Resource Allocation in Willamalane Parks

By
Morgan Brammer
Nicholas Johnson

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Under the Supervision of
Prof. Bruce Blonigen

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Abstract: The purpose of the study is to determine how much time is spent maintaining and improving parks in the Willamalane park district controlling for explicit park attributes. In using this information, the study attempts to specify how much each park feature costs and, consequently, finds the cost of a park in its entirety. Results will inform Willamalane Parks as to how their resources are being utilized and will help them in minimizing maintenance costs by choosing the most cost effective amenities to include in future parks. Lastly, this project takes on the task of finding ways in which data collection techniques can be improved and makes suggestions to Willamalane.

Approved:_____

Professor Bruce Blonigen Date

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Introduction

"Our mission is to provide exceptional park and recreation services that enhance the livability of our community and the lives of the people we serve", announces the Willamalane statement of purpose. As part of fulfilling this declaration many parks have been constructed and are maintained throughout the community. Although park use may be a free service for community members, the formation and upkeep of these parks is quite costly. Not only do the parks require capital and material input, but they also demand a large contribution of time and labor from park service employees. While overall park district costs are recorded yearly, little is known about how costs are distributed among activities and individual parks.

Various researchers have begun to consider the issue of insufficient data on park maintenance activites. There are many studies which focus on the best techniques for measuring activity labor time, such as the *work sampling* technique proposed by Goode (1986). Other studies, such as the paper by Baldwin (1989) about the *work expectancy* theory, as well as, the paper by Siderelis and Roise (1991), resort to questioning managers and administration personnel about how they perceive resources to be allocated. However, these studies do not measure and utilize actual labor hours and accounting information from an extended time period to identify the cost of actual park attributes and, in this way, better understand resource allocation.

The central objective of this study is to help Willamalane gain a better understanding of how resources are being used throughout the parks. Identifying the sources of expenditures is the first step towards becoming more efficient with resource allocation. For this reason, information on how resources are allocated presently, as opposed to an estimate of how they are allocated, is used in this study to estimate the marginal costs of all major park attributes. Time sheet data for the calendar year 2007, which records specific activites, site locations and time spent for each employee, as well as accounting files for 2007, were utilized to find these costs. Costs include wages, supply costs, and monthly utility bills. This will allow Willamalane to distinguish the cost of a particular park facility or attribute and, also, predict the cost of a potential addition in the future.

The project results provide interesting feedback on the current allocation of resources at Willamalane. It was found that while Horticulture requires the largest amount of labor hours, demanding about 44% of all employee labor hours, Vehicles and Equipment has the largest supply costs associated with the activities completed. These costs greatly exceed the supply costs from other categories, at $140,486 for 2007. The resulting marginal costs of park attributes were found with the regression coefficients and calculated hourly cost. Due to high Vehicle and Equipment costs parks located further from headquarters have significantly higher costs than those nearby, as the cost of distance between park and headquarters adds $145.33 or $50.67 per mile, depending upon the assumptions behind the cost calculations. Surprisingly, increasing the area of a park adds minimal monthly maintenance costs. An additional 1000 square feet only adds $0.03 to monthly park costs. Results also show that a park located in a high average income neighborhood costs Willamalane $231 less per month to maintain than a park located in a low average income neighborhood. The monthly costs for other park attributes were also found and are discussed in detail.

Using the results, a comparison between Willamalane and Bend, another noteworthy park district, is performed with the intention of providing helpful insight into the managerial and organizational techniques that allow the Bend park district to achieve such high standards. These methods could be implemented at Willamalane with the expectation of improving their own performance.

In the end, the study provides Willamalane with recommendations on how to improve their data collection system and track resource use more accurately, and also offers tools they could implement to increase efficiency.

Literature Review

There exists a large body of park and recreation oriented studies that cover a variety of issues. Many of the studies consider the benefits of implementing managerial or organizational systems to increase efficiency within a park district. One such study done by Cohen and Eimiche (1994) considered the cost savings of using Total Quality Management (TQM) in the New York City Department of Parks and Recreation. TQM is a method of developing and continually improving management

organization techniques that allow consumer expectations to be met and quality to be enhanced. The goal of improvement is efficiency; to produce more goods and services with the same or fewer resources. The NY Parks Department used TQM to respond to budget cuts without reducing the level of service provided. They tried two specific TQM projects in vehicle maintenance and employee time keeping. This involved asking the day-to-day workers, not management, to make note of problems that cause inefficiencies and then devise ways of improving methods to avoid these difficulties. The conclusion of the study in New York is that costs of quality improvements were lower than the benefits. Studies such as this one may be of use in later stages of the project as guidelines to offer Willamalane more specific recommendations for improvement.

A study by Siderelis and Roise (1991) focuses on resource tracking and directing for a park service. The study gives instructions on how to build an algorithm to optimally apportion park resources based upon resource costs, resource availability, maintenance standards, time per activity, and priority based goal weights of park jobs. Siderelis and Roise collected observations of park maintenance and operations from managers and supervisors, focusing on the planning methods they used to organize and budget for maintenance. Details of the specific information that was collected were not given. Interestingly, the study found the sampled park districts maintained no usable records of job costs or frequency. Willamalane similarly has no usable calculations of job costs or frequency. With such information, Willamalane could construct a meaningful resource allocation algorithm. The activity costs calculated in our study could be utilized in future studies to develop a comparable algorithm to further benefit Willamalane.

Another study, completed by Baldwin (1989), suggests that park managers estimate expected labor times for maintenance activities. The study uses the term *work expectancy* to refer to the time it takes to complete a unit of maintenance. The focus of the study is mainly the benefits obtained from implementing the work expectancy process and how one should go about developing work expectancy activities and standards. This begins with reducing all operations to a small number of general categories. Baldwin (1989) organized work using a pyramid model with the most

general work category on top and progressively more precise tasks and activities below. This structure is parallel to the structure employed in Willamalane's worksheets. Baldwin also suggests the first step in applying *work expectancy* is to divide activities and create charts. Charts of divided work activities have already been created by Willamalane and will be utilized in the organization and analysis of Willamalane's data.

Goode (1986) puts forward the idea of dividing all activities into three broad categories: main tasks, auxiliary tasks, and interruptions and delays. Willamalane's work categories are organized differently, but this structure should be kept in mind, as it may prove to be more effective than Willamalane's current system. Goode's primary focus is the use of the work measurement technique, identified as *work sampling,* in park districts. *Work sampling* estimates frequency and duration of work activities by random sample. In her paper she gives the advantages and disadvantages of *work sampling* and describes ten steps to follow to complete a work sample study. She states that this method is effective at estimating work time for activities that occur more than thirty times per year, assuming that an adequate number of observations are taken. Willamalane continually records work data on time sheets that will allow *workload/cost tracking,* another work measurement technique. Both estimate hours of work spent on specific activities completed at specific locations. However, *work sampling* may be a useful tool to provide information in areas where time sheet data provided by Willamalane is incomplete or non-existent.

