A SYSTEM FOR FORECASTING AND MONITORING
CASH FLOW

Phase II: Forecasting Federal and State Revenues,
Maintenance Contracts, Other Expenditures,
and Cash Balances

by

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(The opinions, findings, and conclusions expressed in this
report are those of the author and not necessarily those of
the sponsoring agencies.)

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PREFACE

This report and the recommendations contained therein are the culmination of research initiated at the request of the director of finance and the budget officer of the Virginia Department of Highways and Transportation. In 1981, shortly after the Budget Division was created, its personnel began to question the reliability of the cash forecasting techniques which had been inherited by the Division. In addition, they anticipated that the cash forecast could be used as an effective management tool only if it were improved and documented. The findings of this research have confirmed that the forecasting techniques can be improved and that improved forecasts can serve as a springboard for a heightened awareness of the role cash management can play in the Department's construction and maintenance program.

ACKNOWLEDGEMENTS

ABSTRACT

The research on which this report is based was performed as part of a study to develop an improved system for generating a two-year forecast of monthly cash flows for the Virginia Department of Highways and Transportation. It revealed that current techniques used by the Department to forecast right-of-way payments, salaries and wages, and allocations to cities, counties, other state agencies, and transit properties require no change. On the other hand, it showed that forecasts of expenditures on materials, supplies and equipment, and maintenance contracts have overestimated actual cash outlays by significant margins. In addition, this research revealed that success in forecasting federal revenue reimbursements is, at best, likely to be spotty and that forecasts typically will be overly optimistic. For state revenues, official forecasts approved by the Office of the Secretary of Transportation necessarily serve as the basis of the official cash forecast; nevertheless a technique is proposed for early identification of significant changes in state revenue collections. The use of techniques derived from this research in a December 1983 forecast of cash flows for January through July 1984 showed that the estimated cash balance for the end of the period was within $4.0 million of the actual balance.

Among the major recommendations are that it may be reasonable to establish cash balances at contingency levels consistent with the expected excess of expenditures over revenues for the months of July through October.

SUMMARY

This report presents the results of Phase II of a study to improve the overall cash flow forecasting system utilized by the Department. It includes an analysis of the performance of the contract construction forecasting technique recommended in the report on Phase I of the study (published September 1983), a proposal for forecasting monthly variations in state revenue, a discussion of the success with which federal aid reimbursements may be forecast, and suggestions regarding expenditure forecasts, including contract maintenance and materials and supplies. This section of the report summarizes the principal results and conclusions of the research on cash flow forecasting.

State Revenues

-- State revenues, which comprise the Highway Construction and Maintenance Fund, are officially forecast by the Office of the Secretary of Transportation based upon major collections estimated by the Division of Motor Vehicles and the Corporation Commission. The Department of Highways and Transportation provides the Secretary's office with an estimate of the state fees and permit revenues it collects, but these are a very small percentage of total state revenue.

-- Estimates of major revenue sources (fuel and sales and use taxes) are updated quarterly by the Division of Motor Vehicles.

-- For the purposes of its cash flow forecast, the Department estimates monthly variations in state revenue by applying historical monthly distribution factors to the official state revenue estimate. This technique, although reasonable, has two drawbacks. First, the historical monthly distribution factors currently in use have not been seasonally adjusted to account for the impact the historical revenue trend may have had upon the monthly distribution pattern. Secondly, the utilization of a revenue forecast updated quarterly or semiannually for the current fiscal year has less than optimal value as a programming, scheduling, and budgetary aid.

-- The Department's errors in the monthly cash forecast can be no smaller than the error in the official state revenue forecast. From January through July 1984 state revenue collections exceeded the estimate forecast in December 1983 by $48.8 million. Over the 25-month period through July 1984, the official forecast, including all updates, explained 77% of the variation in monthly revenue collections from state sources. The standard error was $5.03 million per month. An alternative

technique, based on collections in the third quarter of the previous fiscal year, offers significant potential for identifying shifts in revenue patterns well in advance of official updates of the forecast and, if used properly, can serve as a valuable planning tool in the project development and budgetary process.

Federal Aid Reimbursements

-- Forecasting federal aid reimbursements has been and will likely continue to be among the most difficult tasks of the cash estimation process. The Budget Division forecast for April 1982 through December 1983 captured only 5% of the monthly variation in federal aid reimbursements and had a cumulative error in excess of $100 million, chiefly because during this period contract construction was significantly overestimated.

-- Currently, the federal aid reimbursement forecast is derived from the contract construction payout forecast technique implemented in January 1984. As compared to the technique previously used, this new procedure is performing much better. For the first nine months of 1984 the cumulative error under this monthly factors technique was $30.7 million, whereas for the technique previously used the error was $85.6 million.

-- Nothwithstanding the fact that the error is smaller with the monthly factors technique than with the technique used formerly, the tendency of the forecast to overestimate actual reimbursements is not desirable.

-- The federal aid reimbursement process spans four to five years. It begins when the apportionment is announced and ends four or five years later when the last charges for a construction project have been submitted, approved, and reimbursed. Using multiple regression analysis and the fact that reimbursements from a particular year's apportionment trickle in to the cash balance over a five-year period, a forecast can be developed which avoids the apparent overoptimism of the monthly factors technique. For the period from January through September 1984 this forecast underestimated collections by $7.9 million.

Contract Construction

-- In the Phase I report on this study, a contract construction forecasting technique was recommended which uses size and type

of contract as well as seasonal payout distribution factors. This
technique was implemented in January 1984.

— The technique has performed extremely well during the first nine
   months of use, overestimating total contract payout by a
   cumulative error of approximately $13.0 million.

Payments to Localities, Other Agencies, and Transit Properties, and Expenditures on Salaries and Wages, Equipment, and Right-of-Way

— The forecasting techniques for a number of items which comprise
   the cash flow forecast are performing very well and require no
   change. Among these are the techniques for forecasting payments
   to Arlington and Henrico counties for maintenance, to cities for
   street maintenance, to other agencies such as the Division of
   Motor Vehicles, and to transit properties. In addition, no
   change is required in the estimation techniques for expenditures
   on salaries and wages, equipment, and right-of-way.

Maintenance Contracts

— The Budget Division forecast has tended to overestimate the
   expenditures on maintenance contracts largely because the
   estimate provided by the Maintenance Division has been overly
   optimistic. Annual expenditures can be more accurately
   predicted as a function of the maintenance budget with a simple
   equation based on historical data. Seasonality is stable and
   can be predicted using a Bureau of Labor Statistics seasonal
   adjustment technique.

Consultants, Miscellaneous Contracts, and Other Expenditures

— Several line items in the cash forecast do not correspond to
   line items in the program budget; thus, they tend to be
   difficult to forecast. Among these are consultant fees,
   miscellaneous contracts, and the line item called "other
   expenditures." The most straightforward method of dealing with
   these items for cash flow purposes is to combine them, estimate
   them as a fixed percentage of revenue, and distribute the
   expected payout proportionately over the fiscal year.

Materials and Supplies

-- There has been an apparent tendency to overestimate expenditures
   on materials and supplies. Beginning in July 1982 it was not
   possible to reconcile reported expenditures with reported
   purchases. In the absence of more reliable data, the Budget
   Division forecast has been revised downward to be more
   consistent with reported expenditures. As a result, the
   performance of the forecast should be more consistent with
   actual payout as reported by the Fiscal Division.

Cash Balances

-- Based upon data available through September 1984, the techniques
   proposed in this report provide excellent forecasting results
   for the cash balances available for the nine-month period
   beginning in January 1984. Through July 1984 the estimate was
   within $4.0 million of the actual cash balance and through
   September was within $20.0 million. A forecast based on
   previously used techniques resulted in an error in excess of
   $140.0 million for the same period. Of this error, $49.0
   million were due to errors in the official revenue estimate.

-- The techniques proposed in this report offer the potential for
   much more accurate forecasts than have been the case in the
   past. For the forecast period from July 1984 through June 1986,
   cash balances should be significantly above levels predicted by
   the techniques previously used by the Department. The following
   can be expected for the forecast period.

   -- Under the techniques formerly used, federal aid is
      estimated to be $992.0 million. The estimate is $756.0
      million under the proposed techniques.

   -- Under the techniques formerly used, contract construction
      payout is estimated to be $1.1 billion. The estimate is
      $801.0 million under the proposed techniques.

   -- Under the techniques formerly used, total payout is
      estimated to be $1.953 billion. The estimate is $1.860
      billion under the proposed techniques.

   -- Under the techniques formerly used, the cash balance is
      not expected to be less than $145.0 million. Under the
      proposed techniques, the cash balance is not expected to
      be less than $207.0 million and is expected to average
      approximately $230.0 million over the 24-month period.

-- One criterion by which reasonable cash balances for contingency
purposes can be judged is the stability in the pattern of the
periods during which expenditures exceed monthly revenues.
Since July 1980, expenditures have exceeded revenues for the
months of July, August, September, and October. Revenues have
exceeded expenditures for the months of November through June.
In this context, it may be reasonable to design the programming
and scheduling of the construction program to ensure that the
cash balance accumulated on June 30 of each fiscal year
approximates, with a reasonable margin of error, the expected
excess of expenditures over revenues for the following July
through October. Approximately $70.0 million would not have
been excessive for this purpose for June 30, 1984. The forecast
suggests that approximately $90.0 to $100.0 million may not be
excessive for June 30, 1985. An additional contingency may be
required to obligate any unanticipated federal aid which might
be made available. Maintaining cash balances at reasonable
contingency levels is consistent with maximizing the benefits
from revenues available from user taxes, and establishing
mechanisms to ensure the implementation of a construction
program consistent with maintaining such balances is an
appropriate goal to be achieved through the finance and the
programming and scheduling functions of the Department.

RECOMMENDATIONS

1. The Budget Division should adopt the X-11 Variant of the Census
    Method II Seasonal Adjustment Program, Technical Paper Number 15 as
    the seasonal adjustment technique for establishing monthly
    distribution factors for use in estimating monthly variations in
    state revenue collections and maintenance contract payout.
    Software for this technique can be obtained from the U. S.
    Department of Commerce, Bureau of Economic Analysis. The Division
    should consult the author on the use of the seasonal adjustment
    technique to develop monthly distribution factors.

2. The Budget Division should update the monthly distribution factors
    for state revenue collections and maintenance contract payout
    annually by adding the most recent year's figures for these line
    items to the existing data base. An effort should be made to
    develop and maintain a 60- to 72-month data base.

3. In addition to maintaining a historical file of cash forecasts
    updated monthly, quarterly, or at such times that the official
    revenue forecast is changed, the Budget Division should initiate
    and maintain on floppy disk a file of original 24- and 36-month
    forecasts. Maintaining such a record will facilitate ex post
    evaluation of forecast performance.

4. The Budget Division should evaluate the performance of the cash
    forecast periodically. This evaluation should be made no less
    often than annually and no more often than every 18 months.

5. The Budget Division should closely monitor state revenue
    collections in the third quarter of each fiscal year
    (January-March) as an early indication of the possible need to
    adjust the construction program in the following fiscal year.
    Third-quarter collections are a highly stable proportion of state
    revenue collections in the following fiscal year and over the last
    five fiscal years have averaged 24.835% of the next year's total
    state revenue.

6. Because variations in federal aid reimbursements offer the
    potential for creating significant errors in the cash forecast, and
    because federal aid reimbursements are linked inextricably to the
    federal participation rate on advertised construction projects, the
    Budget Division, in cooperation with staff who are responsible for
    determining and altering the construction advertisement schedule,
    should maintain a data base which records the extent to which
    federal aid projects are advertised on schedule and the extent to
    which, on a monthly basis, the expected awarded amount of federal
    aid contracts is consistent with actual contract awards. This data

base will aid in the evaluation of the appropriateness of the current federal aid forecasting technique.

7. In addition to the current federal aid forecast, the Budget Division should evaluate the alternative technique based upon the five-year payout model of federal aid apportionments described in this report.

8. The Budget Division should make two adjustments in the current federal aid forecasting technique:

   a) Contract participation rates should be multiplied by a contract estimate which excludes an estimate of cost overruns; and

   b) "advance construction" contracts should enter the estimation pool for federal aid reimbursement only after the federal aid agreement for such contracts has been negotiated and approved.

9. The Budget Division should establish a monitoring mechanism which ensures that changes in the advertisement schedule are expeditiously incorporated into the construction payout and federal aid reimbursement line items of the cash forecast.

10. For the purpose of evaluating construction payout forecasts, the Budget Division should continue to estimate a "23-Month Payout Curve" cash forecast through June 1985.

11. The Budget Division should not alter the techniques being used to forecast payments to localities, other agencies, and transit properties, nor the expenditures on salaries and wages, equipment, and right-of-way.

12. Appropriate staff in the Maintenance Division should work cooperatively with the Budget Officer to provide the Budget Division with an accurate estimate of total contract maintenance payout. Contracts expected to be advertised may not be appropriate for this purpose. Provisionally, contract maintenance should be estimated as 26% to 28% of the total maintenance budget, excluding extraordinary storm damage.

13. The Budget Division should consider combining the cash forecast line items for "other expenditures," miscellaneous contracts, and consultant contracts. This combined line item could be estimated as 5.5% to 6.0% of state plus "other" revenue. This estimate should be closely monitored for its performance.

14. The Budget Division, in consultation with the Administrative
    Services and Fiscal Divisions, should reconcile the differences
    which have existed since July 1982 between reported purchases of
    and expenditures on materials in order to enable the forecast of
    expenditures on materials and supplies to be improved.

15. The Department's Executive Committee may wish to employ the cash
    forecast as an aid to structure programming, scheduling, and
    pre-engineering activities to achieve optimum cash balance levels.
    Because of the historical stability of the seasonality of
    expenditures and revenues, two major criteria are available to help
    establish such contingency balances. First, a contingency should
    be maintained to enable the Department to obligate unanticipated
    federal aid. In addition to this contingency, it is reasonable to
    argue that the cash balance anticipated on June 30 of each fiscal
    year should exceed, with an acceptable margin for error, the
    expected excess of expenditures over receipts for the following
    July through October. The value of utilizing such an approach to
    guage necessary balances is that sensitivity analysis can be
    conducted to determine the impact various programming and
    scheduling decisions have on the ability to meet financial
    commitments.

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INTRODUCTION

Methods for forecasting and managing cash flow are well established
in the private sector, where inadequate cash balances can mean bank-
ruptcy and excessive balances can result in foregone business opportu-
nities. In the public sector, until fairly recently there was less
perceived need for close forecasting and monitoring of cash flow.
Revenues for highway and transportation departments were quite
predictable--in the main they could be depended upon to rise steadily.
This and the fact that construction cost increases were moderate made
the planning of a maintenance and construction program free of cash
shortfalls or excessive balances rather straightforward.

During the past several years, revenues for most such departments
have become volatile and unpredictable, and construction expenditures
have been subject to unprecedented rates of inflation. During such
periods, a public works agency such as the Department of Highways and
Transportation runs a serious risk of encountering inappropriate cash
balance levels in carrying out its construction and maintenance program.
This risk can be minimized by (a) maintaining large cash balances which
divert funds from current needs, or (b) developing and using reliable
management tools for short-term forecasting and monitoring of cash
inflows and outflows. From the standpoint of sound public finance
principles, the latter alternative is preferred. However, as is illus-
trated by the comparisons made in Table 1 between the cash balances
which were forecast in July 1983 and the balances that actually oc-
curred, the Department's director of finance has had sufficient reason
to be uncomfortable with the reliability of the forecast as a management
tool.

