UTILIZATION OF CONSULTANTS BY THE STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

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1. PROJECT OBJECTIVES AND CONDUCT OF RESEARCH

1.1 BACKGROUND AND OBJECTIVES

1.1.1 Background

Traditionally, the State Department of Highways and Public Transportation (SDHPT) has, with few exceptions since it was established in 1917, always employed a sufficient number of qualified in-house personnel to provide the planning and engineering services needed to build and maintain the extensive network of highways in Texas. Department employees have been characterized as dedicated and professional individuals replete with the skills and experience necessary to plan, design, and administer the construction, operation, maintenance, and management of a highway system which ranges in complexity from farm roads to sophisticated urban freeways. The Department is also recognized nationally as a leader in highway engineering and in the sponsorship and application of highway research.

Recent events, however, persuaded the Department to reevaluate its tradition of providing all, or virtually all, its needed engineering planning services in-house. Substantial budget increases and the resulting increases in highway construction, executive and legislatively-imposed hiring restraints and the retirement of a large number of experienced engineers, managers, and supervisors left the Department with insufficient personnel to handle the workload and thus induced the use of private consultants to supplement its in-house engineering resources.

The increases in the Department's budget were funded from increases in Federal and State highway-user taxes in 1983 and 1984, respectively. They came, after years of inflation and underfunding, in response to continuing public demands for the improved highway facilities and services that were needed to alleviate the transportation problems associated with increased population, urbanization, and industrial activity together with progressive deterioration of the overall state highway network. The additional funding accelerated the construction programs that were required for rehabilitating, upgrading, and increasing the capacity of the state's highway system, but the resulting need for construction plans exceeded the ability of in-house resources to produce the plans in a timely manner.

Also, during this period of opportunity for accelerated construction, the Department was constrained in expanding the size of its in-house staff by personnel-hiring limits imposed by the legislature. Staff productivity was further aggravated by the retirement of unusually large numbers of experienced supervisors, who would otherwise have been available for supervising, managing,

and training additional or replacement employees who might have been hired to cope with the increased workload. Staff shortages were not evenly distributed among the 24 highway districts; they appeared to be significant in only a few districts. The Strategic Mobility Plan (SMP), published by the Department in August 1984, contains a forecast of the highway construction and maintenance needs for the 20 year period ending in 2005. The SMP, was adopted as the guideline for allocating highway funds throughout the state and shows that a large part of the Department's needs for providing mobility during the next twenty years will be in the districts that encompass the larger urban areas. It is likely that these districts will experience the greatest mis-match between workload and sufficient staff and will, therefore, have the greatest need for consultant's services.

Consequently, this study was commissioned by the SDHPT to investigate the costs and quality of pre-construction engineering produced by in-house resources and by consultants and to make comparisons that might guide the Department in its further assessment of the need for and the desirability of using private consulting engineers in an efficient and effective manner.

It is important to recognize that in comparing the efficiency of a public and a private agency there are points of inquiry that are not capable of resolution because of intrinsic differences in responsibilities and functions between public and private agencies. For example, the Department is expected to respond to demands for services that are not made on a private agency. Futhermore, the Department as a public agency is bound by public expectations for responsiveness and high standards of accountability and must comply with federal, state, and local laws and regulations. Demands by the public for highway improvements and services are not limited nor predictable, although the resources for meeting these demands are limited.

The Department, traditionally, responds to all reasonable requests from the public for information and assistance concerning such matters as, studies, hearings, travel advisories, rights of access, vehicle registration and travel information. These requests, which are generally unanticipated, are a demand on the Department's resources. The Department is also obligated to respond to similar requests from other governmental agencies. To do so, it is important for the Department to maintain an experienced and capable organization which can evaluate these requests and adapt quickly to changing demands. The long life-cycle that is associated with developing, maintaining, and improving some highway projects, which may incorporate several years of negotiations and accumulated information, has also made it important to the public that the Department maintain an experienced, stable organization that could give the continuity required for developing such projects.

While the organizational structure of the Department is designed to accomplish its primary mission of constructing, operating, and maintaining a superior highway system, it also is meant to

meet the relatively unpredictable demands for ancillary services and assistance. This dual responsibility makes it difficult to identify the part of the Department's budget which should be related to its primary mission and the part which should be related to its complementary obligations as a responsible public agency. In studying the cost of delivering pre-construction engineering services, which are associated closely with ancillary services, it is especially difficult to apportion these costs to specific projects as opposed to estimating the annual global (total Departmental) pre-construction engineering cost. This area of cost apportionment is addressed in this study.

1.1.2 Objectives

The principal objectives of this research study, as stated in approved Research Study Proposal No. 3-1-86-1101, entitled "UTILIZATION OF CONSULTANTS BY SDHPT", are:

- to compare the cost and cost-effectiveness of using consulting engineers to do the work in-house and
- to assess the quality of work being performed by the consulting engineers in comparison with Departmental work.

This study investigates and documents the experience of the SDHPT with respect to the cost of delivering pre-construction engineering (P.C.E.) services performed in-house and by consultants and to the quality of these services so performed in-house and by consultants. The cost-effectiveness of utilizing consultants is also addressed. In attaining these objectives, the information that was available within the accounting system of the SDHPT was utilized extensively. This system in an overall sense recognizes Principle 1 of the National Council of Governmental Accounting, which states that:

> **A governmental accounting system must make it possible both: (a) to present fairly and with full disclosure the financial position and *results* of financial operations of the funds and account groups of the governmental unit in conformity with generally accepted accounting principles; and (b) to determine and demonstrate compliance with finance-related legal and contractual provisions.**[1]

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1 "Introduction to Fund Accounting" by Edward S. Lynn and Joan W. Norvelle, Reston Publishing Company, Inc., Reston, Virginia, 1984, p. 9.

However, it does not routinely yield project-specific data concerning all indirect costs of delivering pre-construction engineering services. The methodology for identifying these costs is described in following sections of this report.

1.2 ORGANIZATION OF RESEARCH

1.2.1 Three Participating Study Agencies

The SDHPT has a long and successful tradition of providing, with some exceptions, its own in-house engineering services, and it is expected to continue doing so except for compelling reasons. The private engineering community, which has a financial interest in selling its services to the Department, feels that it can contribute to the Department's mission by providing engineering services that would otherwise be furnished by additional in-house staff personnel. The SDHPT was aware of the controversial nature of this subject and judged it appropriate to engage three agencies to conduct the research study and develop independent findings.

The three agencies engaged are: Ernst & Whinney, a private consultant management firm headquartered in Washington, D. C.; the Texas Transportation Institute (TTI) at Texas A & M University; and the Center for Transportation Research (CTR) at The University of Texas at Austin. TTI and CTR have been conducting research studies for the Department for over twenty years and are the principal research agencies for the SDHPT.

Because of time constraints and in the interest of efficiency, the Department directed the three study agencies to form a joint study team to select, collect, and share such information as might be available for addressing the objectives of the study. The Department further directed each study agency to derive its study findings independently. On April 28, 1986, the study team met with Department representatives in Austin to discuss the objectives, resources, work tasks, communications, and organization of the study. Also present were representatives from the Consulting Engineers Council of Texas (CECT) who were designated to serve along with others as members of a Quality Review Committee. The Quality Review Committee was created to review matters in the study which related to plan quality. The formation and purpose of the Quality Review Committee were discussed at the meeting.

1.2.2 Administrative Divisions

This initial meeting was followed by other meetings with representatives of the administrative divisions most likely to have information relevant to the study. These were the Finance Division (D-3), the Bridge Division (D-5), the Highway Design Division (D-8), the Safety and Maintenance Operations Division (D-18), and the Automation Division (D-19). These divisions were the principal sources of study information at the Austin headquarters offices and/or were the ones which have provided significant support services to the district offices in relation to pre-construction engineering. Brief descriptions of these divisions' services follow.

- **Finance Division (D-3).** This Division maintains the accounting records for the Department. This division provided selected extracts from the records and made resource personnel available to advise study team members as to the definition, relevancy, and availability of accounting data.

- **Bridge Division (D-5).** This Division is responsible for administering consulting engineers contracts and also furnishes a substantial amount of engineering support services to district offices.

- **Highway Design Division (D-8).** This Division is responsible for administering this study and for coordinating communications between the study team and the district and division offices. D-8 is also the principal office for controlling and monitoring all construction project development, for maintaining appropriate records, and for reviewing and preparing all construction plans for contract letting. It also provides planning support services to district offices.

- **Safety and Maintenance Operations Division (D-18).** This Division provides substantial support to district office by furnishing traffic engineering and plan-review services.

- **Automation Division (D-19).** Provides important data processing, interactive-graphics support, and topographical-mapping services to division and district offices.

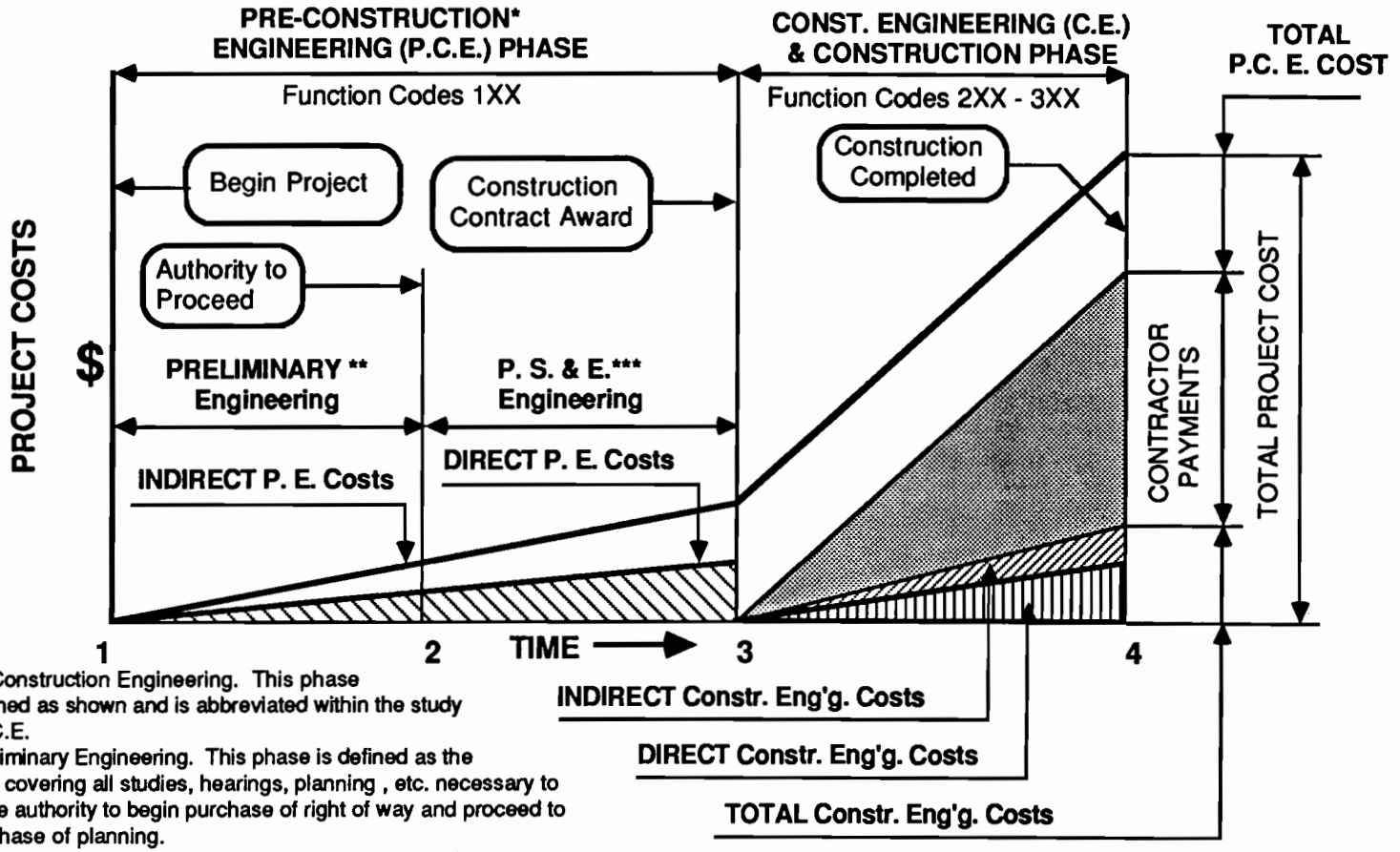
1.2.3 Data Collection

After the preliminary meetings, the study team drafted a questionnaire for distribution to selected district offices. The questionnaire was designed to obtain cost and plan-quality information not otherwise available from the administrative divisions. Before distribution, the questionnaire was reviewed by representatives from selected division and district offices at a meeting in Austin on May 5. This meeting was also attended by a representative from the Consulting Engineers Council of Texas (CECT) and on May 7, the study team and an observer from the CECT met with representatives from District 14 (Austin) to discuss the relevancy, accuracy, and availability of direct and indirect pre-construction engineering and planning cost data that might be obtained at the district office. Subjects discussed were the proposed questionnaire, the evaluation of plan work quality, and the cost of administering consulting engineering contracts. This meeting proved to be a valuable field exercise and was needed to obtain feedback before revising the questionnaire and distributing it to participating districts.

1.2.4 Pairing of In-House and Consultant Projects

The thrust of the study is to compare in-house pre-construction engineering services with consultants pre-construction engineering services. For purposes of this study, pre-construction engineering (P.C.E.) is defined as shown in Fig 1. The measures of comparison are cost and quality. In comparing projects, it is important to recognize any characteristic differences in the projects. Project characteristics, such as design complexity, time (year) of design and construction, geographical location, environment, and construction cost, can all have a consequential effect on the cost of pre-construction engineering and on the quality of the work produced. It is difficult to quantify specific project costs and to assess relative quality of work when comparing projects with significant characteristic differences. Appropriate apportionment of cost is sometimes possible, but evaluation of the quality of work must generally reflect a great deal of subjective judgement.

The participants in the study, at the start, agreed that a logical basis for comparing pre-construction engineering services would be to examine paired in-house and consultant projects. The inherent difficulties in making such a comparison were recognized, and an attempt was made to select pairs of projects with like characteristics, such as construction cost, design complexity, geographical location and time frame of planning and letting to contract and/or status (degree of completion) of planning and/or construction. Finding suitable pairs was difficult because the Department has used consultants, with any consistency, for only the past few years. Project



*Pre-Construction Engineering. This phase is defined as shown and is abbreviated within the study as P.C.E.

** Preliminary Engineering. This phase is defined as the period covering all studies, hearings, planning , etc. necessary to receive authority to begin purchase of right of way and proceed to next phase of planning.

*** P.S.&E. (Plans, Specifications and Estimates) Engineering. This phase is defined as the period, following authority to proceed, when construction plans, specifications, and estimates are prepared. Right of way may be purchased in this phase.

SEQUENCE OF PROJECT COST ACCUMULATION

Figure 1.

evaluations are more meaningful after construction has been completed as much can be revealed about project pre-construction costs and plan quality only during and after construction. The Department has used consultants to a significant extent only since about 1983; consequently, only a relatively few consultant-produced projects have been completed or even let for construction. At the beginning of the study, 27 pairs of projects were selected in seven districts; the number was later trimmed to 23 after four pairs were found to be unsuitable for evaluation. A complete list of the final selections is detailed in Appendix A.

2. DATA

2.1 ACCOUNTANCY SOURCES

This report contends that the cost of delivering pre-construction engineering (P.C.E.) services should include both direct and indirect costs as shown in Figure 1. The SDHPT accounting system does not allocate all the costs that may be attributed to the cost of project development to each specific project. Figure 2 is presented to show the relationship among the principal elements of the Department's accounting system. All expenditures by the Department are identified and accumulated in one or more of these elements. There are administrative and support costs necessary for project development that are accounted for only indirectly and for purposes of this study, P.C.E. costs are defined to include both direct and indirect costs, as follows:

2.1.1 Direct

These are costs assigned directly to specific projects. Charges to projects designated as P.C.E. are identified by Function Codes 100 through 197 in the accounting system. Figure 3 shows excerpts from a SDHPT accounting manual that defines the various functions and activities referred to as P.C.E. in this report. Direct P.C.E. costs that are captured in the accounting system are predominantly direct-labor and labor-overhead costs. Labor and labor overhead (sick leave, vacation, health insurance, retirement, etc.) usually account for about 85 percent of the direct P.C.E. costs that are currently shown in the accounting system. The remainder of these direct costs generally consist of such items as equipment rental, supplies, travel, and distribution of the resident engineer's unassigned costs. In turn, the resident engineer's indirect or unassigned costs are also about 85 percent labor intensive.

2.1.2 Indirect

These are costs identified with activities which support P.C.E. services. Without these activities, P.C.E. services cannot be delivered routinely. If the services are delivered without the support activities, the quality will be significantly diminished. The accounting system does not identify and aggregate all indirect costs nor assign the cost of support activities to specific projects. Indirect costs are assumed to include functions and activities such as administration, furnishing and maintaining offices and utililies, personnel training, furnishing and maintaining data processing services, furnishing and maintaining a Computer-Aided Design and Drafting (CADD) system,

MAJOR ACTIVITIES

ACTIVITY CODE	FUND	PROGRAM/ACTIVITY DESCRIPTION
		Administration and Support
101	006	A. Executive Administration
101	006	- Engineer Director
102	006	B. Planning and Research
103	006	C. Support Operations
		Highway Maintenance
201	006	A. Maintenance Management
202	006	B. Maintenance Work
203	006	C. Ferries and Tunnel Operations
		Highway Construction
301	006	A. Construction Management
302	006	B. Preliminary and Construction Engineering
304	006	D. Contractor Payments
		Highway Auxillary Operations
401	006	A. Public Travel and Information Services
402	006	B. Motor Vehicle Registration and Titling
404	001	C. Off-System Railroad Grade Protection
405	071	D. Outdoor Advertising and Junkyard Control
		E. Traffic Safety Promotion
406	029	- Projects
416	029	- Coordination and Technical Support
407	001	F. Gulf Intercoastal Waterway
		Public Transportation Development
501	451	A. Coordination and Technical Support
502	451	B. Financial Assistance

GENERAL LEDGER ACCOUNTS by SEGMENTS:

- 09 • Warehouse Stock
- 10 • Misc. Equip. Purchases
- 71 • Functional Accounts (Administration, overhead and support operations)
- 76 • Construction (Pre-constr. engineering, constr. engineering, contractor payments)
- xx • etc.

Administrative Divisions and District Offices

DETAIL ACCOUNTS (Linked to specific Ledger Segments):

- 3xx • Dist. Warehouse Stock
- 3 • Engineering Equipment
- 0510 • Dist. Lab. Operations
- 1740 • Dist. Dsn. Management
- 1750 • Dist. Constr. Mgmt.
- 3110 • Exec. Admin. Cost
- CSJ's • Specific Project Costs

KINDS OF PAYROLLS and VOUCHERS for each entry within each DETAIL ACCOUNT:

- 1...11 • Salary, net amount
- 1...12 • Withholding Tax
- 2...21 • Equipment Purchase
- 4...40 • Travel Expense
- X...xx • etc.

FUNCTION CODE defines Work or Operation Functions within each DETAIL ACCOUNT:

- 020 • Normal Operations
- 110 • Prelim. Engineering
- 119 • Public Meetings
- 160 • Detail Plan Prep.
- xxx • etc.

OBJECT OF EXPENDITURE defines purpose of each entry within each DETAIL ACCOUNT:

- 111 • Salaries, full time
- 181 • Travel, in state
- 353 • Payments to contrs.
- 423 • Engineering (Reg. Prof. Engr.)
- xxx • etc.

Chart Showing
RELATION BETWEEN MAIN ELEMENTS OF SDH&PT ACCOUNTING SYSTEM

Figure 2

EXCERPTS FINANCE DIVISION (D-3) MANUAL

COST CENTER/ACTIVITY REFERENCES AND THE CHART OF DETAIL ACCOUNTS UNDER THE FIMS GENERAL LEDGER 1986 FISCAL YEAR

Line	District	Segment	Detail	Activity	Cost Center	Functional Accounts Districts
1.	1-25	71	1710	103	11715	District Administrative Operations
2.	1-25	71	1720	103	11715	District Accounting
3.	1-25	71	1740	301	11717	District Design Management
4.	12	71	1742	302	08142	Contract Section
5.	1-25	71	1840	103	11715	Minor repairs and Alteration
6.	1-25	71	1860	103	11715	Supplies and Miscellaneous Expense for District Headquarters
7.	12	71	1861	103	11715	Switchboard & Mailroom Operations
8.	1-25	71	1865	103	11715	District Telecommunication Services
9.	1-25	71	1866	103	11715	Reproduction Services
10.	1-25	71	1910	103	11715	Employee Training - (All District Personnel Except Field Maintenance Employees
11.	1-25	72	XXXX	102	11714	HPR Research (D-10 Budget)
12.	1-25	77	XXXX	103	11715	Major Building Site Main tenance (D-18 Budget)
13.	1-25	76	CSJ	302	08142	Preliminary and Construction Engineering
		Division				Austin Headquarters Functional Accounts
14.	D-4	71	3430	103	11715	Specification and Purchasing Major Equipment
15.	D-4	71	3810	103	11715	Reproduction Operations; Automation Bldg.
16.	D-5	71	3310	103	11715	Administration
17.	D-5	71	4910	301	11717	Employee Training
18.	D-5	71	4940	302	08142	Special Research & Investigation by Bridge Division Design & Construction
19.	D-7	71	3421	103	11715	Planning
20.	D-7	71	3431	103	11715	Program Analysis and Policy
21.	D-8	71	3309	301	11717	Plans and Projects Services
22.	D-8	71	3310	103	11717	Administration
23.	D-8	71	3324	302	08142	Environmental and Community Factors Section
24.	D-8	71	3325	302	08142	Geometric Design Section
25.	D-9	71	4158	302	08142	Laboratory Research Work
26.	D-10	71	4910	102	11714	Employee Training
27.	D-10	72	XXXX	102	11714	HPR Planning
28.	D-13	71	4911	103	11715	Departmental Training Costs
29.	D-15	71	3310	301	11717	Administration and Staff
30.	D-18	71	3312	302	08142	Landscape Development
31	D-18	71	3315	302	08142	Traffic Engineering
32.	D-18	71	3318	302	08142	Rest Area Engineering
33.	D-19	71	4210	103	11715	Administration
34.	D-19	71	4225	103	11715	Electronic Engineering Systems
35.	D-19	71	4232	103	11715	Engineering Development Section
36.	D-19	71	4234	302	08142	Engineering Graphics

Figure 3

providing engineering supplies and equipment, furnishing tele-communications services, and accounting services, etc.

Both in-house and consultant P.C.E. activities depend upon support activities at the administrative-headquarters and district levels. Costs associated with these support activities are considered to be indirect costs which are not distributed to specific projects but are, rather, collected into Program/Activity and General Ledger Accounts.

For this study, the determination of indirect costs was deduced from investigations into and assessments of the various support functions and activities carried out by division and district offices, and the determination of "whether" and "how much" a particular activity supported P.C.E. In estimating the contribution of a support function or acitvity to the delivery of P.C.E. services, there is a useful test that may be applied. The test is: **"Will the delivery of pre-construction engineering services be diminished or significantly reduced in quality if the function or activity in question is eliminated?"** This applies to both in-house and consultant services and if affirmative, the cost of providing the activity in question should be charged to P.C.E. The next task is to quantify this support cost. Appendix C details the results of a survey of administrative Division P.C.E. support costs, and Appendix D provides similar information at the district level. Both demonstrate a wide range of indirect cost values.

2.1.3 Principal Elements of SDHPT Accounting System

Figure 2 shows the relationship between the major elements in the Department's accounting system. These elements are discussed briefly below.

2.1.3.1 Fund. Aggregations of associated monies, designated by law and regulation, for specific purposes and reported separately, e.g., Highway Construction and Maintenance (006), Traffic Safety (406 and 416), etc. This definition is for information only and is not considered relevant to the study.

2.1.3.2 Cost Center. Code number assigned to each Activity Code for convenience of linking to other accounting files. This definition is for information only and is not considered relevant to the study.

2.1.3.3 Activity Codes. These numbers identify major budgeted programs and activities, such as Planning and Research(102), Construction Management (301), Preliminary and Construction Engineering (302), etc.

2.1.3.4 General Ledger Segments. Aggregations of expenditures (costs) associated with various Department functions and activities, such as Clearing Accounts (70), Functional (Departmental administrative, managerial, service, and support functions) (71), Highway

Research and Planning (72), Construction (76), Project Maintenance (77), etc. General Ledger Segments are linked to specific Activity Codes.

2.1.3.5 Detail Accounts. Each Detail Account defines a particular function or activity. Divisions and districts are assigned Detail Accounts appropriate to their mission. Detail Accounts are also linked to specific Activity Codes and General Ledger Segments. For examples of Detail Accounts, refer to Fig. 3, which shows excerpts from the Finance Division (D-3) manual "Cost Center/Activities References and the Chart of Detail, etc."

2.1.3.6 Function Code. Three digit (xxx) code number which identifies costs associated with a function (task or service) that is performed by an individual employee, such as plan preparation, or with an assigned aggregation of functions,such as contractor's payments, mowing, etc. Costs recorded under various function codes originate from entries on employees' daily time reports, from equipment-usage reports, or from entries to other reports referring to the function or activity performed. Function Codes 100 through 938 (engineering and construction functions and activities) are linked to Ledger Segment 76 and to specific projects. Each project is identified by a unique Control Section and Job (CSJ) number. Other Function Codes are linked to other Ledger Segments.

2.1.3.7 Object of Expenditure. Three digit code number sub-dividing Detail Accounts and Function Code ledger entries into object or kind of expenditure. Examples are: Regular full-time employee on salary basis (111), In-state car mileage (181), Engineering services by a Registered Professional Engineer (423), Payments to highway contractors (353), etc. Object of Expenditure code numbers are assigned to the various tasks, activities, and services performed by and for the Department and may be used to aggregate various categories of expenditures.

2.1.4 P. C. E. Cost Account Sources

Cost accounts most closely associated with P.C.E. are found primarily in General Ledger Segments 71 (Functional Accounts) and 76 (Construction). These costs are also aggregated under Activity Codes 103 (Support Operations), 301(Construction Management), and 302 (Preliminary[1] and Construction Engineering). Segment 71 contains most of the indirect-cost accounts, and Segment 76 contains *all* the direct-cost accounts that are associated in the accounting system with P.C.E. activities. The significance of these two ledger segments and Activity Codes 103, 301, and 302 are discussed briefly in the following paragraphs.

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[1] Preliminary Engineering in this instance is defined the same as *Pre-Construction (P.C.E.)* used in this study.