Data Description

The majority of our data comes from Willamalane in the form of time sheets filled out by employees on a daily basis. These time sheets tell us by date and employee the location and time spent working on particular activities. The locations, or sites, and activities were all given codes by Willamalane. Each park and administrative headquarter was also assigned a site code. Activities are organized into categories and broken down into precisely defined tasks, such as 'Turf – Fertilizer Application.' Employee wage information was collected for all personnel employed during the year in 2007. Data for inventory costs, utility costs, vehicle costs and fixed costs was

collected from the 2007 accounting files. Park attribute data, such as area or number of structures, was collected by hand, retrieved from a GIS program, or provided by each park's specialist. Google Maps was utilized as a source to find distances from park headquarters to each park and the federal Census website was drawn on to find income levels for the neighborhoods surrounding the parks.

Unfortunately, the Willamalane data is incomplete. Some employees have limited to no data on their work activities, particularly temporary employees, which make up a large portion of the summer workforce. Furthermore, few, if any, data sets contain more than one and a half years of employee activity information. There is also reason to believe the data was not always accurately documented. Incorrect documentation on the part of the employees could lead to imprecise conclusions for the project.

All costs incurred in the park district in 2007 were examined and grouped into categories to match the existing activity categories. Summing the costs within each category gave total supply costs for each group, demonstrating which activity groups are consuming more monetary resources for supplies. Figure A shows that the Vehicles and Equipment category greatly surpasses other categories with a sum of $140,486, more than all of the other categories' total costs combined. The second highest supply cost, at $22,468, belonged to the Horticulture group. The smallest expenditure sum was for Irrigation with only $11,991. Employee labor hours were also grouped into activity categories by activity codes as seen in Figure B. This reveals which activites are demanding more time from employees throughout the year. The Horticulture activity group had the largest amount of labor hours at 9145 hours with Structures and Systems containing the second largest at 4879 hours total. Irrigation also contained the smallest amount of labor hours with 1001 hours.

Figure A: Total Supply Costs for 2007

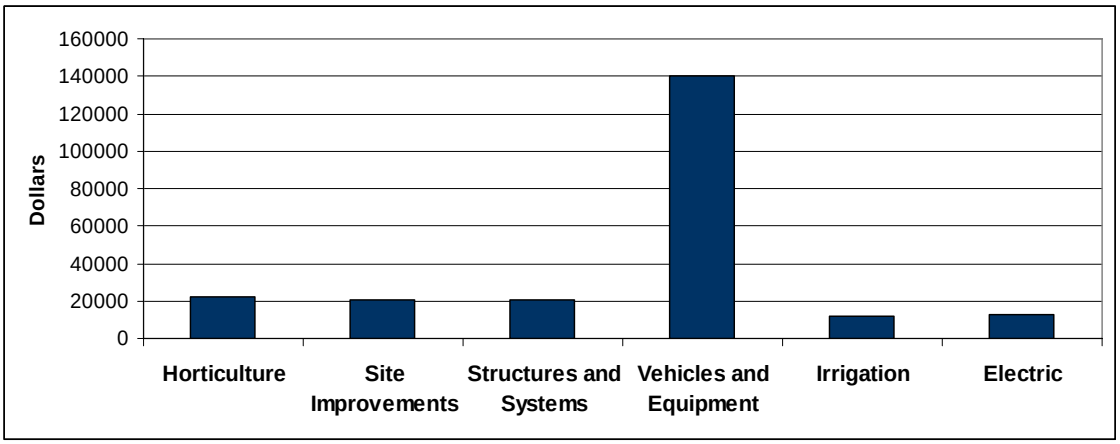
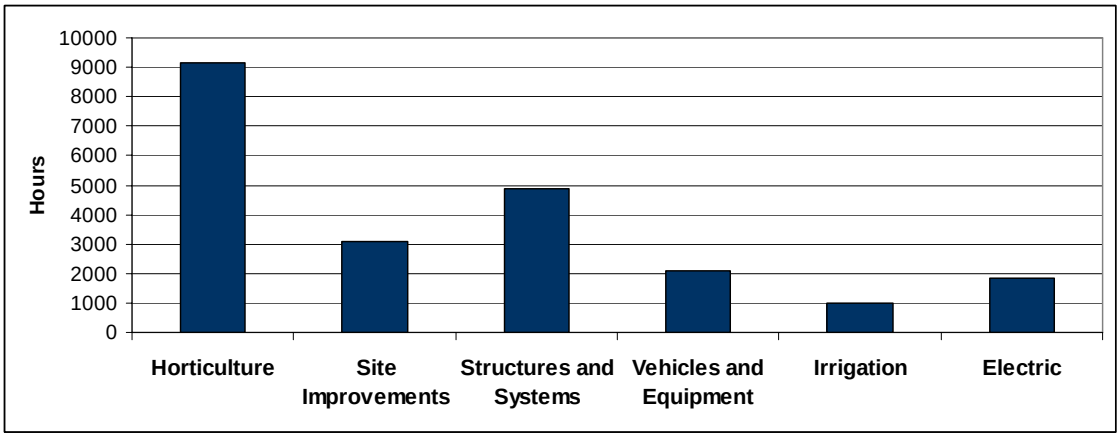


Figure B: Total Activity Time for 2007



In addition to Willamalane data, activity, time, and cost data from the park districts of Bend, Tualatin Hills, and Olympia were considered. This data was meant to be used as a benchmarking comparison for Willamalane, however, much of the data proved to be unusable. The cost data from Olympia was very detailed, however, in a form that was difficult to compare to data from Willamalane. Therefore, the Olympia park data was not utilized further. Tualatin Hills provided a sample of data they created on amenity costs and labor hours. Their format was similar to the desired end results of this project with hourly cost for specified activities; yet, Tualatin Hills used projected labor hours and supply cost rather than using actual figures which would have been very helpful for comparison to this study. The Bend park district has an exceptional system for documenting labor hours per park and per attribute. Their system segments labor hours by attributes within a park and then documents the activity completed rather

than only the park and activity as done at Willamalane. The more specific location codes allow Bend to have fewer activity codes. The park information from Bend also had estimated attribute costs that could be compared to the costs found for Willamalane park attributes. However, this information is not as informative as hoped because the attributes differ between the two park service districts and the assumptions behind Bend's attribute costs are unknown.

