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Urban Mass
Transportation
Administration

Light Rail Transit Capital Cost Study

Prepared by:

Booz•Allen & Hamilton Inc.

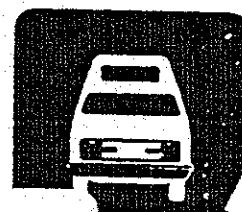
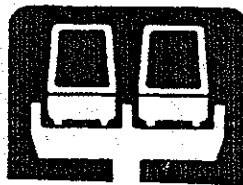
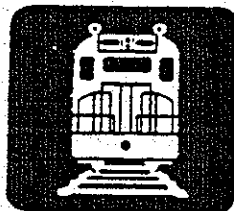
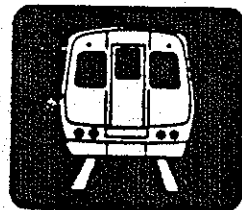
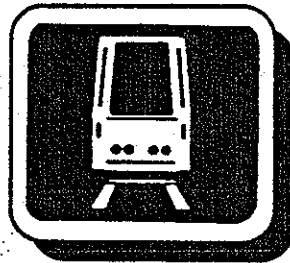
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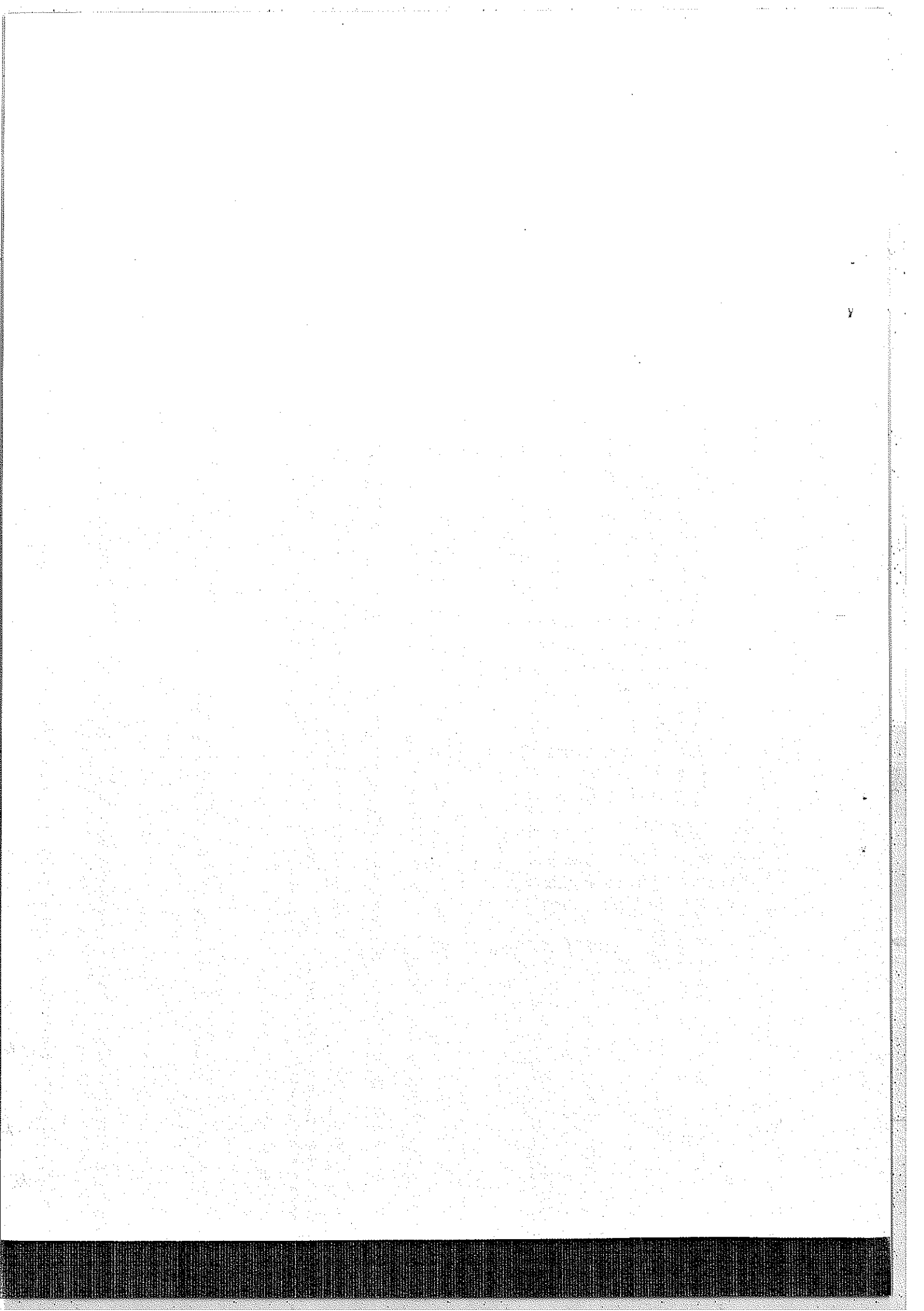
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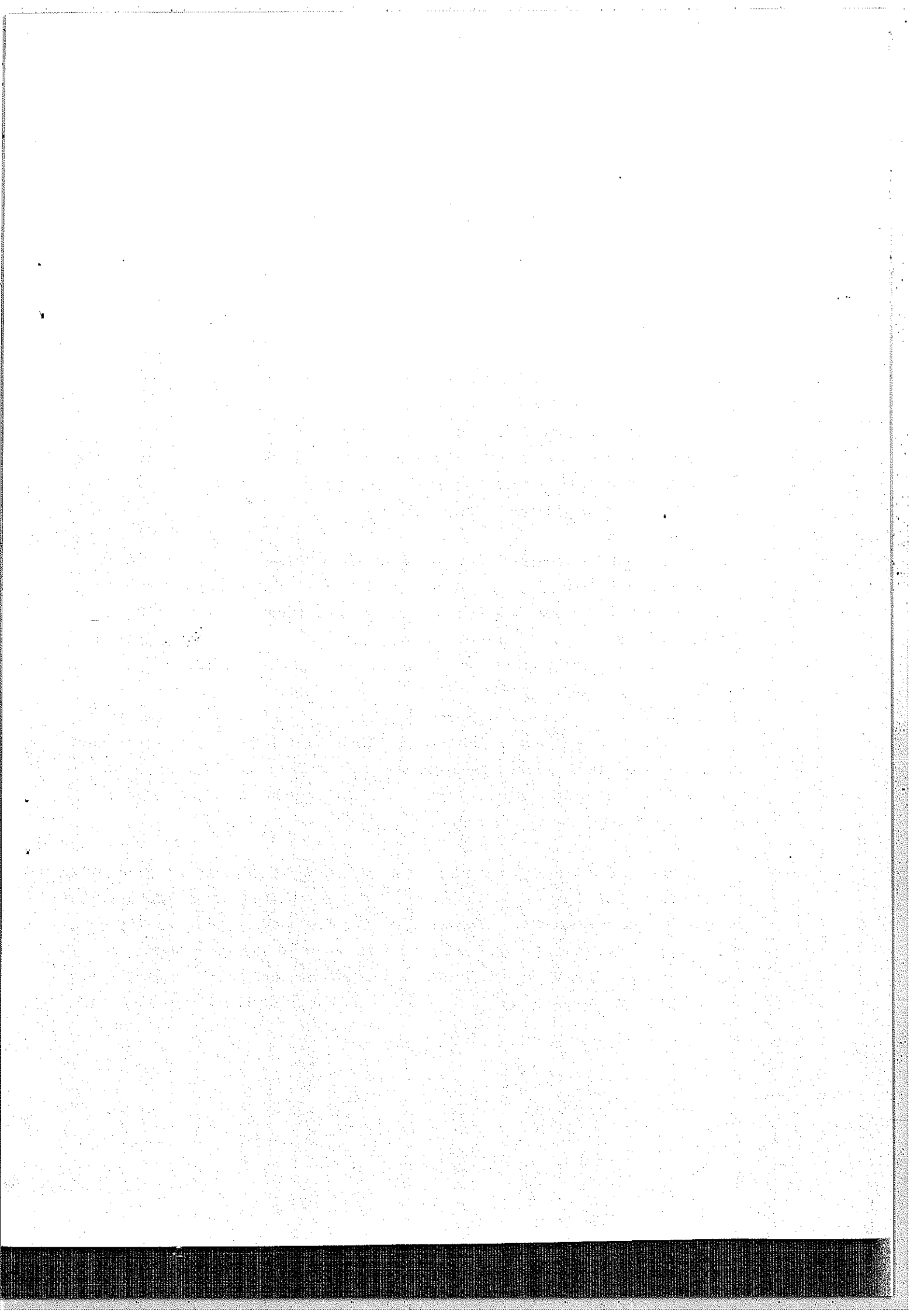
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PREFACE

This document was prepared for the Office of Technical Assistance and Safety of the Urban Mass Transportation Administration (UMTA). The study was conducted by the Transportation Consulting Division of Booz•Allen & Hamilton Inc. through a task order funding grant from the U.S. Department of Transportation, Urban Mass Transportation Administration. Guidance was provided through both the Office of Technical Assistance and Safety and the Office of Grants Management. Technical support was provided by Parsons Brinkerhoff Quade & Douglas in the development of the data collection format and Gibbs & Hill in the review of the cost input and unit cost results. The contents of this report are based on the project staff research and do not necessarily reflect the official views or policies of the U.S. Department of Transportation or the Urban Mass Transportation Administration.

This report was authored by Donald C. Schneck, Richard M. Amodei and Michael G. Ferreri of Booz•Allen with technical assistance from Dr. Fred Ducca and Ghassan Salameh of Booz Allen, Thomas Jenkins of Parsons Brinkerhoff, and David Weiss of Gibbs & Hill. Valuable insight and direction was contributed by Edward Thomas and Ron Jensen-Fisher of UMTA. The authors would like to express their appreciation for the assistance and information provided by the light rail transit systems that became a part of this Fixed Guideway Capital Cost Study. Employees and consultants of these agencies were very helpful in furnishing detailed construction cost information of each system element and then reviewing the initial results.

The Fixed Guideway Capital Cost Study is an attempt to develop a capital cost data base of actual unit costs to construct and procure the various assets necessary to operate mass transit busway and rail systems. This report documents the initial effort at this overall objective by concentrating on the light rail transit mode of passenger rail systems. The term light rail refers more to this mode's relative simplicity and



operational flexibility rather than actual vehicle weight or cost. With an overhead power supply source, light rail systems can operate in mixed traffic and various alignment configurations. Service can be operated in single or multi-unit trains of standard and articulated vehicle fleets that permit close service level design in line with passenger demand. Seven light rail systems that were developed over the past ten years, were the focus of this project. However, only five of the system operating agencies responded with pertinent capital cost information that formed the basis of this study.

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STATEMENT OF PURPOSE

Introduction

This fixed guideway capital cost study represents the first in a series of studies to examine the actual costs of major transit capital investments. This report presents the results of the first task to focus on the recent light rail projects that have been developed during the 1980's. Following studies will utilize this basic analysis structure and apply it to the other transit fixed guideway modes that have been implemented recently.

The information presented in this report should be used in line with the objectives posed for the study. The range of component unit costs should not be confused with any measures of efficiency since there remain other cost sensitive factors that lie outside those measured here. Further, the basic design philosophy of each system will directly affect unit and total costs. For example, some systems adopt a minimum cost design approach while others add amenities to attract higher market share. Station designs are a good example of these different developmental approaches. These effects on unit and total component costs do not easily conform to the quantitative focus of this study.

The component cost ranges produced in this report should provide a test for reasonableness of planning-level capital cost estimates and some guidance on the number and type of assets required for a light rail project. The cost ranges could also be used as a measure of project complexity and overall service levels and passenger carrying capacity -- the more complex and/or greater ridership demand, the more likely the project costs would tend toward the higher end of each component cost range. In addition, site conditions and interpretational provisions will have some direct effect upon the unit cost results. These effects should all be considered with the use of the information presented in this report.

Background

Capital cost estimates are key ingredients in determining the cost effectiveness, financial capacity and overall engineering feasibility of major capital investments. Fixed guideway transit systems, which involve Federal funding are developed in accordance with the Major Capital Investment Policy. This policy established a structured decision-making process that requires the careful development of costs, benefits and impacts of proposed systems. Reliable capital cost estimates are an important element of the investment decision process. The project development study process for major capital investments includes system planning, alternatives analysis and preliminary engineering. Since capital cost estimates are key ingredients to the decisions reached in each of the project study phases, the results of this study are intended to help guide the preparation of these capital costs through the availability of pertinent unit cost information and the typical asset requirements of a fixed guideway transit project.

An important aspect of the cost estimation procedures is the development of "Composite Unit Costs for Sections and Stations." The purpose of this study is to improve the accuracy and comparative compatibility of the capital cost estimates of the various systems under study. The benefit to the industry is the opportunity to check the reasonableness of planning-level cost estimates with the actual experience of building similar systems nationwide.

Good methods and reliable cost information are particularly important when comparing cost effectiveness and financial impacts among alternative capital investment projects. These comparisons require cost information that is compatible among alternative investments and reasonably in line with actual construction and procurement costs of each proposed system under study. More certainty of cost estimates and less variation to actual costs is more critical given the limited governmental

STUDY APPROACH

The study approach concentrated on the development of a data base of actual unit capital costs that could be drawn from actual system development experience. The two key requirements of the data base were the consistent definition of capital asset components and the identification of actual construction and procurement costs at the same level of detail. The workplan structure to meet these technical needs and the overall study objectives included six tasks:

- Identify candidate systems;
- Develop data collection guide;
- Complete data collection survey;
- Prepare file structure and layout;
- Refine data base results; and
- Publish the results.

This task structure was followed in the conduct of the study with varying levels of effort required for each candidate system.

This project focused on the recently constructed light rail transit systems designed and built over the last ten years. Light rail systems were selected as the initial system mode for this analysis, since more systems have been constructed within this system definition and the resulting data base would be the most complete.

There were several steps followed to assemble the complete data base. These included:

1. Definition of a comprehensive list of cost categories and subsets;
2. Development of a data collection guide form;

3. Submission of the data collection guide form to target systems for completion;
4. Checking of returned forms for completeness and/or misunderstandings;
5. Follow-up phone calls and, in several cases, site visits to fill in missing data and clarification of misunderstandings;
6. Entry of data into spreadsheet data base;
7. Return of spreadsheet to target systems for checking and verification; and
8. Editing and finalization of data base.

The development of the data collection guide was accomplished through a cooperative effort of industry professionals representing system operators, funding agencies, engineering and planning firms, and study professionals. The guide was important because it formalized the initial definition of asset components and established the minimum level of unit cost detail. Summary asset categories were included at appropriate subtotal levels to provide more comparative unit cost information, and accommodate systems with a more consolidated level of cost information. The data collection guide was then distributed to each of the candidate systems for completion. Continuous interaction between project staff and system operating staff was necessary to clarify the request; assist in the interpretation of special conditions; and adapt the original data base structure and component definitions to better fit the composition of the available cost information.

The data base file structure was constructed around the format of the data collection guide. As the data collection guides were returned, the cost information was entered into the data system for review and analysis. The data file was prepared in a Lotus 1-2-3 spreadsheet system for ease of

access in this project and later additions of other fixed guideway transit modes. A Lotus 1-2-3 add-in system Impress, was used to prepare the final data base and exhibit graphics for final publication.

Cost values were entered into the data base at the finest level of detail provided by each agency. Costs and quantities at the subsystem level were subtotaled into system level costs. Unit costs were calculated at each level of cost detail available. Unit costs were then updated into a constant 1990 dollar value using published construction cost indices. These 1990 dollar values were then normalized using nationwide cost indices to standardize the unit cost values from each city and form a more comparative cost basis.

The individual category unit costs were indexed to reach a consistent level of comparability. Individual unit costs were indexed in two separate ways. The first method involved inflating the costs to a consistent time basis. All costs were inflated to a Year 1990 base using the following formula and the historical cost indices published by *Means Construction Cost Data*.

$$\text{Cost in Year 1990} = \frac{\text{Index in 1990}}{\text{Index in Construction Year}} * \text{Construction Year Cost}$$

Means Construction Cost Indices are published annually by the R.S. Means Company, Inc. and are also available through the *Engineering News-Record*. City Cost Indices from the same 1990 *Means* report were then applied to the Year 1990 unit costs to normalize to a consistent nationwide comparative cost basis. The total weighted average construction cost indices were applied, representing all construction types and including both material and installation costs.

$$\text{Nationwide Average Unit Cost} = \text{Unit Cost in City A} * \frac{100}{\text{Cost Index for City A}}$$

The nationwide average cost basis of 100 represents the 30 major city cost average as of January 1, 1990. This provides the unit cost comparative basis for the fixed guideway capital cost categories. The cost index for each of the five light rail cities that were used in this study are the following values.

- Portland 99.0
- Sacramento 91.0
- San Jose 80.0
- Pittsburgh 99.4
- Los Angeles 87.6

These five light rail cities all have nationwide cost indices that are less than 100, which indicates that construction costs in those cities exceed the 30 major city cost average as of January 1990. This results in nationwide 1990 unit costs that are consistently lower than the city 1990 unit costs for the same capital cost category.

The data base in Appendix A - E includes all three of the basic costs: 1) actual cost; 2) 1990 costs for each city; and 3) 1990 by city normalized to the nationwide average. Costs presented in the body of the report are 1990 costs normalized to the nationwide comparative basis for each city.

METHOD OF APPLICATION

The estimation of capital costs in project planning is typically based on the definition of alignment conditions, capital asset requirements and unit cost measures of each asset category. The unique alignment conditions and their impact on unit capital costs should be represented by the cost ranges measured for each component. Therefore, development of the study data base concentrated on actual unit capital costs and quantities that should help guide the capital cost estimates under development for the current round of cities considering light rail transit systems.

Candidate Systems

This study concentrated on the actual construction and procurement costs of the light rail transit systems developed over the past few years. Of these seven systems, five were able to provide the type of actual capital cost information necessary for this project. A general description of these five systems, their size, type, complexity and operating characteristics are presented below. System developmental conditions and other unique local conditions and expectations should be carefully considered before drawing any conclusions about the relative costs and how they may be applied to other system plans.

Portland - - Regional public transportation is operated by the Tri-County Metropolitan Transportation District of Oregon (Tri-Met). Portland's light rail system was opened in September 1986 and was christened "MAX", for metropolitan area express. The 15-mile east-west alignment is mostly at-grade with some elevated sections along joint highway alignments. The line utilizes reserved rights-of-way in city streets, arterials and highway medians to connect the city of Gresham and other eastern suburbs with central Portland. Passenger access is through 25 at-grade stations that provide spacing of less than one mile and easy walk-on accessibility for most of the alignment length. Only 5 stations offer park-and-ride facilities, but almost all stations have coordinated bus

transfer facilities. A 26 vehicle articulated fleet operates the full service schedule requirement of 22 peak vehicles with the remaining 4 for scheduled maintenance.

Sacramento - - The Sacramento Light Rail Project became operational with the opening of the first phase in 1987. This first phase includes both the Northeast and Folsom Lines connected through downtown Sacramento. This phase is mostly composed of a single-track main line with double-track passing sections along about 40% of the length. The alignment utilizes unused freeway and abandoned railroad rights-of-way for most of its length. There are 101 grade crossings along this first phase development, indicating the limited investment in guideway elements. The downtown portion was constructed within city streets in both a dedicated transit mall and a mixed traffic operation. The design philosophy was a low-cost approach using off-the-shelf technology and at-grade construction to minimize total project capital costs. However, Sacramento did note a preference for double track designs for the existing and proposed lines, and a priority for the existing line conversion to double track. A total of 28 passenger stations are included in this phase, with seven suburban stations offering parking facilities, and six with bus transfer facilities.

San Jose - - The Guadalupe Corridor Project, opened in December 1987, connects the cities of San Jose and Santa Clara with the surrounding suburban areas. The initial phase of the light rail system consists of a 20-mile North Line that is mainly located along the median area of major roadways and along a transitway through downtown San Jose. The alignment is at-grade along the full length and includes very little in new structural requirements. Only one bridge and two overpasses in new guideway facilities were necessary to connect the full length of the alignment. Almost the entire line is double-tracked with only two small sections of single-track operation. There are presently 22 stations in operation with the planned expansion to 30 upon completion of the proposed full line length to the southern sections of San Jose. This South Line extension will add ten more miles of right-of-way to this light rail

system, but since construction was not completed at the time of this study and actual final construction costs were not available, this section was not included in our project. However, some of the original system elements and support facilities included in this study for the North Line were designed to include this additional South Line operational needs and corresponding cost impacts.

Pittsburgh - - The Port Authority of Allegheny County (PAT) has extensively rehabilitated the previous trolley car alignment and built new extensions to the South Hills Light Rail Line. The expanded service is referred to as Stage I and includes 12.5 miles of new alignment construction and 12 miles of complete right-of-way rehabilitation. The downtown Pittsburgh service is now operated in a 1.6 mile subway alignment, that is fully grade separated and free of traffic congestion-related delay. The suburban alignment includes sections of new trackage over previously unused rail right-of-way and rebuilt trackage and structure along the existing right-of-way. The availability of unused rail alignments provided some low-cost opportunities that contrast with the high-cost subway alignment in the downtown business district area. Transfer connections are provided to local bus services at nine suburban stations plus to regional and busway services at downtown stations. Service and passenger levels have increased when the new and rehabilitated services were implemented and continue to expand. A Stage II plan will next consider expansion of this light rail network into other high density travel areas.

Los Angeles - - The Metro Blue Line connects Long Beach with downtown Los Angeles along a 22.6-mile, mostly at-grade (approximately 80%), and dedicated alignment, that includes a subway section and connection to the Metro Red Line (currently under construction) in downtown Los Angeles. This line was constructed as the first part of a regional network of rail service, serving the entire Los Angeles area. Initial service was inaugurated in July, 1990 over almost the full length, and since February, 1991, into the tunnel connection in central Los Angeles. There are 28 highway, 4 pedestrian and two at-grade railroad

crossings that required warning and control systems. The full alignment is double-tracked except for the one-directional loop in downtown Long Beach. The Blue Line was designed as a modern and more state-of-the-art rail line including connections with other planned lines along its length. There are 22 stations with only 5 offering parking facilities. One station is underground with connections to the Red Line, three on elevated sections, and one combined aerial/at-grade station with a link to the planned Green Line. The service and ridership levels were anticipated at fairly high rates, which required sophisticated control and support systems for this light rail line.

These five light rail transit systems were able to supply actual capital cost information in the format necessary for this study data base. The cost information provided by each agency reflected the full construction and systems procurement costs for the assets described in these candidate descriptions and supported by the detail in the appended data base listings for each system.

Cost Elements

The development of the project data base utilized fairly standard asset component definitions and requested capital cost information at the system and subsystem level. These system and subsystem definitions formed the basis to the structure of the project cost information request. The completion of the information requests by each agency required some flexibility in the level of detail and category definitions of the original request, since unique conditions were encountered in the design, construction and procurement for every light rail system. The individual contracting mechanisms and work scope within each construction or procurement contract directly affected the level of cost detail available for this capital cost data base. For example, when construction bids were contracted for certain line sections, some contractors provided the component cost details for the individual subsystems, while others were not required and submitted only total cost proposals. Only through

extensive research were the operating agencies able to generate the actual cost details, including appropriate subsystem change orders.

The structure of the resulting study data base reflected a consistent format at the subsystem level of detail for every light rail line. The data base format was established under nine major cost categories:

- 0.00 System description;
- 1.00 Guideway elements;
- 2.00 Yards and shops;
- 3.00 System elements;
- 4.00 Stations;
- 5.00 Vehicles;
- 6.00 Special conditions;
- 7.00 Right-of-way; and
- 8.00 Project soft costs.

These eight cost elements were each divided into the related system and subsystems included within each cost category. Units of measure were defined at each of the cost levels from subsystem up to system and category costs. The majority of guideway and right-of-way unit costs were measured in terms of linear feet, while the systems unit costs were mainly measured in terms of each system component. Unit costs which are calculated on either a per mile or per linear foot of guideway basis are defined by overall guideway length, as opposed to track miles, since the actual subsystem cost information was not available by single track and double track sections. In other words, a one mile section of guideway was presented in a combined or average guideway type mile, whether it is a single track or a double track section. The guideway elements were segmented into the various alignment grades and track construction types.

System Description - - A general information section was included at the beginning of each project information request to summarize the overall characteristics of each light rail system. Areas covered in this section include network or line size, service levels and

staffing levels by general categories. The intention of this section was to gauge the system sizing and service level complexities to better understand some of the unit cost differences among the rail systems and the individual asset components. The size and service section quantifies the length and breadth of the line, stations, and auto access facilities; revenue vehicles available and scheduled for service at peak and midday time periods; and, frequency of peak and off-peak services. Staffing levels were also included to size the system manpower requirements by functional area of light rail operation.