Table 1

Comparison of July 1983 Forecast with Actual
Ending Cash Balances
(In Millions of Dollars)

	Sept. '83	Jan. '84	Jun. '84	Sept. '84
Forecast	67.2	61.7	126.5	79.3
Actual	129.9	152.3	261.3	212.9
Error	62.7	90.6	134.8	133.6

The table· shows a consistent tendency to underestimate cash
balances over the forecast period. This stems from underestimates of
revenues, overestimates of total expenditures, or offsetting errors in
estimates of federal aid and state revenues. For example, the forecast
for the period from May to September 1983 overestimated federal aid by
$28.1 million, underestimated state revenue by $28.5 million, and over-
estimated total outlays by $62.0 million. From October 1983 through
June 1984, this July 1983 forecast overestimated federal aid by $53.8
million, underestimated state revenue by $44.3 million, and over-
estimated total outlays by $71.6 million.

STUDY PURPOSE AND SCOPE

A major objective of the study, Phase II of which is reported on
here, has been to develop, in cooperation with the Budget Division, an
improved system for forecasting, monitoring, and managing cash flow over
the short run. An equally important objective is to provide guidelines
for estimating and establishing reasonable minimum cash balances for
contingency purposes. The third objective is to create a heightened
awareness on the part of both management and the staff responsible for
the programming, scheduling, and advertisement of contract construction
that an improved cash flow forecast can be a significant aid in imple-
menting an advertisement schedule which maximizes benefits from the
Highway Construction and Maintenance Fund.

This Phase II report describes the techniques proposed for forecasting monthly variations in state revenue collections; federal aid reimbursements; contract maintenance payout; expenditures on materials, supplies, wages, equipment, and right-of-way; and payments to localities, state agencies, transit properties, and contract consultants. It also describes the performance of the contract construction payout forecasting technique implemented as a result of the Phase I report published in September 1983.(1)

STUDY APPROACH

The forecasting techniques proposed in this report are based upon an examination of the historical pattern exhibited by each line item in the Department's Revenue, Expenditures, and Cash Balances Report, a copy of which is shown as Table 2. For most revenue and expenditure items, 52 months of data were collected. Each line item was subjected to at least two kinds of tests. First, the estimate of total payout was examined to determine its stability as a percentage of a major line item, such as total state revenue, in the Department's budget. Secondly, the U.S. Department of Commerce, Bureau of Economic Analysis's Seasonal Adjustment Program(2) was used to test the monthly variations for a stable seasonal pattern and to estimate monthly distribution factors which would accurately mirror seasonal payout variations. In addition, regression analysis was used to test the accuracy of previously used techniques for forecasting monthly variations on state revenue and federal aid reimbursements.

The technique for forecasting contract construction payout alluded to in this report is described fully in the publication which documents Phase I of the study.(1)

Table 2
VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION ACTUAL REVENUE, EXPENDITURES AND CASH BALANCES FOR FISCAL YEAR JULY 1, 1984 THRU JUNE 1985
(In Millions of Dollars)

NOV 15 1984

DIRECTOR OF FINANCE

	1984 Jul	Aug	Sep	Oct	Nov	Dec	1985 Jan	Feb	Mar	Apr	May	Jun	YTD TOTAL
Beginning Cash Balance	261.3	227.1	216.7										
Revenues: State	44.4	63.3	56.7										
Federal	11.0	19.9	19.2										
Other	1.1	2.8	1.2										
Total Revenues	56.5	85.9	77.1										
Total Available for Expenditures	317.8	313.0	293.8										
Expenditures:													
Counties Not In Sec. Sys.	2.4	1.1	1.1										
City Streets	10.0	6.1	2.1										
Mass Transit and PL	4.2	3.6	3.4										
Other Agencies	6.4	5.0	5.6										
Salaries, Wages and Fringes	17.8	17.8	17.9										
Materials and Supplies	5.4	6.0	4.9										
Equipment Purchases	0.0	0.0	0.1										
Right of Way	3.1	3.5	1.4										
Other Expenditures	1.5	9.1	<1.4>										
Contracts: Construction	29.2	27.5	30.6										
Maintenance	10.3	15.4	14.3										
Consultants	0.2	0.9	0.5										
Miscellaneous	0.2	0.3	0.7										
Total Expenditures	90.7	96.3	80.9										
Ending Cash Balance	227.1	216.7	212.9										

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FORECASTING MONTHLY VARIATIONS IN REVENUE

State Revenue

Current Technique Performance

The official forecast of revenues which comprise the Highway
Construction and Maintenance Fund is issued through the Office of the
Secretary of Transportation of the Commonwealth and is based upon
estimates of the major revenue sources prepared by the Division of Motor
Vehicles and the Corporation Commission. Fees and permit revenues
collected by the Department of Highways and Transportation comprise a
very small proportion of the total revenue estimate and have little
impact on the forecast.

Estimates of monthly revenue collections for the cash forecast are
calculated by multiplying the percentage of annual revenue which has, on
average, been collected for each month by the official estimate of total
revenue. This forecasting technique has two sources of error:
(1) errors in the official forecast of total revenue, and (2) errors in
the estimates of the monthly percentages that are applied to the
forecast. The reader should note that even if seasonality (monthly
percentages of collections) is perfectly forecast, a 24-month cash
forecast can be no more accurate than the official forecast. In other
words, if the official revenue forecast underestimates total collections
over the forecast period by $80.0 million, the cash flow forecast of
revenue collections will have cumulative errors of the same magnitude.

The performance of the revenue forecast should, for the purposes of
cash flow analysis, be examined in light of the fact that impacts on the
Department's monthly cash position significantly lag changes initiated
in the construction and maintenance program. The implication of this
fact is that official forecast updates which apply to a current fiscal
year are of little value to the Department in planning its program to
take maximum advantage of available cash balances. For example, changes
which are made in the official forecast in May, as was the case in 1984,
at best cannot be incorporated into the advertisement schedule until
well into FY 1985.

Statistical analysis was used to examine the accuracy of the
estimates of monthly variations in revenue based upon applying the
Department's seasonal distribution factors to the official forecast.
The results showed that a March 1982 forecast of revenue flows for the
following 20 months explained only 47% of the variation in actual
collections. The standard error was $7.5 million per month. Using
official updates of the original forecast throughout the period improved
performance somewhat, but the standard error remained high at

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$5.03 million per month. With the official updates, 77% of the monthly variation was tracked by the forecast.

Proposed Improvements

Potential improvements in the revenue flow forecast were examined from the standpoint of the two sources of error noted in the previous section—the seasonality of the collections and the aggregate forecast.

Monthly variations in the revenue collection pattern were examined for stable seasonality by applying the Bureau of Labor Statistics (BLS) seasonal adjustment and analytical software program to a data set consisting of 48 months of state revenue receipts. The analysis revealed a highly stable seasonal collection pattern, and the seasonally adjusted monthly factors estimated using the BLS technique differed somewhat from the factors used by the Budget Division. These seasonally adjusted distribution factors are shown in Table 3.

With respect to the aggregate estimate of revenue to which the seasonal factors are applied, the author understands fully that the official forecast must serve as the basis for the Department's budget and as the basis of allocations. Nevertheless, for contingency planning in the context of the programming, scheduling, and advertisement of construction projects, some effort should be made to determine the extent to which the near term official revenue forecast is likely to target actual revenue collections. Such an effort would give an early test, in the current fiscal year, of the reliability of the official forecast which has been made for the following fiscal year in advance of official updates, which typically are made as often as quarterly. A technique which is well suited to such an early testing effort is based upon the finding that state revenue collections in the third quarter of a fiscal year (January, February, and March) exhibit a highly stable proportion of actual collections in the following fiscal year. Since FY 1978 this proportion has averaged 24.835% and its standard error has been 1.02%.

Results from applying this testing technique as a planning tool are shown in Table 4. Over the seven fiscal years beginning in 1978, the error in the test averaged 2.85% of actual collections. The test was an underestimate in fiscal years 1978, 1979, 1981, and 1984. It was an overestimate of collections in 1980, 1982, and 1983. The underestimates averaged from $580,000 to $2.0 million per month, and the overestimates from $1.0 million to $2.4 million per month. Over the last three fiscal years for which official forecasts from the Secretary's Office are readily available, the error averaged 6.5% of actual collections, was an overestimate in FY 1982 ($37.5 million), an underestimate in FY 1983 ($16.7 million), and an underestimate in FY 1984 ($63.6 million). The

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FY 1982 forecast was revised in February of 1982, the FY 1983 forecast was revised in September 1982 and April 1983, and the FY 1984 forecast was revised in December 1983 and April 1984. Clearly, official forecasts need to be updated; but just as clearly, contingency planning in the form of early tests of the potential for actual revenue to be significantly different from the official forecast is a prudent exercise for the Budget Division to consider. In this context it is interesting to note that an FY 1985 forecast of state revenue based on collections in January-March of 1984 yielded an estimate of $728.0 million. The official forecast updated in March 1984 was $709.1 million. It was updated again in August 1984 to $723.772 million, an amount only slightly less than the estimate yielded by the third-quarter collections test.

Table 3

Seasonal Factors for State Revenue and Contract Maintenance

Month	Revenue	Maintenance
January	0.0785	0.017
February	.0845	.012
March	.0995	.004
April	.0816	.005
May	.0909	.023
June	.1119	.103
July	.0521	.124
August	.0795	.168
September	.0828	.168
October	.0862	.169
November	.0795	.147
December	0.0731	0.061

Note: Factors are based on 48 months of data.

Table 4

Test of Forecasts Based on Collections in the Third Quarter
of the Previous Fiscal Year
(In Millions of Dollars)

Fiscal Year	Official Forecast	Third Quarter	Actual Collections
1978	$447.8	$432.3	$455.9
1979	478.1	467.0	480.7
1980	501.1	476.7	460.0
1981	535.6	492.9	499.5
1982	545.8	537.4	508.3
1983	617.8	647.0	634.5
1984	639.7	677.2	703.3

Multiple regression and correlation analyses were employed on a data set consisting of the latest 24 months' revenues as a way of testing the forecasting accuracy that can be expected from the application of the monthly distribution factors derived from the BLS seasonal adjustment program to aggregate revenue estimates derived from both the official forecasts (including updates) and the third-quarter collections technique. The results are noted in the items which follow.

1. Using the monthly factors employed by the Budget Division and the updates to the official forecasts during the 24 month test period, monthly estimates explained 84% of the variation in actual collections and had a standard error of $4.32 million per month. The cumulative error was $25.4 million and this was exhibited for much of the period. It should also be noted that this degree of accuracy was afforded only by frequent updates of the official forecast.

2. Using the seasonally adjusted distribution factors derived in this work applied to a forecast based on third-quarter collections, monthly estimates were within 1% of actual collections, explained 84% of the monthly variation, and exhibited a standard error of $3.75 million per month. The cumulative error was $15.0 million, but was removed in four months and remained under $5.0 million for the balance of the test period.

3. Even if the aggregate forecast is perfect, the standard error of estimated monthly collections can be, at best, in the neighborhood of $3.67 million per month.

Forecast Employing Proposed Techniques

This section presents a comparison of actual collections for January to July 1984 with the results of forecasting state revenues by the techniques available to the Budget Division prior to December 1983 and under the third-quarter forecasting technique using seasonally adjusted monthly factors. For purposes of identification in this report, the techniques in use by the Budget Division have been denoted by "23 MNTH.," this name being taken from the Department's previous 23-month construction payout forecasting method. The proposed techniques are labelled "MNTH. FACTORS," representing a monthly factors distribution technique. When examining Figures 1, 2, and 3, the reader should note that the forecast could have been prepared as early as April 1983, nine months prior to the beginning of the forecast period and eight months prior to the last official forecast revision before the beginning of the forecast period.

Notwithstanding the fact that the official forecast was revised in December 1983, Figures 1, 2, and 3 show that the proposed techniques perform much better than the 23-month payout. Over the seven-month period, the 23-month technique consistently underestimated monthly revenue. Errors ranged from $2.0 million to $22.7 million. The monthly factors forecast error ranged from $0.7 million to $6.3 million. (For details of the forecast test, refer to Appendix A.)

FIG. 1. ESTIMATED STATE REVENUE
FORECAST JANUARY 1984

23 MNTH.   MNTH. FACTORS   ACTUAL
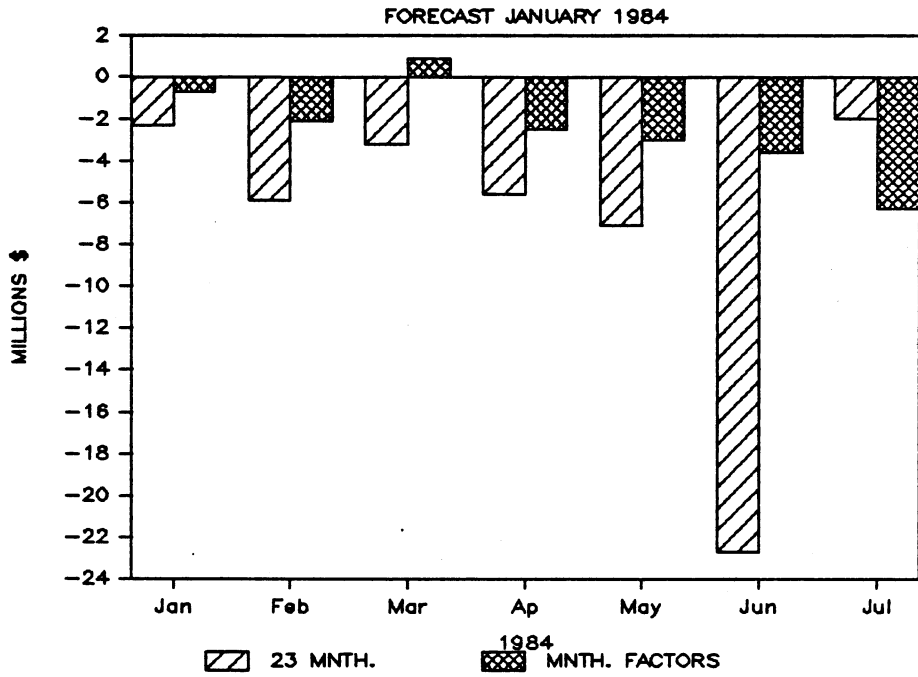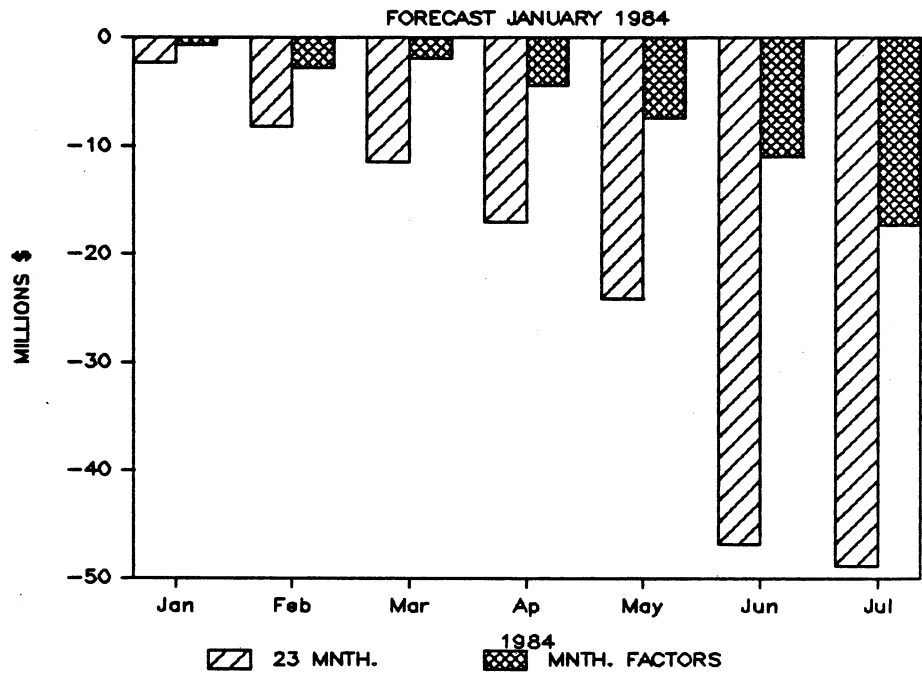
1984
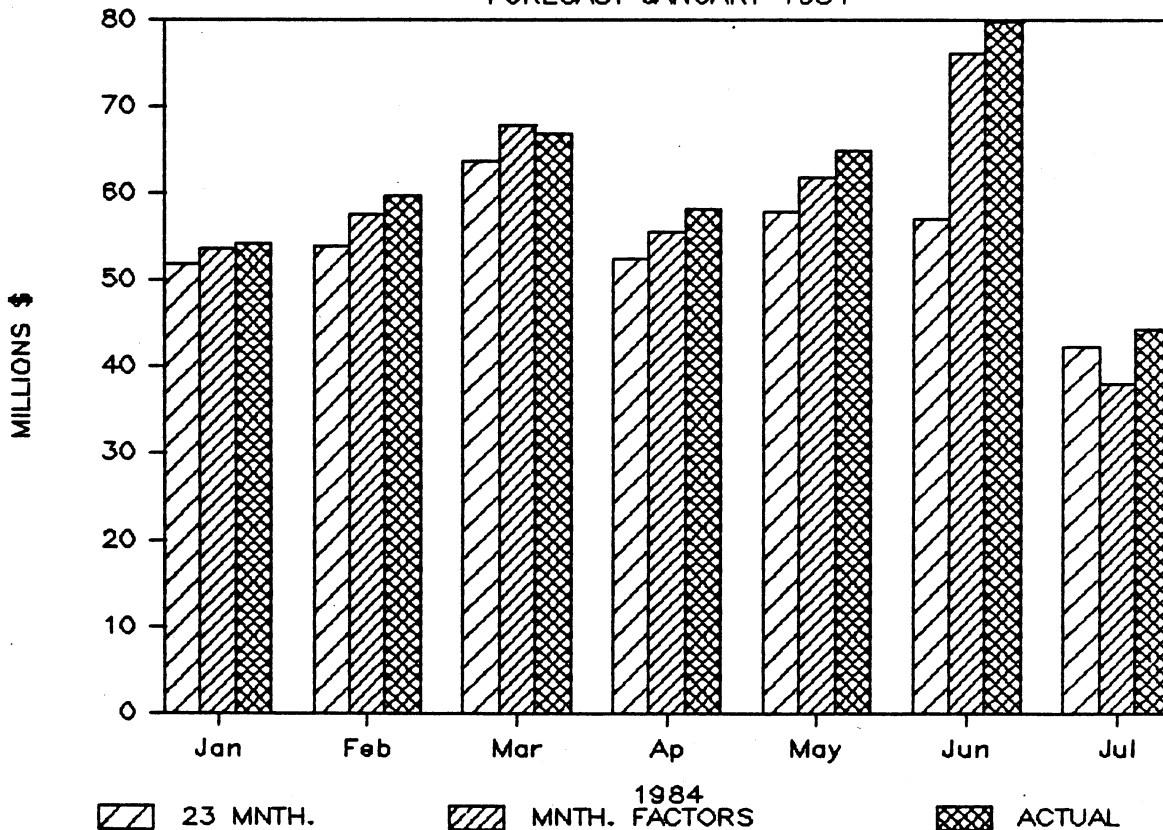
FIG. 2. ESTIM. MINUS ACTUAL VA. REV.