Methodology

First Stage: Estimation of the Marginal Effect of Park Attributes on Labor Time

The first stage of the project was to build a model to estimate labor hours that are a result of various park attributes and factors, for example, the number of hours of horticulture labor that are associated with park area and other park attributes. The model consists of a set of equations, each equation specifying labor hours of a particular group of activities as a function of park attributes and monthly dummy variables to capture seasonal effects. Labor hours of each major group of park activities (e.g., Horticulture or Site Improvements) are the dependent variables of separate equations. We call this model the *activity-time model*. This is an example of an activity-time model with only two groups of activities, X and Y.

$$\text{Hours\_Activity\_X}_{it} = f(\text{Park Attributes}_i, \text{Monthly Dummies}_t)$$
$$\text{Hours\_Activity\_Y}_{it} = f(\text{Park Attributes}_i, \text{Monthly Dummies}_t)$$

where i indexes park, and t indexes month

The specific labor activities were divided into six general groups of activities shown below; Horticulture, Site Improvements, Structures and Systems, Vehicles and Equipment, Irrigation and, finally, Electric. These were chosen based on the preexisting general categories used currently at Willamalane with the exception of Irrigation and Electric. Irrigation and Electric were chosen as separate activity categories based on the large number of labor hours and costs required for these

specialized activites. The labor hours were found using employee time sheet data and accounting records for 2007.[1]

Activity Categories	
Horticulture	Vehicles and Equipment
Site Improvements	Irrigation
Structures and Systems	Electric

The park attributes included in the analysis are park area, total area of impervious surfaces, number of sports fields, number of sprinkler heads, number of park lights, number of benches and tables, number of trashcans, number of park structures, number of play structures, park type, average income in nearby neighborhood, and potable water fixtures which are comprised of sinks, toilets and urinals at a park. The functions also include dummy variables for the twelve months. Additionally, one interaction variable was included in the regressions. This was the interaction of area with park type.[2] These park attributes are listed below. The coefficients of the attributes represent the change in the number of hours of a given activity group worked for one unit change in the attribute.[3] We used OLS regressions to estimate the coefficients.

Park Attributes	
Area	Play structures
Benches	Potable water fixtures
Distance from HQ	Sports fields
Impervious surface area	Sprinkler heads
Natural park	Structures
Neighborhood income	Trashcans
Park lights	Interaction: (Area times Natural park)

[1] See Appendix A for complete details of how the labor hours were estimated.
[2] Refer to Appendix B for an explanation of why the park attributes included were chosen and used in the regression.
[3] Expected coefficient signs are included in table form in Appendix C.

Second Stage: Translation of Statistical Labor Time Estimates into Cost Estimates

The above analysis provides the labor hours caused by one unit of a park attribute within each activity group. From this, the total maintenance cost per unit of each park attribute can be found, however, it is first necessary to translate the labor hours into dollar amounts. To do this cost per hour for each activity category needed to be found. Per hour costs are comprised of both hourly wage cost per category, as well as, hourly supply costs. The second stage was used to estimate these costs. To achieve this, wage costs were assigned to activities based upon the average wage rates of employees who carried out the activity. For every employee, labor hours were separated by activity into activity categories and then multiplied by the wage of that employee. The products of labor hours and wages within the category were grouped for all employees and then summed. This gave the total wage cost for a category. This was then divided by the total hours worked within the category to give the average wage cost for that specific activity grouping. This was done for all six activity groups.

Many activities have costs in addition to wage costs, such as supply costs associated with maintenance activities. For example, structure and systems maintenance costs are not only the wages paid to employees performing the repairs, but also the cost of parts and supplies used. To approximate these expenses on an hourly basis, total expenditures of a particular category of item, taken from the 2007 accounting data, were divided by total recorded labor hours of the activity that uses that category of item. The accounting codes were grouped into categories to match the activity code groupings. Those costs that did not pertain to a category were excluded, including contractual fees and fixed costs. Dividing the total accounting cost of supplies by the total estimated hours worked gives the cost per hour of each group of activites, and when added to wages, would give the total cost of maintenance per hour.

Calculation Concerns

There are a number of issues that should be addressed in regard to the use of these calculations. The chief concern is that the assumptions made previously about the time sheet data may cause problems in estimating wage costs for activites. Because many low wage workers were missing data, their superior's data was used as a proxy.

As a result, time worked doing low skill activities could be underestimated, while time worked doing high skill activities is likely to be overestimated. This simultaneously causes the wage estimates for low skill activities to be overestimated and the wage estimates for high skill activities to be underestimated. Whether the combined effect of these biases would cause downward or upward biases in the cost estimates of park attributes is hard to say. Furthermore, it should be noted that there is no recorded data for any of the recreation employees, nor is there adequate data for security employees. This will cause the time estimates for the specialized activities they complete to be underestimated, which will lead to incorrectly low cost estimates for some attributes that pertain to these activities such as ball fields and potable water fixtures. Administration wages were not factored in to the marginal cost calculations as they are considered to be fixed costs. It is assumed that marginal variations in park attribute levels will not affect these fixed costs.

Final Stage: Estimation of Marginal Park Attribute Maintenance Costs

The second stage provided the hourly cost per activity group. Once the cost per hour for all of the activity groups had been estimated, park attribute maintenance costs could be estimated. To do this the coefficient for a given attribute from the activity-time model was multiplied by the approximated cost per hour associated with that activity group. This was done for every equation for which the desired coefficient was statistically significant. All of these products were then summed. This gave the marginal cost of maintaining a park attribute.

Some park attributes have variable costs that are uncorrelated with labor hours, particularly utility costs. Costs such as these needed to be reduced to the marginal cost per unit of attribute responsible for the charge and then added to the marginal cost of maintenance for the park attribute. Electric, water and sewer cost were found using regressions with panel data. In these regressions the dependent variable was the utility bill for a given park on a given month and the independent variables were the park attributes that are the primary cause of the bill. As trash collection fees are billed to only one location, where the main dumpster is located, marginal trash costs had to be

calculated in another way. The trash bill was divided by the total number of trashcans present in all Willamalane parks to give the cost per trashcan.

Unfortunately, impervious surface tax could not be calculated due to lack of information. Impervious surface taxes are a considerable cost for each park, but are not included in park estimates. It is roughly estimated that the tax is either six or fifteen dollars per month per thousand square feet of impervious surface based on a limited number of utility bills that are believed to be impervious surface taxes. The ambiguity of the exact value of the charge is due to unspecific accounting records, and more significantly, the vague explanation of how fees are calculated by the waste water management facilities responsible for the bills.

