Voluntary Implementation of Forestry Best Management Practices in East Texas

Results from Round 6 of
BMP Implementation Monitoring

TEXAS FOREST SERVICE
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Results from Round 6 of BMP Implementation Monitoring
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by

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TEXAS FOREST SERVICE
Forest Resource Development
Best Management Practices Project

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EXECUTIVE SUMMARY

A Best Management Practices (BMP) monitoring program evaluated the level of implementation with voluntary forestry BMPs. A total of 156 sites on which silvicultural activities occurred were evaluated. These sites were monitored between May 7, 2003 and July 1, 2005 and are believed to be a representative sample of the forestry activities that occurred in East Texas during that time.

Overall BMP implementation on the sites monitored was 91.7%. In general, implementation was highest on sites under public ownership. These national and state forestland sites had an overall implementation of 98.3%, while industry sites had a 95.7% implementation rating. Corporate lands (commercial landowners that do not have wood processing facilities) scored 96.0% overall while family forest owners scored 88.9%.

Implementation with BMPs was statistically significantly higher when:

- the landowner was familiar with BMPs
- the logging contractor had attended formal BMP training
- a forester was involved in the sale or activity
- BMPs were included in the timber sale contract
- the landowner was a member of a forest organization
- the timber was delivered to a Sustainable Forestry Initiative^{SM} (SFI^{SM}) mill
- the landowner lived in a non-metropolitan area
- the landowner was not absentee

Implementation was generally lowest on sites when:

- owned by family forest owners
- the logger had not attended the BMP workshop
- BMPs were not included in the timber sale contract

Major deficiencies noted during the evaluations were:

- failure to restore and stabilize stream crossings on temporary roads
- failure to remove logging debris from streams

Major improvements from previous rounds were:

- a decrease in the number of significant risks to water quality
- a higher overall BMP implementation on permanent and temporary roads
- an increase in BMP implementation on family forest lands

In previous rounds (1, 2, and 3) of monitoring, tracts were graded for implementation using a “Pass or Fail” method. In Round 4, a new system was developed that uses percentages to denote implementation. This method was continued in Rounds 5 and 6.

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BACKGROUND AND OBJECTIVES

The Clean Water Act (CWA), as reauthorized in 1987, called for states to establish a program for development and implementation of Best Management Practices to reduce nonpoint source (NPS) water pollution. The Act also required states to develop methods for determining "BMP effectiveness," including a measure of BMP implementation.

The Texas Silvicultural Nonpoint Source Pollution Project, funded by a FY02 CWA Section 319(h) grant from the Environmental Protection Agency (EPA) through the Texas State Soil and Water Conservation Board (TSSWCB), requires that a monitoring program be conducted to document the level of voluntary implementation of BMPs and effectiveness of BMPs in reducing NPS pollution from silvicultural activities. Objectives of the monitoring program are to:

1) Measure the degree of implementation of BMP guidelines by forest landowners, silvicultural contractors, forest industry, and government agencies.

2) Evaluate the effectiveness of BMPs as applied in the field and identify any weaknesses in the BMP guidelines.

This report documents the findings of the BMP implementation monitoring for 156 sites evaluated between May 7, 2003 and July 1, 2005. This data represents Round 6 of BMP implementation monitoring conducted by Texas Forest Service. Please refer to the Texas Forest Service October, 1992 publication *Voluntary Compliance with Forestry Best Management Practices in East Texas* for Round 1; the Texas Forest Service March, 1996 publication of the same title for Round 2 of implementation monitoring results; the Texas Forest Service April, 1998 publication, also same name, for Round 3; the Texas Forest Service September, 2000 publication, also same name, for Round 4, and the Texas Forest Service November 2002 publication *Voluntary Implementation of Forestry Best Management Practices in East Texas* for Round 5.

DISTRIBUTION AND SELECTION OF IMPLEMENTATION MONITORING SITES

To get a valid estimate of overall implementation with Forestry Best Management Practices in East Texas, monitoring sites were distributed regionally within East Texas and among all forestland ownership categories. Sites were believed to be representative of the distribution of all silvicultural activities across East Texas. The distribution of monitoring sites was based on the estimated annual timber harvest for each county as reported in the annual Texas Forest Service publication*, Texas Forest Resource Harvest Trends*. See Table 1.

Table 1. Distribution of Implementation Monitoring Sites by County.

County	Number of Sites Monitored
Anderson	3
Angelina	5
Bowie	5
Camp	1
Cass	12
Cherokee	7
Gregg	1
Grimes	1
Hardin	6
Harrison	6
Houston	3
Jasper	11
Liberty	5
Marion	3
Montgomery	3
Morris	1
Nacogdoches	6
Newton	8
Orange	1
Panola	9
Polk	11
Red River	3
Rusk	5
Sabine	4
San Augustine	5
San Jacinto	2
Shelby	6
Smith	2
Titus	1
Trinity	4
Tyler	10
Upshur	3
Walker	2
Wood	1
Total	**156**

QUALITY CONTROL

To eliminate bias, implementation monitoring sites were selected in a random manner using several methods, including aerial detection and information from Texas Forest Service (TFS) personnel. All monitoring evaluations were conducted by one or a

combination of two trained foresters assigned to the TFS BMP Project. Using only BMP Project employees as inspectors provided greater accuracy and quality control. At the beginning of the monitoring project, as well as periodically throughout the project, BMP Project foresters jointly evaluated tracts to maintain and improve consistency and fairness. The TFS BMP Project collected monitoring data in accordance with a Quality Assurance Project Plan, approved by TSSWCB and EPA.

MONITORING CHECKLISTS – OLD vs. NEW

After six years and three rounds of monitoring with a scoring system that applied a "Pass or Fail" assessment to each tract, a new, more objective form was implemented for Round 4, continued in Round 5, and used again for Round 6. This was done to follow the *Implementation Monitoring Protocol*, a guidance document approved by the Southern Group of State Foresters to allow states to coordinate their BMP monitoring programs. Although there is a section for the evaluator to record a subjective score, this new form no longer grades a tract as *No Effort*, *Poor*, *Fair*, *Good*, or *Excellent*. Instead, each tract receives a number, or percent, which demonstrates voluntary implementation. In other words, instead of a tract receiving a "Good," it might receive an 89%. This removed the "Pass or Fail" system. It is important to note that this form has been extensively field tested for consistency and accuracy of representing true BMP implementation. Once the field data is collected, it is entered into an Access database for storage and retrieval. This data can easily be imported into a Geographic Information System (GIS) for further analysis and geographical representation. Copies of the new form are found in the Appendix.

Previously, "effort" at installing BMPs was acknowledged. The subjective nature of the old form allowed for a tract that had some improperly installed BMPs to receive credit in some cases. The new form objectively notes whether or not, for example, waterbars were installed properly. No credit was given where BMPs were not effectively installed.

An additional category of "significant risk" appears on the form. A significant risk is a situation or set of conditions that have resulted in or will result in the measurable and significant degradation of water quality that could have been remedied or otherwise mitigated. A determination was made for each BMP or lack of a BMP to see if a significant risk to water quality existed.

For simplification, each question was worded so that a positive answer was recorded with a "Yes," while a negative answer, indicating a departure from BMP recommendations, was answered "No." This allowed readers to quickly determine any problem areas identified during an inspection.

INSPECTION CONTACTS

Landowners were contacted prior to the inspection of the site so that permission for entry onto the property could be obtained. During this initial contact, the forester explained the program and invited the landowner and his/her representative to join the

BMP forester on site during the evaluation. Sites were not inspected if the landowner denied access. In nearly all cases on forest industry property, an industry forester accompanied the BMP forester.

Landowners, logging contractors, and timber buyers (where applicable and identifiable) were provided a copy of the completed checklist, along with a cover letter explaining the BMP Project and instructions on interpreting the form. Recommendations for remediation, if applicable, were made.

RESULTS

Between May 7, 2003 and July 1, 2005, TFS BMP foresters evaluated BMP implementation on 156 sites, totaling 17,572 acres, throughout East Texas. These 156 tracts are geographically represented by ownership category in Figure 1. Tabulated results by question on the BMP implementation monitoring checklist are located in the Appendix.

SITE CHARACTERISTICS

The 156 monitoring sites were distributed both geographically and by ownership, as shown in Figure 1. Ninety-five of the 156 sites (61%) were on family forest lands. Thirty-six sites (23%) were owned by forest industry. Sixteen (10%) sites were owned by corporate landowners. Nine sites (6%) were on publicly owned lands.