Guideway Elements - - This asset category includes the alignment components of track and structural requirements along the entire right-of-way. Capital cost information was requested for each alignment grade and track construction technique. Generally, there are two types of track construction for passenger rail systems - - direct fixation and ballast base. These two main construction techniques were segmented further for mixed traffic track alignments such as embedded and in-pavement ballasted. The alignment grades included all relevant categories that represented significant cost impact such as:

- At-grade;
- Elevated structure;
- Elevated, retained fill;
- Elevated fill;
- Subway; and
- Retained cut.

The asset requirements and capital cost of most all guideway elements were covered by guideway types. Each of these guideway elements were measured in linear feet. Special trackwork and structures were treated separately and noted for each system. The unique construction and operating conditions posed by each system make this category the highest overall cost component of these light rail passenger systems.

Exhibit 1 presents the summary of guideway costs which represented on average, 33% of total project costs, exclusive of the planning/engineering/developmental type soft costs. This summary of actual guideway unit costs presents the number of data entries or observations for each guideway element, plus the minimum, mean, maximum, and range of unit cost values. The unit costs presented in this summary represent the constant dollar values in 1990 dollars, calculated from the original construction cost and year of construction, and then normalized to the nationwide comparative standard using the *Means* construction cost indices.

Guideway element costs in total, ranged from a minimum of \$428 per linear foot to a maximum of \$1,508 per linear foot. This leads to a wide cost range of over \$1,000, which illustrates the extensive cost variation from a mainly single track at-grade alignment to the more sophisticated, higher service volume systems that include mainly grade separated and some subway alignment. The mean or average guideway cost of \$1,016 per linear foot is pertinent if the planned alignment is not sufficiently defined to select one of the more specific unit cost values. The lowest cost guideway was the ballasted track type on an at-grade alignment, while the highest expense guideway was as expected, the direct fixation track type in a subway alignment. The unit cost details are also provided to summarize the individual unit cost information as calculated from the original actual costs submitted by each agency.

Yards and Shops - - Maintenance of the rail system components requires specialty shops for each major asset category. Unit costs were requested for each shop and particular system support function. In cases where system development was more complex, detailed cost information was available by shop; however, in some systems, yard and shop construction was contracted out as a "package" and cost information was only available at a summary level. The capital cost information request included fourteen yard and shop areas that encompassed the full range of system support needs. Flexibility was designed into the request to accommodate both detailed and summary level responses.

RANGE OF UNIT COSTS

EXHIBIT 1

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
1.00 GUIDEWAY ELEMENTS	Linear Feet	5	\$428	\$1,016	\$1,508	\$1,079
1.01 GUIDEWAY AT-GRADE	Linear Feet	5	\$413	\$655	\$1,205	\$792
DIRECT FIXATION		5	\$696	\$696	\$696	\$0
BALLASTED		1	\$350	\$491	\$679	\$329
IN-PAVEMENT BALLASTED		5	\$526	\$1,557	\$2,588	\$2,062
EMBEDDED		2	\$383	\$1,452	\$3,131	\$3,131
1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4	\$410	\$1,768	\$3,041	\$2,631
DIRECT FIXATION		4	\$410	\$1,233	\$2,756	\$2,346
BALLASTED		3	\$1,119	\$2,746	\$4,516	\$3,397
IN-PAVEMENT BALLASTED		3	\$506	\$1,936	\$3,365	\$2,859
EMBEDDED		2	\$947	\$1,009	\$1,172	\$325
1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172	\$325
DIRECT FIXATION		2	\$847	\$1,009	\$1,172	\$325
BALLASTED		1	\$616	\$616	\$616	\$0
IN-PAVEMENT BALLASTED		1	\$616	\$616	\$616	\$0
EMBEDDED		1	\$616	\$616	\$616	\$0
1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$616	\$0
DIRECT FIXATION		1	\$616	\$616	\$616	\$0
BALLASTED		1	\$616	\$616	\$616	\$0
IN-PAVEMENT BALLASTED		1	\$616	\$616	\$616	\$0
EMBEDDED		1	\$616	\$616	\$616	\$0
1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$8,329	\$7,443	\$8,837	\$2,228
DIRECT FIXATION		2	\$8,329	\$7,443	\$8,837	\$2,228
BALLASTED		2	\$6,329	\$13,530	\$20,730	\$14,401
IN-PAVEMENT BALLASTED		2	\$4,730	\$4,730	\$4,730	\$0
EMBEDDED		1	\$506	\$506	\$506	\$0
1.06 GUIDEWAY - RETAINED CUT	Linear Feet	3	\$329	\$3,354	\$5,410	\$5,081
DIRECT FIXATION		3	\$329	\$3,354	\$5,410	\$5,081
BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
IN-PAVEMENT BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
EMBEDDED		2	\$329	\$2,870	\$5,410	\$5,081
1.07 POCKET TRACK	L.F. Guideway	2	\$2,81	\$33,11	\$65,41	\$62,61
1.08 STORAGE TRACK	L.F. Guideway	4	\$15,71	\$25,02	\$35,32	\$19,60
1.09 SPECIAL TRACKWORK	L.F. Guideway	1	\$4,389	\$4,389	\$4,389	\$0
1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet	1	\$4,389	\$4,389	\$4,389	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

Exhibit 2 presents the unit cost summary for yards and shops components. The overall total category costs varied significantly from a minimum of about \$4.1 million to a high of \$42.8 million. This extremely wide cost range demonstrates that there are many factors affecting the cost of light rail yards and shops. The extent of maintenance facility and shop equipment requirements are at least partially driven by system design, capacity and complexity decisions. However, even when the yard and shop costs were measured on a guideway length or revenue vehicle unit cost basis, there was only a minor direct cost relationship to either unit cost measure. This yards and shops component cost information should therefore, be carefully applied in any planning level capital cost efforts, since there appeared to be little direct cost relationship among the standard unit capacity measures. The more detailed line item information about the 14 individual shop categories did not provide any better unit cost support, since the breakout of the cost information was very inconsistent. Therefore, these individual shop costs should only be used as an indication of prior actual experience.

System Elements - - The system needs were clearly defined by asset component and within four general functional categories.

- Signal system;
- Electrification;
- Communications; and
- Fare collection.

Capital cost information was normally available for each functional category, since these components are typically procured and/or installed through separate contracts.

As demonstrated in Exhibit 3, systems costs are somewhat more predictable and related overall, to the linear feet of each system. Systems costs ranged from \$179 per linear foot to a maximum of \$878 per linear foot. This cost range is indicative of the level of systems sophistication

RANGE OF UNIT COSTS

EXHIBIT 2

		UNIT COST SUMMARY				
UNITS OF MEASURE		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
2.00 YARDS & SHOPS		5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
	2.01 BUILDING	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
	2.02 OFFICE FURNITURE & EQUIP.	1	\$252,440	\$252,440	\$252,440	\$0
	2.03 HEAVY REPAIR	3	\$69,070	\$349,318	\$731,367	\$662,297
	2.04 MOTOR SHOPS	2	\$11,512	\$27,032	\$42,553	\$31,042
	2.05 WHEEL SHOP	3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
	2.06 MACHINE SHOP	2	\$236	\$118,112	\$235,988	\$235,752
	2.07 AIR CONDITIONING	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
	2.08 ELECTRONICS	3	\$230,233	\$1,052,600	\$1,645,400	\$1,415,167
	2.09 COMMUNICATIONS	2	\$6,907	\$572,302	\$1,137,698	\$1,130,791
	2.10 CAR WASH/CAR CLEANING	2	\$144,470	\$508,143	\$871,816	\$727,347
	2.11 MAINTENANCE OF WAY SHOPS	4	\$66,700	\$1,633,059	\$5,314,598	\$5,247,898
	2.12 MAINTENANCE OF WAY EQUIPMENT	2	\$27,261	\$41,900	\$56,539	\$29,278
	2.13 REVENUE CENTER	1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
	2.14 CENTRAL CONTROL	1	\$10,159,345	\$10,159,345	\$10,159,345	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RANGE OF UNIT COSTS

EXHIBIT 3

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
3.00 SYSTEMS	Linear Feet	5	\$179	\$482	\$878	\$699
3.01 SIGNAL SYSTEM	L.F. Guideway	5	\$54	\$198	\$443	\$388
3.02 ELECTRIFICATION	L.F. Guideway	5	\$92	\$241	\$448	\$356
3.03 COMMUNICATIONS	Total	4	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$5,456,404	\$4,375,907

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

necessary to operate the different service levels. The systems with higher service levels were grouped at the higher unit cost range, while the other systems were mainly grouped in the lower unit cost range. The mean of systems unit costs therefore is not as pertinent as the two ends of the unit cost range.

Stations - - This asset category was fairly straight forward with the identification of components and definition of their individual characteristics. Stations were first designated by grade, and then by center and side platform locations. Unique station descriptors were included to identify special asset requirements and related cost impacts. These descriptors included platform length, escalator/elevator availability, disability access mode, and weather coverage. In addition, station access amenities were separately requested to define the cost impacts of such elements as parking areas and pedestrian overpasses.

The station unit cost summary is presented in Exhibit 4, where total station-related costs averaged about \$1.4 million per station overall. At-grade center platform stations were the least expensive with a minimum cost of \$180,000 for the most basic station design. The more complex of these at-grade stations reach almost \$1.0 million for center platforms, and almost \$2.0 million for side platform stations. Subway stations were as expected the most expensive ranging from almost \$7.0 million to \$25.2 million for the most extensive station. There were only three elevated stations constructed in the five study systems, which cost almost \$2.7 million. In addition, parking lots averaged about \$1.1 million and a passenger overpass was constructed for \$900,000.

Vehicles - - Revenue and non-revenue vehicles were included in this asset category. Revenue vehicles were identified by separate vehicle orders to differentiate any component and cost impacts. Only one light rail system (Sacramento) had a second vehicle order included in this time period and capital cost data base. Unique vehicle characteristics and/or special componentry were noted to identify unit cost impacts of each vehicle order. These included the make and manufacturer; size and layout

RANGE OF UNIT COSTS

EXHIBIT 4

	UNITS OF MEASURE	UNIT COST SUMMARY				RANGE
		COUNTS	MINIMUM	MEAN	MAXIMUM	
4.00 STATIONS	Each	5	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
4.01 AT-GRADE	Each	5	\$180,861	\$800,732	\$1,961,305	\$1,780,443
4.02 SUBWAY	Each	2	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,444
4.03 ELEVATED	Each	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
4.04 PARKING LOTS	Total	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
4.05 PARKING GARAGES	Total					
4.06 PEDESTRIAN OVERPASSES	Total	1	\$908,360	\$908,360	\$908,360	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

dimensions. Special components such as cab signaling, air conditioning, wheelchair lifts, and the particular farebox system were denoted when included in each vehicle order -- otherwise the farebox costs were included in the systems cost category. Non-revenue vehicles were included as a separate category for service trucks, support automobiles and any other necessary non-revenue equipment.

This asset category had the most consistent unit cost experience for all five light rail systems. Exhibit 5 provides the unit cost summary for the vehicle category. Light rail vehicles had unit costs ranging from a low of \$800,000 to a high of \$1,300,000. These vehicles were all articulated with the main differences in the individual vehicle capability and componentry. The lowest unit cost vehicle order represents the most basic design criteria and the more recent order from this same system was at a much greater cost at over \$1.25 million each. Therefore, the higher unit cost range may be more representative than the low or average vehicle cost values.

Non-revenue vehicle costs varied significantly because of the different operational philosophies. Some systems procured all necessary non-revenue vehicles and others only purchased the minimum amount and contracted for the other support services. The unit cost range reflects these two developmental approaches with a minimum unit cost of \$11,000 for mainly automotive support vehicles and a maximum of \$86,000 each for a support fleet that also includes more heavy trucks and other support vehicles.

Special Conditions -- Development of a light rail system involves some mitigating construction requirements that are not directly related to rail service, but necessary to construct each rail line. The capital costs of these items have been included in this special conditions category. The largest cost component is the relocation of existing utility lines from or within the rail corridor under construction. These costs have been separated by replacements in the same or similar condition and replacement with improved or different utility conditions that was

RANGE OF UNIT COSTS

EXHIBIT 5

	UNITS OF MEASURE	UNIT COST SUMMARY			
		COUNTS	MINIMUM	MEAN	RANGE
5.00 VEHICLES	Each	5	\$968,562	\$1,159,567	\$376,657
5.01 REVENUE VEHICLES -- ORDER A	Each	5	\$806,202	\$1,119,800	\$508,676
5.02 REVENUE VEHICLES -- ORDER B	Each	1	\$1,255,800	\$1,255,800	\$0
5.03 REVENUE VEHICLES -- ORDER C	Each				
5.04 NON-REVENUE VEHICLES	Each	2	\$11,267	\$48,750	\$74,965

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

denoted in the data base as betterments. These replacement costs were listed by utility:

- Gas;
- Telephone;
- Electric;
- Water;
- Pipeline;
- Railroad; and
- Other.

An additional section for utility replacement costs was provided for any unusual or unforeseen circumstances. Three more of these special condition categories were also included for demolitions, roadway changes, and environmental mitigation costs.

These special conditions were measured overall on a linear foot basis to provide a reasonable unit measure for use in planning other light rail systems. Exhibit 6 presents the unit cost summary of special conditions encountered in the development of these light rail systems. The total and unit costs varied significantly for this cost category and should therefore, be carefully considered in cost estimation applications. On a unit cost basis special conditions costs varied from a minimum of \$81 to a maximum of \$1,263 per linear foot, with a mean value of \$337 per linear foot. The total values per system were also provided for each individual cost category. When initial information is available about the extent of special conditions expected for the project, the total costs from the individual cost categories may be most useful, while in the absence of specific special conditions, the overall unit costs may be more appropriate. The lower unit costs may be more appropriate in less dense urban areas and the higher unit costs in more densely developed and/or mature urban areas.

Right-Of-Way - - This capital cost category covered all land acquisition and acquisition-related costs. Land acquisition costs were requested for direct purchases and estimated value for any land donations

RANGE OF UNIT COSTS

EXHIBIT 6

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
6.00 SPECIAL CONDITIONS	Linear feet	5	\$81	\$337	\$1,263	\$1,182
6.01 UTILITY RELOCATION - AS IS	Total	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
6.02 UTILITY RELOCATION - BETMTS.	Total	3	\$495,549	\$41,497,095	\$118,409,923	\$117,914,373
6.03 UTILITY RELOCATION - OTHER	Total					
6.04 DEMOLITIONS	Total	5	\$112,628	\$511,718	\$956,912	\$844,284
6.05 ROADWAY CHANGES	Total	2	\$2,220,974	\$7,086,721	\$11,952,468	\$9,731,494
6.06 ENVIRONMENTAL	Total	3	\$356,640	\$6,349,686	\$16,785,885	\$16,429,246

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

or swaps. The related purchase costs for management, appraisal, and relocation expenses were also listed in this capital cost category. The original data was requested on an acreage basis by functional use -- mainline, stations, yards, and parking.

Similar to the special conditions, land costs are presented on a linear foot basis for the overall category costs and on a project total for the individual cost categories -- Exhibit 7. Overall right-of-way costs ranged from \$160 per linear foot to a high of \$600 per linear foot, with a mean of \$346. Land acquisition costs in total cost from \$15.5 million to as high as \$50.4 million. Land acquisition related costs followed a similar cost pattern ranging from \$800,000 to a high of \$4.1 million. Relocation costs were fairly small and only reported by three of the five systems.

Project Soft Costs - - This section included all other miscellaneous costs related to development of passenger rail services. The majority of these costs were expended in the planning, engineering, and project management efforts. These services included in-house agency staff and the use of consultants for particular tasks. Project start-up and initiation expenses were also included in this cost category. Project financing cost and an "other" expense line item which includes any reconciliations and unaccountable costs, comprise the full range of any project development capital costs.

Exhibit 8 highlights the unit cost summary of all project soft costs incurred in the development of these light rail systems. This capital cost category represents a fairly large expenditure commitment for light rail system development. The wide cost range is some indication of the relative complexity of each system and the extent of professional services necessary for system development. The cost measurement of in-house agency staff support may not be fully represented and possibly an indication of the cost variance among the individual categories and overall project soft costs. The other expense line item included some reconciliation account costs and some other unidentified expenses.

RANGE OF UNIT COSTS

EXHIBIT 7

	UNITS OF MEASURE	UNIT COST SUMMARY			
		COUNTS	MINIMUM	MEAN	MAXIMUM RANGE
7.00 RIGHT-OF-WAY	Linear Feet	5	\$160	\$346	\$600 \$440
7.01 LAND ACQUISITION - PURCHASED	Total	5	\$15,470,477	\$30,823,677	\$50,376,726 \$34,906,250
7.02 LAND ACQUISITION - DONATED	Total				
7.0 ACQUISITION-RELATED COST	Total	4	\$813,454	\$2,296,128	\$4,083,215 \$3,269,761
7.04 RELOCATION	Total	3	\$139,942	\$267,577	\$471,932 \$331,390
7.05 OTHER	Total				

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RANGE OF UNIT COSTS

EXHIBIT 8

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
8.00 SOFT-COSTS	Linear Feet	5	\$359	\$1,491	\$3,068	\$2,708
8.01 FEASIBILITY STUDIES	Total	3	\$3,718,000	\$14,612,295	\$36,398,671	\$32,680,671
8.02 ENGINEERING & DESIGN	Total	3	\$16,009,645	\$48,230,137	\$68,801,392	\$52,791,747
8.03 CONSTRUCTION MANAGEMENT	Total	5	\$4,788,081	\$35,548,854	\$85,158,669	\$80,370,588
8.04 PROJECT MANAGEMENT	Total	5	\$2,173,544	\$14,678,448	\$22,938,149	\$20,764,605
8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
8.06 PROJECT INITIATION	Total	3	\$1,319,808	\$14,136,884	\$35,235,765	\$35,235,765
8.07 FINANCE CHARGES	Total	1	\$546,621	\$546,621	\$546,621	\$0
8.08 TRAINING/START-UP/TESTING	Total	4	\$3,543,743	\$6,480,866	\$9,803,185	\$6,259,441
8.09 OTHER	Total	2	(\$16,589,228)	\$40,319,705	\$97,228,639	\$113,817,867

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RESULTS

This section presents the capital cost results for each light rail system included in the capital cost data base. Capital cost summaries were prepared to present total project costs of each light rail system for each of the eight asset categories described previously. A pie chart of the proportional costs of each cost category was included to illustrate the overall developmental cost requirements. These project cost summaries are presented within this results section, while the details are included in the data base appendices. Detailed data were provided for five light rail systems, including:

- Portland;
- Sacramento;
- San Jose;
- Pittsburgh; and
- Los Angeles.

The component costs are presented by specific system to provide a higher level of unit cost information. When project plans begin to focus on a defined developmental design, unit costs from a specific system may be more pertinent to the cost estimation process.

Exhibit 9 provides a summary of system characteristics to aid in understanding the system specific unit cost data (and variances) that follow. The projects vary from 15 to 23 miles in guideway length, averaging approximately 18-1/2 miles. They are substantially all double-track operations, with the exception of Sacramento, which is approximately 60% single-track and currently in the process of extending double-tracking to about 60%. Average station spacing varies from slightly over one-half mile to one mile. Exhibit 9 also displays a key characteristic that significantly affects unit costs (especially stations and guideway) -- Sacramento and Santa Clara are virtually totally at-grade systems while

Exhibit 9 Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
• Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

at-grade mileage for Portland and Pittsburgh is only two-thirds of the alignment.

The balance of this section provides an overall summary of unit costs by major category, followed by more detailed comparisons of subsystem costs within each category. Appendices A - E include the full capital cost data base of statistics organized by system. Data are provided in both aggregate and detailed unit costs to be useful at various stages in a project's development from early system planning stages to engineering.

Summary Cost Overview

Exhibit 10 presents a summary of the percent of actual (unescalated) as built project costs by major category. Guideway construction is the largest category, averaging 40% of "in-ground" cost. Systems (e.g., signals, electrification, communications, fare collection) comprise the second largest category at almost 18%. Right-of-way averages 14.4% and, if combined with guideway costs, these two items total more than half the "in-ground" costs varying from a low of 36% in Los Angeles to a high of 67% in Portland.

Unit costs by similar categories are displayed in Exhibit 11 (escalated to 1990 dollars). As would be expected, the widest variations occur in the categories most dependent on local characteristics such as "special conditions" where the range is 358% of the average and "stations" which vary from elevated structures to on-street stops. Conversely, the smallest variation is in vehicle unit costs which averaged \$1.272 million with the range being only 37% of the average.

Guideway unit costs average \$5.782 million, with Sacramento and San Jose being at the low end due to virtually 100% at-grade construction. Pittsburgh, with 13% of its alignment in subway, has the highest average guideway unit cost.

Exhibit 10
Summary Costs and Percentages of "As Built" Project Costs By Category
(Current \$ millions)

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Guideway Elements	\$94.6 57.9%	\$46.7 42.5%	\$65.9 35.0%	\$110.5 40.4%	\$148.7 25.4%	\$93.3 40.2%
Yards & Shops	\$11.6 7.1%	\$4.0 3.6%	\$21.3 11.3%	\$38.2 14.0%	\$44.2 7.5%	\$23.9 8.7%
Systems	\$21.2 13.0%	\$19.4 17.7%	\$33.1 17.6%	\$58.9 21.5%	\$115.3 19.7%	\$49.6 17.9%
Stations	\$15.1 9.3%	\$10.3 9.3%	\$4.9 2.6%	\$34.3 12.5%	\$65.9 11.2%	\$26.1 9.0%
Special Conditions	\$5.8 3.5%	\$12.2 11.1%	\$8.5 4.5%	\$10.0 3.7%	\$152.3 26.0%	\$37.8 9.7%
Right-of-Way	\$15.1 9.2%	\$17.4 15.8%	\$54.6 29.0%	\$21.5 7.9%	\$60.1 10.2%	\$33.7 14.4%
Total "In-Ground" Costs	\$163.4 100.0%	\$110.0 100.0%	\$188.3 100.0%	\$273.4 100.0%	\$586.5 100.0%	\$264.3 100.0%
Vehicles as Percent of "In-Ground" Costs	\$25.2 15.4%	\$34.6 31.5%	\$55.6 29.5%	\$57.4 21.0%	\$79.9 13.6%	\$50.5 22.2%
Soft Costs as Percent of "In-Ground" Costs	\$58.3 35.7%	\$36.2 32.9%	\$136.4 72.4%	\$224.8 82.2%	\$210.8 35.9%	\$193.3 51.5%

Exhibit 11
Summary of System Unit Costs
1990 National Dollars in Millions

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>	<u>Range</u>	<u>Percent Range of Average</u>
Cost Per Route Mile								
• Guideway	\$7.0	\$2.3	\$3.6	\$8.0	\$6.0	\$5.4	\$5.7	106%
• Systems	1.6	0.9	1.7	4.2	4.6	2.6	3.7	141%
• Special Conditions	0.4	0.6	0.5	0.7	6.7	1.8	6.2	351%
• Right-of-Way	1.1	0.8	3.2	1.6	2.4	1.8	2.3	127%
Yards & Shops Costs								
Per Shop Capacity	0.1	0.1	0.4	NR	0.7	0.3	0.7	198%
Station Costs Per Station	0.7	0.4	0.2	3.2	3.3	1.6	3.1	202%
Vehicle Costs Per Vehicle	1.3	1.0	1.0	1.2	1.3	1.2	0.4	33%
Total Project Cost Per Route Mile	18.6	8.9	21.5	40.1	36.6	25.1	31.2	124%
Project Cost Per Route Mile Less Vehicles and Soft Costs	\$7.5	\$5.3	\$10.4	\$19.8	\$24.1	\$13.4	\$18.8	140%
Percent of System At-Grade	65%	96%	99%	66%	81%			

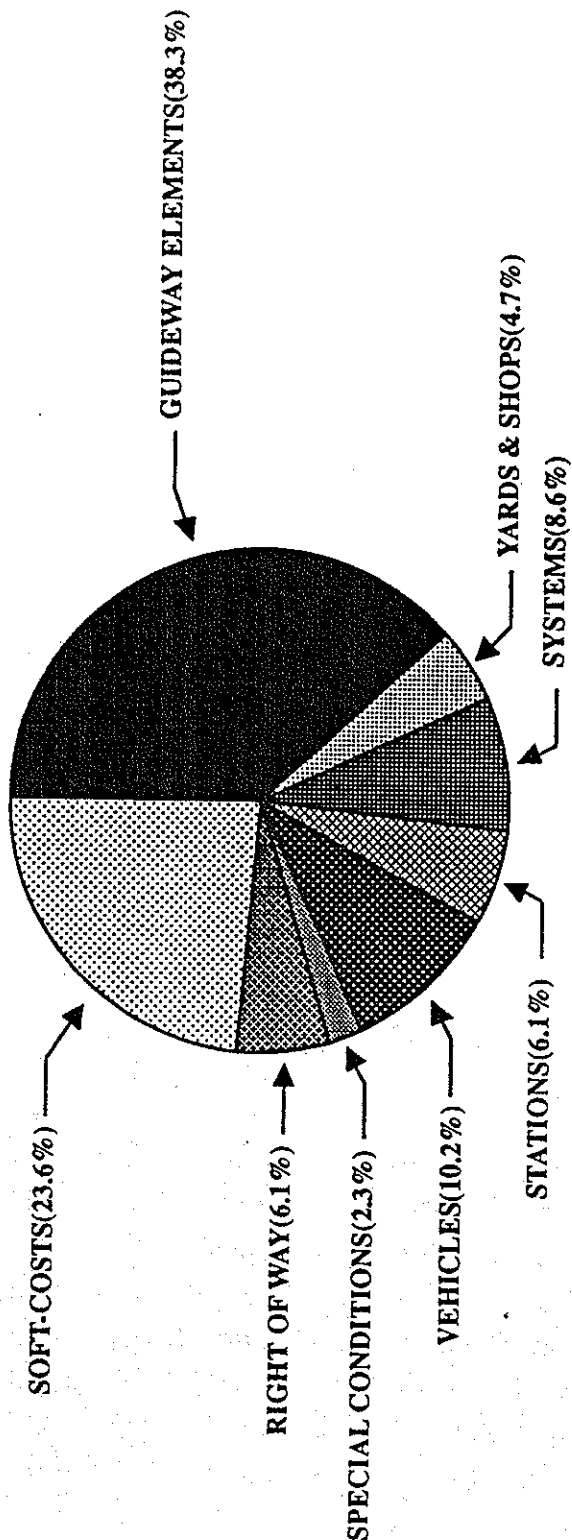
Total project cost per route mile averaged \$27.5 million with a range from \$9.746 million to \$41.748 million. Reasons for these variations are more evident from the sub-category data presented in the following sections.