2.1.4.1 Ledger Segment 71(Functional Accounts). Contains Detail Accounts relating to assigned functions, activities, and services delivered as shown in Figure 3. Some of these detailed functions such as District Design Management (Detail 1740, Activity 301) and P.C.E. for Research, Specifications, etc. (Detail 1872, Activity 302) are clearly associated with P.C.E. and may be assumed to be indirect costs.

2.1.4.2 Ledger Segment 76 (Construction). Pre-construction and construction engineering direct costs are collected in General Ledger Segment 76 (Construction) under Activity Code 302 and and in CSJ accounts for each project. P.C.E, as distinguished from Construction-Engineering costs, are those engineering costs incurred up to the letting of a project for construction (see Fig 1). P.C.E. cost activities are identified by Function Codes 100 through 197. Function Codes identify tasks or activities such as Preliminary Feasibility Investigations (110), Environmental Reports (120), Public Hearing (140), Detail Plan Preparation (not including bridges) (160), Design Review (180), etc. When a project is initiated and assigned a CSJ number all projects costs are collected throughout the project history from P.C.E. through the completion of construction.

2.1.4.3 Activity Code 103 (Support Operations). Major budget item. Support Operations (Activity Code 301) in Fiscal Year 1985 accounted for about 4.3 percent ($68,120,974) of the Department's expenditures. Some of the functions and activities within Support Operations are necessary, in varying degrees, for the delivery of P.C.E. services. Support Operations cover functions and activities such as administration, management, training, as well as purchase and maintenance of buildings, office equipment, data processing equipment, telecommunication services, reproduction, etc.

2.1.4.4 Activity Code 301 (Construction Management). Major budget item. Activity Code 301 (Construction Management) aggregates P.C.E. and construction engineering management costs. Examples of this are shown as lines 3, 17, and 19 in Figure 3. Construction Management Costs, including both P.C.E. and construction engineering are not distributed to projects but are assumed to be valid, indirect P.C.E. costs. Some of the Functional Accounts such as 1740 (District Design Management) and 1750 (District Construction Management) clearly distinguish between P.C.E. and construction-engineering costs. Others such as Detail 4910 (Employee Training) in the Bridge Division (D-5) are not so obvious. However, the total expenditure for Activity 301 (Construction Management) in Fiscal Year 1985 was less than 1 percent of the Department's budget and any error in distinguishing between P.C.E. and construction-engineering costs are not likely to be significant.

2.1.4.5 Activity Code 302 (Preliminary and Construction Engineering). Major budget item. Amounted to over $137 million in Fiscal Year 1985, or about 8.7 percent of the Department's total expenditures. Includes direct and indirect costs incurred by both P.C.E. and construction engineering. Direct costs are always assigned to a specific project identified by a CSJ number. Indirect costs may be identified by assigned Detail Account numbers such as 1740 (District Design Management), 1872 (Preliminary Engineering for Research, Specifications, etc.

2.1.5 Availability of Data

The Department's accounting system has been revised in recent years and as a result some accounting cost data were not available, or at least were not available from the automated data system during the first months of this study. It was also discovered that the accumulated hours worked on a project, which are assigned to various function codes in Ledger 76 (Construction), were posted incorrectly because of a computer programming error. Consequently it was not deemed appropriate to compare in-house hours worked to those reported by consultants for similar plan-preparation tasks. The original time constraints imposed on this study suggested that a lengthy manual search for accounting data that were not available directly from the SDHPT Financial Information Management System (FIMS) would not be feasible. However, the study completion date was subsequently extended and the Highway Design Division (D-8) managed to secure directly from the participating districts better cost data on 17 pairs of projects. (Refer to Appendix B for table showing project cost data. The project ID numbers marked by astericks are those for which project costs were updated during the study and consequently the most reliable cost data should be associated with these projects.) Because of the lack of adequate cost data, in-house P.C.E. costs for some projects selected for review are not inclued in the analysis presented in this report. Alternative analysis methodologies which do not require complete data sets of this type were finally utilized.

2.2 COLLECTION OF DATA

Selected districts and divisions were asked to estimate the indirect cost of supporting P.C.E. within their respective offices. Since the accounting system does not assign and distribute indirect P.C.E. costs to projects, the districts and divisions were each asked to estimate the amount of support services each contributed to P.C.E. activities. The estimates provided by the districts and divisions served as a basis for quantifying indirect costs by inference. Planning costs and plan-

quality information needed from the districts were derived from a questionnaire submitted to the districts and later collected by the study team members following on-site interviews with district representatives at the selected district offices. Arrangements were also made to discuss plan quality with highway contractors. These overall information-collecting activities are described, as follows:

2.2.1 Questionnaire to District Offices

The questionnaire was comprised of two documents. The first document, which was a request for information on district-wide P.C.E. activities, categorized the needed information into four parts:

2.2.1.1 District organization structure, personnel, and size of operations
2.2.1.2 Use of consulting engineers
2.2.1.3 Indirect costs of P.C.E.
2.2.1.4 Use of equipment for P.C.E.

The second document was a request for information about pairs of selected projects. One of the projects in each pair was a project developed in-house, and the other was a project developed totally, or without substantial assistance from the Department, by consultants. The objective of this document was to get information which would permit head-on comparisons of in-house and consultant work. The second document was in three parts:

2.2.1.5 In-house project information request.
2.2.1.6 Consultant project information request.

The first two parts of the documents, respectively listed in sub-paragraphs 2.2.1.5 and 2.2.1.6, were further sub-divided as follows:

i. Project background
ii. P.E. and P.S.&E. activities (see Figure 1)
iii. Project cost
iv. Quality of work appraisal

2.2.1.7 Comparison-of-projects information request

2.2.2 Interviews at District Offices

Questionnaires were submitted to the selected districts two to six weeks prior to the on-site interviews. Each district that was visited was also asked to have available for inspection and copying the following materials: district organization chart, a set of construction plans for each project being reviewed, a copy of the consulting engineer's contract for each project being reviewed, a copy of any study or analysis prepared by the district relating to consulting engineer costs or to in-house costs. The study team's usual method of operation was to first review all the documents including the questionnaire and then spend the remainder of the day discussing the projects and the content of the documents relating to the projects with district representatives.

2.2.3 Interviews at Division Offices.

During the week of June 30 through July 3, the study team conducted interviews with representatives from the following administrative divisions: Finance (D-3), Equipment and Procurement (D-4), Bridge (D-5), Construction (D-6), Planning (D-7), Highway Design (D-8), Materials and Tests (D-9), Human Resources (D-13), Right-of-Way (D-15), Safety and Maintenance Operations (D-18), and Automation (D-19). The Transportation Planning Division (D-10) was visited the following week on July 10. The usual visit and interview consisted of reviewing the division's budget, organization chart, and mission and discussing the division's contribution to P.C.E. activities. If it was determined that a particular division supported P.C.E. to a significant extent, the degree or amount of that support was discussed. Representatives from divisions D-9 and D-15 reported that these divisions furnished very little support to P.C.E. either directly or indirectly. It was finally concurred that about 0.5 percent of D-9's budget and 1.0 percent of D-15's operating budget (not including costs for purchase of rights of way) should be counted as supportive of P.C.E. activities.

The Motor Vehicle Division (D-12), the Travel and Information Division (D-16), and the Insurance Division (D-20) were not visited as it was assumed that any contribution of these divisions to P.C.E. was negligible and could be safely ignored without affecting the study.

2.2.4 Interviews With Highway Contractors

In assessing construction plan quality it was accepted, between the study team and its advisors, that highway contractors should be in position and able to judge plan quality. Contractors, more than any other parties to a construction contract, become entangled in any plan defects and would be appreciative of good planning. Arrangements were made by a representative from District 12,

in Houston, for representatives of three experienced highway contractors to meet with the study team. Appointments were made for July 23 when the study team was in Houston. The three contractors interviewed were very familiar with SDHPT plans and specifications as each had 20 or more years experience in bidding and building projects for the Department. Each contractor also had experience with plans prepared by consultants. In the interviews, each contractor indicated that plan quality was recognizable and important and that plan quality could have a significant effect on the quality and cost of construction.

2.3 METHODOLOGY

The analysis methodology that was used in the study was designed to compare in-house and consultant P.C.E. costs and planning quality and to assess the significance of any differences discovered. The measures of cost and quality are discussed as follows:

2.3.1 Costs

Several cost factors were developed from the cost data that were available to the study team. These were:

2.3.1.1 Total in-house cost, which was assumed to include both direct and indirect costs.

2.3.1.2 Total cost of delivering consultant services, which includes both consultant's fee and in-house cost of administering consultant's work.

2.3.1.3 Categorical unit labor costs, covering professional, technical, and clerical services.

i. For consultants

ii. For in-house personnel

2.3.1.4 Overhead and fixed-fee costs for consultants.

2.3.2 Quality

Quality comparisons were made from analysis of questionnaire responses and from responses by Department personnel and highway contractors during the interviews. It was initially hoped that sufficient quantitative documentation would be found to support any study findings concerning planning quality. Such documentation might exist in the form of field changes, extra work orders, letters authorizing plan changes, and/or supplemental agreements. Evidence in this form generally comes into being following the contract letting of a project when the contractor, the contractor's estimator, sub-contractors, suppliers, fabricators, third parties, and Department personnel uncover

significant plan defects. The final consequences of any plan defects can be assessed only after construction.

For the projects analyzed in the study, such records were insufficient or incomplete because only a few of the projects prepared by consultants have advanced to letting. Consequently planning quality evaluation was primarily subjective in nature.

3. PRE-CONSTRUCTION ENGINEERING (P.C.E.) COSTS

3.1 IN-HOUSE AND CONSULTANT COST COMPARABILITY

3.1.1 Introduction

The cost of delivering P.C.E. services, whether those services are provided in-house or by consultants, includes both direct and indirect costs. Direct and indirect costs as previously defined in Section 2 are now discussed with respect to the origins and determination of total P.C.E. costs.

3.1.1.1 In-House Project P.C.E. Costs. Direct P.C.E. costs are costs charged to specific projects and are identified in the Department's accounting system by Function Codes 1XX (Function Codes 3XX identify direct construction-engineering charges). Projects, in turn, are identified by one or more CSJ numbers. The Department does not identify as an indirect cost any of its Administration and Support Costs (refer to figures 2 and 3) or allocate these to P.C.E. Indirect costs, which include the cost of any supporting function or activity considered necessary for the delivery of P.C.E. services of acceptable quality, are not routinely assigned to specific projects. If such assignments are desired, the following two steps are necessary: First, particular costs which are assumed to be indirect costs must be extracted from Department records. Second, these costs must be allocated to individual projects by some method.

3.1.1.2 Consultant Project P.C.E. Costs. Direct costs are the total fees paid to consultants by the Department for P.C.E. services. Indirect costs are the costs incurred by the Department to administer, manage, and support the delivery of consulting engineering services. Thus, indirect costs incurred by the Department in relation to a particular project may include to some extent both direct and indirect in-house costs.[1]

The Department expends a large amount of resources for supporting P.C.E. services in order to insure the delivery of acceptable highway design and performance standards by its own personnel as well as by consultants. For example, the Department furnishes and maintains maps,

[1] It should be noted that the Department always participates directly, to some degree, in the development of construction project plans and that any set of plans produced for the Department by a consultant will always reflect some direct in-house costs which add to the cost of project development. A distinction should be made between direct/indirect project costs and direct/indirect costs associated with managing and supporting consulting engineering contracts.

engineering design manuals, and materials data. The Department determines design standards and sponsors, conducts, and participates in highway research. The Department also originates, maintains, and furnishes standard drawings and specifications. Although the degree of support required of the Department for consultant P.C.E. will differ from that required to support in-house work, the Department does not require a consultant to develop a project from first principles. Consultants are provided access to the large inventory of design, engineering, and research resources maintained by the State. Consequently, indirect costs associated with the delivery of a consultant's services include a share of the cost to the Department for maintaining this inventory of resources.

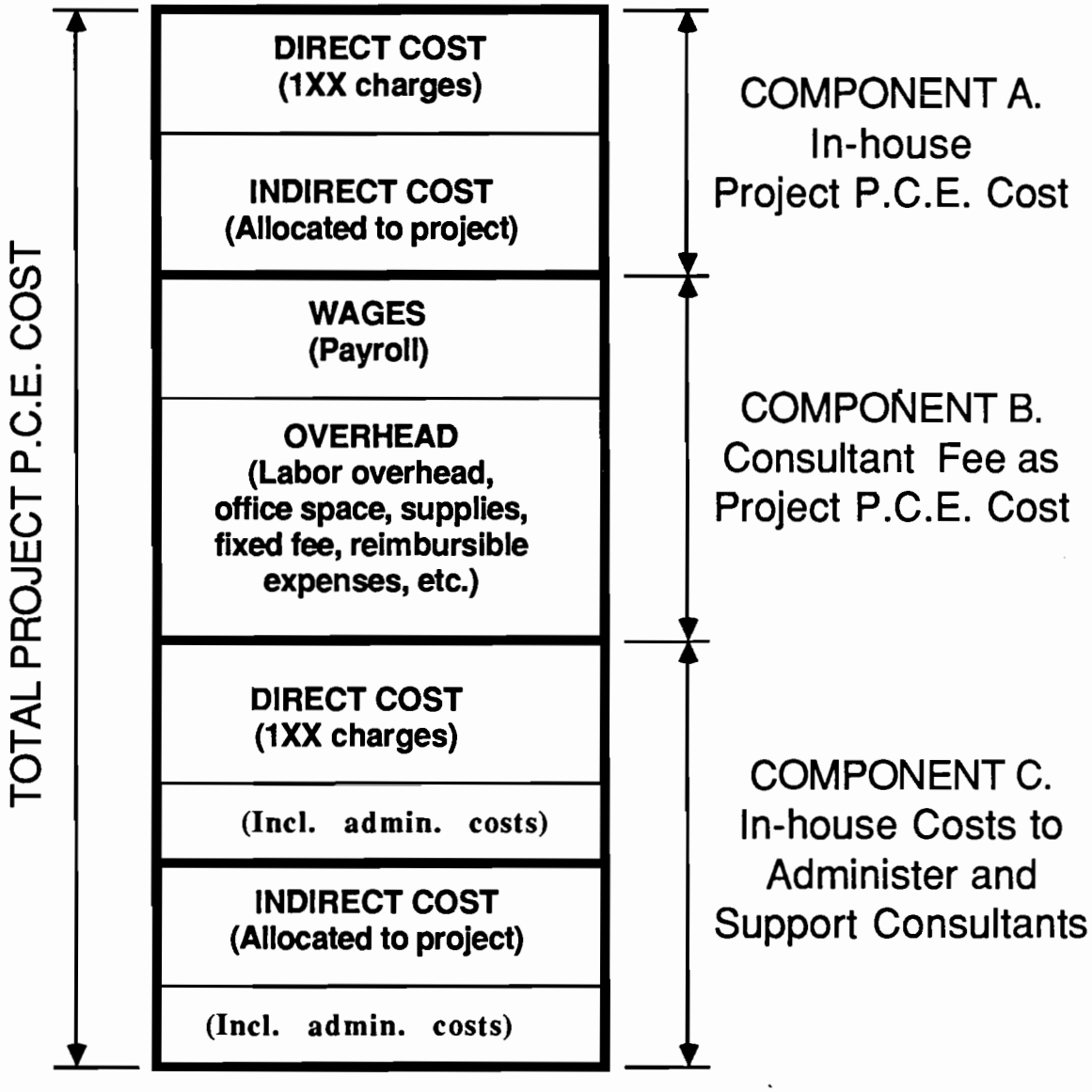
3.1.2 Comparability of In-House and Consultant P. C. E. Costs

Total project P.C.E. cost is comprised of several components displayed in Figure 4. Direct P.C.E. costs for in-house and consultant projects are not entirely comparable, because they are composed differently. Specifically, in-house and consultant P.C.E. costs differ in three significant areas. These include the direct cost bases by which indirect costs are measured, the cost of office space, and the in-house evolutionary costs. These factors are discussed as follows:

3.1.2.1 The direct cost base. The principal cost element of P.C.E. is the cost of labor, as expressed by wages for different classes of personnel. In the Department's accounting system, labor costs reported as 1XX charges include a 42% labor overhead rate to account for retirement, OASI, and insurance payments, as well as allowances for vacation and sick leave.[2] Data supplied to the study team by the Finance Division (D-3) indicates that, for the Department as a whole, during Fiscal Year 1985 labor represented about 84% of the direct costs charged to P.C.E. *Consequently, in order to compare in-house direct costs with those of consultants on the basis of wages, in-house direct costs must be reduced by about 40 percent.* [(1-0.84/1.42)100 = 40.85%]. Consulting engineers' total fees, as negotiated by the Department, are usually comprised of wage costs, the product of wage costs and the indirect cost (overhead) multiplier, reimbursable direct costs (travel, etc.), and a fixed fee. Consultants customarily report direct costs as wages and include labor-overhead costs in the indirect-cost multiplier.

3.1.2.2 Cost of office space. The overhead amounts that consultants charge to the Department also reflect the cost of buying (or leasing) and maintaining office space. However, the

[2]An exception to this is the Budget Monitoring System, which shows labor costs as wages only. Consequently, costs taken from the Budget Monitoring System should be increased if they are used in conjunction with labor cost data taken from the General Ledger Segments.



DESIGNATED COMPONENTS OF TOTAL PROJECT P.C.E. COSTS

(Drawing not to scale; for illustrative purposes only)

NOTE: 1. Projects designated as having been prepared "in-house" would consist only of Component A, above.
2. Projects designated as having been prepared wholly or partly by consultants would consist of Components, A, B, and C, above

Figure 4

Department, like other government agencies, does not charge the capitalized cost (loss of Figureinvestment opportunity) of its buildings and land to any of its accounts, including those for specific projects. The Department does however, record maintenance costs on these facilities, but these are never tied to specific projects.

It is beyond the scope of this study to make a determination of these capitalized costs, and decide what part of them are assignable to P.C.E. costs. Nevertheless, an approximation can be made of the cost of office space needed to support P.C.E. This approximation is based on the relative cost of leased office space to the labor cost of Department employees using the space. Data obtained from District 12 show that an engineering design group of 123 employees is housed in 18,000 square feet of leased office space. This engineering design group is considered to be representative as it is a completely-integrated group of engineers, technicians, and clerical employees (with access to in-house automation support services) dedicated primarily to providing a complete range of P.C.E. services for highway planning in a large urban area. The composite average salary for these 123 employees was estimated to be $2,063 per month.[3] The full-service (including maintenance) lease cost for the office space in which this group works is $17,750 per month or $1,732 ($17,750/123 = $1,732) per employee per year. The study team was advised by the Building and Real Estate Section of the Safety and Maintenance Operations Division (D-18) that owner-maintained lease costs are about 80% of full-service lease costs, and that the great majority of the Department's employees work in state-owned and maintained buildings.

From the preceding data, it is estimated that the capitalized cost of in-house office space needed for the delivery of P.C.E. services is about 6% of salary or wage costs. The calculations supporting this approximation are as follows:

Capitalized Cost of Office Space = [(A x B)/(C x 12)]100 = 5.56%

Where: A = $1,732 (lease cost per employee per year)
B = 0.80 (owner-maintained factor)
C = $2,063 x 12 (annual average salary per employee)

This approximation was confirmed by the Buildings and Real Estate Section, which advised the study team that about 150 square feet per employee is recommended for engineering offices, while full-service lease costs, in 1986, range from $0.70 to $1.00 per square foot, per month, depending on the size and location of the property. This is consistent with the 145 square feet per

[3] $2,063 per month or $11.92 per hour ($2,063/173 hours per month). This is close to the Department's composite average wages for personnel engaged in delivering P.C.E. services. Refer to Appendix F.

employee and $0.99 per square foot per month figures for the engineering design group in District 12.

3.1.3 Evolutionary Costs. Evolutionary costs are incurred when changing circumstances might cause P.C.E. costs to accrue for several years. Discoveries in the planning process and/or changes in the political and economic environment may disrupt the normal development process of a particular project. In such cases, a project may be substantially prolonged or changed in scope and characteristics, or it might even be ended altogether. In the interest of accountability, these costs should not be distributed to any project. Rather, such costs should be written-off or accrued in a separate account. The methods of determining P.C.E. costs presented herein include some indeterminate amount of evolutionary P.C.E. costs. The Department's accounting system does not recognize such costs and, consequently, they could not be quantified. Nonetheless, evolutionary costs are an inherent part of the Department's operations and should be kept in mind when making cost comparisons.

3.2 DIRECT P.C.E. COSTS

Basic wages are the amounts paid at an hourly rate to the various classes of employees (not including labor overhead) for work on P.C.E. Wages can be taken as a common basis for comparing the direct cost for P.C.E. whether the work is done in-house or by consultants. P.C.E. costs recorded by the Department (1XX charges) are composed of basic wage cost, labor overhead, and other kinds of costs whether charged against in-house or consultant-supported projects. Thus, basic wage costs are charged to both types of projects, but they make up different proportions of the recorded P.C.E. costs in each case. The comparability of in-house and consultant basic wages are discussed below and some estimates of the relationship between reported direct cost and basic wage cost for both cases are presented.

Tables 1a and 1b show the difference in wage costs between consultant and in-house P.C.E. work on the projects selected for this study. For each consultant project shown in the tables, the number of hours for each class of personnel and its corresponding wage rate were combined to calculate the composite weighted-average hourly wage cost as shown in Table 1a. Classifications for personnel as stated in each consultant's contract were rearranged to approximate the categories shown when necessary and wage rates were averaged for the classes that were combined. Given the number of hours expended by each class of employee, wage rates for comparable positions in the State Department of Highways and Public Transportation were applied in order to estimate a

Table 1a
WAGE COSTS FOR CONSULTING FIRMS

A	B	C		D		E		F		G		H	I
I.D.	Date	Principals		S. Eng.s		Engineers		Technicians		Clerical		Total	Total Wage
#	of Cont.	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hours	Cost
1	9/84	680	$22.00	1,200	$19.50	3,960	$16.41	1,310	$16.06	660	$8.00	7,810	$129,662
5	9/85	880	$28.00	1,100	$24.00	4,400	$17.93	3,660	$11.77	80	$10.00	10,120	$173,810
6	10/84	100	$31.37	700	$24.07	1,100	$14.09	1,800	$9.90	300	$8.60	4,000	$55,885
7	10/84	30	$35.00	91	$35.00	643	$16.26	408	$10.72	39	$8.33	1,211	$19,389
8	12/84	0	$0.00	325	$25.60	2,973	$17.91	1,620	$10.53	230	$9.67	5,148	$80,849
10	11/84	0	$0.00	2,600	$22.19	15,060	$14.57	16,550	$10.20	0	$0.00	34,210	$445,928
12	6/85	1,756	$28.15	7,424	$20.42	5,682	$13.13	10,502	$10.11	244	$7.50	25,608	$383,639
12	6/85	300	$33.00	0	$0.00	5,944	$20.60	220	$12.70	0	$0.00	6,464	$135,140
12	6/85	192	$28.00	764	$19.00	556	$16.00	1,162	$11.10	0	$0.00	2,674	$41,686
13	7/84	140	$24.00	178	$17.00	190	$12.00	336	$9.00	0	$0.00	844	$11,690
14	7/84	53	$26.13	270	$20.00	0	$0.00	322	$15.23	12	$11.36	657	$11,825
15	7/84	300	$22.00	600	$16.00	1,380	$12.00	1,350	$10.50	0	$0.00	3,630	$46,935
16	8/84	100	$27.56	0	$0.00	2,609	$16.00	960	$10.00	172	$9.00	3,841	$55,648
16	8/84	362	$27.56	0	$0.00	1,408	$13.50	1,648	$6.75	123	$6.50	3,541	$40,908
16	8/84	24	$25.00	58	$18.00	0	$0.00	816	$11.00	80	$8.75	978	$11,320
17	1/85	480	$20.00	850	$16.00	1,660	$14.25	2,475	$10.00	400	$6.50	5,865	$74,205
17	1/85	100	$25.00	150	$17.00	240	$13.50	540	$9.00	0	$0.00	1,030	$13,150
18	10/83	1,274	$24.50	4,214	$18.00	10,218	$14.00	14,120	$9.75	0	$0.00	29,826	$387,787
18	10/83	70	$30.95	300	$22.02	370	$15.77	480	$8.98	160	$7.52	1,380	$20,121
19	10/80	0	$0.00	890	$17.69	1,350	$12.97	3,146	$9.81	338	$6.07	5,724	$66,168
25	3/84	39	$23.08	191	$18.75	704	$16.36	1,687	$9.48	60	$6.46	2,681	$32,379
27	6/84	760	$26.13	4,856	$20.00	1,984	$14.32	5,328	$13.93	160	$11.36	13,088	$221,426

Weighted-Average Hourly Wage Rates:	**$26.10**	**$20.03**	**$15.40**	**$10.48**	**$7.94**

Composite Weighted-Average Hourly Wage Cost: $14.44

Table 1b
EQUIVALENT WAGE COSTS AT SDHPT RATES
(Department Wage Rates Applied to Consultants' Reported Hours from Table 5a)

A	B	C		D		E		F		G		H	I
I.D.	Date	Principals		S. Eng.s		Engineers		Tecnicians		Clerical		Total	Total Wage
#	of Cont.	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hrs.	Rate	Hours	Cost
1	9/84	680	$24.51	1,200	$20.55	3,960	$13.09	1,310	$10.82	660	$6.71	7,810	$111,766
5	9/85	880	$24.51	1,100	$20.55	4,400	$13.09	3,660	$10.82	80	$6.71	10,120	$141,908
6	10/84	100	$24.51	700	$20.55	1,100	$13.09	1,800	$10.82	300	$6.71	4,000	$52,724
7	10/84	30	$24.51	91	$20.55	643	$13.09	408	$10.82	39	$6.71	1,211	$15,698
8	12/84	0	$24.51	325	$20.55	2,973	$13.09	1,620	$10.82	230	$6.71	5,148	$64,667
10	11/84	0	$24.51	2,600	$20.55	15,060	$13.09	16,550	$10.82	0	$6.71	34,210	$429,636
12	6/85	1,756	$24.51	7,424	$20.55	5,682	$13.09	10,502	$10.82	244	$6.71	25,608	$385,249
12	6/85	300	$24.51	0	$20.55	5,944	$13.09	220	$10.82	0	$6.71	6,464	$87,540
12	6/85	192	$24.51	764	$20.55	556	$13.09	1,162	$10.82	0	$6.71	2,674	$40,257
13	7/84	140	$24.51	178	$20.55	190	$13.09	336	$10.82	0	$6.71	844	$13,212
14	7/84	53	$24.51	270	$20.55	0	$13.09	322	$10.82	12	$6.71	657	$10,412
15	7/84	300	$24.51	600	$20.55	1,380	$13.09	1,350	$10.82	0	$6.71	3,630	$52,354
16	8/84	100	$24.51	0	$20.55	2,609	$13.09	960	$10.82	172	$6.71	3,841	$48,144
16	8/84	362	$24.51	0	$20.55	1,408	$13.09	1,648	$10.82	123	$6.71	3,541	$45,960
16	8/84	24	$24.51	58	$20.55	0	$13.09	816	$10.82	80	$6.71	978	$11,146
17	1/85	480	$24.51	850	$20.55	1,660	$13.09	2,475	$10.82	400	$6.71	5,865	$80,425
17	1/85	100	$24.51	150	$20.55	240	$13.09	540	$10.82	0	$6.71	1,030	$14,518
18	10/83	1,274	$24.51	4,214	$20.55	10,218	$13.09	14,120	$10.82	0	$6.71	29,826	$404,355
18	10/83	70	$24.51	300	$20.55	370	$13.09	480	$10.82	160	$6.71	1,380	$18,991
19	10/80	0	$24.51	890	$20.55	1,350	$13.09	3,146	$10.82	338	$6.71	5,724	$72,269
25	3/84	39	$24.51	191	$20.55	704	$13.09	1,687	$10.82	60	$6.71	2,681	$32,752
27	6/84	760	$24.51	4,856	$20.55	1,984	$13.09	5,328	$10.82	160	$6.71	13,088	$203,112

Equivalent Composite Weighted-Average Hourly Wage Cost: $13.72

Composite Weighted-Average for P.C.E. Work by SDHPT (for comparison only – see Appendix G): $11.79

comparable in-house weighted-average wage hourly rate and an equivalent wage cost for each project as shown in Table 1b.