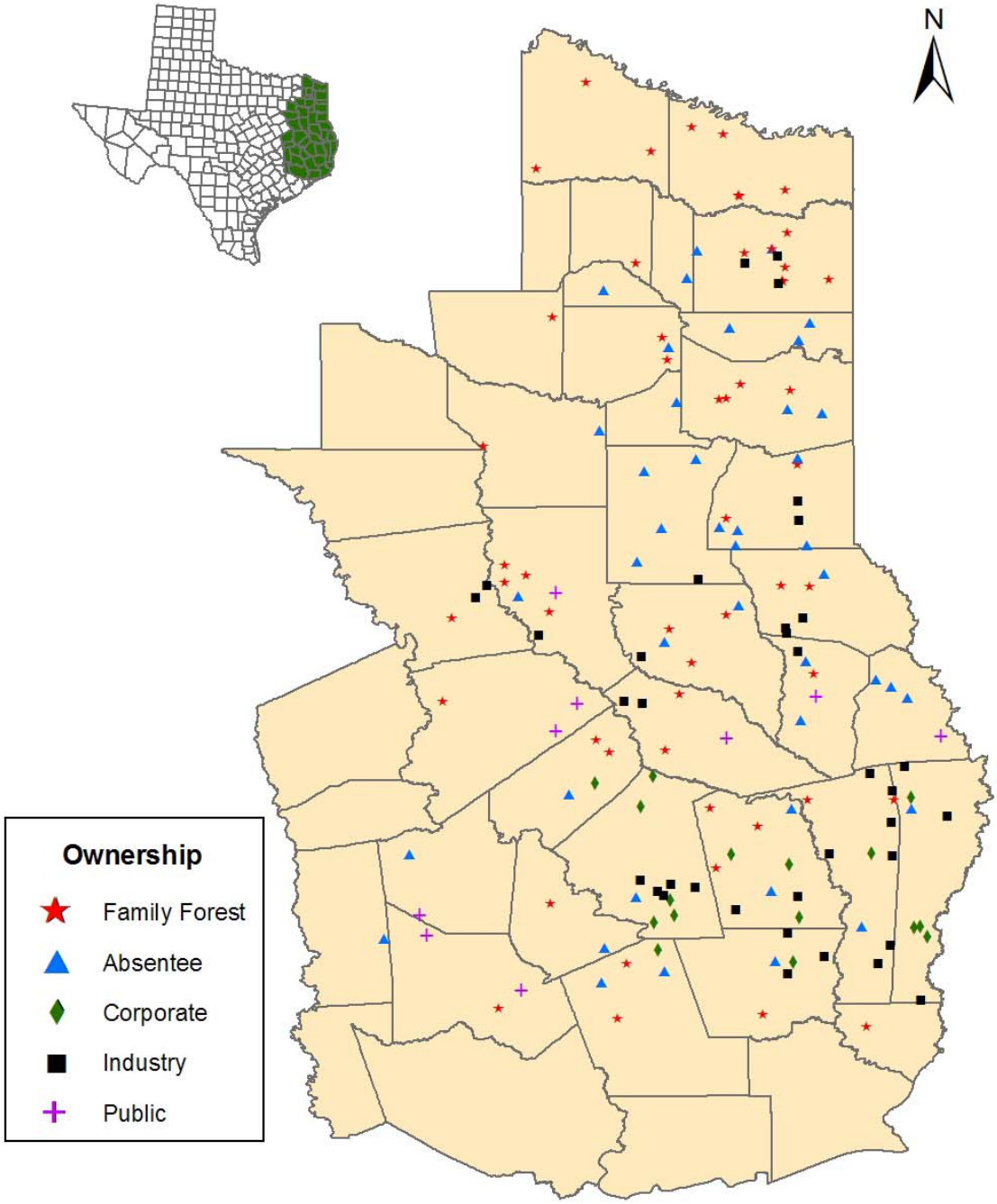
The majority of sites (61%) were monitored after a regeneration harvest, including 85 clearcuts and nine partial harvests (such as diameter cuts, shelterwood cuts, or selection harvests). Fifty-five thinning and seven site preparation operations were evaluated. In 48 cases, the site preparation evaluation was included in elements of the preceding timber harvest operation or succeeding planting operation.

Professional foresters were involved in planning and/or implementing the silvicultural operation on 102 (65%) of the sites. Private consultants were involved on 54 sites. On 39 sites, the forester was employed by forest industry, while U.S. Forest Service and Texas Forest Service foresters were involved on nine sites.

Terrain classification and soil erodibility were recorded from the Natural Resources Conservation Service (NRCS) Soil Survey, if available, or estimated by the forester in the field. Forty-one sites (26%) were on flat terrain. One hundred nine sites (70%) were on hilly terrain and six (4%) were on steep terrain. Fifty-five sites (35%) were on soils with low erodibility, 77 sites (49%) on medium erodibility soils, and 24 (16%) were on high erodibility soils.

Of the 156 sites, 120 had either a perennial (29) or intermittent (60) stream or both perennial and intermittent (31). A permanent water body was found within 1,600 feet of 75 sites (48%).

Figure 1. Site Locations by Ownership Category.



PERMANENT ROADS

Permanent roads were evaluated for implementation of BMPs when they were used in the forestry operation. Permanent roads in the forestry context are generally graded dirt roads that are used for year-round access. County roads were not included in the monitoring, as they are not under the management control of the landowner. Permanent roads were applicable on 120 of the 156 sites. The percent implementation for permanent roads was 93% and two significant risks were noted. The lowest implementation score was for not having roads reshaped and stabilized (81%). The area with the highest level of implementation was for roads respecting sensitive areas, meeting grade specifications, and ditches not dumping into streams (99% for all categories). See Table 2. Figure 2 breaks down the numbers of sites into ownership type.

Table 2. Implementation of BMPs Relating to Permanent Roads.

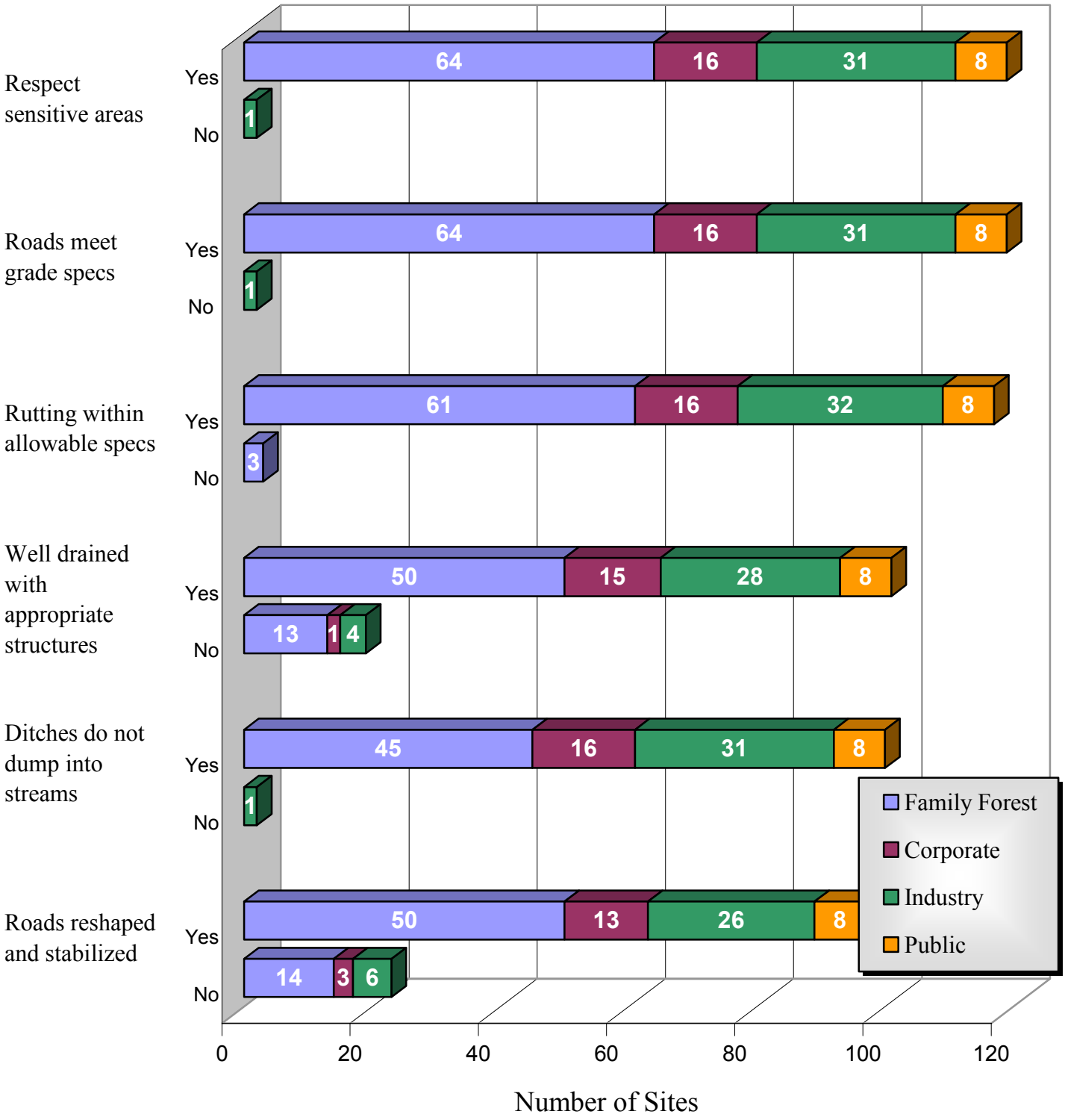
BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Respect sensitive areas	119	1	36	99	0	1.8
Roads meet grade specifications	119	1	36	99	0	1.8
Rutting within allowable specs	117	3	36	97	0	2.9
Well drained with appropriate structures	101	18	37	85	1	6.5
Ditches do not dump into streams	100	1	55	99	0	2.0
Roads reshaped and stabilized	97	23	36	81	1	7.2

