CIP Benchmarking Study

California Multi-Agency CIP Benchmarking Study

Annual Report - Update 2014








Department of PUBLIC WORKS
CITY OF SACRAMENTO

OAKLAND
PUBLIC WORKS AGENCY

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

CITY OF LONG BEACH

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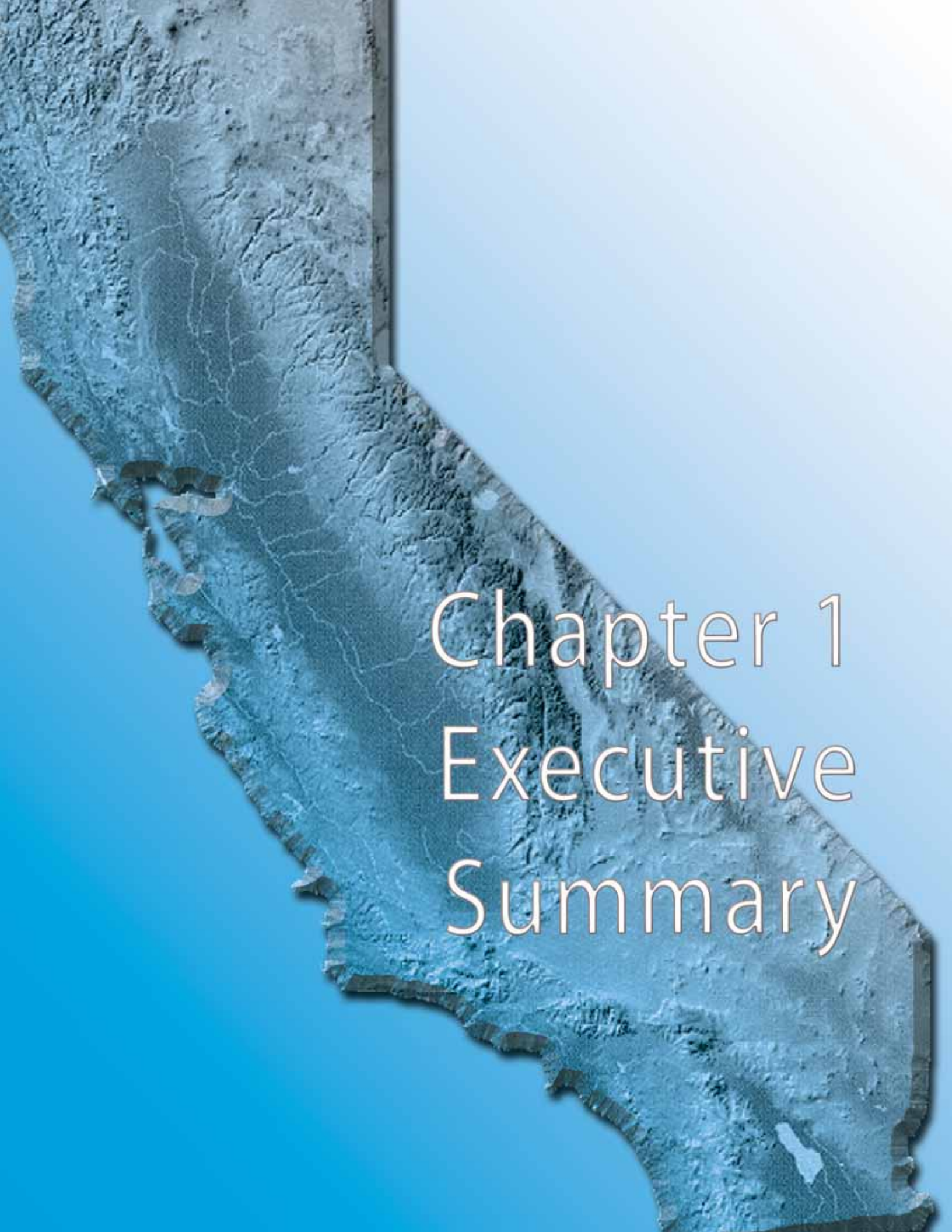

Chapter 1 Executive Summary

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A. INTRODUCTION

As economic growth in California begins to increase, governmental agencies are seeing an increase in their capital improvement programs (CIPs) and a relaxation of hiring restrictions. Despite these changes, municipal agencies in California are still being asked to do more with fewer resources: they are expected to increase their efficiency in delivering services, employ best management practices, implement continuous training programs, and develop best-in-class capabilities. Throughout the changing economic conditions, the *California Multi-Agency CIP Benchmarking Study (Study)* has continued to be an unparalleled tool for sharing the collective CIP implementation experiences of seven of the largest cities in California for the thirteenth consecutive year. Since the participating Cities of Long Beach, Los Angeles, Oakland, Sacramento, San Diego, San José, and the City and County of San Francisco first initiated these efforts, they have developed improved capital project delivery processes and an appreciation for the need to maximize efficiencies in the face of shrinking budgets.

The *Study* provides a forum for the agencies to share information among themselves via meetings that focus on current issues; an online portal where topics for discussion can be posed and challenges addressed; and a database that serves as both a repository of the agencies' projects, and a tool for data analysis. The purpose of this collaboration is to share the best ideas of the group for the benefit of all and to gather insight on how to address challenges that might appear to be new, but which others have already faced and addressed successfully.

In Update 2013, the agencies developed a new Best Management Practice that would develop a framework for analyzing consultant fees. This framework assists the agencies in cost negotiations prior to award. This year (*Update 2014*), the participating agencies performed a Special *Study* to investigate a trend in consultant rates over time. A template form was developed for agencies to collect consultant's rate data for the past 5 years, and this data will be populated by the agencies over the next year. Some of the data being collected are the contract amount, type of work being performed, consultant classification based on duties performed, hourly rate, etc.

B. PERFORMANCE BENCHMARKING

Performance benchmarking involves collecting documented project costs and plotting the component costs of project delivery against the total construction cost (TCC). The objective of this exercise is to develop relationships between these variables by performing regression analyses. Since Update 2009, the results of the regression analyses have yielded significantly better correlation compared to prior years of the *Study*. This is primarily due to the adoption of statistical techniques for model selection and significant improvements in the modeling methodology.

The project costs data are collected from the agencies using a Performance Questionnaire created in Microsoft Excel®. Data are then compiled from the questionnaires in Excel® using a Visual Basic for Applications (VBA) code, and transferred into the database, where the data is reviewed and vetted. A copy of the current Performance Questionnaire can be found in **Appendix A**.

Performance Database

The project data submitted by the agencies are compiled in a customized Microsoft Access® database. This database not only serves as a repository for the data collected since the inception of the *Study*, but also allows for data analysis using built-in functions. The database also provides customized reports and tables for easy data interpretation. Each year, the project database is updated with the inclusion of project data submitted for that *Study* year. The analysis and the reporting features of the database are also updated.

Table 1-1 summarizes the number of projects included in the database and in the analyses. The 5-year database (2009-2013) used for the current analysis contains 665 projects. This total excludes project data older than five years or projects identified as outliers. Projects identified as outliers are not included in the performance data analysis but are retained in the performance database. In addition, projects delivered by alternative delivery methods are excluded from the analysis but included in the database. The 665 projects selected for analysis do not include projects delivered by alternative delivery mechanisms such as design-build, job order contracting (JOC), and CM@Risk. As explained under subsection **A. Study Criteria** of **Section 3**, outlier analysis was performed using statistical techniques to ensure consistency in the selection of outlier data points. This methodology was first implemented during Update 2008 and the agencies recognize the merits of a scientific approach for outlier elimination. Some of the projects classified as outliers in previous *Study* years have been included in the performance data analysis, and vice-versa.

This is an improved practice when compared to prior *Study* years where project data points were classified as outliers based on a combination of statistical parameters and subjective judgments by the Project Team. Previously, projects identified as outliers during one *Study* phase were kept as outliers in subsequent *Study* phases.

Table 1-1 shows that as the rules for project selection were refined, the number of non-representative projects and projects with TCC less than $100K have decreased. In addition, only thirteen projects have been excluded as outliers in the *Update 2014 Study* as compared to the elimination of several hundred projects prior to the refinement of the statistical model in 2009.

In the *Study 2002* report, it was recommended that at least 10 projects per classification and a minimum data set of 2,000 projects distributed evenly among classifications, ranges of TCC, and agencies are necessary to achieve statistically-significant results. While over 2,000 projects have been collected in the database, the number of projects analyzed in any *Study* phase is significantly lower due to the criteria selected for the inclusion of projects in the analyses. Although the requirement for the minimum number of projects per classification has been met for most project categories, more data needs to be collected to ensure an even distribution of projects amongst all classifications.

Table 1-1
Growth of Database

Study Phase[1]	Submitted			Deleted[2]		Count After Deletions[5]	Excluded		Net
	Traditional Projects Submitted	(a) Alternative Delivery Projects Submitted[4]	(b) Total	(c) TCC<$100K	(d) Non-Representative	(e)=(b)-(a)-(c)-(d)	(f) Project Completion Date < 2008	(g) Outliers[3]	Projects in Analyses (h)= (e)-(f)-(g)
I	239	0	239	27	44	168	168	0	0
II	285	0	285	0	35	250	250	0	0
III	262	0	262	0	29	233	233	0	0
IV	173	0	173	18	24	131	131	0	0
V	182	0	182	0	4	178	177	0	0
VI	191	0	191	0	4	187	188	0	0
VII	158	0	158	2	0	156	156	0	0
VIII	155	0	155	2	0	153	149	0	4
IX	174	10	184	2	1	171	44	1	126
X	122	15	137	1	0	121	0	1	120
XI	160	15	175	0	0	160	11	6	143
XII	143	8	151	3	0	140	4	2	134
XIII	145	27	172	0	0	145	4	3	138
Total	**2,389**	**75**	**2,464**	**55**	**141**	**2,193**	**1,515**	**13**	**665**

Notes:

[1] *Study* Phase indicates action taken on the count of projects corresponding to *Study* Years I = 2002, II = 2003, III = 2004, IV = 2005, V = 2006, VI = 2007, VII = 2008, VIII = 2009, IX = 2010, X = 2011, XI = 2012, XII = 2013, and XIII = 2014.

[2] Projects that do not fit *Study* criteria for project classifications and minimum TCC of $100K were removed from the database.

[3] Outliers are identified based on statistical analysis.

[4] These represent projects delivered by alternative project delivery techniques. These projects are kept in the database, but not analyzed. These projects will be analyzed when a sufficient number of such projects are available to facilitate meaningful analyses.

[5] Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

The agencies acknowledge that it is vital to the success of the *Study* to continue increasing the size of the data set, thereby increasing the confidence, consistency, and reliability of results. There are 4 project types (Municipal Facilities, Streets, Pipe Systems, and Parks) and 16 project classifications included in this *Study*.

Characteristics of Data Analyzed

Project performance data were analyzed using the custom database application at both the Project Type level and the Project Classification level.

Project Count and Project Delivery by Completion Year

Table 1-2 summarizes characteristics of the projects included in the analyses by project completion year and shows trends in the average TCC values, median TCC values, design costs, construction management costs, and overall project delivery costs. The median value is the value at which 50 percent of the values are above that value and 50 percent are below that value.

As indicated in **Table 1-2**, median project size has fluctuated considerably since 2009. There was an increase in median project size in 2010 with an approximately

Table 1-2
Project Count and Project Delivery by Completion Year

Project Completion Date	Count by Project Type					Project Delivery Data				
	Municipal Facilities	Streets	Pipes	Parks	Total	Average TCC ($M)	Median TCC ($M)	Design Cost (% of TCC)	Construction Management Cost (% of TCC)	Project Delivery Cost (% of TCC)
2009	28	76	56	10	170	$2.46	$0.82	21%	19%	40%
2010	15	55	80	8	158	$2.35	$0.95	22%	19%	41%
2011	26	51	59	11	147	$2.65	$1.03	27%	21%	48%
2012	10	38	43	11	102	$1.96	$0.86	27%	22%	49%
2013	18	25	40	5	88	$2.47	$1.04	29%	17%	46%
Total	**97**	**245**	**278**	**45**	**665**	**$2.40**	**$0.92**	**25%**	**20%**	**45%**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

16 percent increase over 2009 levels. The median project size continued to increase between 2010 and 2011 by 8 percent, but then dropped 20 percent in 2012. The median project size then increased in 2013 back up to a very similar median project size as in 2011. A similar trend is observed in the average project size. The fluctuations could be due to a combination of several factors such as the selection of projects using the five-year window for analysis, elimination of projects with high TCC values during the outlier analysis, and the addition of several new projects with low TCC values.

While project delivery costs measured as a percentage of the TCC have remained relatively stable in the past, this percentage had increased 8 points from 2010 to 2012. In 2013, the project delivery percentages decreased slightly from what was observed in 2011 and 2012. This increase in project delivery from 2010 to 2012 could be attributed to the "below market rate" bids that were being widely observed in California's construction sector. In addition, factors such as personnel turnover in the agencies have also affected productivity, leading to inefficiencies due to the loss of project specific knowledge. The Special *Study* performed as part of Update 2013 focused on the impacts of declining construction costs on project delivery percentages

Project Delivery Costs by Project Type

Table 1-3 shows project delivery costs by each of the four project types in the *Study* for the full range of TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.

Table 1-3
Average Project Delivery Costs by Project Type (% of TCC)
(Full Range of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	22%	18%	40%	1.87	97
Parks	29%	23%	52%	0.50	45
Pipe Systems	23%	20%	43%	1.10	278
Streets	26%	20%	46%	0.74	245
Average	**25%**	**20%**	**45%**	**0.92**	**665**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

Projects belonging to the Municipal category have the lowest average project delivery percentage while the Parks category had the highest project delivery percentage. The Pipes category has the maximum number of projects (n = 278) in the *Update 2014* database. The Streets category has a similar number of projects in the database (n = 245). The average project delivery percentage for the overall dataset is approximately 44 percent. These percentages have remained relatively stable for the four project types over the past few years.

Table 1-4 shows project delivery costs by each of the four project types in the *Study* for the 80th percentile subset of TCC (Note: In Update 2009, the concept of looking at a subset of projects was introduced. This subset generally characterizes the projects in the type or classification being examined. This step was taken as it was generally believed that project delivery for the very large projects did not characterize the overall projects in the type of classification being examined.). The trends in the delivery costs for the projects in the 80th percentile subset of TCC follow that of the projects in the full range of TCC. As expected based upon the agencies' practical experience, project delivery costs are higher for projects that fall in the 80th percentile subset of TCC.

Table 1-4
Average Project Delivery Costs by Project Type (% of TCC)
(80th Percentile Subset of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	26%	18%	44%	0.97	78
Parks	32%	25%	57%	0.48	36
Pipe Systems	25%	21%	46%	0.82	223
Streets	28%	21%	49%	0.52	196
Average	**27%**	**21%**	**48%**	**0.72**	**533**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

Consultant Usage Analysis

Project delivery performance and consultant usage by agency are presented in **Table 1-5**. The table indicates that approximately 60 percent of the design work and approximately 79 percent of the construction management efforts are completed in-house by the participating agencies. Consultants account for approximately 31 percent of the total project delivery costs while in-house efforts by the participating agencies accounts for the remaining 69 percent of the project delivery costs. For the available data, a clear relationship between the level of in-house effort and project delivery costs cannot be established.

C. REGRESSION ANALYSES

During Update 2008, several changes were made to improve the modeling methodology. These included developing a statistically-sound method for outlier analysis, using a linear trendline regression for modeling project costs relationships, and using the upper and lower bounds of a 95 percent confidence interval to estimate the range of the project delivery percentages. As a result of these improvements, the model relationships could be predicted with a high degree of certainty as compared to previous *Study* years. As previously indicated, during Update 2009, the modeling methodology was further refined by analyzing the data

Table 1-5
Project Delivery Performance and Consultant Usage by Agency

AGENCY	DESIGN					CONSTRUCTION MANAGEMENT					PROJECT DELIVERY					TCC	
	In-House		Consultants		Total % of TCC[2]	In-House		Consultants		Total % of TCC	In-House		Consultants		Total % of TCC	Average	Median
	($M)	% of Design	($M)	% of Design		($M)	% of CM	($M)	% of CM		($M)	% of PD	($M)	% of PD			
Agency A	44.2	71%	17.8	29%	28%	38.4	81%	9.1	19%	18%	82.6	75%	26.8	25%	46%	2.1	1.0
Agency B	12.0	40%	18.2	60%	27%	12.5	57%	9.2	43%	18%	24.5	47%	27.4	53%	45%	2.0	0.5
Agency C	26.8	95%	1.3	5%	19%	24.9	98%	0.5	2%	17%	51.8	97%	1.9	3%	36%	2.0	1.3
Agency D	28.0	53%	24.7	47%	20%	66.1	88%	8.8	12%	31%	94.1	74%	33.6	26%	51%	4.8	1.7
Agency E	7.0	37%	11.7	63%	19%	10.8	37%	18.3	63%	18%	17.8	37%	30.0	63%	37%	1.5	0.7
Agency F	23.0	52%	21.4	48%	28%	37.7	87%	5.5	13%	26%	60.7	69%	26.9	31%	54%	2.8	0.5
Agency G	19.8	63%	11.5	37%	25%	9.3	99%	0.1	1%	10%	29.0	71%	11.7	29%	35%	1.7	0.8
OVERALL	**160.7**	**60%**	**106.7**	**40%**	**25%**	**199.7**	**79%**	**51.6**	**21%**	**20%**	**360.4**	**69%**	**158.3**	**31%**	**45%**	**2.4**	**0.9**

Notes:
[1] In-House and Consultant costs are expressed as percentages of total agency Design, CM (Construction Management), and PD (Project Delivery) costs.
[2] Total Construction Cost (TCC) is the sum of construction contract award, change orders, utility relocation cost, and city forces construction cost.
[3] Design, CM, and PD costs are expressed as percentages of TCC and are unweighted, arithmetic averages of projects by agency.

in two ranges of TCC. Results from the regression analysis methodology are discussed in **Appendix B**.

In most cases, the results reflect the agencies' experience with the delivery of capital projects; on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only 3 out of the 16 categories have lower project delivery percentages for the smaller subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

D. PROJECT DELIVERY PERCENTAGES AS RANGES OF TCC

In addition to evaluating the projects by a smaller 80% subset, the project team evaluated the project delivery percentages on smaller subsets. An analysis was performed on how the project delivery percentage would change if the projects were categorized by TCC cost ranges. The projects included in this analysis followed the same criteria that are included in the report:

- Outliers are excluded
- Only includes projects with TCC greater than $100,000
- Does not include alternative delivery projects
- Includes projects from 2009 to 2013

The results show how the project delivery percentage changes for different ranges of TCC of projects. Projects with higher TCC typically have lower project delivery percentages of TCC and projects with lower TCC typically have a higher project delivery percentage of TCC. The results are further discussed in **Appendix D**.

The project delivery percentage as a range of TCC analysis does not replace or supersede the regression analysis results. The project delivery percentage as a range of TCC analysis is an alternative way to group and analyze the projects to evaluate any trends. These results should be viewed in conjunction with the regression analysis to better understand trends.

E. OTHER CONSIDERATIONS

Size of the Database

Increasing the size of the project database is a major challenge posed to the *Study* participants. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses due to age. The participating agencies are also challenged to identify as many completed projects as possible that meet the rest of the *Study* criteria. The benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database.

BMP Implementation and Project Delivery Costs

It is preferred that project delivery costs decrease as agency efficiencies increase and BMPs implementation is increased. However, project and regional variations, various Agency procedures, market conditions, and other factors can affect such results.

F. SPECIAL STUDY

The *Update 2014* Special *Study* investigated the change in consultant rates over time. A template form was developed for agencies to collect consultant rates data for the past five years, and this data will be populated by the agencies over the next year. The template form was developed by the entire group to confirm the necessary data will be collected to make the *Study* beneficial.

G. BEST MANAGEMENT PRACTICES

At the beginning of this *Study*, the agencies examined over 100 practices used in project delivery. Included in this *Study* were a number of practices that the participants did not commonly use at the time, but believed could add value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at industry changes in order to identify new BMPs. Occasionally, existing BMPs are reworked by the agencies to address specific challenges encountered during implementation. BMPs are also added or modified to reflect relevant experiences by the participants. Each Agency's implementation of these selected practices will continue to be tracked during the *Study*.

While a BMP may be developed to address a specific issue, its implementation may affect other elements of project delivery. A BMP that reduces project schedule, for example, may also favorably impact both communication and project costs. While it is not possible to quantify all the benefits of the BMPs, the participating agencies developed an approach to identify the major benefits associated with each BMP. This was accomplished in Update 2010 *Study* by assigning a Perceived Value to each BMP. The participating agencies judged that each of the BMPs favorably impact one of the following categories:

- Cost
- Schedule
- Quality
- Communication
- Environment
- Customer Service

In *Update 2014*, the Project Team added one new BMP to the BMP implementation tracking list. The new BMP was developed by discussions during a quarterly meeting plus a follow-up conference call. The new BMP is:

- 5.III.k 2014 – Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

This new BMP is believed to directly influence cost, schedule, communication, and customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

H. ONLINE DISCUSSION FORUM

The following discussion topics are summarized in the Chapter 5 Online Discussion Forum.

- Water Quality Inspector
- Design Immunity for Public works Projects
- Project Controls
- CIP and Level-of-Service
- Agency Supplied Materials
- Inspection of Construction Projects

An archive of the full discussion forum is posted confidentially on the *Study* website for access by the participants.

I. CONCLUSIONS

Performance Benchmarking

Performance Benchmarking for the *Update 2014 Study* involved analysis of 665 projects in the projects database. In prior *Study* years, project cost data were only collected and analyzed for projects delivered using the traditional design-bid-build method. In Update 2010, the agencies decided to collect costs data for projects delivered via alternative delivery methods for potential analysis at a later date when sufficient numbers of projects are collected to facilitate meaningful analyses. Collection of projects delivered via alternative methods continued in 2014. There are 73 projects delivered via alternative project delivery mechanisms in the performance database.

The results of the performance benchmarking evaluation show that in almost all cases project delivery costs expressed as a percentage of TCC are higher for projects with lower TCCs. This clearly indicates that an economy of scale exists in the delivery of capital projects. Project delivery percentages (arithmetic averages) for the *Update 2014 Study* varied between the following values for the full range and the smaller project subset of TCC respectively are presented in **Table 1-6**:

Table 1-6
Update 2014 Project Delivery Percentages

Type	Project Delivery Percentages
Municipal Projects	40% - 44%
Parks Projects	52% - 57%
Pipes Projects	43% - 46%
Streets Projects	46% - 49%

Although the results of the performance analyses are based on historical data provided by the participating agencies, there are several factors that could affect project delivery and are not captured in the performance model. These external factors include personnel turnover in the agencies, competitive bids, etc. which impact project delivery. Since such factors are not captured in the performance model, the reader is cautioned to only use the improved results of the regression analyses as a reference and not for prediction of performance. In addition, in light of the current bid environment, it is recommended that the reader use best judgment in the context of the current economic downturn when using the *Study* results for planning and budgeting.

Best Management Practices

In *Update 2014*, the agencies continued to exchange ideas regarding strategies for implementing various BMPs using networking opportunities at the face-to-face meetings, conference calls, and the online discussion forum. In *Update 2014*, the Project Team added one new BMP:

- 5.III.k 2014 – Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

This new BMP is believed to directly influence cost, schedule, communication, and customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

Agencies continue to focus their efforts on monitoring adherence to BMPs that have been implemented and are judged to provide efficiencies in project delivery processes for participating departments. While the Agencies continue to review and update BMPs that have been fully implemented, and pursue full implementation of partially implemented BMPs, in some cases constraints limit the full implementation of BMPs. In addition, many of the major ideas for BMPs have already been identified. While the Agencies try to identify a new BMP, it is getting harder and harder to identify new BMPs. That does not stop continued refinement of BMPs amongst each Agency. Several agencies have established a goal of implementing several BMPs this upcoming year.

To support the linking of BMPs to performance improvements, BMP implementation by the agencies are tracked. As of *Update 2014*, and including the addition of the new BMP, the Agencies have fully implemented about 69 percent of all BMPs. Seven (7) percent of the total BMPs have been partially implemented by the agencies. Many of the remaining BMPs require more involvement and input from multiple departments making them more complicated to implement than other BMPs.

Online Discussion Forum

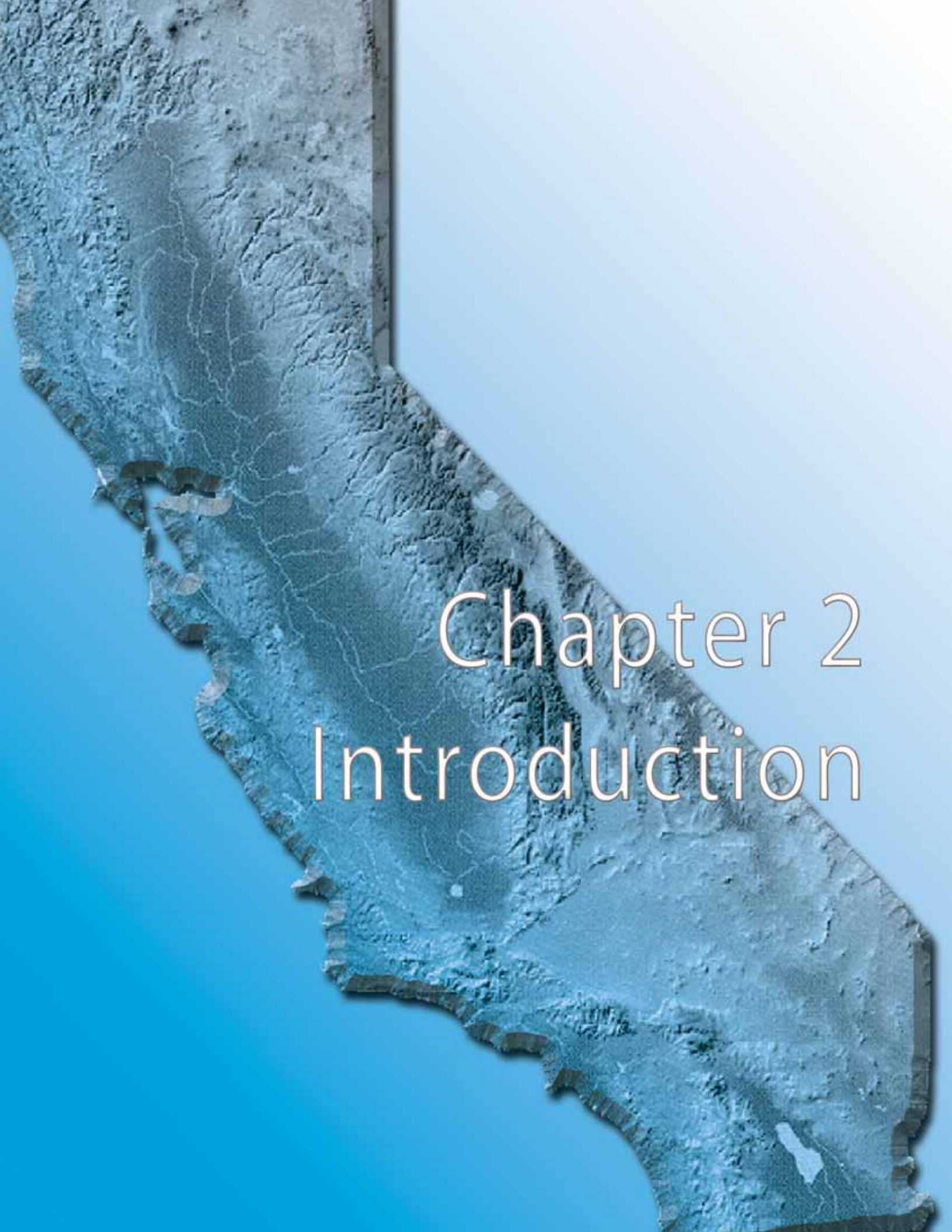
In *Update 2014*, the Online Discussion Forum and open dialog between each Agency continues to be an important feature for *Study* participants. Active, meaningful exchanges occur along with important issues being addressed resulting in changes to policy, approach, or BMP implementation. Participants continue

sharing information through the Online Discussion Forum, conference calls, e-mails, and during the face-to-face meetings. The interesting outcomes of these discussions are presented to the public through the *Study* reports. The continued sharing of challenges and solutions through the Online Discussion Forum remains a remarkable benefit to all participants.

Planning for Update 2015

Over the course of *Update 2014*, the Project Team identified a number of activities to consider including next year in Update 2015. These activities include:

- Continue discussions on how to implement the new BMP (5.III.k);
- Continue collecting data on projects delivered via alternative delivery techniques;
- Developing new BMPs and tracking the implementation of adopted BMPs;
- Continuing discussion on current topics via the round-table discussion forum;
- Continuing meaningful exchanges on the Online Discussion Forum via the SharePoint website; and
- Review consultant rate trends from Special Study.



Chapter 2
Introduction

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As economic growth in California begins to increase, governmental agencies are seeing an increase in their capital improvement programs (CIPs) and a relaxation of hiring restrictions. Despite these changes, municipal agencies in California are still being asked to do more with fewer resources: they are expected to increase their efficiency in delivering services, employ best management practices, implement continuous training programs, and develop best-in-class capabilities. Throughout the changing economic conditions, the *California Multi-Agency CIP Benchmarking Study (Study)* has continued to be an unparalleled tool for sharing the collective CIP implementation experiences of seven of the largest cities in California for the thirteenth consecutive year. Since the participating Cities of Long Beach, Los Angeles, Oakland, Sacramento, San Diego, San José, and the City and County of San Francisco first initiated these efforts, they have developed improved capital project delivery processes and an appreciation for the need to maximize efficiencies in the face of shrinking budgets.

The *Study* provides a forum for the agencies to share information among themselves via meetings that focus on current issues; an online portal where topics for discussion can be posed and challenges addressed; and a database that serves as both a repository of the agencies' projects, and a tool for data analysis. The purpose of this collaboration is to share the best ideas of the group for the benefit of all and to gather insight on how to address challenges that might appear to be new, but which others have already faced and addressed successfully.

This year, the participating agencies performed a Special *Study* to investigate a trend in consultant rates over time. A template form was developed for agencies to collect consultant's rate data for the past 5 years, and this data will be populated by the agencies over the next year.

A. BACKGROUND

In October 2001, the City of Los Angeles, Department of Public Works, Bureau of Engineering initiated the *Study* with several of the largest cities in California. These cities joined together to form the Project Team for the *Study*. The Project Team agrees that there have been significant benefits of collaborating and pooling their project delivery knowledge and experience since the inception of the *Study*.

The *Study* initially involved six agencies, with a seventh joining the team in 2003. The participating agencies currently include:

- City of Long Beach, Department of Public Works and Harbor Department Port of Long Beach
- City of Los Angeles, Department of Public Works, Bureau of Engineering
- City of Oakland, Public Works Department, Bureau of Engineering and Construction

- City of Sacramento, Department of Public Works, and Department of Utilities
- City of San Diego, Engineering and Capital Projects Department
- City and County of San Francisco, Department of Public Works, Building Design and Construction, Infrastructure Design and Construction
- City of San José, Department of Public Works and City Manager's Office

Table 2-1 summarizes some of the general characteristics of the participating agencies and/or of specific departments. While the participating agencies have many similarities in terms of function and capital program delivery, it is important to note that a number of factors create differences. Some of these include organization and cost structure. This is reflected in the "Indirect Rates Applied to Capital Projects" table shown in **Appendix C**. Variances amongst the agency indirect rates can create measureable delivery cost differences between the agencies for similar projects. However, the large magnitude of projects in the *Study* database has normalized these differences when data is compiled for major project categories and/or across all project types.

Upon initiation of the *Study*, it was agreed that published data provided by *Study* participants should remain anonymous in order to create a positive, non-competitive team environment, conducive to meeting the *Study's* goals.

B. BENEFITS OF PARTICIPATION

The participating agencies have been very supportive of the *Study* efforts over the years. The *Study* is possible only because the agencies believe they are benefiting from their continued participation.

The agencies have expressed the benefits they experience in a variety of ways:

- The City of San José continues to benefit by having ready access to the performance data and BMPs of the largest cities in California. This has assisted our decision-making process regarding policy and procedural improvements, as well as our training initiatives as a new generation of project managers enters our workforce. San José also offers: "What is great is that we learn new things at every meeting that lead to ways we can challenge ourselves to improve our processes and procedures. The online forum has also proved to be a very valuable tool between meetings and has generated some very informative discussions on a broad range of topics."
- The City and County of San Francisco use the *Study* in working with other City agencies using our services. Design costs initially quoted by outside consultants may not reflect the final design costs associated with occupied facilities, seis-

mic retrofits, and rehabilitation (especially involving corrosion, dry rot, and hazardous material abatement). Presenting data from seven cities is far more persuasive than presenting our estimates and past data alone. International prices for steel, cement, and petroleum-based products have been volatile over the past 5 years. Tech money and startups have helped stimulate the economy of the San Francisco Bay Area, along with office relocations by social media companies like Twitter, Zynga, and Spotify to the mid-Market St. area in San Francisco. Construction of the 49ers stadium, Apple campus, Google campus, and various condo developments has made the bidding climate even more competitive, the bidding environment has been even more unpredictable. Having the larger sample size of information afforded by the *Study* is essential to forecasting pricing trends with any degree of certainty. The online forum has helped us provide elected officials accurate information quickly regarding other cities' practices on accepting streets and structures for maintenance, and how maintenance work is funded."

- The City of Los Angeles has stated that "the City of Los Angeles has always seen great value in the statistical component of the *Study* to monitor and benchmark delivery costs, but now that the *Study* has matured with many years of data, the value of the *Study* has switched somewhat such that the quarterly discussions with the other agencies has become a more valuable component of the benchmarking *Study* group. The discussions of how executives from other agencies are managing and meeting the many similar challenges that we all face have been extremely helpful."

- The City of Long Beach offers this comment: "For the first time in several years, the City of Long Beach has forecasted budgeted surpluses from a variety of funding sources, and the City Council has directed that the majority of these unanticipated additional revenues be allocated to one time infrastructure projects, as opposed to ongoing programmatic expansions. This direction will have a significant impact on the City's Capital Improvement Program, in terms of both budgets, schedules and staffing needs. Nevertheless, staffing sizes to manage the City's CIP have not expanded, and are not anticipated to expand in the coming years. This will put increased

pressure on the City staff to deliver more projects more efficiently, increasing the need to identify and implement new and proven best management practices in project delivery. Participation in the statewide benchmarking process has allowed the City of Long Beach to share and acquire the knowledge necessary to tackle these project delivery challenges and to determine if the costs of project delivery are reasonable in today's environment".

- According to the City of Sacramento, "the benefits of our continued participation in the *Study* have increased geometrically each year we have participated. Our data collection and tracking have evolved to mirror the *Study* format, making it much easier for us to directly correlate the results of our work and effort with that of our industry peers. As we continue to implement new BMPs each year, our project management and delivery standards continue to improve. We have also found that the online discussion forum is an invaluable resource when we are researching a new policy or practice, as all of the participating agencies are very generous in sharing their own knowledge, standards, and practices."

- The City of San Diego comments that "the *Study* continues to be used as an invaluable resource in providing benchmarks that are significant for municipalities. Although it is well understood that the data changes from year to year based on factors which primarily affect construction costs, the five year state-wide averages are used to continuously review our processes for more efficiency and improved delivery costs. The *Study* also helps staff to better communicate typical CIP challenges e.g., needed resources with elected officials and community stakeholders. The statistical models from the report continue to be refined and provide good benchmarks for estimating our program delivery goals. The City has been so pleased with the results that we now are pursuing similar efforts with regional focus through San Diego Regional Construction Procurement Committee (RCPC). RCPC is working on identifying current and future pressing issues which will have the most significant impact on the region's design and construction plans in the coming decade. The *Study* is a great model for implementing this regional effort. We continue to take advantage of our quarterly meetings and discussion forum, which provide the means to obtain useful information on processes and best management practices from the other participating Cities".

- The City of Oakland offers this comment. "One of the many benefits of the *Study* is the sharing of our challenges in delivering capital projects and ideas on how to address these issues. The Benchmarking group is also an invaluable resource to collect information on common practices of various city policies and standards. We are glad that the Benchmarking group has decided to continue the *Study* and meet semi-annually instead of quarterly during these very difficult economic times. We are proud to be part of this larger Public Works family in California that works together wholeheartedly to improve the delivery of our capital projects".

Table 2-1
Agencies' Overall Information

Information	Population[2]	Area (sq. mi.)	Website	Government Form
Long Beach	467,925	50	http://www.longbeach.gov http://www.polb.com	Council-Manager-Charter[1] Commission-Mayor-Council
Los Angeles	3,866,133	469	http://eng.lacity.org	Mayor-Council
Oakland	399,699	66	http://www2.oaklandnet.com/	Mayor-Council-Administrator
Sacramento	479,686	98	http://www.cityofsacramento.org	Council-Manager
Dept. of Public Works				
Dept. of Utilities				
San Diego	1,328,073	342	http://www.sandiego.gov	Mayor-Council
San Francisco	826,003	49	http://www.sfdpw.org	Mayor-Board of Supervisors (11 members)
San José	983,574	178	http://www.sanJoséca.gov	Mayor-Council-Manager

Notes:
[1] Mayor has veto power.
[2] Source: E-1 Population Estimates for Cities, Counties, and the State — January 1, 2013 and 2014, California Department of Finance

C. STUDY FOCUS

This year, the participating agencies performed a Special *Study* to investigate the change in consultant rates over the past five years. A template form was created and distributed to the agencies to populate. Some of the information collected is the contract amount, type of work being performed, consultant classification based on duties performed, hourly rate, etc. **Appendix D** of the Update 2014 report presents additional analysis conducted to analyze project delivery percentages of projects based on total construction cost ranges. The agencies also developed a new Best Management Practice that is believed to directly influence cost, schedule, communication, and customer service aspects of either design or construction management, and, ultimately, project delivery efficiency. The new BMP is presented below:

- 5.III.k 2014 – Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

Agency implementation of these selected practices has been and will continue to be tracked during the *Study*. A description of the newly added BMP along with their "Perceived Value" is presented in **Chapter 4, Best Management Practices**.

D. STUDY GOALS

The *Study* method is described in detail in the first *Study* report (published in 2002) and modifications to it have been documented in subsequent *Study* reports. In Update 2014 the agencies made progress on several goals:

1. **Update the Database to most recent version of Microsoft Access.** The database was originally creating using Microsoft Access in early 2000, and since then there has been multiple updates to Microsoft office. Some of the functionality of the database was not as compatible with the new versions. This year the database was updated to the most recent version of Microsoft office.

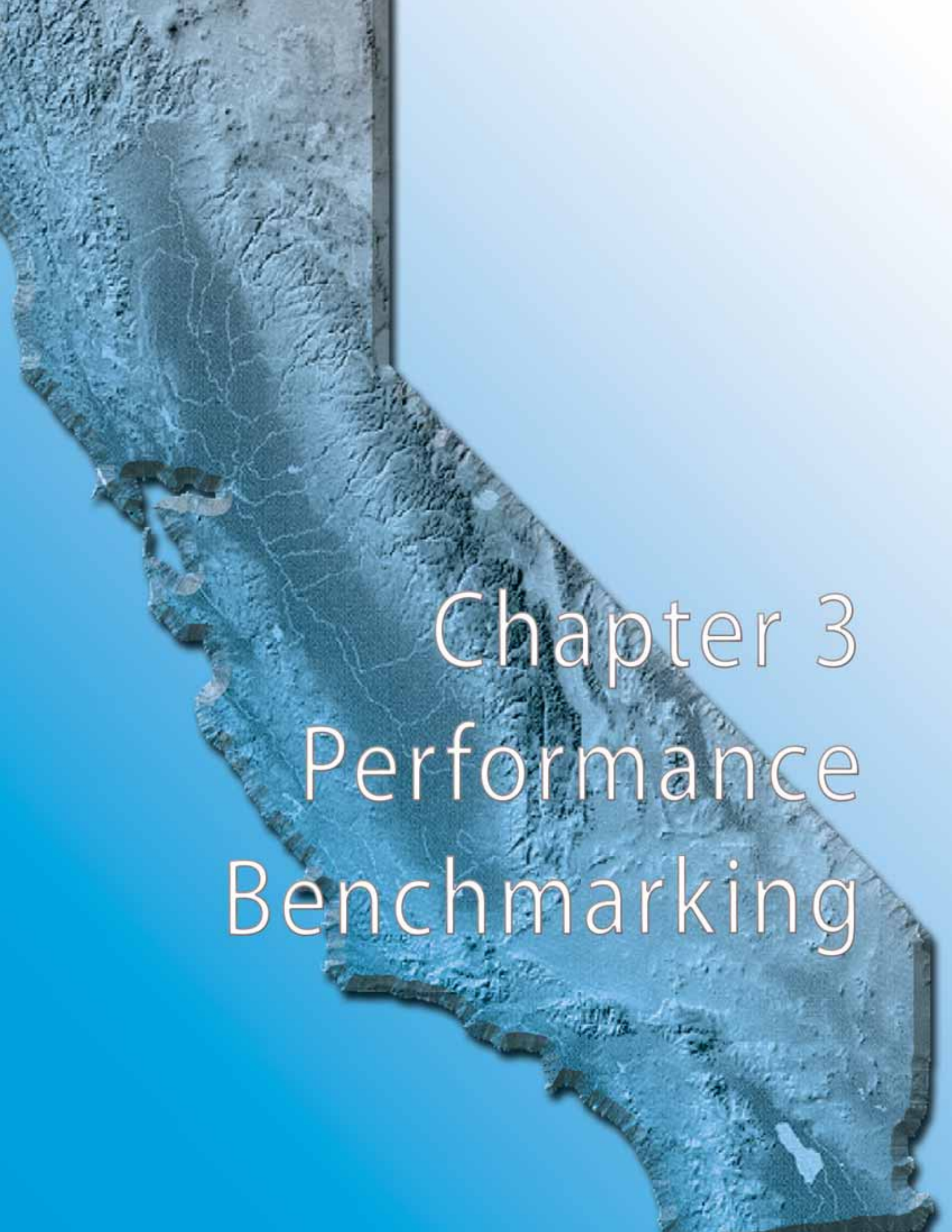
2. **Collect projects delivered by alternative delivery techniques in the performance database.** Over the years, the participating agencies have executed several projects using alternative delivery methods such as design-build and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect cost data for projects delivered via alternative methods. This practice was initiated in Update 2011 and continued in Update

2014. However, the agencies decided that these projects will not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses. In addition, criteria for analysis for projects delivered by alternative delivery techniques needs to be defined.

3. **Track the adoption of BMPs.** The Project Team continued to track the implementation of BMPs in order to link these practices to project delivery performance improvement over time in order to encourage their implementation.

4. **Create new BMPs targeted to address commonly held problem areas.** The Project Team continued to discuss common challenges and share ideas for addressing those challenges during the quarterly meetings as well as in the online discussion forum. One new BMP was adopted by the Project Team for implementation and added to the BMP implementation list.

5. **Continue efficient information sharing with one another through the online discussion forum.** In Update 2014, the Project Team continued to utilize an online portal for discussing issues and challenges. The use of the online portal for exchanging ideas and discussing topics of common interest was first started in 2009. The portal allows for efficient archiving of discussion topics and ease of access. The Project Team uses the discussion forum to share information; survey current processes and policies; and collaborate on implementing new processes and policies.



Chapter 3
Performance Benchmarking

CHAPTER 3 Performance Benchmarking

Performance benchmarking involves collecting documented project costs and plotting the component costs of project delivery against the total construction cost (TCC). The objective of this exercise is to develop relationships between these variables by performing regression analyses. Since Update 2009, the results of the regression analyses have yielded significantly better correlation compared to prior years of the *Study*. This is primarily due to the adoption of statistical techniques for model selection and significant improvements in the modeling methodology.

The project costs data are collected from the agencies using a Performance Questionnaire created in Microsoft Excel®. Data are then compiled from the questionnaires in Excel® using a Visual Basic for Applications (VBA) code and transferred into the database, where the data is reviewed and vetted. A copy of the current Performance Questionnaire can be found in **Appendix A**.

A. STUDY CRITERIA

The following criteria applied to Update 2014 performance benchmarking analyses:

- **Total Construction Cost** – TCC is the sum of costs associated with the awarded construction contract, net change orders, utility relocation, and construction by agency forces. TCC does not include the cost of land acquisition, environmental monitoring and mitigation, design, or construction management. All projects included in the analyses have a TCC exceeding $100,000. The participating agencies use fully-loaded (direct and indirect) costs for project delivery tasks. (See **Appendix C**).

- **Completion Date** – Projects included in the *Study* analyses were completed on or after January 1, 2009 and before December 31, 2013. Projects with earlier completion dates were kept in the database, but excluded from the analyses.

- **Outlier Elimination** – Statistical elimination was used to identify outliers in the performance model. The total project delivery percentage of each project in the database was evaluated against all other projects in the same classification. An outlier was identified as a project whose total project delivery percentage was outside the range expressed by the following equation:

  $y=m \pm 3\sigma$, where;

  where; m represents the mean of the project delivery percentages and σ represents the standard deviation of the project delivery percentages for all projects in the same classification.

It should be noted that this approach, which was first adopted in Update 2008, allows for the inclusion of more data than in previous years. Previously, other methods including visual inspection were used for the elimination of outlier data points. This change was in part allowed by the improved modeling techniques that have been documented in prior *Study* reports.

Projects confirmed as outliers by this statistical technique were kept in the database, but excluded from the analyses.

- **Project Delivery Method** – All projects analyzed in this *Study* were delivered through the traditional design-bid-build method. In prior *Study* years, project costs data were only collected and analyzed for projects delivered using the traditional design-bid-build method. Over the years, the participating agencies have executed several projects using alternative delivery methods such as design-build and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect cost data for projects delivered via alternative methods. However, the agencies decided that these projects will not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses.

- **Change Order Classification** – To support meaningful change order analyses, the Project Team reported change orders in accordance with the following classifications:

1. Changed/Unforeseen Conditions

2. Changes to Bid Documents

3. Client-Initiated Changes

- **Project Classifications** – Sixteen project classifications grouped into four project types are used in this *Study*. In Update 2008, two new project classifications, “Other Municipal Facilities” and “Other Pipes” were added to the Municipal and the Pipes projects categories, respectively. These two classifications will include projects that do not fall under the existing Municipal and Pipes classifications but are representative of the Municipal and the Pipes categories. The agencies will continue to collect data for these classifications for future analyses. The project types and classifications are shown in **Table 3-1**.

