SECTION 7: APPROACH TO ESTIMATING COSTS

7.1 OVERVIEW

This section describes EPA's methodology for estimating costs associated with implementing the regulatory options considered for the final action on construction and development effluent guidelines. EPA estimated three distinct cost categories:

1. Erosion and sediment control (ESC) costs, including design, installation, operation, and maintenance;

2. Administrative costs to permittees for activities such as conducting site inspections and providing certifications;

3. Opportunity and interest costs to permittees.

The methodology for determining costs for categories 1 and 2 are described in this document. Costs for category 3 are described in the document "Economic Analysis for Final Action for Effluent Guidelines and Standards for the Construction and Development Category," EPA-821-B-04-002.

For each state, per site costs were evaluated individually for 24 combinations of site-size and land use types. EPA developed per-site costs based on model construction sites that reasonably represent common construction site features, and factors related to state regulations, topography, and hydrology. Using estimates of the population of new construction acreage developed annually in the U.S. obtained from the USDA's National Resources Inventory (NRI) and the U.S. Census Bureau (described in Section 4 of this document), EPA computed State total costs by multiplying modeled per-site costs by the population of construction sites in each land use/site-size combination for 48 states. Costs for Alaska and Hawaii, as well as the U.S. territories were not estimated because EPA lacked data on the annual amount of construction in these areas. However, due to the small amount of construction that occurs in these areas, EPA expects that these values would be low in comparison to the national costs. National level costs were calculated by summing the State costs. The total costs of the options considered are presented in Table 7-1.

Table 7-1. Total Costs of Options

Option	Annual Cost (millions 2002 dollars)
1 - Inspection and Certification for sites ≥1 acre	$280
2 - Codify EPA Construction General Permit (CGP) with Inspection and Certification for sites ≥5 acres	$585
3 - No Regulation	$0
4 - Codify EPA Construction General Permit (CGP) for sites ≥5 acres	$380

As detailed below, EPA employed a three-step process to compute the total national compliance cost:

1. Model site costs were estimated using national average unit costs;

2. Model site costs were computed using state-specific cost adjustment factors;

3. State totals were summed to produce the national compliance cost estimates; and

7.2 ANALYSIS OF STATE EQUIVALENCY

State construction general permits, erosion and sediment control regulations, and storm water management regulations were collected and compiled to determine if existing state programs were equivalent to requirements contained in the July 2003 EPA Construction General Permit (CGP). The data were collected by reviewing state web sites for general permits, erosion and sediment control regulations, storm water management regulations, and erosion and sediment control and storm water BMP design and guidance manuals. States without web-accessible information were contacted to obtain the appropriate information

For the analysis of equivalency with the construction general permit, EPA focused on six main areas:

1. Requirements for preparing a storm water pollution prevention plan (SWPPP) or equivalent document and for installing general erosion and sediment controls, such as silt fencing, inlet protection and soil stabilization;

2. The amount of time allowed for providing stabilization of exposed soil when construction activities have temporarily or permanently ceased;

3. Requirements for installing sediment traps for drainage areas of less than 10 acres;

4. Requirements for installing sediment basins for drainage areas of 10 or more acres;

5. Requirements for removing accumulated sediment from sediment controls when sediment storage capacity has been reduced by at least 50%; and

6. Requirements to conduct inspections at least every 7 days OR every 14 days and following rainfall of 0.5" or more.

This analysis indicates that many States have requirements similar to those contained in the EPA construction general permit, which is the basis for the requirements contained in Options 2 and 4. No states currently have requirements equivalent to the inspection and certification provisions of Option 1 and 2. For each State, EPA's review determined if certain key BMPs are required, and for what construction site size a particular BMP is required. This information was used to determine the baseline BMP sizes and quantities for each of the 24 model construction sites in each state across the U.S. By comparing these sizes and quantities with those required under each regulatory option, the incremental BMP quantities and size increases can be calculated. For sediment basins and sediment traps, the size of the BMP required by the state program was also noted. Where a state program did not note a sediment basin size, EPA assumed based on BPJ that the baseline size was 1,800 cubic feet per acre. A summary of the state equivalency analysis as of September 2003 is presented in Table 7-2 and detailed data sheets for each state are presented in Appendix D.