The evaluator was able to designate the use of ten specific BMPs (water bar, wing ditch, etc.) after the six questions relating to permanent roads. It is important to note that non-use of a specific BMP does not imply lack of implementation. Often, there are many alternatives that could be applied in a given instance. The value of this question shows whether effort was made to use some of the more commonly recommended BMPs.

SKID TRAILS AND TEMPORARY ROADS

Skid trails and temporary roads were evaluated on 124 of the 156 monitoring sites. Skid trails are routes through the logging area in which logs are skidded or dragged to a permanent road or central loading point called a “set” or “landing.” Temporary roads are not designed to carry traffic long-term and are usually retired, closed, or reforested after the harvest activity. The percent implementation for temporary roads was 90% and

Figure 2. BMP Implementation on Permanent Roads by Ownership Type.



a total of 4 significant risks were noted. This is a major improvement from the last round. The lowest implementation category was for rutting within allowable specifications (82%) and is most likely due to the high amount of rainfall East Texas received in 2004 (approximately 75 inches). The area with the highest implementation (100%) was for slopes less than 15%. See Table 3 and Figure 3.

Table 3. Implementation of BMPs Relating to Skid Trails and Temporary Roads.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Slopes less than 15%	124	0	32	100	0	0
Respect sensitive areas	113	11	32	91	1	5.1
Roads well drained with appropriate structures	103	13	40	89	0	5.8
Roads stabilized	107	16	33	87	2	6.1
Rutting within allowable specifications	102	22	32	82	1	6.9

The evaluator was able to designate the use of ten specific BMPs (water bar, wing ditch, etc.) after the five questions relating to temporary roads. It is important to note that non-use of a specific BMP does not imply lack of implementation. Often, there are many alternatives that could be applied in a given instance. The value of this question shows whether effort was made to use some of the more commonly recommended BMPs.

STREAM CROSSINGS

Stream crossings were evaluated on 70 sites. Eighteen sites had crossings on permanent roads only, 39 had crossings on temporary roads only, and 13 had crossings on both permanent and temporary roads. The percent implementation for stream crossings was 81% and a total of eight significant risks were noted. Stream crossings on permanent roads received the lowest implementation for not being stabilized (81%). The highest implementation, 100%, was for the number of crossings minimized. Crossings on temporary roads scored the lowest for not being restored and stabilized (31%). However, 100% of the crossings were installed at right angles on temporary roads. See Figure 4 and Table 4.

Figure 3. BMP Implementation on Skid Trails/Temporary Roads by Ownership Type.

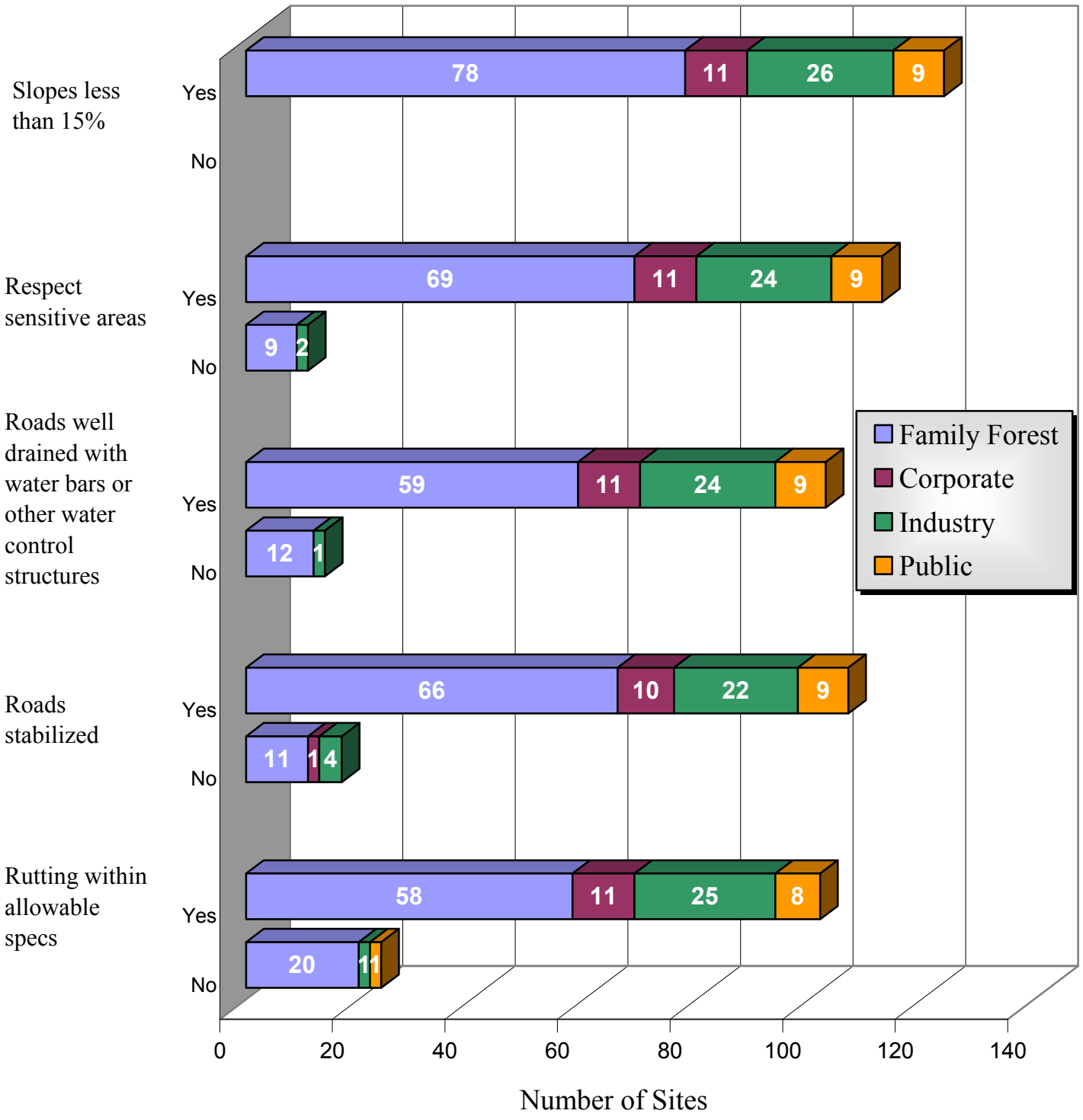


Figure 4. BMP Implementation on Stream Crossings by Ownership Type.