Table 3-1
Project Types and Classifications

Project Types	Classifications
Municipal Facilities	• Libraries • Police and Fire Stations • Community Centers, Recreation Centers, Child Care Facilities, Gymnasiums • Other Municipal Facilities[1]
Streets	• Widening, New, and Grade Separation • Bridges • Reconstruction • Bike Ways, Pedestrian Ways, and Streetscapes • Signals
Pipe Systems	• Gravity Systems • Pressure Systems • Pump Stations • Other Pipes
Parks	• Playgrounds • Sportfields • Restrooms

Notes:
[1] Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, water treatment plants, piers, and animal services centers.

B. DATA COLLECTION AND CONFIRMATION

To obtain meaningful results from the performance model, it is essential that the data collected from the agencies are accurate and conform to the *Study* criteria. The agencies recognize the importance of quality input data and are commited to providing accurate, complete project delivery cost data to support the development of performance models. Project delivery costs are defined as the sum of all agency and consultant costs associated with project planning, design, bid, award, construction management, and closeout activities. Examples of specific activities included in each phase of project delivery are presented in **Table 3-2**.

For the Update 2014 *Study*, the agencies completed the questionnaires with comparable, complete, and accurate values. The agencies also review and compare their data collection and confirmation techniques on a regular basis. For example, in a quarterly meeting during Update 2008, each agency delivered a presentation describing how it compiles the project delivery data for the Performance Questionnaire. In addition, discussion among the Project Team helps clarify and resolve inconsistencies in the data collection methodologies. It also ensures that input data is vetted before projects are submitted for analysis.

Table 3-2
Project Cost Categories

Category and Phase	Description
1) Design Costs:	The design phase (and associated costs) begins with the initial concept development, includes planning as well as design, and ends with the issuance of a construction Notice to Proceed. Design costs consist of direct labor costs, other direct agency costs such as art fees and permits, and consultant services cost associated with planning and design. Design may include the following:
Planning	• Complete schematic design documents • Review and develop scope • Evaluate schedule and budget • Review alternative approaches to design and construction • Obtain owner approval to proceed • Attend hearings and proceedings in connection with the project • Prepare feasibility studies • Prepare comparative studies of sites, buildings, or locations • Provide submissions for governmental approvals • Provide services related to future facilities, systems, or equipment • Provide services as related to the investigation of existing conditions of site or buildings or to prepare as-built drawings • Develop life cycle costs • Complete environmental documentation and clearances • Manage right-of-way procurement process • Monitor and control project costs
Design	• Complete design development documents including outline specifications • Evaluate budget and schedule against updated construction cost estimate • Complete design and specifications • Develop bid documents and forms including contracts • Complete permit applications • Coordinate agency reviews of documents • Review substitutions of materials and equipment • Prepare additive or deductive alternate documentation • Coordinate geotechnical, hazardous material, acoustic or other specialty design requirements • Provide interior design services • Monitor and control project costs
Bid and Award	• Prepare advertisement for bids • Qualify bidders • Manage the pre-bid conference • Evaluate bids • Prepare the recommendation for award • Obtain approval of contract award from Board/Council • Prepare the Notice to Proceed • Monitor and control project costs

Table 3-2
Project Cost Categories (cont'd)

Category and Phase	Description
2) Construction Management Costs:	All costs associated with construction management, including closeout costs, are included in this category. Construction management costs consist of direct labor, other agency costs, and consultant usage. Construction management may include the following:
Construction	• Hold pre-construction conference • Review and approve schedule and schedule updates • Perform on-site management • Review shop drawings, samples, and submittals • Perform testing and inspection • Process payment requests • Review and negotiate Change Orders • Prepare monthly reports to owner and agencies • Respond to Requests for Information • Develop and implement a project communications plan • Perform document control • Manage claims • Perform final inspections and develop and track punch list
Closeout Phase	• Commission facilities and equipment • Train maintenance and operation personnel • Document and track warranty and guarantee information • Plan move-in • File notices (occupancy, completion, etc.) • Check and file as-built documents • Monitor and control project costs
3) Total Project Delivery Costs:	This is the total cost of delivering a capital improvement project, equal to the sum of the design cost and construction management costs indicated above.
4) Change Order Cost:	Please see the Update 2005 Report for descriptions of the following types of change orders: • Changed/unforeseen conditions - This type of change is necessitated by discovery of actual job site conditions that differ from those shown on the contract plans or described in the specifications. These are conditions a designer could not have reasonably been expected to know about during the design of the project. • Changes to Bid Documents - This type of change is necessitated by a mistake or oversight in the original contract documents and is required to correct the plans and specifications. • Client-Initiated Changes - This type of change results from additions, deletions or revisions to the physical work.

Table 3-2
Project Cost Categories (cont'd)

Category and Phase	Description
5)Total Construction Cost (TCC):	This is the direct construction cost, including all change orders during the construction phase (from the issuance of Notice to Proceed to Notice of Completion). The following costs are associated with construction and are included in the TCC: • Direct actual construction • Total amount of positive change orders throughout construction • Fixtures, furnishing, and equipment (FFE) • Utilities relocation • Work performed by the agency's staff and other agencies' staff

C. PERFORMANCE DATABASE

The projects data submitted by the agencies are compiled in a customized Microsoft Access® database. This database not only serves as a repository for the data collected since the inception of the *Study*, but also allows for data analysis using built-in functions. The database also provides customized reports and tables for easy data interpretation. Each year, the projects database is updated with the inclusion of projects data submitted for that *Study* year. The analysis and the reporting features of the database are also updated.

Table 3-3 summarizes the number of projects included in the database and in the analyses. The 5-year database used for the current analysis contains 665 projects. This total excludes project data older than five years or projects identified as outliers. Projects identified as outliers are not included in the performance data analysis but are retained in the performance database. In addition, projects delivered by alternative delivery are excluded from the analysis but included in the database. The 665 projects selected for analysis do not include projects delivered by alternative delivery. As explained under subsection A *Study* Criteria of this chapter, outlier analysis was performed using statistical techniques to ensure consistency in the selection of outlier data points. This methodology was first implemented during Update 2008 and the agencies recognize the merits of a scientific approach for outlier elimination. Some of the projects classified as outliers in previous *Study* years have been included in the performance data analysis, and vice-versa.

This is an improved practice when compared to prior *Study* years where project data points were classified as outliers based on a combination of statistical parameters and subjective judgments by the Project Team. Previously, projects identified as outliers during one *Study* phase were kept as outliers in subsequent *Study* phases.

Table 3-3 shows that as the rules for project selection were refined, the number of non-representative and projects with TCC less than $100K have decreased. In addition, only thirteen projects have been excluded as outliers in the Update 2014 *Study* as compared to the elimination of several hundred projects prior to the refinement of the statistical model in 2009.

In the *Study* 2002 report, it was recommended that at least 10 projects

per classification and a minimum data set of 2,000 projects distributed evenly among classifications, ranges of TCC, and agencies are necessary to achieve statistically-significant results. While over 2,000 projects have been collected in the database, the number of projects analyzed in any *Study* phase is significantly lower due to the criteria selected for the inclusion of projects in the database. Although the requirement for the minimum number of projects per classification has been met for most project categories, more data needs to be collected to ensure an even distribution of projects amongst all classifications.

The agencies acknowledged that it is vital to the success of the *Study* to continue increasing the size of the data set, thereby increasing the confidence, consistency, and reliability of results. As previously indicated, there are 4 project types (Municipal Facilities, Streets, Pipe Systems, and Parks) and 16 project classifications included in this *Study*. **Table 3-4** summarizes the distribution of projects included in the Update 2014 analyses.

Table 3-3
Growth of Database

Study Phase[1]	Submitted			Deleted[2]		Count After Deletions[5]	Excluded		Net
	Traditional Projects Submitted	(a) Alternative Delivery Projects Submitted[4]	(b) Total	(c) TCC <$100K	(d) Non-Repre-sentative	(e)=(b)-(a)-(c)-(d)	(f) Project Completion Date < 2006	(g) Outliers[3]	Projects in Analyses (h)= (e)-(f)-(g)
I	239	0	239	27	44	168	168	0	0
II	285	0	285	0	35	250	250	0	0
III	262	0	262	0	29	233	233	0	0
IV	173	0	173	18	24	131	131	0	0
V	182	0	182	0	4	178	177	0	0
VI	191	0	191	0	4	187	188	0	0
VII	158	0	158	2	0	156	156	0	0
VIII	155	0	155	2	0	153	149	0	4
IX	174	10	184	2	1	171	44	1	126
X	122	15	137	1	0	121	0	1	120
XI	160	15	175	0	0	160	11	6	143
XII	143	8	151	3	0	140	4	2	134
XIII	145	27	172	0	0	145	4	3	138
Total	**2,389**	**75**	**2,464**	**55**	**141**	**2,193**	**1,515**	**13**	**665**

Notes:

[1] *Study* Phase indicates action taken on the count of projects corresponding to Study Years I = 2002, II = 2003, III = 2004, IV = 2005, V = 2006, VI = 2007, VII = 2008, VIII = 2009, IX = 2010, X = 2011, XI = 2012, XII = 2013, and XIII = 2014

[2] Projects that do not fit Study criteria for project classifications and minimum TCC of $100K were removed from the database.

[3] Outliers are identified based on statistical analysis.

[4] These represent projects delivered by alternative project delivery techniques. These projects are kept in the database, but not analyzed. These projects will be analyzed when a sufficient number of such projects are available to facilitate meaningful analyses.

[5] Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

Table 3-4
Projects Distribution Matrix

Agency	San Diego	Sacramento	San Francisco	Los Angeles	Long Beach	San José	Oakland	Total[3]
Municipal Facilities	**22**	**7**	**11**	**11**	**11**	**16**	**19**	**97**
Comm./Rec. Center/ Child Care/Gyms	2	1	4	4	2	4	13	30
Libraries	1	0	3	0	1	8	2	15
Other Municipal Facilities[2]	0	0	0	3	3	3	2	11
Police/Fire Stations	19	6	4	4	5	1	2	41
Parks	**9**	**0**	**5**	**7**	**2**	**13**	**9**	**45**
Playgrounds	4	0	4	4	2	9	7	30
Restrooms	1	0	0	0	0	1	0	2
Sportfields	4	0	1	3	0	3	2	13
Pipe Systems	**97**	**31**	**19**	**53**	**5**	**46**	**27**	**278**
Gravity Systems (Storm Drains/Sewers)	44	21	18	50	1	43	27	204
Other Pipes	44	8	1	0	0	0	0	53
Pressure Systems	3	0	0	0	3	2	0	8
Pump Stations	6	2	0	3	1	1	0	13
Streets	**26**	**42**	**46**	**13**	**68**	**26**	**24**	**245**
Bike/Pedestrian/ Streetscapes	13	18	7	2	2	7	15	64
Bridges (New/Retrofit)	2	4	0	4	6	2	3	21
Reconstructions	3	3	37	4	48	5	0	100
Signals	3	12	2	0	11	11	6	45
Widening/New/ Grade Separations	5	5	0	3	1	1	0	15
Total[1]	**154**	**80**	**81**	**84**	**86**	**101**	**79**	**665**

Notes:

[1] Total refers to the projects included in the Update 2014 analyses only.

[2] Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, water treatment plants, piers, and animal services centers.

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the *Update 2014 Study*.

D. CHARACTERISTICS OF DATA ANALYZED

Project performance data were analyzed using the custom database application at both the Project Type level and the Project Classification level (see **Table 3-1**).

Project Count and Project Delivery by Completion Year

Table 3-5 summarizes characteristics of the projects included in the analyses by project completion year and shows trends in the average TCC values, median TCC values, design costs, construction management costs, and overall project delivery costs. The median value is the value at which 50 percent of the values are above and 50 percent of the values are below.

As indicated in **Table 3-5**, median project size has fluctuated considerably since 2009. The median project size increased approximately 26 percent between 2009 and 2011. After increasing in 2009 and 2010, there was a decrease in median project size in 2012 with an approximately 20 percent decrease over 2011 levels. In 2013, the median project size then increased 20 percent to a similar value as in 2011. A similar trend is observed in the average project size. The fluctuations could be due to a combination of several factors such as the selection of projects using the five-year window, elimination of projects with high TCC values during the outlier analysis, and the addition of several new projects with low TCC values.

Table 3-5
Project Count and Project Delivery by Completion Year

Project Completion Date	Count by Project Type					Project Delivery Data				
	Municipal Facilities	Streets	Pipes	Parks	Total	Average TCC ($M)	Median TCC ($M)	Design Cost (% of TCC)	Construction Management Cost (% of TCC)	Project Delivery Cost (% of TCC)
2009	28	76	56	10	170	$2.46	$0.82	21%	19%	40%
2010	15	55	80	8	158	$2.35	$0.95	22%	19%	41%
2011	26	51	59	11	147	$2.65	$1.03	27%	21%	48%
2012	10	38	43	11	102	$1.96	$0.86	27%	22%	49%
2013	18	25	40	5	88	$2.47	$1.04	29%	17%	46%
Total	**97**	**245**	**278**	**45**	**665**	**$2.40**	**$0.92**	**25%**	**20%**	**45%**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the Update 2014 *Study*.

While project delivery costs measured as a percentage of the TCC have remained relatively stable in the past, this percentage has increased 9 percentage points from 2010 to 2012. This can be attributed to the "below market rate" bids that were being widely observed in California's construction sector. In addition, factors such as personnel turnover in the agencies have also affected productivity, leading to inefficiencies due to the loss of project specific knowledge.

Project Delivery Costs by Project Type

Table 3-6 shows project delivery costs by each of the four project types in the *Study* for the full range of TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.

Projects belonging to the Municipal category have the lowest average project delivery percentage. The Pipes category has the maximum number of projects (n = 278) in the Update 2014 database. The Streets category also has a similar number of projects in the database (n = 245). The Parks category exhibits

Table 3-6
Project Delivery Costs by Project Type (% of TCC) (Full Range of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	22%	18%	40%	1.87	97
Parks	29%	23%	52%	0.50	45
Pipe Systems	23%	20%	43%	1.10	278
Streets	26%	20%	46%	0.74	245
Average	**25%**	**20%**	**45%**	**0.92**	**665**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the Update 2014 *Study*.

a high average project delivery cost. The average project delivery percentage for the overall dataset is approximately 45 percent. These percentages have remained relatively stable for the four project types over the past few years.

Over the course of the *Study*, the agencies have observed that the relatively high average project delivery cost of Streets projects is probably due to increasing cost influences of right-of-way acquisition, community outreach requirements, environmental mitigation requirements, and the smaller median total construction cost of these projects.

Table 3-7 shows project delivery costs by each of the four project types in the *Study* for the 80th percentile subset of TCC (Note: In Update 2009, the concept of looking at a subset of projects was introduced. This subset generally characterizes the projects in the type or classification being examined. This step was taken as it was generally believed that project delivery for the very large projects did not characterize the overall projects in the type of classification being examined.). The trends in the project delivery costs for the projects in the 80th percentile subset of TCC follow that of the projects in the full range of TCC. As expected based upon the agencies' practical experience, project delivery costs are higher for projects that fall in the 80th percentile subset of TCC.

Table 3-7
Average Project Delivery Costs by Project Type (% of TCC)
(80th Percentile Subset of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	26%	18%	44%	0.97	78
Parks	32%	25%	57%	0.48	36
Pipe Systems	25%	21%	46%	0.82	223
Streets	28%	21%	49%	0.52	196
Average	**27%**	**21%**	**48%**	**0.72**	**533**

Notes:

[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.

[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the Update 2014 *Study*.

Consultant Usage Analysis

Project delivery performance and consultant usage by agency are presented in **Table 3-8**. The table indicates that approximately 60 percent of the design work and approximately 79 percent of the construction management efforts are completed in-house by the participating agencies. Consultants account for approximately 31 percent of the total project delivery costs while in-house efforts by the participating agencies accounts for the remaining 69 percent of the project delivery costs. For the available data, a clear relationship between the level of in-house effort and project delivery costs cannot be established.

Table 3-8
Project Delivery Performance and Consultant Usage by Agency

AGENCY	DESIGN					CONSTRUCTION MANAGEMENT					PROJECT DELIVERY					TCC	
	In-House		Consultants		Total % of TCC[2]	In-House		Consultants		Total % of TCC	In-House		Consultants		Total % of TCC	Average	Median
	($M)	% of Design	($M)	% of Design		($M)	% of CM	($M)	% of CM		($M)	% of PD	($M)	% of PD			
Agency A	44.2	71%	17.8	29%	28%	38.4	81%	9.1	19%	18%	82.6	75%	26.8	25%	46%	2.1	1.0
Agency B	12.0	40%	18.2	60%	27%	12.5	57%	9.2	43%	18%	24.5	47%	27.4	53%	45%	2.0	0.5
Agency C	26.8	95%	1.3	5%	19%	24.9	98%	0.5	2%	17%	51.8	97%	1.9	3%	36%	2.0	1.3
Agency D	28.0	53%	24.7	47%	20%	66.1	88%	8.8	12%	31%	94.1	74%	33.6	26%	51%	4.8	1.7
Agency E	7.0	37%	11.7	63%	19%	10.8	37%	18.3	63%	18%	17.8	37%	30.0	63%	37%	1.5	0.7
Agency F	23.0	52%	21.4	48%	28%	37.7	87%	5.5	13%	26%	60.7	69%	26.9	31%	54%	2.8	0.5
Agency G	19.8	63%	11.5	37%	25%	9.3	99%	0.1	1%	10%	29.0	71%	11.7	29%	35%	1.7	0.8
OVERALL	**160.7**	**60%**	**106.7**	**40%**	**25%**	**199.7**	**79%**	**51.6**	**21%**	**20%**	**360.4**	**69%**	**158.3**	**31%**	**45%**	**2.4**	**0.9**

Notes:

[1] In-House and Consultant costs are expressed as percentages of total agency Design, CM (Construction Management), and PD (Project Delivery) costs.

[2] Total Construction Cost (TCC) is the sum of construction contract award, change orders, utility relocation cost, and city forces construction cost.

[3] Design, CM, and PD costs are expressed as percentages of TCC and are unweighted, arithmetic averages of projects by agency.

E. REGRESSION ANALYSES RESULTS

During Update 2008, several changes were made to improve the modeling methodology. These included developing a statistically-sound method for outlier analysis, using a linear trendline regression for modeling project costs relationships, and using the upper and lower bounds of a 95 percent confidence interval to estimate the range of the project delivery percentages. As a result of these improvements, the model relationships could be predicted with a high degree of certainty as compared to previous *Study* years. As previously indicated, during Update 2009, the modeling methodology was further refined by analyzing the data in two ranges of TCC. Results from the regression analysis methodology are discussed in **Appendix B**.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only 3 out of the 16 categories have lower project delivery percentages for the 80th percentile subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

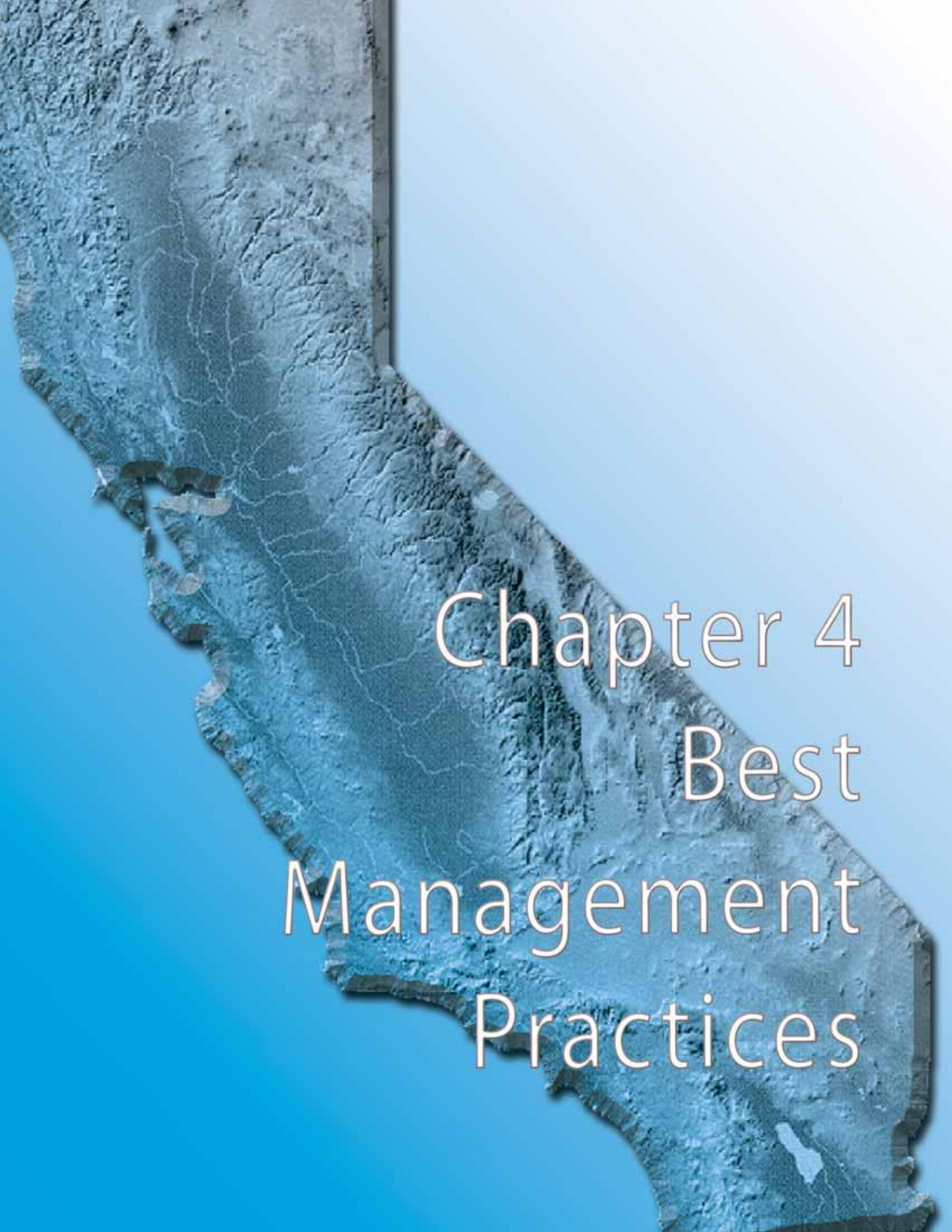
F. OTHER CONSIDERATIONS

Size of the Database

Increasing the size of the project database is a major challenge posed to the *Study* participants. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses based on age. The participating agencies are also challenged to identify as many completed projects as possible that meet the rest of the *Study* criteria. The benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database.

BMP Implementation and Project Delivery Costs

Although it is desirable for project delivery costs to decrease as agency efficiencies increase and BMPs are implemented, this can be confounded by other factors that change annually such as project size and construction cost fluctuations.



Chapter 4 Best Management Practices

CHAPTER 4 Best Management Practices

At the onset of this *Study*, the agencies examined over 100 practices used in project delivery. Included in this *Study* were a number of practices that the participants did not commonly use at the time, but believed could add value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at changes in the industry and reflect on relevant experiences in order to identify new BMPs. Existing BMPs, in some cases, are reworked by the agencies to address specific challenges encountered during implementation. As in the past, agency implementation of these selected practices continues to be tracked during the *Study*.

BMPs are usually developed to address a specific issue, however, its implementation may affect other elements of project delivery. A BMP that reduces project schedule, for example, may also favorably impact both communication and project costs. While it is not possible to discreetly quantify all the benefits of a given BMP, the participating agencies developed an approach to identify the major benefits associated with each BMP. This was accomplished in Update 2010 *Study* by assigning a *Perceived Value* to each BMP. The Agencies continue to identify the *Perceived Value* on all new BMPs. The participating agencies judge that each of the BMPs favorably impact one of the following categories:

- Cost
- Schedule
- Quality
- Communication
- Environment
- Customer Service

To identify the predominant *Perceived Values* associated with each new BMP, the participating agencies vote on which *Perceived Values* are most applicable for their Agency. The responses are then tabulated. A *Perceived Value* receiving three or more votes relative to a BMP is considered to be of significance and received a check mark as shown in **Table 4-1**. If a check mark is not shown, it indicates that the *Perceived Value* received two or less votes relative to a BMP; it does not mean that a BMP has no benefit to that *Perceived Value* category. The majority of the BMPs are assigned a *Perceived Value* of either “cost” or “schedule”, followed by “quality”. This indicates that majority of the agencies found these “*Perceived Values*” as most applicable to the adopted BMPs.

A. NEW BEST MANAGEMENT PRACTICES

In Update 2014, the Project Team added one new BMP to the BMP implementation tracking list. The new BMP was developed by discussions during a quarterly meetings. The new BMP is:

- 5.III.k 2014 – Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

This new BMP is believed to directly influence cost, schedule, communication, and customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

B. DESCRIPTION OF BEST MANAGEMENT PRACTICES

Included in this report are descriptions of each BMP. *Study 2002* report was when they were first included. These descriptions, presented in **Table 4-1**, have been updated to reflect the changes in the interpretation of those BMPs, the inclusion of *Perceived Values* for each BMP as well as additions (year developed shown with number) to the BMP list since 2002.

Table 4-1
Description of Best Management Practices

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Planning	1.a	Define capital projects well with respect to scope and budget including community and client approval at the end of the planning phase.	Changes in project scope or budget increase both total construction cost and the cost of project delivery. The later these changes occur in the life of the project, the greater the increase. Reaching and documenting consensus with the community and the client will reduce changes after the project delivery process begins.	✓	✓		✓		✓
	1.b	Complete Feasibility Studies on projects prior to defining budget and scope.	Feasibility studies should be completed early in the process so that issues are identified and either resolved or accommodated within the final definition of scope, budget, and project delivery schedule. This will also reduce overall project delivery costs. Early feasibility studies are particularly important on complex projects and projects with a construction budget greater than $5 million.	✓	✓	✓			
	1.d	Utilize a Board/Council project prioritization system.	Departments responsible for project delivery have limited resources. A system will ensure that resources are directed to meet the community's most critical needs.		✓		✓		
	1.e	Resource load all CIP projects for design and construction.	The resources required to deliver projects according to the master CIP schedule mandated by the Board/Council should become part of the CIP. This will facilitate defining performance measures and ensure that there is a common understanding of the resources required to deliver the CIP.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Planning	1.f	Include a Master Schedule in the CIP that identifies start and finish dates for projects.	A master schedule can be used to define resource needs and performance measures.		✓		✓		
	1.g 2007	Make an early determination on which environmental document is required and incorporate into the schedule.	Completing the environmental assessment and permitting process influences project schedules and costs. Establish a checklist of potential environmental and permit requirements and examine each project scope against the list early in the planning process.	✓	✓			✓	
	1.i	Show projects on a Geographical Information System (GIS).	Entering and tracking planned projects into a GIS which is available to all private and public sector project planners will reduce the potential for conflicts and re-work.		✓		✓		
Design	2.b.	Provide a detailed clear, precise scope, schedule, and budget to designers prior to design start.	Design professionals will work more efficiently if given a clear scope when contracted to provide the design services. Clear scope and budget should be defined in advance and made a part of the design professional's contract if/when a consultant is used.	✓	✓	✓	✓		
	2.f.	Define requirements for reliability, maintenance, and operation prior to design initiation.	Reliability, maintenance, operational requirements, and standard materials and equipment should be clearly defined in advance, approved by the user/ client, and included in the design professional's contract when a consultant is used.	✓		✓			✓
	2.i.	Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).	Successful designs of fire stations, police facilities, maintenance facilities, pump stations, and many other projects should be re-used when possible. Site adaptations of successful designs may reduce design costs by half.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Design	2.k. 2003	Train in-house staff to use Green Building Standards.	Communities have a stake in the environment as well as in the cost of operating and maintaining public facilities. Utilizing "Green Building Standards" allows facilities to be built and operated with renewable resources and other environmentally sound practices.					✓	
	2.l. 2004	Limit Scope Changes to early stages of design.	It is well known within the industry that the later a change occurs in the construction process, the more costly the change is.	✓	✓				
	2.m. 2004	Require scope changes during design to be accompanied by budget and schedule approvals.	All scope changes after the initial definition within the design agreement will affect project delivery cost and therefore should be documented. Documentation should include an understanding and acceptance/approval by all stakeholders of the cost and time implications of any changes.	✓	✓				
	2.n. 2006	Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval.)	Smaller projects cost more (as a percentage of construction cost) to deliver. One way of reducing the cost of project delivery on small projects is to shorten the bid and award process by setting a threshold amount under which the delivery team may solicit and receive quotes from qualified contractors and award contracts without getting Board/Council prior approval.	✓	✓				
	2.o 2007	Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market.	Having to re-design and re-bid a project on which bids come in over budget can significantly impact project delivery cost. Accurate estimates at the end of each design phase, performed by unbiased, independent, qualified professionals with an understanding of local market conditions will reduce the potential for receiving unexpected bids.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Design	2.p 2008	Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion.	Many times responsible charge design approval is set at a very high level. This can sometimes result in only one person with limited time who can approve all sheets in a design package. This leads to a bottleneck situation.	✓	✓				
	2.q 2010	Receive bids electronically.	Electronic bidding programs have increased over the last several years. Receiving bids electronically provides a centralized location to store all bid related documents for public access along with ability to increase bidder participation.				✓		✓
	2.r.2011	Use of electronic signatures to do direct conversion from CAD to PDF.	Currently wet signatures on all pages is standard practice. This causes scanned files to be very large electronic files. Use of electronic signatures in all but the cover page will reduce file size and allow for easier distribution.	✓	✓	✓			
	2.s.2011	Have awarding authority to approve plans, advertisement and award of contract in one board action.	Combine approval of plans, advertisement and award of contract by the awarding authority into a single action.		✓				
	2.t.2011	Expedite project duration from design completion to notice to proceed. Examples include items such as: - Pre-qualification of contractors - Good Faith Effort submitted on-line - Submittal incentives (i.e., award and material submittals allowed 30 day period. Every day early is added to construction contract duration) - Contract liaison within department. - Electronic proposal documents provided 48 hours after bid opening. Hard copy provided at bid time - Contractor's self certification	Implementation of new practices such as using an electronic process or pre-qualification in an effort to reduce the overall timeframe from design completion to notice to proceed.	✓	✓				✓

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Quality Assurance / Quality Control	3.I.a.	Develop and use a standardized Project Delivery Manual.	Standardized procedures streamline project design, bidding, and construction processes. Standardized design management procedures will reduce scope creep and delays in construction document preparation. During construction, standard procedures will reduce response times on RFIs, and add overall clarity and efficiency to the construction management process. Having a standard manual will also reduce the time necessary for project documentation training.	✓	✓	✓			
	3.II.b.	Perform a formal Value Engineering *Study* for projects larger than $1 million.	Value Engineering identifies life cycle costs of design elements included in a project and certain alternatives. While the cost of the value engineering process may initially add costs to project delivery, overall project costs will be reduced.	✓					
	3.III.a.	Use a formal Quality Management System.	Quality management should include all activities from the preparation of design documents through the closeout of construction. (Constructability reviews, independent cost estimates, classification and auditing of change orders, etc.) The implementation and tracking of quality control should be formalized on a checklist to ensure application.	✓		✓			
	3.III.b	Perform and use post-project reviews to identify lessons learned.	Project Managers should develop formal post project reviews and identify lessons learned. These documents should be made available to PM's on projects of a similar scope and nature. This BMP will make future project management and delivery more efficient and cost effective.			✓			

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Quality Assurance / Quality Control	3.III.k 2007	Establish a Utility Coordinating Committee with members from public and private entities.	Regular meetings of a committee will establish a forum for ideas to improve the utility relocation process and thus improve project progress. Meetings will also be an opportunity for problem projects (relocations) to be discussed.	✓	✓	✓	✓		
	3.III.l 2007	Designate a responsible person or group and establish a process of notifications and milestones for utility relocations.	Identifying a utility relocation specialist within the project delivery team who is familiar with the procedures and contacts within the public and private utility entities will improve communication and problem solving during design and construction.	✓	✓		✓		
	3.III.m 2008	Maintain and regularly update electronic standard contract specifications and related documents, as well as technical/special provisions.	Standard contract specifications and technical special provisions need to be regularly maintained and updated in order to reduce the amount of time required to create contract bid documents. If a City implements new requirements, the standards should be modified for every project one time instead of each manager having to modify these documents of every project.	✓	✓	✓			
Construction Management	4.I.a.	Delegate authority to the City Engineer/ Public Works Director or other departments to approve change orders to the contingency amount.	Change order work should be authorized as soon as is practically possible in order to avoid potential delays to critical work. Scheduling a significant change order for review and authorization by the Board may delay project progress, even though it may be within the contingency amount allowed in the project budget. Authorization of the City Engineer/Public Works Director to approve changes within the contingency budgeted for changes will ensure that critical changes are acted on promptly and that delays are minimized.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Construction Management	4.I.m.	Classify types of change orders.	Classification of change orders into categories such as changed conditions, unforeseen conditions, owner requests, or design changes for owner use improves understanding of the project and lessons learned from the data may improve project delivery on similar projects.			✓			
	4.II.a.	Include a formal Dispute Resolution Procedure in all contract agreements.	Construction is acknowledged as a dispute prone industry. As such, it makes sense to provide options in the contract documents to avoid litigation and to expedite disputes resolution using alternatives to litigation.	✓	✓		✓		
	4.III.a.	Use a team building process for projects greater than $5 million.	Partnering is a team-building process that has a proven record of improving working relationships and production, and reducing claims and disputes on construction projects. It is one of several team-building processes that should be used in the interest of reducing conflict and facilitating project delivery.	✓	✓		✓		✓
	4.IV.a.	Involve the Construction Management Team prior to completion of design.	Experienced contractors and construction managers should be included in the design process to make designs more constructible and lower cost. Construction managers and contractors are frequently more experienced about the products and/or equipment as well as construction methods that are readily available. Their contributions to selections and decisions during the design process will facilitate construction procurement, means and methods.	✓		✓	✓		
	4.IV.b 2010	Implement Electronic Contract Payment Process.	Many approvals are required to process contract payments. Using electronic procedures provides an avenue to expedite the necessary approvals.	✓					✓

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Construction Management	4.IV.c 2010	Agency should file As-built drawings within 6 months of project completion.	One of the last tasks for a project is the updating and filing of As-built drawings. Many times, this task is put off for other pressing matters. This BMP establishes a 6 month deadline.			✓			✓
	4.V.a. 2003	Delegate authority below Council to make contract awards under $1 million.	The time and costs of scheduling and presenting a Council or Board item can be saved and project starts can be expedited if awards on projects with budgets under $1 million can be awarded administratively.	✓	✓				
	4.V.b 2003	Establish a pre-qualification process for contractors on large, complex projects.	Prequalification helps screen contractors for prior performance on similar projects, safety and financial capability thus reducing risk and, ultimately, project delivery cost.		✓	✓			
	4.V.c 2003	Make bid documents available online.	Making bid documents available on line will reduce Agency printing costs. It may also increase bidder participation by making documents easily available to a larger pool of potential bidders and subcontractors.	✓			✓		
Project Management	5.I.f.	Assign a client representative to every project.	Client (end user) representation during the life of the project will expedite decisions on submittals, substitutions, and changes. Their involvement will also help determine intent and streamline the commissioning and occupancy process.		✓		✓		✓
	5.I.j 2003	Create in-house project management team for small projects.	It has been documented that the cost of project delivery of small projects is a higher percentage of the construction cost. Establishing a project management team that specializes in smaller projects may lead to economies such as grouping similar projects during permitting and bidding thus reducing project delivery cost.	✓					

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Project Management	5.I.k 2004	Institutionalize Project Manager performance and accountability.	Recognize that professional project management requires specific education, training, and experience. Provide for PMI, CCM, or other formal training and certification and establish performance measures for project delivery personnel.			✓			
	5.II.a	Provide formal training for Project Managers on a regular basis.	Project Managers come to projects with varying degrees of skill and familiarity with Agency procedures. Orientation and training will improve their ability to deliver the project on the intended schedule. It is also important that updated training is available at least on an annual basis.			✓			
	5.II.d 2006	Implement verification procedures to ensure that PM training includes Agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc).	The success of a project is influenced significantly by the education and skills of the project manager. Agencies should verify that PM's know and use the tools available within an Agency and that they are current with industry practices.		✓	✓			
	5.III.a.	Adopt and use a Project Control System on all projects.	A web-based project control system will improve collaboration and documentation during the design and construction process. Questions, answers, proposals, and decisions can be expedited using a collaborative system.	✓	✓		✓		
	5.III.e 2006	Implement a financial system that tracks expenditures by category to monitor project hard and soft costs during project delivery.	It is recommended that a system that identifies actual expenditures against planned budgets be made available to project managers to be used as a performance measurement tool.	✓					

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Project Management	5.III.f 2006	Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables.	Getting accurate data on the cost of project delivery depends upon being able to capture and classify expenses to the phases of construction on each project. Ideally, costs would be identified by each of five project delivery phases and coded to particular milestones or deliverables.	✓	✓				
	5.III.g 2006	Monitor "earned value" versus budgeted and actual expenditures during project delivery.	Soft costs "burn rate" should be proportionate to percent complete during the design and construction phases. Using a program which measures and relates soft cost expenses to earned values permits better tracking and control during project delivery.	✓					
	5.III.h 2007	Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments.	Prolonged ROW acquisition can be avoided if all stakeholders agree on milestones to complete the acquisitions.		✓				
	5.III.i 2008	Implement an electronic progress payment system to improve efficiency	Reduction in the length of time and inefficiencies in processing of progress payments through the use of electronic means.	✓					
	5.III.j 2012	Implement a schedule tracking system that monitors the actual percent complete against the percent of time elapsed for each identified phase of the approved project.	Establishing a system where a project's schedule is broken into its phases. Actual percent complete is then measured against time elapsed in each phase throughout the development of the project. This system becomes a tool for management by project managers and supervisors.	✓	✓		✓		✓

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Project Management	5.III.k. 2014	Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.	The dashboard concept is based on the ability to drill down to multiple levels of data so the user can get the level of detail desired. The level of detail to be provided in each dashboard is at the discretion of each Agency. The external dashboard increases public awareness of the project delivery performance and increases agency accountability. The internal dashboard provides a platform to measure, monitor, evaluate, and report performance to assist in establishing clear business rules and improve internal communication.	✓	✓		✓		✓
	5.IV.a 2006	Bundle small projects whenever possible.	Bundling small projects so that they are designed, bid, and constructed together will reduce project delivery cost proportionately.	✓	✓				
	5.IV.b 2007	Have a coordinator with expertise in the environmental process within the department delivering the engineering/capital project.	Identifying an environmental specialist within the project delivery team who is familiar with procedures and contacts within the approving entities will reduce permit procurement time and costs.	✓	✓			✓	
Consultant Selection and Use	6.c.	Include a standard consultant contract in the RFQ/RFP with an indemnification clause.	The negotiation of the design contract can be expedited if the consultant understands and agrees to the conditions of the contract at the time a proposal is submitted.	✓	✓				
	6.e.	Delegate authority to the Public Works Director/City Engineer to approve consultant contracts under $250,000 when a formal RFP selection process is used.	Authorization for the Public Works Director/City Engineer to award consulting contracts ensures earlier start of design and construction management activities and will reduce consultant selection process costs.		✓				
	6.g.	Implement and use a consultant rating system that identifies quality of consultant performance.	The performance of consultants should be tracked so that those who deliver quality services at reasonable costs can be adequately considered for future awards.			✓			

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Consultant Selection and Use	6.m 2006	Implement as-needed, rotating, or on-call contracts for design and construction management work that allow work to be authorized on a task order basis to expedite the delivery of smaller projects.	Establishing an on-call list of qualified consultants with expertise in a variety of design disciplines will expedite the start of the design process.	✓	✓				
	6.n.2013	Determine appropriate consultant costs for professional services agreements.	Establish a documented agency methodology for analyzing acceptable consultant costs and billing rates for use in contract negotiations.	✓	✓		✓		✓
Sustainable Development	7.a.2009	Identify the environmental benefits of the project at the time of award.	Provide written, environmental benefits to the awarding authority on projects that use sustainable practices or aim to achieve LEED certification.					✓	

C. PROGRESS ON BEST MANAGEMENT PRACTICE IMPLEMENTATION

For Update 2014, the agencies continued to exchange ideas regarding strategies for implementing various BMPs by using networking opportunities during the face-to-face meetings, team discussions during conference calls, and the online discussion forum. Agencies pursuit of fully implementing BMPs was not as fruitful as with years past. Many Agencies had other competing priorities to deal with. Other impacts were continued staff reductions, furloughs, and the management's increased involvement in resolving budgetary issues. Constraints continue to limit the full implementation of BMPs for some agencies. In those instances, a partially implemented BMP is considered complete by that agency and is noted in **Table 4-2**. Agencies continue to focus their efforts on adherence to BMPs that have been implemented and judged to provide efficiencies in project delivery processes for participating departments. As of Update 2014, and including the addition of the new BMP, the agencies have fully implemented about 69 percent of all BMPs. Seven (7) percent of the total BMPs have been partially implemented by the agencies. Many of the remaining BMPs require more involvement and input from multiple departments making them more complicated to implement than other BMPs.

To support the linking of BMPs to performance improvements, BMP implementation by the agencies is tracked.

BMPs targeted for future implementation and progress on implementation of adopted BMPs since the Update 2014 are summarized below.

I. City of Los Angeles

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
• 4.IV.b 2010 Implement Electronic Contract Payment Process. • 5.III.g 2006 Monitor "earned value" versus budgeted and actual expenditures during project delivery. • 5.III.k.2014 Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.	

II. City of Long Beach

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:

III. City of Oakland

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
	• 5.III.k.2014 Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

IV. City of Sacramento

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
Department of Public Works Department of Utilities	Department of Public Works Department of Utilities • 4.V.c 2003 Make bid documents available online.

V. City of San Diego

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
• 2.o.2007 Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market (partially Implemented) • 5.III.j 2013 Implement a schedule tracking system that monitors the actual percent complete against the percent of time elapsed for each identified phase of the approved project and schedule (partially Implemented) • 7.a.2009 Identify the environmental benefits of the project at the time of award (partially Implemented) • 5.III.k.2014 Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.	

VI. City and County of San Francisco

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
• 5.III.k.2014 Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.	• 5.II.d. 2006 Implement verification procedures to ensure that PM training includes agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc) (Partially Implemented).

VII. City of San José

Implemented from June 2013 to September 2014:	Targeted October 2014 Onward:
• 4.IV.b 2010 Implement Electronic Contract Payment Process. • 5.III.k.2014 Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient (Partially Implemented).	• 3.I.a Develop and use a standardized Project Delivery Manual (partially implemented) • 3.III.a. Use a formal Quality Management System. (partially implemented) • 3.III.m.2008 Maintain and regularly update electronic standard contract specifications and related documents as well as technical/special provisions. • 6.n 2013 Determine appropriate consultant costs for professional services (partially implemented).

Table 4-2 summarizes the BMPs that have been implemented by the participating agencies, as well as the planned implementation priorities.

Table 4-2
Implementation of BMPs

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Planning	1.a.	Define capital projects well with respect to scope and budget including community and client approval at the end of the planning phase.	✓	✓	✓	✓	✓	✓	✓	✓	SC DU: Community involved after project is better-defined, typically at 30% design.
	1.b.	Complete Feasibility Studies on projects prior to defining budget and scope.	✓	✓	✓	✓	✓	✓	✓	✓	LB, SD: When applicable SC DU: Only on complex projects that require a Feasibility *Study*
	1.d.	Utilize a Board/Council project prioritization system.	✓	NI	✓	✓	TBD	✓	✓	NI	LA: Council allows Streets, Bridges and Stormwater programs a project priority system. SC DU: Getting closer to approved Asset Management system that would facilitate this BMP, but project drivers vary (permit requirements, projects in other departments, etc) SD: Result of CIP Benchmarking SF: Capital plan developed City-wide and priorities set by City-wide committee of major department heads.
	1.e.	Resource load all CIP projects for design and construction.	✓	NI	✓	✓	✓	✓	✓	✓	SC DU: Estimate drafting only. SD: Doesn't include human resource loading.
	1.f.	Include a Master Schedule in the CIP that identifies start and finish dates for projects.	✓	NI	✓	✓	✓	✓	✓	✓	SC DU: Completion date only estimated, not determined by scheduling analysis.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Planning	1.g 2007	Make an early determination on which environmental document is required and incorporate into the schedule.	✓	✓	✓	✓	✓	✓	✓	✓	
	1.i.	Show projects on a Geographical Information System.	✓	✓	✓	✓	✓	✓	✓	✓	LB: Infrastructure only
Design	2.b.	Provide a detailed clear, precise scope, schedule, and budget to designers prior to design start.	✓	✓	✓	✓	✓	✓	✓	✓	SC DU: General scope only for simple projects.
	2.f.	Define requirements for reliability, maintenance, and operation prior to design initiation.	✓	✓	✓	✓	NI	✓	✓	✓	SD: Some Asset types only.
	2.i.	Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).	✓	✓	✓	✓	✓	NI	✓	✓	SD: Due to the public input.
	2.k. 2003	Train in-house staff to use Green Building Standards.	✓	✓	✓	NI	NI	✓	✓	✓	This BMP is intended to improve client satisfaction (quality) and may not reduce project delivery cost directly. SF: When applicable

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.l. 2004	Limit Scope Changes to early stages of design.	✓	✓	✓	✓	NI	✓	✓	✓	SC DU, SD: Control and minimize, but difficult to eliminate, since clients and engineers come up with new/better solutions in addition to the community and politicians influence.
	2.m. 2004	Require scope changes during design to be accompanied by budget and schedule approvals.	✓	✓	✓	✓	NI	✓	✓	✓	
	2.n. 2006	Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval).	NI	✓	✓	NI	NI	✓	✓	PI	SC DT: Maintains on-call consultant list for various engineering, traffic, landscape, architecture, and geotechnical services. SF: As-needed job order contracting (JOC). SJ: Regularly procures a number of on-call contractors for various small projects.
	2.o 2007	Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market.	NI	PI, TBD	TBD	TBD	NI	TBD	✓	PI	SF: Establishing estimating database SJ: No criteria established – done on a case-by-case basis.
	2.p 2008	Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion.	✓	TBD	TBD	✓	✓	✓	✓	✓	

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.q 2010	Receive bids electronically.	NI	PI	PI	NI	TBD	✓	NI	TBD	LB: Currently receive bids for projects less than $100k
	2.r. 2011	Use of electronic signatures to do direct conversion from CAD to PDF.	PI	TBD	NI	TBD	✓	✓	TBD	TBD	
	2.s. 2011	Have awarding authority to approve plans, advertisement and award of contract in one board/council action.	NI	✓	✓	✓	✓	✓	TBD	✓	SCDT: City Council approval is not required to advertise. SJ: The Director of Public Works approves all plans and advertisements; also generally awards contracts $1M or less. SD: Part of the CIP streamlining, city council approval is obtained once a year on a list of projects to be awarded as a part of the annual budget hearing.

