



U.S. Army Corps of Engineers
Water Resources Support Center
Institute for Water Resources

Framing the Dialogue:

*Strategies, Issues and
Opportunities*

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Federal Infrastructure Strategy Program

May 1993

IWR Report 93-FIS-1

Federal Infrastructure Strategy Reports

This is the first of a series of interim reports which will be published during the Federal Infrastructure Strategy program, a three-year effort to explore the development of an integrated or multi-agency Federal infrastructure policy. This report documents the activities that took place in 1991 and 1992 during the first half of the program, including the results of the intergovernmental coordination facilitated by the Advisory Commission on Intergovernmental Relations (ACIR).

The Federal Infrastructure Strategy is a dynamic program involving many Government departments and agencies. The series of reports which chronicle the strategy's development reflect the desire to publish interim documentation as results become available. These documents will be used to facilitate the dialogue within the Federal and non-Federal infrastructure communities as policy deliberations continue.

The program will culminate with a final report to be published at the end of 1993. The interim documentation contained herein is not intended to foreclose or preclude the program's final conclusions and recommendations. Within this context, comments are welcome on any of these reports.

The next four reports planned for publication as part of the Federal Infrastructure Strategy Program are:

Challenges and Opportunities for Innovation in the Public Works Infrastructure, Volumes 1 and 2, (IWR Reports 93-FIS-2 and 93-FIS-3);

Infrastructure in the 21st Century Economy: A Review of the Issues and Outline of a Study of the Impacts of Federal Infrastructure Investments (IWR Report 93-FIS-4); and

Federal Public Works Infrastructure R&D: A New Perspective (IWR Report 93-FIS-5).

For further information on the Federal Infrastructure Strategy, please contact Robert A. Pietrowsky, Program Manager at:

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The Federal Infrastructure Strategy study team includes Cameron E. Gordon, Economic Studies Manager and James F. Thompson, Jr., Engineering Studies Manager. The program is overseen by Dr. Eugene Z. Stakhiv, Chief, Policy and Special Studies Division, and Kyle Schilling, Director of the Institute.

Reports may be ordered by writing (above address) or calling Mrs. Arlene Nurthen, IWR Publications, at (703)355-3042.



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
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June 24, 1994



CEWRC-IWR

MEMORANDUM FOR COMMANDER, Defense Technical Information Center,
Cameron Station, Alexandria, VA 22314

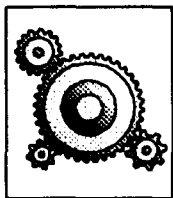
SUBJECT: Transmittal of IWR Report 93-FIS-1

1. Reference AR 70-31.
2. Two copies of IWR Report 93-FIS-1, "Framing the Dialogue: Strategies, Issues and Opportunities", has hereby been submitted.
3. Initial distribution of this report has been made to appropriate Corps of Engineers agencies. It is recommended that copies of this report be forwarded to the National Technical Information Center.
4. Request for the DTIC Form 50 (Incl 2) be completed and returned to WRSC-IWR.

FOR THE DIRECTOR:

Kyle E. Schilling
Director

Enclosure



The Federal Infrastructure Strategy Program

FRAMING THE DIALOGUE: STRATEGIES, ISSUES AND OPPORTUNITIES

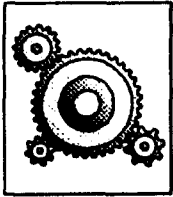
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Framing the Dialogue: Strategies, Issues and Opportunities

EXECUTIVE SUMMARY

Currently there is no integrated Federal policy to address the Nation's many infrastructure problems, including those associated with transportation facilities, water resource systems, and the management of waste. This report describes the progress, to date, of a new Federal interagency initiative to develop a "Federal infrastructure strategy".

The Federal Infrastructure Strategy (FIS) program is a three-year effort to explore opportunities for developing an integrated Federal infrastructure policy. It addresses the roles of the various levels of government and the private sector in devising approaches and solutions for improving infrastructure performance and ensuring more efficient investments. The program is a more detailed follow-up to the work of the National Council on Public Works Improvement, the Congressional Budget Office, the Congressional Office of Technology Assessment, and other national studies. As such, the current effort constitutes the first such examination of national infrastructure issues from the perspective of the responsible Federal agencies.

Development of the strategy recognizes that the Nation's infrastructure needs have already been adequately defined. An initial objective of the strategy is the improvement of interagency coordination of information, strategies, and resources. The ultimate aim of the program is the formulation of a framework that can serve to focus the national debate on the need for, and the elements of, a Federal infrastructure strategy.

PROGRAM PERSPECTIVE

A primary focus of the strategy development has been, and will continue to be, to promote and facilitate the active participation of representatives of the various Federal, state and local public works agencies and offices, along with infrastructure providers, academic and related research organizations, and advocacy, professional, and user groups. The current interest and level of Federal agency participation in the FIS program reflects the desire of the agencies to serve as responsible partners in such a national effort.

The effort is being managed by the Corps as a cooperative intergovernmental effort. The thrust of the approach is one of interagency partnership, with independent third party experts such as the Advisory Commission on Intergovernmental Relations (ACIR), the National Academy of Science's Building Research Board (BRB), the American Public Works Association (APWA), the National Academy of Public Administration (NAPA), the Civil Engineering Research Foundation (CERF), and other groups, being tasked to facilitate and organize the various dialogues, workshops and inquiries on the identified issues.



STRATEGY APPROACH

A three-tier approach is being pursued to involve a broad spectrum of participants in:

- a. A collaborative intergovernmental dialogue to clarify the roles of various levels of infrastructure agencies in resolving national public works problems;
- b. In-depth, interagency inquiries and workshops on important infrastructure topics to better develop the technical and management foundations of the policy formulation process;
- c. The commission of theme papers and technical studies on specific public works issues to serve as the basis for subsequent interagency discussions or follow up, in-depth inquiries.

This approach is aimed at the fundamental goal of utilizing the Federal role as a catalyst for effecting closer coordination between all levels of government. Therefore, the key element of the first phase of the program was the intergovernmental coordination ("the dialogue") that took place in 1991 and 1992. The dialogue was facilitated and coordinated by the staff of the Advisory Commission on Intergovernmental Relations (ACIR), and was guided by a Federal interagency work group.

The preliminary findings of the FIS are largely based on the broad consensus that resulted from this initial phase of interagency coordination regarding the issues essential to the development of a Federal strategy. The outputs of the consultation also included the recommendation of specific opportunities warranting further interagency cooperation. Approximately thirty FIS research elements were formulated within the three-tier framework to address the opportunities identified during the initial dialogue.

INTERAGENCY DIALOGUE

The approach taken was to consult with representatives of a broad range of agencies across the various levels of government and the private sector, in a series of professionally facilitated, one-day workshops convened by the ACIR. The consultation process was divided into two phases. The completed first stage focused on framing the infrastructure issue areas that should be addressed, along with potential opportunities to further Federal interagency cooperation within this framework. This phase culminated in the approval of the study findings by the ACIR, and their publication of the report titled Toward a Federal Infrastructure Strategy, which documents the findings resulting from the interagency coordination process. The subsequent phase, still ongoing, consists of a second round of issue specific interagency workshops which is following up on key recommendations of the initial consultation.

First Phase of ACIR Coordination

This formative phase of the coordination included a series of ten workshops with four separate groups of infrastructure constituencies. The process concluded with a synthesis meeting including all participants which was aimed at the development of a consensus report documenting the outputs of the consultation.



More than 25 Congressional and Federal agencies and departments were represented in the process, including the Departments of Transportation, Interior, Commerce, Energy, Treasury, and Agriculture, the Environmental Protection Agency, General Services Administration, Federal Accounting Standards Board, the Council of Economic Advisors, General Accounting Office, Congressional Budget Office, Congressional Infrastructure Caucus, Office of Technology Assessment, and the House and Senate Public Works Committees. In addition, more than 70 organizations representing other non-Federal infrastructure interest groups also attended the workshops.

Preliminary Findings

During the first half of the program, participants were able to reach agreement regarding the issues which are integral to the development of a comprehensive Federal or multi-agency infrastructure strategy. A broad consensus emerged around five infrastructure issues that both the agency representatives and other participants agreed should be addressed by a Federal strategy. Characterized by the ACIR as the "five essential issues", these topics comprise the initial output of the intergovernmental dialogue.

Strategies for More Efficient Investments: The rationales and priorities established for Federal infrastructure investment should be based on clear national performance based goals aimed at the efficient use of scarce resources. Performance, rather than construction, should be the primary Federal goal, with the cost-effective maintenance of existing stock, rather than large new programs, serving as the focus for investment opportunities. Greater political commitment is needed to support this goal.

This will also require rethinking the output measures upon which public works projects should be evaluated, and redefining the framework for needs assessments to reflect this increased emphasis on performance. Both national needs studies and agencies' individual program evaluations should be more performance-oriented (including an emphasis on physical and economic performance). The use and consistent application of analyses such as cost-benefit evaluations should be increased to support Federal decision strategies and to assess post investment (O&M) decisions.

Clarification of Roles and Responsibilities: Although it is often cost effective and necessary for the Federal government to establish infrastructure related standards and regulations, many state and local governments complain that some requirements unnecessarily displace local decision-making authority, create too much of an administrative burden, and add too much cost to the projects. These perceptions of intergovernmental burdens and lack of flexibility hamper the provision of infrastructure, due in part to the changing expectations associated with the Federal, state, local and private roles. Such differences should be narrowed by building closer partnerships.

Likewise, unnecessary regulatory and administrative burdens in providing infrastructure should be reduced. Flexibility in spending Federal aid for infrastructure, and in complying with Federal and state mandates, should be increased. And, because of limited tax bases and engineering capabilities, small governments sometimes face relatively greater challenges than larger jurisdictions in complying with Federal regulations. Therefore, special attention needs to be given to the compliance problems of small governments.



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Develop and Apply Innovative Technologies: There is a major Federal role in the promotion, demonstration, evaluation, and dissemination of innovative infrastructure technologies. Although many technical, legal and procurement obstacles impede the development and application of Federal infrastructure R&D, the potential for new technologies and other products of research to help solve public works problems remains great. Overall, information technologies and intergovernmental coordination offer the greatest R&D potential for improving infrastructure performance.

Key barriers to public works innovation were identified to include: the fragmented R&D government structure, inadequate emphasis on technology transfer, complexity and requirements of procurement rules, the lack of flexibility in technical standards, and the risk of liability from tort claims.

More effective mechanisms are needed to address the lack of a Federal focus for national infrastructure technology development. In addition, strategies are needed to encourage increased public-private R&D partnerships, to develop more flexible standards, regulations and contracting procedures to accommodate innovation, to accelerate technology transfer sharing, and to institute tort reform, risk-sharing programs and demonstration projects to overcome the fear of liability.

Financing Reforms: The key financing issue is the relationship between the declining Federal financing of public works and the Federal interest in providing infrastructure services. Large capital investment in new programs is greatly constrained by the limited resources of all levels of government, and the growing demand for funding to operate and maintain the national infrastructure systems already in place. Therefore, it is highly unlikely that long term Federal financing for new infrastructure programs will increase in the future, and in fact, significant reductions in many Federal programs can be expected.

The changes in public revenue systems and expenditure patterns over the past decade now requires significant adjustments in infrastructure financing methods. Specific reforms need to address the issues associated with beneficiaries paying a greater share of costs, intergovernmental funding, tax-exempt funding, and revenue diversification. A common problem is the increasingly difficult challenge of assigning the responsibility of project costs. In particular, the broader application of user fees requires more accurate data on project costs and benefits, and should recognize that secondary benefits for some programs and projects are significant.

Improve Infrastructure Management: Management improvements closely parallel the issues associated with strategic investment in that both emphasized the need for infrastructure goals to focus more on performance outputs in order to improve the quality of infrastructure services. However, measures of infrastructure system performance are often difficult to quantify, and improved service measures are an important prerequisite to the development of performance based standards. In this regard, a key issue is the need to improve coordination between the various Federal infrastructure agencies. Also central to a broader definition of infrastructure goals is the need for improved performance monitoring and management techniques to facilitate the measurement of performance.

Management methods and practices should be reformed to focus more on the performance of services (as indicated by output measures) rather than on operating "inputs". Management incentives are an effective means to encourage demand management techniques, improved



management practices, and as an alternative to Federal regulations and mandates. There should also be greater use of incentives to increase the useful lives of public works through improved maintenance, and to lower unnecessary administrative and legislative barriers to using low-capital techniques. More flexible funding and regulations are especially important to insuring performance management, and more use of capital programming and budgeting by the Federal government is essential to improved infrastructure decision-making.

ACIR Recommendations

Based on the results of the initial consultation, ACIR recommended that the interagency coordination process continue with a strong focus on translating the identified issues into specific action plans that will comprise the framework of the Federal strategy. The Commission identified the following opportunities in working toward this framework:

- a. Establishing programs to educate the general public, government officials, and public works professionals about the importance of public works and the innovations that are needed to keep the Nation's infrastructure systems among the world's most productive;
- b. Developing improved methods for preparing performance-based infrastructure needs studies reflecting strategic objectives;
- c. Establishing infrastructure-specific guidelines for applying the Federalism Executive Order, the "small governments" provisions of the Regulatory Flexibility Act, the Administrative Dispute Act of 1990, and the Negotiated Rulemaking Act of 1990;
- d. Making greater use of the National Environmental Policy Act as an interagency focus to combine reviews and streamline the process for issuing environmentally sound public works permits;
- e. Pooling federal agency experiences in using performance-standard regulations and mandate reimbursement practices;
- f. Developing a national cooperative infrastructure research program, including a strong technology transfer component;
- g. Removing or minimizing the barriers and risks confronted when innovating new technologies and practices;
- h. Establishing principles and guidelines for public agency benefit, cost, and deferred maintenance accounting;
- i. Evaluating the benefits and limitations of innovative financing techniques -- including user fee systems, state revolving loan funds, tax exempt financing, and privatization techniques -- and publicizing successful innovations;



- j. Improving the methods and practices of capital improvement programming and benefit-cost analysis; and
- k. Promoting geographic data coordination across all levels of government.

PROGRAM ACTIVITIES

Upon the completion of the first phase of the interagency coordination, the ACIR recommendations were utilized to develop the balance of the FIS program. Work elements were formulated and pursued within the previously framed three-tier approach. The goal was to address the needs reflected by the five essential issues as comprehensively as possible, while continuing strategy development as a collaborative intergovernmental process.

The workplan was structured to emphasize the continued involvement of third party experts to facilitate the conduct of specific study elements. An important part of the program is the second phase of the interagency coordination. In this stage, ACIR has established six interagency task forces which are addressing cross-program Federal infrastructure issues. The task forces are currently working to develop statements of principles and guidelines (P&G) for each topic, and implementation plans for government-wide application. This phase of the interagency dialogue also recognizes the interrelated ongoing initiative by the National Economic Council to articulate and implement elements of the Administration's infrastructure policy.

In addition, the overall program includes the conduct of more than twenty other inquiries and technical studies on a broad spectrum of infrastructure topics. Table ES-1 provides a summary of the program, including the objective and participants for each element. Additional information on the program is included in Chapter II which provides a short narrative summary for each study element. Chapter II also includes a reference guide index to other sections of the main report where more detailed discussions of the various program elements can be found.

SUMMARY

Much has been done to inventory national infrastructure needs and to develop alternative strategies in response to these assessments. However, despite these efforts, no integrated Federal policy exists to address the Nation's many infrastructure problems.

The absence of such an overarching policy limits the Federal government's ability to effectively select and manage infrastructure programs, including those involving water resources, transportation and waste management.

The first phase of interagency coordination working towards the development of a Federal Infrastructure Strategy has been completed. Participants included representatives of Federal agencies, state and local governments, public works interest groups and the professional and academic community.

An output of the first phase of the intergovernmental coordination is the consensus reached in confirming the work of National Council on Public Works Improvement and others by identifying the key issues that need to be addressed by a Federal Infrastructure Strategy.

Table ES-1
Federal Infrastructure Strategy Program Summary

Interagency Dialogue - Collaborative Federal interagency process to identify and explore issues in development of national infrastructure strategies. First phase of workshops completed, ACIR published findings with recommendation for continued interagency work on specific issues described below:

Title	Objective	Participants¹
Infrastructure Investment Strategies	Performance-based decision-making as a management tool for outcome oriented goals, objectives and investment decisions.	ACIR, Various Federal, State and Local Agencies
Infrastructure Investment Analyses	Sharing cost-benefit methodologies, standards, applications and lessons learned towards more consistent and uniform application.	ACIR, Various Federal Agencies, and Offices
Deferred Maintenance and Public Reporting Practices	Application of the concepts of maintenance planning and asset accounting to the infrastructure problem of deferred maintenance.	ACIR, Various Federal, State and Local Agencies
Environmental Decision-Making for Public Works Projects	Effort to integrate multiple environmental permit decisions for Federal public works, each with their own rules, into a streamlined administrative process as a means of reducing project costs.	ACIR, Various Federal, State and Local Agencies
Flexible and Performance-Based Regulation	Examination of more flexible and performance-based Federal regulation of infrastructure development and maintenance.	ACIR, Various Federal, State and Local Agencies
Diversified Infrastructure Financing	Examination of Federal financing alternatives such as user fees, revolving fund loans, grant programs and privatization.	ACIR, Various Federal, State and Local Agencies

¹ In addition to the Corps of Engineers and the Office of the Assistant Secretary of the Army for Civil Works, Federal departments and Congressional offices that are participating in one or more of the task forces include the Departments of Agriculture, Defense, Energy, Interior (including BUREC, FWS), Transportation (including FHWA, FTA, FAA, FRA), and Treasury, the Environmental Protection Agency, General Services Administration, Office of Management and Budget, Government Accounting Standards Board, General Accounting Office, Congressional Budget Office, Office of Technology Assessment, Congressional Research Service, and the Council on Environmental Quality.

Table ES-1 Continued
Federal Infrastructure Strategy Program Summary

In-Depth Inquiries - Concurrent with intergovernmental dialogue, the following inquiries were initiated:

Title	Objective	Participants
Measuring and Improving Infrastructure Performance	Examination of key issues regarding operational definition, measurement and improvement of infrastructure performance.	Building Research Board (BRB)
Economic Impacts of Federal Infrastructure Investments	Interagency assessment of the national economic impacts of Federal public works investments, including a controlled comparison of cost-benefit and productivity models using a data base over nine infrastructure categories. Effort facilitated by Apogee Research with academia support.	Departments of Transportation, Army, Interior, Agriculture, Commerce, and Energy, EPA, OMB
Public Works Infrastructure Innovation	Examination of the innovation process and identification of barriers and opportunities for the promotion of innovation in public works infrastructure.	Construction Engineering Research Laboratories (CECERL)
Federal Roles in Infrastructure R&D	Identification of Federal R&D infrastructure trends for technology transfer being facilitated by ASCE's Civil Engineering Research Foundation (CERF).	CECERL, CERF, Univ. of Illinois
Corps of Engineers Technology Transfer	Cooperative intergovernmental/private sector transfer of Waterways Experiment Station's Falling Weight Deflectometer, and the Institute for Water Resources' IWR-MAIN technologies.	CEWRC-IWR, CEWES, APWA, AWWA
Cooperative Federal R&D Technology Transfer Demonstration Projects	Cost shared, interagency effort aimed at transfer of Federally developed technology into practice within municipal public works community, including cosponsored demonstration projects.	CERF, DOT (FHWA), DOE, EPA, DOI, NIST, CECERL, CEWES
Local Public Financing Impact Model	Development of system for estimating expenditure & revenue impacts of public works at local level using case study approach.	CEWRC-IWR

Table ES-1 Continued
Federal Infrastructure Strategy Program Summary

In-Depth Inquiries - Concurrent with intergovernmental dialogue, the following inquiries were initiated:

Title	Objective	Participants
Public Works Management Practices and Barriers to Improved Performance	Identification and evaluation of roadblocks which prevent local public works departments from implementing improved management practices.	American Public Works Assoc. (APWA), National Academy of Public Admin. (NAPA)
Maintenance Reporting and Accounting	Examination of the utility and effectiveness of the practice of deferred maintenance accounting.	Urban Institute
Budgeting for Capital Programs	Examination of the arguments for a Federal capital budget and the link between budgeting reforms & improved infrastructure investment.	NAPA



Table ES-1 Continued
Federal Infrastructure Strategy Program Summary

Background Papers and Technical Studies - In addition, the following theme papers and technical work have been commissioned:

Title	Objective	Participants
Value of Infrastructure to America	Discussion of the characteristics of the national economy of interest to public works infrastructure and the importance of quantitative measures to decision making.	ACIR (McDowell, Bell)
Alternative Infrastructure Strategies	Evaluation of the alternative strategies for infrastructure identified by National Council for Public Works Improvement (NCPWI).	ACIR (McDowell, Bell)
Innovations in State Financing	Identification of innovative state government financing practices that serve as models for other state and Federal agencies.	Urban Institute
The Role of Tax-Exempt Financing in Public Infrastructure Investment	Discussion of how the 1986 tax reform legislation effects supply and demand of tax exempt bonds.	Apogee Research
Stimulating Innovation	Discussion of the benefits of R&D innovation to Federal public works progress.	CECERL
Relationship Between Standards & Performance	Examination of the linkage between standards and the delivery of goods and services from infrastructure.	GKY & Associates
Capital Budgeting Lessons	Examination of the conceptual and philosophical arguments underlying capital budgeting.	CEWRC-IWR
Infrastructure Summaries	Abstracts of significant infrastructure studies completed and published between 1983-1993.	CEWRC-IWR
Interagency Cooperative Studies	Cost-shared studies on the employment effects of water resources environmental restoration, & water quality based pricing strategies.	EPA/CEWRC-IWR
Fragile Foundations: How Has Congress Responded	Comparison of the NCPWI's recommendations versus the action taken by the 102nd Congress on infrastructure-related legislation.	CEWRC-IWR
Impact of Economic Structure on Public Works Policy	Examination of evolving economic issues that impact on public works policies from the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).	CEWRC-IWR

The issues identified include the need for: 1) strategies for more efficient investment, 2) the reduction of regulatory and administrative burdens, 3) accelerated technology transfer, 4) financing reforms, and 5) improved infrastructure management methods and practices.

A recurring theme within these issues is performance or outcome-based decisionmaking. While many Federal policy discussions on infrastructure focus on the need for investment, fiscal constraints at all levels of government highlight the need for the use of meaningful performance measures in making more efficient investment decisions.

FINDINGS

Preliminary findings, based on the intergovernmental coordination and research completed to date include:

- **National goals for infrastructure should make greater use of performance or outcome-based investment strategies.** Needs studies should be more performance-oriented, including both physical and economic outputs, and directed toward achievement of clear strategic investment goals.
- **Federal infrastructure investment decisions** should be more consistently aimed at improving public works performance, and should be based on the uniform application of analyses such as cost-benefit evaluations.
- **Unintended Federal regulatory and administrative burdens** in providing infrastructure should be relieved, while flexibility in spending Federal aid and in complying with Federal and state mandates is needed.
- **Regulatory procedures** should be examined for opportunities for streamlining public works permitting to reduce investment costs and delays while protecting the environment.
- **The potential for new Federally developed technologies** to address national infrastructure problems is great. However, significant cultural, administrative, legal, and management barriers currently impede the transfer of Federally developed technology to other sectors.
- **Several changes** are needed to increase the effectiveness of **Federal technology transfer**, including designating a centralized focus for a national infrastructure R&D policy with enhanced intergovernmental partnerships.
- **Federal financing reforms** are needed in order to improve the efficiency and equity of infrastructure investments. Emphasis should be placed on developing and using diversified revenue sources including: bond banks, revolving loan funds, tax-exempt bonds, pricing mechanisms, and intergovernmental funding, including having beneficiaries paying a greater share of infrastructure costs.
- **Management methods and practices** should focus more on the performance of services (as indicated by output measures) rather than on facilities and operations "inputs".



- **Maintenance planning and deferred maintenance reporting practices** should be considered to improve the management of existing infrastructure stock.
- **Capital budgeting** should be considered by all levels of government, and the use of low-capital techniques and performance incentives should receive greater attention.

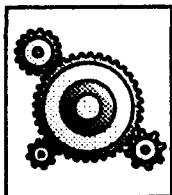
NEXT STEPS

The current coordination between the various infrastructure interests will continue with a focus on the specific issues identified during the first phase. Completion of the initiative, with interim documentation published as results become available, is aimed at facilitating the dialogue within the Federal and non-Federal communities as policy development continues.

A second round of interagency workshops facilitated by ACIR has been initiated to focus on specific topics addressing these issues.

Ongoing in-depth inquiries, technical studies and background papers for a wide range of topics will be completed to further develop the technical and management foundations for strategy development.

The conduct of the program will continue to emphasize interagency participation while focusing on the central theme of improving infrastructure performance. The results of the interagency task forces and other strategy activities are being closely coordinated through the Office of the Assistant Secretary of the Army for Civil Works with the National Economic Council's working groups on Infrastructure Finance and Infrastructure Management, while the scope of ongoing work will remain flexible to enable the program to address evolving policy issues.



Acknowledgements

This report documents the progress to date on a series of intergovernmental analyses undertaken by the U.S. Army Corps of Engineers under a broad administrative directive aimed at the development of a Federal Infrastructure Strategy (FIS).

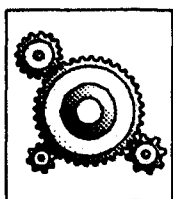
The FIS program is being administered by the Corps as a collaborative interagency effort. Policy guidance for the program is provided by the Office of the Assistant Secretary of Defense (Civil Works) through Dr. Robert N. Stearns, Deputy Assistant Secretary for Project Management, while program execution is overseen by the Corps of Engineers Directorate of Civil Works through Donald Kisicki, Chief, Office of Interagency and International Activities.

The Corps Institute for Water Resources (IWR) has detailed management responsibility under the direction of Mr. Kyle E. Schilling, Director, IWR; Dr. Eugene Z. Stakhiv, Chief, Policy and Special Studies Division; Mr. Robert A. Pietrowsky, Program Manager, for the Federal Infrastructure Strategy; and the FIS Study Team which includes Mr. Cameron Gordon, Economic Studies Manager and Mr. James F. Thompson, Jr., Engineering Studies Manager. Dr. George Antle, Chief, Navigation Division is recognized for sharing his insights on Corps of Engineers infrastructure policy, and special appreciation is given to Ms. Jan Peterson, IWR, for her tireless efforts and patience in formatting and editing the report.

The documentation herein is the product of the substantial efforts of numerous representatives of the participating Federal agencies, departments and Congressional offices, state and local governments, infrastructure users, academic analysts, advocacy groups, and public and private infrastructure providers. The contributions of these participants in the program are greatly appreciated. The interest in strategy development is strong and growing as this report goes to publication. Thanks are extended here to all those outside the Corps who are helping the program become a truly cooperative effort.

In particular, special note must be made of the Advisory Commission on Intergovernmental Relations (ACIR), who has ably guided the intergovernmental dialogue, and whose staff has significantly contributed to the program documentation. In this regard, special mention must be made of Dr. Bruce D. McDowell, Mr. Charles Griffiths, and Mr. Jeffrey Fitzpatrick of the ACIR staff for their invaluable efforts in both formulating and facilitating the interagency dialogue portion of the program, and Dr. Michael E. Bell of John Hopkins University, who co-authored several background papers with Dr. McDowell. Thanks is also due ACIR for allowing the report Toward a Federal Infrastructure Strategy, and Dr. McDowell's article: Public Works for Tomorrow to be included as appendices to this document.





Framing the Dialogue: Strategies, Issues and Opportunities

FEDERAL INFRASTRUCTURE STRATEGY

TABLE OF CONTENTS

<u>SUBJECT</u>	Page
Executive Summary	i
Acknowledgements	xiii
Table of Contents	xv
I. INTRODUCTION	1
II. THE STATE OF FEDERAL INFRASTRUCTURE POLICY	5
III. CLARIFYING RESPONSIBILITIES: THE FEDERAL ROLE	19
IV. MEASURING PERFORMANCE AND CHOOSING INVESTMENTS	37
V. STIMULATING INNOVATION AND TECHNOLOGY TRANSFER	47
VI. ADEQUACY OF INVESTMENT LEVELS AND FINANCING MECHANISMS	53
VII. MANAGING PROGRAMS AND IMPROVING PERFORMANCE	61
VIII. PUTTING THEORY INTO PRACTICE: THE CORPS OF ENGINEERS	67
IX. SUMMARY AND NEXT STEPS	75
ENDNOTES	79



LIST OF TABLES

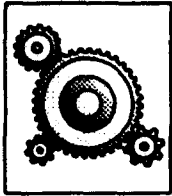
TABLE	Page
1 - Usual Lead Roles in Public Works Categories	21
2 - Organizations Represented at One or More Workshops	28
3 - Infrastructure's Impacts on Economic Activity	40
4 - Sample Performance Barriers Identified in Three Infrastructure Case Studies	44
5 - Barriers to Innovation	50
6 - Summary of State Programs for Community Infrastructure Innovation	56

LIST OF FIGURES

FIGURE	Page
1 - A Strategy for Improving America's Public Works	7
2 - Program Approach - Development of a Federal Infrastructure Strategy	10
3 - Strategy for Public Works Infrastructure R&D and Technology Transfer (IRTT)	48

LIST OF APPENDICES

APPENDIX	Page
A: <u>A Summary of Previous Reports: The Context of the Infrastructure Debate</u>	A-1
B: <u>The Federal Role: A Summary of Federal Responsibilities in Transportation, Water Resources, and Waste Management</u>	B-1
C: Background Paper - <u>Interpreting Trends in Federal Infrastructure Investment</u>	C-1
D: Background Paper - <u>The Value of Infrastructure</u>	D-1
E: Background Paper - <u>Infrastructure Strategies</u>	E-1
F: ACIR Perspective - <u>Public Works for Tomorrow</u>	F-1
G: ACIR Report A-122 - <u>Toward a Federal Infrastructure Strategy: Issues and Options</u> . .	G-1
H: Background Paper - <u>Developing a Federal Infrastructure Strategy</u>	H-1



I. Introduction

The Federal Infrastructure Strategy (FIS) is a three-year program to explore the development of an integrated Federal infrastructure policy or vision. This new initiative addresses the roles of the various levels of government and the private sector in devising approaches and solutions for improving infrastructure performance and ensuring more efficient investments.

The program is a more detailed follow-up to the work of the National Council on Public Works Improvement, the Congressional Budget Office, the Congressional Office of Technology Assessment, and other national studies. Development of the strategy recognizes that the Nation's infrastructure needs have already been adequately defined. This effort constitutes the first such examination of national infrastructure issues from within the design of the Federal implementation agencies.

The aim of the effort is the formulation of a substantive framework that can serve to focus the national debate on the need for, and the elements of, a Federal infrastructure strategy. An initial objective is the improvement of interagency coordination of information, strategies, and resources towards sharing of efficient procedures and technologies, and minimizing programmatic conflicts and redundancies.

AUTHORITY

The Federal Infrastructure Strategy program originated as an Administration initiative included in the General Investigations (GI) portion of the President's Fiscal Year (FY) 1991 budget request for the Corps of Engineers. The FIS was subsequently approved and expanded in scope by the Congress in House Report 101-536, accompanying the 1991 Energy and Water Development Appropriations Act. House Report 101-536 also included language directing the Corps to conduct market feasibility studies for public/private opportunities for providing local infrastructure facilities. This privatization initiative was subsequently separated from the FIS and is being independently pursued under the Corps of Engineers Partners for Environmental Progress (PEP) Program.

The Congressional committee report emphasized pursuing opportunities for providing infrastructure through a partnership including the Departments of the Army, Energy, the Environmental Protection Agency (EPA), and other Federal agencies, state and local governments and the private sector. Consideration was to be given to planning, designing, financing, constructing, operating, and maintaining the nation's infrastructure.¹

SCOPE OF THE INFRASTRUCTURE STRATEGY

The principal provider of most categories of public works infrastructure is overwhelmingly state and local governments. However, Federal grant assistance accounts for a substantial share of state and local public works spending. More significantly, the Federal establishment is clearly the catalyst for changes in national infrastructure policies in light of its authorization, appropriations and regulatory roles, and the accompanying Federal influence on planning, engineering, construction, and operations design standards and management practices.

Within this context, the scope of the Federal Infrastructure Strategy (FIS) encompasses Federally provided, leveraged, or regulated public works infrastructure programs. This scope could include public buildings, public housing, natural resources, human infrastructure and public schools, and emerging telecommunication systems, and other facilities that serve public needs. Elements of the FIS do address some of these programs. However, for the sake of manageability, the strategy is focusing primarily, although not exclusively, on the broad public works infrastructure categories identified by the National Council on Public Works Improvement: transportation (highways, aviation, mass transit and intermodal), water (navigation, flood control, water supply, wastewater and other water resources), and waste (solid, and hazardous).²

These three broad categories encompass large national networks involving many intergovernmental interests. Certainly, lessons to be learned from the nation's transportation, water and waste systems can also be applied to improve the management of other types of facilities. Focusing the scope of the Federal Infrastructure Strategy on these public works modes does not obviate the fact that other infrastructure systems are also important public works. In fact, testimony at the 16 January 1993 hearing on "Investment in America's Infrastructure" before the House Public Works and Transportation Subcommittee on Economic Development, confirms the interest in placing facilities such as public buildings, schools and hospitals within the framework of the national infrastructure dialogue.³

PURPOSE AND ORGANIZATION OF THIS REPORT

This report presents the results of the first half of the Federal Infrastructure Strategy (FIS) program with a focus on the guiding intergovernmental coordination ("the dialogue") that took place in 1991 and 1992. This dialogue was facilitated by the staff of the Advisory Commission on Intergovernmental Relations (ACIR), and was guided by a Federal interagency work group. The ACIR work was funded and managed by the Corps of Engineers as a central component of the FIS program.

This document also serves to outline the resulting components of the FIS program which are currently underway. In addition to this introductory chapter, the main body of this report is organized into eight sections. Chapter II presents an overview of infrastructure policy issues, introduces the Federal Infrastructure Strategy Program, and includes a brief summary of the program elements. The program summary in Chapter II also includes an index to the remaining sections of the report as a reference guide for readers interested in more detailed discussions of the various program elements.

Chapters III through VII are organized to address specific infrastructure themes. These sections present more detailed discussions of the FIS work elements within the context of each

chapter's topic. Finally, Chapter VIII includes a summary of the infrastructure initiatives undertaken by the Corps of Engineers, while Chapter IX presents a summary of the FIS program's findings to date and planned next steps. Preliminary findings of the FIS are based on the broad consensus that resulted from this initial phase of interagency coordination regarding the issues essential to the development of a Federal strategy.

The report also includes eight appendices presenting selected key products completed during the first part of the FIS effort. These appendices are as follows:

Appendix A: A Summary of Previous Reports: The Context of the Infrastructure Debate

Appendix B: The Federal Role: A Summary of Federal Responsibilities in Transportation, Water Resources, and Waste Management

Appendix C: Background Paper - Interpreting Trends in Federal Infrastructure Investment, Gordon, March 1993

Appendix D: Background Paper - The Value of Infrastructure, McDowell and Bell, April 1991

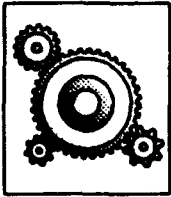
Appendix E: Background Paper - Infrastructure Strategies, McDowell and Bell, April 1991

Appendix F: Background Article - Public Works for Tomorrow, McDowell, Intergovernmental Perspective, Advisory Commission on Intergovernmental Relations, Summer 1992

Appendix G: ACIR Report A-122 - Toward a Federal Infrastructure Strategy: Issues and Options, Advisory Commission on Intergovernmental Relations, August 1992

Appendix H: Background Paper - Developing a Federal Infrastructure Strategy, Vallianos and Stakhiv, Water Resources Update, Autumn 1991





II. The State of Federal Infrastructure Policy

Currently there is no integrated Federal policy or strategy to address the Nation's many infrastructure problems. Over the past decade several major studies on the nation's infrastructure problems have been completed. These studies have primarily focused on defining national issues and assessing the infrastructure needs within the framework of the traditionally defined categories of public works infrastructure, including: transportation facilities, water resource systems, and the management of solid and hazardous waste. Although the many infrastructure problems have been defined and redefined, the range of public works needs listed and assessed, and numerous opportunities for improvement identified, the issues associated with the development of an overarching Federal or multi-agency strategy remain largely unresolved.

THE IMPORTANCE OF INFRASTRUCTURE

Defining the scope of public works infrastructure has often defied Federal policymakers and the communities of engineers, planners and elected officials alike. In fact, Grigg reports that the word "infrastructure" is not even found in some dictionaries.⁴ Webster's II, New Riverside University Dictionary defines infrastructure as: an underlying base or foundation; or the base facilities, equipment, and installation needed for the functioning of a system.⁵

Historically, the physical characteristics of a public works facility or system have been utilized for the definition and assessment of infrastructure condition, while the services provided have been considered for the analysis of economic benefits.⁶ However, even within this context, the various definitions of infrastructure utilized by past national assessments and needs studies have differed significantly.

In Fragile Foundations, the comprehensive study by the National Council on Public Works Improvement, infrastructure was defined as the physical framework upon which the nation's economy depends.⁷ In the broadest sense public works infrastructure includes facilities or services that share the following general characteristics: high capital costs, long economic life, interaction with other parts of a system, and public ownership.⁸ This definition has usually included, as a minimum, transportation, water resources, and waste management systems.

Currently, the policy implications of the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) and the increasing emphasis on the concept of performance is further clouding the definition by shifting the focus of infrastructure characterization from traditional mode categories towards aggregations of service outputs. For example, in developing a National Transportation Policy, the Department of Transportation organized its inquiry along the lines of categories such as intercity freight, intercity passenger, urban/suburban mobility, international, etc.

INFRASTRUCTURE AS A FEDERAL POLICY ISSUE

The condition of the Nation's infrastructure was a subject of widespread interest beginning in the early 1980's. In 1981, a study by Pat Choate and Susan Walter, America in Ruins: The Decaying Infrastructure, suggested that the Nation needs to pay much greater attention to the maintenance of public facilities essential to national economic growth.

America in Ruins triggered a watershed of reports through the 1980's and the early 1990's which debated the fundamental issues surrounding infrastructure need, investment strategies, and the clarification and/or reform of the roles of all levels of government in providing and maintaining public works. A summary of the findings and recommendations of subsequent key national infrastructure studies of interest to the ongoing strategy development can be found in Appendix A, A Summary of Previous Reports: The Context of the Infrastructure Debate. This summary includes key Congressional infrastructure assessments by the Congressional Budget Office (CBO), the Office of Technology Assessment (OTA), and the Joint Economic Committee.

The most comprehensive national study was the 1988 final report of the National Council on Public Works Improvement (the "Council", 1984-1987). The Council was created by the Public Works Improvement Act of 1984 (P.L. 98-501). The Council's conclusions reflected the preparation and synthesis of over 5000 pages of research material involving dozens of infrastructure topics, and the results of numerous public hearings and other public forums. Although the final report concluded that the state of the Nation's infrastructure stock was not as poor as previous reports had purported, there was a danger that, if action is not taken, further deterioration of public facilities will threaten the Nation's economic productivity.

In its report to the President, the Council specifically found "convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements, and insufficient to meet the demands of future economic growth and development."⁹

The report called for a doubling of the Nation's capital investment and for renewed attention to the maintenance of highways, roads, bridges, airports, transit systems, ports, waterways and other water resources projects, and water supply, wastewater treatment, solid waste disposal, and hazardous waste management facilities. The full text of the Council's recommendations are presented in Figure 1.

The debate over the Council's recommendations resulted in a rush of other reports by the Congressional Budget Office and the Congressional Office of Technology. Several of these studies challenged the Council's recommendation that national infrastructure outlays should be increased by as much as 100 percent. For example, in its report New Directions for the Nation's Public Works, CBO placed greater emphasis on ensuring the economic efficiency of each investment or project. This report stated that "although further, carefully selected investments in public infrastructure may well be productive, there is little evidence that substantial, across-the-board increases in current programs would be more productive on average than private investment."¹⁰



Figure 1
A Strategy for Improving America's Public Works

No single approach is adequate to ensure the future viability of America's infrastructure. A broad range of measures is necessary to make a meaningful difference by the turn of the century. Specifically these should include:

- A national commitment, by all levels of government and the private sector, to increase capital spending by as much as 100 percent above current levels.
- Clarification of the respective roles of the Federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability.
- More flexible administration of Federal and state mandates to allow cost-effective methods of compliance.
- Accelerated spending of the Federal highway, transit, aviation, and waterways trust funds.
- Financing of a larger share of the cost of public works by those who benefit from services.
- Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing.
- Strong incentives for maintenance of capital assets and the use of low-capital techniques, such as demand management, coordinated land use planning, and waste reduction and recycling.
- Additional support for research and development to accelerate technological innovation and for training of public works professionals, and
- A rational capital budgeting process at all levels of government.

None of these steps will be easy or unopposed. But the increasing cost of delay is certain. The Council urges the President, the Congress, and the Nation's state and local leaders to act on the agenda immediately.

Source: National Council on Public Works Improvements, Fragile Foundations, 1988.



Today, Federal infrastructure policymaking is focusing on the design of programs that best contribute to economic growth, including the targeting of investments on those projects that will have the highest social rate of return. A current initiative aimed at developing the administration's infrastructure policy is the National Economic Council's interagency working groups on infrastructure management and finance. These groups include representatives from the Departments of Transportation, Treasury, Labor, Army, the Environmental Protection Agency, the Office of Management and Budget, and the President's Council of Economic Advisors.

The management working group is examining methods to improve the ways agencies choose the level and composition of agency investment portfolios, and ways of incorporating performance incentives into Federal infrastructure grant programs.

The finance group is examining how financing methods affect the adequacy and efficiency of infrastructure outlays, including consideration of concepts such as a Federal Infrastructure Bond Bank, added support for state revolving funds dedicated to infrastructure, and liberalizing the rules governing the use of tax-exempt bonds. Other finance proposals under consideration include reforming the pricing infrastructure facilities, variation of cost-sharing formulas, the consequences of adopting some form of a capital budget.

Both groups are receiving the interim reports, background papers, and work-in-progress outputs of the FIS program, including products of the ongoing interagency task force meetings, as inputs to the administration's policy deliberations.

THE FEDERAL INFRASTRUCTURE STRATEGY

Determining the appropriate Federal infrastructure roles, the proper levels of investment in public works, and the changes needed to make Federal programs more efficient and effective is a continuing challenge. The Federal Infrastructure Strategy program was initiated to act as a catalyst in the ongoing debate.

The program is a more detailed follow-up to the work of the National Council on Public Works Improvement, the Congressional Budget Office, the Congressional Office of Technology Assessment, and other national studies. Therefore, development of the strategy recognizes that the Nation's infrastructure needs have already been adequately defined. As such, however, the current effort constitutes the first such examination of national infrastructure issues from within the design of the Federal implementation agencies.

The aim of the effort is the formulation of a substantive framework that can serve to focus the national debate on the need for, and the elements of, a Federal infrastructure strategy. An initial objective is the improvement of interagency coordination of information, strategies, and resources towards sharing of efficient procedures and technologies, and minimizing programmatic conflicts and redundancies.

Strategy Approach

Policy guidance for the Federal Infrastructure Strategy is provided by the Assistant Secretary of the Army (Civil Works) and program execution is overseen by the Headquarters, U.S. Army Corps of Engineers Office of Interagency and International Activities (CECW-I). Detailed

program and technical management, and operational responsibilities reside with the Corps' Institute for Water Resources.

The effort is being managed by the Corps as a cooperative intergovernmental effort. The thrust of the approach is one of interagency partnership, with independent third party experts such as the Advisory Commission on Intergovernmental Relations (ACIR), the National Academy of Science's Building Research Board (BRB), the American Public Works Association (APWA), the National Academy of Public Administration (NAPA), the Civil Engineering Research Foundation (CERF), and other groups, being tasked to facilitate and organize the various dialogues, workshops and inquiries on the identified issues.

As displayed in Figure 2, a three-tier approach is being pursued to involve a broad spectrum of participants in:

- a. A collaborative intergovernmental dialogue to define and clarify the roles of various levels of infrastructure agencies in resolving national public works problems;
- b. In-depth, interagency inquiries, workshops, and technical studies on important infrastructure topics to better develop the technical and management foundations of the policy formulation process;
- c. The commission of theme papers and technical documents on specific public works issues to serve as the basis for subsequent interagency discussions or follow up, in-depth inquiries.

Approximately thirty separate study elements have been formulated within this three-tier approach, with the fundamental goal of utilizing the Federal role as a catalyst for effecting closer coordination between all levels of government.

Basic Principles

During the formative phases of the strategy development, key recommendations of the National Council on Public Works Improvement (1988) and others were examined towards the formulation of guiding principles to frame the interagency dialogue.¹¹ These principles are among the recommendations included in the Council's 1988 report to the President and Congress, but also reflect the influence of subsequent work by the Congressional Budget Office, the Office of Technology Assessment, and the participants in the initial stage of the FIS dialogue facilitated by the Advisory Commission on Intergovernmental Relations.

Note that the current dialogue necessarily confronts the debate suggested by the contrast between the Council's recommendation to double the level of national infrastructure investment, and CBO's cautions against large across-the-board increases in current programs. Of course, since the time these reports were published the ability of public revenue systems to respond to changing infrastructure priorities has further declined at all levels of government.



Program Approach

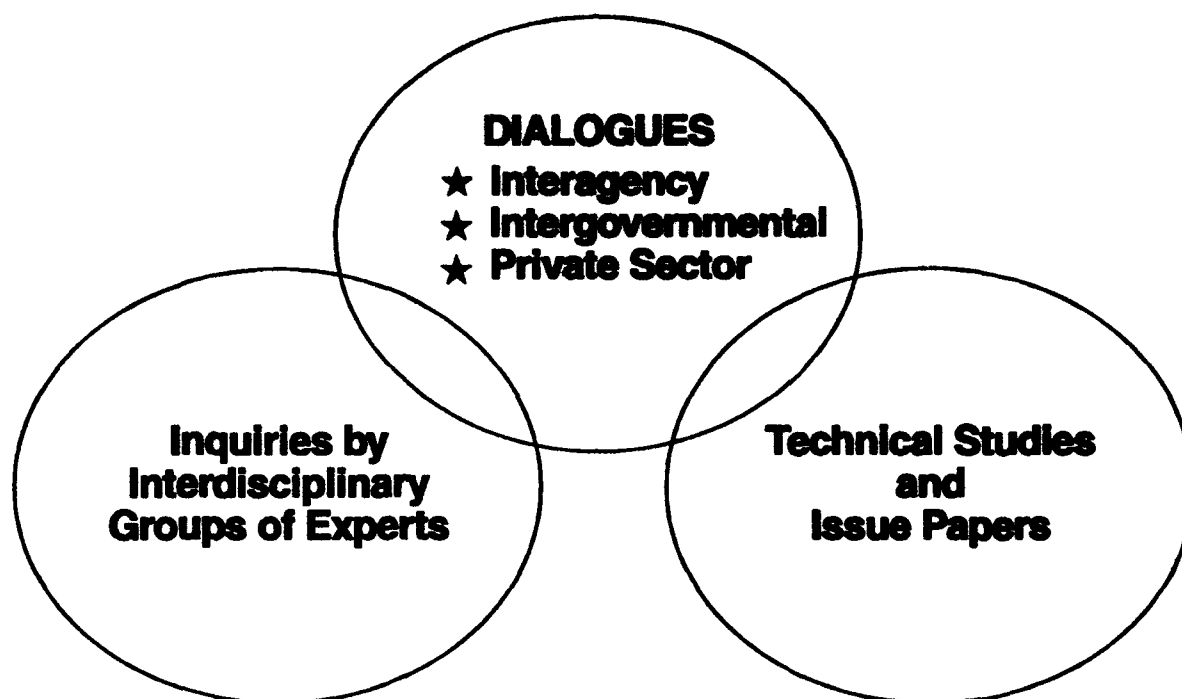


Figure 2
Development of a Federal Infrastructure Strategy

Current policy discussions recognize that strategy development needs to look beyond infrastructure financing reform, and must also focus on improving the management of existing capital stock, while insuring the economic efficiency of future public works investments. The principles selected include:

- Increased emphasis on improving the performance and efficiency of both existing facilities and capital investments;
- Clarification of the respective roles of the Federal, state and local governments in the construction and management of infrastructure to focus responsibility and increase accountability;
- More flexible administration of Federal and state regulations to allow cost-effective methods of compliance;
- Coordinated Federal infrastructure R&D strategies, and accelerated technology sharing programs.
- Financing a larger share of the cost of public works by those who benefit from services;



- **A rational capital budgeting process at all levels of government;**
- **Strong incentives to ensure adequate maintenance and, more rigorous use of low capital techniques for delivering services and meeting performance goals.**

In concluding its report the Council also recommended that state and local governments continue to play their traditional leadership roles in the construction and management of the nation's infrastructure, but conditioned by the Council's belief that:

- **The Federal government must act as a full and responsible partner on a long term basis in the national effort to increase and sustain public capital investment.**

The current interest and level of Federal agency participation in the FIS program reflects the desire of the agencies to serve as responsible partners in such a national effort.

PROGRAM SUMMARY AND INDEX

This section contains a brief narrative summary of each study element within the Federal Infrastructure Strategy Program. The descriptions are presented in accordance with the three-tier study approach, grouped and organized under: the interagency dialogue, in-depth inquiries, and background issue papers. The study descriptions are indexed to provide a reference guide for readers interested in the more detailed discussions of the study elements that can be found elsewhere in the main report.

Interagency Dialogue

The interagency consultation process was divided into two phases. The completed first stage focused on framing the infrastructure issue areas that should be addressed by the Federal government, along with potential opportunities to further interagency cooperation. This phase culminated in the approval of the study findings by the ACIR, and their publication of the report titled Toward a Federal Infrastructure Strategy, which documents the findings resulting from the interagency coordination process. The subsequent phase, still ongoing, consists of a second round of issue specific interagency task forces which are following up on key recommendations of the initial consultation. (Chapter III)

Second Phase of the Interagency Dialogue

This stage of interagency coordination is aimed at the development of principles, guidelines, and action plans to address key issues that were identified during the synthesis workshop of the initial dialogue. The ACIR has agreed to organize and facilitate six interagency task forces, each of which is convening a series of working sessions over a three to four month period on a subject area. These sessions, which will emphasize continued Federal interaction with state and local governments and the private sector, will be followed by a plenary session including all participants. (Chapter III)



The six topics selected are:

Assessing Infrastructure Strategies: This task force will focus on improving the effectiveness of Federal infrastructure strategy development through more consistent use of program performance measurements as a defined rationale for investment decisions. Performance based needs studies, data, and analytical techniques will be shared and examined towards the development of alternative decision-making frameworks that can improve the traditional unevaluated needs study ("wish list") approach towards the development of common practices and cooperative investment opportunities. (Chapter IV)

Applying Cost-Benefit Analyses: This workgroup will examine the current cost-benefit and/or alternative methodologies among Federal agencies in order to share successful techniques and lessons learned, and to promote best practices. The role of cost-benefit analyses to support capital, maintenance and post investment decisions will be assessed, with a focus on how the various Federal infrastructure agencies/offices translate the results of the analyses into policy and programming decisions. In addition, the statutory or administrative barriers to more cooperative and common practices will be critically examined. (Chapter IV)

Deferred Maintenance and Public Reporting Practice: Issues to be addressed include the utility of incorporating the accounting practice of including long term accrued liability as an element of Federal decisionmaking, pricing and budgeting for infrastructure investments. The practice of accounting for the accrued or unfunded liability of a capital asset will be examined, including publicly reporting postponed Federal maintenance spending as a financial liability in order to increase the visibility of deferred maintenance decisions. (Chapter VII)

Environmental Decisionmaking for Public Works Projects: This workgroup will focus on a specific Federal regulation concerns regarding the need to simplify and streamline permitting procedures. The objective of this effort is to reduce infrastructure investment costs and minimize implementation delays, while still insuring environmental protection. Issues involving the sequential steps and separate decision points, the many separate agencies involved (each with differing responsibilities and procedures), and the overlapping Federal, state and local requirements, will be addressed. (Chapter VII)

Flexible and Performance Based Regulations: Issues involved with Federal regulation and unfunded mandates affecting state and local governments will be examined towards the development of more flexible, performance-based regulations and the clarification of regulatory roles and responsibilities at all levels of government. Examples of successfully drafted and implemented performance-based regulations will be shared, and the effective use of the Regulatory Flexibility Act of 1980, including its attention to small governments, will be addressed. (Chapter VII)

Diversified Infrastructure Financing: This task force will examine the development and use of diversified revenue sources to support infrastructure investment initiatives. Topics will include: pricing investments with a view towards the "beneficiary pays" principle, increased emphasis on instituting user fees, greater reliance on revolving loan funds and investment pools, potential tax code modifications (including tax-exempt financing), public/private revenue diversification partnerships, and interagency or inter-trust fund transfers. (Chapter VI)

In-Depth Inquires and Technical Studies

Concurrent with the ACIR facilitated interagency dialogue described above, twelve in-depth inquiries were formulated consistent with the interagency consensus on important infrastructure issues. These studies are being conducted to further address the technical and management needs of an overarching Federal infrastructure strategy.

Completed studies include early work on topics selected based on the previous work of the NCPWI, CBO, OTA, and others. Current work, still ongoing, was formulated to insure that the full range of infrastructure topics are being addressed in accordance with the five essential issue areas identified during the initial phase of the dialogue.

All of the inquiries draw on a diverse cross-section of third party experts to facilitate the studies, as well as the participation of Federal, state and county agencies, professional societies and public interest groups. Several initiatives are being cost shared with other Federal agencies. The studies include the following:

Measuring and Improving Infrastructure Performance: The National Academy of Science's National Research Council, acting through its Building Research Board (BRB), is conducting this study of infrastructure performance. The study will examine how infrastructure performance has been characterized, how standards have been set, and what the impact of this experience has been on the costs of providing infrastructure. A specific objective of the inquiry is to develop options which could be used to integrate performance measurement into our nation's infrastructure planning, design, maintenance, research and management processes. (Chapter IV)

Economic Impacts of Federal Infrastructure Investments: The purpose of this cooperative interagency study is to assess the total rate of return of Federally provided and leveraged infrastructure investment. The study will focus on infrastructure spending in the Nation's public works categories of transportation, water resources development, wastewater treatment, and hazardous and solid waste disposal. The study will build upon the accumulated knowledge to determine what payoffs are likely to result from Federal infrastructure investments. (Chapter IV; and study outline and discussion to be published as IWR Report 93-FIS-4)

Public Works Infrastructure Innovation: This study, recently completed, was conducted by the U.S. Army Corps of Engineers Construction Research Laboratories (USACERL). The study focused on four critical areas of interest: barriers to infrastructure innovations and innovation adoption processes; a model for a national strategy on Infrastructure Research and development (R&D) and Technology Transfer (IRTT); the process of technology dissemination; and the development of a technology diffusion model. (Chapter V; and to be published in two volumes as IWR Reports 93-FIS-2 and 93-FIS-3)

Federal Public Works Infrastructure R&D: This inquiry was undertaken to identify the Federal agencies directly or indirectly involved in infrastructure R&D, as well as the areas of research emphasis and the funding dedicated to these programs. The study also examined how Federal agencies administer infrastructure R&D, while baseline R&D funding trend data is being developed and disaggregated into public works categories, and by Federal agency, office and laboratory. The research was performed by the American Society of Civil Engineers' Civil Engineering Research Foundation (CERF) in cooperation with the Corps of Engineers Civil



Engineering Research Laboratory, and the University of Illinois. (Chapter V; and to be published as IWR Report 93-FIS-5))

Technology Transfer Demonstration Projects

Cooperative Federal R&D Technology Transfer: This effort is aimed at the broader objective of improving the processes for transferring infrastructure related technology from Federal R&D programs into practice within municipal public works agencies. The study is being facilitated by the Civil Engineering Research Foundation (CERF), the research instrument created by the American Society of Civil Engineers (ASCE).

The effort includes the identification and conduct of ten demonstration projects through the application of a five step technology transfer process. The work is being co-sponsored by a range of Federal agency partners, including: the Federal Highway Administration (FHWA), the Environmental Protection Agency (EPA) and the Bureau of Reclamation, Department of the Interior. In addition, other agencies who have agreed to serve on the Study Advisory Group (SAG) include: the National Institute of Standards and Technology (NIST), the Western Power Administration, Department of Energy (DOE), and the Corps Waterways Experiment Station (WES). (Chapter V)

Corps of Engineers Technology. A number of currently available technologies developed by the Corps of Engineers were considered for demonstration under the Federal Infrastructure Strategy (FIS) program. Two currently available technologies were chosen: (1) the nondestructive pavement evaluation and overlay design process developed by the Pavement Systems Division of the Corps Waterways Experiment Station (WES), and (2) the water use forecasting system known as IWR-MAIN developed by the Corps Institute of Water Resources (IWR). (Chapter VIII)

Nondestructive Pavement Testing. WES's nondestructive evaluation procedure using the Falling Weight Deflectometer(FWD) can assess the structural adequacy of pavement and can determine design rehabilitation strategies that perform with reduced life cycle costs. WES is directing the technology transfer process. The Federal Highway Administration(FHWA) and the American Public Works Association (APWA) is serving as partners in the project. Three locations have been selected for the demonstrations: Cincinnati, Ohio, Warren County, Mississippi, and the San Francisco/Berkeley Bay area, California, and the Corps is entering into Cooperative Research Agreements (CRADA's) with each government.

IWR-MAIN. The IWR-MAIN (Institute for Water Resources Municipal And Industrial Needs) state-of-the-art forecasting system is specifically designed for forecasting water requirements within a defined study area, commonly a city, county or water utility service area. IWR is guiding the technology transfer process through an IWR-MAIN Users Group towards the goal of facilitating the training, application, and continuing enhancement of the model to address evolving needs. Current members of the group include the American Water Works Association (AWWA), the American Public Works Association (APWA), and Planning and Management Consultants, Ltd.

Local Public Finance Impact (LPFI Model): The objective of this research by IWR's Navigation Division is to develop and implement a system of procedures for estimating the expenditure and revenue impacts of water resource projects at the state and local government

levels. The model will focus on estimating the project's practical consequences on local public revenues and expenditures, such as secondary employment and income effects. It could be used by local governments to assess the potential relationship between future expenditures and revenues towards the development of a fiscal policy action plan. (Chapter VI)

Public Works Management Practices and Barriers: The Corps has joined with APWA and the National Academy of Public Administration (NAPA) to identify and evaluate roadblocks which prevent municipal public works departments from operating effectively. Using APWA's Management Practices Manual, twelve state/local agencies across the nation have been selected as case studies to determine what legislative, administrative, and technical roadblocks which impede implementation of improved management practices. NAPA will lead the evaluation phase and will also recommend options to overcome the barriers, including drafts of potential legislation or revised administrative or regulatory procedures. (Chapter VII)

Infrastructure Maintenance - Performance Reporting and Accounting: The purpose of this study by the Urban Institute is to determine the utility of accounting systems that provide strong incentives to ensure adequate maintenance of capital assets. The costs of deferred maintenance will be examined, and the links between accounting requirements and maintenance spending will be assessed. Recommendations could address improvements in Federal accounting methods, including the use of disincentives to deferred maintenance by public works decision makers. (Chapter VII)

Federal Budgeting for Capital Programs: The objective of this study is explore the administrative, institutional and programmatic methods for improving the Federal government's capital investments. A panel of experts with background in the relevant Federal programs, financial management and capital budgeting will work with the Corps to recommend realistic and practical capital investment goals, and to determine to what extent the existing Federal capital programs are meeting these goals. (Chapter VII)

Background and Theme Papers

In addition to the inquiries and technical studies discussed above, a wide range of background papers and specific issue studies have been commissioned on selected public works topics. Ten papers have been completed, with several serving as the basis for subsequent interagency discussions or follow up inquiries.