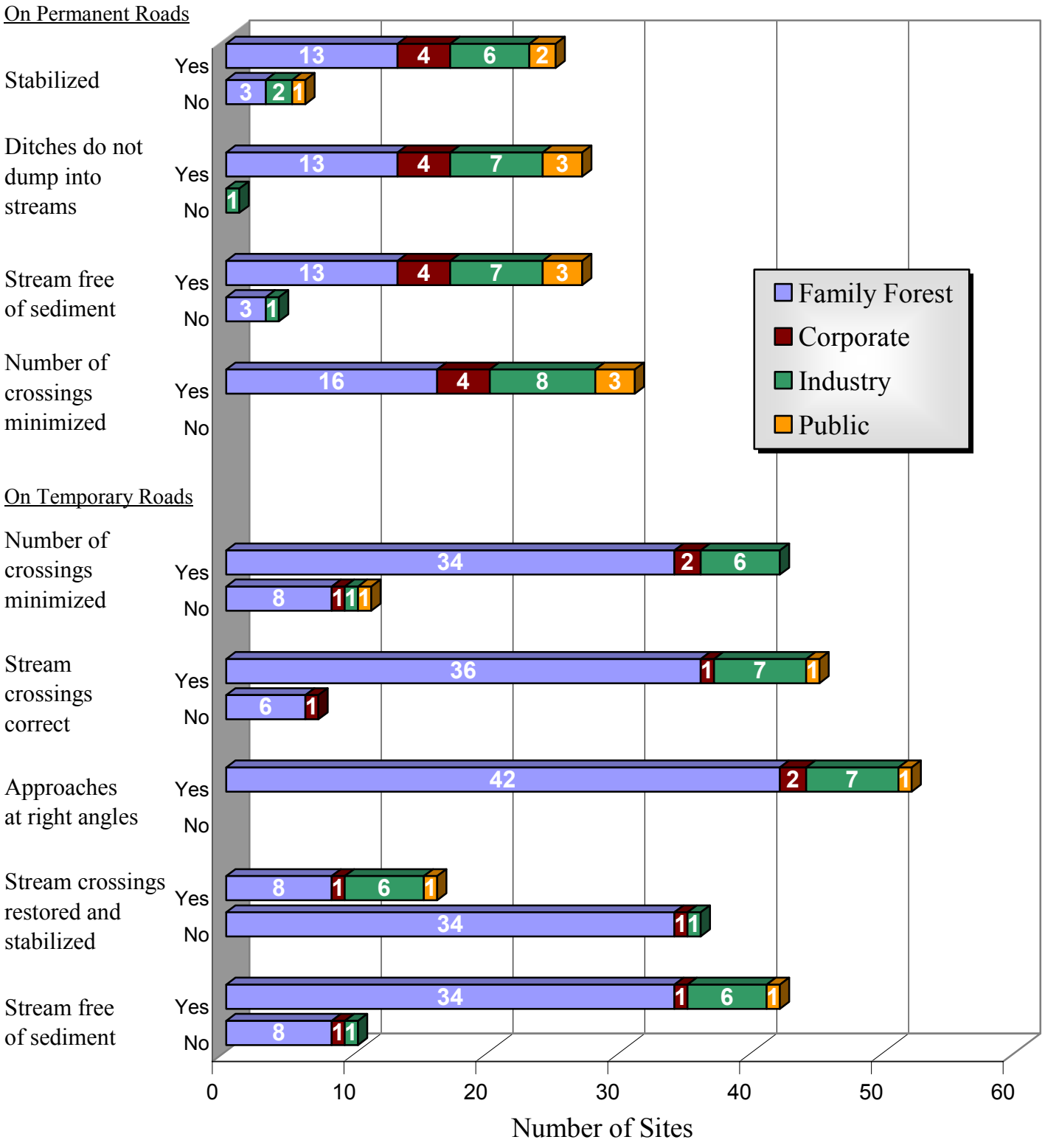


Table 4. Implementation of BMPs Relating to Stream Crossings.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Permanent Roads						
Stabilized	25	6	125	81	1	14.1
Ditches do not dump into streams	27	1	128	96	0	7.4
Stream free of sediment	27	4	125	87	0	12.1
Number of crossings minimized	31	0	125	100	0	0
Temporary Roads						
Number of crossings minimized	42	11	103	81	1	10.8
Stream crossings correct	45	7	104	87	0	9.3
Approaches at right angles	52	0	104	100	0	0
Stream crossings restored and stabilized	16	36	104	31	4	12.8
Stream free of sediment	42	10	104	81	2	10.9

The evaluator was able to designate the use of three specific BMPs (bridge, culvert, ford) after the nine questions relating to stream crossings. It is important to note that non-use of a specific BMP does not imply lack of implementation. Often, there are many alternatives that could be applied in a given instance. The value of this question shows whether effort was made to use some of the more commonly recommended BMPs.

STREAMSIDE MANAGEMENT ZONES

Streamside management zones (SMZs) are recommended on all perennial and intermittent streams, lakes, ponds, and reservoirs. All sites with either perennial or intermittent streams were evaluated for the presence and adequacy of SMZs. Streams were present on 120 of the 156 sites. Of these 120 sites, 29 had perennial streams only, 60 had intermittent streams only, and 31 had both perennial and intermittent streams. Overall implementation of SMZs was 91% with seven significant risks noted, a major improvement from the previous round. It is important to note the BMP implementation of having a SMZ on a permanent stream was 98%. The lowest implementation was for SMZs not being adequately wide (76%). See Figure 5 and Table 5.

Figure 5. BMP Implementation on Streamside Management Zones by Ownership Type.

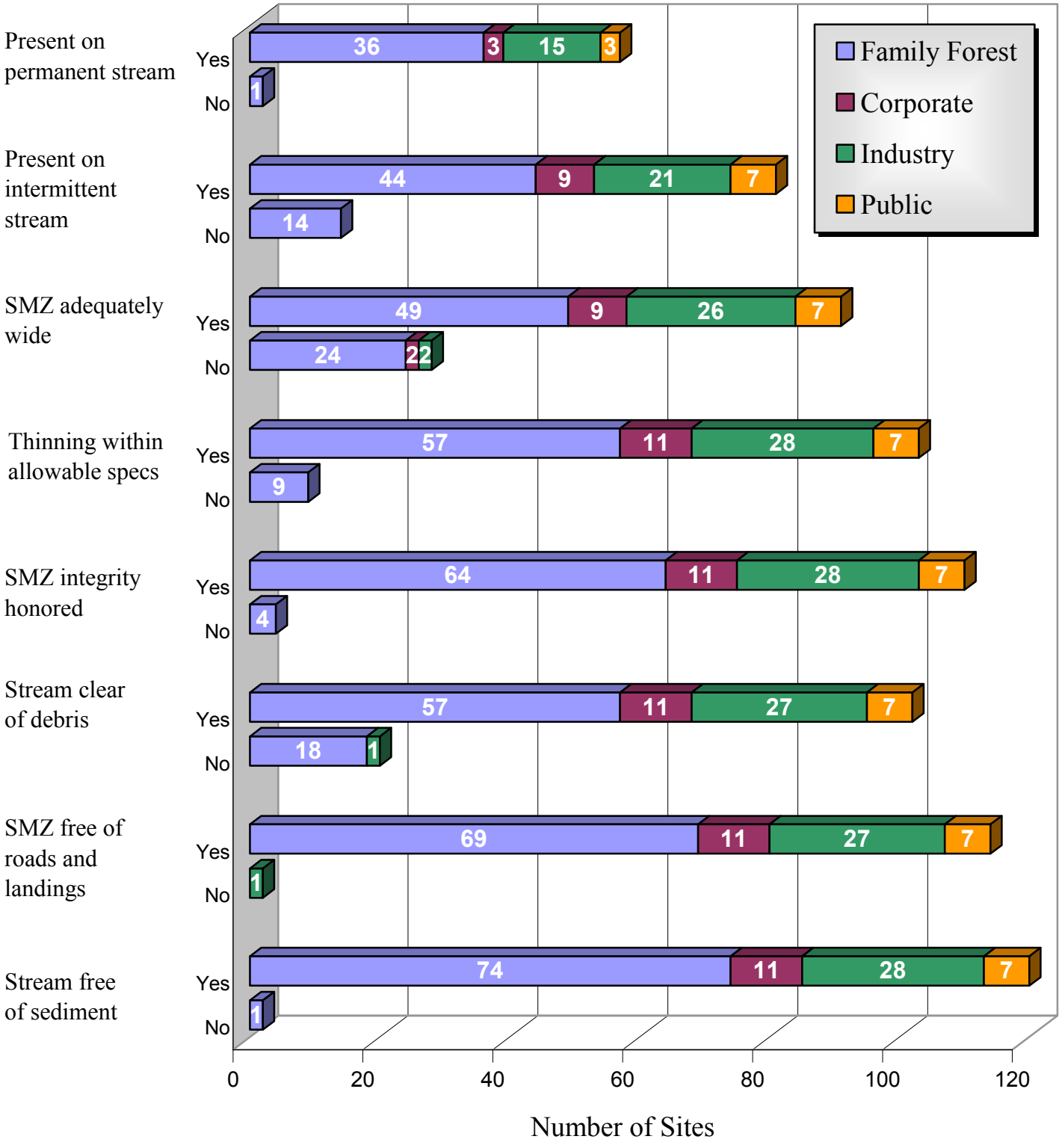


Table 5. Implementation of BMPs Relating to SMZs.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Present on perennial stream	57	1	98	98	1	3.7
Present on intermittent stream	81	14	61	85	0	7.3
Adequately wide	91	28	37	76	0	7.8
Thinning within allowable specs	103	9	44	92	0	5.1
Integrity honored	110	4	42	96	0	3.7
Stream clear of debris	102	19	35	84	5	6.6
Free of roads and landings	114	1	41	99	0	1.9
Stream free of sediment	120	1	35	99	1	1.8

SITE PREPARATION

Forty-eight sites were evaluated for implementation with site preparation BMPs. A variety of site preparation techniques were evaluated, including 44 with some combination of shearing, piling, subsoiling, bedding, and/or burning. Four sites involved application of herbicide only. The implementation for site preparation was 95% and no significant risks were noted. The lowest implementation was for not respecting sensitive areas (87%). See Table 6 and Figure 6.