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Table 4-2
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Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.t. 2011	Lessen time period between design completion and issuance of notice to proceed. Examples include items such as: - Pre-qualification of contractors - Good Faith Effort submitted on-line - Submittal incentives (i.e., award and material submittals allowed 30 day period. Every day early is added to construction contract duration) - Have ability to issue contracts within your department - Electronic proposal documents provided 48 hours after bid opening. Hard copy provided at bid time - Contractor's self-certification	✓	TBD	PI	PI	TBD	✓	TBD	✓	SCDT: Can the last item be clarified? What is meant by "contractor's self-certification"? SD: has an established contractors pre-qualification program
Quality Assurance/ Quality Control	3.I.a.	Develop and use a standardized Project Delivery Manual.	✓	PI, 2011	✓	✓	✓	✓	✓	PI, 2014	SC DU: Badly needs updating. LB: Staffing cuts have delayed completion SD: currently updating it as a result of some organization changes

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Quality Assurance/ Quality Control	3.II.b.	Perform a formal Value Engineering *Study* for projects larger than $1 million.	✓	✓	NI	✓	✓	✓	✓	NI	LA: For projects > $10M LB: As needed SC: As needed SD: As needed SF: As needed
	3.III.a.	Use a formal Quality Management System.	✓	✓	✓	✓	NI	✓	✓	PI 2014	SD: Some asset types only LB: Staffing cuts have delayed completion
	3.III.b	Perform and use post-project reviews to identify lessons learned.	✓	PI	✓	✓	✓	✓	✓	✓	SC DU: For selected projects in one-on-one meetings with design and construction staff. Also includes feedback from client. Intended to promote candid discussion. LB: Is being done only on projects that exceed 10% contingency or go into liquidated damages
	3.III.k 2007	Establish a Utility Coordinating Committee with members from public and private entities.	✓	PI	✓	✓	✓	✓	✓	✓	LB: Committee meets on an ad-hoc basis depending on utility availability
	3.III.l 2007	Designate a responsible person for and establish a process of notifications and milestones for utility relocations.	✓	NI	PI	✓	✓	✓	✓	✓	LB: PM remains responsible for all utility work on their projects SJ: Various Divisions/Sections have a utility coordinator and processes as needed
	3.III.m	Maintain and regularly update electronic standard contract specifications and related documents as well as technical/special provision.	✓	✓	✓	✓	✓	✓	✓	PI, 2014	SD: all standard documents are posted on the Dept. SharePoint for staff use.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Construction Management	4.I.a.	Delegate authority to the City Engineer/Public Works Director or other departments to approve change orders to the contingency amount.	✓	✓	✓	NI	✓	✓	✓	✓	SD: Individual CO < $500,000 SF: At Bureau level SJ: Individual CO < $100,000
	4.I.m.	Classify types of change orders.	✓	✓	✓	✓	✓	✓	✓	✓	LA: Draft Special Order prepared.
	4.II.a.	Include a formal Dispute Resolution Procedure in all contract agreements.	✓	NI	✓	✓	✓	✓	✓	✓	SJ: For projects > $10 M LB: City Attorney will not allow this language in project specifications
	4.III.a.	Use a team building process for projects greater than $5 million.	✓	✓	✓	✓	✓	✓	✓	✓	LB: As-needed SD: As-needed SF: As-needed SJ: For projects > $10 M SCDU: As needed
	4.IV.a.	Involve the Construction Management Team prior to completion of design.	✓	✓	✓	✓	✓	✓	✓	✓	SD: always request a constructability review service from the CM team on all projects.
	4.IV.b 2010	Implement Electronic Contract Payment Process.	NI	PI	TBD	NI	TBD	TBD	✓	TBD	LB: Currently done for some street related projects. SF: We are doing payments electronically via our first generation system which was demonstrated back in San Diego around 2008. We pay within the Mayor's directive of 10 to 15 days. And direct deposit is already available to the contractors through BofA.

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Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Construction Management	4.IV.c 2010	Agency should file As-built drawings within 6 months of project completion.	✓	PI	✓	✓	✓	PI	✓	PI	LB: being done on a go forward basis. Past projects still backlogged. SJ: Generally yes, however, it depends on post-construction circumstances. SD: has been implemented on sewer and water pipeline projects. LA: procedures are established in the Bureau of Engineering Project Delivery Manual.
	4.V.a. 2003	Delegate authority below Council to make contract awards under $1 million.	✓	✓	NI	NI	NI	✓	✓	✓	SD: Up to $30 million
	4.V.b 2003	Establish a pre-qualification process for contractors on large, complex projects.	✓	NI	✓	NI	✓	✓	✓	✓	LB: City uses minimum qualification in project specs in lieu of prequalification process
	4.V.c 2003	Make bid documents available online.	✓	✓	✓	✓	2013	✓	✓	✓	LA: Requested this through our ITA Dept for integration with our bid outreach application, but implementation will depend on their resource availability. SF: Documents on CD in interim SD: Bid documents are always posted on the E-bid board site.
Project Management	5.I.f.	Assign a client representative to every project.	✓	✓	✓	✓	✓	✓	✓	✓	
	5.I.j 2003	Create in-house project management team for small projects.	NI	✓	✓	NI	NI	NI	✓	✓	SC DU: Not enough PMs to justify this. Don't want to restrict staff to small, less-rewarding projects.

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Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Project Management	5.I.k 2004	Institutionalize Project Manager performance and accountability.	✓	✓	✓	✓	PI	✓	✓	✓	SC DU: There is interest but no definite plan. Implementation, although partially complete, is taken as far as it can go with our Agency.
	5.II.a	Provide formal training for Project Managers on a regular basis.	✓	TBD	✓	✓	NI	✓	✓	2014	LB, SD: Program implementation put on hold due to budget cuts
	5.II.d 2006	Implement verification procedures to ensure that PM training includes Agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc).	✓	TBD	✓	✓	NI	✓	PI 2014	2014	
	5.III.a.	Adopt and use a Project Control System on all projects.	✓	✓	✓	✓	NI	✓	✓	✓	
	5.III.e 2006	Implement a financial system that tracks expenditures by category to monitor project hard and soft costs during project delivery.	✓	✓	✓	✓	✓	✓	✓	✓	LA: UPRS, Reports, Page 3. SC DT: Will complete automated report system by 2006. SC DU: Intend to utilize SC DT's software if it proves to function well with our PM Database.
	5.III.f 2006	Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables.	2013	✓	✓	✓	NI	✓	✓	TBD	
	5.III.g 2006	Monitor "earned value" versus budgeted and actual expenditures during project delivery.	2013	NI	✓	✓	NI	PI	✓	NI	

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Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Project Management	5.III.h 2007	Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments.	PI	PI	NI	✓	NI	PI	NI	✓	SF: No additional ROW required outside military base closure. SD: It is difficult to get the commitments side.
	5.III.i 2008	Implement an electronic progress payment/schedule of values system to improve efficiency.	NI	NI	TBD	✓	NI	TBD	✓	TBD	LB: Current accounting system cannot accommodate a fully electronic approval process
	5.III.j 2012	Implement a schedule tracking system that monitors the actual percent complete against the percent of time elapsed for each identified phase of the approved project schedule.	✓	NI	✓	TBD	PI	TBD	PI	TBD	San Francisco DPW has developed a nascent database called the Enterprise Project Management system or EPM. The EPM is utilized for project updates, financial and schedule tracking, and as a reporting tool. Projects are scheduled utilizing MS Project software and imported into the EPM. Project Leads are responsible for creating the schedules per client department MOUs, and tracking actual schedules to baseline schedules. Because the EPM is relatively new, monitoring protocols have not been standardized. However, establishing the monitoring protocols and assuring Project Lead schedule conformance is the task for next year.
	5.III.k. 2014	Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.	✓	2015	2015	2015	TBD	✓	✓	PI	

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Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Project Management	5.IV.a 2006	Bundle small projects whenever possible.	✓	✓	✓	✓	✓	✓	✓	✓	
	5.IV.b 2007	Have a coordinator with expertise in the environmental process within the department delivering the engineering/capital project.	✓	NI	NI	NI	NI	✓	✓	✓	SJ: Various Divisions/Sections have an environmental coordinator as needed
Consultant Selection and Use	6.c.	Include a standard consultant contract in the RFQ/RFP with an indemnification clause.	✓	✓	✓	✓	✓	✓	✓	✓	SD: Some asset types only.
	6.e.	Delegate authority to the Public Works Director/City Engineer to approve consultant contracts under $250,000 when a formal RFP selection process is used.	NI	NI	NI	NI	NI	✓	✓	PI	SC DU: Threshold is $100,000. LB: City Manager retains authority up to $100k. SJ: City Manager has authority described.
	6.g.	Implement and use a consultant rating system that identifies quality of consultant performance.	✓	PI	✓	NI	NI	✓	✓	✓	SC DU: Track performance for those selected for "support services." LB: Used for on-call consulting services contracts

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Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Consultant Selection and Use	6.m 2006	Implement as-needed, rotating, or on-call contracts for design and construction management work that allow work to be authorized on a task order basis to expedite the delivery of smaller projects.	✓	✓	✓	✓	✓	✓	✓	✓	
	6.n 2013	Determine appropriate consultant costs for professional services agreements.	PI 2014	TBD	PI	PI	PI	PI	PI 2014	PI 2014	SC & SD indicate a strategy has been developed.
Sustainable Development	7.a. 2009	Identify the environmental benefits of the project at the time of award	TBD	✓	✓	✓	TBD	TBD	PI, TBD	✓	

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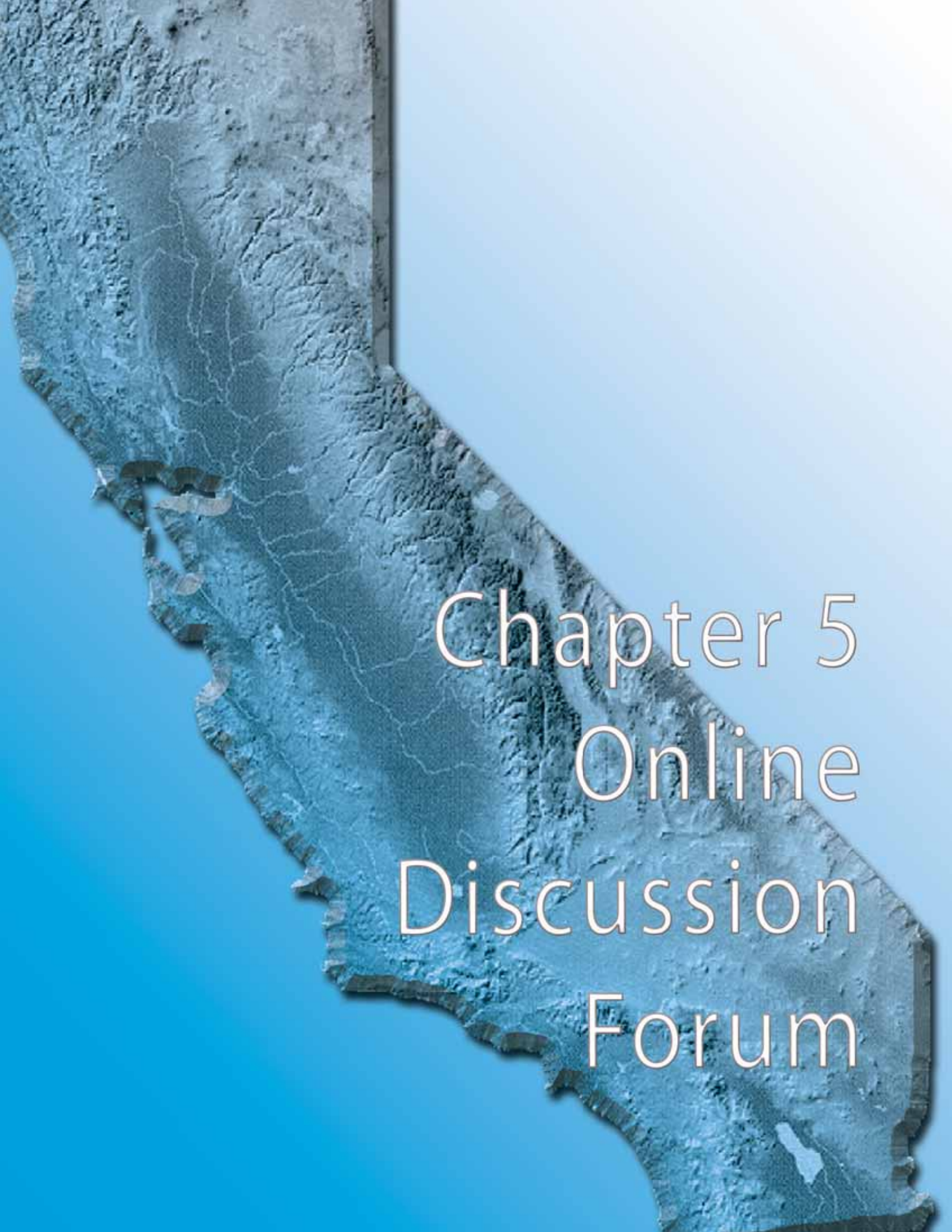


Chapter 5
Online Discussion Forum

CHAPTER 5 Online Discussion Forum

As in previous years, the ability to share issues or concerns continues to be one of the *Study* benefits most appreciated by the participating agencies. Information exchange occurs in a web based forum which provides an avenue to receive input from fellow team members. A total of eleven topics were discussed during Update 2014. From this set of discussions, the following six topics are presented as an example of the types of informational exchanges that occurred within the Update 2014 Online Discussion Forum.

- Water Quality Inspector
- Design Immunity for Public works Projects
- Project Controls
- CIP and Level-of-Service
- Agency Supplied Materials
- Inspection of Construction Projects

A. WATER QUALITY INSPECTOR

The City of Long Beach proposed a question to the Benchmark *Study* Group. They asked what cities had created a "Water Quality Inspector" position, or if they use public works inspectors to perform some of the inspections duties outlined in their MS4 stormwater permit? If they have a water quality inspector position, they would like to see the position description.

The City of Los Angeles stated that their Public Works/Bureau of Sanitation, Watershed Protection Division has a group of inspectors that are involved with all kinds of inspections related to watershed protection (mainly storm water issues), such as potential illegal dumping to open channels, pollution prevention during private construction, etc.

Please see the corresponding links for position descriptions:

- 4292 Environmental compliance inspector - http://per.lacity.org/perspecs/4292.pdf
- 4293 Sr. Environmental compliance inspector - http://per.lacity.org/perspecs/4293.pdf
- 4289 Chief Environmental compliance inspector I and II - http://per.lacity.org/perspecs/4289.pdf

The City of San Francisco provided a PDF file of their Water Control Inspector (#6115) which is found on the Benchmarking Team's SharePoint site.

The City of San José has Environmental Inspectors (see PDF file found in the Benchmarking Team's SharePoint site) in their Environmental Services Department (ESD) and Construction Inspectors in their Public Works (PW) Department. In general, PW Construction Inspectors take the lead role on stormwater compliance for Capital Improvement Projects and ESD Environmental Inspectors take the

lead role on private development projects. However, both departmental teams support each other when needed. For example, PW Construction Inspectors can call ESD Environmental Inspectors to intervene at a Capital project site where ESD can issue a citation (rather than a PW Construction Inspector issuing a work stoppage); and PW Construction Inspectors (who also oversee construction related to private development) will flag issues for ESD if they see anything when they are at a private development site. Similarly, with regard to reporting for the City's permit, PW Construction Inspectors are responsible for supplying data for Capital project sites and ESD Environmental Inspectors are responsible for private development sites.

The City of Sacramento Public Works responded by stating they do not have a Water Quality Inspector position. They use Construction Inspectors to ensure stormwater permit conditions and stormwater water quality construction specifications are followed.

The City of Oakland has not created a Water Quality Inspector position. Their inspectors are responsible for compliance with MS4 requirements. They use staff from the City's Watershed division and consultants to assist inspectors on as-needed basis.

The City of San Diego has the same process as the City of Sacramento: The City of San Diego does not have Water Quality Inspectors. For Engineering Permits (Grading and ROW) and CIP projects, they use Resident Engineers (in-house) to perform all aspects of inspection, including enforcement of storm water regulations. For Building permits, the City uses Building Inspectors (in-house) whose responsibility include enforcement of storm water regulations.

B. DESIGN IMMUNITY FOR PUBLIC WORKS PROJECTS

The California Government Code Section 830.6 affords a "design immunity" defense to agencies, in instances where either the City Council or a designated City staff member formally approves plans or designs prior to the commencement of construction. Wanted to better understand how the other cities do it, the City of Long Beach asked each agency if their agency approves the plans or designs, or if instead has an agency staff member been delegated approval authority? If an agency staff member is designated, what is such person's capacity or job position?

For the City of Los Angeles, the City Engineer signs the cover sheet of all projects and plans and specifications are formally authorized for advertising by the Board of Public Works. They pointed to their Board Journal on their website for an example.

The City of Sacramento, Department of Public Works, requests City Council approval of their plans and specification to preserve their design immunity. Typically, this approval is done as part of the City Council action awarding the construction contract.

San Diego's City Engineer delegates authority to approximately 15 Deputy City Engineers for signing construction plans prepared for City projects. The Deputy City Engineers work in the capacity of Senior Civil Engineers. The referred the Benchmarking group to an attached file labeled ML-2002-1, a Memorandum of Law from their City Attorney, for more information.

In the City of San José, the Director of Public Works approves plans and specifications pursuant to Municipal Code Section 14.04.430:

(http://sanJosé.amlegal.com/nxt/gateway.dll/California/sanJosé_ca/sanJosémunicipalcode?f=templates$fn=default.htm$3.0$vid=amlegal:sanJosé_ca).

The City of Oakland has their project plans and specifications approved by the City Council at the time of construction contract award.

The City of San Francisco's professionally licensed engineers and architects in responsible charge of their projects, stamp and sign the design plans and specs and follow the current standards. They do not have a single staff member designated to sign either engineering plans or architecture plans since each discipline signs their own respectively. The City of San Francisco has design immunity.

The City of Oakland has their project plans and specifications approved by the City Council at the time of construction contract award.

C. PROJECT CONTROLS

The City of San Diego was in the midst of reviewing its current Project Controls functions. They reached out to the other cities to identify best management practices and industry standards. They asked the following questions:

1. How does your agency conduct Project Controls for its CIP implementation?
2. Do you have a dedicated group? If so, what are their roles and responsibilities?
3. Do you hire consultants to schedule, monitor, and report on project performance with respect to time and money?
4. What role do your project management staff play in Project Controls?
5. What system(s) (e.g. Primavera) do you use?

Responses were received from six agencies. The detailed responses can be found in **Table 5-1** below.

Table 5-1
City of San Diego Project Controls

Questions	1. How does your agency conduct Project Controls for its CIP implementation?	2. Is it a plan or an approved budget?	3. What is their process for developing/updating it (how do they involve the elected officials, public, and client departments)?	4. How do you address unfunded needs & risk in the plan?	5. What is the outline (table of contents) of the plan/ report?
City of Los Angeles	Los Angeles Bureau of Engineering uses an in-house project tracking application called the Uniform Project Reporting System (UPRS) for executive level budget and schedule project tracking and reporting	Some larger programs have one person dedicated to project controls and data entry, most do not. One person in the Bureau is also dedicated full time to system training and internal auditing of project data.	For the most part no, but on some of our larger projects and programs we do hire consultants to assist with a variety of tasks including scheduling and other project controls.	Project Managers are required to oversee all aspects of their projects and to update project data in UPRS at least once per month.	For executive level tracking, we use MS Project for the summary Gantt charts from UPRS. Many of our larger projects and programs use Primavera for the detailed project schedule.
City of Oakland	During the planning phase, our PMs negotiate and execute a Project Agreement with our clients establishing the expectations on scope, schedule and budget. We do not have the agreement for internal projects but we basically use our in-house database to track our schedule, design, CM and PM costs.	No. Each PM manages his/her own projects.	No.	They report progress in the database mentioned in question #5.	Internally developed database using MS Access.
City of Sacramento	The City of Sacramento Department of Public Works relies on the Project Manager to manage and proactively implement project controls on projects. By collaborating with the Section Manager and Division Manager, project managers using our Project Budget and Schedule Report can actively monitor and track their schedules and budgets by project phase.	We do not have a dedicated group. The PM is responsible for creating, monitoring and maintaining project scope, schedule and budget.	We do not hire consultants to report on project performance. We use various budget tools and reports to monitor current and future costs.	We rely on the PM to implement Project Controls on projects with support from the Section Manager and Division Manager.	We use Microsoft Project to establish and monitor schedule.

Table 5-1
City of San Diego Project Controls (cont'd)

Questions	1. How does your agency conduct Project Controls for its CIP implementation?	2. Is it a plan or an approved budget?	3. What is their process for developing/updating it (how do they involve the elected officials, public, and client departments)?	4. How do you address unfunded needs & risk in the plan?	5. What is the outline (table of contents) of the plan/ report?
City of San Diego	The City has split the responsibility between a group of 8 employees dedicated to Project Controls support serviced and ten project managers who manage the projects.	Yes. They maintain the City's portfolio of the project's schedules, provide analysis, and run reports for management.	No.	They develop and update the schedules.	Primavera P6 EPPM.
City of San Francisco	There is a Program manager or Project Manager for each program/project.	We have grouped Project Managers under one group, but separated by project types. There are also Program Managers by program type. Each PM manages their own scope, budget, schedule and reports to their respective client(s).	At times, we hire as needed estimators, and schedule reviewers. Depending on the individual project's needs.	They report to the client(s), manage their own budgets and schedules, manage the scope, contractors, implement the bidding process, etc. all while abiding City and public code.	Primavera, Microsoft Project, it varies.

Table 5-1
City of San Diego Project Controls (cont'd)

Questions	1. How does your agency conduct Project Controls for its CIP implementation?	2. Is it a plan or an approved budget?	3. What is their process for developing/updating it (how do they involve the elected officials, public, and client departments)?	4. How do you address unfunded needs & risk in the plan?	5. What is the outline (table of contents) of the plan/ report?
City of San José	The City of San José does not have a formal process for conducting Project Controls. It is each Project Manager's responsibility for their own project – See answer to #4.	No, the City of San José does not have a dedicated group.	No, the City of San José does not typically hire consultants to monitor project performance; however, we have done this on large programs. When the City expanded the San José International Airport, consultant program managers were hired. The City issued a task order to one of the consultants, URS, to monitor and report on schedule and cost. This "controls group" consisted of 3 URS employees and 1 City employee. The City employee provided the interface with the City's financial information for the program. Currently, the City's program to upgrade the Regional Wastewater Facility will be employing a consultant program manager and one of their tasks is expected to be the monitoring of cost and schedule.	The City of San José's project managers manage the design and construction of their projects and are responsible for the project controls. They coordinate the scope with the requesting client, estimate the cost to complete the desired scope, provide a schedule for completion, ensure the project achieves the desired scope, monitor the schedule and costs throughout the duration of the project, review change order requests, negotiate claims, etc.	The City of San José uses software developed in-house called the Capital Project Management System (CPMS). The Project Manager can enter information such as the project scope; schedule of design and construction; and the estimate of resources required to complete the project through all phases, including design and construction. The program includes reporting features which allow the monitoring of costs. Separately, Microsoft Project may be used by the Project Managers for tracking project schedules. On large programs (see No. 3), consultant teams use the Primavera software. The program to expand the airport used Primavera P3 and the current program to upgrade the Regional Wastewater Facility will be using Primavera P6.

D. CIP AND LEVEL-OF-SERVICE

The City of San Diego is in the process of developing a comprehensive consolidated multi-year CIP to address long term capital infrastructure needs. A major topic that they need to address in this plan is the level-of-service for various asset types. The linkage between future infrastructure need and services will occur through the implementation of a monitoring program that provides information regarding public demands and service levels in order to guide elected officials decisions regarding infrastructure investments. For that, they wanted to learn about how the other cities are tackling the level-of-service for various assets in their CIP plan by asking the following questions:

1. Do you have a written service level/ performance measure for each asset that is owned by your City? If yes, how often it is revised and updated?

   San Diego does, but partially. There is not a centralized uniform and current collection of Service Level Standards. Little data is readily available showing frequent updates.

2. And for those that don't have a defined level-of-service, how do you make decisions regarding infrastructure growth?

Asset managing departments have been independently making these decisions in working with the community, Council, and other stakeholders in compliance with the City's General Plan.

The City of Sacramento Department of Public Works measures and monitors the Pavement Quality Index of all of our street pavements to determine if they are achieving their index goal and what level of funding is needed to increase the index to desired levels. However, they do not have a written level of service policy for every other asset. They use our Transportation Programming Guide to make decisions on where to invest transportation funds to support growth, improve public safety and neighborhood livability.

The City of San Francisco, Department of Public works answered that they do not have a performance level standards for particular classes of assets with the exception of streets where the policy is to achieve and then maintain a PCI of 70. For structures such as buildings, bridges, and tunnels the goal is to reach funding levels where the buildings are able to be maintained in their current state of repair. For pipes, the goal is to replace a certain number of miles per year. The City bases decisions on the level of funding that they have available. Projects are then prioritized based on a set of funding principles that are part of the 10-year capital plan. Mandates, asset maintenance, and growth are included in the principles. Please refer to the Capital Planning website at www.onesanfrancisco.org.

The City of Oakland Public Works had a prioritization policy approved by the City Council in 2004 for the City's various infrastructure. That policy addressed Facilities and Structures, Parks and Open Space, Sanitary Sewers, Storm Drainage, Streets, Sidewalks, and Traffic Improvements. Factors evaluated when determining priorities included various levels of service. In 2012, they also prepared an Infrastructure Report Card

that evaluated the condition of the City's Infrastructure and developed short and long-term measures and strategies to address infrastructure priorities and deficiencies. They are currently working on revising the 2012 Infrastructure Report Card.

For Los Angeles Bureau of Engineering, they are not aware of an adopted City policy regarding level of service for infrastructure. Individual operating departments often have their own policies such as pavement slurry/overlay based on PCI, sewer lining based on CCTV grades, etc, but BOE is not an operating Department so they are not knowledgeable of all of the various infrastructure programs and their levels of service. BOE is in charge of one program, which is to manage the bridge inspections and ratings, which is done per Caltrans criteria.

The City of San José provided the following response:

1. With respect to the existence of a written service level/performance measure for City assets, the City of San José responds as follows:

    a. The City has a Sanitary Sewer Level of Service Policy that is approximately 25 years old and is currently being updated with results of the General Plan 2040 which adds jobs and housing to certain areas of San José. The policy guides the upsizing of sewer mains.

    b. The City has separate Traffic Level of Service Policies specific to certain areas of San José. For example, there is a policy for the downtown area and policies for specific plan areas (growth areas) such as North San José. These policies are revised when there is a significant change to the zoning, growth, mass transit corridors, etc,

    c. The City uses a pavement condition index to evaluate the maintenance needs of the City's 2,500 mile network of roadways (1 to 100 scale); however, current funding only covers arterial maintenance (800 miles). The City currently has no residential street maintenance program other that filling potholes.

2. For those assets that do not have a defined level-of-service, the City of San José makes decisions regarding infrastructure growth as follows:

    a. Storm Sewers and Sanitary Sewers - guided by dynamic computer models of the systems, part of their respective Master Plans which identify projects, typically designed, constructed and dedicated by development projects.

    b. Traffic Signals - new signals are prioritized based upon nexus contributions from adjacent developments, analysis of signal warrants, and region-wide projects.

E. AGENCY SUPPLIED MATERIALS

The City of San Diego currently supplies material for the contractor's use in special cases such as water pipeline projects. The City was considering increasing the frequency of providing owner supplied materials so they reached out to the other cities of the Benchmarking *Study* and asked if other agencies directly purchase any CIP materials (concrete, asphaltic concrete, pipeline, etc.) directly in bulk, not through contractors and then supplied the contractors with agency provided materials? If so, can they please let the City of San Diego know more and how they can get a copy of the specification language? Please let the city know if they are aware of any other agency who may also supply some of the materials.

In the City of Oakland, they supply some specific materials such as traffic signal equipment including pole, mast arm, controller and sewer manhole frames and covers. Their specifications specify that these items will be provided by the Agency.

The City of Sacramento Department of Public Works procures the traffic signal poles on a traffic signal project and provide them to the contractor. Mast arm traffic signal poles are custom made and long lead items that can take 4-5 months to produce. By ordering the poles prior to bid advertising and supplying the poles, they are able to cut the amount of construction time by not having to wait for the signal poles. The contractor is notified in the contract specifications that they must coordinate with the City's signal pole vendor for the delivery of the signal poles to the contractor's yard or other location.

The City of San Francisco does not. They used to when their city asphalt plant was up and running. Currently their paving specifications require the contractors to pick up the asphalt from the asphalt plant.

The City of San José does not typically supply materials on construction contracts; however, due to the City's unique requirements, traffic signal controllers are supplied to the contractor. In the contract specifications, it simply states that the item will be furnished by the City.

The City of Los Angeles Bureau of Engineering does not generally buy bulk materials for construction projects (outside of use by their own City Force Account construction crews). However, on occasion, they do purchase long-lead materials for construction projects in which case the specifications would state that the item is to be provided by the City. The City would also obtain Board of Public Works approval to sole source items in those cases and to purchase the items.

F. INSPECTION OF CONSTRUCTION PROJECTS

The City of San José is considering changing the way it inspects its Public Works construction projects and is interested in learning how projects are inspected in other Benchmarking Group Cities. Currently, San José uses a combination of code-certified and non-certified inspectors in the following manner:

City projects ***within*** public right-of-way (roadway widening, storm/sanitary sewers, street lights, traffic signals, etc.):

1. Non-certified inspectors are responsible for inspecting the vast majority of the construction. They coordinate with code inspectors when necessary.

2. Code-certified inspectors typically used for the following:

   a. Structures which were designed specifically for the project (not per standard detail)

   b. Electric wiring/connections, because the City has unique electrical requirements. Although they are asked to sign the Connect Order with PG&E, the code-certified inspector does not inspect the raceway (trench, conduit, etc.) for the electrical system (this is inspected by the non-certified inspector).

City projects located ***outside*** of public right-of-way (parks, community centers, etc.):

1. Non-certified inspector's role:

   a. Monitor the construction on a daily basis and coordinate with code inspectors when necessary.

   b. Inspect site improvements (grading, paving, storm drain, etc.).

2. Code-Certified inspector's role:

   a. Inspect code items within the building itself. This work does not typically include the trenches, conduit, pipeline, etc. for utility connections from the public right-of-way to the building.

   b. Inspect on-site retaining walls when required by code.

The City of San José asked if other cities use code-certified inspectors in combination with non-certified inspectors on their construction projects. What do they inspect? Is there a differentiation in their use between projects located within public right-of-way and those that are not?

The City and County of San Francisco uses a combination of certified and non-certified inspectors. Currently the inspection group is separated into two groups:

1. Buildings

2. Infrastructure, or within the public right of way.

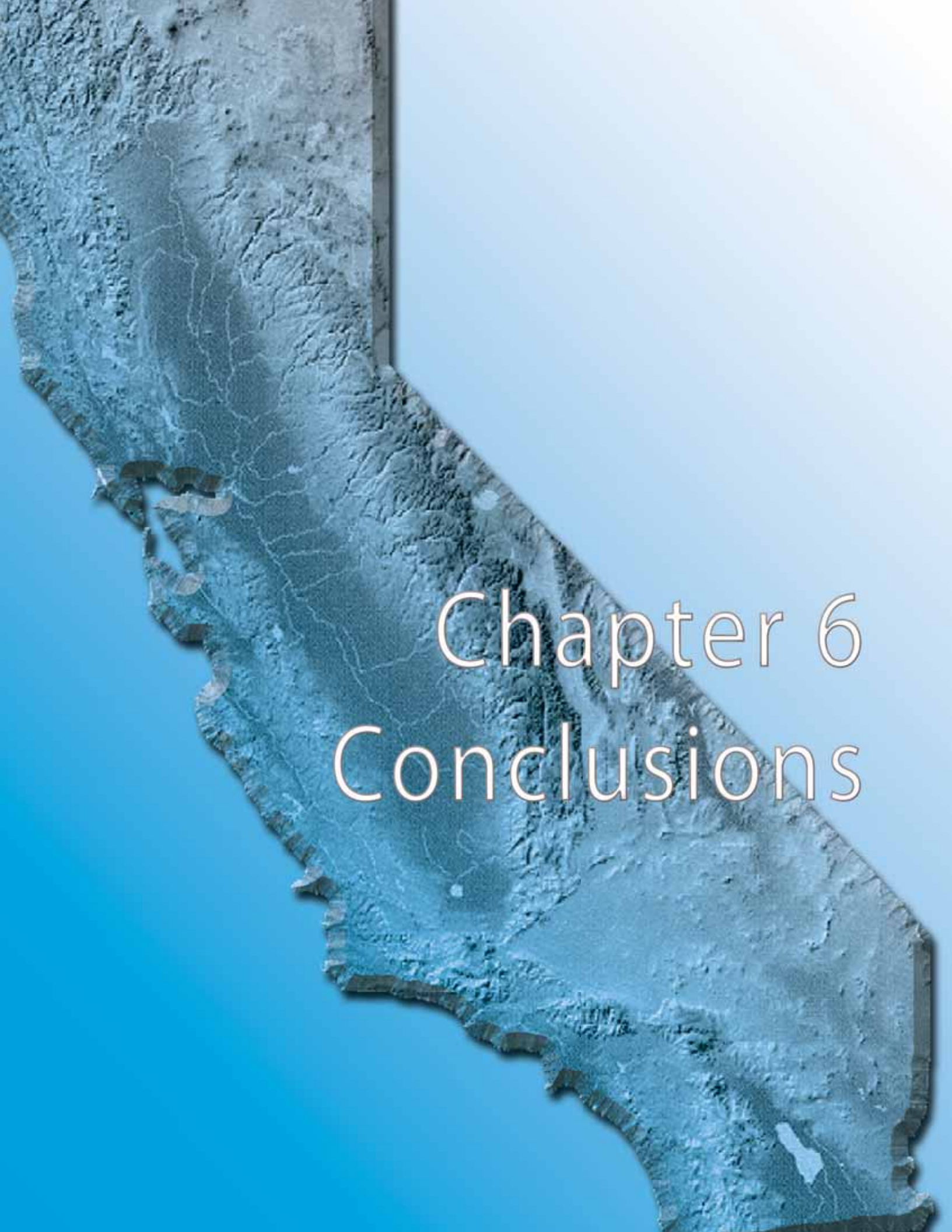
They inspect according to the permitted design drawings and general code knowledge, but with more emphasis on the former, as these are permitted per code anyways. The permitting agency, let's say the Department of Building Inspection, would bring out their inspectors to confirm certain scopes of work (Life Safety, ADA, etc) has been installed per code.

The City of Sacramento Department of Public Works inspects all public works projects in the street right-of-way including new roads, street reconstructions, road widening, water, sewer and drainage pipes, street lighting and park improvements. They use non-certified inspectors to perform this work.

The City of Oakland Public Works Department does not have code-certified inspectors. All civil and architectural projects are inspected by non-certified inspectors. They hire consultants for specialty inspections where needed. Inspection of building, mechanical, plumbing or electrical components is typically performed by various code-certified building inspectors as part of the City's permit review and approval process.

The City of San Diego uses a combination of both code-certified inspectors (Building Inspectors) with non-certified inspectors (Resident Engineers) on construction projects. These two types of inspectors are both used only when a Building Permit is part of the construction project. The differentiation of their construction project is when a Building Permit is part of the construction.

The City of Los Angeles Inspection is performed by the Bureau of Contract Administration in the City of Los Angeles. The City of Los Angeles Bureau of Contract Administration also provided additional details directly to the City of San José.



Chapter 6
Conclusions

CHAPTER 6 Conclusions

A. PERFORMANCE BENCHMARKING

Performance Benchmarking for the Update 2014 *Study* involved analysis of 665 projects in the projects database. The results of the performance benchmarking evaluation show that in almost all cases project delivery costs expressed as a percentage of TCC are higher for projects with lower TCCs. This clearly indicates that an economy of scale exists in the delivery of capital projects. Project delivery percentages (arithmetic averages) for the Update 2014 *Study* varied between the following values for the full range and the 80th percentile subset of TCC respectively:

Table 6-1
Update 2014 Project Delivery Percentages

Type	Project Delivery Percentages
Municipal Projects	40% - 44%
Parks Projects	52% - 57%
Pipes Projects	43% - 46%
Streets Projects	46% - 49%

Although the results of the performance analyses are based on historical data provided by the participating agencies, there are several factors that could affect project delivery and are not captured in the performance model. These external factors include personnel turnover in the agencies etc. which impact project delivery. Since such factors are not captured in the performance model, the reader is cautioned that the improved results of the regression analyses only be used as a reference and not for prediction of performance. In addition, in light of the current bid environment, it is recommended that the reader use best judgment in the context of the current economic downturn when using the *Study* results for planning and budgeting.

In addition to **Table 6-1**, additional analysis was conducted in Update 2014 *Study* to analyze project delivery percentages of projects based on TCC ranges. This analysis further confirmed that projects with low TCC costs have higher project delivery percentages than projects with high TCC costs. This analysis had more variation in project delivery percentages than seen in the previous analysis and is described in **Appendix D**.

B. SPECIAL STUDY

The Update 2014 Special *Study* investigated the trend in consultant rates over time. A template form was developed for agencies to collect consultant rates data for the past 5 years, and this data will be populated by the agencies over the next year. The template form was developed by the entire group to confirm the necessary data will be collected to make the *Study* beneficial.

C. BEST MANAGEMENT PRACTICES

In Update 2014, the agencies continued to exchange ideas regarding strategies for implementing various BMPs using

networking opportunities at the face-to-face meetings, conference calls, and the online discussion forum. In Update 2014, the Project Team added one new BMP:

- 5.III.k 2014 – Establish the use of dashboards as a quick way to check project delivery performance for both internal and external reporting and that is easy to use, has appropriate level of transparency and is efficient.

This new BMP is believed to directly influence cost, schedule, communication, and customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

Agencies continue to focus their efforts on monitoring adherence to BMPs that have been implemented and are judged to provide efficiencies in project delivery processes for participating departments. While the Agencies continue to review and update BMPs that have been fully implemented and pursue full implementation of partially implemented BMPs, in some cases constraints limit the full implementation of BMPs. In addition, many of the major ideas for BMPs have already been identified. While the Agencies try and a new BMP may be identified, it is getting harder and harder to identify new BMPs. That does not stop continued refinement of BMPs amongst each Agency. Several agencies have established a goal of implementing several BMPs this upcoming year.

To support the linking of BMPs to performance improvements, BMP implementation by the agencies are tracked. As of Update 2014, and including the addition of the new BMP, the Agencies have fully implemented about 69 percent of all BMPs. Seven (7) percent of the total BMPs have been partially implemented by the agencies. Many of the remaining BMPs require more involvement and input from multiple departments making them more complicated to implement than other BMPs.

D. ONLINE DISCUSSION FORUM

In Update 2014, the Online Discussion Forum and open dialog between each Agency continues to be an important feature for *Study* participants. Active, meaningful exchanges occur along with important issues being addressed resulting in changes to policy, approach, or BMP implementation. Participants continue sharing information through the Online Discussion Forum, conference calls, e-mails and during the face-to-face meetings. The interesting outcomes of these discussions are presented to the public through the *Study* reports. The continued sharing of challenges and solutions through the Online Discussion Forum remains a remarkable benefit to all participants.

E. PLANNING FOR UPDATE 2015

Over the course of Update 2014, the Project Team identified a number of activities to consider including next year in Update 2015. These activities include:

- Continue discussions on how to implement the new BMP (5.III.k;
- Continue collecting data on projects delivered via alternative delivery techniques;
- Developing new BMPs and tracking the implementation of adopted BMPs;

- Continuing discussion on current topics via the round-table discussion forum;
- Continuing meaningful exchanges on the Online Discussion Forum via the SharePoint website; and
- Review data from Special *Study* consultant rate trends.

F. ACKNOWLEDGEMENTS

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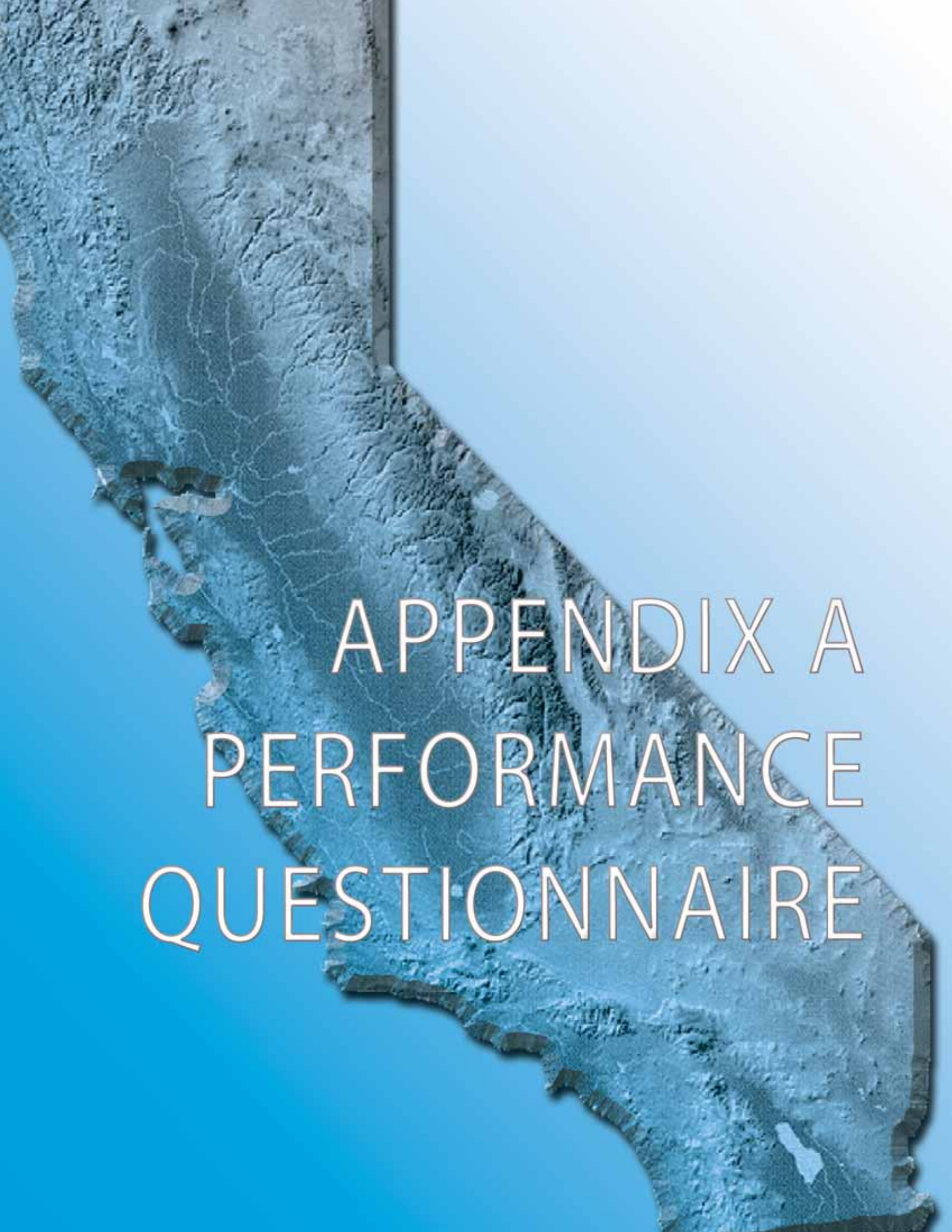
APPENDICES



APPENDIX A
PERFORMANCE QUESTIONNAIRE

APPENDIX A

Performance Questionnaire

California Multi-Agency Benchmarking Study Update 2014 Performance Questionnaire

Agency:

Project Name:

Project Type:

New/Rehab Index:

Alternative Project Delivery:

☐ LEED Green Building

☐ Project Financial Elements Closed and Complete

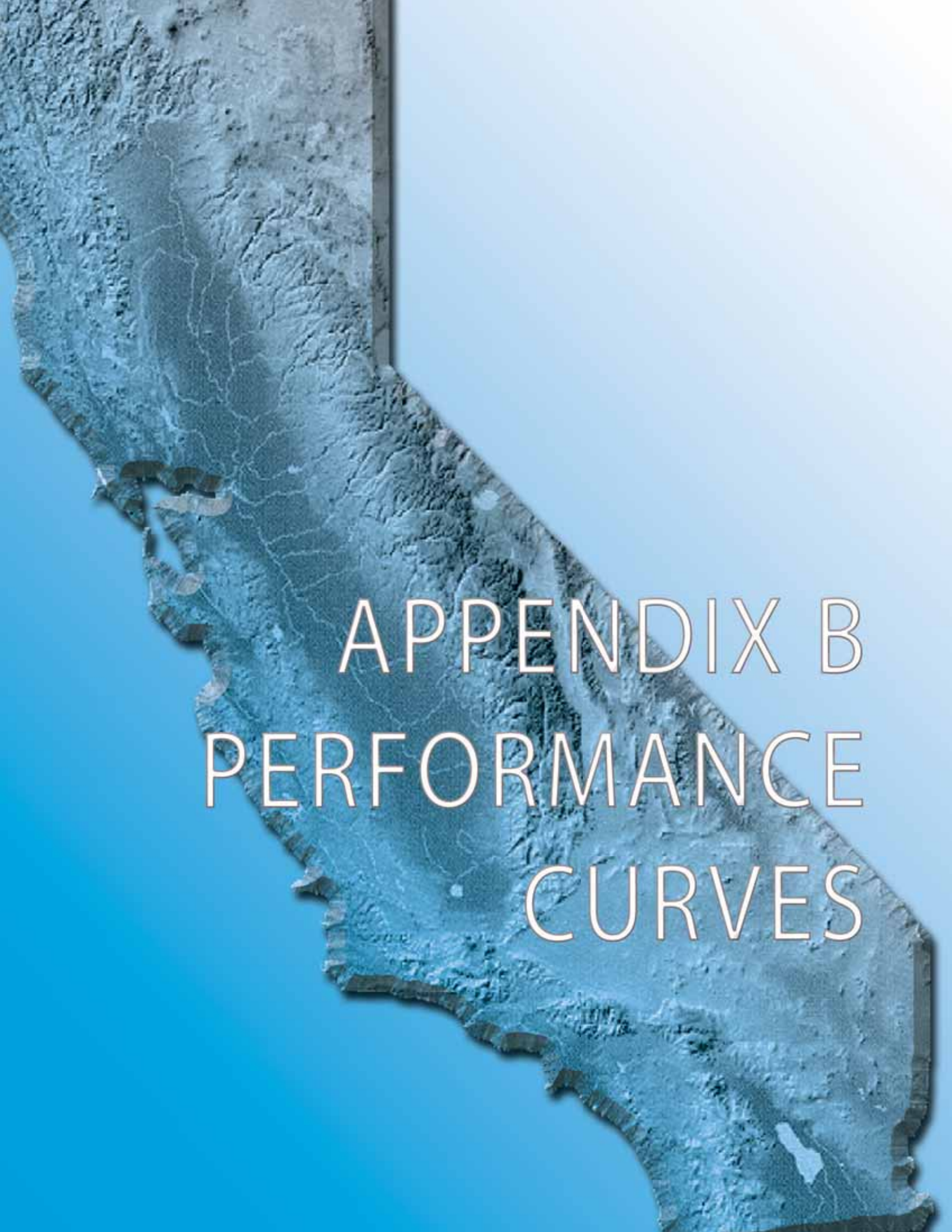
Description:

Comments:

	Planning		Design		Construction		Total	
	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*
AGENCY LABOR								
AGENCY COSTS(1)								
Art Fees								
SUB-TOTAL AGENCY								
CONSULTANT								
TOTALS								
PHASE DURATION		Months		Months		Months		

AMOUNT OF CONSTRUCTION CONTRACT ENGINEER'S ESTIMATE								
COST OF CHANGE ORDERS	Changed Conditions		Changed Bid Documents		Client-Initiated Changes:		Total Change Orders	$-
UTILITY RELOCATION COST								
CITY FORCES CONSTRUCTION								
TOTAL CONSTRUCTION COST (TCC)								
LAND ACQUISITION								
PROJECT COMPLETION DATE								
TOTAL PROJECT COST								$-
NUMBER OF BIDS RECEIVED								

(1) Agency costs include other direct costs and can be listed underneath.
This value is locked and it is calculated from its items (Rows 15 - 19).