By adding the marginal utility costs of a park attribute to the already calculated total hourly cost will give the *total marginal cost* of the park attribute.

Vehicle costs were particularly difficult to distribute because the vehicle data provided was not sufficient for regression analysis. Optimally, vehicle data would have included employee drive time or mileage; however, drive time is not recorded by employees on their timesheets. Due to the data constraints, Google Maps was used to determine the driving distance from the park headquarters to each park. All of the distances were summed. The individual park distances were divided by the sum to give a ratio. The vehicle costs were divided among the parks in proportion to the park distance ratio. The apportionment was done twice; once with vehicle costs including maintenance supplies, fuel and oil, and new purchases found in the 2007 accounting records and also wage costs associated with vehicle maintenance. The second time, only gasoline and oil costs were used. The first apportionment method assumes that all vehicle related costs vary perfectly with changes in the aggregate distance from the headquarters to all parks. The second apportionment method assumes that vehicle costs are fixed except for fuel and oil costs, which vary with changes in the aggregate distance from the headquarters to all parks. The results yielded by the first apportionment method would be more accurate if Willamalane were to add a large number of new parks. This is because adding a large number of parks would greatly increase vehicle use, causing increased vehicle maintenance, and would possibly result in new vehicle purchases. The results yielded by the second apportionment method

would be more accurate in representing the costs caused by small changes in park numbers. The addition of one or two parks would most probably not result in a significant increase in vehicle maintenance or new vehicle purchases, but definitely would increase fuel costs.

The total cost for an attribute (excluding construction costs) can be calculated using the above marginal cost estimations. Total park costs can be estimated by summing costs for all attributes included in the park and adding overall park costs such as vehicle costs. But, as the scale of cost estimation increases with added amenities or added parks so does the inaccuracy of the estimation. This is primarily because the assumptions are built for a marginal cost model with the current size of Willamalane held constant.

Results

Table C shows the original regression results for the five activity categories that use regression analysis and gives a complete list of the resulting coefficient for each park attribute under each activity group. Generally, the regressors that were statistically significant to the 10% level had the hypothesized sign, although, there were some exceptions. For example, Potable Water Fixtures was expected to have a positive coefficient for the Structures and Systems category, but the regression showed a negative coefficient for this attribute. Overall, explanation of the dependent variable by the independent variables was quite good with a high R^2 of 0.66 for Horticulture and a low R^2 of 0.24 for Electric.

Vehicles and Equipment was not analyzed using regressions, and as such is not included in the regressions results tables.

Table C
Employee Time Regression Results

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Area	0.0012*	0.0005*	0	-0.0001	-0.0001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Benches	2.8903***	0.1841	-0.2316	0.0716	0.1075
	(0.52)	(0.23)	(0.19)	(0.07)	(0.11)
Impervious Surface Area	0.0658*	0.0361**	0.0812***	-0.0079	0.0189**
	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)
Income - High	-8.2179***	-0.6898	-2.9108***	-1.2818***	0.0624
	(3.05)	(1.31)	(1.11)	(0.40)	(0.61)
Income - Medium High	-9.2420***	-0.0306	-0.388	-0.8938***	0.5055
	(2.40)	(1.03)	(0.89)	(0.32)	(0.49)
Income -Medium	-4.6244**	0.0936	-0.9392	-0.7739***	0.2849
	(1.96)	(0.85)	(0.72)	(0.26)	(0.40)
Income - Medium Low	-6.155	0.516	0.4254	-0.8273*	0.4889
	(3.85)	(1.64)	(1.39)	(0.49)	(0.76)
Natural Park	6.7611	-0.0434	3.6770**	-0.2037	2.5983**
	(5.00)	(2.16)	(1.87)	(0.66)	(1.03)
Park Lights	-0.166	0.0283	-0.0286	0.0567***	-0.0734***
	(0.10)	(0.04)	(0.04)	(0.01)	(0.02)
Play Structures	-2.0848	0.6575	0.2657	-0.4458**	1.1396***
	(1.66)	(0.71)	(0.61)	(0.22)	(0.34)
Potable Water Fixtures	-1.6511***	0.1293	-0.0239	-0.0833	0.042
	(0.50)	(0.22)	(0.18)	(0.07)	(0.10)
Sports Fields	10.0835***	0.7779	0.1765	0.0038	0.8481**
	(2.05)	(0.87)	(0.74)	(0.26)	(0.41)
Sprinkler Heads	0.0323***	-0.0042	0.0173***	0.0019	0.0070***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Structures	2.0502*	-0.1215	0.288	0.1876	0.078
	(1.06)	(0.46)	(0.39)	(0.14)	(0.21)
Trashcans	0.4613	0.4464*	0.0599	0.0897	-0.3004**
	(0.53)	(0.23)	(0.21)	(0.07)	(0.12)
Interaction (NaturalxArea)	-0.0071*	-0.001	-0.0036**	0.0001	-0.0020**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	10.1090***	0.0754	0.2244	0.7729***	-0.4816
	(2.12)	(0.91)	(0.78)	(0.28)	(0.43)
Observations	363	353	343	343	339
R-squared	0.66	0.39	0.5	0.24	0.36

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table D displays the utility regression results. The R^2 values range from 0.58 for Water to 0.37 for Sewer. The low R^2 value for Sewer is suspected to be due to the effects of missing data, as well as, difficulties in estimating impervious surface charges.

Table D
Utilities Regression Results

Attribute	Electricity	Sewer	Water
Impervious Surface Area			
Park Lights	10.0985***		
	(0.86)		
Potable Water Fixtures		0.2225	
		(0.54)	
Sports Fields			101.3418***
			(15.96)
Sprinkler Heads			0.0177
			(0.10)
Structures	28.1977***	16.2403**	
	(9.48)	(6.53)	
Constant	-15.2975	-10.4175	140.1118***
	(13.41)	(12.14)	(19.24)
Observations	300	60	239
R-squared	0.42	0.37	0.58

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Once the original regression outcomes had been considered new regressions were run for the six activity categories. These regressions only included attributes that would theoretically be important to the specific activity group and, additionally, those attributes that were significant to the 20% level. However, utility regressions were unchanged. Table E gives the revised results for the activity category regressions. The revised regression R^2 values were some what smaller ranging from 0.66 for Horticulture and 0.22 for Electric, yet, the remaining independent variables proved to be very significant. For this reason the revised regression results were used for final attribute cost calculations. The resulting coefficients were only used for the final cost calculation if they were significant at the ten percent level or better. Exceptions to this rule were income levels and the interaction variable. If any of the income levels were significant the others were included. The interaction variable was included even if insignificant as long as both Area and Natural Park attributes were both significant.