Table 6. Implementation of BMPs Relating to Site Preparation.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Respect sensitive areas	42	6	108	87	0	9.5
No soil movement on site	42	3	111	93	0	4.8
Firebreak erosion controlled	26	1	129	96	0	7.5
SMZ integrity honored	35	1	120	97	0	5.7

Windrows on contour/free of soil	14	1	141	93	0	13.2
No chemicals off site	29	0	127	100	0	0
Machine planting on contour	19	1	136	95	0	9.7
Stream free of sediment	40	0	116	100	0	0

LANDINGS

Landings, sometimes called sets, are areas where logs are gathered, delimbed, bucked, and loaded onto log trucks. Landings were evaluated on 120 sites with an overall implementation of 97%. Several areas were found to have fully implemented BMPs (100%), including respecting sensitive areas and being located outside of the SMZ. The lowest implementation was for landings not being free of oil/trash (87%). There were no significant risks noted on landings. See Table 7 and Figure 7.

Table 7. Implementation of BMPs Relating to Landings.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Location free of oil/trash	104	16	36	87	0	6.1
Located outside of SMZ	113	0	43	100	0	0
Well drained location	117	1	38	99	0	1.8
Number and size minimized	117	1	38	99	0	1.8
Respect sensitive areas	118	0	38	100	0	0
Restored/stabilized	116	2	38	98	0	2.6

Figure 6. BMP Implementation on Site Preparation by Ownership Type.

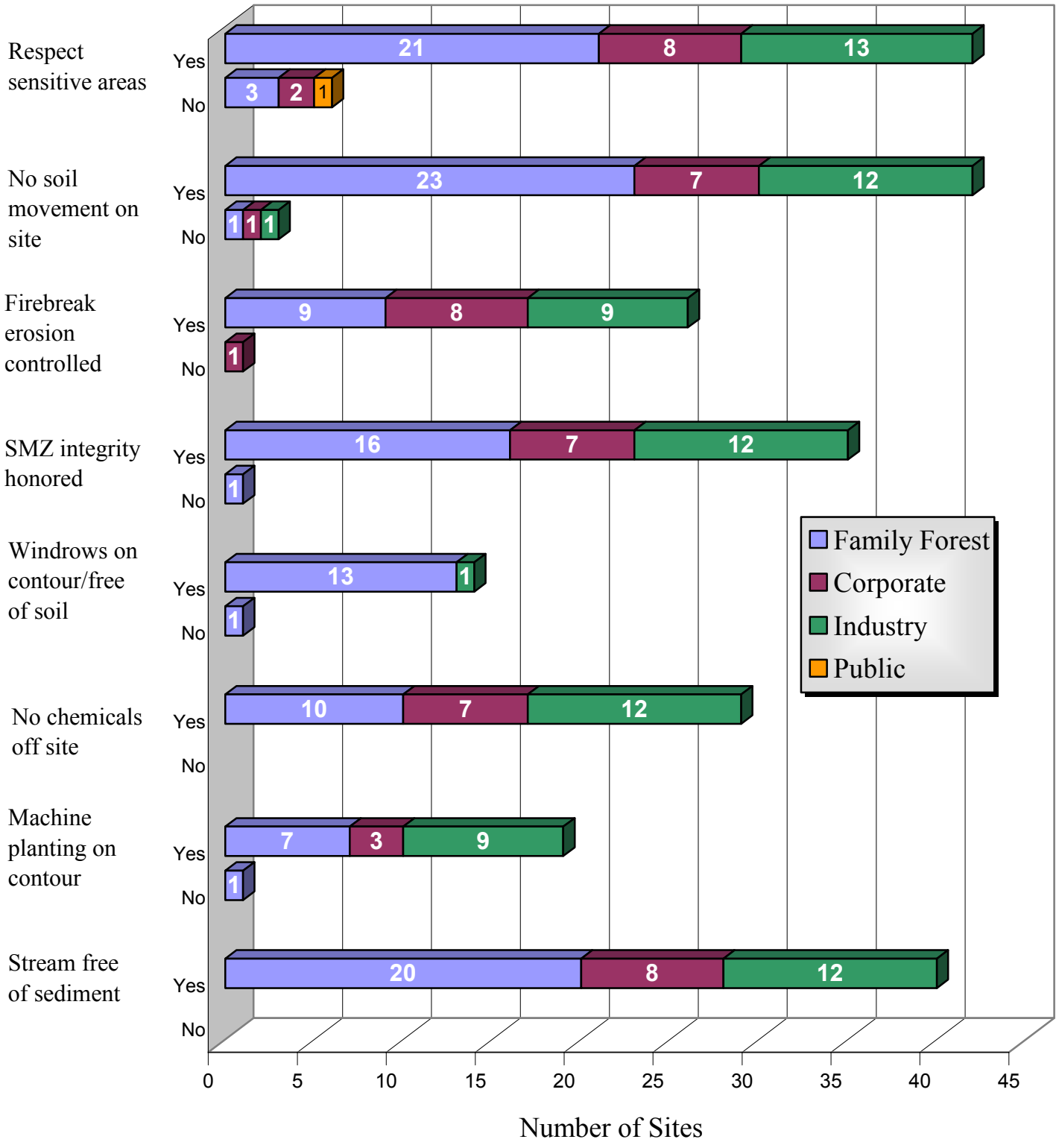
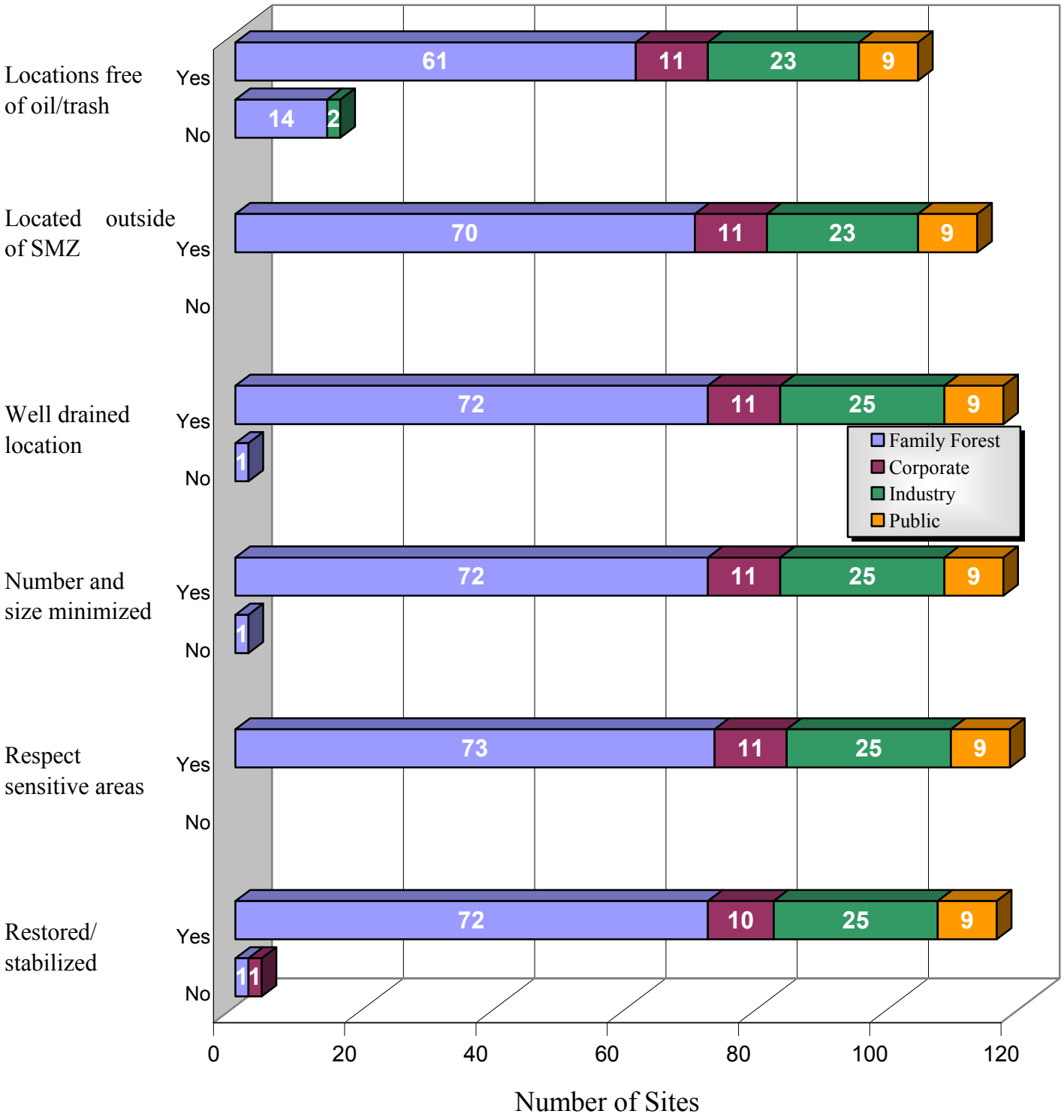


Figure 7. BMP Implementation on Landings by Ownership Type.