The Value of Infrastructure: This background paper by McDowell and Bell discusses the value of infrastructure within the context of the Nation's economic health, describes the relationship between productivity in the public and private sectors, and highlights the importance of suitable quantitative measures to infrastructure decision-making. (Chapter IV; Appendix D)

Alternative Infrastructure Strategies and Implementation Techniques: A second background paper by McDowell and Bell, this effort focuses on techniques for implementing alternative infrastructure strategies, including funding mechanisms, allocating responsibilities, and management tools. (Chapter IV; Appendix E)

Financing Innovations in State Government: This technical study, which is documented in the report prepared by the Urban Institute titled State Programs for Community Infrastructure:



Innovations in Financing Methods and Program Operations, examined programs in nine states to support local water supply, wastewater treatment, and solid waste efforts. The study includes the results of a literature survey and interviews of state administrators focused on examples of innovative State assistance methods. (Chapter VI; and to be included in IWR Report 93-FIS-6)

The Role of Tax Exempt Financing in Infrastructure Development: This background study by Apogee Research, Inc., is documented in the report titled **Effects of Federal Tax Policy on Infrastructure Investment**. The study reviewed the provisions of the Tax Reform Act of 1986 and its amendments that effect tax exempt bonds and their use for state and local financing of public works projects. (Chapter VI; and to be included in IWR Report 93-FIS-6)

Stimulating Innovation: This background paper by J. Walaszek of the Corps of Engineers Construction Engineering Research Laboratories (CECERL), explores the benefits of R&D innovation and outlines common barrier to technology transfer. Methods to overcome these barriers are discussed, including specific Corps programs currently in place. (Chapter V)

Relationship Between Standards and Performance: This background paper by GKY & Associates, Inc., explores the relationships between standards and the performance of infrastructure. It documents fundamental concepts related to infrastructure performance measures, standards, criteria, and objectives, including the analysis of three case studies within the public works categories of transportation (large commercial airports - Federal Aviation Administration), water resources (flood control - Corps of Engineers), and waste (waste to energy - Environmental Protection Agency). (Chapter IV)

Capital Budgeting Lessons: This paper addresses the fundamental issues regarding the concept of capital budgeting towards understanding the budgeting, accounting, and asset management implications of the process. It critically examines the conceptual and philosophical arguments underlying capital budgeting, and analyzes the relationship between budgeting reforms and improved management decisions. (Chapter VII)

Infrastructure Summaries: This is a consolidated listing and summary of reports published between 1981 and 1991 that reflect an interest in the condition of the Nation's public works infrastructure. The summaries report is being used as a living reference document during the Federal Infrastructure Strategy Program. Two editions have already been completed, with a new version planned for 1993. (Chapter VII; and to be updated as IWR Report 93-FIS-7)

Developing a Federal Infrastructure Strategy: An early output of the Federal Infrastructure Strategy program, this paper by L. Vallianos and E.Z. Stakhiv of the Institute's Policy and Special Studies Division, documented the Corps of Engineers' initial thinking on the FIS program and described the strategy's formative activities. (Chapter VIII; Appendix H)

Managing the Nation's Infrastructure - The Role of the Corps of Engineers: Another early effort, this working paper by J. Delli Priscoli, E. Z. Stakhiv and J. Westphall discusses the Corps perspective on and potential contribution to the Nation's future infrastructure needs. Several specific prototype programs are recommended, including the application of a revolving grant/loan trust fund for water resources projects. (Chapter VIII)



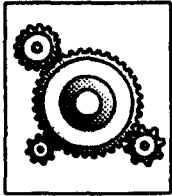
Other Ongoing Work

Interagency Cooperative Studies: Two cooperative efforts with the Environmental Protection Agency (EPA) focusing on: (1) the development of a methodology for analyzing the employment effects of public non-capital environmental investments in water resources restoration programs, and (2) the formulation of a data base of water quality-based pricing strategies for wet weather utilities. Work includes identifying state-of-the-art pricing strategies currently being utilized. (Chapter VIII)

Fragile Foundations and Congressional Policy: How has Congress Responded?: This paper will describe the policy recommendations made by the National Council on Public Works Improvement in Fragile Foundations, and will examine the content and political direction of infrastructure related proposals introduced in Congress between 1988 and 1992. (Chapter IV)

ISTEA: The Impact of Economic Structure on Congressional Public Works Policy: This background paper will address the impact of the changing structure of the national economy on the elected officials and policymakers who allocate infrastructure investments. This includes, at the Federal level, examining how changing economic interests affect the political constituencies of Congress. (Chapter IV)





III. Clarifying Responsibilities: The Federal Role

In 1988 the National Council on Public Works Improvement found that existing responsibilities for public works involve a complex array of institutions and interrelationships for which accountability is sometimes difficult to identify. The roles of the various Federal, state, local, and private sector interests vary not only by the type of infrastructure program, but also by the nature of the programmatic responsibilities involved. The complexities inherent in these relationships remain today, even as Federal aid for infrastructure has declined through the 1980's and state and local governments have assumed more responsibilities.

The principal public works tasks outlined by the Council in Fragile Foundations continues to provide a framework for identifying and allocating basic roles and responsibilities among the various public works interests. These tasks include the following:¹²

- Establishing program goals, policies and strategic plans,
- Establishing design and environmental standards,
- Regulatory oversight,
- Financing capital improvements,
- Financing operations and maintenance activities,
- Planning, designing and constructing projects,
- Owning, operating and maintaining facilities,
- Researching and demonstrating new technologies, and
- Providing technical assistance and promoting innovation.

PRESENT RESPONSIBILITIES

The allocation of responsibilities and the diversity of programs for the Nation's infrastructure are exceedingly complex. Examples of virtually every combination of Federal, state, local and private sector roles can be found in each category of public works infrastructure. At the Federal level infrastructure responsibilities are distributed among a wide number of departments and agencies, often with considerable overlapping and sometimes conflicting missions.¹³

There is a significant amount of literature on this topic, including several of the national infrastructure studies summarized in Appendix A of this report. In particular, the Council's series of reports on nine major public works categories provides an in-depth analysis of the roles of government within each infrastructure mode. In addition, the Congressional Office of Technology Assessment's report Delivering the Goods provides a chapter on the public works institutional framework, including a focus on each of the Federal Agency roles.



Government Roles

The paragraphs below briefly summarize the various government roles, with the primary focus on Federal responsibilities. Table 1, based on Fragile Foundations, also provides an updated summary of lead roles for selected infrastructure categories. Note however, that because of the wide diversity of public works roles and activities, and the still evolving infrastructure related services provided by the various levels of government, it is extremely difficult to generalize about lead agency roles without making many assumptions and ignoring various exceptions that cannot be easily portrayed in the summary. Readers are referred to Appendix B, The Federal Role: A Summary of Federal Responsibilities in Transportation, Water Resources, and Waste Management, for more detailed discussions regarding the Federal responsibilities within each public works category.

Transportation: Within the surface transportation sector, the United States has generally adopted a system of public ownership for rights-of-way and private ownership of the transportation vehicles. Although there are key exceptions (e.g., the railroad system) to this structure, the manifestation of this development is the fundamental ownership role of government.¹⁴

The Federal government's transportation responsibilities primarily reside in its' financing, regulatory, and programmatic administration authorities over the Nation's network of highways, roads and bridges, airports and airways, mass transit, and intermodal systems. The Federal role is managed through the U.S. Department of Transportation and its operating modal administrations. Federal transportation programs are largely supported by user-supported trust funds, including the highway and transit, and the airport and airway funds. These funds provide the financing for the various transportation grant aid programs to state and local governments.

For highways and roads, the primary mechanism for Federal participation is through the provision of funding through grant-aid programs, while state and local governments play the dominant ownership role. State and local interest are also responsible for partially financing and performing all construction, operation and maintenance activities, including those for the Federal Aid Highway system.

For airports and airways, the Federal government plays the key role in airport financing and is responsible for operating and maintaining the airways, while local governments operate 95 percent of all publicly owned aviation facilities nationwide, including all of the large commercial airports.¹⁵ The private sector finances, owns, and operates 75 percent of the nation's airports, and contracts to design, build and maintain most surface transportation facilities.¹⁶

Likewise, state and local governments are primarily responsible for the ownership and partial financing of the construction, operation, and maintenance activities for the urban mass transit systems across the country. Special districts, which operate in all states except Arkansas and Hawaii, control about 70 percent of all state and local spending for mass transit, and over 20 percent for airports.¹⁷

Of particular note within the transportation mode, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 mandates a new direction for surface transportation. ISTEA establishes a policy stating that the National Intermodal Transportation System shall consist of all

Table 1
Usual Lead Roles In Public Works Categories¹

Categories of Public Works	Program Tasks		
	Policy & Standard Setting	Capital Financing	Ownership, Operations & O/M Financing
Transportation:			
<i>Highways</i>			
National Highway System (incl. interstate)	F	F	S
Other	S/L	S/L/PS	S/L
<i>Airports</i>			
Major Commercial	L	L/PS	L/PS
General Aviation & Smaller Commercial	L	F	L/PS
<i>Airways</i>	F	F	F
<i>Mass Transit</i>	L	F	L/PS
<i>Intermodal</i>	F/S	L/PS	L/PS
Water Resources:			
Deep-Draft Ports	F	F	F
Ports (landside)	L	L/PS	L/PS
Inland Navigation	F	F	F
Major Dams/Regional Flood Control	F	F	F
Local Flood Protection	S/L/F	S/L/F	S/L
Urban Stormwater	L	L	L
Shoreline Protection	F	F	F
Water Supply (urban)	F/S	L/PS	L/PS
Wastewater Treatment	F	S/L	L
Solid Waste	S/L	L/PS	L/PS
Hazardous Waste:			
Currently Generated	F/S	PS	PS
Site Cleanup	F	F	PS

LEGEND: F = Federal; S = State; L = Local; PS = Private Sector

¹Roles and responsibilities in the Federal system are exceedingly complex. Therefore, this table is useful only as a summary for generalized lead roles. It must be recognized that there are exceptions to these lead roles, and most Federal lead roles for capital and O&M financing now require cost-sharing with state and local governments.



forms of transportation in a unified, interconnected manner. In order to address this goal, ISTEA calls for an enhanced role for local governments, including increased responsibilities for metropolitan planning organizations (MPO's). ISTEA expanded state responsibilities for intermodal planning, including the development of state Transportation Improvement Plans, and the creation of statewide performance management systems that integrate intermodal transportation facilities and systems. The Act also established an Office of Intermodalism in the U.S. Department of Transportation.¹⁸ Additional discussion of ISTEA is provided in Appendix B.

Water Resources: The Federal government provides water resources services through approximately 25 agencies and departments, although five agencies are dominant: U.S. Army Corps of Engineers (COE), U.S. Department of Interior, Bureau of Reclamation (BUREC), U.S. Department of Agriculture, Soil Conservation Service (SCS), Tennessee Valley Authority (TVA), and the U.S. Environmental Protection Agency (EPA).

The basis for government's role in water resources (including navigation, flood damage reduction, and other related purposes) largely rests on Constitutional authority to promote the public welfare, regulate commerce, including control over navigable waters, protect public lands, and provide for the national defense. It also rests on the desire to provide an equitable distribution of needed services, such as hazard reduction, and on economies of scale realized by expenditure of public resources, such as navigable waterways.¹⁹ For wastewater treatment, the current Federal role includes reviewing plans and priorities, providing design and environmental standards, partial capitalization of state revolving fund loans for wastewater treatment facilities and management techniques, performing research and development activities, providing technical assistance, and establishing water quality standards and regulating management performance.

States have a lead role in regulating a wide range of water related environmental matters in accordance with Federal standards and, in conjunction with local governments and special districts, have increasingly important roles in sharing the capital financing and maintenance of most Federally provided water projects. Non-Federal interests also control the ownership, operation and maintenance of non-Federal dams, water supply facilities, local flood control projects, and stormwater drainage facilities. The private sector is most active in areas where the market offers profit-making opportunities, such as the sale of hydroelectric power, irrigation and water supplies, and port landside facilities.

Waste Management: The primary responsibilities for providing waste management facilities and systems have historically resided with local governments, with the Federal role evolving from environmental legislation governing the U.S. Environmental Protection Agency regulation of the disposal of solid and hazardous wastes.

More recently, the Departments of Defense and Energy are playing increasingly important roles in the remediation of hazardous, toxic and radiological waste sites associated with defense or research activities. Other than these Federal installations, virtually all hazardous waste disposal facilities are owned and operated by the private sector. The key Federal responsibilities are summarized in Appendix B.

CRITERIA FOR EVALUATING PUBLIC WORKS ROLES

Several of the Federal agencies and departments responsible for national public works infrastructure programs are continuing to face significant changes in their roles. McDowell and Bell characterized these role changes as evolutionary rather than revolutionary, with the movement towards programs becoming more, rather than less, intergovernmental.²⁰ Based largely on the work of the National Council on Public Works Improvement, McDowell and Bell proposed a series of criteria for evaluating public works roles. These criteria, also reflects the Kestnbaum Commission's principles for defining the Federal governments roles, and the subsequent work of the Congressional Budget Office, the Evans-Robb Report, and several ACIR reports on criteria for shifting Federal responsibilities.²¹

Principles Justifying a Federal Role

- The activity is national in scope,
- Enumerated constitutional powers must be exercised,
- Fiscal magnitude requires a Federal role,
- Jurisdictional limits of states render multi-state approach impractical,
- Uniform national application of policy cannot be otherwise achieved,
- Negative spillovers among states must be minimized or mitigated,
- Program efficiency can be significantly improved by a Federal role,
- Redistribution of national resources is needed for geographic or demographic equity and program effectiveness.

Criteria for Relinquishing Federal Responsibility

- Federal purpose is unclear, in that it does not represent essential national objectives,
- Federal program is limited in scope or impact,
- Federal role is minor relative to the roles of state and local governments,
- Program effectiveness can be improved through decentralization,
- Non-Federal financing is feasible, assured, and adequate,
- Transfer mechanisms, including transition measures, are feasible, equitable, and simple.



Methods for Implementing Shared Responsibilities

- If the purpose of the program is to stimulate new and greater activity emphasizing Federal leadership:
 - categorical grants
 - direct provision based on cost-sharing
 - cooperative agreements or contracts
 - direct Federal loans
 - loan guarantees
 - tax policy incentives
- If the purpose is to support an intergovernmental common goals emphasizing state or local leadership:
 - block grants
 - general revenue sharing
- If the purpose is to require certain activities while emphasizing Federal leadership:
 - direct regulation
 - conditional grants or loans

CHANGING RESPONSIBILITIES

The Federal infrastructure responsibilities summarized in the preceding sections provide the context for continued future roles. However, Federal roles are constantly changing in response to national needs, and the changes that have occurred during the 1980's and early 1990's can be expected to set the stage for additional public works reforms over the next decade. McDowell and Bell listed changes occurring in the 1980's as including:²²

- Cost sharing was expanded for Federal water resource projects,
- Trust funds were used to support Federal programs for mass transit, inland waterways, and harbor maintenance programs,
- Federal drinking water standards were established and strengthened,
- Federal grants for wastewater treatment facilities were phased out, and the states established revolving loan funds (with Federal assistance) to help finance local wastewater treatment facilities,
- Most Federal aid for local, state and regional planning and coordination was discontinued.



In addition, other legislative and administrative changes in the 1990's have continued to impact on the ways Federal infrastructure agencies perform their responsibilities. These include:

- The 1990 Clean Air Act Amendments provided a basis for changing the transportation focus in "nonattainment " metropolitan areas.²³
- The passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 has placed greater emphasis on intergovernmental planning and performance-based management, and has also increased the flexibility offered to state and local governments in spending between traditional transportation modes.
- The Negotiated Rulemaking Act of 1990 has provided new possibilities for developing administrative regulations that are less intrusive, more flexible, and easier to implement.²⁴
- The number of Federal block grants, which have grown from one in 1965 to 14 in 1991, now also include two important new infrastructure block grant programs created since then: (1) DOT's Surface Transportation Program (from ISTEA), and (2) FAA's state block grants for airports.²⁵
- The U.S. EPA has established the Environmental Financial Advisory Board (EFAB) to address the increased demands placed on local infrastructure spending for Federal environmental mandates.²⁶
- Executive Order 12291 and the subsequent OMB Regulatory Impact Analysis Guidance has required cost-benefit analysis for all proposed Federal regulations which result in an annual effect on the economy exceeding 100 million dollars.²⁷

It is expected that infrastructure roles will continue to evolve with a likely emphasis on the performance measurement and intergovernmental flexibility principles reflected in ISTEA. For example, ongoing Executive Branch initiatives, such as the National Performance Review and the National Economic Council's Infrastructure Working Groups, are aimed at improving the efficiency and effectiveness of Federal programs, and have the potential to fundamentally reform Federal infrastructure roles and responsibilities.

Additionally, the Competitiveness Policy Council, established by Congress in 1990, has issued it's second annual report to the President and the Congress in which it recommends performance measures aimed at improving the quality of infrastructure investments, and Congressional proposals such as the Government Performance and Results Act of 1993 (S.20 & HR. 826) would fundamentally reform the ways in which agencies measure and report the performance of Federal infrastructure programs.

ROLES AND RESPONSIBILITIES: THE INTERAGENCY DIALOGUE

It was recognized early in the FIS program that the existing body of work represented by past studies provided a comprehensive evaluation and assessment of national needs and issues upon which to build. Therefore, the Federal agency representatives participating in this new strategy recommended working towards the development of specific actions to implement the key



recommendations of previous reports rather than focusing the dialogue on the development of a new study.

The outputs of the resulting year long consultation included the identification of the issues essential to a Federal strategy, and the recommendation of specific opportunities warranting further interagency cooperation. Approximately thirty FIS research elements were formulated within the three-tier study framework to address the problems and opportunities identified during the initial dialogue. The following sections describe the first phase of the intergovernmental coordination process, including the issues, opportunities and recommendations that were identified.

Coordination Mechanism

The approach taken was to consult with representatives of a broad range of agencies across the various levels of government, and the private sector, in a series of professionally facilitated, one-day workshops convened by the Advisory Commission on Intergovernmental Relations (ACIR).

The ACIR is a permanent, nonpartisan and independent agency established by Congress in 1959. Its primary missions are to: a) provide a forum for discussion and deliberation on intergovernmental issues and problems; b) conduct research on intergovernmental policies and issues; and c) make recommendations for reform. The Commission is composed of 26 members with the membership including representatives of the executive branch of the Federal government (3), members of Congress (6), governors (4), state legislators (3), and county officials (3). Each Commission member serves a two-year term and may be reappointed.

In working towards a practical answer as to whether a government-wide or multi-agency Federal infrastructure strategy can be developed, the consultation process was divided into two phases. The completed first stage focused on framing the infrastructure issue areas that should be addressed by the Federal government, along with potential opportunities to further Federal interagency cooperation within this framework. This phase culminated in the approval of the study findings by the ACIR, and their publication of the report titled Toward a Federal Infrastructure Strategy, which documents the results of the interagency coordination process (this report is included in its entirety as Appendix G). The subsequent phase, still ongoing, consists of a second round of issue specific interagency workshops which is following up on key recommendations of the initial consultation.

First Phase of ACIR Coordination

This formative phase of the coordination included a series of ten workshops with four separate groups of infrastructure constituencies. The process concluded with a synthesis meeting including all participants which was aimed at the development of a consensus report documenting the outputs of the consultation. The interest groups were organized as follows:

1. Federal agencies and Congressional committees;
2. State and local governments;

3. Infrastructure users, academic analysts, and advocacy groups; and
4. Public and private infrastructure providers.

A questionnaire based on the recommendations of "Fragile Foundations" was utilized by ACIR to survey the participants before the meetings on a variety of infrastructure related management and financing practices. The resulting survey responses were utilized in conjunction with a host of guest speakers on a variety of infrastructure topics to facilitate the workshop discussions.

Participation

The first phase of the intergovernmental dialogue can be characterized as a "bottom up" consultation process including congressional and other Federal agencies and departments, state and local governments, public works providers, and related research, advocacy, professional and user groups.

More than 25 Congressional and Federal agencies and departments were represented in the process, including the Departments of Transportation, Interior, Commerce, Energy, Treasury, and Agriculture, the Environmental Protection Agency, General Services Administration, Federal Accounting Standards Board, the Council of Economic Advisors, General Accounting Office, Congressional Budget Office, Congressional Infrastructure Caucus, Office of Technology Assessment, and the House and Senate Public Works Committees.

In addition, more than 70 organizations representing other non-Federal infrastructure interest groups also attended the workshops. A complete listing of organizations who were represented at one or more of the workshops is as Table 2.

As an outgrowth of the consultation, several Federal agencies are currently partnering with the Corps on cooperative, cost-shared infrastructure studies. These efforts include work on infrastructure technology transfer which is being co-sponsored by the Department of Transportation (Federal Highway Administration), Department of Interior (Bureau of Reclamation), and the Environmental Protection Agency, in coordination with the National Institute of Standards and Technology, and the Department of Energy (Western Power Administration).

The Department of Transportation (including the Federal Aviation, Highway, Railroad, and Transit Administrations) is also collaborating with the Corps and the Departments of Agriculture, Commerce (Bureau of Economic Analysis), Interior (Bureau of Reclamation), and Energy, the Environmental Protection Agency, and the Office of Management and Budget, on a study of the economic productivity of infrastructure investments, and the Environmental Protection Agency is also co-sponsoring research on the economic effects of environmental restoration projects. See Chapter IV for additional information regarding these efforts.

Preliminary Findings²⁸

The questionnaire and the conference discussions focused on the identification and evaluation of the most effective Federal role, and the infrastructure issues of primary importance in



Table 2
Organizations Represented at One or More Workshops

Congress Senate Environment and Public Works Committee House Committee on Public Works and Transportation House Subcommittee on Economic Development Congressional Budget Office Congressional Infrastructure Caucus Congressional Office of Technology Assessment Congressional Research Service—Library of Congress General Accounting Office Executive Branch Council of Economic Advisors Environmental Protection Agency Federal Accounting Standards Advisory Board General Services Administration Department of Agriculture—SCS Department of the Army— Civil Works Corps of Engineers Department of Commerce Department of Energy Department of Interior— Bureau of Reclamation U.S. Geological Survey Department of Transportation— United States Coast Guard Federal Aviation Administration Federal Highway Administration Federal Railroad Administration Federal Transit Administration Maritime Administration Office of the Secretary Transportation Systems Center Department of Treasury State Government Academy for State and Local Government Council of State Governments Ohio House of Representatives, Ways and Means Committee State of New Jersey—Washington Office Local Governments International City/Country Management Association National Association of Counties National Association of Regional Councils National Association of Towns and Townships National Conference of State Legislatures National League of Cities Metropolitan Washington Airports Authority City of Atlanta, Department of Planning and Development Lehigh County (Pennsylvania) Authority Research Groups Apogee Research Building Research Board Civil Engineering Research Foundation Committee for Economic Development Governmental Accounting Standards Board Infrastructure Institute Johns Hopkins University, Institute for Policy Studies	Manufacturers' Alliance National Academy for Public Administration Ohio State University, School of Public Policy and Management Taubman Center for State and Local Government Harvard University Arizona State University, School of Public Affairs Transportation Research Board University of Maryland, Department of Economics University of New Mexico, New Mexico Engineering Research Institute The Urban Institute Professional Associations American Consulting Engineers Council American Planning Association American Society of Civil Engineers Community Transportation Association Government Finance Officers Association Policy Advocates Advocates for Highway and Auto Safety Campaign for New Transportation Priorities National Industrial Transportation League National Wildlife Federation Public Securities Association Raposa Associates Surface Transportation Policy Project Water Environment Federation User Groups American Trucking Association Bell Atlantic Network Services, Inc. Highway Users Federation International Longshoremen's and Warehousemen's Union National Grange Public Works Providers American Association of State Highway and Transportation Officials American Public Transit Association American Public Works Association American Road and Transportation Builders Association American Waterways Operators, Inc. American Water Works Association Associated General Contractors of America Association of American Railroads City of Baltimore, Department of Public Works Bovis, Inc. Greenhorne & O'Mara National Solid Waste Management Association National Stone Association New York Metropolitan Transit Authority Portland Cement Association R.W. Beck and Associates Sverdrup Corporation Tennessee Valley Authority Wade Miller Associates Washington State Public Works Trust Fund, Department of Community Development Greater Chicago Metropolitan Sanitary District, Water Reclamation District
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formulating a Federal strategy. Although the four workshop groups shared common concerns and generally agreed on the relative importance of the various Federal roles in improving public infrastructure, their unique perspectives initially resulted in contrasting views of what were the most significant issues for a national strategy.

Importance of Federal Roles: Participants noted that today the Federal shares provided by many grant programs have been reduced, with many of the programs discontinued or consolidated. Most direct programs now require substantial state or local cost sharing, with increased decision-making and administrative responsibilities also shifting to the non-Federal sector. For both programs, there is also increasing reliance on trust funds and user fees to finance the Federal shares of programs such as highways, mass transit, airports, and ports and inland waterways. These changes have shifted the non-Federal perspective from one of a customer to primarily that of partner.

Meanwhile, from the local perspective, Federal spending limits have resulted in the increased use of Federal regulations aimed at or to be implemented by state and local governments. Legislative mandating in the 1980's included the passage of 27 regulatory statutes and amendments with significant intergovernmental effects.²⁹ The most common complaint by local interests regarding these regulations is that the mandates impose excessive non-Federal expenditures on the affected governments. Concern was also expressed that these changes have not allowed sufficient time for state and local governments to fully adjust to their new role as financial and planning partners for these programs, nor has the Federal establishment fully embraced management frameworks that reflect the new, increased non-Federal role in decision-making.

These programmatic conversions, funding shifts, and regulatory changes, in conjunction with the spending constraints now facing all levels of government, led the workshop participants to agree that any overarching Federal infrastructure strategy needs to clarify and focus the roles and responsibilities of the respective government players. The Federal workgroup met specifically to identify the principles for clarifying the Federal roles. The criteria identified were based on the principles of constitutionality, accountability, equity and common sense as applied within a strategic framework based on the values, political judgments, and technical practices pertinent to the various programs. The ACIR report Toward a Federal Infrastructure Strategy: Issues and Options, presented in Appendix G, includes additional detail regarding the dialogue results regarding the need to clarify the Federal and non-Federal roles.

Issues Important to a Federal Strategy: Both the survey responses and the workshop discussions highlighted the participants differing perceptions on the issues that need to be addressed by a Federal infrastructure strategy. Federal participants emphasized national needs studies, and multi-modal transportation funding.

State and local government participants primarily were concerned about the Federal impact on locally provided facilities, including: the need for greater consistency among Federal programs, greater flexibility in using Federal funds, and a reduction of unnecessary Federal regulatory and administrative burdens.

The research/advocacy/users group put forward the need for more consistent political commitment to strategic investment and greater emphasis on Federal R&D technology transfer



as most important, while the providers group emphasized the importance of regulatory relief and financing reforms, including addressing the problems with unfunded mandates.

Whether a practical comprehensive Federal or multi-agency infrastructure strategy can be developed and implemented is still unclear. However, as the workshops continued the participants were able to reach agreement regarding the issues which are integral to such a strategy. By the conclusion of the synthesis meeting, a broad consensus emerged around five infrastructure issues that both the agency representatives and other participants agreed should be addressed by a Federal strategy: 1) rationales for Federal investment, 2) roles and responsibilities, 3) technology, 4) financing, and 5) management. Within each issue area participants identified the need for: strategic investment, regulatory and administrative reform, greater attention to R&D technology transfer, flexibility in Federal funding, revenue diversification and intergovernmental funding, and management improvement. These five issues are discussed in the paragraphs below:

1) Strategies for More Efficient Investments. Workshop participants recognized that the rationales and priorities established for Federal infrastructure investment should be based on clear national performance based goals aimed at the efficient use of scarce resources. There was also general agreement that performance, rather than construction, should be the primary Federal goal, with the existing capital stock serving as the base for most investment opportunities. This will require rethinking the output measures upon which public works projects should be evaluated, and redefining the framework for needs assessments to reflect this increased emphasis on performance.

The survey results documented a consensus among the four constituent groups that ranked the strategic provision of monies for constructing and maintaining public works as the most important Federal role. Although the survey did not distinguish between capital investments and the maintenance of existing projects, it was clear from the workshop discussions that most participants agreed that spending constraints will require future infrastructure investments to focus on the cost-effective maintenance of existing stock rather than on large new programs.

In addition, many felt that capital intensive new programs should be initiated only if performance measures demonstrate a marginal increase in effectiveness over that of maintaining existing facilities. This argument was tempered somewhat by those who considered innovative new programs, such as high-speed rail or MAGLEV, "smart" highways, and other technological advances led by the private sector, such as in telecommunications, as necessary to maintain the Nation's competitiveness. It was recognized, however, that greater political commitment is needed to support these goals.

Within this context, participants at the synthesis workshop agreed that clear national performance-based goals for infrastructure should be articulated. Both national needs studies and agencies' individual program evaluations should be more performance-oriented (including an emphasis on physical and economic performance). Such assessments should be directed toward the achievement of clear strategic investment goals. Finally, participants agreed that the use and consistent application of analyses such as cost-benefit evaluations should be increased to support Federal decision strategies and to assess post investment (O&M) decisions.

2) Clarification of Roles and Responsibilities. Although it was recognized that it is often cost effective and necessary for the Federal government to establish infrastructure related

standards and regulations, many state and local government participants complained that some requirements unnecessarily displace local decision-making authority, create too much of an administrative burden, and add too much cost to the projects.

These perceptions of intergovernmental burdens and lack of flexibility hamper the provision of infrastructure and were viewed as due in part to the changing, and often clouded, expectations associated with the Federal, state, local and private roles.

Participants agreed that such differences should be narrowed by building closer partnerships. Likewise, unnecessary regulatory and administrative burdens in providing infrastructure should be reduced. Flexibility in spending Federal aid for infrastructure, and in complying with federal and state mandates, should be increased. And, because of limited tax bases and engineering capabilities, small governments sometimes face relatively greater challenges than larger jurisdictions in complying with Federal regulations. Therefore, special attention needs to be given to the compliance problems of small governments.

3) Develop and Apply Innovative Technologies. Participants in all the workshops agreed that there is a major Federal role in the promotion, demonstration, evaluation, and dissemination of innovative infrastructure technologies. Key barriers to public works innovation were identified to include: the fragmented R&D government structure, inadequate emphasis on technology transfer, complexity and requirements of procurement rules, the lack of flexibility in technical standards, and the risk of liability from tort claims.

Participants at the synthesis workshop concluded that more effective mechanisms are needed to address the lack of a Federal focus for national infrastructure technology development. In addition, strategies are needed to encourage increased public-private R&D partnerships, to develop more flexible standards, regulations and contracting procedures to accommodate innovation, to accelerate technology transfer sharing, and to institute tort reform, risk-sharing programs and demonstration projects to overcome the fear of liability.

4) Financing Reforms. The Federal role in public works financing was a major topic of discussion at all of the workshops. The key issue discussed was the relationship between the declining Federal financing of public works and the Federal interest in providing infrastructure services. Most participants agreed that it is highly unlikely that long term Federal financing for new infrastructure programs will increase in the future, and in fact, significant reductions in many Federal programs can be expected. It was recognized that large capital investment in new programs is greatly constrained by the limited resources of all levels of government, and the growing demand for funding to operate and maintain the national infrastructure systems already in place.

The most common problem voiced was the increasingly difficult challenge of assigning the responsibility of project costs. Controversy over increased use of "beneficiaries pay" principles focused on potential application inequities since the beneficiaries of infrastructure facilities are often difficult to identify and are not always limited to users.

Financing recommendations primarily addressed the importance of identifying and diversifying infrastructure sources. The consensus was that the use of Federal funds is expected to decrease, with the accompanying financial burden shifting to other levels of government



through either increased cost sharing, user fees, or regulation. In particular, the broader application of user fees requires more accurate data on project costs and benefits, and should recognize that secondary benefits for some programs and projects are significant.

5) Improve Infrastructure Management. Workshop discussions on management issues closely paralleled the dialogue on strategic investment in that both emphasized the need for infrastructure goals to focus more on performance outputs in order to improve the quality of infrastructure services. Demand management techniques improved management practices were suggested as alternatives to Federal regulations and mandates. The techniques of capital programming and budgeting were put forward to address current priority-setting and policy problems, while more flexible, performance-based regulations were proposed to overcome prescriptive funding barriers. Finally, a central issue identified was the need to improve coordination between the various Federal infrastructure agencies. This problem was also a key finding of the survey, with such coordination deemed most important in Federal R&D and program planning.

The synthesis group concluded that management methods and practices should be reformed to focus on the performance of services (as indicated by output measures) rather than on operating "inputs". There should be incentives to increase the useful lives of public works through better maintenance, to use the most cost-effective means of serving the public in each situation, and to lower unnecessary administrative and legislative barriers to using low-capital techniques. More flexible funding and regulations were viewed as especially important to insuring performance management, and more use of capital programming and budgeting by the Federal government was deemed essential to improved infrastructure decision-making.

ACIR Recommendations

Based on the results of the initial consultation, ACIR recommended to the Corps that the interagency coordination process continue with a strong focus on translating the identified issues into specific action plans that will comprise the framework of the Federal strategy. At the ACIR's 14 June 1992 meeting the recommendations based on the first phase of the coordination were approved by the Commission and subsequently published in ACIR Report A-120 (see Appendix D).

The Commission recommended that the Federal infrastructure agencies work more closely together, and in cooperation with the nation's state and local governments, and the private sector, to make the Nation's infrastructure more efficient, better coordinated, and more highly productive. The Commission identified the following opportunities in working toward these goals:³⁰

- a. Establishing programs to educate the general public, government officials, and public works professionals about the importance of public works and the innovations that are needed to keep the nation's infrastructure systems among the world's most productive;
- b. Developing improved methods for preparing performance-based infrastructure needs studies reflecting strategic objectives;

- c. Establishing infrastructure-specific guidelines for applying the Federalism Executive Order, the "small governments" provisions of the Regulatory Flexibility Act, the Administrative Dispute Act of 1990, and the Negotiated Rulemaking Act of 1990;
- d. Making greater use of the National Environmental Policy Act as an interagency focus to combine reviews and streamline the process for issuing environmentally sound public works permits;
- e. Pooling Federal agency experiences in using performance-standard regulations and mandate reimbursement practices;
- f. Developing a national cooperative infrastructure research program, including a strong technology transfer component;
- g. Removing or minimizing the barriers and risks confronted when innovating new technologies and practices;
- h. Establishing principles and guidelines for public agency benefit, cost, and deferred maintenance accounting;
- i. Evaluating the benefits and limitations of innovative financing techniques--including user fee systems, state revolving loan funds, tax exempt financing, and privatization techniques--and publicizing successful innovations;
- j. Improving the methods and practices of capital improvement programming and benefit-cost analysis; and
- k. Promoting geographic data coordination across all levels of government.

Second Phase of the Interagency Dialogue³¹

The year long consultation process yielded several specific opportunities for the various Federal agencies to cooperate further towards the development of an infrastructure strategy.

Upon the approval of the ACIR recommendations and the subsequent release of the ACIR report, these potential opportunities were reviewed to develop the balance of the FIS program. Work elements were formulated and pursued within the previously framed three-tier approach. The goal was to address the needs reflected by the five essential issues as comprehensively as possible, while continuing the collaborative intergovernmental approach utilized to date. The workplan was also structured to emphasize the continued involvement of third party experts outside of the Federal establishment to facilitate and coordinate the conduct of specific study elements.

During the second phase of the dialogue, the focus of continued coordination has moved beyond the broad overview of Federal infrastructure policy to examine selected key issues selected from the topics recommended by the ACIR as an output of the first phase of the dialogue. Specifically, this stage of interagency coordination is aimed at the development of action plans



and the establishment of priorities for addressing six issues that were identified during the synthesis workshop of the initial dialogue.

The ACIR has agreed to facilitate the establishment of six interagency task forces, each of which will conduct a series of working sessions over a four month period on a subject area. These sessions, are emphasizing continued Federal interaction with state and local governments and the private sector. The task force meetings will be followed by a plenary session including all participants.

Each workgroup session is being guided by a professional facilitator, and each task force is being assisted by a topical expert, employed by ACIR, who is actively participating in the workshop discussions and assisting in preparing meeting materials and project reports. The ACIR engaged the subject matter experts early in the process to assist in the development of the material for the initial round of meetings.

The dialogue topics were selected in close coordination with the staff of the ACIR to insure that the subjects adequately span the five essential issue areas when viewed in conjunction with other ongoing inquiries and technical studies, such as the various efforts addressing technology and infrastructure R&D, as described later in this report. The selection of topics was also guided by the following principles developed by the ACIR staff:³²

Interagency Commonalty - topics relatively broad in application to the programs administered by the Federal infrastructure agencies.

Federal Credibility - topics having both technical and policy credibility within the Federal establishment, with a potential Federal agency/office capable of continuing the initiative after the coordination concludes.

Potential for Results - topics having a high potential for realizing measurable, substantive benefits that can be sustained beyond potential changes in administration or agency leadership.

Needing attention - topics that reflect a wise investment of time and resources and are not already being addressed by another agency or Congressional office.

With these principles in mind, the six topics were selected within the framework of the five essential issues identified during the first phase of the dialogue.³³ The six task forces are listed below and are described in more detail in subsequent sections of this report, as indicated.

1 - Assessing Infrastructure Investment Strategies: This task force is focusing on improving the effectiveness of Federal infrastructure strategy development through more consistent use of program performance measurements as a defined rationale for investment decisions (see Chapter IV).

2 - Applying Infrastructure Investment Analyses: This workgroup is examining the current cost-benefit and/or alternative methodologies among Federal agencies in order to share successful techniques and lessons learned, and to promote best practices (see Chapter IV).

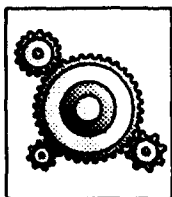
3 - Deferred Maintenance and Public Reporting Practice: Issues being addressed include the utility of incorporating the accounting practice of including long term accrued liability as an element of Federal decisionmaking, pricing and budgeting for infrastructure investments (see Chapter VII).

4 - Environmental Decisionmaking for Public Works Projects: This workgroup is focusing on a specific Federal regulation concerns regarding the need to simplify and streamline permitting procedures, while insuring environmental protection (see Chapter VII).

5 - Flexible and Performance Based Regulations: Issues involved with Federal regulation and unfunded mandates affecting state and local governments are being examined towards the development of more flexible, performance-based regulations and the clarification of regulatory roles and responsibilities at all levels of government (see Chapter VII).

6 - Diversified Infrastructure Financing: This task force is examining the development and use of diversified revenue sources to support infrastructure investment initiatives (see Chapter VI).





IV. Measuring Performance and Choosing Investments

McDowell and Bell have noted that a Federal infrastructure vision and an established national purpose are prerequisites to creating value in major public works networks and systems.³⁴ Participants in the first phase of the interagency coordination process described in Section III agreed that a Federal infrastructure strategy should be based on a clear statement of national values. Just as past national public works initiatives such as the construction of the inland waterway and deep draft navigation systems, the building of the interstate highway system, and the Nation's wastewater treatment program, were undertaken as a result of an established national policy, the major innovations of today, like high-speed rail networks and the establishment of a worldwide telecommunications system, need such commitments if they are to succeed.

However, the participants noted that successful implementation of Federal infrastructure programs will require more than consistency to a national vision; the resulting public works must provide services that improve system performance and meet other economic efficiency goals towards increasing national productivity. Infrastructure performance was viewed as the key to *informed decision-making*, with performance measures and management systems becoming increasingly complex.

Within this context, a number of study elements address the need for greater use of program performance measures and investment analysis. These study elements include the work of two of the interagency groups currently being facilitated by ACIR (Task Force 1 on Investment Strategies, and Task Force 2 on Investment Analyses), and two ongoing interdependent in-depth inquiries on Measuring and Improving Performance, and the Economic Impacts of Infrastructure Investments. In addition, several background and theme papers were undertaken to address these important issues. The scope, status and findings, where available, of each of these studies are summarized in this chapter.

TASK FORCE ON ASSESSING INFRASTRUCTURE INVESTMENT STRATEGIES

Past infrastructure needs studies have been criticized as being unevaluated compilations of all available proposals that lack the uniform application of economic evaluation, cost effectiveness or performance measurement criteria. National needs studies should analyze alternative means of achieving measurable performance goals and should address questions such as: Which programs or systems are likely to improve performance the most? Which projects will provide the greatest return on investment? Specific measurements of how public works programs and projects achieve national goals are central to the development of a clear strategic decisionmaking framework.



This task force is focusing on improving the effectiveness of Federal infrastructure strategy development through more consistent use of program performance measurements as a defined rationale for investment decisions. Performance based needs studies, data, and analytical techniques are being shared and examined towards the development of alternative decision-making frameworks that can improve the traditional unevaluated needs study ("wish list") approach which often provides little guidance to decisionmakers. The use of performance output evaluations as part of capital improvement programming and budgeting systems are also being discussed, while the interagency and intergovernmental development of common practices and cooperative investment opportunities are being pursued.

TASK FORCE ON APPLYING INFRASTRUCTURE INVESTMENT ANALYSES

This workgroup is examining the current cost-benefit and/or alternative methodologies among Federal agencies in order to share successful techniques and lessons learned, and to promote best practices. The role of cost-benefit analyses to support capital, maintenance and post investment decisions is being assessed, with a focus on how the various Federal infrastructure agencies/offices translate the results of the analyses into policy and programming decisions. The technical aspects of measurement techniques are being addressed, including the extent to which secondary benefits and costs are utilized, risk and uncertainty considerations, and application of E.O. 12291. In addition, the statutory or administrative barriers to more cooperative and common practices are being critically examined.

MEASURING AND IMPROVING PERFORMANCE

In general, performance is the ability to carry out a task or fulfill a promise, target or objective, often including economic efficiency or cost effectiveness as measures. For physical infrastructure performance manifests itself in the movement of goods and people, or the provision of flood protection or clean water, and a variety of other services that support the nation's economic and social activities.

The specific factors that describe performance typically differ from one system to another, and providers and users of the facilities often differ in their views of the definition and relative importance of the indicator factors to be used to characterize performance. Although costs, social and economic benefits, and reliability are widely recognized as key elements, there is no single generally accepted framework for comprehensively describing infrastructure performance.

The National Academy of Science's National Research Council, acting through its Building Research Board (BRB), is assisting the Corps and other Federal agencies on this study of infrastructure performance. The study will examine how infrastructure performance has been characterized, how standards have been set, and what the impact of this experience has been on the costs of providing infrastructure, particularly within transportation, water resources, and waste management systems.

Specific objectives of the inquiry are to: 1) analyze and define infrastructure systems performance parameters; 2) develop proposed methods to measure the parameters; and, 3) develop options which could be used to integrate performance measurement into our Nation's infrastructure planning, design, maintenance, research and management processes.

As a first step in the study the Corps and the BRB have agreed that the BRB's Committee on Infrastructure will hold a Colloquium on Infrastructure Performance. The colloquium results will be followed by a detailed examination of the description, measurement, and improvement of infrastructure performance at the operational and policy levels.

ECONOMIC IMPACTS OF INFRASTRUCTURE INVESTMENTS³⁵

In FY 92 direct Federal expenditures for physical capital in non-defense programs totalled over \$20 billion, while Federal grants for public works infrastructure amounted to over \$27 billion.³⁶ However, at present, there is no consensus on whether this spending approaches or exceeds optimum investment levels, or how such investments affect or are affected by economic growth.

Some economists and government analysts believe that infrastructure investment does have a positive affect on measured output, and that more investment is needed to stimulate economic growth and productivity to the levels achieved in the 1950's and 1960's.

Other experts maintain that infrastructure is fundamentally demand-driven, and that positive demographic and income changes in the 1950's and 1960's led to greater infrastructure investment, relative to national output, and that the historic decline of infrastructure investment can explained by the fading of those circumstances.

And finally, there are those on both sides of the debate that maintain that the need to insure the economic efficiency of each infrastructure project is the overriding concern.

The purpose of this study is to reasonably assess the total rate of return of planned Federally provided and leveraged infrastructure investment. The study will focus on infrastructure spending in the Nation's public works categories of transportation, water resources development, wastewater treatment, and hazardous and solid waste disposal. The study will build upon the accumulated knowledge to determine what payoffs are likely to result from Federal infrastructure investments.

The Corps convened a series of workshops to frame the pertinent issues and encourage active interagency participation. Three one-day workshops were held between July and November 1992 with representatives of the following Federal agencies: the Departments of Agriculture, Army, Commerce (Bureau of Economic Analysis), Interior (Bureau of Reclamation), Energy, and Transportation (including the Federal Aviation, Highway, Rail, and Transit Administrations), and the Environmental Protection Agency, and the Office of Management and Budget. Representatives of the Congressional Budget Office, Congressional Research Service, Federal Reserve Bank of Boston and various academic institutions also attended.

The output of the workshops was the development of a workplan for the study. Participants agreed that enough literature surveys have been performed, and that the economic relationships and issues have been identified. Table 3 provides a summary regarding the general conclusion's regarding infrastructures impact's on the economy.



Table 3
Infrastructure's Impacts On Economic Activity

General Conclusion:

Public Investment in Infrastructure Matters to the National Economy

How Infrastructure Matters:

- An input into production;
- Enhancing productivity of other inputs;
- Attracting inputs from elsewhere;
- Providing demand for construction and other services;
- Responding to demographic and structural changes.

Caveats to These Insights:

- Services, not structures, are important;
- Services should be appropriately priced;
- There can be too much as well as too little investment;
- Facilities must be properly maintained;
- New investments must be carefully analyzed, case by case.

Reasons That Not More is Known:

- Complexity of the problem;
- Inconsistencies in what current studies measure;
- Lack of comparability across methods and data;
- Limitations in data themselves;
- Econometric and estimation problems;
- Lack of policy focus in current studies;
- Lack of focus on system-wide performance.

There was a consensus that the overriding need new information and original research. It was also agreed that, although economic theory alone cannot provide the answer of how and to what extent public capital matters, the Federal government needs directed research towards the development of a national investment.

The study is now underway, with the various Federal agencies and offices participating in the work, and several interagency management and technical oversight committee established to direct the effort. A Corps of Engineers Report to be published shortly (IWR Report FIS-93-4) entitled Infrastructure in the 21st Century Economy will describe in some detail the context, processes, scope and organization of the study. Future interim outputs include a report on current and planned Federal infrastructure programs in FY 93, and a report describing work in progress early in FY 94.

THE VALUE OF INFRASTRUCTURE

This background paper by McDowell and Bell is one of the early products of the Federal Infrastructure Strategy program.³⁷ The paper, which is included in this report as Appendix D, discusses the value of infrastructure within the context of the Nation's economic health, describes the relationship between productivity in the public and private sectors, and highlights the importance of suitable quantitative measures to infrastructure decision-making.

For the purposes of the paper, public works infrastructure refers to Nation's transportation, environmental, communications, and energy systems. The authors argue that the demand for such facilities is likely to increase across the Nation in the 1990's because of three factors: (1) the growth in the number of people and jobs, (2) increasing globalization and the competition of international markets, and (3) rising standard for environmental protection. The paper explores the persistent debate regarding the difficulties associated with determining how much public works investment is needed, and the merits of conclusions based on aggregate macroeconomic analysis of public investment.

The paper concludes that macroeconomic analysis of investment trends is not a substitute for specific rate of return analysis for individual programs or projects, but leaves open the question as to whether America is headed in the right direction with respect to the investment levels in the various public works categories. The specific problem identified in making such assessments is the lack of performance-based measures of the link between public works expenditures and the level and quality of infrastructure services. Without explaining the relationship that the quantity and quality of infrastructure services have to economic growth and productivity, meaningful policy recommendations on how much investment is needed cannot be developed.

Finally, the paper also recommends that a number of national initiatives for infrastructure should be pursued. These include: more timely investment decisions through the reform of the regulatory process, the targeting of infrastructure investments consistent with the changing face of the U.S. economy, and the development of a Federal infrastructure strategy based on a clear articulation America's infrastructure vision.

ALTERNATIVE INFRASTRUCTURE STRATEGIES AND IMPLEMENTATION TECHNIQUES

A second background paper by McDowell and Bell, this companion work to The Value of Infrastructure to America is included in its entirety as Appendix E. This effort focuses on techniques for implementing alternative infrastructure strategies, including funding mechanisms, allocating responsibilities, and management tools.³⁸

The context of the growing role of state and local governments as public works providers is discussed, and the various ways governments can fund public works projects are reviewed, including taxes, user fees, earmarked funds, intergovernmental aid, borrowing, and private sector financing.

In addition, the current trends and constraints in funding infrastructure are reviewed, along with a discussion of financing strategies tied to benefits. These strategies address three interdependent questions:



- How much should be spent on infrastructure?
- Who should pay?
- How should spending be financed?

The concepts of responsibility are reviewed in conjunction with the principles of the National Council on Public Works Improvement for justifying Federal involvement and implementing shared responsibilities. The authors also recommend improving management tools as a means of following up on these financing and Federal aid requirements. These include: the use of capital improvement programming and budgeting, the simplification of the regulatory process, and more widespread use of performance management systems.

The paper concludes with the authors' perspective on the direction of the Corps of Engineers' Federal Infrastructure Strategy. They recommend that the Corps pursue an intergovernmental dialogue designed to bring together the various public works interests to develop a national public works agenda in response to the authorizing legislation. Such a national dialogue could include representatives of Federal public works agencies, Congressional committee staffs, state and local governments, public interest groups, the major infrastructure related professions, and the private sector. The types of infrastructure issues recommended to be considered include:

- Establishing national purposes for infrastructure;
- Identifying appropriate Federal responsibilities and relationships;
- Forming Federal interagency partnerships; and
- Enhancing Federal, state, local, and private-sector infrastructure partnerships.

While the authors acknowledge that establishing a national dialogue is only a first step, they expect the resulting coordination and sharing of ideas to build momentum towards developing a national infrastructure strategy.

RELATIONSHIP BETWEEN STANDARDS AND PERFORMANCE

This background paper by GKY & Associates, Inc., explores the relationships between standards and the performance of infrastructure.³⁹ It documents fundamental concepts related to infrastructure performance measures, standards, criteria, and objectives, thus laying the groundwork for currently ongoing work on performance measure issues.

The analysis of three case studies within the public works categories of transportation (large commercial airports--Federal Aviation Administration), water resources (flood control--Corps of Engineers), and waste (waste to energy--Environmental Protection Agency), are used to illustrate the Federal role and the challenges in linking standards to performance outputs involving the delivery of goods or the provision of services.

Observations of this study include:

1. The appropriate Federal role in setting standards is not clear, but varies between public works categories;
2. National infrastructure policy should be coordinated across infrastructure category boundaries;

3. Responsibility and authority for setting standards and developing infrastructure should be coincident;
4. The public's ability to identify infrastructure benefits influences objectives and standards;
5. Objectives and decision-making of public entities are often statutorily limited, which influences the selection of performance measures and standards;
6. Liability and litigation can be reduced through the application of standards, but at the likely expense of potential innovation;
7. Infrastructure objectives, performance measures, and standards should be regularly reviewed and revised to reflect current policy and technical requirements.

The case studies allowed the identification of some specific performance barriers, as summarized in Table 4. The case studies also raised policy issues having broader application to all categories of infrastructure, such as the misuse of different types of standards.

This paper will be published by the Corps of Engineers as part of the Institute for Water Resources' Occasional Paper series for the Federal Infrastructure Strategy.

FRAGILE FOUNDATIONS AND CONGRESSIONAL POLICY: HOW HAS CONGRESS RESPONDED?

This paper will describe the policy recommendations made by the National Council on Public Works Improvement in Fragile Foundations, and will examine the content and political direction of public works and infrastructure related legislative proposals introduced in Congress between 1988 and 1992. This legislative history will be compared with the recommendations of the Council towards determining the extent to which Fragile Foundations has impacted on Federal infrastructure policy.

An interim product of this effort is the completion of a comprehensive inventory of the infrastructure related legislation offered in the 102nd Congress.⁴⁰ This compilation reveals that while several key aspects of Fragile Foundations' recommendations have been addressed by newly enacted laws, most aspects have either been put forward but not enacted, or ignored.

As far as what has been enacted into law, the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) clearly stands out as the most significant achievement. ISTEA has increased the potential spending on transportation infrastructure over the next five years, financed primarily by postponing and partially repealing the planned phase out of the temporary increase in the gasoline tax enacted in 1990. Intergovernmental transportation planning was emphasized in the bill, and new flexibility offered to state and local governments for the shifting of funds between transportation modes. In addition, a new office of transportation Intermodalism was created within the Department of Transportation, and a pilot research effort into high speed trains was introduced.



Table 4
Sample Performance Barriers Identified in Three Infrastructure Case Studies

Case Study	Performance Impairment	Performance Barriers
Airports	Congestion	Difficulty in agreement on equitable trust fund distribution Federal subsidization increasing demand Siting constraints (e.g., noise) Air traffic control capacity Conservative safety standards Slow technological innovation
Waste-to-Energy	Costs Siting	Siting constraints (e.g., environmental) More expensive than other disposal techniques No Federal funding Health/environmental concerns Technology uncertainty
Flood Control	Funding Equity Slow Implementation	Limits on local funding Conservative standards Difficulty estimating benefits Environmental constraints (e.g., wetlands) Congressional involvement in site selection Dispersed Federal roles

Beyond ISTEA, a number of proposals (not enacted) call for new bodies to coordinate Federal infrastructure agencies and their counterparts at the state and local governments. These bills included the National Infrastructure Council Act of 1991 (S.317), the Small Community Environmental Infrastructure Assistance Act of 1990 (S.729), and the National Infrastructure Corporation and Advisory Council Act of 1991 (S.769). Each of these proposals are summarized below:

S.317 proposed a **National Infrastructure Council** composed of the Secretaries of the Army, Interior, Transportation, and Commerce, and the Administrator of EPA. The Council was to develop policy, prepare annual assessments of infrastructure needs, coordinate a national program on infrastructure literacy in primary and secondary schools, and assess priorities for Federal investment. Also proposed were infrastructure technology transfer, technical assistance and R&D programs. An advisory board was also proposed consisting of national government organizations such as the National Governors Association, National League of Cities and others.

S.729 proposed an USEPA grant program for **Small Community Environmental Infrastructure Assistance** for constructing public water systems, wastewater systems and treatment works, solid waste treatment facilities and underground storage tanks. Eligible communities could not exceed 2,500 in population, and would have had to be economically distressed. Cooperating states would have cost-shared 25 percent of the project funding. An office of Community Environmental Infrastructure Assistance was also proposed for the Corps

of Engineers for the construction and Management of similar projects for communities less than 25,000 in population which were economically distressed.

S.769 proposed a **National Infrastructure Corporation** with an Advisory Council composed of the Secretaries of the Army, Interior, Transportation, Commerce and the Administrator of EPA. The Corporation would have conducted needs studies and hold hearings, with a National Infrastructure Revolving Trust Fund proposed to provide interim funding for State nominated projects. Programs in R&D, technology transfer, and an economic study on the value and worth of infrastructure were also proposed, along with a National Infrastructure Institute.

Many of the other transportation proposals that were not enacted were anti-recession bills which relied heavily on either additional expenditures or accelerated spending from trust funds. A number of proposals addressed infrastructure within the context of aid to small or rural communities, or as an anti-poverty measure. Most of the bills which proposed R&D efforts centered on MAGLEV initiatives.

From the financing perspective, several proposed bills called for the removal of infrastructure trust funds from the unified Federal budget, and their was significant interest in lessening the limits on tax-exempt financing for environmental projects. In fact, their was significant interest in the implementation of a wide variety of environmental infrastructure programs.

Council recommendations that have been thus far ignored by the 102nd Congress include: incentives for maintenance and low capital techniques, infrastructure R&D and technology transfer (other than MAGLEV), clarification of the government roles, public works professional training, and a national commitment to invest more efficiently or in greater amounts.

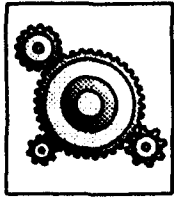
Finally, this survey focused on the public works infrastructure modes presented in Fragile Foundations and it should be noted that there were a number of proposed bills of note on other infrastructure categories, such as telecommunications.

ISTEA: THE IMPACT OF ECONOMIC STRUCTURE ON CONGRESSIONAL PUBLIC POLICY

This background paper will address the impact of the changing structure of the national economy on the elected officials and policymakers who allocate infrastructure investments. This includes, at the Federal level, examining how changing economic interests affect the political constituencies of Congress.

This paper will analyze Congressional positions on key elements of ISTEA and overlay this assessment with the economic structure patterns across the nation. These two perspectives will be compared and inferences made regarding the relationship between economic and policy priorities in making infrastructure investment decisions.





V. Stimulating Innovation and Technology Transfer

A key output of the first phase of the ACIR facilitated dialogue was the need identified for enhanced technological innovation through Federally provided research and development (R&D) programs and improved technology transfer mechanisms. Three topics requiring special attention emerged, resulting in the formulation of the in-depth inquiries outlined below. These studies address key issues regarding: infrastructure innovation, Federal public works R&D, and technology transfer. An early background paper on R&D innovation is also summarized in this section of the report.

PUBLIC WORKS INFRASTRUCTURE INNOVATION⁴¹

The participants in the ACIR workshops agreed that there was a major Federal role in promoting the innovation and dissemination of new infrastructure technologies; however, most also concurred with the findings of a recent report by the Congressional Office of Technology Assessment (OTA) concluded that Federal agencies have not focused R&D programs to make public works programs and projects more productive and cost effective. State and local governments benefit from R&D products only after a very long technology transfer process of development, testing, marketing, evaluation, modification, and dissemination. This length of time, coupled with the lack of investment in public works R&D, and other perceived barriers, make this area relatively unattractive for researchers. The result is a large gap between infrastructure needs and R&D products.

This study responds to this issue by identifying the obstacles that challenge the successful generation and dissemination of innovative research, including the unique transfer problems associated with "on-the-shelf" technologies available from past Federal R&D. The study also examines the opportunities to promote innovation in the construction, management, and maintenance of public works infrastructure.

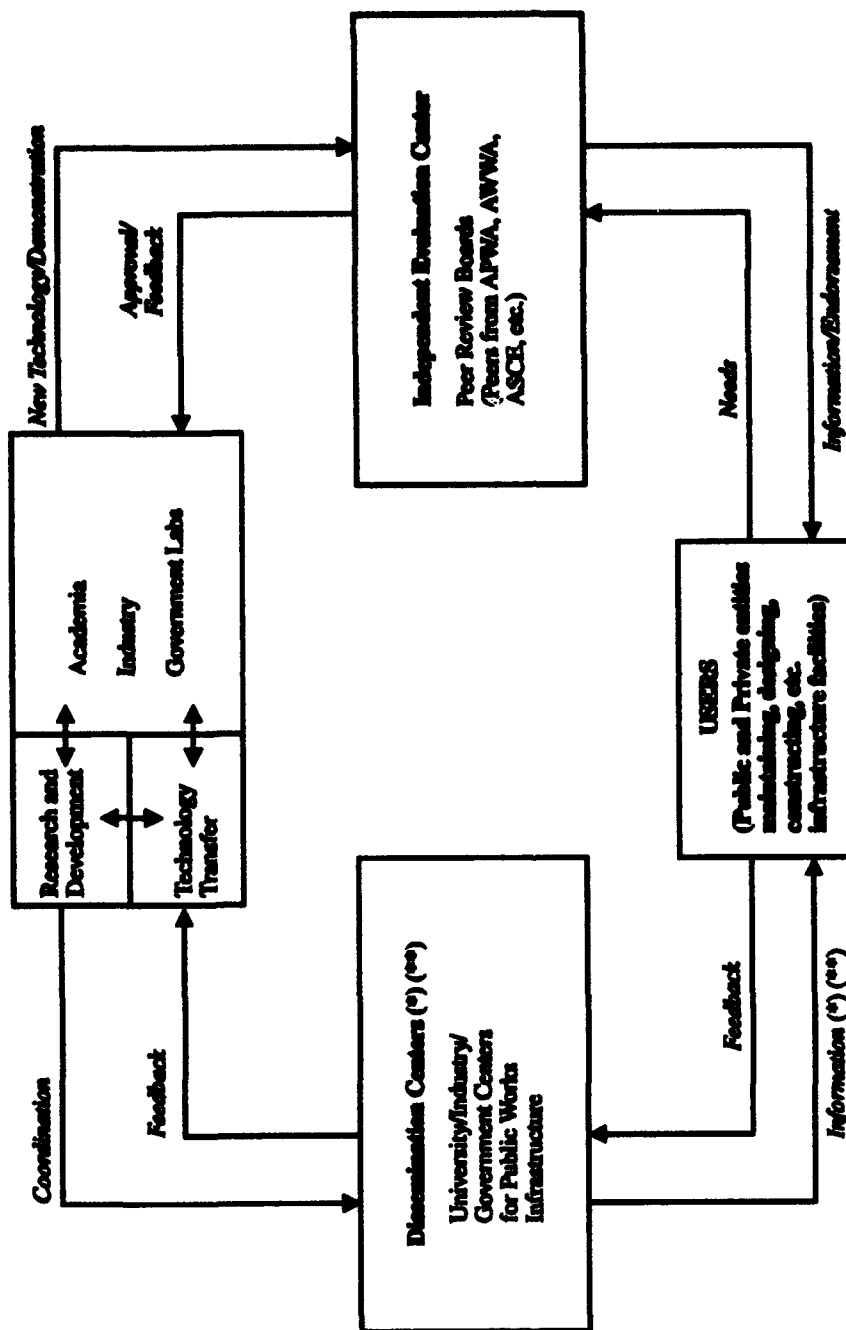
The study, recently completed, was conducted by the U.S. Army Corps of Engineers Construction Engineering Research Laboratories (USACERL). USACERL's work included an extensive literature review and the conduct of a workshop on the challenges and opportunities of promoting innovation in the public works R&D that attracted a distinguished group of experts from academia, government, and industry.

