similar to existing system	Small dropoff in jobs, but would help establish Willow Creek	Would retain approx. half of the trucking jobs
Provides jobs																	
Supports development of transportation infrastructure																	
2.3 Operations (Flexibility, Reliability, Risk)																	
2.3.1 Has flexibility to respond to future changes in disposal and transfer	1-5 scale	3	3	3	3	2	4	3.5	3.5	Metro South moving east would be more expensive; Barge engines are expensive and may be slow to respond to technological change	Metro South moving east would be more expensive; Tug engines are expensive and may be slower to respond to technological change	Metro South moving east would be more expensive; Tug engines are expensive and may be slower to respond to technological change	Metro South moving east would be more expensive; Tug engines are expensive and may be slower to respond to technological change	Metro South moving east would be more expensive; Tug engines are expensive and may be slower to respond to technological change	Very flexible system	Mixes attributes of Scenarios 1a and 3	Mixes attributes of Scenarios 2a and 3
Metro South																	
Respond to new fuels and/or emission technologies																	
2.3.2 Reliable, consistent, timely service throughout contract	1-5 scale	3	3	2	2	2	5	4	3	Other Northwest waste-by-barge operation has proven fairly reliable, excepting planned and unanticipated lock closures	Other Northwest waste-by-barge operation has proven fairly reliable, excepting planned and unanticipated lock closures	Other Northwest waste-by-rail operations have experienced some reliability and consistency concerns. Rail capacity constraints exist and are forecast to worsen.	Other Northwest waste-by-rail operations have experienced some reliability and consistency concerns. Rail capacity constraints exist and are forecast to worsen.	Other Northwest waste-by-rail operations have experienced some reliability and consistency concerns. Rail capacity constraints exist and are forecast to worsen.	Metro's trucking operation has generally proven to be highly reliable	Mixes attributes of Scenarios 1a and 3	Mixes attributes of Scenarios 2a and 3
2.3.3 Manages risk that can not be mitigated	1-5 scale	2	2	3	3	3	4	3	3.5	Various unmitigatable risks exist related to barge operations, in particular related to fishery and other river issues, and low probability/high consequence spill	Various unmitigatable risks exist related to barge operations, in particular related to fishery and other river issues, and low probability/high consequence spill	Various unmitigatable risks exist related to rail operations	Various unmitigatable risks exist related to rail operations	Various unmitigatable risks exist related to rail operations	Relatively few risks that cannot be mitigated. Trucking has much higher fuel use than other modes	Mixes attributes of Scenarios 1a and 3	Mixes attributes of Scenarios 2a and 3
Likelihood of waste release to environment																	
Consequence of waste release to environment																	
Ability to provide backup service during emergency outage																	
Not influenced by potential fishery and dam issues																	
Relatively insensitive to fuel price increases ("Peak Oil")																	