System Cost Summaries

Prior to examining comparative unit costs in detail, it is helpful to review actual systems' cost by category to understand some of the underlying differences in design philosophy and local conditions. Exhibits 12 through 16 display total actual cost for each system in the three types of developmental costs. The "as built" system costs are based on the actual costs expended in the development of each project, and are measured in year-of-expenditure dollars. The city costs represent the inflation of the "as built" costs to a constant 1990 dollar value from each of the individual component procurement years. The national costs then normalize the category costs to account for construction costs of each major metropolitan area. It is evident that costs vary significantly. A few of the reasons for variations include:

- *Portland* is a double-track system with approximately one-third of the guideway elevated, resulting in higher guideway and station costs -- Exhibit 12. Portland represented a mid-range design approach that included some passenger amenities and the operational facilities necessary for a consistent service at a peak headway of 7.5 minutes. The at-grade downtown Portland sections helped to maintain guideway costs in the lower range, however the elevated sections introduced some of the higher range unit guideway costs. The "as built" cost proportions were about average except for the higher guideway and station cost categories.

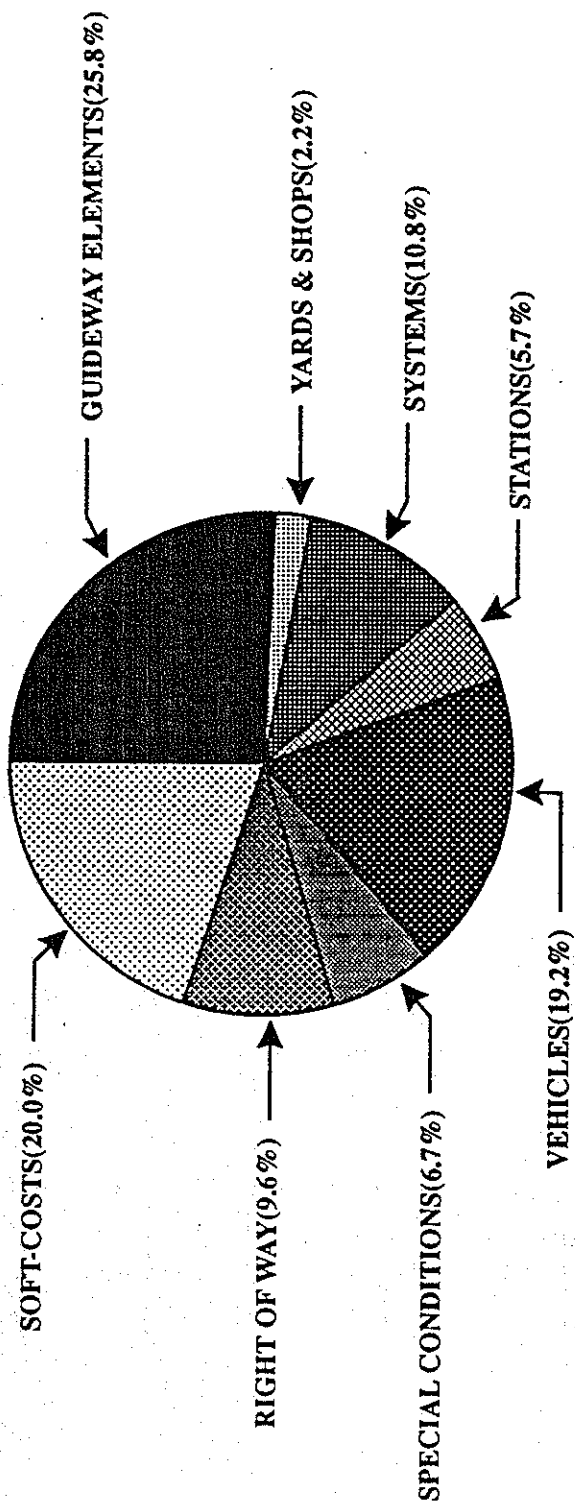
EXHIBIT 12
TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT
CAPITAL COSTS BY PROJECT CATEGORY



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	38.3%	\$94,599,637	\$107,600,218	\$106,600,218
2.00 YARDS & SHOPS	4.7%	\$11,602,000	\$13,490,698	\$13,355,791
3.00 SYSTEMS	8.6%	\$21,167,000	\$24,503,700	\$23,813,163
4.00 STATIONS	6.1%	\$15,107,000	\$17,050,800	\$16,880,275
5.00 VEHICLES	10.2%	\$25,218,000	\$33,579,234	\$33,243,444
6.00 SPECIAL CONDITIONS	2.3%	\$5,756,000	\$6,574,678	\$6,494,499
7.00 RIGHT OF WAY	6.1%	\$15,070,000	\$17,158,306	\$16,997,948
TOTAL HARD COSTS	76.4%	\$188,519,637	\$219,957,634	\$217,385,336
8.00 SOFT-COSTS	23.6%	\$58,278,000	\$65,758,780	\$65,105,348
TOTAL PROJECT COST	100.0%	\$246,797,637	\$285,716,414	\$282,490,686

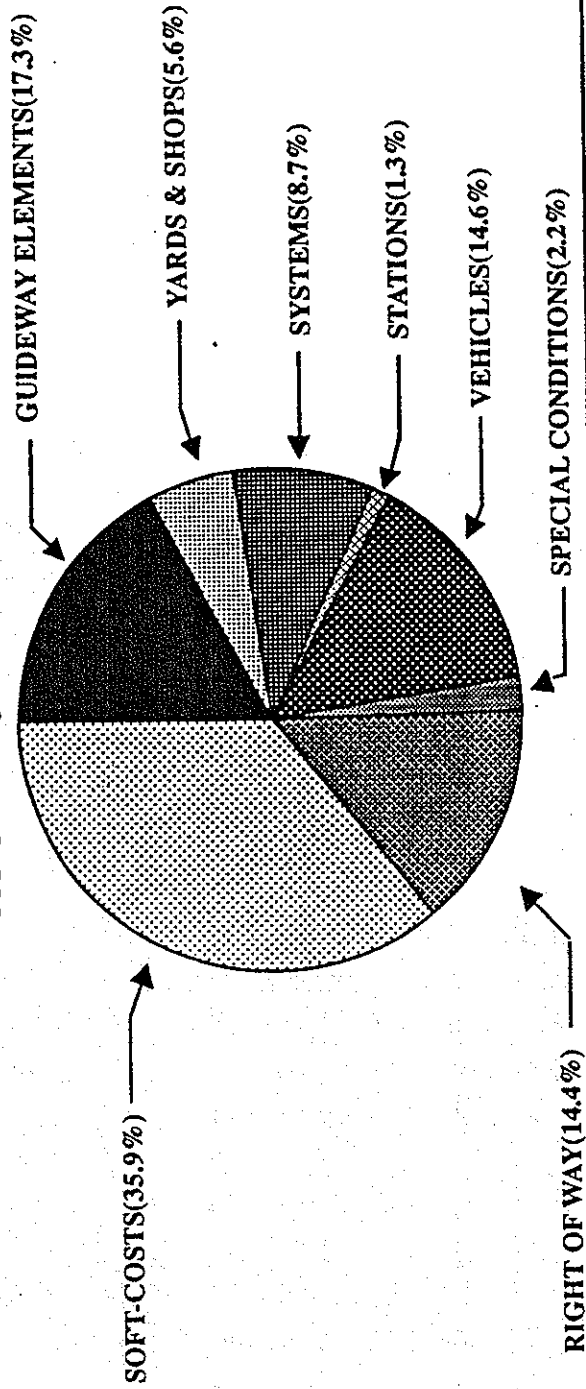
- *Sacramento* is the lowest cost project of the responding systems -- Exhibit 13. This low cost reflects a philosophy of design simplicity using at-grade construction and single track operation as much as possible. A simplified design approach to stations and yards and shops costs also reflect this design philosophy. The capital costs of the recent and ongoing system upgrades to increase the proportion of double track and the additional turnouts necessary to increase operational consistency were not included in this cost summary of the original project. Vehicle costs and special conditions were the proportionately higher "as built" cost categories while the lower categories were yards and shops and soft costs for Sacramento in comparison to the other systems.
- *San Jose*, Exhibit 14, is the initial line of a planned larger light rail system which includes some higher unit costs and additional facilities that relate to the expanded system base, such as yards and shops and other systems capacity. These particular component unit costs would be more representative of the unit capital costs and asset requirements encountered by larger systems with an individual line under development. Elsewhere, this line's unit costs were maintained to about average for the five light rail lines in the data base, since almost the entire line length is at-grade. The 99% at-grade alignment held guideway and station costs below the average. This San Jose line was proportionately slightly high for right-of-way and project soft costs, and low on guideway and station cost proportions.

EXHIBIT 13
SACRAMENTO REGIONAL TRANSIT DISTRICT
CAPITAL COSTS BY PROJECT CATEGORY



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	25.8%	\$46,678,400	\$52,721,856	\$47,908,608
2.00 YARDS & SHOPS	2.2%	\$3,979,000	\$4,490,971	\$4,086,783
3.00 SYSTEMS	10.8%	\$19,448,037	\$22,051,392	\$20,036,544
4.00 STATIONS	5.7%	\$10,270,000	\$11,591,412	\$10,548,188
5.00 VEHICLES	19.2%	\$34,600,000	\$38,316,708	\$34,868,232
6.00 SPECIAL CONDITIONS	6.7%	\$12,153,425	\$13,768,128	\$12,536,832
7.00 RIGHT OF WAY	9.6%	\$17,408,000	\$19,700,736	\$17,909,760
TOTAL HARD COSTS	80.0%	\$144,536,862	\$162,641,203	\$147,894,947
8.00 SOFT-COSTS	20.0%	\$36,119,000	\$44,214,720	\$40,185,024
TOTAL PROJECT COST	100.0%	\$180,655,862	\$206,855,923	\$188,079,971

EXHIBIT 14
SANTA CLARA COUNTY TRANSPORTATION AGENCY
COSTS BY PROJECT CATEGORY

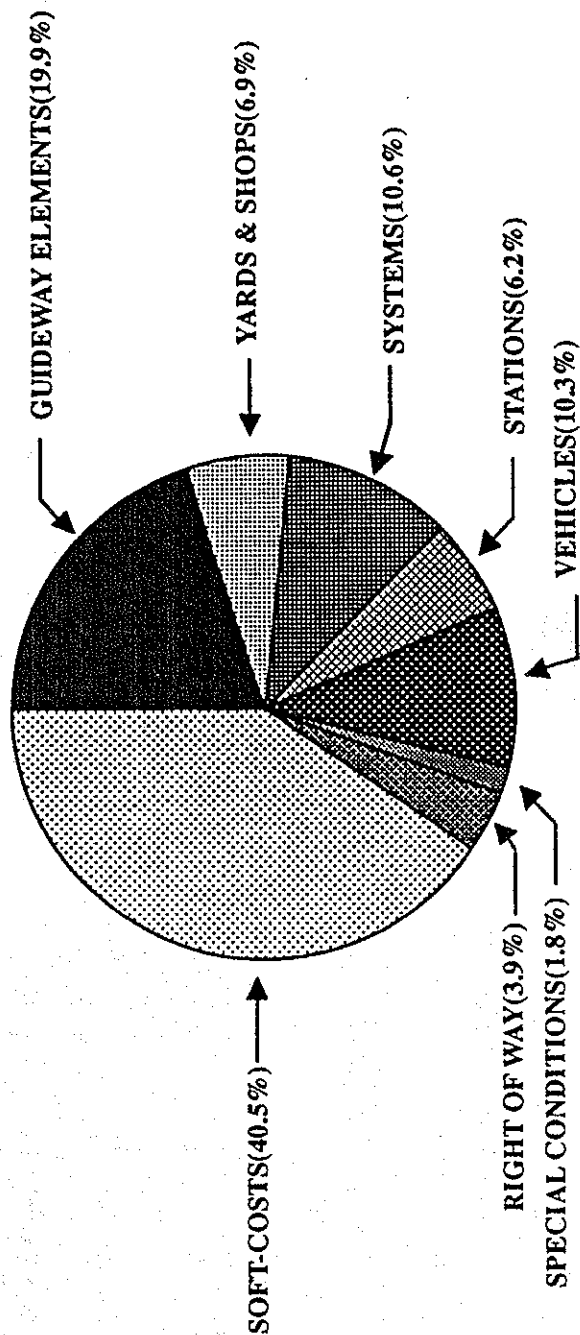


	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	17.3%	\$65,887,000	\$70,078,704	\$56,095,864
2.00 YARDS & SHOPS	5.6%	\$21,291,136	\$23,578,224	\$18,862,579
3.00 SYSTEMS	8.7%	\$33,124,742	\$33,158,400	\$26,505,600
4.00 STATIONS	1.3%	\$4,914,000	\$4,973,694	\$3,978,942
5.00 VEHICLES	14.6%	\$55,611,000	\$64,663,950	\$51,731,150
6.00 SPECIAL CONDITIONS	2.2%	\$8,487,000	\$9,376,728	\$7,484,932
7.00 RIGHT OF WAY	14.4%	\$54,617,000	\$61,606,748	\$49,351,200
TOTAL HARD COSTS	64.1%	\$243,931,878	\$267,436,448	\$214,010,267
8.00 SOFT-COSTS	35.9%	\$136,417,000	\$151,096,924	\$120,828,188
TOTAL PROJECT COST	100.0%	\$380,348,878	\$418,533,372	\$334,838,455

- *Pittsburgh* is a reconstruction and expansion of an existing line with commensurately lower costs for right-of-way and special conditions -- Exhibit 15. These unit costs are representative of the capital costs necessary to rehabilitate an existing light rail line or system. On the other hand, 13% of the line was placed in a new subway alignment, raising overall guideway costs, but also providing a good basis to estimate future subway costs, particularly the highest unit costs for the section through bedrock in downtown Pittsburgh. This subway section also offers cost information for the construction of subway stations through similar grade and high activity construction locations. Proportionately, Pittsburgh was high in soft costs, mainly due to a single line item of \$91 million in other costs.
- *Los Angeles*, is the first in a series of new lines for the region and the entire systems/support facilities were designed to integrate into the total network. The double-track guideway includes elevated and subway sections with provision for connections into the other portions of the regional rail network. This line also provides subway or tunnel construction costs that averaged about the same as Pittsburgh's overall. Exhibit 16 presents the "as built", city and national costs by category with relatively low guideway costs and high special conditions on a proportionate basis.

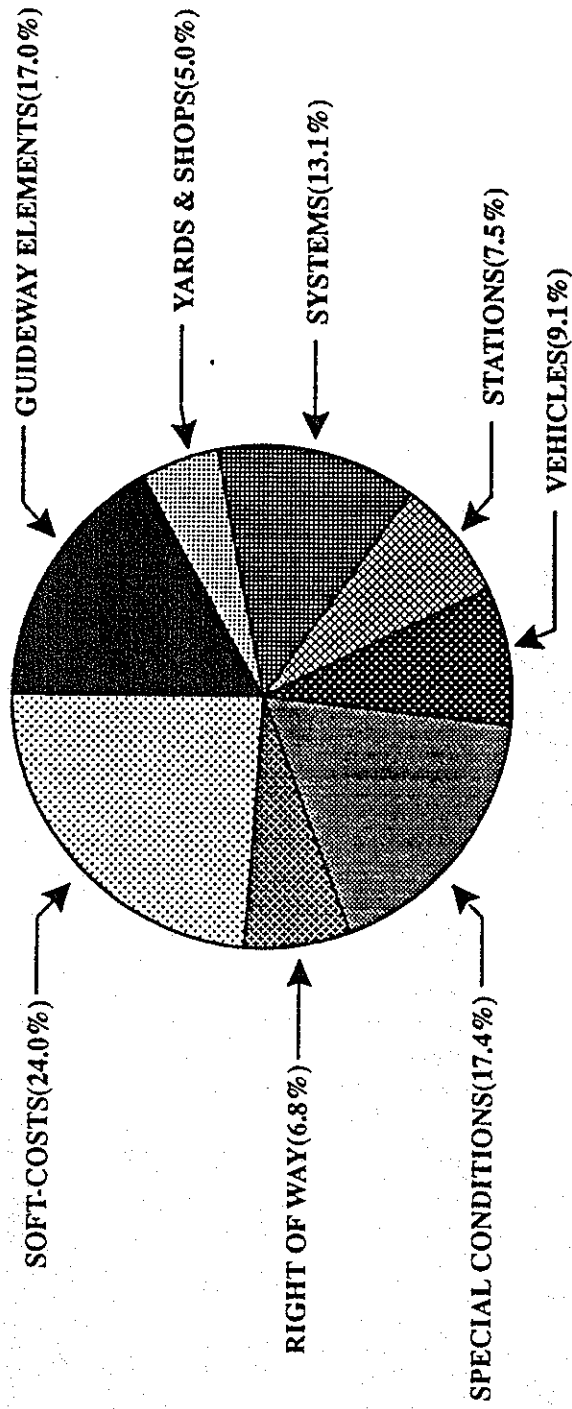
These "as built", city, and national costs by component category form the basis for the comparative unit cost analysis using the normalized national unit cost calculations.

EXHIBIT 15
PORT AUTHORITY OF ALLEGHENY COUNTY
COSTS BY PROJECT CATEGORY



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	19.9%	\$110,472,428	\$125,786,606	\$123,954,584
2.00 YARDS & SHOPS	6.9%	\$38,183,186	\$43,096,147	\$42,837,570
3.00 SYSTEMS	10.6%	\$58,885,157	\$66,498,182	\$66,087,192
4.00 STATIONS	6.2%	\$34,282,779	\$38,693,880	\$38,461,716
5.00 VEHICLES	10.3%	\$57,399,440	\$64,784,940	\$64,396,200
6.00 SPECIAL CONDITIONS	1.8%	\$10,038,972	\$11,425,522	\$11,343,324
7.00 RIGHT OF WAY	3.9%	\$21,511,920	\$24,988,192	\$24,823,796
TOTAL HARD COSTS	59.6%	\$330,773,882	\$375,273,469	\$371,904,382
8.00 SOFT-COSTS	40.5%	\$224,751,180	\$253,663,028	\$252,183,464
TOTAL PROJECT COST	100.0%	\$555,525,062	\$628,936,497	\$624,087,846

EXHIBIT 16
LOS ANGELES COUNTY TRANSPORTATION COMMISSION
CAPITAL COSTS BY PROJECT CATEGORY



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	17.0%	\$148,719,104	\$154,232,919	\$135,147,639
2.00 YARDS & SHOPS	5.0%	\$44,204,740	\$45,855,539	\$40,169,453
3.00 SYSTEMS	13.1%	\$115,273,245	\$119,520,564	\$104,729,596
4.00 STATIONS	7.5%	\$65,893,479	\$68,354,242	\$59,878,302
5.00 VEHICLES	9.1%	\$79,939,129	\$82,924,398	\$72,641,772
6.00 SPECIAL CONDITIONS	17.4%	\$152,349,392	\$172,004,644	\$150,653,166
7.00 RIGHT OF WAY	6.8%	\$60,084,803	\$62,384,486	\$54,631,156
TOTAL HARD COSTS	74.8%	\$666,463,892	\$705,276,792	\$617,851,084
8.00 SOFT-COSTS	24.0%	\$210,805,963	\$237,967,590	\$208,385,654
TOTAL PROJECT COST	100.0%	\$877,269,855	\$943,244,382	\$826,236,738

Comparative Unit Costs

Exhibits 17 through 23 show detailed comparative unit costs by component system. These exhibits cover each cost category except vehicles, which were displayed previously in Exhibit 11. The cost information is presented in 1990 national dollars which represents the individual component costs normalized to the 30 city nationwide construction index.

Guideway Cost per linear foot (Exhibit 17) varies considerably by system as previously mentioned, and also by grade as would be expected. The data base includes each of the major types of guideway construction. The average unit costs correspond with expected industry costs standards, except where at-grade guideway was slightly higher in cost than the elevated fill. The reason behind this was the rehabilitation of extensive elevated fill in Pittsburgh compared to new at-grade alignment costs elsewhere. For example:

<u>Type of Construction</u>	<u>Average Cost Per Linear Foot</u>	<u>Average Cost Per Guideway Mile</u>
At-Grade	\$665	\$3.51 M
Elevated Structure	\$1,768	\$9.34 M
Elevated Retained Fill	\$994	\$5.25 M
Elevated Fill	\$658	\$3.47 M
Subway	\$7,001	\$36.97 M
Retained Cut	\$3,319	\$17.52 M

Within grade categories, there are also variations in track laying methods. For example, the least expensive method for at-grade track is simple

Exhibit 17 **Guideway Costs Per Linear Foot** **1990 National Dollars**

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
At-Grade Avg.	\$1,205	\$413	\$609	\$460	\$636	\$665
Direct Fixation	--	--	--	696	--	696
Ballasted	679	350	610	375	442	491
In-Pavement Ballasted	--	526	--	--	2,588	1,557
Embedded	3,713	--	606	583	906	1,452
Elevated Structure Avg.	3,041	410	--	636	2,986	1,768
Direct Fixation	--	410	--	535	2,756	1,233
Ballasted	2,602	--	--	1,119	4,516	2,746
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	3,365	--	--	506	--	1,935
Elevated Retained Fill Avg.	--	1,077	--	951	943	999
Direct Fixation	--	--	--	--	--	--
Ballasted	1,172	--	--	--	847	1,010
In-Pavement Fallasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Elevated Fill Avg.	--	--	--	699	616	658
Direct Fixation	--	--	--	--	--	--
Ballasted	--	--	--	--	616	616
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Subway Avg.	--	--	6,887	7,182	6,935	7,001
Direct Fixation	--	--	--	20,730	6,329	13,529
Ballasted	--	--	--	--	--	--
In-Pavement Ballasted	--	--	--	4,730	--	4,730
Embedded	--	--	--	506	--	506
Retained Cut	--	4,973	265	4,904	3,133	3,319
Direct Fixation	--	--	--	--	4,322	4,322
Ballasted	5,410	--	--	329	--	2,870
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Special Track Work Per						
Linear Foot of Guideway	\$33	\$15	\$17	NR	\$35	\$25

ballasted guideway and it is clear from the data that this method is used wherever possible -- two-thirds of the 392,000 linear feet of at-grade track in the sample was ballasted. This is also true for elevated track where 64% of the 57,000 linear feet in the sample was ballasted (combining all forms of elevated guideway). Combining the entire sample of 475,847 linear feet yields the following breakdown of construction methods:

<u>Type of Trackwork</u>	<u>Linear Feet</u>	<u>Percent</u>
Ballasted	305,022	64.1%
In-Pavement Ballasted	43,490	9.1%
Direct Fixation	28,912	6.1%
Embedded	<u>98,423</u>	<u>20.7%</u>
Total	475,847	100.0 %

Exhibit 17 also presents comparative unit costs for special trackwork such as turnouts and crossovers which average \$25.00 per linear foot of guideway.