Col. A: The project Identification number.

Col. B: The date the consulting contract in question was signed.

Cols. C-G: The number of work hours for each class of employee, and the wage rate paid by respective firms. In the bottom rows are the corresponding SDHPT wages and the consultants' weighted averages.

Col. H: The total of hours worked.

Col. I: The total direct wage cost for each project, representing the sum of all the hours multiplied by wage rates in cols. C-G.

The composite weighted-average hourly wage cost for the contract-stated mix of employee classes and the respective hourly wage rates on the selected consultant projects was about 5 percent higher ($14.44 - $13.72/$13.72 x 100 = 5.2%) than it would have been if the work had been done in-house with the same mix of employee classes. For comparison, the composite weighted-average hourly wage cost for P.C.E. work done in-house as shown Appendix F was $11.79. This reflects to some degree the difference in the mix of employee classes that are utilized for P.C.E. work.

In comparing consultant and in-house weighted-average wages, two other important non-quantifiable variables should be considered. The first is the comparability of performance levels by consultant and Department personnel. The second is the extent to which consultant and Department employees receive other benefits along with their wages. Consultants' personnel, for example, may have the opportunity to take part in profit-sharing; such an opportunity is not available to state personnel. However, in-house personnel may be compensated by greater potential job security and more generous allowances for vacation, holidays, and sick leave.

Table 2, entitled " Components of Consulting Contract Costs," shows the relationship between the amount of non-wage costs under the contracts for the selected study projects, and the total basic wage cost. The non-wage cost components fall roughly into three categories; general overhead (including labor and administrative overhead), fixed fees (the profit charged by the firm), and reimbursable direct costs (such as travel, supplies, etc.). Reimbursable direct costs are not directly related to basic wage costs, and thus the ratio of these two costs varies considerably among

Table 2
COMPONENTS OF CONSULTING CONTRACTS

A	B	C	D	E	F	G	H	I	J
I.D. #	Total Wage Cost	Fixed Fee	C / B X 100	Contract Overhead	E / B X 100	Reimburs. Costs	G / B X 100	C + E + G	I / B X 100
1	$129,662	$46,438	36%	$177,851	137%	$7,690	6%	$231,979	179%
5	$173,810	$64,028	37%	$253,053	146%	$4,109	2%	$321,190	185%
6	$55,885	$22,291	40%	$83,449	149%	$3,031	5%	$108,771	195%
7	$19,389	$7,674	40%	$24,238	125%	$598	3%	$32,510	168%
8	$80,849	$27,905	35%	$105,181	130%	$5,823	7%	$138,909	172%
10	$445,928	$177,300	40%	$544,975	122%	$191,242	43%	$913,517	205%
12	$383,639	$137,788	36%	$534,947	139%	$178,411	47%	$851,146	222%
12	$135,140	$35,958	27%	$159,429	118%	$97,936	72%	$293,323	217%
12	$41,686	$12,263	29%	$56,418	135%	$5,685	14%	$74,366	178%
13	$11,690	$3,600	31%	$18,470	158%	$945	8%	$23,015	197%
14	$11,825	$3,902	33%	$20,693	175%	$3,685	31%	$28,280	239%
15	$46,935	$20,575	44%	$70,790	151%	$19,000	40%	$110,365	235%
16	$55,648	$19,210	35%	$72,418	130%	$6,498	12%	$98,126	176%
16	$40,908	$13,491	33%	$40,627	99%	$11,434	28%	$65,552	160%
16	$11,320	$3,905	34%	$14,716	130%	$0	0%	$18,621	164%
17	$74,205	$28,412	38%	$103,709	140%	$14,505	20%	$146,626	198%
17	$13,150	$4,201	32%	$14,860	113%	$0	0%	$19,061	145%
18	$387,787	$141,711	37%	$500,982	129%	$55,970	14%	$698,663	180%
18	$20,121	$6,553	33%	$27,822	138%	$17,804	88%	$52,179	259%
19	$66,168	$24,461	37%	$74,127	112%	$43,374	66%	$141,962	215%
25	$32,379	$11,304	35%	$48,660	150%	$4,295	13%	$64,259	198%
27	$221,427	$97,588	44%	$384,510	174%	$45,153	20%	$527,251	238%
Totals:	$2,459,551	$910,558	37%	$3,331,925	135%	$717,188	29%	$4,959,671	**202%**

projects. Some firms, for example, provide most or all of their own computer work, while the Department supplies such support for others.

It should be noted that some of the total wage costs are slightly understated, because some contracts reported clerical labor costs as reimbursable costs or as overhead, and not as wage costs. In general, it must also be noted that some variation in the costs of these contracts stems from the fact that each contract was the product of negotiation. Items from the contracts were not adjusted for inflation as all the contracts were negotiated within one or two years of each other. Any variation due to inflation was considered negligible. Futhermore, in some cases direct allowances for inflationary costs were included in the contract and were assumed to be included indirectly in some of the others. An explanation of the items in Table 2 is given below:

Col. A: Project Identification number.

Col. B: The total wage cost for each of the projects.

Col. C: The total amount of fixed fee, or profit, allotted to the firm under the contract, however it was derived.

Col. D: The ratio, expressed as a percentage, of fixed fee to basic wage cost.

Col. E: The total amount, in dollars, of all overhead charged by each respective firm.

Col. F: The ratio of E to B, in percentages.

Col. G: The amount of reimbursable non-labor costs charged under each contract.[4]

Col. H: The ratio of G to B, in percentages.

Col. I: The total of non-wage P.C.E. costs under each contract, equal to the sum of C, E, and G.

Col. J: The ratio of total non-wage costs (I) to the basic wage cost (B), in percentages.

For this selected group of consultant projects, the average of the ratios of indirect costs to direct (wage) costs was 202 percent.

3.3 INDIRECT P.C.E. COSTS

The Department incurs indirect costs for P.C.E. that are not associated specifically with this function in the accounting system. The overall cost of administrative and support services within

[4] Wide variations in these costs are explained in many contracts by whether or not computer services are reported as reimbursible direct costs. It is assumed that in some contracts computer services are included in the indirect cost or overhead multiplier. The Department also supplied computer services to some consultants.

the Department are reflected in the system, however. In order to estimate the entire cost of P.C.E. for a specific project, or for a group of projects, this overall cost needs to be separated first into the the part that relates to P.C.E., and then apportioned to individual projects, or groups of projects, as indirect costs.

It is desirable to express the indirect costs for P.C.E. on a specific project in terms of the associated direct costs. Two methods were developed in this study for estimating the relationship between indirect and direct costs for P.C.E. on a project-specific basis. In both methods, a ratio of indirect to direct project costs for P.C.E. is defined. This ratio can be viewed as a multiplier which can be applied to direct costs to estimate the associated indirect costs which contribute to the total cost of P.C.E. for the project. The two methods are presented below.

3.3.1 The Functional Method

Many functions and activities defined in the Department's accounting system are assigned to districts and divisions for execution. Some of these functions and activities indirectly support (to varying degrees) the delivery of P.C.E. services. The application of the Functional Method of estimating indirect P.C.E. costs requires the determination of which and to what degree these functions and activities supplement the cost of delivering P.C.E. services. In making these determinations, the various functions and activities performed by each of the district and division offices were evaluated to determine the indirect costs that support delivery of P.C.E. services. These evaluations were based on responses to questionnaires and on interviews with personnel from selected districts and divisions.

Table 3, entitled "Allocation of Indirect P.C.E. Costs by Functional Method," displays the multipliers that were arrived at by applying the functional method of estimating indirect costs. The multiplier applied to a particular project's direct P.C.E. cost is made up of two components, those of district- and division-level support. The value of the multiplier (or ratio) applied to specific projects would thus depend on which district handled the project, and whether P.C.E. was done in-house or by consulting engineers (see Appendices C and D). An explanation of the items in Table 3 is shown below:

I. District Estimates:

Col. A: The district in question.

Col. B: The total FY 1985 expenditures for each district, from the district's Segment 71 ledger, which includes the general operating expenditures for the district.

Col. C: Indication of whether the following information is for consultant (C) or in-house (I) projects.

Table 3
ALLOCATION OF INDIRECT P.C.E. COSTS
BY THE
FUNCTIONAL METHOD
Summary Table

I. Estimates of Indirect Costs Incurred by Districts:

A	B	C	D	E	F
Dist.	FY 1985	I/C	PCE Indirect	Total 1XX	Ratio
(in thousands of dollars)					
12	$17,721	I	$2,236	$7,265	31%
		C	$1,257	$11,389	11%
14	$3,654	I	$601	$1,791	34%
		C	$194	$1,634	12%
15	$4,607	I	$1,214	$5,006	24%
		C	$116	$1,714	7%
16	$4,150	I	$471	$1,805	26%
		C	$46	$520	9%
18	$3,923	I	$662	$3,536	19%
		C	$243	$3,471	7%
20	$2,952	I	$307	$1,118	27%
		C	$91	$1,114	8%
24	$3,222	I	$327	$871	38%
		C	$112	$1,330	8%
Totals	**$40,229**	I	**$5,818**	**$21,392**	**27%**
		C	**$2,059**	**$21,172**	**10%**

II. Estimates of Indirect Costs Incurred by Divisions (all Divisions):

G	H	I	J
I/C	PCE Indirect	Total 1xx	Ratio
I	$27,038	$40,523	**67%**
C	$6,897	$25,727	**27%**

III. Total Indirect Cost Multiplier – Districts and Divisions:

K			L
I			**94%**
C			**37%**

Col. D: The total expenditures made by districts in support of P.C.E., as estimated from the expenditure items summarized in Col. B.

Col. E: The total of direct P.C.E. (1XX) charges for districts for FY 1985.

Col. F: The ratio of C to D, or the ratio of total direct P.C.E. costs to indirect P.C.E. costs, both for in-house (I) and consultant (C) projects, for each district.

II. Division Estimates:

Col. G: The same as C above.

Col. H: The total of indirect P.C.E. expenditures made by all divisions in FY 1985, divided between in-house and consultant projects.

Col. I: The total of direct P.C.E. expenditures divided between in-house and consultant projects, for FY 1985.

Col. J: The ratio of 6). to 7)., or the ratio of the total amount of indirect P.C.E. costs incurred by divisions, and the total of direct P.C.E. costs for FY 1985.

III. Total Indirect Costs -- Districts and Divisions:

Col. K: The same as C and G above.

Col. L: The sum of the total ratios in F and J, equalling the total functional indirect cost multiplier.

On a statewide basis, indirect costs for P.C.E. on a project can be estimated by multiplying direct project cost (1XX charges) by 0.94 for in-house projects and 0.37 for consultant projects.

3.3.2 The Weight Method

There are two variations on the "Weight Method" of estimating indirect P.C.E. costs. The first (hereinafter referred to as Case 1) is to allocate the supplemental indirect (support) costs to an activity in proportion to the annual expenditures ("weight") reported for that activity. The assumption warranting this method is that an activity requires support in proportion to the amount of funds expended for that activity. See Figure 1, Appendix G for a graphic depiction.

The second variation (Case 2) of the weight method is to consider the "weight" of the "operational" costs of those activities associated with large cash outlays for purchasing materials and services, as well as for making cash grants. "Operational" costs are defined as the cost of delivering materials and services and awarding grants. It is assumed that the operational costs will be less variable than outlays and grant values from year to year.

Indirect P.C.E. costs estimated by the weight method in both cases are global in nature, in that the estimate of indirect costs is a reflection of the annual costs for projects. The weight method has the virtue of being simple in application, but it does not provide any insight about the origins and scope of indirect costs within the various divisions of the Department

Tables 4a and 4b, entitled *P.C.E. Cost Analysis by Activity Weight*, Case 1 and Case 2, display a method of estimating total P.C.E. costs. These tables are a compilation and manipulation of selected SDHPT major activity annual expenditures for Fiscal Years 1982 through 1985, producing *total* P.C.E. costs. The expenditure (cost) data in this table were extracted from the Department's Annual Financial Report and from P.C.E. and Construction Engineering (C.E.) cost data supplied by the Internal Review and Audit Section (IRAS). Tables 4a and 4b are discussed as follows:

Col. A: Fiscal Year. It would be desirable to investigate P.C.E. costs over a longer period of time, but complete data sets were not available for fiscal years earlier than 1982.

Cols. B & C: P.C.E. (Pre-construction Engineering) and C.E. (Construction Engineering) costs, respectively. This cost data was extracted from the Department's accounting data files, and was furnished to the study team by the Internal Review and Audit Section (IRAS). The P.C.E. and C.E. costs represent the total of Function Code 1XX and 3XX charges, respectively, and are assumed to be the Department's total of all direct P.C.E. and C.E. costs for each Fiscal Year shown. These same P.C.E. and C.E. direct costs are also contained in Activity Code 302 (Preliminary and Construction Engineering) in the Annual Financial Report.

Col. D: Ratio of P.C.E. to total of P.C.E. and C.E. [Col. B./(Col. B. + Col. C)]. This ratio is used in extracting (by proration) P.C.E. costs from accounts that are predominantly made up of P.C.E. and C.E. costs, such as A.C. 301 (Construction Management) and A.C. 302 (Preliminary and Construction Engineering), and the share of Management and Support Activities (A.C. 101, 102 and 103) considered to be necessary for the delivery of the major activity, Highway Construction (A.C. 301,302,303, & 304)

Col. E: Annual expenditures for Construction Management (A.C. 301), copied from the Annual Reports. A.C. 301 represents an aggregation of P.C.E. and C.E. indirect costs.

Col. F: Annual expenditures for Preliminary and Construction Engineering (A.C. 302), copied from the Annual Financial Reports. A.C. 302 aggregates all 1XX (P.C.E.) and 3XX (C.E.) project costs as well as a relatively small amount of indirect costs. A comparison of the P.C.E. and C.E. data supplied by IRAS and that taken from the Annual Reports indicates some small differences. Since indirect costs are also charged to A.C. 302 in addition to direct project

Table 4a
ALLOCATION OF INDIRECT P.C.E. COSTS
BY THE
WEIGHT METHOD (CASE 1)

A	B	C	D	E	F	G	H
FISCAL YEAR	Pre-Const. Engineering (P.C.E.) X $1000	Construction Engineering (C.E.) X $1000	Ratio P.C.E. / P.C.E. + C.E., or B/(B+C)	Construction Management A.C. 301 X $1000	P.C.E. and C.E. A.C. 302 X $1000	Contractor Payments A.C. 304 X $1000	Administration and Support A.C. 101-103 X$1000
1982	39,844	51,831	.4346	12,220	90,867	762,295	75,849
1983	48,311	61,776	.4388	13,493	107,488	764,238	81,525
1984	51,489	63,169	.4491	14,466	110,818	742,546	79,928
1985	69,861	63,793	.5227	13,923	137,249	833,557	83,087
1982-85 Avg	52,376	60,142	.4655	13,526	111,606	775,659	80,097

Col.	I	J	K	L	M	N
FISCAL YEAR	Alloc. of A&S P.C.E. + C.E.: Col. H X [X(n)] X $1000	A&S Cost Alloc to P.C.E.: Col. I X D X $1000	Alloc. A.C. 301 to P.C.E. Col. D X E X $1000	Total Indirect Costs Alloc. to P.C.E.: J+K X $1000	Total P.C.E. Costs: Col. B + L X $1000	Percent Indrt. Cost to P.C.E.: (L/B)X100 %
1982	52,012	22,606	5,311	27,917	67,761	70.1
1983	56,139	24,636	5,921	30,558	78,869	63.3
1984	54,364	24,413	6,496	30,909	82,398	60.0
1985	58,119	30,379	7,278	37,656	107,517	53.9
1982-85 Avg	55,159	25,676	6,296	31,972	84,348	**61.0**

Table 4b
ALLOCATION OF INDIRECT P.C.E. COSTS
BY THE
WEIGHT METHOD (CASE 2)

A	B	C	D	E	F	G	H
FISCAL YEAR	Pre.-Const. Engineering (P.C.E.) X $1000	Construction Engineering (C.E.) X $1000	Ratio P.C.E. / P.C.E. + C.E. or B/(B+C)	Construction Management A.C. 301 X $1000	P.C.E. and C.E. A.C. 302 X $1000	Contractor Payments A.C. 304 X $1000	Administration and Support A.C. 101-103 X$1000
1982	39,844	51,831	.4346	12,220	90,867	762,295	75,849
1983	48,311	61,776	.4388	13,493	107,488	764,238	81,525
1984	51,489	63,169	.4491	14,466	110,818	742,546	79,928
1985	69,861	63,793	.5227	13,923	137,249	833,557	83,087
1982-85 Avg	52,376	60,142	.4655	13,526	111,606	775,659	80,097

Col.	I	J	K	L	M	N
FISCAL YEAR	Alloc. of A&S to (PCE+CE) Col. H X [X(n)] X $1000	A&S Cost Alloc to P.C.E.: Col. I X D X $1000	Alloc. A.C. 301 to P.C.E. Col. D X E X $1000	Total Indirect Costs Alloc. to P.C.E.: J+K X $1000	Total P.C.E. Costs Col. B + L X $1000	Percent Indrt. Cost to P.C.E. (L/B)X100 %
1982	53,782	23,375	5,311	28,686	68,530	72.0
1983	58,531	25,686	5,921	31,607	79,918	65.4
1984	58,403	26,227	6,496	32,723	84,212	63.6
1985	62,344	32,587	7,278	39,865	109,726	57.1
1982-85 Avg	58,265	27,122	6,296	33,418	85,794	**63.8**

costs, annual expenditures for A.C.302 should be larger than the sum of the P.C.E. (1XX) and C.E.(3XX). A comparison of the sum of Cols. B & C. and Col. F shows that the values in Col. F vary from -3.47 percent to +2.62 percent for each Fiscal Year listed although the 1982-85 average varies by only -0.82 percent. These differences are probably due to the dates when the data were collected. The P.C.E. and C.E. data furnished by IRAS was collected recently whereas the data collected for the Annual Reports was collected immediately following each fiscal year. It is understood that accounting records are being continually reconciled after the Annual Financial Reports are published. Considering that the Activity Weight method of allocating P.C.E. costs is, at best, an approximation, small changes in the A.C. 302 annual expenditures should not affect the usefulness of the results.

Col. G: Annual payments to construction contractors, copied from Annual Financial Reports. For reference only, not used in any calculations in this table.

Col. H: Annual expenditures for Administration and Support Activities (A.C.101, 102 & 103), copied from Annual Financial Reports. In estimating indirect P.C.E costs it is assumed that a share (proportional weight) of all Administrative and Support Activities is an indirect P.C.E. cost, as shown in Figure 1, Appendix G.

Col. I: Shows allocation of Administrative and Support (A &S) Activities to Highway Construction (A.C. 301, 302, 303, & 304). There are two variations of this allocation method which are designated as Case 1 and Case 2. Refer to the tables in Appendix G for the tabulation of distribution derived from the two variations of cost allocation by weight.

Col. J: Allocation of Administrative and Support Activities costs to P.C.E. (Col. I X Col. D).

Col. K: Allocation of Construction Management (A.C. 301) indirect costs to P.C.E. (Col. D. X Col. E.) The allocation is assumed to be proportional to the "weight" of P.C.E. as given by ratios in Col. D.

Col. L: Total of indirect costs allocated to P.C.E. Cols., J + K (Administrative and Support Activities plus Construction Management).

Col. M: The estimated total cost of P.C.E. stated as the percentage of indirect to direct costs

Col. N: Indirect P.C.E. costs as a percentage of direct P.C.E. costs

3.4 COMPARISON OF TOTAL P.C.E. COSTS.

Estimates of direct and indirect P.C.E. costs can be used to compare in-house and consultant costs. Such comparisons can be made on two levels: a "global" approach, and an individual-project approach. Considering the unresolved problems in quantifying plan quality and effectiveness, time-cost factors, and questions about the relative difficulty of projects and of events affecting project development, the individual-project approach was not considered to be desirable for use in this study. The global approach, however, seemed to be a more convincing means of comparison for the purposes of this study. The global approach also appeared to be desirable in order to look at the Department's P.C.E. operations as a whole rather than extrapolating conclusions from a sampling of a relatively few projects. In the following paragraphs, both levels are discussed even though no conclusions are drawn from using the individual-project approach.

3.4.1 Global Approach. Tables 5a, 5b, and 5c compare in-house and consultant total costs for P.C.E. services. *These estimates indicate that consultants overhead or indirect costs to deliver P.C.E. services to the Department about 45 percent higher that similar overhead or indirect costs for the Department* . This conclusion, however, assumes that in-house and consultant wage rates are the same. The range of indirect-cost-to-wage ratio for in-house P.C.E. services was estimated between 1.94 and 2.12 shown in tables 5a, 5b, and 5c. This ratio for consultant P.C.E. services ranged from 2.86 to 3.07 Thus, it appears that consultants' services cost about 45 percent more than similar services in-house.

However these costs may *also* be stated as the ratio of *total costs* to wage costs ((i.e., (indirect costs + wage costs)/wage cost) = (indirect/wages) + 1+ 0.06(office allowance)) in which case the ratio of in-house P.C.E.costs would be between 2.94 (1.94+ 1=2.94) and 3.12 and consultants ratio of costs vary between 3.86 and 4.07. Thusly speaking consultants' P.C.E. services would appear to cost about 30 percent more than those furnished in-house. These differences in costs may be greater if wage differentials are taken into account as the wage studies shown in tables 1a, 1b, and Appendix F. These wage costs suggest that consultant wages are about 5 percent higher than equivalent Department wages for about the *same* mix of positions (skills) and are about 20 percent higher *if* the selected Department payroll group of represent *as* efficient collection of skills to deliver P.C.E. services than do the group of consultants firms which were studied.

The consultant projects reviewed by the study team were, as a group, average or slightly above average in complexity. In the global approach all projects are included, which would include many in-house projects of low complexity and low pre-construction costs. The Department prepares

Table 5a

COMPARATIVE COSTS

Based on Fiscal Year 1985 Cost Data

(in thousands of dollars)

Functional Method of Indirect Cost Allocation

	A	B	C	D*	E	F
Consultants Total P.C.E. Cost Ratios:	Consultants Payments	Consultants Wages = Col. A/3.02	Consultants Overhead= Col. A - B	Indirect P.C.E. Admn.&Supp. Costs	Total Indirect P.C.E. Costs Col. C+D	Total P.C.E. as Ratio of Ind. Costs to Wages Col. E/B
	$25,727	$8,519	$17,208	$8,956	$26,164	**3.07**
	G	**H**	**I**	**J**	**K**	**L**
In-house Total P.C.E. Cost Ratios:	In-house Direct P.C.E. Costs (1XX)	In-house Wages = Col. G X .5915	Indirect P.C.E. Costs= Col. G - H	Indirect P.C.E. Admn.&Supp. Costs	Total Indirect Costs Col. I + J	Total P.C.E. as Ratio of Ind. Costs to Wages K/H +.06(Off)
	$40,523	$23,969	$16,554	$32,856	$49,410	**2.12**

* Refer to Table 3, Cols. D & H. Tot. Cons. Ind.Supp. Cost: $2.059+6,897= $8,956.

Table 5b

COMPARATIVE COSTS

Based on Fiscal Year 1985 Cost Data

(in thousands of dollars)

Weight Method of Indirect Cost Allocation, Case 1

A	B	C	D	E	F	G	H
Fiscal Year:	Total P.C.E. (1XX Charges) = X $1000	Total Consultant Payments X $1000	In-house P.C.E. Costs (1XX Charges) = (Col. B - C) X $1000	Total In-house Wages = (Col. D X .5915) X $1000	In-house P.C.E. (1XX) Overhead = (Col. D - E) X $1000	Indirect P.C.E. Costs (Refer to Col. L, Tab. 4a) X $1000	1982 Indirect In-house P.C.E. Cost (Col. L, Table 4a Inflated to 1985 @3%)
1982	39,844	0	39,844	23,568	16,276	27,917	27,917
1985	66,250	25,727	40,523	23,969	16,554	37,656	30,506

	I	J	K	L	M	N
	Indirect Cost Allocation to Consultant = (Col. G - H) X $1000	Total indirect In-house P.C.E. Costs = (Col. F + H) X $1000	Total In-house P.C.E. as Ratio of Wages = (Col. J / E) + .06 (office)	Total Consultant Wages = (Col. C / 3.02) X $1000	Consultant Total Indirect P.C.E. Cost = (Col. I + C - L) X $1000	Total Consultant P.C.E. as Ratio of Wages = (Col. M / L)
1982	0,000	44,193	**1.94**	N/A	N/A	N/A
1985	7,150	47,059	**2.02**	8,519	24,358	**2.86**

Table 5c

COMPARATIVE COSTS

Based on Fiscal Year 1985 Cost Data

(in thousands of dollars)

Weight Method of Indirect Cost Allocation, Case 2

A	B	C	D	E	F	G	H
Fiscal Year:	Total P.C.E. (1XX Charges) = X $1000	Total Consultant Payments X $1000	In-house P.C.E. Costs (1XX Charges) = (Col. B - C) X $1000	Total In-house Wages = (Col. D X .5915) X $1000	In-house P.C.E. (1XX) Overhead = (Col. D - E) X $1000	Indirect P.C.E. Costs (Refer to Col. L, Tab. 4b) X $1000	1982 Indirect In-house P.C.E. Cost (Col. L, Table 4b Inflated to 1985 @3%)
1982	39,844	0	39,844	23,568	16,276	28,686	28,686
1985	66,250	25,727	40,523	23,969	16,554	39,865	31,346

	I	J	K	L	M	N
	Indirect Cost Allocation to Consultant = (Col. G - H) X $1000	Total indirect In-house P.C.E. Costs = (Col. F + H) X $1000	Total In-house P.C.E. as Ratio of Wages = (Col. J / E) + .06 (office)	Total Consultant Wages = (Col. C / 3.02) X $1000	Consultant Total Indirect P.C.E. Cost = (Col. I + C - L) X $1000	Total Consultant P.C.E. as Ratio of Wages = (Col. M / L)
1982	0,000	44,962	**1.97**	N/A	N/A	N/A
1985	8,519	47,900	**2.06**	8,519	25,727	**3.02**

plans for a large number of construction projects which are recurring and similar in their physical characteristics or repetitious in detail. Plans for these types of projects can be be produced for a low cost or for a very low percentage of the construction cost. Examples are long bridges with uniform span lengths and details, asphaltic overlays, district-wide seal coat projects, standard traffic signal installations, etc. None of the consultant projects was deemed to be in the category; consequently, the cost comparisons may be biased.

