FINAL

Soil Stabilization BMP Research for Erosion and Sediment Controls

Cost Survey Technical Memorandum

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Executive Summary

A survey of erosion and sediment control contractors in California was conducted in order to update cost data for twelve soil stabilization techniques common to Caltrans projects. The purpose of this Technical Memorandum is to provide Caltrans with a matrix of the average installed costs for soil stabilization Best Management Practices (BMPs) as well as supporting graphics of the distribution of the installed cost information. The results of the survey are intended to help designers estimate costs for standard versus more difficult applications and for small and large size projects as well.

The project was accomplished through the development of a contractor/vendor questionnaire and incorporation of the questionnaire results in a comprehensive matrix that includes a summary table for ease of use. The design of the questionnaire separated the BMP installed cost information into small or large projects, depending on size of project and slope length. A slope inclination of 2:1 (horizontal: vertical) was used for both project sizes. The project size was then separated into two categories, standard versus more difficult, that differentiated each project by staging and application characteristics (i.e. distance from home base, availability of staging and length of hose runs).

Thirty contractor/vendors were polled for their responses. Of that number, ten supplied the requested information; sixteen were non-responsive; and four declined participation. Responses from the contractors were averaged and are presented in a matrix.

The matrix shows that the average installation costs for most of the BMPs were distributed over a wide range. Boxplots were utilized to graphically provide some indication of the estimated installed cost's symmetry and skewness. The boxplots show that there was consistency in pricing for the more commonly used soil stabilization BMPs, such as temporary hydroseeding, bonded fiber matrix, polyacrylamide and straw with tackifier, but not for the less common BMPs such as pneumatically-applied wood bark mulch and rolled erosion control products (i.e. blankets and netting). The boxplots also indicate that there were outliers in the price for each of the BMPs, suggesting that a contractor's cost estimate for a particular soil stabilization practice that they do not specialize in, or may not routinely bid on projects involving these particular methods, may not be representative of competitive costs (e.g. wood (bark) mulching, refer to Table 3-2). Price outliers may also reflect particular stabilization methods that may not be as readily available in a certain geographic areas.

Overall, the results of the Contractor Survey should be useful to Caltrans' engineers and designers in updating the cost information currently used to derive estimates for soil stabilization BMPs for Caltrans' projects.

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TABLE OF CONTENTS

SOIL STABILIZATION BMP RESEARCH FOR EROSION AND SEDIMENT CONTROLS
COST SURVEY TECHNICAL MEMORANDUM

TABLE OF CONTENTS

TABLE OF CONTENTS

SOIL STABILIZATION BMP RESEARCH FOR EROSION AND SEDIMENT CONTROLS
COST SURVEY TECHNICAL MEMORANDUM

TABLE OF CONTENTS (continued)

List of Figures

List of Tables

1. Introduction

The purpose of this Technical Memorandum is to provide Caltrans with a matrix of installed costs for twelve soil stabilization BMP techniques common to Caltrans projects. Cost information was obtained from surveys of erosion and sediment control contractors in California. Costs are presented for standard versus more difficult applications and for small and large size projects. The mean, average and range of installed costs for each of the BMPs are presented in Tables 3-1 through 3-3. The installed cost information is also presented as boxplots (Figures 3-1 through 3-8) to graphically illustrate the provided cost distribution.

The results of this survey are intended to update the cost information currently used by Caltrans' engineers and designers to derive estimates for soil stabilization BMPs for Caltrans' projects. As such, the information from this study can be used to update Caltrans Field Guide "Soil Stabilization for Temporary Slopes" (Caltrans 1999).

1.1 Project Description

The first step in the data acquisition process was a review and evaluation of existing data in the document "Soil Stabilization for Temporary Slopes" (Caltrans 1999). From this document and the related Scope of Work for Caltrans Storm Water Contract #43A0172, a list of the erosion control BMPs and candidate erosion control contractors was established. Twelve soil stabilization techniques common to Caltrans projects were selected as the candidate BMPs and thirty erosion control contractors, representing a broad range of geographic and project experience were selected to be interviewed.

A contractor questionnaire (Table 1-1) was developed to acquire cost data from the various erosion control contractors located throughout California. The design of the questionnaire separated the BMP installed cost information into small (0.12 acres) or large projects (2.0-5.0 acres), depending on size of project and slope length. A slope inclination of 2:1 (horizontal: vertical) was used for both project sizes. The project size was then separated into two categories, standard versus more difficult, that differentiated each project by staging and application characteristics (i.e. distance from home base, availability of staging and length of hose runs). The questionnaire was used to assemble cost data, which was collected via phone interviews and faxed or emailed forms. The data is presented in Tables 3-1 through 3-3, showing each BMP and its related installed costs.

Table 1-1. Contractor/Vendor Questionnaire Form

BMP Type & Description	Installed Cost (cost/acre)			
	Small Project[1]		Large Project[2]	
	Category 1[3]	Category 2[4]	Category 1[3]	Category 2[4]
Wood (bark) Mulching				
Straw with Tackifier				
Crimped or Punched Straw				
Hydraulic Mulch Fiber with Polyacrylamide (PAM)				
Temporary Hydroseed				
Temporary Hydraulic Mulch				
Bonded Fiber Matrix				
Caltrans Erosion Control Type C				
Caltrans Erosion Control Type D				
Erosion Control Blanket				
Erosion Control Netting				
Temporary Cementitious Binder				

NOTES:

[1] *Small Projects: 0.12 acres (5,000 sq ft) to 0.5 acres (22,000 sq ft); slope inclination of 2:1 and slope length that does not exceed 30 feet*

[2] *Large Projects: 2.0 - 5.0 acres; 2:1 slope and slope length from 50 - 100 feet*

[3] *Category 1: Within 20 miles; access from top or bottom (but not both); shooting from the tower; no long hose runs.*

[4] *Category 2: Further than 20 miles; access from top or bottom (but not both); long hose runs will likely be required*

2. Data Base Preparation (Contractor Questionnaire)

2.1 Project Type

The project types were broken down into two types, small and large projects, as defined below:

Small:

- The BMP is to be applied to an area between 0.12 acre (5,000 SF) and 0.5 acre (22,000 SF).
- The area has a slope inclination of 2(horizontal):1(vertical) and a slope length that does not exceed 30 ft.