Yards and Shops Cost and comparative features are provided in Exhibit 18. Both cost per facility and cost per unit of shop capacity vary by a factor of almost 10. Some of this variation is explained by facility features (e.g., Sacramento does not incorporate heavy repair, motor or car wash/cleaning shops). There is also variation because some yards and shops were designed to accommodate future system expansions (e.g., Los Angeles). Variations also exist for local cost of construction. For example, even when "national average" construction indices were applied to Los Angeles and Pittsburgh costs, they were still significantly higher than the other three systems. Further unit cost and component details are provided

Exhibit 18
Summary Yards and Shops Costs and Features
1990 National Dollars

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Yards & Shops Per Facility	\$13.36M	\$4.09M	\$18.86M	\$42.84M	\$40.17M	\$23.86M
Cost per Shop Capacity	\$133,558	\$81,735	\$362,402	\$441,624	\$743,879	\$352,640
Heavy Repair	Y	N	Y	NR	Y	
Motor Shops	N	N	Y	NR	NR	
Wheel Shop	Y	Y	Y	NR	Y	
Machine Shop	Y	Y	Y	NR	NR	
Air Conditioning	NR	Y	Y	NR	NR	
Electronics	Y	Y	Y	NR	Y	
Communications	Y	Y	Y	NR	NR	
Car Wash/Cleaning	Y	N	Y	NR	Y	
Maintenance-of-Way Shops	Y	Y	NR	Y	NR	
Maintenance-of-Way Equipment	Y	Y	NR	NR	Y	
Revenue Center	NR	N	NR	Y	NR	
Control Center	NR	N	NR	NR	Y	

for every system and cost category in the data base sheets in Appendices A - E.

Systems Costs ranges vary by more than 100% of the average for every component category (Exhibit 19). Several of the categories vary because of operating complexities and designs for future expansion (e.g., communications costs in Los Angeles). The method of fare collection varies from on-board fareboxes to self-service impacting fare collection hardware costs. This category is also affected by single-track operation. For example, electrification costs per linear foot of guideway in Sacramento is \$92 compared to an average for the other four systems of \$259 per linear foot of guideway.

Station Cost is shown in Exhibit 20 which highlights the wide variation of designs from fairly simple "on-street" stops to major buildings. Of the 109 stations in the sample, over 90% are at-grade and three-quarters of the total are side platforms. At-grade costs range from a low of \$156,000 per station for a center platform to a high of \$1,924,000 for a side platform station. The other station cost categories are limited and provide mainly cost examples.

Special Condition Costs are driven by particular local situations (Exhibit 21). Utility relocations are the largest category and most typically include gas, telephone, electric and water. All systems incurred some "demolitions" costs, but the balance of the costs are very site-specific. On average, these systems cost \$353 per linear foot of guideway, but a consistent grouping was formed by four of the systems with an average of \$125.50 per linear foot.

Right-of-Way and Related Costs averaged \$412.76 per linear foot of guideway, with 90% of this category involving land acquisition (Exhibit 22). As would be expected, this group of costs are very location-sensitive, with the range being 70% of the average.

Exhibit 19
Summary Systems Costs
1990 National Dollars

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Signal System per Linear Foot of Guideway	\$105	\$76	\$54	\$322	\$310	\$173
Electrification per Linear Foot of Guideway	\$148	\$92	\$142	\$369	\$377	\$225
Total Communications Cost	NR	\$196,121	\$2,348,358	\$10,016,547	\$17,348,680	\$7,477,427
Total Fare Collection Equipment Cost	\$3,631,126	\$1,080,497	\$3,460,050	NR	\$5,456,404	\$3,407,019
Total Systems Cost per Linear Foot of Guideway	\$297	\$179	\$251	\$804	\$878	\$482

Exhibit 20

Summary Stations Costs and Features

1990 National Dollars in Thousands

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles	Number/ Average
At-Grade						
Center Platform						
• Number	5	0	3	0	15	23
• Cost per Station	\$492	\$0	\$156	\$0	\$981	\$543
Side Platform						
• Number	20	28	19	9	3	79
• Cost per Station	\$539	\$377	\$185	\$1,924	\$830	\$771
Elevated						
Center Platform						
• Number	0	0	0	0	3	3
• Cost per Station	\$0	\$0	\$0	\$0	\$2,661	\$2,661
Side Platform						
• Number	0	0	0	0	0	0
• Cost per Station	\$0	\$0	\$0	\$0	\$0	\$0
Subway						
Center Platform						
• Number	0	0	0	0	0	0
• Cost per Station	\$0	\$0	\$0	\$0	\$0	\$0
Side Platform						
• Number	0	0	0	3	1	4
• Cost per Station	\$0	\$0	\$0	\$6,806	\$25,157	\$15,982
Parking Lots	5	8	NR	NR	5	
Parking Spaces	1,636	3,850	NR	NR	1,051	
Cost per Space	\$2	NR	NR	NR	\$7	\$5

Exhibit 21
Summary of Special Conditions Costs
1990 National Dollars in Thousands
All Costs Per Linear Foot of Guideway

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Utility Relocation Total	\$79.46	\$44.51	\$142.69	\$55.52	\$21.16	
• New Installation	\$0.00	\$3.55	\$54.76	\$0.00	\$0.00	
• Gas	\$0.00	\$0.00	\$1.70	\$7.95	\$3.29	
• Telephone	\$0.00	\$0.41	\$0.25	\$3.42	\$1.49	
• Electric	\$13.84	\$23.63	\$1.70	\$40.46	\$0.43	
• Water	\$65.62	\$0.00	\$3.80	\$3.70	\$1.08	
• Pipeline	\$0.00	\$11.29	\$0.00	\$0.00	\$8.34	
• Railroad	\$0.00	\$5.24	\$0.00	\$0.00	\$0.00	
• Other	\$0.00	\$0.39	\$0.47	\$0.00	\$6.53	
Utility Betterments Total	\$0.00	\$4.42	\$0.00	\$67.97	\$992.98	
• New Installation	\$0.00	\$4.42	\$0.00	\$7.71	\$0.00	
• Gas	\$0.00	\$0.00	\$0.00	\$9.14	\$38.45	
• Telephone	\$0.00	\$0.00	\$0.00	\$10.57	\$16.51	
• Electric	\$0.00	\$0.00	\$0.00	\$39.32	\$176.70	
• Water	\$0.00	\$0.00	\$0.00	\$0.00	\$51.14	
• Pipeline	\$0.00	\$0.00	\$0.00	\$0.00	\$227.02	
• Railroad	\$0.00	\$0.00	\$0.00	\$0.00	\$467.62	
• Other	\$0.00	\$0.00	\$0.00	\$1.22	\$15.55	
Demolitions	\$1.41	\$3.06	\$5.52	\$10.51	\$8.02	
Roadway Changes	\$0.00	\$59.52	\$0.00	\$0.00	\$100.21	
Environmental	\$0.00	\$0.00	\$23.18	\$4.33	\$140.72	
Total All Special Conditions	\$80.86	\$111.51	\$171.38	\$138.33	\$1,263.10	\$353.04

Exhibit 22
Summary of Right-of-Way and Related Costs
1990 National Dollars

Cost per Linear Foot of Guideway	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles	Average
• Land	\$192.95	\$152.46	\$563.41	\$302.48	\$422.34	\$326.73
• Legal & Consulting	\$33.99	\$4.41	\$10.14	NR	\$16.89	\$16.36
• Appraisal	\$33.99	\$2.78	\$10.14	NR	\$0.31	\$11.80
• Property Management	\$3.67	\$0.08	\$10.14	NR	\$17.13	\$7.76
• Relocation	\$2.39	NR	\$5.73	NR	\$1.17	\$3.10
• Total	\$266.98	\$159.73	\$599.57	NR	\$457.83	\$405.71
Land Cost per Acre	\$108.94	NR	\$302.89	NR	NR	--

Project Soft Costs are shown in Exhibit 23. Approximately half of these costs are in the construction/project management category, with almost 40% in the feasibility/engineering and design studies. Several projects were carried out prior to the requirement for project management oversight and show no cost in this category.

Exhibit 23
Summary of Project Soft Costs
1990 National Dollars
All Costs Per Linear Foot of Guideway

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Feasibility/Engineering and and Design Studies	\$246.04	\$199.41	\$442.53	\$728.47	\$576.79	\$438.65
Construction/Project Management	\$422.36	\$124.39	\$887.26	\$355.65	\$906.23	\$539.18
Project Management Oversight			\$15.73		\$38.05	
Project Initiation • Insurance • Mobilization • Maintenance of Traffic	\$73.02	\$11.79	\$75.58 \$5.40		\$295.75	
Finance Charges		\$4.89				
Training/Start-Up/Testing	\$99.21	\$41.29	\$43.16		\$82.19	\$66.46
Total Soft Costs	\$840.64	\$381.77	\$1,469.58	\$1,084.13	\$1,899.01	\$1,135.02

**APPENDIX:
CAPITAL COST DATA BASE**

PORTLAND

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
1	1.00 GUIDEWAY ELEMENTS	Linear Feet	80,179	\$1,180	\$94,599,637		\$1,342	\$1,329
2	1.01 GUIDEWAY AT-GRADE	Linear Feet	52,212	\$1,070	\$55,869,000		\$1,217	\$1,205
3	DIRECT FIXATION							
4	BALLASTED		42,949	\$590		\$25,377,000	\$686	\$679
5	IN-PAVEMENT BALLASTED							
6	EMBEDDED		9,263	\$3,297		\$30,542,000	\$3,751	\$3,714
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4,032	\$2,700	\$10,886,000		\$3,072	\$3,047
8	DIRECT FIXATION							
9	BALLASTED		1,713	\$2,310		\$3,957,000	\$2,628	\$2,602
10	IN-PAVEMENT BALLASTED							
11	EMBEDDED		2,319	\$2,988		\$6,929,000	\$3,399	\$3,365
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	23,665	\$1,018	\$24,089,000		\$1,184	\$1,172
13	DIRECT FIXATION							
14	BALLASTED		23,665	\$1,018		\$24,089,000	\$1,184	\$1,172
15	IN-PAVEMENT BALLASTED							
16	EMBEDDED							
17	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet						
18	DIRECT FIXATION							
19	BALLASTED							
20	IN-PAVEMENT BALLASTED							
21	EMBEDDED							
22	1.05 GUIDEWAY - SUBWAY	Linear Feet						
23	DIRECT FIXATION							
24	BALLASTED							
25	IN-PAVEMENT BALLASTED							
26	EMBEDDED							
27	1.06 GUIDEWAY - RETAINED CUT	Linear Feet	270	\$4,804	\$1,297,000		\$5,465	\$5,410
28	DIRECT FIXATION							
29	BALLASTED		270	\$4,804		\$1,297,000	\$5,465	\$5,410
30	IN-PAVEMENT BALLASTED							
31	EMBEDDED							
32	1.07 POCKET TRACK	L.F. Guideway	80,179	\$2.49	\$200,000		\$2.84	\$2.87
33	1.08 STORAGE TRACK	L.F. Guideway	80,179	\$28.17	\$2,258,637		\$32.76	\$32.43
34	1.09 SPECIAL TRACKWORK	L.F. Guideway	58	\$21,163	\$1,227,445		\$24,608	\$24,362
35	TURNOUTS	Each	31	\$18,458		\$572,198		
36	#5							
37	#4		7	\$19,237		\$134,659	\$22,369	\$22,145
38	#6		17	\$21,551		\$366,367	\$25,059	\$24,809
39	#8							
40	#10							

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT					1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS (continued)			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
41 #20			3	\$51,407		\$154,221	1983	\$59,776	\$59,178
42 OTHER - SPECIFY			20	\$51,560	\$1,031,192		1982	\$63,108	\$62,477
43 GIRDER, 25 METER			1	\$112,546		\$112,546	1982		
44 GIRDER, 50 METER			9	\$46,804		\$421,236	1982		
45 #4, GIRDER			10	\$49,741		\$497,410	1982		
46 #8 SINGLE CROSSOVER									
47 #4 DOUBLE CROSSOVER									
48 #5 DOUBLE CROSSOVER									
49 INTERSECTION									
50 1.10 GUIDEWAY-SPECIAL STRUCTURES									
51 BRIDGES	Linear Feet								
52 OVERPASSES	Each								
53 OTHER	Each								
54									
55 2.00 YARDS & SHOPS	Total		1	\$11,602,000	\$11,602,000		1983	\$13,490,698	\$13,355,791
56 2.01 BUILDING	Each		1	\$9,201,000	\$9,201,000		1983	\$10,698,837	\$10,591,849
57 DES. LIFTION	Revenue Vehicles		100	\$116,020			1983	\$134,907	\$133,558
58 SHOP CAPACITY *	Revenue Vehicles		26						
59 YARD STORAGE CAPACITY	Each		12						
60 WORKSTATIONS	Linear Feet		7,728						
61 TRACK LENGTH	Spaces								
62 PARKING	All								
63 2.02 OFFICE FURNITURE & EQUIP.	(Y/N)		1	\$60,000	\$60,000		1983	\$69,767	\$69,070
64 2.03 HEAVY REPAIR	(Y/N)		Y						
65 BODY	(Y/N)		Y						
66 TRUCK	(Y/N)		Y						
67 EQUIPMENT	(Y/N)		Y						
68 2.04 MOTOR SHOPS	(Y/N)		1	\$10,000	\$10,000		1983	\$11,628	\$11,512
69 VARIABLE TEST LOAD	(Y/N)		N						
70 REWIND	(Y/N)								
71 OTHER	(Y/N)								
72 2.05 WHEEL SHOP	(Y/N)		1	\$676,000	\$676,000		1983	\$786,047	\$776,186
73 WHEEL PRESS	Each								
74 WHEEL TRUING	Each								
75 2.06 MACHINE SHOP	(Y/N)		1	\$205,000	\$205,000		1983	\$238,372	\$235,988
76 LATHE	Each								
77 DRILL PRESS	Each								
78 2.07 AIR CONDITIONING	(Y/N)								
79 2.08 ELECTRONICS	(Y/N)		1	\$200,000	\$200,000		1983	\$232,558	\$230,253

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT					1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
80	2.00 YARDS & SHOPS (continued)	(Y/N)	60	\$6,000	\$360,000		1983	\$6,877	\$6,807
81	2.09 COMMUNICATIONS	(Y/N)	Y						
82	2.10 CAR WASH/CAR CLEANING		1	\$137,000	\$137,000		1983	\$159,302	\$157,709
83	2.11 MAINTENANCE OF WAY SHOPS								
84	SIGNAL	(Y/N)				\$137,000			
85	TRACTION POWER	(Y/N)							
86	COMPONENT REPAIR	(Y/N)							
87	TRACK	(Y/N)							
88	2.12 MAINTENANCE OF WAY EQUIPMENT		15	\$50,200	\$753,000		1984	\$57,110	\$56,539
89	TRUCK	Each	10	\$51,900		\$519,000	1984		
90	CRANE	Each	1	\$54,000		\$54,000	1984		
91	OTHER	Each	4	\$45,000		\$180,000	1984		
92	2.13 REVENUE CENTER								
93	CASH COUNTING MACHINE								
94	VAULT								
95	OTHER								
96	2.14 CENTRAL CONTROL	(Y/N)							
97	MIMIC BOARD	(Y/N)							
98	PUBLIC ADDRESS	(Y/N)							
99	COMPUTER	(Y/N)							
100	FIRE/INTRUSION DETECTOR	(Y/N)							
101	MAINLINE CONTROL	(Y/N)							
102	YARD CONTROL	(Y/N)							
103	SEISMIC OR GAS DETECTION	(Y/N)							
104	OTHER								
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity								
106	3.00 SYSTEMS		80,179	\$264.00	\$21,167,000		1984	\$300	\$297
107	3.01 SIGNAL SYSTEM	Linear Feet	80,179	\$92.99	\$7,456,000		1984	\$106	\$105
108	TRAIN CONTROL - WAYSIDE	L.F. Gulldeway	80,179	\$85.52	\$6,857,000		1984	\$97	\$96
109	INSTALLATION		80,179	\$85.52		\$6,857,000	1984		
110	HARDWARE								
111	DESIGN		21	\$28,524	\$599,000		1984	\$32,450	\$32,126
112	CROSSING PROTECTION	Each	21	\$28,524		\$599,000	1984	\$32,450	\$32,126
113	TRAFFIC SIGNALS	Each							
114	INSTALLATION								
115	GATES	Each							
116	OTHER								
117	3.02 ELECTRIFICATION	L.F. Gulldeway	80,179	\$130.79	\$10,487,000		1984	\$149	\$147
118	SUBSTATIONS	Each	15	\$236,667	\$3,550,000		1984	\$269,245	\$266,553

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT					1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
				QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
3.00 SYSTEMS (continued)										
1119	PURCHASE	Each	15	\$220,000			\$3,300,000	1984		\$97.44
1120	INSTALLATION	Each					\$250,000	1984	\$98	
1121	CATENARY	L.P. Guideway	80,179	\$86.52	\$6,937,000			1984		
1122	INSTALLATION	Each	80,179	\$6.24			\$500,000	1984		
1123	POLES AND COMPONENTS	Each	1,000	\$6,000			\$6,000,000	1984	\$6,826	\$6,758
1124	WIRE	Each	330,000	\$1.32			\$437,000	1984	\$1.51	\$1.49
1125	TROLLEY		330,000	\$1.32			\$437,000	1984		
1126	MESSENGER									
1127	FEEDER									
1128	RETURN									
1129	3.03 COMMUNICATIONS	Total	1	\$3,224,000	\$3,224,000			1984	\$3,667,804	\$3,631,126
1130	3.04 FARE COLLECTION	Total								
1131	FAREBOX		68	\$35,632			\$2,423,000	1984		
1132	VENDING MACHINE		88	\$9,102			\$801,000	1984		
1133	OTHER									
4.00 STATIONS										
1135	4.01 AT-GRADE	Each	25	\$604,280	\$15,107,000			1985	\$682,032	\$675,211
1136	CENTER PLATFORM	Each	25	\$473,400	\$11,835,000			1985	\$534,312	\$528,968
1137	PLATFORM LENGTH	Each	5	\$440,200	\$2,201,000		\$2,000,000	1985	\$496,840	\$491,871
1138	ESCALATOR/ELEVATOR	Linear Feet	1,000	\$80,000						
1139	HANDICAP ACCESS MODE	(Y/N)	0/3							
1140	WEATHER COVERAGE	Type	WAYSIDE LIFT	\$40,200			\$201,000	1985		
1141	WEATHER COVERAGE	Percent								
1142	SIDE PLAT -ORM	Each	20	\$481,700	\$9,634,000			1985	\$543,679	\$538,243
1143	PLATFORM LENGTH	Linear Feet	8,000	\$1,104			\$8,831,000			
1144	ESCALATOR/ELEVATOR	(Y/N)								
1145	HANDICAP ACCESS MODE	Type	WAYSIDE LIFT	\$40,150			\$803,000	1985		
1146	WEATHER COVERAGE	Percent								
1147	WEATHER COVERAGE	Each								
4.02 SUBWAY										
1148	CENTER PLATFORM	Each								
1149	PLATFORM LENGTH	Linear Feet								
1150	ESCALATOR/ELEVATOR	(Y/N)								
1151	HANDICAP ACCESS MODE	Type								
1152	WEATHER COVERAGE	Percent								
1153	WEATHER COVERAGE	Each								
1154	SIDE PLATFORM	Linear Feet								
1155	PLATFORM LENGTH	(Y/N)								
1156	ESCALATOR/ELEVATOR	Type								
1157	HANDICAP ACCESS MODE	(Y/N)								
1158	WEATHER COVERAGE	Percent								

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY	1990 NATIONAL
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	UNIT COST ESTIMATES	UNIT COST ESTIMATES
4.00 STATIONS (continued)								
4.03 ELEVATED		Each						
CENTER PLATFORM		Each						
PLATFORM LENGTH		Linear Feet						
ESCALATOR/ELEVATOR		(Y/N)						
HANDICAP ACCESS MODE		Type						
WEATHER COVERAGE		Percent						
SIDE PLATFORM		Each						
PLATFORM LENGTH		Linear Feet						
ESCALATOR/ELEVATOR		(Y/N)						
HANDICAP ACCESS MODE		Type						
WEATHER COVERAGE		Percent						
4.04 PARKING LOTS		Total	5	\$654,400	\$3,272,000		\$738,600	\$731,214
NUMBER OF LOTS			5	\$654,400				
NUMBER OF SPACES			1,636	\$2,000	\$3,272,000			
4.05 PARKING GARAGES		Total						
NUMBER OF LOTS								
NUMBER OF SPACES								
4.06 PEDESTRIAN OVERPASSES		Total						
5.00 VEHICLES								
5.01 REVENUE VEHICLES -- ORDER A		Each	26	\$969,923	\$25,218,000		\$1,291,509	\$1,278,594
MAKE/MANUFACTURER		Each	26	\$965,269	\$25,097,000		\$1,285,312	\$1,272,459
BODY TYPE (RIGID,ARTIC)		Name	BOMBARDIER	\$883,000			\$1,175,766	\$1,164,008
LENGTH OVER COUPLERS		Type	ARTIC					
WIDTH		Linear Feet	89					
NUMBER JEATS		Linear Feet	8.7					
AIR CONDITIONING		Each	76					
CA - SIGNAL EQUIPMENT		(Y/N)	N					
BRAKING SYSTEM (AIR,ELEC)		(Y/N)	N					
TYPE OF STEPS (HIGLOW)		Type	HYDRAULIC					
HANDICAPED (LIFT RAMP)		Type	HIGH					
ON-BOARD FAREBOX		Type	WAYSIDE LIFT					
PROCUREMENT COST		(Y/N)	N					
SPARE PARTS		Total	26	\$34,615		\$900,000	\$46,092	\$45,631
SPECIAL EQUIPMENT COST		Total	26	\$47,654		\$1,239,000	\$63,454	\$62,819
5.02 REVENUE VEHICLES -- ORDER B		Total	26					
MAKE/MANUFACTURER		Each						
BODY TYPE (RIGID,ARTIC)		Name						
LENGTH OVER COUPLERS		Type						
		Linear Feet						

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
				QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
5.00 VEHICLES (continued)			Linear Feet						
197	WIDTH		Each						
198	NUMBER SEATS		(Y/N)						
199	AIR CONDITIONING		(Y/N)						
200	CAB SIGNAL EQUIPMENT		Type						
201	BRAKING SYSTEM (AIR,ELEC)		Type						
202	TYPE OF STEPS (HIGH,LOW)		Type						
203	HANDICAPPED (LIFT,RAMP)		(Y/N)						
204	ON-BOARD FAREBOX		Total						
205	PROCUREMENT COST		Total						
206	SPARE PARTS		Total						
207	SPECIAL EQUIPMENT COST		Each						
208	MAKE/MANUFACTURER		Name						
209	BODY TYPE (RIGID,ARTIC)		Type						
210	LENGTH OVER COUPLERS		Linear Feet						
211	WIDTH		Linear Feet						
212	NUMBER SEATS		Each						
213	AIR CONDITIONING		(Y/N)						
214	CAB SIGNAL EQUIPMENT		(Y/N)						
215	BRAKING SYSTEM (AIR,ELEC)		Type						
216	TYPE OF STEPS (HIGH,LOW)		Type						
217	HANDICAPPED (LIFT,RAMP)		(Y/N)						
218	ON-BOARD FAREBOX		Total						
219	PROCUREMENT COST		Total						
220	SPARE PARTS		Total						
221	SPECIAL EQUIPMENT COST		Each						
222	SERVICE TRUCKS			12	\$10,083	\$121,000		1985	\$11,351
223	AUTOMOBILES			2	\$10,500		\$21,000	1985	
224	OTHER			10	\$10,000		\$100,000	1985	\$11,267
225									
226									
227									
6.00 SPECIAL CONDITIONS			Linear feet	80,179	\$72	\$5,756,000		1984	\$81
228	6.01 UTILITY RELOCATION - AS IS		Total	1	\$5,656,000	\$5,656,000		1984	\$6,370,239
229	NEW INSTALLATION								
230	GAS								
231	TELEPHONE								
232	ELECTRIC			1	\$985,000		\$985,000	1984	\$1,120,592
233	WATER			1	\$4,671,000		\$4,671,000	1984	\$5,313,993
234	PIPELINE								\$1,109,386
235									\$5,260,853