3.4.2 Individual-project Approach. P.C.E. plan costs and other data concerning the selected projects have been collected and collated. The original purpose for organizing these data was to compare in-house and consultant plan work on the basis of cost per plan sheet. However, as was subsequently discovered during the course of the study, questions about quantifying plan quality and the relative effectiveness of individual plan sheets arose and were never satisfactorily resolved from the standpoint of making comparisons between pairs of individual projects. The plan sheet is a convenient unit of measurement for making estimates of the cost of and personnel requirements for preparing construction plans; however, individual plan sheets can vary widely as to the quality, amount, accuracy, and effectiveness of the information impressed thereon. In evaluating the cost of plan preparation by consultants, it was also difficult to ascertain the amount of "input" or contribution that in-house personnel made to the process. Such input could have been in the form of constructive review, furnishing of design details and information, and providing standard drawings which could be used and modified. The use of plan sheets as a unit of comparison would not be useful in comparing P.C.E. effectiveness in certain unusual preliminary engineering investigations and feasibility studies. Some other unit of measurement should be utilized for these cases.

In summary, the global cost analysis suggested that consultant *indirect* and *total* P.C.E. costs were respectively 45 and 30 percent greater than similar in-house P.C.E. costs. In addition the salary comparison study indicated that consultant wages were 5 or 22 percent higher than those paid by the Department depending on the assumptions made as to the mixture of personnel skill classifications used to deliver P.C.E. services. Similar figures were not developed from individual project data because the individual project approach for comparing projects was considered unconvincing. Also, the determination of plan sheet costs can be a very useful method of analyzing P.C.E. costs and for estimating future engineering costs, and for that reason the data in Appendix B are included in this report. These data can also be useful for projecting personnel requirements and budgets for P.C.E. and in negotiating with consultants. It should be noted that the data shown in Appendix B are a mixture of projections (estimates) and final values. Some of the

projects were only partially completed at the time that the study was being conducted; therefore only projections of engineering and construction costs and numbers of plan sheets were available.

4. QUALITY OF PLAN PREPARATION

4.1 INTRODUCTION

Two orders of quality factors relate to plan preparation. The first order is the quality of plan development and presentation and is identifiable by factors such as accuracy, legibility, comprehensiveness, and clarity. The second order of quality is the result of planning and is identifiable by factors such as construction costs, life-cycle maintenance costs, traffic handling during construction, safety, and operational efficiency.

For this study, the second order of quality is of lesser concern because of the high standards of basic highway and structural design that are demanded by the Department, the FHWA, and the engineering profession. These standards are such that substantive deficiencies in overall plan quality would be unlikely whether planning was performed in-house or by consultants. Thus, this study generally addresses only the first order of quality, which concerns plan development and presentation.

The ultimate effects of plan quality on a project can be assessed only after highway construction has been completed and and the facility has been opened to traffic. As mentioned previously, the Department has not used consultants long enough for any significant number of consultant-designed projects to have arrived at or passed through the construction stage of project development. Consequently, any evaluation of the quality of consultant plans that would be attempted at this time would be made without substantial knowledge of the long-range results of the total plan-development and implementation process. However, it is doubtful that waiting for information about the long-range results of the consultants' plans that were reviewed during this study would have a significant effect on the conclusions drawn. As discussed above, long-range results are affected more by design standards than by the design decisions that are made during the development of plans for specific projects.

Several considerations have a bearing on the evaluation of planning quality and should be kept in mind when reflecting on quality standards and quality comparisons. These considerations are discussed briefly as follows:

4.1.1 Documentation. The conclusions about plan quality that are presented in this study report are based upon the authors' personal inspection of plan sets for the selected projects that were made available in the district offices, upon evaluation of information contained in responses to the questionnaires that were submitted to selected districts, as well as upon interviews with district and division representatives and with highway contractors.The

strongest impressions were drawn from the general experience of the responders. There was little documentation available to support a quantitative assessment of quality. This lack of documentation should not be surprising since the Department's method of administering plan preparation calls for periodic reviews of plans in progress. At the time of plan review, problems are solved and errors and omissions are discussed and corrected. The process is positive in that its aim is continual improvement throughout the various stages of plan development. A score card is not maintained on the number of errors since they are corrected as discovered. The Department's objective is to achieve quality as a final result without undue concern for deviations encountered in pursuit of the final goal.

4.1.2 Subjective values of quality. One characteristic of engineering planning that makes the evaluation of quality troublesome is the relative values that different individuals place on attributes of quality such as the value of time, aesthetics, safety, and public relations. There is a limit to the specificity with which plan quality can be defined. More powerful microscopes and brighter lights might reveal more numerous minor deficiencies but will not necessarily resolve differences in subjective values. These subjective values tend to blur if examined too closely; therefore, determination of fine distinctions in the quality of highway plans should not be expected. What is expected is acceptable plan quality. This in itself should inspire intense commitment to professional performance by engineers in recognition of the fact that the proper course of action should be pursued without wasting resources.

4.1.3 Weight given to quality factors. If quality factors are quantifiable to some acceptable degree, there remains the further difficulty of weighting the importance of the various quality factors. For instance, will accuracy deficiencies be offset by neatness and clarity? It is evident that wide variations in quality factors can be present in a set of plans without affecting the end results. During the visits to the districts, the study team was shown examples of uncomplicated, ordinary rural highway widening plans which were tersely drafted and sketchy in appearance but which have proven to be entirely satisfactory for use by able resident construction engineers and experienced highway contractors.

4.1.4 Variable standards of quality. Experienced design engineers know that it is cost-effective to vary quality standards for specific projects and that quality standards relate to the relative importance, cost, complexity, urgency, and uniqueness of each individual project. Even if plans contain deficiencies, they can be modified during the construction stage of a project to produce acceptable construction work.

4.1.5 Unpredictability element in planning. There is in highway engineering planning an element of unpredictability concerning the occurrence and effect of the physical and political environment that might exist during project development. Some of the unpredictibles can be discovered during the planning process and can be resolved only by the application of

engineering and ethical judgement and through personal negotiations and bargaining. Discovery is inherent to the planning process. If contracts for engineering services could contain specifications sufficiently precise so as to guarantee planning results of acceptable quality, these services could be secured through the "low-bid" process. This would be a means of assuring the least expensive first-cost in engineering planning. Such a process is not utilized because all the risk of an unfavorable planning result would rest with the Department. It would prepare the specifications, and the consulting engineer would be obligated to do only what was necessary to meet the requirements of the specifications. Because of this element of unpredictability and the reliance of the client on the judgement of the engineer to provide necessary feedback, engineering contracts are negotiated. Professional judgement is essential to protecting the public interest and requires placing values on transient events of which the client (Department) may not be aware at the time of project initiation. The consulting engineer is expected to exercise judgement and integrity and to keep the client informed of significant events that occur during plan development.

4.1.6 Coping with plan deficiencies. The Department's construction management is capable of coping with certain levels of plan deficiencies and still deliver satisfactory construction results. The costs associated with deficient planning result from factors such as extra work orders, field changes, plan changes, quantity changes, supplemental agreements, construction delays, and cost overruns. Certain plan changes are desirable. These changes should be effected during construction if the result is a cost-effective, timely improvement in the highway project. Thus, the number of plan modifications *per se* is not necessarily a proper indicator of original plan quality. Some additional insight into the reasons for modifying plans during construction is required if the overall quality of plans is to be judged according to the number of changes occurring during the construction stage.

4.1.7 Pairing of projects. In comparing in-house and consultant work an attempt was made to compare like, or at least similar, projects. This proved to be of doubtful value in making close comparisons because the differences between the most judiciously-paired projects were enough to make it uncertain whether or not differences in engineering costs and quality were the result of planning difficulties or intrinsic project differences. In spite of elaborate design and procedural standards which govern the development of highway projects, each highway project is custom designed and can be considered unique. There are many similarities in design and function, but highway projects must be designed to accommodate a variety of times, environments, and circumstances. It is doubtful that the quality evaluations of the type that are common to manufacturing processes can ever be satisfactorily applied to highway planning.

4.1.8 Computer-aided design and drafting (CADD). Presently, both the Department and consultants are making increased use of CADD systems (sometimes referred to as interactive-

graphics systems) in order to enhance planning efficiency and quality. A CADD system can be a powerful planning tool because of the potential for the user to interact with many sources of data and modify ideas and plans easily. The design process is one of cut and try; therefore, the easier and more convenient this process becomes the more likely it is that planning quality will be improved. It is conjectured that a good many of the hand-crafted project construction plans that were reviewed by the study team would be produced by a CADD system if they were being developed today. It is expected that the use of CADD will improve the quality of planning. The major use of CADD in the Department and by consultants currently is for drafting. As more interactive-design software is developed and engineers are trained in its use, computer-aided-design will make more significant contributions to the overall effectiveness of the plan development process.

The authors suggest that the findings reached herein may relate well to the overall quality of planning within the Department, even though they were based upon a sample of projects. This position is believed to be warranted because of the uniformity of responses and experiences cited concerning plan preparation quality that were communicated to the study team by the Department representatives who participated in the study. It is also the authors' opinion that more, and more elaborate, documentation of past experience by the Department in its use of consultants would not have had any significant effect on the conclusions.

4.2 QUALITY OF IN-HOUSE PLANS

The quality of planning varied. Variations were accounted for by two principal factors: letting schedule pressures, and shortages of qualified personnel. The schedule pressures came from large increases in the construction budget in Fiscal Years 1985 and 1986. The availability of qualified personnel was a function of the rate of retirement of a large number of experienced supervisors and their replacement with young, inexperienced employees at a time when staffing restraints were imposed on the Department by the legislature. Unfortunately for the Department, these changes in personnel were taking place at the same time that the construction budget was increasing; this caused the Department to stretch its plan-preparation resources. In the study, all participating districts and plan-review divisions reported variable but adequate plan quality in most cases in spite of these limiting factors.

The last two years have been a time of transition for the Department, as evidenced by increased funding, changes in age and experience of the work force, and the utilization of consultants for the first time to any significant degree. It is speculated that the observations made during this study in

a time of transition may not be representative of the conditions that will exist two or three years from now.

All participating districts agreed that there are cost-effective trade-offs between plan quality and the need to complete a project at the earliest possible date. There may be large public benefits derived from highway improvements, and some sacrifice in quality may be acceptable if a project can be completed sooner. There is within the Department a sense of urgency to advance to construction as soon as possible projects which have been long delayed because of past funding shortages.

In summary, the in-house plan preparation quality is adequate during a time of increasing work load and personnel changes, and plan preparation is being managed adequately while recognizing the importance of moving projects to letting as soon as possible.

4.3 QUALITY OF CONSULTANT PLANS

As with in-house planning, the quality of consultants' plan preparation was judged to be variable. It appeared that among the districts participating in this study confidence in consultants' ability to produce satisfactory work was in proportion to the district's experience in administering and managing consultant contracts. In no case was it reported that accepted consultants' work was of such poor quality that it could not be used, although in some instances Department representatives reported that it required an extraordinary amount of review time and counseling on their part in order to secure acceptable work. Some consultants, otherwise considered capable, were reported to require tutoring in order to produce satisfactory highway construction plans. Instances of poor performance may be a result of the Department's desire to award engineering contracts to as many different consulting firms as is considered practicable. It was also observed that the quality of the work from some of the firms, which were initially considered as inexperienced, improved considerably when they were given a second chance. Some districts reported that some consultants' work was equal in quality to the best by the Department.

Responsibility for quality remains with the Department regardless of whether or not the P.C.E.services are delivered in-house or by consultants. If a consultant does not produce work of satisfactory quality, the Department has the privilege of not continuing the service or, as a matter of proper administration, refusing to employ that consultant in the future. Consequently, past instances of poor performance by particular constultants should not influence future expectations of quality. Similarly, consultants who have performed well *should,* as a matter of proper administration, be encouraged to negotiate for further work with the Department. In summary, recent instances of poor quality work by consultants should not necessarily be a guide to the

Department respecting future work. Instead, the quality of future consultant servuces should be considered as a function of the quality of consultant contract administration.

Department personnel who are responsible for administering consultants' contracts appeared confident that their abilities to assess consultant qualifications, select consultants, negotiate reasonable fees and satisfactory contract conditions, and otherwise manage consultants' contracts have improved during the last two years. All districts reported that it usually requires a minimum of 6 months from initial request for consultant services until authority for the consultant to begin work is received, and some districts believed that the usual case is about 9 months. It was speculated that delays in engaging consultants may have an effect on plan work quality if such delays crowd the planning time required to meet a project deadline. All districts postulated that a faster turn-around time in securing consultant services would be productive.

Securing the best work from consultants requires a commitment from the Department. Administering and managing consultant contracts requires capable personnel who are in constant communication with the consultant and who have the ability to recognize deficiencies as the plan work progresses and authority to settle any ambiguities or answer questions forwarded by the consultant. Similarly the consultant should be represented by someone with the authority to carry out the directions of the Department. Most problems reported in managing consultants appeared to stem from poor communications. One of the most severe consultant-management problems reported by a district apparently came about because the consultant's local representatives lacked authority and consequently were hesitant about correcting planning errors. Another difficulty reported was that the consultant's office was located in a city outside the district that was managing the contract. This strained communications between the Department and the consultant and increased the difficulty of securing satisfactory work. The district reporting this problem feels strongly that having the consultant at a convenient location is important and should be a condition of a consultant's contract.

In summary, the Department can obtain satisfactory quality plan work from private consultants. To do so, the Department must be committed to proper administration and management of the consultant's contract, and there must be a similar commitment from the consultant to produce quality work. The investigations that were made during this study lead to the conclusion that there is every reason to believe that a qualified consultant can, if properly guided, prepare construction plans that are at least equal in quality to those done by the Department.

5. CONCLUSIONS

5.1 P.C.E. COSTS

The cost of P.C.E. services as estimated in this study is stated as a ratio of indirect (overhead and support) costs to personnel (salaries, wages) costs. A comparison (between in-house and consultants) of the ratios of indirect costs to payroll costs suggest that, on the whole, in-house P. C. E. services may be delivered for less cost than consultants' services. The conclusions reached from this method of estimating P.C.E. costs assumes that the services delivered per dollar of wages by consultants and by Department personnel produce the same *quantity* of engineering services. However, if consultants deliver P.C.E. services more effectively (i.e., if consultant personnel were more productive than in-house personnel and/or used automation more effectively) per unit of cost than in-house personnel, differences in costs can be offset. It was not feasible to determine a value or quantity by which the effectiveness of a unit of time or a unit of cost expended for P.C.E. could be measured. The difficulty and credibility of quantifying quality has been discussed elsewhere in this report and consequently estimates of cost-effectiveness were not made.

Initially, an attempt was made to estimate P.C.E. costs as a function of plan sheet costs. This method was discarded because of the difficulty in assessing the comparability of planning quality effectiveness, and conclusions are not tendered with respect to the unit cost aspect of construction plan preparation. It is believed that examining the monetary and time costs per plan sheet for selected categories of plan sheets detail would be a useful approach in comparing cost-effectiveness if the issue of quantifying comparability can be resolved. The allocation of Administrative and Support Costs to P.C.E. services is a significant part of the cost of delivering P.C.E. services. The methods used in this study for making such allocations have been described previously. It is recognized that these allocations significantly affect the estimated costs of both in-house and consultant P.C.E. services and that the method used for these allocations was unsophisticated. Better insight is needed to make equitable allocations of Administrative and Support costs since these costs are a sizeable component of the Department's operating budget.

5.2 COST-EFFECTIVENESS AND THE PLANNING PROCESS

No quantifiable measures of cost-effectiveness were determined during the course of this study because there were no reliable data available to relate unit costs of P.C.E. services to a unit measuring quality and/or effectiveness of P.C.E. services. Aspects of cost-effectiveness (or cost

and effectiveness) provide some degree of guidance in assessing and comparing in-house and consultant engineering services, even though a method is not recommended for quantifying such activities.

Quality is related to cost-effectiveness insofar as quality standards may affect the delivery time of a project. Plan quality is important, and there is a point at which a project may need to be delayed in order to obtain plans of acceptable quality. Moving a project to early completion is also recognized as important, and in many instances perceived to be cost-effective. In resolving the questions surrounding the use of consultants' services, consideration must be given to the value to the public of delivering a particular project at an earlier date than would otherwise be the case if the project plans were prepared in-house.

Effectiveness concerns the timeliness and quality of services rendered to the travelling public. The importance of effectiveness is shown in the following investment case study which evaluates the total agency and user costs of delaying the project for one year.

The case study evaluates delaying improvements to a well-traveled arterial street in a large urban area. The existing street is assumed to be a four-lane forty-foot-wide undivided city street without left-turn lanes. The improvement is to widen the street to a median-divided four-lane street with provisions for left-turn lanes. The estimated cost of improvements includes modernization of the traffic control signal system and allowances for drainage facitlities and utility adjustments. The construction costs and traffic volumes assumed are consistent with those existing in Texas in urban areas of 50,000 or more population. The Before-and-After street improvements, traffic data, cost, and economic assumptions are given in Table 6.

The economic analysis was performed using the Highway Economic Evaluation Model (HEEM), which was developed for the Department by McKinsey & Co. and later improved by TTI. The model estimates user's costs as time and operating costs due to congestion and safety costs. The model accounts for future maintenance costs, changes in travel time due to traffic changes, and the time value of money. The analysis showed the example project to have a benefit-to-cost ratio of about 8 to 1. The cost to the user of delaying the project for one year is estimated at $1,100,000.

This example demonstrates the desirability of moving a project to completion as soon as possible, as the value of the project to the user is considerably more than the plan-preparation cost, which for the example project would be in the $300,000 range. Not all projects deliver $1,100,000 in benefits the first year although a good many projects will deliver considerably more. The value of a project to the user should be a consideration when the cost and risks of speeding the delivery of a project are being weighed.

TABLE 6 ECONOMIC ANALYSIS DATA

DATA ITEM	EXISTING	IMPROVED
Street Width	4 -10 foot lanes	4 -12 foot lanes
Median Width	None	12 feet
Left-Turn Lane ?	No	Yes
1986 ADT	25,000	25,000
2006 ADT, est.	44,000	44,000
Percent Trucks	5	5
Speed Limit	40 mph	45 mph
Length of Project	2 miles	2 miles
Diverson Route Speed	15 mph	15 mph
Est. Constr. Cost		$4,000,000

5.3 SUMMARY FINDINGS

The fact that the Department's systematic use of consulting engineers has been relatively brief limits the conclusions that may be drawn from this study. Since the Department is engaged in programs of work that may take twenty or more years to fulfil and in the development of individual projects that may take fifteen or more years to complete. Cost data and other information used to assess the cost-effectiveness of providing P.C.E. services in-house or by a consultant should represent a longer time span than was possible for this study. The availability of qualified in-house personnel is affected by the economic environment in which the Department operates, as well as by law. These effects are not always uniform across the state, and may affect some Districts more than others.

In establishing staffing levels, the Department should review its history since 1965 of employment levels and associated construction work loads. The Department had to administer involuntary reductions in staff levels in 1974, and consequently was compelled to secure a significant amount of supplementary consultant services beginning in 1983. In the past and in some districts in which the private economy has been booming, there has been intense competition between the Department and private industry to hire engineers and technicians. Primarily because of salary differences, some of these Districts experienced very high (up to 40 percent) turnover in personnel. Such turnover severely inhibited engineering efficiency. This should be considered in determining staffing levels if such conditions reoccur in the future. During the the short term, at least, in some Districts hiring consultant services may be a way for the Department to compete in the market price for P.C.E. services. Recent experience in hiring and maintaining personnel levels may not be a reliable guide to the future.

This study is limited by the fact that the conclusions drawn represent global findings and may or may not be applicable when considering the cost effectiveness of using a consultant for a particular project. As discussed previously, conclusions about cost-effectiveness comparisons for any one project investigated in this study are not drawn. Although there were some projects reviewed by the study team in which the P.C.E. services received — both from consultant and in-house personnel — were considered less than desirable, such anecdotal information did not support any general conclusions *as to future expectations*.. Undesirable experiences should not be taken as an indication of the future quality of consultant P.C.E. services, rather they should be used as a stimulus to improve the administration of consultants' contracts and to be more circumspect in the selection of consultants. It is clear that undesirable experiences will become increasingly rare in the future, as the Department gains experience in assessing and utilizing consultants and in upgrading its own skills and resources. This study was conducted during a transition time when the experience profile of the Department's personnel was (and is) undergoing

significant changes and when increasing use was (and is) being made of automated data systems to increase the efficiency of the Department's staff. Consequently, some of these findings may not be representative of conditions in future years.

Finally, this study concludes that any savings in P.C.E. costs at the expense of significantly delaying a project's completion is clearly not cost-effective.

6. ADDENDUM
SUMMARY OF RESPONSES BY THE CONSULTING ENGINEERING COMMUNITY CONCERNING THE UTILIZATION OF CONSULTING ENGINEERS BY THE SDHPT

6.1 Introduction

At a meeting on November 11, 1986, between the Administration of the SDHPT and representatives from the three agencies conducting the study, including the study team, it was announced that the scope of the study had been expanded to:

6.1.1 include more input and interaction with the consulting engineer community;

6.1.2 address the HPT Commission's general position "that consulting engineers be used for peak load and specialty work," and

6.1.3 address other productivity issues, such as the development and maintenance of staff, that might be a consequence of the Commission's current position on using consulting engineers.

The Engineer-Director instructed the study team to canvass Texas' consulting engineering community for their response to the issues being addressed by the subject study . It was agreed that the study team would first solicit the views of the group of about 120 consulting engineering firms who, during the past several years, applied for work from the Department and secondly to ask for a response from each of the group of 13 consulting firms whose work was selected as a "comparable" project to be examined in detail as part of the study. Necessarily, the first group included the smaller number of firms selected in the second group; consequently some firms were given two opportunities to respond.

Both written responses and oral interviews were requested. The second group was mailed a questionnaire pertaining to each of the planning projects reviewed by the study team. The questionnaire was similar to the one covering both in-house and consultant planning projects which was previously submitted and responded to by Department personnel. The number of responses was as follows:

- Written responses from consulting firms not attending interview sessions.....22
- Consultants from the first group attending interview sessions in Austin on December 8,9,10, and 12, 1986 11
- Consultants from the second group attending interview sessions in Austin on January 6, 1987 2
- Consultants from the second group attending interview sessions in Houston on January 7, and 8, 1987 8

Total responses.....43

The study team was also advised that the Consulting Engineers Council of Texas would be asked to submit a position paper addressing the issues to be considered in the study .

The response of the consulting engineering community to the study issues is summarized in the paragraphs 6.2.1 through 6.2.4. Item 6.1.3 is addressed in Section 6.3.

6.2 Response of the Consulting Engineering Community

The following represents a summary of the major concerns and comments by the consulting engineering community regarding the study. This summary was derived from both the written and oral responses is as follows:

6.2.1 Factors relating to cost comparisons.

If all the Department's cost factors, such as the large overhead and support costs, are considered when making cost comparisons, and if allowance is made for costs incurred by the private sector because of public policy, such as some taxes and insurance costs, it is believed that consultants can deliver pre-construction engineering services for the same or less cost than the Department.

There is concern that in estimating project pre-construction engineering costs the Department does **not** add overhead and support costs such as: *computer services and software development office space, cost of self-insurance, training costs, investment opportunity costs due to investment*

in buildings and real estate, communications services, management and administrative costs, library and reference costs, etc.

For the purpose of making cost comparisons it is considered inequitable to include certain taxes and profit (necessary for survival) as part of the consultant's cost of doing business where such costs are not part of the Department's costs. It is not necessarily in the public interest to avoid payment of certain taxes and avoid increased investment opportunities because certain engineering work can be performed in-house.

Apprehension was expressed that the Department shows undue concern about consultant overhead charges or multiplier factor which may or may not indicate an efficient operation. It is acknowledged that overhead multipliers may vary considerably, say between 1.1 and 1.7. There are reasons why this may occur. Some differences in overhead among consultants is accounted for by whether or not certain charges , such as clerical assistance or computer time, are billed directly or included in the overhead. Overhead for one consultant may include the investment costs in a data processing system whereas another may provide for computer services as a direct charge. In any case, a client's costs are affected principally by employee productivity rather than overhead rates. Consultants are in a **competitive** business and consequently feel compelled to keep expenses down and demand productivity from their employees. It is held that an engineering organization in the private sector is more cost-effective than a similar organization in the public sector because of the stimulus of the competitive environment.

Consultants are considered liable for design errors and consequently many believe it a necessary responsibility to carry liability insurance. The premiums for this type of liability insurance are reported by some consultants to amount to about five percent of their gross income. In similar circumstances the Department has, by law, only a limited liability for design errors and substantially lower insurance costs. Is it in the public interest for a governmental agency to avoid that which may be required in the private sector, and if not, in making cost comparisons, should costs assigned to the private sector be reduced proportionally?

6.2.2 Quality considerations.

Consultants feel very strongly that they can turn out work of the same quality as the Department. In order for consultants to produce quality work it is necessary that the Department be explicit in describing the characteristics and scope of work to be performed, furnish adequate reference materials, and provide timely and decisive, periodic review of completed work.