Large:

- The BMP is to be applied to an area between 2.0 acres and 5.0 acres.
- The area has a slope inclination of 2(horizontal):1(vertical) and a slope length that varies between 50 ft and 100 ft.

2.2 Project Category

Installation costs for the candidate BMPs were further broken down into two categories, standard and more difficult jobs as defined below:

Standard:

- The project is located within 20 miles of the contractor's home base
- Access to the top or bottom of the slope is available
- Long hose runs will not be required
- Staging within the project site is available.

More Difficult:

- The project is located more than 20 miles from the contractor's home base.
- Access is only available to the top or bottom of the slope.
- Long hose runs will likely be required.
- Staging within the project site is not available.

2.3 Candidate BMPs

Data was collected for the following types of erosion control BMPs:

1) **Wood Mulching**: Wood and bark mulch or unscreened compost is applied in a 2-inch thick layer. Application method can be pneumatic (blower), mechanical (dozer or conveyer), or by hand.
2) **Straw and Tack**: Straw is applied at a rate of 2 tons per acre. Application method can be pneumatic (blower) or by hand. Hydraulically applied tackifier consisting of guar or equivalent at a rate of 150 lbs per acre and fiber (paper, wood, or both) at 1200 lbs per acre shall be applied to affix the straw.
3) **Punched Straw**: Straw is applied at a rate of 2 tons per acre. Application method can be pneumatic (blower) or by hand. Straw is crimped into the soil using a self propelled or dragged finned roller or crimper (not tracked dozer).
4) **PAM and Fiber**: A polyacrylamide (PAM) formulated for erosion control is hydraulically applied at 10 gallons per acre along with 1800 lbs of fiber (paper, wood, or both). The PAM shall be EarthGuard, Earthbound L or equivalent.
5) **Temporary Hydroseed**: This is a single-application treatment. It consists of hydraulically applying the following mixture at a per acre rate: fiber (paper, wood, or both) at 1800 lbs, guar or equivalent tackifier at a rate of 150 lbs, and cereal grass seed at 50 lbs.
6) **Temporary Hydraulic Mulch**: This is a single-application treatment although multiple passes may be required. It consists of hydraulically applying the following mixture at a per acre rate: wood fiber at 1800 lbs and guar or equivalent tackifier at a rate of 150 lbs.
7) **Bonded Fiber Matrix**: This is a single-application treatment although multiple passes may be required. A commercially available bonded fiber matrix (BFM) product such as EcoAegis II, SoilGuard, or equivalent shall be hydraulically applied at a rate of 3500 lbs per acre.
8) **Caltrans Erosion Control (Type C)**: This is a two-application treatment. The first application consists of hydroseeding the following mixture at a per acre rate: wood fiber at 900 lbs, compost such as Hydropost at 1500 lbs, native seed at 40 lbs, commercial fertilizer at 100 lbs. The second application consists of applying straw at a rate of 2 tons per acre. Application method can be pneumatic (blower) or by hand. Straw is crimped into the soil using a self propelled or dragged finned roller or crimper (not tracked dozer).
9) **Caltrans Erosion Control (Type D)**: This is a three-application treatment. The first application consists of hydroseeding the following mixture at a per acre rate: fiber (paper, wood, or both) at 900 lbs, compost such as Hydropost at 1500 lbs, native seed at 40 lbs, and commercial fertilizer at 100 lbs. The second application consists of applying straw at a rate of 2 tons per acre. Application method can be pneumatic (blower) or by hand. The third application consists of hydraulically applying the following mixture at a per acre rate: fiber (paper, wood, or both) at 900 lbs, compost such as Hydropost at 1500 lbs, and guar or equivalent tackifier at a rate of 150 lbs.
10) **Erosion Control Blanket**: This is a two-application treatment. The first application consists of hydroseeding the following mixture at a per acre rate: wood fiber at 900 lbs, compost such as Hydropost at 1500 lbs, native seed at 40 lbs, commercial

fertilizer at 100 lbs. The second application consists of applying a blanket composed of 30 percent coir fiber and 70 percent straw (ECTC Category 2D), such as North American Green SC150, American Excelsior Premier, or RoLanka StrawCocoMat.

11) **Erosion Control Netting**: This is a two-application treatment. The first application consists of applying an open weave textile consisting of 100 percent coir fiber yarn (ECTC Category 4) such as DeKowe 400. The second application consists of hydroseeding the following mixture at a per acre rate: wood fiber at 900 lbs, compost such as Hydropost at 1500 lbs, native seed at 40 lbs, commercial fertilizer at 100 lbs through the netting.

12) **Temporary Cementitious Binder**: This is a single-application treatment although multiple passes may be required. It consists of hydraulically applying the following mixture at a per acre rate: a formulated gypsum-based product such as Airtrol Geobinder at 6000 lbs and wood fiber at 1800 lbs.

3. Summary of Results

Thirty contractor/vendors were polled for their responses. Of that number, ten supplied the requested information; sixteen were non-responsive; and four declined participation. Responses from the contractors are presented in Tables 3-1 through 3-3. All Tables utilized data obtained from a minimum of at least three contractors. It is significant to note that the widest ranges of cost data appear to have occurred for the BMPs that had the least response by the contractors, e.g., wood mulch and cementitious binders. In addition, the contractors installed cost estimates for "wood mulching" showed a wide range of values suggesting that a contractor may not specialize in that particular soil stabilization practice or may not routinely bid on a project involving these particular methods, therefore their estimates may not be representative of actual competitive market costs. Furthermore, contractors installed cost estimates for "erosion control blanket" and "erosion control netting" increased for "Large Projects" compared to "Small Projects". The increased costs are most likely due to increased labor costs associated with installation around existing vegetation in the form of ornamental or containerized planting that requires increased labor and irrigation.

3.1 Installed Mean Costs for Soil Stabilization BMPs

Table 3-1 presents the installed mean costs for the candidate BMPs. Costs are presented in dollars per acre for small and large projects as well as less difficult (Category 1) versus difficult (Category 2) sites.

