APPENDIX I

Facility Plan Cost Model

Facility Plan
Appendix
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Seattle Public Utilities
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Introduction

Seattle Public Utilities with assistance from Financial Consulting Solutions Group, Ecodata and CH2M HILL built the Facility Plan Cost Model (FCPM) to calculate the total cost of a solid waste transfer, hauling, rail loading, rail hauling and disposal to aid in the decision process regarding selection of appropriate facilities to manage Seattle's solid waste in the future.

The FCPM is an Excel Workbook, which allows the user to input key assumptions, and then calculates the cost of a particular option that is being analyzed. The model allows quick turnaround when doing sensitivity analysis and is set up to be able to be used over the course of the facility planning, design and construction period expected to extend into 2012.

The purpose of this document is to describe in a fairly summary fashion the model and it's components and how the model works. This document also presents results of the analysis for Option 0 (the Status Quo option) and Option 11 (the recommended option). Another document will be prepared in the fall of 2003 will provide technical software details for input modelers.

Section 1 of this document contains an overall summary of the model and then goes on to explain in more detail how each of the main components of the model work. Section 2 contains detailed model input. Section 3 contains the results of the FPCM for Option 0 and Option 11. Section 4 describes some additional work performed to quantify difficult to value benefits of the options. Section 5 contains the conclusion.

SECTION 1

Overall Model Summary/Description

The FCPM was built to calculate the total system cost of Seattle's solid waste handling system beginning with the function of waste transfer and continuing on through final disposal of the waste at a landfill. The FPCM does not include any modeling of the collection of solid waste or recycling. Those activities are covered in separate modules of the overall Recycling Potential Assessment/Systems Analysis Models developed and maintained by SPU. Collection does play a minor role in the FPCM however. If a particular option being analyzed has the effect of causing the residential and commercial collection trucks (those under contract with SPU) additional travel to a transfer location other than the one currently being used, the additional costs of this extra collection time are included.

The model is constructed to do full life cycle cost analysis in the sense that costs are calculated annually for a 32 year period from 2006 to 2038. One of the main model outputs used to analyze and compare results is the Present Value of the 32 year cost stream. This present value is referred to as the Net Present Value (NPV) of the option. It is "net" in the sense that all costs are calculated for each option. To the extent that there are savings or efficiencies with an option, those are netted out. All costs in the model are portrayed in real 2003 dollars. The present value calculations use a discount rate of 3 percent.

The FPCM was used to model around 15 different systems or scenarios. These included different combinations of adding a city-owned intermodal facility to the system, and modeling the costs of either remodeling or rebuilding one or both of the two city-owned transfer facilities. The output from the model for the options analyzed was then compared with each other. The cost information from this model, along with other information on the quality of service (or non-monetary benefits) can be used to evaluate the economic feasibility or cost/benefit of an option.

For modeling purposes the activities within a transfer/intermodal facility were categorized into "functions". These six functional areas are:

- Scale: Includes the scale weighing facility, scales, and computer systems.
- Waste Compaction: Includes everything that happens inside the waste compaction part of the transfer facility, including: receiving refuse from collection trucks, compacting the waste into intermodal containers, moving the full containers to the yard or loading them onto the transfer truck for hauling.
- Hauling: Includes the activity of hauling refuse or yard waste.
- Rail Loading: Includes moving the containers from the yard onto a rail car.
- Rail Hauling: Includes assembling the train and hauling to the final disposition site.
- Disposal/Processing: Includes unloading the train and any final transport of material to the landfill face and final disposal (or processing in the case of yard waste).

- Recycling: Recycling equipment, labor, O&M, and market revenue have been determined by a separate analysis and are entered into the FPCM in a summary fashion.

How the Model Works

This section describes the inputs and functions of the model and how they calculate the output values.

1. Begin with a Tonnage Forecast

The FPCM begins with an annual forecast of total municipal solid waste (MSW) generated in Seattle over the next 35 years. Next, tonnage recycled outside of city transfer stations (which includes curbside, apartment and yard waste recycling as well as all commercial recycling) is deducted from the tonnage forecast. What remains is tonnage flowing to the transfer stations by self-haul customers and collected residential and commercial MSW. The tonnage forecast is translated into number of vehicle trips arriving at the station. Knowing the number of trips arriving at the stations is important because this information is used by the model to estimate the number of scales and associated staff that are needed at a facility. All other functions use tons to calculate values in the model.

2. Flow the Tons to the Appropriate Facility

The next step in the model is to determine how much waste will arrive at each of the facilities proposed in the particular scenario being analyzed. Each option that was developed included a detailed flow chart of where that tonnage would be directed. This flow was done by sector (residential, commercial and self haul) for both garbage and organics. The decision on what proportion of each waste stream to flow to each facility was based on the type of facilities being designed and the overall goal of a particular scenario. Self-haul tonnage was always assumed to arrive at the City's stations in approximately the same proportions as it does presently. The exception is that some of the larger self-haulers who arrive now in packer or other large trucks were modeled to flow to the same place as the residential contract haulers. This flow direction was input for modeling purposes and actual practices may vary over time. Also, for modeling purposes, the designation of waste flow was kept constant over the study period; however, it is possible that the actual designation of waste flow between facilities may vary over time.

3. Determine Equipment Needs

The first main calculation in the FPCM is to determine the types and quantities of equipment that are necessary to handle the tons (or trips in the case of the scale function) that are arriving. This is done for four main functions within the facility; scale, waste compaction, hauling, and rail loading.

Information on the purchase price, operating cost and operating capabilities of the equipment was obtained by SPU's consultant and put into the model. Equipment requirements in the FPCM are not based on average daily tons flowing to the facility but rather are determined by peak tons. Thus, equipment needs under peak use periods are calculated. For this calculation a "weekly" peak for each waste stream was calculated from existing transfer station tonnage and trip data.

Next, the specific types of equipment that are needed for a particular facility (given the layout, tons flowing there, etc) are picked from a list. Also chosen at this time is the number of hours per day (or shift) that the equipment will be operated.

The model then calculates how many pieces of each type of equipment are needed to handle the tons flowing to the facility each year for the next 30 years. The model “purchases the equipment” in the year that it is needed based on growth in tonnage, the life and intensity of use of each piece of equipment, and the assumption about how many tons per hour the equipment can process. The model automatically adds in the cost of a new piece of equipment when its useful life is over.

There is a section of the equipment module that allows the user to choose which pieces of equipment will have backups. In addition, the user can choose which general equipment (not driven by tonnage) is needed by picking from a list of equipment such as sweeper trucks or yard scale.

4. Calculate Equipment Operation and Maintenance (O&M) Costs

The next module calculates the cost of operating and maintaining each piece of equipment based on the hours of use and an assumption about costs per hour for equipment O&M provided by the equipment manufacturers. This O&M includes fuel and electricity usage, maintenance (including labor maintenance) and any other lubricants, oils, etc that the machine requires. It does not include the labor to operate the equipment, which is calculated in the next module.

This is a straightforward calculation where the number of hours the equipment is operating is multiplied by the cost per hour of operating the equipment. The cost of operating the equipment is calculated separately by the four main functions of scale, waste compaction, hauling and rail loading.

5. Determine Labor Needs

The next step in the model calculation is to estimate the amount of labor necessary to process the tons and trips arriving at the facility. (This is also done separately for each of the four main functions.) As mentioned in the equipment module description, each piece of equipment is assigned a particular type of labor. For example, if you have a scale you need a scale attendant. A loader and bulldozer (used for moving waste on the floor, in pit or loading the compactors) require heavy equipment operators. A gantry crane, used in the rail loading function requires two people, a heavy equipment operator plus a laborer who duties are to secure the containers onto the railcar that have just been loaded by the crane. Some equipment has “zero” labor, such as the pettibone. This piece of equipment is used to tamp and level loads of yard waste that have been dumped into open top trailers. The dozer operators are able to switch over and operate this piece of equipment as needed; therefore, no additional labor is required for this piece of equipment.