Table E
Revised Employee Time Regression Results

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Area	0.0012*	0.0005***			
	(0.00)	(0.00)			
Benches	2.8903***	-0.1213			
	(0.52)	(0.15)			
Impervious Surface Area	0.0658*	0.0395***	0.0543***		0.0059
	(0.04)	(0.01)	(0.01)		(0.00)
Income - High	-8.2179***		-2.8499***	-1.0746***	
	(3.05)		(1.03)	(0.33)	
Income - Medium High	-9.2420***		-1.3335*	-0.5945**	
	(2.40)		(0.73)	(0.25)	
Income -Medium	-4.6244**		-1.3978**	-0.5541**	
	(1.96)		(0.69)	(0.24)	
Income - Medium Low	-6.155		-0.1129	-0.3094	
	(3.85)		(1.17)	(0.44)	
Natural Park	6.7611		-0.0939		0.1751
	(5.00)		(0.74)		(0.37)
Park Lights	-0.166			0.0413***	-0.0471**
	(0.10)			(0.01)	(0.02)
Play Structures	-2.0848	1.5928***		-0.1719	0.8387***
	(1.66)	(0.47)		(0.17)	(0.23)
Potable Water Fixtures	-1.6511***		-0.054		
	(0.50)		(0.09)		
Sports Fields	10.0835***				0.356
	(2.05)				(0.22)
Sprinkler Heads	0.0323***		0.0188***	0.0023***	0.0067***
	(0.01)		(0.00)	(0.00)	(0.00)
Structures	2.0502*		0.4542***	0.0396	
	(1.06)		(0.17)	(0.05)	
Trashcans	0.4613	0.6548***			
	(0.53)	(0.13)			
Interaction (NaturalxArea)	-0.0071*				
	(0.00)				
Constant	10.1090***	-0.6087	0.8843	0.5685**	-0.1429
	(2.12)	(0.40)	(0.59)	(0.24)	(0.21)
Observations	363	353	343	343	339
R-squared	0.66	0.37	0.48	0.22	0.32

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Resulting Attribute Marginal Costs for Each Activity Category and Utility

The following tables together give a full listing of each attribute and its marginal cost per activity group, as well, as total marginal cost for each attribute over all activity groups. Total marginal costs for each attribute are the sum of all the activity category and utility cost columns. These total marginal costs will be the most functional figures when putting the results to use. Also when using these figures, it is necessary to begin with the constant and adjust the cost figure by adding or subtracting the marginal costs for each attribute when applicable.

Constant

The constant for this analysis represents a park with no extra park attributes and takes into account the effect of the income dummy variable for a park located in a low average income neighborhood. After all manipulation of the data was complete it was found that a park located in a low average income neighborhood with all other attributes held constant at zero will cost $345.05 per month.

Table F
Constant Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Constant	$169.02	$0.00	$19.45	$16.47	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Constant	$0.00	$0.00	$140.11	$0.00	$0.00	$345.05

Marginal costs measured in dollars per month

Area, Natural Park, and Interaction Variable

Enlarging the area of a park by an additional 1000 square feet will increase monthly park costs by only $.03. The type of park can also affect its monthly cost. A natural park will cost $113.05 per month more than other park types, all else equal. The interaction variable showed that natural parks require less maintenance per 1000 square feet than do other types of parks, so the cost per 1000 square feet of a natural park is negative $.09 per month. This improbable outcome is most likely the manifestation of excluded variable bias. Area is correlated with almost all park

attributes, so any other interaction between a park attribute and whether a park is natural or not would likely be taken in by the included interaction variable.

Table G
Area, Natural Park and Interaction Variable Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Area	$0.02	$0.01	$0.00	$0.00	$0.00
Natural Park	$113.05	$0.00	$0.00	$0.00	$0.00
Interaction (NaturalxArea)	-$0.12	$0.00	$0.00	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Area	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03
Natural Park	$0.00	$0.00	$0.00	$0.00	$0.00	$113.05
Interaction (NaturalxArea)	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.12

Area measured in thousands of square feet
Marginal costs measured in dollars per month

Benches, Park Lights and Trashcans

Including a bench in a park will simply increase maintenance costs for a park by $48.33 per month. Each park light will cost $9.84 per month to maintain. A trashcan will generate fees of $90.51 per month.

Table H
Benches, Park Lights and Trashcans Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Benches	$48.33	$0.00	$0.00	$0.00	$0.00
Park Lights	$0.00	$0.00	$0.00	$1.20	-$1.45
Trashcans	$0.00	$15.51	$0.00	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Benches	$0.00	$0.00	$0.00	$0.00	$0.00	$48.33
Park Lights	$10.10	$0.00	$0.00	$0.00	$0.00	$9.84
Trashcans	$0.00	$0.00	$0.00	$75.00	$0.00	$90.51

Marginal costs measured in dollars per month

Distance

For every mile the park is located away from park headquarters it will cost $145.33 per month, if vehicle costs are assumed to be perfectly variable, and $50.67 per month if vehicle costs, except fuel and oil costs, are assumed to be fixed.

Table I
Distance Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Distance from HQ	$0.00	$0.00	$0.00	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Distance from HQ	$0.00	$0.00	$0.00	$0.00	$145.33* $50.67**	145.33* 50.67**

Distance measured in miles
Marginal costs measured in dollars per month
*If vehicle costs include all vehicle related costs
**If vehicle costs only include fuel and oil costs

Impervious Surface Area

The monthly cost to maintain a park will increase by $3.23 for every 1000 square feet of impervious surface area included in a park. The taxes for impervious surface area are not included in this estimate.

Table J
Impervious Surface Area Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Impervious Surface Area	$1.10	$0.94	$1.19	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Impervious Surface Area	$0.00	$0.00	$0.00	$0.00	$0.00	$3.23

Area measured in thousands of square feet
Marginal costs measured in dollars per month

Income

The location of a park has a considerable affect on monthly costs. A park located in a high income neighborhood would have lower monthly costs than a park found in a low income neighborhood. It was found that a park located in a medium-low income neighborhood would cost $114.36 less per month than an identical park located

in a low income neighborhood. In the same way, a park located in a medium income neighborhood would have maintenance costs that are $124.11 less per month when compared to a park in a low income neighborhood, holding all else constant. A park located in a medium-high income neighborhood would cost $201.07 per month less to maintain than an identical park located in a low income neighborhood. And, a park located in a high income neighborhood would have maintenance costs totaling $231.20 per month less than an identical park in a low income neighborhood.