Some consultants believe the Department is requiring higher standards for consultants than that required in-house. This suggests lack of trust by the Department's personnel who administer consultant contracts. This lack of trust appears to engender additional plan work calling for

supplementary plan details, geometric data, and additional collation and enumeration of construction items.

The trend toward greater use of data processing and CADD (Computer Aided Design and Drafting) equipment is doing much to improve the overall quality of plan work as well as reduce the variability in plan work.

Inferior quality work by some consultants is acknowledged but it would be difficult to draw any conclusions from isolated cases since the Department doesn't advertise its own planning errors which make comparisons difficult.

The Department should exercise rigorous controls to ensure the selection of consultants who can perform satisfactorily. A post-mortem should be performed on all planning projects. These post-project evaluations should be weighed when determining future qualifications and eligibility for selection.

It is held by some that the group of 120 or so firms currently listed as eligible and desiring to perform planning work for the Department, is too large and stricter pre-qualifications should be invoked to reduce the number in this group. Since 1980, 120 consultants have been used; of these, 97 have not had more than one job. Many of the comments about quality stem from the inexperience of some of these consultants, and the Department's position of spreading the work may have resulted in some inferior work being done.

It is held that an inexperienced but otherwise qualified consultant should be expected to perform work for the same costs as an experienced consultant and any reduction in profit or losses because of inexperience should be written off as a learning investment. Experienced consultants hold that inexperience should not be compensated by the Department by additional allowances for cost and time overruns.

There was scepticism expressed about the gravity of the allegations attributed to some highway contractors who alluded to the inferior quality of construction plans prepared by consultants. These allegations appear to be self serving considering that highway contractor's construction contracts are administered **only** by in-house personnel.

6.2.3 Personnel management considerations.

There is a trend, by government, toward the purchase of engineering services from the private sector rather than supplying such services through employment of in-house personnel. Some states formerly furnishing all or a large part of their pre-construction engineering services in-house are now purchasing more of these services from private consultants. Some of the states cited were: Washington, Illinois, North Carolina, South Carolina, Pennsylvania, New Jersey, Virginia, California and Florida.

Management problems, associated with increased regimentation of public employees, maintenance of employment levels, geographical allocation of employees, together with associated increases in non-salary benefits and privileges for these workers, can be diminished by substituting consultant services for those otherwise delivered by public employees.

Considering that consultants have a variety of clients, both private and public, and both in-state and out-of-state, there is an opportunity for consultants to shift resources among a variety of clients. This shifting of resources has, within the consulting community, a leveling effect on peak period resource utilization problems. Having a variety of client types who are geographically diverse enhances the stability of the consulting engineering industry. A substantial participation in Texas' highway program by consultants will strengthen the consulting engineering base in Texas and consequently make this resource available locally when needed by the Department. This participation in the highway program is important to Texas considering the present depressed economic conditions in the petro-chemical industry which is causing the state to lose much of the engineering and technology services supporting this industry.

The Department has only one client, itself, and is therefore required to match its personnel needs to the resources available, which have been variable if considered over any reasonable length of time. In the middle 1970's the Department reduced its payroll from over 21,000 employees to less than 15,000. By electing to purchase some part of its needed engineering services from the private sector the department can avoid the risk of overhiring. One of the principal allures, to many potential employees, of the Department as an employer is assurances of job security and planned understaffing is a means to ensure and enhance this perception.

6.2.4 Peak load and specialty assistance.

One of the principle attractions for hiring consultant services is the convenience of securing engineering services on an as needed basis without the risk of long range commitment. If the Department wishes to exercise this option **only** when "peak" loads occur, the consulting community is saddled with the risk of maintaining these resources until another "peak" occurs. These engineering resources may not be available when needed unless there is sufficient consulting work available between peak periods to support a viable consulting engineering industry. It is not contended that the Department should be the sole support of the consultant engineering community, but it is contended that support is essential also at times other than the periods of peak work load.

These peak load concerns are consistent with the economic arguments of marginal value versus average cost pricing. If the Department wishes to hire at peak load it should recognize that prices for such services may be determined by marginal, not average, costs. Comparing in-house costs to consultants may be biased in favor of in-house costs if in-house costs happen to be average

costs whereas consultants costs may be peak load marginal costs. To some extent all private consultants recognize that in order to survive, with their organization intact, they have to absorb some non-productive costs which in turn are added to overhead and passed on to the clients. A consultant is more competitive as non-productive costs are reduced.

The amount of consulting work that the Department may define as *specialty* is considered to be rather minor and unpredictable in occurrence and requires skills that may be difficult to maintain for a Texas-based consultant whose principle clients are only in Texas.

As previously discussed, the experience and skills gained from clients, both in and out of Texas, are also available to the Department through consultants. If the consultant industry in Texas is not sustained, then this reservoir of knowledge acquired from other clients may not be available to the Department except from out-of-state consultants. It is in state's interest to be an exporter rather than an importer of engineering services. This issue may be critical as this report is written because the number of potential clients in the land development and the petro-chemical industry potentially available to consultants has been greatly diminished.

6.3 Productivity and Staffing Issues.

Historically, the Department with some exceptions has, as for example during World War II, managed a continually evolving highway system rather than merely managing and maintaining a status-quo system. Texas' highway system has been increasing in traffic capacity as well as sustaining more intense vehicular loadings. The engineering services required to expand this highway system are far greater than those required only to maintain a system. This report assumes that the demand for highway capacity and usage will increase within the foreseeable future and that staffing qualities should be consistent with this assumption.

The Department should maintain, overall, a staff sufficiently large to provide the technical, engineering, administrative, and management skills needed to cope with the recurring conditions and problems encountered in constructing, maintaining, and operating the state highway system and sustain its character as a responsive and responsible public agency and as a leader in highway engineering. The Department, within its overall organization, should as a minimum, have an engineering staff sufficiently large to develop, maintain, and practice state-of-the-art engineering capabilities necessary to cope with the demand for recurrent pre-construction engineering services. These capabilities should be locally available on an as-needed state-wide basis consistent with the Department's traditional policy of de-centralization. The demand for all pre-construction engineering services is not uniform among all the district offices. A particular engineering need that may be recurrent in a large urban district may be needed infrequently in a predominantly rural district and consequently the staffing needs in the urban district may require skills not needed

elsewhere. The role for the consultant would be to supply the need for infrequent services when and where needed and to supply the need for those recurrent services above a certain level supplied in-house. Consequently, there may be a need for a bridge engineering and geotechnical engineering skills in one district and not in another. Additionally, these minimum engineering capabilities may also be practiced and preserved in the administrative divisions offices as a resource to be used by the district offices.

In order to select and administer consultants effectively it is important that the Department be represented by qualified engineers. Becoming a qualified engineer is not best done through watching others perform engineering but through hands-on experience. This is particularly true for young engineers learning engineering and management skills for the first time. In determining a minimum staffing level the Department should consider what pre-construction engineering services should be maintained and the distribution of these services throughout the department. In reality, a dedicated highway engineer who has maintained an active and progressive interest in highway engineering with a broad experience background should possess practically all the skills needed to provide state-of-the-art engineering services. The many engineering skills needed by the Department will not necessarily require a like number of specialists but a much smaller number of versatile engineers supported by adequate resources. Consequently, the minimum size engineering staff required is also a function of the versatility of the people on the staff. The maintenance of engineering capabilities requires that the Department have a balanced staff of engineers and technicians of varying age, knowledge, and experience not only to ensure that quality services are available but that there are sufficient resources devoted to transmitting this knowledge and experience down to the most junior employee. The maintenance and continuity of quality engineering services should be considered a long range objective. A staff sufficient to meet only immediate objectives might prove to be inadequate over the long haul. Some allowance for staff development beyond immediate needs should be considered in determining the minimum size staff. The alternative to internal staff development, in order to maintain a balanced staff, is to acquire on the open job market, the needed type and level of skills, at the proper place and proper time. This alternative may be risky if the job market is not productive since the results of internal staff development have to be anticipated years in advance of the need.

APPENDICES TO

UTILIZATION OF CONSULTANTS BY THE
STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

by

W. V. Ward
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Research Report Number 1101-1F

Utilization of Consultants by the State Department of
Highways and Public Transportation

Research Project 3-1-86-1101

conducted for

Texas
State Department of Highways and Public Transportation

by the

CENTER FOR TRANSPORTATION RESEARCH
BUREAU OF ENGINEERING RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

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CONTENTS

Appendix A — Projects Selected for Study

Appendix A is a series of tables supplied by the Department showing the original list of projects selected to be reviewed in depth by the study team. Projects are identified serially beginning with the lowest number for District 12. The tables show the projects aggregated by Districts. Project identification numbers suffixed with the letter "A" are those projects considered as being developed in-house. Project identification numbers without the suffix are considered to have been developed with significant assistance from private consultants. The consultants' names are shown with these projects.

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 12

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
1	Harris County, Control 3245-2-28, Beltway 8: From East of Drummet to 0.2 Mile West of US 59	Brown & Root Development, Inc.	45-84PS5010 ($459,750.00)	12-30-83 (01-31-85)	PS&E	High	Major Urban Freeway
1A	COMPARATIVE PROJECT (STATE DESIGN) Harris County, Control 3256-2-13, Project C 3256-2-13, Beltway 8: From IH 45 (N) to Drummet Blvd.	SDH&PT District 3 Wichita Falls			PS&E	High	Major Urban Fwy. Let 8-82 $ 21,665,246.72
2	Brazoria County, Control 598-2-13, Project F 318(29), SH 288 - Interchanges at McHard Rd. and FM 518	Lockwood, Andrews & Newnam, Inc.	45-84PS5012 ($263,520.00)	01-10-84 (08-31-84)	PS&E (Bridge)	Med.	Diamond Interchange
2A	COMPARATIVE PROJECT (STATE DESIGN) Brazoria County, Control 598-2-13, Project F 318(29), SH 288 - Interchanges at McHard Rd. and FM 518	SDH&PT District 12			PS&E (Bridge)	Med.	Diamond Interchange
3	Harris & Montgomery Counties, Control 177-5-53, Project F 514(74), US 59: From Canal St. in Houston to Liberty Co. Line; and Liberty Co., Control 177-3-63, Project F 426(20), US 59: From Montgomery C/L to the Cleveland Bypass, 4.1 Miles N. of Montgomery C/L.	Howard Needles Tammen & Bergendoff	45-84PS5019 ($1,421,500.00) (New Cont. # 124XXP5005)	03-01-84	(Schematic Plan and Environmental Reports)	High	High Traffic Volume Urban Freeway Expansion
3A	COMPARATIVE PROJECT (STATE DESIGN) Harris County, Project I45-1(174)033, Controls 500-3-295, Etc., IH 45: From Dowling St. to Choate Rd.	SDH&PT H. U. Office			Preliminary Engineering	High	$ 75,000,000.00 EST., High Traf. Vol. Urban Fwy. Exp.

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 12

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
4	Harris County, Control 3256-01-035, Project C3256-1-35, Beltway 8 - IH 45(S) to IH 225 NS 59(S) to IH 10 (W)	Damico-Zajicek & Associates, Inc.	45-84PS5032 ($459,991.00)	05-30-84 (12-31-85)	Environmental Study	Med.	
4A	COMPARATIVE PROJECT (STATE DESIGN) Harris County, Controls 28-2-54 & 55, US 90: From IH 10 to Beltway 8	SDH&PT District 12			Environmental Study	Med.	
5	Harris County, Control 1685-3-40, FM 1960: From 0.3 mi. West of Lake Houston to 0.4 mi. East of Lake Houston	Fowler & Assoc., Inc. (dba Fowler & Munger Consulting Engineers)	12-545P5011 ($22,638.02)	03-22-85 (06-30-85)	Preliminary Study	High	Bridge Evaluation
5A	COMPARATIVE PROJECT (STATE DESIGN) Galveston County, Control 500-1-78, Project ID 45-1(162)003, IH 45, at Galveston Bay Causeway (EB Rdwy.)	SDH&PT D-5			Preliminary Study	High	Bridge Evaluation Let 8-79
12	Harris County, SH 146, F 839(17): From SH 225 to Loop 201, Ship Channel Crossing, Control 389-12-52	1. Figg and Muller Engineers 2. Grainer Engr.	12-545P5047 ($1,376,151) 12-545P5048 ($1,376,600)		PS&E Bridge Design	High	Bridge Design Complex Est. Cost $107,261,000.00
12A	COMPARATIVE PROJECT (STATE DESIGN) Jefferson County, SH 87, BRF 654(14), Control 306-3-84, Neches River Br., PE 306,3-79, IPE 549	SDH&PT D-5	$110,338.17 PE		PS&E Bridge Design	High	Bridge Design Complex Est. Cost $ 22,789,034.00

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 14

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
6	Hays County, PE: IH 35 to W. Control 1539-01-003, PD 8/03, Project RS 1392(1)A, FM 1626: From Junction of FM 1626 & FM 967 to FM 2770	ARE, Inc.	14-545P5010 ($214,655.33)	10-24-8 04-87	PS&E	Low	Rural, New 2-Lane Roadway $ 2,240,000.00
6A	COMPARATIVE PROJECT (STATE DESIGN) Williamson County, FM 3406: From IH 35 to 2.1 Mi. SW. 1378-6-2 RS 3469(1) A 1378-6-3 RSG 3469(2)	SDH&PT District 14		09/80	PS&E	Low	Rural, New 2-Lane Roadway $ 2,290,225.00
7	Low CSJ 19-9-69 Hays County, FM 1631 Marble Falls, Loop 82: From IH 35 to Bugg Lane 16-9-19 M P472(1)	Page Southerland & Page	14-545P5009 ($73,899.00)	11-19-84 08/87	PS&E	Med.	Existing 2-Ln. Rural to 4-Ln. Urban Street $ 981,000.00
7A	COMPARATIVE PROJECT (STATE DESIGN) Burnet County, FM 1431: From Marble Falls W.C.L. to US 281 Construction CSR 1378-4-19 PE 1378-4-20, IPE 547	SDH&PT District 14	PE $72,281.06	08/84	PS&E	Med.	Existing 2-Ln. Rural to 4-Ln. Urban Street $ 1,351,155.00
8	Travis County, 183 Springdale Rd., Control 265-1-66, F 1068(27) SH 71: Proposed Grade Separation for Avenue "F" at Bergstrom AFB	Turner Collie & Braden, Inc.	14-545P5012 ($271,657.69)	11-26-84	PS&E	Med.	Diamond Interchange at Major Street Crossings $ 3,500,000.00
8A	COMPARATIVE PROJECT (STATE DESIGN) Travis County, US 183 Springdale Road I/C PE 151-9-23, IPE 447 Construction 151-9-26, EACF 1068(24)	SDH&PT District 14 & D-5	PE $259,751.36		PS&E	Med.	Diamond Interchange at Major Street Crossings $ 3,410,160.00

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 14

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
9	Travis County, Controls 113-8-37, 113-9-30 & 113-13-65, US 290/SH 71: From RM 1836 West of Oak Hill, East to US 183, 113-9-36, 113-9-37	Lockwood, Andrews, & Newnam, Inc.	14-545P5015 ($1,870,022.89)	05-16-85	Preliminary Engineering	High	Major Urban Freeway Expansion
9A	COMPARATIVE PROJECT (STATE DESIGN) Travis County, IH 35: From Colorado River to Ben White Blvd., PE 15-13-156, EACI 35-3(97)231, IPE 502 CN = 15-13-158, IR 35-3(106)232, IPE 502 CN = 15-13-162, Add 2 Main Lanes & CTB CN = 15-13-176, IR 35-3(141)233, IPE 502	SDH&PT District 14	PE $1,410,000.00 obligated PE $ 559,808.00 spent	01-82 03-88 03-85	Preliminary Engineering	High	Major Urban Freeway Expansion
10	Travis County, MoPac - US 183 LP1: From Steck Avenue to US 183, 3136-1-39 F 1124(25)	Howard, Needles, Trammen, & Bergentorf	14-545P5001 ($1,577,045.00)	10-29-84	PS&E	High	Urban Freeway Expansion with Directional Interchange
10A	COMPARATIVE PROJECT (STATE DESIGN) Travis County, IH 35/US 290 I/C, 15-13-149, I35-3-(99)239 15-13-128, I35-3(83)239 (IPE 909)	SDH&PT District 14 & D-5		Ph.II 06-88 Ph.I 07-76	PS&E	High	Urban Freeway Expansion with Directional Interchange

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 15

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
13	Bexar County, Control 2452-3-27, Project RS 2359(19), Loop 1604: From Bulverde Rd. to 0.2 Mi. W. of MPRR	W.E. Simpson, Inc.	15-44SP5001 ($48,955.00)	07-12-84 (11-30-84)	PS&E	Med.	Prestressed I-beam Grade Separation Structures
13A	COMPARATIVE PROJECT (STATE DESIGN) Bexar Co., SH 151, Control 3508-1-1, N.W. Freeway: From I 410 to US 90	SDH&PT (D-5)			PS&E	Med.	Prestressed I-beam Grade Separation Structures
14	Bexar County, Controls 2452-2-22, Etc., Projects RS 2359(24), Etc., Loop 1604: From 0.3 Mi. W. of T & No RR to Blanco Rd.	Lockwood, Andrews & Newnam, Inc.	15-445P5003 ($51,705.00)	07-12-84 (08-31-84)	PS&E Structures	Med.	Prestressed I-beam Grade Separation Structures
14A	COMPARATIVE PROJECT (STATE DESIGN) Bexar County, Control 2452-3-37, Loop 1604: From 0.2 Mi. W. of MP RR to 0.5 Mi. W. of IH 35	SDH&PT District 15			PS&E Structures	Med.	Prestressed I-beam Grade Separation Structures
15	Bexar County, Controls 2452-2-28, Etc., Project M A-M Q159(2), Etc., Loop 1604: Fr. Blanco Rd. to Bulverde Rd. & Incl. Salado Cr. in San Antonio	Howard Needles Tammen & Bergendoff	15-445P5002 ($174,300.00)	07-13-84 (01-31-85)	PS&E Structures	Med.	Prestressed I-beam Grade Separation Structures
15A	COMPARATIVE PROJECT (STATE DESIGN) Bexar Co., SH 151, Control 3508-1-5, at Military Dr., at Westover Hills Blvd. and at Wiseman Blvd.	SDH&PT (D-5)			PS&E	Med.	Prestressed I-beam Grade Separation Structures

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 16

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
16	Jim Wells Co., Control PE 255-01-043 US 281: From 1.4 Miles South of SH 141 to FM 716 North of Premont CN = 255-1-48, MAF 429(32), let 9/85	Turner Collie & Braden, Inc. and Coym & Rehmet (Joint Venture)	16-545P5002 ($290,175.00)	11-12-84 (05-17-85)	PS&E Only ROW & Schematics	Low	2-Ln. Conv. to 4-Ln. Divided $ 8,745,028.00
16A	COMPARATIVE PROJECT (STATE DESIGN) SH 44 & 359 (Jim Wells), PE 86-11-26 Duval C/L to Alic, IPE 162, CN = 86-11-27, MAF 424(31), let 7/83	SDH&PT District 16	$198,681.69	04/83	PS&E	Low	2-Ln. Conv. to 4-Ln. Divided $ 4,177,471.40
17	Refugio County, Control 371-03-80, Project F 1100(10), US 77: From Aransas River, N. to FM 1360 in Woodsboro (PD 8131 & PE 373-3-79, IPE 343) let 12/85	Maverick Engineering Co.	16-545P5003 ($253,042.00) Expired 7-29-85 (Completion of authorized work under Contract No. 16545P5012 which was completed 8-31-85) $689,000.00 obligated for PE	01-07-85	PS&E	Low	2-Ln. Conv. to 4-Ln. Divided $ 11,482,000.00
17A	COMPARATIVE PROJECT (STATE DESIGN) San Patricio & Refugio Counties, US 77: From Aransas River to Sinton PE 371-3-77, IPE 344 CN = 371-4-32, EACF 1100(9) From Aransas River to 2.9 Mi. N.E. of Sinton CN = 371-4-34, F 1100(11) From 2.9 Mi. N.E. of Sinton to Sinton (E. End of Chiltipin Creek Br.)	SDH&PT District 16	$110,946.29 PE $407,500.00 obligated 02-89 107,210.00 spent 4-25-86	03-81	PS&E	Low	2-Ln. Conv. to 4-Ln. Divided $ 3,590,265.00 $ 7,697,800.00

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 18

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
18	Dallas County, Control 47-7-12, Project MA-F-515(37), US 75: From IH 635 to N. of Belt Line Road	Howard Needles Tammen & Bergendoff	45-84PS5001 ($1,218,120.00)	09-23-83	PS&E	High	Widening and upgrading Urban Freeway $ 54,015,413.00
18A	COMPARATIVE PROJECT (STATE DESIGN) Dallas County, US 183 - SH 356, Control 94-3-53, Project F 634(31), US 183: From West of Belt Line to East of Belt Line	SDH&PT District 18		03-83	PS&E	High	Major Urban Freeway Reconstruction $ 19,047,127.00
19	Dallas County, MH 72 (Skillman Ave.) Fr. Abrams Rd. to Merriman Parkway Control 8090-18-4, Project M 5090(5)	Hunter Associates Inc.	18-445P5016 ($26,704.00)4F	07-19-84	PS&E	Med.	$ 2,850,00.00 (Estimate)
19A	COMPARATIVE PROJECT (STATE DESIGN) Dallas County, Control 8076-18-2, Project M 5076(2), MH 419 (Valley View Lane): From IH 635 to 0.3 Mi. East of Elm Fork Trinity River	SDH&PT District 18		01-82	PS&E	Med.	$ 5,241,082.00
20	Dallas County, Control 48-1-28, Project M 5182(2), SH 342 (Corinth St.): From Morell Ave. to Illinois Ave. in Dallas	Turner Collie & Braden			PS&E	High	6-Ln Div. Urban Thoroughfare $ 6,388,429.00
20A	COMPARATIVE PROJECT (STATE DESIGN) Collin County, Control 91-5-24, Project M 5009(2), SH 289: From SH 190 to Dallas County Line	SDH&PT (D-8G)		04-85	PS&E	High	6-Ln Urban Thoroughfare $ 7,540,094.00

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 20

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
21	Liberty County, Control 593-1, Texas F 839(), SH 321 - SPT RR Crossing in Dayton, Texas	Lockwood, Andrews & Newnam, Inc.	45-84PS5004 ($268,200.00)	11-18-83 (08-31-85)	PS&E	Med.	RR Underpass
21A	COMPARATIVE PROJECT (STATE DESIGN) Jefferson County, Control 307-1-95, SH 87	SDH&PT District 20			PS&E	Med.	RR Underpass
22	Jefferson County, Control 28-7-43, Project F 312(10), US 90: From near Amelia (FM 364) East to IH 10	Mark W. Whitely, P.E., Inc.	20-545P5004 ($354,895.00)	01-24-85 (09-30-85)	PS&E	Med.	4-Ln Div. Urban Street to 6-Ln with CLT & C&G
22A	COMPARATIVE PROJECT (STATE DESIGN) Jefferson County, Control 8025-20-1, MH 220	SDH&PT District 20			PS&E	Med.	2-Ln Street to 4-Ln with CLT & C&G
23	Jefferson County, Control 667-2-45, Project M V236(3), FM 366 in Port Neches: From Nederland Avenue to Spurs 136	Chas. R. Haile Associates, Inc. (dba CRH Assoc., Inc.	20-545P5008 ($339,025.60)	02-15-85	PS&E	Med.	Urban Street Upgrade
23A	COMPARATIVE PROJECT (STATE DESIGN) Orange County, Controls 710-2-39 & 28-9-85, FM 105	SDH&PT District 20			PS&E	Med.	Urban Street Upgrade
24	Chambers County, Control 389-2-36, Project MA-F 839(15), SH 146: From IH 10 North to Liberty Co. Line	Brinkley & Holmes, Inc.	20-545P5012 ($326,870.00)	04-16-85 (12-31-85)	PS&E	Low	Rural 4-Ln with CLT
24A	COMPARATIVE PROJECT (STATE DESIGN) Jefferson County, Control 932-1-58, FM 365	SDH&PT District 20			PS&E	Low	Rural 4-Ln with CLT

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 24

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
25	El Paso County, Control 2552-4-12, Project M XO27(6), Loop 375 (Border Highway) - Interchange at Juarez Avenue in El Paso	Sub-Land, Inc.	45-84PS5023 ($101,739.05)	03-01-84 (03-31-85)	PS&E	Med.	Construct Interchange Urban Area
25A	COMPARATIVE PROJECT (STATE DESIGN) El Paso County, Control 2552-4-8, Project M XO27(2), Lp 375 Interchange at Midway Drive in El Paso	SDH&PT District 24		10-77	PS&E	Med.	Construct Interchange Urban Area $ 1,153,677.00
25B	COMPARATIVE PROJECT (STATE DESIGN) El Paso County, Control 2552-4-10, Project M XO27(4), Lp 375 Interchange at Yarbrough Drive in El Paso	SDH&PT District 24		06-83	PS&E	Med.	Construct Interchange Urban Area $ 1,495,000.00
26	El Paso County, Control 2121-2 & 3, Project IR 10-1(187)023, IH 10: Fr. Chelsea St. to Ft. Bliss RR Spur O'Pass in El Paso	Parkhill, Smith & Cooper, Inc.	24-445P5001 ($1,334,648.00)	06-20-84	PS&E	High	Widen & Upgrade Urban Freeway
26A	COMPARATIVE PROJECT (STATE DESIGN) El Paso County, Control 2121-3-83, Project IR 10-1(189)028, IH 10: From 0.2 Mi. W. of McRae Blvd. to 0.5 Mi. E. of Lomaland Dr. in El Paso	SDH&PT District 24		07-84	PS&E	High	Widen & Upgrade Urban Freeway $ 3,600,000.00

CONTRACTS FOR CONSULTANT SERVICES

DISTRICT 24

	DESCRIPTION CO., CONT., ETC.	CONSULTANT FIRMS	CONTRACT # & AMT.	DATE APPROVED (COMPLETED)	CONSULTANT WORK/TYPE	COMPLEXITY	CONSTRUCTION WORK/TYPE & EST. COST
27	El Paso County, Control 2121-3-86, Project IR 10-1(188)025, IH 10: From Ft. Bliss RR Spur O'Pass (Near Airways Blvd) to McRae Blvd. in El Paso	Lockwood, Andrews & Newnam, Inc.	24-445P5002 ($981,907.00)	06-20-84	PS&E	High	Widen & Upgrade Urban Freeway
27A	COMPARATIVE PROJECT (STATE DESIGN) El Paso County, Control 2121-3-83, Project IR 10-1(189)028, IH 10: From 0.2 Mi. W. of McRae Blvd. to 0.5 Mi. E. of Lomaland Dr. in El Paso	SDH&PT District 24		07-84	PS&E	High	Widen & Upgrade Urban Freeway $ 3,600,000.00

Appendix B — Basic Data on Selected Projects

Appendix B is a reference table showing basic, unrefined data on the projects selected for study. The information presented here was generally derived from the responses to the district questionnaires. However, in cases where information was missing or inconsistent, refererence was made to other available sources; these included project ledgers, DCIS forms, contracts, etc. Much of the information remained unavailable, as is shown in this Appendix. Below is an explanation of the items on the table:

1). The I.D. number assigned to projects by the study team.
2). The primary control-section-job number assigned to projects by the Department. Most projects have more than one CSJ number.
3). The district that handled the project.
4). The county in which the project was located.
5). The total amount of direct (1xx) charges that were payments to consultants for P.C.E. work on a project . For in-house projects this number will, of course, be zero.
6). The total amount of direct (1xx) charges to a project by the Department for in-house P.C.E. work, which is equal to total P.C.E. direct expenses less the amount paid to consultants in 5).
7). The total direct P.C.E. cost for a project, equalling the sum of 5). and 6).
8). Based on district estimates, the amount of indirect costs incurred at the district level to administer a consultant project. For in-house projects this number will be zero.
9). The amount spent on construction of a project; for projects not yet completed (as denoted by an asterisk), this number is an estimate.
10). The date that P.C.E. for the project was started.
11). The date P.C.E. was completed ("n/c" stands for "not completed").
12). The number of original plan sheets drafted for a project (estimated for incomplete projects).
13). The total number of plan sheets for a project, including standard plan sheets.