FORECAST JANUARY 1984

Legend: ▨ 23 MNTH.   ▨ MNTH. FACTORS

1984

FIG. 3. CUMUL STATE REVENUE ERROR

FORECAST JANUARY 1984

Legend: ▨ 23 MNTH.   ▨ MNTH. FACTORS

1984

10

Federal Aid Reimbursements

Recent Forecast Performance

Forecasting federal aid reimbursements has been and likely will continue to be among the most difficult tasks of the monthly cash flow estimation process. The Budget Division forecast for April 1982 through December 1983 captured only 5% of the monthly variation in federal aid reimbursements and exhibited a cumulative overestimation error in excess of $100.0 million. That forecast was based upon an estimate of aggregate construction payout in the federal aid category, an assumed average federal participation rate, and a one-month lag between payout and reimbursement. The overly optimistic reimbursement forecast can be traced to the inaccuracy of the contract construction forecast technique being used in 1982.(1)

In January 1984, the Budget Division implemented a new contract construction payout forecasting technique as a result of work completed in an earlier phase of this study.(1) Concurrently, a new federal aid forecasting technique was implemented. Because federal aid reimbursements are a direct function of the federal aid portion of the construction program, the current forecast is estimated as the multiplicative product of the expected monthly payout for each construction contract and its specific participation rate summed over all federal aid projects. Reimbursements are estimated to lag payout by one month.

Figures 4, 5, and 6 summarize the performance of the new forecasting technique implemented in January 1984. As compared to the 23-month payout technique used prior to that time, the monthly factors model appears to perform well. For the first seven months of 1984, the cumulative error in the new forecast was $13.0 million. The error using the former technique was $49.7 million. Through September 1984 these cumulative overestimates had grown to $30.7 million for the new technique and $85.6 million for the former method.

Notwithstanding the fact that errors which result from the monthly factors technique are likely to be significantly smaller than under the formerly used 23-month payout model, the tendency of the forecast to consistently overestimate actual reimbursements is not desirable should it be found to persist. It is quite reasonable to hypothesize that the difficulty in estimating reimbursements stems largely from the fact that the lag structure which typically applies to federal aid receipts (around 39 days) is made significantly longer and highly variable by reimbursements which fall into three "adjustment" categories: (1) charges to projects for which no federal aid agreement exists, such as advance construction; (2) charges whose appropriateness has been questioned by the FHWA and for which the Department has returned federal funds while the matter is being reviewed; and, (3) cost overruns not

11

covered by an existing federal aid agreement and for which a modified
agreement must be negotiated. When a charge falls into either one of
these categories, several months to several years may elapse before
reimbursement is received. The best information available to the author
indicates that as much as $15.0 to $20.0 million fall into the cost
overrun category at any point in time, and that much of this money is
not reimbursed until the final FHWA audit two years after project
completion.

FIG. 4. ESTIMATED FEDERAL AID
FORECAST JANUARY 1984

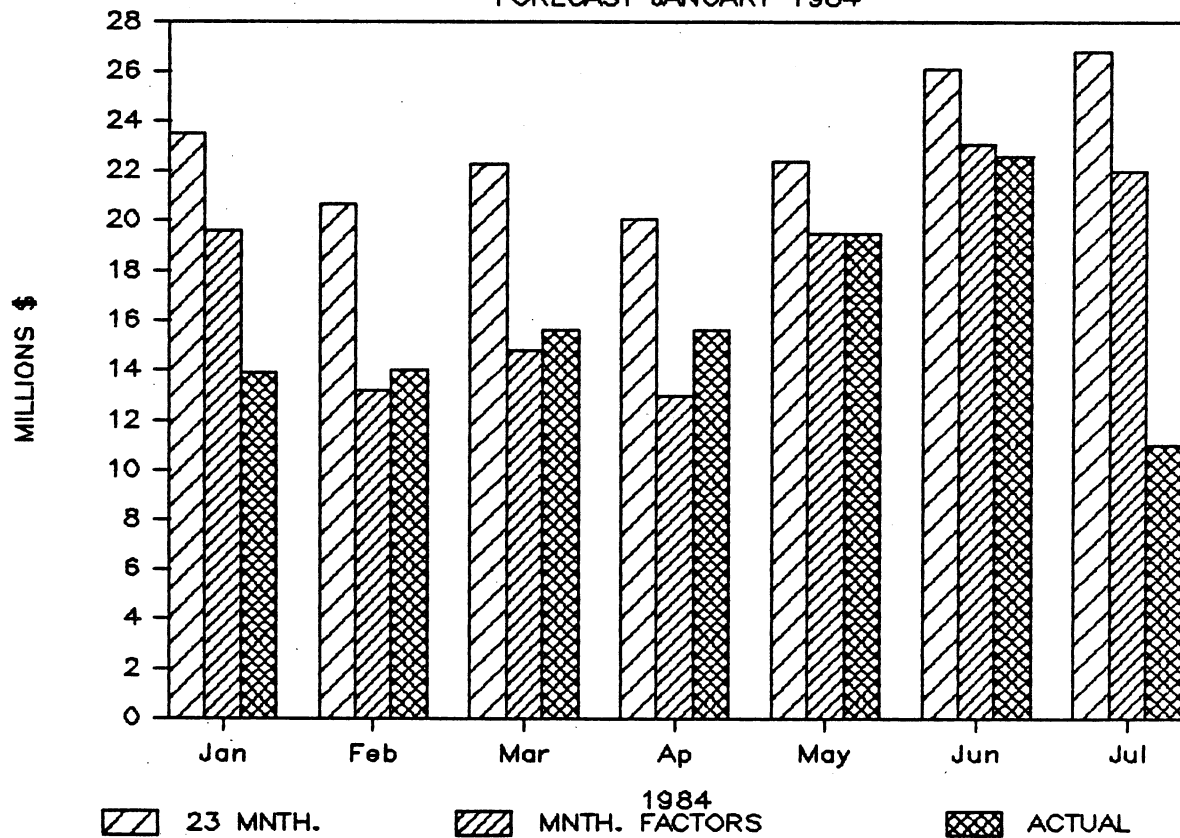Legend: ▨ 23 MNTH.   ▨ MNTH. FACTORS   ▨ ACTUAL

FIG. 5. ESTIM. MINUS ACTUAL FED. AID

FORECAST JANUARY 1984

Legend: 23 MNTH.   MNTH. FACTORS
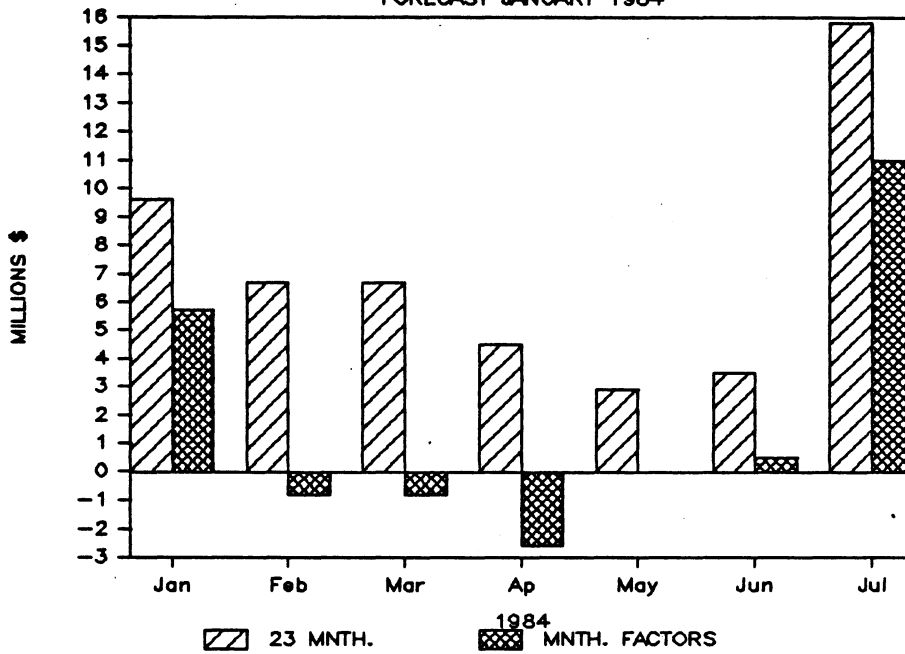
FIG. 6. CUMULATIVE FED AID ERROR

FORECAST JANUARY 1984

Legend: 23 MNTH.   MNTH. FACTORS

13
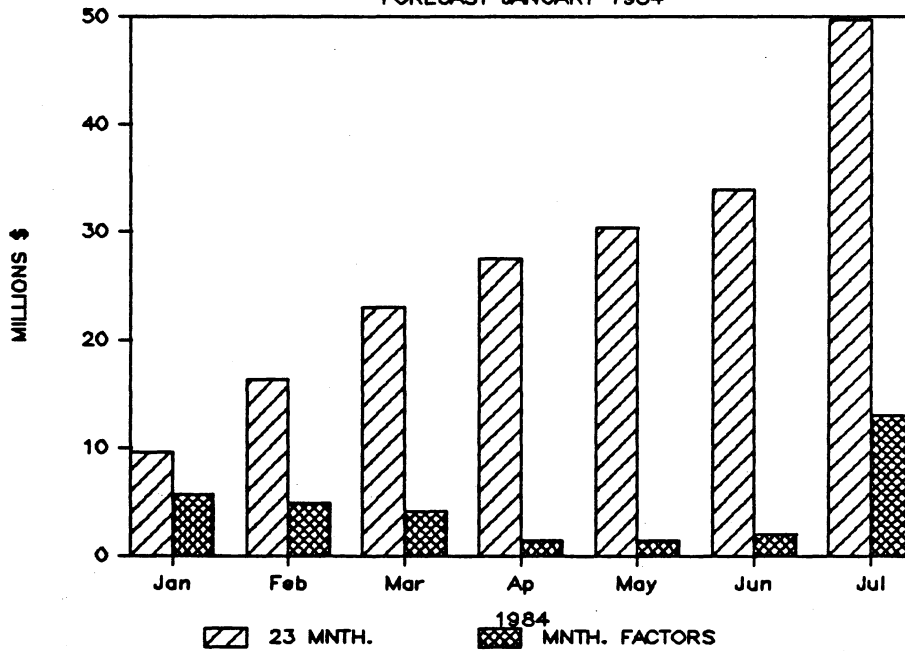
Proposed Improvements

Consistent overestimation is an undesirable characteristic of the federal aid forecast. Two alternatives are proposed here as avenues for correcting this tendency. The first relates to the currently used monthly factors technqiue and the second to a technique based on federal aid apportionments.

Logic strongly suggests that the monthly factors technique currently being used by the Budget Division should produce an accurate forecast. Notwithstanding this fact, the tendency of the technique to overestimate might be somewhat corrected by two adjustments. The first relates to cost overruns. In the monthly factors construction payout technique developed in the first phase of this study, disbursements are based on a final contract estimate that <u>includes</u> an estimate of cost overruns. Because cost overruns are typically not part of negotiated federal aid agrements, the federal aid monthly factors model should be adjusted so that contract participation rates are multiplied by a contract estimate which <u>excludes</u> the estimate of cost overruns. The second adjustment which should be considered relates to those instances when the Department initiates and designates a construction project as a federal aid participating project in advance of the approval of a negotiated federal agreement. Such projects should be included in the estimation pool for federal aid reimbursement only after the negotiated agreement has been approved.

A second technique which offers potential for improving the federal aid forecast should be employed in addition to the monthly factors technique now in use until the latter can be tested over a longer period of time. This technique is predicated upon the assumption that the Department will continue to obligate all available federal aid and upon the recognition that reimbursements received in a particular fiscal year stem from apportionments and obligation authority spanning five years.(3) This trickle of reimbursements begins with the apportionment announcement and ends four or five years later when the last charges to a construction project have been submitted, approved, and reimbursed. The proposed technique consists of the following steps:

1. Reimbursement in each month is assumed to consist of a seasonally stable percentage of the apportionment in the current and previous four fiscal years.

2. Monthly distribution factors are derived by applying the BLS statistical package to a data set consisting of actual federal aid reimbursements. Because reimbursement in a particular month is comprised of obligation authority available over a five-year period, the estimated monthly

factors are divided by 5. The resulting factors are shown in Table 5.

3. Preliminary estimates of monthly federal aid for a particular year are derived by summing the apportionment bundles for that year and the previous four fiscal years and multiplying the sum by the factor for the month in question shown in Table 5.

4. Final monthly estimates of federal aid are derived by using the equation

Final Estimate = 1.06 (Preliminary Estimate) - 5.18.