The study focused on four critical areas of interest. First, it examined barriers to infrastructure innovations and innovation adoption processes. Second a model for a national strategy on Infrastructure Research and development (R&D) and Technology Transfer (IRTT) was developed, as shown on Figure 3.





National Catalyst for Public Works Infrastructure R&D



(*) Recommended immediate action.

(**) In the long term these dissemination centers will become technology transfer centers, providing not only information on new technologies, but implementation assistance, support, and training.

Figure 3
Strategy for Public Works Infrastructure R&D and Technology Transfer (IRTD).

Third, based on the IRTT model, the process of technology dissemination was examined in detail, including a review of selected technology transfer models. Finally, a mechanism was developed for the transfer of currently available innovative approaches by incorporating and expanding three diffusion models: The Rogers, the Shaffer, and the NASA (National Aeronautics and Space Administration) models.

The literature survey and workshop discussions generated seven major categories of barriers: 1) cultural values and social perceptions, 2) governmental structure and regulations, 3) risk and liability, 4) public and private partnership issues, 5) funding, 6) size and type of infrastructure projects, and 7) education, research and technology transfer systems.

A list of six specific barriers was developed based on their importance and the practicality of applying method to overcome them. These barriers include:

- Lack of a Federal initiative (focus) for defining the policy and vision for national infrastructure technology (R&D).
- Inadequate technology transfer mechanisms.
- Lack of public awareness.
- Complexity of regulations.
- Reluctance to innovate for fear of legal liability.
- Inadequate organizational management for innovation adoption.

Recommendations were formulated to address these six critical areas. Table 5 provides a summary of these key obstacles along with recommended methods to overcome. For a full discussion of these issues the reader is referred to the final report entitled Challenges and Opportunities for Innovation in Public Works Infrastructure (Volumes 1 and 2), included in the series of Federal Infrastructure Strategy Program reports as IWR Reports 93-FIS-2, and 93-FIS-3.

FEDERAL PUBLIC WORKS INFRASTRUCTURE R&D⁴²

The Federal government has been and continues to be a principle provider of public works R&D. However, baseline information regarding the specific Federal infrastructure R&D programs has not been consolidated or analyzed in the past.

Therefore, an inquiry was undertaken to identify the Federal agencies directly or indirectly involved in infrastructure R&D, as well as the areas of research emphasis and the funding dedicated to these programs. The study also examined how Federal agencies administer and prioritize infrastructure R&D, while baseline R&D funding trend data was developed and disaggregated into public works categories, and by Federal agency, office and laboratory. The role of the U.S. government in infrastructure R&D was contrasted and compared with selected European nations and Japan towards evaluating financial commitments, resource levels, and institutional arrangements.



Table 5
Barriers to Innovation Transfer

Barrier	Methods to Overcome
Lack of a Federal initiative (focus) for defining the policy and vision for national infrastructure technology (R&D). Diverse and fragmented governmental structure and private sector organizations dealing with infrastructure: fragmented R&D efforts throughout the nation.	Create a comprehensive Federal initiative to establish a national infrastructure policy that will: (1) Act as a catalyst for innovation; (2) Keep abreast of international R&D for new technologies; (3) Foster intergovernmental partnerships between State and local governments to develop improved fiscal and political tools for promoting innovation.
Inadequate technology transfer mechanisms. Lack of public- and private-sector R&D cooperation: lack of R&D partnerships between the public and private sectors.	Develop adequate technology transfer mechanisms and commit necessary resources to support them; greater leadership from all levels of Government in support of R&D programs, and development of incentives to reward R&D investment by the private sector.
Lack of public awareness. Public opposition; discordance with widespread cultural values: "not invented here" syndrome; emphasis on short-term benefits, not long-term benefits to the nation.	Active partnership with community groups; building awareness and support groups; communicate with Congress; create mechanisms to resolve controversy; effective education related to key technologies and relevant research; communicate the importance of innovation in a national context.
Complexity of regulations. Governmental technical standards and regulations are complex and sometimes contradictory; increasing rate of legal challenges; obsolescence of regulations.	Developing flexible standards to accommodate technological and design innovation; regular review and appropriate revision of regulations affecting major technologies.
Reluctance to innovate for fear of legal liability. Conservative approaches intended to reduce potential risks; highly visible and publicized failures are penalized while successes go unrewarded; reluctance of financial institutions to fund infrastructure projects with unusual potential risks.	Risk-sharing to encourage innovation; peer evaluation of innovation; demonstrations of innovation, adequately monitored and documented; dissemination of the findings of the demonstrations to all potential users.
Inadequate organizational management for innovation adoption. Resistance to innovation that did not involve the user in defining the problem and specifying the solution; resistance to change; lack of flexibility in regulations; emphasis on short-term, high-visibility results; tendency to cut funding for "unglamorous" public works programs in favor of more visible programs.	Promote top management commitment; nurture active change agents; empower active technology gatekeepers and technology transfer task forces; comprehensive user training programs; promote Total Quality Management (TQM) of all the processes in innovation and technology transfer; innovative financing of public works projects.



As part of the study a comprehensive survey of Federal departments and offices was made, with the results indicating that public works research R&D, while concentrated in a relatively small number of Federal laboratories, is more extensive than documented in previous studies. Specifically, 32 of the 257 Federal laboratories identified by the Federal Laboratory Consortium, primarily in the Departments of Transportation, Defense, and Energy, and the Environmental Protection Agency, are engaged in public works infrastructure research. Observations note the lack of an integrated national infrastructure R&D policy, and recommendations include the cooperative development of a national public works research agenda by the Federal, state and local governments, and the private sector.

The research was performed by the American Society of Civil Engineers' Civil Engineering Research Foundation (CERF) in cooperation with the Corps of Engineers Civil Engineering Research Laboratory, and the University of Illinois. The support and assistance by the Federal Laboratory Consortium was integral to the completion of the research. The work has been recently completed, with a draft report issued by CERF entitled Federal Public Works Infrastructure R&D: A New Perspective, initially published as CERF Draft Technical Report No. 92-F1003. A final report, including recommendations for further action, is being published by the Corps as IWR Report 93-FIS-5.

TECHNOLOGY TRANSFER DEMONSTRATION PROJECTS

It is clear that many obstacles impede the development and application of a Federal technology transfer processes. Significant advances in technology have occurred over the last 15 years, yet innovation in public works are relatively few. Much work has focused on these problems, including on the difficulties of transferring currently available Federally developed advances into practice. A major barrier to adopting public works innovations has been the lack of effective vehicles for demonstration projects. The Office of Technology Assessment (OTA) concluded in its 1991 report to Congress that "cooperative joint efforts between government, and private sector suppliers to demonstrate and evaluate new technologies for safety, durability, and long term costs are excellent ways to spread the risk and overcome some of the difficulties of the procurement process for new technologies."

In response to these needs, the Corps of Engineers is pursuing a range of technology transfer demonstration projects as part of the Federal Infrastructure Strategy program. Some of these initiatives are being conducted to address dissemination opportunities associated with Corps of Engineers technology, and are presented in Section VIII of this report. In addition to the initiatives associated with available Corps technology, a comprehensive research effort was also initiated to address the broader objective of improving the processes for transferring infrastructure related technology from Federal R&D programs into practice within municipal public works agencies.

This study is being facilitated by the Civil Engineering Research Foundation (CERF), the research instrument created by the American Society of Civil Engineers (ASCE). The work is being co-sponsored by a range of Federal agency partners, including: the Federal Highway Administration (FHWA), the Environmental Protection Agency (EPA) and the Bureau of Reclamation, Department of the Interior. In addition, other agencies who have agreed to serve on the Study Advisory Group (SAG) include: the National Institute of Standards and Technology (NIST), the Western Area Power Administration, Department of Energy (DOE), and the Corps



Waterways Experiment Station (WES), with other agencies also expected to accept invitations to join.

The effort includes the identification and conduct of ten demonstration projects through the application of a five step technology transfer process: (1) problem identification, classification, and priority; (2) problem and technology matching; (3) market survey; (4) technology demonstration partner identification; and, (5) technology demonstration.

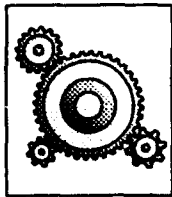
CERF will utilize a literature search and survey of public works practitioners to identify problems within the municipal public works community that require the infusion of new technology. The problems will be classified into subject areas and prioritized in coordination with the SAG. The matching of problems and technology will include a comprehensive review of Federal R&D programs and outputs, including patents, licenses, and CRADA's. The market potential of the candidate technologies will be tested, and technology transfer agencies and manufacturers identified for the actual demonstrations.

STIMULATING INNOVATION

This background paper was prepared by Jeffrey J. Walaszek, Chief of the Corps Construction Engineering Research Laboratories Public Affairs and Marketing Communications Office.⁴³ The paper explores the benefits of R&D innovation and outlines common barrier to technology transfer, including : ineffective communications, human resistance to change, and organizational and industry constraints. Methods to overcome these barriers are discussed, including specific Corps programs currently in place. The general suggestions included: the development of peer communication support, institutionalizing technology transfer, the use of demonstration projects, and public-private partnerships.

The importance of patent licensing agreements, and cooperative research and development agreements (CRDA's) are also emphasized in the process design of R&D products. The roles of the various Corps of Engineer laboratories in Army R&D are outlined, with a specific focus on the objectives of the Construction Productivity Advancement Research (CPAR) Program. Finally, USACERL's work with the American Public Works Association on the labs' Pavement Maintenance Management System (PAVER) is used as an example of a professional society or trade association working to make a nonpatentable product developed by the Federal government available to its constituents.

This paper, which preceded the in-depth inquiry on the challenges and barriers facing infrastructure innovation, is planned for publication as part of IWR's Occasional Paper series for the Federal Infrastructure Strategy.



VI. Adequacy of Investment Levels and Financing Mechanisms

INVESTMENT LEVELS

One characterization of the value of the Nation's infrastructure is in terms of its monetary worth. The value of the capital stock represented in the Nation's roads, bridges, mass transportation, airports, ports and waterways, water supply, wastewater treatment, and solid waste disposal facilities is estimated to be about \$2.7 trillion, slightly over 20 percent of the country's total public and private capital stock.⁴⁴ Federal, State and local governments currently spend about \$140 billion annually on building, operating, and maintaining these facilities.⁴⁵

However, infrastructure is not an end in itself. Although infrastructure is often seen as physical project outputs such as a highway, a bridge, a dam, or a port, the true output of infrastructure is the performance of a service. Infrastructure's importance to the Nation is derived from its ability to perform, or the degree to which it achieves stated functional objectives, such as the movement of people, the reduction of congestion or accident rates, the value of flood damages averted, or the improvement of shipping times. As McDowell and Bell point out, even well engineered public works facilities may be of little value if the services they provide are not available when needed, if they are located improperly, if they are operated inefficiently, or if they are allowed to deteriorate and to fall into disuse.⁴⁶

That infrastructure services are an important underpinning of the modern economy is a largely undisputed premise. However, what is not as clear is at what level should public works investment be targeted, and how should that investment be allocated.

The current literature reflects controversy over whether the Nation's level of public investment in infrastructure has been sufficient. Arguments on either side of the debate are usually supported by past public spending statistics. A review of the literature would allow one to conclude that public investment in America's infrastructure is currently declining, rising, and staying about the same, depending on the time period analyzed and the context of the statistics used. Remarkably, it is possible to reach all three of the above conclusions simultaneously without engaging in a contradiction. American public works spending *is* rising, falling and staying constant, all at the same time, depending on the context of the numbers consulted. A detailed examination of this seemingly paradoxical state of affairs is provided in the background paper Interpreting Trends in Federal Infrastructure Investment, which appears as Appendix C of this report.

In addition, an interim output of the in-depth inquiry on the economic study of Federal infrastructure investments, previously discussed in Chapter IV, includes the design of an overarching framework to organize, characterize, and understand the data and the investment trends for different types of infrastructure. Disaggregated data for the Federal and non-Federal



expenditures for the public works categories outlined in Fragile Foundations, both in the past and projected into the future, are being collected, organized and analyzed. The resulting database will be comprised of the Nation's infrastructure spending in the categories of transportation (highways and bridges, airways and airports, mass transit, and intermodal), water resources development (flood control inland and deep-draft navigation, water supply, and waste water treatment), and waste management (solid and hazardous).

FINANCING

The 1980's resulted in major changes in infrastructure financing. Federal infrastructure aid declined proportionally while state and local financing played increasingly important roles. However, all levels of government are facing increased budget constraints, and many state and local governments now lack adequate funds to meet perceived infrastructure needs.

Cost-sharing changes, such as the provisions of the Water Resources Development Act of 1986 (P.L. 99-662), have placed greater emphasis on "beneficiary pays" principles and have resulted in local sponsors contributing substantially larger portions of infrastructure project costs. Sponsors are required to be more active partners in all planning, financing and implementation decisions, and they often need much more information in order to assess the local public finance impacts of their project related decisions.

One of the ACIR interagency task forces (Group 6) is focusing on the issues associated with revenue diversification, while several other technical studies have addressed financing innovations in state government, and the role of tax exempt financing in infrastructure development. Finally, another research effort was initiated to develop and implement a system aimed at local government use for estimating the expenditure and revenue impacts of public works projects. Each of these efforts are summarized below.

Task Force on Revenue Diversification

This task force is examining the development and use of diversified revenue sources to support infrastructure investment initiatives. In recognition of the declining Federal role in the direct funding of public works, agency representatives will share experiences regarding alternative financing mechanisms at all levels of government. Topics include: pricing investments with a view towards the "beneficiary pays" principle, increased emphasis on instituting user fees, greater reliance on revolving loan funds and investment pools, potential tax code modifications (including tax-exempt financing), public/private revenue diversification partnerships, and interagency or inter-trust fund transfers.

Financing Innovations in State Government

Local governments often face major financing and management obstacles in planning, maintaining, and rehabilitating existing infrastructure. In some cases State governments have instituted a variety of innovative techniques to assist local jurisdictions obtain needed public works. This technical study, which is documented in the report prepared by the Urban Institute titled State Programs for Community Infrastructure: Innovations in Financing Methods and Program Operations, examined programs in nine states to support local water supply, wastewater



treatment, and solid waste efforts. This report will be published by the Corps of Engineers as Report IWR 93-FIS-6.

The study includes the results of a literature survey and interviews of state administrators focused on examples of innovative State assistance methods. The report also provides Federal agencies with a perspective on successfully applied techniques, and concludes with several suggestions for relatively low cost activities that could be undertaken by the Federal government in support of state and local infrastructure efforts.

The range of state techniques examined include innovative financial measures, the provision of technical assistance, the use of the terms and conditions of infrastructure loans and grants to screen projects, the use of project selection incentives, the application of decentralized decision-making, the use of bond banks, monitoring and evaluation assistance, and the accomplishment of needs assessments. Table 6 presents a summary of the state programs examined.

The principle finding of the study is that state governments can exercise a wide range of influence to guide and support local implementation of infrastructure facilities in addition to simply providing dollars. Specific examples include:

1. Terms, Conditions and Special Requirements for Infrastructure Financial Assistance. Several states are using the opportunity provided by financial assistance programs to require local governments to adopt a variety of public works practices. These include the: the development of capital improvement plans; the adoption of fee and charges; the establishment of dedicated funding for infrastructure maintenance; and the adoption of water conservation incentives.
2. Scope of Infrastructure Financial Assistance. Some states are also broadening the impact of grant and loan programs by extending the scope of activities that may be financed by the program. These "expanded uses" are sometimes applied to activities not directly related to the provision of physical infrastructure, such as for nonpoint source runoff, groundwater estuary and coastal protection, or wetlands and water quality protection.
3. Project Selection Process. The criteria used by states to select the specific infrastructure projects which receive loans and grants can be utilized to foster desirable public works management practices or environmental initiatives, such as water conservation and water reduction programs. In some cases the application of procedures for assigning "bonus points" are used to encourage efforts towards environmental or management goals.
4. Technical Assistance. Several states have innovative technical assistance programs for very small and/or rural communities. These include assistance aimed at reducing the cost of public works projects, and programs related to help communities operate and manage existing infrastructure facilities. Of particular note is New York State's Self-Help Support System, a public-private partnership which is currently being introduced in several other states under the Small Town Environmental Program by the U.S. Environmental Protection Agency and the Renesselaerville Institute.



Table 6
Summary of State Programs for Community Infrastructure Innovation

State	Agency/Program	Type of Innovation
Georgia	Clean Water Act Revolving Loan/Grant Program	Grants to soil and water conservation districts for equipment purchases
Illinois	Water Pollution Control Revolving Fund	Project selection bonus points for best management practices
	Public Infrastructure Program (Build Illinois Program)	Financing for water related projects as part of an economic development program
	Illinois Rural Bond Bank	Financial assistance to local governments
		Technical assistance regarding issuance of bonds
Kansas	Clean Water Act Revolving Fund - Nonpoint Source Pollution Program	Cost sharing assistance to landowners for erosion control conservation measures
Maryland	Clean Water Act Revolving Fund Program	Loans to cleanup lake eutrophication
Missouri	Soil Tax Fund	Sales tax dedicated for soil conservation measures
New York	Department of Environmental Conservation, Health and State, and the Rennselaerville Institute: Self-Help Support System	Innovative public-private partnership for technical assistance to small rural communities aimed at reducing costs of infrastructure projects
North Carolina	Clean Water Revolving Loan and Grant Program	Adoption of sewer ordinances, fees and charges for conservation efforts
		Project selection bonus points for water conservation and water loss reduction programs
		Annual reporting requirements
Ohio	Public Works Commission "State Issue #2"	Terms and conditions of financial assistance
		Special requirements for community planning
		Decentralized decisionmaking
		Emergency assistance and small government programs
Tennessee	Department of Environment and Conservation, and University of Tennessee's Institute for Public Service: Municipal Technical Advisory Service	Project monitoring and annual reporting
		Innovative technical assistance to improve operation and maintenance of infrastructure



Table 6 Continued
Summary of State Programs for Community Infrastructure Innovation

State	Agency/Program	Type of Innovation
Texas	Water Development Board: Program for Economically Distressed Areas	Special requirements for financial assistance
Utah	Drinking Water Board	Drinking water loans include special requirements for financial assistance
	Department of Environmental Quality	State needs assessments to prioritize projects
	Clean Water Act State Revolving Fund	Loans for soil and water conservation projects
Washington	Department of Community Development: Public Works Trust Fund	Special requirements for financial assistance
		Use of revolving fund for nonpoint source pollution projects
		Selection bonus points for best maintenance practices, willingness to cost share and fiscal management ability
Wisconsin	Department of Natural Resources: Clean Water Fund Nonpoint Source Pollution Control	Technical assistance in form of capital improvement planning manual
		Maintenance compliance requirements for wastewater treatment systems
		Cost sharing based on best practices for pollution abatement

5. **Decentralized Decision-Making.** The concept of decentralized decision-making for state programs is an alternative to traditional state administration of infrastructure loan and grant programs. Such regionalization allows state programs to respond more directly to community needs, although it may result in the inconsistent application of project selection criteria. Decentralization also has a greater potential for local politics to intrude more explicitly into the decision process.
6. **State Bond Banks.** State bond banks can provide significant advantages to local jurisdictions. By pooling the bonds of a number of different local governments and issuing bonds in their behalf, state bond banks compensate for the differing credit ratings of the participating communities, thus allowing them to receive equal treatment in the bond market. Local entities using state bond banks tend to pay less to finance projects since by joining together they can often obtain lower interest rates than most individual local governments.



7. **Monitoring and Evaluation.** The legislated requirement of some states for annual reports has been expanded and used as a project monitoring mechanism to help identify infrastructure marketing needs, milestone and financial accomplishment, and the identification of problems. A few states are also incorporating a sample of field verification site visits to assess the extent of compliance to previous mandates and to document lessons learned.

Finally, the study also identified a number of recommendations to the Federal government for national assistance efforts based on the examples provided by the state programs. These recommendations are aimed at providing states and local governments with information on a national basis that they could adapt to their own circumstances. Such a Federal role could include such relatively low cost efforts as supporting the preparation of guidance materials on: project selection procedures; procedures for undertaking assessments of future needs; guidance for states conducting program evaluations; and, the reporting to all states on innovative state assistance programs.⁴⁷

The Role of Tax Exempt Financing in Infrastructure Development

The tax status of municipal bonds is part of the larger policy debate regarding whether it is appropriate for the Federal government to subsidize local infrastructure construction, and if so, whether exempting municipal bonds from Federal taxation is the proper mechanism for providing that subsidy. This background study, which was conducted for the Federal Infrastructure Strategy by Apogee Research, Inc., is documented in the report titled Effects of Federal Tax Policy on Infrastructure Investment, and will be published by the Corps of Engineers in IWR Report 93-FIS-6. The study reviewed the provisions of the Tax Reform Act of 1986 and its amendments that effect tax exempt bonds and their use for state and local financing of public works projects.

The Tax Reform Act of 1986 contains several provisions that restrict or place conditions on the use of tax-exempt bonds to finance infrastructure facilities. These provisions have generally been assumed to have discouraged the use of tax exempt bonds and increased the cost of providing basic public infrastructure services. The Act has been viewed as impacting issuers in three ways: by reducing the volume of tax-exempt bonds that can be issued to finance infrastructure, by increasing the costs associated with those bonds that are tax exempt, and by forcing some projects to be financed through taxable bonds.

The study examines the volume of tax exempt bonds issued over the period 1979-1989 in order to assess the impact that the 1986 Tax Reform Act had on the ability of state and local governments to finance public works projects, and also reviews the trend of infrastructure costs to verify whether the Act has indeed resulted in more expensive projects.

The study revealed that over the 1979-1989 period, the volume of tax exempt bonds issued to finance infrastructure has remained steady in real terms, while the volume of taxable bonds has risen slightly. Since the volume of tax-exempt bonds has not changed significantly, it is possible to conclude that infrastructure investment is continuing at the pre-tax reform level. However, whether the post-tax reform sample period has fully responded to the Act, and whether these levels of investment meets the nations's current infrastructure needs, remain as outstanding issues.



The study also concluded that although the tax-exempt investment has maintained a steady pace, the Act has had the unintended effect of increasing the costs for public works facilities. Four major factors were identified as contributing to this increase: higher tax-exempt interest rates, a narrowing of the market for the tax-exempt bonds by eliminating certain large-volume institutional buyers, delays in issuing bonds due to the Act's limitations on the volume of private activity each year, and the resulting increase of taxable public bonds which increases borrowing costs significantly.⁴⁸

Local Public Finance Impact (LPFI) Model

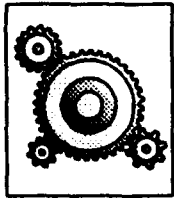
The objective of this research is to develop and implement a system of procedures for estimating the expenditure and revenue impacts of water resource projects at the state and local government levels. The model will focus on estimating the project's practical consequences on local public revenues and expenditures, such as secondary employment and income effects. The model is being constructed from the point of view of local public officials and their decision making processes for providing public services. It could be used by local governments to assess the potential relationship between future expenditures and revenues towards the development of a fiscal policy action plan.⁴⁹

Work includes a literature review, model design based on standard outputs of existing models (e.g., Input-Output and Economic Base), and the development of a computer-aided program that implements the LPFI model, along with supporting technical documentation and on line data sources to operate the model.

The methodological approach will be sufficiently flexible to accommodate a broad range of infrastructure projects, and will be consistent in terms of data requirements with the Corps Regional Interindustry Program (RIP), Multi-Regional Variable Input Output Model (MRVIO), and Small Area Assessment Model (SAAM). Estimated government finance outputs will include revenue categories such as: intergovernmental transfers, taxes (sales and gross receipts, property, individual and corporation income), charges and miscellaneous revenues, and other revenue (utility, liquor store, insurance trust), while estimated expenditure categories will include: education, health, transportation, police, fire, recreation, welfare and housing, sanitation, finance and administration, and other expenditures.

The model will operate on the main-frame computer at the U.S. Army Construction Engineering Research Laboratories (USACERL).





VII. Managing Programs and Improving Performance

The initial phase of the interagency coordination highlighted several recurring management issues, primarily involving the need for management initiatives involving the areas of performance, incentives, and capital budgeting. In response to these needs, three interagency task forces (Group 3 on Deferred Maintenance, Group 4 on Regulatory and Administrative Relief, and Group 5 on Streamlining Permitting for Public Works Projects), and three in-depth inquiries and several background papers on management improvement topics have been initiated with the assistance of third party subject matter experts. These program elements are presented below.

TASK FORCE ON FLEXIBLE AND PERFORMANCE BASED REGULATIONS

Issues involved with Federal regulation and unfunded mandates affecting state and local governments are being examined towards the development of more flexible, performance-based regulations and the clarification of regulatory roles and responsibilities at all levels of government. The role of processes such as negotiated rulemaking and dispute resolution in the formulation of more flexible rules are being explored. Examples of successfully drafted and implemented performance-based regulations are being shared, and the effective use of the Regulatory Flexibility Act of 1980, including its attention to small governments, is being examined.

TASK FORCE ON ENVIRONMENTAL DECISIONMAKING FOR PUBLIC WORKS

This workgroup is focusing on a specific Federal regulation concerns regarding the need to simplify and streamline permitting procedures. The objective of this effort is to reduce infrastructure investment costs and minimize implementation delays, while still insuring environmental protection. Issues involving the sequential steps and separate decision points, the many separate agencies involved (each with differing responsibilities and procedures), and the overlapping Federal, state and local requirements, are being addressed.

Attention is being given to more effective uses of the National Environmental Policy Act (NEPA) to improve the coordination of environmental reviews, mitigation plans, and permit requirements, and the consideration of increasing state permitting approvals in lieu of multiple state, local and Federal controls. Finally, the task force is exploring the development of a Federal strategy to further intergovernmental environmental sensitivity, facilitate informed environmental decision-making, and to assist non-Federal interests in meeting environmental requirements in a timely manner.



TASK FORCE ON DEFERRED MAINTENANCE PRACTICES

Issues being addressed include the utility of incorporating the accounting practice of including long term accrued liability as an element of Federal decisionmaking, pricing and budgeting for infrastructure investments. The practice of accounting for the accrued or unfunded liability of a capital asset is being examined, including publicly reporting postponed Federal maintenance spending as a financial liability in order to increase the visibility of deferred maintenance decisions. Examples of past government or other deferred maintenance accounting systems is being presented, while the relationships between maintenance accounting and Federal agency programming and budgeting is being explored.

PUBLIC WORKS MANAGEMENT PRACTICES AND BARRIERS

This is a study aimed at identifying and evaluating the roadblocks which prevent municipal public works departments from operating effectively, and developing strategies which would improve the performance and operating efficiencies of these agencies. The Corps identified an ongoing project by the American Public Works Association (APWA) which will, with supplemental requirements, further these goals.

Local infrastructure problems such as revenue shortfalls, decreased Federal aid, increased liability costs, and the deterioration of key public works facilities, have led the APWA to develop and publish a manual of over 400 management practices.⁵⁰ These practices are designed to assist public works managers in planning for and improving performance. In an iterative self-assessment process, APWA instructs municipal managers regarding the practices, followed by local application and feedback to APWA, with subsequent revision and modification to the practices manual.

As part of this study, the Corps has joined with APWA and the National Academy of Public Administration to specifically apply an enhanced version of the assessment process to twelve state/local agencies across the nation to determine the perceived legislative, administrative, and technical roadblocks which impede implementation of improved management practices. The types of public works functions to be assessed include: municipal engineering, design, construction, buildings, grounds, equipment, potable water, solid waste collection, solid waste processing and disposal, streets, snow and ice control, stormwater and wastewater.

APWA and NAPA have assembled expert panels to perform the case studies over the spring and summer of 1993. The panels have developed a pre-site visit package, questionnaire, and evaluation check list, to be used for the local interviews. NAPA is also working towards providing an abbreviated questionnaire to be use for a broad based mail-out survey.

APWA publicized the program at their national conference and the newsletter mailings to member local governments. The number of agencies expressing interest in the program provided a large pool of potential sites.

Public works agencies were subsequently selected to insure that both rural and urban areas were represented, and to reflect locations varying in geographic, climactic, and demographic settings. Of course, the willingness and level of commitment expressed by the various agencies,

along with the need to obtain a wide representation of public works functions, also guided the selection process.

The following agencies have been selected to serve as case studies:

Wakefield, Massachusetts
Pittsburgh, Pennsylvania
Atlanta, Georgia
Lawrence, Kansas
Waukegan, Illinois
St. Paul, Minnesota
Round Rock, Texas
Billings, Montana
Snohomish County, Washington
Foster City, California
Los Angeles, California
Arizona Department of Transportation

Outputs of the process will include APWA/NAPA's evaluation of the Federal legislative, regulatory, administrative and technical issues judged as significant obstacles to improved service. NAPA will lead the evaluation phase and will also recommend options to overcome the barriers, including drafts of potential legislation or revised administrative or regulatory mandates; methods that could serve as incentives to insure the maintenance of capital assets; and proposals to facilitate the adoption of new technologies.

INFRASTRUCTURE MAINTENANCE: PERFORMANCE ACCOUNTING

The vulnerability of infrastructure due to maintenance deferral is increasing as budget constraints confront all levels of government. Deferral, coupled with temporary, low-cost maintenance procedures, have become more common as government officials face difficult decisions regarding the allocation of scarce resources across the country. One proposed solution is to increase the awareness, visibility, and accountability of maintenance deferrals by requiring explicit display of such decisions in the financial accounting and budgeting processes of government. Some suggest that reformed accounting and reporting systems would improve infrastructure management decisions by forcing decisionmakers to recognize the financial ramifications of maintenance decisions in annual budget priority discussions. Information on the performance of public infrastructure is not currently a integral part of the Federal budget process of the United States.

The purpose of this study is to determine the utility of accounting systems that provide strong incentives to ensure adequate maintenance of capital assets by increasing the visibility and accountability for the practice of deferred maintenance. The costs of deferred maintenance will be examined, and the links between accounting requirements and maintenance spending will be assessed. A range of depreciation methods will be explored for public works systems. Recommendations could address improvements in Federal accounting methods, including the use of disincentives to deferred maintenance by public works decision makers.



The study includes a literature search, the convening of an expert advisory panel, and the examination of case studies (at least one Federal agency, and also U.S. city or state governments, or the systems used by other nations) where innovative practices concerning infrastructure maintenance and accounting mechanisms are currently being applied. Specifically the use of renewals accounting techniques, which obviate the need for an assumed project life, will be examined as an alternative to depreciation accounting methods for public works.

Finally, a comparison of public and private sector accounting practices and decisionmaking will be accomplished, and a case study comparison of applicable methods documented.

REFORMING FEDERAL BUDGETING FOR CAPITAL PROGRAMS

There is a growing concern that the structure of the Federal budget does not adequately integrate capital investment plans or methods in the management of public works infrastructure. Although almost all states have some sort of a capital budget, the Federal budget structure and processes do not fundamentally recognize capital spending. Critics charge that Federal capital expenditures are sacrificed in the interest of balancing budgets because their long range benefits are often not recognized nor reflected in basic budget decisions. However, it is recognized that merely changing the budget procedures may not address the issue, since any new procedures would still be imposed on the current program structure, institutions, and management policies.

This objective of this study is explore the administrative, institutional and programmatic methods for improving the Federal government's capital investments. It will address Federal capital programs in nine categories in three major areas: transportation (highways, air, mass transit, intermodal), water (water resources, navigation, water supply), and waste (water, solid, and hazardous). After identifying the Federal capital programs in each of the nine categories, a literature review will focus on defining goals for successful capital asset management, and a survey of capital management programs will be used to formulate benchmarks against which the Federal programs can be compared.

A panel of experts with background in the relevant Federal programs, financial management and capital budgeting will work with the Corps to recommend realistic and practical capital investment goals, and to determine to what extent the existing Federal capital programs are meeting these goals.

CAPITAL BUDGETING LESSONS

This paper addresses the fundamental issues regarding the concept of capital budgeting towards understanding the budgeting, accounting, and asset management implications of the process. It critically examines the conceptual and philosophical arguments underlying capital budgeting, and analyzes the relationship between budgeting reforms and improved management decisions. Actual instances of budget mechanism changes are described at state government levels, and inferences are made regarding the effectiveness of the resulting policy changes, and lessons learned documented.⁵¹

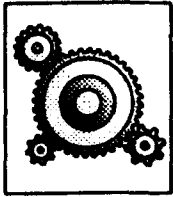
This paper, which served as the basis for the ongoing in-depth inquiry on capital budgeting, will be published as part of IWR's Occasional Papers series for the Federal Infrastructure Strategy.

INFRASTRUCTURE SUMMARIES

As part of the Federal Infrastructure Strategy the Corps of Engineers' Institute for Water Resources developed a consolidated listing and summary of reports published between 1981 and 1991 that reflect an interest in the condition of the Nation's public works infrastructure. Reports of interest included those addressing national scope policies and issues related to infrastructure, national needs assessments for one or more categories of public works, the financing and management of infrastructure systems, and other special topics on infrastructure strategy issues.⁵²

The summaries report is being used as a living reference document during the Federal Infrastructure Strategy Program. The first edition was published in 1991, with an updated version issued early in 1992. A final edition is planned for 1993 as IWR Report 93-FIS-7. This latest update will include new infrastructure related work completed in 1991 and 1992, as well as any past reports that may have been omitted.





VIII. Putting Theory into Practice: The Corps of Engineers Response

The ongoing coordination between Federal agencies regarding the development of a Federal infrastructure strategy reflects the desire of these agencies to respond to the NCPWI's challenge to serve as responsible partners in a cooperative effort to improve the condition of the Nation's infrastructure. However, achieving measurable results is largely dependent upon the initiatives of each agency towards the improvement of programs residing within their own purview. In many ways, the Corps own programmatic response to the Council's recommendations has served as a model for development of the Federal Infrastructure Strategy (FIS) effort.

This chapter presents a brief summary of key examples of Corps of Engineers' initiatives and FIS background studies which typify the Federal commitment to long-term infrastructure improvement. This includes the establishment of the Headquarters' Infrastructure Task Force to coordinate the application of infrastructure improvements to Corps programs. Of additional interest, are two early products of the Corps' Institute for Water Resources which explore the conceptual applications of the NCPWI's recommendations that ultimately led to several ongoing elements of the FIS program. This chapter concludes with a summary of other ongoing Corps research aimed at improving technology transfer and investment analyses, and other ongoing FIS interagency cooperative studies.

CORPS OF ENGINEERS INFRASTRUCTURE TASK FORCES

In January 1989 the Chief of Engineers established an internal Infrastructure Initiatives Work Group (IIWG) to determine the agency response to the findings of the National Council on Public Works Improvement (NCPWI, 1988). This workgroup was chaired by the Director of the Civil Engineering Research Laboratories and also included senior Corps leaders having expertise in infrastructure from the viewpoints of the Corps' Civil Works, Military Programs, and Research and Development missions as applied to new construction, operations, maintenance, and rehabilitation and repair.

The IIWG final report, Army Corps of Engineers Infrastructure Initiatives, July 1989, eventually led to the Corps Director of Civil Works (DCW) establishing a Infrastructure Task Force in 1990 to provide the strategic oversight needed to apply the recommendations of the NCPWI to Corps programs. The Task Force was headed by the DCW, and included representatives from the Corps' Headquarters, regional and field offices, and laboratories. Outputs of the Task Force included a Corps of Engineers Infrastructure Action Plan to maintain and improve the quality of agency infrastructure through the use of innovative technologies, improved data collection and decision-making analyses, and enhance management techniques and investment strategies. The Task Force's efforts were aimed at the coordination of a corporate



response to the Council's challenge, and resulted in a broad application of technical and management infrastructure improvements to Corps programs, as described throughout this chapter.

DEVELOPING A FEDERAL INFRASTRUCTURE STRATEGY

An early output of the FIS program, this paper, by L. Vallianos and E.Z. Stakhiv of the Institute's Policy and Special Studies Division, was first published by the Universities Council on Water Resources in their 1991 Autumn Update (see Appendix H). The paper documented the Corps of Engineers' initial thinking on the FIS program and described the strategy's formative activities. It also included a specific focus on Corps of Engineers infrastructure activities that addressed the recommendations of *Fragile Foundations* by aiming to increase the productivity and performance of the Corps civil and military programs.

The Corps activities described include:

1. Construction Productivity Advancement Research (CPAR) Program;
2. Inland Navigation Investment Priorities (INIP);
3. Repair, Evaluation, Maintenance and Rehabilitation (REMER) Research Program;
4. Dredging Research Program (DRP);
5. Hydropower Efficiency Improvements Program;
6. Construction Partner Program;
7. Life Cycle Project Management (LCPM) program; and
8. Policy and Procedures Study for Project O&M.

Finally, the paper also argues that there is evidence that the various Federal agencies are taking positive individual actions to improve the effectiveness of their respective programs. Examples of such actions include the recent strategic plans of the Departments of Transportation and Energy.⁵³

MANAGING THE NATION'S INFRASTRUCTURE: The Role of the Corps of Engineers

Another early effort, this working paper by J. Delli Priscoli, E.Z. Stakhiv and J. Westphall actually predated the initiation of the Federal Infrastructure Strategy. The paper discusses the Corps perspective on and potential contribution to the Nation's infrastructure needs. The authors argue that the Corps technical capability, diverse experience and focus on program management uniquely qualifies it to provide engineering service to the nation.⁵⁴

The paper asserts that the Corps existing civil and military programs could serve as a prototype for a Federal strategy that addresses the major needs of public works, as outlined by the Council:

- cost sharing based on user pays principles
- improved performance
- accountability for cost, schedule and quality
- innovative financing, partnerships and joint ventures

Several specific prototype programs are recommended, including the application of a revolving grant/loan trust fund to the Corps traditional civil works engineering services based on the grant/loan program proposed by Senator Moynihan (S.2088, 100th Congress). Four water resources programs were suggested as examples where grant programs could be applied: dam safety/rehabilitation, small flood control projects, single purpose water supply, and a package of near term infrastructure measures focusing on research and development, innovative financing, intergovernmental training, and the cleanup of hazardous and toxic waste.

CORPS OF ENGINEERS TECHNOLOGY

A number of currently available technologies developed by the Corps of Engineers were considered for demonstration under the Federal Infrastructure Strategy (FIS) program. It is noted that, in accordance with Section 7 of the Water Resources Development Act of 1988 (P.L. 100-676), the Corps has initiated a collaborative research and development program with the U.S. construction industry known as CPAR, the Construction Productivity Advancement Research Program.⁵⁵ CPAR has received strong industry support, and has proved to be an effective means for the Federal government to identify, develop, and apply productivity-improving research in partnership with the private sector on a cost shared basis. However, CPAR is designed to best respond to ideas received from industry and does not specifically address the need for improving the diffusion of "on-the-shelf" technology.

Therefore, one area of emphasis for the FIS demonstration program was improving the transfer process for existing Corps of Engineers technologies. Two currently available technologies were chosen: (1) the nondestructive pavement evaluation and overlay design process developed by the Pavement Systems Division of the Corps Waterways Experiment Station (WES), and (2) the water use forecasting system known as IWR-MAIN developed by the Corps Institute of Water Resources (IWR). These projects are summarized in the paragraphs below:

Nondestructive Pavement Testing

Many of the highways, roads, and streets managed by state and local governments across the nation require major rehabilitation. Most agencies apply a standard overlay in all cases, which is often not cost effective. Some pavements are structurally sound and a less extensive surface treatment would provide the rehabilitation needed. With WES's nondestructive evaluation procedure using the Falling Weight Deflectometer (FWD), the structural adequacy of the pavement can be assessed, and the materials properties can be determined to design rehabilitation strategies that perform with reduced life cycle costs.⁵⁶



WES is directing the technology transfer process. The Federal Highway Administration (FHWA) is serving as a partner in the project. FHWA engineers are assisting in the calibration of the pavement overlay design procedure to insure that results will conform to presently used methods, and they will also assist in the distribution of the products (video tapes, computer software, etc.) that will be produced.

The American Public Works Association (APWA) is serving as co-sponsor of the project. They have facilitated the search for candidate government agencies for the demonstrations, and will conduct a one day seminar and an equipment demonstration with the selected engineering firms at each site.

Three locations have been selected for the demonstrations based on their willingness to participate, their need for pavement rehabilitation, and the goal of geographic/climatic diversity: Cincinnati, Ohio, Warren County, Mississippi, and the San Francisco/Berkeley Bay area, California. The Corps is entering into Cooperative Research Agreements (CRADA's) with each government. The local agencies are responsible for furnishing pavement design, maintenance, and rehabilitation records for the pavements selected.

At each of the selected locations WES will issue contracts to qualified engineering firms to perform the FWD work. The Corps will prepare and issue guide specifications for use in the testing, and will furnish the procedure for the pavement evaluation, including all software and design methods to be used.

IWR-MAIN

Deteriorating water supply and distribution systems, coupled with growing concentrations of people and industry greatly contribute to increasing the demand for water, particularly in water short regions. Insuring the availability of adequate future water supply depend on the ability to reliably forecast needs, to implement cost effective conservation programs, and to fund water projects. The IWR-MAIN system can provide reliable forecasts and assess the effectiveness of conservation measures.

The IWR-MAIN (Institute for Water Resources Municipal And Industrial Needs) state-of-the-art forecasting system is specifically designed for forecasting water requirements within a defined study area, commonly a city, county or water utility service area. Water requirement forecasts can be disaggregated by water use sector, for residential, commercial/institutional, industrial and public/unaccounted uses, and by seasonal differences.⁵⁷

IWR-MAIN is currently used by a number of state and local users, and the number of Federal applications, both civil and military, are increasing. Most users have identified two features which make IWR-MAIN particularly valuable: the ability to interact with, select and control the determinants of water use within the model, and, the ability of the model to evaluate the effectiveness of proposed water conservation measures prior to their implementation.

IWR is guiding the technology transfer process through an IWR-MAIN Users Group, including representatives from the public, private and professional sectors, towards the goal of facilitating the training, application, and continuing enhancement of the model to address evolving needs. Current members of the group include the Corps of Engineers (IWR), the American Water

Works Association (AWWA), the American Public Works Association (APWA), and Planning and Management Consultants, Ltd.

User group activities are funded by IWR-MAIN users as well as revenues from the training courses. APWA is responsible for administering the groups activities, and, in conjunction with AWWA, leads outreach and information dissemination activities. PMCL is responsible for the preparation and packaging of proprietary software for distribution through the users group, and they will prepare the user manuals and system descriptions to be published by IWR, APWA, and/or AWWA.

Coordination to date has resulted in the publication of a training course workbook for IWR-MAIN version 5.1, the delivery of a training course at Kentucky State University, and the planning of additional training courses and update of the manual, in conjunction with the new 6.0 version of the model.

PROGRAM IMPROVEMENT INITIATIVES

The Corps of Engineers is specifically undertaking a number of efforts which are aimed at improving the quality of data and analysis used to manage infrastructure programs, make investment decisions, and assess the impact and performance of those decisions. Many of these programs are discussed in the Vallianos and Stakhiv background paper Developing a Federal Infrastructure Strategy which is summarized above and presented in Appendix H.

It must be emphasized that improvements resulting from these research programs are actively applied to Corps of Engineers' programs through the publication of agency manuals and circulars that institutionalize the use of the new techniques. For example, the Corps budget Engineering Circular (EC) is revised annually to incorporate state-of-the-art criteria and procedures resulting from program related research.

In addition to the previously discussed initiatives, other key efforts to improve infrastructure data and/or analysis include the Risk Assessment Research Program, and the National Operation and Maintenance Program Plan of Improvement (an element of the Policy and Procedures Study for Project Operation and Maintenance). As discussed below, these efforts are cross-cutting, examining infrastructure investments from several different perspectives, including greater use of risk analysis and performance-based decision making.

The Risk Assessment Research Program

This is an ongoing effort to extend the application of risk and uncertainty methods within the planning and design functions of the Corps civil works program. The program has evolved from an initial focus on dam safety risk considerations to a broader research program that has applied risk analysis to a wide spectrum of economic, design, environmental and management aspects of the Corps water resources program.

The current program includes the development of comprehensive economic risk analysis procedures for water resources and water transportation planning and management, hydrologic



analysis, environmental analysis, and decision making for project operations and maintenance. Specific recent efforts include:

- 1) Risk-based benefit-cost analysis for the major rehabilitation program, including the development of analytical procedures for calculating reliability costs and recommending changes in policies for reliability and hydropower capacity.
- 2) Risk management strategies for water resources investment, including a review of Corps and external approaches to decisions incorporating risk analysis.
- 3) Risk-based planning, management and decision support system of maintenance dredging, including development of a risk-based sedimentation model and evaluation of dredging decision process.
- 4) Quantifying and applying risk aspects of flood damage functions, including the development of uncertainty parameters for flood damage reduction benefit computations.
- 5) Risk-based procedures for the economic evaluation of reservoir storage reallocation.
- 6) Risk analysis applications for environmental goals, including the development of a dredge disposal risk model.
- 7) Risk analysis for local protection project safety, function and workability.

For example, for engineering analysis one recent emphasis has been on developing a specific methodology for evaluating pile structures using new reliability methods. A second example, for the planning area, involves procedures for specifically addressing the risk and uncertainty elements of a flood control evaluation, such as those associated with the stage-damage relationship, the frequency-discharge relationship and the discharge-stage relationship.

The Operation and Maintenance Program Plan of Improvement

This is a comprehensive review of current practices for the civil works O&M function, which accounts for approximately one-half of the Corps total water resources budget. This comprehensive study is not only identifying improvements to current management practices, but, based on input from the Office of Management and Budget, is also investigating new methods of financing and executing the program.

In the programmatic area, the effort includes a policy and procedures study for project operation and maintenance which is examining the O&M budget process. Several actions have been identified to improve management of the O&M program through changes in budget development, execution, reporting and monitoring. Implemented together, these changes are aimed at more equitably allocating resources on a national basis and reducing the annual budget submittal documentation for the relatively fixed requirements of projects.

A key aspect of these changes is to rebuild the levels 1 and 2 baseline requirements for each O&M project in accordance with new, more stringent definitions of baseline effort reflected in a revised funding level matrix. Once definitive baseline requirements are developed Corps-wide,

subsequent years' budget submittals for baseline requirements could be limited to a single baseline work package with an adjustment for inflation for each project. This could reduce by about 75 % the over 20,000 work items contained in the overall Corps O&M budget submittal, while focusing the process on the dynamic non-baseline work of primary interest to decision makers.

Other proposed changes involve the out-year budget process, including the formulation of a mid-range planning tool consisting of a detailed 5-year budget projection for periodic and non-recurring work items above a selected cost threshold.

INTERAGENCY COOPERATIVE STUDIES

A number of jointly sponsored, cost-shared interagency studies have been initiated in response to the interest expressed by various Federal agencies in the Federal Infrastructure Strategy program. Most of these efforts are aimed at sharing data and pooling funding towards an efficient use of Federal resources in the pursuit of infrastructure related research of mutual interest. Several of these studies have been described in previous sections on the in-depth inquiries which are now underway. In addition to these larger studies, several other cooperative joint ventures with Federal agencies have been initiated on selected topics. These include work in cooperation with the Environmental Protection Agency, as described below:

Employment Effects of Public Investments in Water Resources Environmental Restoration

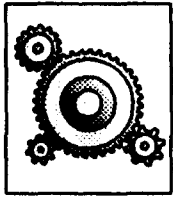
This effort is focused on the development of a methodology for analyzing the employment effects of public non-capital environmental investments in water resources restoration programs. The types of activities that are being evaluated include wetlands restoration and mitigation, riparian zone revegetation, stream channel and bank restoration, and abandoned mine remediation.

The evaluation framework being developed is addressing both long and short-run effects, and, direct and indirect employment impacts. The methodology is also evaluating the quality and type of employment, and linked employment effects across the economy. The study includes case studies in consultation with other Federal agencies in order to illustrate and describe site-specific effects.

Water Quality - Based Pricing Strategies

This study is aimed at formulating data base of water quality-based pricing strategies for wet weather utilities. Work includes the a review of current literature in conjunction with a review of selected storm water and combined sewer overflow utilities and interviews with public and private sector experts toward identifying the state-of-the-art on the pricing strategies currently being utilized. It will also identify potential Federal actions to encourage flexible and market-based water quality and conservation policies at state and local levels.





IX. Summary and Next Steps

SUMMARY

Much has been done to inventory national infrastructure needs and to develop alternative strategies in response to these needs assessments. However, despite these efforts, no integrated Federal policy exists to address the Nation's many infrastructure problems.

The absence of such an overarching policy limits the Federal government's ability to effectively select and manage infrastructure programs, including those involving water resources, transportation and waste management.

The first phase of interagency coordination working towards the development of a Federal Infrastructure Strategy has been completed. Participants included representatives of Federal agencies, state and local governments, public works interest groups and the professional and academic community.

An output of the first phase of the intergovernmental coordination is the consensus reached in confirming the work of National Council on Public Works Improvement and others by identifying the key issues that need to be addressed by a Federal Infrastructure Strategy.

The issues identified include the need for: 1) strategies for more efficient investment, 2) the reduction of regulatory and administrative burdens, 3) accelerated technology transfer, 4) financing reforms, and 5) improved infrastructure management methods and practices.

A recurring theme within these issues is performance or outcome-based decisionmaking. While many Federal policy discussions on infrastructure focus on the need for investment, fiscal constraints at all levels of government highlight the need for the use of meaningful performance measures in making more efficient investment decisions.

FINDINGS

Preliminary findings, based on the intergovernmental coordination and research completed to date include:

- National goals for infrastructure should make greater use of **performance or outcome-based investment strategies**. Needs studies should be more performance-oriented, including both physical and economic outputs, and directed toward achievement of clear strategic investment goals.

- **Federal infrastructure investment decisions** should be more consistently aimed at improving public works performance, and should be based on the uniform application of analyses such as cost-benefit evaluations.
- **Unintended Federal regulatory and administrative burdens** in providing infrastructure should be relieved, while flexibility in spending Federal aid and in complying with Federal and state mandates is needed.
- **Regulatory procedures** should be examined for opportunities for streamlining **public works permitting** to reduce investment costs and delays while protecting the environment.
- The potential for new **Federally developed technologies** to address national infrastructure problems is great. However, significant cultural, administrative, legal, and management barriers currently impede the transfer of Federally developed technology to other sectors.
- Several changes are needed to increase the effectiveness of **Federal technology transfer**, including designating a centralized focus for a national infrastructure R&D policy with enhanced intergovernmental partnerships.
- **Federal financing reforms** are needed in order to improve the efficiency and equity of infrastructure investments. Emphasis should be placed on developing and using diversified revenue sources including: bond banks, revolving loan funds, tax-exempt bonds, pricing mechanisms, and intergovernmental funding, including having beneficiaries paying a greater share of infrastructure costs.
- **Management methods and practices** should focus more on the performance of services (as indicated by output measures) rather than on facilities and operations "inputs".
- **Maintenance planning and deferred maintenance reporting practices** should be considered to improve the management of existing infrastructure stock.
- **Capital budgeting** should be considered by all levels of government, and the use of low-capital techniques and performance incentives should receive greater attention.

NEXT STEPS

The current coordination between the various infrastructure interests will continue with a focus on the specific issues identified during the first phase. Completion of the initiative, with interim documentation published as results become available, is aimed at facilitating the dialogue within the Federal and non-Federal communities as policy development continues.

A second round of interagency workshops facilitated by ACIR has been initiated for Federal agencies to work together on cross-program topics addressing six of these issues.

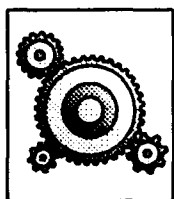
Ongoing in-depth inquiries, technical studies and background papers for a wide range of topics will be completed to further develop the technical and management foundations for strategy development.

The conduct of the program will continue to emphasize interagency participation while focusing on the central theme of improving infrastructure performance. The results of the interagency task forces and other strategy activities are being closely coordinated through the Office of the Assistant Secretary of the Army for Civil Works with the National Economic Council's working groups on Infrastructure Finance and Infrastructure Management, while the scope of ongoing work will remain flexible to enable the program to address evolving policy issues as needed.

The results of the deliberations by the six task forces and the various inquiries and technical studies will be synthesized into a final Federal Infrastructure Strategy report early in Fiscal Year 1994. Based on the findings to date, it is expected that the resulting Federal strategy will include recommendations addressing the following infrastructure elements:

- More consistent use of outcome-based performance measurement and decisionmaking;
- Strengthened procedures for investment budgeting;
- Improved applications and usage of investment analyses;
- A centralized focus for national infrastructure R&D policy;
- More effective Federal technology transfer mechanisms;
- Improved management methods and practices for infrastructure programs;
- Better planning and tracking of infrastructure maintenance;
- More practical and effective approaches to the Federal regulation of infrastructure;
- A timely, less costly, and more effective process for issuing approvals for public works;
- Practical financing programs linked to specific infrastructure plans.





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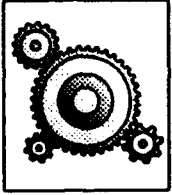
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Appendix A

A Summary of Previous Reports: The Context of the Infrastructure Debate

APPENDIX A

A SUMMARY OF PREVIOUS REPORTS: THE CONTEXT OF THE INFRASTRUCTURE DEBATE

**Institute for Water Resources
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TABLE OF CONTENTS

<u>SUBJECT</u>	Page
Introduction	A-1
Public Works Infrastructure: Policy Considerations for the 1980's	A-1
Hard Choices: A Report on the Increasing Gap Between America's Infrastructure Needs and Our Ability to Pay for Them	A-1
Fragile Foundations: A Report on the Nation's Public Works	A-2
New Directions for the Nation's Public Works	A-5
Rebuilding the Foundation: A Special Report on State and Local Public Works Financing and Management	A-5
Delivering the Goods: Public Works Technologies, Management, and Financing	A-6
How Federal Spending for Infrastructure and other Public Investments Affects the Economy	A-6
Paying for Highways, Airways, and Waterways: How Users can be Charged?	A-7
Trends in Public Infrastructure Outlays and the President's Proposals for Infrastructure Spending in 1993.	A-7

LIST OF FIGURES

<u>FIGURE</u>	Page
A-1 Report Card on the Nation's Public Works	A-3
A-2 A Strategy for Improving America's Public Works	A-4



A SUMMARY OF PREVIOUS REPORTS: THE CONTEXT OF THE INFRASTRUCTURE DEBATE

Introduction

The condition of the Nation's infrastructure has been a subject of widespread interest beginning in the early 1980's. In 1981, a study by Pat Choate and Susan Walter, America in Ruins: The Decaying Infrastructure, challenged the Nation to pay more attention to the maintenance of public facilities essential to national economic growth.

The study recommended the preparation of a Special Analysis to accompany each annual Federal budget, outlining the Nation's public works needs within the context of national economic performance. It also called for the Executive Branch to undertake an inventory of national public works needs, and for Congress to utilize the inventory in the preparation of a capital budget framework that would match phased capital investments to both short-term cyclical and long-term needs. Other suggestions included efforts to reduce regulatory and other delays in the construction of public facilities, and an initiative by the Advisory Commission on Intergovernmental Relations (ACIR), or a new body constituted for the purpose, to review the public works responsibilities of each level of government and propose guidelines for reallocating functions and responsibilities.¹

America in Ruins was followed by numerous reports through the 1980's and the early 1990's which debated the fundamental issues surrounding infrastructure need, investment strategies, and the clarification and/or reform of the roles of all levels of government in providing and maintaining public works. The following paragraphs summarize the findings and recommen-

dations of nine subsequent key national infrastructure studies which are central to the ongoing strategy development. For a consolidated listing and summary of national scope inquiries into the subject of public works infrastructure, readers are referred to the Corps report: Infrastructure Summaries, last published in January 1992. An updated edition is planned in 1993 as IWR Report 93-FIS-7.

Public Works Infrastructure: Policy Considerations for the 1980's

This 1983 report by the Congressional Budget Office (CBO) analyzed specific investment needs in the public works categories of transportation (highways, public transit, air traffic control and airports) and water (water resources, water supply and wastewater treatment). Contrary to the findings of America in Ruins, CBO found that the selected modes of public works were generally functioning adequately at present spending levels. Although CBO found some unmet needs, the study concluded that traditional national studies often overstated the need for capital facilities and that funding priorities should be reordered rather than increased. It also concluded that problems related to the deterioration of service associated with existing facilities were often due to overuse caused by inadequate pricing.²

Hard Choices: A Report on the Increasing Gap Between America's Infrastructure Needs and Our Ability to Pay for Them

In 1984 the Joint Economic Committee of the U.S. Congress, through



the University of Colorado at Boulder, completed a study that focused on the range of financing issues associated with public works projects in the transportation and water categories. The purpose of the study was to develop aggregate estimates of national infrastructure needs and available revenues to address these needs through the end of the century.

The study concluded that the Nation is facing a serious, but manageable, problem related to the condition and adequacy of basic infrastructure facilities. Specifically, state and local infrastructure outlays have declined from 2.2% of GNP in 1961 to 1.9% in 1982, and have been reduced across all regions of the nation. For the 23 states studied in detail, the examination of projected revenue to address future infrastructure needs for the years 1983 to 2000 resulted in a shortfall of about \$290 billion (1982 dollars). For the country as a whole, the funding expected to be available for infrastructure needs within the selected categories resulted in a financing gap of approximately \$450 billion (1982 dollars).³

The single most dominant national need identified was highways and bridges, and on a regional basis, the greatest highway needs projected for the Midwest. Water supply was the predominant water need, with the greatest need projected in the South-Central and Western regions.

Fragile Foundations: A Report on the Nation's Public Works

The most comprehensive national study was the 1988 final report of the National Council on Public Works Improvement (the "Council", 1984-1987). The Council was created by the Public Works Improvement Act of 1984 (P.L. 98-501) to assess the state of infrastructure in the United States. The Council was to

specifically analyze: age and condition changes; methods of finance; trends in financing methods; maintenance needs; and expenditures needed for improvement. Nine categories of infrastructure were examined by the Council: highways, roads, and bridges; airways and airports; mass transit systems; intermodal transportation; ports, waterways and other water resources projects; water supply; wastewater treatment; solid waste disposal; and, hazardous waste management.

The Council's conclusions reflected the preparation and synthesis of over 5000 pages of research material involving dozens of infrastructure topics, and the results of numerous public hearings and other public forums. Although the final report concluded that the state of the Nation's infrastructure stock was not as poor as previous reports had purported, there was a danger that, if action is not taken, further deterioration of public facilities will threaten the Nation's economic productivity.

In its report to the President, the Council specifically found "convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements, and insufficient to meet the demands of future economic growth and development."⁴ The Council also concluded that current performance levels of infrastructure systems are difficult to determine in the aggregate. Nevertheless, the Council summarized the relative performance of the major infrastructure categories in the form of a "report card" on the Nation's public works (Figure A-1).