Table 7-2. State Equivalency with EPA CGP Requirements

State	Seeding Required 14 Days After Construction Activity Ends	Basic Sediment Controls Required	Sediment Trap for Drainage Areas < 10 acres	Sediment Basin for Drainage Areas ≥ 10 acres	Sediment Removal when Storage Capacity Reduced 50% or More	Inspections every 7 days OR Every 14 Days and Following Storms ≥ 0.5 inches	Sediment Trap Storage Volume (ft^3/ acre drained)	Sediment Basin Storage Volume (ft^3/ acre drained)
Alabama		Yes		Yes	Yes			3,600
Alaska	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Arizona	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Arkansas	Yes	Yes	Yes	Yes		Yes	1,800	3,600
California		Yes		Yes				3,600
Colorado		Yes				Yes		1,800
Connecticut		Yes				Yes		1,800
DC	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Delaware	Yes	Yes		Yes				3,600
Florida	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Georgia	Yes	Yes				Yes		1,800
Hawaii		Yes				Yes		1,800
Idaho	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Illinois	Yes	Yes				Yes		1,800
Indiana	Yes	Yes						1,800
Iowa	Yes	Yes	Yes	Yes		Yes	1,800	3,600
Kansas		Yes		Yes		Yes		3,600
Kentucky	Yes	Yes		Yes	Yes	Yes		3,600
Louisiana		Yes	Yes	Yes	Yes	Yes	1,800	3,600
Maine	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Maryland		Yes						1,800
Massachusetts	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Michigan		Yes		Yes		Yes		3,600
Minnesota		Yes		Yes	Yes	Yes		3,600
Mississippi		Yes		Yes	Yes	Yes		3,600

Missouri		Yes						1,800
Montana		Yes				Yes		1,800
Nebraska		Yes	Yes			Yes	1,800	1,800
Nevada	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
New	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
New Jersey		Yes						1,800
New Mexico	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
New York	Yes	Yes	Yes	Yes		Yes	1,800	3,600
North Carolina				Yes	Yes	Yes		3,600
North Dakota		Yes				Yes		1,800
Ohio	Yes	Yes				Yes		1,800
Oklahoma	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Oregon		Yes			Yes	Yes		1,800
Pennsylvania		Yes	Yes	Yes	Yes		1,800	3,600
Rhode Island		Yes				Yes		1,800
South Carolina	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
South Dakota	Yes	Yes		Yes	Yes	Yes		3,600
Tennessee	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Texas	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Utah	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Virginia	Yes	Yes	Yes	Yes	Yes	Yes	1,800	3,600
Vermont		Yes				Yes		1,800
Washington		Yes				Yes		1,800
West Virginia	Yes	Yes	Yes	Yes			1,800	3,600
Wisconsin		Yes				Yes		1,800
Wyoming		Yes			Yes	Yes		1,800

Note: "Yes" indicates that the requirement for the particular element is equivalent to that contained in the EPA CGP.

7.3 DEVELOPMENT OF MODEL CONSTRUCTION SITES AND ESTIMATES OF BMP QUANTITIES

In order to determine BMP quantities for baseline conditions as well as for the regulatory options considered, EPA developed a series of model construction sites that contained representative BMPs for each of the 24 site size and land use combinations developed in Section 4 (see Table 4-9). This analysis used four land use types to account for variations in amounts of ESC BMPs expected to be used across the range of land uses resulting from construction, and six site-size classes to account for economies of scale that might occur with the design and installation costs for certain BMPs (i.e., some BMPs are employed only if the site size is greater than a threshold value).