Table 3-1. Installed Mean Costs for Soil Stabilization BMPs

BMP Type & Description	Installed Cost (cost/acre)			
	Small Project[1]		Large Project[2]	
	Category 1[3]	Category 2[4]	Category 1[3]	Category 2[4]
Wood (bark) Mulching	$13,363	$15,701	$10,952	$13,288
Straw with Tackifier	$3,955	$4,802	$1,823	$2,172
Crimped or Punched Straw	$3,879	$5,375	$2,458	$2,778
Hydraulic Mulch Fiber with Polyacrylamide (PAM)	$4,337	$5,610	$2,537	$3,083
Temporary Hydroseed	$3,477	$3,964	$1,951	$2,150
Temporary Hydraulic Mulch	$3,210	$3,625	$1,688	$1,861
Bonded Fiber Matrix	$6,151	$6,880	$3,901	$4,219
Caltrans Erosion Control Type C	$6,791	$7,325	$2,816	$3,284
Caltrans Erosion Control Type D	$7,291	$8,286	$3,390	$3,841
Erosion Control Blanket	$14,998	$16,443	$16,325	$18,247
Erosion Control Netting	$20,082	$22,329	$21,746	$24,158
Temporary Cementitious Binder	$5,865	$6,799	$3,012	$3,179

NOTES:

[1] *Small Projects: 0.12 acres (5,000 sq ft) to 0.5 acres (22,000 sq ft); slope inclination of 2:1 and slope length that does not exceed 30 feet*

[2] *Large Projects: 2.0 - 5.0 acres; 2:1 slope and slope length from 50 - 100 feet*

[3] *Category 1: Within 20 miles; access from top and bottom (but not both); shooting from the tower; no long hose runs.*

[4] *Category 2: Further than 20 miles; access from top or bottom (but not both); long hose runs will likely be required*

COMMENTS:

- PAM is assumed to be in the dry form and not the emulsified form for the cost estimates
- Two of the ten contractors did not make a distinction between small and large projects (pricing was the same for the two categories).
- Cost estimates are based on information from 10 contractors

3.2 Data Ranges for Large, Small, Difficult and Less Difficult Sites

Table 3-2 presents the range of the candidate BMP installation costs per acre for both small and large projects in for less difficult (Category 1) and more difficult (Category 2) sites.

Table 3-2 Range of BMP Installation Costs: Small and Large Projects in Each of the Two Categories

	Small - Category 1[1]		
BMP Type	Low	High	No. of Submittals
Wood Mulch	$70	$30,000	3
Straw Tackifier	$1,195	$10,500	8
Crimped Straw	$1,895	$10,000	5
PAM	$2,396	$11,000	7
Hydroseed	$1,525	$6,100	9
Hydraulic Mulch	$1,495	$6,000	9
Bonded Fiber	$3,703	$11,500	8
Caltrans Type C	$1,895	$13,000	7
Caltrans Type D	$1,742	$14,000	8
EC Blanket	$3,595	$32,250	9
EC Netting	$9,995	$41,000	9
Cementitious Binder	$2,396	$11,500	3

	Small - Category 2[3]		
BMP Type	Low	High	No. of Submittals
Wood Mulch	$84	$37,000	3
Straw Tackifier	$1,495	$14,500	8
Crimped Straw	$1,895	$10,000	5
PAM	$2,396	$19,000	7
Hydroseed	$1,525	$7,900	9
Hydraulic Mulch	$1,525	$7,800	9
Bonded Fiber	$3,703	$15,000	8
Caltrans Type C	$1,995	$15,000	7
Caltrans Type D	$2,003	$20,000	8
EC Blanket	$3,895	$36,750	9
EC Netting	$10,995	$48,000	9
Cementitious Binder	$2,396	$14,000	3

	Large - Category 1[2]		
BMP Type	Low	High	No. of Submittals
Wood Mulch	$54	$23,000	3
Straw Tackifier	$1,000	$2,381	8
Crimped Straw	$1,000	$5,009	7
PAM	$2,178	$4,356	7
Hydroseed	$1,000	$3,088	9
Hydraulic Mulch	$1,200	$2,791	9
Bonded Fiber	$3,485	$5,900	8
Caltrans Type C	$1,340	$4,282	7
Caltrans Type D	$1,340	$5,548	8
EC Blanket	$3,395	$56,420	9
EC Netting	$9,495	$56,420	9
Cementitious Binder	$2,287	$3,650	3

	Large - Category 2[4]		
BMP Type	Low	High	No. of Submittals
Wood Mulch	$62	$30,000	3
Straw Tackifier	$1,269	$3,150	8
Crimped Straw	$1,395	$5,009	7
PAM	$2,178	$4,356	8
Hydroseed	$1,416	$3,685	10
Hydraulic Mulch	$1,400	$2,791	10
Bonded Fiber	$3,485	$6,600	9
Caltrans Type C	$1,514	$5,800	7
Caltrans Type D	$1,514	$6,400	8
EC Blanket	$8,276	$60,760	9
EC Netting	$9,995	$60,760	9
Cementitious Binder	$2,287	$3,850	3

NOTES:

[1] *Small Projects: 0.12 acres (5,000 sq ft) to 0.5 acres (22,000 sq ft); slope inclination of 2:1 and slope length that does not exceed 30 feet*

[2] *Large Projects: 2.0 – 5.0 acres; 2:1 slope and slope length from 50-100 feet*

[3] *Category 1: Within 20 miles; access from top and bottom (but not both); shooting from the tower; no long hose runs.*

[4] *Category 2: Further than 20 miles; access from top or bottom (but not both); long hose runs will likely be required.*

3.3 Summary Matrix

Table 3-3 summarizes the mean installed costs and ranges for each of the candidate BMP types. Costs are presented in dollars per acre for small and large projects as well as less difficult (Category 1) versus difficult (Category 2) sites.