One special type of labor are the floor workers whose job is to direct traffic, sweep up spills and attend to customer questions. In most cases these workers are assumed to be associated with the scale function since trips not tons drive the need for both scales and for these workers. In order to have the model properly assign floor labor, a fictitious piece of equipment called a broom was used to assign this labor type. This was necessary because it is equipment that is first calculated, then labor is calculated based on the equipment that is needed to process the tons (trips) flowing to the facility.

As in the equipment module, there is a section where general labor can be added. This section is where station managers, crew chiefs, office staff and operations division finance staff are entered.

The sequence of calculations in the model is as follows. First, based on the equipment chosen by the model, the amount and type of labor required to operate each piece of equipment is calculated. This amount is then increased by a factor of 1.21 to account for paid time spent on the job in meetings, safety training, vacation and sick days. The rational is that workers in meetings, training, sick, and on vacation are not present to operate the equipment needed to process the waste flowing through the facility. Thus adequate labor needs to be present to perform the duties. This is referred to as non-operating time. For budgeting purposes SPU uses a factor of 220 days available out of total of 260 days for a factor of 1.18. The Facility Plan cost model assumes a higher than City average factor for non-operating time due to the need for safety and crew meetings associated with solid waste field operations.

Other Model Components

This section of the document describes the other components of the model when, taken together with the components described above, completely describe and model the Seattle waste system from the point of transfer to the final disposal of the waste, or in the case of self haul recycling, until the material is readied for the market.

Construction Costs Module

The model allows input of total construction costs for each of the facilities (NRDS, SRDS & Intermodal). The input portion of the model allows the construction cost to be separated by the scale, waste compaction, hauling and rail loading functions to facilitate tracking the total costs of each of these activities separately.

The model allows the user to spread the construction cost over a period of four years or less and to specify the first year of operation for each of the facilities.

Existing Facility Costs

The model assumes that the existing facilities will continue in operation until the last year of construction for each of the facilities, at which time the facility will be shut down for that year. Up until the last year of construction, existing costs for the NRDS and SRDS facilities are assumed. These costs are based on 2002 actual expenditures.

Input Cash Flows

This portion of the model calculates some general costs associated with the facilities. You can enter an annual amount for general facility maintenance, and an amount per FTE worker to cover the costs of training, travel, and supplies. In this portion of the model property costs are input along with lease costs if applicable and recycling costs.

Recycling Costs

As mentioned earlier, recycling costs are calculated outside the model by SPU's consultant, building upon work done for an earlier analysis of self-haul recycling. The model user inputs in the years in which they occur the following recycling costs: construction, capital equipment, O&M (includes equipment and labor), and any revenue/fees associated with marketing the recyclables. The number of full-time equivalents (FTE) associated with recycling is also input separately from the labor O&M so that the FTE count can drive the labor training, travel and supplies overhead calculation.

Private Transfer, Private Rail Load and Organics Processing

Some scenarios analyzed included transferring some tons at the privately owned transfer stations. In addition, there are scenarios where no intermodal solid waste transfer facility is built. Under these scenarios tons needing to be loaded onto the train are assumed to be loaded at the existing Argo Rail Yard. Costs per ton for private transfer, rail loading and Argo and private yard waste processing are all input into the model as costs per ton. These costs are then multiplied by the tons projected to flow to those facilities to calculate the total costs of private transfer, rail load and organics processing.

Rail Haul and Disposal

There is a separate model that has been used to calculate the cost of rail haul. This model is described in a separate appendix. The outputs of that model are input into the Rail Haul and Disposal module of the FPCM and the resulting output is an annual cost per ton for rail haul and disposal. This annual number is multiplied by the tons disposed to get the total cost of rail haul and disposal for each of the options analyzed. There are two main rail haul and disposal scenarios that are allowed. First, there is an option where there is no intermodal facility, therefore rail haul and disposal occur much as they do under Seattle's existing contracts. Secondly, there is an option for when there is an intermodal solid waste transfer facility. The existence of an intermodal facility changes the rail haul costs because containers can be loaded to a higher weight, there is the possibility of competition among rail lines and disposal companies, and there are also partnering arrangements that allows a unit train to be built and dispatched in an efficient manner. All of these affect the cost of rail haul and/or disposal.

Output Modules

The last sections of the FPCM display the output of the model in different formats. One output module, called the Net Cash Flow, shows annual costs by facility for each of the facilities being analyzed with a final section showing the results of the contracted costs such as private transfer, organics processing, Argo rail load, rail haul and disposal.

Another output module called Scenario Management, shows a combination of input and outputs for a given scenario in net present value terms. There are a series of charts generated for each model run as well. An add-on workbook keeps track of the output of all the current options presenting them side by side either in tables or charts.

SECTION 2

Model Inputs/Assumptions

The facility plan cost model (FCPM) described in the previous section was used to analyze many different options which include building a new facility to transfer and rail load Seattle's MSW. The options also included rebuilding or remodeling Seattle's existing two city-owned transfer facilities.

The purpose of this section of the report is to highlight the specific inputs and outputs of the Facility Plan Cost Model for the final set of four options that were analyzed. These options include

Option 0: Continue to operate 30 years into the future using the existing two public and existing two private transfer facilities, investing just enough capital into the two public facilities to keep them functional.

Option 5: Assumes additional land acquisition and therefore additional space to build stations that meet all the design criteria and maximizes recycling.

Option 8: Assumes no additional land acquisition, and attempts to minimize construction in a way that moves towards the goals of the facility plan but is restrained to the existing sites. This option does not include a new intermodal transfer facility and relies on a contractor to provide rail loading and transportation to a landfill.

Option 11: This is the recommended option and includes a new intermodal solid waste receiving and transfer facility for collected waste and a rebuild of the two city-owned transfer stations with additional property at these facilities for improved recycling facilities.

Tonnage Forecast

Table 2-1 shows the forecasted tonnage that is generated and disposed by sector. Recycling is assumed to reach a 50 percent level citywide with the commercial and residential recycling rates progressing halfway to the goal from the current levels. The self-haul recycling rate is dependent on which facility option is being analyzed and is different for different options. Table 2-2 contains the various self haul recycling rates for the final four options analyzed.

TABLE 2-1
Forecasted Seattle MSW Generated and Disposed

	Residential		Commercial		Self Haul
	Generated	Disposed	Generated	Disposed	Generated
2010	306,800	138,000	405,500	202,700	123,200
2020	339,000	152,500	494,300	247,100	143,000
2030	374,400	168,500	602,500	301,300	165,900
Average Annual Rate of growth in generated waste	1%	Na	2%	Na	1.5%
Highest level of recycling assumed to be achieved.	55%		50%		Varies by option, see Table 2

TABLE 2-2
Self- Haul Recycling Rates

Option	Rate Including Yard Waste	Rate Excluding Yard Waste
0	18%	7%
5	50%	38%
8	20%	9%
11	36%	25%

Tonnage Allocation Assumptions

The forecasted tons disposed for each sector are then allocated to a particular facility. Table 2-3 and Table 2-4 show the assumptions used to allocate tons for each of the final four options.

TABLE 2-3
Garbage Tonnage Allocation

	Option 0	Option 5	Option 8	Option 11
Commercial Collection	15% NRDS 5% SRDS 80% Private	100% Intermodal	40% SRDS 60% Private	100% Intermodal
Residential Collection	30% NRDS 70% SRDS	100% Intermodal	100% SRDS	100% Intermodal
Self Haul	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS

TABLE 2-4
Organics Tonnage Allocation

	Option 0	Option 5	Option 8	Option 11
Commercial Collected Organics	100% Private	100% Private	100% Private	100% Private
Residential Collected Organics	25% NRDS 25% SRDS 50% Private	100% Intermodal	100% Private	100% Intermodal
Self Haul Organics	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS	Status Quo 60% NRDS 40% SRDS

Equipment Costs

Table 2-5 includes the list of equipment by function. The table firsts list the calculated price for each piece of equipment. This price is a factor of 1.2 times the purchase price. The factor represents SPU's experience with the actual cost of equipment, including acquisition costs, versus the manufacturers listed price. The next column shows the tons (or trips in the case of the scale function) that each piece of equipment can process. This is sometimes based on the specification of the manufacturer and other times based on the operating experience of SPU. The next two columns show type and amount of labor that is needed to operate the equipment.