The report called for a doubling of the Nation's capital investment and for renewed attention to the maintenance of public works facilities. The full text of the Council's recommendations are presented in Figure A-2. The debate over the Council's recommendations resulted in a rush of other

Figure A-1
NCPWI Report Card

REPORT CARD ON THE NATION'S PUBLIC WORKS			
Subject Category	Grade	Successes/ Recent Changes	Problems/ Future Weaknesses
HIGHWAYS	C+	Federal and state gas tax increases have injected new capital into the system. This, along with increased O&M spending, has improved pavement conditions. However, quality of service in terms of congestion is declining.	Spending for system expansion has fallen short of need in high-growth urban and suburban areas. Many roadways and bridges are aging and require major work. Needs of most rural and smaller systems exceed available resources. Highway Trust Fund has a sizeable cash balance.
MASS TRANSIT	C-	Federal capital grants have helped improve quality of service in some areas, but overall productivity of the system has declined significantly. Growth of transit vehicles is double the rate of increase in ridership. Diverting people from cars is increasingly difficult.	Mass transit is overcapitalized in many smaller cities and inadequate in large, older cities. Systems rarely are linked to land-use planning and broader transportation goals. Maintenance has been erratic and inadequate, especially in older cities.
AVIATION	B-	In general, the aviation system has handled rapid increases in demand safely and effectively. However, service has begun to decline in the face of increasing airport and airspace congestion as a result of strong traffic growth. The air traffic control system is currently undergoing a \$16 billion modernization.	Congestion is the system's primary problem. Despite recent increases in authorizations, sizeable cash balance remains unspent in the Airport and Airway Trust Fund. The air traffic control system needs substantial upgrading to maintain safety.
WATER RESOURCES	B	Water Resources Act of 1986 made cost-sharing mandatory for many types of water projects. This change should improve project selection and reduce overall project costs.	Cost-sharing will improve efficiency but also increase local costs of water projects. Poorer communities may find it difficult to finance projects. Implementation is often excessively slow and cumbersome.
WATER SUPPLY	B-	While regional performance varies, water supply stands out as an effective, locally-operated program. Strict new standards created by the 1986 Safe Drinking Water Act will require drastic increases in water rates over the next decade.	Many public water systems suffer from pricing below costs, inability to meet purity standards, or source contamination. Storage and distribution systems are deteriorating in some older cities and supplies are limited in some parts of the West and several cities along the East coast.
WASTEWATER	C	Over 75% of U.S. population is served by secondary treatment plants. Shift from federal grants to state revolving loans may improve efficiency of plant construction. Broadened focus on nonpoint source pollution and groundwater contamination may accelerate progress toward cleaner water.	Despite \$44 billion federal investment in sewage treatment since 1972, water quality has not improved significantly. This is due in part to uncontrolled sources of pollution, such as run-off from farmland and roadways. Overall productivity of secondary treatment facilities is declining, resulting in an increase in water quality violations.
SOLID WASTE	C-	Testing and monitoring of solid waste facilities are more rigorous as a result of tougher environmental standards. Waste-to-energy technology is growing as alternative to landfills. More aggressive waste reduction, separation, and recycling efforts are beginning at the local level. However, few states have moved boldly on these measures.	Nation faces significant costs of adequate and safe facilities. Limited data suggest trends toward fewer but safer landfills, rapid growth in resource recovery, and little progress toward waste reduction. Public opposition to siting all types of facilities is a major problem.
HAZARDOUS WASTE	D	Funding for site clean-up has increased five-fold since 1986, but progress has been slower than expected. Only a small fraction of the two tons of waste per capita produced in America each year is being treated safely. Major challenge is still ahead of us.	Nation has forfeited much of its opportunity to reduce waste before it is produced. Waste control legislation promotes "end-of-pipe" rather than source reduction solutions. Congressional mandates and schedules may be overly optimistic, given administrative resources. A massive backlog of poisons and needed cleanup projects faces the nation.



Figure A-2
A Strategy for Improving America's Public Works

No single approach is adequate to ensure the future viability of America's infrastructure. A broad range of measures is necessary to make a meaningful difference by the turn of the century. Specifically these should include:

- A national commitment, by all levels of government and the private sector, to increase capital spending by as much as 100 percent above current levels.
- Clarification of the respective roles of the Federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability.
- More flexible administration of Federal and state mandates to allow cost-effective methods of compliance.
- Accelerated spending of the Federal highway, transit, aviation, and waterways trust funds.
- Financing of a larger share of the cost of public works by those who benefit from services.
- Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing.
- Strong incentives for maintenance of capital assets and the use of low-capital techniques, such as demand management, coordinated land use planning, and waste reduction and recycling.
- Additional support for research and development to accelerate technological innovation and for training of public works professionals, and
- A rational capital budgeting process at all levels of government.

None of these steps will be easy or unopposed. But the increasing cost of delay is certain. The Council urges the President, the Congress, and the Nation's state and local leaders to act on the agenda immediately.

Source: National Council on Public Works Improvements, Fragile Foundations, 1988.



reports, including several by the Congressional Budget Office, and the Congressional Office of Technology.

New Directions for the Nation's Public Works

This 1988 study fulfilled the requirements of P.L. 98-501 that the Congressional Budget Office (CBO) review and report on the findings of the National Council on Public Works Improvement, and also discusses policies that the Congress might consider to improve the effectiveness of infrastructure programs at the request of the Senate Budget Committee.

CBO's report pointed to the difficulties in assessing infrastructure programs, ranging from the fundamental problem of adequately defining the national scope of public works to be characterized as infrastructure, to the problematic issue of *measuring how much infrastructure investment is needed to sustain economic growth*. With regard to the latter issue, CBO challenged the recommendation by the Council that national infrastructure outlays should be increased by as much as 100 percent. Instead, CBO placed greater emphasis on ensuring the economic efficiency of each investment or project. Their report stated that "although further, carefully selected investments in public infrastructure may well be productive, there is little evidence that substantial, across-the-board increases in current programs would be more productive on average than private investment."⁵

The report also outlined a number of options aimed at making Federal infrastructure policies more effective, including: better pricing of infrastructure services (more reliance on user fees), improved targeting of Federal services, the delegation of more decisionmaking responsibility to

state and local governments, and fostering greater intermodal competition by either (1) ceding to states and localities greater discretion in the use of Federal subsidies, or (2) changing the manner in which the Federal government allocates those subsidies.

Rebuilding the Foundation: A Special Report on State and Local Public Works Financing and Management

The purpose of this study by the Congressional Office of Technology Assessment (OTA) was to evaluate how technologies, management and financing could improve public works and make them more efficient and productive. Throughout the study, the OTA utilized an advisory panel and public workshops as mechanisms for study participants, and a host of government, industry, and private citizen reviewers to contribute a broad range of perspectives.

OTA found widespread agreement on the need to maintain and upgrade public works, and to increase support for infrastructure. The report concluded that benefit charges and earmarked taxes have proven to be relatively reliable and politically acceptable revenue sources. Although many state and local governments have successfully increased the levels of these charges and taxes for specified top-priority public works projects, OTA cautioned that in areas where property taxes have reached extremely burdensome levels for low- and fixed-income homeowners, greater emphasis should be placed on use of revenue-raising approaches that exert "income-impacts" which are more broadly-based.⁶

The report noted that increases in Federal fuel taxes, which provide approximately 24% of total national expenditures for highways, could provide a major boost



in the funds allocated to the transportation infrastructure. OTA maintained that such tax increases are less likely to encounter opposition from the large and powerful transport and construction industries if the associated tax revenues are dedicated to transportation improvements.

OTA also concluded, however, that benefit charges and private sector strategies frequently are not workable for low-growth districts, or small rural communities. In such districts and communities, private capital investment in infrastructure projects is unlikely to pay off because credit costs are high, and residents have limited ability to pay higher user fees. OTA recognized that while issues related to benefit charges are difficult, such issues are not without solutions. Before embracing user fees as a major means of financing, decision makers will want to weigh and address each carefully.

Finally, OTA's research indicated that state and local public works problems could be eased significantly if the Federal Government developed and implemented a national transportation policy and restructured transportation and environmental program management, including congressional oversight.

Delivering the Goods: Public Works Technologies, Management, and Financing

This comprehensive report by OTA (1991) responds to requests from the House and Senate public works committees by examining ways to reform Federal policies and programs towards making public works more effective. The report focuses on a full range of infrastructure modes, including: highways, bridges, mass transportation, airports, ports and waterways, water supply, wastewater treatment, and solid waste

management; and addresses the key issues associated with the Federal institutional and management frameworks, and the financing and research needs.

OTA identified several immediate steps, including: 1) refocusing Federal programs to fit the many new environmental standards, demographic shifts, energy use trends and industrial changes that have transformed the nature of many public works problems, 2) increasing the national investment in public works, despite budget constraints, and 3) identifying priorities to frame the Federal infrastructure agenda, such as the reauthorization of the Federal highway program.⁷

How Federal Spending for Infrastructure and other Public Investments Affects the Economy

This CBO study, published in July 1991, examined the effect on the economy of three broad classes of Federal investment spending: physical infrastructure, including programs for transportation and environmental facilities; human capital, including programs that increase the skills and productive knowledge that people bring to their work; and intangible capital, such as research and development. Within each of these categories, the study examined spending trends, discusses the rationales for that spending, and reviews evidence on the contribution of public investment to economic performance.

The report concludes that Federal investments in physical infrastructure such as highways and aviation projects would yield economic rates of return higher than the average return on private capital, with the highest economic benefits associated with maintaining existing infrastructure assets and from expanding capacity in highly congested facilities. Likewise, the study

indicated that certain types of Federal R&D (for example, basic and academic research in science and engineering) offer significant economic benefits. Finally CBO noted that although the economic effects of some Federal human resource programs (such as job training) have led to modest economic gains, most human resource programs have been designed to further non-economic goals, and assessing them for their economic returns is very difficult.⁸

Paying for Highways, Airways, and Waterways: How Users can be Charged?

The Congressional Budget Office (CBO) published this report in May 1992 in response to a request from the Senate Committee on the Budget. The study examines the advantages and disadvantages of alternative user fee structures, including existing taxes for highways, airways, and waterways. The study addresses the concept of revenue adequacy - whether public works revenues can recover infrastructure investment costs. It notes that a framework to evaluate revenue adequacy, in conjunction with measures of economic efficiency, provides the criteria by which infrastructure financing should be evaluated.

The study concludes that existing Federal taxes produce enough revenue to fund current spending on the nation's system of highways, although the present highway tax structure is not as efficient as it could be since the fees do not closely reflect the costs imposed by various classes of users. For example, the revenues generated from operators of heavy trucks do not cover the pavement damage these vehicles cause, while the level of highway congestion is not reflected in current automobile charges from fuel taxes.⁹

For airways, the study found that the total revenues from airline passenger ticket and international departure taxes, air freight taxes, and general aviation fuel taxes, cover all investment spending by the Federal Aviation Administration, but do not pay for all operating costs. Taxes paid by commercial air carriers were found to be adequate, while those of general aviation fall short. It also concluded that aviation taxes do not closely correlate with the costs of FAA services, and charges reflecting the marginal costs of the air traffic control system, including congestion fees, may meet the criterion of revenue adequacy.

Finally, the report notes that users of the inland waterways pay fuel taxes that amount to less than ten percent of the spending by the Army Corps of Engineers for the system. Although these taxes appear efficient in that they approximately reflect the users' marginal costs on a system-wide basis, some segments of the inland waterway system cost much more to operate than others. The report suggests that users of low-cost waterways may be subsidizing those of higher-cost waterways, although more data is needed to estimate marginal costs with greater confidence.

Trends in Public Infrastructure Outlays and the President's Proposals for Infrastructure Spending in 1993.

This paper by the Congressional Budget Office examines trends in spending for infrastructure by all levels of government over the last 35 years, and reviews the President's proposals for Federal spending on infrastructure in 1993.¹⁰ The paper also reviews the extent to which data on trends in spending can inform policy choices about how much the nation should spend. Eight categories of infrastructure facilities are



addressed: highways, mass transit, rail, aviation, water transportation, water resources, water supply, and wastewater treatment. The data used in the analysis was compiled by the CBO from the Office of Management and Budget, and the Bureau of the Census.

Although total aggregate public spending for infrastructure rose in real terms throughout much of the 1956-1989 period, the study found that the patterns in spending differ greatly between capital outlays (primarily the construction or rehabilitation of facilities) and noncapital outlays (primarily the operation and maintenance of facilities); between Federal outlays and state and local spending; and among outlays for different types of infrastructure. These trends reflect three themes:

- Capital outlays have been far more volatile than noncapital outlays, with spending in the latter category rising steadily throughout the 1956-1989 period, while the former fluctuating widely at each level of government.

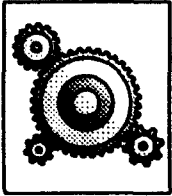
- Trends in Federal and state spending do not always appear closely linked. Priorities for infrastructure spending have changed far more at the Federal level than at the state level over the last three decades, with Federal spending moving from highways and water resources in the 1960s to wastewater treatment, transit, and water supply in the 1970's, before returning to highways and aviation in the 1980's.
- Between 1956 and 1989, state and local governments averaged nearly 70 percent of total public spending for infrastructure. Although the Federal government plays a substantial role in providing infrastructure, state and local governments remain the dominant source of funding, with aggregate spending trends following the priorities for state and local governments.

Appendix C, Interpreting Trends in Federal Infrastructure Investment, includes additional discussion on this topic.

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Appendix B

The Federal Role: A Summary of Federal Responsibilities in Transportation, Water Resources, and Waste Management

APPENDIX B

THE FEDERAL ROLE:

A SUMMARY OF FEDERAL RESPONSIBILITIES IN TRANSPORTATION, WATER RESOURCES, AND WASTE MANAGEMENT

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TABLE OF CONTENTS

<u>SUBJECT</u>	Page
Transportation	B-1
Highways	B-3
Airports and Airways	B-3
Mass Transit	B-4
Intermodal Aspects of Transportation	B-4
Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991	B-5
Water Resources	B-6
Deep-Draft Ports	B-6
Inland Waterways	B-7
Flood Damage Reduction	B-7
Shoreline Protection	B-8
Water Supply	B-9
Wastewater Management	B-9
Waste Management	B-10
Solid Waste Management	B-10
Hazardous Waste Management	B-10

LIST OF TABLES

<u>TABLE</u>	Page
B-1 Usual Lead Roles in Public Works Categories	B-2



THE FEDERAL ROLE: A SUMMARY OF FEDERAL RESPONSIBILITIES IN TRANSPORTATION, WATER RESOURCES, AND WASTE MANAGEMENT

This section briefly summarizes the various government roles in the provision of public works, with a primary focus on Federal responsibilities. There is a significant body of literature on this topic, including several of the national infrastructure studies previously discussed in Appendix A of this report.

In particular, the National Council on Public Works Improvement's series of reports on nine major public works categories provide an in-depth analysis of the roles of government for each infrastructure mode. In addition, the Congressional Office of Technology Assessment's report Delivering the Goods provides a chapter on the public works institutional framework, including a focus on each of the Federal agency roles.

Table B-1 provides a summary of lead roles for selected infrastructure categories. This table is an updated version of a similar summary contained in the Council's final report, Fragile Foundations. Note that the wide diversity of public works roles and activities identified by the Council still exists. In fact, as infrastructure-related services provided by the various levels of government continue to evolve, it is extremely difficult to generalize about lead agency roles without making many assumptions and ignoring numerous exceptions that cannot be easily portrayed in the summary. Readers are referred to the documents noted herein and in Appendix A for more detailed discussions.

Transportation

Within the surface transportation sector, the United States has generally adopted a system of public ownership for rights-of-way and private ownership of the transportation vehicles. Although there are key exceptions (e.g., the railroad system) to this structure, the manifestation of this development is the fundamental ownership role of government.¹

For highways and roads, state and local governments play the dominant ownership role. State and local interests are also responsible for partially financing and performing all construction, operation and maintenance activities, including those for the Federal Aid Highway system.

For airports and airways, local governments operate 95 percent of all publicly owned aviation facilities nationwide, including all of the large commercial airports.² The Federal government plays the key role in airport financing and is responsible for operating and maintaining the airways. Likewise, state and local governments are primarily responsible for the ownership and partial financing of the construction, operation, and maintenance activities for the urban mass transit systems across the country. Special districts, which operate in all states except Arkansas and Hawaii, control about 70 percent of all state and local spending for mass transit, and over 20 percent for airports.³



Table B-1
Usual Lead Roles in Public Works Categories¹

Categories of Public Works	Program Tasks		
	Policy & Standard Setting	Capital Financing	Ownership, Operations & O/M Financing
Transportation:			
<i>Highways</i>			
National Highway System (incl. interstate)	F	F	S
Other	S/L	S/L/PS	S/L
<i>Airports</i>			
Major Commercial	L	L/PS	L/PS
General Aviation & Smaller Commercial	L	F	L/PS
<i>Airways</i>	F	F	F
<i>Mass Transit</i>	L	F	L/PS
<i>Intermodal</i>	F/S	L/PS	L/PS
Water Resources:			
Deep-Draft Ports	F	F	F
Ports (landside)	L	L/PS	L/PS
Inland Navigation	F	F	F
Major Dams/Regional Flood Control	F	F	F
Local Flood Protection	S/L/F	S/L/F	S/L
Urban Stormwater	L	L	L
Shoreline Protection	F	F	F
Water Supply (urban)	F/S	L/PS	L/PS
Wastewater Treatment	F	S/L	L
Solid Waste	S/L	L/PS	L/PS
Hazardous Waste:			
Currently Generated	F/S	PS	PS
Site Cleanup	F	F	PS

LEGEND: F = Federal; S = State; L = Local; PS = Private Sector

¹Roles and responsibilities in the Federal system are exceedingly complex. Therefore, this table is useful only as a summary for generalized lead roles. It must be recognized that there are exceptions to these lead roles, and most Federal lead roles for capital and O&M financing now require cost-sharing with state and local governments.

The private sector finances, owns, and operates 75 percent of the nation's airports, and contracts to design, build and maintain most surface transportation facilities.⁴

The Federal government's transportation responsibilities primarily reside in its' financing, regulatory, and programmatic administration authorities over the Nation's network of highways, roads and bridges, airports and airways, mass transit, and intermodal systems. The Federal role is managed through the U.S. Department of Transportation and its operating modal administrations. Federal transportation programs are largely supported by user-supported trust funds, including the highway and transit, and the airport and airway funds. These funds provide the financing for the various transportation grant aid programs to state and local governments. The major Federal transportation responsibilities are summarized in the sections below.

Highways

The Federal government's highway ownership extends only to those roads on Federal lands. The primary mechanism for Federal participation in the development of the nation's highways is through the provision of funding to states and local governments through grant-aid programs. Prior to the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, highway funding was made available under the Federal-Aid System. The Federal-Aid system was functionally allocated to include parts of the Nation's highway network which are of national interest. This included all interstate highways, and about 99 percent of all principle arterial, 96 percent of all minor arterial, and about half of the collector highway miles across the nation.⁵ As discussed in later sections on changing roles, ISTEA created a new National Highway System (including the

Interstate System) which is replacing the existing Federal-Aid groupings.

Key Federal responsibilities include planning, setting standards for, and providing capital financing for the roads eligible for Federal aid; and conducting research and development, and performing demonstration projects, through the U.S. Department of Transportation, Federal Highway Administration (FHWA).

Airports and Airways

The Federal government has an important role in each of the three components of the aviation system: airports, airlines, and airways.

Through the U.S. Department Transportation's Federal Aviation Administration (FAA), the Federal government participates in virtually all stages of the development of major airports. The Airport and Airway Trust Fund helps finance airport planning and construction through grants to more than 3,000 airports across the country. Originally, all aspects of airline operation was directly controlled through regulation; today, aircraft safety remains as the only aspect of the airline industry so regulated. In contrast, the Federal regulatory role for airways (air traffic control) has remained almost totally controlled by the Federal government. The FAA operates the air traffic control system and finances all its capital and the majority of its operating costs through the Airport and Airway Trust Fund.⁶

Primary Federal responsibilities include participating in the planning, financing and construction of major airports, and the construction of small airports; regulating aircraft safety; and operating and maintaining airways, all through the FAA.



Mass Transit

The roles of the Federal, state, and local governments in mass transit systems have been changing over the last fifteen years, prompted first by declining Federal funding levels in the 1980's and, more recently by ISTEA. However, despite the funding reductions of the 1980's, the Federal government's financing and regulatory responsibilities continue to strongly influence mass transit policies in urban areas. With the passage of ISTEA, mass transit systems have their largest funding authorizations since Federal programs began in 1964.⁷

Federal financial participation for capital projects, and to a much lesser extent operating expenses, remain as important sources of mass transit funding. In fact, Federal influence on mass transit capital decisions is greater than its funding share would suggest since much of the state and local funding is provided as a match for Federal monies. In contrast to most other Federal infrastructure grant programs, virtually all Federal transit grants are made to local rather than state governments.⁸ In addition, Federal regulations and mandates have a major impact on local mass transit policies, influencing decisions ranging from bus design to access for the disabled. And finally, the Federal government serves as the primary source of funding for research, technical assistance, and planning activities.

Key Federal responsibilities are currently carried out through the U.S. Department of Transportation, Federal Transit Administration (FTA). These responsibilities include: providing shares of planning funds, capital financing and operating costs; performing research and development activities, and demonstration projects; and providing regulatory oversight.

Intermodal Aspects of Transportation

The National Council on Public Works Improvement defined intermodal transportation as broadly including the movement of goods and/or people by two or more modes of transportation between specific origins and destinations.⁹ Thus, intermodal transportation may involve highly complex freight movements over several multimodal networks, or a simple commuter connection between bus and rail.

Over the last fifteen to twenty years intermodal transportation has emerged as an increasingly important element for reducing costs and improving the distribution of both domestic and international goods. The continued technological development of improved techniques such as for containerization and air-to-surface exchanges have served to increase interactions between transportation modes.

Although the advantages of more effectively integrating the various transportation modes into a coordinated system are widely recognized, relatively little progress has been made towards true intermodal planning at the Federal or state levels.¹⁰ Although transportation movements of people and freight are not entirely uncoordinated, there has been no consistent historical focus at any level of government for intermodal planning activities.

However, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 mandates a new direction for surface transportation. The bill represents a significant revision of national surface transportation policies, which for the last 35 years were primarily aimed at the completion of the Interstate highway network. ISTEA establishes a policy stating that the National Intermodal Transportation System

shall consist of all forms of transportation in a unified, interconnected manner.

Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991

ISTEA represents a \$151 billion plan to reform transportation policies for the Nation's highway and mass transit networks. The bill authorizes \$119.5 billion for highways and \$31.5 billion for mass transit through Fiscal Year 1996, which represents an average annual increase of 28 percent over the previous five year authorization period. Most important, the bill represents a significant shift in traditional roles and relationships, with the central themes being intergovernmental decisionmaking reform and spending flexibility.¹¹

The two new programs which dominate the bill each provide state officials with the flexibility to shift funding from highways to mass transit facilities. One of the new programs would establish a comprehensive national highway system which includes the Interstate system and other new and existing primary and feeder roads. Funding is also authorized to complete the Interstate system. The second major surface transportation program provides for roads, mass transit, bridges, bicycle paths and other purposes.

Key provisions of the legislation have:¹²

- Replaced the four existing Federal-aid highway systems with one new 155,000 mile network designated as the National Highway System. This new system includes the Interstate System (44,000 miles) and other major roadways which are being designated from within the existing Federal-aid highways.
- Placed increased emphasis on mass transit by more than doubling its

authorized funding to \$31.5 billion over six years.

- Provided a new flexibility by authorizing transfers of funds between most surface transportation programs in response to state or local government requests.
- Provided for the postponement and partial repeal of the planned expiration of the 1990 temporary gas tax increase; half of the tax would now be extended until 1999.
- Created an enhanced role for local governments, including increased responsibilities for metropolitan planning organizations (MPO's). Among other responsibilities, MPO's are charged with the preparation of Transportation Improvement Plans aimed at optimizing the combined use of the various surface modes.
- Established a new multimodal surface transportation block grant program, with substantial funds allocated by formula to urbanized areas of 200,000 population or more, and project selections determined by the MPO's.
- Required that metropolitan transportation plans be consistent with state and regional air quality plans in accordance with the 1990 Clean Air Act Amendments.
- Provided authorization of significant research and development funding for new and advanced technologies, such as high speed rail, MAGLEV, and "intelligent" highways, and includes the creation of a new National Surface Transportation R&D Plan, and a Transit Cooperative Research Program.



- Provided \$1 billion in competitive grants per year for the next six years for projects to reduce congestion and air pollution in the Nation's key air quality "nonattainment" areas.
- Created a Bureau of Transportation Statistics, a National Highway Institute, and an Office of Intermodalism within the Department of Transportation.
- Required states to develop new performance-based planning and management systems, including systems for highway pavement maintenance, bridge maintenance, highway safety, traffic congestion mitigation, transit facility and equipment maintenance, and intermodal transportation activities.
- Required the preparation of state-wide transportation plans, in addition to metropolitan plans.

Water Resources

The basis for government's role in water resources rests on the Constitutional authority to promote the public welfare, regulate commerce, including control over navigable waters, protect public lands, and provide for the national defense. It also rests on the desire to provide an equitable distribution of needed services, such as hazard reduction, and on economies of scale realized by expenditure of public resources, such as navigable waterways.¹³

States have a lead role in regulating a wide range of environmental matters in accordance with Federal standards and, in conjunction with local governments and special districts, have increasingly important roles in sharing the capital financing and maintenance of most Federally provided

water projects. Non-Federal interests also control the ownership, operation and maintenance of non-Federal dams, water supply facilities, local flood control projects, and stormwater drainage facilities. The private sector is most active in areas where the market offers profit-making opportunities, such as the sale of hydroelectric power, irrigation and water supplies, and port landside facilities.

The Federal government provides water resources services through approximately 25 agencies and departments, although five agencies are dominant: U.S. Army Corps of Engineers (COE), U.S. Department of Interior, Bureau of Reclamation (BUREC), U.S. Department of Agriculture, Soil Conservation Service (SCS), Tennessee Valley Authority (TVA), and the U.S. Environmental Protection Agency (EPA). The key Federal water resources roles and responsibilities are summarized below:

Deep-Draft Ports

The Federal government plays the lead role in the provision of deep-draft navigation channels and maintenance dredging in support of domestic and foreign waterborne commerce. Unlike the grant programs for surface and air transportation, the Federal role in navigation includes directly providing for both the construction and maintenance of shipping channels.

The U.S. Army Corps of Engineers (COE) is responsible for the financing (on a cost-shared basis), planning, design, and construction of capital projects associated with Federally authorized shipping channels and general navigation works. The Corps is also responsible for the subsequent maintenance dredging for the channels. The U.S. Coast Guard provides aids to navigation, while the Maritime Administration provides subsidies for the U.S. flag fleet in areas of construction,

repair, refurbishment, and operation. The Maritime Administration also provides training of officers of the U.S. merchant fleet. These agencies are also actively involved in establishing design standards for navigation works, regulating navigation access, and the conduct of research and development activities.

Inland Waterways

Federal responsibilities for the Nation's inland and intracoastal waterways are focused on the water routes, while the responsibilities for providing and operating waterway vessels and port facilities are entirely non-Federal. While this division of responsibilities parallels the Federal-non-Federal roles in the U.S. highway and airways systems, an important distinction is that Federal investment in waterways includes the direct provision of significant portions of planning, design, construction, and operation and maintenance services, rather than the provision of financial grant aid.

The inland waterways system is recognized as those waterways which are subject to the waterway user fuel tax. This fuel tax system is comprised of shallow-draft waterways, including both dredged and natural channels with controlling depths of at least nine feet on most portions of the network. These waterways are eligible for Federal improvement financed in part from the Inland Waterways Trust Fund.

The Federal government is the largest single participant in the waterways system based on investment, although the combined investments of other participants, predominantly private enterprises, are approximately as large on an annual basis. The Federal agencies most directly involved in development and operation of the waterways system are the U.S. Army Corps of Engineers and the U.S. Department of

Transportation (DOT). The Corps responsibility is to facilitate the movement of vessels by widening, deepening, and straightening channels, and regulating water depths with dams and associated locks. This encompasses providing, operating and maintaining almost all of the waterway elements utilized by commercial navigation, including the primary navigation channels, locks and dams (the major infrastructure facilities on much of the fuel tax system), river training works, ice control structures, bridge pier protection works, and mooring facilities.¹⁴

The Department of Transportation, through the U.S. Coast Guard, is responsible for vessel and navigation safety, and provides the aids to navigation and search and rescue services for the system. The DOT's Maritime Administration promotes the development and efficient operation of port facilities and waterway vessels.

Other related Federal responsibilities include setting design standards, performing research and development, and regulating construction activities within the jurisdiction of navigable waters.

Flood Damage Reduction

The Federal government is the principal provider of major flood damage reduction facilities across the nation. Such facilities include flood control and multipurpose dams and lakes, levee systems, channel modifications, tunnel diversions, and non-structural projects. In contrast the conveyance of excess drainage or stormwater runoff is a management companion to flood control which is exclusively a non-Federal responsibility. The conventional distinction between stormwater drainage and flood control is that drainage refers to the conveyance of flows before reaching defined watercourses.



The four Federal agencies primarily involved in providing flood damage reduction facilities are the U.S. Army Corps of Engineers, the U.S. Department of Interior, Bureau of Reclamation (BUREC), the U.S. Department of Agriculture, Soil Conservation Service (SCS), and the Tennessee Valley Authority (TVA). Federal responsibilities include the direct provision of a wide array of services ranging from the initial planning of projects to the actual construction of facilities, almost all of which are now cost-shared with non-Federal sponsors.

The Water Resources Development Act of 1986 (P.L. 99-662) revised the policies for cost sharing Federal flood control projects with project sponsors. Local sponsors will now finance 25 to 50 percent of the cost of flood control projects, with mandatory contributions during the construction period.

Specific Federal roles include: providing a portion of capital financing and performing project planning, design and construction activities on a cost-shared basis; operating and maintaining major flood control and multipurpose [including water supply, hydroelectric power, recreation, fish and wildlife purposes] dams and lakes; setting design standards; performing research and development; and financing and conducting emergency preparedness response activities in coordination with the Federal Emergency Management Agency (FEMA). The Flood Insurance Agency (FIA) within FEMA administers the National Flood Insurance Program. The Corps of Engineers also regulates discharges into wetlands through Section 404 of the Clean Water Act of 1977, as amended.

In addition, the U.S. Environmental Protection Agency, and the U.S. Department of the Interior (including the U.S. Geological Survey, and U.S. Fish and

Wildlife Service) have various lead or consultative Federal roles in the regulation, protection, and management of a wide range of natural resources, and in the research of hydrologic, geographic, and groundwater data, and riverine and wetland biological habitats.

Shoreline Protection

Several agencies share the Federal responsibility for coastal shore protection.¹⁵ The U.S. Army Corps of Engineers has the most direct involvement in providing shore facilities which offer protection against hurricanes and other tidal storms, and erosion control. Such projects are limited to the protection of public facilities. This role includes project planning, setting design standards, performing research and development, providing a share of capital and maintenance financing, and constructing and maintaining coastal protection projects. The Corps also regulates development along coastal areas through administration of Section 10 of the Rivers and Harbors Act of 1899, and Section 104 of the Clean Water Act of 1977.

Other Federal agencies with shore protection responsibilities include: the National Oceanic and Administration (NOAA), which through its Office of Ocean and Coastal Resource Management administers the provisions of the Coastal Zone Management Act of 1972 and provides grants to states with approved coastal zone plans; the Department of Interior (DOI), which is the focal point for Federal consultation on activities impacting undeveloped coastal barriers stretching approximately 725 miles along the Atlantic and the Gulf Coasts under the provisions of the Coastal Barriers Resource Act; and the Federal Emergency Management Agency which administers the Flood Insurance Program along coastal areas. In addition, the U.S. Environmental Protection Agency,

and the U.S. Department of Commerce (National Marine Fisheries Service), perform scientific research in support of the protection and regulation of the coastal environment.¹⁶

Water Supply

The organization and ownership of water supply providers varies greatly, ranging from investor owned utilities to state chartered public corporations and special districts, quasi-governmental units and independent non-political boards, municipally owned systems, developers and homeowner associations who provide water to their clientele, and Federally provided supplies. Most can be characterized as either community systems which serve primarily residential areas, or as non-community systems serving other users. Public systems, which make up slightly less than half of all systems nation-wide, are predominantly owned by local municipal governments. However, a number of public systems are owned by the Federal government.¹⁷

The Federal role is focused on four levels of involvement: leadership in the planning, construction, ownership, and operation of major multi-purpose water development projects for which water supply is a purpose; providing financial assistance when there is a proven need; regulatory functions; and, providing information and technical assistance.

The Federal role in major water development projects is administered through the programs of the U.S. Army Corps of Engineers, and in the western seventeen states, the U.S. Department of Interior, Bureau of Reclamation. Such projects are limited to providing municipal water supply storage in multi-purpose water projects for which users are required to repay part of the capital investment and

operating costs to the Federal government. No single purpose water supply projects are authorized under this authority. The Corps of Engineers supplies water from multi-purpose reservoirs under its management to public water systems. Currently, approximately ten million acre-feet out of a total of over 200 million acre-feet of active Corps reservoir storage is allocated to water supply.¹⁸

The Corps, the U.S. Environmental Protection Agency, and the U.S. Department of the Interior (Bureau of Reclamation, and U.S. Geological Survey) also provide research and development, information management and technical assistance to states and local interests. The EPA also establishes water standards and regulates water quality under the Safe Drinking Water Act.

Wastewater Management

In 1972 Congress enacted a strong Federal program to address the severe pollution in the Nation's waterways. The program included: setting ambient water quality standards, issuing discharge permits to municipal and industrial dischargers in accordance with these standards, developing regional and statewide plans for managing water quality, and providing Federal grants to finance the construction of local wastewater facilities. More recently, the responsibility for operating the pollution control program has been shifted to the states, with Federal oversight. Federal grants for financing the construction of local wastewater treatment plants have been replaced by loans from state revolving funds capitalized by the Federal government. The Federal capitalization grant program is only authorized through 1994, after which State Revolving Funds are expected to be self-sustaining.



The current Federal role continues to be administered through the U.S. Environmental Protection Agency, and includes reviewing plans and priorities, providing design and environmental standards, partial capitalization of state revolving fund loans for wastewater treatment facilities and management techniques, performing research and development activities, providing technical assistance, and establishing water quality standards and regulating management performance.

Waste Management

The primary responsibilities for providing waste management facilities and systems have historically resided with local governments, with the Federal role evolving from environmental legislation governing the regulation of the disposal of solid and hazardous wastes.

More recently, the Departments of Defense and Energy are playing increasingly important roles in the remediation of hazardous, toxic and radiological waste sites associated with defense or research activities. Other than these Federal installations, virtually all hazardous waste disposal facilities are owned and operated by the private sector. The key Federal responsibilities are summarized below:

Solid Waste Management

Solid waste management can generally be disaggregated into the following general categories: the collection, transportation, and disposal of municipal solid waste. The primary government responsibilities for these services varies widely across the country, but the dominant role over-especially in the collection and transportation categories. The limited Federal role is one of regulation over the environmental effects of the disposal of hazardous

and solid waste. The principal means of waste disposal currently available to local officials are: sanitary landfills, incineration (including resource recovery or waste to energy facilities), and recycling.¹⁹

The current Federal role originates from legislation governing the disposal of hazardous and municipal waste. Through the U.S. Environmental Protection Agency, the Federal responsibilities include establishing environmental performance and design standards for disposal, such as for air and water quality, gas migration, sanitation, cover soil, and for landfill siting and operation. EPA also regulates disposal and recovery performance, performs research and development activities, and provides technical assistance to states and local governments.

Hazardous Waste Management

The overwhelming majority of hazardous waste treatment, storage, and disposal facilities are privately owned and operated, and taxes on industry finance the majority of the cleanup costs for abandoned and uncontrolled waste disposal sites eligible for Federally administered cleanup. However, the Federal government still plays a major role in hazardous waste management through its regulation of hazardous waste management activities, and hazardous waste site remediation.²⁰

Under present Federal law, hazardous wastes are required to be managed under the provisions of one of two statutes. The Federal Resource Conservation and Control Act (RCRA) deals with the production of hazardous wastes and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) deals with hazardous wastes that are already in existence and have been disposed of in ways that pose a threat to human health or the environment.

Through the U.S. Environmental Protection Agency, the Federal responsibilities include the identification of wastes to be regulated, setting environmental and design standards for hazardous materials and waste management facilities, regulating performance and enforcing standards; and specifically for the Superfund program: planning and evaluating hazardous sites, identifying sites, providing capital financing (on a cost shared basis) for cleanup, implementing cleanup, and coordinating emergency response to hazardous spills and releases.

Over 5,000 Federal facilities have been identified as potential hazardous waste sites. These facilities include research laboratories, maintenance facilities, and former oil, gas and mining operations. The Department of Defense has the highest number of hazardous waste sites (over

3,500), while the remaining sites are from civilian agencies, including the Departments of Interior (Forest Service), Transportation (Coast Guard, Federal Aviation Administration,) Energy, and the National Aeronautics and Space Administration. While Federal agencies are currently liable for cleanup of hazardous waste sites, less than one hundred are currently on the National Priority List (NPL).

The U.S. Departments of Defense and Energy play lead roles in the identification, planning, capital financing and implementing remediation activities at Department of the Defense installations, the national weapons complex, and the national laboratories, in accordance with EPA standards. Radioactive contamination at such Federal sites are not included in the NPL, although they pose significant problems.



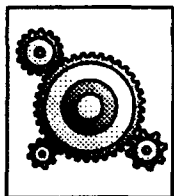
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Appendix C

Interpreting Trends in Federal Infrastructure Investment

APPENDIX C

INTERPRETING TRENDS IN FEDERAL INFRASTRUCTURE INVESTMENT

by

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TABLE OF CONTENTS

<u>SUBJECT</u>	Page
Introduction	C-1
Public Works Spending - Nominal Dollars	C-1
Inflation, Population, Wealth, and Productivity Effects	C-1
Spending as a Percent of GNP or GDP	C-2
Inflation Adjustments	C-2
Per-Capita Adjustments	C-4
Other Adjustments	C-4
Making Sense of the Numbers	C-8
Next Steps	C-10

LIST OF TABLES

<u>TABLE</u>	Page
C-1 U.S. Population, Nominal and Real GDP and GNP	C-3
C-2 Federal, State and Local Spending on Public Works	C-5
C-3 Selected Price Indices	C-6
C-4 Federal, State and Local Spending on Public Works Per Capita and as a Percent of GDP and GNP	C-7
C-5 Federal, State and Local Spending on Public Works, Capital Versus Noncapital Spending	C-9



LIST OF FIGURES

FIGURE	Page
C-1 Public Works Spending as a Percent of GDP and GNP (1960-1989)	C-11
C-2 Public Works Spending (1960-1989, 1987 \$'s)	C-12
C-3 Public Works Per Capita Spending (1960-1989)	C-13
C-4 Public Works Spending as a Percent of GDP and GNP (1980-1989)	C-14
C-5 Public Works Spending (1980-1989, 1987 \$'s)	C-15
C-6 Public Works Per Capita Spending (1980-1989)	C-16

INTERPRETING TRENDS IN FEDERAL INFRASTRUCTURE INVESTMENT

Introduction

The current literature on public capital's impact on productivity reflects controversy over whether the Nation's level of public investment in infrastructure has been sufficient. Arguments on either side of the debate are usually supported by past public spending statistics. A review of the literature would allow one to conclude that public investment in America's infrastructure is currently declining, rising, and staying about the same, depending on the time period analyzed and the context of the statistics used. Remarkably, it is possible to make all reach all three of the above conclusions simultaneously without engaging in a contradiction. American public works spending is rising, falling and staying constant, all at the same time, depending on the context of the numbers consulted.

Public Works Spending - Nominal Dollars

The place to begin is with the total amount of spending on infrastructure by Federal, State and local governments. One set of public spending statistics which are generally accepted has been produced by the Congressional Budget Office (CBO) in their Trends in Public Infrastructure Outlays and the President's Proposals for Infrastructure Spending in 1993.¹ CBO has calculated the total amount of infrastructure spending by Federal, State and local governments in the categories of highways, mass transit, rail, aviation, water transport (excluding navigation expenditures by the Corps of Engineers), water resources (which includes navigation expenditures by the Corps of Engineers), water supply and sewage treatment.

The CBO's infrastructure statistics exclude a number of important categories such as solid and hazardous waste treatment expenditures. Nonetheless, they are a good starting point. Measured in nominal dollars, that is, in dollars which are not adjusted for inflation, total infrastructure spending by all levels of government rose from less than \$12 billion in 1956 to over \$138 billion in 1989 (Table A-1, in the CBO Report).

Were this number the only meaningful and available measure of infrastructure spending, the talk about an infrastructure crisis could be dismissed. After all, between 1956 and 1989, total government infrastructure spending, limited to the categories mentioned above, rose by over 1100%.

Inflation, Population, Wealth, and Productivity Effects

Of course, the conclusions based on nominal infrastructure spending figures can be grossly misleading. The America of 1956 is a much different place than the America of 1989. First, inflation effects have been significant since 1956, so it takes a lot more dollars to buy the same amount of infrastructure now than it did then. Second, there are obviously many more people residing in the United States now, so even without inflation one would expect that a larger total amount of money would have to be spent serving a larger population at a given level of service. Third, America is a lot wealthier now than in 1956; that is, the total amount which the American economy produces has grown considerably over the course of 35 years. Therefore, it is reasonable to expect it to be necessary to spend a greater amount on public works to maintain this higher level of output.



Table C-1 shows in detail the changes in the American economy and population since 1960. The American population has grown from roughly 180 million people to just under 250 million as of 1989, an increase of close to 40 percent over the period.

Both nominal Gross Domestic Product (GDP) and nominal Gross National Product (GNP) rose over tenfold. (GDP and GNP are both measures of total output and track each other very closely as the table makes clear. Very roughly speaking U.S. GDP measures all economic activity which ends up within American borders, while GNP measures all economic activity which accrues to American ownership but does not necessarily occur within American borders. Thus GDP includes things GNP does not, such as dividend payments paid by companies located overseas but received by shareholders in the U.S., and excludes things GNP includes, such as dividend payments which American companies make to overseas residents) When adjusted for inflation GDP and GNP have grown less dramatically, but still significantly at around 270 percent between 1960 and 1989.

Spending as a Percent of GNP or GDP

These figures form the basis of many of the adjustments that public policy analysts and economists make to total public works spending. Mechanically, these adjustments are made using simple arithmetic. Essentially, the total spending numbers are divided by some other number to arrive at an average spending figure. This average figure usually behaves quite differently from the total number from which it was derived.

One such adjustment is to divide total public works spending by GDP or GNP, to indicate how much of the national income is being spent on infrastructure. This measure has shown a relative decline in public works

expenditures. Using the CBO numbers, whereas in 1960 America spent over 3% of its GNP or its GDP on public works, in 1989, the country spent only 2.6%. The decline, while not constant, has been steady over the last 30 years. Figure C-1 shows these trends graphically. Table C-4 shows the numbers behind these trends.

Inflation Adjustments

Other adjustments over this period do not show the same growth patterns. The nominal total spending numbers have already indicated a dramatic growth in total public works expenditures, but when these same total spending numbers are divided by an appropriate price index, the growth is much less sharp, revealing the effects of inflation more acutely. Figure C-2 compares total spending, expressed in inflation-adjusted spending curves are considerably flatter than the nominal spending curve. While between 1960 and 1989, spending grew by nearly a factor of 10 (over a factor of 11 when measured since 1956), real spending only doubled.

Table C-2 shows the nominal and real (that is inflation-adjusted) spending totals for the years 1960 to 1989. Table C-3 presents the three different GDP price deflators which were used to calculate the inflation-adjusted expenditures. Inflation factors such as these are meant to measure the change in price for different categories of spending. Thus the GDP deflator measures price changes for all categories of goods; the GDP fixed investment deflator is meant to measure price changes only across fixed assets; and the GDP nonresidential fixed investment deflator is meant to measure price changes only for those fixed assets outside of housing.

These may seem like technical points, particularly since the gross trends seem to be relatively unaffected by the choice of

Table C-1
U.S. Population, Nominal and Real GDP AND GNP

Year	Population (thousands)	Nominal Gross Domestic Product (billions of dollars)	Real Gross Domestic Product (billions of 1987 dollars)	Nominal Gross National Product (billions of dollars)	Real Gross National Product (billions of 1987 dollars)
1960	180,671	513.4	1,807.7	516.6	1,819.0
1961	183,691	531.4	1,884.4	535.4	1,898.6
1962	186,538	571.6	1,998.6	575.8	2,013.3
1963	189,242	603.1	2,086.9	607.7	2,102.8
1964	191,889	648.0	2,219.2	653.0	2,236.3
1965	194,303	702.7	2,374.0	708.1	2,392.2
1966	196,560	769.8	2,523.9	774.9	2,540.7
1967	198,712	814.3	2,585.1	819.8	2,602.5
1968	200,706	889.3	2,703.0	895.5	2,721.9
1969	202,677	959.5	2,765.1	965.6	2,782.7
1970	205,052	1,010.7	2,769.0	1,017.1	2,786.6
1971	207,661	1,097.2	2,872.3	1,104.9	2,892.4
1972	209,896	1,207.0	2,980.2	1,215.7	3,001.7
1973	211,909	1,349.6	3,213.3	1,362.3	3,243.6
1974	213,854	1,458.6	3,143.5	1,474.3	3,177.4
1975	215,973	1,585.9	2,975.4	1,599.1	3,000.2
1976	218,035	1,768.4	3,107.9	1,785.5	3,138.0
1977	220,239	1,974.1	3,220.4	1,994.6	3,253.8
1978	222,585	2,232.7	3,357.4	2,254.5	3,390.2
1979	225,055	2,488.6	3,423.1	2,520.8	3,467.4
1980	227,722	2,708.0	3,351.5	2,742.1	3,393.7
1981	229,958	3,030.6	3,363.6	3,063.8	3,400.4
1982	232,192	3,149.6	3,304.9	3,179.8	3,336.6
1983	234,321	3,405.0	3,580.4	3,434.4	3,611.4
1984	236,370	3,777.2	3,951.0	3,801.5	3,976.5
1985	238,492	4,038.7	4,180.8	4,053.6	4,196.3
1986	240,680	4,268.6	4,338.0	4,277.7	4,347.3
1987	242,836	4,539.9	4,539.9	4,544.5	4,544.5
1988	245,057	4,900.4	4,766.9	4,908.2	4,774.5
1989	247,343	5,244.0	4,984.8	5,248.2	4,988.8

SOURCE: U.S. Statistical Abstract, Economic Report of the President/NOTE: Calculations of Real GDP and Real GNP were performed by author using GDP deflators. Hence above real GNP and GDP figures are similar to but different from those reported in the Economic Report.



price deflator when one examines Figure C-2. But the more detailed the analysis, the more important the choice of the inflation index can become. For example, note how the three inflation-adjusted curves diverge between 1975 and 1985. When using the rate of change in all prices, that is, the GDP deflator, real spending appears to be higher, and growing faster, than when one uses one of the GDP fixed asset deflators.

This is because fixed asset prices were rising more quickly during the late 1970's and early 1980's than overall prices were. Using that overall inflation rate exaggerates the amount that a dollar could buy when it was to be used only for fixed assets. Thus, real infrastructure spending rose between 18 percent and 25 percent between 1975 and 1985, depending on which of the three deflators here are used. Of course, specific capital assets, such as highways, may have a very different inflation rate than other capital assets, such as sewage treatment plants. That is why CBO and others use even more specific inflation factors, and why the deflators used here are only crude approximations of the effects of inflation on infrastructure spending.

Per-Capita Adjustments

A less often used measure is per-capita infrastructure spending. In this case, total public works spending is divided by the total population to arrive at the public works dollars per person. Once again, the trends change, as Figure C-3 indicates. Thus, if one divides total nominal spending by population, the trend rises sharply from \$88 per person to \$558 per person. However, real per capita spending rises much less sharply from \$338 to \$514 a person. Table C-4 shows both the trends in GNP and GDP-adjusted and per-capita infrastructure spending.

Other Adjustments

There are yet other measures which one could choose to divide total spending by. For example, one could divide total nominal public works spending by total government spending to indicate how much of the total budget is being devoted to infrastructure. Or one could divide total nominal public works spending by total nominal private and public capital investment, to see how much of total investment is accounted for by public investment.

These numbers, particularly the numbers relating to the share of total government spending devoted to public works, reveal yet other trends. For example, CBO calculations show that, when considering Federal expenditures alone, infrastructure investment as a share of the total budget rose from 2% in 1956 to 5.5% in 1965, steadily falling since then back down to 2.5% in 1990 (CBO: How Federal Spending for Infrastructure and Other Public Investments Affects the Economy, July 1991, Table 1, Page 14).² The analysis becomes even more varied as one considers the data in more detail. Figures C-4 through C-6 graph the public works spending as a percentage of GDP and GNP, nominal and real total public works spending by all levels of government, and per capita public works spending for the same categories as for Figures C-1 through C-3, except here the graphs present data between 1980 and 1989, rather than 1960 through 1989.

Whereas Figure C-1 showed a decline in spending when measured as a proportion of GNP and GDP, Figure C-4 is largely trendless as a ruler laid across the graph will show. Trendless also, by and large, is the real per capita expenditure shown in Figure C-6. And while real total spending is up in the 1980's, the graph

Table C-2
Federal, State and Local Spending on Public Works

Year	Nominal Public Works Spending (millions of \$)	Real Public Works Spending (millions of 1987 \$) using GDP Deflator	Real Public Works Spending (millions of 1987 \$) using GDP Fixed Investment Deflator	Real Public Works Spending (millions of 1987 \$) using GDP Nonresidential Fixed Investment Deflator
1960	15,879	61,073	59,472	55,712
1961	17,008	64,669	63,940	60,312
1962	17,763	66,280	66,280	62,108
1963	19,191	70,555	71,608	66,405
1964	19,966	72,079	73,675	68,377
1965	21,181	74,581	75,918	71,557
1966	22,459	76,391	77,179	73,636
1967	23,882	78,818	79,342	75,816
1968	25,194	79,476	80,236	76,578
1969	27,009	81,108	81,108	77,836
1970	28,878	82,274	82,745	79,118
1971	32,601	88,111	89,563	85,343
1972	35,283	90,936	91,883	87,119
1973	36,782	89,061	90,373	87,576
1974	39,508	87,991	87,407	85,147
1975	46,593	94,701	90,825	87,417
1976	50,164	95,916	92,044	88,162
1977	54,036	96,665	91,742	88,150
1978	58,531	97,066	90,465	88,017
1979	67,785	103,489	95,204	93,239
1980	77,764	108,457	98,187	96,243
1981	84,757	107,423	96,534	94,070
1982	85,749	102,326	92,104	89,978
1983	90,490	103,773	97,511	95,152
1984	96,527	106,074	102,798	100,970
1985	105,789	112,065	111,006	109,512
1986	115,447	119,140	118,286	117,324
1987	123,046	123,046	123,046	123,046
1988	130,866	125,954	126,808	127,302
1989	138,034	127,338	130,221	131,211

SOURCE: Congressional Budget Office, 1992; calculations by author.



Table C-3
Selected Price Indices

Year	GDP Deflator (1987=100)	GDP Fixed Investment Deflator 1987=100)	GDP Nonresidential Fixed Investment Deflator (1987=100)
1960	26.0	26.7	28.4
1961	26.3	26.6	28.2
1962	26.8	26.8	28.6
1963	27.2	26.8	28.9
1964	27.7	27.1	29.2
1965	28.4	27.9	29.6
1966	29.4	29.1	30.5
1967	30.3	30.1	31.5
1968	31.7	31.4	32.9
1969	33.3	33.3	34.7
1970	35.1	34.9	36.5
1971	37.0	36.4	38.2
1972	38.8	38.4	40.5
1973	41.3	40.7	42.0
1974	44.9	45.2	46.4
1975	49.2	51.3	53.3
1976	52.3	54.5	56.9
1977	55.9	58.9	61.3
1978	60.3	64.7	66.5
1979	65.5	71.2	72.7
1980	71.7	79.2	80.8
1981	78.9	87.8	90.1
1982	83.8	93.1	95.3
1983	87.2	92.8	95.1
1984	91.0	93.9	95.6
1985	94.4	95.3	96.6
1986	96.9	97.6	98.4
1987	100.0	100.0	100.0
1988	103.9	103.2	102.8
1989	108.4	106.0	105.2

SOURCE: Economic Report of the President

Table C-4
Federal, State and Local Spending on Public Works
Per Capita and As a Percent of GDP and GNP

Year	Nominal Total Spending As a Percent of GDP	Nominal Total Spending As a Percent of GNP	Nominal Total Spending Per Person	Real Total Spending Per Person (in 1987 \$)
1960	3.1	3.1	87.89	338.03
1961	3.2	3.2	92.59	352.05
1962	3.1	3.1	95.22	355.32
1963	3.2	3.2	101.41	372.83
1964	3.1	3.1	104.05	375.63
1965	3.0	3.0	109.01	383.84
1966	2.9	2.9	114.26	388.64
1967	2.9	2.9	120.18	396.65
1968	2.8	2.8	125.53	395.98
1969	2.8	2.8	133.26	400.18
1970	2.9	2.8	140.83	401.23
1971	3.0	3.0	156.99	424.30
1972	2.9	2.9	168.10	433.24
1973	2.7	2.7	173.57	420.28
1974	2.7	2.7	184.74	411.45
1975	2.9	2.9	215.74	438.49
1976	2.8	2.8	230.07	439.91
1977	2.7	2.7	245.35	438.91
1978	2.6	2.6	262.96	436.09
1979	2.7	2.7	301.19	459.84
1980	2.9	2.8	341.49	476.27
1981	2.8	2.8	368.58	467.14
1982	2.7	2.7	369.30	440.69
1983	2.7	2.6	386.18	442.87
1984	2.6	2.5	408.37	448.76
1985	2.6	2.6	443.57	469.89
1986	2.7	2.7	479.67	495.02
1987	2.7	2.7	506.70	506.70
1988	2.7	2.7	534.02	513.98
1989	2.6	2.6	558.07	514.82

SOURCE: Author calculations



shows a distinct flattening by the end of the decade when figures are adjusted for inflation using the GDP deflator for nonresidential fixed investment. These graphs would seem to indicate a clear lethargy in public investment during the 1980's.

But total dollars spent do not reveal where those dollars are spent. These figures will reveal a much more varied picture. Table C-5 shows how the composition of total spending is split between capital and noncapital spending on infrastructure. Thus more and more of total government spending since 1960 has gone for noncapital expenses such as maintenance, than on the purchase or major rehabilitation of capital assets.

Further disaggregation would show different growth rates for the various infrastructure categories and across geographic areas. For example, spending on highways has declined somewhat from previous highs, but has largely flattened out, while water resources spending has shown a marked decline in the 1970's and 1980's (CBO, May 1992).

Making Sense of the Numbers

The question arises of which assumptions regarding these various adjustments are most meaningful for addressing the issues surrounding infrastructure investment. The decision will depend both on the specific aspect of the problem which one is trying to analyze and the economic theory and policy perspective one brings to the analysis. Thus in trying to determine the fiscal capacity of governments to meet new infrastructure spending needs, data showing the share of infrastructure spending and other types of spending in the total budget would be a good place to start.

As far as determining whether America is currently underinvesting in infrastructure, the statistical starting place is less obvious, and its interpretation is less clear. Nominal dollars are clearly the least useful numbers because they include effects of inflation and are not scaled to account for changes in the wealth of the country or the size of the Nation's population. But nominal dollars are what governments, particularly State and local governments, have to spend in a fiscal year and as far as determining the ability of governments to meet upcoming infrastructure cash demands, they should not be summarily discarded.

Real numbers are more useful, though great care must be taken in adjusting them for inflation. The GDP and population adjusted numbers would seem to have yet more utility since they are adjusted to take into account other changes in society which may affect the need for more or less infrastructure spending. But even within these frameworks, should we necessarily expect that public works expenditures per person, or as a percentage of GDP, must continue to increase for the Nation's economy to grow? Should the United States be spending three percent of its total budget on infrastructure, five percent, or ten percent? How should one interpret the various sets of statistics and the trends they reveal? Should past trends be followed in the future?

Theory and more detailed evidence, as well as some expert judgment and gut instinct come into play in turning aggregate numbers into policy guidance. For example, the fact that infrastructure spending has fallen as a percentage of GDP since 1960 indicates that more infrastructure spending should be forthcoming if one assumes that public works are equivalent to social investment and that there are significant returns to be had on additional investment. In this case, the overall drop in infrastructure

Table C-5
Federal, State and Local Spending on Public Works
Capital Versus Noncapital Spending

Year	Nominal Total Spending (in millions of \$)	Nominal Total Capital Spending (in millions of \$)	Nominal Total Noncapital Spending (in millions of \$)	Nominal Capital to Total Spending (in percent)
1960	15,879	9,464	6,415	59.6
1961	17,008	10,082	6,926	59.3
1962	17,763	10,753	7,010	60.5
1963	19,191	11,535	7,656	60.1
1964	19,966	12,093	7,873	60.6
1965	21,181	12,728	8,453	60.1
1966	22,459	13,363	9,096	59.5
1967	23,882	14,148	9,734	59.2
1968	25,194	14,662	10,532	58.2
1969	27,009	15,563	11,446	57.6
1970	28,878	16,078	12,800	55.7
1971	32,601	18,099	14,502	55.5
1972	35,283	19,568	15,715	55.5
1973	36,782	19,705	17,077	53.6
1974	39,508	20,812	18,696	52.7
1975	46,593	24,315	22,278	52.2
1976	50,164	25,545	24,619	50.9
1977	54,036	25,649	28,387	47.5
1978	58,531	26,910	31,621	46.0
1979	67,785	32,619	35,166	48.1
1980	77,764	38,088	39,676	49.0
1981	84,757	38,429	46,328	45.3
1982	85,749	37,481	48,268	43.7
1983	90,490	38,683	51,807	42.7
1984	96,527	41,152	55,375	42.6
1985	105,789	46,429	59,360	43.9
1986	115,447	52,115	63,332	45.1
1987	123,046	55,709	67,337	45.3
1988	130,866	59,700	71,166	45.6
1989	138,034	62,015	76,019	44.9

SOURCE: Congressional Budget Office, 1992



spending as a percentage of income indicates that the country is living off its savings, and foregoing cost-effective opportunities to increase those savings.

On the other hand, the same facts can be used to indicate overinvestment if one believes that public works spending has a considerable consumption element to it (gold-plated bridges would be an extreme example) and that most of the infrastructure America needs has already been built. Looked at this way, real GDP has almost tripled since 1960 and yet our relative spending on infrastructure has fallen only slightly. Infrastructure might be more like food rather than savings in this analysis: public works, like food, is a necessity, but as income grows one would generally expect the percentage of income spent on food to decline. An increasingly rich person who spends even the same percentage of his income on food might be engaging in gluttony or waste.

There are yet other complications to this already complex story. Most of the data being analyzed do not take quality changes into account. To the extent that infrastructure is becoming higher-quality, it may be necessary to spend less on it since it is more efficient. On the other hand, more sophisticated technologies, while higher performing, may also be more expensive, at least when initial outlays are being made. Thus quality improvement may significantly impact on how much should be spent on infrastructure.

All of which is to say that the infrastructure situation must be carefully analyzed before firm policy pronouncements are made. Even then, there will always be considerable uncertainty which only experience may illuminate. From this discussion, however, it should not be concluded that aggregate numbers are useless; they are the forest which the trees make up. But forests are easy to get lost in if one does not mark a trail.

Next Steps

To begin to achieve further understanding of the significance of Federal infrastructure investment trends, and to draw some additional conclusions about the directions these trends should take in the future, the Corps of Engineers is undertaking a study of planned Federal expenditures in the public works categories outlined in Fragile Foundations. Detailed and disaggregated data for different types of infrastructure expenditures, both historical and projected into the future, are being collected. An overarching analytical framework is also being designed to organize and characterize the data and better understand the reasons the trends which may be found are occurring and what these trends might mean for national productivity and growth. Finally, to try and account for the effects that different modelling and analytic methods might have on predicting the output and productivity effects of public capital, a controlled comparison between two methods will be run on similar data.