Table 3-3 Summary Matrix Representing the Mean Installed Costs and Ranges for Soil Stabilization BMPs

BMP Type & Description	Installed Cost (cost/acre)							
	Small Project[1]				Large Project[2]			
	Category 1[3]		Category 2[4]		Category 1[3]		Category 2[4]	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Wood (bark) Mulching	$13,363	$70 — $30,000	$15,701	$84 — $37,000	$10,952	$54 — $23,000	$13,288	$62 — $30,000
Straw with Tackifier	$3,955	$1,195 — $10,500	$4,802	$1,495 — $14,500	$1,823	$1,000 — $2,381	$2,172	$1,269 — $3,150
Crimped or Punched Straw	$3,879	$1,895 — $10,000	$5,375	$1,895 — $10,000	$2,458	$1,000 — $5,009	$2,778	$1,395 — $5,009
Hydraulic Mulch Fiber with Polyacrylamide (PAM)	$4,337	$2,396 — $11,000	$5,610	$2,396 — $19,000	$2,537	$2,178 — $4,356	$3,083	$2,178 — $4,356
Temporary Hydroseed	$3,477	$1,525 — $6,100	$3,964	$1,525 — $7,900	$1,951	$1,000 — $3,088	$2,150	$1,416 — $3,685
Temporary Hydraulic Mulch	$3,210	$1,495 — $6,000	$3,625	$1,525 — $7,800	$1,688	$1,200 — $2,791	$1,861	$1,400 — $2,791
Bonded Fiber Matrix	$6,151	$3,703 — $11,500	$6,880	$3,703 — $15,000	$3,901	$3,485 — $5,900	$4,219	$3,485 — $6,600
Caltrans Erosion Control Type C	$6,791	$1,895 — $13,000	$7,325	$1,995 — $15,000	$2,816	$1,340 — $4,282	$3,284	$1,514 — $5,800
Caltrans Erosion Control Type D	$7,291	$1,742 — $14,000	$8,286	$2,003 — $20,000	$3,390	$1,340 — $5,548	$3,841	$1,514 — $6,400
Erosion Control Blanket	$14,998	$3,595 — $32,250	$16,443	$3,895 — $36,750	$16,325	$3,995 — $56,420	$18,247	$8,276 — $60,760
Erosion Control Netting	$20,082	$9,995 — $41,000	$22,329	$10,995 — $48,000	$21,746	$9,495 — $56,420	$24,158	$9,995 — $60,760
Temporary Cementitious Binder	$5,865	$2,396 — $11,500	$6,799	$2,396 — $14,000	$3,012	$2,287 — $3,650	$3,179	$2,287 — $3,850

NOTES:

[1] *Small Projects: 0.12 acres (5,000 sq ft) to 0.5 acres (22,000 sq ft); slope inclination of 2:1 and slope length that does not exceed 30 feet*

[2] *Large Projects: 2.0 - 5.0 acres; 2:1 slope and slope length from 50 - 100 feet*

[3] *Category 1: Within 20 miles; access from top and bottom (but not both); shooting from the tower; no long hose runs.*

[4] *Category 2: Further than 20 miles; access from top or bottom (but not both); long hose runs will likely be required*

3.4 Boxplots

Figures 3-1 through 3-8 include boxplots that were developed to graphically present the data obtained from the contractor surveys. The boxplots also illustrate the symmetry and skewness of the installed cost data. Boxplots were generated for each project combination: small project – less difficult (Category 1); small project –difficult (Category 2); large project – less difficult (Category 1); and large project – difficult (Category 2). Each of these combinations was further divided based on the range of surveyed costs.

Figure 3-1 (also Table 4-1 in the "Conclusions") present installed cost for soil stabilization techniques on small – less difficult (Category 1) projects and small, difficult (Category 2) projects, respectively, where the range of surveyed installed costs was less than $15,000/acre. Nine of the surveyed soil stabilization techniques fell into this price category. Figures 3-2 and 3-3 presents installed cost for soil stabilization techniques on small – less difficult (Category 1) projects and small difficult (Category 2) projects,

respectively, where the range of surveyed installed costs was greater than $15,000/acre. Three of the soil stabilization techniques surveyed fell into this price category.

Figures 3-5 and 3-7 present installed cost for soil stabilization techniques on large – less difficult (Category 1) projects and large, difficult (Category 2) projects, respectively, where the range of surveyed installed costs was $6,000/acre or less. Nine of the soil stabilization techniques surveyed fell into this price category. Figures 3-6 and 3-8 present installed cost for soil stabilization techniques on large standard (Category 1) projects and large, greater difficulty (Category 2) projects, respectively, where the range of surveyed installed costs greater than $6,000/acre. Three if the soil stabilization techniques fell into this price category.

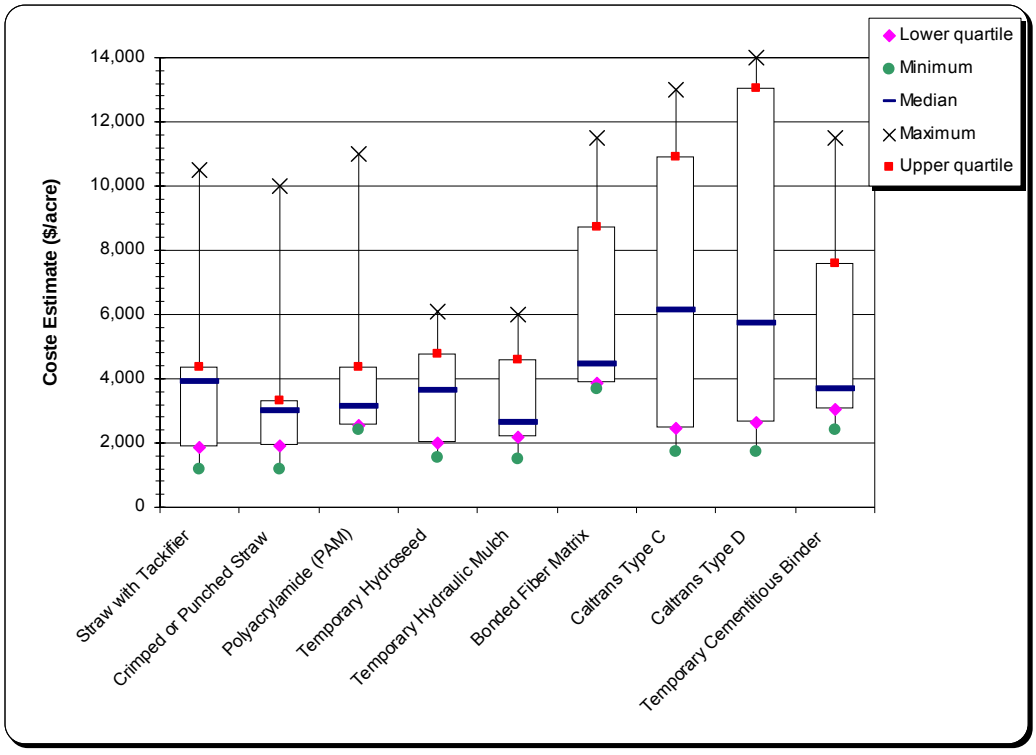

Figure 3-1. Small Project – Category 1 boxplots for BMPs where installed costs had ranges less than $15,000/acre.