As documented in detail within Appendix A, six-site geometries (one per construction site size category) were developed on which to base this analysis. Each model construction site was placed within a model watershed system where first order watersheds occupy 25 acres, in order to define topography and preexisting drainage pathways. The assessment of 19 ecoregions found first order streams can occupy between 22 and 57 acres, and a 25 acre watershed represents a reasonable lower end value. Next, for each site-size category, the area within each model construction site was apportioned to three surface flow pathways:

1. Disturbed areas that drain to a centralized point;

2. Undisturbed areas that drain to a centralized point; and

3. Perimeter drainage that discharges in diffuse fashion through the site perimeter.

This was necessary in order to account for the fact that construction sites typically contain multiple drainage pathways due to the topography of the site. Proper BMPs selection and sizing should account for these drainage patterns, and a single site will typically employ different BMPs to serve various portions of the site. A 25-foot width of perimeter drainage was assumed for portions of site border that would likely drain radially outward and away from the site through perimeter BMPs such as silt fencing. For the central drainage portion of each model site, a pattern of internal drainage features (pipes and swales) that are commonly employed were assumed, with these areas ultimately draining to a sediment control practice such as a sediment trap or basin. The division between disturbed and undisturbed acreage within this central drainage area was based on land use specific pervious/imperviousness ratios provided by CWP (2001) and shown in Table 7-3. This distinction was necessary in order to account for two factors. First, portions of each site will be maintained in a relatively undisturbed state as open space, and will contribute little or no sediment. EPA assumed that one half of the pervious footprint on each site would remain undisturbed.

Table 7-4 shows the resulting percentage of site area for each of the three pathways introduced above, for each of the four land uses evaluated to categorize the industry.

Table 7-3. Land Use-Specific Impervious Cover Factors

Land Use Category	Percentage Impervious Cover	Percent Used in EPA Modeled Land Use
Agriculture	2	Not modeled
Low Density Residential	11-14	Not modeled
Medium Density Residential	21-28	24.3 for Single Family Residential
High Density Residential	33-44	43.4 for Multi-Family Residential
Industrial	53	52.8 for Industrial
Commercial	72	72 for Commercial

Source: Adapted from Capiella and Brown, 2001

Table 7-4. Percentage of Construction Site in Each of Three Flow Pathways

Site Size (acres)	Centralized Drainage (Disturbed Acreage)				Centralized Drainage (Undisturbed Acreage) *				Perimeter Drainage **			
	SF	MF	Comm	Ind	SF	MF	Comm	Ind	SF	MF	Comm	Ind
0.5***	0%	0%	0%	0%	38%	28%	24%	14%	34%	34%	34%	34%
3	42%	51%	56%	66%	38%	28%	24%	14%	20%	20%	20%	20%
7.5	42%	51%	56%	66%	38%	28%	24%	14%	20%	20%	20%	20%
25	55%	64%	69%	78%	38%	28%	24%	14%	8%	8%	8%	8%
70	54%	64%	68%	78%	38%	28%	24%	14%	8%	8%	8%	8%
200	55%	64%	69%	79%	38%	28%	24%	14%	7%	7%	7%	7%

* Assumed to retain original topography and vegetative cover.
** The portion of the site that drains radially outward toward the site boundary.
*** Note, the half-acre site group percentages do not add up to 100 percent because they do not include the site fraction that is disturbed but unmanaged because the site falls below the CGP minium site size of 1 acre. These sites do not experience any incremental changes as a result of the options, but are carried through the analysis in order to have a complete accounting of baseline sediment loads for the loadings and benefits analysis presented in Section 8.
SF = single family
MF = multi-family
Comm = commercial
Ind = industrial

After defining the site geometries and drainage pathways for each of the six site size categories, the BMP quantities and sizes required by the EPA CGP (the technical basis for Options 2 and 4) were determined based on BPJ. Appendices A and B contain detailed descriptions of each of the model sites developed. The specific BMPs contained in the model site analyses include:

- Silt Fencing
- Runoff Diversions/Inlet Protection
- Seeding and Mulching
- Stabilized Construction Entrances
- Stone Check Dams
- Sediment Traps
- Sediment Basins