Table K
Income Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Income - High	-$137.40	$0.00	-$62.67	-$31.13	$0.00
Income - Medium High	-$154.53	$0.00	-$29.32	-$17.22	$0.00
Income - Medium	-$77.32	$0.00	-$30.74	-$16.05	$0.00
Income - Medium Low	-$102.91	$0.00	-$2.48	-$8.96	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Income - High	$0.00	$0.00	$0.00	$0.00	$0.00	-$231.20
Income - Medium High	$0.00	$0.00	$0.00	$0.00	$0.00	-$201.07
Income - Medium	$0.00	$0.00	$0.00	$0.00	$0.00	-$124.11
Income - Medium Low	$0.00	$0.00	$0.00	$0.00	$0.00	-$114.36

Distance measured in miles

Play Structures and Structures

Including a play-structure in a park will increase maintenance costs by $63.62 per month. If a structure is placed on the park it will add $88.71 per month to the parks overall maintenance costs.

Table L
Play Structures and Structures Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Play Structures	$0.00	$37.73	$0.00	$0.00	$25.88
Structures	$34.28	$0.00	$9.99	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Play Structures	$0.00	$0.00	$0.00	$0.00	$0.00	$63.62
Structures	$28.20	$16.24	$0.00	$0.00	$0.00	$88.71

Marginal costs measured in dollars per month

Potable Water Fixtures and Sprinkler Heads

It was shown by the regression results that including a potable water fixture would lower monthly park maintenance costs by $27.61; however, this is most likely an underestimation caused by the fact that time sheet data for employees who were responsible for potable water facility maintenance was not complete and, therefore, not part of the regression. Sprinkler heads installed in a park will cost $1.23 each per month.

Table M
Potable Water Fixtures and Sprinkler Heads Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Potable Water Fixtures	-$27.61	$0.00	$0.00	$0.00	$0.00
Sprinkler Heads	$0.54	$0.00	$0.41	$0.07	$0.21

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Potable Water Fixtures	$0.00	$0.00	$0.00	$0.00	$0.00	-$27.61
Sprinkler Heads	$0.00	$0.00	$0.00	$0.00	$0.00	$1.23

Marginal costs measured in dollars per month

Sports Fields

A sports field located in a park will require $269.94 per month to maintain. This figure may be underestimated due to missing labor data for a number of employees that maintained sports fields.

Table N

Sports Fields Marginal Costs for Each Activity Category and Utility

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Sports Fields	$168.60	$0.00	$0.00	$0.00	$0.00

Attribute	Utility - Electricity	Utility - Sewer	Utility - Water	Utility - Trash	Vehicles	Total
Sports Fields	$0.00	$0.00	$101.34	$0.00	$0.00	$269.94

Marginal costs measured in dollars per month

Using the Analysis: New Park and Renovation Cost Estimates

There are many practical uses for the figures found through the above analysis. Estimates for monthly maintenance costs can be calculated for park updates or for an entire new park using the results from the previous section. Below are three such examples, including two new parks and one illustration of hypothetical additions to an existing park.

Jasper Meadows

This year Willamalane opened two new parks, Jasper Meadows and Rob Adams. As an example of how the previously found cost estimates can be used, total cost estimates for one year are estimated for each of these parks. Table O shows that Jasper Meadows' monthly cost, assuming that all vehicle costs except fuel and oil costs are fixed, would reach about $609 per month bringing its yearly cost to nearly $7,312. Under the assumption of largely fixed vehicle costs, a large proportion of Jasper Meadows' costs still are caused by its being 3.8 miles from headquarters. If vehicle costs were assumed to be perfectly variable, then Jasper Meadows' costs would rise to $969 per month and $11,628 per year, with costs related to Jasper Meadows' distance from headquarters making up an even larger portion of the park's total costs. Also notable is the cost savings caused by being located near a high income neighborhood. This saves $231 per month or $2,772 a year, when compared to an identical park in a low income neighborhood.

Table O
Jasper Meadows Estimated Costs

Attribute	Marginal Cost	Park Attributes	Park Attribute Costs
Area	$0.03	101.83	$3.25
Benches	$48.33	0	$0.00
Distance from HQ	$145.33* $50.67**	3.8	$552.25* $192.55**
Impervious Surface Area	$3.23	6.97	$22.51
Income - High	-$231.20	1	-$231.20
Income - Medium High	-$201.07	0	$0.00
Income - Medium	-$124.11	0	$0.00
Income - Medium Low	-$114.36	0	$0.00
Natural Park	$113.05	0	$0.00
Park Lights	$9.84	0	$0.00
Play Structures	$63.62	1	$63.62
Potable Water Fixtures	-$27.61	0	$0.00
Sports Fields	$269.94	0	$0.00
Sprinkler Heads	$1.23	28	$34.35
Structures	$88.71	1	$88.71
Trashcans	$90.51	1	$90.51
Interaction (Natural x Area)	-$0.12	0	$0.00
Constant	$345.05	1	$345.05
Total Cost per month			$969* $609**
Total Cost per year			$11,628* $7,312**

Area measured in thousands of square feet
Distance measured in miles
Marginal costs measured in dollars per month
*If vehicle costs include all vehicle related costs
**If vehicle costs only include fuel and oil cost

Rob Adams

Table P gives the marginal cost and park attributes of Rob Adams Park. Rob Adams is a larger park than Jasper Meadows and has a few extra benches and trashcans. It also contains 158 more sprinkler heads. This brings the monthly cost of Rob Adams, under the assumption of largely fixed vehicle costs, to $1,120 and yearly costs to $13,435. Costs related to Rob Adams' distance from the headquarters are larger than those of Jasper Meadows, as Rob Adams is 0.1 miles further from headquarters. But for Rob Adams these costs make up a smaller portion of the park's total maintenance costs due to Rob Adams having more amenities.