The column titled "Useful Life" shows the expected hours of useful life. The source of this information is from the equipment manufacturer. It is typically listed as total hours of operation before a piece of equipment needs to undergo a major overhaul. This value has been translated to years assuming 2080 hours per year of operation. If a shift different than 2080 per year is chosen for a particular function, the model recalculates the useful life given the assumption of hours the equipment is operating annually. The final column shows the operating cost per hour for each type of equipment. This operating cost includes maintenance labor, fuels, lubricants, etc.

TABLE 2-5
Equipment Table

Capital Equipment Inputs							***Capital Equipment Pages***
	Equipment Price Factor---->		**1.2**		**Factor**	**100%**	**$**
Capital Equipment	**Calculated Unit Price**	**Input Unit Price**	**Tons (Trips) per Hour**	**Labor Description**	**Operator Req't**	**Useful Life in Years Based on 2,080 hr/yr**	**Maintenance per Operating Hour**
Scale			(scale requirements is a factor of vehicle trips)				
In Scale-40 ft w/Labor	$48,840	$40,700	90	Scale Attendant	1	63.0	$2.75
Out Scale-40 ft w/Labor	$48,840	$40,700	90	Scale Attendant	1	63.0	$2.75
In Scale-70 ft w/Labor	$72,240	$60,200	90	Scale Attendant	1	63.0	$2.75
In Scale-70 ft NO Labor	$72,240	$60,200	90	Zero Dollar Labor	1	63.0	$2.75
Out Scale-70 ft- w/Labor	$72,240	$60,200	90	Scale Attendant	1	63.0	$2.75
Out Scale-70 ft- NO Labor	$72,240	$60,200	90	Zero Dollar Labor	1	63.0	$2.75
Broom Floor Labor Existing	$0	$0	15	Laborer	1	15.0	$0.00
Broom Floor Labor Existing	$0	$0	20	Laborer	1	15.0	$0.00
Waste Compaction							
Track Loader (pit)	$340,200	$283,500	100	Hvy Equip Operator	1	5.0	$25.00
Wheel Loader (push) w/Labor	$251,400	$209,500	100	Hvy Equip Operator	1	5.0	$22.00
Placeholder	$36,000	$30,000	8		1	4.0	$6.00
D6 Bull Dozer (pit)	$420,000	$350,000	100	Hvy Equip Operator	1	5.0	$20.50
Pettibone	$192,000	$160,000	48	Hvy Equip Operator	1	5.0	$16.00
Compactor 1 Bale	$1,076,160	$896,800	100	Compactor Operator	1	14.0	$13.35
Compactor 2 Bale	$750,000	$625,000	75	Compactor Operator	0.5	14.0	$13.35
Yard Goat	$99,240	$82,700	200	Truck Driver	1	6.0	$12.00
Broom Floor Labor Existing	$0	$0	15	Laborer	1	15.0	$0.00
Scale 40 Ft Platform	$48,840	$40,700	48	Zero Dollar Labor	1	15.0	$2.00
Broom Floor Labor New	$36,000	$30,000	30	Laborer	1	15.0	$2.00
Hauling							
G Tractor N to Argo 25t	$117,240	$97,700	19	Truck Driver	1	4.0	$20.00
G Tractor S to Argo 25t	$117,240	$97,700	28	Truck Driver	1	4.0	$20.00
YW Tractor N to CG 16t	$117,240	$97,700	7	Truck Driver	1	4.0	$20.00
YW Tractor S or IM to CG 16t	$117,240	$97,700	9	Truck Driver	1	4.0	$20.00
G Chassis N to Argo 25t	$40,800	$34,000	19	Zero Dollar Labor	1	3.0	$7.00
G Chassis S to Argo 25t	$40,800	$34,000	28	Zero Dollar Labor	1	3.0	$7.00
YW Trailer N to CG 16t	$74,040	$61,700	7	Zero Dollar Labor	1	3.0	$14.00
YW Trailer S or IM to CG 16t	$74,040	$61,700	9	Zero Dollar Labor	1	3.0	$14.00
G Tractor N to IM 20t	$117,240	$97,700	15	Truck Driver	1	15.0	$20.00
G Tractor S to IM 20t	$117,240	$97,700	22	Truck Driver	1	15.0	$20.00
G Chassis N IM 20t	$40,800	$34,000	15	Zero Dollar Labor	1	15.0	$7.00

TABLE 2-5
Equipment Table

Capital Equipment Inputs							***Capital Equipment Pages***
	Equipment Price Factor---->		**1.2**		**Factor**	**100%**	**$**
Capital Equipment	**Calculated Unit Price**	**Input Unit Price**	**Tons (Trips) per Hour**	**Labor Description**	**Operator Req't**	**Useful Life in Years Based on 2,080 hr/yr**	**Maintenance per Operating Hour**
G Chassis S IM 20t	$40,800	$34,000	22	Zero Dollar Labor	1	15.0	$7.00
G Trailer N to IM 20t	$36,000	$30,000	15	Zero Dollar Labor	1	15.0	$14.00
G Trailer S to IM 20t	$36,000	$30,000	22	Zero Dollar Labor	1	15.0	$14.00
YW Tractor IM to CG 25t	$36,000	$30,000	14	Truck Driver	1	15.0	$20.00
YW Trailer IM to CG 25t	$74,040	$61,700	14	Zero Dollar Labor	1	15.0	$14.00
Rail Loading							
Reach Stacker	$576,000	$480,000	660	1 Operator/ 1 Laborer	2	14.0	$16.00
Gantry Crane 45 ft	$960,000	$800,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
Gantry Crane 60 ft	$1,440,000	$1,200,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
Gantry Crane 75 ft	$1,800,000	$1,500,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
Mast Stacker	$390,000	$325,000	990	Hvy Equip Operator	1	14.0	$16.00
Yard Goat	$99,240	$82,700	200	Truck Driver	1	15.0	$12.00
Gantry Crane 45 ft on rails	$960,000	$800,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
Gantry Crane 60 ft on rails	$1,440,000	$1,200,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
Gantry Crane 75 ft on rails	$1,800,000	$1,500,000	990	1 Operator/ 1 Laborer	2	29.0	$16.00
General							$2.00
Scale-70 foot	$72,240	$60,200	90		0	63.0	$0.00
Axle Scale	$12,990	$10,825	90		0	5.0	$0.00
Flusher Truck	$84,000	$70,000	15	Zero Dollar Labor	1	5.0	$2.00
Sweeper Truck	$25,920	$21,600	13	Zero Dollar Labor	1	5.0	$2.00
Skid Steer Loader	$31,800	$26,500	100	Zero Dollar Labor	1	10.0	$2.00
Wheel Loader no Labor (push)	$251,400	$209,500	100	Zero Dollar Labor	1	10.0	$2.00

Labor Cost

Table 2-6 shows the hourly labor cost including fringe benefits for each of the labor types used in the Facility Plan Cost Model. The 2003 annual salary is the starting point. Next the salary is multiplied by a factor of 1.5 to reflect fringe benefits. This salary is then translated to an hourly wage rate that is used in the model to calculate the cost per hour for the various types of labor.