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT					1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
6.00 SPECIAL CONDITIONS (continued)									
236	RAILROAD	Total							
237	OTHER								
238	NEW INSTALLATION								
239	GAS								
240	TELEPHONE	Total							
241	ELECTRIC								
242	WATER								
243	PIPELINE								
244	RAILROAD	Total							
245	OTHER								
246	NEW INSTALLATION								
247	GAS								
248	TELEPHONE	Total							
249	ELECTRIC								
250	WATER								
251	PIPELINE								
252	RAILROAD	Total							
253	OTHER								
254	NEW INSTALLATION								
255	GAS								
256	TELEPHONE	Total							
257	ELECTRIC								
258	WATER								
259	PIPELINE								
260	RAILROAD	Total							
261	OTHER								
262	NEW INSTALLATION								
263	GAS								
264	TELEPHONE	Total							
265	ELECTRIC								
266	WATER								
267	PIPELINE								
268	RAILROAD	Total							
269	OTHER								
270	NEW INSTALLATION								
271	GAS								
272	TELEPHONE	Total							
273	ELECTRIC								
274	WATER								
275	PIPELINE								
276	RAILROAD	Total							
277	OTHER								
278	NEW INSTALLATION								
279	GAS								
280	TELEPHONE	Total							
281	ELECTRIC								
282	WATER								
283	PIPELINE								
284	RAILROAD	Total							
285	OTHER								
286	NEW INSTALLATION								
287	GAS								
288	TELEPHONE	Total							
289	ELECTRIC								
290	WATER								
291	PIPELINE								
292	RAILROAD	Total							
293	OTHER								
294	NEW INSTALLATION								
295	GAS								
296	TELEPHONE	Total							
297	ELECTRIC								
298	WATER								
299	PIPELINE								
300	RAILROAD	Total							
301	OTHER								
302	NEW INSTALLATION								
303	GAS								
304	TELEPHONE	Total							
305	ELECTRIC								
306	WATER								
307	PIPELINE								
308	RAILROAD	Total							
309	OTHER								
310	NEW INSTALLATION								
311	GAS								
312	TELEPHONE	Total							
313	ELECTRIC								
314	WATER								
315	PIPELINE								
316	RAILROAD	Total							
317	OTHER								
318	NEW INSTALLATION								
319	GAS								
320	TELEPHONE	Total							
321	ELECTRIC								
322	WATER								
323	PIPELINE								
324	RAILROAD	Total							
325	OTHER								
326	NEW INSTALLATION								
327	GAS								
328	TELEPHONE	Total							
329	ELECTRIC								
330	WATER								
331	PIPELINE								
332	RAILROAD	Total							
333	OTHER								
334	NEW INSTALLATION								
335	GAS								
336	TELEPHONE	Total							
337	ELECTRIC								
338	WATER								
339	PIPELINE								
340	RAILROAD	Total							
341	OTHER								
342	NEW INSTALLATION								
343	GAS								
344	TELEPHONE	Total							
345	ELECTRIC								
346	WATER								
347	PIPELINE								
348	RAILROAD	Total							
349	OTHER								
350	NEW INSTALLATION								
351	GAS								
352	TELEPHONE	Total							
353	ELECTRIC								
354	WATER								
355	PIPELINE								
356	RAILROAD	Total							
357	OTHER								
358	NEW INSTALLATION								
359	GAS								
360	TELEPHONE	Total							
361	ELECTRIC								
362	WATER								
363	PIPELINE								
364	RAILROAD	Total							
365	OTHER								
366	NEW INSTALLATION								
367	GAS								
368	TELEPHONE	Total							
369	ELECTRIC								
370	WATER								
371	PIPELINE								
372	RAILROAD	Total							
373	OTHER								
374	NEW INSTALLATION								
375	GAS								
376	TELEPHONE	Total							
377	ELECTRIC								
378	WATER								
379	PIPELINE								
380	RAILROAD	Total							
381	OTHER								
382	NEW INSTALLATION								
383	GAS								
384	TELEPHONE	Total							
385	ELECTRIC								
386	WATER								
387	PIPELINE								
388	RAILROAD	Total							
389	OTHER								
390	NEW INSTALLATION								
391	GAS								
392	TELEPHONE	Total							
393	ELECTRIC								
394	WATER								
395	PIPELINE								
396	RAILROAD	Total							
397	OTHER								
398	NEW INSTALLATION								
399	GAS								
400	TELEPHONE	Total							
401	ELECTRIC								
402	WATER								
403	PIPELINE								
404	RAILROAD	Total							
405	OTHER								
406	NEW INSTALLATION								
407	GAS								
408	TELEPHONE	Total							
409	ELECTRIC								
410	WATER								
411	PIPELINE								
412	RAILROAD	Total							
413	OTHER								
414	NEW INSTALLATION								
415	GAS								
416	TELEPHONE	Total							
417	ELECTRIC								
418	WATER								
419	PIPELINE								
420	RAILROAD	Total							
421	OTHER								
422	NEW INSTALLATION								
423	GAS								
424	TELEPHONE	Total							
425	ELECTRIC								
426	WATER								
427	PIPELINE								
428	RAILROAD	Total							
429	OTHER								
430	NEW INSTALLATION								
431	GAS								
432	TELEPHONE	Total							
433	ELECTRIC								
434	WATER								
435	PIPELINE								
436	RAILROAD	Total							
437	OTHER								
438	NEW INSTALLATION								
439	GAS								
440	TELEPHONE	Total							
441	ELECTRIC								
442	WATER								
443	PIPELINE								
444	RAILROAD	Total							
445	OTHER								
446	NEW INSTALLATION								
447	GAS								
448	TELEPHONE	Total							
449	ELECTRIC								
450	WATER								
451	PIPELINE								
452	RAILROAD	Total							
453	OTHER								
454	NEW INSTALLATION								
455	GAS								
456	TELEPHONE	Total							
457	ELECTRIC								
458	WATER								
459	PIPELINE								
460	RAILROAD	Total							
461	OTHER								
462	NEW INSTALLATION								
463	GAS								
464	TELEPHONE	Total							
465	ELECTRIC								
466	WATER								
467	PIPELINE								
468	RAILROAD	Total							
469	OTHER								
470	NEW INSTALLATION								
471	GAS								
472	TELEPHONE	Total							
473	ELECTRIC								

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$1,473,000	\$1,473,000		\$1,802,938	\$1,784,908
282	LEGAL & CONSULTING		1			\$615,000		
283	APPRAISAL		1			\$615,000		
284	PROPERTY MANAGEMENT		1			\$243,000		
285	7.04 RELOCATION	Total	1	\$158,000	\$158,000		\$193,360	\$191,457
286	BUSINESS		1	\$79,000		\$79,000		
287	RESIDENCE		1	\$79,000		\$79,000		
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	80,179	\$727	\$58,278,000		\$820	\$812
290	8.01 FEASIBILITY STUDIES	Total	1	\$2,535,000	\$2,535,000		\$3,755,558	\$3,718,000
291	8.02 ENGINEERING & DESIGN	Total	1	\$13,212,000	\$13,212,000		\$16,171,359	\$16,009,645
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$17,000,000	\$17,000,000		\$19,340,159	\$19,146,758
293	8.04 PROJECT MANAGEMENT	Total	1	\$13,172,000	\$13,172,000		\$14,866,817	\$14,718,149
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total						
295	8.06 PROJECT INITIATION	Total	1	\$5,240,000	\$5,240,000		\$5,914,221	\$5,855,079
296	INSURANCE							
297	MOBILIZATION		1	\$5,240,000		\$5,240,000	\$5,914,221	\$5,855,079
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING		1	\$7,119,000	\$7,119,000		\$8,034,989	\$7,954,639
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER							

SACRAMENTO

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
1	1.00 GUIDEWAY ELEMENTS	Linear Feet	111,936	\$417	\$46,678,400		1985	\$428
2	1.01 GUIDEWAY AT-GRADE	Linear Feet	106,920	\$402	\$42,866,000		1985	\$413
3	DIRECT FIXATION							
4	BALLASTED		68,904	\$341		\$23,489,000	1985	\$350
5	IN-PAVEMENT BALLASTED		38,016	\$512		\$19,477,000	1985	\$526
6	EMBEDDED							
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	5,016	\$399	\$2,000,000		1985	\$410
8	DIRECT FIXATION		5,016	\$399		\$2,000,000	1985	\$410
9	BALLASTED							
10	IN-PAVEMENT BALLASTED							
11	EMBEDDED							
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet						
13	DIRECT FIXATION							
14	BALLASTED							
15	IN-PAVEMENT BALLASTED							
16	EMBEDDED							
17	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet						
18	DIRECT FIXATION							
19	BALLASTED							
20	IN-PAVEMENT BALLASTED							
21	EMBEDDED							
22	1.05 GUIDEWAY - SUBWAY	Linear Feet						
23	DIRECT FIXATION							
24	BALLASTED							
25	IN-PAVEMENT BALLASTED							
26	EMBEDDED							
27	1.06 GUIDEWAY - RETAINED CUT	Linear Feet						
28	DIRECT FIXATION							
29	BALLASTED							
30	IN-PAVEMENT BALLASTED							
31	EMBEDDED							
32	1.07 POCKET TRACK	L.F. Guideway						
33	1.08 STORAGE TRACK	L.F. Guideway						
34	1.09 SPECIAL TRACKWORK	L.F. Guideway						
35	TURNOUTS	Each	111,936	\$15.30	\$1,712,400		1985	\$15.71
36	#5		25	\$34,248		\$856,200	1985	\$35,176
37	#4							
38	#6		4	\$25,000		\$100,000	1985	\$25,677
39	#8		8	\$30,000		\$240,000	1985	\$30,813
40	#10		5	\$33,000		\$165,000	1985	\$33,894

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS (continued)			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
41 #20			8	\$43,900		\$351,200	1985	\$45,089
42 OTHER - SPECIFY								
43 GIRDER 25 METER								
44 GIRDER 50 METER								
45 #4 GIRDER								
46 #8 SINGLE CROSSOVER								
47 #4 DOUBLE CROSSOVER								
48 #5 DOUBLE CROSSOVER								
49 INTERSECTION								
50 1.10 GUIDEWAY-SPECIAL STRUCTURES					N.R.			
51 BRIDGES	Linear Feet		1					
52 OVERPASSES	Each		2					
53 OTHER	Each							
54								
55 2.00 YARDS & SHOPS								
56 2.01 BUILDING	Total		1	\$3,979,000	\$3,979,000	\$3,979,000	1985	\$4,086,783
57 DESCRIPTION	Each		1	\$3,979,000	\$3,979,000	\$3,979,000	1985	\$4,086,783
58 SHOP CAPACITY *	Revenue Vehicles		50					
59 YARD STORAGE CAPACITY	Revenue Vehicles		26					
60 WORKSTATIONS	Each		3					
61 TRACK LENGTH	Linear Feet		2,080					
62 PARKING	Spaces							
63 2.02 OFFICE FURNITURE & EQUIP.	All		76					
64 2.03 HEAVY REPAIR								
65 BODY	(Y/N)		N					
66 TRUCK	(Y/N)		N	\$79,580			1985	\$81,736
67 EQUIPMENT	(Y/N)		N					
68 2.04 MOTOR SHOPS								
69 VARIABLE TEST LOAD	(Y/N)		N					
70 REWIND	(Y/N)		N					
71 OTHER	(Y/N)		N					
72 2.05 WHEEL SHOP			2					
73 WHEEL PRESS	Each		1					
74 WHEEL TRUING	Each		1					
75 2.06 MACHINE SHOP			10					
76 LATTIE	Each		4					
77 DRILL PRESS	Each		6					
78 2.07 AIR CONDITIONING	(Y/N)		Y					
79 2.08 ELECTRONICS	(Y/N)		Y					

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
80	2.00 YARDS & SHOPS (continued)							
81	2.09 COMMUNICATIONS	(Y/N)	Y					
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	N					
83	2.11 MAINTENANCE OF WAY SHOPS		0					
84	SIGNAL	(Y/N)	Y					
85	TRACTION POWER	(Y/N)	Y					
86	COMPONENT REPAIR	(Y/N)	Y					
87	TRACK	(Y/N)	Y					
88	2.12 MAINTENANCE OF WAY EQUIPMENT		14					
89	TRUCK	Each	8					
90	CRANE	Each	1					
91	OTHER	Each	5					
92	2.13 REVENUE CENTER	Each	0					
93	CASH COUNTING MACHINE							
94	VAULT							
95	OTHER							
96	2.14 CENTRAL CONTROL	(Y/N)	0					
97	MIMIC BOARD	(Y/N)	N					
98	PUBLIC ADDRESS	(Y/N)	N					
99	COMPUTER	(Y/N)	N					
100	FIRE/INTRUSION DETECTOR	(Y/N)	Y					
101	MAINLINE CONTROL	(Y/N)	Y					
102	YARD CONTROL	(Y/N)	N					
103	SEISMIC OR GAS DETECTION	(Y/N)	N					
104	OTHER							
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS							
107	3.01 SIGNAL SYSTEM	Linear Feet	111,936	\$174.33	\$19,514,037		1985	\$179
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	111,936	\$73.58	\$8,236,632		1985	\$76
109	INSTALLATION		111,936	\$61.67		\$6,903,484	1985	\$63
110	HARDWARE					\$311,989		
111	DESIGN					\$6,591,495		
112	*CROSSING PROTECTION	Each	90	\$14,813		\$1,333,148	1985	\$15,214
113	TRAFFIC SIGNALS	Each	90	\$14,369		\$1,293,217	1985	\$14,758
114	INSTALLATION					\$39,931	1985	
115	GATES	Each						
116	OTHER							
117	3.02 ELECTRIFICATION	L.F. Guideway	111,936	\$89.64	\$10,034,456		1985	\$92
118	SUBSTATIONS	Each	14	\$346,886		\$4,856,409	1985	\$356,283

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
3.00 SYSTEMS (continued)								
119	PURCHASE	Each						
120	INSTALLATION	Each						
121	CATENARY	L.F. Guideway	111,936	\$46.26		\$3,618,472	1985	\$47.51
122	INSTALLATION	Each				\$1,237,937		
123	POLES AND COMPONENTS	Each	1,000	\$1,520		\$5,178,047	1985	\$1,716
124	WIRE	Each	438,000	\$2.70		\$2,475,877	1985	\$3.05
125	TROLLEY		194,000			\$1,520,025		
126	MESSENGER		142,000			\$1,182,145		
127	FEEDER		102,000					
128	RETURN							
129	3.03 COMMUNICATIONS	Total	1	\$190,949	\$190,949		1985	\$196,121
130	3.04 FARE COLLECTION	Total	1	\$1,052,000	\$1,052,000		1985	\$1,080,407
131	FAREBOX					\$66,000		
132	VENDING MACHINE							
133	OTHER					\$986,000		
134								
4.00 STATIONS								
135	4.01 AT-GRADE	Each	28	\$366,786	\$10,270,000		1985	\$376,721
136	CENTER PLATFORM	Each	28	\$366,786	\$10,270,000		1985	\$376,721
137	PLATFORM LENGTH	Linear Feet						
138	ESCALATOR/ELEVATOR	(Y/N)						
139	HANDICAP ACCESS MODE	Type						
140	WEATHER COVERAGE	Percent						
141	WEATHER COVERAGE	Percent						
142	WEATHER COVERAGE	Percent						
143	WEATHER COVERAGE	Percent						
144	WEATHER COVERAGE	Percent						
145	WEATHER COVERAGE	Percent						
146	WEATHER COVERAGE	Percent						
147	WEATHER COVERAGE	Percent						
148	WEATHER COVERAGE	Percent						
149	WEATHER COVERAGE	Percent						
150	WEATHER COVERAGE	Percent						
151	WEATHER COVERAGE	Percent						
152	WEATHER COVERAGE	Percent						
153	WEATHER COVERAGE	Percent						
154	WEATHER COVERAGE	Percent						
155	WEATHER COVERAGE	Percent						
156	WEATHER COVERAGE	Percent						
157	WEATHER COVERAGE	Percent						

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
159	4.00 STATIONS (continued)	Each						
160	4.03 ELEVATED	Each						
161	CENTER PLATFORM	Linear Feet						
162	PLATFORM LENGTH	(Y/N)						
163	ESCALATOR/ELEVATOR	Type						
164	HANDICAP ACCESS MODE	Percent						
165	WEATHER COVERAGE	Each						
166	SIDE PLATFORM	Linear Feet						
167	PLATFORM LENGTH	(Y/N)						
168	ESCALATOR/ELEVATOR	Type						
169	HANDICAP ACCESS MODE	Percent						
170	WEATHER COVERAGE	Total			N.R.			
171	4.04 PARKING LOTS							
172	NUMBER OF LOTS		8					
173	NUMBER OF SPACES		3,850					
174	4.05 PARKING GARAGES	Total						
175	NUMBER OF LOTS							
176	NUMBER OF SPACES	Total						
177	4.06 PEDESTRIAN OVERPASSES	Each	36	\$961,111	\$34,600,000		1986	\$968,562
178	5.00 VEHICLES	Each	26	\$800,000	\$20,800,000	\$20,800,000	1986	\$806,202
179	6.01 REVENUE VEHICLES - ORDER A	Name	Siemens/Duewag					
180	MAKE/MANUFACTURER	Type	Artic					
181	BODY TYPE (RIGID, ARTIC)	Linear Feet	79.50					
182	LENGTH OVER COUPLERS	Linear Feet	8.75					
183	WIDTH	Each						
184	NUMBER SEATS	(Y/N)	Y					
185	AIR CONDITIONING	(Y/N)	N					
186	CAB SIGNAL EQUIPMENT	Type	Spring/Elec					
187	BRAKING SYSTEM (AIR, ELEC)	Type	Low					
188	TYPE OF STEPS (HIGH, LOW)	Type	Ramp					
189	HANDICAPED (LIFT, RAMP)	(Y/N)	N					
190	ON-BOARD FAREBOX	Total						
191	PROCUREMENT COST	Total						
192	SPECIAL EQUIPMENT COST	Total						
193	5.02 REVENUE VEHICLES - ORDER B	Each	10	\$1,380,000	\$13,800,000		1990	\$1,255,800
194	MAKE/MANUFACTURER	Name						
195	BODY TYPE (RIGID, ARTIC)	Type						
196	LENGTH OVER COUPLERS	Linear Feet						

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
197	198		QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
5.00 VEHICLES (continued)								
199	200	Width						
199	200	NUMBER SEATS						
200	201	AIR CONDITIONING						
201	202	CAB SIGNAL EQUIPMENT						
202	203	BRKING SYSTEM (AIR.ELEC)						
203	204	TYPE OF STEPS (HIGHLOW)						
204	205	HANDICAPED (LIFT RAMP)						
205	206	ON-BOARD FAREBOX						
206	207	PROCUREMENT COST						
207	208	SPECIAL EQUIPMENT COST						
208	209	SPECIAL EQUIPMENT COST						
209	210	REVENUE VEHICLES - ORDER C						
210	211	MAKE/MANUFACTURER						
211	212	BODY TYPE (RIGID,ARTIC)						
212	213	LENGTH OVER COUPLERS						
213	214	WIDTH						
214	215	NUMBER SEATS						
215	216	AIR CONDITIONING						
216	217	CAB SIGNAL EQUIPMENT						
217	218	BRKING SYSTEM (AIR.ELEC)						
218	219	TYPE OF STEPS (HIGHLOW)						
219	220	HANDICAPED (LIFT RAMP)						
220	221	ON-BOARD FAREBOX						
221	222	PROCUREMENT COST						
222	223	SPECIAL EQUIPMENT COST						
223	224	SPECIAL EQUIPMENT COST						
224	225	SERVICE TRUCKS						
225	226	AUTOMOBILES						
226	227	OTHER						
227	228	SPECIAL CONDITIONS						
228	229	UTILITY RELOCATION - AS IS						
229	230	NEW INSTALLATION						
230	231	GAS						
231	232	TELEPHONE						
232	233	ELECTRIC						
233	234	WATER						
234	235	PIPELINE						
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CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
6.00 SPECIAL CONDITIONS (continued)								
236	RAILROAD		1	\$570,767		\$570,767		
237	OTHER		1	\$42,644		\$42,644		
238			1	\$482,480	\$482,480		1985	\$485,549
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total						
240	NEW INSTALLATION		1	\$482,480		\$482,480		
241	GAS							
242	TELEPHONE							
243	ELECTRIC							
244	WATER							
245	PIPELINE							
246	RAILROAD							
247	OTHER							
248	6.03 UTILITY RELOCATION - OTHER	Total						
249	NEW INSTALLATION							
250	GAS							
251	TELEPHONE							
252	ELECTRIC							
253	WATER							
254	PIPELINE							
255	RAILROAD							
256	OTHER							
257	6.04 DEMOLITIONS	Total	2	\$165,568	\$333,136		1985	\$171,080
258	BUILDINGS							
259	REMOVALS		2			\$333,136		
260	6.05 ROADWAY CHANGES	Total	3	\$2,162,399	\$6,487,198		1985	\$2,220,974
261	BRIDGES							
262	STREETS							
263	OTHER							
264	6.06 ENVIRONMENTAL	Total						
265	NOISE							
266	VISUAL							
267	VIBRATION							
268	OTHER							
269	7.00 RIGHT-OF-WAY	Linear Feet	111,936	\$156	\$17,408,000		1985	\$160
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$16,616,000	\$16,616,000	\$15,983,000	1985	\$17,066,095
271	MAINLINE	Acres	1					
272	STATION	Acres						
273	YARD	Acres	1	\$633,000		\$633,000		
274	PARKING	Acres						

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$792,000	\$792,000	\$481,000	\$993,905	\$813,454
282	LEGAL & CONSULTING		1	\$481,000		\$302,000		
283	APPRAISAL		1	\$302,000		\$9,000		
284	PROPERTY MANAGEMENT		1	\$9,000				
285	7.04 RELOCATION	Total						
286	BUSINESS							
287	RESIDENCE							
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	111,936	\$323	\$36,119,000		\$395	\$359
290	8.01 FEASIBILITY STUDIES	Total	1	\$16,557,000	\$16,557,000		\$24,528,899	\$22,321,289
291	8.02 ENGINEERING & DESIGN	Total	1	\$9,050,000	\$9,050,000		\$10,523,258	\$9,576,163
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$4,199,000	\$4,199,000		\$4,777,019	\$4,347,088
293	8.04 PROJECT MANAGEMENT	Total	1	\$1,285,000	\$1,285,000		\$1,450,339	\$1,319,808
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$1,285,000	\$1,285,000		\$1,450,339	\$1,319,808
295	8.06 PROJECT INITIATION							
296	INSURANCE		1	\$1,285,000		\$1,285,000		
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES		1	\$528,000	\$528,000		\$600,883	\$546,821
300	8.08 TRAINING/START-UP/TESTING		1	\$4,500,000	\$4,500,000		\$5,079,007	\$4,621,896
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER							

SAN JOSE

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
1	1.00 GUIDEWAY ELEMENTS	Linear Feet	82,252	\$801	\$65,887,000		1987	\$682
2	1.01 GUIDEWAY AT-GRADE	Linear Feet	82,252	\$715	\$58,816,000		1987	\$609
3	DIRECT FIXATION							
4	BALLASTED		48,050	\$717		\$34,473,000	1987	\$611
5	IN-PAVEMENT BALLASTED							
6	EMBEDDED		34,202	\$712		\$24,343,000	1987	\$606
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet						
8	DIRECT FIXATION							
9	BALLASTED							
10	IN-PAVEMENT BALLASTED							
11	EMBEDDED							
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet						
13	DIRECT FIXATION							
14	BALLASTED							
15	IN-PAVEMENT BALLASTED							
16	EMBEDDED							
17	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet						
18	DIRECT FIXATION							
19	BALLASTED							
20	IN-PAVEMENT BALLASTED							
21	EMBEDDED							
22	1.05 GUIDEWAY - SUBWAY	Linear Feet						
23	DIRECT FIXATION							
24	BALLASTED							
25	IN-PAVEMENT BALLASTED							
26	EMBEDDED							
27	1.06 GUIDEWAY - RETAINED CUT	Linear Feet						
28	DIRECT FIXATION							
29	BALLASTED							
30	IN-PAVEMENT BALLASTED							
31	EMBEDDED							
32	1.07 POCKET TRACK	L.F. Guideway						
33	1.08 STORAGE TRACK	L.F. Guideway						
34	1.09 SPECIAL TRACKWORK	L.F. Guideway						
35	TURNOUTS	Each	82,252	\$19.51	\$1,605,000		1987	\$17
36	#5		36	\$8,611	\$310,000		1987	\$7,329
37	#4		35	\$8,000			1987	
38	#6							
39	#8							
40	#10		1	\$30,000			1987	\$25,532

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES	
				QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST			YEAR
1.00 GUIDEWAY ELEMENTS (continued)										
41	#20			20	\$64,750	\$1,295,000		1987	\$55,106	
42	OTHER - SPECIFY									
43	GIRDER 25 METER			2	\$5,000		\$10,000	1987		
44	GIRDER 50 METER			14	\$52,500		\$735,000	1987		
45	#4 GIRDER			3	\$100,000		\$300,000	1987		
46	#8 SINGLE CROSSOVER									
47	#4 DOUBLE CROSSOVER									
48	#5 DOUBLE CROSSOVER									
49	INTERSECTION			1	\$250,000		\$250,000	1987		
50	1.10 GUIDEWAY-SPECIAL STRUCTURES			1060	\$5,157	\$5,466,000		1987	\$4,389	
51	BRIDGES	Linear Feet					\$4,822,000			
52	OVERPASSES	Each		1	\$322,000		\$644,000			
53	OTHER	Each		2						
54										
2.00 YARDS & SHOPS										
55	2.01 BUILDING	Total		1	\$21,291,136	\$21,291,136		1986	\$18,862,579	
56	DESCRIPTION	Each		1	\$13,500,000	\$13,500,000		1987	\$11,489,362	
57	SHOP CAPACITY *	Revenue Vehicles		1	\$13,500,000		\$13,500,000	1987	\$362,402	
58	YARD STORAGE CAPACITY	Revenue Vehicles		50	\$425,823			1987		
59	WORKSTATIONS	Each		13						
60	TRACK LENGTH	Linear Feet		10,000						
61	PARKING	Spaces								
62	2.02 OFFICE FURNITURE & EQUIP.	All		1	\$279,577	\$279,577		1985	\$252,440	
63	2.03 HEAVY REPAIR			1	\$809,989	\$809,989		1985	\$731,367	
64	BODY	(Y/N)		YES						
65	TRUCK	(Y/N)		YES						
66	EQUIPMENT	(Y/N)		YES			\$809,989	1987	\$42,553	
67	2.04 MOTOR SHOPS			1	\$50,000	\$50,000				
68	VARIABLE TEST LOAD	(Y/N)		YES						
69	REWIND	(Y/N)		YES			\$50,000			
70	OTHER	(Y/N)		YES						
71	2.05 WHEEL SHOP			1	\$30,000	\$30,000		1987	\$25,632	
72	WHEEL PRESS	Each		1			\$30,000			
73	WHEEL TRUNG	Each		6	\$262	\$1,570		1985	\$236	
74	2.06 MACHINE SHOP			0						
75	LATHIE	Each		6						
76	DRILL PRESS	Each		1	\$2,680,000	\$2,680,000	\$1,570		\$2,419,865	
77	2.07 AIR CONDITIONING	(Y/N)		1	\$1,420,000	\$1,420,000		1985	\$1,282,167	
78	2.08 ELECTRONICS	(Y/N)		1				1985		
79										