APPENDIX B
PERFORMANCE CURVES

APPENDIX B Performance Curves

REGRESSION ANALYSIS RESULTS

The results of the regression analysis performed using the performance model are presented in the following paragraphs.

REGRESSION DEFINITIONS

A brief overview of the relevant statistical terminology and their definitions is provided in the following paragraphs:

Performance curves produced for this *Study* are regressions of data, demonstrating how close of a relationship exists between the dependent variable (on the y-axis) and the independent variable (on the x-axis). For instance, a regression curve of design cost versus total construction cost (TCC) would be prepared to evaluate how much of the variability in design cost is due to the TCC value.

The regression trendline can be used as a starting point for evaluating the budget for a suite of projects. Caution and use of professional judgment is required if using the regression trendline to budget an individual project.

Confidence Interval

The upper and lower bounds of the confidence interval indicates the level of certainty in a data set and how likely it is that a random sample from the data set will fall within the interval. The wider the distance between the upper and lower bounds of a confidence interval, the less certainty in the model and greater the need to collect more data before drawing conclusions from the data set.

Coefficient of Determination

A best-fit logarithmic curve is calculated using the least-squares method in Excel®, and a R^2 value is displayed. The R^2 value, also called the coefficient of determination, is a value between 1 and 0, with a value approaching 0 indicating a poor model and a value approaching 1 indicating a high dependence of the y-value statistic on the x-value statistic.

Statistical Significance

To evaluate the statistical significance of the result obtained, the regression analyses included a calculation of p-values. Whereas the R^2 value is a descriptive statistic (i.e., describes the current set of data), the p-value is a predictive statistic. It indicates whether there are enough data points to arrive at statistically-significant results and whether the data set could be used to forecast new values. The selection of a desirable p-value is subjective, though 0.10 or 0.05 is typically used as the maximum desirable value.

For the purposes of this *Study*, a critical p-value of 0.10 was selected. Thus, any result where $p \leq 0.10$ is considered statistically significant. There is no difference between a p-value slightly below 0.10 as one that is far below 0.10. Both results are considered to have equal statistical significance.

For regressions resulting in a p-value above 0.10, additional projects should be added to the database to improve the result. Please see the *Study 2002* report for additional detail on the connection between the number of projects and p-values.

For each of the regressions, the R^2 value and p-value should be considered separately. A high R^2 value does not mean the result is statistically-significant, and vice-versa.

The results of the regression analyses are discussed in the remainder of this section. The results of the regression analyses are summarized in **Table B-1** and **Table B-2**. **Table B-1** summarizes the performance model results for the full range of TCC while **Table B-2** summarizes the results for the 80th percentile subset of TCC. These tables also summarize the design, construction management, and project delivery costs expressed as a percentage of the TCC and the R^2 and the p-values for the different project types.

It is important to note that while the slopes of the linear regression models are an expression of the project delivery cost as a percentage of construction, the slopes are not equal to the average and median project delivery percentages shown in **Table 3-5**, Table 3-6 and Table 3-7. This is due to the fact that the linear trendline is fit by the least squares method.

This is better explained by the following example. Consider 5 projects in the municipal category having the a1, a2, a3, a4, and a5 as their individual project delivery costs and b1, b2, b3, b4, and b5 as their individual TCC. The arithmetic average of the project delivery percentages would be represented as:

Project Delivery Percentage =

$$\left(\frac{a1}{b1} + \frac{a2}{b2} + \frac{a3}{b3} + \frac{a4}{b4} + \frac{a5}{b5} \right) \Big/ 5$$

The project delivery percentages presented in **Table 3-5, Table 3-6,** and **Table 3-7** are computed using the above formula which is the average of the individual project delivery percentages

In the regression analysis, the project delivery percentage is computed in fashion that is more similar to the following formula which represents the average slope of the least squares fit.

Project Delivery Percentage =

$$\left(\frac{a1 + a2 + a3 + a4 + a5}{b1 + b2 + b3 + b4 + b5} \right)$$

The project delivery percentages presented in **Table B-1** and **Table B-2** are computed using the above formula.

The plots depicting the regression relationships are shown in this section. It should also be noted that while majority of projects are clustered near the origin of the graph, the slope of the trendline is predominantly governed by the data points scattered at relatively high TCC values.

Since the slope of the trendline provides the design, construction management, or the project delivery costs as a percentage of the TCC for a group of projects, the results better reflect the properties of a program of projects rather than that of an individual project. Therefore, the reader must avoid budgeting individual projects based solely on these analyses.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only 3 out of the 16 categories have lower project delivery percentages for the 80th percentile subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

For projects belonging to the Pipes category, there is an increase of approximately ten percent in the project delivery percentages for projects evaluated in the 80th percentile subset of TCC. Similarly, project delivery percentages for projects belonging to the Parks category also exhibit an eighteen percent increase, while projects belonging to the Municipal category exhibit an increase of seventeen percent. Project delivery percentages for projects belonging to the Streets category exhibit a thirteen percent increase. Comparing the results summarized in **Table B-1** and **Table B-2** shows that an economy of scale exists in delivering projects with a higher TCC versus those with a lower TCC.

In addition, it should be noted that although the R^2 values are slightly smaller and p-values are higher than in last year's *Study* phase, the reader is cautioned that this table only be used as a reference and not for prediction of performance. Readers are urged to review the curves in this section in conjunction with using this table.

Table B-1
Summary of Performance Models (Full Range of TCC)

Project Type or Classification	Number of Projects (N)	Design Cost				Construction Management Cost				Project Delivery Cost			
		(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value
Municipal Projects	**97**	**10%**	**9%-11%**	**0.65**	**3.71E-33**	**12%**	**10%-13%**	**0.58**	**2.43E-25**	**22%**	**20%-24%**	**0.72**	**6.43E-37**
Libraries	15	15%	13%-17%	0.75	7.19E-10	16%	13%-18%	0.78	4.46E-09	31%	27%-34%	0.88	8.89E-12
Police/Fire Stations	11	10%	8%-11%	0.91	4.99E-08	8%	6%-10%	0.72	5.23E-06	18%	15%-21%	0.87	1.76E-07
Comm./Rec.Center/ Child Care/Gyms	30	16%	13%-20%	0.56	1.23E-10	12%	10%-14%	0.64	3.61E-11	28%	24%-32%	0.75	1.8E-14
Other Municipal	41	7%	6%-9%	0.53	8.43E-11	18%	15%-22%	0.69	6.6E-13	25%	21%-30%	0.71	8.13E-14
Streets Projects	**245**	**16%**	**15%-16%**	**0.89**	**6.1E-128**	**12%**	**12%-13%**	**0.90**	**8.3E-138**	**28%**	**27%-29%**	**0.94**	**7.1E-158**
Widening/New/ Grade Separations	15	15%	13%-17%	0.94	6.54E-11	12%	11%-13%	0.96	3.61E-12	27%	25%-29%	0.97	5.0E-13
Bridges	21	19%	15%-23%	0.57	3.62E-09	14%	12%-17%	0.75	1.48E-10	33%	29%-37%	0.84	1.51E-13
Reconstructions	101	16%	14%-19%	0.38	4.86E-28	16%	14%-18%	0.50	6.65E-32	32%	29%-36%	0.52	6.27E-35
Bike/Pedestrian/ Streetscapes	64	24%	21%-27%	0.59	7.34E-25	13%	10%-15%	0.20	5.13E-17	37%	33%-41%	0.61	2.1E-28
Signals	45	19%	16%-22%	0.69	3.44E-17	15%	13%-17%	0.70	4.6E-21	34%	31%-37%	0.82	2.9E-24
Pipes Projects	**278**	**11%**	**10%-12%**	**0.58**	**4.02E-83**	**18%**	**18%-19%**	**0.86**	**1.4E-132**	**29%**	**28%-30%**	**0.86**	**1.7E-140**
Gravity Mains	204	10%	9%-10%	0.55	1.29E-58	17%	17%-18%	0.91	7.6E-115	27%	26%-28%	0.89	2.7E-113
Pressure Systems	53	18%	16%-19%	0.80	3.54E-27	14%	13%-16%	0.76	9.82E-25	32%	29%-35%	0.82	3.22E-28
Pump Stations	8	11%	-1%-23%	0.30	6.83E-02	17%	14%-21%	0.91	3.91E-06	28%	17%-40%	0.45	5.67E-04
Other Pipes	13	15%	12%-17%	0.91	1.09E-08	32%	29%-34%	0.98	1.55E-11	46%	44%-49%	0.99	2.78E-14
Parks Projects	**45**	**15%**	**11%-19%**	**0.22**	**4.5E-09**	**13%**	**10%-15%**	**0.44**	**1.15E-11**	**28%**	**22%-34%**	**0.37**	**1.11E-11**
Playgrounds	30	33%	29%-37%	0.84	3.94E-16	16%	11%-21%	0.37	5.02E-07	49%	40%-57%	0.71	1.98E-12
Sportfields	13	7%	5%-10%	0.23	4.52E-05	11%	7%-15%	0.58	2.45E-05	18%	13%-23%	0.59	4.38E-06
Restrooms	2	34%	-230%-298%	-3.2	3.51E-01	19%	-240%-277%	-1.09	5.27E-01	52%	-470%-575%	-1.88	4.23E-01

Notes:

[1] TCC = = Total Construction Cost; Des. = Design Cost; CM = Construction Management Cost, and PD = Project Delivery Cost. CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to Appendix B for the corresponding regression curves, R^2 values, and N values for more details.

[2.] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the Update 2014 *Study*.

Table B-2
Summary of Performance Models (80th Percentile Subset of TCC)

Project Type or Classification	80th Percentile ($)	Number of Projects (N)	Design Cost				Construction Management Cost				Project Delivery Cost			
			(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value
Municipal Projects	**78**	**23%**	**20%-26%**	**0.58**	**1.73E-24**	**17%**	**14%-19%**	**0.54**	**3.82E-22**	**39%**	**35%-43%**	**0.67**	**1.30E-29**	**3.15E-35**
Libraries	12	17%	14%-20%	0.60	1.85E-07	16%	13%-18%	0.82	1.66E-08	33%	28%-38%	0.77	2.14E-08	1.68E-9
Police/Fire Stations	8	15%	8%-23%	-0.01	1.67E-03	21%	12%-29%	0.43	8.41E-04	36%	24%-48%	0.41	2.12E-04	5.58E-7
Comm./Rec.Center/ Child Care/Gyms	24	24%	18%-30%	0.57	5.77E-08	17%	13%-21%	0.69	4.11E-09	41%	34%-48%	0.76	3.87E-11	2.33E-12
Other Municipal	33	36%	30%-43%	0.73	7.61E-13	31%	23%-38%	0.60	1.52E-09	67%	54%-81%	0.68	1.88E-11	1.5E-10
Streets Projects	**196**	**23%**	**20%-25%**	**0.33**	**1.72E-48**	**18%**	**16%-20%**	**0.39**	**4.08E-57**	**41%**	**38%-44%**	**0.44**	**4.06E-63**	**4.32E-67**
Widening/New/ Grade Separations	12	33%	24%-41%	0.74	5.01E-06	14%	7%-21%	0.30	6.84E-04	47%	35%-58%	0.74	2.22E-06	6.47E-6
Bridges	16	29%	24%-33%	0.81	8.73E-10	16%	12%-20%	0.56	4.21E-07	45%	38%-51%	0.82	2.25E-10	3.66E-9
Reconstructions	81	20%	17%-22%	0.37	8.61E-24	18%	16%-21%	0.48	5.06E-27	38%	34%-43%	0.49	8.91E-29	4.06E-35
Bike/Pedestrian/ Streetscapes	51	27%	22%-32%	0.09	1.36E-15	19%	16%-22%	0.24	8.36E-19	46%	40%-52%	0.20	4.51E-20	1.97E-19
Signals	**36**	**24%**	19%-29%	0.19	1.10E-11	21%	17%-25%	-0.03	6.50E-12	45%	39%-51%	0.21	3.77E-17	6.71E-16
Pipes Projects [1]	223	21%	**19%-22%**	**0.29**	**2.75E-59**	**19%**	**17%-20%**	**0.41**	**1.07E-71**	**39%**	**37%-42%**	**0.48**	**6.08E-86**	**5.72E-80**
Gravity Mains	164	21%	18%-23%	0.27	1.33E-41	21%	19%-23%	0.49	2.52E-56	42%	39%-44%	0.54	9.73E-67	1.94E-59
Pressure Systems	42	18%	15%-20%	0.31	4.16E-17	14%	12%-16%	0.35	1.58E-17	31%	28%-35%	0.39	2.19E-19	4.37E-20
Pump Stations	**6**	**17%**	2%-33%	-1.0	3.44E-02	22%	14%-30%	0.65	1.05E-03	39%	24%-55%	-0.05	1.17E-03	9.18E-6
Other Pipes	**10**	**15%**	4%-27%	-0.6	1.67E-02	24%	19%-30%	0.82	4.14E-06	40%	23%-56%	0.32	4.25E-04	4.99E-4
Parks Projects	36	28%	**24%-32%**	**0.45**	**1.28E-16**	**18%**	**14%-22%**	**-0.15**	**6.91E-11**	**46%**	**40%-52%**	**0.31**	**8.84E-18**	**2.04E-21**
Playgrounds	24	33%	28%-38%	0.60	9.40E-13	20%	15%-26%	0.00	8.50E-08	53%	46%-60%	0.54	1.01E-13	1.98E-14
Sportfields	10	17%	9%-24%	-0.1	5.60E-04	13%	8%-19%	-0.30	3.57E-04	30%	20%-40%	-0.18	8.78E-05	5.74E-4
Restrooms [2]	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.01E-1

Notes:

[1] TCC = Total Construction Cost; Des. = Design Cost; CM = Construction Management Cost, and PD = Project Delivery Cost. CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to **Appendix B** for the corresponding regression curves, R^2 values, and N values for more details.

[2] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 665 projects selected for analysis in the Update 2014 *Study*.

[3] Restrooms only has one value for the 80 percent subset of projects and therefore regression analysis could not be performed on one data point

The elimination of auto-correlation in Update 2008 and the use of the linear trendline to describe the relationship between project delivery costs and the TCC have significantly improved the R^2 values in the past five years as compared to the *Study* years prior to 2008.

For projects evaluated under the full range of TCC, Pipes and Streets projects exhibit higher R^2 values as compared to Municipal Facilities and Parks projects for the project delivery versus TCC regressions. This may be attributed to a larger number of projects for Pipes and Street categories. This would lead to more consistent performance and therefore higher R^2 values.

It is observed that the R^2 values are lower for projects falling in the 80th percentile subset of TCC than for projects falling under the full range of TCC. This is explained due to the fact that there is greater scatter amongst the project data points evaluated under a 80th percentile range of TCC than the full range of TCC. Project classifications with very few data points typically exhibit low R^2 values (less than 0.5).

Table B-3 Summary of Regression Equations

Project Type or Classification	Design Cost ($) vs. TCC($) Full Range of TCC	Design Cost ($) vs. TCC($) Smaller Project Subset of TCC	CM Cost ($) vs. TCC($) Full Range of TCC	CM Cost ($) vs. TCC($) Smaller Project Subset of TCC	Project Delivery Cost ($) vs. TCC($) Full Range of TCC	Project Delivery Cost ($) vs. TCC($) Smaller Project Subset of TCC
Municipal Projects	**0.1011x**	**0.2266x**	**0.1162x**	**0.1654x**	**0.2173x**	**0.392x**
Libraries	0.1504x	0.1686x	0.1565x	0.1579x	0.3069x	0.3265x
Police/Fire Stations	0.0972x	0.1528x	0.0793x	0.2059x	0.1765x	0.3587x
Comm./Rec. Center/	0.1629x	0.2413x	0.1191x	0.1683x	0.282x	0.4096x
Other Municipal	0.0743x	0.3647x	0.1802x	0.3071x	0.2545x	0.6718x
Streets Projects	**0.1573x**	**0.2274x**	**0.1225x**	**0.1796x**	**0.2798x**	**0.407x**
Widening/New/ Grade Separations	0.152x	0.3251x	0.1182x	0.1409x	0.2702x	0.4659x
Bridges	0.1924x	0.2866x	0.1411x	0.1614x	0.3335x	0.448x
Reconstructions	0.1642x	0.1966x	0.16x	0.185x	0.3242x	0.3816x
Bike/Pedestrian/ Streetscapes	0.2416x	0.2692x	0.1268x	0.1922x	0.3684x	0.4614x
Signals	**0.1918x**	0.2381x	0.1479x	0.2098x	0.3397x	0.4479x
Pipes Projects	0.1086x	**0.2054x**	**0.1831x**	**0.1883x**	**0.2917x**	**0.3936x**
Gravity Mains	0.0957x	0.2052x	0.1737x	0.2105x	0.2693x	0.4157x
Pressure Systems	0.1772x	0.1751x	0.1442x	0.1394x	0.3214x	0.3145x
Pump Stations	**0.1103x**	0.1729x	0.1741x	0.2203x	0.2844x	0.3933x
Other Pipes	**0.1467x**	0.1534x	0.3162x	0.2432x	0.4629x	0.3967x
Parks Projects	0.1514x	**0.2831x**	**0.1254x**	**0.179x**	**0.2767x**	**0.462x**
Playgrounds	0.3296x	0.3281x	0.1592x	0.2047x	0.4889x	0.5328x
Sportfields	0.0717x	0.1672x	0.1101x	0.1329x	0.1818x	0.3001x
Restrooms	0.3381x	N/A	0.1868x	N/A	0.5249x	N/A

Note:

[1] m = slope of the regression trendline which is the project delivery percentage.

[2] Restrooms only has one value for the 80 percent subset of projects and therefore regression analysis could not be performed on one data point

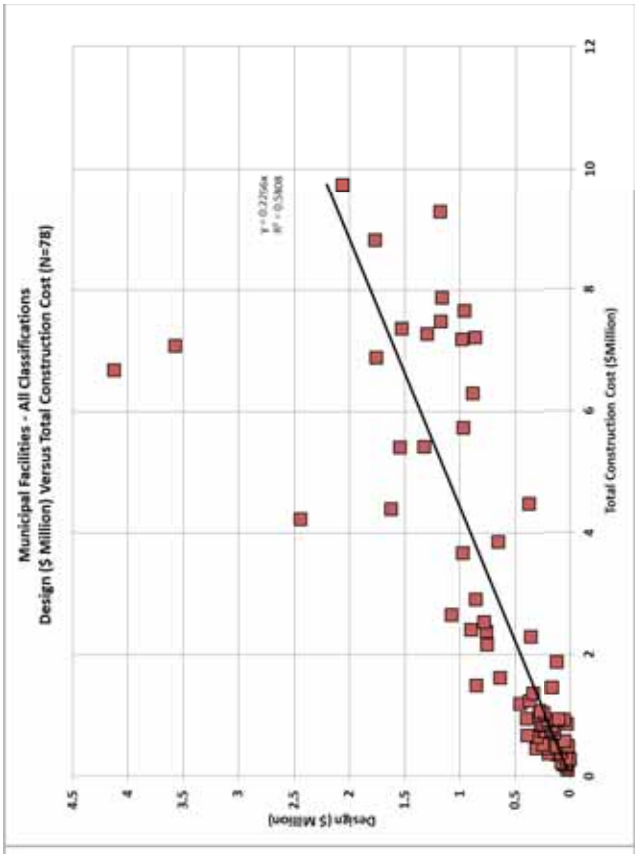
APPENDIX B

Performance Curves

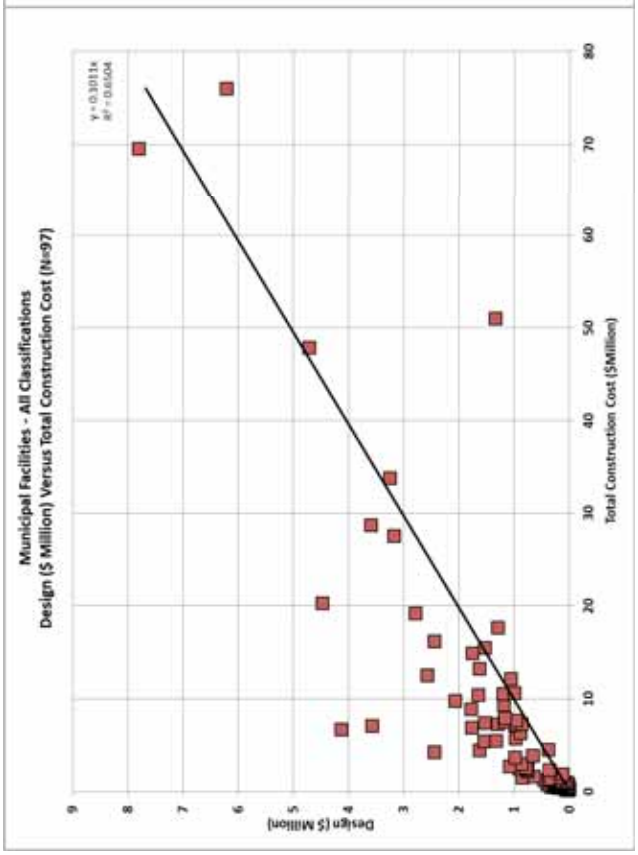
CURVES GROUP 1

Design Cost
vs
Total Construction Cost

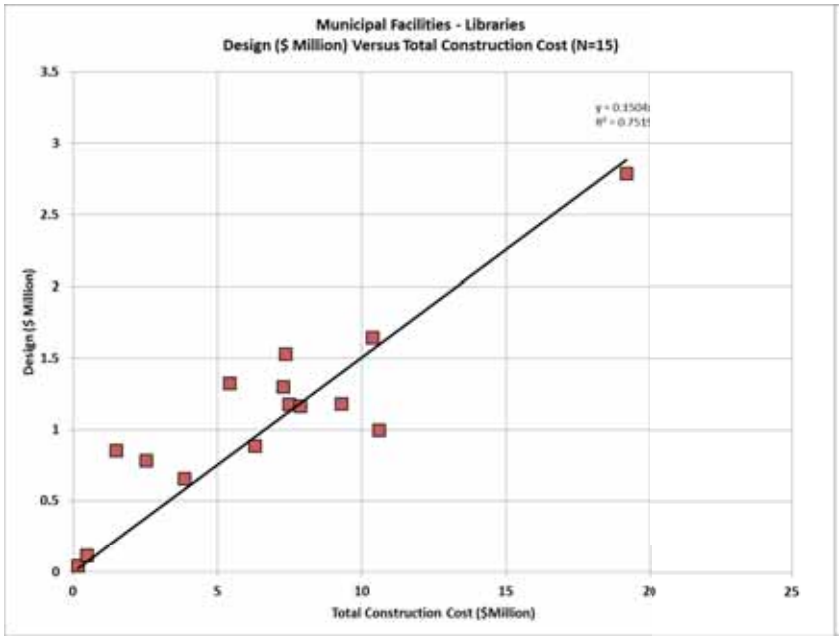
80th Percentile Projects



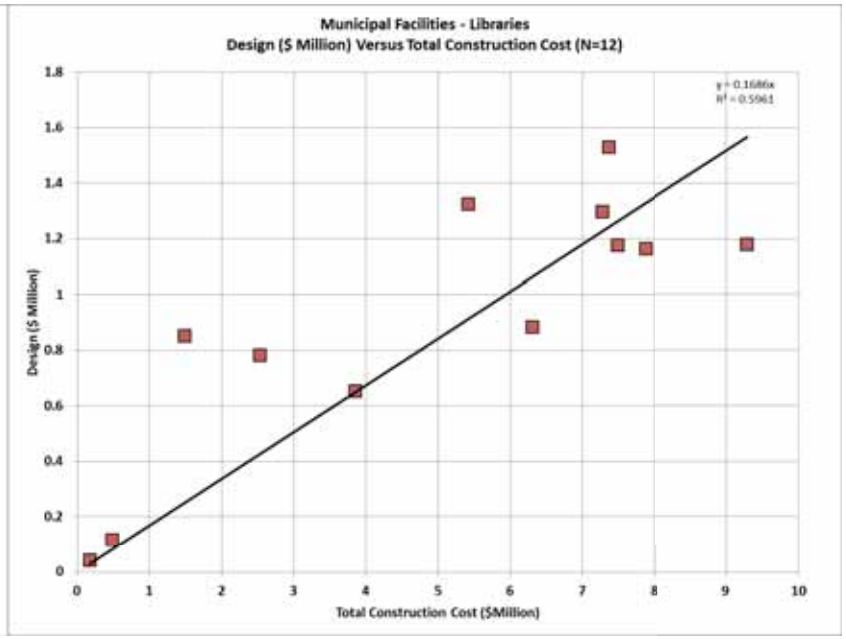
All Projects



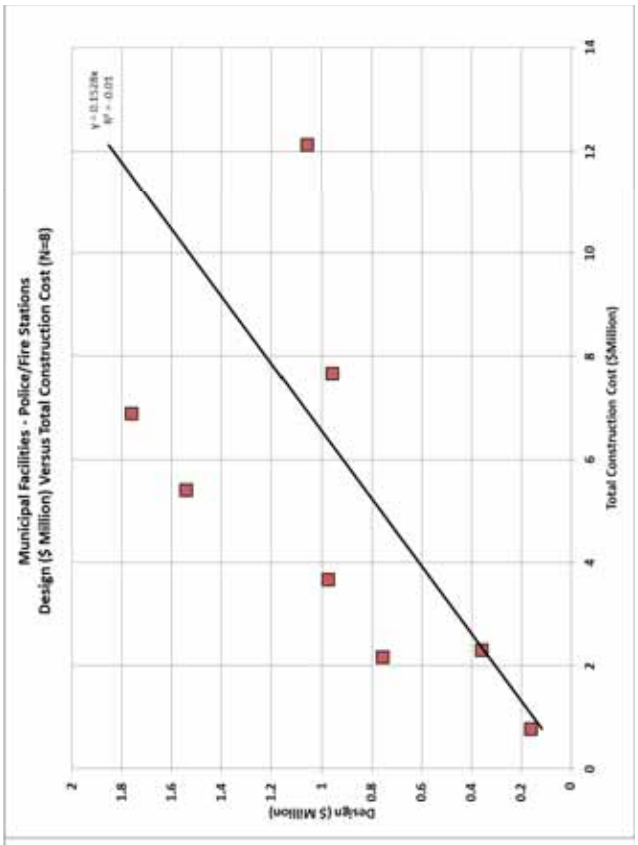
All Projects



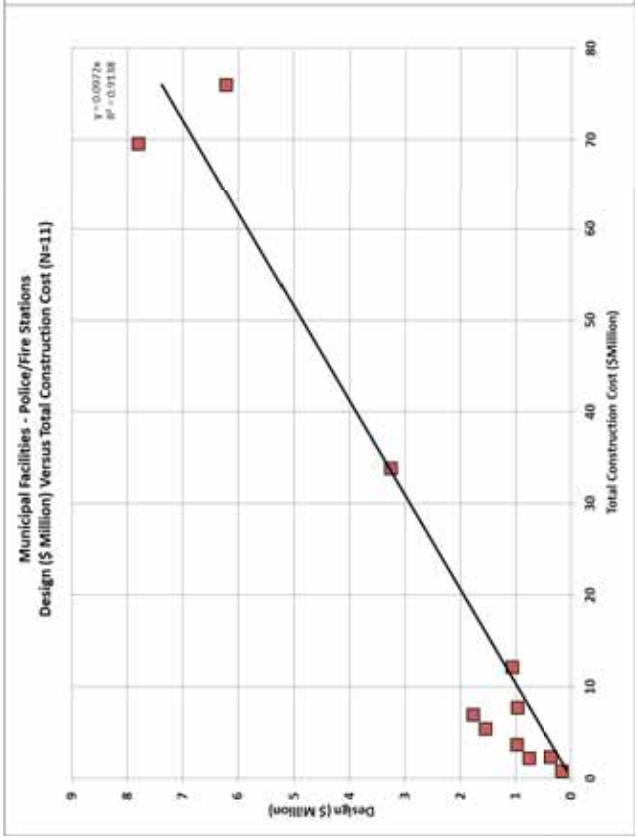
80th Percentile Projects



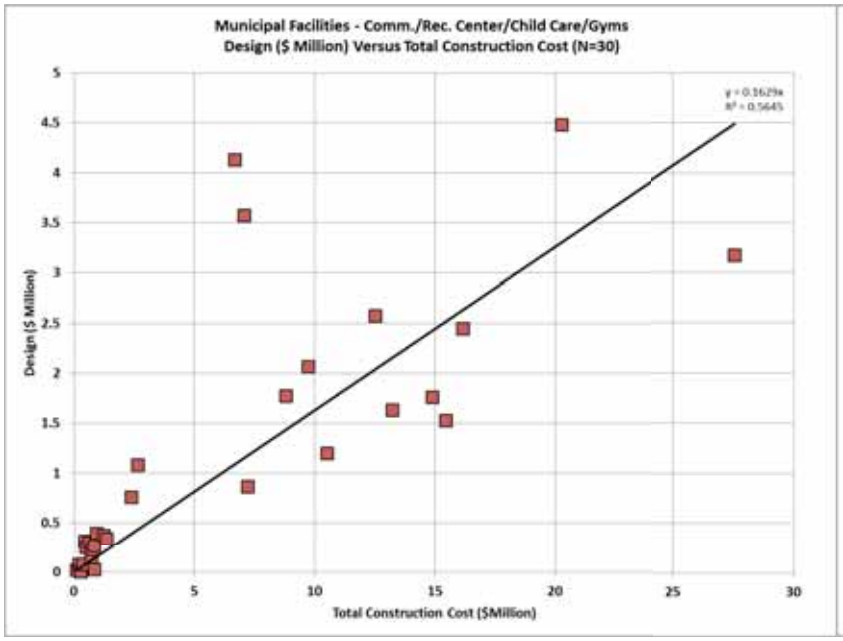
80th Percentile Projects



All Projects



All Projects



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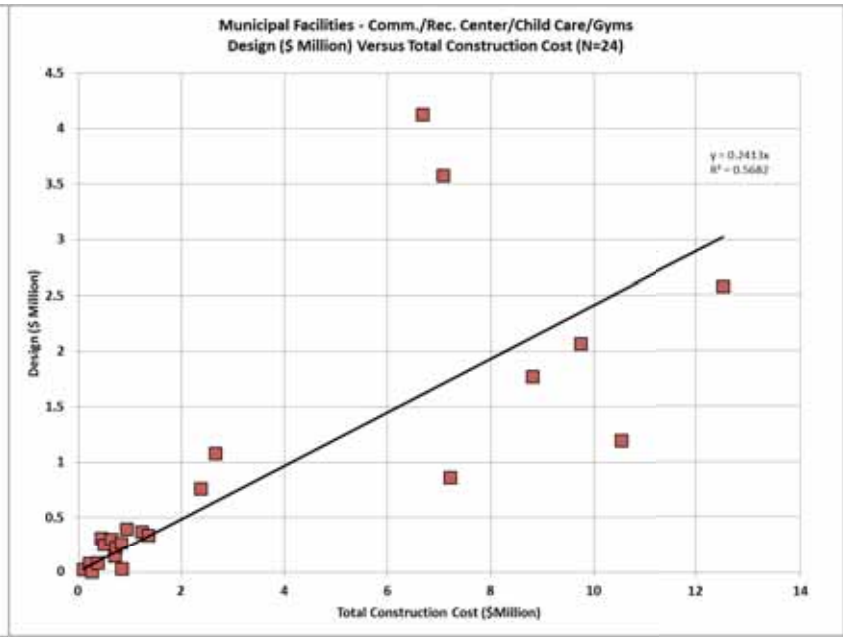

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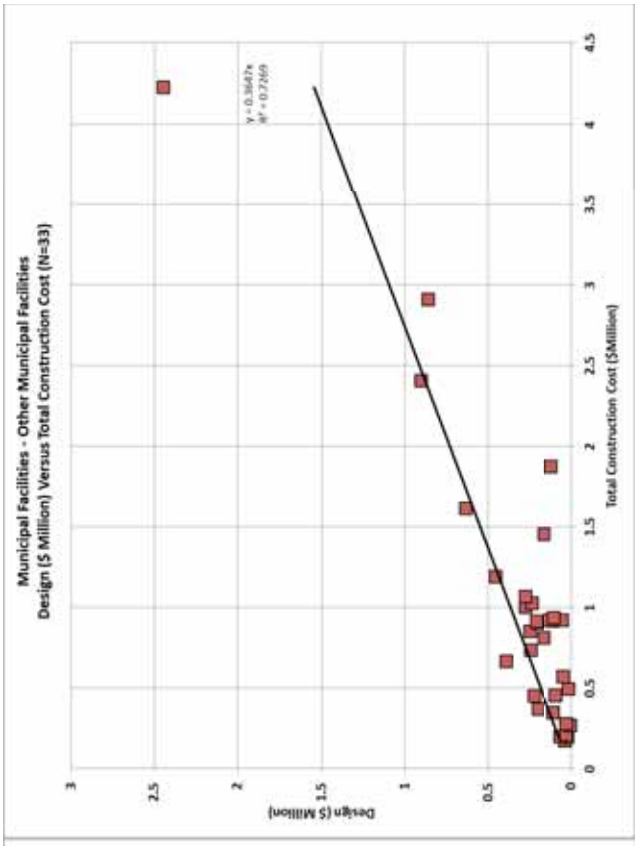
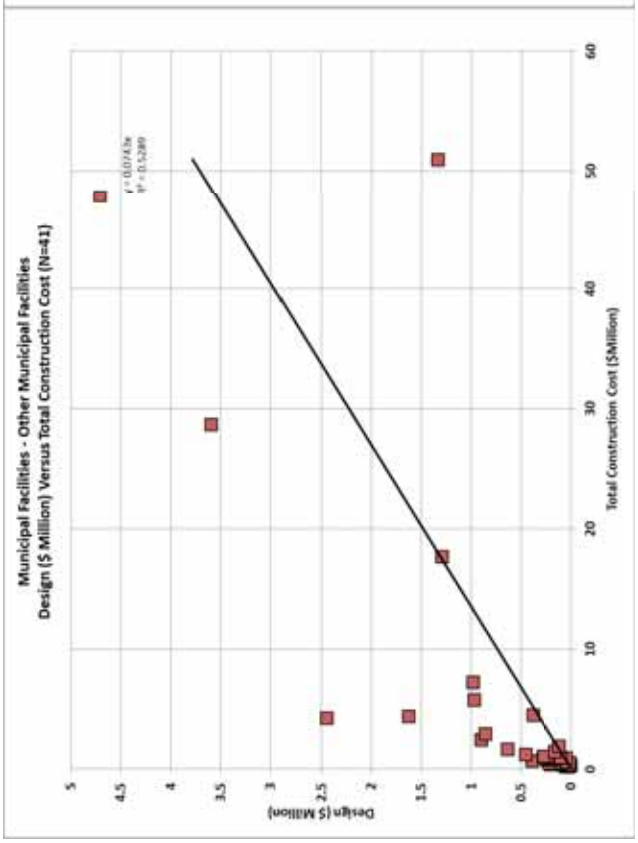
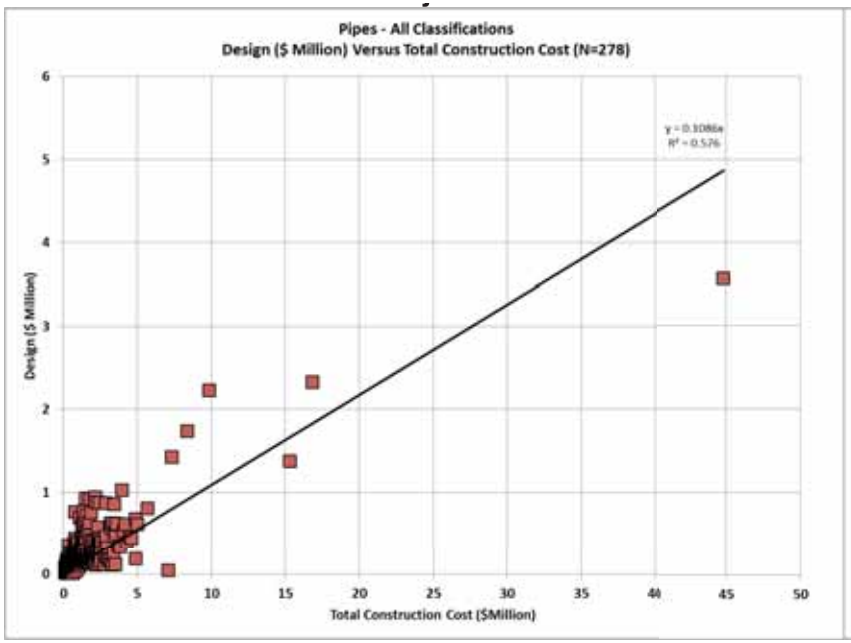


All Projects



All Projects



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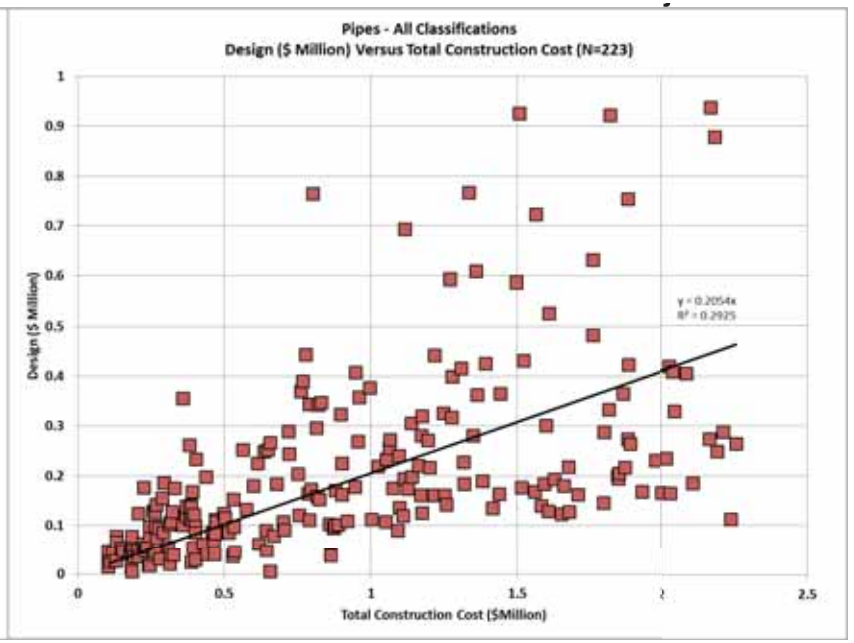

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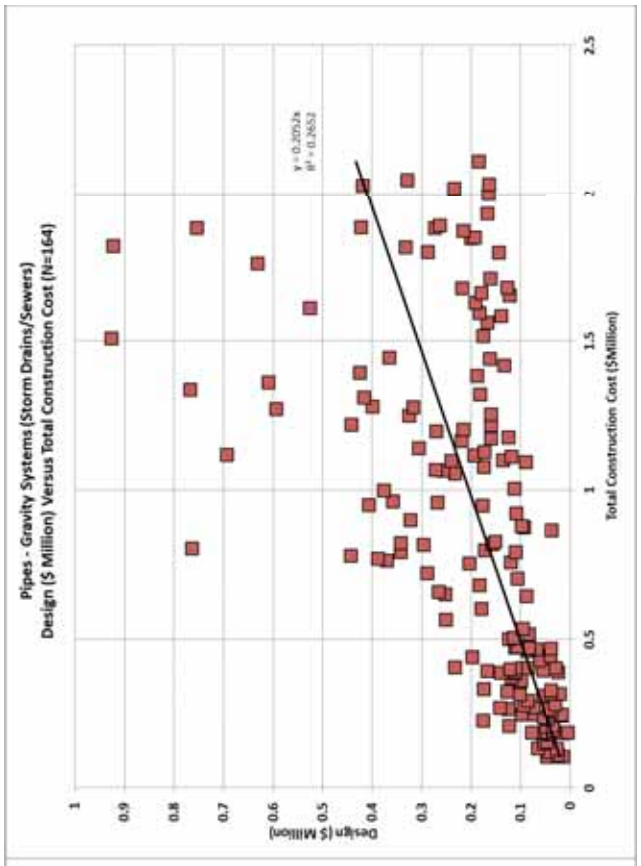
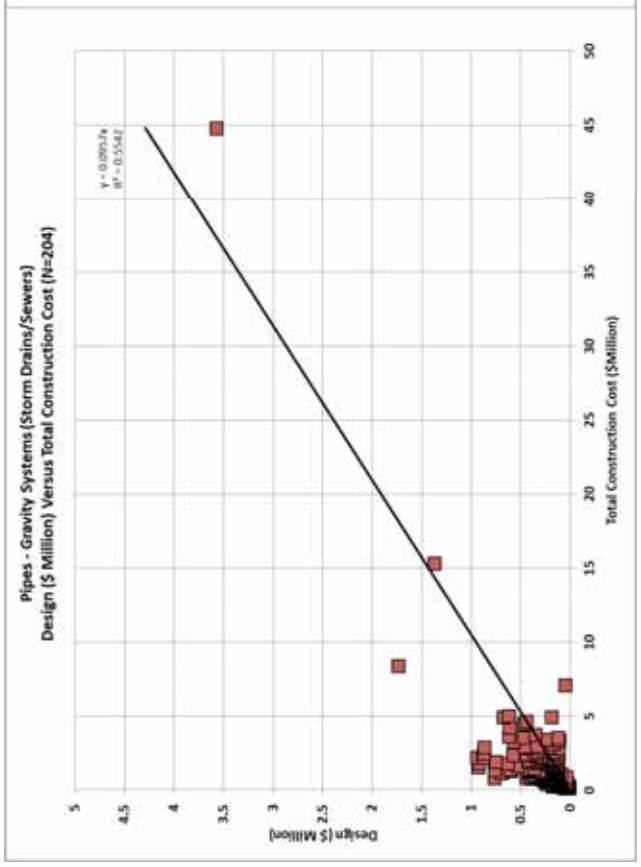
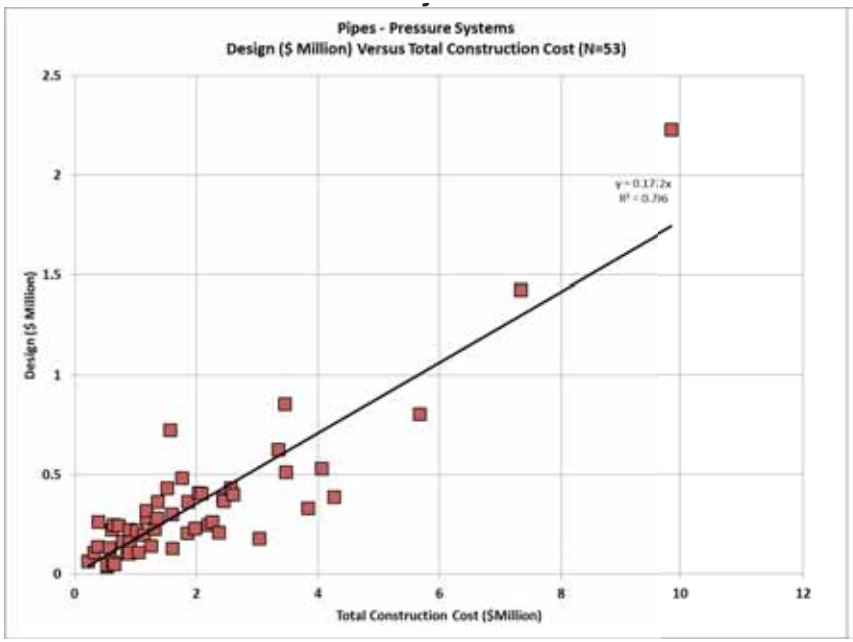


All Projects



All Projects



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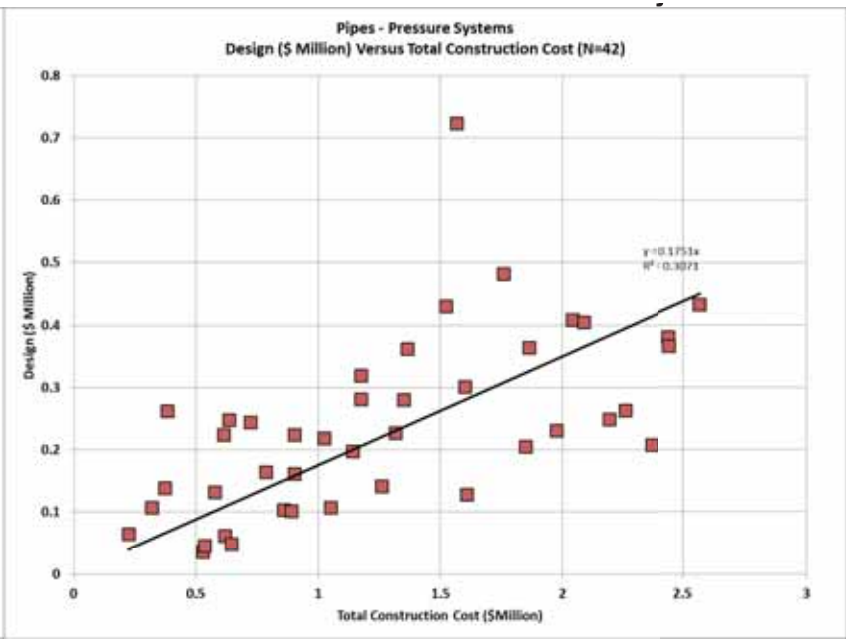