TABLE 2-6
Labor Cost Table

Labor Inputs	Benefit Factor =	1.5	*Applies to Labor Cost*
Labor Type	**Input Salary**	**Loaded Salary**	**Hourly Wage**
Admin	$37,066	$55,598	$26.73
Analyst	$49,067	$73,601	$35.39
CrewChief1	$52,499	$78,749	$37.86
Manager2	$71,323	$106,985	$51.44
Executive	$104,000	$156,000	$75.00
Laborer	$32,968	$49,452	$23.78
Compactor Operator	$36,254	$54,382	$26.15
Hvy Equip Operator	$51,459	$77,189	$37.11
Truck Driver	$45,677	$68,515	$32.94
Scale Attendant	$34,570	$51,854	$24.93
1 Operator/ 0.5 Laborer	$46,836	$70,255	$33.78
1 Operator/ 1 Laborer	$78,250	$117,374	$56.43
Zero Dollar Labor	$0	$0	$0.00
Placeholder	$0	$0	$0.00
Zero Dollar Labor	$0	$0	$0.00

Construction Costs and Recycling Construction, O&M and Market Revenue Assumptions

The next table, Table 2-7, shows construction costs for each of the final options analyzed. These cost estimates have been developed by consultants hired to assist in the plan. The costs are shown by station and by function.

TABLE 2-7
Planning Level Capital Cost Estimates ($1,000s), 07-31-03: Options 5B, 8 - 11

	Option 0	Option 5B	Option 8	Option 9	Option 10	Option 11
	Status Quo	Aggressive Recycle				Balanced Approach
NRDS						
Scale infrastructure	$0	$422	$575	$575	$574	$574
Waste compaction	$3,984	$13,801	$17,743	$17,743	$17,714	$17,714
Hauling (probably $0)	$0	$0	$0	$0	$0	$0
Rail Loading	$0	$0	$0	$0	$0	$0
General	$1,992	$9,879	$8,513	$8,513	$8,532	$8,532

TABLE 2-7
Planning Level Capital Cost Estimates ($1,000s), 07-31-03: Options 5B, 8 - 11

	Option 0	Option 5B	Option 8	Option 9	Option 10	Option 11
	Status Quo		Aggressive Recycle			Balanced Approach
Subtotal	$5,976	$24,102	$26,831	$26,831	$26,820	$26,820
Recycling Construction	$0	$14,526	$73	$73	$740	$740
Recycling Capital Equipment	$191	$1,064	$694	$694	$777	$777
Subtotal	$191	$15,590	$767	$767	$1,517	$1,517
Total NRDS	**$6,167**	**$39,692**	**$27,598**	**$27,598**	**$28,337**	**$28,337**
SRDS						
Scale infrastructure	$0	$557	$609	$453	$428	$427
Waste compaction	$4,344	$16,526	$12,816	$12,752	$10,795	$10,998
Hauling (probably $0)	$0	$0	$0	$0	$0	$0
Rail Loading	$0	$0	$0	$0	$0	$0
General	$6,535	$15,727	$10,712	$14,140	$15,148	$16,133
Subtotal	$10,879	$32,810	$24,137	$27,345	$26,371	$27,558
Recycling Construction	$0	$36,897	$1,538	$1,524	$11,716	$12,484
Recycling Capital Equipment	$191	$3,055	$694	$694	$1,195	$2,395
Subtotal	$191	$39,952	$2,232	$2,218	$12,911	$14,879
Total SRDS	**$11,070**	**$72,762**	**$26,369**	**$29,563**	**$39,282**	**$42,437**
Intermodal						
Scale infrastructure	$0	$277	$0	$277	$277	$277
Waste compaction	$0	$26,376	$0	$26,376	$26,376	$26,376
Hauling (probably $0)	$0	$0	$0	$0	$0	$0
Rail Loading	$0	$2,601	$0	$2,601	$2,601	$2,601
General	$0	$10,779	$0	$10,779	$10,779	$10,779
Subtotal	$0	$40,033	$0	$40,033	$40,033	$40,033
Recycling Construction	$0	$0	$0	$0	$0	$0
Recycling Capital Equipment	$0	$0	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0	$0	$0
Total Intermodal	**$0**	**$40,033**	**$0**	**$40,033**	**$40,033**	**$40,033**
System Total	**$17,237**	**$152,487**	**$53,967**	**$97,194**	**$107,652**	**$110,807**

TABLE 2-7
Planning Level Capital Cost Estimates ($1,000s), 07-31-03: Options 5B, 8 - 11

	Option 0	Option 5B	Option 8	Option 9	Option 10	Option 11
	Status Quo	Aggressive Recycle				Balanced Approach
Recycling O&M (Annual)[a]						
NRDS	$130	$2,932	$132	$132	$214	$214
SRDS	$130	$4,999	$436	$436	$987	$1,592
Annual Recycled Material Sales - Costs and (Revenues)						
NRDS	$52	$251	$91	$91	$91	$91
SRDS	$111	$342	$83	$83	$157	$308
Recycling FTE						
NRDS	0.90	13.23	1.08	1.08	2.33	2.33
SRDS	2.90	36.55	5.08	5.08	11.60	13.85

[a] Excludes costs for private operation of reuse facilities and material revenues for recyclables.

NOTE: The above cost opinion is in January 2003 dollars and does not include escalation, financial or O&M costs (except for recycling O&M as noted).

The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Contracted Functions: Assumption of Per Ton Price

In order to calculate the total cost of an option, the costs incurred in the private sector for handling Seattle MSW tons must be included. The approach used in the Facility Plan Cost Model to handle these costs was to use a price per ton assumption for each of the major contractual costs. When an option modeled tons flowing to a private function, then the total cost was calculated by multiplying the appropriate number of tons by the price per ton found in the Table 2-8 below. The table also includes a rational for the number chosen.

TABLE 2-8
Contracted Functions Price Assumptions

Contracted Function	Price per Ton	Basis for Number
Private Transfer and Haul of MSW	$10.30	Based on current commercial contracts
Private Transfer and Haul of Organics	$16.05	Based on current residential contract
Argo Rail Load	$2.50	Based on SPU estimates of current cost for this

TABLE 2-8
Contracted Functions Price Assumptions

Contracted Function	Price per Ton	Basis for Number
		function
Processing Price for Organics	$22.50	Based on current SPU contract with Cedar Grove
Current Price for Rail Haul + Disposal	$42.75	April 2003 contract price with Washington Waste Systems (WWS)
Rail Haul Cost Per ton if Intermodal	$13.70	Rail model
Disposal Price if Intermodal is built	$16.70	Kitsap County Price of disposal at Columbia Ridge Landfill in 2003
Discount to current contracted price for rail and disposal if no intermodal is built	$2.00	SPU estimate

Miscellaneous Other Assumptions

Various other assumptions were made to fully capture costs associated with the solid waste system. Table 2-9 below details these cost assumptions.

TABLE 2-9
Miscellaneous Assumptions

Cost Type	Assumption	Basis
Facility O&M	$197,500 per year if pit resurfaced annually, 122,500 if flat floor or pit not resurfaced annually	Current costs.
Labor O&M	$3,500 per FTE	Current Costs, this covers supplies, training, travel and other admin overhead necessary to support the staff

SECTION 3

Results of the 2003 Facility Plan Model

The Facility Plan Cost Model contains many different ways to view the results. There are summary tables, detailed tables, charts and graphs of the results. This section displays summary results of the model for Options 0, 5, 8 and 11 and some detailed results for Options 0 and Option 11.

Summary Results

Table 3-1 summarizes some key model inputs and outputs for each scenario. The very bottom of the table contains the NPV for each option. The top of the table contains some key input assumptions, while the middle of the table displays some of the results by facility.