Table P
Rob Adams Estimated Costs

Attribute	Marginal Cost	Park Attributes	Park Attribute Costs
Area	$0.03	401.12	$12.80
Benches	$48.33	3.00	$144.98
Distance from HQ	$145.33* $50.67**	3.9	$566.79* $197.61**
Impervious Surface Area	$3.23	26.92	$86.95
Income - High	-$231.20	1	-$231.20
Income - Medium High	-$201.07	0	$0.00
Income - Medium	-$124.11	0	$0.00
Income - Medium Low	-$114.36	0	$0.00
Natural Park	$113.05	0	$0.00
Park Lights	$9.84	0	$0.00
Play Structures	$63.62	1	$63.62
Potable Water Fixtures	-$27.61	0	$0.00
Sports Fields	$269.94	0	$0.00
Sprinkler Heads	$1.23	186	$228.20
Structures	$88.71	0	$0.00
Trashcans	$90.51	3	$271.54
Interaction (Natural x Area)	-$0.12	0	$0.00
Constant	$345.05	1	$345.05
Total Cost per month			$1489* $1,120**
Total Cost per year			$17,865* $13,435**

Area measured in thousands of square feet
Distance measured in miles
Marginal costs measured in dollars per month
*If vehicle costs include all vehicle related costs
**If vehicle costs only include fuel and oil cost

Bluebelle

Bluebelle is one of Willamalane's simplest parks, making it a good example park for presenting a hypothetical renovation. Bluebelle's present estimated costs are given in Table Q. The hypothetical renovation to Bluebelle is composed of the addition of an irrigation system with 70 sprinkler heads, a play structure, two benches, two park lights, and one more trashcan. A renovation such as this would make Bluebelle resemble parks of similar size in terms of the number and types of amenities.

Table Q
Bluebelle Present Estimated Costs

Attribute	Marginal Cost	Park Attributes	Park Attribute Costs
Area	$0.03	123.923	$3.95
Benches	$48.33	0	$0.00
Distance from HQ	$145.33* $50.67**	2.1	$305.19* $106.41**
Impervious Surface Area	$3.23	8.387	$27.09
Income - High	-$231.20	0	$0.00
Income - Medium High	-$201.07	0	$0.00
Income - Medium	-$124.11	0	$0.00
Income - Medium Low	-$114.36	1	-$114.36
Natural Park	$113.05	0	$0.00
Park Lights	$9.84	0	$0.00
Play Structures	$63.62	0	$0.00
Potable Water Fixtures	-$27.61	0	$0.00
Sports Fields	$269.94	0	$0.00
Sprinkler Heads	$1.23	0	$0.00
Structures	$88.71	0	$0.00
Trashcans	$90.51	1	$90.51
Interaction (Natural x Area)	-$0.12	0	$0.00
Constant	$345.05	1	$345.05
Total Cost per month			$657* $459**
Total Cost per year			$7,889* $5,504**

Area measured in thousands of square feet
Distance measured in miles
Marginal costs measured in dollars per month
*If vehicle costs include all vehicle related costs
**If vehicle costs only include fuel and oil cost

Table P shows Bluebelle's attributes after the renovation, the costs associated with these attributes, and the changes in cost caused by the renovation. In total, the renovation would increase park maintenance costs by $356 per month and $4276 per year.

Table P
Bluebelle Costs After Hypothetical Renovation

Attribute	Potential Attributes	Potential Costs	Changes in Cost
Area	123.923	$3.95	$0
Benches	2	$96.65	+ $96.65
Distance from HQ	2.1	$305.19* $106.41**	$0
Impervious Surface Area	8.387	$27.09	$0
Income - High	0	$0.00	$0
Income - Medium High	0	$0.00	$0
Income - Medium	0	$0.00	$0
Income - Medium Low	1	-$114.36	$0
Natural Park	0	$0.00	$0
Park Lights	2	$19.68	+ $19.68
Play Structures	1	$63.62	+ $63.62
Potable Water Fixtures	0	$0.00	$0
Sports Fields	0	$0.00	$0
Sprinkler Heads	70	$85.88	+ $85.88
Structures	0	$0.00	$0
Trashcans	2	$181.02	+ $90.51
Interaction (Natural x Area)	0	$0.00	$0
Constant	1	$345.05	$0
Total Cost per month		$1,014* $815**	+ $356
Total Cost per year		$12,165* $9,780**	+ $4276

Area measured in thousands of square feet
Distance measured in miles
Marginal costs measured in dollars per month expect in the 'Total Cost per year' row
*If vehicle costs include all vehicle related costs
**If vehicle costs only include fuel and oil cost

Conclusion

By using the information found in this study Willamalane could potentially lower cost by using resources more efficiently and, in doing so, could better serve the community and fulfill their mission statement. For example, Willamalane can consider the full cost of including a specific amenity before including it in a park. What's more, this study provides a basis for future analyses of parks and park services, so Willamalane can continue to improve and grow.

Improving data collection would provide Willamalane with many more opportunities for future projects. If care were taken to fill in time sheets more precisely this project could be executed again and provide more accurate results. This would

give Willamalane more accurate attribute costs, allowing them to plan with greater efficiency. A more in-depth look at vehicle costs could be very beneficial to Willamalane as vehicle costs are a large part of their overall supply expenses. This would require better documentation and data recording from Willamalane over an extended period, but having the information could prove to be very beneficial in the long run. In addition to studying vehicle costs, examining the feasibility and cost savings of alternative modes of transportation or the optimal arrangement of park regions may provide further information on resource conservation.

Suggestions for Willamalane

The last stage of the project is to compare Willamalane to other park districts in the areas of data collection and resource allocation. The only park district that is usable for comparison is the Bend park district. The Bend park district has an excellent data collection and data organizing structure which they use to record park maintenance. There system uses abbreviated park names in place of numerical codes to identify parks and then uses park attributes, to which the maintenance is being completed, as sub-site codes. When labor time is recorded in this manner the need for regressions and extensive analysis of labor hours is not necessary to find the cost of an attribute; the process is made much less complicated. The Bend park district simplifies this data collecting and organizing by using a computer system specifically created by Vermont Systems called "MainTrac" for park maintenance recording. Although their methods are efficient and orderly, the resulting numbers for cost and labor time were not useful for comparison with those found for Willamalane. Nevertheless, there are many good ideas that can be taken from the Bend park district's data gathering structure.

Continued improvement on Willamalane's data collection system would allow them to construct better resource allocation models, as well as, increase the feasibility of future projects. To begin, employees need to understand the importance of this data for Willamalane. They should be informed that only complete and accurate time sheets will benefit Willamalane and that the time sheets are not used to monitor them personally, only to track park activities. Secondly, a few alterations could be made to aid park employees with the documentation of work activities. One such modification

would be to refer to parks and activities using abbreviated names in place of numerical codes. This would be easier for employees to remember and would increase accuracy of documentation and decrease recording time by eliminating the need to search for each code. Giving each special event its own individual code will increase visibility of cost flows. Also, using the same site and activity codes in both the accounting records and the timesheets would reduce ambiguity and allow for a more exact relationship between costs and parks to be formed. Using a computer system would assist in the organization of the data, giving it uniformity and completeness, and would reduce the time necessary to document data. Looking into computer systems already in use at other park districts would be a good starting point. Additionally, providing Personal Digital Assistants (PDAs) for each employee may be a good investment. Each employee could document labor hours immediately, reducing the likelihood they forget and estimate incorrectly later, and at the end of each day these could be quickly transferred into the main computer system for storage. Lastly, some measure of vehicle use, such as mileage, should be put in place and documented habitually to enhance the vehicle data collection.