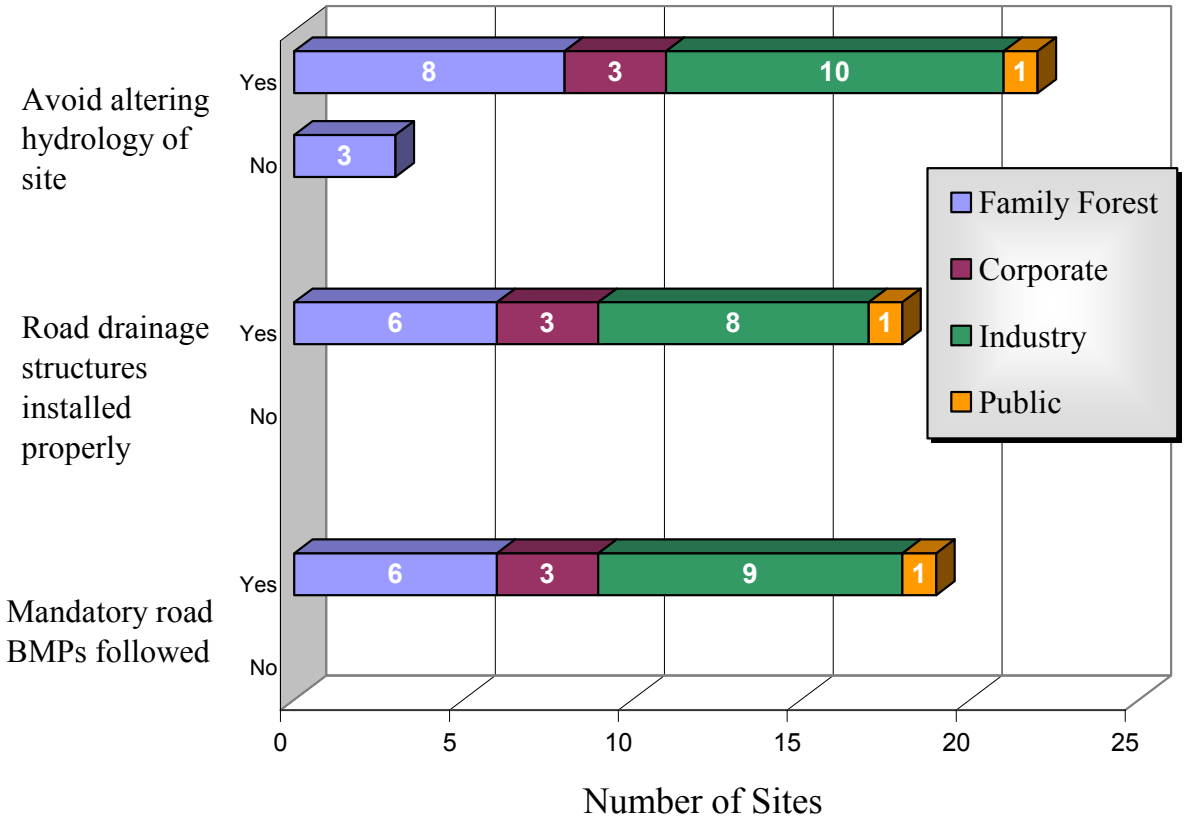
WETLANDS

Twenty-five sites had wetland or "wetland like" areas – not necessarily jurisdictional wetlands. These sites had an overall implementation of 95%. No significant risks were noted and all mandatory road BMPs for wetlands were followed. See Table 8 and Figure 8.

Table 8. Implementation of BMPs Relating to Wetlands.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Avoid altering hydrology of site	22	3	131	88	0	13.0
Road drainage structures installed properly	18	0	138	100	0	0
Mandatory road BMPs followed	19	0	137	100	0	0

Figure 8. BMP Implementation on Wetlands by Ownership Type.



OVERALL BMP IMPLEMENTATION

To illustrate the spread of the implementation scores, Figures 9 and 10 separate the results into five categories: 0-50%, 51-70%, 71-80%, 81-90%, and 91-100%. Figure 9 geographically illustrates implementation across all ownership types. Figure 10 provides the number of tracts across all ownership types receiving the respective level of implementation.

IMPLEMENTATION BY SITE CHARACTERISTICS

Ownership

BMP implementation varied by ownership type. The public ownership category fared best, with 98.3% for the nine tracts with no significant risks noted.

The 16 sites owned by corporate landowners had an overall BMP implementation of 96.0% and had only one significant risk.

Forest industry owned 36 of the sites and had an overall implementation of 95.7% with only three significant risks.

Family forest owners had an implementation rating of 88.9% with 17 significant risks on 95 sites. This represents the lowest level of the four ownership types, but also the highest implementation score ever received by this landowner type.

Type of Activity

Four types of silvicultural activities were monitored: regeneration harvests, partial regeneration cuts, thinning, and site preparation. Seven sites were evaluated for site preparation only, although site preparation was evaluated along with a regeneration harvest or planting 41 times. See Table 9.

Table 9. Overall BMP Implementation by Type of Operation.

Type of Operation	BMP Implementation
Regeneration harvest (clearcut)	88%
Regeneration harvest (partial cut)	89%
Thinning	97%
Site preparation (only)	95%

Figure 9: Overall Implementation Scores Across all Ownerships and Monitoring Criteria.