Appendix B

BASIC COST DATA - SELECTED PROJECTS (*Indicate projects for which some costs were updated during course of study)

PROJECT IDENTIFICATION				PROJECT COSTS (1,000'S)					PROJECT CHARACTERISTICS			
ID # 1).	CSJ # 2).	DIST. 3).	COUNTY 4).	CONTRACT PCE 5).	STATE PCE 6).	TOTAL 7). =(5+6)	ADMIN. EST. 8).	CONST. 9).	START 10).	COMP. 11).	O. PLANS 12).	T. PLANS 13).
1*	3256-02-26	12	HARRIS	$504	117	621	$2	$13,704	9/84	n/c	99	237
1-A*	3256-02-013	12	HARRIS	$0	$332	$332	$0	$24,665	6/81	5/82	n/a	400
2	598-02-013	12	BRAZORIA	$264	$73	$337	$2	$11,500	2/84	n/c	62	115
2-A	598-02-013	12	BRAZORIA	$0	$336	$336	$0	$5,293	n/a	n/a	n/a	n/a
5	1685-03-091	12	HARRIS	$554	$27	$581	$2	$22,940	10/85	11/86	98	98
5-A	500-01-078	17	GALVESTON	$0	$161	$161	$0	$16,238	n/a	n/a	34	34
6*	1539-01-003	14	HAYS	$415	$2	$417	$5	$4,000	11/84	n/c	100	130
6-A*	1378-06-003	14	WILLIAMSON	$0	$64	$64	$0	$955	9/77	6/80	37	56
7*	0016-09-019	14	HAYS	$74	n/a	n/a	$8	$981	12/84	n/c	100	135
7-A*	1378-04-020	14	BURNET	$0	$72	$72	$0	$1,302	9/83	11/84	54	74
8*	0265-01-066	14	TRAVIS	$308	$12	$320	$6	$5,121	12/84	n/c	100	146
8-A*	0151-09-023	14	TRAVIS	$0	$260	$260	$0	$3,213	8/75	3/81	123	158
10*	3136-01-039	14	TRAVIS	$1,566	$323	$1,889	$10	$40,000	11/84	n/c	650	680
10-A*	15-13-128	14	TRAVIS	$0	$666	$666	$0	$35,100	?/73	4/76	400	433
12	389-12-052	12	HARRIS	$3,550	$119	$3,669	$3	$43,300	6/85	6/86	690	690
12-A	306-03-084	12	JEFFERSON	$0	n/a	n/a	$0	$22,789	3/83	10/83	163	198
16*	0255-01-043	16	JIM WELLS	$273	$118	$391	$17	$10,715	11/84	5/85	76	112
16-A*	0086-11-026	16	JIM WELLS	$0	$199	$199	$0	$3,956	9/82	3/83	67	113
17*	0371-03-080	16	REFUGIO	$253	$51	$304	$18	$9,126	1/85	9/85	71	132
17-A*	0371-03-077	16	REF./S.PAT.	$0	$111	$111	$0	$3,590	8/80	4/81	51	87
18*	0047-07-112	18	DALLAS	$1,226	$96	$1,322	$3	$39,834	10/83	10/85	343	472
18-A*	0094-03-052	18	DALLAS	$0	$423	$423	$0	$16,191	1/81	6/83	206	239
19*	8090-18-004	18	DALLAS	$179	$22	$201	$0	$2,850	10/80	11/86	50	75
19-A	8076-18-002	18	DALLAS	$0	$126	$126	$0	$3,200	9/78	10/81	79	118

				Appendix B (cont'd.)								
				PROJECT COSTS (1,000'S)					PROJECT CHARACTERISTICS			
ID #	CSJ # 2).	DIST. 3).	COUNTY 4).	CONTRACT PCE 5).	STATE PCE 6).	TOTAL 7). =(5+6)	ADMIN. EST. 8).	CONST. 9).	START 10).	COMP. 11).	O. PLANS 12).	T. PLANS 13).
20*	0048-01-027	18	DALLAS	$304	$51	$355	$3	$5,676	4/78	4/83	126	148
20-A*	0091-05-024	18	COLLIN	$0	$158	$158	$0	$0	1/83	7/85	77	115
21*	0593-01-071	20	LIBERTY	$268	$15	$283	$4	$4,042	11/83	1/86	66	103
21-A*	0307-01-095	20	JEFFERSON	$0	$40	$40	$0	$580	n/a	n/a	40	55
22*	0028-07-043	20	JEFFERSON	$252	$43	$295	$5	$12,215	12/85	n/c	70	117
22-A*	8025-20-001	20	JEFFERSON	$0	$137	$137	$0	$2,812	12/76	2/77	37	46
23*	0667-02-045	20	JEFFERSON	$327	$9	$336	$3	$4,500	3/85	7/86	94	125
23-A*	0710-02-036	20	ORANGE	$0	$98	$98	$0	$2,847	n/a	5/83	38	59
24*	0389-02-036	20	CHAMBERS	$308	$12	$320	$6	$8,475	n/a	n/a	75	123
24-A*	0932-01-052	20	JEFFERSON	$0	$74	$74	$0	$1,569	4/81	4/83	31	55
25*	2552-04-012	24	EL PASO	$102	$37	$139	$26	$2,803	3/84	2/85	46	107
25-A*	2552-04-008	24	EL PASO	$0	$36	$36	$0	$1,154	3/77	10/77	32	61
25-B*	2552-04-013	24	EL PASO	$0	$41	$41	$0	$1,495	7/79	2/81	33	58
26*	2121-02-067	24	EL PASO	$1,403	$70	$1,473	$55	$16,765	9/84	6/86	288	350
26-A*	2121-03-083	24	EL PASO	$0	$142	$142	$0	$3,600	11/83	7/84	66	92
27	2121-03-086	24	EL PASO	$982	$20	$1,002	$13	$25,400	9/84	11/85	242	311
27-A	2121-03-083	24	EL PASO	$0	$72	$72	$0	$3,200	11/83	7/84	66	92

Appendix C — Estimates of Indirect P.C.E. Costs for Selected SDHPT Districts in 1985

Appendix C shows the estimated amount of indirect, or support, costs associated with P.C.E. direct costs in fiscal year 1985 for Divisions 3 - 20. The amounts for each division are estimates derived from our interviews with division personnel. These amounts were totalled and expressed as a percentage of total P.C.E. expenditures for the year. This percentage can thus be used to estimate an appropriate additive to a particular project's P.C.E. costs to reflect indirect costs incurred at the divisional level for that project. Below is an explanation of the items in each column:

1). The division number.

2). The total expenditures of the division for FY1985, as reported in the Budget Monitoring Report for that year.

3). The total operating expenditures for FY1985, which are equal to 2). less any direct payments of funds (such as payments to contractors and grants to other organizations) that do not reflect directly on a division's level of activity. These amounts thus amount mainly to personnel costs.

4). The total of expenditures by a division under Activity Codes 301 (Construction Management) and 302 (Pre-construction and Construction Engineering).

5). The total amount estimated to have been spent by each division in support of in-house PCE.

6). The total amount estimated to have been spent by each division in support of PCE by consultants.

7). A description of how each of the amounts listed in 5). and 6). were derived.

Sources: The information in 2), 3), and 4) is from FY 1985 Budget Monitoring Reports provided by D-3. The estimates are based on interviews at the divisions in question. The total

amount of PCE spending was taken from D-3's report of total 1XX charges for FY 1985; the amount from this total spent for consultants was taken from the table "Professional Fees and Services," Schedule 3 of the State Department of Highways and Public Transportation Annual Financial Report for the fiscal year ended August 31, 1985 (pp. 70-77). The latter amount was subtracted from the former to get the total PCE spending in-house for FY 1985.

APPENDIX C
ALLOCATION BY FUNCTION

Division Indirect PCE Costs
Summary Table

1). DIV.	FY 1985 2). Tot. Exp.	3). Op. Exp.	4). 301+302	Est. Indirect Exp. for PCE 5). In-House	6). Consultant	7). Explanation
	(in thousands of dollars)					
D-3	$2,210	$2,210	$350	$120	$70	8.6% of Op. Budget to PCE; 0.37 to consult.
D-4	$89,642	$7,124	$5,938	$613	$0	8.6% of Op. Budget to in-house.
D-5	$2,556	$2,556	$2,510	$1,423	$836	90% of 301-302 charges, 0.37 to consult.
D-6	$966	$966	$966	$10	$0	1% of Op. Budget to in-house.
D-7	$0	$0	$0	$0	$0	No PCE support.
D-8	$3,368	$3,368	$3,207	$1,818	$1,068	90% of 301-302 costs, 0.37 to consult.
D-9	$5,515	$5,515	$5,510	$17	$10	0.5% of Op. Budget to PCE, .37 to consult.
D-10	$23,326	$5,110	$0	$4,964	$2,916	D-10 estimate, .37 to consult.
D-12	$29,030	$29,030	$0	$0	$0	No PCE support.
D-13	$1,250	$1,250	$0	$108	$0	8.6% of Op. Budget, non to consult.
D-15	$61,510	1676.1	$1,624	$11	$6	1% of Op. Budget, .37 to consult.
D-16	$5,897	$5,897	$0	$0	$0	No PCE support.
D-18	$19,804	$7,711	$609	$345	$203	90% of 301-302 costs, .37 to consult.
D-19	$14,093	$14,093	$2,986	$10,600	$0	D-19 estimate, negligible support to consult.
D-20	$4,553	$4,553	$0	$0	$0	No PCE support.
Totals:	**$263,720**	**$91,060**	**$23,699**	**$20,028**	**$5,109**	**A**
				$27,038	**$6,897**	**B (A plus 35%)**
TOTAL FY85 PCE COSTS (IN-HOUSE AND CONSULTANT):				**$40,523**	**$25,727**	**C**
				49.42%	**19.86%**	**A/C**
INDIRECT/DIRECT COST RATIO:				**66.72%**	**26.81%**	**B/C**

Appendix D — Estimates of Direct P.C.E. Costs for Selected SDHPT Districts in 1985

The following tables outline the estimations of indirect P.C.E. costs for the districts visited by the study team. The sources for the expenditure figures are the Segment 71 functional ledgers, which detail expenditures for general operations, etc. For each detail account in the ledger, an appropriate percentage was taken, based on interviews with district personnel. These percentages, when applied to the actual detail account expenditures, provide an estimate of estimate of actual P.C.E. indirect costs made by the districts in FY 1985. The total of indirect P.C.E. costs (allocated to consultant and in-house project support), when divided by the district's total P.C.E. direct costs for consultant and in-house projects (reproted as 1xx charges) for the same time period, is the district's indirect P.C.E. cost ratio. This ratio can then be applied to the direct P.C.E. costs of individual projects as part of a multiplier. Below is an explanation of the numbered items in the tables:

1). Detail numbers for each account in listed in the districts' Segment 71 ledger.

2). Descriptive titles for each account.

3). The total expenditures in FY 1985 for respective accounts.

4). The percentage of 3). that supports all P.C.E., whether consultant or in-house.

5). The product of 4). and 3).

6). The amount of 5). that supported in-house projects.

7). The amount of 5). that supported consultant projects.

DISTRICT 12

1). Detail	2). Description	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$0	0%	$0	$0	$0
302	WAREHOUSE STOCK	$4	0%	$0	$0	$0
304	WAREHOUSE STOCK	$0	0%	$0	$0	$0
305	WAREHOUSE STOCK	$64	0%	$0	$0	$0
306	WAREHOUSE STOCK	$8	0%	$0	$0	$0
307	WAREHOUSE STOCK	$5	0%	$0	$0	$0
308	WAREHOUSE STOCK	$0	0%	$0	$0	$0
309	WAREHOUSE STOCK	$4	0%	$0	$0	$0
310	WAREHOUSE STOCK	$4	0%	$0	$0	$0
311	WAREHOUSE STOCK	$0	0%	$0	$0	$0
312	WAREHOUSE STOCK	$140	0%	$0	$0	$0
313	WAREHOUSE STOCK	$1	0%	$0	$0	$0
329	WAREHOUSE STOCK	$23	0%	$0	$0	$0
330	WAREHOUSE STOCK	$3	0%	$0	$0	$0
333	WAREHOUSE STOCK	$0	0%	$0	$0	$0
336	WAREHOUSE STOCK	$0	0%	$0	$0	$0
338	WAREHOUSE STOCK	$0	0%	$0	$0	$0
339	WAREHOUSE STOCK	$0	0%	$0	$0	$0
340	WAREHOUSE STOCK	$54	0%	$0	$0	$0
341	WAREHOUSE STOCK	$0	0%	$0	$0	$0
342	WAREHOUSE STOCK	$0	0%	$0	$0	$0
343	WAREHOUSE STOCK	$3	0%	$0	$0	$0
399	WAREHOUSE STOCK	$84	0%	$0	$0	$0
1710	DISTRICT ADMINISTRATIVE OPERATIONS	$671	14%	$94	$37	$57
1720	DISTRICT ACCOUNTING	$457	14%	$64	$25	$39
1725	PERSONNEL	$112	14%	$16	$16	$0
1730	DISTRICT WAREHOUSING	$668	14%	$94	$94	$0
1740	DISTRICT DESIGN MANAGEMENT	$858	100%	$858	$335	$524
1741	CENTRAL DESIGN SECTION	$653	100%	$653	$255	$398
1742	CONTRACT SECTION	$45	35%	$16	$6	$16
1743	SYSTEMS PLANNING DESIGN	$48	100%	$48	$19	$29
1745	ADVANCED PLANNING	$76	100%	$76	$29	$46
1750	DISTRICT CONSTRUCTION MANAGEMENT	$208	0%	$0	$0	$0
1755	FUNC-ACCUM 1755 NOT ON TACS TFIN006	$152	0%	$0	$0	$0
1760	DISTRICT ROW MANAGEMENT	$202	0%	$0	$0	$0
1770	DISTRICT MAINTENANCE MANAGEMENT	$813	0%	$0	$0	$0
1775	DISTRICT TRAFFIC MANAGEMENT	$367	14%	$51	$20	$31
1777	COURTESY PATROL	$0	0%	$0	$0	$0
1780	TORT CLAIM COSTS	$30	14%	$4	$2	$3
1810	INVENTORY ADJUSTMENT	$105	0%	$0	$0	$0
1820	UNDISTRIBUTED ENGINEER. COST-MAINT.	$39	0%	$0	$0	$0
1825	UNDISTRIBUTABLE DISTRICT LAB COSTS	$112	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING & PROTECTION	$247	20%	$49	$49	$0
1840	MINOR REPAIRS TO ALL DISTRICT BLDGS	$456	20%	$91	$91	$0
1851	RADIO COMMUNICATIONS MAINTENANCE	$80	14%	$11	$11	$0
1852	ADDTN. MOBILE EQUIPMENT	$63	14%	$9	$9	$0
1853	REPLACEMENT-EXIST. RADIO EQUIPMENT	$6	14%	$1	$1	$0
				(in 1,000's)		

1). Detail	2). Description	3). FY 1985 T. Exp.	Indirect PCE Breakdown 4). % Alloc.	5). $ Alloc.	6). SDHPT	7). Con.
1854	TRAFFIC OPERATIONS COSTS UNDIST.	$2,163	0%	$0	$0	$0
1860	SUPPLIES AND MISCELLANEOUS EXPENSE	$310	20%	$62	$62	$0
1861	SWITCHBOARD AND MAILROOM	$149	34%	$51	$51	$0
1865	DIST./URBAN TELECOMMUNICATION SERV.	$447	30%	$134	$134	$0
1866	REPRODUCTION SERVICES	$336	80%	$269	$269	$0
1872	RESEARCH-SPEC.-GENERAL MATERIALS	$9	0%	$0	$0	$0
1873	SPECIAL RESEARCH & INVEST. SOILS/SOUR.	$0	0%	$0	$0	$0
1875	RR GRADE PROTECTION DEVICE-PE500	$77	0%	$0	$0	$0
1876	INVEST./PLANS FOR HWY TRAFFIC SIG. LIGHT	$179	100%	$179	$70	$109
1910	EMPLOYEE TRAINING	$426	14%	$60	$60	$0
1911	EMPLOYEE TRAINING	$102	14%	$14	$14	$0
1920	ISSUANCE OF SIGN PERMITS	$72	0%	$0	$0	$0
1925	HB 1330 SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$0	0%	$0	$0	$0
1985	MANAGEMENT AUDIT FY 85	$0	14%	$0	$0	$0
2600	REIMBURS. COSTS DUE-OUTSIDE DEPT.	$27	0%	$0	$0	$0
2801	BAYTOWN TUNNEL	$918	0%	$0	$0	$0
2811	BOLIVAR FERRY	$5,368	0%	$0	$0	$0
4960	ISSUE PERMITS-OVERSIZE/OVERWEIGHT	$210	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$62	14%	$9	$3	$5
	TOTALS	**$17,721**		**$2,911**	**$1,660**	**$1,257**
	OFFTCE SPACE			$336	$336	$0
	EQUIPMENT DEPRECIATION			$240	$240	$0
	TOTAL INDIRECT PROJECT COST:			**$3,487**	**$2,236**	**$1,257**
	FY85 1XX ENPENDITURES			**$18,654**	**$7,265**	**$11,389**
	DISTRICT 12 INDIRECT PCE COST RATIOS:			**18.69%**	**30.78%**	**11.04%**
				(in 1,000's)		

DISTRICT 14

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$3	0%	$0	$0	$0
302	WAREHOUSE STOCK	$24	0%	$0	$0	$0
303	WAREHOUSE STOCK	$70	0%	$0	$0	$0
304	WAREHOUSE STOCK	$4	0%	$0	$0	$0
305	WAREHOUSE STOCK	$53	0%	$0	$0	$0
306	WAREHOUSE STOCK	$22	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$1	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$2	0%	$0	$0	$0
311	WAREHOUSE STOCK	$0	0%	$0	$0	$0
312	WAREHOUSE STOCK	$14	0%	$0	$0	$0
313	WAREHOUSE STOCK	$0	0%	$0	$0	$0
320	WAREHOUSE STOCK	$0	0%	$0	$0	$0
326	WAREHOUSE STOCK	$0	0%	$0	$0	$0
327	WAREHOUSE STOCK	$1	0%	$0	$0	$0
328	WAREHOUSE STOCK	$0	0%	$0	$0	$0
331	WAREHOUSE STOCK	$0	0%	$0	$0	$0
370	WAREHOUSE STOCK	$0	0%	$0	$0	$0
380	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$33	0%	$0	$0	$0
1710	DISTRICT ADMINISTRATIVE OPERATIONS	$366	17%	$62	$32	$30
1720	DISTRICT ACCOUNTING	$411	17%	$70	$36	$34
1730	DISTRICT WAREHOUSING	$366	17%	$62	$62	$0
1740	DISTRICT DESIGN MANAGEMENT	$220	100%	$220	$114	$106
1750	DISTRICT CONSTRUCTION MANAGEMENT	$98	0%	$0	$0	$0
1760	DISTRICT ROW MANAGEMENT	$107	0%	$0	$0	$0
1770	DISTRICT MAINTENANCE MANAGEMENT	$440	0%	$0	$0	$0
1775	DISTRICT TRAFFIC MANAGEMENT	$174	17%	$30	$15	$14
1780	TORT CLAIM COSTS	$0	17%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	$0	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINTENANCE	$28	0%	$0	$0	$0
1825	UNDISTRIBUTABLE DISTRICT LAB COSTS	$93	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING AND PROT.	$166	17%	$28	$28	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$111	17%	$19	$19	$0
1851	RADIO COMMUNICATIONS MAINTENANCE	$34	17%	$6	$6	$0
1852	ADDITIONAL MOBILE RADIO EQUIPMENT	$15	17%	$3	$3	$0
1853	REPLACEMENT -- EXISTING RADIO EQUIP.	$0	17%	$0	$0	$0
1854	TRAFFIC OPERATIONS COST -- UNDIST.	$209	0%	$0	$0	$0
1860	SUPPLIES AND MISCELLANEOUS EXPENSE	$170	17%	$29	$29	$0
1865	DIST./URBAN TELE COMM. SERVICE	$65	30%	$20	$20	$0
1866	REPRODUCTION SERVICES	$5	80%	$4	$4	$0
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
1872	RESEARCH -- SPEC. -- GEN. MATERIALS	$0	0%	$0	$0	$0
1873	SPEC. INVEST. — SOILS/SURFACES	$0	0%	$0	$0	$0
1875	RAILROAD GRADE PROTECTION DEVICE	$9	0%	$0	$0	$0
1876	INVEST./PLANS F/HWY. SIGNAL LIGHTS	$20	100%	$20	$10	$10
1910	EMPLOYEE TRAINING	$125	17%	$21	$21	$0
1911	EMPLOYEE TRAINING	$62	17%	$11	$11	$0
1920	ISSUANCE OF SIGN PERMITS	$23	0%	$0	$0	$0
1925	HB 1330 SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$33	0%	$0	$0	$0
1985	MANAGEMENT AUDIT -- FY85	$0	17%	$0	$0	$0
2600	REIMBURS. -- COSTS DUE OUTSIDE DEP.	$4	0%	$0	$0	$0
4960	ISSUE PERMITS OVERSIZE/OVERWEIGHT	$61	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$14	17%	$2	$1	$1
	TOTALS	**$3,656**		**$606**	**$412**	**$194**
	OFFICE SPACE			$141	$141	$0
	EQUIPMENT DEPRECIATION			$48	$48	$0
	TOTAL INDIRECT PROJECT COST			**$795**	**$601**	**$194**
	FY85 1XX EXPENDITURES			**$3,425**	**$1,791**	**$1,634**
	DISTRICT14 INDIRECT PCE COST RATIO:			**23.21%**	**33.55%**	**11.87%**
				(in 1,000's)		

DISTRICT 15

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$0	0%	$0	$0	$0
302	WAREHOUSE STOCK	$0	0%	$0	$0	$0
303	WAREHOUSE STOCK	$0	0%	$0	$0	$0
304	WAREHOUSE STOCK	$0	0%	$0	$0	$0
305	WAREHOUSE STOCK	$0	0%	$0	$0	$0
306	WAREHOUSE STOCK	$0	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$3	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$0	0%	$0	$0	$0
311	WAREHOUSE STOCK	$1	0%	$0	$0	$0
312	WAREHOUSE STOCK	$0	0%	$0	$0	$0
313	WAREHOUSE STOCK	$0	0%	$0	$0	$0
314	WAREHOUSE STOCK	$0	0%	$0	$0	$0
315	WAREHOUSE STOCK	$2	0%	$0	$0	$0
316	WAREHOUSE STOCK	$0	0%	$0	$0	$0
317	WAREHOUSE STOCK	$0	0%	$0	$0	$0
318	WAREHOUSE STOCK	$0	0%	$0	$0	$0
319	WAREHOUSE STOCK	$0	0%	$0	$0	$0
320	WAREHOUSE STOCK	$5	0%	$0	$0	$0
321	WAREHOUSE STOCK	$0	0%	$0	$0	$0
322	WAREHOUSE STOCK	$0	0%	$0	$0	$0
323	WAREHOUSE STOCK	$67	0%	$0	$0	$0
324	WAREHOUSE STOCK	$0	0%	$0	$0	$0
325	WAREHOUSE STOCK	$0	0%	$0	$0	$0
350	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$3	0%	$0	$0	$0
1710	DISTRICT ADMIN. OPERATIONS	$200	19%	$38	$28	$10
1720	DISTRICT ACCOUNTINS	$431	19%	$82	$61	$21
1730	DISTRICT WAREHOUSING	$332	19%	$63	$63	$0
1740	DISTRICT DESIGN MANAGEMENT	$283	100%	$283	$209	$74
1750	DISTRICT CONSTRUCTION MANAGEMENT	$128	0%	$0	$0	$0
1760	DISTRICT ROW MANAGEMENT	$117	0%	$0	$0	$0
1770	DISTRICT MAINTENANCE MANAGEMENT	$347	0%	$0	$0	$0
1775	DISTRICT TRAFFIC MANAGEMENT	$202	19%	$38	$28	$10
1777	COURTESY PATROL	$0	0%	$0	$0	$0
1780	TORT CLAIM COSTS	$0	19%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	$0	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINT.	$6	0%	$0	$0	$0
1825	UNDIST. DISTRICT LAB COSTS	$140	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING AND PROT.	$91	19%	$17	$17	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$311	19%	$59	$59	$0
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
1851	RADIO COMMUNICATIONS MAINTENANCE	$152	19%	$29	$29	$0
1852	ADDITIONAL MOBILE RADIO EQUIPMENT	$70	19%	$13	$13	$0
1853	REPLACEMENT -- EXIST. RADIO EQUIP.	$32	19%	$6	$6	$0
1854	TRAFFIC OPERATIONS COST UNDIST.	$109	0%	$0	$0	$0
1860	SUPPLIES AND MISCELLANEOUS EXP.	$265	19%	$50	$50	$0
1865	DIST./URBAN TELECOMM. SERV.	$166	30%	$50	$50	$0
1866	REPRODUCTION SERVICES	$113	80%	$90	$90	$0
1872	RES. -- SPEC. -- GENERAL SERVICES	$186	0%	$0	$0	$0
1873	RES, & INVEST., SOILS/SOURCES	$0	0%	$0	$0	$0
1875	RAILROAD GRADE PROTECTION DEVICE	$0	0%	$0	$0	$0
1876	INVEST./PLANS FOR HWY. TRAFFIC SIG.	$0	100%	$0	$0	$0
1910	EMPLOYEE TRAINING	$384	19%	$73	$73	$0
1911	EMPLOYEE TRAINING	$212	19%	$40	$40	$0
1920	ISSUANCE OF SIGN PERMITS	$44	0%	$0	$0	$0
1925	HB 1330 SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$1	0%	$0	$0	$0
1935	MANAGEMENT AUDIT F1785	$0	19%	$0	$0	$0
2600	REIMBURS. COSTS DUE -- OUTSIDE DEPART.	$3	0%	$0	$0	$0
4960	ISSUE PERMITS -- OVERSIZE/OVERWEIGHT	$165	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$36	19%	$7	$5	$2
	TOTALS	**$4,607**		**$940**	**$823**	**$116**
	OFFICE SPACE			$331	$331	$0
	EQUIPMENT DEPRECIATION			$60	$60	$0
	TOTAL INDIRECT PROJECT COST			**$1,331**	**$1,214**	**$116**
	FY 85 1XX EXPENDITURES			**$6,720**	**$5,006**	**$1,714**
	DISTRICT 15 INDIRECT PCE COST RATIOS:			**19.80%**	**24.25%**	**6.79%**
				(in 1,000'S)		