TABLE 3-1
Summary Table

Table 2	Option 0			Option 5			Option 8			Option 11		
Optimize Facilities	2006	2017	2038	2006	2017	2038	2006	2017	2038	2,006	2,017	2,038
Tonnage												
Recycling Rate												
Residential	52%	55%	55%	52%	55%	55%	52%	55%	55%	52%	55%	55%
Commercial	47%	50%	50%	47%	50%	50%	47%	50%	50%	47%	50%	50%
Self-Haul Net of YW	7%	7%	7%	7%	38%	38%	7%	9%	9%	7%	25%	25%
Tonnage Growth Rate												
Residential	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Commercial	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Self-Haul Net of YW	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Peak Tonnage Factor												
Self-Haul Garbage	1.21			1.21			1.21			1.21		
All other Garbage	1.09			1.09			1.09			1.09		
Organics/Yard Waste	1.49			1.49			1.49			1.49		
NTS												
Construction Cost	$5,976,000			$23,823,000			$26,831,000			$26,820,000		
Construction Year	2005			2008			2007			2008		
1st Year Operation post Construction	2009			2012			2011			2012		
FTEs 5th Year Operation	25.1			19.5			22.1			20.7		
Recycling FTEs 5th Yr	0.9			13.2			1.1			2.3		
Facility NPV	$80,191,423			$137,122,842			$77,397,729			$79,638,615		
NPV dollars per ton	$22.39			$69.69			$39.33			$40.47		
Annual Tonnage	143,965	161,014	212,811	143,965	51,111	66,569	143,965	71,347	94,231	143,965	60,409	79,278
Levelized Annual Facility Cost	$3,933,118			$6,725,412			$3,796,097			$3,906,005		
STS												
Construction Cost	$10,446,000			$32,579,000			$24,137,000			$27,558,000		

TABLE 3-1
Summary Table

Table 2	Option 0			Option 5			Option 8			Option 11		
Optimize Facilities	**2006**	**2017**	**2038**	**2006**	**2017**	**2038**	**2006**	**2017**	**2038**	**2,006**	**2,017**	**2,038**
Construction Year	2005			2007			2006			2007		
1st Year Operation post Construction	2009			2011			2010			2011		
FTEs 5th Year Operation	31.1			27.5			34.1			27.5		
Recycling FTEs 5th Yr	2.9			36.6			5.1			13.9		
Facility NPV	$95,084,570			$222,634,792			$121,809,215			$132,469,126		
NPV dollars per ton	$22.28			$109.39			$18.82			$65.09		
Annual Tonnage	177,727	193,942	247,491	177,727	48,111	63,569	177,727	309,543	414,868	177,727	57,409	76,278
Levelized Annual Facility Cost	$4,663,577			$10,919,484			$5,974,330			$6,497,163		
IMF												
Construction Cost	$0			$40,033,000			$0			$40,033,000		
Construction Year	2005			2006			2005			2006		
1st Year Operation post Construction	2009			2010			2009			2010		
FTEs 5th Year Operation	0.0			22.6			0.0			22.6		
Facility NPV	$0			$109,367,607			$0			$109,464,331		
NPV dollars per ton	$0.00			$14.21			$0.00			$14.22		
Annual Tonnage	0	0	0	0	415,929	570,425	0	0	0	0	415,929	570,425
Levelized Annual Facility Cost	$0			$5,364,111			$0			$5,368,855		
All Facilities												
Construction Cost	$16,422,000			$96,435,000			$50,968,000			$94,411,000		
FTEs 5th Year Operation	56.3			69.6			56.3			70.8		
Recycling FTEs 5th Yr	3.8			49.8			6.2			16.2		
Facility NPV	$175,275,993			$469,125,241			$199,206,944			$321,572,073		
NPV dollars per ton	$22.33			$40.10			$23.61			$27.49		
Annual Tonnage	321,692	354,956	460,302	321,692	515,151	700,562	321,692	380,889	509,099	321,692	533,746	725,982
Levelized Annual Facility Cost	8,596,695			23,009,007			9,770,427			15,772,023		
Full Facilities & Contract Costs												
Scenario NPV	$628,076,567			$796,424,991			$649,299,040			$656,983,487		
NPV dollars per ton	$50.84			$64.46			$52.55			$53.18		
Annual Tonnage	498,025	558,767	760,186	498,025	515,151	700,562	498,025	555,622	755,887	498,025	533,746	725,982
Levelized Annual Facility Cost	30,805,032			39,061,953			31,845,922			$32,222,818		
	Option 0			**Option 5**			**Option 8**			**Option 11**		
NPV Differences from Option 0				$168,348,425			$21,222,474			$28,906,921		
Levelized Cost Diff from Option 0				$8,256,921			$1,040,891			$1,417,787		

Equipment Results

Table 3-2 summarizes the equipment needs of each of the facilities. The table shows the total number of each piece of equipment that is necessary to have by 2038, the last year of the planing horizon. In some cases, extra pieces of equipment are necessitated by growth in tonnage and these pieces of equipment are not purchased in the first year of operation, but in the year that are needed. The table also does not show backup equipment. In most all cases, the assumption is that all equipment has one back up that is purchased in the first year of operation (and replaced as needed) except for the Gantry Crane. The crane costs almost a million dollars and the assumption is that the mast stacker which performs a similar function, can be used as a back up. In addition there is a back-up mast stacker. The table also shows the "shift" assumption for each of the four main functions. For example, the scales and NRDS and SRDS are assumed to operate 3,458 hours per year (or 9.5 hours per day 364 days per year.) The intermodal facility waste compaction hours are also 7 days a week, which is necessary to accommodate commercial waste that is collected 7 days a week. The rail loading hours of operation, on the other hand are 2080 or an 8 hour shift 5 days per week. This is all that is required in order to load Seattle's waste.

TABLE 3-2
Equipment Summary

SPU Solid Waste Facility Cost Model	**Option = 11**		
	Equipment Purchase Summary (2006-2038)		
Not Including Backup Equipment Purchase Summary	**North Transfer Station**	**South Transfer Station**	**Intermodal Facility**
Scale Hours of Operation	3,458	3,458	2,496
In Scale-40 ft w/Labor	1	1	
Out Scale-40 ft w/Labor	2	2	
In Scale-70 ft w/Labor			1
In Scale-70 ft NO Labor			
Out Scale-70 ft- w/Labor			
Out Scale-70 ft- NO Labor			1
Broom Floor Labor Existing			
Waste Compaction Hours	3,458	3,458	3,458
Track Loader (pit)			
Wheel Loader (push) w/Labor	1	1	1
D6 Bull Dozer (pit)			
Pettibone			
Compactor 1 Bale			1
Compactor 2 Bale			
Yard Goat	1	1	1
Broom Floor Labor Existing			
Scale 40 Ft Platform	1	1	3
Broom Floor Labor New			

TABLE 3-2
Equipment Summary

SPU Solid Waste Facility Cost Model	**Option = 11**		
	Equipment Purchase Summary (2006-2038)		
Not Including Backup Equipment Purchase Summary	**North Transfer Station**	**South Transfer Station**	**Intermodal Facility**
Hauling Hours of Operation	2,080	2,080	2,080
Hauling			
G Tractor N to Argo 25t			
G Tractor S to Argo 25t			
YW Tractor N to CG 16t	1		
YW Tractor S or IM to CG 16t		1	
G Chassis N to Argo 25t			
G Chassis S to Argo 25t			
YW Trailer N to CG 16t	1		
YW Trailer S or IM to CG 16t		1	
G Tractor N to IM 20t	3		
G Tractor S to IM 20t		2	
G Chassis N IM 20t			
G Chassis S IM 20t			
G Trailer N to IM 20t	3		
G Trailer S to IM 20t		2	
YW Tractor IM to CG 25t			2
YW Trailer IM to CG 25t			2
Rail Loading Hours of Operation	3,458	3,458	2,080
Reach Stacker			
Gantry Crane 45 ft			1
Gantry Crane 60 ft			
Gantry Crane 75 ft			
Mast Stacker			1
Yard Goat			2
Gantry Crane 45 ft on rails			
Gantry Crane 60 ft on rails			
Gantry Crane 75 ft on rails			

Labor Summary

Table 3-3, Labor Summary, summarizes the labor requirements by facility for selected years.