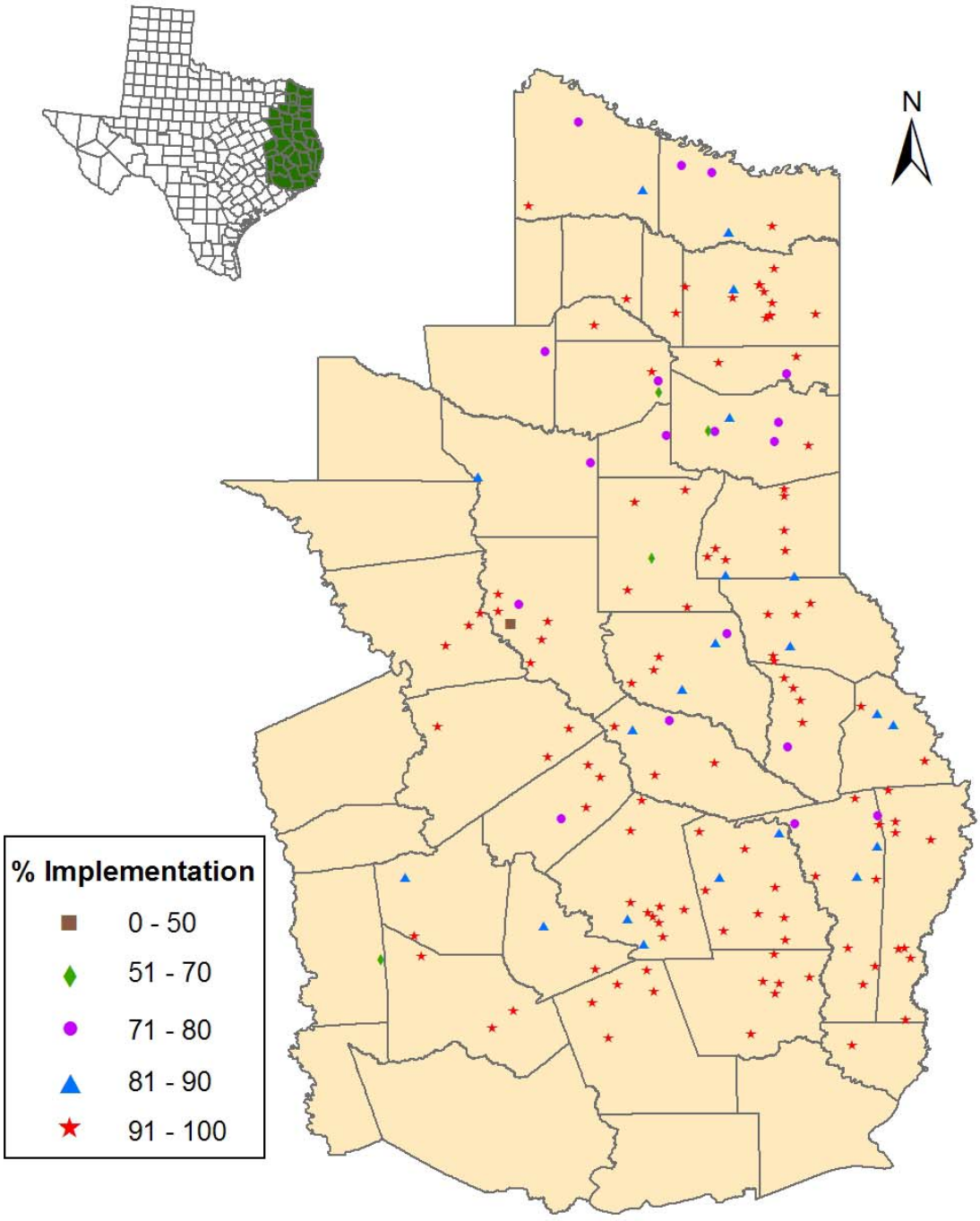
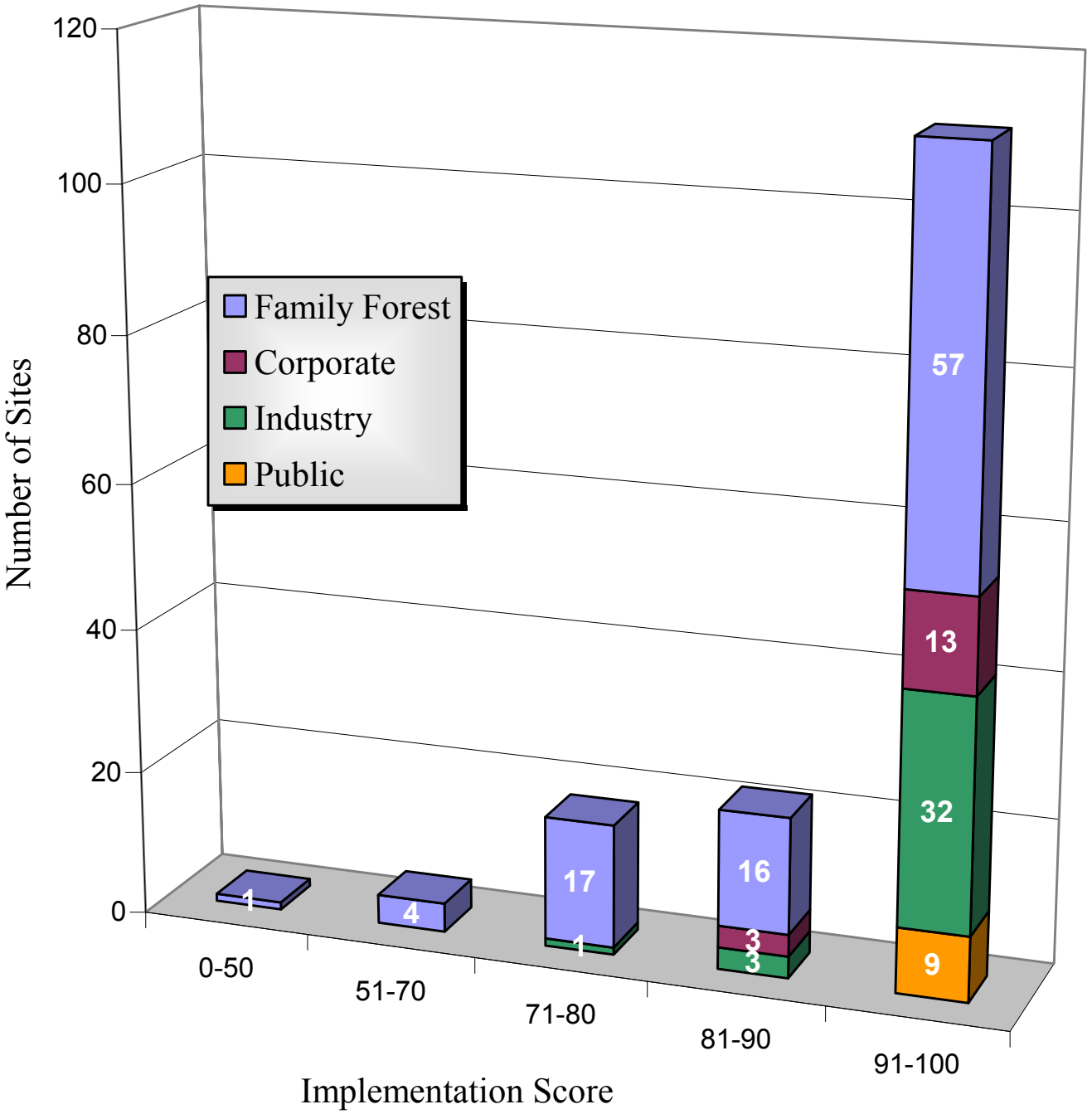


Figure 10. Overall Implementation Scores by Number of Sites and Ownership.



Region

East Texas was divided into two regions, North and South, for easy comparison of BMP implementation rates. The line was drawn along the northern boundary of Leon, Houston, Angelina, San Augustine, and Sabine Counties. Eighty-one sites were monitored in the southern region and had an implementation rating of 94.4% while 75 sites were monitored in the northern region with an implementation rating of 88.7%. The higher BMP implementation in Southeast Texas is expected due to the high concentration of public and industrial ownership, flatter topography, and less erodible soils.

Terrain

Monitoring sites were classified by BMP foresters as *Flat*, *Hilly*, or *Steep*. BMP implementation on the 41 flat sites was 94.2% with two significant risks; on the 109 hilly sites, 90.5% with 19 significant risks; and on the six steep sites, 97.5% with no significant risks.

Erodibility

Monitoring sites were identified as having *Low*, *Medium*, or *High* soil erodibility. BMP implementation on a total of 55 low erodibility sites was 93.7% with two significant risks; on 77 medium erodibility sites, 90.1% with 15 significant risks; and on 24 high erodibility sites, 92.4% with four significant risks.

Distance to Permanent Water

Distance to nearest permanent water was determined for each monitoring site. BMP implementation on 71 sites with permanent water less than 300 feet away was 90.3% with 15 significant risks. On four sites with permanent water 300 to 800 feet away, implementation was 95.7% with no significant risks. Of the 81 sites in which permanent water was greater than 1,600 feet away, BMP implementation was 92.8% with 17 significant risks.

River Basin

Monitoring sites were identified to be in the following river basins: Cypress, Neches, Red, Sabine, San Jacinto, Sulphur, and Trinity. BMP implementation was highest in the Trinity River Basin (93.5%) on 12 sites and lowest in the Red River Basin (74.4%) on three sites. See Table 10 and Figure 11.

Hydrologic Unit Code (Watershed)

Monitoring sites were also tracked by their eight digit hydrologic unit code (HUC). One HUC (12020007) had an implementation score of 100%. Seventeen of the 21 watersheds (76%) scored over 90%. The lowest rated watershed had a BMP implementation rating of 74.4% (11140106). See Table 11 and Figure 12.

Table 10. BMP Implementation by River Basin.

River Basin	Number of Sites	% Implementation	Significant Risks
Cypress	26	88.8	3
Neches	62	92.8	11
Red	3	74.4	0
Sabine	38	92.5	3
San Jacinto	9	93.4	0
Sulphur	6	90.9	2
Trinity	12	93.5	2

Table 11. BMP Implementation by Hydrologic Unit Code.

Hydrologic Unit Code	Number of Sites	% Implementation	Significant Risks
11140106	3	74.4	0
11140302	6	90.9	2
11140304	2	94.4	0
11140305	4	92.1	0
11140306	13	93.6	0
11140307	7	76.5	2
12010002	15	88.0	2
12010004	9	93.3	7
12010005	14	95.3	1
12020001	11	87.7	0
12020002	11	97.1	1
12020003	7	91.9	0
12020004	6	93.2	1
12020005	12	90.7	2
12020006	14	96.4	1
12020007	1	100.0	0
12030201	1	92.0	0
12030202	8	91.6	2
12030203	4	99.3	0
12040101	4	90.5	0
12040103	4	94.7	0

Proximity to 303 (d) Listed Stream Segments

The proximity of BMP monitoring sites to 303 (d) listed (impaired) stream segments was analyzed using GIS. Nineteen sites were identified to be within 1.5 miles of a listed stream segment or lake and had an implementation rating of 92.1%. It should be noted that BMP implementation was higher near these listed waters than the overall BMP implementation for all monitored sites. Forest operations provided greater water quality protection near these sensitive areas.