This equation was developed with the aid of multiple regression analysis, explains 67% of the variation in monthly federal aid for the 28-month period beginning in November 1981, and has a standard regression error of $3.51 million per month.

Employing steps 1 through 4 results in a forecast for January through September 1984 that cumulatively underestimates federal aid collections by $7.9 million. The forecast is shown in Table 6.

Table 5

Monthly factors for Five Years
Federal Aid Reimbursement Estimation

Month	Factor
October	0.0272
November	.0208
December	.0184
January	.0160
February	.0120
March	.0102
April	.0168
May	.0148
June	.0192
July	.0198
August	.0110
September	0.0138

Table 6

Forecasted and Actual 1984 Federal Aid by
The Five Year Federal Aid Reimbursement Technique
(In Millions of Dollars)

	Forecast	Actual
January	$17.37	$13.90
February	11.84	14.00
March	9.29	6.90
April	18.66	24.30
May	15.82	19.50
June	22.06	22.60
July	22.9	11.00
August	10.42	19.80
September	14.40	19.20

Total Revenues

The results of using the techniques proposed for forecasting state revenue and federal aid are shown in Figures 7 and 8. The errors in estimating total revenues are much smaller under the proposed techniques than under techniques used by the Department prior to December 1983. The average error for the previously used techniques is $10.11 million, with a standard error of $6.84 million per month. Under the proposed techniques, the average error is $6.56 million, with a standard error of $4.6 million per month.

FIG. 7. ESTIMATED TOTAL REVENUE

FORECAST JANUARY 1984

MILLIONS $ (y-axis: 0 to 110)
X-axis: Jan, Feb, Mar, Ap, May, Jun, Jul
1984

Legend: 23 MNTH.   MNTH. FACTORS   ACTUAL
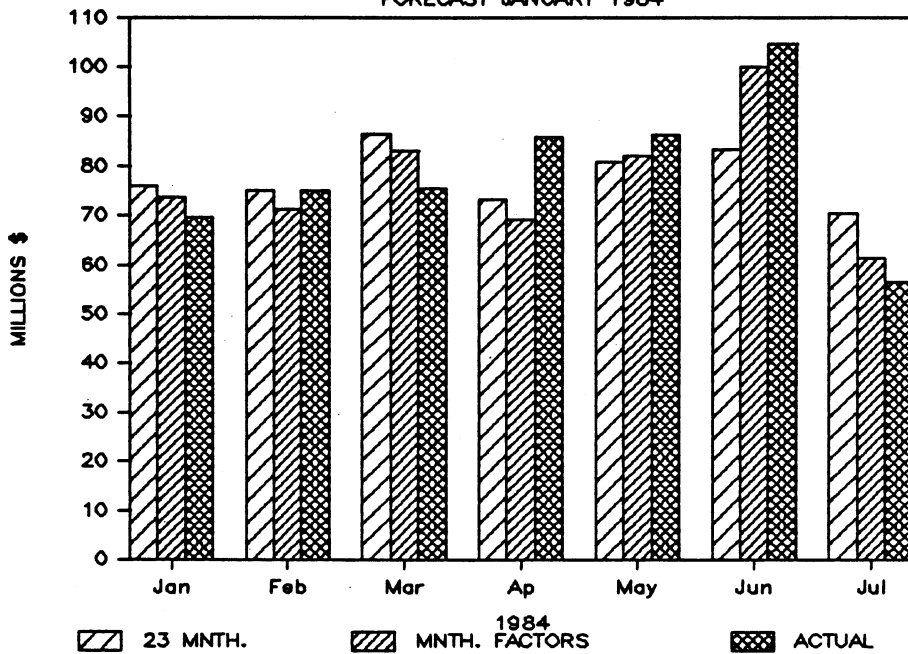
FIG. 8. ESTIM. MINUS TOTAL REVENUE

FORECAST JANUARY 1984

MILLIONS $ (y-axis: -25 to 15)
X-axis: Jan, Feb, Mar, Ap, May, Jun, Jul
1984

Legend: 23 MNTH.   MNTH. FACTORS

17
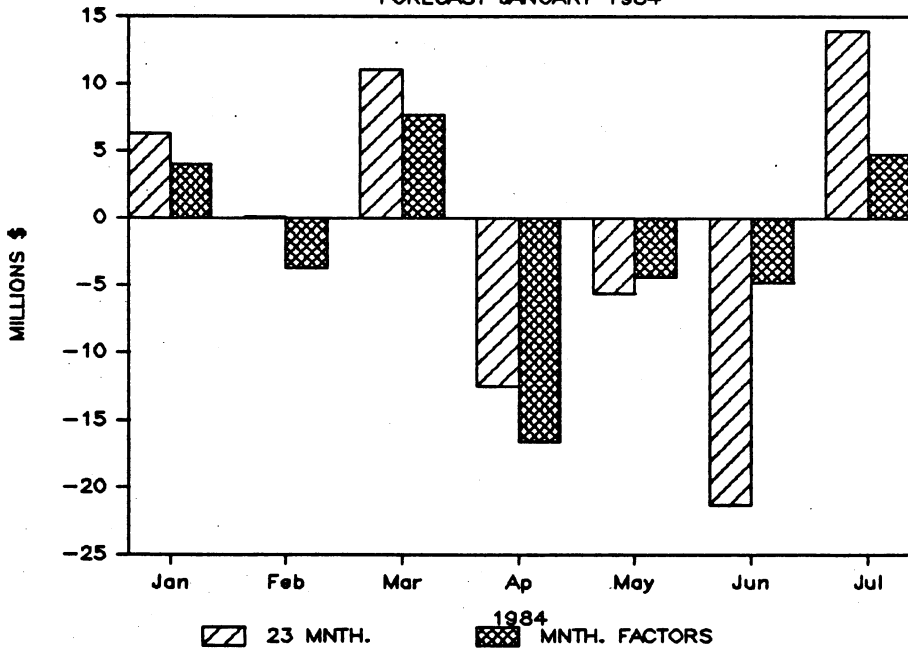
FORECASTING CONTRACT CONSTRUCTION

As a result of recommendations made in the Phase I report on this study(1), the Budget Division implemented a new forecasting technique for estimating contract construction payouts. This technique, called the "monthly factors model," has been the basis of the construction payout forecast since January 1984 and has performed extremely well.

The forecast performance is documented in Figures 9, 10, and 11. Through July 1984, the monthly factors model overestimated payout by an average of $2.31 million per month. The standard error was $2.25 million and the cumulative error $16.2 million. The technique used previously overestimated actual payout by $11.46 million per month and resulted in a cumulative overestimate of $80.2 million. As of the end of September, the monthly factors model showed a cumulative error of $13.2 million. Clearly, the monthly factors model is exhibiting excellent performance.

FIG. 9. ESTIMATED CONSTRUCTION
FORECAST JANUARY 1984

23 MNTH.   MNTH. FACTORS   ACTUAL
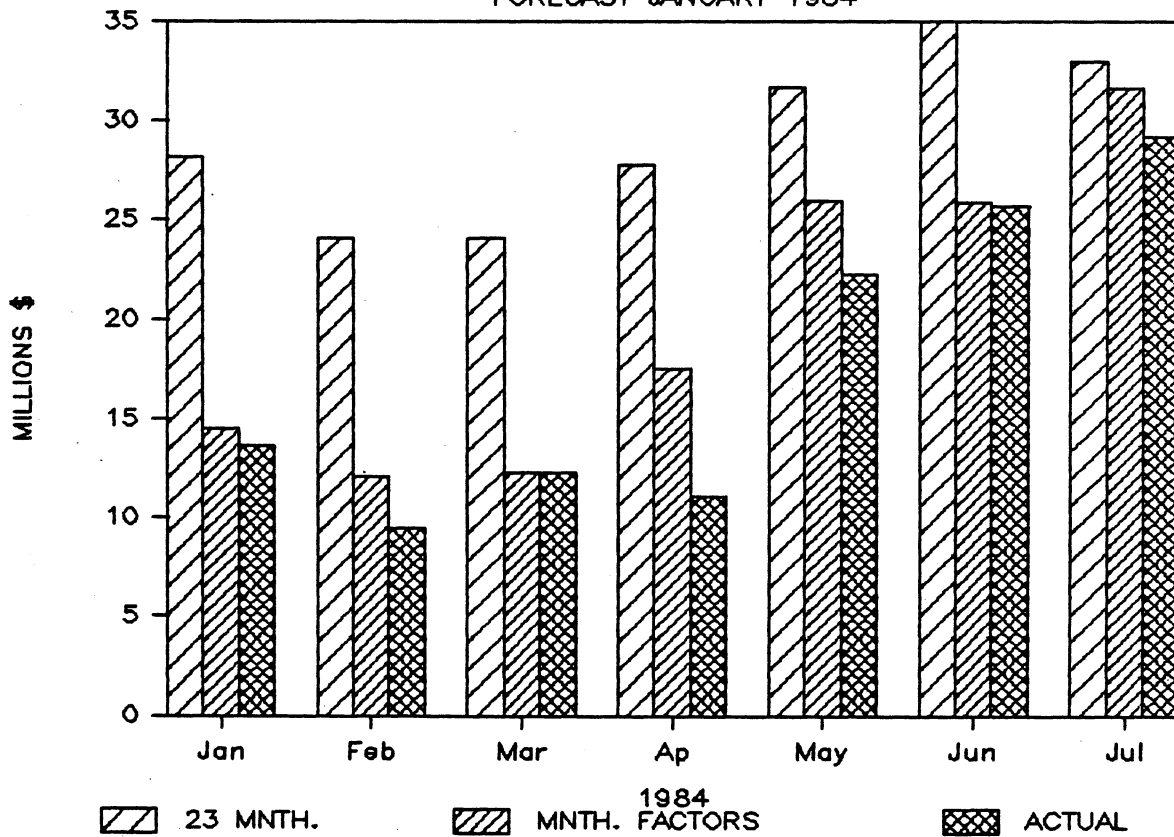
FIG. 10. ESTIM. MINUS ACT. CONSTRUCT.

FORECAST JANUARY 1984

MILLIONS $

Legend: 23 MNTH. | MNTH. FACTORS

1984
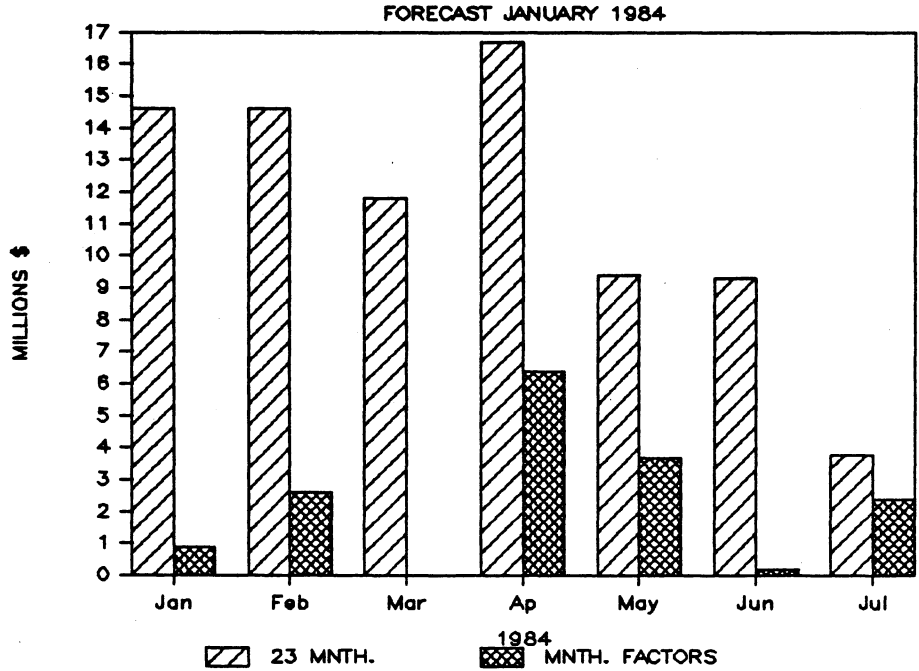
FIG. 11. CUMULATIVE CONST. ERROR

FORECAST JANUARY 1984

MILLIONS $

Legend: 23 MNTH. | MNTH. FACTORS

1984
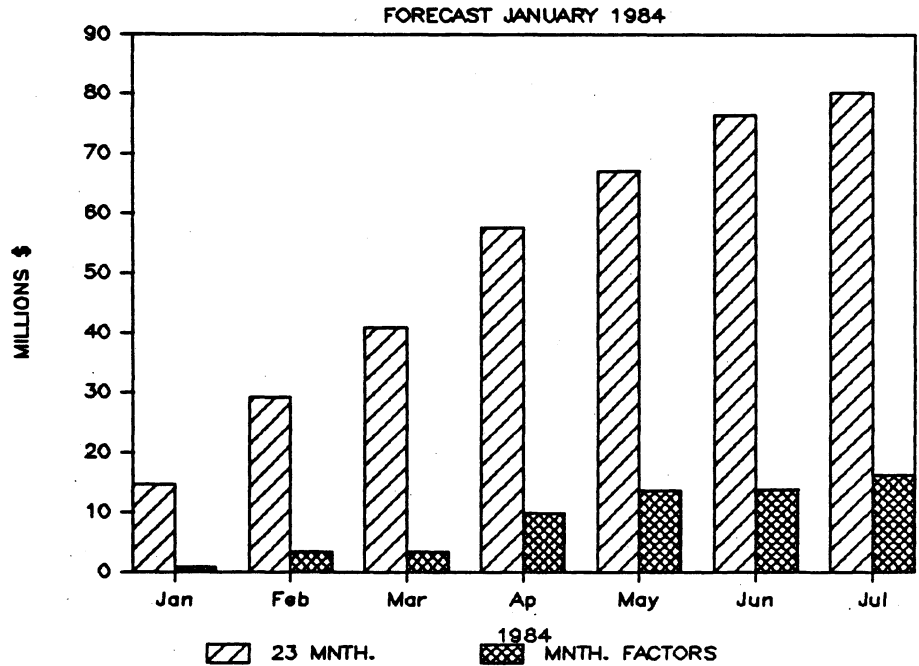
FORECASTING PAYMENTS TO LOCALITIES,
OTHER AGENCIES, AND TRANSIT PROPERTIES, AND
EXPENDITURES ON SALARIES, WAGES,
EQUIPMENT, AND RIGHTS-OF-WAY

The Budget Division forecasts for a number of line items in the cash forecast have performed very well and require no change. These are listed below.

1. Payments to the counties of Arlington and Henrico

2. Payments to cities for street maintenance

3. Payments to other state agencies

4. Payments to transit properties

5. Expenditures on salaries and wages

6. Expenditures on equipment

7. Expenditures on right-of-way

FORECASTING MAINTENANCE CONTRACTS

Current Technique Performance

Contract maintenance is not a line item in the Department's budget, although it is a line item in the cash forecast. Over the past three fiscal years, the Budget Division has based estimates of monthly payout for maintenance contracts on figures provided by the Maintenance Division. These estimates have consistently been overly optimistic in terms of the amount of maintenance which would be performed under contract, and in the first seven months of 1984 payouts were overestimated by $11.2 million.

Proposed Improvements

The BLS seasonal adjustment program(2) was used to analyze historical data on contract maintenance payout. The analysis revealed that payout exhibits a highly stable seasonal pattern. Monthly factors which can be applied to the total estimate of contract maintenance were shown earlier in Table 3.