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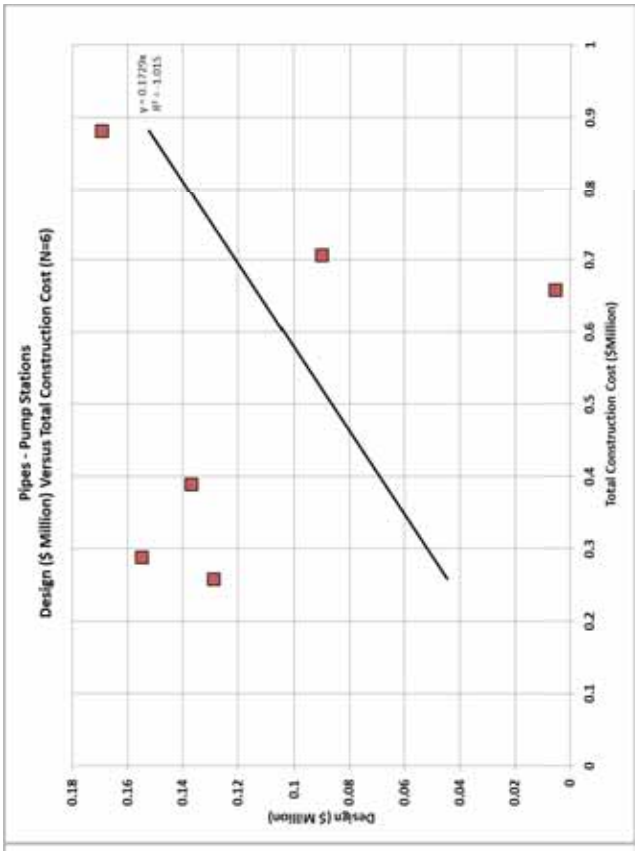
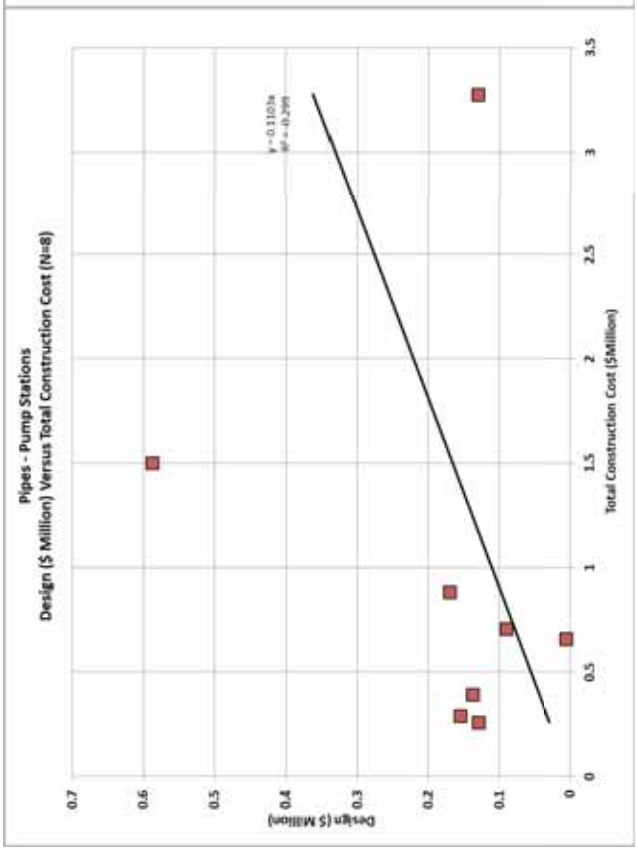
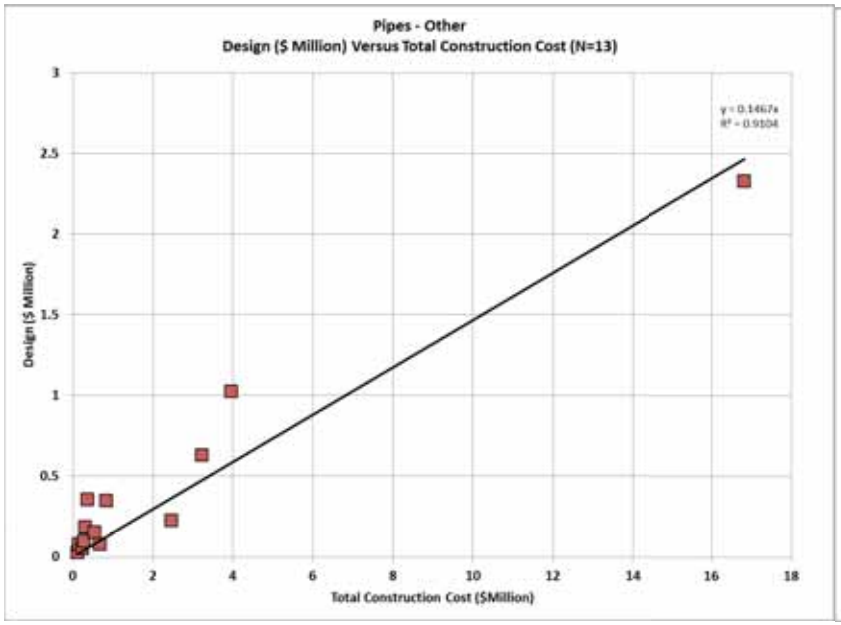


All Projects



All Projects



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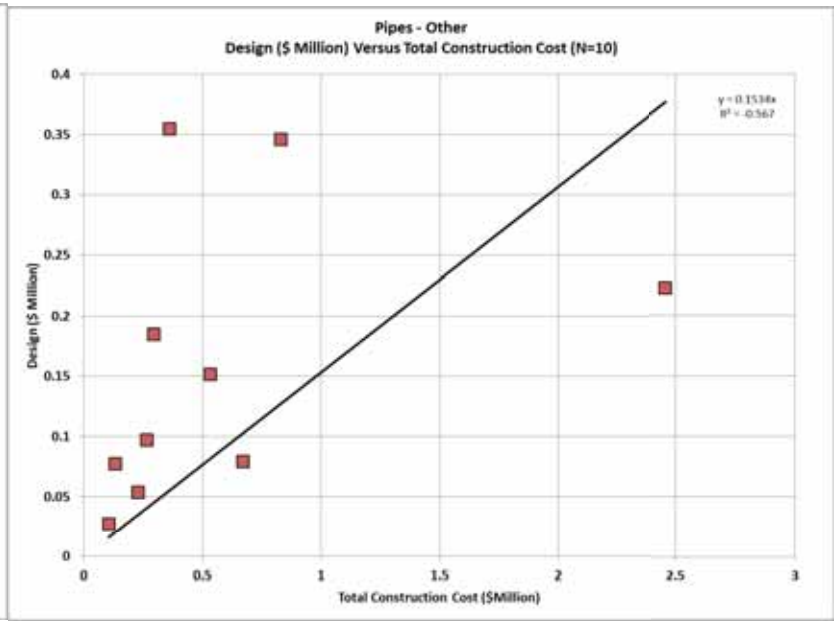

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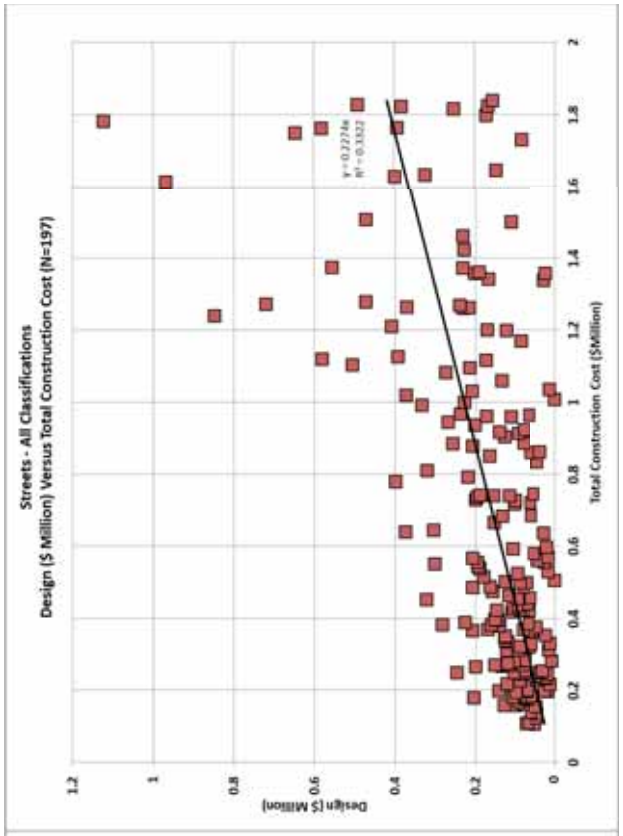
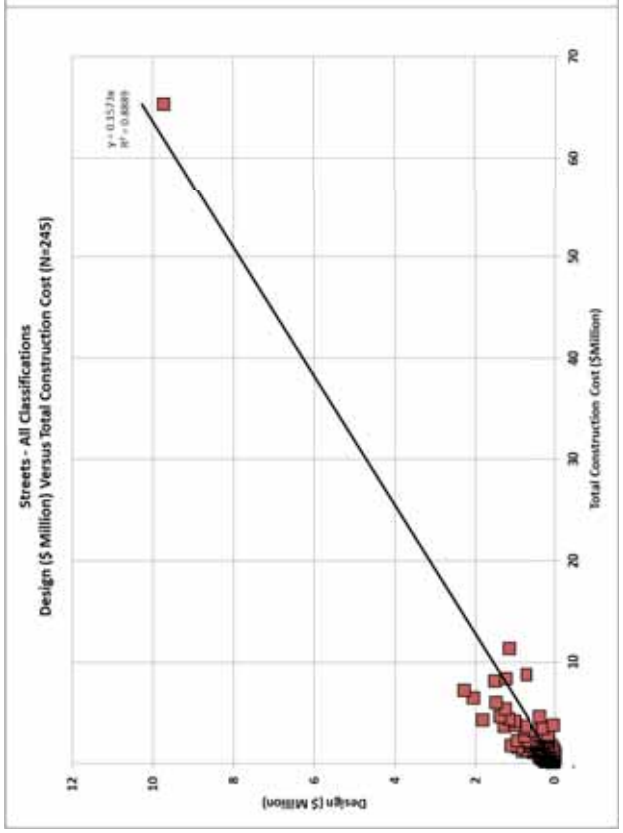
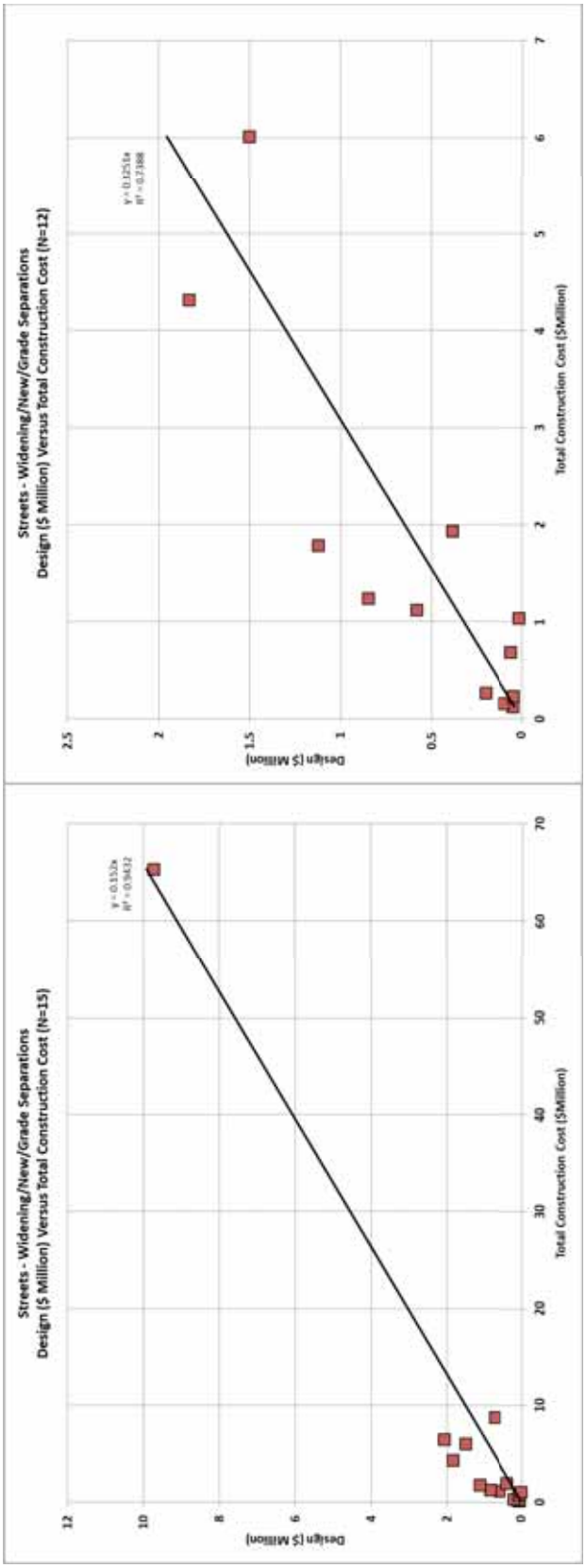
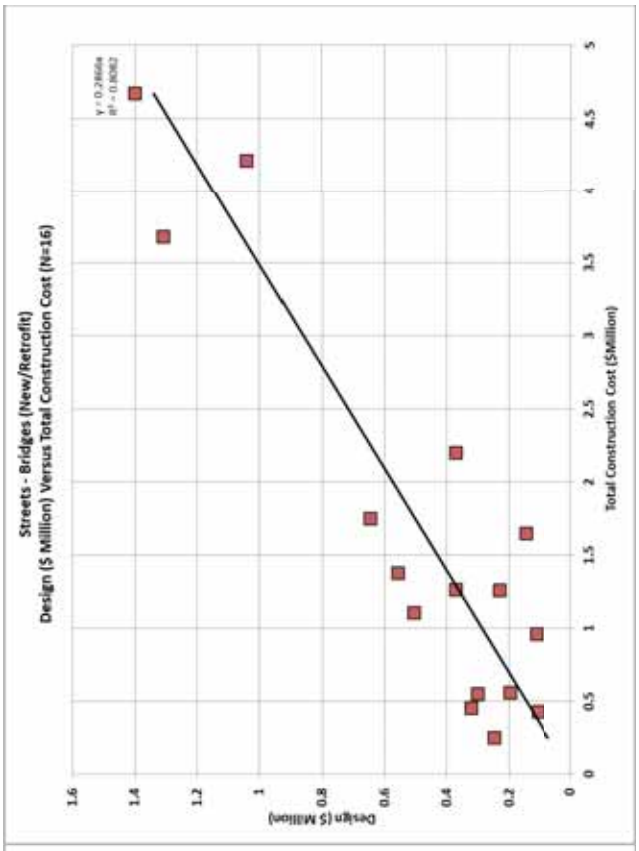


All Projects

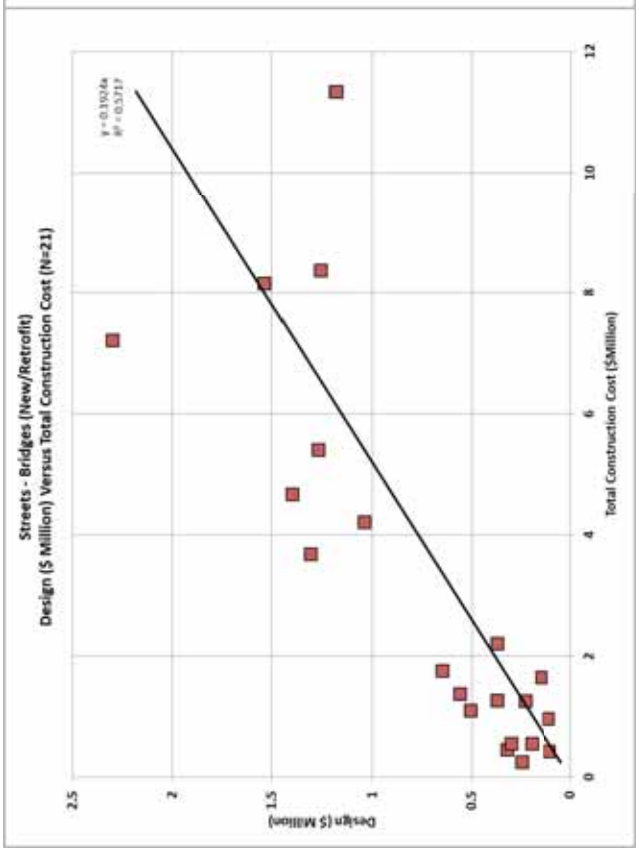



80th Percentile Projects
Streets - Widening/New/Grade Separations
Design ($ Million) Versus Total Construction Cost (N=12)
Design ($ Million)
Total Construction Cost ($Million)
All Projects
Streets - Widening/New/Grade Separations
Design ($ Million) Versus Total Construction Cost (N=15)
Design ($ Million)
Total Construction Cost ($Million)

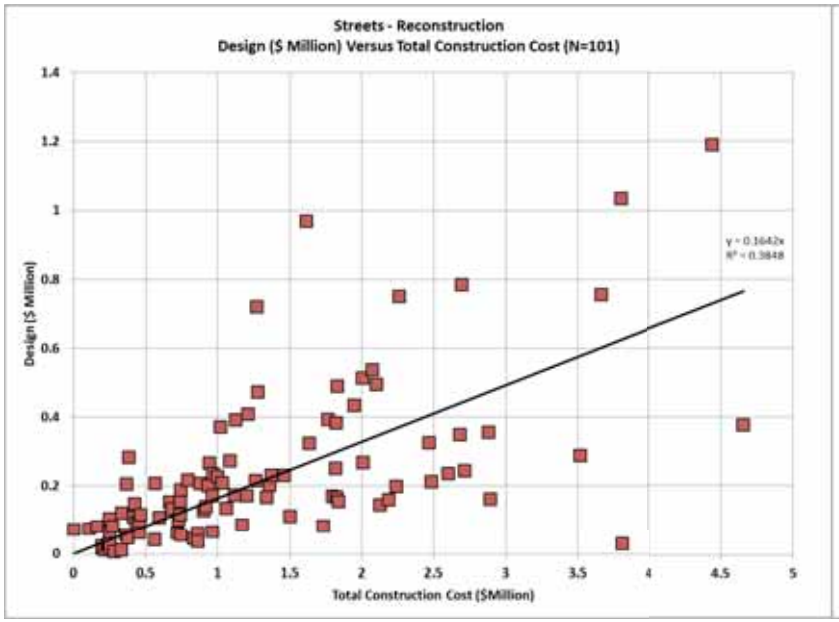
80th Percentile Projects



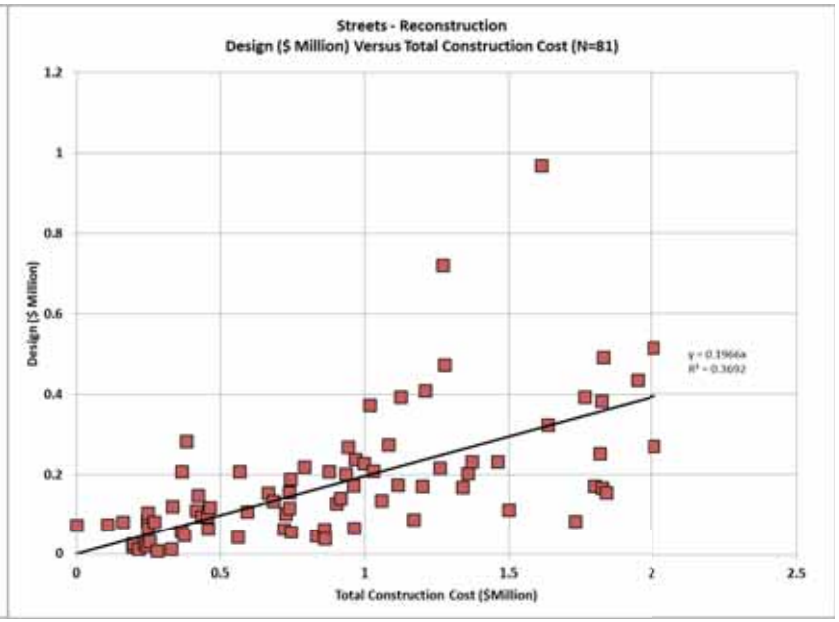
All Projects



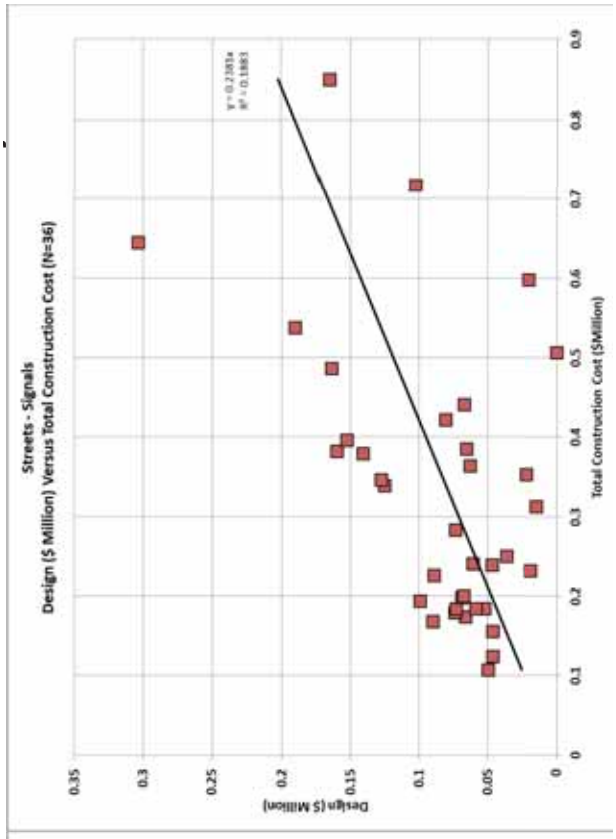
All Projects



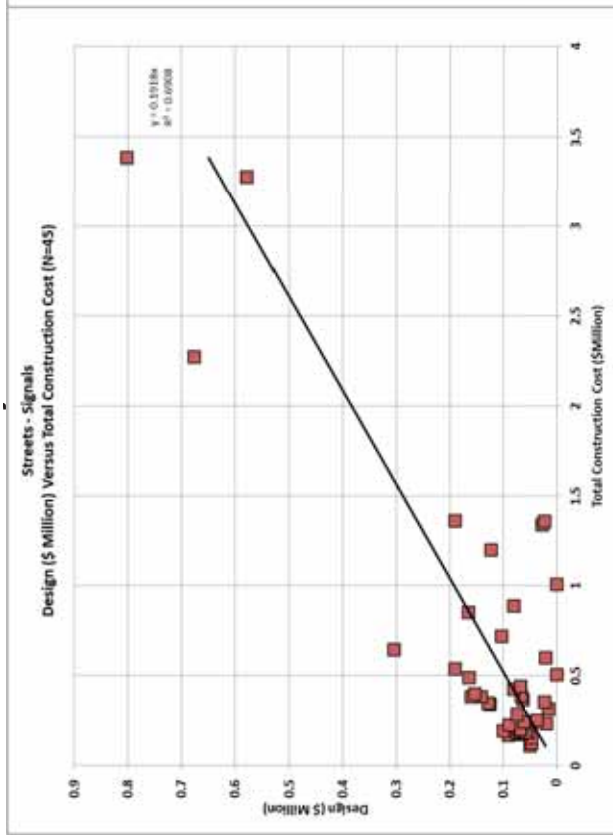
80th Percentile Projects



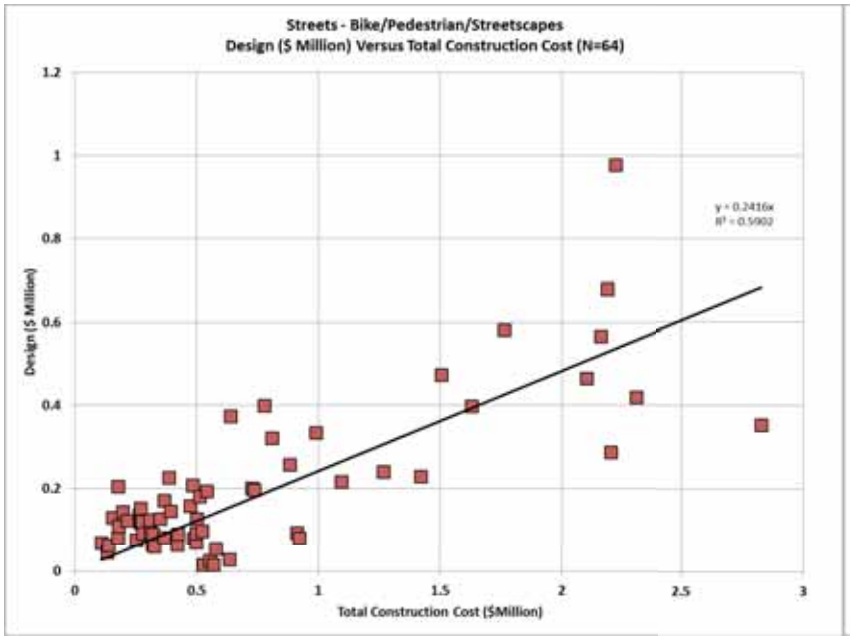
80th Percentile Projects



All Projects



All Projects



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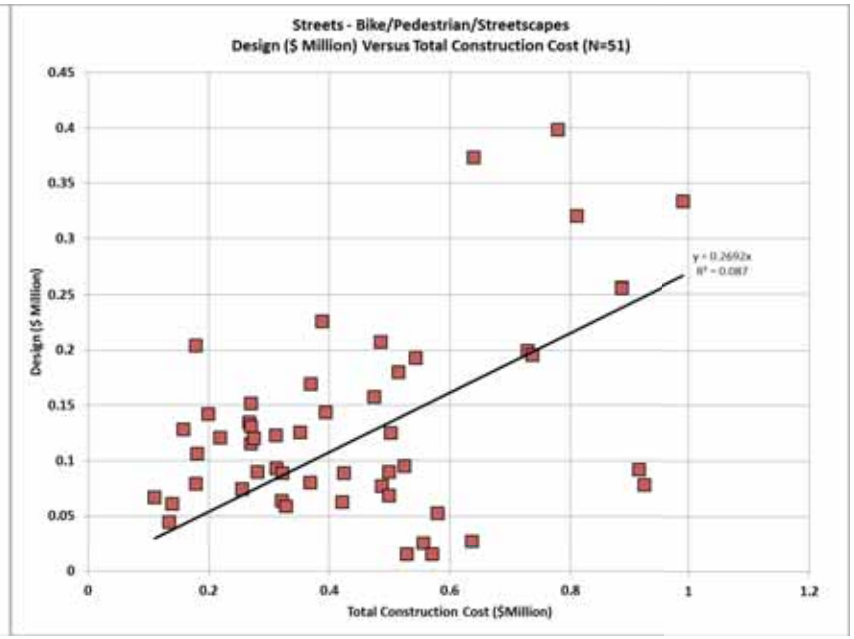

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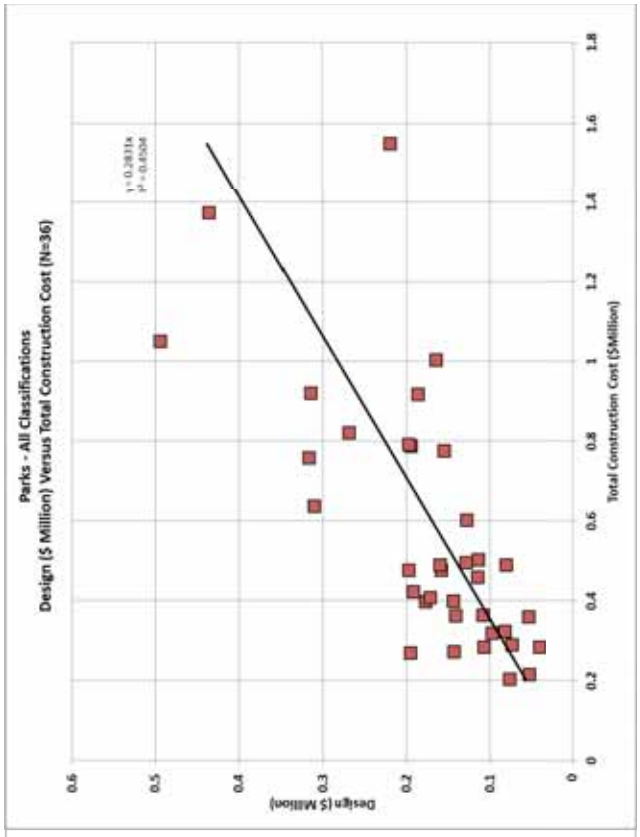
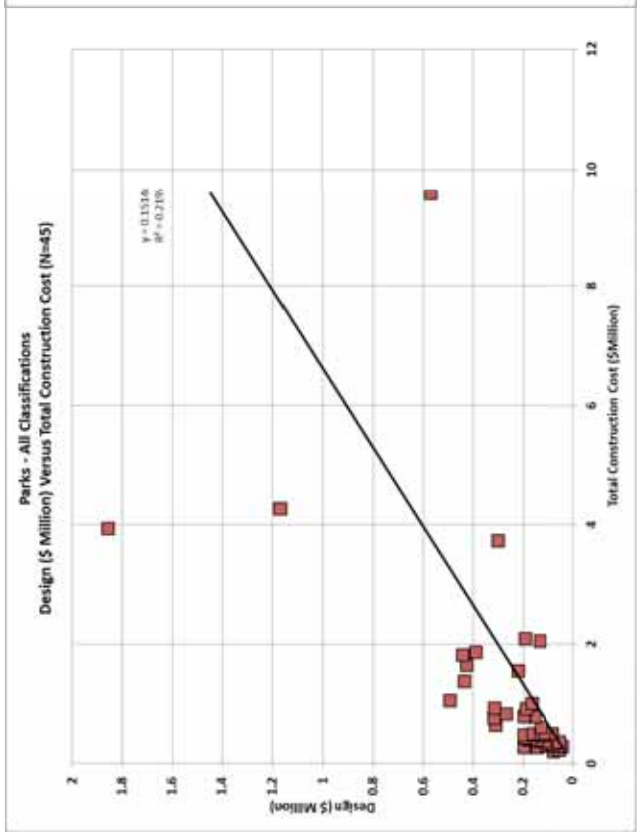
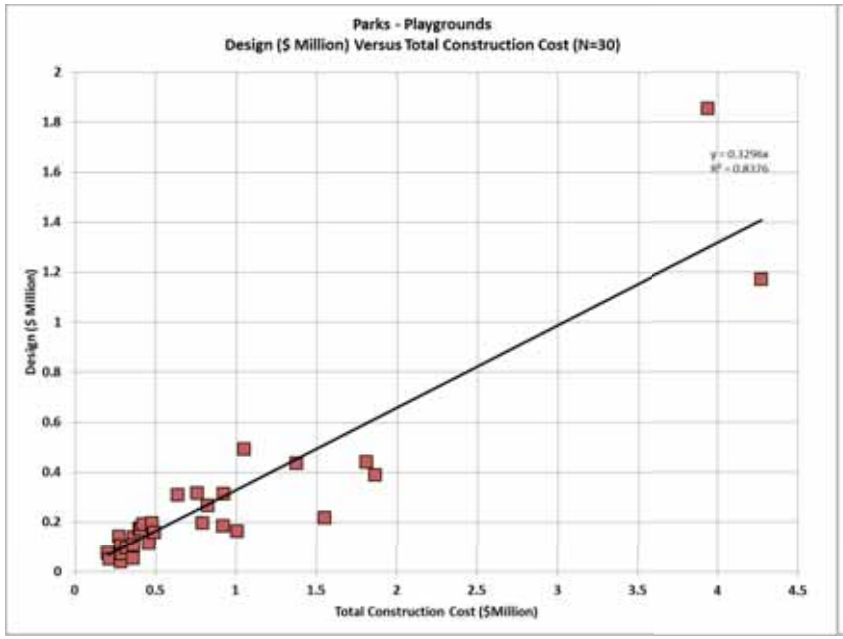


All Projects



All Projects



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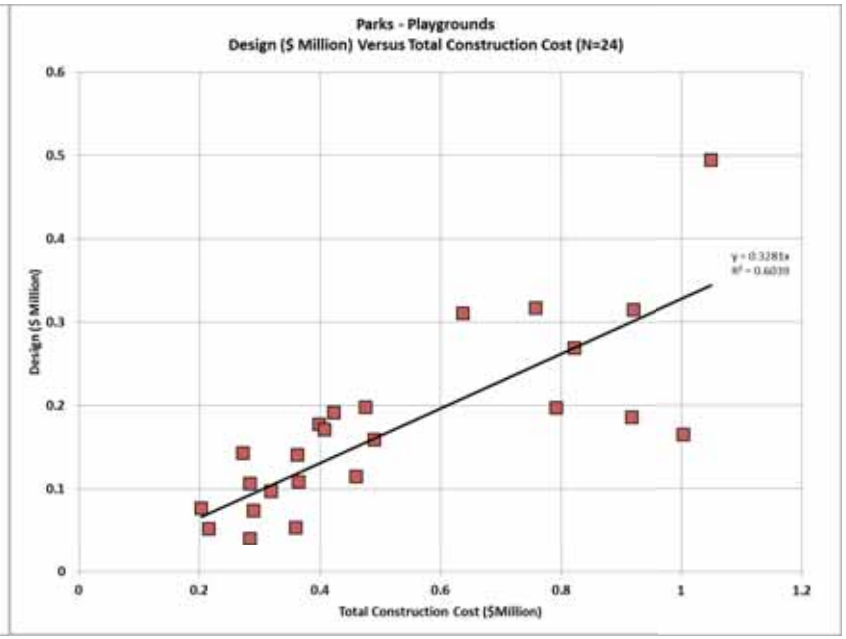

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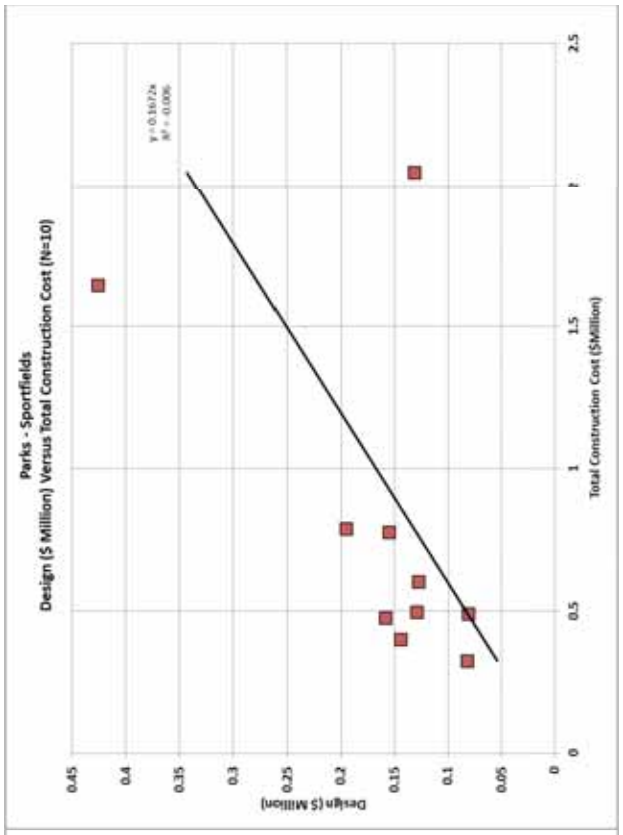
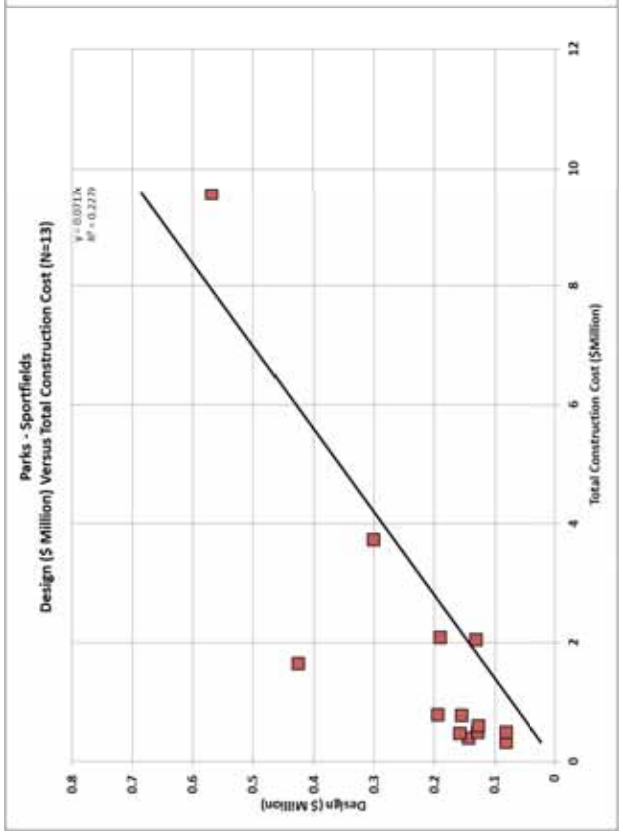
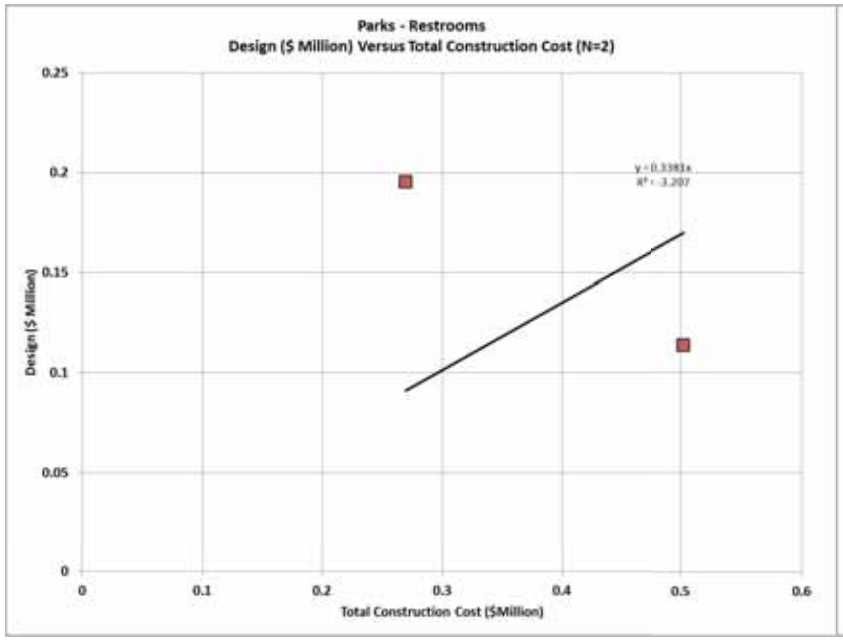