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
80	2.00 YARDS & SHOPS (continued)	(Y/N)						
81	2.09 COMMUNICATIONS	(Y/N)	1	\$1,260,000	\$1,260,000		\$1,422,122	\$1,137,698
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1	\$160,000	\$160,000		\$180,587	\$144,470
83	2.11 MAINTENANCE OF WAY SHOPS		1	\$1,100,000	\$1,100,000		\$1,241,535	\$993,228
84	SIGNAL	(Y/N)						
85	TRACTION POWER	(Y/N)						
86	COMPONENT REPAIR	(Y/N)						
87	TRACK	(Y/N)						
88	2.12 MAINTENANCE OF WAY EQUIPMENT							
89	TRUCK	Each						
90	CRANE	Each						
91	OTHER	Each						
92	2.13 REVENUE CENTER	Each						
93	CASH COUNTING MACHINE							
94	VAULT							
95	OTHER							
96	2.14 CENTRAL CONTROL	(Y/N)						
97	MIMIC BOARD	(Y/N)						
98	PUBLIC ADDRESS	(Y/N)						
99	COMPUTER	(Y/N)						
100	FIRE/INTRUSION DETECTOR	(Y/N)						
101	MAINLINE CONTROL	(Y/N)						
102	YARD CONTROL	(Y/N)						
103	SEISMIC OR GAS DETECTION	(Y/N)						
104	OTHER							
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS	Linear Feet	105,600	\$313.68	\$33,124,742		\$314	\$250.95
107	3.01 SIGNAL SYSTEM	L.F. Guideway	105,600	\$67.89	\$7,169,292		\$68	\$54.31
108	TRAIN CONTROL - WAYSIDE		105,600	\$66.28	\$6,999,292		\$66	\$53.02
109	INSTALLATION					\$3,182,635		
110	HARDWARE					\$3,513,954		
111	DESIGN					\$302,703		
112	CROSSING PROTECTION	Each	6	\$28,333.33	\$170,000		\$28,333	\$22,667
113	TRAFFIC SIGNALS	Each						
114	INSTALLATION	Each	4			\$110,000		
115	GATES	Each	2			\$60,000		
116	OTHER							
117	3.02 ELECTRIFICATION	L.F. Guideway	105,600	\$177.04	\$18,694,939		\$177	\$141.63
118	SUBSTATIONS	Each	30	\$256,589.30	\$7,697,679		\$256,589	\$205,271

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS								
3.00 SYSTEMS (continued)								
119	PURCHASE	Each	15			\$5,527,894		
120	INSTALLATION	Each	15			\$2,169,785		\$83.31
121	CATENARY	L.F. Guideway	105,600	\$104.14	\$10,997,260		\$104	
122	INSTALLATION	Each				\$4,132,000		
123	POLES AND COMPONENTS	Each				\$6,865,260		
124	WIRE							
125	TROLLEY							
126	MESSANGER							
127	FEEDER							
128	RETURN							
129								
130	3.03 COMMUNICATIONS	Total	1	\$2,935,448	\$2,935,448		\$2,935,448	\$2,348,358
131	3.04 FARE COLLECTION	Total	1	\$4,325,063	\$4,325,063		\$4,325,063	\$3,460,050
132	FAREBOX							
133	VENDING MACHINE		93	\$43,394		\$4,035,602		
134	OTHER		54	\$5,360		\$289,461		
135	4.00 STATIONS							
136	4.01 AT-GRADE	Each	22	\$223,364	\$4,914,000		\$226,077	\$180,861
137	CENTER PLATFORM	Each	22	\$223,364	\$4,914,000		\$226,077	\$180,861
138	PLATFORM LENGTH	Linear Feet	3	\$192,333		\$577,000	\$194,669	\$155,735
139	ESCALATOR/ELEVATOR	(Y/N)	334					
140	HANDICAP ACCESS MODE	Type	N					
141	WEATHER COVERAGE	Percent	100					
142	WEATHER COVERAGE	Each	19					
143	PLATFORM LENGTH	Linear Feet	312	\$228,263		\$4,337,000	\$231,036	\$184,828
144	ESCALATOR/ELEVATOR	(Y/N)	Y					
145	HANDICAP ACCESS MODE	Type						
146	WEATHER COVERAGE	Percent	100					
147		Each						
148	4.02 SUBWAY							
149	CENTER PLATFORM	Each						
150	PLATFORM LENGTH	Linear Feet						
151	ESCALATOR/ELEVATOR	(Y/N)						
152	HANDICAP ACCESS MODE	Type						
153	WEATHER COVERAGE	Percent						
154	WEATHER COVERAGE	Each						
155	SIDE PLATFORM	Linear Feet						
156	PLATFORM LENGTH	(Y/N)						
157	ESCALATOR/ELEVATOR	Type						
	HANDICAP ACCESS MODE	Percent						
	WEATHER COVERAGE							

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
				QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
158	159	4.00 STATIONS (continued)	Each						
160	161	4.03 ELEVATED	Each						
162	163	CENTER PLATFORM	Linear Feet						
164	165	PLATFORM LENGTH	(Y/N)						
166	167	ESCALATOR/ELEVATOR	Type						
168	169	HANDICAP ACCESS MODE	Percent						
170	171	WEATHER COVERAGE	Each						
172	173	SIDE PLATFORM	Linear Feet						
174	175	PLATFORM LENGTH	(Y/N)						
176	177	ESCALATOR/ELEVATOR	Type						
178	179	HANDICAP ACCESS MODE	Percent						
180	181	WEATHER COVERAGE	Total						
182	183	4.04 PARKING LOTS							
184	185	NUMBER OF LOTS							
186	187	NUMBER OF SPACES							
188	189	4.05 PARKING GARAGES							
190	191	NUMBER OF LOTS							
192	193	NUMBER OF SPACES							
194	195	4.06 PEDESTRIAN OVERPASSES							
196	197	NUMBER OF LOTS							
198	199	NUMBER OF SPACES							
200	201	5.00 VEHICLES							
202	203	5.01 REVENUE VEHICLES - ORDER A							
204	205	MAKEMANUFACTURER	Each	50	\$1,112,220	\$55,611,000		\$1,293,279	\$1,034,623
206	207	BODY TYPE (RIGID,ARTIC)	Each	50	\$1,112,220	\$55,611,000		\$1,293,279	\$1,034,623
208	209	LENGTH OVER COUPLERS	Name	UTDC					
210	211	WIDTH	Type	ARTIC					
212	213	NUMBER SEATS	Linear Feet	89.50					
214	215	AIR CONDITIONING	Linear Feet	8.75					
216	217	CAB SIGNAL EQUIPMENT	Each	75					
218	219	BRKING SYSTEM (AIR,ELEC)	(Y/N)	YES					
220	221	TYPE OF STEPS (HIGH,LOW)	Type	ATR					
222	223	HANDICAPED (LIFT,RAMP)	Type	NO					
224	225	ON-BOARD FAREBOX	Type	NO					
226	227	PROCUREMENT COST	(Y/N)						
228	229	SPARE PARTS	Total						
230	231	SPECIAL EQUIPMENT COST	Total						
232	233	5.02 REVENUE VEHICLES - ORDER B	Total				\$1,405,000	1983	
234	235	MAKEMANUFACTURER	Each				\$4,206,000	1983	
236	237	BODY TYPE (RIGID,ARTIC)	Name						
238	239	LENGTH OVER COUPLERS	Type						
240	241		Linear Feet						

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
5.00 VEHICLES (continued)								
197	WIDTH	Linear Feet						
198	NUMBER SEATS	Each						
199	AIR CONDITIONING	(Y/N)						
200	CAB SIGNAL EQUIPMENT	(Y/N)						
201	BRAKING SYSTEM (AIR-ELEC)	Type						
202	TYPE OF STEPS (HIGH/LOW)	Type						
203	HANDICAPPED (LIFT,RAMP)	Type						
204	ON-BOARD FAREBOX	(Y/N)						
205	PROCUREMENT COST	Total						
206	SPARE PARTS	Total						
207	SPECIAL EQUIPMENT COST	Each						
208	MAKE/MANUFACTURER	Name						
209	BODY TYPE (RIGID,ARTIC)	Type						
210	LENGTH OVER COUPLERS	Linear Feet						
211	WIDTH	Each						
212	NUMBER SEATS	(Y/N)						
213	AIR CONDITIONING	(Y/N)						
214	CAB SIGNAL EQUIPMENT	Type						
215	BRAKING SYSTEM (AIR-ELEC)	Type						
216	TYPE OF STEPS (HIGH/LOW)	Type						
217	HANDICAPPED (LIFT,RAMP)	(Y/N)						
218	ON-BOARD FAREBOX	Total						
219	PROCUREMENT COST	Total						
220	SPARE PARTS	Each						
221	SPECIAL EQUIPMENT COST							
222	SERVICE TRUCKS							
223	AUTOMOBILES							
224	OTHER							
225								
226								
227								
228			13		N.R.			
229			4					
230			4					
231			5					
232								
233								
234								
235								
6.00 SPECIAL CONDITIONS								
6.01 UTILITY RELOCATION - AS IS								
236	NEW INSTALLATION	Linear feet	82,252	\$103	\$8,487,000		1986	\$91
237	GAS	Total	1	\$5,822,000	\$5,822,000		1986	\$5,157,918
238	TELEPHONE					\$5,086,000		
239	ELECTRIC					\$158,000		
240	WATER					\$23,000		
241	PIPELINE					\$158,000		
242						\$353,000		

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
236	6.00 SPECIAL CONDITIONS (continued)							
237	RAILROAD							
238	OTHER					\$44,000		
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total						
240	NEW INSTALLATION							
241	GAS							
242	TELEPHONE							
243	ELECTRIC							
244	WATER							
245	PIPELINE							
246	RAILROAD							
247	OTHER							
248	6.03 UTILITY RELOCATION - OTHER	Total						
249	NEW INSTALLATION							
250	GAS							
251	TELEPHONE							
252	ELECTRIC							
253	WATER							
254	PIPELINE							
255	RAILROAD							
256	OTHER							
257	6.04 DEMOLITIONS	Total	1	\$513,000	\$513,000		\$568,106	\$454,485
258	BUILDINGS							
259	REMOVALS		1			\$513,000		
260	6.05 ROADWAY CHANGES	Total						
261	BRIDGES							
262	STREETS							
263	OTHER							
264	6.06 ENVIRONMENTAL	Total	1	\$2,152,000	\$2,152,000		\$2,383,167	\$1,906,534
265	NOISE							
266	VISUAL					\$1,324,000		
267	VIBRATION							
268	OTHER					\$828,000		
269	7.00 RIGHT-OF-WAY	Linear Feet	82,252	\$664	\$54,617,000		\$749	\$600
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$51,323,000	\$51,323,000		\$57,926,637	\$46,341,309
271	MAINLINE	Acres	73	\$342,394		\$25,029,000		
272	STATION	Acres	23	\$312,743		\$7,068,000		
273	YARD	Acres	37	\$313,333		\$11,468,000		
274	PARKING	Acres	20	\$389,849		\$7,758,000		

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YAS J							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$2,772,000	\$2,772,000	\$924,000	\$3,128,668	\$2,502,935
282	LEGAL & CONSULTING					\$924,000		
283	APPRAISAL					\$924,000		
284	PROPERTY MANAGEMENT					\$924,000		
285	7.04 RELOCATION	Total	1	\$522,000	\$522,000		\$589,165	\$471,332
286	BUSINESS		15					
287	RESIDENCE		86			\$476,000		
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	82,252	\$1,659	\$136,417,000		\$1,837	\$1,469
290	8.01 FEASIBILITY STUDIES	Total	1	\$41,085,000	\$41,085,000		\$45,498,339	\$36,398,671
291	8.02 ENGINEERING & DESIGN	Total						
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$63,260,000	\$63,260,000		\$70,055,371	\$58,044,297
293	8.04 PROJECT MANAGEMENT	Total	1	\$19,115,000	\$19,115,000		\$21,168,328	\$16,934,662
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$1,457,000	\$1,457,000			
295	8.06 PROJECT INITIATION	Total	1	\$7,500,000	\$7,500,000			
296	INSURANCE							
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC		1			\$7,000,000		
299	8.07 FINANCE CHARGES		1			\$500,000		
300	8.08 TRAINING/START-UP/TESTING							
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER		1	\$4,000,000	\$4,000,000		\$4,429,679	\$3,543,743

PITTSBURGH

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicle	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
0.00 SYSTEM DESCRIPTION			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
0.01 SERVICE								
ROUTE MILES		Route Miles	* 41.1					
TRACK MILES		Track Miles	62.4					
STATIONS		Each	13					
VEHICLES IN SERVICE		Revenue Vehicles	97					
PEAK		Revenue Vehicles	70					
MIDDAY		Revenue Vehicles	28					
HEADWAY								
PEAK								
MIDDAY		Minutes						
0.02 STAFFING - TOTAL		Minutes	502.7					
ADMINISTRATIVE		Total						
OPERATORS		FTE's						
MAINTENANCE		FTE's	1122					
VEHICLE		FTE's						
FACILITY		FTE's						
OTHER (eg Fare Inspection)		FTE's						
			390.5					
			* Total System Mileage not Project Mileage					

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS				PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
11.00 GUIDEWAY ELEMENTS	UNITS OF MEASURE	QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR			
1.01 GUIDEWAY AT-GRADE	Linear Feet	82,198	\$1,344	\$110,472,428		1985		\$1,517	\$1,508
DIRECT FIXATION	Linear Feet	54,627	\$410	\$22,416,945		1985		\$463	\$460
BALLASTED		5,131	\$620		\$3,183,075	1985		\$700	\$696
IN-PAVEMENT BALLASTED		34,933	\$334		\$11,666,125	1985		\$377	\$375
EMBEDDED		14,563	\$520		\$7,567,746	1985		\$587	\$583
1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	5,012	\$587	\$2,841,209		1985		\$640	\$636
DIRECT FIXATION		2,141	\$477		\$1,020,441	1985		\$538	\$535
BALLASTED		963	\$997		\$960,077	1985		\$1,126	\$1,119
IN-PAVEMENT BALLASTED									
EMBEDDED		1,908	\$451		\$860,691	1985		\$509	\$506
1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet								
DIRECT FIXATION									
BALLASTED									
IN-PAVEMENT BALLASTED									
EMBEDDED									
1.04 GUIDEWAY - ELEVATED FILL	Linear Feet								
DIRECT FIXATION									
BALLASTED									
IN-PAVEMENT BALLASTED									
EMBEDDED									
1.05 GUIDEWAY - SUBWAY	Linear Feet	10,721	\$7,627	\$81,770,847		1985		\$8,609	\$8,557
DIRECT FIXATION		3,462	\$18,478		\$63,976,786	1985		\$20,855	\$20,730
BALLASTED									
IN-PAVEMENT BALLASTED		3,856	\$4,216		\$16,259,569	1985		\$4,759	\$4,730
EMBEDDED		3,402	\$451		\$1,534,493	1985		\$509	\$506
1.06 GUIDEWAY - RETAINED CUT	Linear Feet	11,838	\$291	\$3,443,427		1984		\$331	\$329
DIRECT FIXATION									
BALLASTED									
IN-PAVEMENT BALLASTED									
EMBEDDED									
1.07 POCKET TRACK	L.F. Guideway								
1.08 STORAGE TRACK	L.F. Guideway								
1.09 SPECIAL TRACKWORK	L.F. Guideway								
TURNOUTS	Each								
#5									
#4									
#6									
#8									
#10									

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
1.00 GUIDEWAY ELEMENTS (continued)								
41	#20							
42	OTHER - SPECIFY							
43	GIRDER 25 METER							
44	GIRDER 50 METER							
45	#4 GIRDER							
46	#8 SINGLE CROSSOVER							
47	#4 DOUBLE CROSSOVER							
48	#5 DOUBLE CROSSOVER							
49	INTERSECTION							
50	1.10 GUIDEWAY-SPECIAL STRUCTURES							
51	BRIDGES	Linear Feet						
52	OVERPASSES	Each						
53	OTHER	Each						
54								
55	2.00 YARDS & SHOPS							
56	2.01 BUILDING	Total	1	\$38,183,186	\$38,183,186		1985	\$42,837,570
57	DESCRIPTION	Each	1	\$32,090,648	\$32,090,648		1985	\$36,002,375
58	SHOP CAPACITY *	Revenue Vehicles	1	\$32,090,648		\$32,090,648	1985	
59	YARD STORAGE CAPACITY	Revenue Vehicles	97	\$393,641			1985	\$441,624
60	WORKSTATIONS	Each						
61	TRACK LENGTH	Linear Feet						
62	PARKING	Spaces						
63	2.02 OFFICE FURNITURE & EQUIP.	All						
64	2.03 HEAVY REPAIR	(Y/N)						
65	BOT*	(Y/N)						
66	TRUCK	(Y/N)						
67	EQUIPMENT	(Y/N)						
68	2.04 MOTOR SHOPS	(Y/N)						
69	VARIABLE TEST LOAD	(Y/N)						
70	REWIND	(Y/N)						
71	OTHER	(Y/N)						
72	2.05 WHEEL SHOP							
73	WHEEL PRESS	Each						
74	WHEEL TRUNG	Each						
75	2.06 MACHINE SHOP							
76	LATHE	Each						
77	DRILL PRESS	Each						
78	2.07 AIR CONDITIONING	(Y/N)						
79	2.08 ELECTRONICS	(Y/N)						

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UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
80	2.00 YARDS & SHOPS (continued)							
81	2.09 COMMUNICATIONS	(Y/N)						
82	2.10 CAR WASH/CAR CLEANING	(Y/N)						
83	2.11 MAINTENANCE OF WAY SHOPS							
84	SIGNAL	(Y/N)	1	\$5,025,877	\$5,025,877		1987	\$5,314,598
85	TRACTION POWER	(Y/N)						
86	COMPONENT REPAIR	(Y/N)						
87	TRACK	(Y/N)						
88	2.12 MAINTENANCE OF WAY EQUIPMENT							
89	TRUCK	Each						
90	CRANE	Each						
91	OTHER	Each						
92	2.13 REVENUE CENTER	Each	1	\$1,066,661	\$1,066,661		1984	\$1,206,213
93	CASH COUNTING MACHINE							
94	VAULT							
95	OTHER							
96	2.14 CENTRAL CONTROL	(Y/N)						
97	MIMIC BOARD	(Y/N)						
98	PUBLIC ADDRESS	(Y/N)						
99	COMPUTER	(Y/N)						
100	FIRE/INTRUSION DETECTOR	(Y/N)						
101	MAINLINE CONTROL	(Y/N)						
102	YARD CONTROL	(Y/N)						
103	SEISMIC OR GAS DETECTION	(Y/N)						
104	OTHER	(Y/N)						
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS							
107	3.01 SIGNAL SYSTEM	Linear Feet	82,198	\$716.38	\$58,885,157		1985	\$804
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	58,083	\$394.49	\$22,913,020		1985	\$443
109	INSTAL ATION		58,083	\$394.49	\$22,913,020		1985	\$443
110	HARDWARE							
111	DESIGN							
112	CRCKSSING PROTECTION	Each						
113	TRAFFIC SIGNALS	Each						
114	INSTALLATION							
115	GATES	Each						
116	OTHER							
117	3.02 ELECTRIFICATION	L.F. Guideway	68,219	\$396.43	\$27,043,907		1984	\$448
118	SUBSTATIONS	Each	4	\$3,007,949	\$12,031,797		1984	\$3,401,481

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PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
3.00 SYSTEMS (continued)								
119	PURCHASE	Each						
120	INSTALLATION	Each						
121	CATENARY	L.F. Guideway	68,219	\$220	\$15,012,110		1984	\$250
122	INSTALLATION	Each	1	\$181,509	\$181,509		1984	
123	POLES AND COMPONENTS	Each	1	\$1,113,906	\$1,113,906		1984	\$1,267,242
124	WIRE	Each	1	\$1,066,033	\$1,066,033		1984	\$1,205,503
125	TROLLEY							
126	MESSANGER							
127	FEEDER							
128	RETURN							
129	3.03 COMMUNICATIONS	Total	1	\$8,928,230	\$8,928,230		1985	\$10,077,009
130	3.04 FARE COLLECTION	Total						
131	FAREBOX							
132	VENDING MACHINE							
133	OTHER							
134								
4.00 STATIONS								
4.01 AT-GRADE								
135	CENTER PLATFORM	Each	12	\$2,856,898	\$34,282,779		1985	\$3,224,490
136	PLATFORM LENGTH	Each	9	\$1,748,205	\$15,733,846		1985	\$1,973,143
137	ESCALATOR/ELEVATOR	Linear Feet						
138	HANDICAP ACCESS MODE	(Y/N)						
139	WEATHER COVERAGE	Type						
140	WEATHER COVERAGE	Percent						
141	WEATHER COVERAGE	Each	9	\$1,748,205	\$15,733,846		1985	\$1,973,143
142	SIDE PLATFORM	Each						
143	PLATFORM LENGTH	Linear Feet						
144	ESCALATOR/ELEVATOR	(Y/N)						
145	HANDICAP ACCESS MODE	Type						
146	WEATHER COVERAGE	Percent						
147	4.02 SUBWAY	Each	3	\$6,182,978	\$18,548,933		1985	\$6,978,530
148	CENTER PLATFORM	Each						
149	PLATFORM LENGTH	Linear Feet						
150	ESCALATOR/ELEVATOR	(Y/N)						
151	HANDICAP ACCESS MODE	Type						
152	WEATHER COVERAGE	Percent						
153	WEATHER COVERAGE	Each	3	\$6,182,978	\$18,548,933		1985	\$6,978,530
154	SIDE PLATFORM	Linear Feet						
155	PLATFORM LENGTH	(Y/N)						
156	ESCALATOR/ELEVATOR	Type						
157	HANDICAP ACCESS MODE	Percent						
	WEATHER COVERAGE							

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
4.00 STATIONS (continued)								
158	4.03 ELEVATED	Each						
159	CENTER PLATFORM	Each						
160	PLATFORM LENGTH	Linear Feet						
161	ESCALATOR/ELEVATOR	(Y/N)						
162	HANDICAP ACCESS MODE	Type						
163	WEATHER COVERAGE	Percent						
164	WEATHER COVERAGE	Each						
165	SIDE PLATFORM	Linear Feet						
166	PLATFORM LENGTH	(Y/N)						
167	ESCALATOR/ELEVATOR	Type						
168	HANDICAP ACCESS MODE	Percent						
169	WEATHER COVERAGE	Total						
170								
171	4.04 PARKING LOTS							
172	NUMBER OF LOTS							
173	NUMBER OF SPACES							
174	4.05 PARKING GARAGES							
175	NUMBER OF LOTS							
176	NUMBER OF SPACES							
177	4.06 PEDESTRIAN OVERPASSES							
178								
179	5.00 VEHICLES							
180	6.01 REVENUE VEHICLES -- ORDER A	Each	55	\$1,043,626	\$57,399,440		1985	\$1,170,840
181	MAKE/MANUFACTURER	Each	55	\$1,043,626	\$57,399,440		1986	\$1,170,840
182	BODY TYPE (RIGID,ARTIC)	Name						
183	LENGTH OVER COUPLERS	Type						
184	WIDTH	Linear Feet						
185	NUMBER SEATS	Linear Feet						
186	AIR CONDITIONING	Each						
187	CAB SIGNAL EQUIPMENT	(Y/N)						
188	BRAKING SYSTEM (AIR,ELEC)	(Y/N)						
189	TYPE OF STEPS (HIGH/LOW)	Type						
190	HANDICAPED (LIFT RAMP)	Type						
191	ON-BOARD FAREBOX	(Y/N)						
192	PROCUREMENT COST	Total						
193	SPECIAL EQUIPMENT COST	Total						
194	5.02 REVENUE VEHICLES -- ORDER B	Each						
195	MAKE/MANUFACTURER	Name						
196	BODY TYPE (RIGID,ARTIC)	Type						
	LENGTH OVER COUPLERS	Linear Feet						