The historical pattern of contract maintenance serves as an appropriate technique for arriving at an aggregate estimate of payout for a particular fiscal year. In FY 1984 contract maintenance was 24.3% of the maintenance budget; from FY 1979 to FY 1984, excluding flood damage, the average was 26.1%. Until such time that the Maintenance Division can provide estimates which do not tend toward being overly, optimistic, averaged historical payout can serve as a reasonable aggregate estimating technique. Applying an estimate of 27% of the maintenance budget results in total payout estimates of $75.53 million for FY 84 and $81.98 million for FY 1985. The results of a forecast using the monthly factors shown in Table 3 are summarized in Figures 12 and 13. Over the forecast period, the cumulative error of this proposed technique is a $1.7 million underestimate. As of September 1984 the forecast exhibited an overestimate of only $100,000.

FIG. 12. ESTIM. MAINTENANCE CONTRACTS

FORECAST JANUARY 1984

1984

| ZZ 23 MNTH. | ZZ MNTH. FACTORS | XX ACTUAL |
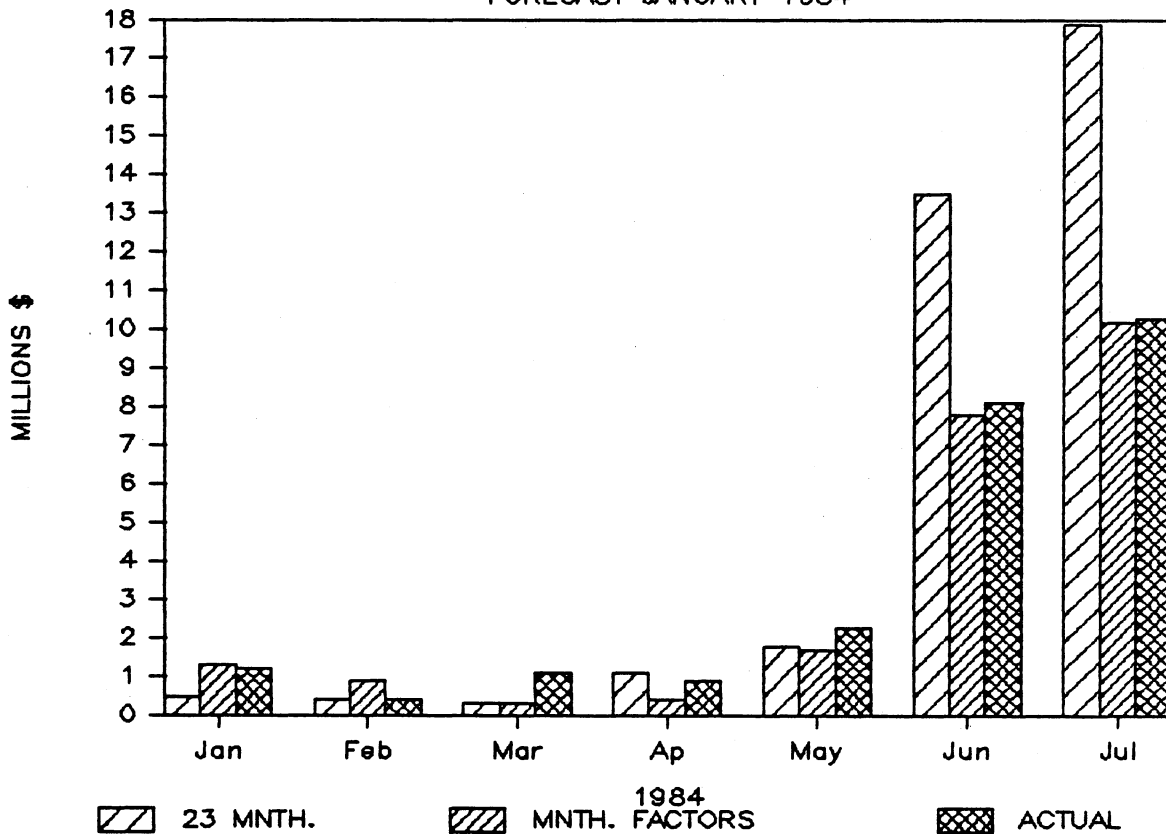
FIG. 13. CUMUL. ERROR IN MAINTENANCE

FORECAST JANUARY 1984

23 MNTH.　　　MNTH. FACTORS
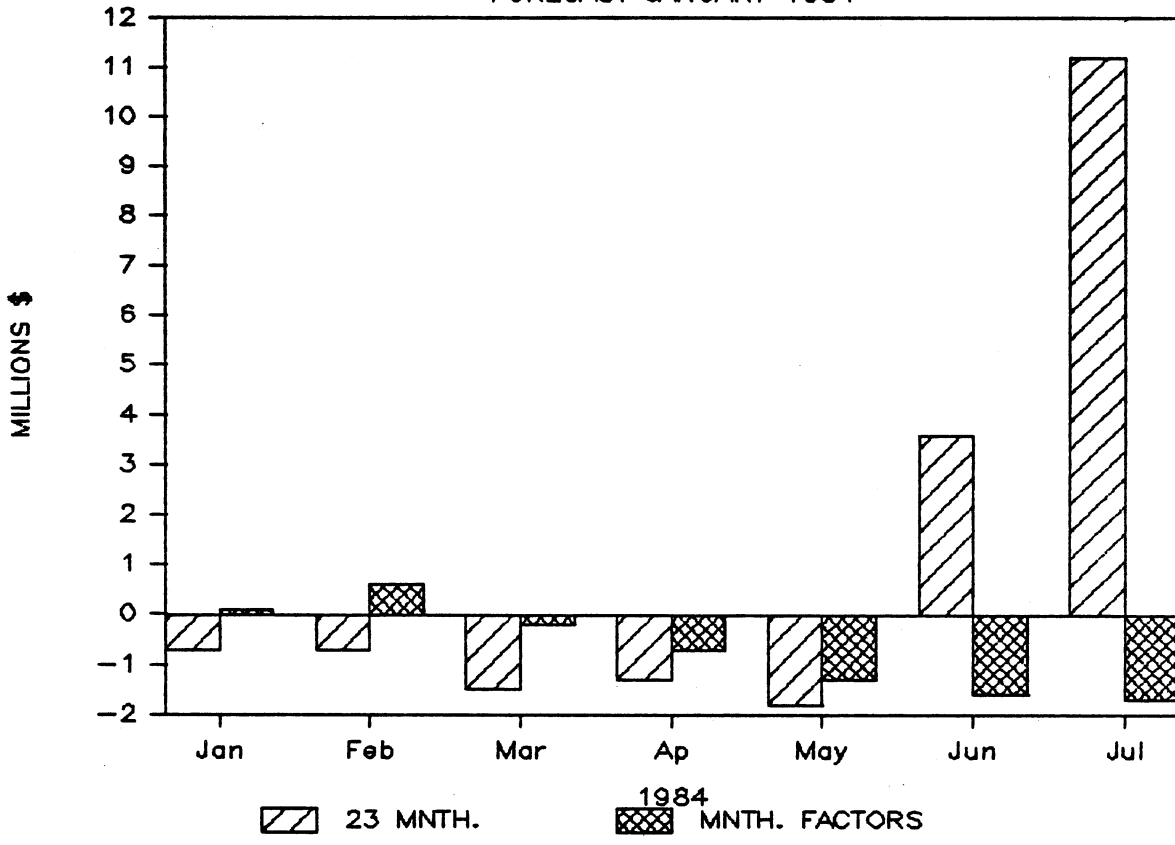
FORECASTING CONSULTANT CONTRACTS, MISCELLANEOUS
CONTRACTS, AND OTHER EXPENDITURES

Current Technique Performance

In addition to contract maintenance, several other line items in the cash forecast do not correspond to line items in the Department's program budget. Among these are the line items designated as "consultants," "miscellaneous contracts," and "other expenditures."

Obtaining data by which to develop a forecsting method for these line items proved impossible, partly because the historical data comprising them lacked continuity. Verification of the "consultant" line item presented an additional complication because the reported expenditures for accounting object codes which presumably correspond to expenditures for "consultants," average about $300,000 per month, an amount significantly less than the $2.8 million per month average indicated by the July 1982-December 1983 cash balance reports prepared by the Fiscal Division. Finally, the line item denoted as "other expenditures" frequently contains negative entries.

Proposed Improvements

Because consultant contracts, miscellaneous contracts, and "other expenditures" appear to lack a seasonal pattern and because of the inclusion of negative entries for "other expenditures," the cash forecast could be simplified by combining these three line items into one item, estimating the aggregate fiscal year payout as equal to 5.5% to 6.5% of the arithmetic sum of state revenue and "other" revenue, and distributing the payout in equal proportions throughout the months of the fiscal year.

FORECASTING EXPENDITURES ON
MATERIALS AND SUPPLIES

Current Technique Performance

Figures 14 and 15 graphically portray forecasted cash balances which result from applying all of the proposed improvements described in the previous sections for a forecast period from January through July 1984. In addition, actual cash balances and a forecast using the 23-month payout technique are shown for comparison. While the proposed improvements resulted in a monthly factors estimate significantly better than the estimate produced by the 23-month payout curve, they fell short of providing a satisfactory forecast. The large cumulative

error (an underestimate of $84.2 million during a seven-month period) prompted the author to pursue additional ways to improve the model.

Analysis summarized graphically in Figures 16 and 17 revealed that the forecast of miscellaneous expenditures (excluding construction and maintenance contracts) typically overestimated actual amounts. In fact, for the monthly factors model, nearly 70% ($56.8 million) of the cash balance error was comprised of an overestimated miscellaneous expenditure total. Because the proposed construction and maintenance forecasting techniques had been shown to perform quite well, the error in miscellaneous expenditures (Figures 16 and 17) was, in addition, largely responsible for an overestimate of total payout (Figure 18).

Examination of the forecast of expenditures on materials and supplies revealed it as the culprit in the overestimate of miscellaneous expenditures and total payout. For January–July 1984, the monthly estimate always exceeded the payout, in some months by as much as $10.0 million.

Purchases of materials and supplies is a line item in the Department's program budget. As a result, the cash forecast of the payout on materials and supplies historically has been derived by distributing the budgeted amount proportionately throughout each month of the fiscal year. This procedure was followed in arriving at the estimate of cash balances shown in Figure 14. It obviously did not work well for the forecast period. Furthermore, it did not work well for the Budget Division's forecast prepared in December 1983. From January 1984 through June 1984, the forecasted payout was $97.8 million; payout for this period was $39.6 million.

FIG. 14. FIRST ESTIMATE CASH BALANCE

FORECAST JANUARY 1984

Legend:
□ 23 MNTH.   ◇ MNTH. FACTORS   ▽ ACTUAL
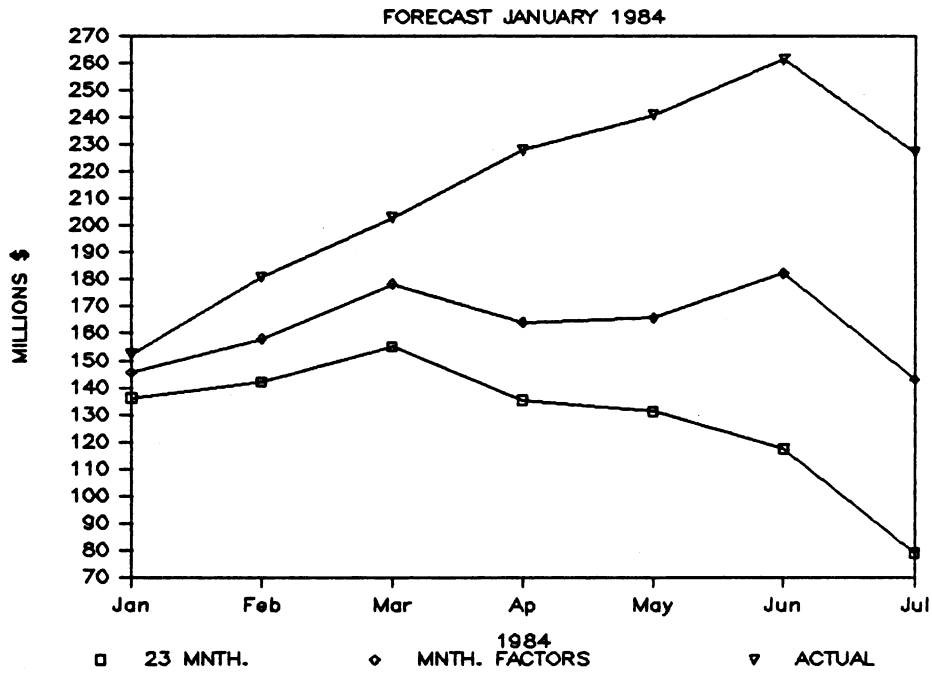
1984

FIG. 15. CUMUL. CASH BALANCE ERROR

FORECAST JANUARY 1984

Legend:
▨ 23 MNTH.   ▨ MNTH. FACTORS

1984

25
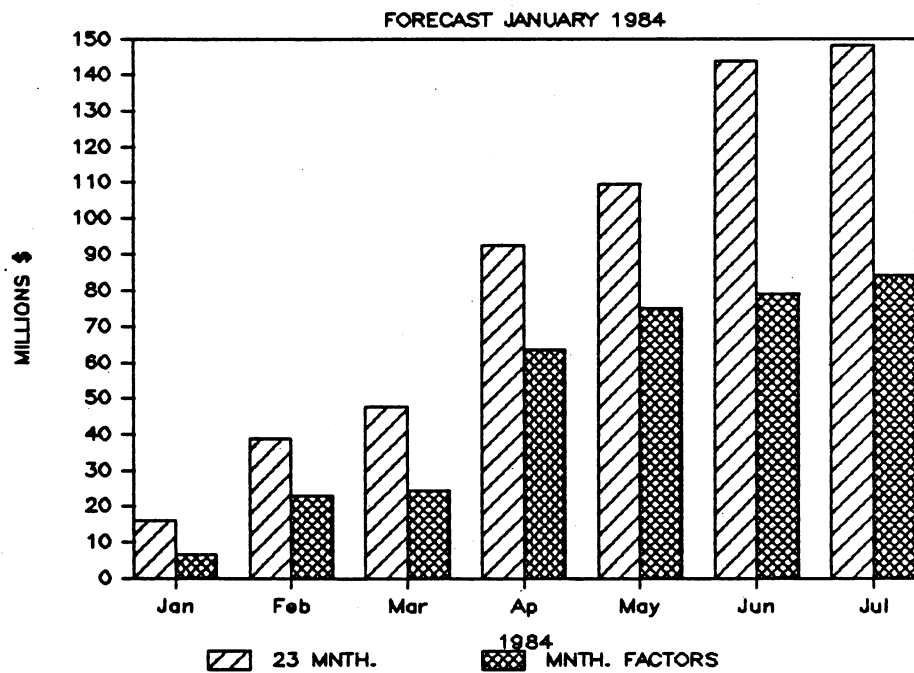
FIG. 16. ESTIM. MINUS MISC. EXPEND.