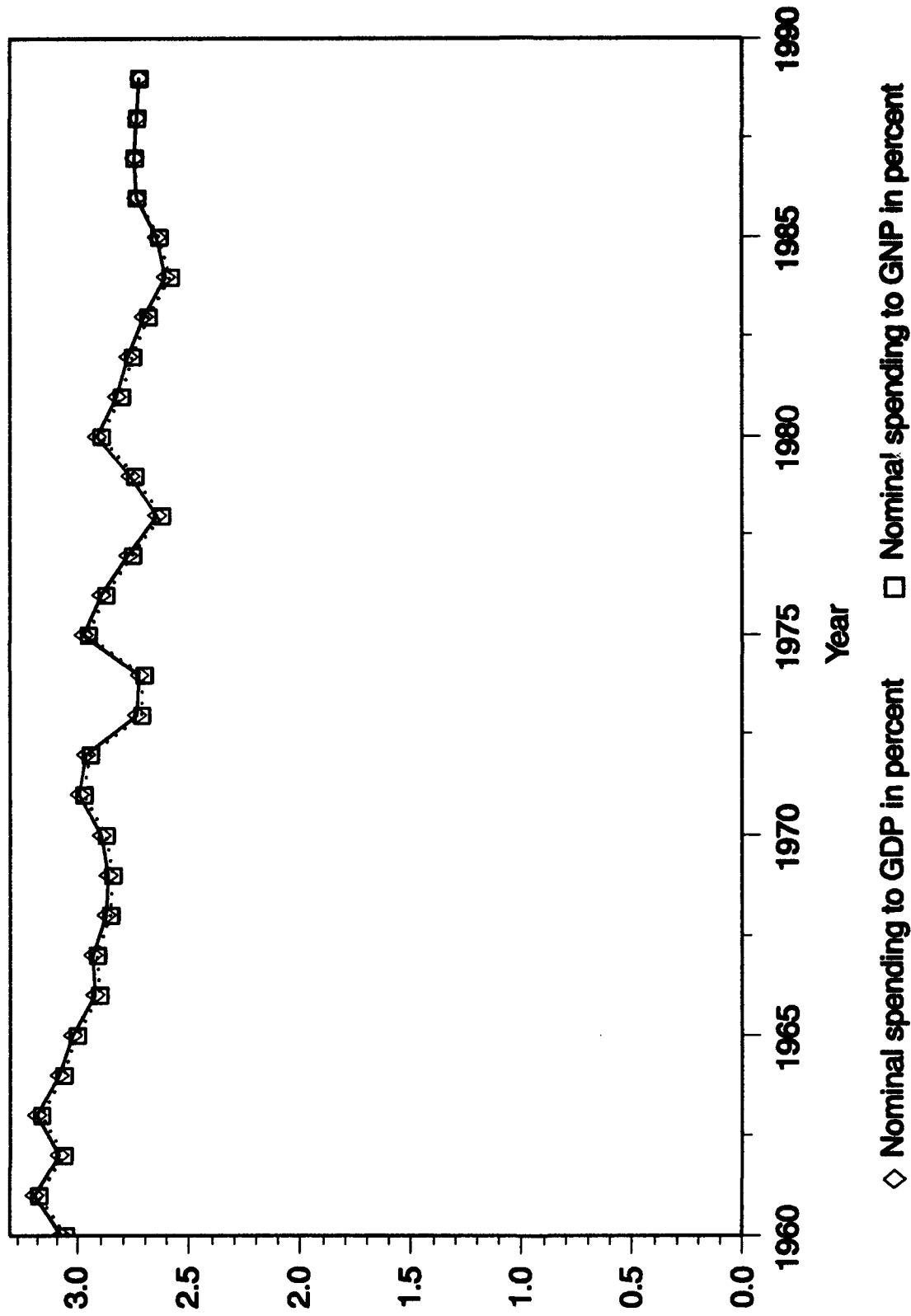


Figure C-1
Public Works Spending As a Percent of GDP and GNP



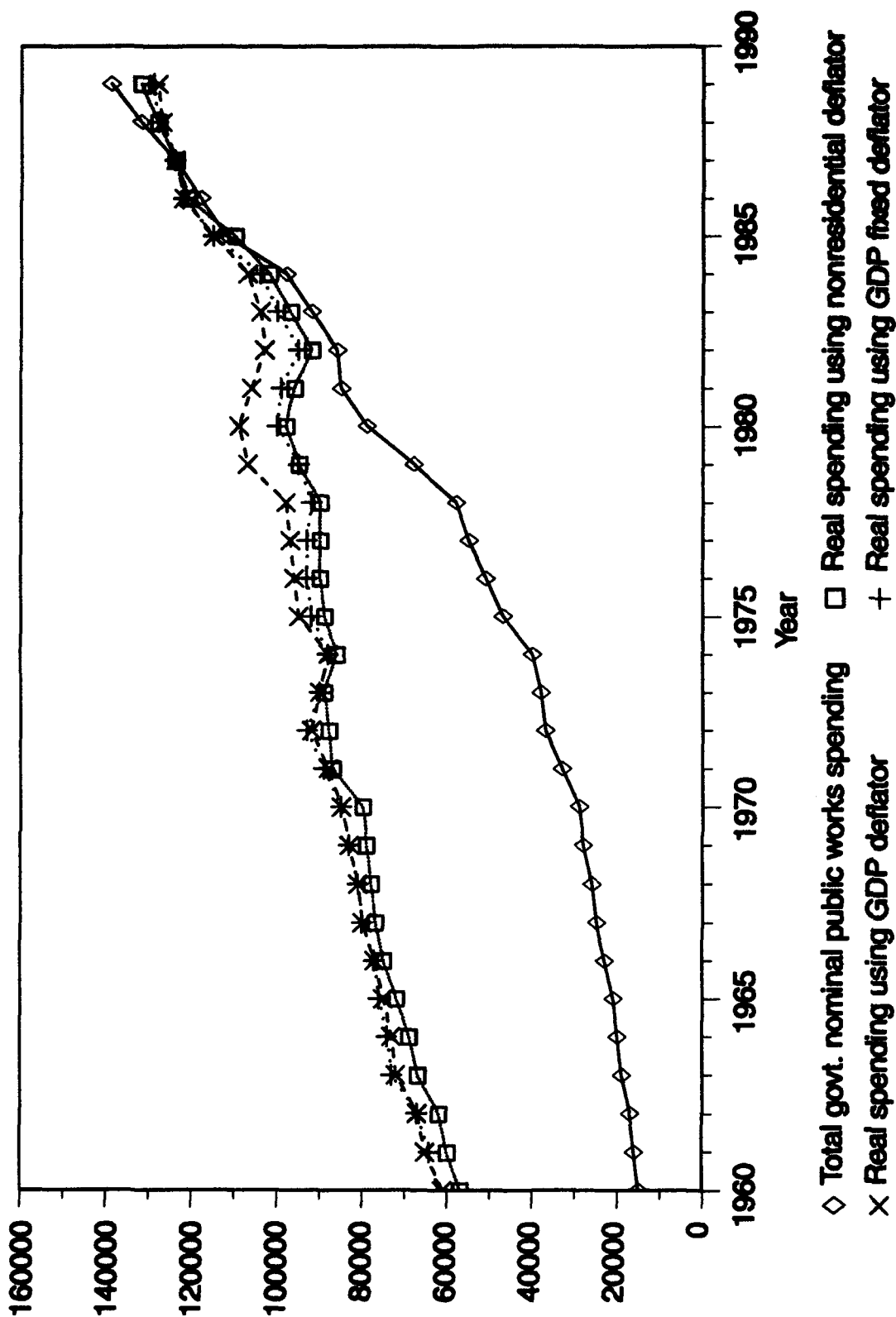


Figure C-2
Public Works Spending
Millions of dollars (1987=100)

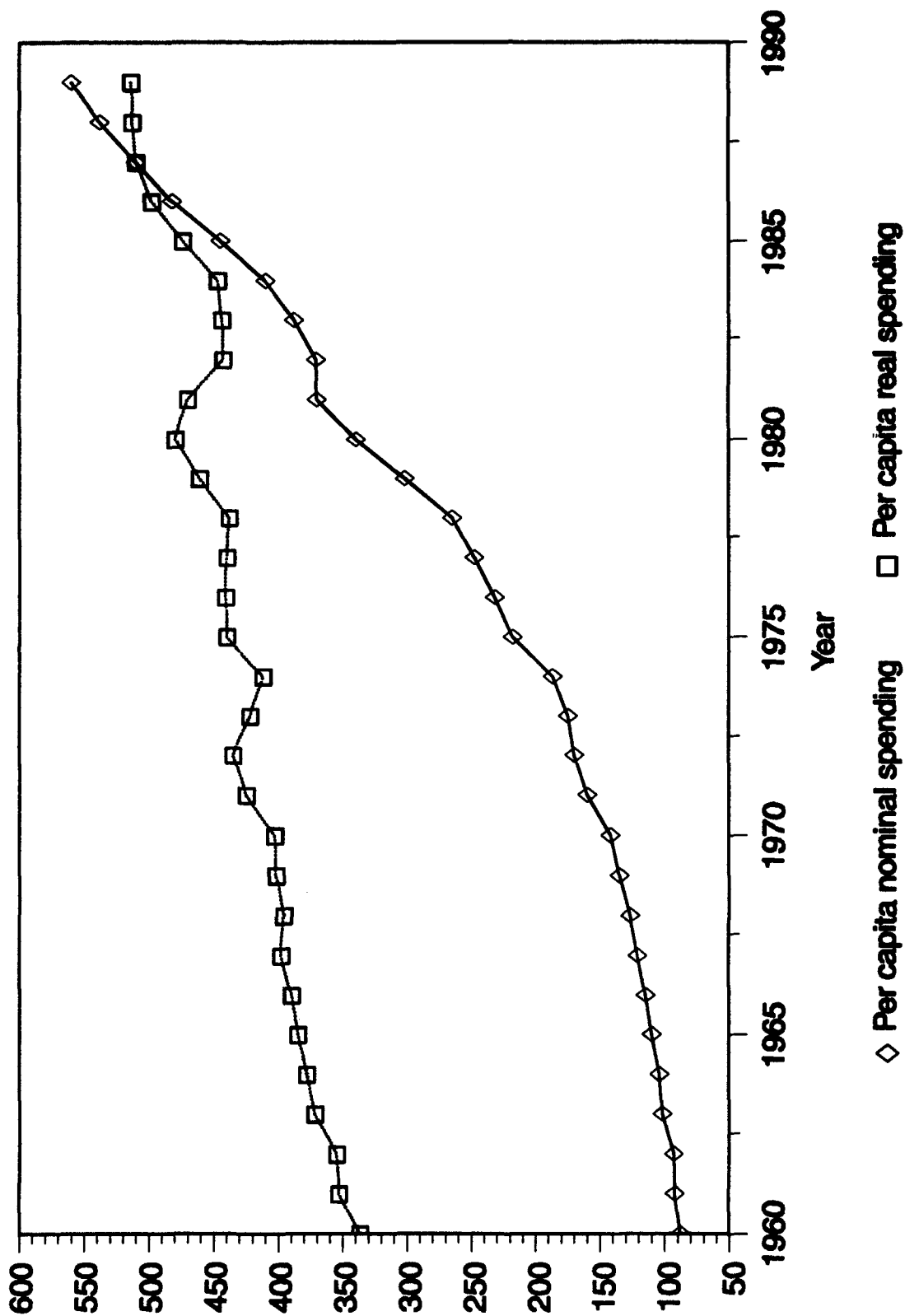


Figure C-3
Public Works Spending Per Capita (in dollars)

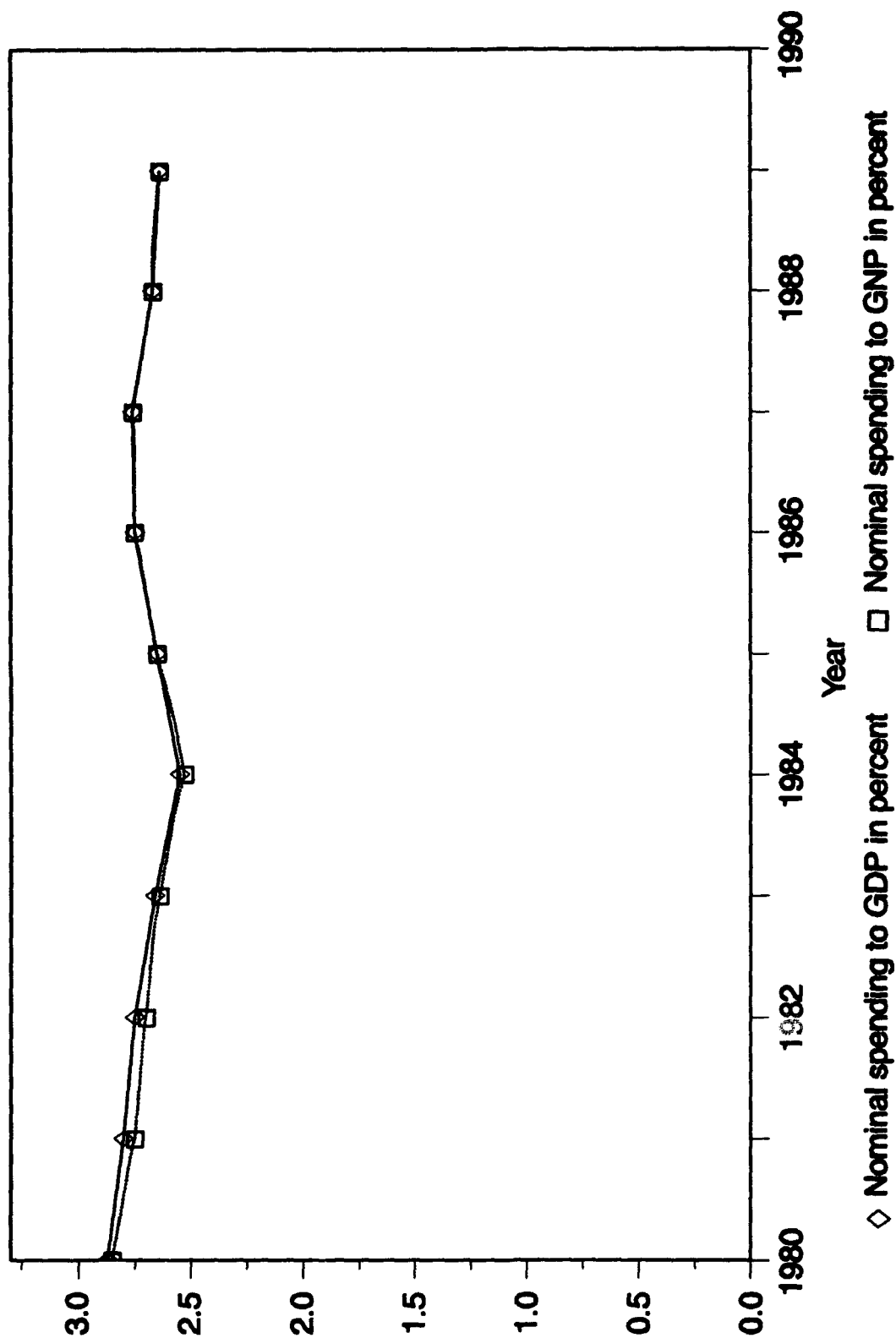


Figure C-4
Public Works Spending As a Percent of GDP and GNP

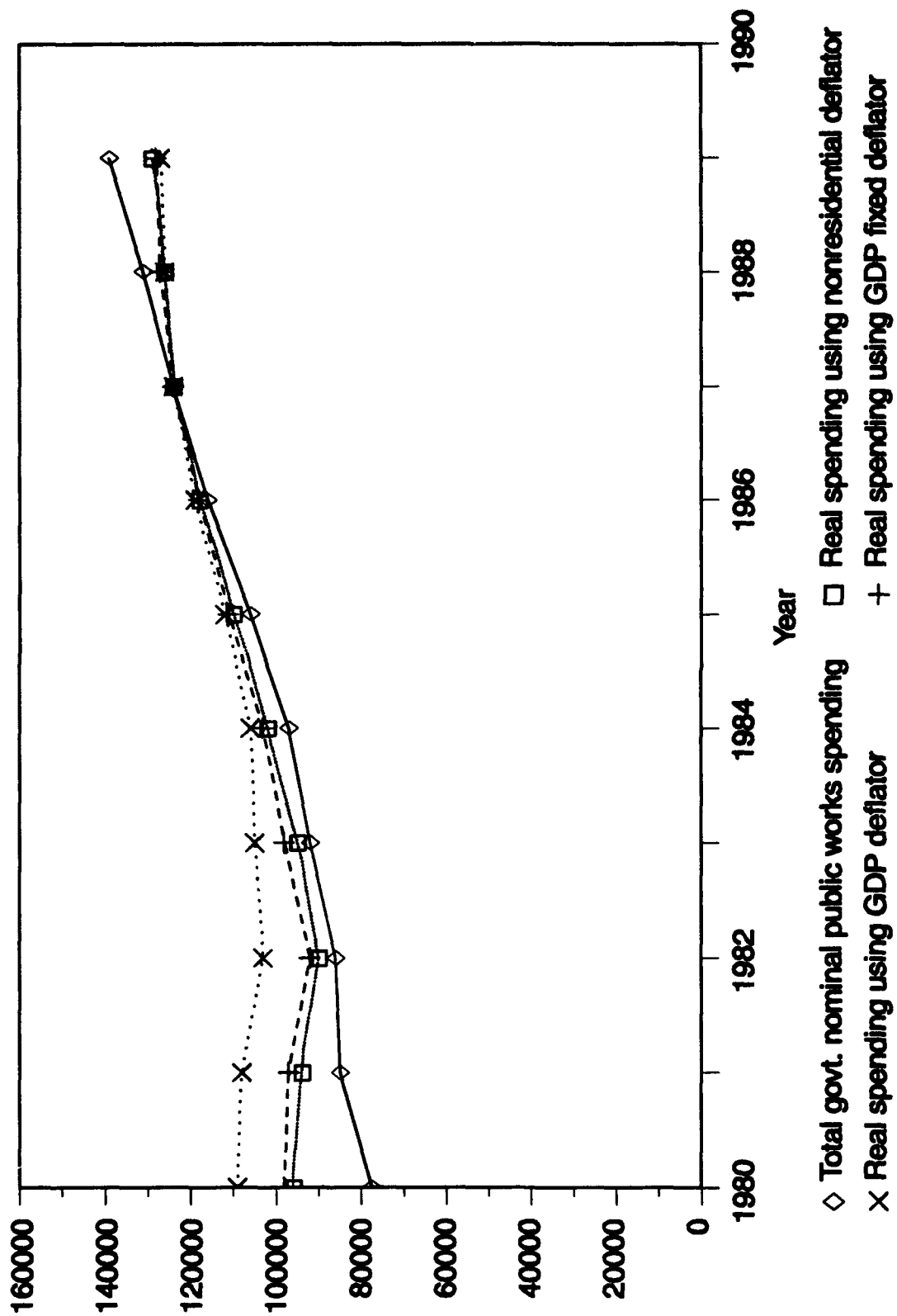


Figure C-5
Public Works Spending
Millions of Dollars (1987=100)

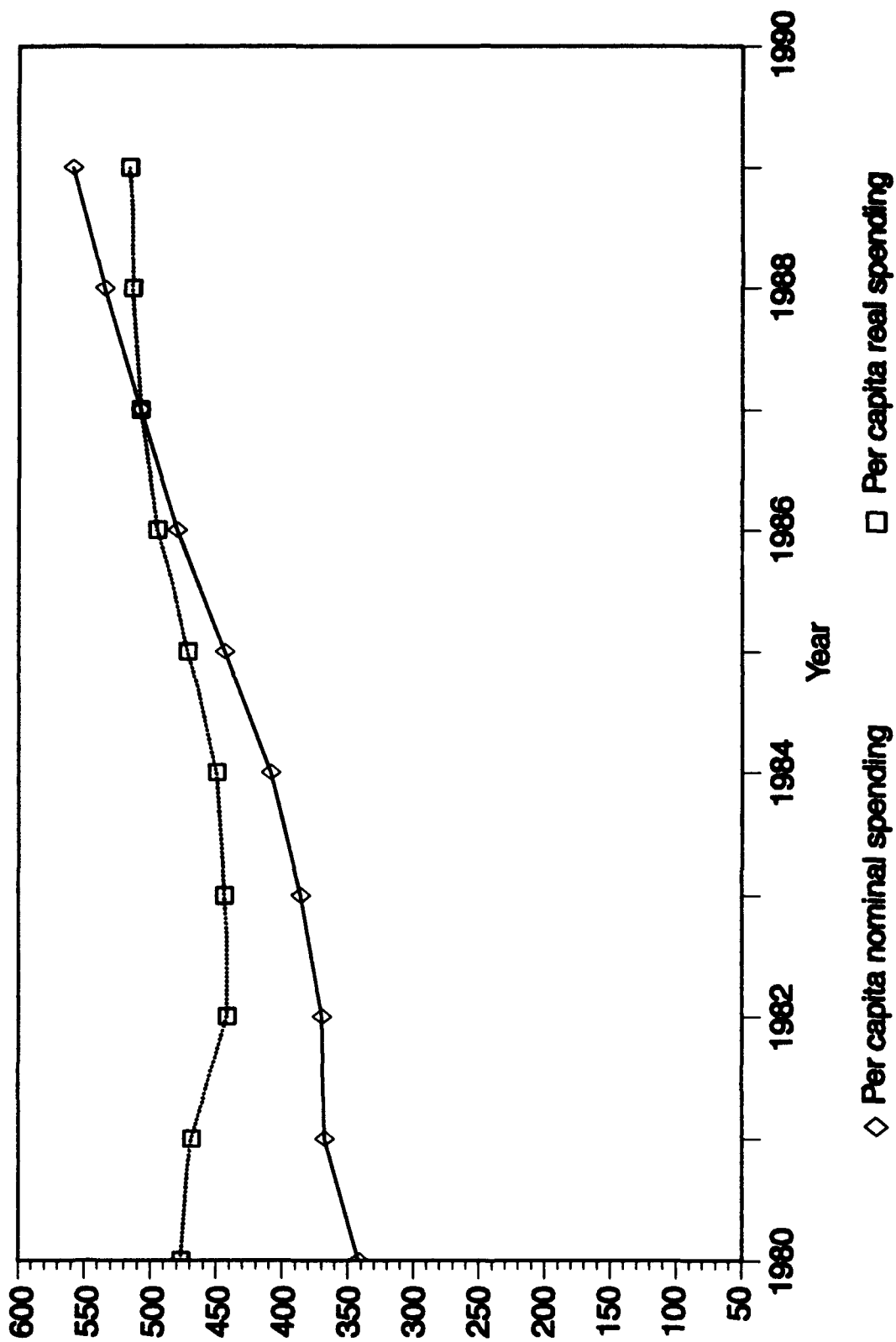
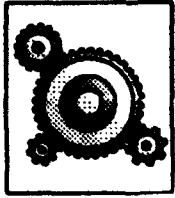


Figure C-6
Public Works Spending Per Capita (in dollars)

ENDNOTES

1. U.S. Congressional Budget Office, Trends in Public Infrastructure Outlays and the President's Proposals for Infrastructure Spending in 1993, CBO Papers, Washington DC, May 1992.
2. U.S. Congressional Budget Office, How Fiscal Spending for Infrastructure and Other Public Investments Affect the Economy, Washington DC, July 1991.





Appendix D

The Value of Infrastructure to America

APPENDIX D
THE VALUE OF INFRASTRUCTURE TO AMERICA

**A Background Paper
on Issues for Consideration in
Developing a Federal Infrastructure Strategy**

Submitted to the U.S. Corps of Engineers

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EXECUTIVE SUMMARY

America's infrastructure undergirds a high standard of living and a vast, rapidly changing economy. This infrastructure consists of public facilities with high fixed costs and long economic lives, that are important not only to the nation's economy, but also to national defense, public health and safety, and the smooth functioning of the communities we live in. Public works facilities—broadly speaking—include transportation, environmental, communications, and energy systems.

This paper discusses the value of a well-funded infrastructure to the economic health of the United States, describes the relationship between productivity in the public and private sectors, and highlights the importance of suitable quantitative measures to infrastructure decision making.

Key Forces Driving Infrastructure Demand

Many of the forces that will likely increase demand for public works in the future are: (1) growth in the population and employment opportunities, (2) the competition of international markets, and (3) rising standards for environmental protection.

Nineteen million new jobs are expected to be created in the United States by 2000, and demographers predict many immigrants will be lured to this country to fill those jobs. This growth will put pressure on the existing infrastructure, requiring a projected growth in public works expenditures of approximately one-third more in the 1990s than in the 1980s. Similarly, the competitiveness of international markets necessitates new investment in infrastructure. If the United States is to maintain its place as a leader in the global

economy, we will need to upgrade and maintain those sectors of our infrastructure that move goods to and from markets. The public is now more environmentally conscious, as evidenced by preference for cleaner water, safer waste treatment methods, and more recycling of resources. Satisfying these policy preferences will require a substantial commitment both from government and the private sector to bring on line or retrofit the necessary infrastructure facilities.

The federal government will continue to play a significant role in these areas of public works given its constitutional responsibilities in commerce and established role in environmental protection.

Economic Views of Infrastructure

Although public works spending has a positive effect on the economy, the level of public works investment necessary to support a sustained and expanded economy has been the subject of controversy.

In 1988, the National Council on Public Works Improvement, examined a broad-scale needs and aggregate investment trends, and recommended to Congress and the President that the nation increase its infrastructure investment by up to 100 percent to match demand and reverse the trend of declining investment. The Congressional Budget Office criticized the Council's recommendation, suggesting instead greater attention to detail analysis of the benefits, costs, and economic returns of specific types of investments and individual projects. The debate over which is more suitable, micro- or macro-analysis, is important because additional spending requests will require rigorous analytical



support if they are to elicit a consensus. Both types of analysis are necessary.

It is also important to examine the costs and benefits of infrastructure services to help determine who should pay for them. Some public services, such as elements of transportation, water supply, and electric utilities, have a large proportion of private benefits which can be paid for with fees. Yet, infrastructure services usually have both private and public benefits, suggesting that some share of their costs be paid by taxes.

In addition, public works frequently have "network effects" on regions and states, where greater rates of investment tend to boost the economy. This stimulative relationship suggests that a balance between private and public investment in infrastructure be maintained. The cost of imbalance may be a reduction in productivity, if private corporations must shift their own capital and labor to compensate for services more appropriately paid for with public funds. The importance of inter-regional relationships to the nation's domestic and international economic growth suggests that the federal government has an interest in maintaining an adequate level and quality of infrastructure.

Changing Characteristics of the Economy

Major components of the economy that influence economic growth are being transformed. For example, small scale computer-integrated manufacturing systems more responsive to the rapidly-changing demands of today's marketplace are replacing standardized mass-production processes. The new technology's infrastructure needs are different from earlier processes, placing greater emphasis

on transportation networks within metropolitan areas rather than between them.

Also, the industrial sector has shifted from domination by domestic industrial firms to a diverse collection of multinational corporations, and from technologies that require few skilled workers, more unskilled workers, heavy raw materials, and large, bulky outputs, to information technologies that require many skilled workers, utilize lighter raw materials, and produce smaller, easier to transport outputs.

America's new high-tech industries allow corporations to split up the various parts of the production process in order to take advantage of the infrastructure benefits of a particular area. The result of this scattering of functions is increased functional specialization by cities and states, based on the distinct infrastructure services they can offer business. State and local governments no longer try to entice heavy manufacturing industries with industrial development bonds and tax breaks alone. Instead, they compete by offering higher quality workforces and environments conducive to the needs of both business and workers.

Most of the new jobs created since 1970 have been in the service sector. These services have become more specialized in their attempts to tap fragmented markets. The impacts of services such as tourism and retirement centers on the economic health of some localities is major, and their infrastructure needs are very different from other services.

Infrastructure Decision-making

While financial commitment to public works is necessary to revitalize the country's infrastructure, it is not, by itself, sufficient. Matching that commitment with clear and

consistent national purposes, mastering the regulatory process, and authorizing projects in a timely fashion are equally important. A number of national purposes and initiatives for infrastructure should be considered by federal agencies. Several might be pursued in combination.

The complex interplay of environmental, safety, and land use regulations, as well as the high number of decision makers involved, slows down and drives up the cost of the regulatory process. The public works investment process now often is drawn as long as 10 or 15 years in the case of many projects. Such delays can make projects too expensive to complete or inadequate to meet their original purposes.

Attempts at reform have run up against the independent missions of federal agencies, and the increased use of federal

preemptions and mandates to achieve national goals. State and local governments frequently must foot much of the bill for federal infrastructure initiatives.

While satisfactory performance measures are critical to increasing the value of America's infrastructure, they usually are lacking. Credible and acceptable performance measures allow decision makers to design public works projects that satisfy budgetary constraints, industry's need for new and different services, and the public's demand for a high standard of living. Federal involvement in designing, funding, and regulating the nation's infrastructure, and increased efforts to develop the appropriate analytical measures could help to meet the America's infrastructure needs in the 1990s and contribute to the nation's continued economic success.



TABLE OF CONTENTS

SUBJECT	Page
Executive Summary	D-i
Purpose and Scope of this Paper	D-1
What Is Infrastructure?	D-2
Key Forces Driving Infrastructure Demand	D-4
People and Jobs	D-4
International Competition	D-4
Environmental Protection	D-4
Summary	D-5
Economic Views of Infrastructure	D-7
The Private and Public Values of Infrastructure	D-8
Intergenerational Values of Infrastructure	D-9
Infrastructure for Economic Development	D-10
The Changing Face of the Economy	D-12
Changes in Nature of Production Processes	D-12
Changes in Industrial Structure	D-12
Changes in Location of Economic Activities	D-13
The Rise of the Service Economy	D-15
The U.S. Infrastructure Industry	D-15
Conclusions About the Economy	D-15
Infrastructure Decision-Making	D-17
National Infrastructure Purposes and Needs	D-17
The Regulatory Environment	D-18
Timely Decisions	D-19
Performance Measures	D-18



Purpose and Scope of this Paper

The U.S. Army Corps of Engineers has been funded to work in partnership with other federal agencies and with state and local governments to develop a federal infrastructure strategy involving the private sector. This paper is one of a series of papers examining issues for consideration in developing this strategy.

The topic of this paper is "the value of infrastructure to America." For purposes of this paper, "infrastructure" refers to the major public works systems that assist the nation and its communities to function effectively and efficiently as places where people live, do business, and strive for a better life. These public works--broadly speaking--include transportation, environmental, communications, and energy systems. The public and private sectors both play important roles in providing these essential infrastructure systems, and will continue to do so in the future.

The real value of such infrastructure lies not in the physical facilities themselves, but in the services they provide and the extent to which these services are needed, dependable, convenient, cost-effective, safe, and pleasing. Even the best facilities may be of little value if the services they provide are not available when needed, if they are in the wrong place, if they are operated ineffectively or inefficiently, if they are allowed to deteriorate so that they no longer reliably perform as they were designated to perform, if they produce off-setting dangers, or if they are unwanted and allowed to fall into disuse.

Public works are not sufficient, by themselves, to ensure the continued economic success of America, or of its states, its metropolitan areas, or its rural communities.¹ Highly developed human resources, entrepreneurial freedom, and other factors are equally necessary. As a factor in economic production, however, America's public works have played, and will continue to play, vital roles in the dynamism of America. This relationship is close enough that higher productivity in the public works sector can be expected to lead to higher productivity in other sectors of the economy, even though there may not be a consistent one-to-one relationship between these factors.

Although there is little disagreement that these relationships exist, measuring them accurately and predicting precisely the future effects of infrastructure investments are difficult tasks. This lack of accuracy and precision, at a time when public funds are scarce and national goals for infrastructure are becoming increasingly uncertain, magnifies the difficulty of making public decision about the proper amount of investment in infrastructure.

The issues explored briefly in this paper include: identifying the types of infrastructure having essential value to the nation; examining some key forces driving infrastructure demand; reviewing linkages between infrastructure and the economy; and considering how the value of infrastructure can be more accurately and realistically reflected in public infrastructure decision-making.



What Is Infrastructure?

For purposes of this paper, the term infrastructure refers to facilities that have high fixed costs, long economic lives, and importance to the nation's economy, the national defense, the public health and safety, and the smooth functioning of the communities in which we live.² A list of such infrastructure generally includes transportation systems (highways, streets, roads, bridges, mass transit, railroads, airports and airways, ports, locks and inland waterways); environmental systems (water supply, wastewater treatment, solid and hazardous waste facilities, and flood control); telecommunication systems (wire, wireless, satellite, fiber-optic, and other); and the nation's energy supply (hydro-electric, fossil-fueled, nuclear, and other).

Many federal agencies are involved with these infrastructure systems. For example:

- Transportation systems involve the Corps of Engineers, the Department of Transportation (DOT), the Environmental Protection Agency (EPA), the Interstate Commerce Commission (ICC), and the Department of Agriculture (USDA).
- Environmental systems involve the Corps of Engineers, EPA, USDA, and the Department of the Interior (DOI).
- Telecommunications systems involve the Federal Communications Commission (FCC), the National Aeronautics and Space Administration (NASA), the White House Office of Telecommunications Policy, the Department of Commerce, and USDA.

- Energy systems involve the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), DOI, the Corps of Engineers, and USDA.

The nation's infrastructure provides basic services that support the economy and society we know today. Too often the quality of the nation's infrastructure has been evaluated simply by looking at the physical facilities that provide these critical services. Those facilities, however, are not ends in themselves. Rather, their value to the economy and society derives from the services they provide. For example, infrastructure facilities aid:

- the supply of usable water for domestic, industrial, and agricultural purposes;
- the daily movement of people to and from work, school and shopping;
- the distribution of raw materials and intermediate and finished goods throughout the economy;
- access to recreational activities;
- improvement in the quality of life through a cleaner and safer environment;
- the lighting of our homes and the running of our factories, computers, and hairdryers; and
- the instantaneous interchange of information over short and long distances.

In other words, services like mobility and safety are of prime importance, not just roads, wastewater treatment plants, and flood control facilities. The value that society places on such services determines the value of specific infrastructure facilities.

This value must be measured in units of service performed and costs incurred if the public is to be convinced that the value



received is satisfactory. Government accounting systems, however, seldom provide such measures. Without these data, public policy-makers in general, and public works decision-makers more specifically, are ill-equipped to link their decisions to the infrastructure values they intend to create.



Key Forces Driving Infrastructure Demand

In the 1990s, demand for public works is likely to increase because of three factors: (1) the growth in the number of people and jobs, (2) the competition of international markets, and (3) rising standards for environmental protection (although this last factor also may dampen demand for certain types of public works). These three factors are examined briefly below.

People and Jobs

The 1990 Census is a reminder that America is not standing still. Although the final figures are not in yet, preliminary figures and projections have begun to be released.³ Growth is proceeding especially rapidly in the sunbelt cities, and, overall, nearly 19 million new jobs are projected for the nation by the year 2000. Only one major metropolitan area--New Orleans--is expected to experience a population decline by the turn of the century, and that will be a very modest 0.1 percent decline.

In addition to natural increase, America remains very attractive to immigrants. Bowing to this increased demand, the 1990 Immigration Act has raised the number of immigrants allowed in future years.

More people and more jobs dispersed over a greater area mean more travel, more housing, more urban development of all kinds, and--if we are not careful--more congestion and more pollution as well. Expanded, maintained, and revitalized public works will be needed to keep up with demand. A careful study prepared for the National Council on Public Works Improvement by the U.S. Department of Commerce projected the growth in public works investment needed just for sustaining

expected growth of American industries to be about one-third more in this decade than in the last decade.⁴

International Competition

As markets become increasingly global, trade, travel, and tourism rise rapidly. As the amount of travel, transportation, and communications rises, so does the pressure to increase the productivity of the public facilities needed to remain competitive with other nations. These pressures affect air transportation and intermodal goods movements, in particular. The efficiency of transfers from ship to barge to rail to truck, and vice versa, is a significant element in maintaining America's competitive edge.

America's ports, waterways, and railroads, as well as its highways, must be updated to meet the competition. For example, the Corps of Engineers recently has been authorized to deepen two U.S. ports to the 50-foot drafts required by the newest ships in international commerce. The Corps also has "presented three options to Congress to help U.S. industry develop a magnetic levitation high-speed transportation system by the year 2000."⁵ In addition, the nation's highways need further adjustment to rapid increases in trucking, and the federal air-traffic control system needs further modernization and expansion.⁶

Increasing globalization also is likely to create new needs for moving foreign goods across the nation. European goods destined for nationwide markets tend to arrive on the East Coast, while goods from the Pacific Rim tend to arrive on the West Coast.

Environmental Protection

As our domestic standards for environmental protection rise, many changes



in public works programs will be needed. These changes will dampen the demand for certain types of facilities while expanding the demand for others.

For example, major new water-supply dams are getting harder to justify because of rising sensitivities to the environmental damage they can cause and the rising costs of mitigating such damage. Yet, even with improved conservation practices, the need for increased water supplies is likely to grow as the nation continues to expand. A forthcoming report from the U.S. Advisory Commission on Intergovernmental Relations⁷ suggests that connecting underground and surface-water supplies, and managing them together as is done in California, offers potentials in many places for augmenting supplies and providing an alternative source of supply in the event that one source becomes unavailable or unusable. Such interconnections would require new public works projects.

Strict water pollution control and drinking water standards also will continue to create demand for new or improved public works.⁸

In addition, new concepts of waste management will require new public works.⁹ Many existing landfills do not meet recently established standards for environmental safety. They will have to be closed, rebuilt, cleaned up, or replaced by some other type of facility. Increasing costs of safe waste disposal also are spurring the development of recycling programs that require new public collection, transportation, and processing facilities, as well as new private-sector reuse industries.

Furthermore, a variety of broadly applicable environmental protection standards will affect many public works projects. Among these are requirements for:

- mitigation of nonpoint sources of water pollution (that specifically target urban transportation facilities among a long list of other polluters),
- wetlands protection (that may prohibit or make more costly any public facility to be located on marshy lands);
- endangered species and historic preservation (that may delay, prohibit, or increase the cost of constructing public facilities at some locations); and
- air quality (that may require expansion and greater use of transit, railroad, and water transportation systems to help reduce the use of cars and trucks; and improvement of highway and street systems to smooth traffic flows and reduce pollution; and programs to cleanup emissions from fossil-fueled power generating plants).

Finally, many older public works facilities may have to be replaced or retrofitted because they no longer meet acceptable standards.

Summary

Taken together, these three factors--jobs, international competition, and environmental protection--guarantee that significant public works challenges lie ahead.

America will not be able to rest on its laurels, maintaining its existing public facilities. New initiatives and improved productivity will be necessary.

The federal government's role in public works will continue to be important because of its constitutional responsibilities for immigration, interstate commerce, and



foreign economic affairs. Furthermore, its established role in setting minimum national environmental protection standards is likely to grow through a combination of domestic and foreign pressures.

Economic Views of Infrastructure

Much of the literature concerning the value of infrastructure is concerned with economic factors. These factors were of great concern to the Congress when it established the National Council on Public Works Improvement (NCPWI) in 1984. At that time, Congress asked the Council to determine how much public works investment is needed to support a sustained and expanding economy. The Council's answer, four years later, was that the nation should increase its rate of infrastructure investment by as much as 100 percent to keep up with rising demand and to catch up with a long-term decline in such investment.¹⁰ But, this answer, based on examination of broad-scale needs studies and aggregate analyses of investment trends, has become controversial.

The act that set up the council also required the Congressional Budget Office (CBO) to review the council's final report within 90 days of its submission to the President and the Congress. When CBO made its review, it remarked that this central question posed by Congress was the most difficult to answer, and it criticized the council's call for increased investment.¹¹ CBO suggested, instead, applying better studies of rates of return on specific types of investments and individual projects—a more micro-analytic form of analysis than that used by the council.

Others have joined the debate about the relative merits of using macro or micro analysis. Leading the argument for using aggregate analysis is Dr. David Aschauer, an economist who was with the Federal Reserve Bank of Chicago, and is now at Bates College. Aschauer argues that declining public infrastructure investment in the United States has damaged the nation's economic productivity. According to Aschauer, there is "a strong and robust link"

between the rate of public works investment and productivity improvements in the nation's economy.¹² Aschauer's time-series correlations between public works spending and productivity of the national economy, and similar studies by others, show output elasticities in the range of 0.3 to 0.4.¹³ In other words, Aschauer argues that each 1 percent increase in the stock of public infrastructure raised the output of the overall economy by 0.39 percent. According to this view, rising public works spending increases private investments and corporate profits. However, not all scholars are convinced that this is sound analysis of causation.

CBO is joined by Charles Schultze of the Brookings Institution and others in calling Aschauer's macroeconomic correlations spurious, and suggesting, at least, that his results are highly inflated.¹⁴ Although no one denies that infrastructure is necessary to the health of the nation's economy, there is no single set of figures that analysts presently agree on as the precise measure of that linkage. Indeed, there may be no single set that has enduring validity.

CBO may have been right in suggesting that this question about the proper amount of public works spending is the most difficult of all to answer. With tight public budgets, nothing less than iron-clad proof that additional spending is essential would be likely to elicit a consensus. Certainly, macroeconomic analysis of investment trends is not a substitute for more precise return-on-investment analysis for specific programs and projects.

Still, the question persists as to whether America is headed in the right direction or the wrong direction with respect to its public works investment levels. The three historical working papers prepared by



the Public Works Historical Society for the National Council on Public Works Improvement¹⁵ examined ten types of public works over the history of the nation and found that:

- Public works were at the center of many of the cutting-edge issues of their day.
- They often involved all governments in our federal system--federal, state, and local.
- Most innovation in public works spread rapidly with federal government encouragement.
- There was usually important university, industry, and professional society involvement as well--often including some very close working relationships.
- Public works often representing the large-scale application of cutting-edge science and technology to save lives, promote the economy, and raise the American standard of living to one of the highest in the world.

Until about 1875, America borrowed much of its public works expertise from Europe, but between 1875 and 1900, American itself became the technological leader. In succeeding generations, several major national infrastructure programs helped to build America.

These great public works thrusts of the past established thriving ports, coastal navigation, and inland waterways; opened the West with rail transportation, water, and electrical power; made agriculture thrive in arid regions; brought electricity to rural America; protected major river valleys from floods; tied the nation together with the world's biggest and best freeway system; established air transportation as the dominant carrier for long-distance travel; and brought modern wastewater treatment to

75 percent of the nation's population--all as a matter of national policy. The two major infrastructure initiatives with federal support at present are the establishment of world-wide satellite communications and the upgrading of the air-traffic control system. Undoubtedly, additional initiatives will be needed if America is to stay prosperous, clean up its environment, and maintain one of the world's highest standards of living.

The Private and Public Values of Infrastructure

Another economic issue regarding infrastructure concerns who benefits from the services provided and who should pay for these services. Many of the infrastructure systems included in the definition cited above have what are typically regarded by economists as "private good" characteristics. Specifically, such facilities serve identifiable consumers; their use can be measured; those who use the service can be charged a price; and those who do not pay can be refused service. These characteristics apply to elements of transportation, water supply, wastewater treatment, solid and hazardous waste disposal systems, communications networks, and electric utilities. In fact, the private sector is often involved in providing these services. For example, of the 59,071 water supply systems in the United States (27 percent), serving 37.5 million people (16 percent of the population), are privately owned;¹⁶ 64 percent of the nation's airports are not available for use by the general public;¹⁷ two-thirds of the investment made in the solid waste industry is by private providers;¹⁸ and between 90 and 95 percent of the nation's hazardous waste storage, treatment and disposal facilities are privately owned and operated.¹⁹

By contrast, other public programs, such as national defense, police, and fire protection, generally do not lend themselves



as easily to the identification of individual beneficiaries. Therefore, they are more appropriately financed through general government revenues.²⁰

Even though these infrastructure services have characteristics similar to private goods, that does not suggest they should always be fully financed through user fees. Users are not always the only beneficiaries from such public services. For example, mass transit benefits both riders and motorists who use less congested roads. Similarly, society in general benefits from having a safe and assured supply of potable water that reduces the spread of communicable diseases. This "public good" character of infrastructure derives from its system of network characteristics. Likewise, a reliable supply of electric energy is derived from the electric power industry as a whole, not from individual suppliers. To reflect this public benefit, it is appropriate to supplement user fees with general revenues so that both indirect beneficiaries and direct users help defray the costs of providing the service.

An established body of economic evidence concludes that, in the absence of government support, public goods tend to be underprovided. It also has been shown that individual local and state governments tend to underprovide goods and services that have benefits which extend beyond their boundaries. This suggests that some degree of government support of basic infrastructure can be justified because the public good aspects derived from its system characteristics are likely to be underprovided in the absence of such support. In fact, concern for such network effects has contributed to the passage of numerous federal transportation, water resources, environmental protection, and energy supply programs in the past.

Intergenerational Values of Infrastructures

Another aspect of deciding who should pay for public works is the timing of payments. To the extent that the benefits of infrastructure services are intergenerational, economic theory suggests that future generations should contribute to the costs of such facilities. This is an argument for debt financing, rather than for relying solely on pay-as-you-go financing for long-lived infrastructure facilities. Also, given the relatively long lives of such facilities, it can be argued that at least part of the debt should be governmental, because governments value future social benefits more than the private sector—especially in the face of high levels of real interest rates, which tend to compress individual and corporate time horizons.

State and local governments, as well as private communities, commonly borrow for capital improvements, and the federal government traditionally has supported this practice through tax exemptions on publicly issued bonds and deductible interest payments on mortgages that frequently internalize some community development costs. This traditional role has been clouded by the Tax Reform Act of 1986 and other efforts to reduce the use of tax exempt bonds that help to support capital expenditures for infrastructure.

The issue of intergenerational payments recently has taken on new political overtones.²¹ Because of the unusually large size of the "baby boom" generation (born from 1946-1960) and the increased longevity of the population, the sides of the traditional population pyramid are tilting increasingly vertical. The implication is that fewer workers will be supporting more retirees in the future. Thus, unless the productivity of workers increases dramatically, growing amounts of debt for



pensions, senior-citizen health care, and other obligations will grow increasingly burdensome to workers and taxpayers. This emerging situation could argue strongly for current funding of future obligations.

In the public works field, this issue is most obviously pertinent to the maintenance of facilities. When such maintenance is deferred, a future financial liability is created--not to mention the physical deterioration and growing potentials for unreliable operation and safety hazards. However, because government accounting systems seldom measure the extent of deferred maintenance, this issue usually is debated in general rather than specific terms.

Infrastructure for Economic Development

As mentioned above, infrastructure services often are inputs into private production and consumption decisions. When the economy changes and grows, infrastructure systems must keep pace. Therefore, a full understanding of the value of infrastructure services rests on an understanding of the links between infrastructure and economic development.

In the last several decades, many analytical tools have been developed to help quantify various dimensions of the economic impact of infrastructure investments.²² These techniques include benefit-cost analysis, input-output models that analyze the multiplier effects of infrastructure investments for the nation and for regions, local land-use and land-value impact models, and infrastructure demand models.

While all of these tools are useful and important, concerns about the relationship between infrastructure and economic development have evolved so that traditional approaches to evaluating the economic impact of specific infrastructure

investments are no longer sufficient by themselves. For example, states are no longer merely chasing after heavy manufacturing plants from the outside, using industrial development bonds and tax breaks; instead, they are undertaking a more balanced set of policy initiatives to create business climates and living environments conducive to entrepreneurial activity, including promoting new business starts, retaining and expanding existing businesses, and attracting new businesses.²³ In pursuing these objectives, they have rediscovered the importance of educational opportunities that supply a high quality workforce, quick access to air travel for business people, reduced traffic congestion for commuters, a clean environment for everyone, first class cultural opportunities, and tax rates that remain reasonable and fair in the minds of businesses and other taxpayers.²⁴ As part of this new awareness about prospects for a region's growth, there are emerging concerns about the impact of wastewater treatment, air quality attainment, solid waste management, and hazardous waste safety.

Despite the recent increase in attention to public infrastructure issues, research has not yet fully explained the relationship that the quantity and quality of infrastructure services have to private-sector productivity and growth.

Economic development depends on the advantages a location offers. Thus, firms seek areas offering greater opportunities for profit. In this context, infrastructure services can be thought of as factors of production for private firms paid for through taxes and user fees.

Recent empirical evidence has begun to document the relationship between infrastructure and private inputs in production. Such research includes estimates of production functions for

metropolitan areas showing that local public investment complements both private capital and labor (i.e. specific levels of infrastructure services in a metropolitan area are necessary to support given levels of private investments and employment).²⁵

While this relationship may change over time as a result of technological improvements, a balance must be maintained between public and private investments. To the extent that there is an imbalance between public and private capital investments within a region, productivity may be reduced as industry substitutes private capital and labor for nonexistent or inadequate public infrastructure services. In effect, firms compensate by using more private capital and labor to produce the same output. As mentioned earlier, Aschauer argues that the current imbalance between public and private investment nationwide already has reduced rates of return on private investment.²⁶

The ability of private firms to substitute private inputs (labor and capital) for inadequate or insufficient infrastructure services is easier in growing than in declining regions. As a result, inadequate infrastructure may exacerbate the downward spiral of depressed areas and eventually compromise the nation's overall economic and social well-being.²⁷

Unfortunately, there is no analysis or data which provides a precise link between actual dollar expenditures on infrastructure and the level and quality of infrastructure services resulting from such expenditures. For example, real per-capita investment in public works decreased from 1965 to 1984 in absolute terms and relative to GNP, but real per-capita spending on operating and maintaining public works increased over the same period at about the same rate as GNP. It is unclear how these two trends affected the overall level and quality of infrastructure

services.²⁸ The actual performance of each type of infrastructure was simply not measured systematically.

The lack of such measurements is a major impediment to extracting meaningful policy recommendations from less exact analytical work that relates aggregate dollar flows of infrastructure spending to national productivity as well as to gross state products, regional employment, and other measures of economic activity. Those macro studies can help make the general point that the nation needs to spend more on infrastructure, but they provide little guidance on how these expenditures should be allocated to obtain the highest level and quality of infrastructure services.

Another type of emerging empirical evidence suggests that infrastructure investments have network effects that contribute to the economic growth of regions and states.²⁹ For example, a 1987 study by Garcia-Mila and McGuire found that public expenditures on a state's highway network and education system help explain differences in the level of economic activity from state to state. Similarly, Munnell found that states investing more in total infrastructure tend to have greater output, more private investment, and more employment growth than other states. Thus, infrastructure services are important not only from the firm's and individual's perspectives, but also from regional and societal perspectives.

As a targeted regional development tool, however, public works investment has not been universally successful. The uneven success of such investments in stimulating regional growth reflects the fact that they cannot compensate for other economic limitations of a region. Even major new infrastructure investments will change economic development patterns little if facilities remain unused or underutilized.



The Changing Face of the Economy³⁰

A major factor influencing economic growth is the recent economic restructuring in the United States which can be described as four transformations taking place concurrently. They are: (1) changes in intra-firm production processes; (2) changes in the structure of the industrial sector (including both institutional structure and the types of products being produced); (3) shifts in the location of various economic activities; and (4) the increasing importance of the service sector in the economy. All of these transformations are driven to some extent by the revolution in information technology.³¹ Additionally, given the link between infrastructure and economic development discussed above, each of these trends affects the demand for infrastructure services.

These four transformations are described briefly in this section. This description focuses only on the aspects of each transformation that have ramifications for the demand for infrastructure services.³²

Changes in the Nature of Production Processes. Since the industrial revolution, the primary direction of change in production processes has been toward mass production. Underlying this trend was a stable demand for undifferentiated products. The epitome of standardized production processes was the large assembly line.

In recent years, increasing economic uncertainty and increased exporting of jobs to countries with lower wages has led to a need for smaller scale, more flexible production lines able to change products quickly in response to changing preferences of various market segments.³³ These new techniques require, in addition to multi-use machines, complex task programming, higher labor skills, the ability to receive

diverse inputs just in time, and close relationships with markets.

In a recent study of the changing economy and its implications for future infrastructure use, the U.S. Department of Commerce³⁴ observed that

The computer integrated flexible manufacturing system will break the hold that the search for economies of scale has had on manufacturing up to now. Big scale, single purpose, long production run plants will be a thing of the past.

The Commerce Department's report continues by arguing that because of these new computer-integrated flexible manufacturing systems, production will become much more of a local matter. Plants will be able to make a batch of differentiated products almost on demand. These manufacturing centers will be able to manufacture nearly an infinite variety of classes of products. The report also argues that major cities will tend to become ringed by companies operating computer-integrated flexible manufacturing systems. Such a transformation in economic geography will place greater emphasis on distribution networks within metropolitan areas relative to networks connecting different metropolitan regions.

Changes in Industrial Structure. The economic dislocations of the 1970s and early 1980s, characterized by large layoffs in basic industries,³⁵ can be viewed, in part, as the manifestation of a double transformation of the industrial sector. First, the institutional structure of the sector evolved from one dominated by domestic industrial firms to one with many multinational corporations. These corporations often control a large number of

spatially dispersed manufacturing and non-manufacturing operations for which international trade has become important.

Second, through economic restructuring, the composition of the industrial sector is changing. As a result of the development of information technologies, new industries are emerging at the same time that many basic industries in the United States continue to decline. In contrast to the basic industries on which the U.S. economy was based for the last century, the new industries are characterized by the knowledge-intensity of their products.

These new industries--best characterized by semi-conductor, biotechnology, and computer companies--often have bifurcated labor forces, including a large percentage of highly skilled engineers and researchers, as well as unskilled assembly workers.³⁶ Firm location decisions in these industries must be sensitive to the availability of housing for both segments of the labor force. Any mismatch between the location of housing and employment will add demand for transportation services, as has been experienced in Silicon Valley.³⁷

In many cases, the physical inputs and outputs of these sectors are small, yet highly valuable. As documented in the study by the U.S. Department of Commerce, the older declining sectors in the nation's economy tend to require large amounts of physical inputs and to produce large amounts of physical outputs. Alternatively, the expanding industries tend to be less material intensive. The report concludes that "there is evidence supporting the notion that future economic growth will require less in the way of transportation of heavy industrial raw materials per unit of output."³⁸

Changes in the Location of Economic Activities. As a result of the information revolution and advances in telecommunications and computer technologies, firms have been able to spatially separate different parts of their production processes.³⁹ Thus, management, research and development (R&D), and various phases of production can each be located at places best suited for them. Increasingly, this differentiation has international dimensions, and it applies to service industries as much as to others.⁴⁰ Specialized production services are located near management headquarters, while other services can be located elsewhere. The result of this intra-sectoral spatial differentiation of functions has been that places increasingly specialize in function, rather than by economic sector.⁴¹

Prior to restructuring, regions were differentiated by the dominant sector driving their growth. For example, Detroit was dominated by the automobile industry while Pittsburgh was the center of steel production. In each region, the most important source of jobs was the production within the dominant sector. Today, certain regions specialize and compete over production, while others specialize in management of R&D. Logan and Molotch,⁴² for example, identify five types of cities in the United States today, differentiated by their role in the nation's economy: headquarters cities, innovation centers, module production places, migration entreports, and retirement centers.

Most places lack any special qualities that would make them attractive for headquarters, R&D, or retirement centers. They compete, therefore, for routine production tasks. These are not limited to manufacturing, because government and private services, for example, have many routine information-processing functions requiring no special qualities.



Yet, as Saxenian⁴³ shows for the semiconductor industry, there is also a hierarchy of routine production tasks. Some require higher levels of skill than others, and have different impacts on their environments. Thus, better suited places may obtain more desirable production activities, while less endowed places may settle for functions not desired elsewhere (such as waste handling). Generally, the lower the production function in terms of skills, the greater the importance of cost in determining locational desirability. For this reason, many of the most routinized low-skill functions have been shifted to low-cost developing countries.

Alternatively, there are a number of geographic patterns for such activities as R&D.⁴⁴ Some of this activity is directly related to corporate decision-making, and tends to locate near other production services in the headquarters city. In other cases, it may be linked directly with plant operations. The "pure" type of R&D, at the top of the "product cycle," is often footloose. In such cases, agglomeration benefits with universities, public research institutions (military as well as civilian), and other private R&D units may be very important.⁴⁵

Many studies indicate that a major consideration in the location of R&D facilities is the availability of a highly skilled research-oriented labor force.⁴⁶ The location of R&D facilities, thus, would be a function of the locational preferences of such a labor force.⁴⁷ Although there is still much to be learned about these location preferences, several studies indicate that access to other researchers and research centers, as well as quality-of-life considerations play an important role in the preferences of this group. To make a region attractive for such manpower, the transportation system must allow access to other research institutions, primarily via air.⁴⁸

In addition, the transportation system has to allow good access to services in an environmentally sensitive manner.⁴⁹

Headquarters cities serve the functions of control over wide-spread operations and of centers for interaction between firms (both face-to-face and remote). They require good air transportation and telecommunication access for both control purposes and interactions among top executives.⁵⁰ Interestingly, employee access seems to be only a minor consideration in central management locational decisions, allowing highly congested cities to retain their national and world economic positions.⁵¹

In addition to the changes in national location patterns of economic activities, the intra-regional location patterns of various activities is shifting as a result of this restructuring. In particular, many activities not requiring extensive face-to-face contacts have shifted to the suburbs or ex-urban locations. Thus, much of the differentiation of functions in the national economy, described above, is reflected both within and across regions. While management functions remain in the CBD, along with associated services (such as financial and legal services), R&D and production functions, as well as routinized services (such as data processing) are more decentralized. Furthermore, some processes decentralize to the employee's home, generating the term "telecommuting."

The demand for infrastructure services will be affected by these shifts as different production activities require different types, levels, and qualities of transportation, utility, and environmental protection services. Also, as economic activities become less tied to central cities, traditional transportation networks that serve downtown areas become less adequate. For example, when activities decentralize in a



metropolitan area, commuting patterns change as more people travel in cars by themselves from suburb to suburb, congesting the region's transportation network.

The Rise of the Service Economy. Most of the new jobs created since 1970 have been in the service sector, particularly in services to producer companies.⁵² Reasons for the increase in producer services include the increasingly complex management of multi-locational, multi-national firms. An additional reason is that increasing importance of such functions as marketing, product development, and finance in the new environment of international competition.

The nature of the services provided, and the way they are provided, also have changed. Many routinized functions have been automated. This includes, for example, many routine bank transactions and most data processing. Services became much more specialized, focusing on the needs of specific market segments, much like the industrial sector. Changes in the nature of the service sector have important implications for the locational requirements of various service functions. These implications, however, are highly sensitive to the exact type, or combination, of services provided.⁵³

Although retailing and distributive services (e.g., transportation, communication, wholesaling, and utilities) have not grown as fast as the rest of the economy, tourism and retirement centers have become major components of the economic base of some localities. The location and infrastructure needs of such services are very different than those of producer or non-profit (e.g., education, health and government) services.

The U.S. Infrastructure Industry

Most public work design and construction in the United States, and the manufacture of construction equipment, is in the private sector. In addition, some of the management and maintenance of public works also is performed by private companies. Therefore, public works programs give rise to a major sector of the private economy. That sector has a considerable presence in the global marketplace also, although not as dominant a place as it once had.

Federal government research support and trade policies could be important to the U.S. construction equipment and public works engineering, management, and construction industries. A more efficient and productive U.S. infrastructure industry could not only be more internationally competitive but it also could help increase the productivity of U.S. infrastructure.

Conclusions About the Economy

The previous sections argued that (1) infrastructure services complement private capital investment and support economic growth; (2) a persistent imbalance between public and private capital investments could retard economic growth; (3) the forces of international competition and economic restructuring are changing the sectoral composition of regional economies and their demands for infrastructure services; and (4) the infrastructure sector of the private economy is significant to the nation.

Inter-metropolitan economic transactions, as well as transactions within the nation's economic regions, are important to the national economy. Linkages between regions are important for the export-oriented



growth of individual regions, as well as for overall national growth. Therefore, under the commerce clause of the U.S. Constitution, the federal government has an interest in facilitating such linkages and in guaranteeing an adequate level and quality of infrastructure services necessary to promote such inter-regional exchanges. These interests include the interstate highway system, other interstate transportation networks (e.g., harbors, water navigation, canals, inland waterways, and the national airways), telecommunications networks, environmental protection, and water resources.

Similarly, intra-metropolitan transactions are important to the aggregate level of activity in the nation's economy as a whole. However, in contrast to inter-regional activities, where the systemic or network effects of infrastructure facilities are the major concern, the internal infrastructure systems must focus on the unique economic structure of each region and the benefits of infrastructure services accruing to individual businesses and persons within the region. Thus, state, local, and regional organizations have the greatest interest in tailoring these systems to local conditions.

Infrastructure Decision-Making

The final element in understanding and improving the value of America's infrastructure is the decision-making process. The success of an infrastructure investment decision rests not only on the allocation of funds to projects consistent with national purposes, but also on mastering the regulatory environment within which the decision is made, and on getting the decision made in a timely fashion.

National Infrastructure Purposes and Needs

To a significant extent, the value of infrastructure is in the eye of the beholder. It takes vision and established national purpose to create value in major infrastructure systems. Neither benefit-cost analysis nor any other technical method of economic analysis will create much value unless guided by broader purposes--purposes such as those that guided the great American public works thrusts of the past, which were listed near the beginning of this paper.

Therefore, a federal interagency infrastructure strategy should rest on a clear articulation of the values of infrastructure to America. Potential initiatives that may elicit some national interest might include the following:

- Interconnect underground and surface supplies of water where feasible so they can be managed together.
- Update America's ports and waterways to meet the growing challenges of international competition.
- Speed goods to and from America's shores, and from coast-to-coast, to make sure that this nation remains one of the world's most efficient traders.

- Build high-speed rail links in certain high-density corridors to link major metropolitan areas most efficiently and to relieve overcrowded airspace.
- Expand America's airport and air-traffic control systems to help keep American the most mobile and easily accessible country in the world.
- Conquer urban congestion to reduce inefficiencies in metropolitan America.
- Perfect and apply the technologies needed for practical and cost-effective intelligent vehicle-highway systems, and build such systems to vastly increase the capacity and safety of existing roadways, thereby minimizing the environmental impact of the otherwise needed major new facilities.
- Enhance water purification technologies, including economical desalination, to relieve pressures on surface and groundwater resources in arid areas.
- Achieve a high degree of recycling for solid and hazardous wastes to make the American economy more efficient and to avoid environmental degradation.

Federal research resources, interstate commerce responsibilities, partnerships with industry and universities, and inter-governmental aid all could play important parts in achieving such initiatives. In particular, the coordinated use of federal laboratories could be important.

Interagency cooperation in achieving authorized national infrastructure goals will be necessary because of the close ties between development projects and environmental protection. One way of viewing this



link is to recognize that the environment suffers when public works are neglected. America has a strong commitment to environmental protection, but, according to the National Council on Public Works Improvement, we are neglecting our public works. Combining the strengths of our public works agencies with our environmental protection agencies might serve all of these agencies well.

The Regulatory Environment

Regulation is a ubiquitous companion of public works. It includes economic regulation (or deregulation), environmental regulations of many different types, safety regulations, and land-use regulations.