In addition, EPA estimated the number of certifications required to meet the provisions of Options 1 and 2, and the number of site inspections required to meet the inspection provisions of the CGP. The BMP quantities for each of the model site sized required by the EPA CGP are shown in Table 7-5. Next, the baseline BMP quantities and sizes were determined for each of the six site size categories for each state based on the equivalency analysis contained in Table 7-2. Tables B-10 and B-11 contain detailed BMP quantities for the six site size categories for all 48 states (excluding Alaska and Hawaii). One important assumption was made that the amount of acreage requiring seeding and mulching for erosion control does not change from baseline conditions. The assumption is that the EPA CGP requirement to provide stabilization of exposed soil areas within 14 days after construction activities have temporarily or permanently ceased does not actually change the quantity of acreage requiring stabilization, but that it merely changes the timing by which the stabilization must occur. As a result, there are no additional costs attributable to this requirement.

This data on BMP quantities, in combination with the state-level estimates of the number of construction sites contained in Appendix E, allowed for estimation of the total number and size of BMPs implemented for all construction sites nationally under baseline conditions as well as under the EPA CGP (see Tables B-10 and B-11 in Appendix B, and note than Baseline conditions are listed as Option 3 in these tables). For the inspection and certification provisions of Options 1 and 2, EPA estimated the total number of professional hours required to conduct these activities for each of the site sizes. Multiplying by the state-level estimates of the number of construction sites allowed for estimation of the total number of hours required to conduct these activities.

Table 7-5. BMP Quantities Required by EPA CGP for Model Construction Sites

Site Size (acres)	Silt Fencing (linear miles	Inlet Protection (Installations)	Seeding and Mulching (acres)[3]	Number of Stabilized Construction Entrances	Number of Stone Check Dams	Sediment Traps[2]		Sediment Basins[1]	
						Number	Size Each (cubic feet)	Number	Size Each (cubic feet)
0.5	0.09	2	0.31/0.43	1	0	0	0	0	0
3	0.20	3	1.9/2.6	1	3	0	0	0	0
7.5	0.50	6	4.7/6.5	1	6	2	4,725/5,400	0	0
25	0.63	10	13/21.5	1	11	0	0	2	31,500/36,000
70	1.36	20	36.4/60.2	2	20	0	0	3	58,800/67,200
200	7.73	60	124/172	4	62	0	0	10	50,400/57,600

[1] Range demonstrates variation with land use. Sediment basins designed to 3,600 cubic feet per acre in volume (1,800 cubic feet of which is for sediment storage) applicable to States equivalent to National Construction General Permit. Divide values in half to obtain values for non-equivalent States.
[2] Range demonstrates variation with land use. Sediment or silt traps are designed based on 1,800 cubic feet per acre served.
[3] Ranges between 62 and 86 percent of the site acreage depending on land use

7.4 ESTIMATION OF BMP COSTS

Estimated unit cost data for each BMP element was derived from literature sources including R.S. Means (2000), data from the article "The Economics of Stormwater Treatment: An Update" (Schueler, 2000), from the EPA Nonpoint Source Management Measures Guidance (EPA, 1993), and from evaluation of a variety of references that contain BMP unit cost data, primarily bids on highway construction projects and municipal bonding requirements (EPA, 2003). National average unit costs for the BMPs contained in the cost model are given in Table 7-6.

A single unit cost factor was used for sediment basins and silt traps. While basin costs are expected to be non-linear (i.e., the unit cost for large basins is less than for small basins), no single costing relationship was identified that satisfied the range of basin sizes encountered in the model site sizes. Hence a constant value of $13,068 per acre-foot (or $0.30 per cubic foot) was used to estimate costs for all site sizes and all options. This value was taken from the EPA Nonpoint Source Management Measures Guidance (EPA, 1993). Since this reference was somewhat dated, EPA evaluated a number of additional data sources (EPA, 2003) to determine if the cost factor of $0.30 per cubic foot was still valid. Based on a review of 32 recent references, it was determined that the value of $0.30 per cubic foot was still valid. As a result, this value was used to determine the unit costs of all sediment basins and sediment traps.