DISTRICT 16

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
304	WAREHOUSE STOCK	$0	0%	$0	$0	$0
305	WAREHOUSE STOCK	$0	0%	$0	$0	$0
306	WAREHOUSE STOCK	$0	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$0	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$0	0%	$0	$0	$0
311	WAREHOUSE STOCK	$0	0%	$0	$0	$0
312	WAREHOUSE STOCK	$0	0%	$0	$0	$0
313	WAREHOUSE STOCK	$0	0%	$0	$0	$0
314	WAREHOUSE STOCK	$0	0%	$0	$0	$0
315	WAREHOUSE STOCK	$0	0%	$0	$0	$0
316	WAREHOUSE STOCK	$2	0%	$0	$0	$0
320	WAREHOUSE STOCK	$0	0%	$0	$0	$0
330	WAREHOUSE STOCK	$0	0%	$0	$0	$0
340	WAREHOUSE STOCK	$0	0%	$0	$0	$0
350	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$1	0%	$0	$0	$0
1710	DIST. ADMINISTRATIVE OPERATIONS	$174	10%	$17	$14	$4
1720	DIST. ACCOUNTING	$287	10%	$29	$22	$6
1730	DIST. WAREHOUSING	$271	10%	$27	$27	$0
1740	DIST. DESIGN MANAGEMENT	$136	100%	$136	$106	$30
1760	DIST. R.O.W. MANAGEMENT	$45	0%	$0	$0	$0
1770	DIST. MAINTENANCE MANAGEMENT	$223	0%	$0	$0	$0
1775	DIST. TRAFFIC MANAGEMENT	$60	10%	$6	$5	$1
1780	TORT CLAIM COSTS	$3	10%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	($60)	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINTENANCE	$1	0%	$0	$0	$0
1825	UNDIST. DIST. LAB COSTS	$44	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING AND PROT.	$142	10%	$14	$14	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$134	10%	$13	$13	$0
1851	RADIO COMM. MAINTENANCE	$71	10%	$7	$7	$0
1852	ADDITIONAL MOBILE RADIO EQUIP.	$3	10%	$0	$0	$0
1853	REPLACEMENT - EXISTING RADIO EQUIP.	$21	10%	$2	$2	$0
1854	TRAFFIC OPERATIONS COST UNDIST.	$318	0%	$0	$0	$0
1860	SUPPLIES AND MISC. EXPENSES	$168	10%	$17	$17	$0
1865	DIST./URBAN TELECOMM. SERVICES	$70	30%	$21	$21	$0
1866	REPRODUCTION SERVICES	$27	80%	$22	$22	$0
1872	RESEARCH-SPEC.-GEN. MATERIALS	$0	0%	$0	$0	$0
1873	SPEC. RES. & INVEST., SOILS/SOURCES	$6	0%	$0	$0	$0
1875	RAILROAD GRADE PROT. DEVICE	$3	0%	$0	$0	$0
1876	INVEST./PLANS FOR HWY. TRAFFIC SIG.	$15	100%	$15	$12	$3
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
1910	EMPLOYEE TRAINING	$258	10%	$26	$26	$0
1911	EMPLOYEE TRAINING	$208	10%	$21	$21	$0
1920	ISSUANCE OF SIGN PERMITS	$2	0%	$0	$0	$0
1925	SIGN CONTROL	$1	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$1	0%	$0	$0	$0
1985	MANAGEMENT AUDIT FY85	$0	10%	$0	$0	$0
2600	REIMBURS. COSTS DUE- OUTSIDE DEPT.	$41	0%	$0	$0	$0
2821	PORT ARANSAS FERRY	$1,265	0%	$0	$0	$0
4960	ISSUE PERMITS OVERSIZE/OVERWEIGHT	$172	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$37	10%	$4	$3	$1
	TOTALS	**$4,150**		**$377**	**$332**	**$46**
	OFFICE SPACE			$84	$84	$0
	EQUIPMENT DEPRECIATION			$55	$55	$0
	TOTAL INDIRECT PROJECT COST			**$517**	**$471**	**$46**
	FY85 1XX EXPENDITURES			**$2,325**	**$1,805**	**$520**
	DISTRICT 16 INDIRECT PCE COST RATIO:			**22.22%**	**26.08%**	**8.76%**
				(in 1,000's)		

DISTRICT 18

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$0	0%	$0	$0	$0
302	WAREHOUSE STOCK	$9	0%	$0	$0	$0
303	WAREHOUSE STOCK	$0	0%	$0	$0	$0
304	WAREHOUSE STOCK	$0	0%	$0	$0	$0
305	WAREHOUSE STOCK	$5	0%	$0	$0	$0
306	WAREHOUSE STOCK	$5	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$7	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$10	0%	$0	$0	$0
311	WAREHOUSE STOCK	$0	0%	$0	$0	$0
312	WAREHOUSE STOCK	$0	0%	$0	$0	$0
313	WAREHOUSE STOCK	$0	0%	$0	$0	$0
314	WAREHOUSE STOCK	$11	0%	$0	$0	$0
315	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$19	0%	$0	$0	$0
1710	DIST. ADMINISTRATIVE OPERATIONS	$198	9%	$18	$9	$9
1720	DIST. ACCOUNTING	$433	9%	$39	$19	$19
1730	DIST. WAREHOUSING	$479	9%	$43	$43	$0
1740	DIST. DESIGN MANAGEMENT	$257	100%	$257	$129	$129
1750	DIST. CONSTRUCTION MANAGEMENT	$78	0%	$0	$0	$0
1760	DIST. R.O.W. MANAGEMENT	$154	0%	$0	$0	$0
1770	DIST. MAINTENANCE MANAGEMENT	$360	0%	$0	$0	$0
1775	DIST. TRAFFIC MANAGEMENT	$181	9%	$16	$8	$8
1780	TORT CLAIM COSTS	$0	9%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	$43	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINT.	$0	0%	$0	$0	$0
1825	UNDIST. DIST. LAB COSTS	$81	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING & PROT.	$213	9%	$19	$19	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$114	9%	$10	$10	$0
1851	RADIO COMM. MAINTENANCE	$35	9%	$3	$3	$0
1852	ADD. MOBILE RADIO EQUIP.	$0	9%	$0	$0	$0
1853	REPLACEMENT-RADIO EQUIP.	$30	9%	$3	$3	$0
1854	TRAFFIC OPERATIONS COST UNDIST.	$0	0%	$0	$0	$0
1860	SUPPLIES AND MISC. EXPENSES	$229	9%	$21	$21	$0
1865	DIST. URBAN TELECOMM. SERVICES	$189	30%	$57	$57	$0
1866	REPRODUCTION SERVICES	$67	80%	$54	$54	$0
1872	RES.-SPEC.-GENERAL MATERIALS	$0	0%	$0	$0	$0
1873	SPEC. RES. & INVEST. SOILS/SOURCES	$0	0%	$0	$0	$0
1875	RAILROAD GRADE PROT. DEVICE	$21	0%	$0	$0	$0
1876	INVEST./PLANS HWY TRAFFIC SIG.	$152	100%	$152	$76	$76
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
1910	EMPLOYEE TRAINING	$250	9%	$23	$23	$0
1911	EMPLOYEE TRAINING	$35	9%	$3	$3	$0
1920	ISSUANCE OF SIGN PERMITS	$30	0%	$0	$0	$0
1925	SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$40	0%	$0	$0	$0
1985	MANAGEMENT AUDIT FY85	$0	9%	$0	$0	$0
2600	REIMBURS. COSTS DUE OUTSIDE DEPT.	$10	0%	$0	$0	$0
4960	ISSUE PERMITS OVERSIZE/OVERWEIGHT	$140	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$38	9%	$3	$2	$2
	TOTALS	**$3,923**		**$720**	**$478**	**$243**
	OFFICE SPACE			$131	$131	$0
	EQUIPMENT DEPRECIATION			$53	$53	$0
	TOTAL INDIRECT PROJECT COST			**$904**	**$662**	**$243**
	FY85 1XX EXPENDITURES			**$7,007**	**$3,536**	**$3,471**
	DISTRICT 18 INDIRECT PCE COSTS:			**12.91%**	**18.71%**	**6.99%**
				(in 1,000's)		

DISTRICT 20

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$0	0%	$0	$0	$0
302	WAREHOUSE STOCK	$11	0%	$0	$0	$0
303	WAREHOUSE STOCK	$0	0%	$0	$0	$0
304	WAREHOUSE STOCK	$3	0%	$0	$0	$0
305	WAREHOUSE STOCK	$0	0%	$0	$0	$0
306	WAREHOUSE STOCK	$0	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$0	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$0	0%	$0	$0	$0
321	WAREHOUSE STOCK	$0	0%	$0	$0	$0
322	WAREHOUSE STOCK	$0	0%	$0	$0	$0
324	WAREHOUSE STOCK	$0	0%	$0	$0	$0
326	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$55	0%	$0	$0	$0
1710	DIST. ADMINISTRATIVE OPERATIONS	$195	7%	$14	$7	$7
1720	DIST. ACCOUNTING	$181	7%	$13	$6	$6
1730	DIST. WAREHOUSING	$369	7%	$26	$26	$0
1740	DIST. DESIGN MANAGEMENT	$126	100%	$126	$63	$63
1750	DIST. CONSTRUCTION MANAGEMENT	$133	0%	$0	$0	$0
1760	DIST. R.O.W. MANAGEMENT	$79	0%	$0	$0	$0
1770	DIST. MAINTENANCE MANAGEMENT	$397	0%	$0	$0	$0
1775	DIST. TRAFFIC MANAGEMENT	$105	7%	$7	$4	$4
1780	TORT CLAIM COSTS	$0	7%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	($106)	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINTENANCE	$3	0%	$0	$0	$0
1825	UNDIST. DIST. LAB COSTS	$42	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING AND PROT.	$151	7%	$11	$11	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$109	7%	$8	$8	$0
1851	RADIO COMMUNICATIONS MAINT.	$67	7%	$5	$5	$0
1852	ADDITIONAL MOBILE RADIO EQUIP.	$3	7%	$0	$0	$0
1853	REPLACEMENT-EXISTING RADIO EQUIP.	$0	7%	$0	$0	$0
1854	TRAFFIC OPS. COST UNDIST.	$85	0%	$0	$0	$0
1860	SUPPLIES AND MISC. EXPENSES	$133	7%	$9	$9	$0
1865	DIST. URBAN TELECOMM. SERVICES	$94	30%	$28	$28	$0
1866	REPRODUCTION SERVICES	$21	80%	$17	$17	$0
1872	RES.-SPEC.-GEN. MATERIALS	$18	0%	$0	$0	$0
1873	SPEC. RES./INVEST. SOILS & SOURCES	$2	0%	$0	$0	$0
1875	RAILROAD GRADE PROTECTION DEVICE	$0	0%	$0	$0	$0
1876	INVEST./PLANS HWY. TRAFFIC SIG.	$20	100%	$20	$10	$10
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE 4). % Alloc.	5). $ Alloc.	Breakdown 6). SDHPT	7). Con.
1910	EMPLOYEE TRAINING	$212	7%	$15	$15	$0
1911	EMPLOYEE TRAINING	$89	7%	$6	$6	$0
1920	ISSUANCE OF SIGN PERMITS	$30	0%	$0	$0	$0
1925	SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$0	0%	$0	$0	$0
1985	MANAGEMENT AUDIT FY85	$0	7%	$0	$0	$0
2600	REIMBURS. COSTS DUE OUTSIDE DEPT.	$148	0%	$0	$0	$0
4960	ISSUE PERMITS OVERSIZE/OVERWT.	$116	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$36	7%	$3	$1	$1
	TOTALS	**$2,927**		**$307**	**$215**	**$91**
	OFFICE SPACE			$54	$54	$0
	EQUIPMENT DEPRECIATION			$38	$38	$0
	TOTAL INDIRECT PROJECT COST			**$399**	**$307**	**$91**
	FY85 1XX EXPENDITURES			**$2,232**	**$1,118**	**$1,114**
	DISTRICT 20 INDIRECT PCE COSTS:			**17.86%**	**27.50%**	**8.18%**
				(in 1,000's)		

DISTRICT 24

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE Breakdown 4). % Alloc.	5). $ Alloc.	6). SDHPT	7). Con.
301	WAREHOUSE STOCK	$10	0%	$0	$0	$0
302	WAREHOUSE STOCK	$2	0%	$0	$0	$0
303	WAREHOUSE STOCK	$0	0%	$0	$0	$0
304	WAREHOUSE STOCK	$5	0%	$0	$0	$0
305	WAREHOUSE STOCK	$0	0%	$0	$0	$0
306	WAREHOUSE STOCK	$0	0%	$0	$0	$0
307	WAREHOUSE STOCK	$0	0%	$0	$0	$0
308	WAREHOUSE STOCK	$6	0%	$0	$0	$0
309	WAREHOUSE STOCK	$0	0%	$0	$0	$0
310	WAREHOUSE STOCK	$0	0%	$0	$0	$0
311	WAREHOUSE STOCK	$0	0%	$0	$0	$0
312	WAREHOUSE STOCK	$0	0%	$0	$0	$0
313	WAREHOUSE STOCK	$0	0%	$0	$0	$0
314	WAREHOUSE STOCK	$0	0%	$0	$0	$0
315	WAREHOUSE STOCK	$0	0%	$0	$0	$0
399	WAREHOUSE STOCK	$26	0%	$0	$0	$0
1710	DIST. ADMINISTRATIVE OPERATIONS	$171	9%	$15	$6	$9
1720	DIST. ACCOUNTING	$356	9%	$32	$13	$19
1730	DIST. WAREHOUSING	$309	9%	$28	$28	$0
1740	DIST. DESIGN MANAGEMENT	$116	100%	$116	$46	$70
1750	DIST. CONSTRUCTION MANAGEMENT	$113	0%	$0	$0	$0
1760	DIST. R.O.W. MANAGEMENT	$100	0%	$0	$0	$0
1770	DIST. MAINTENANCE MANAGEMENT	$373	0%	$0	$0	$0
1775	DIST. TRAFFIC MANAGEMENT	$172	9%	$15	$6	$9
1780	TORT CLAIM COSTS	$0	9%	$0	$0	$0
1810	INVENTORY ADJUSTMENT	$198	0%	$0	$0	$0
1820	UNDIST. ENG. COSTS FOR MAINT.	$36	0%	$0	$0	$0
1825	UNDIST. DIST. LAB COSTS	$46	0%	$0	$0	$0
1830	ROUTINE BLDG. CLEANING AND PROT.	$132	9%	$12	$12	$0
1840	MINOR REPAIRS TO ALL DIST. BLDGS.	$217	9%	$20	$20	$0
1851	RADIO COMMUNICATIONS MAINT.	$143	9%	$13	$13	$0
1852	ADDITIONAL MOBILE RADIO EQUIP.	$20	9%	$2	$2	$0
1853	REPLACEMENT EXIST. RADIO EQUIP.	$16	9%	$1	$1	$0
1854	TRAFFIC OPERATIONS COST UNDIST.	$39	9%	$4	$1	$2
1860	SUPPLIES AND MISC. EXPENSES	$221	9%	$20	$20	$0
1865	DIST.-URBAN TELECOMM. SERVICES	$80	30%	$24	$24	$0
1866	REPRODUCTION SERVICES	$29	80%	$23	$23	$0
1872	RES.-SPEC.-GENERAL MATERIALS	$5	0%	$0	$0	$0
1873	SPEC. RES. & INVEST., SOILS/SOURCES	$0	0%	$0	$0	$0
1875	RAILROAD GRADE PROTECTION DEVICE	$1	0%	$0	$0	$0
1876	INVEST./PLANS HWY TRAFFIC SIGNALS	$0	100%	$0	$0	$0
				(in 1,000's)		

1). Detail	2). DESCRIPTION	3). FY 1985 T. Exp.	Indirect PCE Breakdown 4). % Alloc.	5). $ Alloc.	6). SDHPT	7). Con.
1910	EMPLOYEE TRAINING	$117	9%	$11	$11	$0
1911	EMPLOYEE TRAINING	$82	9%	$7	$7	$0
1920	USSUANCE OF SIGN PERMITS	$0	0%	$0	$0	$0
1925	HB 1330 SIGN CONTROL	$0	0%	$0	$0	$0
1930	OPERATIONAL STUDY GROUP	$0	0%	$0	$0	$0
1985	MANAGEMENT AUDIT FY85	$0	9%	$0	$0	$0
2600	REIMBURS. COSTS DUE OUTSIDE DEPT.	$14	0%	$0	$0	$0
4960	ISSUE PERMITS OVERSIZE/OVERWEIGHT	$32	0%	$0	$0	$0
4970	INTERNAL REVIEW FUNCTION	$37	9%	$3	$1	$2
	TOTALS	**$3,224**		**$346**	**$234**	**$112**
	OFFICE SPACE			$50	$50	$0
	EQUIPMENT DEPRECIATION			$43	$43	$0
	TOTAL INDIRECT PROJECT COST			**$440**	**$327**	**$112**
	FY85 1XX EXPENDITURES			**$2,201**	**$871**	**$1,330**
	DIST. 24 OVERHEAD RATE			**19.98%**	**37.52%**	**8.44%**
				(in 1,000's)		

Appendix E — Adjustment of Project Costs for Inflation

Appendix E, comprising two tables, explains how project costs were adjusted for inflation for this study. The adjustments were made using the State Department of Highways and Public Transportation's Construction Cost Indexes for the years 1972-1986, which were compiled by the SDHPT. Table 1 displays the indexes themselves, while Table 2 shows how these indexes were applied to specific project costs. The first vertical column in Table 2 lists the identification numbers of the study projects for which complete information was available. For each project, there are two corresponding cells for each year in the period 1972-1986. The first column of cells under each year shows the amount of direct (1xx) P.C.E. expenditures, plus estimated administrative support costs, incurred in that year. The next column shows the same amount adjusted to a 1986 equivalent. The last column, on the third page, displays the total of all the adjusted amounts for each project.

Direct P.C.E. costs were divided among the years of the projects based on estimates in the district questionnaires. When these estimates were not available, the costs were merely divided equally among the years of the projects' continuance.

(FOR INFORMATION ONLY)

Appendix E
Table 1
State Department of Highways and Public Transportation
Construction Cost Index, 1972-1986

1972	36.68%
1973	40.97%
1974	61.01%
1975	63.00%
1976	57.45%
1977	64.69%
1978	83.84%
1979	100.00%
1980	126.63%
1981	108.38%
1982	107.68%
1983	101.51%
1984	109.23%
1985	120.91%
Jun-86	131.72%

Base Year -- 1979

Appendix E
Table 2

SELECTED PROJECT COSTS, ADJUSTED FOR INFLATION

Using the SDHPT's Construction Cost Index
(Base Year -- FY 1979)

Project	FY72		FY73		FY74		FY75		FY76		FY77	
I.D. #	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $
1-A		$0		$0		$0		$0		$0		$0
2		$0		$0		$0		$0		$0		$0
5		$0		$0		$0		$0		$0		$0
6		$0		$0		$0		$0		$0		$0
6-A		$0		$0		$0		$0		$0		$0
7-A		$0		$0		$0		$0		$0		$0
8		$0		$0		$0		$0		$0		$0
8-A		$0		$0		$0		$0	$52,000	$119,224	$52,000	$105,881
10		$0		$0		$0		$0		$0		$0
10-A		$0		$0		$0		$0		$0		$0
13-A		$0		$0		$0		$0		$0		$0
16		$0		$0		$0		$0		$0		$0
16-A		$0		$0		$0		$0		$0		$0
17		$0		$0		$0		$0		$0		$0
17-A		$0		$0		$0		$0		$0		$0
18		$0		$0		$0		$0		$0		$0
20-A		$0		$0		$0		$0		$0		$0
21		$0		$0		$0		$0		$0		$0
21-A	$89,000	$319,604		$0		$0		$0		$0		$0
23		$0		$0		$0		$0		$0		$0
23-A		$0		$0		$0		$0		$0		$0
25		$0		$0		$0		$0		$0		$0
25-A		$0		$0		$0		$0		$0	$32,000	$65,158
25-B		$0		$0		$0		$0		$0		$0
26-A		$0		$0		$0		$0		$0		$0
27		$0		$0		$0		$0		$0		$0
27-A		$0		$0		$0		$0		$0		$0

Project I.D. #	FY78		FY79		FY80		FY81		FY82	
	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $
1-A		$0		$0		$0		$0	$332,000	$406,120
2		$0		$0		$0		$0		$0
5		$0		$0		$0		$0		$0
6		$0		$0		$0		$0		$0
6-A	$21,000	$32,993	$21,000	$27,661	$22,000	$22,884		$0		$0
7-A		$0		$0		$0		$0		$0
8		$0		$0		$0		$0		$0
8-A	$52,000	$81,697	$52,000	$68,494	$52,000	$54,090		$0		$0
10		$0		$0		$0		$0		$0
10-A		$0		$0		$0		$0		$0
13-A		$0		$0		$0		$0		$0
16		$0		$0		$0		$0		$0
16-A		$0		$0		$0		$0		$0
17		$0		$0		$0		$0		$0
17-A		$0		$0		$0	$111,000	$134,904		$0
18		$0		$0		$0		$0		$0
20-A		$0		$0		$0		$0		$0
21		$0		$0		$0		$0		$0
21-A		$0		$0		$0		$0		$0
23		$0		$0		$0		$0		$0
23-A		$0		$0		$0		$0		$0
25		$0		$0		$0		$0		$0
25-A	$4,000	$6,284		$0		$0		$0		$0
25-B		$0		$0	$13,000	$13,523	$41,000	$49,829		$0
26-A		$0		$0		$0		$0		$0
27		$0		$0		$0		$0		$0
27-A		$0		$0		$0		$0		$0

Project I.D. #	FY83		FY84		FY85		FY86	TOTAL	TOTAL
	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Adj. $	Nom. $	Unadj. $	Adj. $
1-A		$0		$0	$0	$0	$0	$332,000	$406,120
2		$0	$112,000	$135,060	$112,000	$122,013	$112,000	$336,000	$369,074
5		$0		$0		$0	$580,000	$580,000	$580,000
6		$0		$0	$98,000	$106,762	$174,000	$272,000	$280,762
6-A		$0		$0		$0		$64,000	$83,538
7-A		$0	$72,000	$86,824		$0		$72,000	$86,824
8		$0		$0	$26,000	$28,325	$237,000	$263,000	$265,325
8-A		$0		$0		$0		$260,000	$429,386
10		$0		$0	$580,000	$631,855	$1,005,000	$1,585,000	$1,636,855
10-A		$0	$588,000	$709,067	$96,000	$104,583		$684,000	$813,650
13-A		$0		$0		$0	$600,000	$600,000	$600,000
16		$0		$0	$385,000	$419,421		$385,000	$419,421
16-A	$199,000	$258,224		$0		$0		$199,000	$258,224
17		$0		$0	$377,000	$410,706		$377,000	$410,706
17-A		$0		$0		$0		$111,000	$134,904
18		$0		$0	$1,341,000	$1,460,893		$1,341,000	$1,460,893
20-A	$50,000	$64,880	$50,000	$60,295	$50,000	$54,470	$6,000	$156,000	$185,645
21		$0	$80,000	$96,472	$156,000	$169,947	$46,000	$282,000	$312,419
21-A		$0	$0	$0	$0	$0	$0	$89,000	$319,604
23		$0		$0		$0	$349,000	$349,000	$349,000
23-A	$98,000	$127,165		$0		$0		$98,000	$127,165
25		$0	$68,000	$82,001	$68,000	$74,080		$136,000	$156,080
25-A		$0		$0		$0		$36,000	$71,442
25-B		$0		$0		$0		$54,000	$63,352
26-A		$0	$72,000	$86,824		$0		$72,000	$86,824
27		$0		$0	$1,002,000	$1,091,584		$1,002,000	$1,091,584
27-A		$0	$72,000	$86,824		$0		$72,000	$86,824

Appendix F — Average Salary Rates for Selected SDHPT Employees

Table 1 in Appendix F shows the method of determining the average salary rate for a selected group of Department employees. The employee group selected was from District 12 and is considered to representative of an engineering group containing a representative sample of all the skill, experience, and resources needed to provide P. C. E. services within a large urban district.

Table 2 shows the method of computing composite hourly wage rates for several selected classes of employees. The composite groups were taken from District 12 and District 2 payrolls. These composite salaries computed for the various classes of employees were used to compare SDHPT salaries with those of consultants for the selected classes of employees. The employee classifications used are those commonly used in consulting engineers' contracts. The various grades of Department employees placed within each classification for estimating the composite hourly wages was a matter of judgement.