TABLE 3-3
Labor Summary

NTS Labor				
Option 11				
Total FTE Each Labor Type		2015	2025	2035
	Admin	--	--	--
	Analyst	--	--	--
	CrewChief1	2.0	2.0	2.0
	Manager2	1.0	1.0	1.0
	Executive	--	--	--
	Laborer	6.0	6.0	8.0
	Compactor Operator	--	--	--
	Hvy Equip Operator	2.0	2.0	2.0
	Truck Driver	5.6	5.6	5.6
	Scale Attendant	4.0	4.0	4.0
	1 Operator/ 0.5 Laborer	--	--	--
	1 Operator/ 1 Laborer	--	--	--
	Zero Dollar Labor	--	--	--
	Placeholder	--	--	--
	Zero Dollar Labor	--	--	--
	Total FTE	20.7	20.7	22.7
	NTS Recycling Labor	2.3	2.3	2.3
STS Labor		**2015**	**2025**	**2035**
	Admin	3.0	3.0	3.0
	Analyst	2.0	2.0	2.0
	CrewChief1	2.0	2.0	2.0
	Manager2	1.0	1.0	1.0
	Executive	1.0	1.0	1.0
	Laborer	8.0	10.1	12.1
	Compactor Operator	--	--	--
	Hvy Equip Operator	2.0	2.0	2.0
	Truck Driver	4.4	4.4	4.4
	Scale Attendant	4.0	4.0	4.0
	1 Operator/ 0.5 Laborer	--	--	--
	1 Operator/ 1 Laborer	--	--	--
	Placeholder	--	--	--
	Zero Dollar Labor	--	--	--
	Total FTE	27.5	29.5	31.5
	STS Recycling Labor	13.9	13.9	13.9
IMF Labor		**2015**	**2025**	**2035**
	Admin	--	--	--
	Analyst	--	--	--
	CrewChief1	2.0	2.0	2.0
	Manager2	1.5	1.5	1.5
	Executive	--	--	--
	Laborer	2.9	4.4	4.4
	Compactor Operator	2.9	2.9	2.9

TABLE 3-3
Labor Summary

NTS Labor				
Option 11				
Total FTE Each Labor Type		**2015**	**2025**	**2035**
	Hvy Equip Operator	4.1	4.1	4.1
	Truck Driver	5.3	5.3	6.5
	Scale Attendant	1.5	1.5	1.5
	1 Operator/ 0.5 Laborer	--	--	--
	1 Operator/ 1 Laborer	2.4	2.4	2.4
	Placeholder	--	--	--
	Placeholder	--	--	--
	Zero Dollar Labor	--	--	--
	Total FTE	22.6	24.1	25.3
All Facilities				
	Total	71	74	80
	Total Recycling	16	16	16

Discussion of Results for Option 11

Chart 3-1 below shows how costs (in NPV terms) are distributed across the main functions for option 11. The largest component of costs is the cost for disposal, which makes up almost 50 percent of the total NPV. The costs of property purchase or lease and construction make up the next largest component of the NPV of costs.

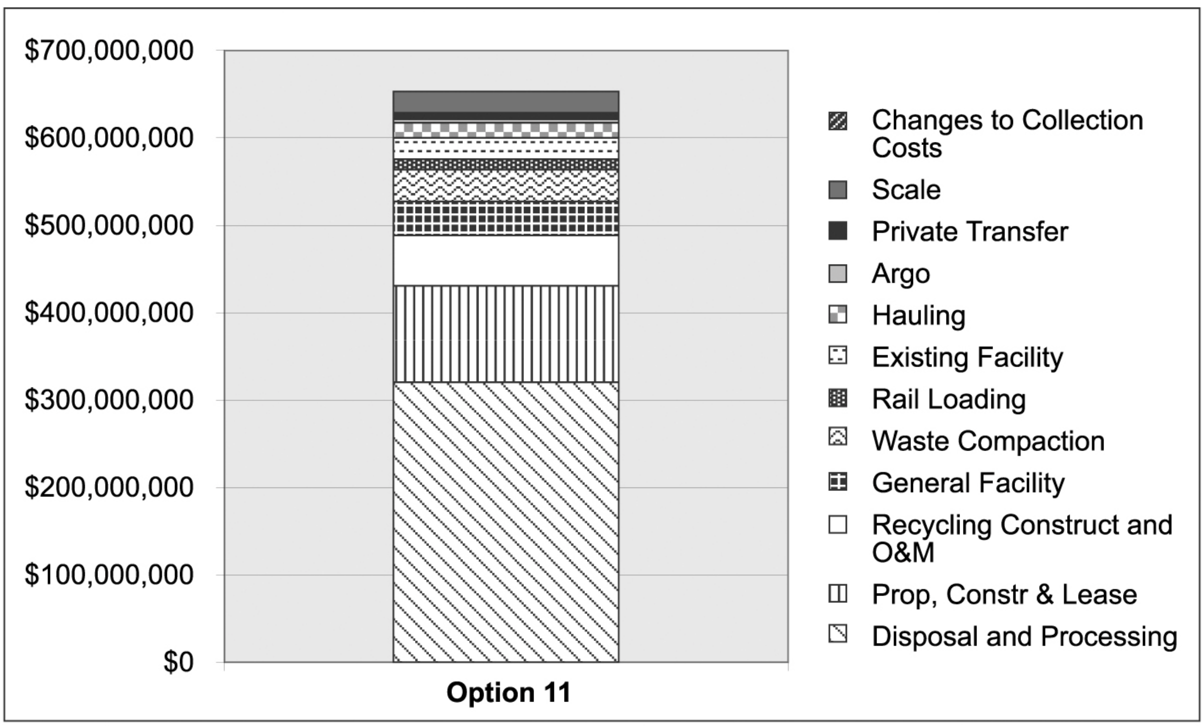

Chart 3-1: Option 11 Total Net Present Value by Function

Chart 3-2 shows the same categories of cost, but this time illustrates how these costs vary over the 32 year planning horizon.

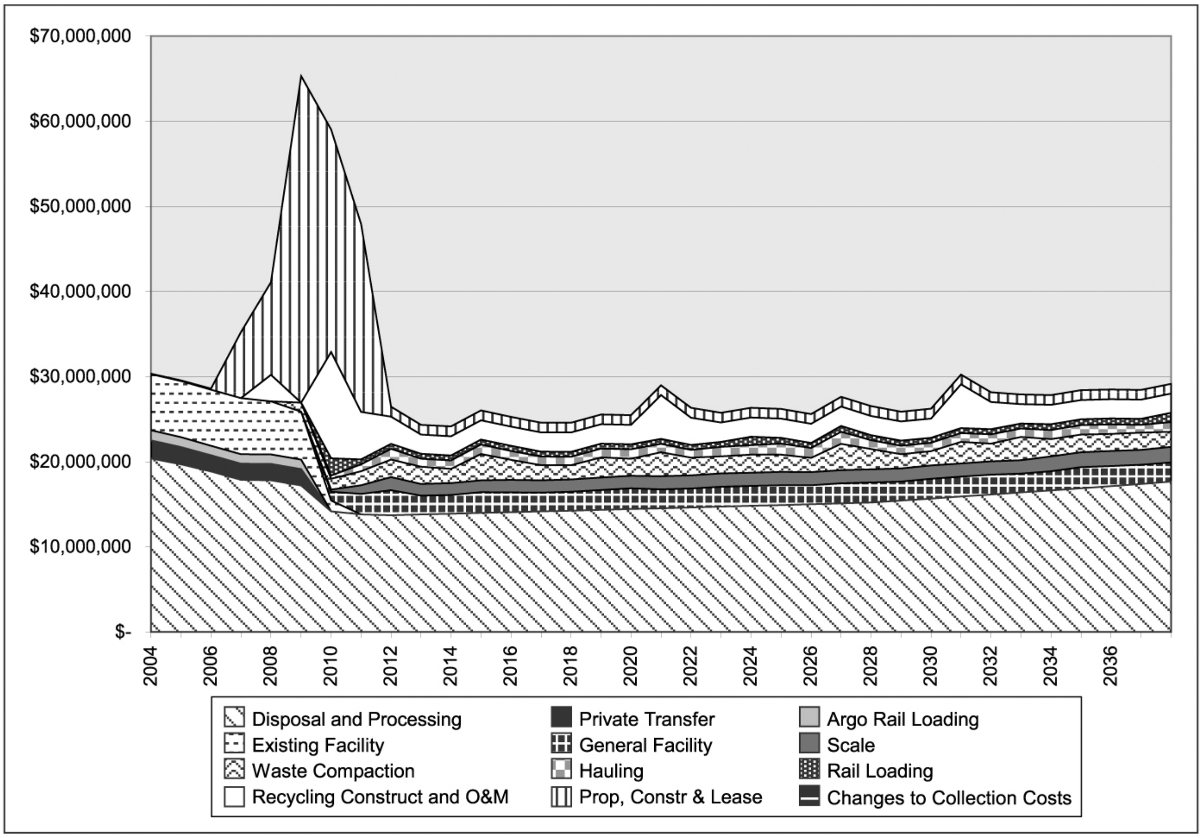

Chart 3-2: Option 11 Annual Cost by Function

Chart 3-2 illustrates construction costs beginning in 2006 and continuing until 2012, which is the completion date for the last facility. You can see the existing facility costs phasing out as the new facilities come on line. The larger blips in 2008 and 2010 are the purchases of all the new equipment to operate the facilities. The increase in capital equipment costs shown in about 2021 and 2031 are replacement costs for the compactor at the Intermodal Transfer and Rail Load facility.