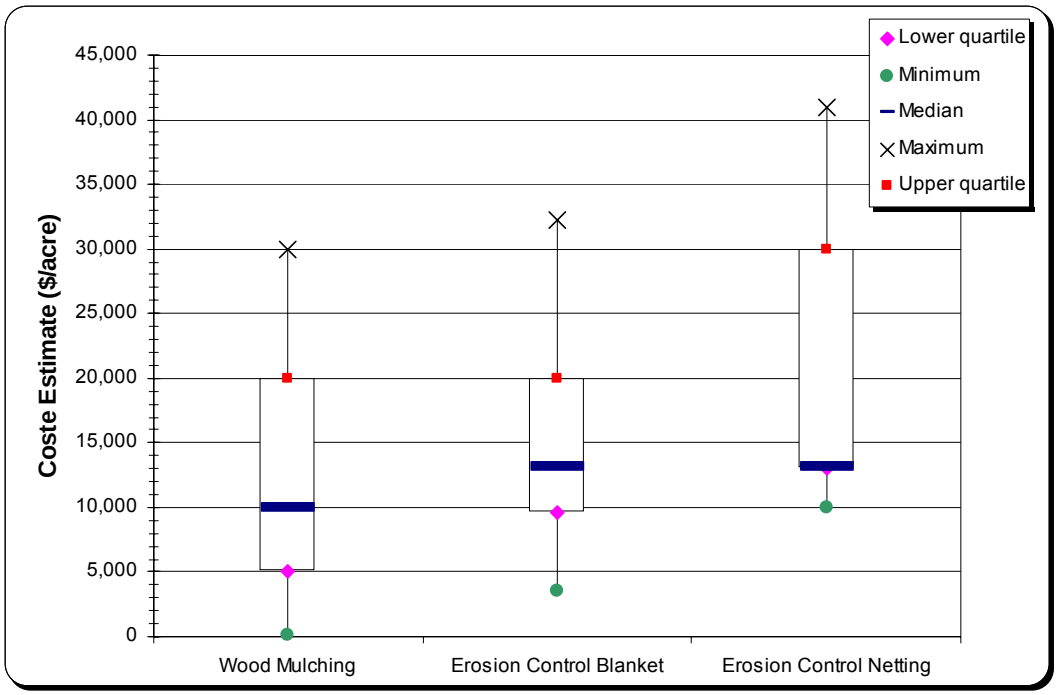

Figure 3-2. Small Project – Category 1 boxplots for BMPs where installed costs had ranges above $15,000/acre.

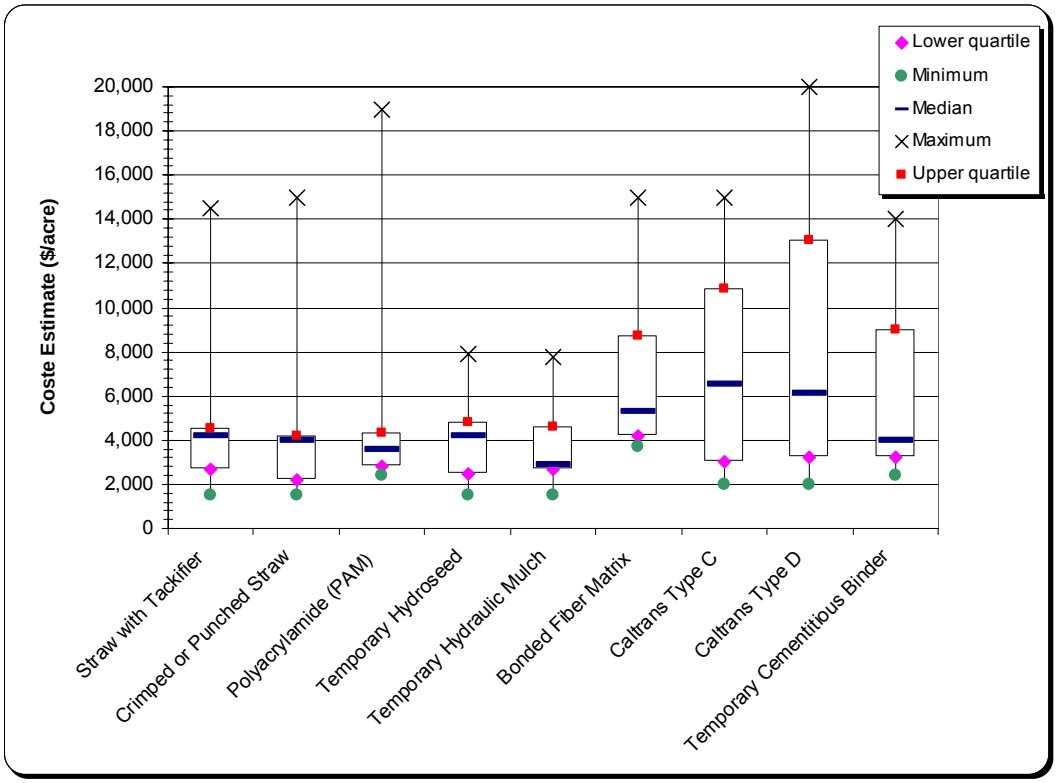

Figure 3-3. Small Project – Category 2 boxplots for BMPs where installed costs had ranges of $15,000/acre or less.