Table 1
AVERAGE SALARY RATE
FOR A UNIT OF
DESIGN ENGINEERING EMPLOYES AT DISTRICT 12

Employee No.	Salary ($/Month)	Employee No.	Salary ($/Month)	Employee No.	Salary ($/Month)	Hourly Salary ($/Hour)
1	1,617	46	2,102	91	2,478	
2	1,617	47	1,969	92	1,844	
3	1,726	48	1,617	93	1,419	
4	1,419	49	2,173	94	1,617	
5	1,419	50	1,617	95	1,969	
6	1,671	51	2,478	Avg.Sal. 741	1,944	11.24
7	1,419	52	2,562			
8	2,244	53	2,102	1	2,648	
9	2,173	54	1,419	2	1,419	
10	1,906	55	1,251	3	1,671	
11	2,102	56	1,906	4	2,035	
12	1,419	57	2,173	5	2,648	
13	1,617	58	1,419	6	1,671	
14	1,844	59	2,102	7	2,562	
15	1,419	60	1,617	8	2,173	
16	3,804	61	1,419	9	1,726	
17	1,844	62	1,906	10	3,561	
18	1,515	63	3,225	11	3,804	
19	2,102	64	1,671	12	2,562	
20	1,671	65	1,419	13	2,648	
21	2,244	66	2,399	14	4,060	
22	1,969	67	1,844	15	2,102	
23	1,466	68	1,419	16	2,244	
24	1,251	69	1,969	17	2,102	
25	2,244	70	2,102	18	1,617	
26	1,969	71	1,617	19	2,102	
27	1,969	72	2,102	20	2,322	
28	2,244	73	1,906	21	2,173	
29	1,969	74	1,969	22	3,561	
30	1,617	75	1,671	23	2,648	
31	1,419	76	1,566	24	2,102	
32	2,322	77	3,331	25	4,240	
33	1,969	78	1,515	26	2,102	
34	2,102	79	1,251	27	2,244	
35	1,969	80	1,969	28	2,399	
36	1,419	81	2,322	Avg.Sal 740	2,470	14.28
37	1,969	82	2,244	740/741 Avg	**2,063**	**11.92**
38	2,173	83	3,019			
39	3,561	84	1,617			
40	2,173	85	2,562			
41	1,419	86	3,120			
42	2,102	87	2,035			
43	1,844	88	1,251			
44	2,322	89	1,419			
45	1,671	90	3,019			

Table 2
COMPOSITE HOURLY WAGE RATES FOR
SELECTED SDHPT ENGINEERING, TECHNICAL, AND CLERICAL POSITIONS

Descr. of Cons. Position for Study 1101	Composite Hrly Wage Rate - $	Equivalent Composite SDHPT Position	Composite Hrly Wage Rate - $
•Principal		Director III	**24.51**
•Sen. Engr.		Engrs. IVs&Vs	**20.55**
•Engineers		Engrs. Is,IIs & IIIs Eng.Assts IIs&IIIs	**13.09**
•Technicians		Engr.Tech I- V Drftsmn I,II,&III	**10.82**
•Clerical		Engr. Aide III & IV	**6.71**

SDHPT Positions	No. in Position (Dist. 12)	Total Annual Salary	Hourly Wage Rate ($)	No. in Position (Dist. 2)	Total Salary - $	Hourly Wage Rate - $
Director III	1	$50,882		1	$50,882	
Total	1	$50,882	**$24.51**	1	$50,882	24.51
% of Grnd. Tot		0.25%			0.70%	
Engineer V	11	$493,488		5	$228,240	
Engineer IV	34	$1,426,320		16	$674,064	
Total	45	$1,919,808	**$20.55**	21	$902,304	20.70
% of Grnd.Tot		9.56%			12.42%	
Engineer III	14	$524,544		9	$342,684	
Engineer II	18	$581,772		9	$311,448	
Engineer I	3	$81,720		5	$151,056	
Engr. Asst. III	69	$1,845,348		12	$314,641	
Engr. Asst. II	57	$1,366,800		9	$213,411	
Engr. Asst. I	5	$110,640		2	$44,256	
Total	166	$4,510,824	**$13.09**	46	$1,377,496	14.42
% of Grnd. Tot		22.45%			18.97%	
Engr. Tech. V	158	$4,770,348		58	$1,760,220	
Engr. Tech. IV	110	$2,614,824		41	$1,040,162	
Engr. Tech. III	133	$2,656,848		33	$714,000	
Engr. Tech. II	125	$2,162,772		23	$401,444	
Engr. Tech. I	56	$843,336		27	$410,761	
Draftsman III	14	$356,434		4	$110,520	
Draftsman II	4	$79,560		0	$0	
Draftsman I	1	$15,012		0	$0	
Total	601	$13,499,134	**$10.82**	186	$4,437,107	11.49
% of Grnd. Tot		67.19%			61.10%	
Engr. Aide IV	3	$45,036		7	$107,364	
Engr. Aide III	5	$66,360		24	$320,525	
Engr. Aide II	0	$0		4	$46,534	
Engr. Aide I	0	$0		2	$20,020	
Total	8	$111,396	**$6.71**	37	$494,443	6.44
% of Grnd. Tot		0.55%			6.81%	
Grand Total	821	$20,092,044	**$11.79**	291	$7,262,232	12.02

Appendix G — Allocation of Administrative and Support Operations Costs by the Weight Method

Appendix G contains Figure 1 and a series of tables showing the allocation of *administrative and support operations costs*, by the Weight Method, among the other principal activities of the SDHPT. This distribution is made by two methods designated as Case 1 and Case 2. These two methods are illustrated and described by Figure 1. Administrative and support costs were allocated by the Case 1 and Case 2 methods for each of Fiscal Years 1982, 1983, 1984, and A table for each Fiscal Year and Case shows the cost allocations.

All costs used in the the Appendix G tables are the actual reported costs for the various principal activities as shown in the SDHPT Annual Financial Reports.

	A	B	C	D	E	F
1	ACTIVITY	ACT.CODE	FY 1982 Exp	FY 1982 Exp	'82 Excludin	%of A&S
2	Admin. & Support		X $1,000.	% of Total	Adm.&Supp.	to other Act.
3	Commissioners	101	82	0.0058		
4	State Engineer-Dir.	101	56	0.0039		
5	Other Executive Admi	101	730	0.0517		
6	Planning & Research	102	10,090	0.7138		
7	Support Operations	103	64,891	4.5905		
8	Sub-total, Admin.&Supp.		75,849	5.3657		
9						
10	Highway Maintenance					
11	Maintenance Mgmt.	201	9,073	0.6419		
12	Maintenance Work	202	364,657	25.7964		
13	Sub-total, Maintenance		373,731	26.4383	27.9373	1.4990
14						
15	Highway Construction					
16	Construction Mgmt.	301	12,220	0.8645	0.9135	0.0490
17	Prelim. & Const. Eng'g	302	90,867	6.4281	6.7925	0.3645
18	Right-of-way Acquist.	303	51,957	3.6755	3.8839	0.2084
19	Contract Const.	304	762,295	53.9259	56.9835	3.0575
20	Sub-total, Highway Const.		917,340	64.8940	68.5734	3.6794
21						
22	Highway Auxill. Opertns.					
23	Public Travel & Info.	401	4,650	0.3290		
24	Motor Veh. Regist.	402	22,310	1.5782		
25	Ferries & Tunnels	203	5,248	0.3712		
26	Off-Syst. RR Gr. Prot.	404	0			
27	Outdr. Advt.&Jnkyrd.	405	551	0.0390		
28	Traffic Safety Prom.	406 & 416	5,553	0.3928		
29	Gulf Intracstl. Wtrwy.	407	52	0.0037		
30	Sub-total, Hwy.Aux.Oprtn.		38,363	2.7139	2.8677	0.1539
31						
32	Public Trans. Development.					
33	Coord.&Tech.Support		415	0.0294		
34	Financial Assist.		7,900	0.5588		
35	Sub-total, Pub.Trans.Dev.		8,315	0.5882	0.6215	0.0333
36	TOTAL		1,413,596	100.0000	100.0000	5.3657

	A	B	C	D	E	F
1	ACTIVITY	ACT.CODE	FY 1983 Exp	FY 1983 Exp	'83 Excludir	% of A&S
2	Admin. & Support		X $1,000.	% of Total	Adm.&Supp.	to other Act.
3	Commissioners	101	89	0.0058		
4	State Engineer-Dir.	101	61	0.0040		
5	Other Executive Admi	101	781	0.0512		
6	Planning & Research	102	11,155	0.7307		
7	Support Operations	103	69,439	4.5487		
8	Sub-total, Admin.&Supp.		81,525	5.3404		
9						
10	Highway Maintenance					
11	Maintenance Mgmt.	201	9,969	0.6530		
12	Maintenance Work	202	384,855	25.2107		
13	Sub-total, Maintenance		394,824	25.8638	27.3229	1.4592
14						
15	Highway Construction					
16	Construction Mgmt.	301	13,493	0.8839	0.9337	0.0499
17	Prelim. & Const. Eng'g	302	107,488	7.0412	7.4385	0.3972
18	Right-of-way Acquist.	303	127,842	8.3745	8.8470	0.4725
19	Contract Const.	304	746,236	48.8837	51.6416	2.7579
20	Sub-total, Highway Const.		995,059	65.1833	68.8608	3.6775
21						
22	Highway Auxill. Opertns.					
23	Public Travel & Info.	401	5,349	0.3504		
24	Motor Veh. Regist.	402	24,521	1.6063		
25	Ferries & Tunnels	203	6,501	0.4259		
26	Off-Syst. RR Gr. Prot.	404	48	0.0031		
27	Outdr. Advt.&Jnkyrd.	405	414	0.0271		
28	Traffic Safety Prom.	406 & 416	5,866	0.3843		
29	Gulf Intracstl. Wtrwy.	407	46	0.0030		
30	Sub-total, Hwy.Aux.Oprtn.		42,744	2.8001	2.9580	0.1580
31						
32	Public Trans. Development.					
33	Coord.&Tech.Support		680	0.0445		
34	Financial Assist.		11,722	0.7679		
35	Sub-total, Pub.Trans.Dev.		12,402	0.8124	0.8582	0.0458
36	TOTAL		1,526,554	100.0000	100.0000	5.3404

	A	B	C	D	E	F
1	ACTIVITY	ACT.CODE	FY 1984 Exp	FY 1984 Exp	'84 Excludir	% of A&S
2	Admin. & Support		X $1,000.	% of Total	Adm.&Supp.	to other Act.
3	Commissioners	101	99	0.0069		
4	State Engineer-Dir.	101	65	0.0045		
5	Other Executive Admi	101	902	0.0629		
6	Planning & Research	102	13,981	0.9751		
7	Support Operations	103	64,881	4.5249		
8	Sub-total, Admin.&Supp.		79,928	5.5743		
9						
10	Highway Maintenance					
11	Maintenance Mgmt.	201	9,816	0.6846		
12	Maintenance Work	202	370,204	25.8186		
13	Sub-total, Maintenance		380,020	26.5031	28.0677	1.5646
14						
15	Highway Construction					
16	Construction Mgmt.	301	14,466	1.0088	1.0684	0.0596
17	Prelim. & Const. Eng'g	302	110,818	7.7286	8.1849	0.4562
18	Right-of-way Acquist.	303	53,069	3.7011	3.9196	0.2185
19	Contract Const.	304	742,546	51.7862	54.8433	3.0571
20	Sub-total, Highway Const.		920,899	64.2248	68.0162	3.7914
21						
22	Highway Auxill. Opertns.					
23	Public Travel & Info.	401	5,848	0.4079		
24	Motor Veh. Regist.	402	22,318	1.5565		
25	Ferries & Tunnels	203	6,461	0.4506		
26	Off-Syst. RR Gr. Prot.	404	757			
27	Outdr. Advt.&Jnkyrd.	405	363	0.0253		
28	Traffic Safety Prom.	406 & 416	8,082	0.5636		
29	Gulf Intracstl. Wtrwy.	407	47	0.0032		
30	Sub-total, Hwy.Aux.Oprtn.		43,875	3.0599	3.2405	0.1806
31						
32	Public Trans. Development.					
33	Coord.&Tech.Support		566	0.0395		
34	Financial Assist.		8,580	0.5984		
35	Sub-total, Pub.Trans.Dev.		9,147	0.6379	0.6756	0.0377
36	TOTAL		1,433,869	100.0000	100.0000	5.5743

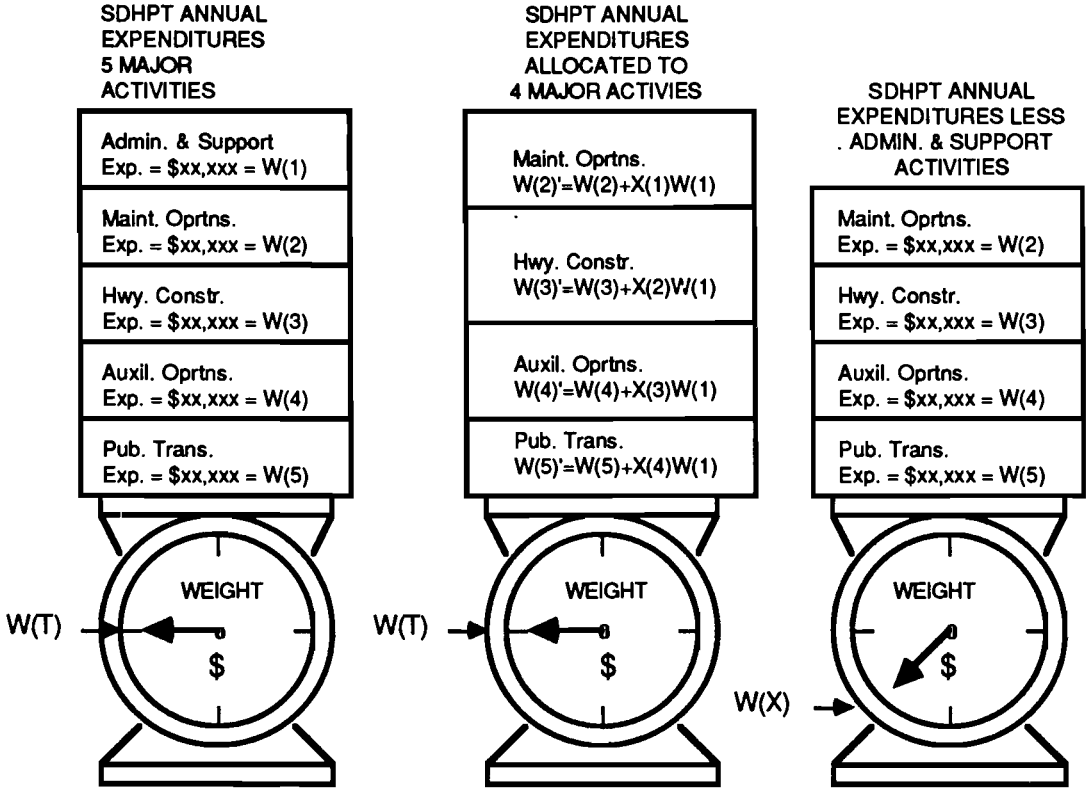
	A	B	C	D	E	F
1	ACTIVITY	ACT.CODE	FY 1985 Exp	FY 1985 Exp	'85 Excludin	% of A&S
2	Admin. & Support		X $1,000.	% of Total	Adm.&Supp.	to other Act.
3	Commissioners	101	104	0.0066		
4	State Engineer-Dir.	101	67	0.0043		
5	Other Executive Admi	101	1,093	0.0693		
6	Planning & Research	102	13,703	0.8693		
7	Support Operations	103	68,121	4.3213		
8	Sub-total, Admin.&Supp.		83,088	5.2707		
9						
10	Highway Maintenance					
11	Maintenance Mgmt.	201	10,468	0.6640		
12	Maintenance Work	202	382,696	24.2764		
13	Sub-total, Maintenance		393,164	24.9404	26.3281	1.3877
14						
15	Highway Construction					
16	Construction Mgmt.	301	13,923	0.8832	0.9323	0.0491
17	Prelim. & Const. Eng'g	302	137,249	8.7064	9.1908	0.4844
18	Right-of-way Acquist.	303	59,834	3.7956	4.0068	0.2112
19	Contract Const.	304	833,557	52.8768	55.8189	2.9420
20	Sub-total, Highway Const.		1,044,563	66.2620	69.9488	3.6868
21						
22	Highway Auxill. Opertns.					
23	Public Travel & Info.	401	5,155	0.3270		
24	Motor Veh. Regist.	402	27,641	1.7534		
25	Ferries & Tunnels	203	6,091	0.3864		
26	Off-Syst. RR Gr. Prot.	404				
27	Outdr. Advt.&Jnkyrd.	405	359	0.0228		
28	Traffic Safety Prom.	406 & 416	7,917	0.5022		
29	Gulf Intracstl. Wtrwy.	407	49	0.0031		
30	Sub-total, Hwy.Aux.Oprtn.		47,212	2.9949	3.1615	0.1666
31						
32	Public Trans. Development.					
33	Coord.&Tech.Support		538	0.0341		
34	Financial Assist.		7,848	0.4978		
35	Sub-total, Pub.Trans.Dev.		8,385	0.5319	0.5615	0.0296
36	TOTAL		1,576,413	99.9999	99.9999	5.2707
37						
38						
39						
40						
41						
42						
43						

	A	B	C	D	E	F
1			FY 1982 Exp		% Admn. &	
2	ACTIVITY	ACT.CODE	ExclPymts	FY 1982 Exp	Supp. to	
3	Admin. & Support		X $1,000.	% of Total	Act. Mgmt.	
4	Commissioners	101	0	0.0000		
5	State Engineer-Dir.	101	0	0.0000		
6	Other Executive Admi	101	0	0.0000		
7	Planning & Research	102	0	0.0000		
8	Support Operations	103	0	0.0000		
9	Sub-total, Admin.&Supp.		0	0.0000		
10						
11	Highway Maintenance					
12	Maintenance Mgmt.	201	9,073	6.2408		
13	Maintenance Work	202	0	0.0000		
14	Sub-total, Maintenance		9,073	6.2408	0.3349	
15						
16	Highway Construction					
17	Construction Mgmt.	301	12,220	8.4054	0.4510	
18	Prelim. & Const. Eng'g	302	90,867	62.5007	3.3536	
19	Right-of-way Acquist.	303	0	0.0000	0.0000	
20	Contract Const.	304	0	0.0000	0.0000	
21	Sub-total, Highway Const.		103,087	70.9061	3.8046	
22						
23	Highway Auxill. Opertns.					
24	Public Travel & Info.	401	4,650	3.1985		
25	Motor Veh. Regist.	402	22,310	15.3451		
26	Ferries & Tunnels	203	5,248	3.6095		
27	Off-Syst. RR Gr. Prot.	404	0			
28	Outdr. Advt.&Jnkyrd.	405	551	0.3789		
29	Traffic Safety Prom.	406 & 416	0	0.0000		
30	Gulf Intracstl. Wtrwy.	407	52	0.0358		
31	Sub-total, Hwy.Aux.Oprtn.		32,810	22.5677	1.2109	
32						
33	Public Trans. Development.					
34	Coord.&Tech.Support		415	0.2854		
35	Financial Assist.		0	0.0000		
36	Sub-total, Pub.Trans.Dev.		415	0.2854	0.0153	
37	TOTAL		145,386	100.0000	5.3657	
38						
39						
40						
41						
42						
43						
44						

	A	B	C	D	E
1			FY 1983		% Admn. &
2	ACTIVITY	ACT.CODE	ExclPymts	FY 1983 Exp	Supp. to
3	Admin. & Support		X $1,000.	% of Total	Act. Mgmt.
4	Commissioners	101	0	0.0000	
5	State Engineer-Dir.	101	0	0.0000	
6	Other Executive Admi	101	0	0.0000	
7	Planning & Research	102	0	0.0000	
8	Support Operations	103	0	0.0000	
9	Sub-total, Admin.&Supp.		0	0.0000	
10					
11	Highway Maintenance				
12	Maintenance Mgmt.	201	9,969	5.9159	
13	Maintenance Work	202	0	0.0000	
14	Sub-total, Maintenance		9,969	5.9159	0.3159
15					
16	Highway Construction				
17	Construction Mgmt.	301	13,493	8.0073	0.4276
18	Prelim. & Const. Eng'g	302	107,488	63.7881	3.4065
19	Right-of-way Acquist.	303	0	0.0000	0.0000
20	Contract Const.	304	0	0.0000	0.0000
21	Sub-total, Highway Const.		120,981	71.7954	3.8342
22					
23	Highway Auxill. Opertns.				
24	Public Travel & Info.	401	5,349	3.1743	
25	Motor Veh. Regist.	402	24,521	14.5516	
26	Ferries & Tunnels	203	6,501	3.8582	
27	Off-Syst. RR Gr. Prot.	404	48	0.0282	
28	Outdr. Advt.&Jnkyrd.	405	414	0.2459	
29	Traffic Safety Prom.	406 & 416	0	0.0000	
30	Gulf Intracstl. Wtrwy.	407	46	0.0270	
31	Sub-total, Hwy.Aux.Oprtn.		36,878	21.8853	1.1688
32					
33	Public Trans. Development.				
34	Coord.&Tech.Support		680	0.4034	
35	Financial Assist.		0	0.0000	
36	Sub-total, Pub.Trans.Dev.		680	0.4034	0.0215
37	TOTAL		168,508	100.0000	5.3404

	A	B	C	D	E	F
1			FY 1984 Exp		% Admn. &	
2	ACTIVITY	ACT.CODE	ExclPymts	FY 1984 Exp	Supp. to	
3	Admin. & Support		X $1,000.	% of Total	Act. Mgmt.	
4	Commissioners	101	0	0.0000		
5	State Engineer-Dir.	101	0	0.0000		
6	Other Executive Admi	101	0	0.0000		
7	Planning & Research	102	0	0.0000		
8	Support Operations	103	0	0.0000		
9	Sub-total, Admin.&Supp.		0	0.0000		
10						
11	Highway Maintenance					
12	Maintenance Mgmt.	201	9,816	5.7248		
13	Maintenance Work	202	0	0.0000		
14	Sub-total, Maintenance		9,816	5.7248	0.3191	
15						
16	Highway Construction					
17	Construction Mgmt.	301	14,466	8.4367	0.4703	
18	Prelim. & Const. Eng'g	302	110,818	64.6326	3.6028	
19	Right-of-way Acquist.	303	0	0.0000	0.0000	
20	Contract Const.	304	0	0.0000	0.0000	
21	Sub-total, Highway Const.		125,284	73.0693	4.0731	
22						
23	Highway Auxill. Opertns.					
24	Public Travel & Info.	401	5,848	3.4108		
25	Motor Veh. Regist.	402	22,318	13.0164		
26	Ferries & Tunnels	203	6,461	3.7682		
27	Off-Syst. RR Gr. Prot.	404	757			
28	Outdr. Advt.&Jnkyrd.	405	363	0.2114		
29	Traffic Safety Prom.	406 & 416	0	0.0000		
30	Gulf Intracstl. Wtrwy.	407	47	0.0272		
31	Sub-total, Hwy.Aux.Oprtn.		35,793	20.8755	1.1637	
32						
33	Public Trans. Development.					
34	Coord.&Tech.Support		566	0.3303		
35	Financial Assist.		0	0.0000		
36	Sub-total, Pub.Trans.Dev.		566	0.3303	0.0184	
37	TOTAL		171,459	100.0000	5.5743	
38						
39						
40						
41						
42						
43						
44						

	A	B	C	D	E
1			FY1985 Exp		% Adm. &
2	ACTIVITY	ACT.CODE	ExclPymts.	FY 1985 Exp	Supp. to
3	Admin. & Support		X $1,000.	% of Total	Act. Mgmt.
4	Commissioners	101	0	0.0000	
5	State Engineer-Dir.	101	0	0.0000	
6	Other Executive Admi	101	0	0.0000	
7	Planning & Research	102	0	0.0000	
8	Support Operations	103	0	0.0000	
9	Sub-total, Admin.&Supp.		0	0.0000	
10					
11	Highway Maintenance				
12	Maintenance Mgmt.	201	10,468	5.1957	
13	Maintenance Work	202	0	0.0000	
14	Sub-total, Maintenance		10,468	5.1957	0.2739
15					
16	Highway Construction				
17	Construction Mgmt.	301	13,923	6.9107	0.3642
18	Prelim. & Const. Eng'g	302	137,249	68.1230	3.5906
19	Right-of-way Acquist.	303	0	0.0000	0.0000
20	Contract Const.	304	0	0.0000	0.0000
21	Sub-total, Highway Const.		151,172	75.0337	3.9548
22					
23	Highway Auxill. Opertns.				
24	Public Travel & Info.	401	5,155	2.5585	
25	Motor Veh. Regist.	402	27,641	13.7196	
26	Ferries & Tunnels	203	6,091	3.0232	
27	Off-Syst. RR Gr. Prot.	404			
28	Outdr. Advt.&Jnkyrd.	405	359	0.1781	
29	Traffic Safety Prom.	406 & 416	0	0.0000	
30	Gulf Intracstl. Wtrwy.	407	49	0.0242	
31	Sub-total, Hwy.Aux.Oprtn.		39,295	19.5037	1.0280
32					
33	Public Trans. Development.				
34	Coord.&Tech.Support		538	0.2668	
35	Financial Assist.		0	0.0000	
36	Sub-total, Pub.Trans.Dev.		538	0.2668	0.0141
37	TOTAL		201,472	100.0000	5.2707



$W(T) = W(1)+W(2)+W(3)+W(4)+W(5)$ &

$W(T) = W(2)'+W(3)'+W(4)'+W(5)'$ &

$W(X) = W(T) - W(1)$ &

$W(X) = W(2)+W(3)+W(4)+W(5)$ &
$X(1) = W(2)/W(X)$ &
$X(2) = W(3)/W(X)$ &
$X(3) = W(4)/W(X)$ &
$X(4) = W(5)/W(X)$

Where X(n)= Distribution factor for proportioning Admin. & Supp. costs to other major actilvities.

ALLOCATING ADMINISTRATION AND SUPPORT COSTS

(Refer to Case 1 & 2 Tables):
CASE 1. Admin. & Supp. Activity Costs allocated in proportion to annual expenditure (weight) of each activity excluding Admin. & Supp.
CASE 2. Same as CASE 1 except that major activity annual expenditures(weights) have been reduced by sub-activity (program) expenditures for Maintenance Work, Right of Way Purchases, Contractor Payments, Traffic Safety Grants, and Public Transportation Assistance Grants. It is contended that the costs of these programs may vary greatly without affecting the cost of delivering these programs.
It is assumed that the annual expenditure balance for each major activity, after deducting the program expenditures, should reflect a reasonable estimate of the actual operational costs of delivering those programs and may be weighed accordingly.

ALLOCATION OF ADMINISTRATION AND SUPPORT ACTIVITIES COSTS TO OTHER MAJOR ACTIVITIES BY WEIGHT METHOD

Figure 1