For site inspection costs, EPA estimated that the average construction site would require 16 hours to conduct an inspection, with an average labor costs of $28 per hour. For certification costs, EPA estimated that the average construction site would require $455 per certification, with an average labor costs of $57 per hour.

In order to account for state-level variation in supply, material and labor costs, EPA used the state-level cost adjustment factors shown in Table 7-7. All unit costs in Table 7-6 were multiplied by these cost adjustment factors to arrive at state-specific unit costs. In addition, EPA added costs to account for BMP design, operation and maintenance. Design costs only apply to certain BMPs that in general require customization for each construction site. In addition, only certain BMPs will incur O & M costs over the duration of the assumed construction period (estimated to be 1 year). The estimated design costs as a percentage of installation costs are presented in Table 7-8.

Using the state estimates of BMP quantities contained in Tables B-10 and B-11 in Appendix B along with the unit costs and cost adjustment factors contained in Tables 7-6 and 7-7, the total national installation costs were calculated for each option as well as under the baseline condition. Adding design and O&M costs contained in Table 7-8, the total national compliance costs (without opportunity and interest costs) were determined. Tables B-12 and B-13 in Appendix B contain national and state-level total costs by regulatory option (note than Baseline conditions are listed as Option 3 in these tables). Contingency costs were added according to the methodology contained in the Economic Analysis document. Please see the EA for an explanation of this methodology, as well as for information on calculating the total costs of the regulatory options.

Table 7-6. Unit Cost Factors For BMPs

BMP	National Unit Cost Value (no profit or overhead)	Unit Cost Units	Data Source
Silt Fence	$4,857.60	Per Mile	R.S. Means
Runoff Diversion	$2,904.00	Per Mile	R.S. Means
Mulching for Erosion Control	$1,113.20	Per Acre	R.S. Means
Construction Entrances	$692.00	Per installation	R.S. Means
Rock Check Dam	$45.53	Per installation	R.S. Means
Silt Trap	$13,068.00	Per acre foot of storage	EPA, 1993
Sediment Basins	$13,068.00	Per acre foot of storage	EPA, 1993
Inlet Protection	$100.00	Per installation	R.S. Means
Installation Certification	$455.00	Per Certification	BPJ
E&S Site Inspection	$113.48	Per inspection	BPJ

Table 7-7. State Cost Adjustment Factors

State	Unit Cost Adjustment Factor	State	Unit Cost Adjustment Factor
AL	0.80	NC	0.77
AR	0.80	ND	0.81
AZ	0.92	NE	0.84
CA	1.13	NH	0.90
CO	0.92	NJ	1.10
CT	1.07	NM	0.89
DC	0.95	NV	1.00
DE	0.99	NY	1.15
FL	0.86	OH	0.95
GA	0.78	OK	0.83
IA	0.87	OR	1.07
ID	0.92	PA	1.00
IL	1.00	RI	1.06
IN	0.92	SC	0.75
KS	0.88	SD	0.86
KY	0.88	TN	0.82
LA	0.86	TX	0.85
MA	1.10	UT	0.87
MD	0.90	VA	0.86
ME	0.84	VT	0.84
MI	0.98	WA	1.04
MN	1.00	WI	0.97
MO	0.92	WV	0.95
MS	0.78	WY	0.83
MT	0.95		

Reference: R.S. Means, 2000

Table 7-8. Design and O & M Costs as a Percentage of Installation Costs

Costed Items	Design as a Percent of Installation Cost*	Operation and Maintenance Costs as a Percent of Installation Cost**
Silt Fence	16	100
Runoff Diversion	16	10
Mulching for Erosion Control	16	2
Construction Entrances	16	5
Rock Check Dam	16	5
Silt Trap	16	20
Sediment Basin	16	25

* Source: focus groups conducted with NAHB
** Source: Best Professional Judgement

7.5 REFERENCES

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