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PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
5.00 VEHICLES (continued)								
197	WIDTH	Linear Feet						
198	NUMBER SEATS	Each						
199	AIR CONDITIONING	(Y/N)						
200	CAB SIGNAL EQUIPMENT	(Y/N)						
201	BRAKING SYSTEM (AIR/ELEC)	Type						
202	TYPE OF STEPS (HIGH/LOW)	Type						
203	HANDICAPPED (LIFT/RAMP)	Type						
204	ON-BOARD FAREBOX	(Y/N)						
205	PROCUREMENT COST	Total						
206	SPARE PARTS	Total						
207	SPECIAL EQUIPMENT COST	Total						
208	5.03 REVENUE VEHICLES - ORDER C	Each						
209	MAKEMANUFACTURER	Name						
210	BODY TYPE (RIGID/ARTIC)	Type						
211	LENGTH OVER COUPLERS	Linear Feet						
212	WIDTH	Linear Feet						
213	NUMBER SEATS	Each						
214	AIR CONDITIONING	(Y/N)						
215	CAB SIGNAL EQUIPMENT	(Y/N)						
216	BRAKING SYSTEM (AIR/ELEC)	Type						
217	TYPE OF STEPS (HIGH/LOW)	Type						
218	HANDICAPPED (LIFT/RAMP)	Type						
219	ON-BOARD FAREBOX	(Y/N)						
220	PROCUREMENT COST	Total						
221	SPARE PARTS	Total						
222	SPECIAL EQUIPMENT COST	Total						
223	5.04 NON-REVENUE VEHICLES	Each						
224	SERVICE TRUCKS							
225	AUTOMOBILES							
226	OTHER							
227								
228	6.00 SPECIAL CONDITIONS	Linear feet	82,198	\$122	\$10,038,972			\$138
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$4,034,435	\$4,034,435		1984	\$4,562,262
230	NEW INSTALLATION							
231	GAS		2		\$578,064			
232	TELEPHONE		1		\$248,253			
233	ELECTRIC		4		\$2,939,444			
234	WATER		1		\$268,674			
235	PIPELINE							

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PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
6.00 SPECIAL CONDITIONS (continued)								
236	RAILROAD	Total	1	\$4,939,567	\$4,939,567		\$5,619,530	\$5,585,813
237	OTHER		1		\$560,596			
238	NEW INSTALLATION		1		\$664,702			
239	GAS		1		\$767,687			
240	TELEPHONE		1		\$2,857,500			
241	ELECTRIC		1					
242	WATER		1					
243	PIPELINE		1					
244	RAILROAD		1					
245	OTHER		1		\$89,082			
246	NEW INSTALLATION	Total	1					
247	GAS		1					
248	TELEPHONE		1					
249	ELECTRIC		1					
250	WATER		1					
251	PIPELINE		1					
252	RAILROAD		1					
253	OTHER		1					
254	NEW INSTALLATION	Total	1					
255	GAS		1					
256	TELEPHONE		1					
257	ELECTRIC		1					
258	WATER		1					
259	PIPELINE		1					
260	RAILROAD		1					
261	OTHER		1					
262	NEW INSTALLATION	Total	1					
263	GAS		1					
264	TELEPHONE		1					
265	ELECTRIC		1					
266	WATER		1					
267	PIPELINE		1					
268	RAILROAD		1					
269	OTHER		1					
270	NEW INSTALLATION	Total	1					
271	GAS		1					
272	TELEPHONE		1					
273	ELECTRIC		1					
274	WATER		1					
275	PIPELINE		1					
276	RAILROAD		1					
277	OTHER		1					
278	NEW INSTALLATION	Total	1					
279	GAS		1					
280	TELEPHONE		1					
281	ELECTRIC		1					
282	WATER		1					
283	PIPELINE		1					
284	RAILROAD		1					
285	OTHER		1					
286	NEW INSTALLATION	Total	1					
287	GAS		1					
288	TELEPHONE		1					
289	ELECTRIC		1					
290	WATER		1					
291	PIPELINE		1					
292	RAILROAD		1					
293	OTHER		1					
294	NEW INSTALLATION	Total	1					
295	GAS		1					
296	TELEPHONE		1					
297	ELECTRIC		1					
298	WATER		1					
299	PIPELINE		1					
300	RAILROAD		1					
301	OTHER		1					
302	NEW INSTALLATION	Total	1					
303	GAS		1					
304	TELEPHONE		1					
305	ELECTRIC		1					
306	WATER		1					
307	PIPELINE		1					
308	RAILROAD		1					
309	OTHER		1					
310	NEW INSTALLATION	Total	1					
311	GAS		1					
312	TELEPHONE		1					
313	ELECTRIC		1					
314	WATER		1					
315	PIPELINE		1					
316	RAILROAD		1					
317	OTHER		1					
318	NEW INSTALLATION	Total	1					
319	GAS		1					
320	TELEPHONE		1					
321	ELECTRIC		1					
322	WATER		1					
323	PIPELINE		1					
324	RAILROAD		1					
325	OTHER		1					
326	NEW INSTALLATION	Total	1					
327	GAS		1					
328	TELEPHONE		1					
329	ELECTRIC		1					
330	WATER		1					
331	PIPELINE		1					
332	RAILROAD		1					
333	OTHER		1					
334	NEW INSTALLATION	Total	1					
335	GAS		1					
336	TELEPHONE		1					
337	ELECTRIC		1					
338	WATER		1					
339	PIPELINE		1					
340	RAILROAD		1					
341	OTHER		1					
342	NEW INSTALLATION	Total	1					
343	GAS		1					
344	TELEPHONE		1					
345	ELECTRIC		1					
346	WATER		1					
347	PIPELINE		1					
348	RAILROAD		1					
349	OTHER		1					
350	NEW INSTALLATION	Total	1					
351	GAS		1					
352	TELEPHONE		1					
353	ELECTRIC		1					
354	WATER		1					
355	PIPELINE		1					
356	RAILROAD		1					
357	OTHER		1					
358	NEW INSTALLATION	Total	1					
359	GAS		1					
360	TELEPHONE		1					
361	ELECTRIC		1					
362	WATER		1					
363	PIPELINE		1					
364	RAILROAD		1					
365	OTHER		1					
366	NEW INSTALLATION	Total	1					
367	GAS		1					
368	TELEPHONE		1					
369	ELECTRIC		1					
370	WATER		1					
371	PIPELINE		1					
372	RAILROAD		1					
373	OTHER		1					
374	NEW INSTALLATION	Total	1					
375	GAS		1					
376	TELEPHONE		1					
377	ELECTRIC		1					
378	WATER		1					
379	PIPELINE		1					
380	RAILROAD		1					
381	OTHER		1					
382	NEW INSTALLATION	Total	1					
383	GAS		1					
384	TELEPHONE		1					
385	ELECTRIC		1					
386	WATER		1					
387	PIPELINE		1					
388	RAILROAD		1					
389	OTHER		1					
390	NEW INSTALLATION	Total	1					
391	GAS		1					
392	TELEPHONE		1					
393	ELECTRIC		1					
394	WATER		1					
395	PIPELINE		1					
396	RAILROAD		1					
397	OTHER		1					
398	NEW INSTALLATION	Total	1					
399	GAS		1					
400	TELEPHONE		1					
401	ELECTRIC		1					
402	WATER		1					
403	PIPELINE		1					
404	RAILROAD		1					
405	OTHER		1					
406	NEW INSTALLATION	Total	1					
407	GAS		1					
408	TELEPHONE		1					
409	ELECTRIC		1					
410	WATER		1					
411	PIPELINE		1					
412	RAILROAD		1					
413	OTHER		1					
414	NEW INSTALLATION	Total	1					
415	GAS		1					
416	TELEPHONE		1					
417	ELECTRIC		1					
418	WATER		1					
419	PIPELINE		1					
420	RAILROAD		1					
421	OTHER		1					
422	NEW INSTALLATION	Total	1					
423	GAS		1					
424	TELEPHONE		1					
425	ELECTRIC		1					
426	WATER		1					
427	PIPELINE		1					
428	RAILROAD		1					
429	OTHER		1					
430	NEW INSTALLATION	Total	1					
431	GAS		1					
432	TELEPHONE		1					
433	ELECTRIC		1					
434	WATER		1					
435	PIPELINE		1					
436	RAILROAD		1					
437	OTHER		1					
438	NEW INSTALLATION	Total	1					
439	GAS		1					
440	TELEPHONE		1					
441	ELECTRIC		1					
442	WATER		1					
443	PIPELINE		1					
444	RAILROAD		1					
445	OTHER		1					
446	NEW INSTALLATION	Total	1					
447	GAS		1					
448	TELEPHONE		1					
449	ELECTRIC		1					
450	WATER		1					
451	PIPELINE		1					
452	RAILROAD		1					
453	OTHER		1					
454	NEW INSTALLATION	Total	1					
455	GAS		1					
456	TELEPHONE		1					
457	ELECTRIC		1					
458	WATER		1					
459	PIPELINE		1					
460	RAILROAD		1					
461	OTHER		1					
462	NEW INSTALLATION	Total	1					
463	GAS		1					
464	TELEPHONE		1					
465	ELECTRIC		1					
466	WATER		1					

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PORT AUTHORITY OF ALLEGHENY COUNTY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total						
282	LEGAL & CONSULTING							
283	APPRAISAL							
284	PROPERTY MANAGEMENT							
285	7.04 RELOCATION	Total						
286	BUSINESS							
287	RESIDENCE							
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	82,198	\$2,734	\$224,751,180		1985	\$3,068
290	8.01 FEASIBILITY STUDIES	Total						
291	8.02 ENGINEERING & DESIGN	Total	1	\$106,746,730	\$106,746,730		1985	\$119,758,747
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$11,236,750	\$11,236,750		1985	\$12,606,467
293	8.04 PROJECT MANAGEMENT	Total	1	\$14,821,100	\$14,821,100		1985	\$16,627,735
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total						
295	8.06 PROJECT INITIATION	Total						
296	INSURANCE							
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING							
301	SAFETY CERTIFICATION							
302	ORT-SITE LRV TESTING							
303	8.09 OTHER		1	\$91,946,600	\$91,946,600		1987	\$97,228,639

LOS ANGELES

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
		QUANTITY		UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
1	1.00 GUIDEWAY ELEMENTS								
2	1.01 GUIDEWAY AT-GRADE		Linear Feet	119,283	\$1,247	\$148,719,104		\$1,293	\$1,133
3	DIRECT FIXATION		Linear Feet	96,253	\$700	\$67,408,808		\$726	\$636
4	BALLASTED			61,869	\$487			\$505	\$443
5	IN-PAVEMENT BALLASTED			1,618	\$2,848			\$2,954	\$2,588
6	EMBEDDED			32,766	\$997			\$1,034	\$906
7	1.02 GUIDEWAY - ELEVATED STRUCTURE		Linear Feet	10,785	\$3,286	\$35,437,638		\$3,409	\$2,986
8	DIRECT FIXATION			9,376	\$3,033			\$3,146	\$2,756
9	BALLASTED			1,409	\$4,970			\$5,155	\$4,516
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED								
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL		Linear Feet	6,407	\$932	\$5,973,099		\$967	\$847
13	DIRECT FIXATION			6,407	\$932			\$967	\$847
14	BALLASTED								
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL		Linear Feet	2,052	\$678	\$1,390,912		\$703	\$616
18	DIRECT FIXATION			2,052	\$678			\$703	\$616
19	BALLASTED								
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY		Linear Feet	3,296	\$6,965	\$22,955,679		\$7,225	\$6,329
23	DIRECT FIXATION			3,296	\$6,965			\$7,225	\$6,329
24	BALLASTED								
25	IN-PAVEMENT BALLASTED								
26	EMBEDDED								
27	1.06 GUIDEWAY - RETAINED CUT		Linear Feet	490	\$4,756	\$2,330,510		\$4,934	\$4,322
28	DIRECT FIXATION			490	\$4,756			\$4,934	\$4,322
29	BALLASTED								
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK		L.F. Guideway	119,283	\$71.99	\$8,586,709		\$74.67	\$65.41
33	1.08 STORAGE TRACK		L.F. Guideway	119,283					
34	1.09 SPECIAL TRACKWORK		L.F. Guideway	119,283	\$38.66	\$4,635,749		\$40.31	\$35.32
35	TURNOUTS		Each	57	\$38.938			\$40.392	\$35.383
36	#5								
37	#4								
38	#6								
39	#8								
40	#10								

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS (continued)			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
41 #20								
42 OTHER - SP" CITY								
43 GIRDER, 25 METER								
44 GIRDER, 50 METER								
45 #, GIRDER								
46 #8 SINGLE CROSSOVER			12	\$93,340		\$1,120,080	1988	\$84,819
47 #4 DOUBLE CROSSOVER			1	\$205,473		\$205,473	1988	\$186,716
48 #5 DOUBLE CROSSOVER			2	\$329,791		\$659,582	1988	\$299,686
49 INTERSECTION			4	\$107,787		\$431,149	1988	\$97,948
50 1.10 GUIDEWAY SPECIAL STRUCTURES		Linear Feet						
51 BRIDGES		Each						
52 OVERPASSES		Each						
53 OTHER		Each						
54								
55 2.00 YARDS & SHOPS		Total	1	\$44,204,740	\$44,204,740		1988	\$40,169,453
56 2.01 BUILDING		Each	1	\$25,229,864	\$25,229,864		1988	\$22,926,723
57 DESCRIPTION		Revenue Vehicles				\$13,724,388	1988	
58 SHOP CAPACITY *		Revenue Vehicles					1988	\$743,879
59 YARD STORAGE CAPACITY		Each	54	\$818,606		\$11,505,476	1988	
60 WORKSTATIONS		Linear Feet	54					
61 TRACK LENGTH		Spaces						
62 PARKING		All	11	\$272,383	\$2,996,208		1988	\$247,518
63 2.02 OFFICE FURNITURE & EQUIP.		(Y/N)	2			\$1,838,720		
64 2.03 HEAVY REPAIR		(Y/N)	2			\$347,413		
65 BODY		(Y/N)	7			\$790,075		
66 TRUCK		(Y/N)						
67 EQUIPMENT		(Y/N)						
68 VARIABLE TEST LOAD		(Y/N)						
69 REWIND		(Y/N)						
70 OTHER		(Y/N)						
71 2.05 WHEEL SHOP		Each	1	\$1,144,662	\$1,144,662		1988	\$1,040,170
72 WHEEL PRESS		Each				\$1,144,662		
73 WHEEL TRUING		Each						
74 2.06 MACHINE SHOP		Each						
75 LATHE		Each						
76 DRILL PRESS		Each						
77 2.07 AIR CONDITIONING		(Y/N)	1	\$1,810,691	\$1,810,691		1988	\$1,645,400
78 2.08 ELECTRONICS		(Y/N)						
79								

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES		1990 NATIONAL UNIT COST ESTIMATES	
QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	MEASURE	UNITS OF			
2.00 YARDS & SHOPS (continued)									
2.09 COMMUNICATIONS					(Y/N)				
2.10 CAR WASH/CAR CLEANING					(Y/N)				
2.11 MAINTENANCE OF WAY SHOPS					(Y/N)				
SIGNAL					(Y/N)				
TRACTION POWER					(Y/N)				
COMPONENT REPAIR					(Y/N)				
TRACK					(Y/N)				
2.12 MAINTENANCE OF WAY EQUIPMENT									
TRUCK					Each				
CRANE					Each				
OTHER					Each				
2.13 REVE YUE CENTER					Each				
CASH COUNTING MACHINE									
VAULT									
OTHER									
2.14 CENTRAL CONTROL					(Y/N)				
MIMIC BOARD					(Y/N)				
PUBLIC ADDRESS					(Y/N)				
COMPUTER					(Y/N)				
FIRE/INTRUSION DETECTOR					(Y/N)				
MAINLINE CONTROL					(Y/N)				
YARD CONTROL					(Y/N)				
SEISMIC OR GAS DETECTION					(Y/N)				
OTHER									
3.00 SYSTEMS									
3.01 SIGNAL SYSTEM					Linear Feet				
TRAIN CONTROL - WAYSIDE					L.F. Guideway				
INSTALLATION									
HARDWARE									
DESIGN									
CROSSING PROTECTION									
TRAFFIC SIGNALS									
INSTALLATION									
GATES									
OTHER									
3.02 ELECTRIFICATION					L.F. Guideway				
SUBSTATIONS					Each				

* Line 38 - Unit Cost calculated by dividing total cost by shop capacity

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
119	3.00 SYSTEMS (continued)	Each				\$15,991,760		
120	PURCHASE	Each				\$5,067,828		\$216,15
121	INSTALLATION	L.F. Guideway	119,282	\$237.86		\$28,372,430	1988	\$247
122	CATENARY	Each						
123	INSTALLATION	Each	994	\$14,301		\$14,214,975	1988	\$14,835
124	POLES AND COMPONENTS	Each	119,282	\$118.69		\$14,157,455	1988	\$123
125	WIRE					\$1,905,017		
126	TROLLEY					\$2,565,811		
127	MESSENGER					\$9,686,627		
128	FEEDER							
129	RETURN							
130	3.03 COMMUNICATIONS	Total	1	\$19,091,470	\$19,091,470		1988	\$17,348,680
131	3.04 FARE COLLECTION	Total	1	\$6,004,536	\$6,004,536		1988	\$5,456,404
132	FAREBOX							
133	VEN JING MACHINE		74	\$57,288		\$4,239,307	1988	\$59,427
134	OTHER					\$1,765,229		\$52,058
135	4.00 STATIONS	Each	22	\$2,995,158	\$65,893,479		1988	\$2,721,741
136	4.01 AT-GRADE	Each	18	\$1,051,819	\$18,932,742		1988	\$855,802
137	CENTER PLATFORM	Linear Feet	15	\$1,079,409		\$16,191,134	1988	\$980,874
138	PLATFORM LENGTH	(Y/N)						
139	ESCALATOR/ELEVATOR	Type						
140	HANDICAP ACCESS MODE	Percent						
141	WEATHER COVERAGE	Each						
142	SIDE PLATFORM	Linear Feet	3	\$913,869		\$2,741,608	1988	\$830,446
143	PLATFORM LENGTH	(Y/N)						
144	ESCALATOR/ELEVATOR	Type						
145	HANDICAP ACCESS MODE	Percent						
146	WEATHER COVERAGE	Each	1	\$27,684,300	\$27,684,300		1988	\$25,157,102
147	4.02 SUBWAY	Each						
148	CENTER PLATFORM	Linear Feet						
149	PLATFORM LENGTH	(Y/N)						
150	ESCALATOR/ELEVATOR	Type						
151	HANDICAP ACCESS MODE	Percent						
152	WEATHER COVERAGE	Each						
153	SIDE PLATFORM	Linear Feet	1	\$27,684,300		\$27,684,300	1988	\$25,157,102
154	PLATFORM LENGTH	(Y/N)						
155	ESCALATOR/ELEVATOR	Type						
156	HANDICAP ACCESS MODE	Percent						
157	WEATHER COVERAGE	Each						

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY	1990 NATIONAL
UNITS OF MEASURE			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	UNIT COST ESTIMATES	UNIT COST ESTIMATES
4.00 STATIONS (continued)								
158	4.03 ELEVATED	Each	3	\$2,928,894	\$8,786,682		\$3,038,272	\$2,661,526
159	CENTER PLATFORM	Each	3	\$2,928,894		\$8,786,682	\$3,038,272	\$2,661,526
160	PLATFORM LENGTH	Linear Feet						
161	ESCALATOR/ELEVATOR	(Y/N)						
162	HANDICAP ACCESS MODE	Type						
163	WEATHER COVERAGE	Percent						
164	WEATHER COVERAGE	Each						
165	SIDE PLATFORM	Linear Feet						
166	PLATFORM LENGTH	(Y/N)						
167	ESCALATOR/ELEVATOR	Type						
168	HANDICAP ACCESS MODE	Percent						
169	WEATHER COVERAGE	Total	5	\$1,698,107	\$8,480,533		\$1,761,521	\$1,543,093
170	4.04 PARKING LOTS		5					
171	NUMBER OF LOTS		1,051	\$3,079			\$8,380	\$7,341
172	NUMBER OF SPACES	Total						
173	4.05 PARKING GARAGES							
174	NUMBER OF LOTS							
175	NUMBER OF SPACES							
176	4.06 PEDESTRIAN OVERPASSES	Total	2	\$999,611	\$1,999,222		\$1,036,941	\$908,360
177	5.00 VEHICLES	Each	54	\$1,480,354	\$79,939,129		\$1,535,637	\$1,345,218
178	5.01 REVENUE VEHICLES - ORDER A	Each	54	\$1,446,955	\$78,136,129		\$1,601,001	\$1,314,877
179	MA, MANUFACTURER	Name						
180	BODY TYPE (RIGID,ARTIC)	Type						
181	LENGTH OVER COUPLERS	Linear Feet						
182	WIDTH	Linear Feet						
183	NUMBER SEATS	Each						
184	AIR CONDITIONING	(Y/N)						
185	CAB SIGNAL EQUIPMENT	(Y/N)						
186	BRAKING SYSTEM (AIR,ELEC)	Type						
187	TYPE OF STEPS (HIGLOW)	Type						
188	HANDICAPED (LIFT,RAMP)	Type						
189	ON-BOARD FAREBOX	(Y/N)						
190	PROCUREMENT COST	Total						
191	SPARE PARTS	Total						
192	SPECIAL EQUIPMENT COST	Total						
193	5.02 REVENUE VEHICLES - ORDER B	Each						
194	MA/MANUFACTURER	Name						
195	BODY TYPE (RIGID,ARTIC)	Type						
196	LENGTH OVER COUPLERS	Linear Feet						

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
197	5.00 VEHICLES (continued)	Linear Feet						
198	WIDTH	Each						
199	NUMBER SEATS	(Y/N)						
200	AIR CONDITIONING	(Y/N)						
201	CAB SIGNAL EQUIPMENT	Type						
202	BRAKING SYSTEM (AIR/ELEC)	Type						
203	TYPE OF STEPS (HIGH/LOW)	Type						
204	HANDICAPPED (LIFT/RAMP)	(Y/N)						
205	ON-BOARD FAREBOX	Total						
206	PROCUREMENT COST	Total						
207	SPARE PARTS	Total						
208	SPECIAL EQUIPMENT COST	Each						
209	5.03 REVENUE VEHICLES-- ORDER C	Name						
210	MAKE/MANUFACTURER	Type						
211	BODY TYPE (RIGID/ARTIC)	Linear Feet						
212	LENGTH OVER COUPLERS	Linear Feet						
213	WIDTH	Each						
214	NUMBER SEATS	(Y/N)						
215	AIR CONDITIONING	(Y/N)						
216	CAB SIGNAL EQUIPMENT	Type						
217	BRAKING SYSTEM (AIR/ELEC)	Type						
218	TYPE OF STEPS (HIGH/LOW)	Type						
219	HANDICAPPED (LIFT/RAMP)	(Y/N)						
220	ON-BOARD FAREBOX	Total						
221	PROCUREMENT COST	Total						
222	SPARE PARTS	Total						
223	SPECIAL EQUIPMENT COST	Each						
224	5.04 NON-REVENUE VEHICLES		19	\$94,896	\$1,803,000	\$680,000	1988	\$86,232
225	SERVICE TRUCKS		5		\$136,000	\$340,000		
226	AUTOMOBILES		12		\$28,333	\$783,000		
227	OTHER		2		\$391,500			
228	6.00 SPECIAL CONDITIONS		119,282	\$1,277	\$152,349,392		1985	\$1,263
229	6.01 UTILITY RELOCATION - AS IS	Linear feet	1	\$2,553,505	\$2,553,505		1985	\$2,524,684
230	NEW INSTALLATION	Total						
231	GAS					\$397,776		
232	TELEPHONE					\$179,117		
233	ELECTRIC					\$52,175		
234	WATER					\$130,065		
235	PIPELINE					\$1,006,224		