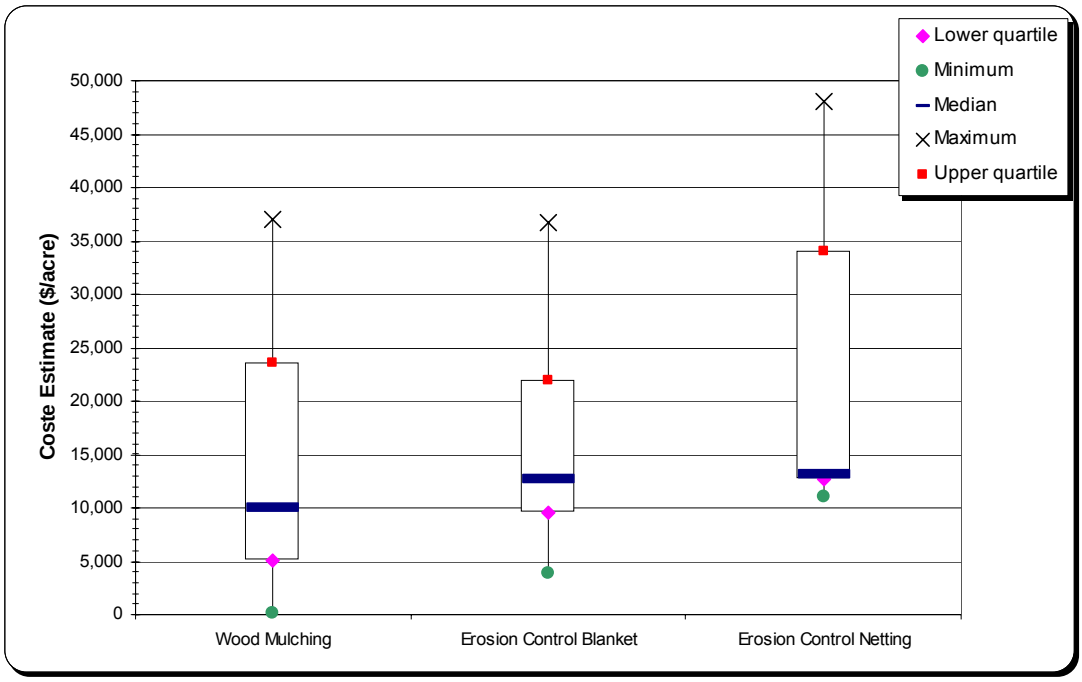

Figure 3-4. Small Project – Category 2 boxplots for BMPs where installed costs had ranges above $25,000/acre.

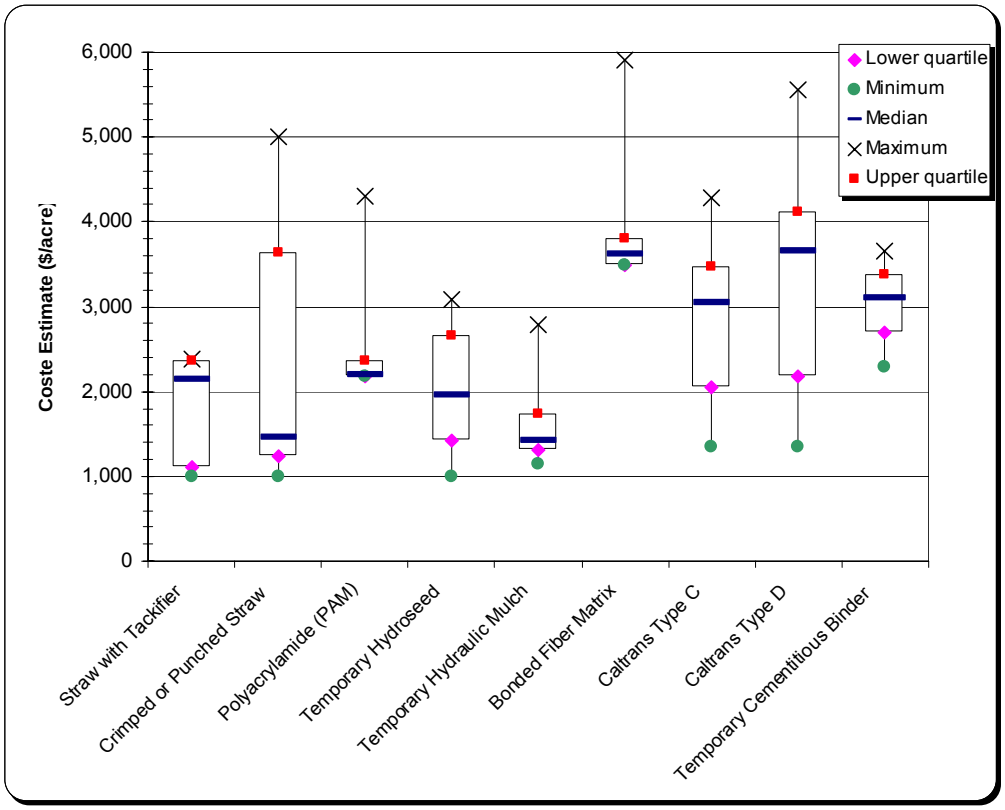

Figure 3-5. Large Project – Category 1 boxplots for BMPs where installed costs had ranges of $6,000/acre or less.

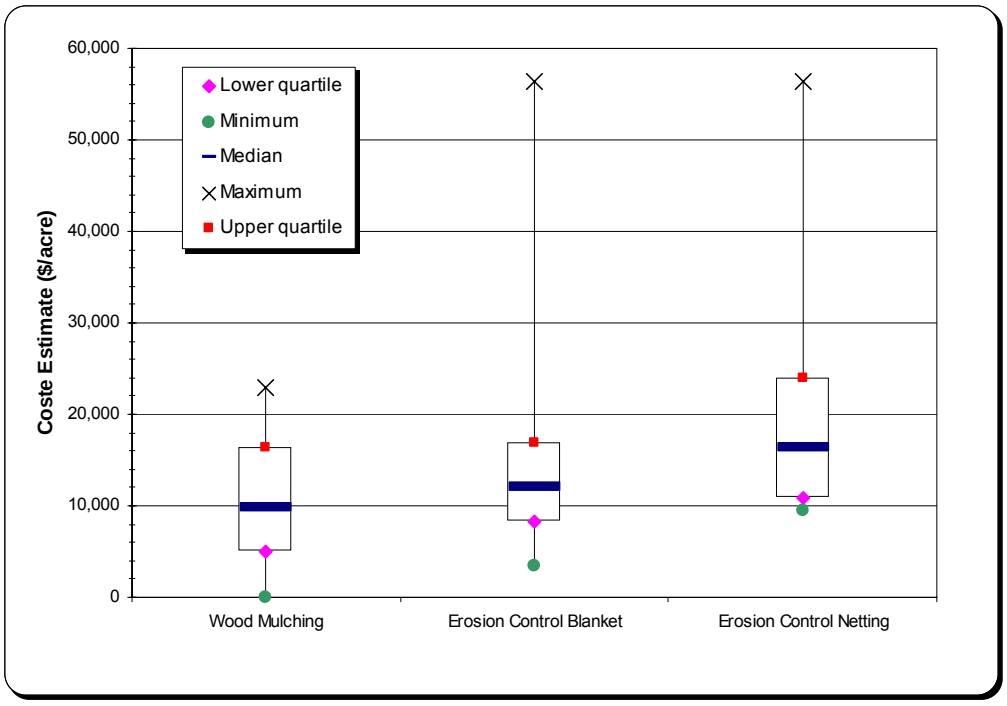

Figure 3-6. Large Project – Category 1 boxplots for BMPs where installed costs had ranges above $6,000/acre.