FORECAST JANUARY 1984

MILLIONS $

Jan Feb Mar Ap May Jun Jul

1984

▨ 23 MNTH. ▧ MNTH. FACTORS
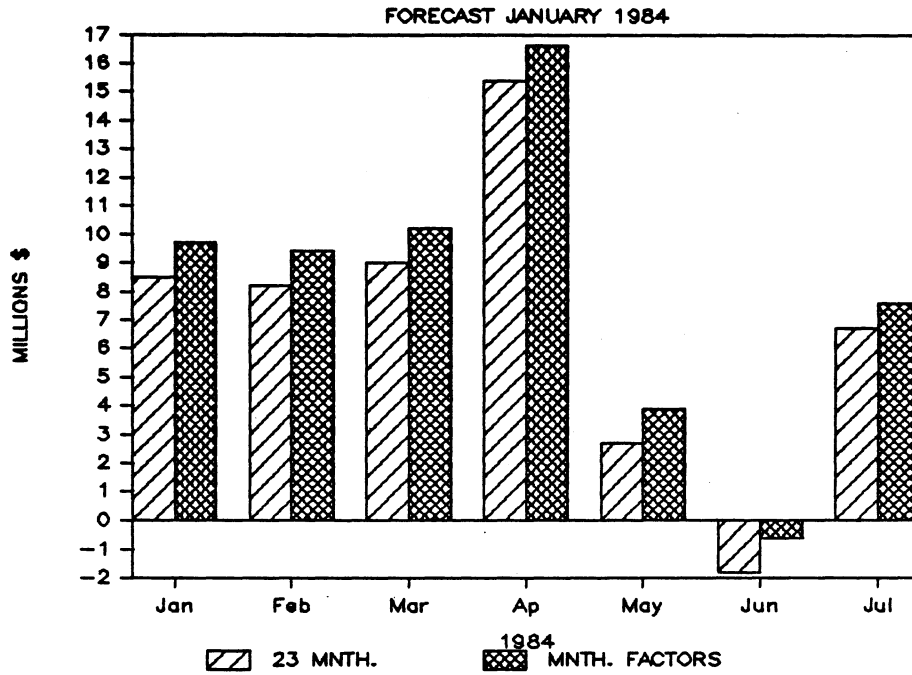
FIG. 17. CUMUL. MISC. EXPEND. ERROR

FORECAST JANUARY 1984

MILLIONS $

Jan Feb Mar Ap May Jun Jul

1984

▨ 23 MNTH. ▧ MNTH. FACTORS
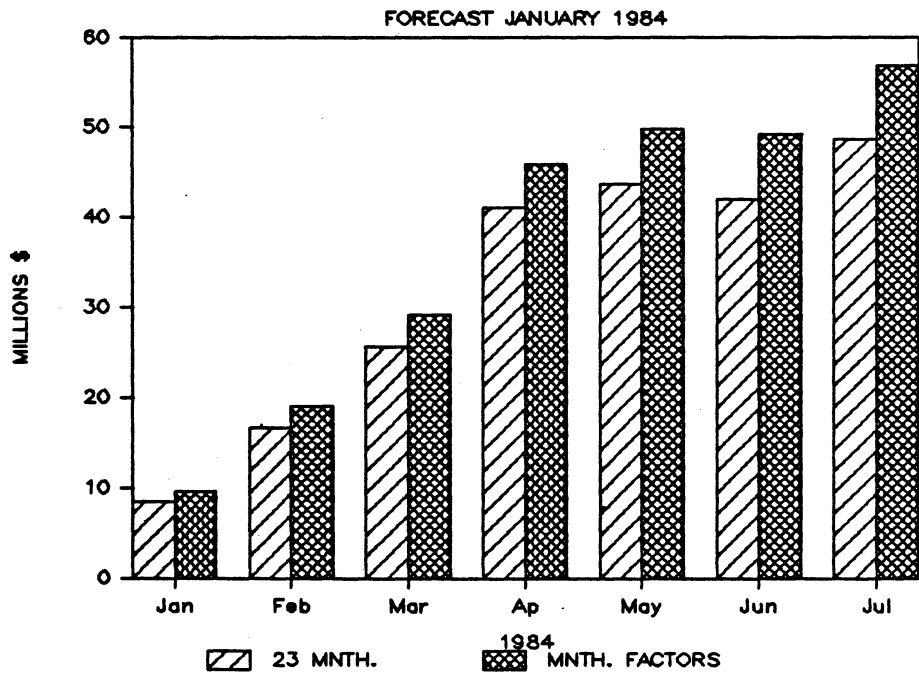
FIG. 18. ESTIM. MINUS TOTAL PAYOUT

FORECAST JANUARY 1984

Bar chart. Y-axis: MILLIONS $, ranging from −2 to 34. X-axis labeled 1984 with months Jan, Feb, Mar, Ap, May, Jun, Jul.

Legend: ▧ 23 MNTH.   ▨ MNTH. FACTORS
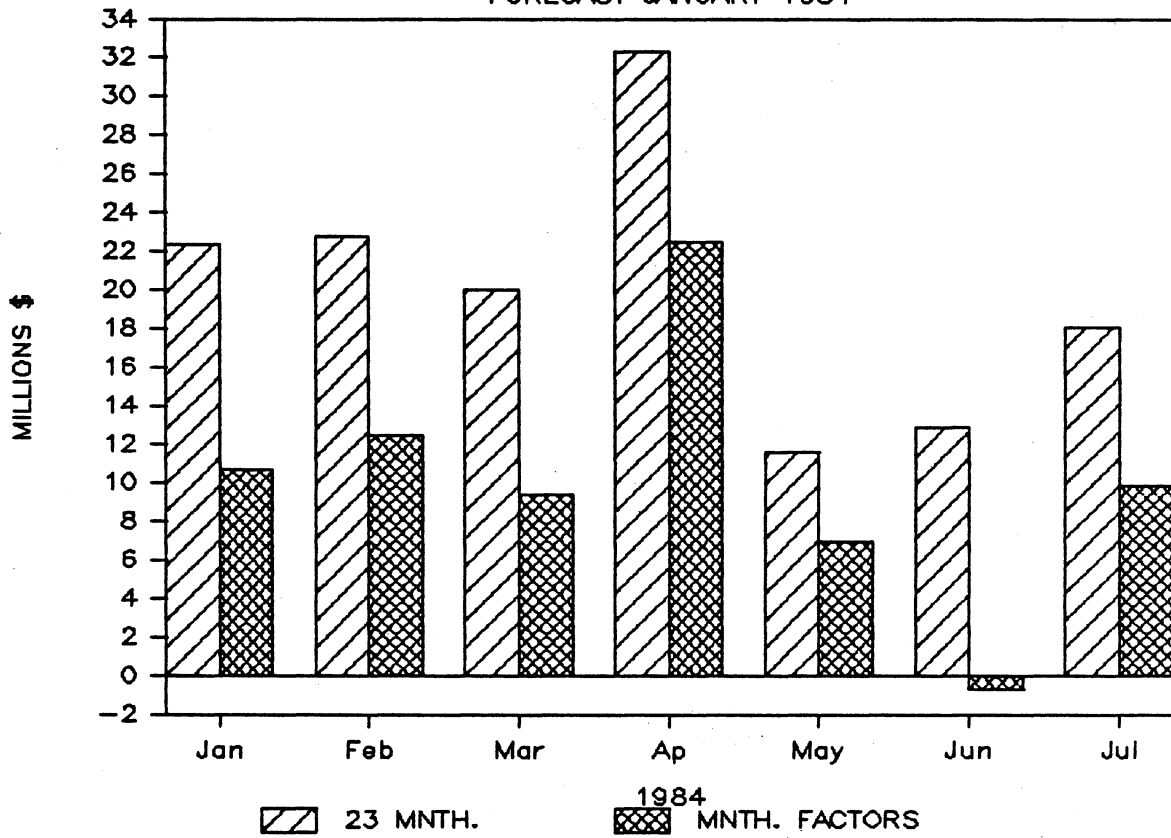
Proposed Improvements

Using budget figures provided by the Administrative Services Division as the basis for forecasting payout on materials and supplies seems quite reasonable. Nevertheless, this approach shows an apparent tendency to overestimate actual expenditures. It is not clear that the budgeted amount is the cause of this tendency. In fact, several changes have been made in the format of the monthly expenditures and cash balances report over the past two years which may have been responsible for the fact that since July 1982, reported expenditures do not track recorded purchases of materials and supplies even if reasonable time lags are allowed between purchase dates and payment dates.

Two options are available which may, if pursued, improve the forecast. The first, which has been initiated in the Division's latest cash forecast, is to somewhat reduce the budgeted amount for cash payout forecasting purposes. This option was pursued for testing purposes and the results are shown in Figures 19 and 20. Figure 19 presents a comparison of actual expenditures for all items other than contract construction and contract maintenance with a forecast of these items adjusted for the tendency to overestimate expenditures for materials and supplies. When incorporated into the total payout forecast shown in Figure 20, the outcome was very encouraging -- total payout through July 1984 is overestimated by $2.7 million and data collected through September 1984 showed the overestimate is now $6.2 million for the forecast period beginning in January 1984. The second option for improvement is for the Fiscal, Administrative Services, and Budget Divisions to cooperate in identifying the cause of the disparity between reported purchases and reported expenditures on materials and supplies.

FIG. 19. MISC. MATERIAL—ADJ. EXPEND.

FORECAST JANUARY 1984

MILLIONS $

ACTUAL   MNTH. FACTORS
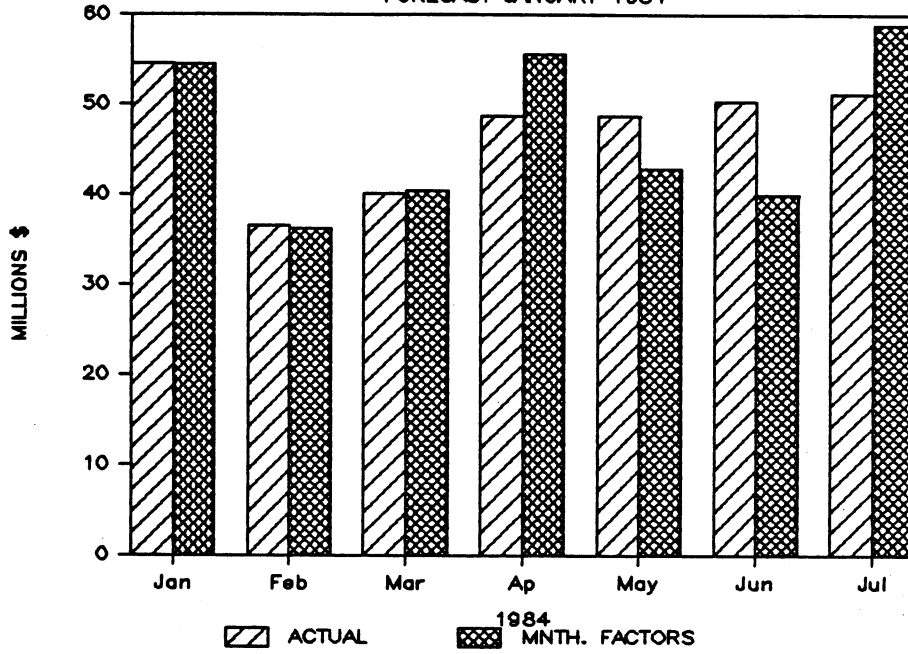
1984

FIG. 20. TOTAL VS MAT'R—ADJ PAYOUT

FORECAST JANUARY 1984

MILLIONS $

ACTUAL   MNTH. FACTORS

1984

29
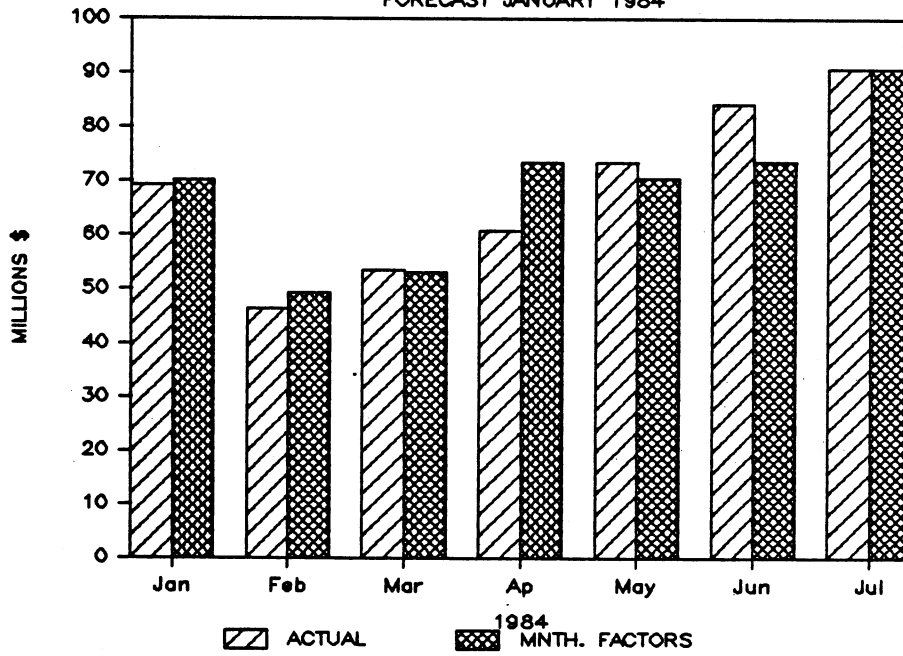
THE BOTTOM LINE: CASH BALANCES

January 1984 to July 1984

The techniques proposed in the previous sections, including the adjustment for materials purchases, were applied to derive a cash balance forecast for January 1984 to July 1984. The accuracy of this forecast is shown graphically in Figure 21. Details of the forecast are presented in Appendix A and reveal that the cumulative error as of July 1984 was only $4.0 million. Data available through September 1984 showed the cumulative error to be approximately $20.0 million, most of which resulted from overestimates of federal aid ($18.3 million) in September and October. For the forecast period, the error averaged ±$8.3 million per month and had a standard deviation of $9.1 million.

Fiscal 1985 and Fiscal 1986

The techniques proposed in this report offer the potential for much more accurate forecasts than have been the case in the past. For the forecast period from July 1984 through June 1986 cash balances should be significantly above levels predicted by the techniques previously used by the Department. Details of the forecast by the monthly factors model and the 23-month payout curve technique are the subjects of Appendix B and Appendix C, respectively. A summary of major line items under each forecast technique is presented in Figures 22-25. The following can be expected for the forecast period:

-- Under the techniques formerly used, federal aid is estimated to be $992.0 million. The estimate is $756.0 million under the proposed techniques.

-- Under the techniques formerly used, contract construction is estimated to be $1.1 billion. The estimate is $801.0 million under the proposed techniques.

-- Under the techniques formerly used, total payout is estimated to be $1.953 billion. The estimate is $1.860 billion under the proposed techniques.

-- Under the techniques formerly used, the cash balance is not expected to be less than $145.0 million. Under the proposed techniques the balance is expected to remain substantially higher, peaking at close to $300.0 million.

FIG. 21. MATERIAL—ADJUSTED CASH BAL.