Discussion of Option 0

Chart 3-3 and Chart 3-4 show the total Net Present Value of Option 0 by function. Chart 3-4 shows how the annual costs are incurred over the planning horizon. While the construction costs are substantially less than the construction costs for Option 11, the disposal costs are higher for several reasons. First, the tons needing to be disposed are greater because there is no ability to increase self haul recycling beyond the current program which is a series of drop boxes available for customers to put in some of the major types of recycling. Currently metal and wood make up the bulk of the approximately 6,000 tons recycled at the City's two stations. In addition, Option 0 disposal costs are higher because it is assumed that the City can negotiate a more favorable price if it builds an intermodal facility with access to more than one of the major landfills in the region. Thus the cost per ton for disposal in Option 11 is lower than in Option 0.

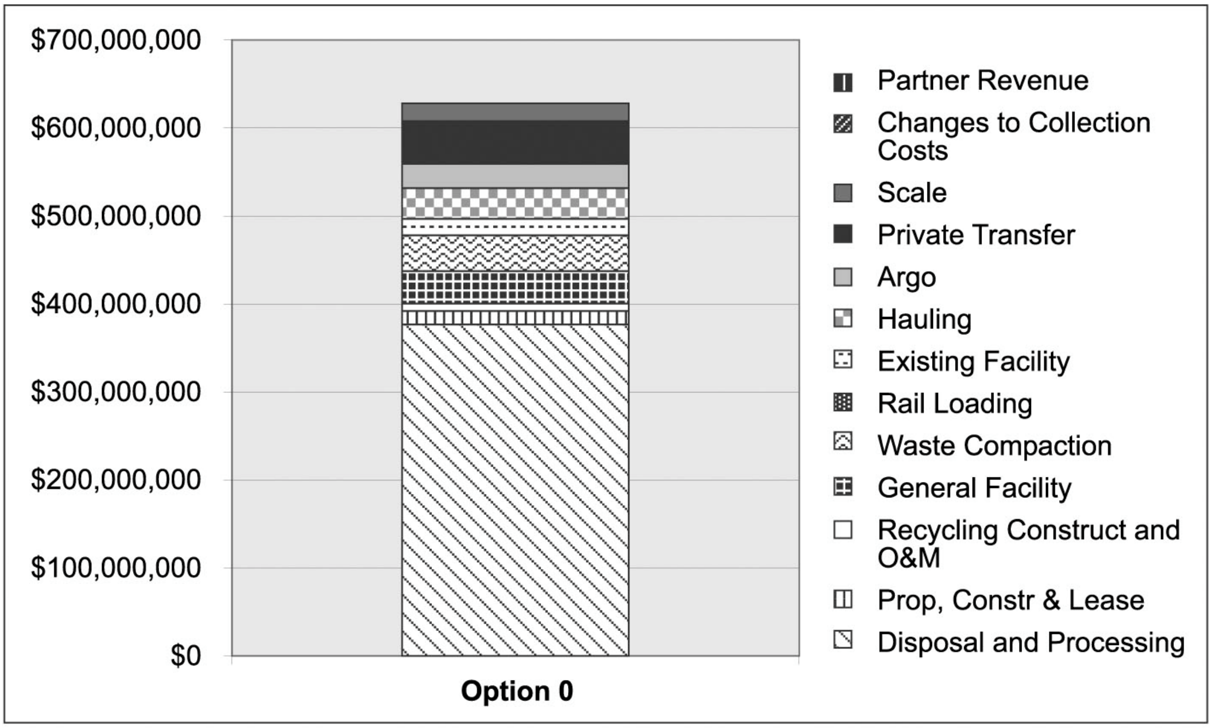

Chart 3-3: Total Net Present Value Option 0

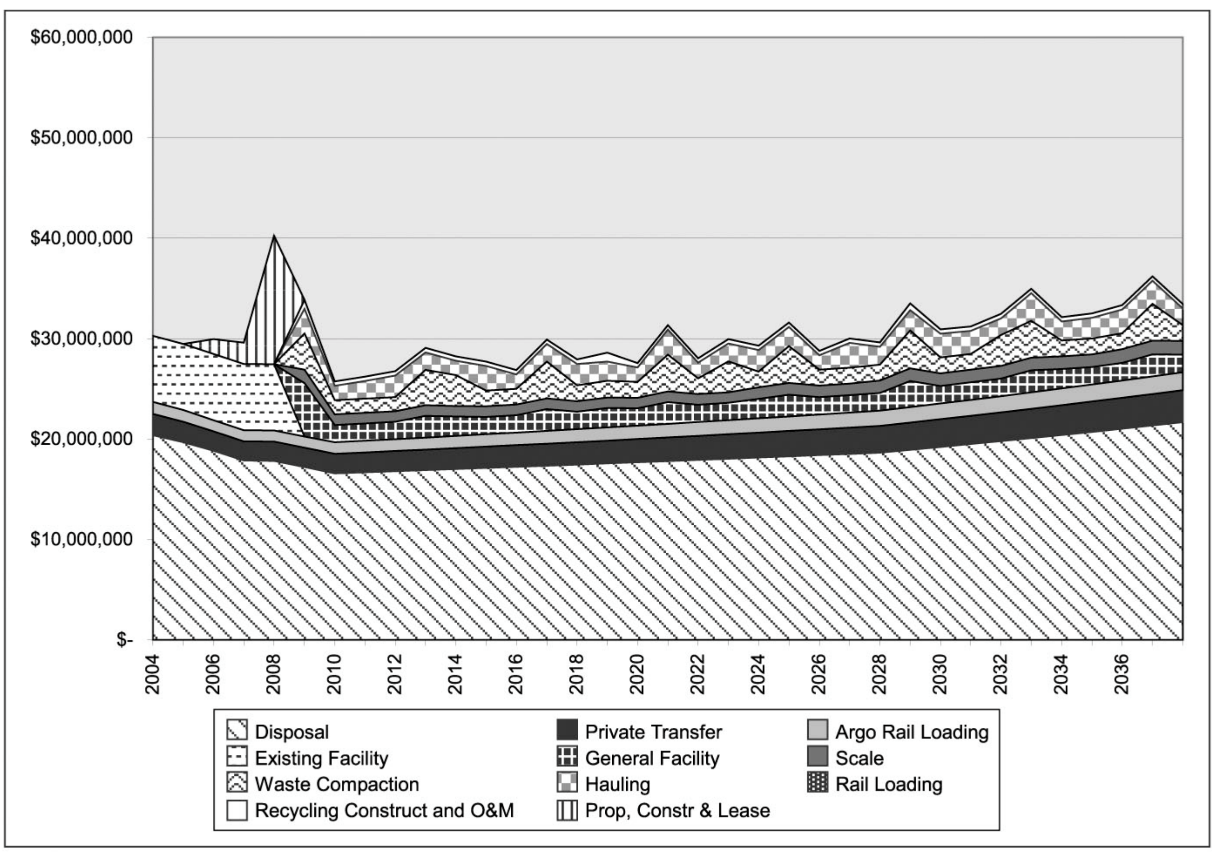

Chart 3-4: Option 0 Annual Cost by Function

Comparison of Option 0 and Option 11

The NPV of Option 0, the status quo scenario is 628 million dollars. The NPV of Option 11 is 656 million dollars. In annualized terms, Option 11 is about 1.4 million dollars more per year than Option 11.