Many different decision-makers are involved in these regulatory matters. Often, they operate quite independently of the decision-makers responsible for making the investment decision. Economic regulation or deregulation can affect the economic viability of services provided by the project or system. Overlapping and, in some cases, incompatible environmental regulations have become so complex that they often add several years of debate, redesign, mitigation, and accommodation before any decision can be reached. Safety regulations may cause redesign of a project. Land-use regulations may thwart the siting of many public works projects. It is not uncommon for federal, state, and local governments all to get involved in the decision-making process before any final investment decision can be made.

Three problems in the regulatory arena appear to be of particular concern. One is that each of the regulatory decisions preceding the investment decision may be carried out serially rather than in parallel, thereby multiplying the amount of time needed to obtain the necessary clearances. The second problem is that regulations

frequently change during the long period of time required to traverse the whole regulatory process, making some reviews start over again. The third problem is that when federal agencies disagree about a project, there appears to be no forum, short of intervention by the Congress, to bring the parties together to mediate the dispute in a timely fashion so that the federal government can speak with a single voice.

Proposals for regulatory stability and "single permit" processes have been made, tried, or implemented to some extent in a few places, but generally they have not achieved notable success. The independence of each regulatory authority is jealously guarded in most cases. This independence is not only an intergovernmental issue, but also an issue of diverse and conflicting values being strongly held by the many different interests represented in the public policy arena. As greater experience is gained with the regulations affecting public works, new enactments can be expected to become fewer, and techniques for streamlining their administration may become better known.

During the past two decades, the federal government's traditional practice of working cooperatively with state and local governments, using financial and technical assistance to achieve common goals, has been giving way to greater use of federal preemptions and mandates.⁵⁴ The environmental protection field, in particular, illustrates this shift toward unfunded regulations, compounded by a complex set of interrelationships among concurrent regulations administered by several cooperating federal agencies. A current ACIR study is examining the complex of federal environmental protection regulations to see what might be done to simplify and coordinate it so that state and local public works projects can comply more easily.⁵⁵

The states also place unfunded mandates on local governments, along with substantial local revenue limitations.⁵⁶ In the public works field, the result of unfunded mandates placed on local governments by federal and state governments has been to pass increasing proportions of infrastructure costs along to developers.⁵⁷ The principal means have been impact fees, mandatory community associations,⁵⁸ and negotiated exactions.

Timely Decisions

The National Council on Public Works Improvement found that many public works investment decisions that formerly took a year or two to make, now typically may take as long as 10 or 15 years. Planning often is not done that far in advance, or if it is, the plans often cannot be held in effect that long. Therefore, by the time many public works decisions are made, they run the risk of being too-little-too-late, or even inappropriate.

Obviously, the longer it takes to make the decision, the more the project will cost. It is not uncommon for the costs of delay to make projects too expensive to pursue. The environmental decision-making process usually is the most lengthy, so anything that can be done to shorten it--as discussed above--could benefit public works programs.

Performance Measures

At several points in this paper, it has been noted that measures of the services provided by public works generally are not available. This situation cripples good decision-making. It makes it impossible to demonstrate quantitatively and convincingly how much the economic return to investment is, who benefits how much, what the costs are, how costs should be allocated among users and other beneficiaries, what the effects of price changes are on the use of services, whether and how much maintenance is being deferred, and how much the environment is being damaged or benefitted.

Each of these performance measures is needed by decision-makers to increase the value of infrastructure. Each of these measures also is needed by the public to hold the decision-makers accountable. One place to start might be with the current effort of the Government Accounting Standards Board to establish standards for public asset accounting and the measurement of services.⁵⁹ Another beginning point might be to improve and expand the FHWA and UMTA performance reporting systems, and to develop similar systems for other types of infrastructure.

With public funds as scarce as they are currently, an important key to having adequate infrastructure is to learn to invest smarter. Better performance measures are essential to this task.



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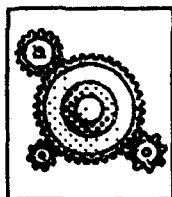
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Appendix E

Alternative Infrastructure Strategies and Implementation Techniques

APPENDIX E
ALTERNATIVE INFRASTRUCTURE STRATEGIES
AND IMPLEMENTATION TECHNIQUES

A Background Paper
on Issues for Consideration in
Developing a Federal Infrastructure Strategy

Submitted to the U.S. Corps of Engineers

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EXECUTIVE SUMMARY

This paper focuses on the following techniques for implementing alternative infrastructure strategies: funding mechanisms, allocating responsibilities, and management tools.

Understanding Funding Mechanisms

There are many ways governments can fund public works projects. Taxes, user fees, earmarked funds, intergovernmental aid, borrowing, and private sector financing are all frequently used. Even with all of these options, however, the dollars raised often are not enough to meet current or future infrastructure needs. In 1988, in response to these funding inadequacies, the National Council on Public Works Improvement (NCPWI) called for up to a doubling of the present rate of infrastructure investment by federal, state, and local governments, and the private sector.

The role of state and local governments as providers of public goods and services has grown dramatically over the last 10 to 15 years, while that of the federal government has decreased. Between 1981 and 1988, state and local revenue collections and direct expenditures increased at a rate nearly twice as great as that for the federal government. In addition, between 1978 and 1988, while federal aid to individuals remained constant as a share of federal outlays, all other federal subsidies fell to their lowest level since 1963. At the same time, there has been a shift of emphasis in federal infrastructure assistance from environmental to transportation programs, and from programs paid for by general revenues to programs supported by user charges and earmarked taxes.

State and local governments now are assuming greater responsibility for providing public infrastructure financing. But as they do, they must face state constitutional and statutory limitations on their ability to issue long-term debt. In addition, local governments can levy only those taxes that the state has authorized. The dominant local tax--the local property tax--varies in importance as a source of local revenue because of different state restrictions, but it still generates nearly three-fourths of overall local tax revenues.

Policy makers must balance the interdependent questions of amount, sources, and methods of infrastructure financing against current budget constraints. They are under pressure to seek more funds outside the general budget, and they often turn to infrastructure services that have identifiable beneficiaries. These services can be priced so that direct users, indirect beneficiaries, and producers of wastes pay the costs associated with their activities through earmarked taxes and fines, user fees, special districts, and debt financing. To increase these revenues, policy makers must demonstrate to voters and legislators clear and explicit benefit-cost relationships.

Allocating Responsibilities

In 1987, NCPWI found a complex mixture of federal, state, local, special district, and private roles in infrastructure. Intergovernmental and public-private partnerships, the Council determined, were common in the planning, financing, building, operating, and regulating of public works projects. Future changes in infrastructure responsibilities are likely, and



may be prompted by common concerns about research, federal trust funds, federal and state mandates, the scale of projects, potentials for regional approaches, and inter-provider tensions.

When evaluating public works programs and services, the key challenge is to clarify the intergovernmental and private sector roles, and match responsibility with authority and accountability. The process of delineating roles, while never easy, should be based on a well conceived sense of national purpose and an understanding of the proper balance among the levels of government. This task can be simplified by considering principles justifying federal involvement, criteria for relinquishing federal responsibility, and appropriate methods for implementing shared responsibilities.

The private sector's role in infrastructure financing can be either direct or in the form of public-private cooperation. The direct approach works well when infrastructure demands are growing rapidly and users who have the ability to pay can be identified.

Many localities have begun to require developers to finance off-site as well as on-site infrastructure. Direct private financing methods include impact fees, mitigation fees, developer exactions, system development charges, and the like. Even when the use of direct private financing is appropriate, however, it typically accounts for only approximately one-third of the infrastructure costs of new development.

Public-private partnerships have received increasing attention over the last decade. These partnerships range from contracted services to private ownership, operation, and maintenance of facilities; frequently the private options are supported by tax benefits.

These partnerships have a number of advantages and potential disadvantages that should be considered before municipalities enter into them. While public-private cooperation may help to relieve municipal budgets, too much privatization of infrastructure can disrupt public planning. As more private money flows into public works financing, once-public infrastructure decisions increasingly become influenced by the private sector. The result may be an increased tendency for public works decisions to follow rather than lead development, and for negotiations with particular developers to displace public planning.

Improving Management Tools

Federal public works programs typically have required regional, statewide, and local planning by recipients of federal aid. The concerted effort by many different federal agencies in the 1960s and 1970s to fund and require regional planning both in metropolitan and non-metropolitan areas, gave way in the 1980s to the disappearance of most federal requirements and funding for regional planning.

In addition to general plans, capital improvements programming and budgeting generally have been required. Capital improvement programs typically lay out a 5-year series of projects to be built sequentially in such a way as to accomplish systemwide, areawide, or statewide goals. Although capital improvements planning makes sense for federal-aid recipients, the idea of a national capital budget encompassing construction grants to state and local governments has never achieved consensus. There is not the same need for the federal government to operate under a balanced budget rule, coordinate funds from different sources, or strictly segregate operating and capital funds from one



another, as is the case for state and local governments.

Although federal, state, and local regulation of the design, planning, construction, and operation of public works projects is necessary, taken together, the process can be highly complex and time consuming for public works managers and policy makers. The regulatory process needs to be simplified, and the costs of mandates may need to be reimbursed in some cases. The Advisory Commission on Intergovernmental Relations has recommended that federal preemption of state and local powers be reserved for those cases where a clear national purpose is served, and that mandated costs be reimbursed to the extent that they are incurred by a local or state government while benefits accrue more widely.

NCPWI has suggested a number of ways to improve the performance and efficiency of the regulatory processes that link broad regional planning, construction-oriented capital improvement programming, and the regulation of land development. The recommended improvements would require more and better data, reported more frequently and more publicly. The widespread availability of personal computer increases the probability that such systems will be established and will lead to improved performance of the nation's infrastructure.

Developing a Federal Infrastructure Strategy

Historically, many mechanisms have been used for developing and coordinating

policies involving multiple federal agencies. A review of them suggests models for developing a federal interagency infrastructure strategy. Their current suitability and worth should be examined.

A sound next step in developing a federal infrastructure strategy will be to convene a national seminar on key infrastructure issues. This seminar will be designed to bring together various public works actors who can help set an agenda for developing a national public works strategy in the 1990s. The types of issues considered might include:

- Establishing national purposes for infrastructure;
- Identifying appropriate federal responsibilities and relationships;
- Forming federal interagency partnerships; and
- Enhancing federal, state, local, and private-sector infrastructure partnerships.

Focus groups will be used to prepare the topics and background materials distributed to participants prior to the seminar so participants can come prepared to negotiate a common approach. The results of the seminar are expected to be published and disseminated to a wide audience.

While such a national seminar is only the first step, it is expected to foster the sharing of ideas, establish networks, and build momentum for further progress in developing a national infrastructure strategy.



TABLE OF CONTENTS

<u>SUBJECT</u>	Page
Purpose and Scope of this Paper	E-1
Understanding Funding Mechanisms	E-2
Overview of Funding Sources	E-2
Current Trends and Constraints in Funding Infrastructure	E-3
Federal Grants-in-Aid	E-3
Tax-Exempt Debt	E-4
State and Local Financial Constraints	E-5
A Financing Strategy Tied to Benefits	E-5
Earmarked Revenues	E-7
User Fees and Special Assessments	E-9
Special Districts	E-12
Debt Financing	E-13
Summary	E-13
Allocating Responsibilities	E-15
Present Responsibilities for Infrastructure	E-15
Changing Responsibilities for Infrastructure	E-16
Criteria for Evaluating Public Works Roles	E-17
The Private Sector's Role in Infrastructure	E-18
Direct Private Provision of Infrastructure	E-18
Public-Private Partnerships	E-18
Improving Management Tools	E-21
Regional Planning	E-21
Capital Improvement Programming	E-21
Regulation	E-22
Performance Management	E-22
Developing a Federal Infrastructure Strategy	E-24
Experience with Federal Policy Processes	E-24
Next Steps	E-24



Purpose and Scope of this Paper

The U.S. Army Corps of Engineers has been funded to work in partnership with other federal agencies and with state and local governments to develop a federal infrastructure strategy involving the private sector. This is one of a series of papers examining issues for consideration in developing this strategy.

This paper focuses on techniques for implementing alternative infrastructure strategies. For purposes of this paper, "infrastructure" refers to the major public works systems that assist the nation and its communities to function effectively and efficiently as places where people live, do business, and strive for a better life. These public works--broadly speaking--include transportation, environmental, communications, and energy systems. These systems are further defined and discussed in another paper in this series entitled "The Value of Infrastructure to America." (See Appendix A of this report. The public and private sectors both play important roles in providing these essential infrastructure systems now, and will continue to do so in the future.

The subjects assigned to be covered within the overall topic of implementation fall generally within four groups:

- funding mechanisms (including identifying them and examining their problems and constraints);
- concepts of responsibility (including "user pays" and "beneficiary pays" components);
- allocating responsibilities (among federal, state, and local governments, and between the public and private sectors); and
- management tools (including federal funding policies, the use of capital budgeting, the funding of R&D and demonstration projects, and methods of balancing demands for services with costs).

In examining these subjects, it has seemed wise to expand three of them somewhat. The subject of funding mechanisms has been expanded to include consideration of the effects of present trends toward scarcity of funds for public works. Under concepts of responsibility, the principle that polluters should pay for clean-ups has been added. And, to the discussion of management tools has been added regulatory tools and consideration of the need for new approaches that link the exercise of spending and regulatory powers.

Finally, this paper concludes with some thoughts about how to develop a workable federal interagency infrastructure strategy.



Understanding Funding Mechanisms

Overview of Funding Sources

The federal, state, and local governments in America each have a range of independent revenue sources available to them.¹ In recent times, the federal government has relied most heavily on income taxes and wage taxes; most states have relied mainly on a combination of income and sales taxes; and local governments have relied largely on real estate taxes. Of course, each government has numerous other less productive taxes, including transaction taxes on such things as imports, airline tickets, motor vehicle registration, and recording of deeds, plus excise taxes on such products as alcoholic beverages, cigarettes, amusements, and gasoline.

Besides taxes, public revenues also are derived from a wide variety of user fees, lotteries, mineral royalties, leases, special assessments, fines, interest earnings, and other non-tax sources.

Both tax and non-tax revenues sometimes are earmarked for particular spending purposes. This is a quite common technique, in fact, in the public works field. Such earmarking can be accomplished in three basic ways: (1) by establishing a special district to collect and spend the funds on a well defined (usually single) purpose, (2) by establishing a special trust fund into which a general government deposits earmarked funds and from which it makes designated program expenditures, and (3) by legislative set-asides in revenue and appropriations acts that produce results similar to a trust fund. Examples are state and local water, sewer, soil conservation, and transit districts, and the federal trust funds for waterways, harbors, highways, and air transportation.

In addition to each government's own sources of revenue, federal aid is important to state and local governments, and state aid is important to local governments. In the public works field, federal aid has been particularly important for water pollution control, highways, mass transit, airports community development, and small watershed development. State aid has been important largely for highways, mass transit, and water pollution control.

There are several forms of inter-governmental aid for public works: categorical grants, block grants, revenue sharing, low-interest loans, loan guarantees, cooperative agreements with cost sharing, and tax exemptions for borrowing to finance public works. These are described, more fully later in this paper.

In addition to using current revenues and intergovernmental aid to meet public works needs, governments frequently borrow in the private bond markets. For state and local governments, capital improvement borrowing is the only kind of long-term debt they may create. Federal tax exemptions of the interest earned on state and local bonds help to hold interest rates down, and state assistance to small local governments frequently is helpful in allowing those localities to borrow at favorable rates.

The federal government can borrow without constitutional limit, but state and local governments, including special districts, must operate within balanced budgets each year. Full debt service on any long-term capital borrowing—including scheduled principal repayments and current interest—must be funded in state and local budgets under the terms of state constitutions in all but one state.

In addition to balanced budget requirements, state constitutions and laws

place various other limits on state and local authority to tax and borrow. Usually, these limits fall hardest on local governments. Nevertheless, many state and local governments meet political limitations on taxing and borrowing before they reach their legal limits.

In addition to using public funds to meet infrastructure needs, governments have options for turning to the private sector. These options include regulations that mandate private action, negotiated cost sharing, or simple non-performance in the public sector that induces private infrastructure spending out of self-interest. The 1980s produced many studies of such "creative" finance schemes.²

From this overview, it can be seen that there are many funding mechanisms to choose from when public works dollars are needed. The problem is that even with so many options, the dollars available too often fall short of meeting the need.³

Current Trends and Constraints in Funding Infrastructure

As a result of initiatives over the last 10 to 15 years to realign the American federal system, state and local governments have become more important providers of public goods and services. Between 1981 governments of their own funds increased 81 percent, while federal own-source spending for civilian services increased only 47 percent. At the same time, local revenue collections increased 86 percent, and state revenue collections increased 80 percent, while federal revenues rose just 41 percent. If these trends continue throughout the 1990s, state and local governments will be the majority partners in financing domestic programs before the year 2000.

This realignment of the federal system has reduced federal subsidies to state

and local governments. While federal grants-in-aid for payments to individuals remained a relatively constant share of federal outlays between 1978 and 1988, all other grants fell by more than half--from 11.7 percent of federal outlays in 1978 to 5.1 percent in 1988, their lowest level since 1963.

Similarly, Congress has modified tax-exempt bond law five times in the 1980s, with changes made by the Tax Reform Act of 1986 being the most significant. The Supreme Court opened the door for further limitations in state and local tax-exempt debt in its South Carolina v. Baker decision, which said, in essence, that state and local governments do not have a constitutional right to issue tax-exempt debt; it is a congressionally granted privilege.

More detailed evidence on the trends in federal subsidies to state and local governments for financing public infrastructure follows below.

Federal Grants-In-Aid. Most public works are local, but the federal government traditionally has funded a significant share of capital investment (construction funds) in all categories of public infrastructure except water supply and solid waste. In the aggregate, local governments pay for about two-thirds of operations and maintenance expenditures, but only about one-quarter of construction and new equipment costs. In mass transit, wastewater, water supply, and solid waste, local governments pay virtually all operations and maintenance expenditures and, except for mass transit, most of the capital investments as well.⁴

However, these traditional patterns are changing. The Consolidated Federal Funds Report (CFFR) for 1983 and 1986 reveal recent trends in federal aid to state and local governments for public



infrastructure. Of the more than 800 federal grant programs listed in the CFFR in 1986, 46 were identified as falling directly into the public infrastructure categories discussed here. Of these 46 programs, four--airports and airways, mass transit, highways, and wastewater--accounted for 98.3 percent of the \$21.1 billion of federal assistance to state and local governments for infrastructure in 1986.⁵ From 1983 to 1986, obligations increased by nearly 50 percent for airports and airways; nearly one-quarter for mass transit; and 16 percent for highways and bridges. Obligations for wastewater treatment assistance programs declined by 36 percent over this period.

In the aggregate, these trends indicate a general shift of emphasis in federal infrastructure assistance programs from environmental to transportation programs. They also indicate a shift from programs paid for by general revenues, to programs supported primarily by user charges or by earmarked tax revenues.⁶ This is consistent with research that suggests that programs funded by earmarked tax revenues, user charges and special districts, which link financing with services provided, generally gain voter acceptance easier than those funded by increases in general revenues.⁷ With the exception of the Urban Mass Transportation Administration's capital improvement grant program, these major programs distribute funds to recipient governments by formula or on a project basis subject to a formula distribution.

Tax-Exempt Debt. State and local governments, when raising capital for investing in public infrastructure, often issue debt whose interest income is exempt from federal income taxation. Concern about the growing volume of tax-exempt bonds, and the associated revenue loss, motivated Congress in 1986 to place a number of restrictions on the issuance of tax-exempt debt.⁸ Specifically, Congress systematically

narrowed the definition of public purposes qualifying for tax-exempt financing, established state caps for "private activity" tax-exempt debt, eliminated the ability of state and local governments to earn arbitrage, and established cost-of-issuance restrictions. The Supreme Court's South Carolina v. Baker decision gives Congress even more latitude in restricting the issuance of tax-exempt bonds.

In a speech in May of 1988, Representative Rostenkowski, Chairman of the House Ways and Means Committee, told the Council of Infrastructure Finance Agencies that "I don't think you'll see any frontal attack on the tax exempt interest paid on infrastructure bonds. But you may see a spirited debate about what infrastructure means."⁹ Thus, while Congress may continue to further restrict the issuance of state and local tax exempt debt, it appears there may be some support for infrastructure bonds which could become a favored category of tax exempt bonds.

In April 1989, Senator Domenici sought to allay that concern by introducing S.700, the Environmental Infrastructure Act of 1989. That bill would amend the tax code by creating an environmental infrastructure bond. According to the bill, 95 percent of the proceeds of such a state or local bond would have to be used to provide infrastructure facilities which are defined to include sewage, solid waste disposal, hazardous waste disposal, and water facilities as well as other facilities constructed, reconstructed, rehabilitated, or acquired for the purpose of complying with federal statutes and regulations administered by the Environmental Protection Agency. These bonds would be exempted from most of the bond restricted contained in the Tax Reform Act of 1986 (TRA86).

With large federal budget deficits expected to continue into the foreseeable

future, the most important tax-exempt bond policy issue may be where to draw the line between which activities should receive such preferential treatment and which activities should not.

State and Local Financial Constraints. As previously noted, the federal government, faced with continuing large budget deficits, is reducing its role in financing public infrastructure. As a result, state and local governments are playing a greater role in providing public infrastructure funding. However, there are a number of institutional constraints which may limit the ability of state and local governments to meet these new infrastructure financing responsibilities.¹⁰

The most relevant constitutional constraints are those that limit the ability of state and local governments to issue debt to pay for long-term capital investments. In 1986, 38 states had some form of constitutional limits on state borrowing. Of the twelve states that had no constitutional limits, six required some form of super majority (60, 67 or 75 percent votes by the legislature) to incur long-term debt. The remaining six states had no constitutional limitations on state borrowing and required a simple majority vote of the legislature. Those six states are Alaska, Connecticut, Maryland, New Hampshire, Tennessee, and Vermont.¹¹

In 1986, 42 states had some type of constitutional or statutory limits on local governments' ability to issue long-term general obligation debt.¹² Of the eight states that have no constitutional or statutory limitations, one (California) requires a two-thirds majority vote by local officials or the electorate to authorize issuance of debt. The remaining seven states have no limits and allow all jurisdictions to issue general obligation debt with a simple majority vote of the local officials or the electorate.

Those states are Alaska, Florida, Maine (counties only), Maryland (nonchartered counties and municipalities), Nebraska, Tennessee, and Virginia (counties only).

In addition, local governments can only levy those taxes that the state has explicitly authorized. While the 50 state and local fiscal structures exhibit significant diversity, property taxes dominate local tax systems nationally. Among all potential revenue sources, the property tax is the only one available to all general purpose local governments; it accounts for nearly three-quarters of local tax revenues.

This heavy local reliance on the property tax as a source of revenue, notwithstanding, a significant difference does exist among the states in the relative importance of the property tax as a source of local revenue because of different state tax and expenditure limits imposed on local governments. Only five states have no controls on local fiscal actions--Connecticut, Maine, New Hampshire, South Carolina, and Vermont. Of the remaining 45 states, 25 have enacted new property tax restrictions since 1978--the beginning of the tax revolt kicked off by passage of Proposition 13 in California.¹³ Most of the restrictions apply to all types of local governments, but several apply only to school districts. Most restrictions apply to local property taxes, but 11 states limit local general revenue or general expenditures. Of the 45 states with some sort of restrictions on local taxing and spending powers, 32 have two or more types of limitations.

A Financing Strategy Tied to Benefits

Since the federal, state, and local governments must live within annual budget constraints which recently have limited public works spending more than in the past, policy-makers at all levels of government are under great pressure to seek



more funds outside the general budget, and to consider how to get the most benefit from available revenues.

In private markets, the sale of goods and services finances their production. Consumer demand, including a willingness to pay, together with available technology, dictates the producer's scale of operation and production levels. In contrast, this link between the quantity demanded and the price paid breaks down for public goods that are not identified with individual beneficiaries who can be charged in relation to actual consumption.

Infrastructure services are, in a sense, a hybrid between a public and private good. While each segment or component of individual categories of infrastructure may have private good characteristics, the system or network, in the aggregate, has value to society generally. Thus, government at all levels has a stewardship responsibility toward the continued efficient operation of each system or network, e.g. the transportation or environmental protection network. However, like private goods, these individual public infrastructure facilities also provide important services to identifiable consumers. Thus, their use can be measured and priced, and those who do not pay can be excluded from the service. This provides governments with an opportunity to raise extra funds, particularly for most elements of transportation, water supply, wastewater treatment, and solid and hazardous waste facilities. In each of these cases, charging users directly for some portion of the cost of providing the service recaptures a fair share of the public costs. To the extent that such prices accurately reflect the true costs of providing infrastructure services, this allocation of charges can help avoid over supplying those services.

In order to promote economic efficiency and get the most benefit from a limited level of resources, public infrastructure should be financed by beneficiaries whenever possible. However, this principle has certain limitations. For example,

- User fees set below the level necessary to cover the cost of providing the service or facility may not provide the correct resource allocation signals.
- Isolating financing decisions too narrowly on some facilities ignores the amounts to be spent on complementary services.
- If there are beneficiaries who cannot afford to cover the full cost of the service, general fund subsidies may be necessary.
- If there is a new technology being applied to a particular service, the ultimate users may not be easily identifiable or may be unable to shoulder the entire risk associated with the new process.
- Beneficiaries are not always the same as users. For example, in mass transit, the beneficiaries may include not only the riders of the mass transit system but only the neighborhoods that have less pollution, the automobile drivers who face less congestion, and the firms that get additional business. Similarly, there is a benefit to the general community that has a safe supply of potable water which does not transmit communicable diseases.
- If pollution is produced and sent downstream or downwind, it is the polluter who should be responsible for the clean-up costs rather than those who would

"benefit" directly from the clean-up. This principle is illustrated by the "superfund" hazardous waste clean-up program.

Implementing the beneficiary finance principle--along with its corollaries--depends on techniques like earmarked taxes and fines, user fees, special districts, and debt financing. Each of these financing techniques links payments with benefits, but each also has certain advantages and limitations as briefly outlined below.

Earmarked Revenues.¹⁴ Earmarking dedicates revenues from certain sources for particular expenditures. This is in contrast to the practice of combining all revenues into a general fund which is then appropriated to specific activities or expenditure functions through an unrestrained budget and appropriations process. Thus, earmarking has two important characteristics: (1) the earmarking is done by the jurisdiction that imposes the tax, user fee, fine, or other designated revenue source, and (2) earmarked revenues can be spent only on specific activities, and they generally are not subject to competition with other expenditure demands in the annual budget process.

Some form of earmarking is used by federal, state, and local governments. For example, 27 states earmark all gas tax revenues for highway use, both to guarantee a reliable revenue source and to ensure that taxes paid are linked to transportation benefits. Similarly, 12 states permit local jurisdictions to levy a general sales tax dedicated for transportation purposes¹⁵ and 4 states earmark at least a portion of their lottery revenues for infrastructure purposes.¹⁶ In addition, some states earmark revenues from specific taxes for non-transportation infrastructure, e.g., Maryland levies a tax on boat sales which is

dedicated to the state's clean water program; Missouri dedicates 0.1 percent of the state sales tax to water programs; and Washington dedicates an 8 cent per-pack tax on cigarettes to finance its clean water program.¹⁷

Earmarking of specific tax revenues is also popular with the federal government. For example, taxes on certain chemicals and hazardous materials are earmarked to clean up hazardous waste dumps. In the transportation area,

- about 20 percent of public expenditures on the nation's highways are financed by earmarked federal funds derived primarily from taxes on motor vehicle fuels and on heavy vehicles;
- aviation users pay taxes which cover about one-fifth of total capital investment in airport improvements, 100 percent of federal spending on aviation facilities, equipment and research, and a small percentage of the federal costs of operating the air traffic control system; and
- marine users pay taxes dedicated to funding the improvement of most of the inland waterways and the maintenance of deepwater harbors including channel dredging.¹⁸

Proponents of earmarking claim that one of its major advantages is that it is often consistent with the benefits-received principle of taxation. According to this view, the goals of economic efficiency and fiscal equity can be satisfied when each taxpayer contributes to the cost of providing a specific service an amount equal to the benefits received from the service. However, when the link between the tax "price" paid and expenditure benefits



received cannot be demonstrated, the only real justification for such earmarking is political and fiscal expediency. For example, earmarking lottery revenues for infrastructure investments does not link the "price" paid with the benefits received, so there is no real efficiency or equity gain; it is merely politically and fiscally expedient.

Earmarking also can be a way to introduce new spending programs or taxes in spite of fiscal austerity. Voters and legislators often are more likely to approve a new tax if they can see a clear benefit from it.¹⁹ For example, the state of Iowa passed a feedstock tax on fertilizers. The revenues are earmarked for studying the impact of fertilizer use on the pollution of the state's groundwater supply and for developing ways to protect the long-term supply of drinking water in the state. Funding a similar program from general revenues may have been more difficult.

Finally, earmarking may be necessary to assure a minimum level of spending on a particular activity. However, the ultimate impact of such earmarking may vary between new and old programs, in part because legislatures that feel unduly restricted by such provisions can offset them by reallocating other program funds. The earmarked funds then simply replace general funds that would have been spent in any event.

Whether or not they actually increase spending, earmarking provisions can encourage improved program planning and management. A consistent and reliable revenue stream can help assure that funds are available when public infrastructure needs arise. Such stability can compensate for short terms of office for elected officials and the prevalence of short-term budgeting at all levels of government.²⁰

However, earmarking also has disadvantages. For example, one criticism of earmarking is that it hampers effective budget control. The concern is that earmarking interferes with the ability of elected officials to shift budget priorities as conditions and voter preferences change.²¹ In Montana, for example, earmarking provisions are so pervasive that they create serious fiscal management problems for the state.²² Some of the fiscal rigidity imposed by extensive earmarking can be mitigated by regulations that require earmarking provisions to lapse after a certain length of time unless explicitly extended or renewed by legislation. Nevertheless, attempts to roll back earmarking can be frustrated by the efforts of special interest groups and the legislative committees that oversee such programs.

A related concern is that earmarked revenues may not be subjected to the same intensity of annual budgetary review as other revenue and expenditure decisions. This may reduce effective political accountability for aligning voter preferences with program expenditures if politicians feel that they no longer have responsibility to appropriate additional general funds to support the program or to make sure that each earmarked dollar is spent as productively as possible. Some fear that when the current spending level for an activity is more than the amount of revenues earmarked for that program, earmarking could result in revenue reductions rather than increases.²³

In summary, earmarking can promote reliable long-term funding for public infrastructure that encourages better planning and management, and that provides revenues more nearly matched to service demands. However, earmarking must be used carefully. When earmarking limits budgetary decisions too stringently, it can

bind elected officials to outdated priorities. When earmarking does not limit budgetary decisions, it may be relatively ineffective, substituting dedicated funds for other funds that may have been spent in any event.

User Fees and Special Assessments.²⁴ User fees, or charges, are voluntary payments by households, firms or other consumers made to a governmental body or other public works provider based on direct, measurable consumption of publicly provided goods or services. Since such fees or charges are usually levied per unit of good or service consumed, the total cost to users varies with the quantity consumed. In 1988, such fees and charges accounted for 22.2 percent of total local own-source revenues nationally.²⁵

In contrast to user fees, general taxes are compulsory payments not tied to the consumption of specific public goods or services. There is no direct link between the benefits individuals receive from public goods and services and their actual tax payments.²⁶

A third revenue source that falls between user fees, on one extreme, and general taxes, on the other, are special assessments. Special assessments involve compulsory payments, but those payments are related to estimated benefits from public expenditures. For example, special assessments might include payments for specific neighborhood improvements such as sidewalks, street paving, and lighting which provides benefits to identifiable properties proportionate to the number of feet of street frontage.²⁷ These assessments often are called front foot benefit charges.

User fees may be technically feasible if the beneficiaries are identifiable and it is possible to exclude non-payers from receiving the benefits of the program, but they may not be economically feasible to

collect.²⁸ Economic feasibility is determined by comparing the cost of administering the user fee system to the efficiency and equity gains expected from collecting user fees instead of general taxes.

The strongest case for user fees or charges occurs when efficiency gains from charging users directly for services received are high. Functioning as "prices" in the private market, such fees result in efficiency gains by improving the allocation of scarce resources between competing public and private purposes. However, the way a user fee is set affects decisions about the use and expansion of current physical capacity. A user fee set too low to cover the costs of the service, or with too little differentiation among different users and classes of users, may not encourage efficient use or provision of infrastructure.

Generally, user fees are set equal to the average cost of providing a service by taking the facility's budget, subtracting expected subsidies, and dividing by units of output or by users. Two alternative methods of setting prices to encourage efficient use and expansion decisions are (1) pricing based on the marginal cost of providing an additional unit of service, and (2) pricing based on the cost of providing the service during peak periods.

For several infrastructure categories, expanded user fees could help manage facilities' use and make certain facilities self-supporting. For example:

- Airport user fees could help manage traffic and expand the capacity of existing facilities like New York's Kennedy and LaGuardia airports which increased landing fees for small aircraft from \$5 to \$25 during peak periods. This increase reduced general aviation air



traffic by 30 percent and decreased the number of delays in takeoffs and landings by 50 percent.²⁹

- Cost sharing agreements implemented by the U.S. Army Corps of Engineers resulted in a fundamental reconsideration of design criteria with non-Federal sponsors supporting cost-reducing design modifications or staged construction.³⁰
- Taxes on the manufacturing and use of certain difficult-to-dispose-of items would result in a price that reflects the true social cost associated with their disposal, and the funds can be used to treat the wastes so they do not pollute the environment.

In addition, developer fees and negotiated exactions constitute an application of the user fee approach to financing the public costs associated with real estate development.³¹ These impact fees, mitigation fees, and developer exactions imposed on new developments have become a popular growth management tool over the past decade and are used to fund not only on-site infrastructure, but off-site infrastructure expansion and construction. Typically, such fees and charges are set at fixed rates by the jurisdiction and are applied equally to all rates by the jurisdiction and are applied equally to all developments. Thus, all developers are treated equally. However, the jurisdiction forgoes the opportunity to negotiate directly with each developer and is unable to tailor specific charges to the unique circumstances of individual developments. As a result, the cost of providing infrastructure services to a specific development generally are not fully covered by the fees paid by that development. In some cases, however, the fees may be too high for some

developments, causing the development to change its nature, or be postponed.

Such impact fees are different than charges paid through tax increment financing or other special assessment districts. For example, impact fees may apply to development anywhere in the jurisdiction, not just in a specified geographic area. Also, impact fees do not require the preapproval of the property owners as do fees in special assessment districts.³²

In contrast to impact fees, negotiated developer exactions are defined as land, construction, cash, materials or facilities provided by the developer to a public jurisdiction by agreement, in exchange for development privileges. Such exactions traditionally include land dedications for rights of way, parks, etc.; donations of specific facilities; and construction of off-site infrastructure such as intersections and roads adjacent to developments, low-income housing, and the like. At times, a fee may be negotiated in lieu of in-kind dedications and contributions.³³

Exactions are most often used in areas experiencing rapid economic development. Such exactions are typically negotiated with developers individually. Thus, they may more accurately reflect the cost of a development to the jurisdiction, but they are considered inequitable because different developers pay different relative amounts for infrastructure. Local jurisdictions usually enforce exactions through their zoning powers, and their authority to issue building permits. Developers typically prefer impact fees to negotiated exactions because the amounts are known in advance and they apply equally to all.³⁴

In the 1960s, home rule communities in California became the first jurisdictions to assess impact taxes. Now, such fees are

emerging as the dominant form of development finance mechanism in California because the courts have continued to protect the flexibility of this revenue source.³⁵ On the other hand, voter initiatives and legislative actions have reduced the flexibility associated with impact taxes (constrained by Proposition 62 in 1986) and mitigation fees. It has been estimated that such impact charges on new single family dwellings in California average from \$3,527 up to nearly \$9,500.³⁶

In Florida, because of taxpayer resistance to increasing property taxes, local communities have applied a variety of development fees, since before 1975, in an effort to shift costs of new facilities from current residents to developers. Florida courts have established a "dual rational nexus" test which requires the amount of the impact fee to be related to the new facilities needed because of the development, and the fees collected to be used to finance such facilities. This is a narrower concept of impact fees than in California where the state Supreme Court held that this direct linkage is not required so long as the fee is necessary to maintain the general welfare.³⁷

Such techniques, however, are not a panacea for localities struggling to pay for public works. They are most successful in areas that are growing rapidly and, even in those areas, typically account for no more than one-third of the infrastructure costs for new development.³⁸

The increased use of development fees and exactions results from four factors:

- residents in many communities are unwilling to continue to subsidize new development;
- the realization that the costs attributable to private development are higher than previously thought;

- the recognition that economic efficiency considerations argue for private developers internalizing the public costs of private development; and
- the reluctance of voters to allow revenues to be raised through traditional general revenue sources like the property tax.³⁹

In addition to efficiency concerns, such user charges and fees also may enhance fiscal equity. Proponents of such charges argue that they represent a "fair" method of financing public goods and services since individuals pay for benefits received. In this context, user fees are "fair" on grounds of horizontal equity, i.e. people in similar situations, including their consumption of publicly provided goods and services, are treated equally.⁴⁰ This is consistent with the benefits received principle of taxation.

Alternatively, financing public infrastructure through user fees designed to recover full costs also has potential disadvantages and undesirable outcomes. The most frequent argument against such fees and charges is that they impose an unfair burden on low-income families and individuals. Specifically, the poor and those living in hard-to-serve areas might find public infrastructure services unaffordable if the services are priced at full cost. Thus, user fees may be inconsistent with the ability-to-pay principle of taxation. In fact, one analyst foresees a user fee backlash in the 1990s because of this concern over equity.⁴¹

There are two fundamental qualifications to this concern, however. First, society has an interest in making sure that water and sanitation facilities are universally available, even if a particular facility cannot be supported solely by its users, because a clean safe supply of water does not transmit communicable diseases. In other words,



both the consumer and the general public, benefit, and both should pay. This is an argument for selective general-fund subsidies and/or alternative institutional arrangements for providing necessary personal benefits at affordable rates.

Second, if user fees require direct beneficiaries to pay the full cost of those services, even though some benefits accrue to the general public, these fees may put an unfair burden on users, and may be especially burdensome to low income families. This concern about the potentially regressive nature of user fees may be ameliorated, however. For example, in Bloomington Indiana, city-wide programs like tennis or swimming lessons and summer day camp carry fees, while programs available in community centers in low-income neighborhoods are free.⁴²

In this context, Due and Friedlander provide useful guidelines for determining when it is appropriate, or inappropriate, to rely on user charges or fees to finance public goods and services. Specifically, using a pricing mechanism where possible, instead of free distribution funded by general taxation, is considered desirable when:

- benefits are primarily direct, so that charges will not cause significant loss of external benefits.
- demand has some elasticity, so that the use of prices aids resource allocation and eliminates excess supplies.
- charges do not result in inequities to lower-income groups, on the basis of accepted standards.
- costs of collecting charges or fees are relatively low, or alternate taxes levied in proportion to use can be employed.

Use of such fees and charges are less appropriate when:

- external benefits are significant and will be lost in part if charges are made.
- demand is perfectly inelastic, so that resource allocation is insensitive to the pricing system.
- equity standards require that the lower income groups be assured of obtaining the services without undue hardship.
- collection costs are relatively high and alternative tax measures related to usage cannot be devised.⁴³

In summary, user fees can be a valuable tool in linking benefits received with prices paid, thereby enhancing the provision of public infrastructure services. Like earmarked revenues, however, user fees must be designed with care to reflect true social costs of consumption; otherwise efficiency gains may not be realized. Finally, while user fees have the potential to improve the efficiency of public works, their use may change who uses them and how much they are used. Policy-makers at all levels of government should be aware of these potential impacts and consider measures such as the life-line rates currently used by telephone, gas, and electric utilities to ameliorate any unintended consequences.

Special Districts.⁴⁴ "Special districts" are limited-purpose governmental units with the power to levy taxes, user charges, and other fees. "Public authorities" perform similar functions but are not considered units of government for the purposes of debt liability or state constitutional restrictions because they do not have taxing powers. Both institutional mechanisms offer a way to shift infrastructure financing from all taxpayers to those directly served.



Special districts and authorities are the nation's most rapidly growing form of government. In 1987, there were 29,487 such districts in operation--accounting for one-third of all local governments nationally. This represents an increase of 61 percent since 1962. Over 36 percent of these special districts provide public works, and they accounted for about 15 percent of all public works spending in 1987.

Special districts and authorities providing infrastructure services can offer ways to transcend the fiscal, bureaucratic, and geographic limitations of general-purpose governments. Since their revenue streams are segregated from competing priorities, and their geographic boundaries can be drawn specifically to encompass only the intended beneficiaries, districts theoretically can make better scale, pricing and maintenance decisions.

In practice, however, the fact that most districts are not self-supporting means that they may not be insulated from the funding problems of general-purpose governments. Inadequate techniques for setting prices, and political limitations on the scale of their operations, also limit the advantages of districts and authorities. Furthermore, inadequate accountability and coordination with general-purpose governments can limit the effectiveness of special districts. Where these districts are used, care should be taken to assure that they are accountable to voters or to the general-purpose governments that create the districts.

Special districts have the clearest financial advantage in providing public works if the service can be self-supporting or can generate a profit, or if fiscal limitations prevent general-purpose governments from assuming these responsibilities.

Debt Financing. Traditional general obligation bonds and project-specific revenue bonds are the two primary debt financing mechanisms that local governments have at their disposal. These funding mechanisms are repaid over a number of years either by general tax revenues, or by specific revenue sources generated by the project being financed by the debt.

Such debt instruments are appropriate for infrastructure financing because infrastructure projects generally have fixed costs and long economic lives. Bonds, with repayment schedules that match the life expectancy of the capital facility being financed with the bonds, will increase efficiency by linking beneficiaries with those who pay for the infrastructure investments.⁴⁵

Summary. Infrastructure finance debates revolve around three basic questions:

- How much should we spend?
- Who should pay?
- How should spending be financed?

The answers to these questions are interdependent. How much to spend depends on who will pay and how the charges will be collected. The financing mechanism chosen, in turn, will determine whether the revenues are adequate and reliable.

In order to meet future needs within given budget constraints, public infrastructure services should be priced so that direct users, indirect beneficiaries, and producers of wastes pay the costs associated with their activities. If prices reflect true social costs, the public's use of a facility and its willingness to pay for services will



indicate the appropriate scale and distribution of public works.

The various financing techniques discussed above can improve public infrastructure management. Public works lend themselves particularly well to dedicated financing techniques because of their longlives, need for continued maintenance,

and the unevenness of their replacement and rehabilitation expenditures.

In addition, a clear benefit-cost connection often promotes easier acceptance of new spending programs by voters and legislatures. Making such a connection explicit will become particularly important for financing new needs such as hazardous and solid waste disposal.

Allocating Responsibilities

This is an extraordinary time of change in the American federal system. The 1960s and 1970s saw the ascendance of federal aid programs, to the great benefit of public works. The 1970s and 1980s saw the ascendance of regulatory federalism, with many new federal preemptions and mandates making public works more necessary, more expensive, and more time consuming to provide. The 1980s saw a significant downturn in federal aid programs for public works. The rapidly rising federal deficit, and the heavy shift of federal expenditures toward the social safety net, defense, and interest on the national debt in the 1980s, have substantially muted federal leadership in public works and many other domestic programs.

As federal aid for public works have declined through the 1980s, state and local governments, and the private sector, have picked up more of the responsibility for public works. This shift has been hastened by the rapid acceleration of federal preemptions and mandates--especially in the environmental protection field.

Present Responsibilities for Infrastructure⁴⁶

When the National Council on Public Works Improvement studied existing responsibilities for the nation's infrastructure in 1987, it found a striking mixture of governmental and private roles. These roles vary not only by the type of infrastructure, but also by the types of responsibilities undertaken. The Council listed the principal public works tasks as:

- Establishing general program goals, policies, and strategic plans.
- Regulating facilities and services.

- Planning, building, owning, operating, and maintaining specific facilities (projects).
- Financing capital improvements, operations, and maintenance.
- Researching and demonstrating new technologies and techniques.
- Providing technical assistance and promoting innovation.

All of these tasks are necessary, but they do not all need to be done by the same government or private company. In fact, intergovernmental and public-private partnerships are common in providing public works.

For example, looking only at governmental outlays for seven major types of public works, NCPWI found a "heavy concentration of federal financing in the capital sector, the general dominance of local financing for operations and maintenance, and the relatively small state financing role...[except]...in highways and in some aspects of water projects." In general the NCPWI report went on to summarize lead roles in 1987 roughly as follows:

- Federal: planning, setting standards for, and providing capital financing for the Federal Aid Highway System; operating and maintaining airways, harbors, major dams, irrigation, and regional flood control projects; cleaning up hazardous waste sites; providing capital financing for mass transit, wastewater treatment, and many small airports; setting standards for drinking water, wastewater treatment, and hazardous waste management.
- State: building, operating, and maintaining federal-aid highways; pursuing non-federal dam safety programs; financing mass transit (and even operating it in a few states); and



regulating environmental matters in accordance with federal standards.

- **Local:** providing local roads; operating and maintaining mass transit, public airports, landside facilities at water ports, water supply, urban stormwater facilities, and solid waste facilities.
- **Special District (operating in all states except Arkansas and Hawaii):** control about 70% of all state and local spending for mass transit, about 60% for water transport, over 20% for airports and water supply, nearly 20% for sewerage and natural resources, 11% for sanitation other than sewerage, and about 2% for highways. Of course, the significance of special districts varies greatly among the states.
- **Private Sector:** finances, owns, and operates three-fourths of the nation's airports, most non-federal hazardous waste facilities, many waste-to-energy facilities, many solid waste landfills, much of the waste hauling and recycling industries, and many landside facilities at water ports; contracts to design, build, and maintain many roads, streets, highways, bridges, airports, transit, water supply, sewage, and other facilities; finances and builds community facilities within many new developments.

Changing Responsibilities for Infrastructure

These established roles provide powerful precedents for continued responsibilities in the future. However, changes in these patterns do occur over time. Some of the changes occurring during the 1980s were:

- Cost sharing was modified for the construction of federal water resource projects.

- Trust funds were used to support federal programs for mass transit, inland waterways, and harbor maintenance programs (highway and airport trust funds had been established earlier).
- Federal drinking water standards were established and strengthened.
- Federal grants for wastewater treatment facilities were phased out.
- The states established revolving loan funds, with federal assistance, to help local governments finance wastewater treatment facilities.
- Most federal aid for substate and multistate regional planning and coordination was discontinued.
- A significant number of local governments, with state encouragement or acquiescence, have allowed and encouraged developers to establish residential community associations (RCAs) that take over the ownership, operation, and maintenance of community facilities that typically would have been dedicated to the public in earlier years. Such facilities may include such items of infrastructure as local streets, open spaces, recreational facilities, waste disposal, and water supply.
- Some states have invited private developers and businesses to help provide the non-federal match for federal highway funding.

Such changes, undoubtedly, will continue to take place in the 1990s. NCPWI's thorough analysis of nine major types of public works produced the following list of common concerns about present governmental roles and intergovernmental arrangements:⁴⁷

- The need for national leadership in research, development, demonstration, and innovation-transfer programs.

- The reliability of federal trust funds.
- The effects of federal and state mandates.
- Concern for the needs of smaller public works systems.
- The potential of regional approaches to address public works issues.
- Tensions among the various providers of public works at the state and local levels.

Criteria for Evaluating Public Works Roles⁴⁸

The governmental role changes proposed in studies prepared for NCPWI were evolutionary rather than revolutionary. Even if they all were to be adopted, the nine categories of public works studies would remain intergovernmental. Some, such as water resources and waste disposal, are becoming more rather than less intergovernmental. Also, private sector involvement remains significant in several categories, and prospects are for it to become more rather than less important.

The challenge in sorting through these mixed responsibilities is to clarify the roles. If the roles are clear, authority and accountability can match responsibility. It is unlikely that clarifications of roles will leave any major public works functions exclusively within a single level of government. Thus, intergovernmental relationships will continue to need attention.

Clarifying roles, however, is not an easy task. The criteria offered to guide this process should be applied along with political judgment. As Woodrow Wilson wrote, each generation must seek its own definition of national purpose and proper balance among the levels of government.⁴⁹ Nevertheless, a number of guidelines have been put forward by various groups, and summarized by NCPWI as follows:

Principles Justifying Federal Involvement:

- Enumerated constitutional powers must be exercised.
- Fiscal magnitude requires federal role.
- Multistate dimension cannot be addressed otherwise.
- Uniform activity is needed nationwide.
- Negative spillovers among states must be prevented or redressed.
- Efficiency or effectiveness of programs can be significantly improved by a federal role.
- Redistribution of resources across the nation is needed for geographic or demographic equity and program effectiveness (this includes emergency responses).

Criteria for Relinquishing Federal Responsibility:

- Federal purpose is unclear.
- Federal program is too small.
- Federal role is minor relative to state and local roles.
- Nonfederal financing is feasible, assured, and adequate (perhaps including general federal support grants to states with low fiscal capacities backed up by state responsibilities for easing interlocal disparities).
- Devolution mechanisms (including transition measures) are feasible, equitable and simple.

Appropriate Methods of Implementing Shared Responsibilities:

- If the purpose of the program is to stimulate new and greater activity, emphasizing federal leadership, use:
 - categorical grants,
 - cooperative agreements,
 - direct federal loans,



- loan guarantees, or
- tax policy.
- If the purpose is simply to help support common purposes (emphasizing state or local leadership), use:
 - block grants or
 - general revenue sharing
- If the purpose is to require certain activities (emphasizing federal leadership), use:
 - direct regulation or
 - conditional grants or loans (categorical grants are best); makes "voluntary" regulations attached to financial assistance irresistible.⁵⁰

These guidelines provide a starting point for reevaluating the proper infrastructure roles of federal, state, and local governments, as well as the private sector.

The Private Sector's Role in Infrastructure

As traditional sources of financing infrastructure have come under increasing pressure in recent years from declining federal aid, state and local tax revolts, and the federal Tax Reform Act of 1986, state and local governments have explored new means of meeting infrastructure needs. This section discusses ways in which the private sector helps to fill this gap.

There are basically two ways that the private sector helps to provide urban infrastructure. First, it can pay directly for additional infrastructure capacity required by new development, rather than relying on governments to provide it. Second, the private sector can be actively involved in providing infrastructure services through some form of public-private cooperation.

Direct Private Provision of Infrastructure. The "private good" characteristics of infrastructure, allowing users to be identified and required to pay a fee or be excluded from consuming the service, provides one way to support private provision of infrastructure. In increasing numbers of cases, private developers are footing virtually the whole bill for public infrastructure, and may not even turn it over to the public for maintenance and operation. Instead, rapidly growing numbers of residential community associations are retaining responsibility for their own roads, open spaces, recreational facilities, waste collection and disposal, and security.⁵¹ The developer provides all these facilities and turns them over to the residents as they buy the developed property and become members of the community association.

Public-Private Partnerships. In addition to the direct provision of infrastructure by the private sector, infrastructure can be provided by public-private cooperation. In the United States this option, often referred to as "privatization," has received increasing attention over the last decade.

The term "privatization" has come to mean many things to many different people. The Office of Management and Budget defined privatization to be "a strategy to shift the production of goods and services from the government to the private sector in order to reduce government expenditures and to take advantage of the efficiencies that normally result when services are provided through the competitive market place."⁵² Although this definition may seem to suggest full private control, operation and ownership of a public facility or service, interactions between the public and private sectors involve a range of relationships including:⁵³

- contract services where the private sector is contracted to provide a specified municipal service such as solid waste collection and/or disposal, or to maintain and operate a publicly owned facility such as a municipal landfill.
- turnkey facilities where the private sector designs, constructs, and operates a facility that is owned by the public sector. The public sector generally assumes the financing risk and the risk for guaranteeing minimum levels of service.
- developer financing where the private sector (usually private developers) finances the construction or expansion of a facility in return for the right to build houses, stores or other commercial and industrial facilities.
- privatization of services where the private sector owns, builds and operates a facility with the expectation of making a profit. They also partially or totally finance the facility.
- merchant facilities where the private sector not only owns and operates the facility, as in privatization, but also makes the decision to provide the particular service to the community.

Which option a jurisdiction selects for a particular infrastructure project depends on the costs and benefits associated with each option and the legal alternatives available to the governmental jurisdiction. Before the privatization options can be evaluated, one needs to analyze the constitutional and statutory authority of the jurisdiction to enter into long-term service contracts, to sell or lease existing facilities, to purchase facilities from a private vendor, to require competitive bidding, and to take other such actions.⁵⁴ For example, only 28 states permit private solid waste collection and disposal, and only 24 states permit private sewer and water facilities.⁵⁵

After the constitutional and statutory authority for involving the private sector in providing infrastructure services is determined, the costs and benefits of each alternative must be evaluated. In general, public-private cooperation offers municipalities the following benefits:⁵⁶

- reduced costs of a public works project to the municipality due to equity contributions and sharing tax benefits;
- transfer of the majority of the design, construction, permit, and performance risk to the private party;
- shorter time for development, design, construction, and start-up of a facility;
- reduced costs for interest during construction;
- improved performance of certain types of facilities because of private expertise;
- reduction in the use of the local municipality's general obligation debt;
- potential for sharing in certain revenue streams generated by the facility (energy generation, sale of compost, etc.);
- allocation of a portion of the financial responsibility for a project to those parties that might benefit most from its implementation (particularly applicable in developing communities);
- more creative financing structures as compared to traditional municipal financing structures; and
- access to more sophisticated technologies.

Weighed against these potential benefits from private involvement in providing infrastructure services are certain potential disadvantages cited by municipalities including:

- loss of control of the facility;



- complicated legal proceedings to structure and finance the public-private partnership;
- retention of a portion of the risk of the facility;
- reduction in the municipal work force;
- on-going need for monitoring of the quality of the services provided;
- difficulty in determining the net cost of an equitable basis; and
- in some cases, a requirement to buy the facility back at the end of the service contract.

Private firms participate in such cooperative projects in order to make profits. Firms can profit from such projects if they have a guaranteed income stream from a long-term government contract to operate the facility; if they can reduce their tax liability through accelerated depreciation, investment tax credits, or other tax advantages provided by the federal, state, or local governments; or if they reduce their costs by receiving some form of capital subsidy from the jurisdiction through tax-exempt bond financing and the like. However, federal tax benefits for private firms engaged in such enterprises, which were available in the early 1980s, were substantially curtailed in 1986.

As local governments have pressed greater responsibility for public works into the private sector, private developers have gained a great deal more say about where and when they pursue their projects, since they pay more of the bill for public facilities. On top of the growing trend for local governments to negotiate contributions from developers to build public facilities completely beyond the borders of the developer's own property, negotiations over the form and nature of developments governed by mandatory community associations result in give-and-take with the private sector that potentially will revise public master plans in significant ways.

The trend toward privatization means that private money and private decisions are becoming increasingly influential in determining the shape of America's metropolitan areas.⁵⁷ Consequentially, public works decisions, increasingly, follow rather than lead development. In this situation, public visions of future development patterns give way to coping mechanisms. Development, therefore, increasingly is being negotiated rather than planned. Public planners are becoming deal-makers. Too much privatization, therefore, may have its drawbacks.

Improving Management Tools

Federal public works programs typically have required statewide, regional, and local planning by recipients of federal aid. In the past, a considerable amount of federally financed research has gone into developing improved planning and management techniques to be used at each of these levels, and federal aid conditions have brought them into general use in state and local governments as well as regional bodies. Examples include computer analysis and simulation models, program budgeting, agency management, citizen participation, and interagency as well as intergovernmental coordination.

Regional Planning

In the 1960s and 1970s, there was a concerted effort by many different federal agencies to fund and require regional planning both in metropolitan and non-metropolitan areas. Many federal programs designated the same regional planning body in a single area to perform the required planning and coordination functions. By this means, the various federal agencies reinforced the capacity of the regional organizations to perform their functions for each program, and to coordinate the activities of the various programs with one another. During the 1980s, however, most of the federal requirements for regional planning, and most of the federal assistance for regional planning disappeared. The only program of this type still required and still well funded is the comprehensive, cooperative, and coordinated (3C) metropolitan planning for surface transportation sponsored by the U.S. Department of Transportation under joint regulations issued by the Federal Highway Administration and the Urban Mass Transportation Administration. Obviously, transportation cannot be planned by itself. Therefore, the resources of this one

remaining program are stretched very thin. If additional public works and environmental protection programs became available to support regional planning and coordination, it would be desirable to designate the same organization already undertaking the responsibilities for DOT.

Capital Improvement Programming

To follow up on general plans produced in response to these federal aid requirements, capital improvement programming (CIP) and budgeting generally have also been required. Any agency responsible for designing, constructing, or funding specific projects to implement public works systems should use a CIP process of some sort. Typically, the capital improvements program lays out a 5-year series of projects to be built sequentially in such a way as to accomplish systemwide, areawide or statewide goals.

The issue of capital improvement programming for the federal government has been debated for many years. It obviously makes sense for construction agencies such as the General Services Administration, the Department of Defense, the Corps of Engineers, the Bureau of Reclamation, and the Postal Service, all of which are construction agencies. However, the idea of a national capital budget encompassing construction grants to state and local governments has never achieved consensus. Although these funds, undeniably, support long-term capital facilities construction, they frequently are not project specific in the national budget. In addition, the federal government does not have the same need as state and local governments to segregate capital funds from operating funds, because it does not operate under a balanced budget rule. In fact, it may deliberately adopt budgets that are out of balance to achieve desired economic results.



Regional capital budgets have the advantage of aggregating local capital programs, and adding in federal and state projects to be built in the same geographic region. The purpose is to help coordinate funds from many different sources.

The capital budgets of governmental actually responsible for construction of facilities also coordinate the use of funds within the responsibility of that government, they serve directly as management tools to prioritize, schedule, and manage the construction work of the several departments and districts serving the jurisdiction.

Increasingly, however, strict segregation of operating and capital funds from one another is being found to be less desirable than it once was. As the gauge of success becomes performance services, rather than simply construction and maintenance of facilities, trade-offs between operating, maintenance, and capital funds frequently are desirable.

For several reasons, therefore, the orthodoxy of capital improvement programming is giving way to more flexible budget concepts. This does not mean that capital improvement programs are no longer desirable or needed, but only that they should not be used as barriers to good management. Instead, they should become carefully orchestrated components in a larger management process.

Regulation

The federal, state, and local governments all regulate public works as well as community development projects. Federal regulations provide for access to public facilities by the handicapped, prevailing wages for construction workers, environmental protection, relocation assistance for people and businesses displaced by federally assisted public works projects, planning and

coordination of public works with related development, and living conditions within public institutions such as jails, prisons, and hospitals. State mandates often cover organizational and operational procedures of local governments, programmatic service standards, interlocal relationships, local tax base limits, and personnel standards and benefits for local government employees. Local regulations cover such things as the subdivision of land, the zoning of land for specific types and densities of use, and the timing of development in relation to the provision of public works.

All of these regulations are necessary, but, taken together, they may present the public works manager and policy-maker with a highly complex and time consuming process. Key issues are the need to simplify these processes and to determine whether some reimbursements for mandates might be desirable or necessary in cases where some benefits accrue beyond the jurisdiction accruing the costs.

Several studies over the past 35 years have recommended that the federal government use its preemption powers sparingly and intentionally, and limit their use to cases where there is a clear national need to be achieved. When it does preempt the authority of state and local governments or places mandates on these units, according to these reports, the federal government should do so only to the extent necessary to carry out national purposes, leaving the maximum amount of state and local discretionary authority intact. The Federalism Executive Order (No. 12612) directs federal agencies to consider these principles when developing legislative and regulatory proposals.

Performance Management⁵⁸

In its final report to the President and Congress, the National Council on Public



Works Improvement recommended steps to improve the performance and efficiency of existing facilities, strong incentives for better maintenance, development of new technologies, and more use of low-capital techniques for delivering services (including demand management, coordinated land-use planning, and waste reduction).⁵⁹

Obviously, this performance approach to public works goes well beyond any single-minded concentration on broad regional planning, construction-oriented capital improvement programming, or regulation. In a sense, it links all three in a results-oriented management system that also includes other factors.

NCPWI postulated the following six performance goals to be met by this management system:

1. Synchronizing the pace of public works provision with the pace of private development.
2. Attaining desired service levels.
3. Supporting economic development.
4. Distributing public works benefits equitably.
5. Limiting deferred maintenance liabilities.
6. Enhancing economic return on investments.

To successfully practice this type of integrated performance management, better data of several types is needed. The data should include precise measures of service levels, service benefits and costs, maintenance liabilities, the pace of authorized development, existing capacities of infrastructure, and the pace at which new infrastructure capacity is being produced. This information would allow administration of an "adequate public facilities ordinance," such as the one in Montgomery County, Maryland, which ties the capital improvement program together with the development permit process. It would also allow better informed setting of user fees and developer exactions at appropriate levels to meet desired service levels and required degrees of environmental protection.