FORECAST JANUARY 1984

ACTUAL   ▽ MNTH. FACTORS

31
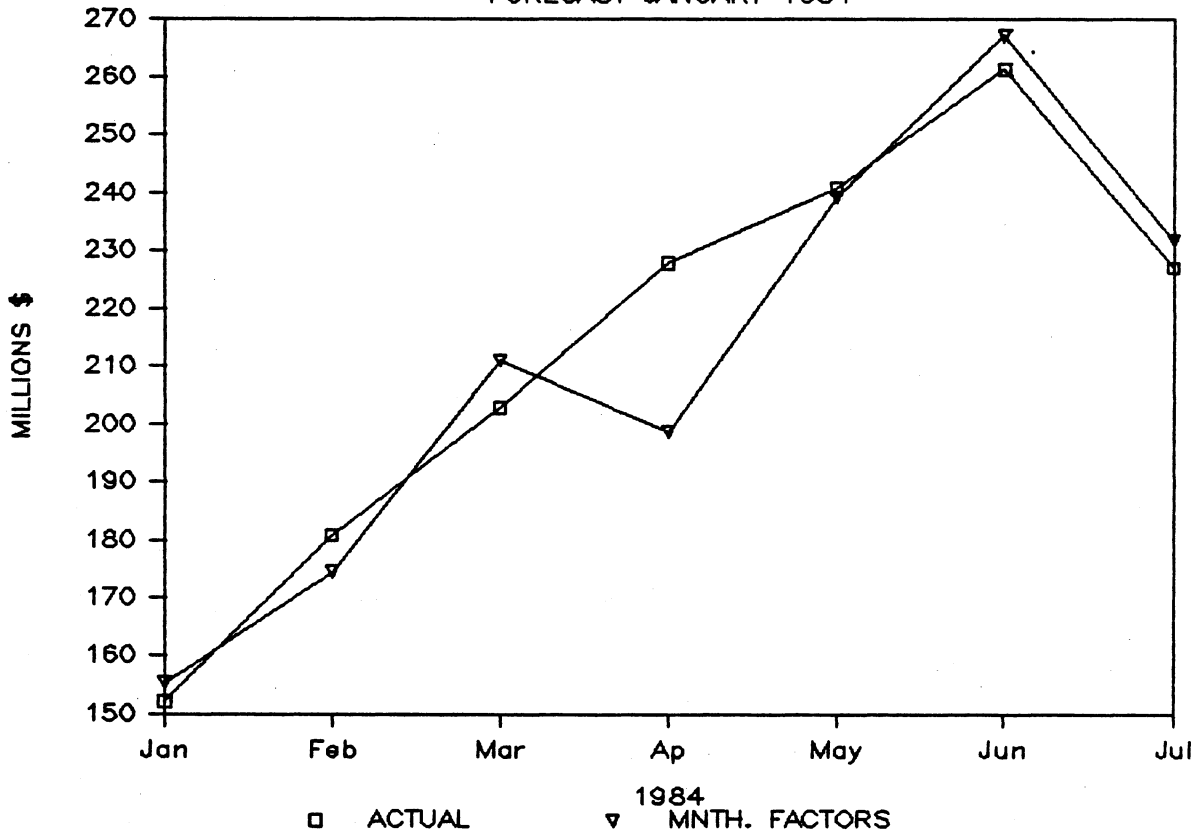
FIG. 22. FEDERAL AID JUL 84—JUN 86

PAYOUT CURVE VS MONTHLY FACTORS

□ 23 MNTH   ▽ MNTHLY FACTORS
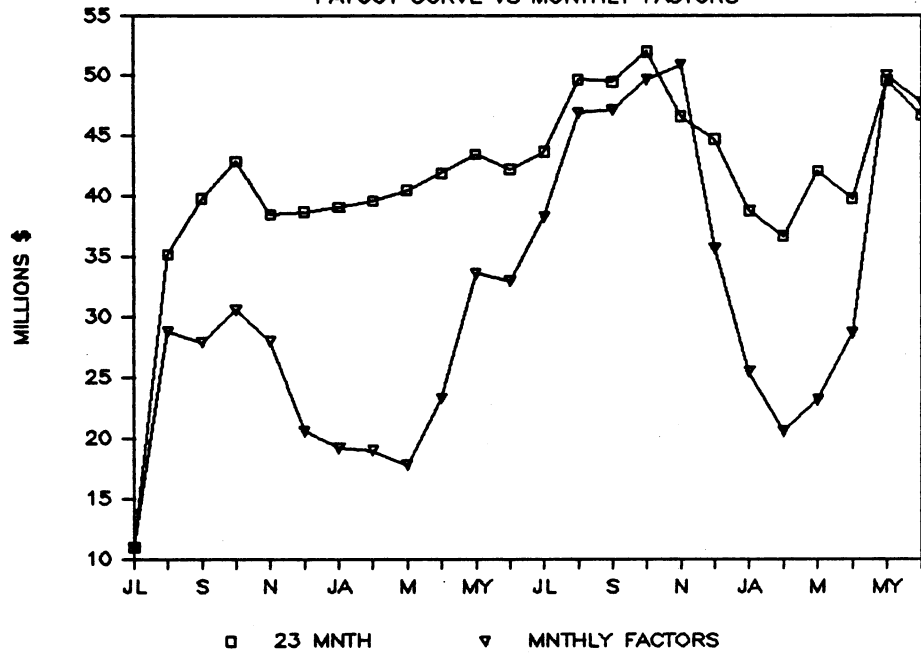
FIG. 23. CONSTRUCTION JUL 84—JUN 86

PAYOUT CURVE VS MONTHLY FACTORS

□ 23 MNTH   ▽ MNTHLY FACTORS

32
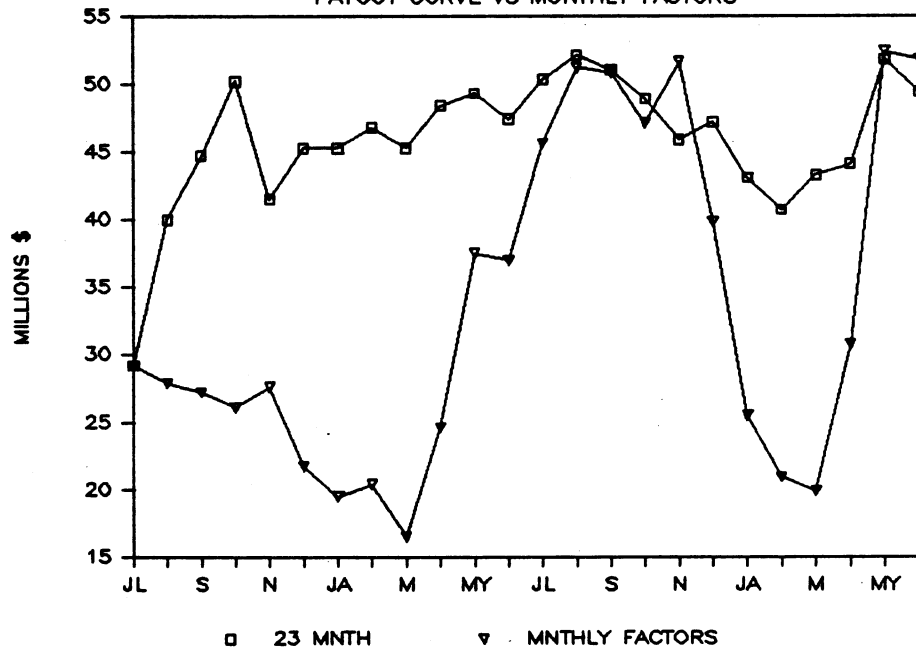
FIG. 24. TOTAL PAYOUT JUL 84–JUN 86

PAYOUT CURVE VS MONTHLY FACTORS

□ 23 MNTH   ▽ MNTHLY FACTORS
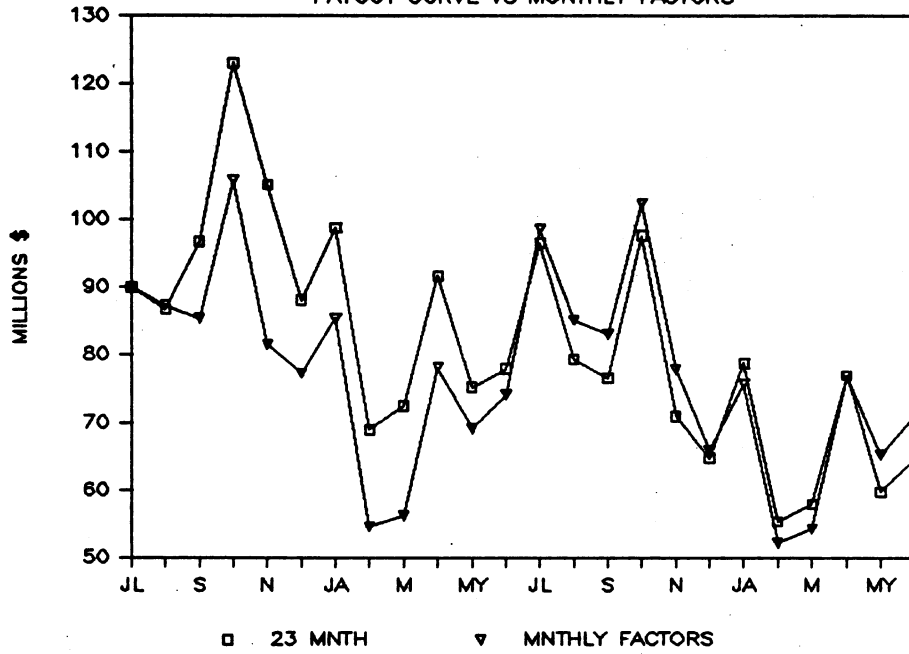
FIG. 25. CASH BALANCE JUL 84–JUN 86

PAYOUT CURVE VS MONTHLY FACTORS

□ 23 MNTH   ▽ MNTHLY FACTORS

33
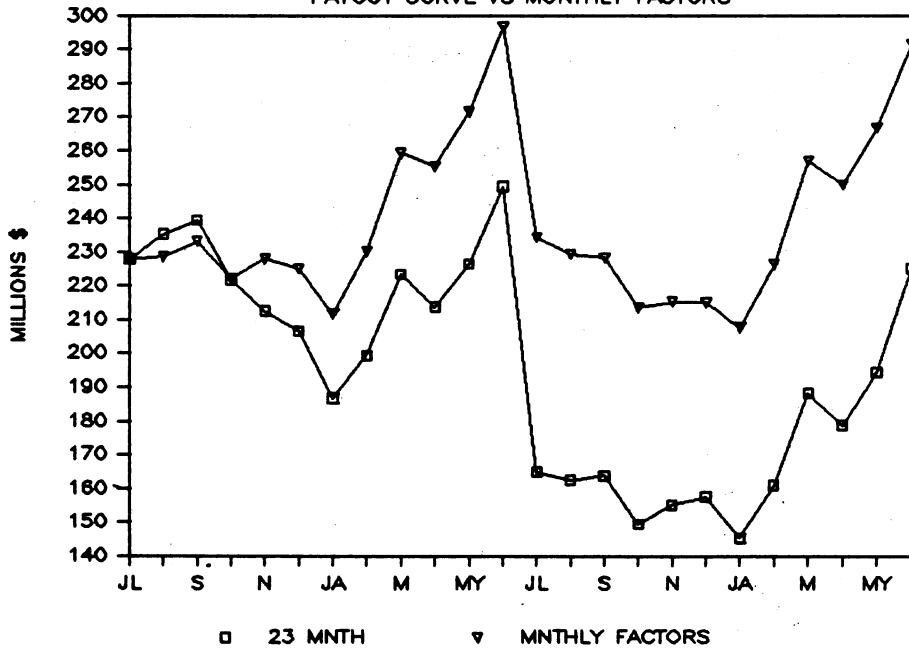
What Are Reasonable Cash Balances?

In addition to maintaining a contingency to take advantage of unanticipated federal aid, another criterion by which to gauge the reasonableness of cash balances for contingency purposes is in light of the stability in the pattern of the periods during which expenditures exceed monthly revenues. Since July 1980, expenditures have exceeded revenues for the months of July, August, September, and October. Revenues have exceeded expenditures for the months of November through June. Thus, it may be reasonable to design the programming and scheduling of the construction program to ensure that the cash balance accumulated on June 30 of each fiscal year approximates, with a reasonable margin of error, the expected excess of expenditures over revenues for the following months of July through October. Approximately $70.0 million may have been a reasonable balance for this purpose for June 30, 1984. Approximately $90.0 to $100.0 million may not be excessive for June 30, 1985, assuming the proposed advertisement schedule proceeds on target and the seasonality of revenue follows its historical pattern. Additional amounts would be necessary for a federal aid contingency.

Maintaining cash balances at reasonable contingency levels is consistent with maximizing the benefits from revenues available from user taxes, and establishing mechanisms to ensure the implementation of a construction program consistent with maintaining such balances is an appropriate goal to be achieved through the finance and the programming and scheduling functions of the Department. However, extreme caution must be exercised in proposing, at a glance, that balances are too high or too low. Nevertheless, with the aid of the forecasting techniques proposed in this study, "what if" scenarios can be developed to determine the extent to which changes in the construction program result in unacceptably low or high cash balances.

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2. U.S. Department of Commerce, Bureau of Economic Analysis, The X-11 Variant of Census Method II Seasonal Adjustmesnt Program, Technical Paper No. 15, February 1967.

3. U.S. Department of Transportation, Federal Highway Administration, Financing Federal Aid Highways, October 1983.

TEST OF MONTHLY FACTORS MODEL VERSUS 23-MONTH PAYOUT MODEL

FY1984

	Jan	Feb	Mar	Ap	May	Jun	Jul
ESTIMATED BEGINNING BALANCE							
Payout Curve		136.2	142.1	155.2	135.4	131.2	117.4
Monthly Factors		145.6	158	178.3	164.2	165.8	182.2
Actual	151.9	152.3	180.9	202.9	227.9	240.9	261.3
ESTIMATED CONSTRUCTION							
Payout Curve	28.2	24.1	24.1	27.8	31.7	35	33
Monthly Factors	14.5	12.1	12.3	17.5	26	25.9	31.6
Actual	13.6	9.5	12.3	11.1	22.3	25.7	29.2
ESTIMATED STATE REVENUE							
Payout Curve	51.9	53.8	63.7	52.5	57.8	57.1	42.4
Monthly Factors	53.5	57.6	67.8	55.6	61.9	76.2	38.1
Actual	54.2	59.7	66.9	58.1	64.9	79.8	44.4
ESTIMATED FEDERAL REVENUE							
Payout Curve	23.5	20.7	22.3	20.1	22.4	26.1	26.8
Monthly Factors	19.6	13.2	14.8	13	19.5	23.1	22
Actual	13.9	14	15.6	15.6	19.5	22.6	11
TOTAL INCOME							
Payout Curve	76	75.2	86.6	73.3	80.8	83.3	70.4
Monthly Factors	73.7	71.4	83.2	69.2	82	99.9	61.3
Actual	69.7	75.1	75.5	85.8	86.4	104.6	56.5
ESTIMATED MAINTENANCE							
Existing	0.5	0.4	0.3	1.1	1.8	13.5	17.9
Monthly Factors	1.3	0.9	0.3	0.4	1.7	7.8	10.2
Actual	1.2	0.4	1.1	0.9	2.3	8.1	10.3
OTHER EXPENDITURES							
Payout Curve	63	44.8	49.1	64.2	51.5	48.6	57.9
Monthly Factors	64.2	46	50.3	65.4	52.7	49.8	58.8
Actual	54.5	36.6	40.1	48.8	48.8	50.4	51.2
ADVERTISEMENTS							
Expected Advertisements	20.8	21.1	62.1	75.2	43.1	95.8	44.6
Actual	18.3	15.7	59.9	50.9	54.2	94.3	
EXPECTED OUTLAYS (WITH ADS)							
Payout Curve	91.7	69.3	73.5	93.1	85	97.1	108.8
Monthly Factors	80	59	62.9	83.3	80.4	83.5	100.6
Actual	69.3	46.5	53.5	60.8	73.4	84.2	90.7
ESTIMATED CASH BALANCE							
Payout Curve	136.2	142.1	155.2	135.4	131.2	117.4	79
Monthly Factors	145.6	158	178.3	164.2	165.8	182.2	142.9
Actual	152.3	180.9	202.9	227.9	240.9	261.3	227.1
CASH BAL. ERROR (CUMULATIVE)							
Payout Curve	16.1	38.8	47.7	92.5	109.7	143.9	148.1
Monthly Factors	6.7	22.9	24.6	63.7	75.1	79.1	84.2