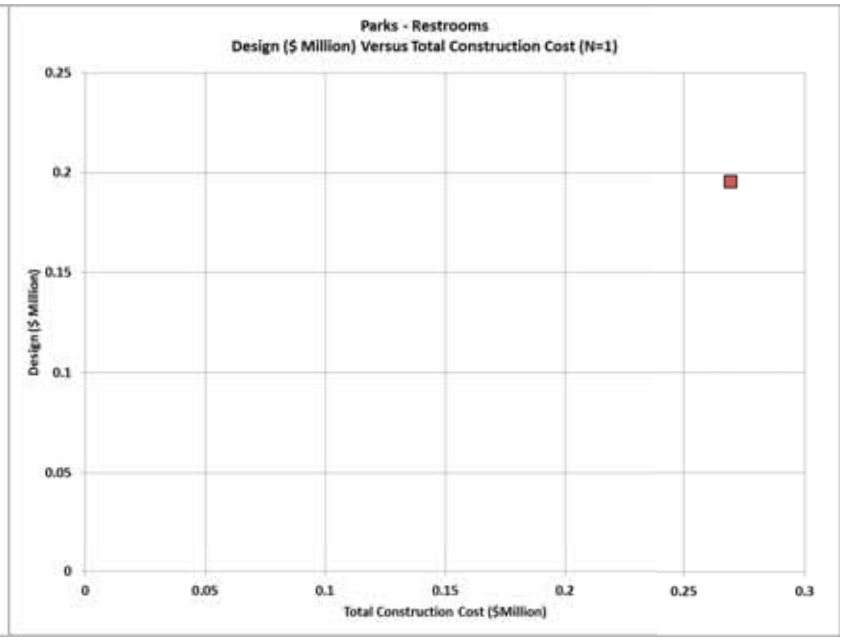
All Projects



All Projects



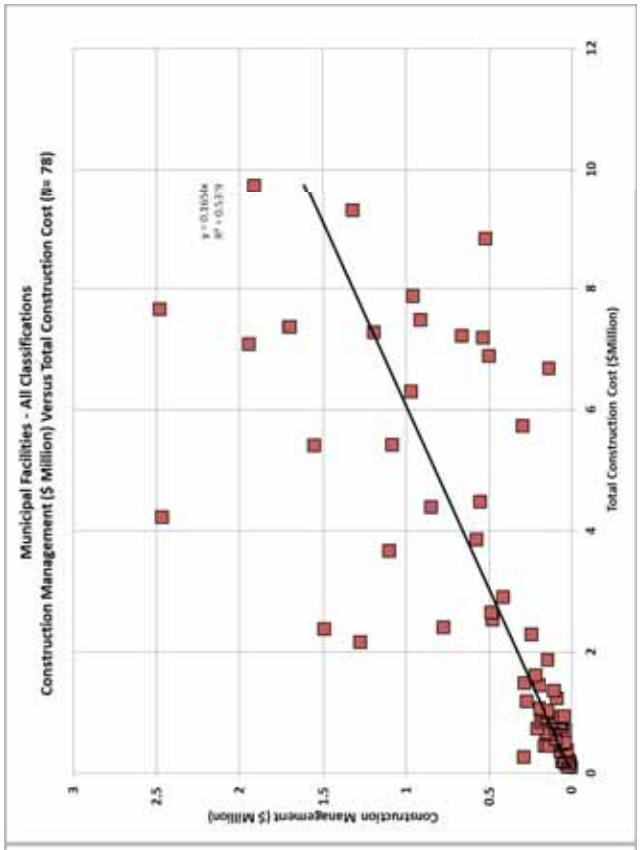
80th Percentile Projects



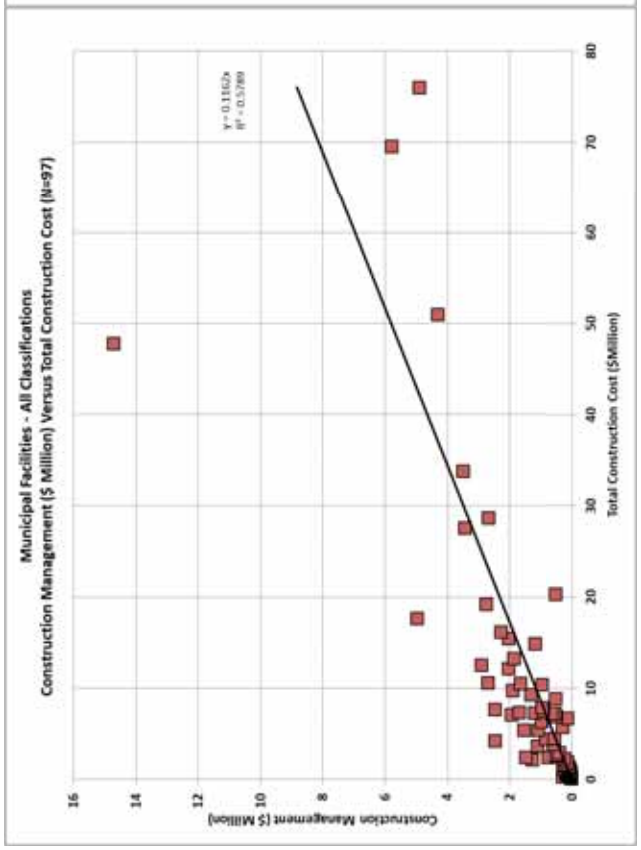
CURVES GROUP 2

Construction Management Cost
vs
Total Construction Cost

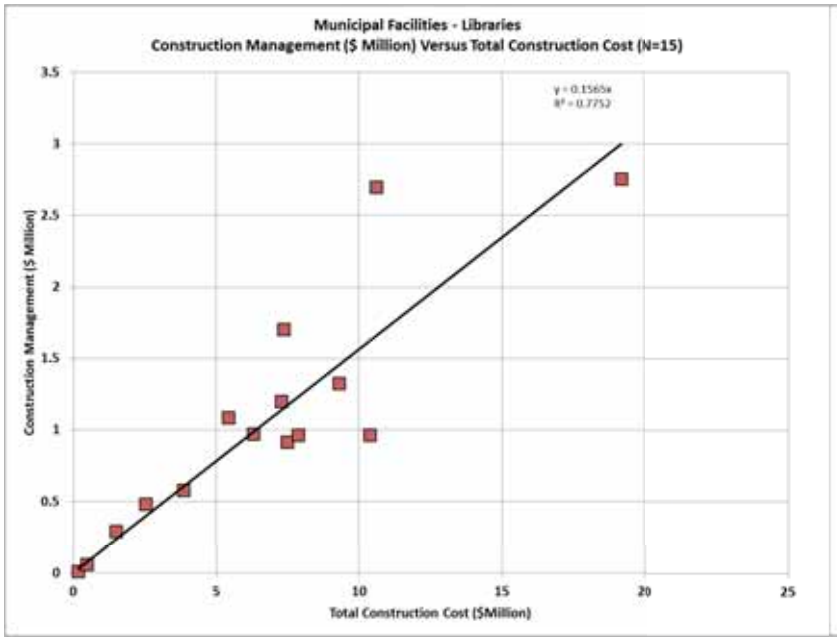
80th Percentile Projects



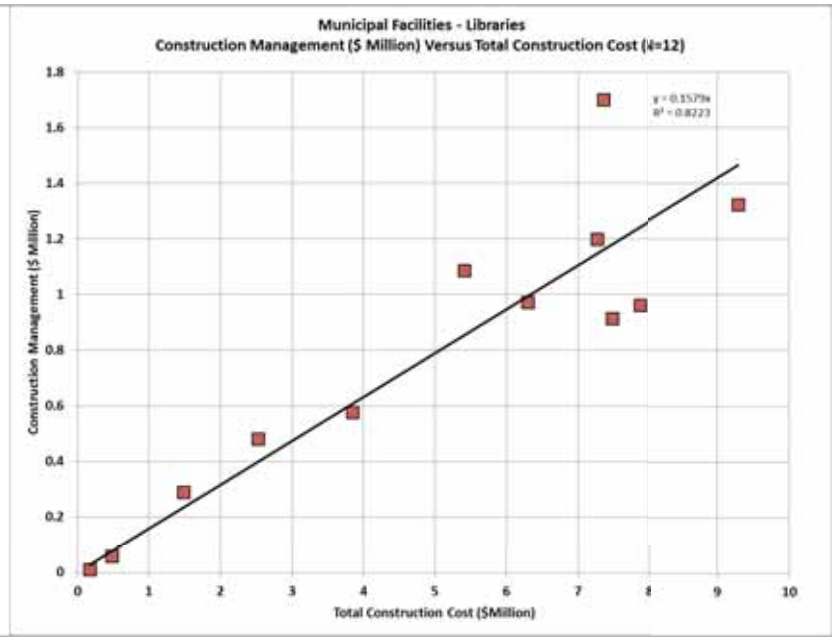
All Projects



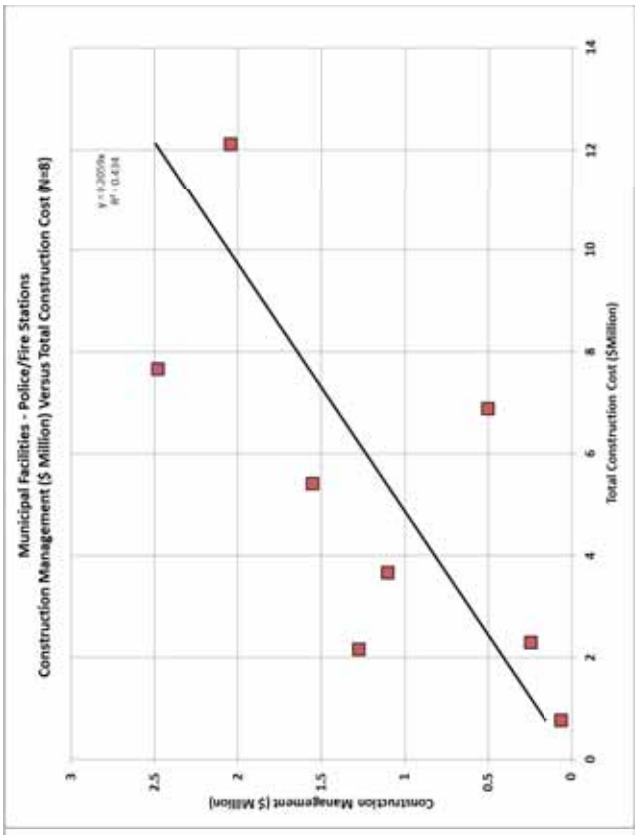
All Projects



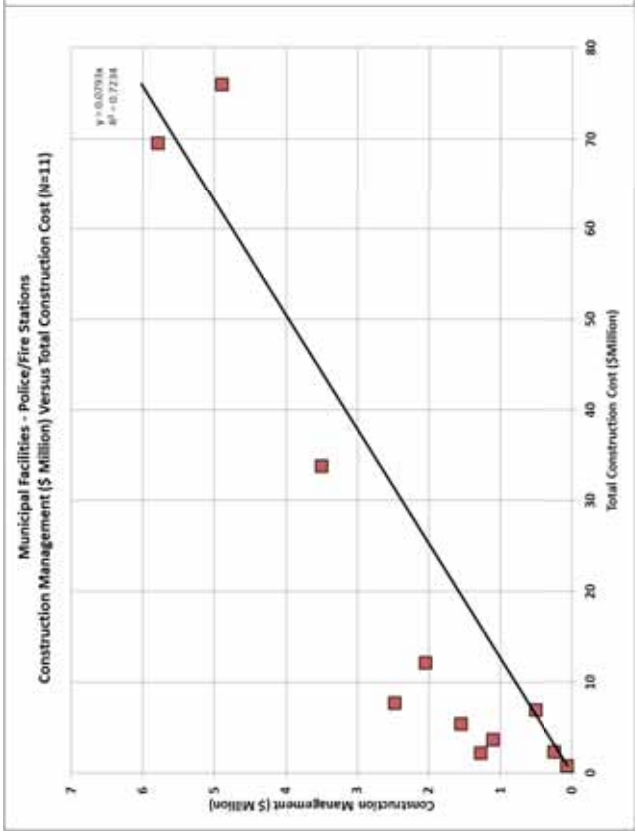
80th Percentile Projects



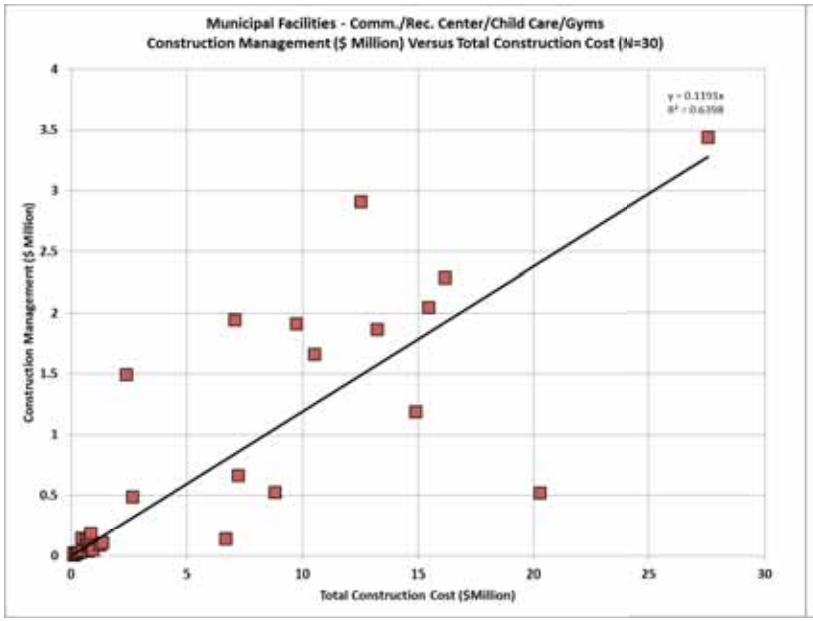
80th Percentile Projects



All Projects



All Projects



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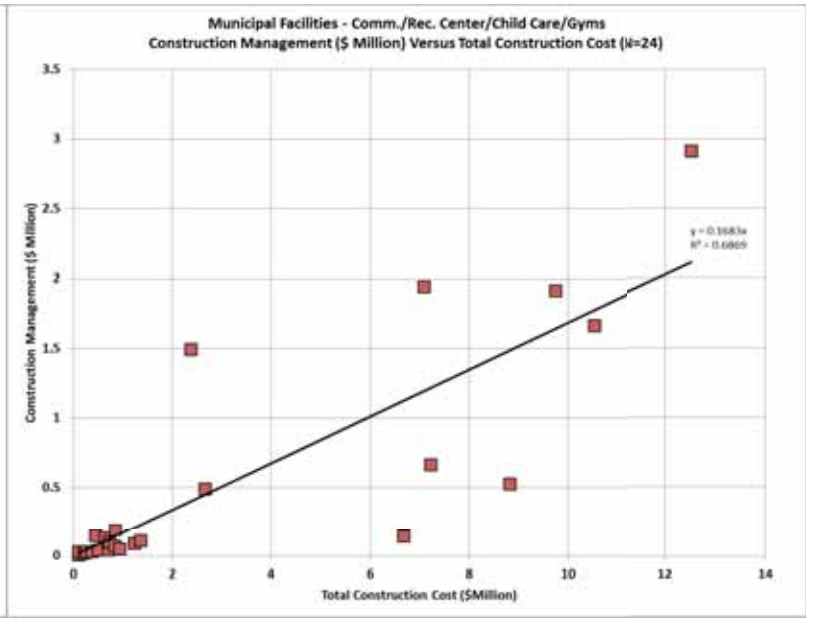
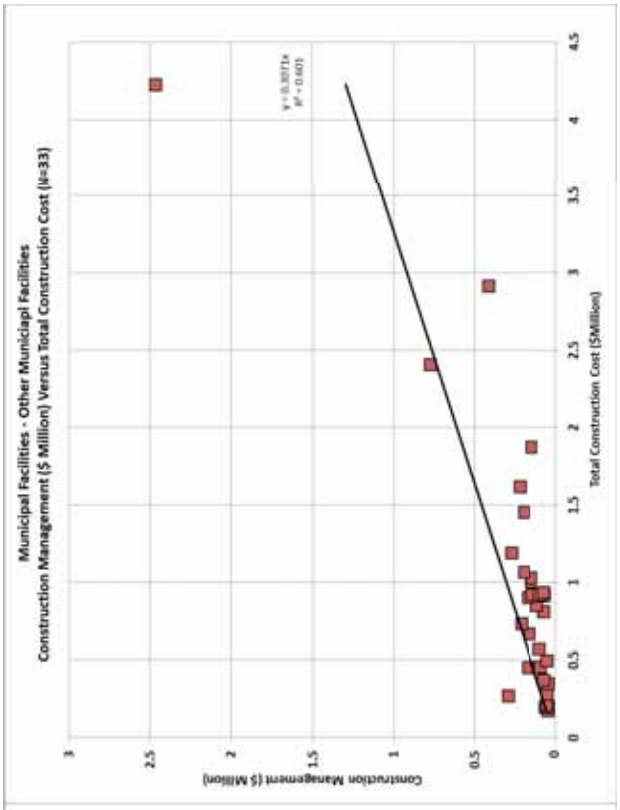
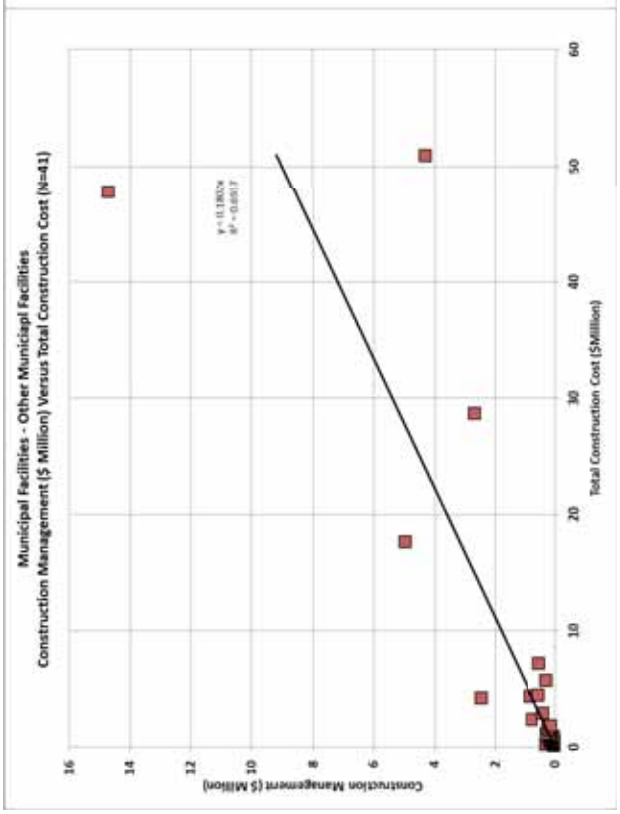
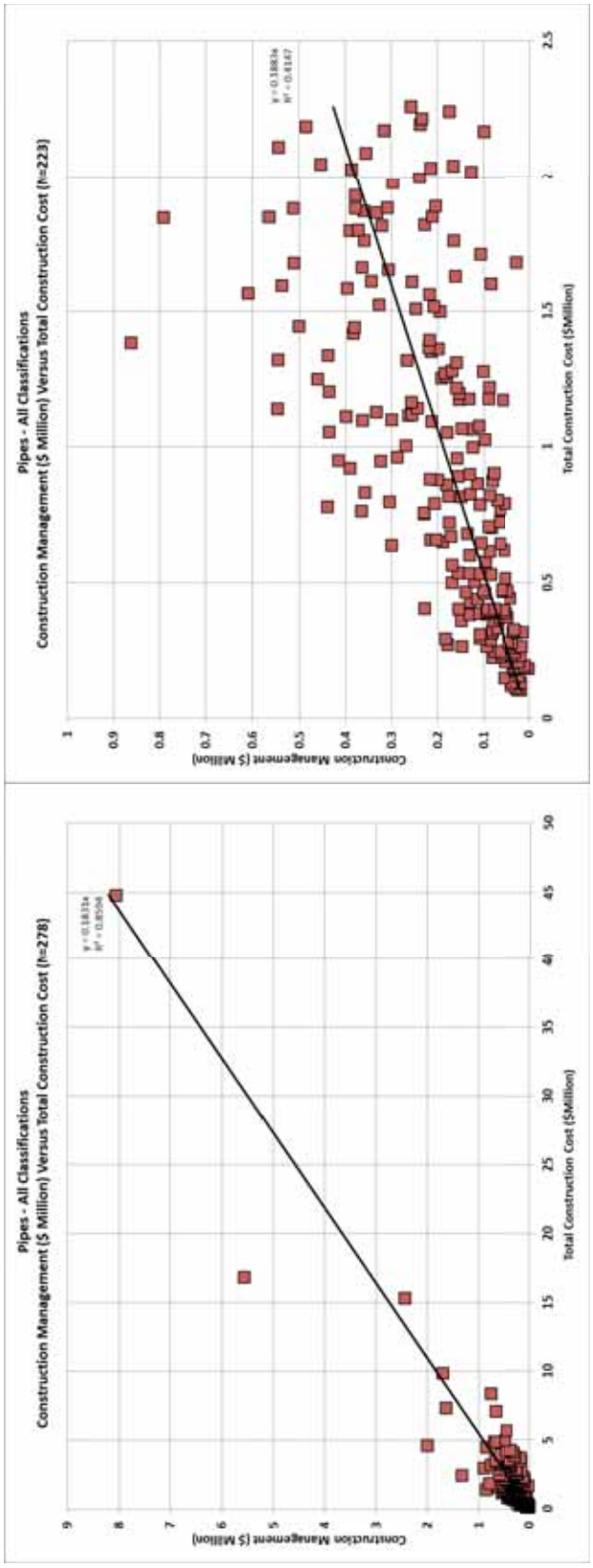


80th Percentile Projects

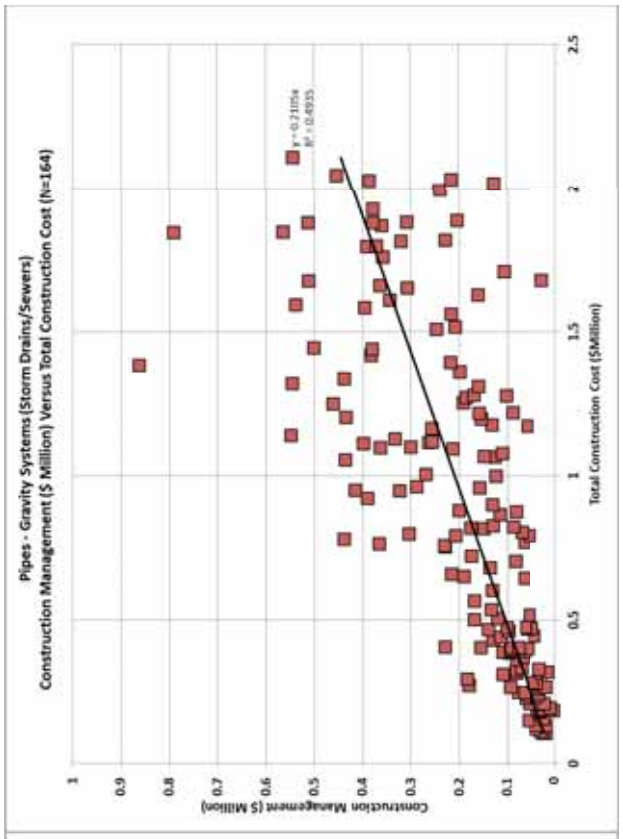


All Projects

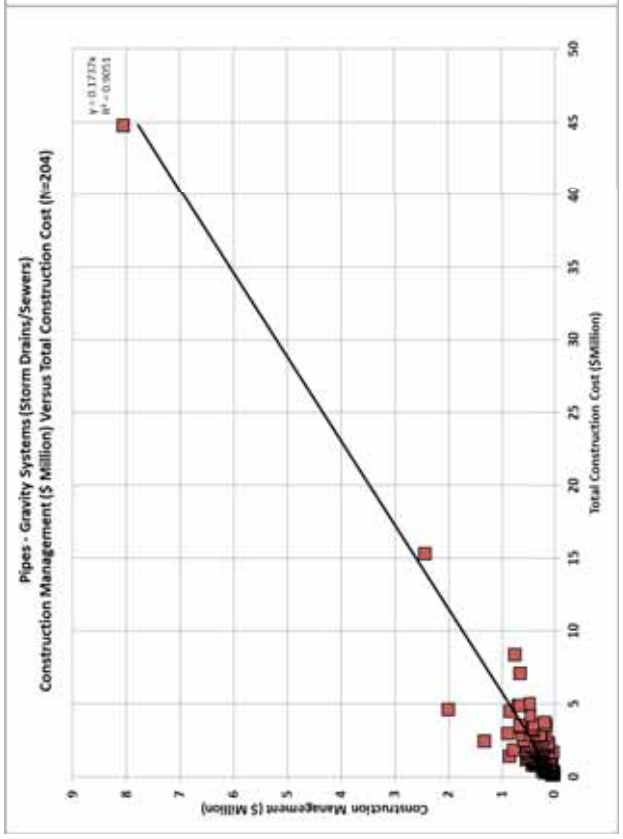



80th Percentile Projects
Pipes - All Classifications
Construction Management ($ Million) Versus Total Construction Cost (n=223)
Construction Management ($ Million)
Total Construction Cost ($Million)
All Projects
Pipes - All Classifications
Construction Management ($ Million) Versus Total Construction Cost (n=278)
Construction Management ($ Million)
Total Construction Cost ($Million)

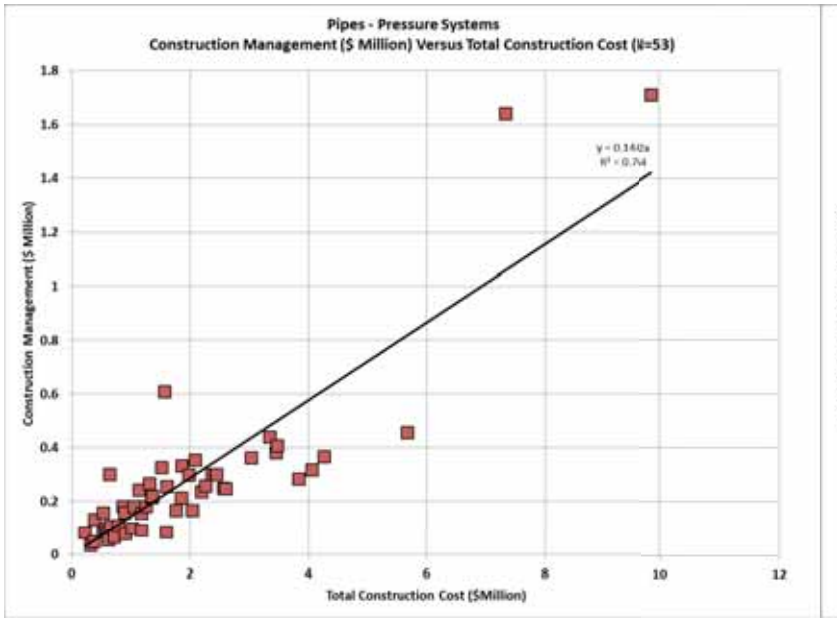
80th Percentile Projects



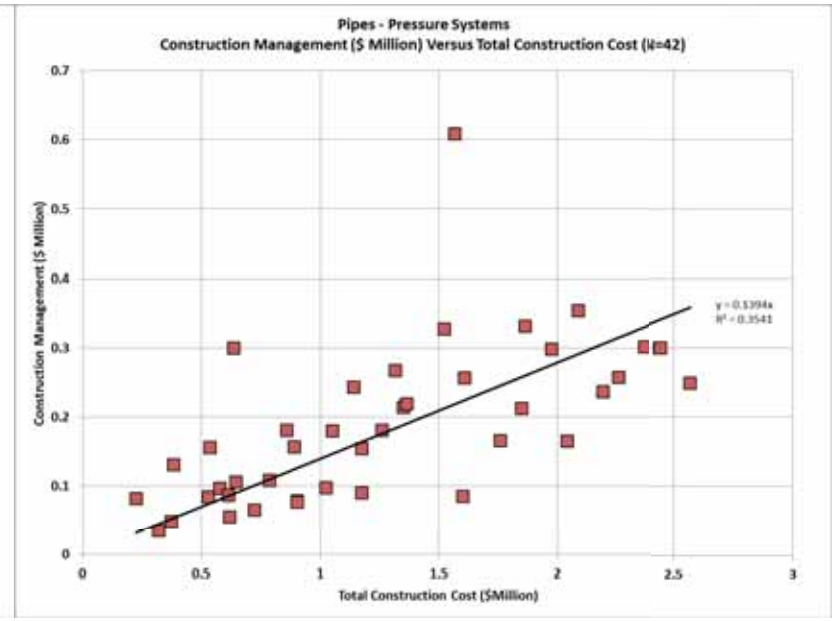
All Projects



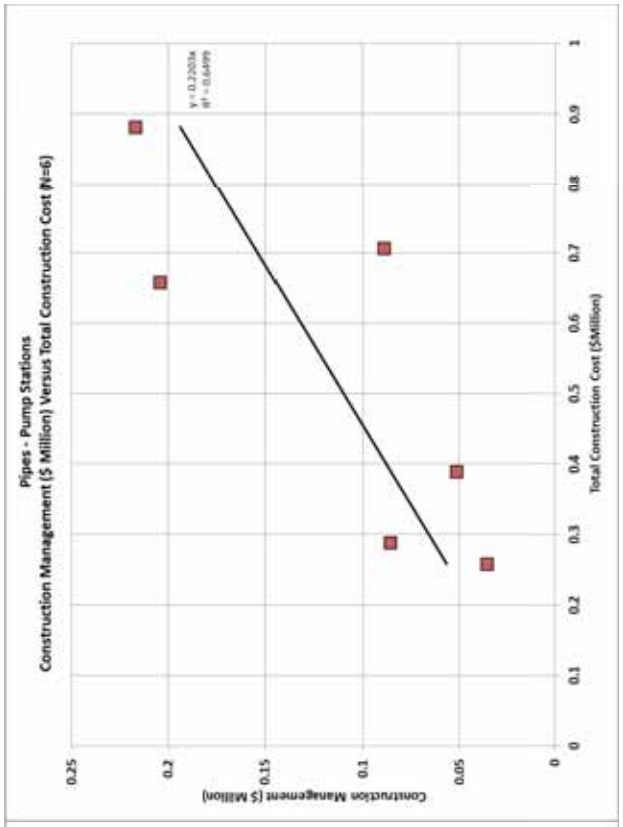
All Projects



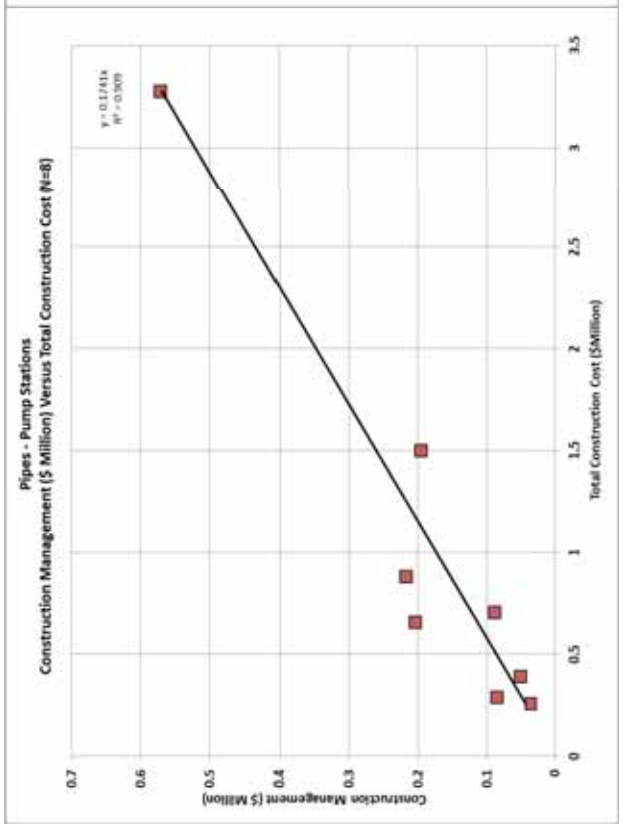
80th Percentile Projects



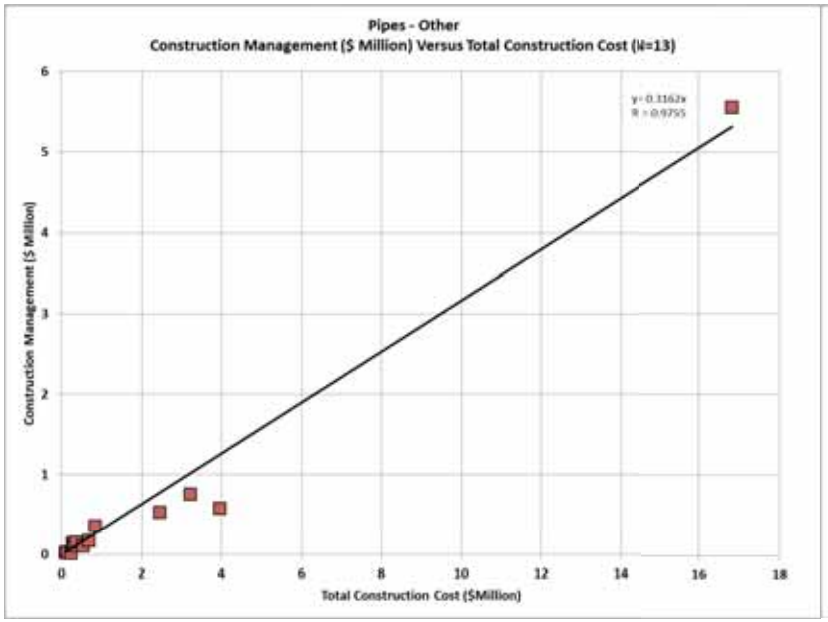
80th Percentile Projects



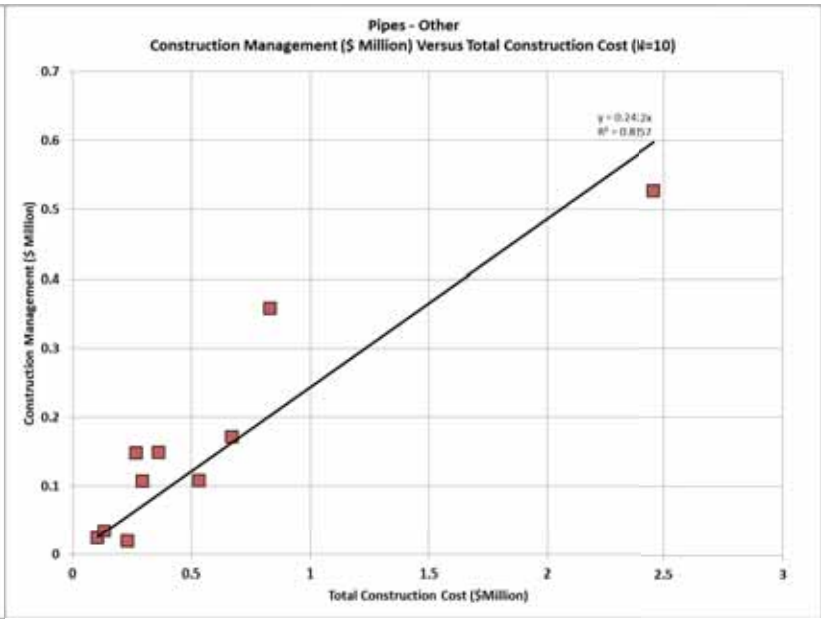
All Projects



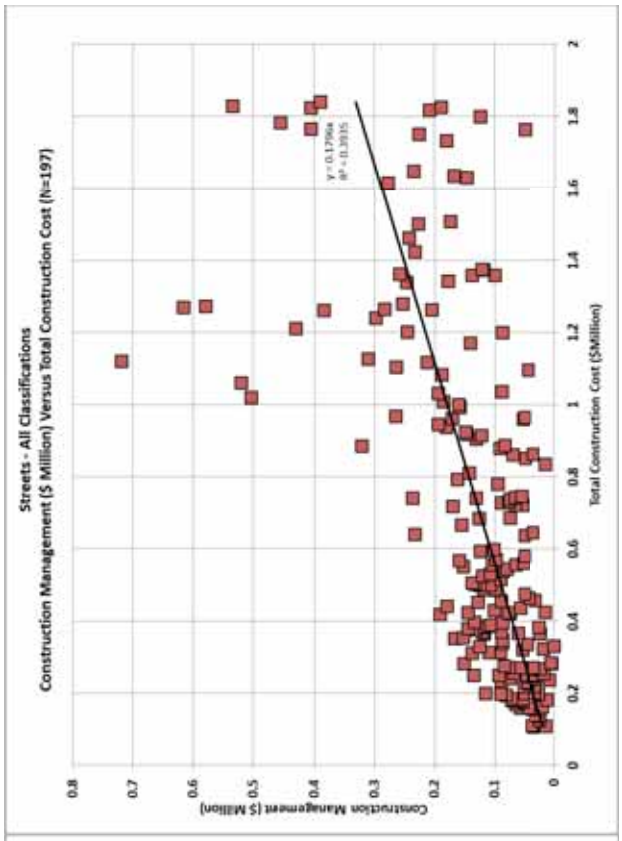
All Projects



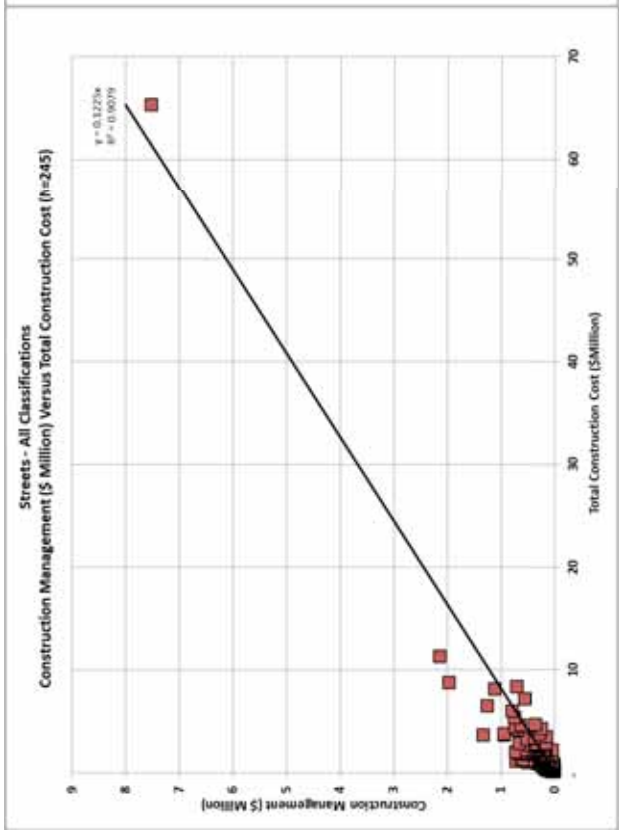
80th Percentile Projects



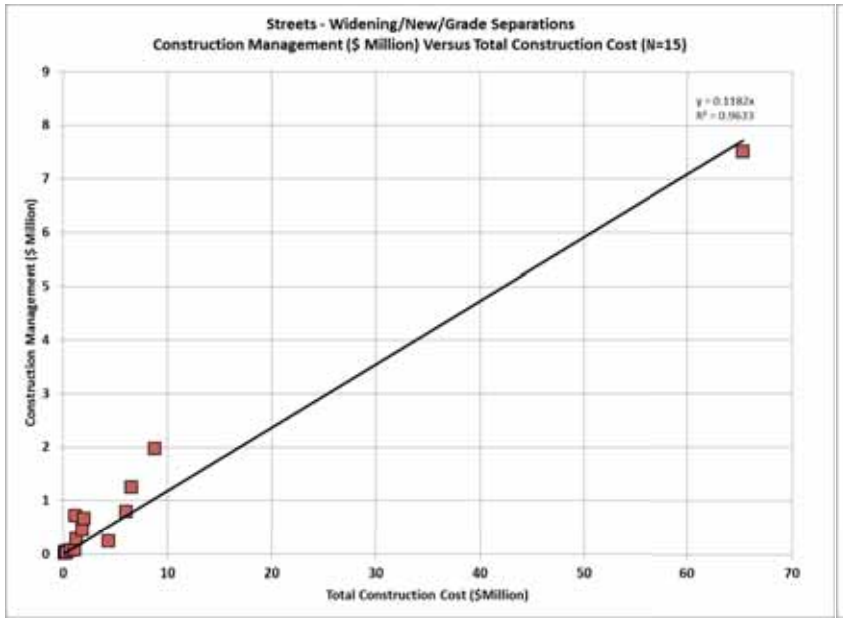
80th Percentile Projects



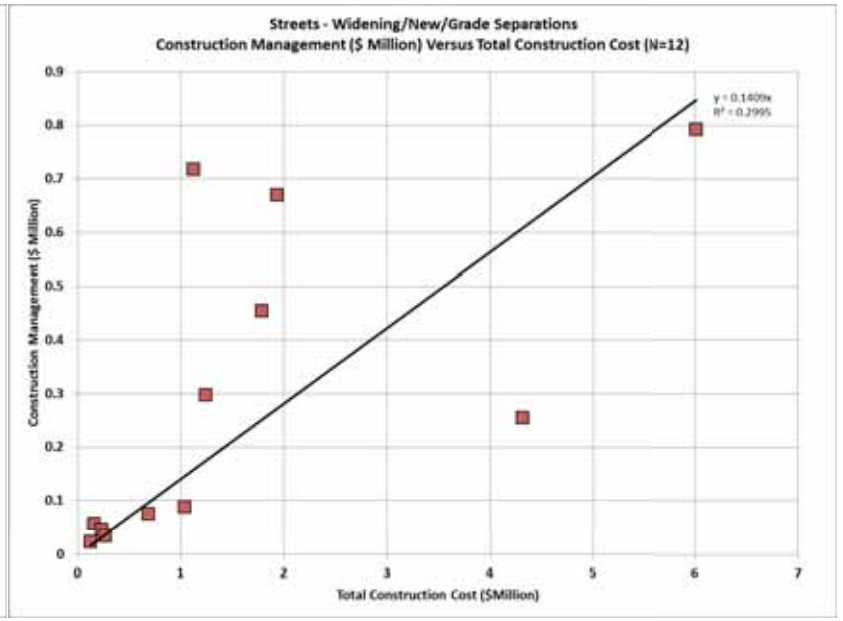
All Projects



All Projects



80th Percentile Projects



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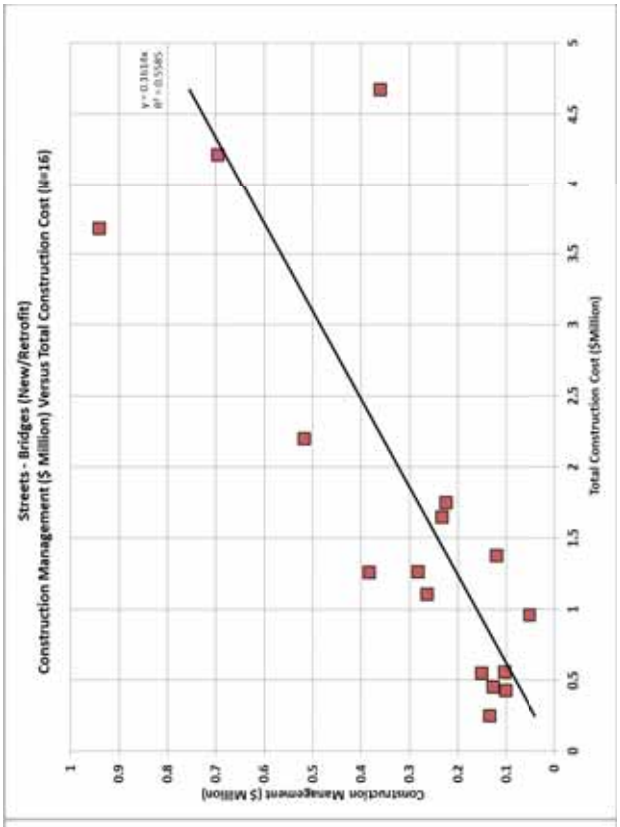

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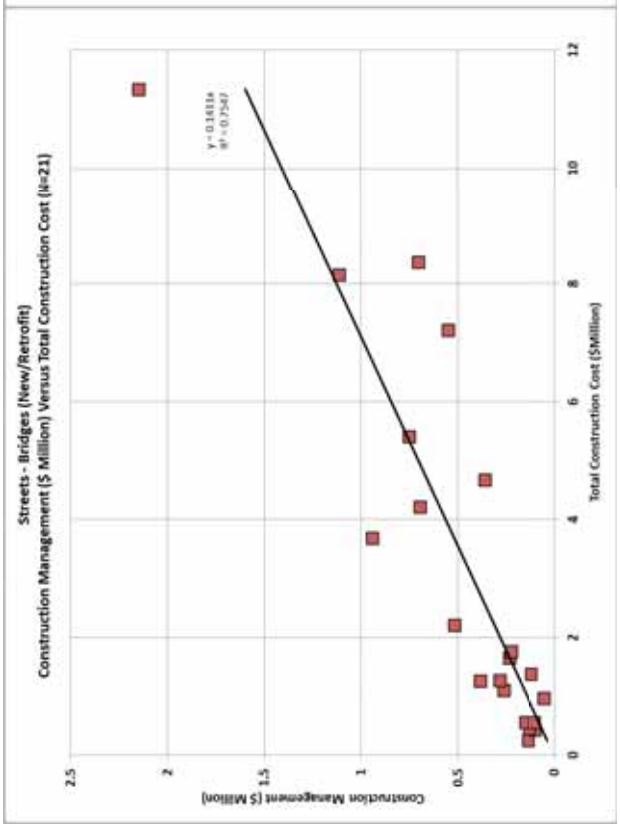

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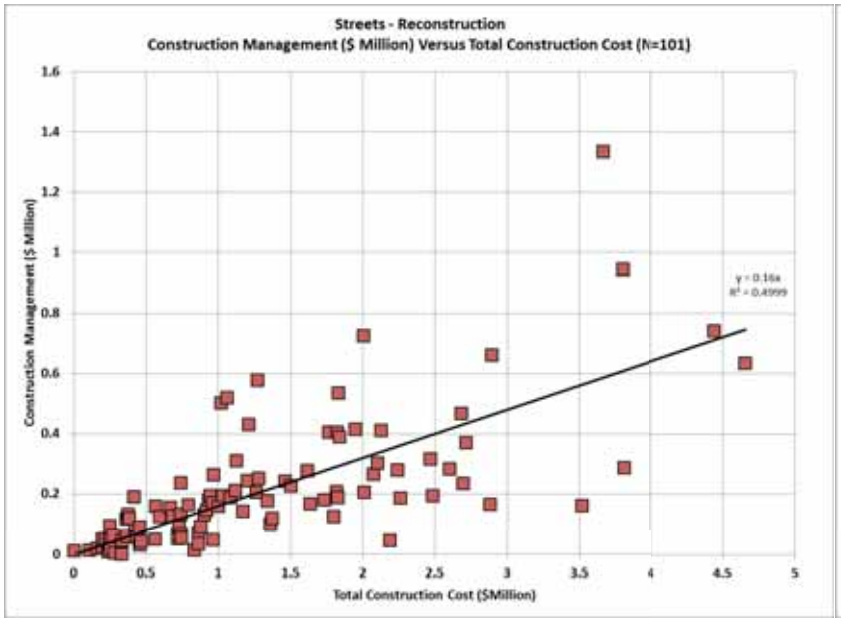

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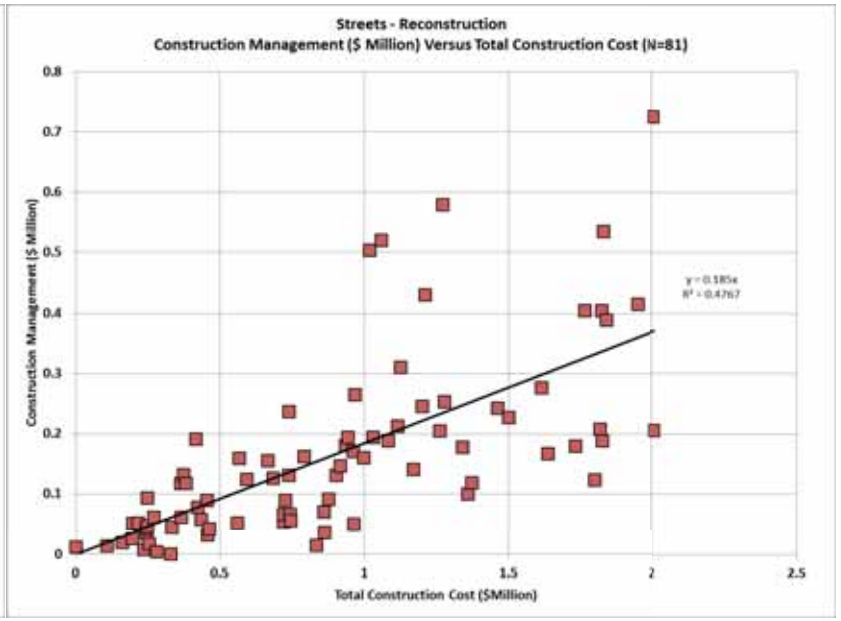

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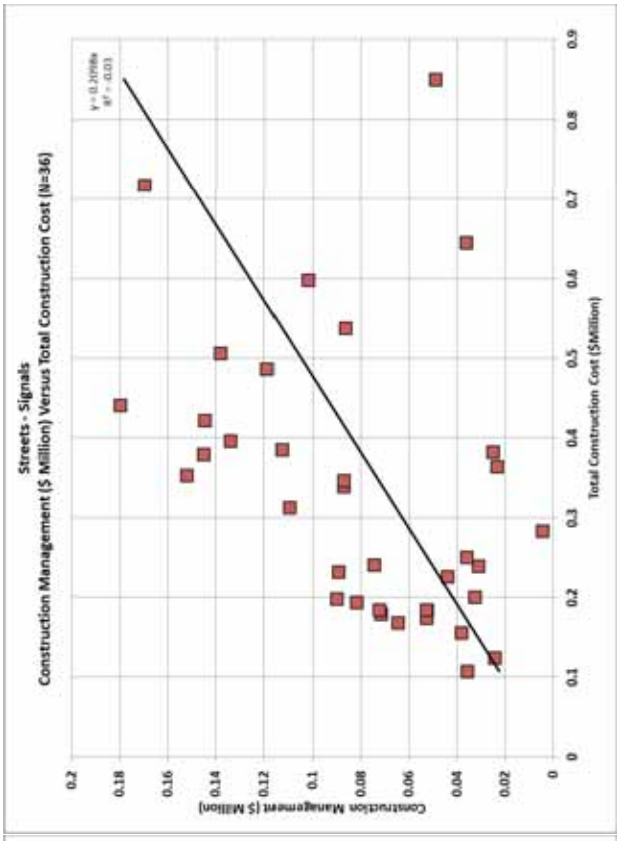

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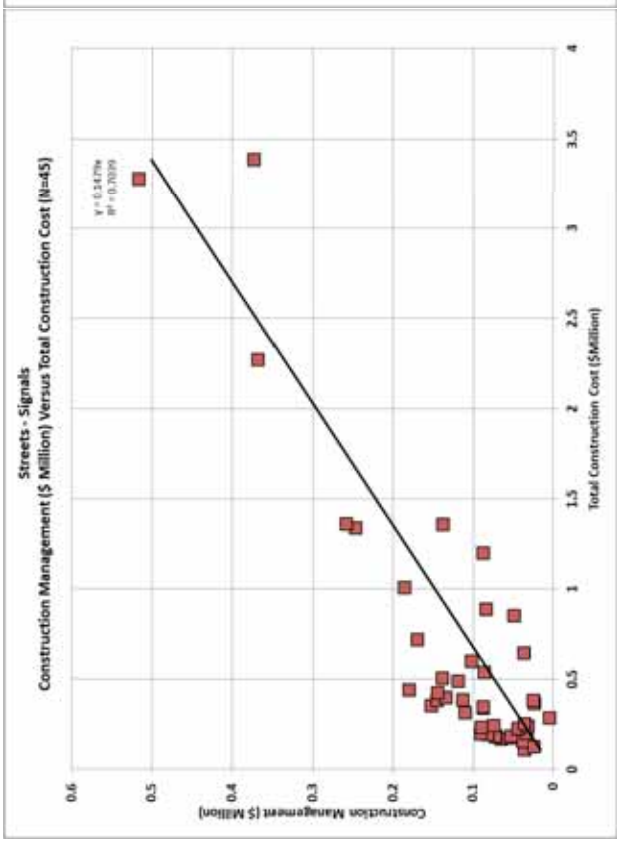

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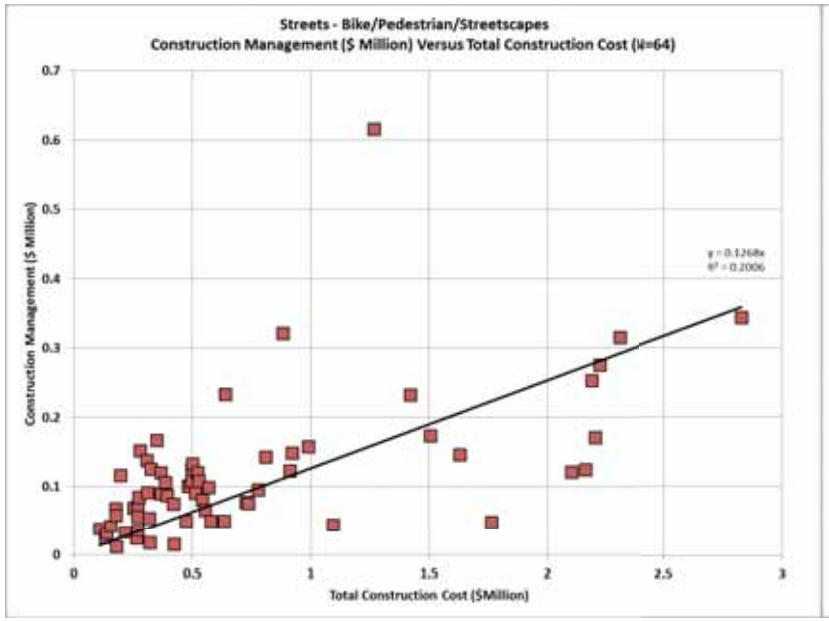