As difficult as it may seem to establish such a performance management system, there are precedents for each element of it. The widespread availability of personal computers now makes such systems very likely to appear in more highly developed and integrated forms in the near future. These systems will combine such elements as infrastructure asset inventories, condition surveys, deferred maintenance reports, pavement management systems, service level surveys, cost accounting, benefit-cost analysis, fiscal impact analysis, forecasting models, capital improvement programming systems, and growth management systems.

Developing a Federal Infrastructure Strategy

In setting out to develop a federal infrastructure strategy, it may be instructive to examine past experience with relevant federal policy processes before considering next steps.

Experience with Federal Policy Processes

Over the years, the federal government has established a variety of broad policy processes that can serve the needs of infrastructure strategy development. For example, in every even numbered year, the President is required to submit to the Congress a national urban policy. That policy is developed with the Department of Housing and Urban Development in the lead, and sometimes has used a working group of the domestic policy council in the White House to provide interagency input.

Another example of a broad infrastructure policy process is the rural development policy report required annually. The present one was released in January 1990 by the Secretary of Agriculture who chaired the working group on rural development of the Economic Policy Council in the White House. It is entitled Rural Economic Development for the 90's: A Presidential Initiative.

The annual reports of the Council on Environmental Quality, over the years, also have frequently reported quite comprehensively on a wide variety of infrastructure issues.

For a number of years, until the mid-1980s when it was abolished, the National Water Resources Council worked on national water policy issues and issued several reports. It was an interagency group chaired by the Secretary of the Interior.

The Federal Aviation Administration regularly updates the National Airport and Airways Plan called for by Congress.

Finally, there have been a number of special, one time, studies of infrastructure issues--both broad and narrow--by standing organizations such as the Congressional Budget Office, the Office of Technology Assessment, and the General Accounting Office, and by temporary study commissions such as the National Council on Public Works Improvement and several national transportation study commission. In February 1990, the Secretary of Transportation released a major report outlining his strategies for the 1990s. In February 1991, the Secretary of Energy issued a similar strategy document for his department. Another such study underway currently is a three-year national drought study being pursued by the U.S. Army Corps of Engineers at the direction of Congress.

Obviously, there is no lack of mechanisms for preparing, considering, and adopting national infrastructure strategies. The main questions are whether these mechanisms are taken seriously and whether they make a difference. Experience with them up to now has been mixed.

Next Steps

To assist the Corps in opening constructive dialogues with other federal agencies having infrastructure responsibilities, a national seminar on key infrastructure issues will be developed. The purpose of the seminar will be to bring together representatives of key federal public works agencies, appropriate congressional committee staffs, state and local governments and public interest groups, the major public works and infrastructure-related professions, and the private sector to help set an agenda for developing a national



public works strategy in the 1990s pursuant to language in the Corps' appropriation act. The results of this seminar are expected to audience.

The types of infrastructure issues to be examined in this seminar might include:

- # Establishing national purposes for infrastructure: the value of infrastructure to the economy; the need to maintain, modernize, and augment existing national facilities; the need to recognize and respond to rising expectations for environmental protection.
- # Identifying appropriate federal responsibilities and relationships: setting national goals and standards in accordance with the Federalism Executive Order and Congress' fiscal notes process; coordinating the increasingly complex environmental decision making process; responding to the new provisions of the Administrative Procedures Act concerning administrative dispute resolution and negotiated rulemaking; pursuing high priorities for infrastructure R&D; promoting such techniques as capital improvement programming, benefit-cost approaches to prioritizing public works projects, public asset accounting, pricing of infrastructure to promote efficiency of service, performance monitoring to measure progress toward public works goals, and innovative financing.
- # Forming federal interagency partnerships: to reconcile public works and environmental protection objectives; to agree on using consistent approaches to infrastructure accounting and financial analysis; to pool the expertise of federal labs having infrastructure

expertise; and to standardize performance monitoring measures and practices.

- # Enhancing federal, state, local, and private-sector infrastructure partnerships: using federal aid and tax expenditures; developing inter-governmental cooperation; transferring research results from federal labs into the field where state and local governments and industry can use them; using the programs of the Intergovernmental Personnel Act to develop expertise and place it where it is most needed; encouraging public-private partnerships.

For such a seminar to be productive, adequate preparation will be required. Such preparation will include the convening of several informal meetings of small groups of potential participants to "test market" the topics and to help develop constructive discussion papers to stimulate the dialogue.

For each of these preparatory meetings, a brief issues paper will be distributed ahead of time to act as a discussion guide. A summary will be prepared afterwards to capture the results and transmit them back to the participants. These summaries will be synthesized to help design the best possible proposal for the national seminar. The final seminar program will be set after all the preparatory meetings have been completed and analyzed.

Obviously these initial meetings, and the national seminar, will only be a first step. If it goes well, it could lead to a White House conference on infrastructure or a National Public Works Summit. In any case, closer working relationships among federal infrastructure agencies are expected to result.



ENDNOTES

1. For a current compendium of revenue sources and rates, see ACIR's annual publication entitled Significant Features of Fiscal Federalism, Vol. I (Washington, DC: Advisory Commission on Intergovernmental Relations, February 1991).
2. For example see Lester A. Hoel, ed., Innovative Financing for Transportation: Practical Solutions and Experiences (Washington, DC: U.S. Department of Transportation 1986).
3. ACIR's annual publication, Significant Features of Fiscal Federalism Vol. II, provides historical and current information about yields from the various sources of government revenue.
4. Ibid., pp. 75-78.
5. CFFR data represents obligated funds. In the budget process, program funds are authorized, appropriated, obligated and finally spent (outlays). Congress determines the first two amounts, and then the program agencies and recipient governments determine the last two. The major difference between obligations and outlays is the timing of the expenditures. Obligation data will identify declines in federal commitments for individual programs sooner than outlay data.
6. See U.S. Congress, Office of Technology Assessment, Rebuilding the Foundation: A Special Report on State and Local Public Works Financing and Management, OTA-SET-447 (Washington D.C.: Government Printing Office, March 1990), pp. 6 and 15.
7. Ibid., p. 16; and NCPWI, Fragile Foundations pp. 59-73.
8. Dennis Zimmerman, Tax-Exempt Bonds and Twenty Years of Tax Reform: Controlling Public Subsidy of Private Activities Washington, DC: Congressional Research Service, November 1987), Report 87-922 E.
9. Credit Markets, June 1988.
10. OTA, Rebuilding the Foundations, pp. 59-60.
11. ACIR, Significant Features of Fiscal Federalism, 1989, Volume I (Washington, D.C.: Advisory Commission on Intergovernmental Relations, January 1989), Table 47.
12. Ibid., Table 48.
13. There is evidence that property tax limits imposed since 1978 have been more effective in holding down local property tax revenues than limits imposed before 1978. See Michael E. Bell, "A New Generation of State Property Tax Relief Efforts: How Successful Have They Been?" Public Budgeting and Financing Management, 2 (1990): 253-77.
14. This section draws on material in Robert D. Ebel ed., A Fiscal Agenda for Nevada (Reno, Nevada: University of Nevada Press, 1990), Chapter 5.
15. Arizona, California, Colorado, Florida, Georgia, Illinois, Missouri, Nevada, New York, Ohio, Texas and Washington.

16. Arizona, Colorado, Iowa, and Oregon.
17. OTA, Rebuilding the Foundations, pp. 65, 70, 73, and 80.
18. U.S. Department of Transportation, Moving America: New Directions. New Opportunities (Washington, DC: Government Printing Office, February 1990), pp. 54-55.
19. NCPWI, Fragile Foundations, p. 60; and OTA, Rebuilding the Foundations.
20. NCPWI, Fragile Foundations, p. 61.
21. Ebel, A Fiscal Agenda, pp. 162-3.
22. For a discussion of this and other examples of experiences with earmarking see Charles F. Adams, Astrid E. Merget, and Frederick D. Stocker, "Earmarking Revenues for Public Works Projects," prepared for the National Council on Public Works Improvement, September 1987.
23. Ebel, A Fiscal Agenda, p. 163.
24. This section draws on material in Advisory Commission on Intergovernmental Relations, Local Revenue Diversification: User Charges (Washington, DC: Advisory Commission on Intergovernmental Relations, October 1987), p. 5.
25. If user charges are thought of as voluntary price-like payments directly linked to the consumption of specific public goods and services, the Census definition of current charges is too broad in some respects (e.g. it includes special assessments), and too narrow in others (e.g. it excludes charges from government operated utilities and liquor stores). However, Bowman and Mikesell conclude that no alternative source of information comes as close to the definition of user fees. John H. Bowman and John L. Mikesell, Local Government Tax Authority and Use (Washington, D.C.: National League of Cities, August 1987), p. 145-51.
26. ACIR, Local Revenue Diversification: User Charges.
27. Ibid.
28. Ibid.
29. NCPWI, Fragile Foundations, p. 62
30. Ibid.
31. Bradford Case, "Development Fees and Exactions: Special Analysis" in Robert W. Rafuse ed., Intergovernmental Fiscal Relations in Hawaii: Final Report, prepared for the Tax Review Commission, State of Hawaii (December 1989), Chapter 7. See also, NCPWI, Fragile Foundations, pp. 61-64.
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Other Land Regulation Charges," and James C. Nicholas, "Florida's Experience with Impact Fees," in James C. Nicholas, ed., The Changing Structure of Infrastructure Finance, Monograph #85-5 (Cambridge, Massachusetts: Lincoln Institute for Land Policy, 1985).

33. Apogee Research, Inc., Financing Infrastructure, p. 77.

34. Ibid., and U.S. Senate Budget Committee, Report of the Private Sector Advisory Panel on Infrastructure Financing, A Committee Print, S.Prt. 100-40 (August 1987), pp. IV-9-11.

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38. NCPWI, Fragile Foundations, p. 63.

39. Ibid., p. 370.

40. ACIR, Local Revenue Diversification: User Charges, p. 31.

41. Dr. Michael Pagano, Miami University of Ohio, as quoted in Penelope Lemov, "User Fees, Once the Answer to City Budget Prayers, May Have Reached Their Peak," Governing (March 1989): 24-30.

42. Ibid., p. 28.

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45. For a more detailed discussion of these issues see Dennis Zimmerman, The Private Use of Tax-Exempt Bonds: Controlling Public Subsidy of Private Activity, (Washington, DC: Urban Institute Press, 1991).

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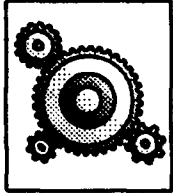
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52. Office of Management and Budget, Budget of the United States Government, Fiscal Year 1988 (Washington, D.C.: Government Printing Office, January 1987), pp. 2-44.
53. U.S. Environmental Protection Agency, Administrative and Resources Management, Public-Private Partnerships for Environmental Facilities: A Self-Help Guide for Local Governments (Washington, D.C.: Government Printing Office, May 1990).
54. For a more detailed discussion of the role of state and local constitutional and statutory authorities for cooperating with the private sector in providing infrastructure services see U.S. Senate Budget Committee, Report of the Private Sector Advisory Panel, pp. IV-11-22.
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Appendix F

Public Works for Tomorrow

Public Works for Tomorrow

Bruce D. McDowell

In 1981, a popular book entitled *America in Ruins* challenged the nation to pay more attention to the neglect of the public facilities that everyone takes for granted. Shortly thereafter, a major freeway bridge in Connecticut collapsed, with catastrophic results, and the debate was on. The need for more attention to this topic has been documented throughout the 1980s and up to the present time.

One of the most wide-ranging studies was *Fragile Foundations*, the 1988 final report of the National Council on Public Works Improvement. Its title suggested that things were not as bad as the 1981 report had charged, but that the nation was in danger of letting its public facilities become inadequate to sustain the quality of life and world-class economic productivity that Americans expect. The report called for doubling the nation's capital investment and for renewed attention to the maintenance of highways, streets, roads, bridges, airports, transit systems, waterworks, wastewater treatment plants, dams, flood control works, ports, waterways, solid waste landfills, hazardous waste management facilities, and the like.

The debate over the council's recommendations has blossomed into a cottage industry. Several economists published papers on the question of how much productivity improvement can be expected from increased public works spending. The Congressional Budget Office published two major reports in response to *Fragile Foundations*—(1) *New Directions for the Nation's Public Works* (1988) and (2) *How Federal Spending for Infrastructure and Other Public Investments Affects the Economy* (1991). The Congressional Office of Technology Assessment also published two reports on the subject—*Rebuilding the Foundations* (1990) and *Delivering the Goods* (1991).

As the debate raged, two defining events unfolded. One was the 1990 decision by the U.S. Environmental Protection Agency to veto the proposed Two Forks Dam in Colorado, signaling the end of an era of building major dams to meet growing demands for water. The other was the passage of the *Intermodal Surface Transportation Efficiency Act of 1991*. This first highway and transit act passed since completion of the Interstate highway system marks a striking transition from the dominance of highway building as the means of moving people and goods. The need to meet service demands is not denied by either event, but both eliminated the assumption that new construction is the only way or even the best or most efficient way to meet demonstrated needs.

A New Vision of Public Works

If these two events are accurate indicators, the era of massive construction programs may be over. This does not mean that we will stop building public facilities, but it does signal that there will not be any new public works programs of national scale comparable to the Interstate highway system or opening the West by supplying federal water and power. The future is more likely to focus on maintaining and getting the most out of existing facilities, keeping costs down, making public facilities fit more comfortably into the natural environment, and being more ingenious in meeting needs in the most efficient ways that science can devise.

Performance—not construction—is now the goal. And performance is being defined in increasingly complex ways. For example, it is no longer good enough simply to add more capacity to highways to handle more vehicles. The new goals are to move more people with fewer vehicles, to use less fuel, to create less air pollution, to keep highway runoff from polluting water supplies, and to minimize noise in adjoining neighborhoods. With water development projects, the goals also have grown more complex.



In-stream flows need to be maintained to meet a variety of habitat requirements, return flows need to be of high quality for reuse, priorities need to be set among competing uses of water when natural limits are reached, and conservation methods must be used to satisfy growing needs with limited supplies. In managing waste materials, the simplicity of the city dump has been replaced by a complex of approaches including recycling, nonpolluting landfills, clean waste-to-energy incinerators, and secure hazardous materials depositories. The search is on for the best results at affordable costs. This search is not simple.

The vision for future public works is no longer a pre-set design that can be drawn up on a piece of paper and worked toward for decades. The new vision is a performance management system to be followed consistently, every year, until our public facilities produce the desired results. Ensuring sound performance may not be as exciting as cutting ribbons to open new facilities, but it is a lot more important. And it can be made satisfying, at least, if properly reported and publicized.

The National Council on Public Works Improvement suggested a set of performance goals to guide this new style of management:

- Synchronize public works with development;
- Attain established levels of service;
- Support economic development and fiscal policies;
- Distribute services equitably;
- Limit deferred maintenance liabilities; and
- Enhance economic return on investment.

This list may not be complete, but it illustrates the concept of performance goals and it can be built on. For example, environmental goals and the need to ensure the reliability of services should be brought out much more explicitly.

Toward a Federal Infrastructure Strategy

In 1990, an appropriation was made to the U.S. Army Corps of Engineers to develop a federal infrastructure strategy. This work was directed to be done in consultation with other federal agencies, state and local governments, and the private sector. The Corps asked ACIR to assist in the consultation process, and the Commission approved that request in March 1991. On June 12, 1992, the Commission approved the initial report resulting from these consultations.

The Commission confirms the essential nature of the nation's infrastructure, the urgent need to improve it, the intergovernmental importance of the issue, and the presence of many opportunities to "improve investment efficiency, program coordination, and economic efficiency..." (*Toward a Federal Infrastructure Strategy*, forthcoming). ACIR enumerated 11 elements that should be worked on in the coming year. Four of them, which are described below, provide opportunities for federal interagency cooperation that could make a real difference in how effectively, efficiently, and accountably all governments—federal, state, and local—will provide infrastructure services in the future.

Performance-Based Needs Studies. Many public works needs studies are considered to be unevaluated, un-

realistic wish lists that usually are too costly to be funded by available resources. Without clear priorities and options, they provide little guidance to decisionmakers.

Several techniques are available to improve the typical needs study. For example, U.S. Comptroller General Charles A. Bowsher recently called performance measurement "an important tool in managing for results" when testifying before the Committee on Governmental Affairs of the United States Senate. He recommended clear articulation of outcome-oriented goals, establishment of measurable objectives, and annual reporting of progress toward goals as means of ensuring citizens "that the government can effectively account for where their tax dollars go and how they are used." Recognizing that this is not an easy task, Mr. Bowsher recommended "starting with pilots. . . ."

One of the best pilots is the long-standing Highway Performance Monitoring System (HPMS) required by the Congress every two years. A similar transit data reporting system is now being merged with HPMS. These systems rely on state and local data reported in standard form to gauge national conditions, performance, and capital investment requirements. These reports have been improved gradually over recent years. The Federal Highway Administration's report on *The 1991 Status of the Nation's Highways and Bridges* is sufficiently refined to differentiate between the cost to *maintain* and the cost to *improve* 1989 conditions and performance for several different types of urban and rural highways.

Additional techniques that can be used to improve needs studies include risk analysis, benefit-cost analysis, return-on-investment analysis, and interactive simulation models for alternative policy options. These are more difficult techniques than simple performance measurements, but they are beginning to be used on a limited basis. They hold out the promise of answering questions such as: What are the safety and cost increase risks of delaying certain projects? Which projects will give the greatest return on investment? Which systemwide strategies are likely to improve performance most?

It is essential to ask and answer questions like these if needs studies are to be used as strategic investment tools.

Performance-Based Accounting Systems. Governmental accounting systems provide relatively little information for management decisions other than budget compliance. Accounts are seldom kept for costs, benefits liabilities, and assets, yet, such accounts could improve decisions about infrastructure significantly.

For example, some form of asset accounting may help solve one of the toughest infrastructure problems—deferred maintenance. The concept includes inspecting capital facilities regularly, determining the cost of needed maintenance, and either making the repairs or reporting the financial amount of needed repairs not made as a liability in the annual financial report. Tracking this amount would allow management, policymakers, and citizens to assess the status of infrastructure maintenance more precisely and realistically than is possible now and would save money by avoiding the catastrophic failures of facilities that often trigger large replacement costs. The recent creation of the Federal Accounting Standards Advisory Board, provides an opportunity to make progress on this issue.



Better accounting standards also could help decision-makers assign responsibilities for costs, which is one of the biggest infrastructure financing challenges. If governments were to follow the "beneficiaries pay" principle more closely, they would need much better data on costs and benefits. Benefit and cost accounting, when done at all, is now generally limited to direct benefits and costs. Secondary benefits and costs also can be of great significance. In order to set fair and productive prices for infrastructure services and to allocate intergovernmental aid properly, public accounting systems would have to be reformed fundamentally. Relative tax capacities and efforts also would figure into such calculations.

Streamlined Environmental Decisionmaking. Many different environmental requirements must be satisfied before a public works project can move forward. Frequently, these requirements are applied sequentially. With numerous state and local requirements in addition to federal requirements, and the threat of litigation, the approval process has lengthened to many years. Sometimes, approval of a project takes so long that the rules change and the process has to start all over again.

The idea of one-stop permitting has been around for a long time, with little to show for it. Two recent events, however, give rise to optimism that progress can be made on this issue. First, the Council on Environmental Quality is more actively promoting the concept that the environmental impact statement (EIS) required by the *National Environmental Policy Act* (NEPA) can serve as a single vehicle for satisfying all federal environmental requirements (see page 17). Second, in May, Transportation Secretary Andrew H. Card, Jr., Environmental Protection Agency Administrator William K. Reilly, and Army Assistant Secretary for Civil Works Nancy Dorn signed a joint memorandum of understanding to facilitate implementation of the *Intermodal Surface Transportation Efficiency Act of 1991* by expediting environmental reviews.

Geographic Information Systems (GIS). Infrastructure planning and decisionmaking requires enormous amounts of very expensive geographic data. The data needed keep growing with every new requirement for environmental protection, archaeological and historic preservation, congestion management, and quality of life enhancement.

The federal, state, and local governments collect geographic data on natural features, demographic characteristics, and man-made features, including the location and characteristics of public works. Too often, however, there is no interagency cooperation in the type or form of the data collected. The technology is available to avoid this waste. Even relatively small public works and planning offices have computers capable of establishing GIS programs. But these systems generally are independent of one another.

Through the work of the Federal Geographic Data Committee, chaired by the U.S. Geological Survey, several types of federal geographic data are being put into standard formats using compact disc technology. If state and local data were compatible, eventually, any kind of geographic data could be shared to great advantage at affordable cost. USGS is exploring ways of involving state and local governments in its GIS work.

With the proper cooperation and data standards, federal, state, and local data could be fed into three-dimensional multimedia technologies that would allow public works decisionmakers to "walk through" current conditions, apply proposed policy options, and experience the future consequences without ever breaking ground.

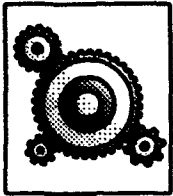
Conclusion

These highlights of opportunities for federal agencies to work together to improve the performance of the nation's public works just scratch the surface. Many other improvements have been identified, including education and training, institutional relationships, materials research, and innovative finance. However, the federal, state, local, and private sector participants in our consultation process ranked information technologies at the top of strategies for improving the performance of public works. The systems highlighted above rely on those technologies to bring better information to the decisionmakers and citizens who provide and use the nation's infrastructure.

A strategy of federal interagency cooperation in infrastructure programs could benefit state and local governments in a variety of ways, including (1) improving technical and managerial practices, and (2) providing a consistent federal approach to the administrative and regulatory requirements that state and local governments must meet.

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Appendix G

Toward a Federal Infrastructure Strategy: Issues and Options

Toward a Federal Infrastructure Strategy: Issues and Options

EXECUTIVE SUMMARY

Toward a Federal Infrastructure Strategy documents the progress of an interagency initiative to develop a federal infrastructure strategy through a partnership including the Department of the Army, the Environmental Protection Agency (EPA), the Department of Energy, other federal agencies, state and local governments, and the private sector. Emphasis was placed on planning, design, finance, construction, operation, and maintenance.

The Advisory Commission on Intergovernmental Relations convened a series of workshops for representatives from more than 25 congressional and other federal agencies and departments, and more than 70 organizations representing state and local governments, public works providers, and related research, advocacy, professional, and user groups. The year-long consultations were guided by a federal interagency work group. The participants concluded the project with a call for federal agencies to pursue new opportunities for action on infrastructure improvements together with state and local governments and the private sector.

The findings and recommendations of earlier reports provided a framework for the dialogue. Each group also responded to questionnaires covering basic financing, performance, and governing practices. The participants advised working toward specific actions to carry out the recommendations contained in earlier reports rather than conducting another study.

Based on the consultations, a broad consensus emerged around five infrastructure issues that should be addressed by the federal government: (1) rationales for federal investment, (2) regulations, (3) technology, (4) financing, and (5) management.

Within each category, participants examined (in order of importance): strategic investment, regulatory and administrative relief, flexibility in federal funding, research and development plus technology transfer, intergovernmental funding, revenue diversification, and management improvement.

Rationales for Federal Investment. The issue statement focused on (1) clear goals; (2) visions of specific infrastructure systems and programs; (3) national needs studies; and (4) principles for determining appropriate federal roles.

Most public works are provided by local governments, state governments, and the private sector. Developing broad *national* infrastructure strategies, therefore, involves intergovernmental relationships and public-private partnerships. *Federal* infrastructure strategy is best understood as a subset of a broader national infrastructure strategy.

Traditional federal infrastructure programs were of two types: (1) grants (e.g., highways, transit, wastewater treatment plants, public housing, and open space), and (2) direct building and operation of federal projects (e.g., flood control facilities, harbors, and air traffic control facilities). Many grant programs have been consolidated, discontinued, or downsized, and most of the direct federal programs now require significant state or local cost sharing. There also is increasing reliance on user fees and trust funds to finance highways, transit, airports, airways, waterways, and harbors.

Federal aid for infrastructure has declined significantly over the past decade. State and local governments have been looking more to the private sector. Techniques being

used include developer exactions, impact fees, transportation management associations, and administration of community facilities by private community associations.

Federal Standards, Regulations, and Mandates. The issue statement focused on (1) standard setting, (2) regulations and mandates, (3) burdens on state and local governments, (4) flexible regulations based on performance goals, (5) stability, (6) reimbursement of state and local costs, (7) small governments, and (8) relationships.

There has been a large increase in the number and cost of regulations, most of which focus on process or technical standards rather than on performance. Proposals were made to (1) shift from technical regulations to performance standards, (2) apply sanctions when performance standards are not satisfied, and (3) require that the federal government share in the cost of implementing regulations.

New Technologies, Research, and Innovation. The issue statement focused on (1) potential for technological, managerial, legal, institutional, and other innovations; (2) innovation in procurements, reducing or spreading liabilities, and accounting; (3) a major federal role in infrastructure R&D; and (4) technology transfer.

The federal government could fulfill its leadership role in innovation and technology sharing by (1) shifting from technical to performance standards and encouraging experimentation, (2) funding federal labs, (3) spreading the risk of new technologies, (4) tort reform, (5) financing project evaluations, (6) promoting technology sharing, and (7) creating a means to facilitate information sharing.

Financing. The issue statement focused on (1) changes in infrastructure finance, (2) the "beneficiaries pay" principle, (3) intergovernmental financing, (4) revenue diversification, and (5) federal income tax treatment of infrastructure investments by state and local governments and private investors.

Most participants (1) agreed that there should be stability in funding sources, (2) saw little probability of a resurgence in federal financing, (3) thought limited resources could be used more efficiently if federal grant programs were redesigned, and (4) believed that more investments should be eligible for tax-exempt financing. Financing initiatives to be watched include (1) federal promotion of state revolving loan funds for wastewater treatment facilities, (2) the ISTEA authorization for mixing public and private funds, (3) experiences with the May 1992 executive order on privatizing public facilities acquired with federal funds, and (4) model public/private cost-sharing contracts.

Management. The issue statement focused on (1) performance rather than inputs, (2) flexibility in regulations and funding, (3) economic incentives, (4) capital improvement programming and budgeting, and (5) training.

Performance is difficult to quantify because there are too few agreed-on standards. Better measures of infrastructure services need to be constructed so that performance standards can be developed. There also is a need for better coordination and cooperation between federal agencies that have infrastructure-related responsibilities.



PREFACE

In 1990, an appropriation was made to the U.S. Army Corps of Engineers to develop a federal infrastructure strategy in consultation with other federal agencies, state and local governments, and private organizations. At the Corps' request, the Advisory Commission on Intergovernmental Relations assisted in the process by convening a series of workshops for government representatives, public works providers, and related groups.

The consultation process was bottom up, and its goal was to find practical steps that can be taken by federal agencies working together to improve existing programs. A number of such opportunities were identified.

Coordination within the federal government can benefit state and local governments in a variety of ways, including improving technical and managerial policies for infrastructure and developing consistent federal approaches to administrative and regulatory requirements.

This report documents the year-long consultation process and recommends that it continue, with a strong focus on developing specific opportunities for improvement. ACIR anticipates working with the Corps and a series of intergovernmental task forces on helping to make the nation's infrastructure more efficient, better coordinated, and more productive.

The Commission believes that maintaining, expanding, and modernizing America's infrastructure is essential to the nation's continued economic and environmental health. The Commission is pleased to have taken part in the consultation process and urges all governments to cooperate in developing the opportunities that are unfolding to improve the infrastructure.

Robert B. Hawkins, Jr.
Chairman



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Marlene Eide, Chair, Transportation Steering Committee, National Association of Counties;

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Max Whitman, President, American Public Works Association.

At the Commission meeting on June 12, 1992, at which this report was adopted, the Commission was addressed by:

Edwin Dickey, Principal Deputy Assistant Secretary of the Army for Civil Works;

Thomas Larson, Administrator, Federal Highway Administration; and

Tad McCall, Deputy Associate Administrator for Federal Enforcement, U.S. Environmental Protection Agency.

The Commission expresses its sincere appreciation to all of these persons and to the 200 or so others who played significant roles in making this study a success. The Commission and staff take full responsibility for the accuracy and content of this report.

John Kincaid.
Executive Director



TABLE OF CONTENTS

SUBJECT	Page
Introduction	G-1
Context for a New Federal Initiative on Infrastructure	G-3
The Early Reports	G-3
The More Recent Reports	G-3
Definitions of Infrastructure	G-4
Consulting the Actors	G-5
Five Essential Infrastructure Issues and Opportunities for Action	G-7
The Essential Issues	G-10
I. Rationales for Federal Investment	G-10
Formal Issue Statement	G-10
National vs. Federal Infrastructure Strategies	G-10
Carving Out Appropriate Federal Roles for the 1990s	G-10
Criteria for Justifying a Federal Role	G-11
Survey Findings on Federal Roles	G-13
Potential Opportunities for Interagency Cooperation	G-14
II. Federal Standards, Regulations, and Mandates	G-14
Formal Issue Statement	G-14
Workshop Discussion	G-14
Potential Opportunities for Interagency Cooperation	G-15
III. New Technologies, Research, and Innovation	G-15
Formal Issue Statement	G-15
Workshop Discussion	G-16
Strategies for Improving the Performance of Public Works	G-16
Potential Opportunities for Interagency Cooperation	G-16
IV. Financing	G-18
Formal Issue Statement	G-18
Workshop Discussion	G-18
Survey Findings on Infrastructure Financing	G-19
Potential Opportunities for Interagency Cooperation	G-20
V. Management	G-21
Formal Issue Statement	G-21
Workshop Discussion	G-22
Survey Findings on Importance of Federal Coordination	G-22
Potential Opportunities for Interagency Cooperation	G-22



Conclusion	G-23
Recommendation	G-25
Appendix	G-27
Executive Order 12612, Federalism President Ronald Reagan October 26, 1987	G-27
Memorandum on Federalism Executive Order for the Heads of Executive Departments and Agencies President George Bush February 16, 1990	G-29

INTRODUCTION

This report documents the progress, to date, of a new federal interagency initiative to develop "a federal infrastructure strategy." The congressional committee report¹ initiating this new effort emphasized "pursuing opportunities for providing local infrastructure facilities" through a partnership including the Department of the Army, the Environmental Protection Agency (EPA), the Department of Energy, other federal agencies, state and local governments, and the private sector. Consideration was to be given to planning, designing, financing, constructing, operating, and maintaining the nation's infrastructure. Special mention was made of identifying public/private financing opportunities.

Major studies of the nation's infrastructure problems were undertaken in the last ten years. These reports focused largely on transportation facilities; water resources, supplies, and quality; and the management of solid and hazardous wastes. The issues have been defined over and over again. Some progress has been made, and additional opportunities to move ahead have been identified. But the problems continue.

The federal agency representatives brought together in this effort to develop a new strategy advised working toward specific actions to carry out the recommendations contained in the previous reports rather than producing a new study. The approach taken was to consult with representatives of governments and the private sector in a series of workshops convened by the Advisory Commission on Intergovernmental Relations (ACIR). The consultations were guided by a federal interagency work group. The workshop deliberations included more than 25 congressional and other federal agencies and departments, and more than 70 organizations representing state and local governments, public works providers, and related research, advocacy, professional, and user groups (see Figure 1, next page).

¹ U.S. House of Representatives, House Report 101-536, Accompanying the *Energy and Water Development Appropriations Act, 1991*, October 19, 1990, p. 22.

The workshop participants focused on three questions:

1. Can a government-wide or multi-agency federal infrastructure strategy be developed?
2. What issues should a federal infrastructure strategy address?
3. Can federal agencies work more closely together to create greater value from federal investment and involvement in infrastructure?

The past decade has brought significant changes in the federal government's infrastructure roles—its financing role has declined while its regulatory role has expanded. State and local governments and the private sector are picking up greater infrastructure responsibilities, but the transition has not been smooth. State and local governments, like the federal government, have budget problems, and the private sector has been in a long economic recession.

In reassessing the appropriate size and form of the federal role, therefore, it is necessary to ask: Can and should state and local governments and the private sector take greater responsibility for the nation's infrastructure?

Whether it is practical to develop a comprehensive federal infrastructure strategy is a question that remains open. Nevertheless, based on the consultations, a broad consensus emerged around five key infrastructure issue areas that should be addressed by the federal government: (1) rationales for federal investment, (2) regulations, (3) technology, (4) financing, and (5) management. In the process of reaching this consensus, several potential opportunities for federal interagency cooperation were identified.

The following sections briefly set the current infrastructure debate in historical context, describe the process, still ongoing, that brought the different groups together, examine the five infrastructure issues identified above, and note opportunities for action. The report ends with a call for federal agencies to pursue these opportunities together, in cooperation with state and local governments and the private sector.



Figure 1
Organizations Represented at One or More Workshops

Congress

Senate Environment and Public Works Committee
House Committee on Public Works and Transportation
House Subcommittee on Economic Development
Congressional Budget Office
Congressional Infrastructure Caucus
Congressional Office of Technology Assessment
Congressional Research Service—Library of Congress
General Accounting Office

Executive Branch

Council of Economic Advisors
Environmental Protection Agency
Federal Accounting Standards Advisory Board
General Services Administration
Department of Agriculture—SCS
Department of Army—
 Civil Works
 Corps of Engineers
Department of Commerce
Department of Energy
Department of Interior—
 Bureau of Reclamation
 U.S. Geological Survey
Department of Transportation—
 United States Coast Guard
 Federal Aviation Administration
 Federal Highway Administration
 Federal Railroad Administration
 Federal Transit Administration
 Maritime Administration
 Office of the Secretary
 Transportation Systems Center
Department of Treasury

State Government

Academy for State and Local Government
Council of State Governments
Ohio House of Representatives, Ways and Means Committee
State of New Jersey—Washington Office

Local Governments

International City/County Management Association
National Association of Counties
National Association of Regional Councils
National Association of Towns and Townships
National Conference of State Legislatures
National League of Cities
Metropolitan Washington Airports Authority
City of Atlanta, Department of Planning and Development
Lehigh County (Pennsylvania) Authority

Research Groups

Apogee Research
Building Research Board
Civil Engineering Research Foundation
Committee for Economic Development
Governmental Accounting Standards Board
Infrastructure Institute
Johns Hopkins University, Institute for Policy Studies

Manufacturers' Alliance

National Academy for Public Administration
Ohio State University, School of Public Policy and Management
Taubman Center for State and Local Government
Harvard University
Arizona State University, School of Public Affairs
Transportation Research Board
University of Maryland, Department of Economics
University of New Mexico, New Mexico Engineering
 Research Institute
The Urban Institute

Professional Associations

American Consulting Engineers Council
American Planning Association
American Society of Civil Engineers
Community Transportation Association
Government Finance Officers Association

Policy Advocates

Advocates for Highway and Auto Safety
Campaign for New Transportation Priorities
National Industrial Transportation League
National Wildlife Federation
Public Securities Association
Rapoza Associates
Surface Transportation Policy Project
Water Environment Federation

User Groups

American Trucking Association
Bell Atlantic Network Services, Inc.
Highway Users Federation
International Longshoremen's and Warehousemen's Union
National Grange

Public Works Providers

American Association of State Highway and
 Transportation Officials
American Public Transit Association
American Public Works Association
American Road and Transportation Builders Association
American Waterways Operators, Inc.
American Water Works Association
Associated General Contractors of America
Association of American Railroads
City of Baltimore, Department of Public Works
Bovis, Inc.
Greenhorne & O'Mara
National Solid Waste Management Association
National Stone Association
New York Metropolitan Transit Authority
Portland Cement Association
R.W. Beck and Associates
Sverdrup Corporation
Tennessee Valley Authority
Wade Miller Associates
Washington State Public Works Trust Fund,
 Department of Community Development
Greater Chicago Metropolitan Sanitary District,
 Water Reclamation District



CONTEXT FOR A NEW FEDERAL INITIATIVE ON INFRASTRUCTURE

The Early Reports

In 1981, *America in Ruins* charged that lack of maintenance was seriously endangering the ability of the nation's infrastructure to continue meeting essential needs. Shortly thereafter, some highway bridges fell down, with catastrophic results, and the need for action appeared urgent.

The Congress followed with three studies in rapid succession during the mid-1980s. *Hard Choices* (1984), prepared for the Joint Economic Committee, indicated that infrastructure investment needs were far outstripping the funds available. A study for the Senate Budget Committee by the Private Sector Advisory Panel (1987) also called for greater investment, emphasizing a strong federal role and greater use of trust funds, tax exempt bonds, and public/private partnerships. Finally, the Congress established the National Council on Public Works Improvement (NCPWI) to study these issues definitively.

In *Fragile Foundations* (1988), its final report, NCPWI concluded that the nation's infrastructure was "barely adequate to fulfill current requirements and insufficient to meet the demands of future economic growth and development." The council called on federal, state, and local governments, in partnership with the private sector, to double the nation's rate of capital investment in infrastructure by 2000. The

NCPWI report also identified key needs for improving the performance of public works systems, such as:

- Using better management techniques;
- Carving out more appropriate roles for the federal, state, and local governments and the private sector;
- Establishing incentives for better maintenance;
- Taking advantage of new technologies;
- Exploring low-cost methods of providing services;
- Providing better trained personnel; and
- Using innovative financing techniques.

Figure 2 contains the summary recommendations from *Fragile Foundations*.

The More Recent Reports

Fragile Foundations touched off a series of debates that continues to the present. In passing the law that established NCPWI, the Congress required the Congressional Budget Office (CBO) to evaluate the council's final report within 90 days. CBO's report, *New Directions for the Nation's Public Works* (1988), challenged the need to double the rate of investment. It emphasized, instead, the need to make sure that each infrastructure project be

Figure 2
A Strategy for Improving America's Public Works

No single approach is adequate to ensure the future viability of America's infrastructure. A broad range of measures is necessary to make a meaningful difference by the turn of the century. Specifically, these should include:

- A national commitment, shared by all levels of government and the private sector, to increase capital spending by as much as 100 percent above current levels;
- Clarification of the respective roles of the federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability;
- More flexible administration of federal and state mandates to allow cost-effective methods of compliance;
- Accelerated spending of the federal highway, transit, aviation, and waterways trust funds;
- Financing of a larger share of the cost of public works by those who benefit from services;

- Removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing;
- Strong incentives for maintenance of capital assets and the use of low-capital techniques, such as demand management, coordinated land use planning, and waste reduction and recycling;
- Additional support for research and development to accelerate technological innovation and for training of public works professionals; and
- A rational capital budgeting process at all levels of government.

None of these steps will be easy or unopposed. But the increasing cost of delay is certain. The Council urges the President, the Congress, and the nation's state and local leaders to act on this agenda immediately.

Source: National Council on Public Works Improvement, *Fragile Foundations*, 1988.



carefully evaluated for its economic productivity. By thistime, a major argument was raging among economists about the macro effects of infrastructure investment on the nation's economy. Some saw infrastructure investments leveraging the economy to much higher rates of growth than others. CBO followed up in 1991 with a more in-depth report, *How Federal Spending for Infrastructure and Other Public Investments Affects the Economy*.

The Congressional Office of Technology Assessment (OTA) produced two major reports on infrastructure entitled *Rebuilding the Foundations* (1990) and *Delivering the Goods* (1991). These reports examine state and local public works financing and management issues, as well as public works technology, management, and financing activities of the federal government.

While none of these studies reached a definitive conclusion on the benefits of infrastructure investment in general, the OTA reports clearly pointed to substantial

needs for additional spending on infrastructure to remedy current deficiencies.

Definitions of Infrastructure

As these reports accumulated, it became apparent that definitions of infrastructure differ. Some definitions include public buildings, public housing, rural electrification, emerging telecommunications technologies, and other facilities that serve public needs, whether publicly owned or not. For the sake of manageability, NCPWI limited its studies to transportation, water, and waste. These three broad categories involve large intergovernmental systems of major national significance. Narrowing the definition of infrastructure in this way does not deny the fact that other facilities are public works of great importance. Much of what can be said of good practices in the fields of transportation, water, and waste also can be said about managing other facilities.

CONSULTING THE ACTORS

The federal infrastructure strategy project consulted separately with four constituencies and then brought representatives of all groups together into a "synthesis group" to resolve differences. The findings and recommendations of the reports summarized above were presented to workshop participants and provided a framework for much of the dialogue that occurred. The four groups convened were:

- Representatives of federal agencies as well as congressional committees and policy evaluation units having infrastructure responsibilities;
- State and local government policymakers;
- Nongovernmental policy analysts, infrastructure users, and advocacy groups; and
- Public and private infrastructure providers.

Each group was surveyed before the meetings by questionnaires covering basic financing, performance, and governing practices.

The survey questions were drawn from the recommendations of *Fragile Foundations* (see Figure 2).

The next section of the report is based on the survey responses and the professionally facilitated workshop discussions that comprised the consultation process.



FIVE ESSENTIAL INFRASTRUCTURE ISSUES AND OPPORTUNITIES FOR ACTION

In questionnaire responses and the workshops, participants identified five issues as being of primary importance in developing steps for federal action. These five issues were discussed initially as "strategies" or action statements (see Figure 3), but were not ratified in that form by the synthesis group. The issues/strategies pairs are:

I. Rationales for Federal Investment—Invest Strategically

II. Regulation—Agree on Roles and Responsibilities

III. Technology—Develop and Apply New Technologies

IV. Financing—Readjust Infrastructure Financing

V. Management—Improve Infrastructure Management

Figure 3
Five Essential Issues to be Addressed by a Federal Infrastructure Strategy

I. Invest Strategically ■ Improved infrastructure is needed to sharpen America's competitive edge, economic productivity, and efficiency. ■ Clear national goals for infrastructure—a persuasive vision of the future—should be articulated. ■ Greater political commitment is needed to support a healthy infrastructure. ■ National needs studies should be directed toward effective achievement of clear strategic investment goals.
II. Agree on Roles and Responsibilities ■ Regulatory and administrative burdens in providing infrastructure should be reduced. ■ Flexibility in spending federal aid for infrastructure, and in complying with federal and state mandates, should be increased. ■ The intergovernmental burdens and lack of flexibility that hamper the provision of infrastructure are symptoms of differing perceptions about appropriate federal, state, local, and private roles. These differences should be narrowed by building closer partnerships. ■ Special attention needs to be given to the compliance problems of small governments.
III. Develop and Apply New Technologies ■ The potential for new technologies, and other products of research, to help solve infrastructure problems is great; it should receive greater attention. ■ Accelerated technology sharing programs should be an integral part of this effort. ■ More effective federal strategies and greater resources are essential to the success of this effort.
IV. Readjust Infrastructure Financing ■ The enormous changes in public revenue systems and expenditure patterns that have occurred over the past decade have left infrastructure at a disadvantage. ■ This situation requires significant adjustments in infrastructure financing methods. ■ Specific adjustments that should be considered include: - Mechanisms that result in beneficiaries paying a greater share of costs - Intergovernmental funding - Tax-exempt funding - Revenue diversification
V. Improve Infrastructure Management ■ Management methods and practices should be reformed to focus on the performance of services (as indicated by output measures) rather than on facilities and operations "inputs." ■ There should be incentives (1) to stretch the safe and useful lives of public works through better maintenance, (2) to use the most cost-effective means of serving the public in each situation, and (3) to lower arbitrary barriers to using low-capital techniques. ■ Flexible funding and flexible regulations can help ensure successful performance management. ■ Capital improvement programming and prioritizing should be used more fully, in appropriate settings, by all governments.



The synthesis group wanted to explore the issues more thoroughly before committing to strategic positions. An extended discussion of strategies versus issues made the following points:

- A coherent (overarching) federal infrastructure strategy could offer benefits, such as: reinforcing larger national goals like international competitiveness, economic productivity, and quality of life; putting federal programs into better relationship with state, local, and private sector efforts; and developing consistency and mutual reinforcement among federal programs.
- However, a coherent (overarching) federal infrastructure strategy may not be possible because, for example: responsibilities for federal infrastructure programs are divided among too many different federal agencies and congressional committees; the missions of these institutions are very diverse; the division of infrastructure responsibilities among the nation's federal, state, and local governments—and between the public and private sectors—is too dynamic and uncertain; and proposals to establish or more fully utilize interagency policy-setting and coordinating mechanisms are unlikely to be enacted (e.g., a federal infrastructure council, a cabinet council on infrastructure, a consolidated congressional infrastructure committee, a consolidated federal infrastructure department, or an infrastructure coordination role for OMB, the Domestic Policy Council, or the Council of Economic Advisors).

Still, the federal government has an infrastructure strategy by default that is the net result of its diverse infrastructure programs and policies. Some thought to coordinating certain elements of these programs and policies might produce benefits. Political leadership in the Congress, at the White House, or in one or more major federal departments or agencies might help such coordination efforts to develop further. Examples of such leadership are the strategic planning process at the U.S. Department of Transportation (DOT) and the recent authorization of federal surface transportation programs in the *Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)*.

Care should be taken to ensure that requirements for coordination not be allowed to gridlock the decision process and prevent the provision of essential infrastructure facilities and services.

Whether or not it is possible to develop a coherent federal infrastructure strategy spanning a wide range of programs, the five essential federal infrastructure issues listed above are important to address.

Table 1 compares three perspectives on public works issues: (1) the highest priority issues cited by questionnaire respondents on an open-ended question; (2) the main points discussed at the workshop meetings of the four constituent groups; and (3) *Fragile Foundations* recommendations.

Although the four workshop groups had some common concerns, they initially had very different perspectives. Table 2 summarizes responses by each group to the open-ended survey question on the most important issues that a federal infrastructure strategy should address. The issues listed received multiple responses within each group, and they appear in the order of greatest to lowest number of multiple responses.

Table 1
Three Perceptions of Public Works Issues

	Workshop Discussions (main points receiving attention)	Questionnaires: Issue Priorities (in rank order of importance to respondents)	Fragile Foundations (summary of recommendations)
I	1. Definitions/Goals 2. A Vision	1. Strategic Investment	1. A National Commitment to Invest More 2. Clarification of Federal-State-Local Roles
II	3. Regulations	2. Regulatory/Administrative Relief 3. Flexibility of Federal Funding	3. Flexible Administration of Federal and State Mandates
III	4. Technology	4. R&D/Technology Transfer	4. Accelerate Innovation through R&D
IV	5. Financing	5. Intergovernmental Funding 6. Revenue Diversification	5. Beneficiaries Should Finance a Greater Share of Costs 6. Reduce Limits on Tax Exempt Bonds 7. Accelerated Spending of the Federal Trust Funds
V	6. Performance	7. Management Improvement	8. Accelerate Innovation through Training Public Works Professionals 9. Incentives for Maintenance 10. Incentives for Low-Capital Techniques 11. Capital Budgeting by All Governments

Table 2
Most Important Issues for a Federal Infrastructure Strategy¹
(rank order by survey group)

Federal Group (N = 13)	S-L Government (N = 16)	Research/Advocacy/Users (N = 25)	Providers (N = 28)
1. National Needs Study	1. Consistency among Federal Programs	1. Political Commitment to Strategic Investment	1. Regulatory Relief
2. Multi-Modal Transportation Funding	2. Flexibility in Using Federal Funds	2. R&D plus Technology Transfer	2. Intergovernmental Funding and Mandate Reimbursement
	3. Reducing Federal Regulatory and Administrative Overload, especially for Small Governments	3. Regulatory Relief and Flexibility	3. R&D plus Technology Transfer
	4. Tax Policy	4. Reliable Revenue Sources	4. Strategic Investment
		5. Intergovernmental Funding and Fiscal Equalization	5. Privatization
			6. Management Improvement

¹ Based on Survey Question 7—What are the two or three most important infrastructure issues that the federal government needs to address? These tabulations were prepared at the time of the meetings. Later tabulations resulted in a total of 97 responses, as follows: Federal—17 (a 29 percent response); State-Local—19 (36 percent); Research, etc.—27 (35 percent); Providers—34 (68 percent).

What becomes evident most quickly from this table is that the federal working group had the most narrow programmatic concerns and the fewest concerns that received multiple responses (although many other issues were cited by a single individual on the 17 federal questionnaires returned).

Responses from the state and local government policymakers might be characterized as concerns about the federal impact on their infrastructure responsibilities. The research/advocacy/user respondents listed a broad range of strategies and practical concerns. The public works providers had the highest rate of response and the broadest mix of major concerns.

Table 2 also provides some details pertaining to the five key issues. Respondents saw the need to examine the following factors:

1. Strategic investment,
2. Regulatory and administrative relief,
3. Flexibility in federal funding,
4. Research and development plus technology transfer,
5. Intergovernmental funding,
6. Revenue diversification, and
7. Management improvement.

This list represents the composite rank order of issues raised by all four groups, with strategic investment being the highest priority. This is the ranking used to organize Table 1 and to arrive at the five larger categories of issues: rationales, regulation, technology, finance, and management.

Strategic investment was listed as the top priority by respondents from the research/advocacy/user group, who

tied it to developing political commitment to these objectives, as well as to international competitiveness and economic efficiency. The providers group linked strategic investment to economic development, productivity, efficiency, and international competitiveness. Some of the providers also linked it to a call for clear national priorities. In the words of one respondent, it is certainly easier to "follow the leader" if it is clear where the leader is going.

In a related view, the federal group's top priority was given to national needs studies, which could be used as strategic investment tools if prepared properly. An additional federal respondent listed international competitiveness, another listed investment for performance, and others pushed national defense, transportation, and dam safety strategies. All of these responses indicate support for certain types of strategic investment.

Regulatory relief and flexibility was the second highest priority overall. It was the top priority of public works providers and was ranked third by state and local government policymakers and the research/advocacy/user group. In addition, the first-place call by state and local policymakers for consistency among federal programs reinforces the issue of regulatory and administrative overloads resulting from federal actions. The state and local policymakers also tied this issue to the special needs of small governments for relief from the increasingly technical and demanding requirements of federal programs.

Flexibility in federal funding was in third place overall. This issue placed second among the priorities of both the federal group and the state and local policymaker group. It was also imbedded in the third-place issues listed by the state/local and research/advocacy/user groups calling for flexibility and consistency among programs.



Research and development (including technology transfer) received the fourth priority overall. Although it came in second with the research/advocacy/user group and third with the providers, it did not make the top rung of issues as seen by the federal and state/local groups.

Intergovernmental funding was in fifth place overall, especially with regard to reimbursing state and local governments for the costs of meeting federal mandates. The providers gave it their second highest priority, but the research/advocacy/user group dropped it to fifth place and tied it to issues of fiscal equalization. The federal and state/local groups implied support only obliquely through their interest in flexible federal funding.

Revenue diversification, in sixth place overall, is seen in various forms in the responses from three groups. For example, revisions in tax policy, especially with respect to municipal bond authority, received a fourth-place priority from the state and local policymakers, and the research/advocacy/user group gave the same ranking to ensuring reliable revenue sources. The provider group brought this issue up in relation to privatizing financial responsibilities. The federal group did not focus on this issue.

Management improvement, including the use of performance data came in last overall. The provider group was the only one to rank this issue.

The Essential Issues

Each of the five essential infrastructure issues categories is discussed more fully below. The formal issue statement agreed to by the synthesis group is presented first. Additional details are provided from the workshop discussions and the questionnaire surveys. Related opportunities for interagency cooperation that came to light during the consultation process are then described briefly.

I. Rationales for Federal Investment

Formal Issue Statement

Clear Goals. Infrastructure is not an end in itself. Therefore, wise investment in infrastructure requires the clear articulation of other larger goals for such purposes as international competitiveness, economic productivity, health and safety, national defense, and quality of life.

Vision. Specific visions of how infrastructure systems and programs can contribute to achieving clear national goals are necessary to generate political commitment and adequate financial support.

Needs Studies. National needs studies should be conducted to calibrate the amount of infrastructure investment needed. Such studies should not be simply compilations of all available proposals, but instead should analyze alternative means of achieving measurable performance standards and seek the most cost-effective investment opportunities. Needs studies should be developed through cooperative intergovernmental and public-private processes.

Principles. Principles for determining appropriate federal roles to help meet infrastructure needs should be established. These principles should have a firm constitutional foundation, but should also reflect present conditions and intergovernmental consultations. Economies of scale and equity considerations may form the basis of some federal roles.

National vs. Federal Infrastructure Strategies

Many federal infrastructure programs finance major capital investments with high federal shares of project costs. Such programs and projects frequently receive widespread media coverage. In addition, federal environmental and other regulations often affect the construction of public works projects that are not federally financed. It is common, therefore, to view the federal government as dominant in the infrastructure field.

Nevertheless, as pointed out in *Fragile Foundations*, most public works are provided by local governments, either directly or through the private sector. Most major highways are owned by state governments. Many water supply systems are privately owned and operated. Most hazardous waste disposal is privately provided. Much of the ordinary trash collection and disposal is private. Developing broad *national* infrastructure strategies, therefore, involves many intergovernmental relationships and public-private partnerships. *Federal* infrastructure strategy is best understood as a subset of a broader national infrastructure strategy. Thus, a national strategy must be set forth before a federal strategy can be established realistically. NCPWI set forth such a strategy in 1988, calling for a federal-state-local-private partnership (see Figure 1).

Carving Out Appropriate Federal Roles for the 1990s

Traditional federal infrastructure programs were of two types: (1) grants and (2) direct building and operation of federal projects. The grants generally had fairly high federal shares of project costs, required state and local planning, and called for federal approval of the projects to be funded. These programs included highways, transit, airports, wastewater treatment plants, public housing, urban renewal, community facilities, and open space.

The direct federal programs, usually funded completely by the federal government (except perhaps for land contributed by a state or local government), included flood control facilities, dams, harbors, waterways, and air traffic control facilities. Amtrak is also heavily dependent on direct federal appropriations.

In recent years, there have been many changes in the grant and direct programs. For example, many grant programs have been consolidated, discontinued, or downsized, and most of the direct federal programs now require significant state or local cost sharing.

There also is increasing reliance on user fees and trust funds to finance the federal shares of federal infrastructure programs. These apply to highways, transit, airports, airways, waterways, and harbors. It has been the goal in recent years to move the Department of Transportation toward complete funding by user fees and trust funds. That goal has been about 80 percent achieved.



Another change was consolidation of the urban renewal, open space, and community facilities programs into the community development block grant, thereby reducing federal control. In addition, the more than 800,000 miles of federally designated highways have been replaced by a 155,000-mile national highway system and a flexible intermodal surface transportation block grant for state and local use. The wastewater treatment facilities construction grant program (with a 75 percent federal share) has been converted into a state revolving loan program. The new safe drinking water program mandates standards without offering financial assistance.

Looking at the overall record, and judging it by buying power and percentage of state and local infrastructure budgets, federal aid has declined significantly over the past decade.

With fewer federal dollars to count on, state and local governments have been looking more to the private sector to help finance and provide infrastructure. Techniques being used more frequently include residential developer exactions, impact fees, transportation management associations to mitigate the traffic impact of new commercial development and redevelopment, and administration of community facilities by private community associations rather than by local governments. Last year, the Congress voted to allow federal funds to be mixed with private funds for highways and to permit tolls to be collected more freely on federally aided highways.

It takes time for state and local governments to adjust to such changes, and still more changes may be on the way because of the federal government's deficit position. Federal infrastructure programs, in general, have been caught in the part of the federal budget getting squeezed out by the pressures of entitlements, national defense, and interest on the national debt. Maintaining the federal partnership in infrastructure programs under these conditions requires new thinking.

Criteria for Justifying a Federal Role

On April 24, 1992, the federal work group met to identify principles or criteria for judging the appropriateness of federal roles in infrastructure programs. The group reviewed lengthy excerpts and other selected quotes from five major infrastructure reports, Executive Order 12612 on Federalism (see Appendix A), and a table comparing the concepts in these sources (see Table 3). The group determined that there were three types of criteria:

- Values connoting "what's right" in terms of basic societal principles;
- Political judgments confirming collective wants or desires; and
- Technical judgments about the best ways of achieving results.

These three types of criteria do not always reinforce each other. They are like three circles or spheres of influence. If they are too far apart, there is no overlap; if they overlap some, there is at least a bit of common ground; if they are coincident, there is complete agreement. Generally, there is partial overlap and a need to resolve differences.

Values

Four more specific criteria for determining the federal role in infrastructure were placed in the category of values—constitutionality, accountability, equity, and common sense.

Constitutionality. Federal responsibilities are those enumerated in the U.S. Constitution or "reasonably implied" from it. Judgments differed about what could be reasonably implied. The Federalism Executive Order is designed to limit the size and role of the federal government through strict interpretation of the Constitution, avoiding preemptions of state and local discretion, avoiding extraneous conditions in federal-aid programs, and promoting flexibility in the means of complying with federal requirements. To some participants, however, limiting the size of government was not as important as other goals, and it was not emphasized in the other source documents. Nevertheless, the group agreed with the "federalism assessments" required by the Executive Order for gauging the impact of major policy initiatives on state and local governments. Selective use of this technique, to avoid overburdening the rulemaking process, was recommended.

Accountability. Those responsible for making a decision should be held responsible for the consequences. Policymakers, therefore, need to take care that their policies are practical to implement without imposing impossible or inequitable burdens on others. Some unfunded federal mandates may pass an inappropriate burden to state and local governments because they are enacted without the restraint of fiscal discipline. It is easy to enact a mandate if there is no responsibility to fund it; it may not be so easy for others to find the funding. Federalism assessments under Executive Order 12612 in the Executive Branch, and fiscal notes in the Congress are designed to surface these practical issues before major decisions are made. If these processes work well, the resulting decisions are more likely to be "sustainable" over the long run because they will be practical to implement.

Equity. Those who benefit from a program should pay for it. At the same time, the beneficiaries should pay in proportion to their ability to pay. Essential needs must be supplied to everyone, even if they cannot pay. Governments as well as individuals should be treated equitably. Program needs should be considered in relation to fiscal capacities and fiscal effort.

Common Sense. Infrastructure programs should put the right facilities and services at the right place when needed, for a fair price, and the right people should pay for them. In other words, governments should reconcile diverse values, desires, and responsibilities to satisfy the "customer."

Political Judgments

The group identified three important criteria under the heading of political judgments: national interest, declared national goals and programs, and national standards.



Table 3
Principal Elements of the Federal Government's Roles: Executive Order 12612,
National Council on Public Works Improvement, Congressional Budget Office, and Office of Technology Assessment

Principal Elements	12612	NCPWI	CBO	OTA
1. Federal Policy Goals				
A. Set Uniform Standards	X	X	X	X
B. Ensure Social Equity		X	X	X
C. Limit Size of National Government	X			
D. Coordinate Local Actions		X		
E. Address National Goals (Rather than Local Ones)	X	X	X	X
EXCEPT:				
F. Provide Services Where Benefits/Costs "Spill Over" Local Boundaries		X	X	X
G. Provide Services Where There Are Economies of Scale		X	X	X
2. Criteria for Choosing Policy Tools				
A. Stay within Constitution	X	X	X	X
B. Encourage Local Flexibility in Meeting Goals	X	X	X	X
C. Avoid Preempting Local Powers	X	X		
D. Seek Policy Stability				X
E. Keep Plans Simple				X
F. Avoid Extraneous Requirements	X			X
3. Recommended Federal Policy Actions				
A. Intra-Agency "Federalism" Officer	X			
B. Federalism Assessment for New Programs	X			
C. Benefit-Cost Analysis	X	X	X	X
D. User Fees to Ensure Beneficiaries Pay Costs		X	X	X
E. Targeted Grants to Manage Use Levels		X	X	X
F. Efficient Facility Prices		X	X	X
G. National Infrastructure Financing Bank			X	
H. Public Infrastructure Block Grants			X	
I. Improved Capital Budgets		X	X	
J. Performance Reporting		X	X	
K. Integrated and Coordinated Federal Policymaking			X	X

Note: A blank indicates that the source document did not explicitly address the issue, not necessarily that the concept was approved or disapproved.

National Interest. There is a national interest in problems that are larger than individual states, that cannot be resolved between states because the incentives are wrong (spillover effects such as environmental pollution), and that will not be settled except by federal government action.

Declared National Goals and Programs. Irrespective of the "national interest" principle, national goals and programs that are legislated legally establish legitimate federal roles.

National Standards. It is often necessary and desirable for the federal government to set standards and issue regulations affecting state and local infrastructure activities. Minimum standards, allowing some state and local preferences to be exercised, often are preferable to uni-

form standards. Performance standards that promise uniform results without uniform actions offer an additional degree of flexibility that frequently is desirable.

Best Technical Practices

The group identified three important criteria under the heading of best technical practices—demonstrated need, economy, and effectiveness.

Demonstrated Need. There needs to be some technically accurate and reliable way to measure infrastructure needs for new construction, maintenance, and operation. These methods must be able to evaluate alternatives for demand reductions. Assumptions must be explicit and open to public view.