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
6.00 SPECIAL CONDITIONS (continued)								
236	RAILROAD	Total	1	\$118,761,634	\$118,761,634	\$788,148	\$135,171,144	\$118,408,923
237	OTHER							
238	6.02 UTILITY RELOCATION - BETTERMENTS							
239	NEW INSTALLATION							
240	GAS							
241	TELEPHONE					\$4,636,851		
242	ELECTRIC					\$1,991,741		
243	WATER					\$21,311,426		
244	PIPELINE					\$6,168,122		
245	RAILROAD					\$27,379,768		
246	OTHER					\$56,398,574		
247	NEW INSTALLATION					\$1,875,152		
248	6.03 UTILITY RELOCATION - OTHER	Total						
249	NEW INSTALLATION							
250	GAS							
251	TELEPHONE							
252	ELECTRIC							
253	WATER							
254	PIPELINE							
255	RAILROAD							
256	OTHER							
257	6.04 DEMOLITIONS	Total	1	\$967,836	\$967,836	\$384,438	\$1,082,366	\$956,912
258	BUILDINGS					\$583,398		
259	REMOVALS							
260	6.05 ROADWAY CHANGES	Total	1	\$12,088,912	\$12,088,912		\$13,644,370	\$11,952,468
261	BRIDGES							
262	STREETS							
263	OTHER					\$400,000		
264	6.06 ENVIRONMENTAL	Total	1	\$16,977,505	\$16,977,505	\$11,688,912	\$19,161,970	\$16,785,885
265	NOISE							
266	VISUAL					\$10,124,905		
267	VIBRATION							
268	OTHER					\$6,852,600		
269	7.00 RIGHT-OF-WAY	Linear Feet	119,282	\$504	\$60,084,803		\$523	\$458
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$55,437,402	\$55,437,402		\$57,507,678	\$50,376,728
271	MAINLINE	Acres	1	\$55,437,402		\$55,437,402		
272	STATION	Acres						
273	YARD	Acres						
274	PARKING	Acres						

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$4,493,401	\$4,493,401	\$2,211,075	\$4,661,204	\$4,083,215
282	LEGAL & CONSULTING					\$40,500		
283	APPRAISAL					\$2,241,826		
284	PROPERTY MANAGEMENT							
285	7.04 RELOCATION	Total	1	\$154,000	\$154,000	\$77,000	\$159,751	\$139,942
286	BUSINESS		1			\$77,000		
287	RESIDENCE		1			\$77,000		
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	119,282	\$1,767	\$210,805,963		\$1,995	\$1,747
290	8.01 FEASIBILITY STUDIES	Total						
291	8.02 ENGINEERING & DESIGN	Total	1	\$69,586,796	\$69,586,796		\$78,540,402	\$68,801,392
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$86,130,800	\$86,130,800		\$97,213,093	\$85,158,669
293	8.04 PROJECT MANAGEMENT	Total	1	\$23,200,000	\$23,200,000		\$26,185,102	\$22,938,149
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,591,000	\$4,591,000		\$5,181,716	\$4,539,183
295	8.06 PROJECT INITIATION	Total	1	\$35,638,000	\$35,638,000	\$35,638,000	\$40,223,476	\$35,235,765
296	INSURANCE							
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING		1	\$9,915,093	\$9,915,093		\$11,190,850	\$9,803,185
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER		1	\$18,255,726	\$18,255,726		\$18,937,475	\$16,589,228

UNIT COST SUMMARY

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY			
0.00 SYSTEM DESCRIPTION	0.01 SERVICE		OBSERVATIONS	MINIMUM	MEAN	RANGE
1	ROUTE MILES	Route Miles	5	0	18	30
2	TRACK MILES	Track Miles	5	26	40	62
3	STATIONS	Each	5	13	22	28
4	VEHICLES IN SERVICE	Revenue Vehicles	5	26	51	97
5	PEAK	Revenue Vehicles	5	15	31	70
6	MIDDAY	Revenue Vehicles	5	8	15	28
7	HEADWAY	Minutes	4	0	9	15
8	PEAK	Minutes	4	0	13	30
9	MIDDAY	Minutes	4	0	13	30
10	STAFFING - TOTAL	Total	5	83	231	603
11	ADMINISTRATIVE	FTE's	4	0	14	28
12	OPERATORS	FTE's	5	32	62	112
13	MAINTENANCE	FTE's	4	0	29	55
14	VEHICLE	FTE's	4	0	27	53
15	FACILITY	FTE's	4	0	27	53
16	OTHER (eg Fare Inspection)	FTE's	5	5	99	391
17						
18						

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM		UNIT COST SUMMARY				
LIGHT RAIL SYSTEMS		UNITS OF MEASURE	OBSERVATIONS	MINIMUM	MEAN	MAXIMUM
1.00 GUIDEWAY ELEMENTS						RANGE
1	1.01 GUIDEWAY AT-GRADE	Linear Feet	5	\$428	\$1,016	\$1,508
2	DIRECT FIXATION	Linear Feet	5	\$413	\$665	\$1,205
3	BALLASTED		1	\$696	\$696	\$0
4	IN-PAVEMENT BALLASTED		3	\$359	\$491	\$329
5	EMBEDDED		2	\$526	\$1,557	\$2,062
6	1.02 GUIDEWAY - ELEVATED STRUCTURE		4	\$593	\$1,452	\$3,131
7	DIRECT FIXATION	Linear Feet	4	\$410	\$1,768	\$3,041
8	BALLASTED		3	\$410	\$1,233	\$2,346
9	IN-PAVEMENT BALLASTED		3	\$1,119	\$2,746	\$4,516
10	EMBEDDED		2	\$506	\$1,936	\$3,365
11	1.03 GUIDEWAY - ELEVATED RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172
12	DIRECT FIXATION		2	\$847	\$1,009	\$1,172
13	BALLASTED		2	\$847	\$1,009	\$1,172
14	IN-PAVEMENT BALLASTED		2	\$847	\$1,009	\$1,172
15	EMBEDDED		2	\$847	\$1,009	\$1,172
16	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$0
17	DIRECT FIXATION		1	\$616	\$616	\$0
18	BALLASTED		1	\$616	\$616	\$0
19	IN-PAVEMENT BALLASTED		1	\$616	\$616	\$0
20	EMBEDDED		1	\$616	\$616	\$0
21	1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$6,329	\$7,443	\$8,557
22	DIRECT FIXATION		2	\$6,329	\$13,530	\$20,730
23	BALLASTED		2	\$6,329	\$13,530	\$20,730
24	IN-PAVEMENT BALLASTED		2	\$6,329	\$13,530	\$20,730
25	EMBEDDED		2	\$6,329	\$13,530	\$20,730
26	1.06 GUIDEWAY - RETAINED CUT	Linear Feet	3	\$329	\$3,354	\$5,410
27	DIRECT FIXATION		3	\$329	\$3,354	\$5,410
28	BALLASTED		3	\$329	\$3,354	\$5,410
29	IN-PAVEMENT BALLASTED		3	\$329	\$3,354	\$5,410
30	EMBEDDED		3	\$329	\$3,354	\$5,410
31	1.07 POCKET TRACK	L.F. Guideway	2	\$2,811	\$34,111	\$65,411
32	1.08 STORAGE TRACK	L.F. Guideway	2	\$2,811	\$34,111	\$65,411
33	1.09 SPECIAL TRACKWORK	L.F. Guideway	4	\$15,711	\$25,021	\$35,321
34	TURNOUTS	Each	4	\$15,711	\$25,021	\$35,321
35	#5					
36	#4					
37	#6					
38	#8					
39	#10					
40						

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				RANGE
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	
41	1.00 GUIDEWAY ELEMENTS (continued)						
42	OTHER - SPECIFY						
43	GIRDER, 25 METER						
44	GIRDER, 50 METER						
45	#4, GIRDER						
46	#8 SINGLE CROSSOVER						
47	#4 DOUBLE CROSSOVER						
48	#5 DOUBLE CROSSOVER						
49	INTERSECTION						
50	1.10 GUIDEWAY-SPECIAL STRUCTURES						
51	BRIDGES	Linear Feet	1	\$4,389	\$4,389	\$4,389	\$0
52	OVERPASSES	Each					
53	OTHER	Each					
54		Each					
55	2.00 YARDS & SHOPS	Total	5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
56	2.01 BUILDING	Each	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
57	DESCRIPTION						
58	SHOP CAPACITY *	Revenue Vehicles					
59	YARD STORAGE CAPACITY	Revenue Vehicles					
60	WORKSTATIONS	Each					
61	TRACK LENGTH	Linear Feet					
62	PARKING	Spaces	1	\$252,440	\$252,440	\$252,440	\$0
63	2.02 OFFICE FURNITURE & EQUIP.	All	3	\$69,070	\$349,318	\$731,367	\$662,287
64	2.03 HEAVY REPAIR						
65	BODY	(Y/N)					
66	TRUCK	(Y/N)					
67	EQUIPMENT	(Y/N)					
68	2.04 MOTOR SHOPS		2	\$11,512	\$27,032	\$42,553	\$31,042
69	VARIABLE TEST LOAD	(Y/N)					
70	REWIND	(Y/N)					
71	OTHER	(Y/N)					
72	2.05 WHEEL SHOP		3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
73	WHEEL PRESS	Each					
74	WHEEL TRUING	Each	2	\$236	\$118,112	\$235,988	\$235,752
75	2.06 MACHINE SHOP						
76	LATHIE	Each					
77	DRILL PRESS	Each					
78	2.07 AIR CONDITIONING	(Y/N)	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
79	2.08 ELECTRONICS	(Y/N)	3	\$230,233	\$1,052,600	\$1,645,400	\$1,415,167

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
80	2.00 YARDS & SHOPS (continued)						
81	2.09 COMMUNICATIONS	(Y/N)	2	\$6,907	\$572,302	\$1,137,688	\$1,130,781
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	2	\$144,470	\$508,143	\$871,816	\$727,347
83	2.11 MAINTENANCE OF WAY SHOPS		4	\$66,700	\$1,633,059	\$5,314,598	\$5,247,898
84	SIGNAL	(Y/N)					
85	TRACTION POWER	(Y/N)					
86	COMPONENT REPAIR	(Y/N)					
87	TRACK	(Y/N)					
88	2.12 MAINTENANCE OF WAY EQUIPMENT		2	\$27,281	\$41,800	\$56,539	\$28,278
89	TRUCK	Each					
90	CRANE	Each					
91	OTHER	Each					
92	2.13 REVENUE CENTER	Each	1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
93	CASH COUNTING MACHINE						
94	VAULT						
95	OTHER						
96	2.14 CENTRAL CONTROL	(Y/N)	1	\$10,159,345	\$10,159,345	\$10,159,345	\$0
97	MIMIC BOARD	(Y/N)					
98	PUBLIC ADDRESS	(Y/N)					
99	COMPUTER	(Y/N)					
100	FIRE/INTRUSION DETECTOR	(Y/N)					
101	MAINLINE CONTROL	(Y/N)					
102	YARD CONTROL	(Y/N)					
103	SEISMIC OR GAS DETECTION	(Y/N)					
104	OTHER	(Y/N)					
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity						
106	3.00 SYSTEMS						
107	3.01 SIGNAL SYSTEM	Linear Feet	5	\$179	\$482	\$878	\$699
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	5	\$54	\$198	\$443	\$388
109	INSTALLATION						
110	HARDWARE						
111	DESIGN						
112	CROSSING PROTECTION	Each					
113	TRAFFIC SIGNALS	Each					
114	INSTALLATION						
115	GATES	Each					
116	OTHER						
117	3.02 ELECTRIFICATION	L.F. Guideway	5	\$92	\$241	\$448	\$356
118	SUBSTATIONS	Each					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY			
			OBSERVATIONS	MINIMUM	MEAN	RANGE
119	3.00 SYSTEMS (continued)					
120	PURCHASE	Each				
121	INSTALLATION	Each				
122	CATENARY	L.F. Guideway				
123	INSTALLATION	Each				
124	POLES AND COMPONENTS	Each				
125	WIRE					
126	TROLLEY					
127	MESSANGER					
128	FEEDER					
129	RETURN					
130	3.03 COMMUNICATIONS	Total	4	\$196,121	\$7,477,427	\$17,152,559
131	3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$4,375,907
132	FAREBOX					
133	VENDING MACHINE					
134	OTHER					
135	4.00 STATIONS	Each	5	\$180,861	\$1,431,936	\$3,024,282
136	4.01 AT-GRADE	Each	5	\$180,861	\$800,732	\$1,780,443
137	CENTER PLATFORM	Each	3	\$155,735	\$542,827	\$825,139
138	PLATFORM LENGTH	Linear Feet				
139	ESCALATOR/ELEVATOR	(Y/N)				
140	HANDICAP ACCESS MODE	Type				
141	WEATHER COVERAGE	Percent				
142	WEATHER COVERAGE	Each	5	\$184,828	\$778,309	\$1,739,553
143	SIDE PLATFORM	Linear Feet				
144	PLATFORM LENGTH	(Y/N)				
145	ESCALATOR/ELEVATOR	Type				
146	HANDICAP ACCESS MODE	Percent				
147	WEATHER COVERAGE	Each	2	\$6,936,659	\$16,046,881	\$18,220,444
148	4.02 SUBWAY	Each				
149	CENTER PLATFORM	Each				
150	PLATFORM LENGTH	Linear Feet				
151	ESCALATOR/ELEVATOR	(Y/N)				
152	HANDICAP ACCESS MODE	Type				
153	WEATHER COVERAGE	Percent				
154	WEATHER COVERAGE	Each	2	\$6,936,659	\$16,046,881	\$18,220,443
155	SIDE PLATFORM	Linear Feet				
156	PLATFORM LENGTH	(Y/N)				
157	ESCALATOR/ELEVATOR	Type				
158	HANDICAP ACCESS MODE	Percent				
159	WEATHER COVERAGE	Each				

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNIT COST SUMMARY				
	UNITS OF MEASURE	OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
4.00 STATIONS (continued)	Each	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
4.03 "LEVATED"	Each					
CENTER PLATFORM	Linear Feet					
PLATFORM LENGTH	(Y/N)					
ESCALATOR/ELEVATOR	Type					
HANDICAP ACCESS MODE	Percent					
WEATHER COVERAGE	Each					
SIDE PLATFORM	Linear Feet					
PLATFORM LENGTH	(Y/N)					
ESCALATOR/ELEVATOR	Type					
HANDICAP ACCESS MODE	Percent					
WEATHER COVERAGE	Total	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
4.04 PARKING LOTS						
NUMBER OF LOTS	Total					
NUMBER OF SPACES						
4.05 PARKING GARAGES						
NUMBER OF LOTS	Total	1	\$908,360	\$908,360	\$908,360	\$0
NUMBER OF SPACES						
4.06 PEDESTRIAN OVERPASSES						
5.00 VEHICLES	Each	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
5.01 REVENUE VEHICLES -- ORDER A	Each	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
MAKE/MANUFACTURER	Name					
BODY TYPE (RIGID,ARTIC)	Type					
LENGTH OVER COUPLERS	Linear Feet					
WIDTH	Linear Feet					
NUMBER SEATS	Each					
AIR CONDITIONING	(Y/N)					
CAB SIGNAL EQUIPMENT	(Y/N)					
BRAKING SYSTEM (AIR,ELEC)	Type					
TYPE OF STEPS (HIGH,LOW)	Type					
HANDICAPED (LIFT,RAMP)	Type					
ON-BOARD FAREBOX	(Y/N)					
PROCUREMENT COST	Total					
SFARE PARTS	Total					
SPECIAL EQUIPMENT COST	Total					
5.02 REVENUE VEHICLES -- ORDER B	Each	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
MAKE/MANUFACTURER	Name					
BODY TYPE (RIGID,ARTIC)	Type					
LENGTH OVER COUPLERS	Linear Feet					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
197	5.00 VEHICLES (continued)	Linear Feet					
198	W/TH	Each					
199	NUMBER SEATS	(Y/N)					
200	AIR CONDITIONING	(Y/N)					
201	CAB SIGNAL EQUIPMENT	Type					
202	BRAKING SYSTEM (AIR,ELEC)	Type					
203	TYPE OF STEPS (HIGH/LOW)	Type					
204	HANDICAPPED (LIFT RAMP)	Type					
205	ON-BOARD FAREBOX	(Y/N)					
206	PROCUREMENT COST	Total					
207	SPARE PARTS	Total					
208	SPECIAL EQUIPMENT COST	Total					
209	5.03 REVENUE VEHICLES - ORDER C	Each					
210	MAKE/MANUFACTURER	Name					
211	BODY TYPE (RIGID,ARTIC)	Type					
212	LENGTH OVER COUPLERS	Linear Feet					
213	WIDTH	Linear Feet					
214	NUMBER SEATS	Each					
215	AIR CONDITIONING	(Y/N)					
216	CAB SIGNAL EQUIPMENT	(Y/N)					
217	BRAKING SYSTEM (AIR,ELEC)	Type					
218	TYPE OF STEPS (HIGH/LOW)	Type					
219	HANDICAPPED (LIFT RAMP)	Type					
220	ON-BOARD FAREBOX	(Y/N)					
221	PROCUREMENT COST	Total					
222	SPARE PARTS	Total					
223	SPECIAL EQUIPMENT COST	Total					
224	5.04 NON-REVENUE VEHICLES	Each	2	\$11,267	\$48,750	\$86,232	\$74,965
225	SERVICE TRUCKS						
226	AUTOMOBILES						
227	OTHER						
228	6.00 SPECIAL CONDITIONS	Linear feet	5	\$81	\$337	\$1,263	\$1,182
229	6.01 UTILITY RELOCATION - AS IS	Total	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
230	NEW INSTALLATION						
231	GAS						
232	TELEPHONE						
233	ELECTRIC						
234	WATER						
235	PIPELINE						

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY			
			OBSERVATIONS	MINIMUM	MEAN	RANGE
236	6.00 SPECIAL CONDITIONS (continued)					
237	RAILROAD					
238	OTHER					
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	3	\$485,549	\$41,497,095	\$118,408,923
240	NEW INSTALLATION					
241	GAS					
242	TELEPHONE					
243	ELECTRIC					
244	WATER					
245	PIPELINE					
246	RAILROAD					
247	OTHER					
248	6.03 UTILITY RELOCATION - OTHER	Total				
249	NEW INSTALLATION					
250	GAS					
251	TELEPHONE					
252	ELECTRIC					
253	WATER					
254	PIPELINE					
255	RAILROAD					
256	OTHER					
257	6.04 DEMOLITIONS	Total	5	\$112,628	\$511,718	\$844,284
258	BUILDINGS					
259	REMOVALS					
260	6.05 ROADWAY CHANGES	Total	2	\$2,220,974	\$7,086,721	\$9,731,494
261	BRIDGES					
262	STREETS					
263	OTHER					
264	6.06 ENVIRONMENTAL	Total	3	\$356,640	\$5,349,686	\$16,785,885
265	NOISE					
266	VISUAL					
267	VIBRATION					
268	OTHER					
269	7.00 RIGHT-OF-WAY	Linear Feet	5	\$160	\$346	\$440
270	7.01 LAND ACQUISITION - PURCHASED	Total	5	\$15,470,477	\$30,823,677	\$50,376,726
271	MAINLINE	Acres				
272	STATION	Acres				
273	YARD	Acres				
274	PARKING	Acres				

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UNITA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY			
			OBSERVATIONS	MINIMUM	MEAN	RANGE
3.00 SYSTEMS (continued)						
119	PURCHASE	Each				
120	INSTALLATION	Each				
121	CATENARY	L.F. Guideway				
122	INSTALLATION	Each				
123	POLES AND COMPONENTS	Each				
124	WIRE	Each				
125	TROLLEY					
126	MESSANGER					
127	FEEDER					
128	RETURN					
129	3.03 COMMUNICATIONS	Total	4	\$186,121	\$7,477,427	\$17,152,559
130	3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$4,375,907
131	FAREBOX					
132	VENDING MACHINE					
133	OTHER					
134						
4.00 STATIONS						
135	4.01 AT-GRADE	Each	5	\$180,861	\$1,431,936	\$3,024,282
136	CENTER PLATFORM	Each	5	\$180,861	\$600,732	\$1,780,443
137	PLATFORM LENGTH	Linear Feet	3	\$155,735	\$542,827	\$825,139
138	ESCALATOR/ELEVATOR	(Y/N)				
139	HANDICAP ACCESS MODE	Type				
140	WEATHER COVERAGE	Percent				
141	WEATHER COVERAGE	Each				
142	SIDE PLATFORM	Linear Feet				
143	PLATFORM LENGTH	(Y/N)	5	\$184,828	\$778,309	\$1,739,553
144	ESCALATOR/ELEVATOR	Type				
145	HANDICAP ACCESS MODE	Percent				
146	WEATHER COVERAGE	Each				
147	4.02 SUBWAY	Each	2	\$6,936,659	\$16,046,881	\$18,220,444
148	CENTER PLATFORM	Each				
149	PLATFORM LENGTH	Linear Feet				
150	ESCALATOR/ELEVATOR	(Y/N)				
151	HANDICAP ACCESS MODE	Type				
152	WEATHER COVERAGE	Percent				
153	WEATHER COVERAGE	Each				
154	SIDE PLATFORM	Linear Feet	2	\$6,936,659	\$16,046,881	\$18,220,443
155	PLATFORM LENGTH	(Y/N)				
156	ESCALATOR/ELEVATOR	Type				
157	HANDICAP ACCESS MODE	Percent				
	WEATHER COVERAGE	Each				

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS			UNIT COST SUMMARY				
UNITS OF MEASURE			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
4.00 STATIONS (continued)							
158	4.03 "LEVATED	Each	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
159	CENTER PLATFORM	Each					
160	PLATFORM LENGTH	Linear Feet					
161	ESCALATOR/ELEVATOR	(Y/N)					
163	HANDICAP ACCESS MODE	Type					
164	WEATHER COVERAGE	Percent					
165	SIDE PLATFORM	Each					
166	PLATFORM LENGTH	Linear Feet					
167	ESCALATOR/ELEVATOR	(Y/N)					
168	HANDICAP ACCESS MODE	Type					
169	WEATHER COVERAGE	Percent					
170	4.04 PARKING LOTS	Total	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
171	NUMBER OF LOTS						
172	NUMBER OF SPACES						
173	4.05 PARKING GARAGES	Total					
174	NUMBER OF LOTS						
175	NUMBER OF SPACES						
176	4.06 PEDESTRIAN OVERPASSES	Total	1	\$908,360	\$908,360	\$908,360	\$0
5.00 VEHICLES							
177	5.01 REVENUE VEHICLES -- ORDER A	Each	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
178	MAKE/MANUFACTURER	Each	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
179	BODY TYPE (RIGID,ARTIC)	Name					
180	LENGTH OVER COUPLERS	Type					
181	WIDTH	Linear Feet					
182	NUMBER SEATS	Linear Feet					
183	AIR CONDITIONING	Each					
184	CAB SIGNAL EQUIPMENT	(Y/N)					
185	BRAKING SYSTEM (AIR,ELEC)	(Y/N)					
186	TYPE OF STEPS (HIGH/LOW)	Type					
187	HANDICAPED (LIFT,RAMP)	Type					
188	ON-BOARD FAREBOX	Type					
189	PROCUREMENT COST	(Y/N)					
190	SPARE PARTS	Total					
191	SPECIAL EQUIPMENT COST	Total					
192	5.02 REVENUE VEHICLES -- ORDER B	Total	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
193	MAKE/MANUFACTURER	Each					
194	BODY TYPE (RIGID,ARTIC)	Name					
195	LENGTH OVER COUPLERS	Type					
196		Linear Feet					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM		UNITS OF MEASURE	UNIT COST SUMMARY				
LIGHT RAIL SYSTEMS			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
275	7.00 RIGHT-OF-WAY (continued)	Total					
276	7.02 LAND ACQUISITION - DONATED						
277	MAINLINE						
278	STATION						
279	YARD						
280	PARKING						
281	7.03 ACQUISITION-RELATED COST	Total	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
282	LEGAL & CONSULTING						
283	APPRAISAL						
284	PROPERTY MANAGEMENT						
285	7.04 RELOCATION	Total	3	\$139,942	\$267,577	\$471,332	\$331,390
286	BUSINESS						
287	RESIDENCE						
288	7.05 OTHER	Total					
289	8.00 SOFT-COSTS	Linear Feet	5	\$359	\$1,491	\$3,068	\$2,708
290	8.01 FEASIBILITY STUDIES	Total	3	\$3,718,000	\$20,812,853	\$36,398,671	\$32,680,671
291	8.02 ENGINEERING & DESIGN	Total	3	\$16,009,645	\$68,189,928	\$119,758,747	\$103,749,102
292	8.03 CONSTRUCTION MANAGEMENT	Total	5	\$9,576,163	\$36,506,471	\$85,158,669	\$75,582,508
293	8.04 PROJECT MANAGEMENT	Total	6	\$4,347,098	\$15,113,157	\$22,938,149	\$18,591,061
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
295	8.06 PROJECT INITIATION	Total	3	\$1,319,808	\$14,136,864	\$35,235,765	\$33,915,957
296	INSURANCE						
297	MOBILIZATION						
298	MAINTENANCE OF TRAFFIC						
299	8.07 FINANCE CHARGES		1	\$546,621	\$546,621	\$546,621	\$0
300	8.08 TRAINING/START-UP/TESTING		4	\$3,543,743	\$6,480,866	\$9,803,185	\$6,259,441
301	SAFETY CERTIFICATION						
302	OFF-SITE LRV TESTING						
303	8.09 OTHER		2	(\$16,589,228)	\$40,319,705	\$97,228,639	\$113,817,867

03/19/91

Booz, Allen & Hamilton