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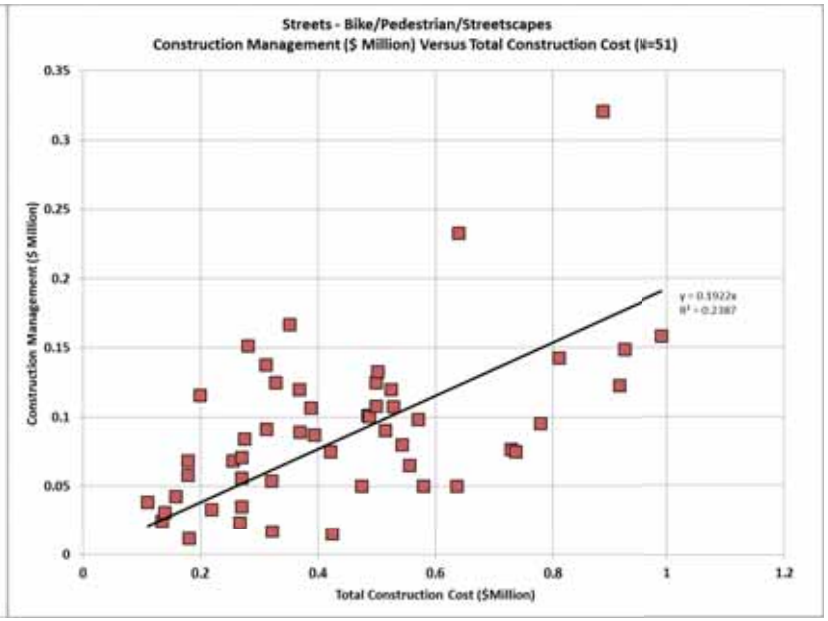

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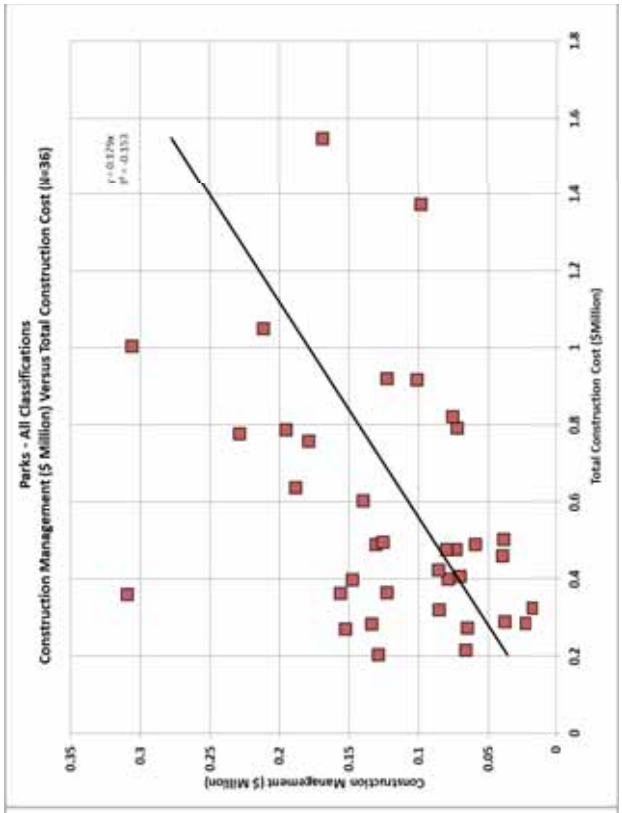

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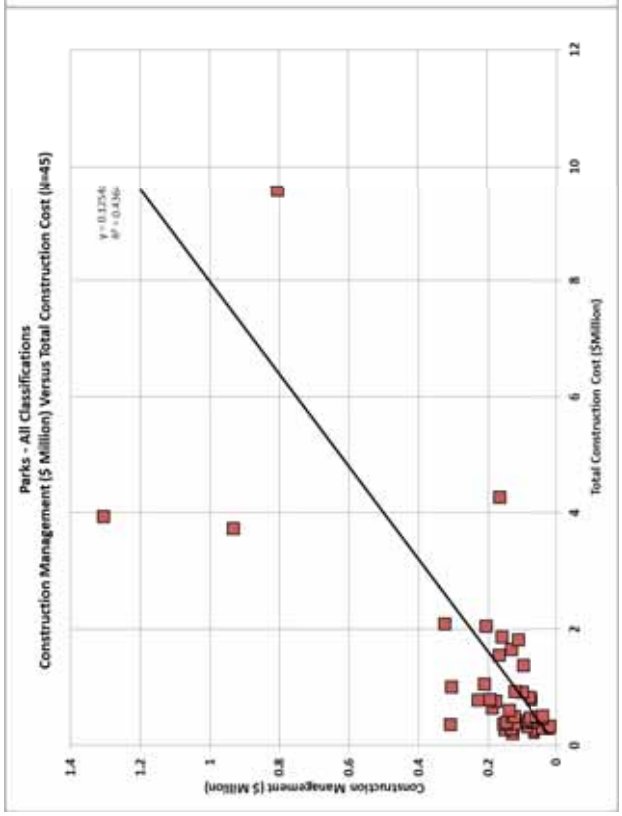

All Projects

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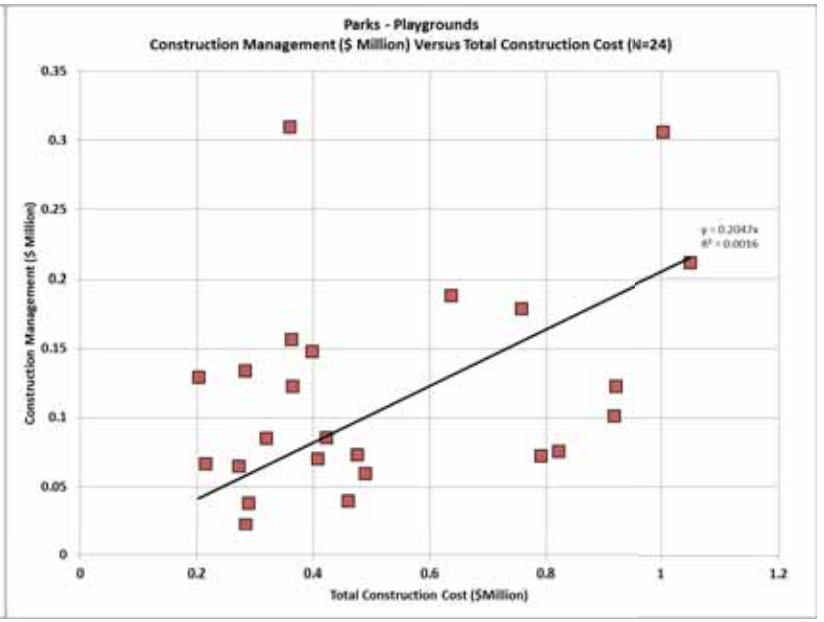

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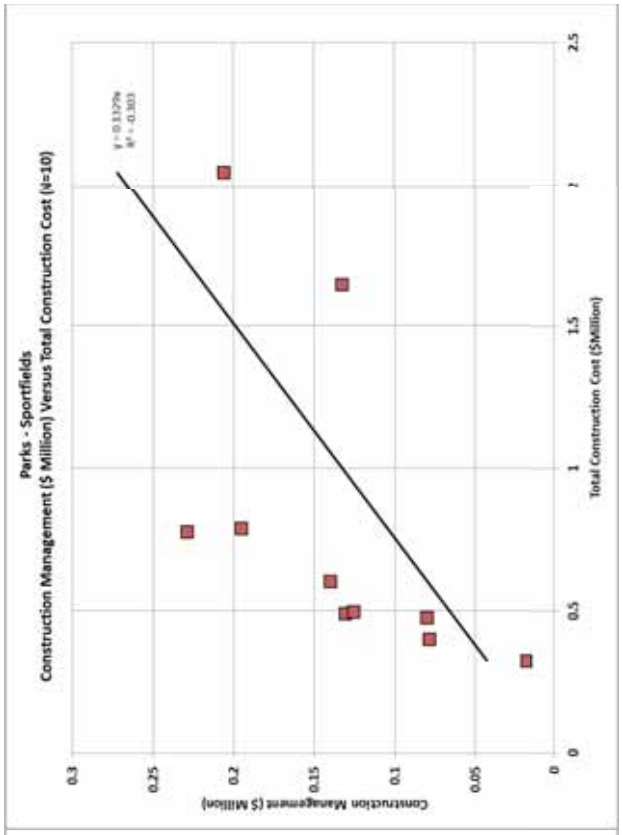

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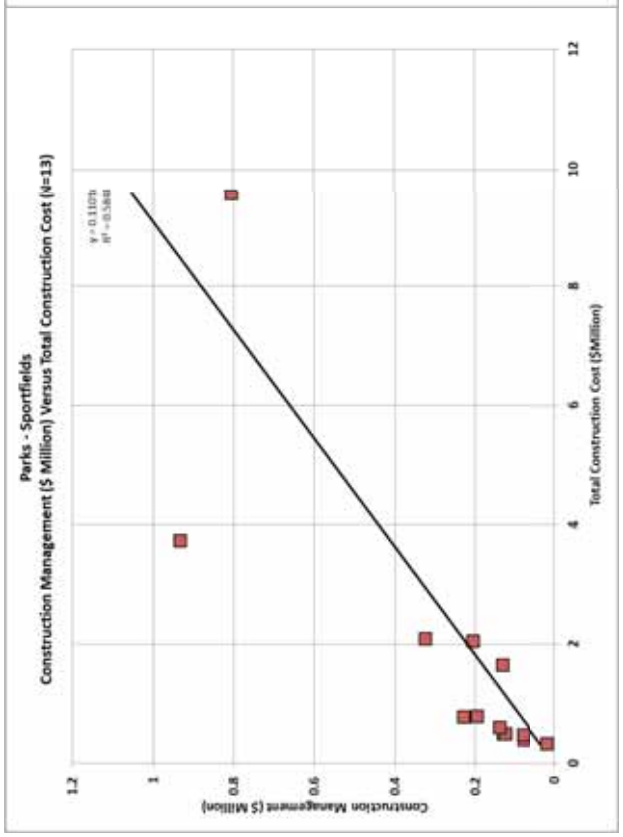

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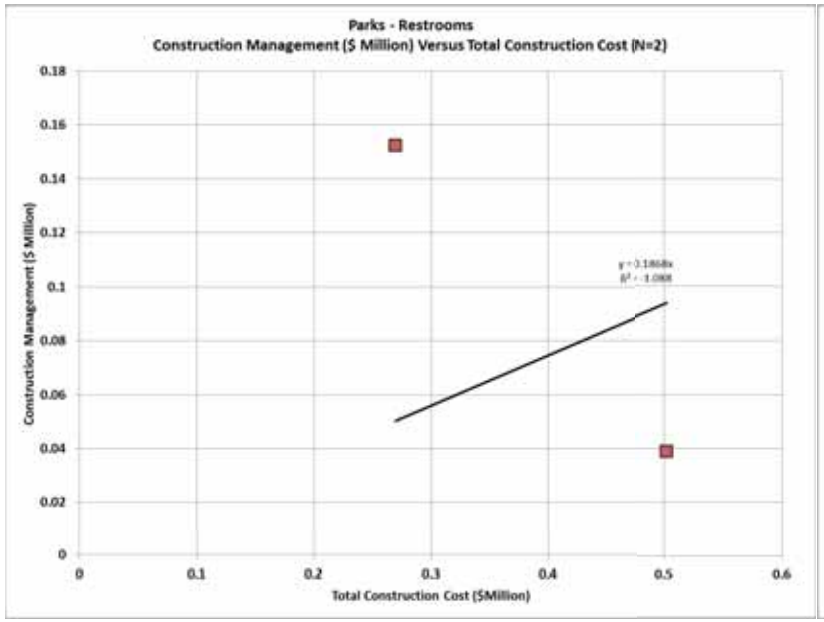

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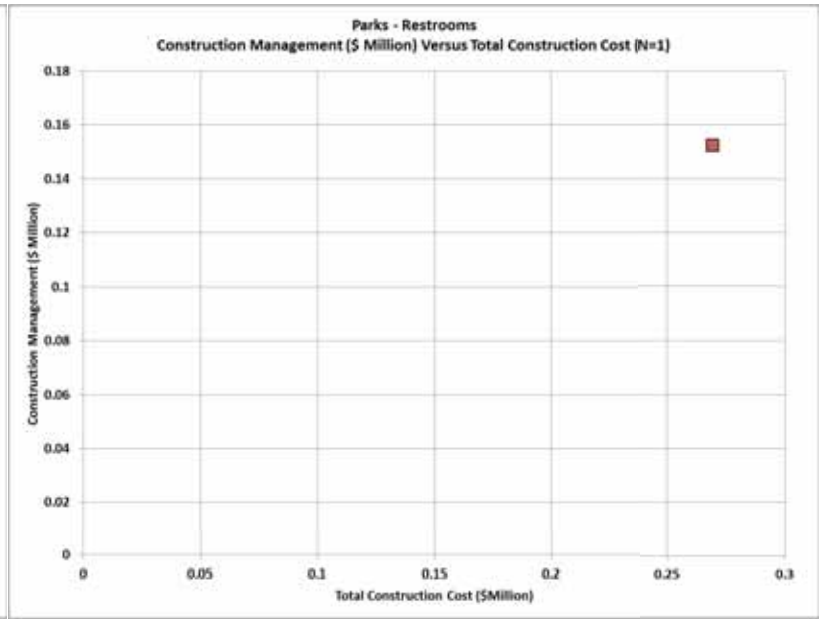
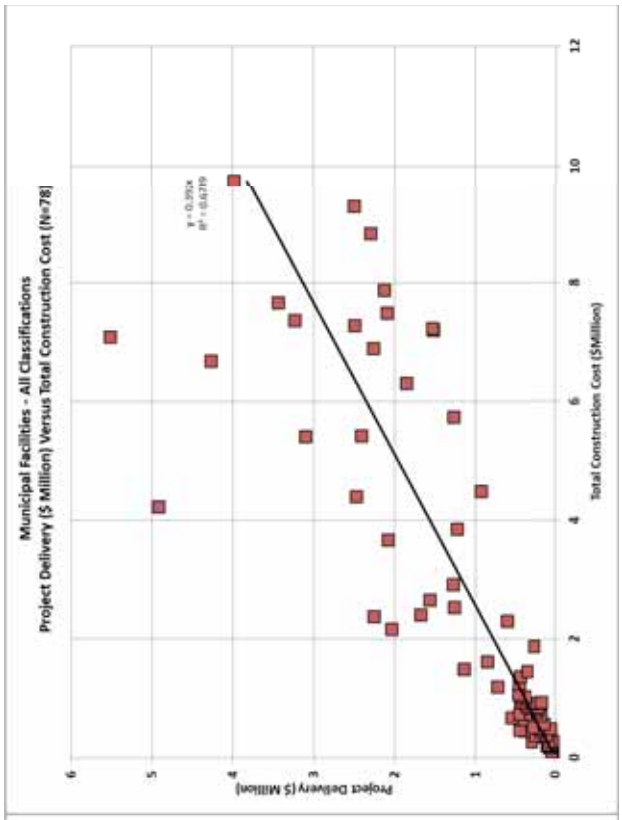


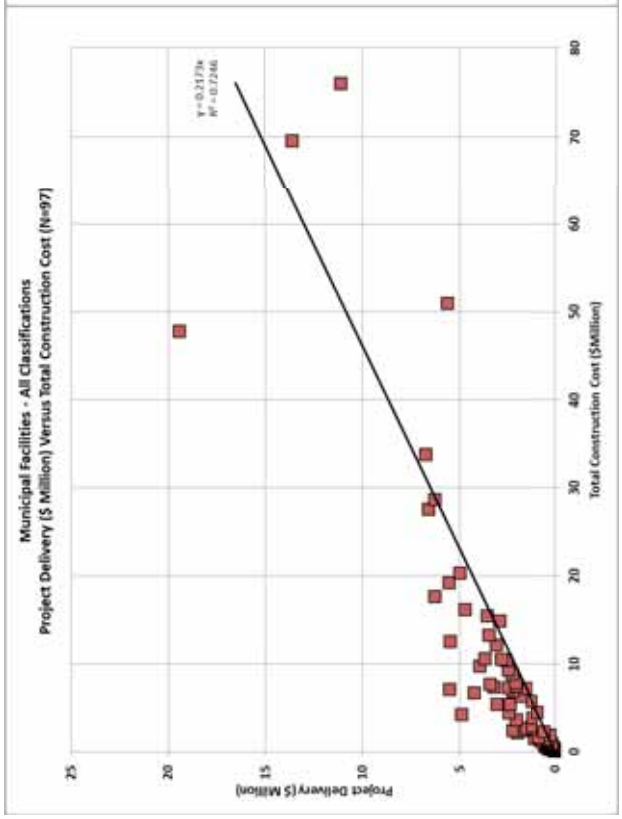
CURVES GROUP 3

Project Delivery Cost
vs
Total Construction Cost

80th Percentile Projects



All Projects



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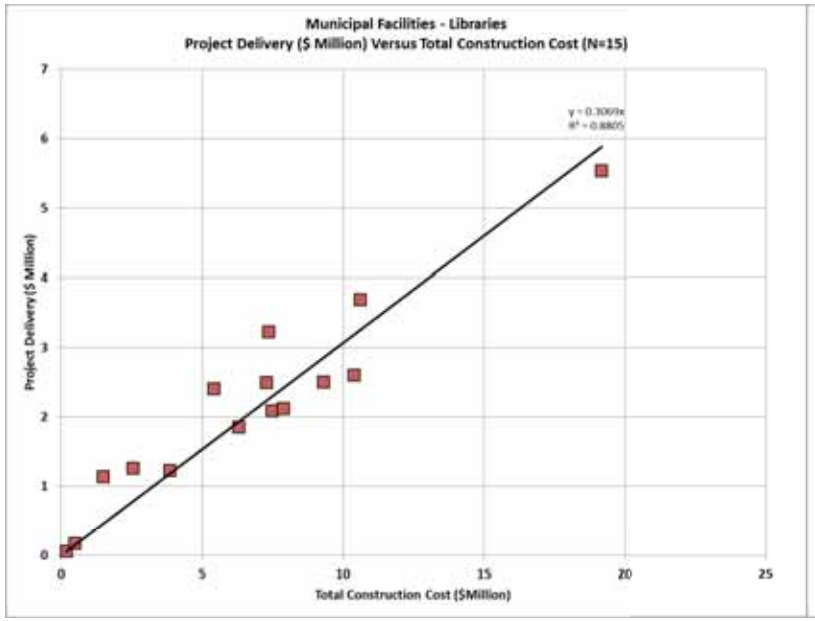

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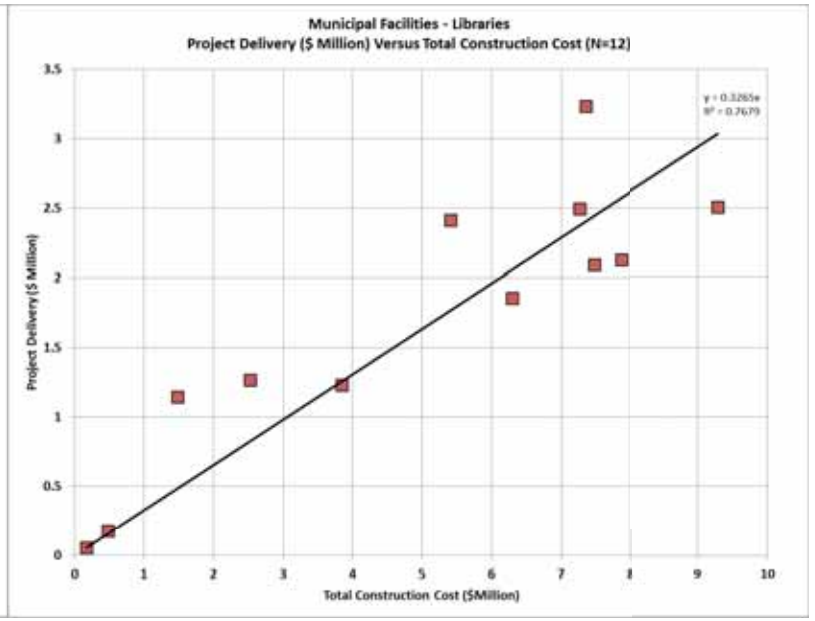

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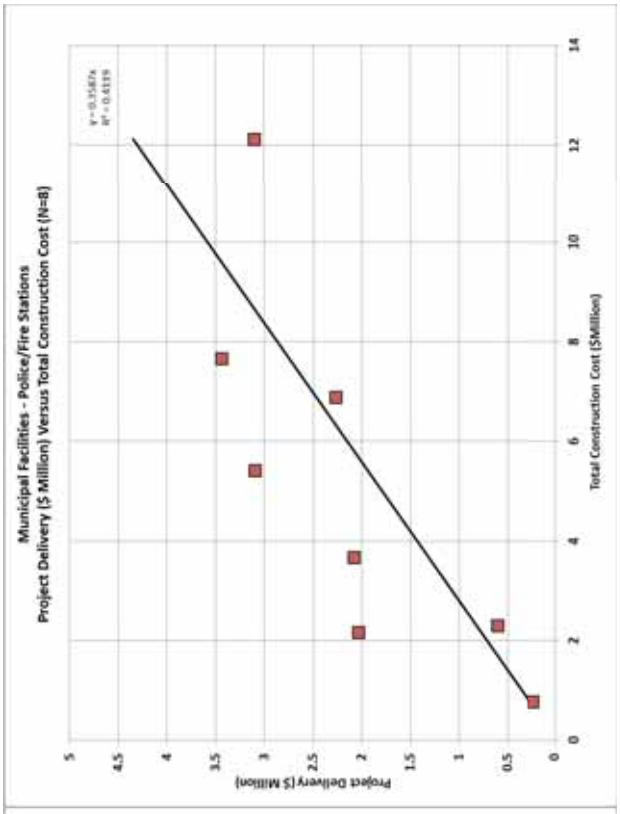

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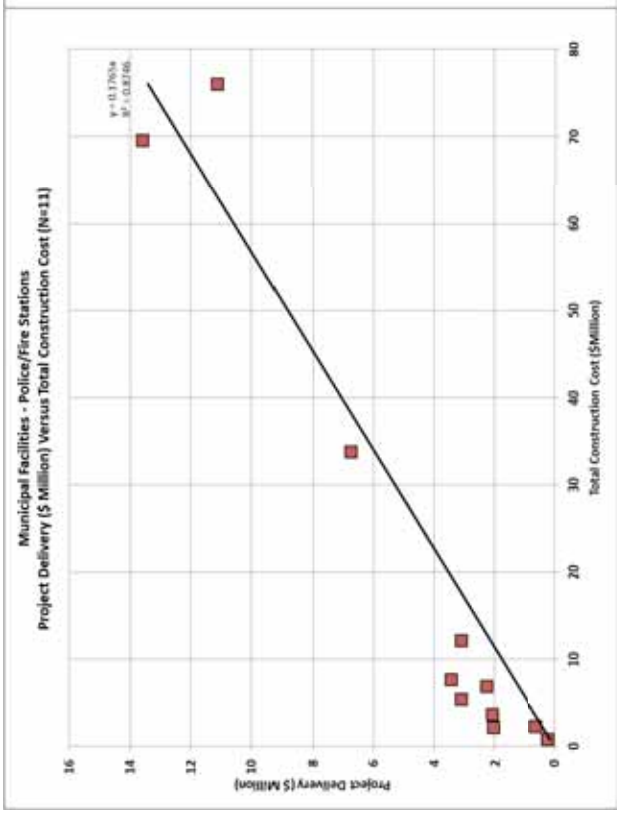

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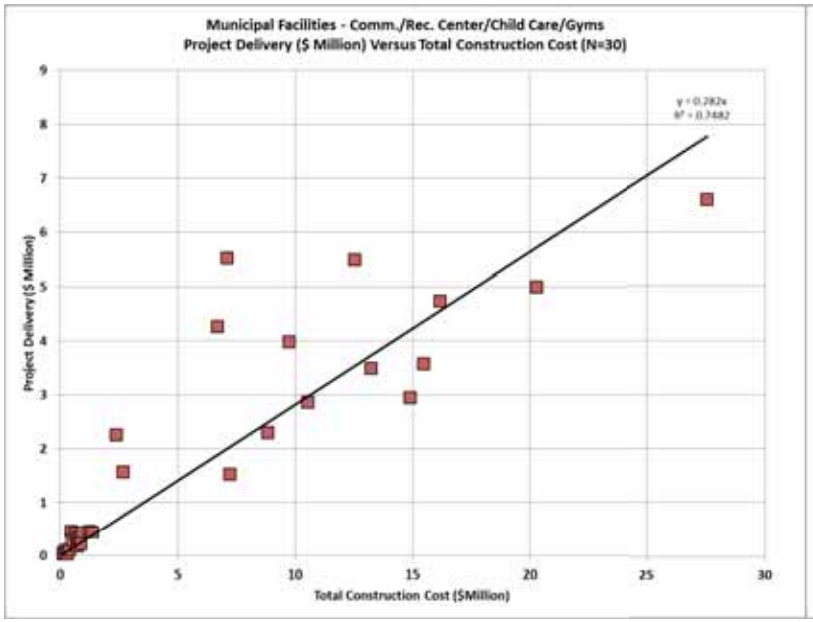

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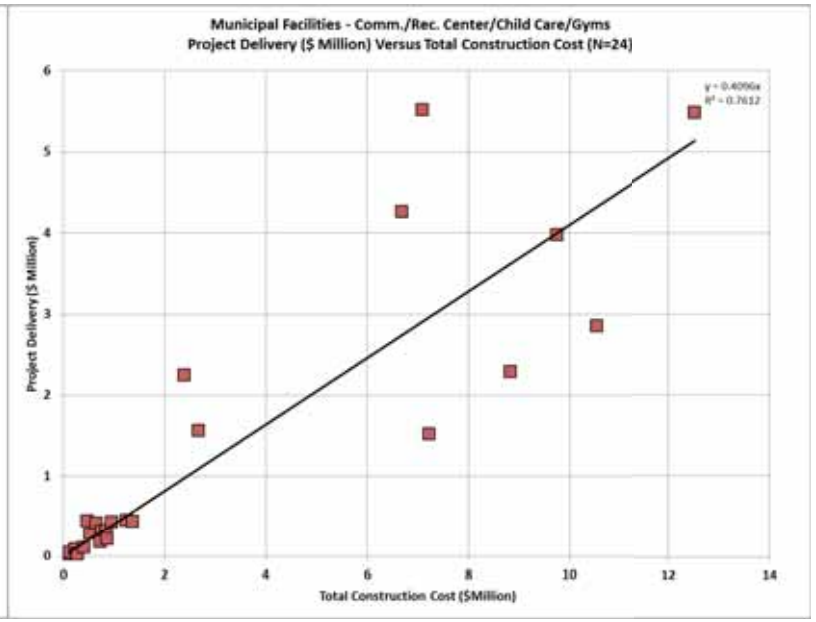

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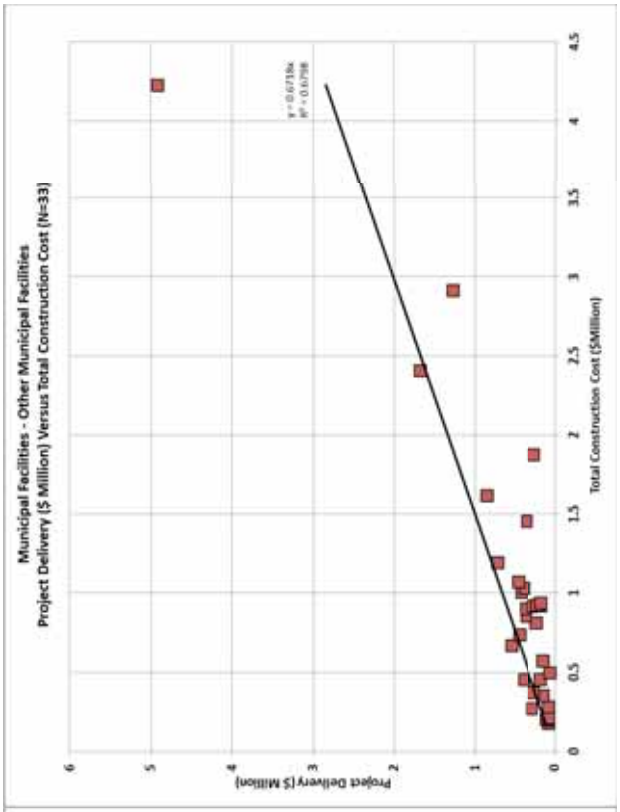

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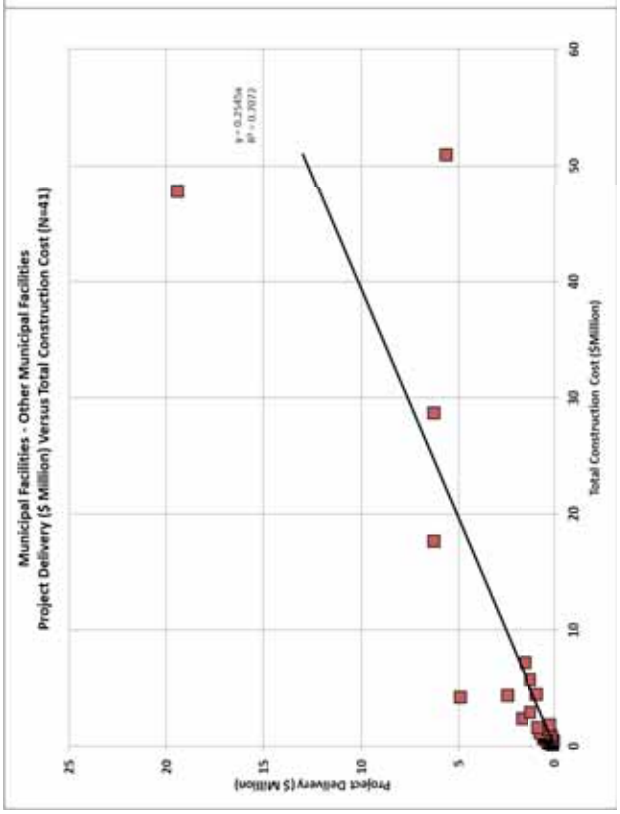
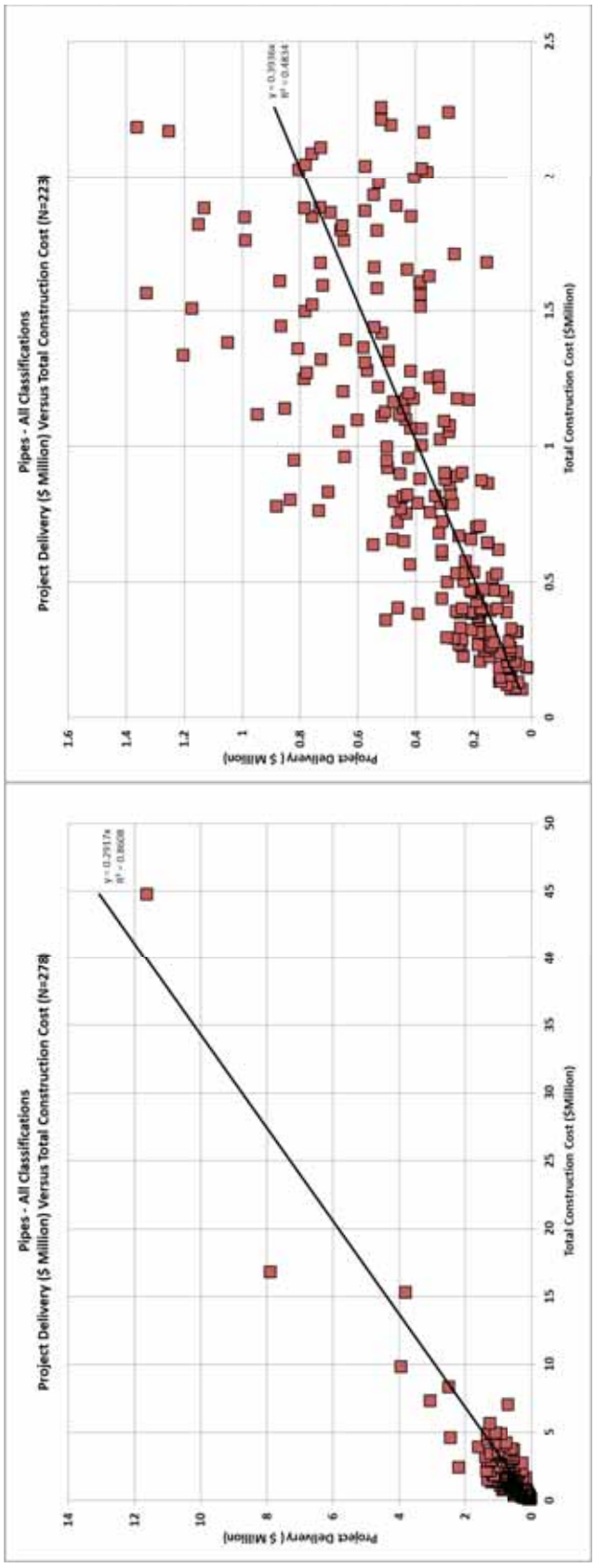
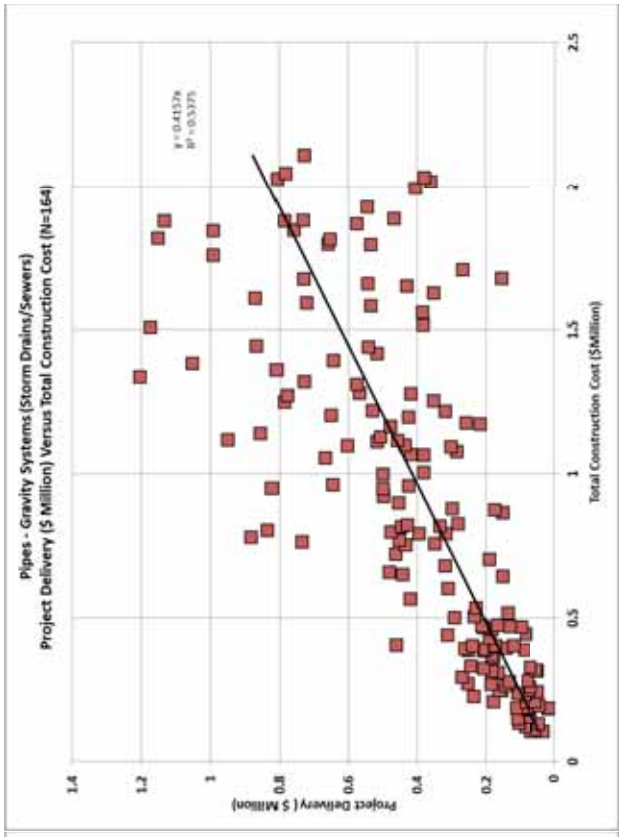




80th Percentile Projects

All Projects

80th Percentile Projects



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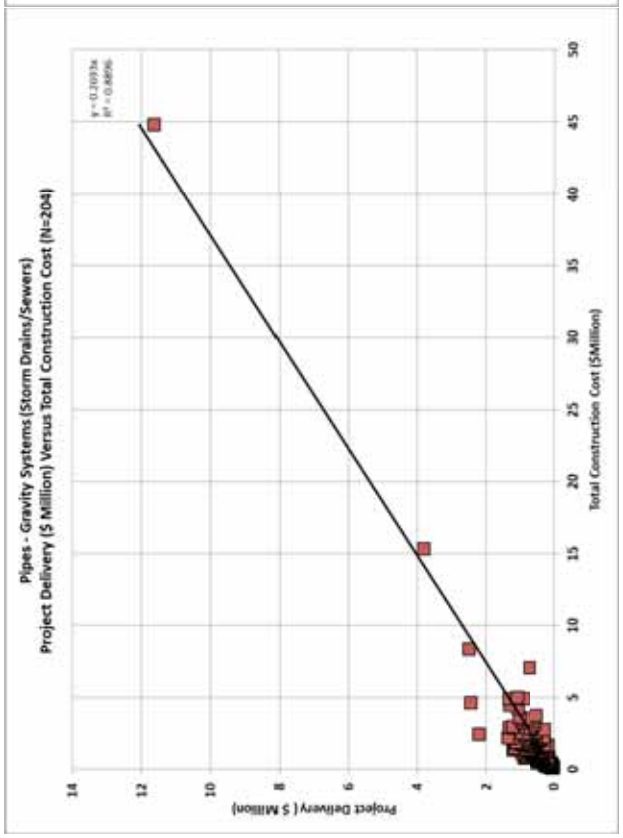

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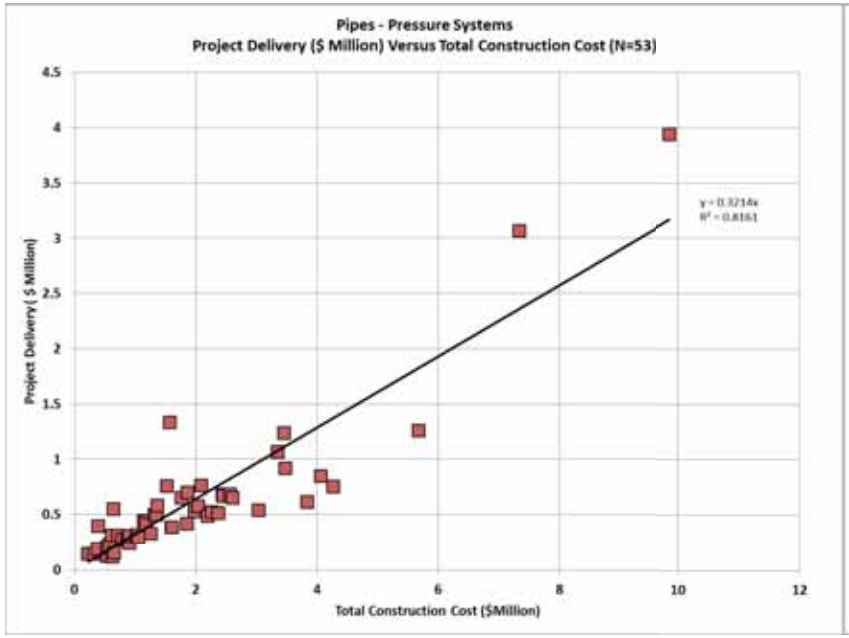

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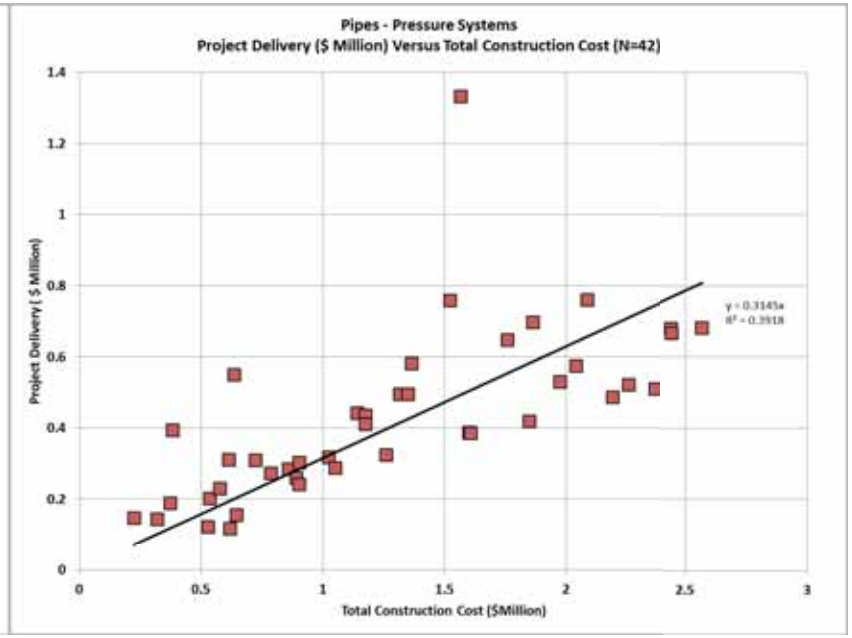

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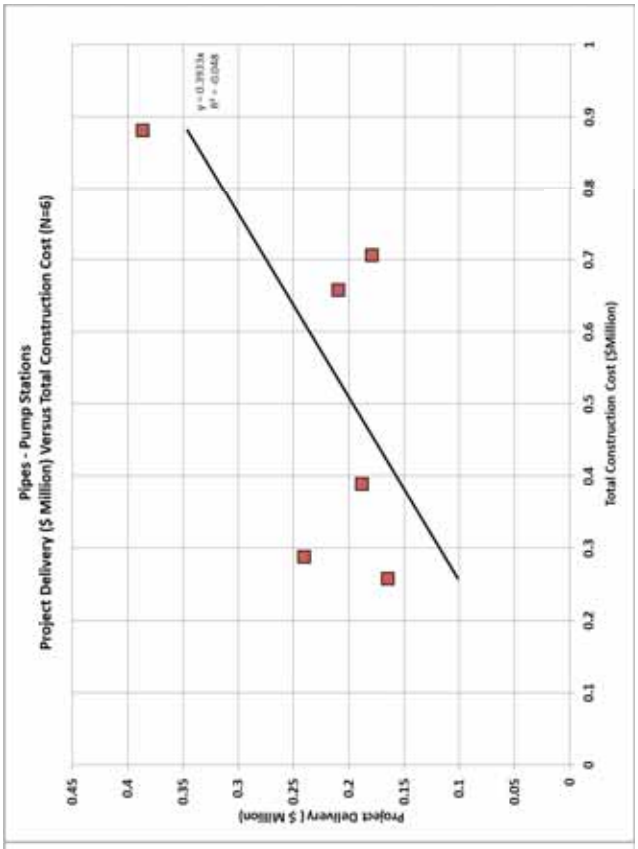

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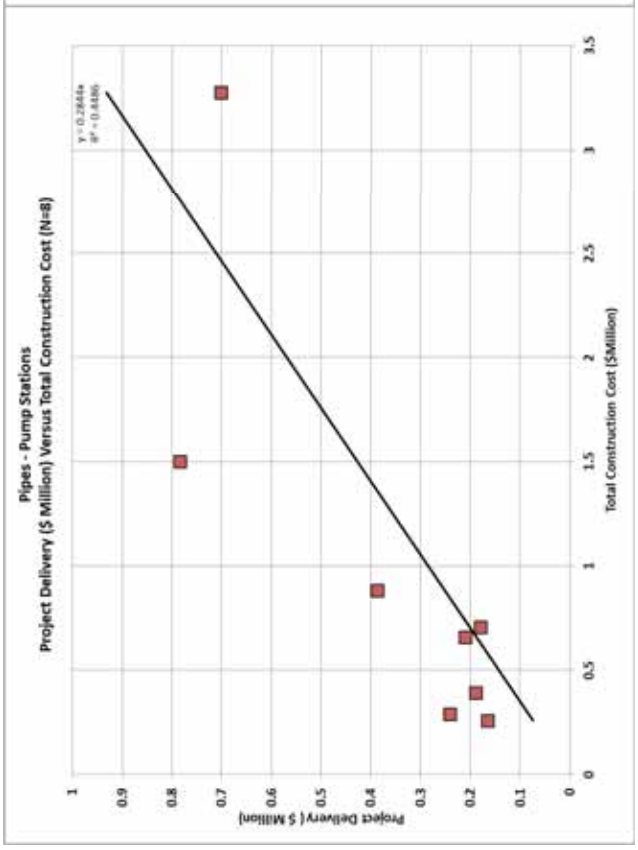
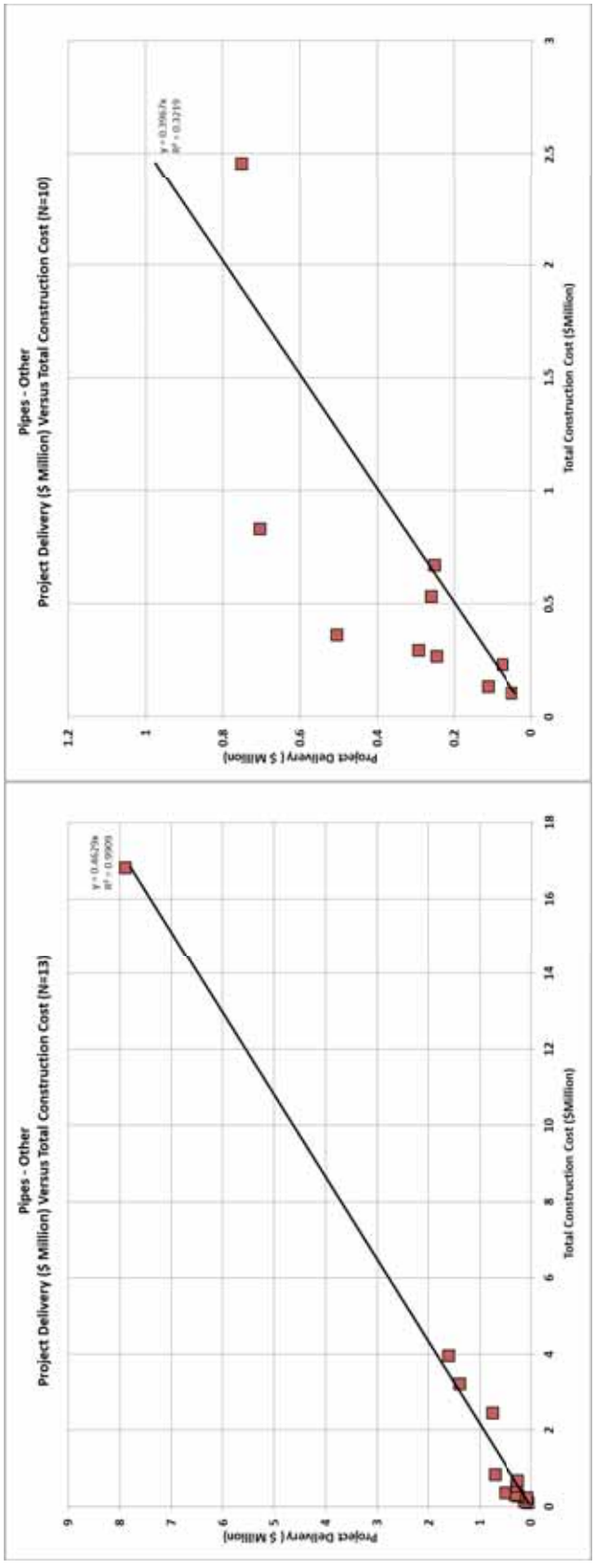
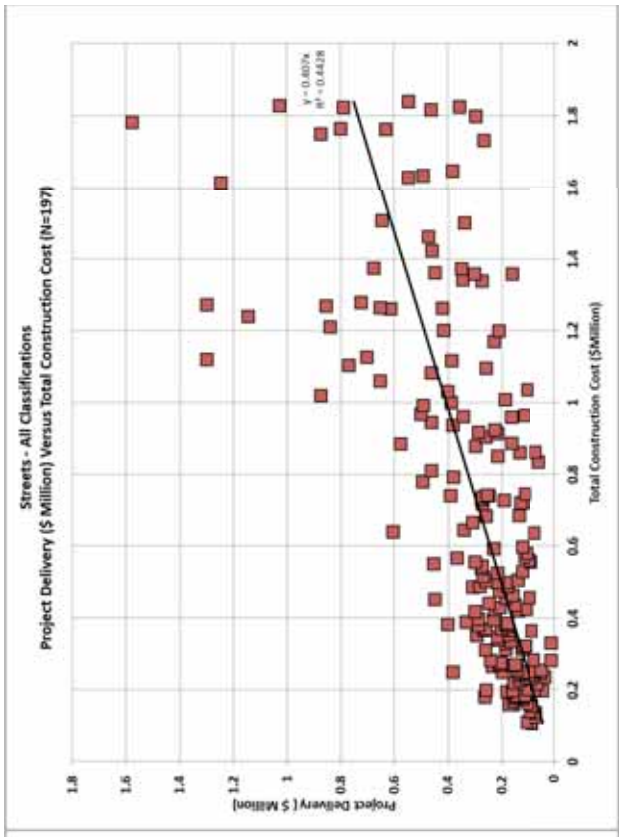