Table 4
Importance of Federal Roles¹
(rank order)

Federal Roles	Working Groups				Composite Rank
	Federal	State-Local	Research, etc.	Provider	
A. Direct Provision				3	
B. Capital Funding for Others	2	1	1	1	1
C. Funding Operations by Others		6	6	4	5
D. Regulating Performance		4			
E. Regulating Environmental Impacts	5			2	
F. Aesthetic and Historical Impacts					
G. Performing R&D	6		4		
H. Promoting R&D by Others	1	2	2		2
I. Sharing Technology	3	3	3		3
J. Intergovernmental Cooperation and Coordination	4	5	5	5	4

¹ Based on Survey Question 5—Listed are some of the roles the federal government plays in improving public infrastructure. Indicate by ranking (1 = most important) which roles you believe are most important for the federal government.

Economy. Benefits (properly measured) should exceed costs. Efficiency and economies of scale should be maximized. Pricing policies to improve efficiency should be explored. Waste should be minimized.

Effectiveness. Performance goals should be established, monitored, and evaluated. Programs should be simple enough to administer, and be stable enough over time to have a reasonable chance of success. Programs should be flexible enough to be administered successfully by small and large governments.

Survey Findings on Federal Roles

Criteria for justifying a federal role are not the same as the federal roles themselves. To get at the actual roles, work group members were asked to evaluate the importance of

ten federal government roles for infrastructure. Table 4 shows responses by all four groups, and a composite ranking.

Significant importance was attached to five of the ten roles by at least three groups. Consensus among the four groups was that providing capital funds for others who build and maintain public works was the most important federal role. In second place was federal promotion of research carried out by others. The closely related role of technology sharing came in third, while fourth place went to promoting intergovernmental cooperation and coordination. All except the federal group thought that funding infrastructure operations carried out by others was an important federal role.

All the federal roles in the survey, except "aesthetic and historical impacts," were ranked important by at least one of the four work groups. Table 5 shows that the federal roles cited in this survey question are related to those

Table 5
Relationships between Issue Priorities and the Importance of Federal Roles
(responses to ACIR questionnaire)

Most Important Issues (Question 7)		Importance of Federal Roles (Question 5)	
Rank	Issue	Rank	Federal Role
1.	Strategic Investment	*	Direct Federal Provision
2.	Regulatory/Administrative Relief	*	Regulatory Performance
		*	Regulating Environmental Impacts
		*	Aesthetic and Historical Impacts
3.	Flexibility of Federal Funding	4.	Intergovernmental Cooperation/Coordination
4.	R&D/Technology Transfer	2.	Promoting R&D by Others
		3.	Sharing Technology
		*	Performing R&D
5.	Intergovernmental Funding	1.	Capital Funding for Others
6.	Revenue Diversification	5.	Funding Operations by Others
7.	Management Improvement		

* The federal roles were not ranked important by most respondents even though they relate to high-priority issues.



listed as the most important infrastructure issues in the open-ended question.

Potential Opportunities for Interagency Cooperation

Federal agency representatives saw two problem areas in the "investment strategy" category that potentially could be improved through interagency cooperation. One concerns national needs studies (the most important issue identified by federal survey respondents); the other concerns the Federalism Executive Order that governs federal agency development of regulatory and legislative initiatives affecting state and local governments.

The numerous deficiencies noted in most infrastructure needs studies suggest that a major effort should be undertaken to improve methods and practice in this field. In particular, best practice calls for performance-based studies that are rare at present. All fields of infrastructure could benefit. The Department of Transportation is a leader in this activity.

It also was found that familiarity with the Federalism Executive Order is not widespread. If present trends for shifting greater infrastructure responsibilities to state and local governments continue, it would appear that more federalism assessments should be prepared. An interagency effort to establish principles for applying this order to public works programs could benefit all infrastructure agencies. Among infrastructure agencies, the Department of Transportation appears to be most familiar with this process.

II. Federal Standards, Regulations, and Mandates

Formal Issue Statement

Standard Setting. It is often constitutionally appropriate, cost effective, and necessary for the federal government to establish infrastructure and infrastructure-related standards. This is true especially when interstate and international considerations come into play. Such standards may promote health, safety, efficiency, equity, and program effectiveness.

Regulations and Mandates. Federal standards may be imposed on state and local governments by regulations that prohibit certain activities and mandate others. An alternative is to develop standards "nationally" by nongovernmental organizations, such as the Governmental Accounting Standards Board (GASB). In this case, guidelines for good practice are developed and applied, perhaps with technical and/or financial assistance to encourage their use.

Burdens. Many state and local governments complain that federal requirements associated with infrastructure programs unnecessarily displace too much state and local decisionmaking authority, change too frequently, create too much administrative burden, and induce too much added cost to state and local projects. Unnecessary and avoidable burdens should be reduced, but it may be difficult to determine which ones are unnecessary. Burdens that are disproportionate to benefits should be considered

for reduction. Benefit-cost analysis is one possible method for guiding such decisions.

Flexibility. Flexible regulations, based on performance goals rather than on specific design specifications, often are urged as a way to reduce regulatory burdens, to get better decisions from decisionmakers closer to the scene, and to save money by allowing economies. However, one person's flexibility may be another's perversion of the standards. The results of flexibility may be uncertain, and it may be difficult to write and monitor flexible regulations. Too much flexibility may indicate lack of any essential federal role. Substituting equivalent state and local regulations for federal regulations may help to reduce duplication, conflict, and waste.

Stability. Broadly applicable, infrequently changing federal regulations can add a degree of nationwide stability to infrastructure programs.

Reimbursement. Federally imposed burdens on state and local governments may be reduced by federal reimbursement of state and local costs in complying with federal requirements. Principles for determining what to reimburse could be helpful.

Small Governments. Because of limited tax bases and technical capabilities, small governments sometimes experience proportionally greater burdens than others in complying with federal regulations. The *Regulatory Flexibility Act of 1980* recognizes this fact, but it has not been fully used to grant needed relief.

Relationships. Those who do the regulating and those who are being regulated might get more done by working in partnership rather than in contention with each other. New federal authority for negotiated rulemaking and administrative dispute resolution might offer fruitful opportunities to reduce regulatory and administrative burdens.

Workshop Discussion

Participants in all workshops agreed that there has been an explosion of regulations affecting how state and local governments deliver infrastructure services. Most of these regulations focus on process or technical standards rather than on infrastructure performance. Some participants at each workshop expressed the view that there are too many regulations that are often conflicting, are too costly, and perhaps are not always necessary.

There were strong beliefs at all of the workshops that the federal government was:

- Shifting its participation in the infrastructure community from providing financial assistance to promulgating regulations;
- Often mandating specifications for delivering infrastructure services that are too rigid and could not be matched to many site-specific situations; and
- Not adequately balancing federal activity between promulgating regulations and providing financial assistance.



Participants at all workshops expressed their views that something needs to be done to avoid regulatory gridlock. While no clear priorities emerged, proposals were made to address concerns about the increasing number and cost of regulations. These proposals included shifting from process and technical regulations to performance standards, using regulations as a sanction when performance standards are not satisfied, and requiring the federal government to share in the cost of implementing specific regulations.

From the local perspective, there also was a concern about the independent nature of federal agencies in promulgating such regulations. As a result, when these regulations are applied at the local level, there are cases of inconsistencies, conflicts, and confusion. This was particularly true for the perceived conflict between environmental regulations and the need to provide infrastructure. The general view was that:

- The interaction between federal regulators and local officials needs to be improved.
- There needs to be better coordination among federal agencies (especially between those directly involved in infrastructure activities and the EPA).
- Local officials could improve the level and quality of infrastructure services if they had more flexibility in the use of funds.

While there was agreement that the number and cost of regulations increased significantly during the 1980s, there was not much discussion of how to determine which regulations are appropriate, which are excessive, and when a regulation is too costly. It was suggested that improved benefit-cost analysis, with performance standards, might help this situation.

Another theme that emerged during two workshops was the process of procuring infrastructure design, construction, and operation services. One concern was the impact of regulations on the time required to construct new facilities. Another major concern was that current federal procurement requirements mandate detailed technical requirements and selection of the lowest bidder for construction. It was felt that this process discourages innovation and removes accountability for system performance from the contractor. This process was contrasted with the European practice in which contractors are involved in developing design specifications and held responsible for the performance of the system after it is built. It was noted, however, that the European practice is more expensive in the short run, and would be politically difficult to follow in the United States, although it could save money in the long run.

Potential Opportunities for Interagency Cooperation

Strained relationships between the federal government and the state and local governments appear greatest in regulatory matters. The 1990 enactment of additional authority for all federal agencies to use negotiated regulation and administrative dispute resolution techniques ap-

pears to open new opportunities for easing these tensions. EPA, the U.S. Army Corps of Engineers, DOT, and perhaps other agencies have substantial experience with these mechanisms. The Administrative Conference of the United States is charged with promoting greater use of these techniques. It might be beneficial for federal infrastructure agencies to pool their experience and develop infrastructure-specific guidelines for applying this new authority.

Guidelines for applying the "small governments" provisions of the *Regulatory Flexibility Act* to public works programs are badly needed. EPA has accumulated significant experience with this issue in recent years—experience that might be of benefit to other departments and agencies.

Environmental regulations of many varieties frequently are the most difficult for state and local governments to comply with. The number, complexity, cost, and time delays of these regulations are increasing. The *National Environmental Policy Act* (NEPA) was supposed to provide linkages between these numerous regulations, but there has been difficulty in reaching that goal. The Council on Environmental Quality (CEQ), which oversees NEPA implementation, is offering workshops for federal agencies to help them take fuller advantage of the law. This is of particular relevance to infrastructure agencies.

Other regulatory issues on which federal infrastructure agencies might benefit from pooling their experience include the development of performance-standard regulations and principles for determining federal reimbursement responsibilities for federal mandates.

III. New Technologies, Research, and Innovation

Formal Issue Statement

Potential. Technological, managerial, legal, institutional, and other innovations are needed to improve the nation's infrastructure and keep America prosperous, competitive, productive, efficient, and a nation that offers a high quality of life. Research and development (R&D) programs have greater potential than is realized to contribute to such innovation. Some participants believe that a research strategy related to achieving widely held national goals could help to achieve more cost-effective innovation.

Special Topics. Three types of innovation that need special attention are (1) the procurement process, (2) reducing or spreading the liabilities of trying new techniques and new technologies, and (3) accounting more precisely for the value and incidence of infrastructure benefits and pollution responsibilities.

Federal Role. To achieve economies of scale in R&D and to make best use of the significant technical research capabilities of the federal government (including many laboratories, some of which can be expected to shift their focus from defense to domestic issues), the federal government has a major role to play in infrastructure R&D. This role, however, should not be top-down. The long-established National Cooperative Highway Research Program provides an example of how state, federal, and other interests can work together creatively to establish effective and responsive national research priorities.



Technology Transfer. R&D efforts, to be most effective, should be matched with technology transfer programs designed to get the word out about innovations that have potential widespread applications. Some new technologies, however, are proprietary. Sharing them may be more difficult and/or more expensive.

Workshop Discussion

Participants in all the workshops agreed that there was a major federal role in promoting innovation, demonstration, evaluation, and dissemination of new technologies in the infrastructure area. This discussion reinforced the survey results that ranked research and technology transfer among the high priority infrastructure issues (see Table 2) and assigned great importance to the federal government's role in these activities (see Table 4).

A number of suggestions were made as to how the federal government could fulfill this leadership role in technological innovation and technology sharing. These recommendations included:

- Shifting from technical to performance standards and encouraging experimentation;
- Funding federal labs to develop expertise in these areas and share those innovations with infrastructure providers;
- Spreading the risk of new technologies so that innovative ideas and approaches can be tried;
- Providing tort reform so that local governments will be willing to experiment rather than feeling compelled to follow traditionally accepted engineering standards;
- Financing demonstration projects that will allow the evaluation of new technologies;
- Promoting technology sharing and dissemination of innovative approaches to infrastructure challenges; and

- Creating an organization or entity to facilitate information sharing.

Strategies for Improving the Performance of Public Works

The surveys of constituent groups indicated that certain types of research are expected to play an increasingly important role in improving public works performance, while technology transfer is not expected to grow in importance quite so much. These findings are shown in Table 6, where the four groups ranked the growing importance of seven strategies for improving the performance of public works. This table also shows the composite ranking by all four groups.

Overall, research and development on information technologies was felt to offer the most rapidly growing potential for improving public works performance. Neck and neck for the second and third ranks were intergovernmental/interagency cooperation and coordination, and education and training for present and future employees. Thus, the top three ranks all went to what many people term the "soft side" factors. In fourth place was growth in the contributions of research and development on materials technology, followed by R&D for management and policy processes. Bringing up the rear were technology transfer strategies plus research and development on risk analysis techniques. The greatest consensus among the groups was on the top-ranked strategy (R&D for information technology) and bottom-ranked strategy (R&D on risk analysis).

Potential Opportunities for Interagency Cooperation

A strong beginning on developing a national cooperative infrastructure research agenda has been made by the Civil Engineering Research Foundation. Twelve federal agencies and 25 professional organizations are participating in this effort (see Figure 4, next page). The agenda of 35 specific research projects, released in September 1991, is summarized in Figure 5 (see next page). It emphasizes revitalizing the nation's public works, keeping America

Table 6
Strategies for Improving Performance of Public Works¹
(rank order of rate by growth in importance)

Means of Influence	Working Groups				Composite Rank	High-Low Difference
	Federal	State-Local	Research, etc.	Provider		
A. R&D						
(1) Materials Technology	4	4	2	6	4	4
(2) Information Technology	1	3	3	3	1	2
(3) Management/Policy Approaches	6	6	1	4	5	5
(4) Risk Analysis	5	7	7	5	7	2
B. Technology Transfer	7	5	4	7	6	3
C. Education/Training of Employees	3	2	5	1	3	4
D. Intergovernmental/Interagency Cooperation and Coordination	2	1	6	2	2	5

¹ Based on Survey Question 4—How important are the following means of improving the performance of public works in the view of your organization (agency)?



Figure 4
National Civil Engineering Research Needs Forum

Supported in Part by:	Cosponsors:	Participating Organizations:
Civil Engineering Research Foundation National Science Foundation	ATLSS Engineering Research Center Federal Aviation Administration Federal Highway Administration Federal Emergency Management Agency National Institute of Standards & Technology U.S. Air Force U.S. Army Corps of Engineers U.S. Department of Energy U.S. Department of Interior U.S. Environmental Protection Agency U.S. Navy	ACEC Research & Management Foundation Associated General Contractors of America AIA/ACSA Council on Architectural Research American Academy of Environmental Engineers American Association of Engineering Societies American Society of Civil Engineers ASFE/The Association of Engineering Firms Practicing in the Geosciences ASME Center for Research & Technical Development AWWA Research Foundation Building Officials & Code Administrators International Building Research Board Construction Industry Presidents Forum Earthquake Engineering Research Institute Foundation of the New Jersey Alliance for Action International Conference of Building Officials Institute of Transportation Engineers National Association of Corrosion Engineers National Conference of States on Building Codes National Institute of Building Sciences National Society of Professional Engineers Southern Building Code Congress International Technology Transfer Society Transportation Research Board WPCF Research Foundation

Source: Civil Engineering Research Foundation, *Setting a National Research Agenda for the Civil Engineering Profession*, September 1991.

Figure 5
A National Research Agenda for the Civil Engineering Profession

Revitalization of Public Works - Developing Tools to Make Smart Management Decisions - Finding New Ways to Finance Infrastructure Investment - Extending the Useful Life of the Infrastructure - Protecting Bridges from Natural Hazards - Identifying Structural Problems through Diagnosis - Removing Institutional Barriers to Innovation - Economic Benefits from Public Works Investments - Improving Water-Resource Systems Data through New Technology - Mitigating Coastal Damage from Natural Hazards - Protecting Dams against Earthquakes and Floods	Enhancement of the Environment - Turning Wastes into Treasures - Improving our Water Quality - Corralling Groundwater Pollutants - A Universal Approach to Site Cleanup - Natural and Engineered Ecosystems for Eliminating Pollutants - In-Situ Remediation and Treatment
Improvement of Competitiveness - Integrated Computer-Aided Engineering - Making Quality a Top Priority - Alternate Ways to Bid Contracts - Making a Case for Innovation in Civil Engineering - How to Organize for Innovation - People—the Industry's Most Valuable Resource	Technological Innovation - Automation Technologies for Construction Productivity - Robotic Technologies for Man-Remote Missions - Developing Super Construction Materials - Setting Standards to Predict the Life of Materials - Adapting New Materials to Civil Engineers for the 21st Century - Research to Application through Teamwork
	Technology Transfer - Clearing a Path to the Marketplace - Breaking the Legal and Regulatory Barriers to Innovation - Taking the Lead in Setting International Standards - Bringing Engineering Standards into the Computer Age - Identifying the Right Way and Wrong Way - Keeping Up-to-Date through Education

Source: Civil Engineering Research Foundation, *Setting a National Research Agenda for the Civil Engineering Profession*, September 1991.



competitive, enhancing the environment, advancing technologies, and accelerating technology transfer.

The increases in research funding under the new surface transportation program offer significant opportunities for many federal, state, and local infrastructure agencies. Interagency pooling of these research efforts might bring greater benefits to the nation than a more limited, transportation only, use of the research. For example, work on geographic information systems (GIS) could be beneficial to many programs.

IV. Financing

Formal Issue Statement

A Time of Change. The 1980s produced major changes in infrastructure finance. The federal government is moving spending toward other goals. Local tax revolts have limited the role of property taxes in infrastructure finance. The federal tax code encouraged privatization of infrastructure in the early 1980s but reversed that position in 1986. Some federal trust funds established to support infrastructure programs have been hoarded rather than spent. Thus, the means of financing infrastructure are in flux. The following finance issues need attention in 1990s.

Beneficiaries Pay. User fees and earmarked taxes are financing increased shares of infrastructure costs. This raises questions of equity when benefits accrue to others besides users. It also raises questions of affordability for some low-income members of society. In addition to beneficiaries, some costs can be attributed to persons responsible for creating costs (for example, polluters). Thus, allocating costs equitably is a complex task, full of controversy.

Intergovernmental Financing. Allowable local revenues usually are too limited to fund all necessary infrastructure. In addition, some infrastructure has benefits that clearly extend beyond local communities. Some benefits are clearly in scope. At the same time, most infrastructure is owned and operated by state and local governments.

Federal and state aid for infrastructure is common. During the 1980s, however, federal infrastructure aid declined proportionally while state aid played an increasing role. The proper roles of federal and state aid depend on judgments about the relative infrastructure roles and responsibilities of the federal, state, and local governments and the private sector. Further realignment in state and federal aid infrastructure programs may be needed.

Revenue Diversification. The federal government and most state and local governments lack adequate funds to meet perceived infrastructure needs. Little or no growth is expected in the use of general funds and grants for this purpose. Alternative means of raising additional funds are being examined intensively. Increased use of user fees, earmarked taxes, trust funds, special districts, revolving loan funds, cost sharing, regulation, and privatization are the primary alternatives being used or considered. The need to consider a replacement for the per-gallon gasoline tax is becoming urgent in the minds of

some observers because of energy and air quality policies designed to reduce the use of that fuel.

The Tax Code. Federal income tax treatment of infrastructure investments by state and local governments, as well as by private investors, may increase or decrease the cost of these investments. The wide swing in tax policy between 1981 and 1986 illustrates the controversial nature of this issue. Much of the argument revolves around the definition of what constitutes legitimate public works and the extent to which there is a federal interest. Interest in readjusting some of the 1986 tax reforms affecting infrastructure investments is apparent among some constituencies. There also is substantial support for tax code simplification and the lessening of certain compliance burdens, especially in the area of tax-exempt financing.

Workshop Discussion

The federal role in financing the nation's infrastructure was a major topic of discussion at each of the workshops. The key question concerned the impact of declining federal infrastructure financing on the federal interest and role in ensuring adequate levels and quality of infrastructure services. Most participants agreed that there should be stability in funding sources so that a long-term perspective could be taken in providing infrastructure services.

Most participants conceded that the probability of a near-term resurgence in federal financing for infrastructure was low or nonexistent. It was pointed out that many infrastructure networks developed by the federal government are virtually completed. Many workshop participants thought the limited resources allocated through these mechanisms could be used more efficiently if federal grant programs were redesigned. For example, the current priority given by some federal grants to capital investment may bias local decisions against cost-effective maintenance and operational improvements. *The Intermodal Surface Transportation Efficiency Act of 1991* provides flexibility in highway and transit programs to overcome such biases.

Participants at the state and local workshop raised questions about the matching ratios of federal infrastructure grants. In some cases, the participants thought the federal matching ratios may be too high, while in others they may be too low. Differences in such matching ratios change relative prices paid by local officials, thereby encouraging some behavior and discouraging other behavior. The participants felt that increased local discretion in allocating federal grant dollars would reduce any bias. In addition, there was some feeling that federal infrastructure grant programs limited to governmental entities may introduce bias against private providers of infrastructure services.

Concern was expressed about federal restrictions on the use of tax-exempt financing for infrastructure over the last decade. Efforts to limit access to tax-exempt financing treats different types of infrastructure investment differently. The general view was that there should be more consistency across categories of infrastructure, and the focus should be on making more investments eligible for tax-exempt financing.

Pricing of infrastructure services also drew comment. Individual users of many infrastructure facilities can be identified, charged a price, and excluded if they do not pay that price. This is generally true for mass transit, water supply, and wastewater treatment, and for the collection, storage, and disposal of solid and hazardous wastes. Some infrastructure services are provided directly by the private sector because of their pricing and profit potential. Examples include energy supply, telecommunications, and water supply, and the collection, storage, and disposal of solid and hazardous waste.

In such an environment, charging a price per unit of service consumed aligns the benefits received from infrastructure facilities with the price paid. Thus, pricing can increase the level and quality of infrastructure service being provided. The survey results indicated strong expectations by all four work groups that more use will be made of infrastructure pricing strategies in the future.

Some concerns were expressed, however, about the general applicability of such pricing, for several reasons:

- The beneficiaries of infrastructure facilities may not be limited to the users. Thus, pricing mechanisms designed to recover the full cost of providing the service will overcharge the actual users. In such circumstances there may be a need for general fund support.
- If the efficiency gains attributed to such pricing strategies are to be realized, individuals must have sufficient income to make choices. This is not the case for families with limited incomes, so there is an important distribution issue to address.
- Pricing policies may inhibit innovation because the beneficiaries of new technologies may not be known and identified before such technologies are developed and tried.

As reflected here, most of the discussion of financing issues focused on the strengths and weakness of various tools used by the federal government to provide financial support.

Survey Findings on Infrastructure Financing

Three questions in the survey related to finance: investment trends, influences on infrastructure spending, and the relative importance of various financing sources. These trend questions were designed to help assess changes that are likely to occur. The measure used in evaluating responses to these questions, therefore, is the ranking of expected degrees of change.

Investment Trends. Table 7 shows the median response in each work group and the average of these medians for present and expected spending on new construction; maintenance, reconstruction, and modernization; and operations. All four groups showed new construction holding its own at the present time, but two of them expected it to grow in the future. For maintenance, reconstruction, and modernization, the research/advocacy/user group saw a present decline, the federal group saw spending holding the line, and state and local officials and public works providers saw current spending increases. All saw moderate spending increases in the future. The four groups saw spending on operations holding the line at present, but all except the federal group expected future increases.

Overall, the trend seemed to be for moderate increases expected in spending for operations, maintenance, reconstruction, and modernization, but less increase for new construction.

Influences on Infrastructure Spending. Table 8 shows the rankings by each of the four groups and composite of the importance of ten different means of influencing infrastructure spending strategies. Overall, regular reporting of system and/or facility performance got the top

Table 7
Present and Future Infrastructure Investment Trends¹
Median Response on a Scale of Increasing Spending (+5) to Decreasing Spending (-5)

Type of Infrastructure Investment	Working Groups				Average Median	Rank Strength of Increase
	Federal	State-Local	Research, etc.	Provider		
A. New Construction						
■ Present	0	0	0	0	0.00	
■ Future	0	0	+1	+1	+0.5	3
B. Maintenance, Reconstruction, and Modernization						
■ Present	0	+1	-1	+1	+0.25	
■ Future	+1	+2	+1	+2	+1.50	1
C. Operations						
■ Present	0	0	0	0	0.00	
■ Future	0	+1	+1	+1	+0.75	2
Composite Score	+1	+4	+2	+5	+3.00	

¹ Based on Survey Question 1—How would you characterize the infrastructure investment policies that guide your organization (agency)?



Table 8
Means of Influencing Infrastructure Expenditure Strategies¹
(rank order by growth in importance)

Means of Influence	Working Groups				Composite Rank	High-Low Difference
	Federal	State-Local	Research, etc.	Provider		
A. Strategic Planning	4	8	5	1	5	7
B. Performance Rating	6	3	1	2	1	5
C. Needs Studies	7	10	4	8	9	6
D. Benefit-Cost Evaluations	8	1	3	5	4	7
E. Capital Improvement Programming	2	7	2	4	2	5
F. Available Resources	1	2	8	6	3	7
G. Environmental Protection Requirements	5	6	10	3	6	7
H. Citizen Participation	9	4	6	9	8	5
I. Political Considerations	*	5	9	*	10	9
J. Required Planning/Programming by Others	3	9	7	7	7	6

* No change expected.

¹ Based on Survey Question 2—How important are the following factors in your organization (agency) when developing infrastructure investment policies?

ranking for expected growth of importance in influencing expenditure strategies. The next fastest growing technique was capital improvement programming, followed by estimates of available resources, benefit-cost evaluations, and strategic planning. In the bottom half of the rankings were environmental protection requirements, required planning and programming by others, citizen participation, needs studies, and political considerations. It should be noted that political considerations are quite influential, and two groups (federal and public works providers) expected no change.

Table 8 also shows a relatively large spread in how the groups ranked their expectations for the rising influence of these investment planning factors. The greatest divergence was on the question of political considerations, with state and local policymakers ranking this in the middle range of increasing influence, while the other three groups saw little change. Considerable diversity was also observed with respect to increases in strategic planning, benefit-cost evaluations, estimates of available resources, and environmental protection requirements. The narrowest differences were in expectations for increased use of performance reporting (expected to increase the most), needs studies, capital improvement programming, citizen participation, and required planning and programming by others.

The growing influence of capital improvement programming was ranked second highest. Thus, there was a considerable degree of consensus among the groups on the rapid increase of the two top ranked techniques for influencing expenditure strategies.

Importance of Financing Sources. Table 9 shows the expectations for shifts in financing sources in the future. The use of general funds was expected to decrease by all of the groups except the state and local policymakers. The

use of federal and state grants was not expected to change overall. The other sources of funding were expected to grow in importance, with increased cost sharing taking the lead. Growth of user fees and the use of earmarked taxes, trust funds, and special districts were next. Shifting costs to others through regulation and tax incentives was expected to increase less. Overall, if these expectations were to be realized, they would strongly support the sixth most important issue identified in the open-ended question, namely, revenue diversification.

Potential Opportunities for Interagency Cooperation

One of the biggest financing challenges is assigning responsibilities for meeting costs. If governments were to follow the currently popular "beneficiaries pay" principle more closely, they would need better data on costs and benefits. Benefit accounting and cost accounting, when done at all, generally are limited to direct benefits and costs. Secondary benefits and costs also can be significant. In order to set fair and productive infrastructure service prices and to allocate intergovernmental aid properly, public accounting systems would have to be reformed fundamentally. Relative tax capacities and efforts also would figure into such calculations. The new Federal Accounting Standards Advisory Board might be a mechanism to help establish standards for use by public agencies to account for benefits and costs more accurately.

Lessons learned from new financing initiatives should be shared widely. For example, federal promotion of state revolving loan funds for wastewater treatment facilities is now several years into implementation. The potential for applying this concept to other types of infrastructure could be explored.

Table 9
Importance of Financing Sources¹
(rank order by growth in importance)

Federal Roles	Working Groups				Composite Rank
	Federal	State-Local	Research, etc.	Provider	
A. General Fund	*	5	*	*	*
B. User Fees	2	2	4	2	2
C. Earmarked Taxes, Trust Funds, and Special Districts	4	3	1	5	3
D. Federal and State Grants	NA	6	***	6	***
E. Shifting Financial Responsibilities to Others					
(1) by Regulation	5	1	5	4	4
(2) by Increased Cost Sharing	1	4	2	3	1
F. Tax Incentives	3**	7**	3	1	5

*Expected to decrease in importance.

**Despite growth in importance, still rated unimportant by more respondents than rated this source as important.

***No change expected.

¹ Based on Survey Question 3—How important are the following financing sources in the view of your organization (agency)?

Another initiative to be watched might be the new authorization for mixing public and private funds under ISTEA. Similarly, experiences with the May 1992 executive order on privatizing public facilities acquired with federal funds also should be monitored. Model cost-sharing contracts between the public and private sectors might be explored.

V. Management

Formal Issue Statement

Focus on Performance. Many infrastructure management practices have grown up around construction or maintenance of particular types of facilities. Traditionally, there has been little opportunity to transfer funds between programs. These narrow programs focus on inputs rather than on outcomes for the user, and they limit the problem solving ability of management.

Increasingly, infrastructure goals are being defined more broadly. For example:

- Mobility of persons is replacing highway construction.
- Communication is becoming a clearer alternative to transportation.
- Coordinated management and water conservation are becoming alternatives to building new dams.
- Landfills, incinerators, ocean dumping, and recycling are alternatives to each other, holding different implications for the cleanliness of land, water, and air resources.

These broader goals require greater freedom to assess a range of alternatives and transfer funds where they

are needed to achieve the best overall outcomes. Intermodal transfer authority is becoming more common in transportation programs, but intermedia flexibility for environmental protection and exchanges of surface-water with groundwater are rare.

The new congestion management systems required by ISTEA may provide a model for outcome-oriented management. Congestion measurements and their effects on air quality will be the focus of attention rather than any single input such as a new lane of highway or a new bus route. Various combinations of construction, equipment, maintenance, operational, and demand reduction improvements should be tried until acceptable results are attained.

Flexibility. Obviously, more than new performance monitoring and management techniques will be required for output-oriented performance management to work. Many inflexible regulations and funding restrictions will need to be reformed. For example, block grants rather than narrow categorical grants, or transfers of funds among categorical programs should be considered. They offer means of lowering arbitrary barriers to sound performance management practices.

Incentives. When certain behaviors are clearly necessary but absent, an alternative to heavy-handed requirements and mandates is to offer economic incentives. For example, the maintenance of U.S. highway pavements, bridges, and transit facilities and equipment is now inadequate. In addition to requiring annual management plans for rectifying this situation, ISTEA provides special funding for these purposes. There also is a provision for special funding to encourage congestion management and air quality compliance. Similar approaches should be considered for other types of infrastructure.



Capital Improvement Programming and Budgeting.

This technique is used routinely by most state and local governments in preparing annual capital budgets. The federal budget has no separate section or subtotal for capital investments. There is only supplementary reporting on capital investments, such as OMB's annual report required by the *Public Works Improvement Act of 1984*. There is a long history behind the difference in approach between the federal government and the state and local governments, and there is strong resistance to change.

Nevertheless, long-term capital improvement programming and priority-setting, as distinct from actual budgeting, are used by some of the physical development departments and agencies of the federal government. There also is a growing public concern about declining infrastructure that may induce other agencies to consider capital improvement programming.

The use of capital improvement programming is expected to become increasingly influential in setting federal, state, and local capital investment policies in the future. Providing a firmer, more analytical basis for capital improvement programming could help it live up to these high expectations.

Training. Good management requires well trained employees. As the scope of infrastructure concerns expands, as the current wave of retirements bites deeper, as public budgets shrink, and as the issues to be addressed become more complex, an adequate supply of qualified public works employees is becoming more problematic. The training of existing and future employees needs attention.

Workshop Discussion

There was a consensus that more attention needs to be paid to the level and quality of infrastructure services being produced. It was felt that this is not being done now because the performance of infrastructure networks is difficult to quantify and because there are too few agreed-on standards to gauge performance. Better measures of infrastructure services need to be constructed so that performance standards can be developed.

If better performance standards and measurements can be developed, then alternative service delivery approaches can be explored. In this context, workshop participants saw opportunities for infrastructure services to be provided in a manner that could maximize public benefits at the least cost to the private sector.

A number of participants also thought it was critical to develop a system that rewards good management practices and provides incentives to focus on demand management issues in addition to new construction. If there were improved performance standards and measurements, there would be more incentives to seek the most effective and efficient management of existing facilities.

Another major theme at each workshop was the need for better coordination and cooperation. Specifically, there needs to be improved coordination of federal agencies that have infrastructure related responsibilities; the Congress and federal agencies need to coordinate policy objectives across seemingly disparate programs; local offi-

cials need to be involved in the promulgation and development of federal regulations from the earliest possible moment; and infrastructure systems that extend beyond the political boundaries of state and local governments create a need for regional coordination.

Discussion of these issues raised many questions. For example, participants at the federal workshop raised questions about the difficulties in motivating agencies with different objectives to coordinate their activities, and the need to provide institutional incentives that could promote coordination/cooperation both among federal agencies and with the state and local governments.

Survey Findings on Importance of Federal Coordination

Table 10 shows the survey responses of the four work groups, with a composite ranking, to five types of coordination within the federal establishment. Most important, overall, is coordination of research resources, results, and expertise. The federal and research work groups gave this top priority, while the other two groups ranked it second. This reinforces the relatively great importance of research and development as an issue on the open-ended survey question.

In second place, overall, is the importance of coordinating planning and decisionmaking procedures. The state and local policymakers and public works providers felt especially strongly about this need, and their responses relate strongly to the high ratings given to the issue of flexibility in federal funding.

In third place is the need for coordinating federal regulatory strategies. This reinforces the ranking of regulatory relief as the second most important issue overall.

The fourth place finish of the need to coordinate federal program structures and grant conditions compares to the third place finish of administrative relief and flexibility among the most important overall issues.

The need for coordinating federal funding strategies came in last. This relates to the fifth most important issue—intergovernmental funding.

Potential Opportunities for Interagency Cooperation

A key concept in improving infrastructure management is the focus on performance. This focus is strongly fixed in the new surface transportation program. Thus, other federal agencies have an opportunity to watch how the new required management systems play out in the DOT programs. The President's Council on Management Improvement and the Competitiveness Council might want to consider nudging this process along.

In addition, there are new opportunities in the data and accounting fields that should be explored. Good management systems are data dependent. The U.S. Geological Survey chairs two recently reformulated data committees of key interest to infrastructure agencies: the Federal Geographic Data Committee that is at the cutting edge of GIS operations, and the Water Information Coordination Program. Both are interagency and intergovernmental activities that could provide significant benefits to infrastructure agencies.

Table 10
Importance of Federal Program/Agency Coordination¹
 (rank order of types of coordination)

Types of Coordination	Working Groups				Composite Rank
	Federal	State-Local	Research, etc.	Provider	
A. Program Structures and Grant Conditions	4	5	4	4	4
B. Funding Strategies		4	5	5	5
C. Regulatory Strategies	3	3	2	3	3
D. Research	1	2	1	2	1
E. Planning and Decisionmaking Procedures	3	1	3	1	2

¹ Based on Survey Question 6—How important do you believe it is for federal agencies to better coordinate their infrastructure programs in the following respects?

On the accounting side, there is an opportunity to make some headway against one of the toughest problems—deferred maintenance of capital facilities. The solution may come through some form of capital asset accounting. This topic was broached a few years ago by the Governmental Accounting Standards Board, but is relatively dormant. The concept is to inspect capital facilities regularly, determine the cost of needed maintenance, and either make the repairs or report the financial amount of needed repairs not made as a liability in the annual financial report. Tracking this financial record annually would allow management, policymakers, and citizens to assess the status of infrastructure maintenance much more precisely and realistically than is possible now and would save money by avoiding the catastrophic failures of facilities that often trigger large replacement costs. The opportunity to reopen this issue is occasioned by creation of the Federal Accounting Standards Advisory Board.

Other management techniques that might benefit from pooled federal agency development and coordination efforts with a special infrastructure emphasis are capital improvement programming, priority setting, and budgeting; benefit-cost analysis; administrative dispute resolution; and negotiated rulemaking.

Based on current involvement and expertise, DOT

might take the lead on the first; the U.S. Army Corps of Engineers might lead the second; and the other two might involve EPA, DOT, the Corps, and the Administrative Conference.

Conclusion

ACIR conducted a year-long consultation process on improving the nation's infrastructure with working groups representing federal, state, and local governments, public works providers and users, and research, professional, and advocacy organizations. This report documents that process, which sought to identify opportunities for federal interagency cooperation and coordination to help improve public works. A number of such opportunities were found.

Coordination within the federal establishment can benefit state and local governments in a variety of ways, including (1) improving technical and managerial practices and (2) providing consistency among federal agencies in their approaches to the administrative and regulatory requirements that state and local governments must meet.

Based on the results of the initial consultation process, ACIR recommends that the process continue with a strong focus on developing specific opportunities for improvements.



RECOMMENDATION

The Commission finds that maintaining, expanding, and modernizing America's infrastructure is essential to the nation's continued economic and environmental health and to raising the quality of life for every American. The Commission finds, furthermore, that fiscal stresses in federal, state, and local budgets, along with growing competition from other nations, demand urgent efforts to improve investment efficiency, program coordination, and economic productivity in the nation's infrastructure programs. Finally, the Commission finds that numerous timely opportunities exist to improve the nation's infrastructure by these means.

The Commission recommends, therefore, that the nation's state and local governments, and the several federal infrastructure agencies, work more closely together, and in cooperation with the private sector, to take advantage of opportunities to make the nation's infrastructure more efficient, better coordinated, and more highly productive. The opportunities that should be considered in working toward these goals include:

(a) Establishing programs to educate the general public, public officials, and public works professionals about the importance of public works to the nation and the innovations that are needed to keep America's infrastructure systems among the world's most productive;

(b) Developing improved methods for preparing performance-based infrastructure needs studies reflecting strategic objectives;

(c) Establishing infrastructure-specific guidelines for applying the Federalism Executive Order, the "small governments" provisions of the Regulatory Flexibility Act, the Administrative Dispute Resolution Act of 1990, and the Negotiated Rulemaking Act of 1990;

(d) Making greater use of the National Environmental Policy Act as an interagency focus to combine reviews and streamline the process for issuing environmentally sound infrastructure permits;

(e) Pooling federal agency experiences in using performance-standard regulations and mandate reimbursement practices;

(f) Developing a national cooperative infrastructure research program, including a strong technology transfer component;

(g) Removing or minimizing the barriers and risks confronted when innovating new technologies and practices;

(h) Establishing principles and guidelines for public agency benefit, cost, and deferred maintenance accounting;

(i) Evaluating the benefits and limitations of innovative financing techniques—including user fee systems, state revolving loan funds, tax exempt financing, and privatization techniques—and publicizing successful innovations;

(j) Improving the methods and practices of capital improvement programming and benefit-cost analysis; and

(k) Promoting geographic data coordination.



APPENDIX

Executive Order 12612, Federalism
President Ronald Reagan
October 26, 1987
(Federal Register, Vol. 52, No. 210,
October 30, 1987, p. 41685)

By the authority vested in me as President by the Constitution and laws of the United States of America, and in order to restore the division of governmental responsibilities between the national government and the States that was intended by the Framers of the Constitution and to ensure that the principles of federalism established by the Framers guide the Executive departments and agencies in the formulation and implementation of policies, it is hereby ordered as follows:

Section 1. Definitions. For purposes of this Order:

(a) "Policies that have federalism implications" refers to regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on the States, on the relationship between the national governments and the States, or on the distribution of power and responsibilities among the various levels of government.

(b) "State" or "States" refer to the States of the United States of America, individually or collectively, and, where relevant, to State governments, including units of local government and other political subdivisions established by the States.

Section 2. Fundamental Federalism Principles. In formulating and implementing policies that have federalism implications, Executive departments and agencies shall be guided by the following fundamental federalism principles:

(a) Federalism is rooted in the knowledge that our political liberties are best assured by limiting the size and scope of the national government.

(b) The people of the States created the national government when they delegated to it those enumerated governmental powers relating to matters beyond the competence of the individual States. All other sovereign powers, save those expressly prohibited the States by the Constitution, are reserved to the States or to the people.

(c) The constitutional relationship among sovereign governments, State and national, is formalized in and protected by the Tenth Amendment to the Constitution.

(d) The people of the States are free, subject only to restrictions in the Constitution itself or in constitutionally authorized Acts of Congress, to define the moral, political, and legal character of their lives.

(e) In most areas of governmental concern, the States uniquely possess the constitutional authority, the resources, and the competence to discern the sentiments of the people and to govern accordingly. In Thomas Jefferson's words, the States are "the most competent administrations for our domestic concerns and the surest bulwarks against antirepublican tendencies."

(f) The nature of our constitutional system encourages a healthy diversity in the public policies adopted by the people of the several States according to their own conditions, needs, and desires. In the search for enlightened public policy, individual States and communities are free to experiment with a variety of approaches to public issues.

(g) Acts of the national government—whether legislative, executive, or judicial in nature—that exceed the enumerated powers of that government under the Constitution violate the principle of federalism established by the Framers.

(h) Policies of the national government should recognize the responsibility of—and should encourage opportunities for—individuals, families, neighborhoods, local governments, and private associations to achieve their personal, social, and economic objectives through cooperative effort.

(i) In the absence of clear constitutional or statutory authority, the presumption of sovereignty should rest with the individual States. Uncertainties regarding the legitimate authority of the national government should be resolved against regulation at the national level.

Section 3. Federalism Policymaking Criteria. In addition to the fundamental federalism principles set forth in section 2, Executive departments and agencies shall adhere, to the extent permitted by law, to the following criteria when formulating and implementing policies that have federalism implications:



(a) There should be strict adherence to constitutional principles. Executive departments and agencies should closely examine the constitutional and statutory authority supporting any Federal action that would limit the policymaking discretion of the States, and should carefully assess the necessity for such action. To the extent practicable, the States should be consulted before any such action is implemented. Executive Order No. 12372 ("Intergovernmental Review of Federal Programs") remains in effect for the programs and activities to which it is applicable.

(b) Federal action limiting the policymaking discretion of the States should be taken only where constitutional authority for the action is clear and certain and the national activity is necessitated by the presence of a problem of national scope. For the purposes of this Order:

(1) It is important to recognize the distinction between problems of national scope (which may justify Federal action) and problems that are merely common to the States (which will not justify Federal action because individual States, acting individually or together, can effectively deal with them).

(2) Constitutional authority for Federal action is clear and certain only when authority for the action may be found in a specific provision of the Constitution, there is no provision in the Constitution prohibiting Federal action, and the action does not encroach upon authority reserved to the States.

(c) With respect to national policies administered by the States, the national government should grant the States the maximum administrative discretion possible. Intrusive, Federal oversight of State administration is neither necessary nor desirable.

(d) When undertaking to formulate and implement policies that have federalism implications, Executive departments and agencies shall:

(1) Encourage States to develop their own policies to achieve program objectives and to work with appropriate officials in other States.

(2) Refrain, to the maximum extent possible, from establishing uniform, national standards for programs and, when possible, defer to the States to establish standards.

(3) When national standards are required, consult with appropriate officials and organizations representing the States in developing those standards.

Section 4. Special Requirements for Preemption

(a) To the extent permitted by law, Executive departments and agencies shall construe, in regulations and otherwise, a Federal statute to preempt State law only when the statute contains an express preemption provision or there is some other firm and palpable evidence compelling the conclusion that the Congress intended preemption of State law, or when the exercise of State authority directly conflicts with the exercise of Federal authority under the Federal statute.

(b) Where a Federal statute does not preempt State law (as addressed in subsection (a) of this section), Executive departments and agencies shall construe any authorization in the statute for the issuance of regulations as authorizing preemption of State law by rulemaking only when the statute expressly authorizes issuance of preemptive regulations or there is some other firm and palpable evidence compelling the conclusion that the Congress intended to delegate to the department or agency the authority to issue regulations preempting State law.

(c) Any regulatory preemption of State law shall be restricted to the minimum level necessary to achieve the objectives of the statute pursuant to which the regulations are promulgated.

(d) As soon as an Executive department or agency foresees the possibility of a conflict between State law and Federally protected interests within its area of regulatory responsibility, the department or agency shall consult, to the extent practicable, with appropriate officials and organizations representing the States in an effort to avoid such a conflict.

(e) When an Executive department or agency proposes to act through adjudication or rulemaking to preempt State law, the department or agency shall provide all affected States notice and an opportunity for appropriate participation in the proceedings.

Section 5. Special Requirements for Legislative Proposals. Executive departments and agencies shall not submit to the Congress legislation that would:

(a) Directly regulate the States in ways that would interfere with functions essential to the States' separate and independent existence or operate to directly displace the States' freedom to structure integral operations in areas of traditional governmental functions;

(b) Attach to Federal grants conditions that are not directly related to the purpose of the grant; or

(c) Preempt State law, unless preemption is consistent with the fundamental federalism principles set forth in section 2, and unless a clearly legitimate national purpose, consistent with the federalism policymaking criteria set forth in section 3, cannot otherwise be met.

Section 6. Agency Implementation.

(a) The head of each Executive department and agency shall designate an official to be responsible for ensuring the implementation of this Order.

(b) In addition to whatever other actions the designated official may take to ensure implementation of this Order, the designated official shall determine which proposed policies have sufficient federalism implications to warrant the preparation of a Federalism Assessment. With respect to each such policy for which an affirmative determination is made, a Federalism Assessment, as described in subsection (c) of this section, shall be prepared. The department or agency head shall consider any such Assessment in all decisions involved in promulgating and implementing the policy.

(c) Each Federalism Assessment shall accompany any submission concerning the policy that is made to the Of-

Office of Management and Budget pursuant to Executive Order No. 12291 or *OMB Circular No. A-19*, and shall:

(1) Contain the designated official's certification that the policy has been assessed in light of the principles, criteria, and requirements stated in sections 2 through 5 of this Order;

(2) Identify any provision or element of the policy that is inconsistent with the principles, criteria, and requirements stated in sections 2 through 5 of this Order;

(3) Identify the extent to which the policy imposes additional costs or burdens on the States, including the likely source of funding for the States and the ability of the States to fulfill the purposes of the policy; and

(4) Identify the extent to which the policy would affect the States' ability to discharge traditional State governmental functions, or other aspects of State sovereignty.

Section 7. Governmentwide Federalism Coordination and Review

(a) In implementing Executive Order No. 12291 and *OMB Circular No. A-19*, the Office of Management and Budget, to the extent permitted by law and consistent with the provisions of those authorities, shall take action to ensure that the policies of the Executive departments and agencies are consistent with the principles, criteria, and requirements stated in sections 2 through 5 of this Order.

(b) In submissions to the Office of Management and Budget pursuant to Executive Order No. 12291 and *OMB Circular A-19*, Executive departments and agencies shall identify proposed regulatory and statutory provisions that have significant federalism implications and shall address any substantial federalism concerns. Where the departments or agencies deem it appropriate, substantial federalism concerns should also be addressed in notices of proposed rulemaking and messages transmitting legislative proposals to the Congress.

Section 8. Judicial Review. This Order is intended only to improve the internal management of the Executive Branch, and is not intended to create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its agencies, its officers, or any person.

Memorandum on Federalism Executive Order for the Heads of Executive Departments and Agencies President George Bush February 16, 1990

I wish to take this opportunity to reaffirm an important Executive order, issued when I served as Vice President, and call for your personal commitment in ensuring your department's or agency's compliance with its provisions. This order, which is entitled "Federalism" (No.

12612, October 26, 1987), establishes fundamental principles and criteria to guide you in developing and implementing policies that have substantial direct effects on States and local governments. Let me note a few of the order's more important provisions:

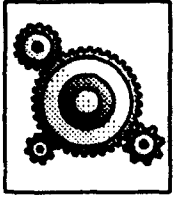
- In most areas of governmental concern, the States uniquely possess the constitutional authority, the resources, and the competence to discern the sentiments of the people and to govern accordingly.
- The nature of our constitutional system encourages a healthy diversity in the public policies adopted by the people of the several States according to their own conditions, needs, and desires. In the search for enlightened public policy, individual States and communities are free to experiment with a variety of approaches to public issues.
- Federal action limiting the policymaking discretion of the States should be taken only where constitutional authority is clear and certain and the national activity is necessitated by a problem of national scope.
- With respect to national policies administered by the States, the national Government should grant the States the maximum administrative discretion possible.
- When undertaking to formulate and implement policies that have Federalism implications, Federal executive departments and agencies should (1) encourage States to develop their own policies to achieve program objectives and to work with appropriate officials in other States; (2) refrain, to the maximum extent possible, from establishing uniform national standards for programs and, when possible, defer to the States to establish standards; and (3) when national standards are required, consult with appropriate officials and organizations representing the States in developing those standards.

The Executive order has special requirements dealing with preemption and with legislative proposals. It also requires that, when a proposed policy has sufficient Federalism implications, the agency must prepare a Federalism Assessment. This assessment is intended to provide the agency and the Administration with an evaluation of the extent to which the policy imposes additional costs or burdens on States and local governments. You are to consider the Federalism Assessment before adopting and implementing the policy.

The order also requires that you designate an official to be responsible for ensuring your agency's implementation of the order. Please ensure that your agency has provided the name of the designated official to the Director of the Office of Management and Budget.

I want to stress that the principles of this order are central to my Administration. I ask that each of you personally review the provisions of Executive Order No. 12612 and assure that the mechanisms necessary to ensure their implementation are in place.





Appendix H

Developing a Federal Infrastructure Strategy

DEVELOPING A FEDERAL INFRASTRUCTURE STRATEGY

L. Vallianos and E.Z. Stakhiv
Institute for Water Resources
U.S. Army Corps of Engineers

Introduction

Over the past decade much has been said and written concerning the declining condition of, and need to improve and sustain the Nation's public works infrastructure. Many assessments of the major problems besetting infrastructure suggest the need for significant increases in expenditures for new facilities as well as maintenance and rehabilitation of existing infrastructure. However, it is also generally recognized that significant improvements could be gained by changes in the areas of related management and existing institutional arrangements and interrelationships. Potential improvements in these areas are receiving ever-increasing attention, given the austere budgetary constraints which now confront all levels of government.

Among the many suggestions for improvements in management and institutional relations is the frequently expressed notion that all levels of government should effect closer coordination of their various agencies which administer and/or regulate infrastructure components. The expectation underlying this notion is that increased coordination between agencies would prevent duplicative efforts, minimize programmatic conflicts, focus combined efforts on high priority problems and result in the sharing of efficient procedures, technologies and resources. For example and as concerns the national government, a report prepared by Congress' Office of Technology Assessment (OTA; 1991) states:

OTA finds the Federal Government has fallen behind industry, world credit markets, State, regional and local authorities, the courts, and international organizations in determining the national public works agenda. Stronger Federal leadership is needed to develop integrated, long-range na-

tional water resources, transportation, and environmental policies that will direct and coordinate intergovernmental and private activities. This effort may result in new goals as well as institutional mechanisms for achieving them.

OTA concludes that the time is ripe to review the Federal oversight structure and management practices for public works so that policies are better coordinated and more cost-effective, and decisions about priorities made wisely.

Federal Agencies Initiative

Within the Federal infrastructure establishment there is an increasing awareness of the desirability to strengthen agency linkages and to broaden the scope of interagency coordination activities. This awareness is reflected in a recent initiative to establish a process in which the relevant federal agencies can explore the potential for development of a federal infrastructure strategy and the form that it might take. Among the basic initial objectives for developing of a strategy are the enhancement of interagency exchanges of information and sharing strategies, procedures and resources such as research laboratory facilities.

Departments and agencies invited to participate in the strategy development process include the Departments of Agriculture, Commerce, Energy, Housing and Urban Development, Interior, Transportation, Treasury, and the Environmental Protection Agency, Corps of Engineers and the General Services Administration. Also invited to join in this interagency process are representatives of Congressional staffs dealing with infrastructure matters.

Development Process

Interagency discussions with respect to a



federal infrastructure strategy are being facilitated and coordinated by the staff of the Advisory Commission on Intergovernmental Relations (ACIR). This effort is being funded by the U.S. Army Corps of Engineers through its Federal Infrastructure Strategy Study. The ACIR is a permanent, bipartisan and independent agency established by Congress in 1959. Its primary missions are to: (a) provide a forum for discussion and deliberation on intergovernmental issues and problems; (b) conduct research on intergovernmental issues; and (c) make recommendations for reform. The Commission is composed of 26 members with the membership including representatives of the executive branch of the federal government (3), members of Congress (6), governors (4), state legislators (3), and county officials (3). Each Commission member serves a two-year term and may be reappointed.

The basic process that the ACIR staff is using to facilitate and coordinate the dialogues between the federal agencies consists of a series of workshops to surface and examine key issues related to public works infrastructure. In order that these issues can be addressed in the context of national concerns, the views of diverse infrastructure constituencies and their interactions with the federal establishment must be considered. Therefore, the federal agency representatives in the strategy development process will be participating in workshops attended by representatives of state and local governments, public works professions, private sector providers of infrastructure components, public interest groups, and policy analysts and researchers. This strategy is consistent with the overall goal of broadening the federal interest as a catalyst for an integrated national infrastructure renewal strategy.

At present it is anticipated that the workshops, to be conducted at the offices of ACIR, will be carried out and completed by end of this year. Further, on the basis of the results of those workshops, it is planned to have a national conference in February of 1992 to formulate a preliminary federal strategy and to set its agenda. The strategy would be finalized after a series of four regional

conferences that are expected to draw broad interests and participation around the nation and to provide valuable input for finalizing a strategy.

Basic Principles

During the present formative stage in the process of exploring the development of an infrastructure strategy, a few basic recommendations of the National Council on Public Works Improvement (1988) have been selected as guiding principles. These recommendations are contained in the Council's report to the President and Congress in 1988 and are listed therein as follows:

- Clarification of the respective roles of the federal, state and local governments in the construction and management of infrastructure to focus responsibility and increase accountability;
- Steps to improve the performance and efficiency of existing facilities;
- A rational capital budgeting process at all levels of government;
- Strong incentives to ensure adequate maintenance and, where appropriate, adopt new technologies; and
- More rigorous and widespread use of low capital techniques for delivering services and meeting service needs, such as demand management, coordinated land-use planning, and waste reduction and recycling.

In summarizing its findings, the Council also recommended that state and local governments continue to play their traditional leadership roles in the construction and management of the nation's infrastructure. But this was conditioned by the Council's expressed belief that:

the federal government must act as a full and responsible partner on a long-term basis in the national effort to increase and sustain public capital investment.

Agency Actions

The initiation of discussions between federal agencies concerning a possible infrastructure strategy is one manifestation of the desire of these agencies to serve as responsible partners in a national effort to improve and sustain the condition of the country's infrastructure. However, in the final analysis, improvements will largely depend on the actions taken by individual agencies in addressing problems within their respective programmatic areas. In that regard, there are impressive recent examples of two large agencies establishing strategic plans to assure a reasoned, long-term commitment to the nation's infrastructure needs. Specifically, the strategic plans developed by the U.S. Department of Transportation (1990) and the Department of Energy (1991/1992).

Within the authors' own experience with programs of the U.S. Army Corps of Engineers, considerable emphasis is being placed on activities and programs directed at increasing the productivity and performance of the public works infrastructure within the purview of the Corps' civil and military facilities responsibilities. Some of these programs are summarized below. It will be noted that each of these programs is directed at one or more of the objectives recommended by the NCPWI, namely: (a) clarification of roles accountability, and enhanced partnerships; (b) improved performance and efficiency; (c) rational capital budgeting; (d) adequate maintenance; and (e) adoption of new technologies and use of low capital techniques.

Construction Productivity Advancement Research (CPAR) Program. The CPAR program is a cost-shared partnership between the Corps of Engineers and the U.S. construction industry, academic institutions, state and local governments and other groups to help the U.S. construction industry regain its competitive edge nationally and internationally. The program objective is to facilitate research, development and application of advanced technologies through cooperative R&D, field demonstrations, licensing agreements and other forms

of technology transfer. Research focuses on four main areas - design improvement, improved construction site productivity, advanced materials and technology transfer innovations.

CPAR has several features which distinguish it from similar cooperative programs: - research ideas and proposal are generated by industry, not the Corps; - CPAR projects are fully cost-shared partnerships between the Corps and industry; - rapid transfer and application of R&D results are facilitated through aggressive technology transfer/marketing actions, including exclusive licensing of the industry partner.

Inland Navigation Investment Priorities (INIP). The Water Resources Development Act of 1986 set up an Inland Waterways Users Board to provide oversight and guidance to the Corps of Engineers for the long range development and rehabilitation of the inland navigation system. The Corps developed a system-wide strategy (INIP) for evaluating and setting economic priorities for improvements to the system, which take into account the reality that expenditures could not exceed the accumulation of funds in the Waterways Trust Fund, collected through a fuel tax on vessels and barges using the system.

Repair, Evaluation, Maintenance and Rehabilitation (REMER) Research Program. The overall objective of the REMER research program is to identify and develop effective and affordable technology for maintaining and extending the service life of existing water resources projects. In this connection, REMER technology requirements of aging infrastructure, in many cases, cannot be met with technologies applicable to new construction. The program addresses REMER problems in seven broad areas: Concrete and Steel Structures, Geotechnical, Hydraulics, Coastal, Electrical and Mechanical, Environmental Impacts, and Operations Management.

Savings to the Corps from the results of this program over the past 6 years are estimated at \$69 million with projected savings in the next 5 years



of \$200 million. Use of the REMER technologies by other Federal agencies, state and local governments and the private sector substantially increases the benefits of the program.

Dredging Research Program (DRP). The DRP is structured to provide new technologies in the physical aspects of dredging for use by Corps field offices and the dredging industry. The program focuses on five topical areas, namely: (a) the fate of dredged material placed in open waters; (b) material properties related to navigation and dredging; (c) dredge plant equipment and system processes; (d) vessel positioning, survey controls and dredge monitoring systems; and (e) management of dredging projects. The products of this research activity result in increased cost-efficiencies in operations, reduction in undesirable dredging-induced environmental impacts, and reduction in contract claims.

Hydropower Efficiency Improvements Program. The Corps is initiating a detailed analysis of its current operations and maintenance, and capital improvement practices pertaining to Corps hydropower facilities. The objectives of this detailed analysis are to determine the best means by which to implement recommendations of a general study on facilities performance. Those recommendations are largely based on the conclusion that the Corps should establish an operations/maintenance philosophy consistent with that of the private-sector power industry, including: (a) maintaining projects in perpetuity; (b) targeting forced outage rates to not more than one percent; and (c) changing from preventive to predictive maintenance practices.

Construction Partner Program. This program involves establishing cooperative management teams (Corps/contractors) including the key participants in major construction efforts. Through a facilitated workshop process, the management teams focus on common goals and benefits to be achieved thorough contract execution. Though conflicts are not entirely eliminated by this process, the construction partner program is demonstrating its effectiveness in reducing the number of disputes that result

in litigations.

Life Cycle Project Management (LCPM). The Corps has moved from fragmented project management along functional lines to a centralized management system in each district office. The basic system consists of a full-time life cycle project management staff and a project management review board. Development and use of a written management plan for each project, from its inception, is an essential element of this system. The plan identifies at the outset what the roles are of the various elements of the Corps and the non-federal project sponsor(s). The LCPM system has been found to be effective in increasing accountability for project scope, quality, cost, budget and schedule and improving project management continuity.

Policy and Procedures Study for Project O&M. At present, operations and maintenance (O&M) of the Corps Civil Works projects accounts for 45 percent of the agency's budget and utilizes about half of its work force. This major program requires constant review to insure management of these resources in an efficient and effective manner. A new major O&M management study has been initiated by the Corps with the objective being that federal expenditures for O&M provide justified levels of service in the least cost manner. The output of this study is expected to be practical measures, i.e. the policies and procedures that could be applied toward the study objective.

Summary

There is a recognition on the part of the infrastructure agencies of the federal government that the effectiveness and efficiencies of their respective programs could be enhanced by strengthening interagency linkages and coordination activities. Towards that end, a recent initiative has been taken whereby the relevant federal agencies are beginning to explore the potential for developing a federal infrastructure strategy. Some initial objectives of such a strategy would be to enhance means of exchanging information, and to share



strategies, procedures and possibly resources such as research laboratory facilities. The principles on which the interagency dialogues are being based are the findings of the National Council on Public Work Improvement (NCPWI) which recommended: (a) clarification of the respective roles of governments; (b) rational capital budgeting; (c) improvements in performance and efficiency; (d) incentives to assure adequate maintenance and adoption of new technologies; and (e) broader use of low capital techniques. There is also strong evidence that the various federal infrastructure agencies are taking positive actions on individual levels, that are consonant with the NCPWI recommendation's in order to improve the effectiveness of their respective programs. Examples of such actions are the recent strategic plans of the Departments of Transportation and Energy and various infrastructure related programs instituted by the Corps of Engineers.

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