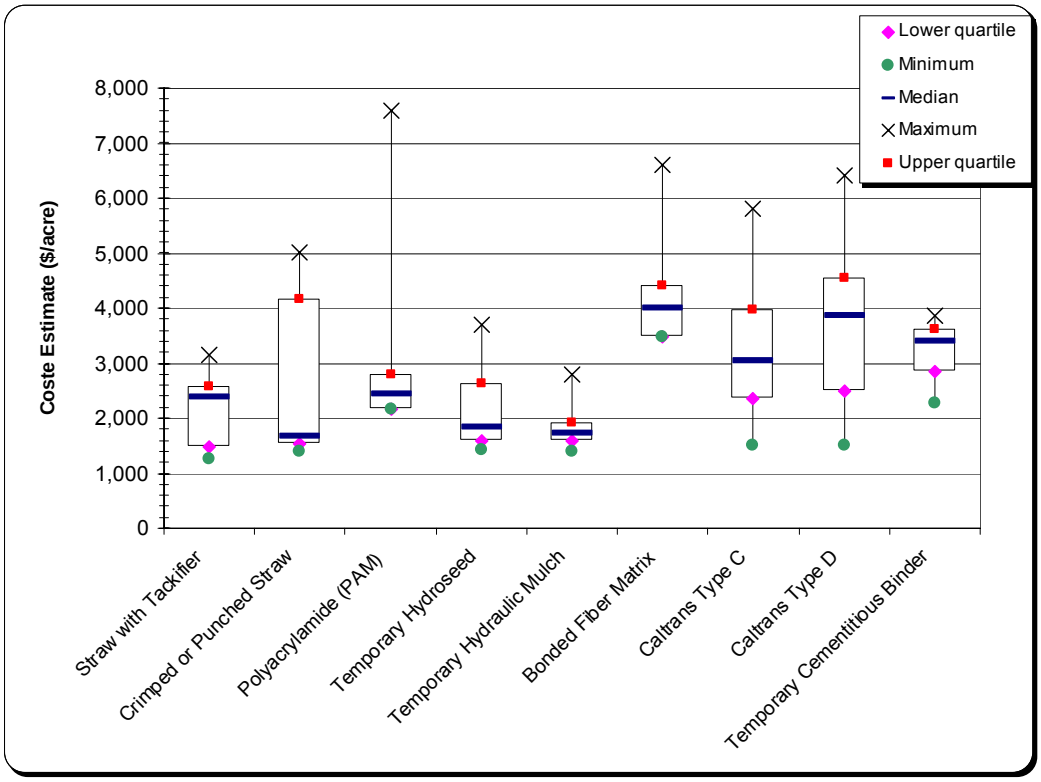

Figure 3-7. Large Project – Category 2 boxplots for BMPs where installed costs had median values of $5,000/acre or less.

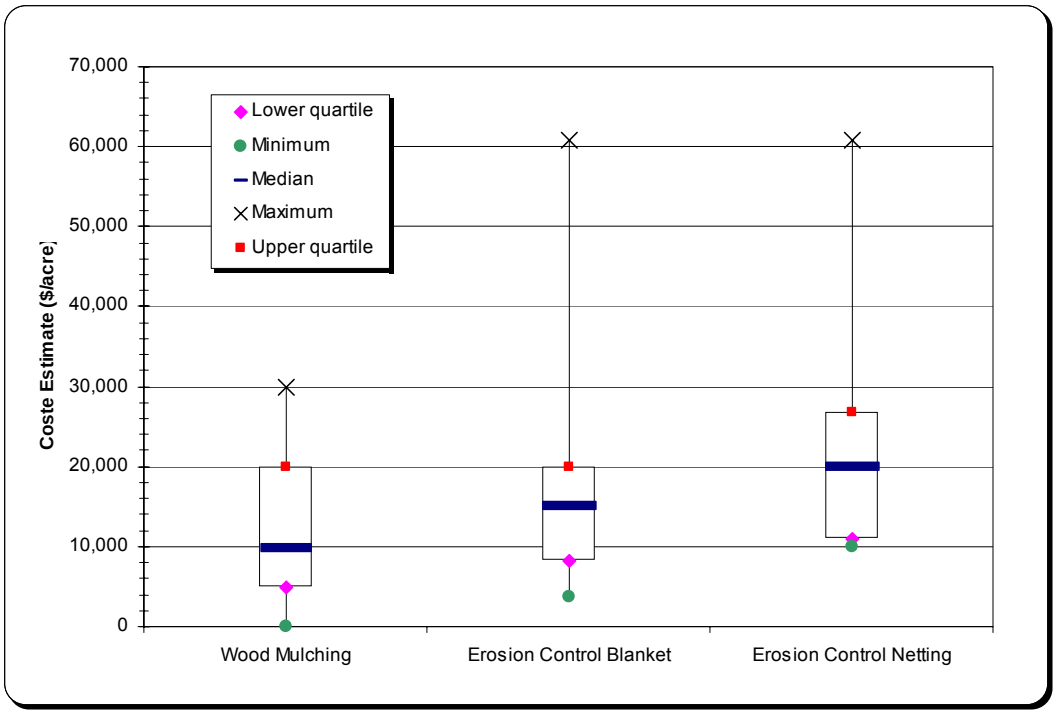

Figure 3-8. Large Project – Category 2 boxplots for BMPs where installed costs had ranges above $6,000/acre.