All Projects
Pipes - Other
Project Delivery ($ Million) Versus Total Construction Cost (N=13)
Project Delivery ($ Million)
Total Construction Cost ($Million)
80th Percentile Projects
Pipes - Other
Project Delivery ($ Million) Versus Total Construction Cost (N=10)
Project Delivery ($ Million)
Total Construction Cost ($Million)

80th Percentile Projects



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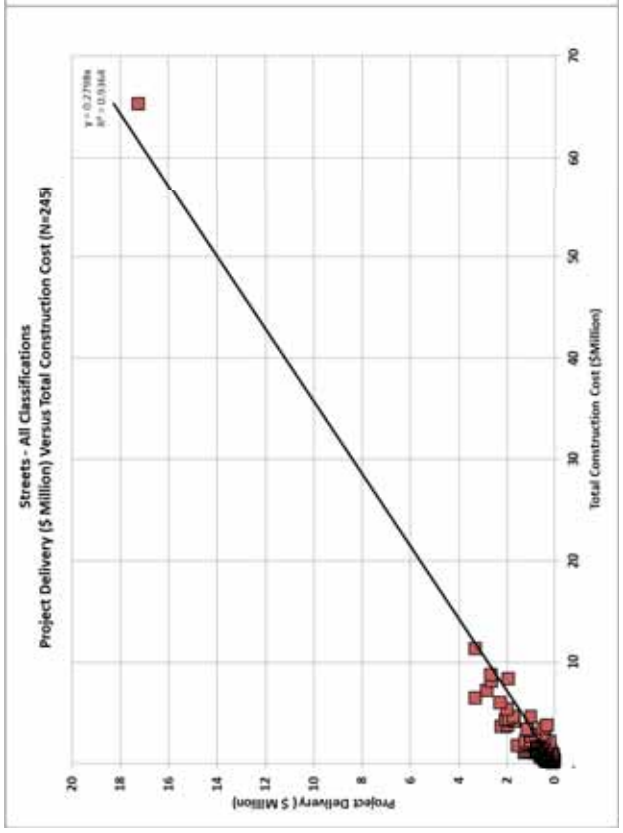

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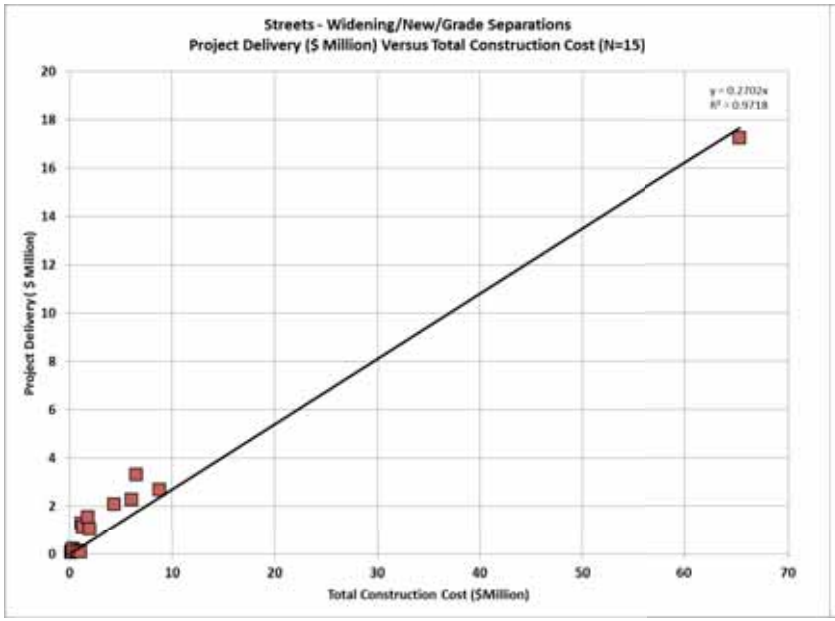

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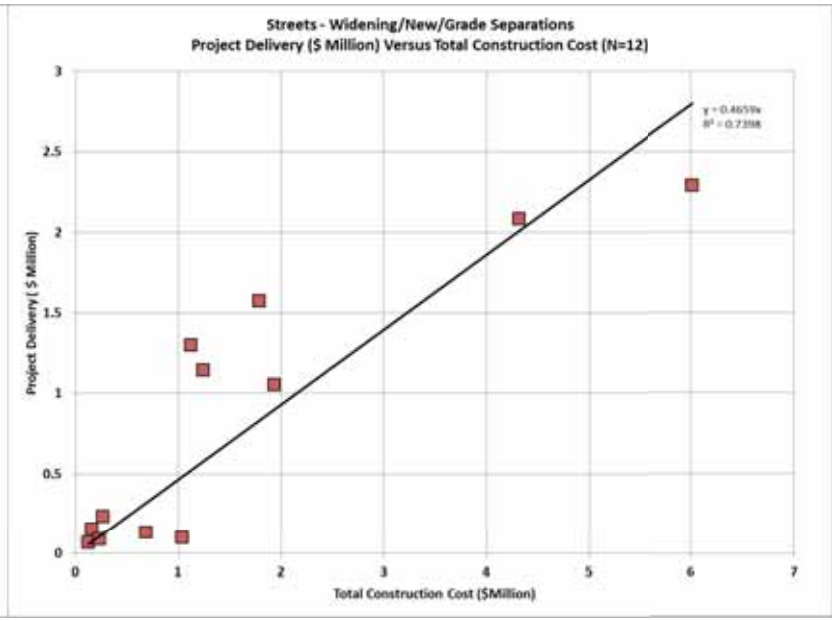

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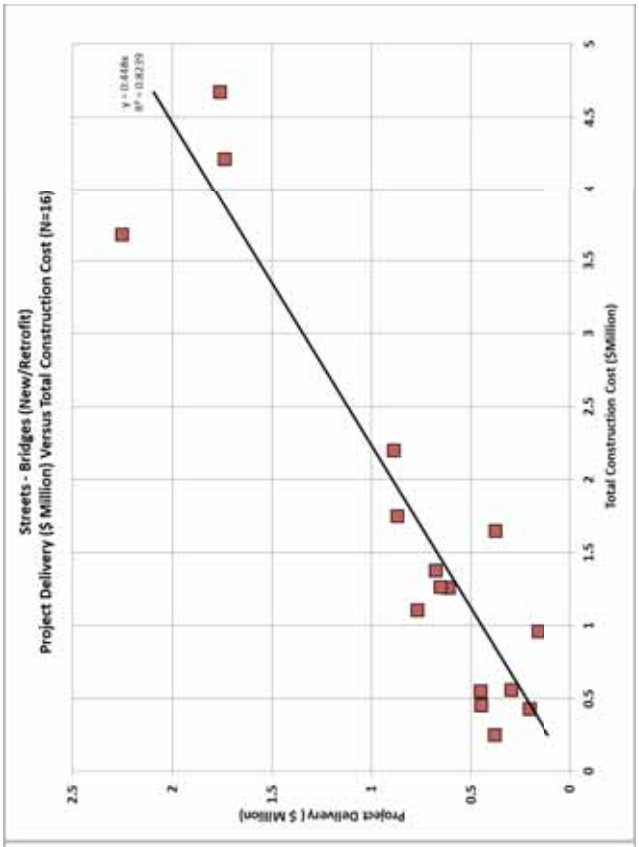

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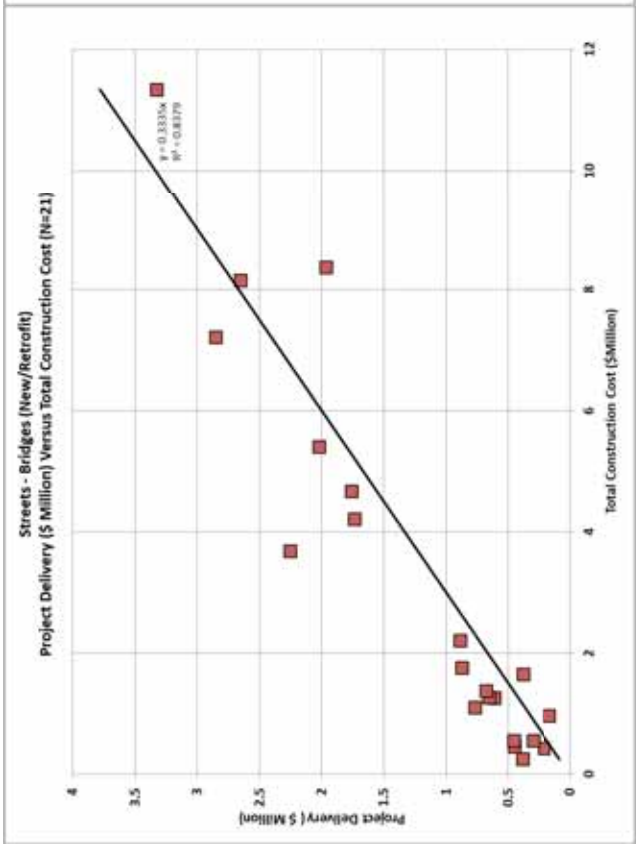

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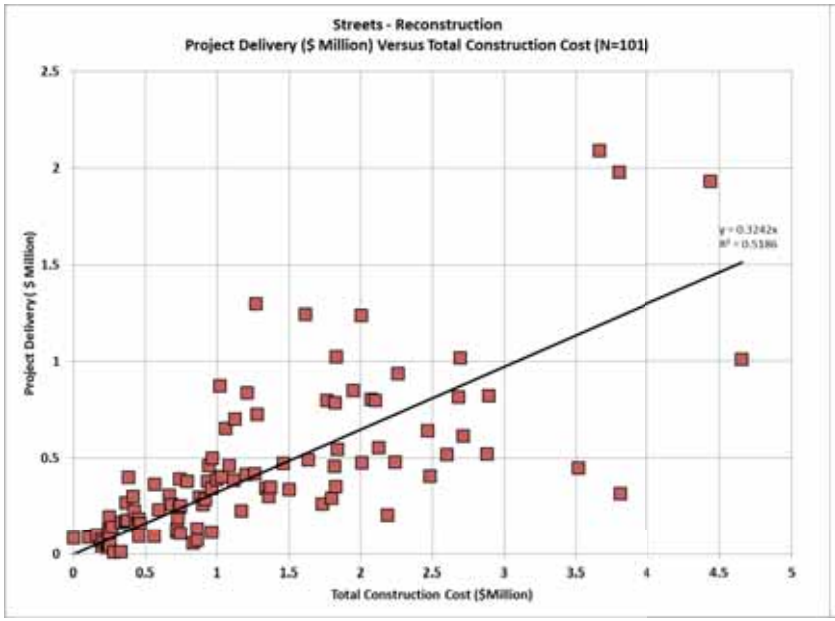

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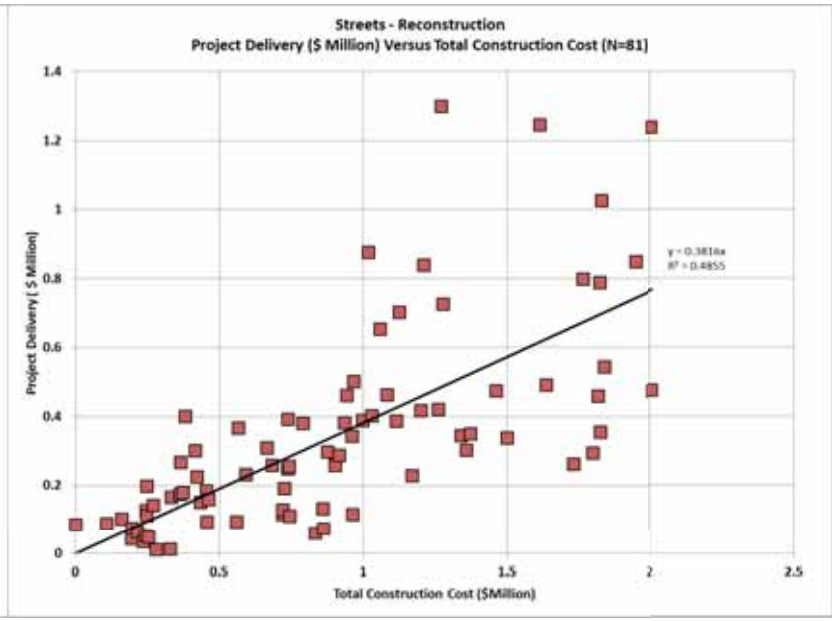

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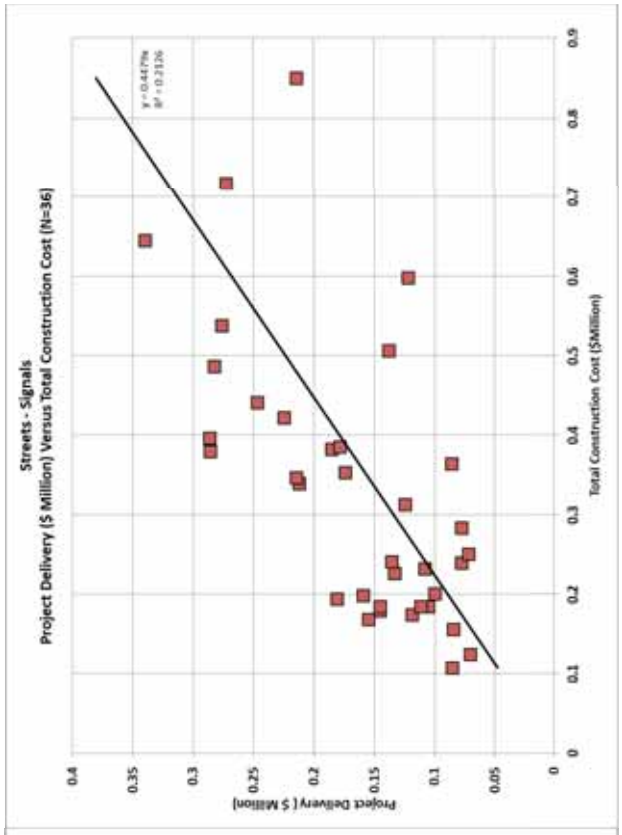

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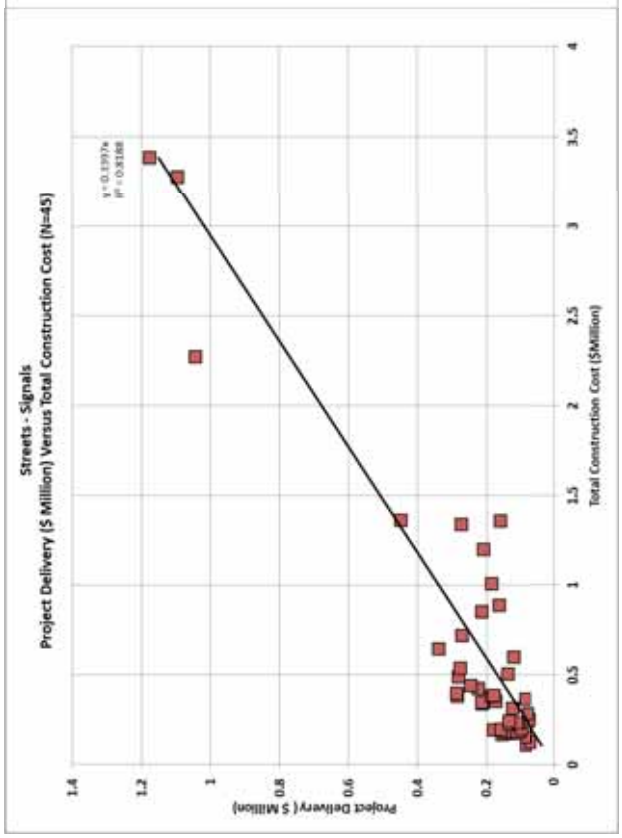

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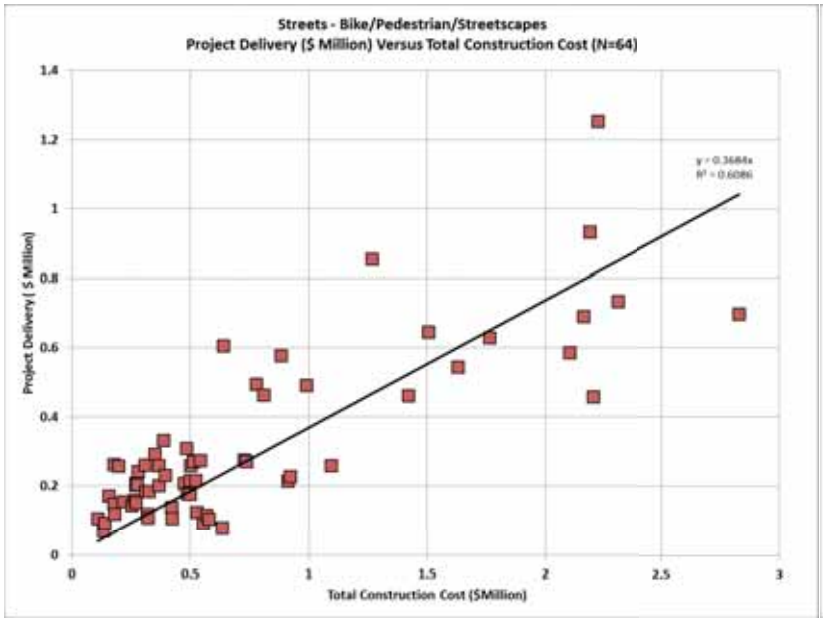

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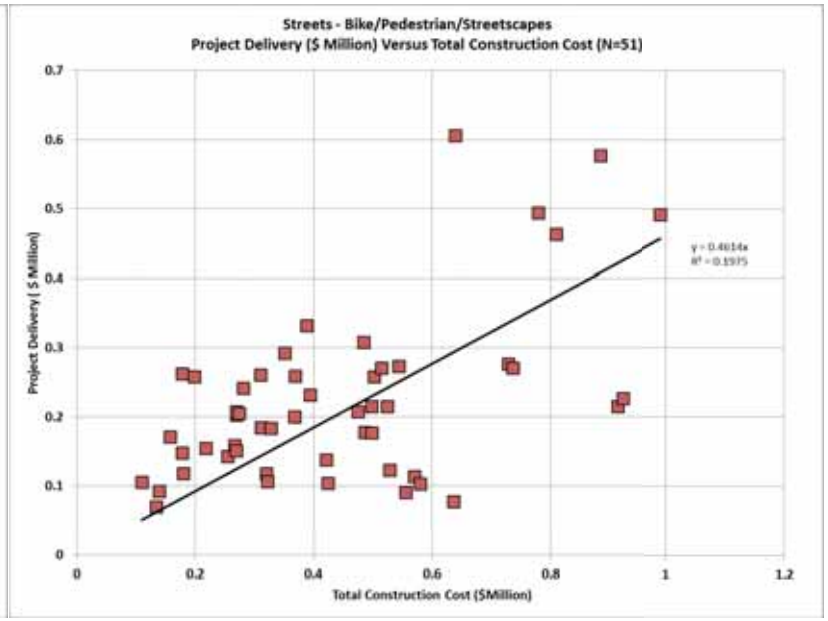

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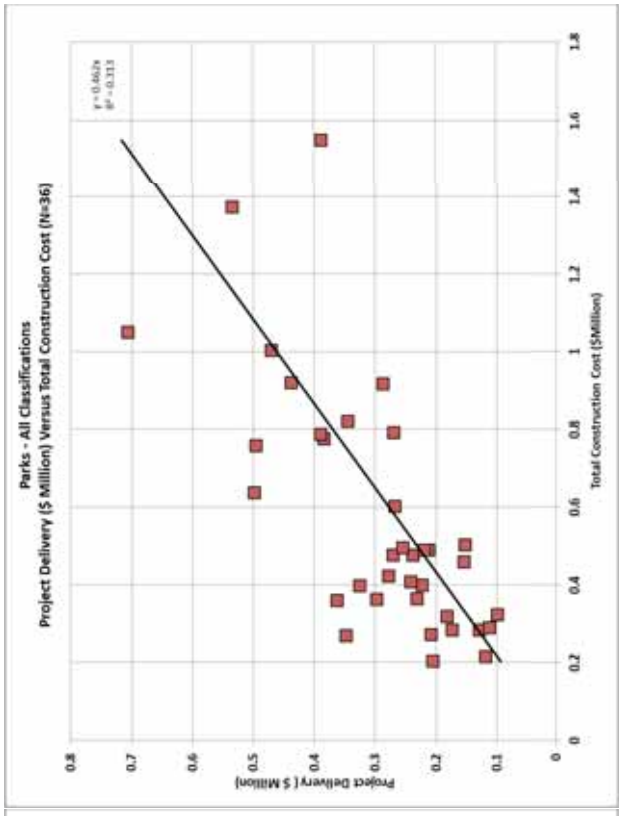

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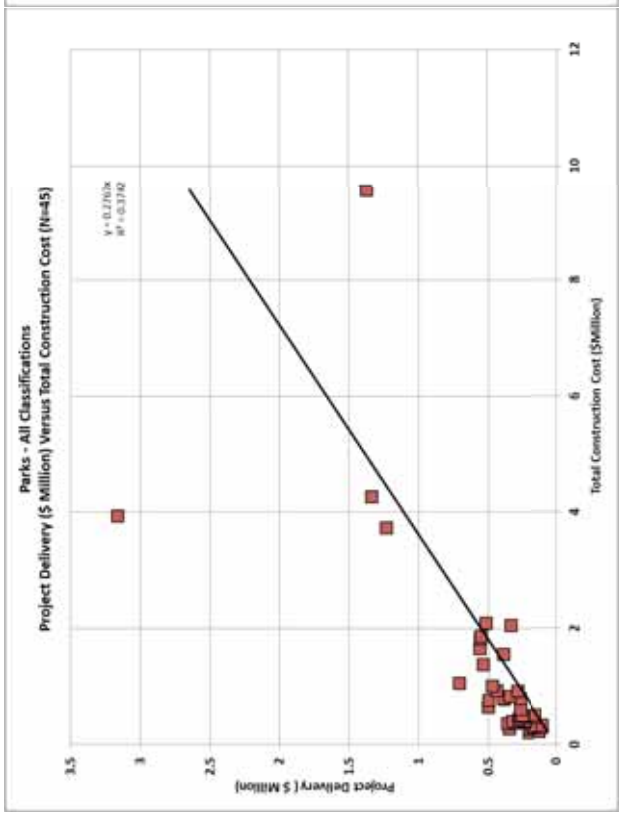

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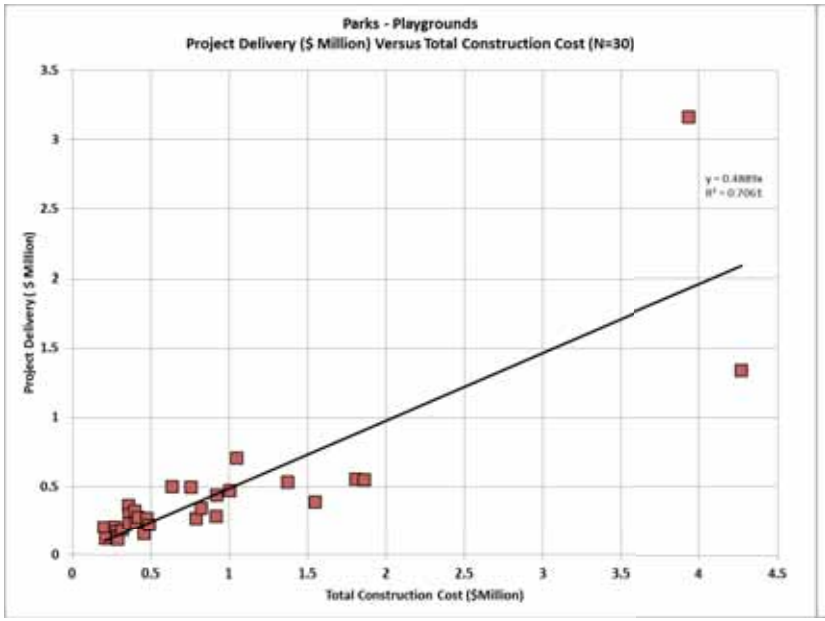

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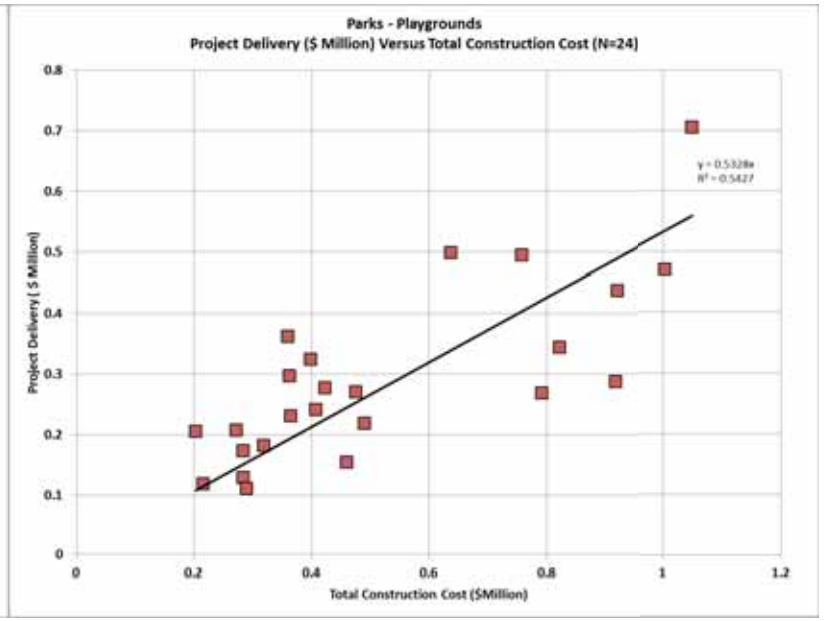

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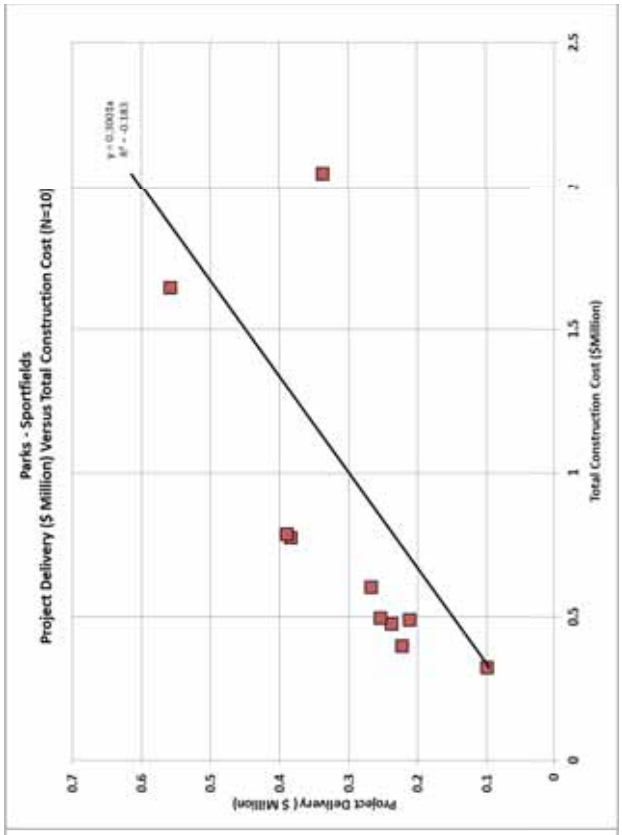

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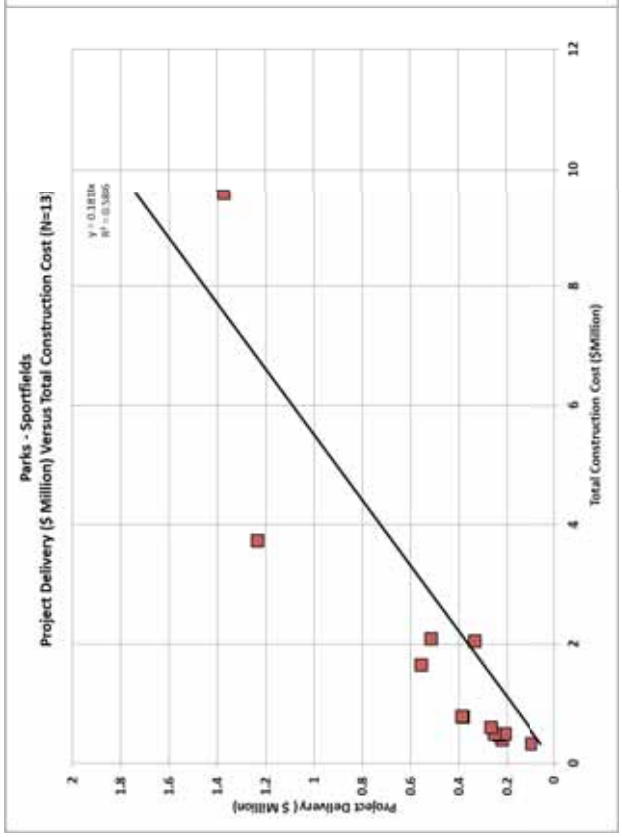

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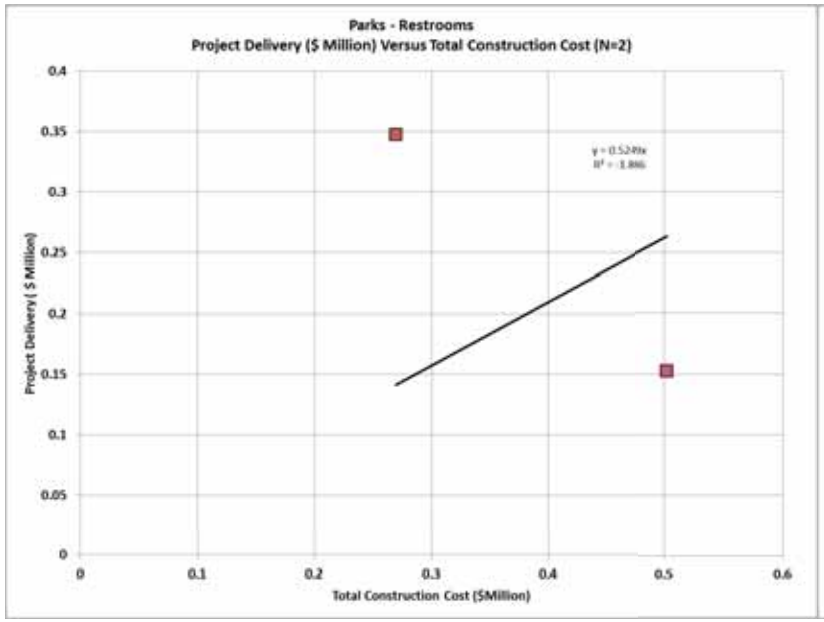

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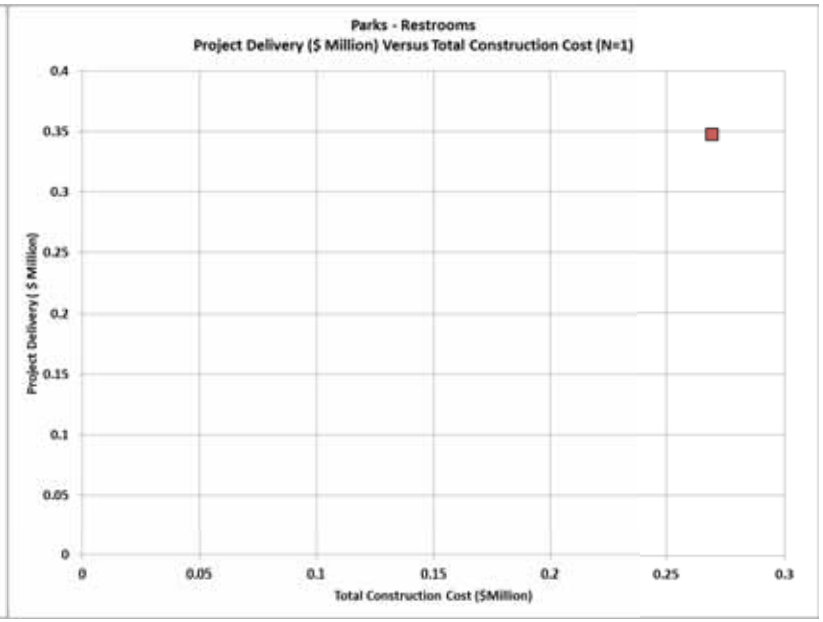
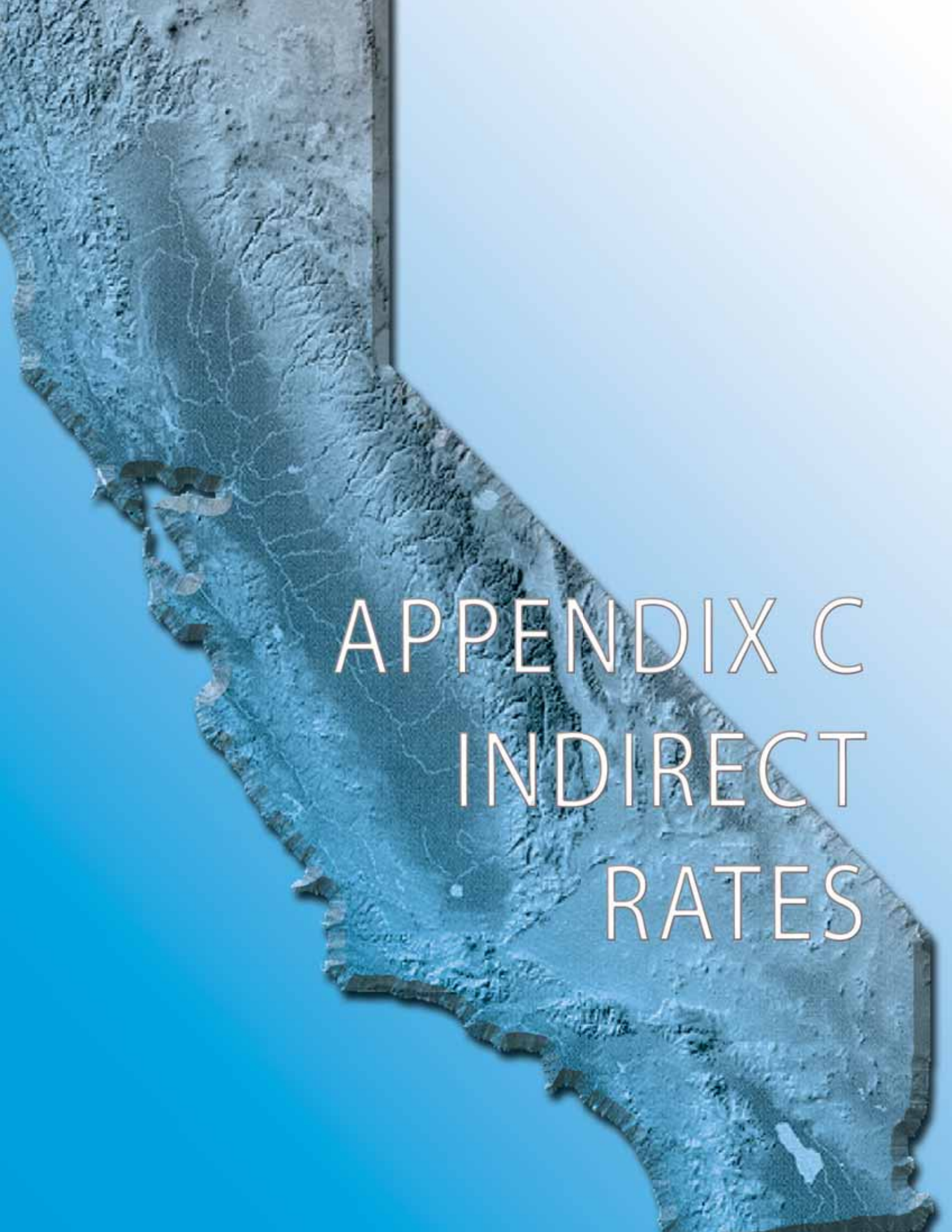




APPENDIX C
INDIRECT RATES

Table C-1
Indirect Rates Applied to Capital Projects

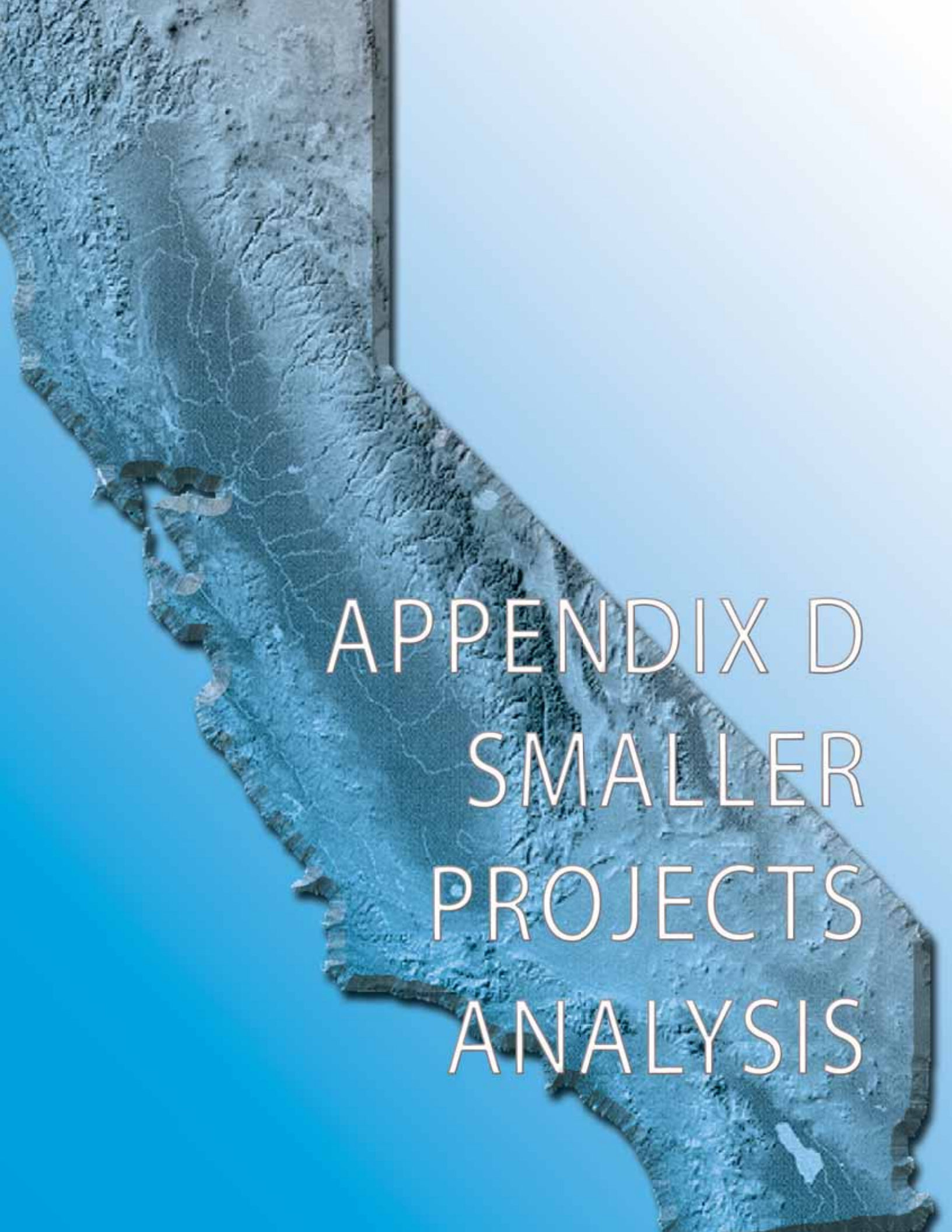
Agency	Fringe Benefits	Compensated Time Off	City Overhead	Department Overhead	Agency Overhead	Indirect Rate Factor[1]	Receive General Fund Support For CIP
City of Long Beach Department of Public Works[2]	41.92%	19.40%	0%	2.5%	49.21%	149.63%	YES
City of Los Angeles Department of Public Works Bureau of Engineering[3]	44.77%	21.25%	4.52%	16.74%	51.52%	138.90%	YES
City of Oakland Department of Engineering & Construction	68.65%	21.65%	20.22%	29.00%	18.90%	158.42%	NO
City of Sacramento							NO
Department of Transportation (FY15 Budgeted)	38.13%	19.96%	26.34%	14.87%	68.94%	168.24%	
Department of Utilities	37.17%	18.70%	108.59%			164.46%	
City of San Diego Engineering and Capital Projects	65%	17.60%	0%	0%	82.60%	165.2%	NO
City and County of San Francisco Department of Public Works Bureau of Engineering Bureau of Construction Management Bureau of Architecture	42.52%	27.43%	0%	51.79%	53.89	175.64%	NO
City of San Jose Department of Public Works (FY13-14)	70.36%	26.87%	46.74%	16.35%	Included	209.63%	NO

Notes:

[1] This value may be different from the sum of overhead values since the compounding formula may vary by agency.

[2] The City of Long Beach is currently in the process of recomputing its overhead rates. Rates shown in the above table are 2012 rates.

[3] Based on averages of all Bureau program overhead rates provided under CAP 33.



APPENDIX D
SMALLER PROJECTS ANALYSIS

APPENDIX D

Smaller Project Analysis

INTRODUCTION

In 2009, the project team decided to differentiate the projects based on the full set of projects and a subset of "smaller cost projects". It was hypothesized that projects with smaller total construction cost (TCC) will have a higher project delivery percentage due to costs associated with project delivery which are independent of the size of project. These project delivery costs include:

- regulatory requirements (such as CEQA)
- public involvement and outreach
- right of way acquisition
- project alternatives and scope development
- utility agreements and relocations
- bidding costs and procurement of public contracts

In Update 2009, it was decided that the "smaller projects" cutoff limit would be the smallest 80 percent of projects ranked by the TCC for each category of projects. For example, if there were 100 street projects, the 80 least expensive TCC street projects would be included in the smaller projects cutoff. The hypothesis was confirmed, and it was found that the smaller projects typically have about a 3 to 5 percent higher project delivery percentage of TCC than the full set of projects.

In Update 2014, the project team reconsidered the smaller project cutoff limit, especially since the actual project delivery cost for "small projects" was felt to be much greater than that of the 80th percentile subset of projects. Therefore, an analysis was performed to evaluate the project delivery percentage for the projects in the database based on various TCC cost ranges. The projects included in this analysis followed the same criteria that are included in the report:

- Outliers were excluded
- Only projects with TCC greater than $100,000 were included
- Alternative delivery projects were excluded
- Only projects from 2009 to 2013 were included

Tables D-1 through **D-4** show the project delivery percentages for a range of construction costs by project type. In each project type category, the projects were arranged within four to five cost ranges. More than five cost ranges were not developed because more cost ranges lead to a fewer number of projects in each category, allowing the project delivery percentage to be more easily influenced by projects with extreme (either high or low) project delivery percentages.

In discussing the results presented in the tables below, the project team felt that the project delivery percentages shown are more reflective of the actual project delivery costs for small projects and are a useful tool for determining the expected project delivery costs of smaller projects.

Table D-1
Streets (2009-2013) Project Delivery Percentage based on Cost Ranges of TCC

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
$X	$Y		Design %	Const Mang %	Project Delivery %
100,000	300,000	52	40%	25%	65%
300,000	600,000	59	26%	23%	49%
600,000	1,300,000	60	22%	19%	41%
1,300,000	2,400,000	44	21%	15%	36%
2,400,000	66,000,000	30	19%	14%	33%

Table D-2
Municipal Facilities (2009-2013) Project Delivery Percentage based on Cost Ranges of TCC

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
$X	$Y		Design %	Const Mang %	Project Delivery %
100,000	800,000	28	27%	20%	47%
800,000	3,000,000	28	26%	17%	43%
3,000,000	10,000,000	22	24%	18%	42%
10,000,000	76,000,000	19	12%	14%	26%

Table D-3
Pipes (2009-2013) Project Delivery Percentage
based on Cost Ranges of TCC

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
$X	$Y		Design %	Const Mang %	Project Delivery %
100,000	300,000	42	31%	23%	54%
300,000	600,000	44	27%	22%	49%
600,000	1,300,000	76	25%	21%	46%
1,300,000	2,400,000	66	20%	18%	38%
2,400,000	45,000,000	50	13%	16%	29%

Table D-4
Parks (2009-2013) Project Delivery Percentage
based on Cost Ranges of TCC

Dollar Ranges of Projects based on TCC		Number of Projects	AVERAGE of projects between Cost X and Cost Y, % TCC		
$X	$Y		Design %	Const Mang %	Project Delivery %
100,000	350,000	9	36%	30%	66%
350,000	500,000	13	33%	28%	61%
500,000	1,000,000	10	29%	18%	47%
1,000,000	10,000,000	13	22%	14%	36%

PARTICIPATING AGENCIES

City of Long Beach
Department of Public Works
Harbor Department Port of Long Beach

City of Los Angeles
Department of Public Works
Bureau of Engineering

City of Oakland
Public Works Department
Bureau of Engineering & Construction

City of Sacramento
Department of Public Works
Department of Utilities

City of San Diego
Engineering & Capital Projects Department

City & County of San Francisco
Department of Public Works
Building Design & Construction
Infrastructure Design & Construction

City of San Jose
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