SECTION 4

Capturing the Benefits of the Options

The purpose of this section is to discuss in more detail how the benefits of the various options were treated. In particular, this section will focus on quantification of benefits occurring outside the main cost areas of the solid waste system.

Benefits Included in the Cost Model

As explained in the main body of the report, quality of service factors were determined as part of the overall review and analysis of the options. All of the benefits of the various options that were "internal to the system cost" were included in the cost analysis presented above. For example, Option 11 results in lower hauling costs than Option 0 because in Option 11 the collection trucks deliver waste to a transfer facility that is located on rail. There is no need to haul waste from a transfer facility to the rail yard as is the case in Option 0. This benefit of reduced hauling costs is completely captured in the total system cost of Option 11.

Benefits Calculated Outside of the FPCM

However, there are other benefits to an option that are external to the system costs, but they are real benefits nonetheless. A benefit to Option 11 over Option 0 is that Option 11 is designed such that adequate stalls exist within the facility such that queues do not build up as vehicles wait to enter the station.

Time Lost in Queues

Currently, there exist queues at the City's two public transfer stations on most weekends and also in the afternoons during the week beginning around 3pm. In order to capture the benefits to SPU customers of not having to wait in line, the consultants queuing model was used to predict the length of the lines over time.

The queuing model actually predicts long lines at the stations based on current station usage both annually as well as over the week and over the hours of the day. The value of customer's time, based on 3 different assumptions about how long customers would wait, is calculated. A value of $12 per hour for residential customers and $20 per hour for commercial business customers was assumed for this analysis. The methodology behind these values is the same as used in many Washington State Department of Transportation traffic studies.

The resulting NPV of the value of time lost while waiting in Option 0 was calculated using an assumption that customers would wait, 45, 60 and 120 minutes before turning away from the stations. The Chart 4-1 shows how adding in this cost to Option 0 affects the NPV of the option in comparison with the other options. The chart also shows that Option 8 results in queues at the stations. Somewhere not too far beyond 60 minutes, the value of the time is large enough to cause Option 11 to have a lower overall NPV than Option 0.

The results could be thought of as conservative from the perspective that vehicles who are not able to get into our stations will either turn away and try to come back at another time or drive a further distance to a county-owned facility. Either of these actions will result in further lost time for customers that is not calculated or presented in Chart 4-1.

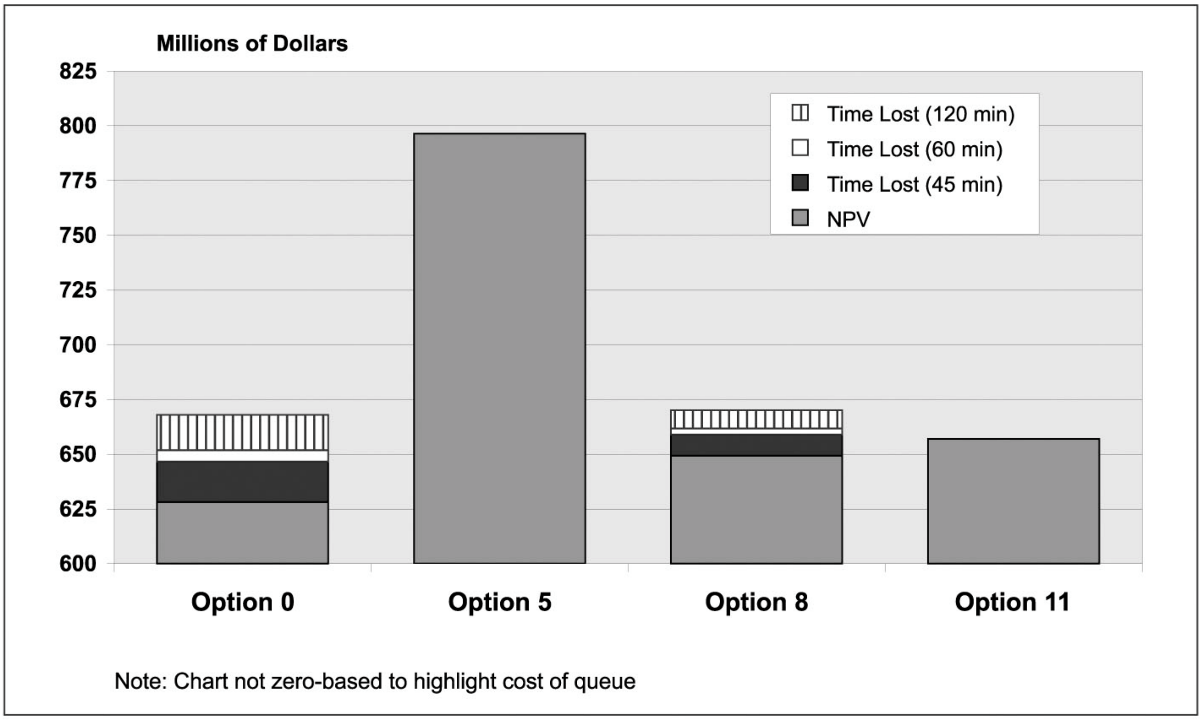

Chart 4-1: Net Present Value of Options Including Value of Time Spent in Queues

Green House Gases and Particulate Matter

Green housed gases and particulate matter were also calculated for the options. The vehicles waiting in line result in emissions of CO2 as well as particulate matter, two items of importance to the air quality in the Seattle area. Table 4-1 displays the amounts of C02 and particulate matter emitted from the vehicles waiting in line. For this analysis, performed for SPU by the Puget Sound Clean Air Agency, it was assumed that 80 percent of the vehicles visiting the station were of the same mix as the general vehicle mix on the roads in Seattle. The other 20 percent are assumed to be heavy trucks. This is meant to represent the collection vehicles that are also among the vehicles waiting in the lines at the transfer stations.

TABLE 4-1
CO2 and Particulate Matter

From Vehicles in Transfer Facility Queue in Option 0		
Year	**Tons of CO2**	**Pounds of Particulate Matter**
2015	313	13.6
2025	406	17.2

SECTION 5

Conclusion

The Facility Plan Cost Model was built in order to calculate the total system cost of a large number of options that were modeled during the development of the Solid Waste Facilities Master Plan. The model determines the equipment and labor requirements for a transfer and rail loading facility, given assumptions about tonnage flows to the facility. It calculates the equipment O&M, adds in existing facility costs, recycling costs, and calculates all the costs associated with functions that are assumed to be contracted out under different scenarios. The result of the model is a net present value of the costs of each system. The planning horizon is 2006 to 2038.

The NPV is the primary number that is used to summarize the costs of the option. The model also calculates an annualized number that is useful to help put these new costs in perspective with the existing costs for these functions.

The model allows quick turnaround of sensitivity analysis, allows “what-ifs” to be run to test the importance of assumptions and inputs. It is anticipated that the FPCM will be of great value over the next decade as the individual projects are analyzed in Environmental Impact Statements, go through detailed design and internal review through the Asset Management Committee of SPU.

This report explained how the model works, displayed the primary inputs to the model including assumptions about tonnage growth, recycling rates and equipment and labor costs. This report also showed the results of the FPCM for Options 0 and Option 11 as well as summary output for Options 5 and 8.

Finally, this report presents an economic quantification of queuing time and vehicle exhaust emissions as it relates to the status quo option compared to the preferred option. The value of time lost waiting in queues and quantities of pollutants released into the atmosphere were calculated and found to be higher than the net present value difference between the status quo option and the preferred option, making the preferred option less costly than the status quo when these considerations are captured in the analysis.