4. Conclusions

The summary matrix (Section 3.3, Table 3-3) shows that the average installation costs for most of the BMPs were distributed over a wide range. The boxplots (Section 3.4) show that there was consistency in pricing for the more commonly used soil stabilization BMPs, such as temporary hydroseeding, bonded fiber matrix, polyacrylamide and straw with tackifier but not for the less common BMPs such as pneumatically-applied wood bark mulch, erosion control blankets and netting.

The boxplots also indicate that there were outliers in the price for each of the BMPs, suggesting that a contractor's cost estimate for a particular soil stabilization practice that they do not specialize in, or may not routinely bid on projects involving these particular methods, may not be representative of competitive costs (e.g. wood (bark) mulching, refer to Table 3-2). Price outliers may also reflect particular stabilization methods that may not be as readily available in a certain geographic areas.

Skewness was also observed in the installed cost estimates, suggesting that either there was not enough cost information provided or that the contractor was not as familiar with the particular soil stabilization practice. For example, there were only three submittals out of the ten vendors interviewed for the wood mulching BMP, which suggested that the practice is not as commonly applied. Additionally, the boxplots showed that the installed cost values for wood mulch were distributed over a large range. For example, the lowest installed cost for a small project was indicated as $70 per acre with the highest being $30,000 per acre.

In order to reduce the skewness of the distributed installed costs, outliers were excluded and a new mean was established (Table 4-1). The outliers were determined using the box plots as well as professional judgment. Box plot values that showed an abnormal distance from other values (deemed more "normal" or common) were generally excluded. New ranges of installed costs for the candidate BMPs were then determined using 20% above and below the new mean for the high and low values, respectively.

Finally, it should be noted that most of the contractors interviewed felt that the Category 1 and 2 criteria (less difficult versus difficult projects) had less bearing on pricing than the actual size of the project. This can be interpreted as meaning that few contractors bid and/or complete projects beyond a certain distance from their home base. A consistent comment was that more difficult projects are not necessarily those that require long hose deployments or areas that have steeper slopes, but consist of those projects that have existing vegetation in the form of ornamental or containerized planting that need to be "worked around."

Table 4-1. Installed Cost Ranges for Soil Stabilization BMPs

BMP Type & Description	Installed Cost (cost/acre)							
	Small Project[1]				Large Project[2]			
	Category 1[3]		Category 2[4]		Category 1[3]		Category 2[4]	
	Mean[5]	Range	Mean[5]	Range	Mean[5]	Range	Mean[5]	Range
Wood (bark) Mulching	$20,000	$16,000 — $24,000	$23,000	$18,400 — $27,600	$13,676	$10,941 — $16,411	$19,901	$15,921 — $23,881
Straw with Tackifier	$3,020	$2,416 — $3,624	$3,417	$2,734 — $4,100	$1,823	$1,458 — $2,187	$2,172	$1,738 — $2,607
Crimped or Punched Straw	$2,349	$1,879 — $2,819	$2,968	$2,374 — $3,562	$2,033	$1,626 — $2,440	$2,778	$2,223 — $3,334
Hydraulic Mulch Fiber with Polyacrylamide (PAM)	$3,226	$2,581 — $3,871	$3,378	$2,702 — $4,054	$2,537	$2,030 — $3,044	$2,438	$1,950 — $2,926
Temporary Hydroseed	$3,149	$2,519 — $3,779	$3,473	$2,778 — $4,168	$1,951	$1,561 — $2,341	$2,150	$1,720 — $2,580
Temporary Hydraulic Mulch	$2,862	$2,290 — $3,434	$3,103	$2,482 — $3,724	$1,688	$1,351 — $2,026	$1,861	$1,488 — $2,233
Bonded Fiber Matrix	$4,057	$3,246 — $4,868	$5,222	$4,178 — $6,266	$3,901	$3,121 — $4,682	$4,219	$3,375 — $5,063
Caltrans Erosion Control Type C	$4,705	$3,764 — $5,646	$5,077	$4,062 — $6,092	$2,816	$2,253 — $3,380	$3,284	$2,627 — $3,940
Caltrans Erosion Control Type D	$7,291	$5,833 — $8,749	$5,537	$4,430 — $6,644	$3,390	$2,712 — $4,069	$3,841	$3,073 — $4,610
Erosion Control Blanket	$14,162	$11,330 — $16,994	$15,334	$12,267 — $18,401	$12,445	$9,956 — $14,934	$14,238	$11,390 — $17,086
Erosion Control Netting	$17,468	$13,974 — $20,962	$19,120	$15,296 — $22,944	$14,971	$11,977 — $17,965	$16,523	$13,218 — $19,828
Temporary Cementitious Binder	$3,048	$2,438 — $3,658	$3,198	$2,558 — $3,838	$3,012	$2,410 — $3,615	$3,179	$2,543 — $3,815

NOTES:

[1] *Small Projects: 0.12 acres (5,000 sq ft) to 0.5 acres (22,000 sq ft); slope inclination of 2:1 and slope length that does not exceed 30 feet*

[2] *Large Projects: 2.0 - 5.0 acres; 2:1 slope and slope length from 50 - 100 feet*

[3] *Category 1: Within 20 miles; access from top and bottom (but not both); shooting from the tower; no long hose runs.*

[4] *Category 2: Further than 20 miles; access from top or bottom (but not both); long hose runs will likely be required*

[5] *Mean was established by eliminating outlier data using professional judgement. Value ranges set at 20% above and below the mean installed costs.*

ADDITIONAL NOTES:

Contractors indicated that Category 1 & 2 (less difficult versus more difficult) had less bearing on pricing than the actual size of the project. A consistent comment was that more difficult projects are not necessarily those that require long hose deployments or areas that have steeper slopes, but consist of those projects that have existing vegetation in the form of ornamental or containerized plantings that need to be "worked around".

4.1 Company Name of Questionnaire Participants

- Acacia Hydroseeding
- Hanford Applied Restoration
- Hydro-Plant, Inc.
- Hydrosprout, Inc.
- Inland Erosion Control
- J & M Land Restoration
- Nature-Gro
- Nitta Construction Inc.
- Pacific Erosion Control
- Selby Erosion Control

5. References

California Department of Transportation (Caltrans). 1999. *Field Fuide: Soil Stabilization for Temporary Slopes.* (Caltrans Contract No. 43A0004C, Task Order 17, Prepared by URS Greiner Woodward Clyde), Caltrans Document Number: CTSW-RT-99-082, Sacramento, CA., November, 30