TEST OF MONTHLY FACTORS MODEL VERSUS 23-MONTH PAYOUT MODEL

	Jan	Feb	Mar	Ap	May	Jun	Jul
ESTIM. MINUS ACT. REVENUE MONTHLY							
Payout Curve	6.3	0.1	11.1	-12.5	-5.6	-21.3	13.9
Monthly Factors	4	-3.7	7.7	-16.6	-4.4	-4.7	4.8
ESTIM. MINUS ACT. EXPENSE MONTHLY							
Payout Curve	22.4	22.8	20	32.3	11.6	12.9	18.1
Monthly Factors	10.7	12.5	9.4	22.5	7	-0.7	9.9
NET MONTHLY ERROR							
Payout Curve	16.1	22.7	8.9	44.8	17.2	34.2	4.2
Monthly Factors	6.7	16.2	1.7	39.1	11.4	4	5.1
EST. MINUS ACT. FED. AID MONTHLY							
Payout Curve	9.6	6.7	6.7	4.5	2.9	3.5	15.8
Monthly Factors	5.7	-0.8	-0.8	-2.6	0	0.5	11
EST. MINUS ACT. STATE REV. MONTHLY							
Payout Curve	-2.3	-5.9	-3.2	-5.6	-7.1	-22.7	-2
Monthly Factors	-0.7	-2.1	0.9	-2.5	-3	-3.6	-6.3
CUMULATIVE FED. AID ERROR							
Payout Curve	9.6	16.3	23	27.5	30.4	33.9	49.7
Monthly Factors	5.7	4.9	4.1	1.5	1.5	2	13
CUMULATIVE STATE REV. ERROR							
Payout Curve	-2.3	-8.2	-11.4	-17	-24.1	-46.8	-48.8
Monthly Factors	-0.7	-2.8	-1.9	-4.4	-7.4	-11	-17.3
EST. MINUS ACT. CONSTRUCTION							
Payout Curve	14.6	14.6	11.8	16.7	9.4	9.3	3.8
Monthly Factors	0.9	2.6	0	6.4	3.7	0.2	2.4
CUMULATIVE CONSTRUCTION ERROR							
Payout Curve	14.6	29.2	41	57.7	67.1	76.4	80.2
Monthly Factors	0.9	3.5	3.5	9.9	13.6	13.8	16.2
CUMUL. ERROR OTHER EXPENDITURES							
Payout Curve	8.5	16.7	25.7	41.1	43.8	42	48.7
Monthly Factors	9.7	19.1	29.3	45.9	49.8	49.2	56.8
CUMULATIVE ERROR IN MAINT.							
Payout Curve	-0.7	-0.7	-1.5	-1.3	-1.8	3.6	11.2
Monthly Factors	0.1	0.6	-0.2	-0.7	-1.3	-1.6	-1.7
MONTHLY ERROR OTHER EXPENDITURES							
Payout Curve	8.5	8.2	9	15.4	2.7	-1.8	6.7
Monthly Factors	9.7	9.4	10.2	16.6	3.9	-0.6	7.6
OTHER EXPENDITURES CORRECTED							
Monthly Factors	54.4	36.2	40.5	55.6	42.9	40	58.8
Actual	54.5	36.6	40.1	48.8	48.8	50.4	51.2
EXPECTED OUTLAYS ADJUSTED							
Monthly Factors	70.2	49.2	53.1	73.5	70.6	73.7	90.8
Actual	69.3	46.5	53.5	60.8	73.4	84.2	90.7
EXPECTED CASH BAL. (ADJUSTED)							
Monthly Factors	155.4	174.5	211	198.6	239.3	267.1	231.8
Actual	152.3	180.9	202.9	227.9	240.9	261.3	227.1

APPENDIX B

MONTHLY FACTORS MODEL CASH FORECAST FOR FY 1985

FY85

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP	MAY	JUN	TOTALS
BEGINNING CASH BALANCE	261.30	227.80	228.67	233.04	222.21	227.98	225.45	213.42	234.19	265.66	264.93	286.40	
INCOME													
State	44.40	58.20	60.60	63.10	58.20	53.50	57.50	61.90	72.80	59.70	66.50	81.90	738.30
Federal Current	11.00	28.80	27.90	30.60	27.90	19.70	13.30	10.00	11.40	13.30	17.60	16.30	227.80
Other	1.10	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
TOTAL INCOME	56.50	88.20	89.70	94.90	87.30	74.40	72.00	73.10	85.40	74.20	85.30	99.40	980.50
EXPENDITURES													
Counties	2.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	13.40
City Street Payments	10.00	0.00	0.00	19.30	0.00	0.00	19.30	0.00	0.00	19.30	0.00	0.00	75.30
Transit	4.20	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	35.60
Other Agencies	6.40	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	68.30
Salaries, Wages, Other	17.80	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	233.40
Materials & Supplies	5.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	75.80
Equipment	0.00	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	15.40
Right of Way	3.10	3.50	2.80	4.50	2.50	3.60	2.10	1.40	5.00	3.00	4.90	4.60	41.00
Miscellaneous & Consultants	1.90	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	42.93
SUBTOTAL EXPENDITURES	51.20	44.33	43.63	64.63	43.33	44.43	62.23	42.23	45.83	63.13	45.73	45.43	601.13
CONTRACTS													
Maintenance	10.20	13.80	13.80	13.90	12.10	5.00	1.40	1.00	0.30	0.40	1.90	8.40	82.00
Current Construction	29.20	27.90	27.20	26.10	27.50	20.40	12.20	9.10	7.80	11.40	16.20	14.80	229.80
SUBTOTAL CONTRACTS	38.80	43.00	41.70	41.10	38.20	32.50	21.80	10.10	8.10	11.80	18.10	23.20	311.80
TOTAL EXPENDITURES	90.00	87.33	85.33	105.73	81.53	76.93	84.03	52.33	53.93	74.93	63.83	68.63	912.93
NET CASH BALANCE	227.80	228.67	233.04	222.21	227.98	225.45	213.42	234.19	265.66	264.93	286.40	317.17	317.17
PROPOSED ADVERTISEMENTS	23.70	71.50	188.90	26.10	12.00	35.00	35.30	6.20	22.90	156.70	8.50	16.80	603.60
(-) Proposed Construction	0.00	0.00	0.00	0.00	0.10	1.30	7.30	11.30	8.70	13.20	21.30	22.20	85.40
(+) Reimbursable Federal-Aid	0.00	0.00	0.00	0.00	0.10	0.90	5.90	9.00	6.40	10.00	16.00	16.70	65.00
Net Reduction	0.00	0.00	0.00	0.00	0.00	-0.40	-1.40	-2.30	-2.30	-3.20	-5.30	-5.50	-20.40
Accum. Reduction	0.00	0.00	0.00	0.00	0.00	-0.40	-1.80	-4.10	-6.40	-9.60	-14.90	-20.40	-20.40
ADJUSTED CASH BALANCE	227.80	228.67	233.04	222.21	227.98	225.05	211.62	230.09	259.26	255.33	271.50	296.77	296.77

MONTHLY FACTORS MODEL CASH FORECAST FOR FY 1986

FY86

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP	MAY	JUN	TOTAL
BEGINNING CASH BALANCE	296.77	261.58	264.95	272.18	265.04	275.02	281.44	278.07	300.47	334.52	332.96	358.51	
INCOME													
State	38.74	59.10	61.56	64.09	59.11	54.35	58.36	62.83	73.98	60.67	67.58	83.20	743.57
Federal Current	16.40	20.00	19.30	22.20	19.30	10.30	8.70	6.90	9.70	8.00	13.30	11.00	165.10
Other	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
TOTAL INCOME	56.34	80.30	82.06	87.49	79.61	65.85	68.26	70.93	84.88	69.87	82.08	95.40	923.07
EXPENDITURES													
Counties	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
City Street Payments	19.30	0.00	0.00	20.80	0.00	0.00	20.80	0.00	0.00	20.80	0.00	0.00	81.70
Transit	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	36.00
Other Agencies	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	66.00
Salaries, Wages, Other	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	249.60
Materials & Supplies	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	84.00
Equipment	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	16.80
Right of Way	2.10	3.50	2.80	4.50	2.50	3.60	2.10	1.40	5.00	3.00	4.90	4.60	40.00
Miscellaneous & Consultants	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	3.73	44.76
SUBTOTAL EXPENDITURES	64.03	46.13	45.43	67.93	45.13	46.23	65.53	44.03	47.63	66.43	47.53	47.23	633.26
CONTRACTS													
Maintenance	10.80	14.70	14.70	14.80	12.80	5.30	1.50	1.00	0.30	0.40	2.00	9.00	87.40
Current Construction	16.70	16.10	14.70	11.90	11.70	7.90	4.60	3.50	2.90	4.60	7.00	6.20	107.80
SUBTOTAL CONTRACTS	27.50	30.80	29.40	26.70	24.50	13.20	6.10	4.50	3.20	5.00	9.00	15.20	195.20
TOTAL EXPENDITURES	91.53	76.93	74.83	94.63	69.63	59.43	71.63	48.53	50.83	71.43	56.53	62.43	828.46
NET CASH BALANCE	261.58	264.95	272.18	265.04	275.02	281.44	278.07	300.47	334.52	332.96	358.51	391.48	391.48
PROPOSED ADVERTISEMENTS	82.40	23.60	2.60	42.50	13.70	10.70	211.60	13.90	25.00	13.00	32.90	11.90	483.80
(-) Proposed Construction	28.90	35.10	36.10	35.20	39.90	31.90	20.90	17.40	17.00	26.20	45.40	45.60	379.60
(+) Reimbursable Federal-Aid	21.90	26.90	27.90	27.50	31.60	25.40	16.80	13.70	13.50	20.70	36.70	36.80	299.40
Net Reduction	-7.00	-8.20	-8.20	-7.70	-8.30	-6.50	-4.10	-3.70	-3.50	-5.50	-8.70	-8.80	-80.20
Accum. Reduction	-27.40	-35.60	-43.80	-51.50	-59.80	-66.30	-70.40	-74.10	-77.60	-83.10	-91.80	-99.90	-99.90
ADJUSTED CASH BALANCE	234.18	229.35	228.38	213.54	215.22	215.14	207.67	226.37	256.92	249.86	266.71	291.58	291.58

TWENTY-THREE MONTH PAYOUT CURVE CASH FORECAST FOR FY 1985

FY85

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP	MAY	JUN	TOTALS
BEGINNING CASH BALANCE	261.30	227.80	235.30	239.40	222.40	214.40	211.70	196.60	215.40	245.50	242.50	262.60	
INCOME													
State	44.40	57.80	60.00	62.20	60.00	53.40	56.30	61.40	73.10	58.50	64.40	79.90	731.40
Federal Current	11.00	35.20	39.70	42.10	34.50	27.60	21.40	19.20	22.30	22.30	22.40	19.60	317.20
Other	1.10	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.30
TOTAL INCOME	56.50	94.20	100.90	105.50	95.70	82.20	78.90	81.80	96.50	82.00	88.00	100.70	1062.90
EXPENDITURES													
Counties	2.40	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	15.60
City Street Payments	10.00	0.00	0.00	19.30	0.00	0.00	19.30	0.00	0.00	19.30	0.00	0.00	75.30
Transit	4.20	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	35.60
Other Agencies	6.40	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	68.30
Salaries, Wages, Other	17.80	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60	233.40
Materials & Supplies	5.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	75.80
Equipment	0.00	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	15.40
Right of Way	3.10	3.50	2.80	4.50	2.50	3.60	2.10	1.40	5.00	3.00	4.90	4.60	40.00
Miscellaneous & Consultants	1.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	34.80
SUBTOTAL EXPENDITURES	51.20	43.70	43.00	64.00	42.70	43.80	61.60	41.60	45.20	62.50	45.10	44.80	594.20
CONTRACTS													
Maintenance	10.30	13.80	13.80	13.90	12.10	5.00	1.40	1.00	0.30	0.40	1.90	8.40	82.00
Current Construction	29.20	40.00	44.60	48.90	36.10	31.00	22.80	20.40	20.90	22.10	20.90	17.20	354.10
SUBTOTAL CONTRACTS	38.80	43.00	53.80	58.50	61.00	41.10	32.40	21.40	21.20	22.50	22.80	25.60	436.10
TOTAL EXPENDITURES	90.00	86.70	96.80	122.50	103.70	84.90	94.00	63.00	66.40	85.00	67.90	70.40	1030.30
NET CASH BALANCE	227.80	235.30	239.40	222.40	214.40	211.70	196.60	215.40	245.50	242.50	262.60	292.90	292.90
PROPOSED ADVERTISEMENTS	23.70	71.50	188.90	26.10	12.00	35.00	35.30	6.20	22.90	156.70	8.50	16.80	603.60
(-) Proposed Construction	0.00	0.00	0.10	1.30	5.40	14.30	22.50	26.40	24.40	26.30	28.40	30.20	179.30
(+) Reimbursable Federal-Aid	0.00	0.00	0.10	0.80	4.00	11.10	17.70	20.40	18.30	19.60	21.10	22.60	135.70
Net Reduction	0.00	0.00	0.00	-0.50	-1.40	-3.20	-4.80	-6.00	-6.10	-6.70	-7.30	-7.60	-43.60
Accum. Reduction	0.00	0.00	0.00	-0.50	-1.90	-5.10	-9.90	-15.90	-22.00	-28.70	-36.00	-43.60	-43.60
ADJUSTED CASH BALANCE	227.80	235.30	239.40	221.90	212.50	206.60	186.70	199.50	223.50	213.80	226.60	249.30	249.30

TWENTY-THREE MONTH PAYOUT CURVE CASH FORECAST FOR FY 1986

FY86

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP	MAY	JUN	TOTAL
BEGINNING CASH BALANCE	249.30	216.80	223.50	233.60	228.30	242.90	253.90	250.20	273.20	308.60	307.10	331.80	
INCOME													
State	38.70	58.70	61.00	63.20	61.00	54.30	57.20	62.50	74.40	59.50	65.40	87.70	743.60
Federal Current	15.90	17.00	15.80	18.80	14.60	11.60	8.30	7.20	9.70	6.70	8.90	6.70	141.20
Other	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
TOTAL INCOME	55.80	76.90	78.00	83.20	76.80	67.10	66.70	70.90	85.30	67.40	75.50	95.60	899.20
EXPENDITURES													
Counties	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
City Street Payments	19.30	0.00	0.00	20.80	0.00	0.00	20.80	0.00	0.00	20.80	0.00	0.00	81.80
Transit	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	35.80
Other Agencies	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	65.70
Salaries, Wages, Other	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	20.80	249.60
Materials & Supplies	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	84.00
Equipment	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	16.80
Right of Way	2.10	3.50	2.80	4.50	2.50	3.60	2.10	1.40	5.00	3.00	4.90	4.60	40.00
Miscellaneous & Consultants	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	34.80
SUBTOTAL EXPENDITURES	63.20	45.30	44.60	67.10	44.30	45.40	64.70	43.20	46.80	65.60	46.70	46.40	622.90
CONTRACTS													
Maintenance	10.80	14.70	14.70	14.80	12.80	5.30	1.50	1.00	0.30	0.40	2.00	9.00	87.40
Current Construction	14.30	10.20	8.60	6.60	5.10	5.40	4.20	3.70	2.80	2.90	2.10	0.70	66.60
SUBTOTAL CONTRACTS	25.10	24.90	23.30	21.40	17.90	10.70	5.70	4.70	3.10	3.30	4.10	9.70	154.00
TOTAL EXPENDITURES	88.30	70.20	67.90	88.50	62.20	56.10	70.40	47.90	49.90	68.90	50.80	56.10	776.90
NET CASH BALANCE	216.80	223.50	233.60	228.30	242.90	253.90	250.20	273.20	308.60	307.10	331.80	371.30	371.30
PROPOSED ADVERTISEMENTS	82.40	23.60	2.60	42.50	13.70	10.70	211.60	13.90	25.00	13.00	32.90	11.90	483.80
(-) Proposed Construction	36.00	41.90	42.40	42.30	40.80	41.80	38.90	37.00	40.50	41.20	49.70	48.70	501.20
(+) Reimbursable Federal-Aid	27.80	32.70	33.70	33.20	32.00	33.10	30.50	29.50	32.40	33.10	40.70	40.00	398.70
Net Reduction	-8.20	-9.20	-8.70	-9.10	-8.80	-8.70	-8.40	-7.50	-8.10	-8.10	-9.00	-8.70	-102.50
Accum. Reduction	-51.80	-61.00	-69.70	-78.80	-87.60	-96.30	******	******	******	******	******	-146.10	-146.10
ADJUSTED CASH BALANCE	165.00	162.50	163.90	149.50	155.30	157.60	145.50	161.00	188.30	178.70	194.40	225.20	225.20

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**** Indicates The Accumulated Reduction Exceeds $100 Million