The recommendations made are offered in order to provide Willamalane with inspiration. These are possible ways in which they may improve upon their own data collecting structure and system. Improved data gathering and organization will help Willamalane more fully understand their own resource allocation and, ultimately, help them better reach their goal of providing excellent park and recreation services to the community.

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Appendix A

Willamalane supplied time sheets for all of their employees. Employees had been asked to record their work activities daily on these sheets using site codes, activity codes and, also, time spent on the activity. However, many gaps became apparent after electronically entering all of the 2007 data, as some employees did not fully complete the time sheets. Many techniques were used to find proxies for missing 2007 data. If available, data for a month in 2006 was used for an employee missing the same month in 2007. If no 2006 or 2007 data was available, data for the preceding month in 2007 may have been used in its place. This technique was not possible for employees who had an entire season missing as activites may vary greatly over the different seasons. Therefore, if an employee was missing more than one month, and there was no existing 2006 data to use as a proxy, the time sheet data of a co-worker holding the same position would be substituted. If no co-worker data was available a superior's time sheet data was used. If even this was not possible, we were forced to exclude an employee from the analysis.

There are two exceptions for the above mentioned procedure for time estimates. The first is for a particular employee who neglected to record activity codes for his work. He spent each day at only one park, so all of his labor hours were attributed to that park. The second exception is mowing. Mowing is a significant cost to Willamalane and there is no existing 2007 data recorded for mowing. As such, it was necessary to estimate using what was available. The only time sheet data available was for a primary, or lead, mower in May and June of 2006. However, time spent mowing will vary with the seasons so it was not correct to use May and June as proxies for other months of the year. Willamalane also had a document of total blade time in 2005, which records the amount of time the mower was in operation. The blade time for each month in 2005 was used as a model for what the proportions of total blade time in each month of 2006 should be. It was assumed that the time spent mowing at each park remained proportionally the same to other parks no matter the month or total number of mowing hours in that month. Mowing hours for each park and month were estimated using blade time to proportionally scale the recorded mowing hours from May and June. It could not be safely assumed that activities other than mowing would scale

proportionally to blade hours, when, in fact, the opposite is more likely true. So, for the months besides May and June, all time that was not mowing time was lumped into an "other" category. Because mowing time was scaled up in proportion to 2005 data there were some cases where the estimate for total mowing time exceeded the actual number of hours worked by the mower in a month. When this occurred it was assumed that the maximum number of mowing hours possible would be equal to seven out of every eight work hours. This estimated 2006 data was used as a proxy for 2007 mowing. Although this estimating technique only gave time estimates for primary mowers, trim mowers, or secondary mowers, were estimated in the same manner as primary mowers. This required the assumption that trim mowers follow primary mowers and, therefore, spend the same proportion of their mowing time at each park as primary mowers.

Appendix B

The list of independent variable is composed of park attributes that are expected to have a significant effect on park maintenance costs.

As park area increases the time spent maintaining the park is expected to increase, along with supplies and costs to do the maintenance.

The larger the impervious surface area, the larger the amount of surface runoff is predicted to be, causing Willamalane to be charged more by the Springfield waste water management facilities for the storm drain fees. However, impervious surface area prevents that area from being occupied by other amenities which may require more maintenance and so causes cost to decrease.

Sports fields may draw a larger number of patrons to a park, increasing the effort and resources needed to maintain the parks cleanliness. Also, sports field upkeep involves specific labor tasks that other amenities do not require, which further increases the cost of sports fields.

The number of sprinkler heads may indicate the amount of irrigation, as well as irrigation supplies and maintenance a park needs. A larger number of sprinkler heads would indicate greater time spent at a park and higher costs associated with that park.

Lights represent the amount of electricity, electrical maintenance and supplies required by a park. Similar to the effects of sprinkler heads, more park lights are expected to increase park costs for electricity.

Park structures are expected to increase the time and costs spent maintaining a park, as these amenities attract patrons and vandalism. Equally, benches are often the targets of vandalism and, therefore, require more cleaning and repairing then other amenities. Play structures may also need special repairing and may attract a large number of visitors to a park, requiring more clean-up.

If a trashcan is present it will acquire trash and need to be emptied leading to trash disposal fees.

The type of park may determine the amount of labor needed for its up-keep; specifically, natural parks are hypothesized to require less maintenance per acre in comparison to maintained parks. At the same time, independent of area, natural parks attract more transients, drug activity, and usage that results in a necessary increase in park maintenance.

The average income of the surrounding neighborhood could determine how much time is dedicated to a park. Parks in richer neighborhoods may not require the attention that parks in poorer neighborhoods demand as the parks in poorer neighborhoods receive more activity that leads to increased maintenance and costs.

Potable water facilities create the necessity to clean and maintain the site and also add sewer costs.

As the seasons change, so will patronage to each park and activities preformed to maintain the parks. Therefore, it is important to include dummy variables for each month to take into account the changes in activites that occur with the passing seasons.

Below, in Appendix C, is a table that summarizes the expected sign of each attribute's coefficient for each activity group based on the logic explained above.

Appendix C

Table A
Employee Time Expected Signs

Attribute	Horticulture	Site Improvements	Structures and Systems	Electric	Irrigation
Area	+				+
Benches	+	+			
Impervious Surface Area	+	+	+		
Income - High	-	-	-		-
Income - Medium High	-	-	-		-
Income -Medium	-	-	-		-
Income - Medium Low	-	-	-		-
Natural Park	+	+	+	+	
Park Lights				+	
Play Structures	+	+		+	
Potable Water Fixtures			+		
Sports Fields	+	+		+	+
Sprinkler Heads	+			+	+
Structures			+	+	
Trashcans	+				
Interaction (Natural x Area)	-				
Constant	+	+	+	+	+

Table B
Utilities Expected Signs

Attribute	Electricity	Water	Sewer
Area		+	
Benches			
Impervious Surface Area			+
Income - High			
Income - Medium High			
Income -Medium			
Income - Medium Low			
Natural Park			
Park Lights	+		
Play Structures			
Potable Water Fixtures		+	+
Sports Fields	+	+	
Sprinkler Heads	+	+	
Structures	+		+
Trashcans			
Interaction (Natural x Area)			
Constant			