Figure 11. Site Location by River Basin.

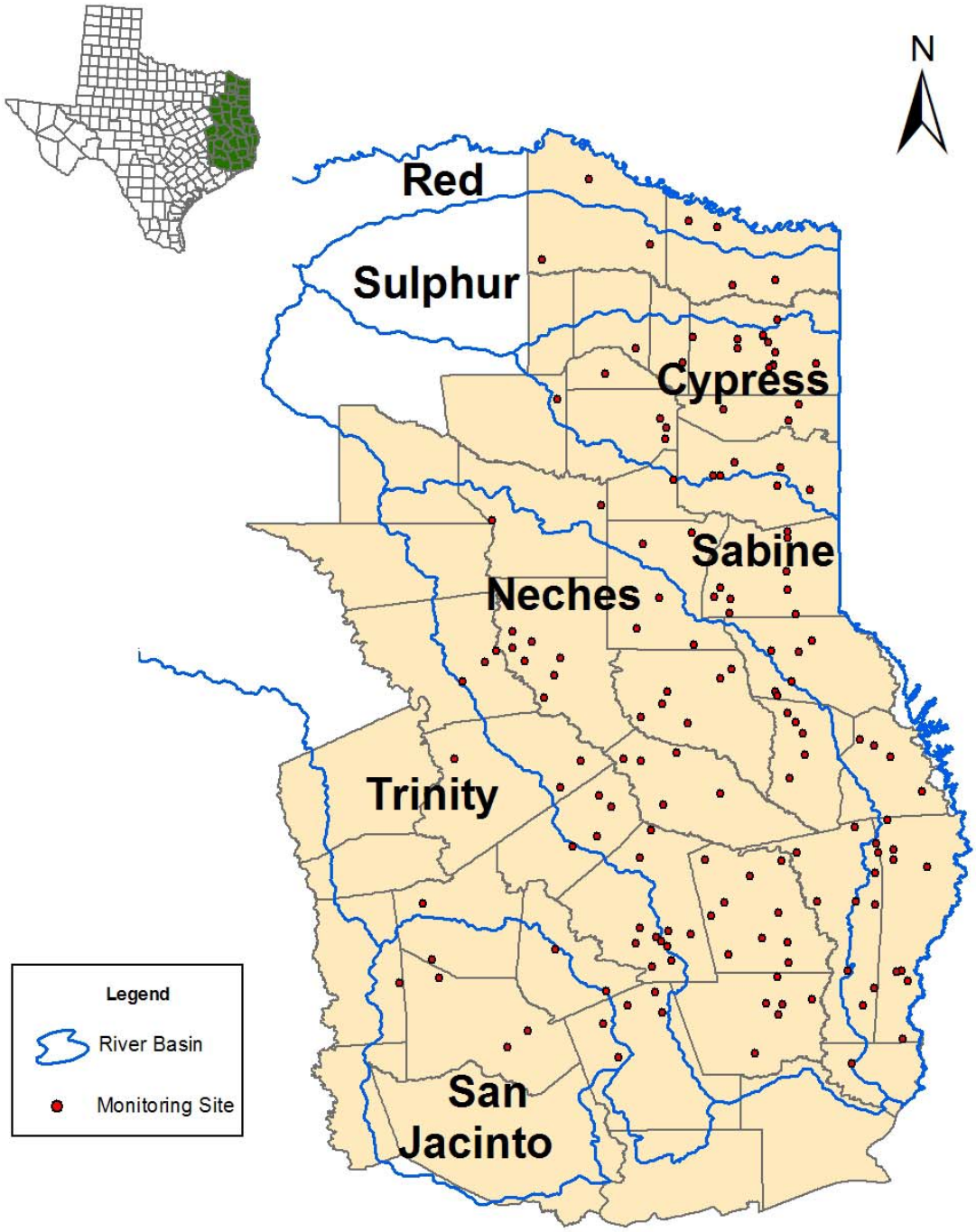
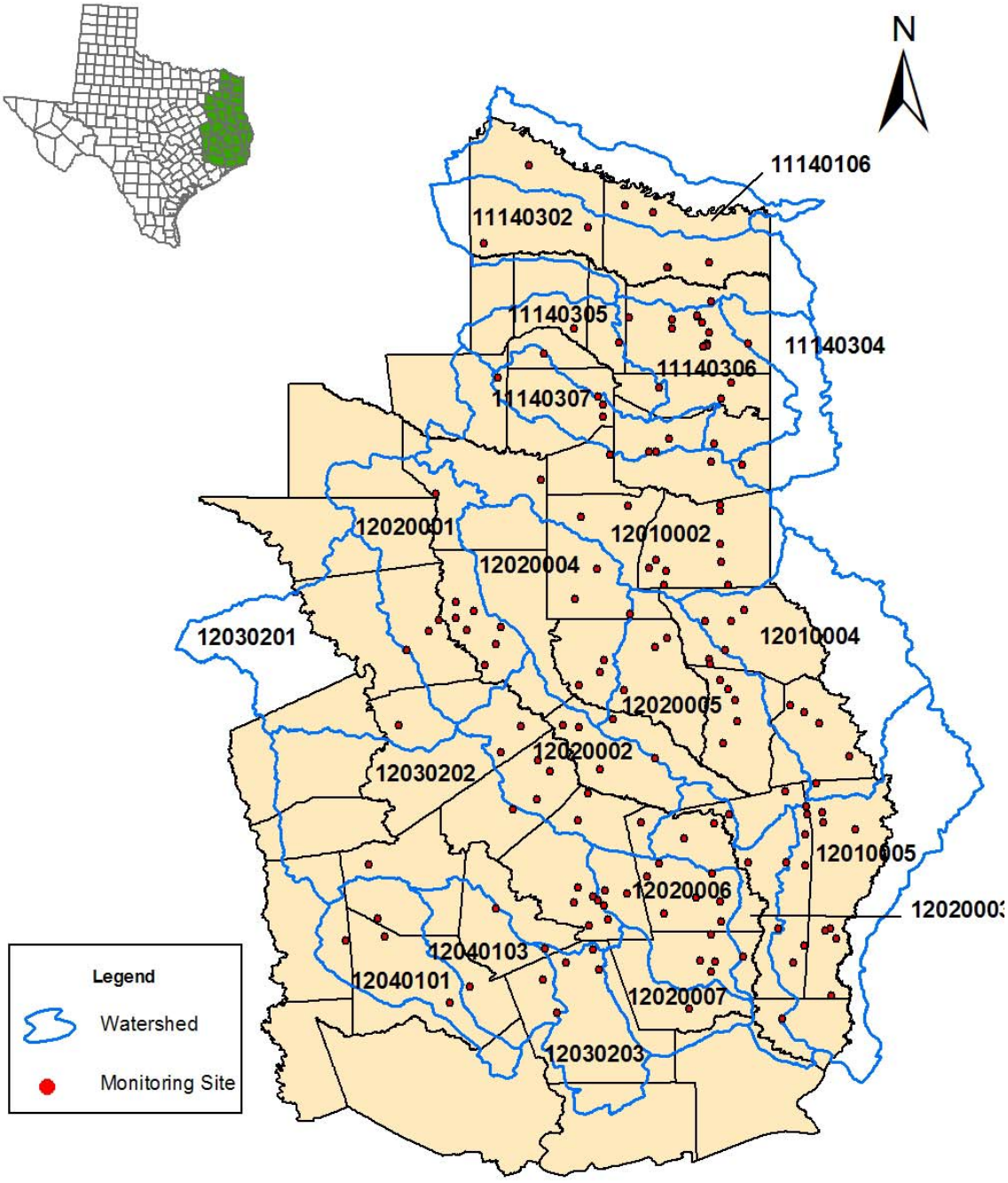


Figure 12. Site Location by Hydrologic Unit Code (Watershed).



STATISTICAL ANALYSIS

Statistical tests were performed to provide further information about the accuracy of the data collected. BMP trend analyses were also performed on certain categories to determine statistical significance. By understanding these trends where higher BMP implementation occurred, the forestry community can develop outreach efforts that encourage the use of these practices.

STATISTICAL TESTS

Margin of Error

The margin of error expresses the maximum likely difference observed between the sample mean and the true population mean with 95% probability. It is an important statistical calculation that was performed on all individual BMPs (i.e. SMZs present on perennial streams) using the respective percent implementation and total number of applicable questions. See Tables 2 – 8.

Confidence Interval

The 95% confidence interval is a tool that statisticians use to demonstrate their confidence in the measured mean of a sample. It provides a range for which they are 95% confident (i.e. 19 times out of 20) that the actual mean will be found. For Round 6, the 95% confidence interval for the overall BMP implementation across all sites was (.90114, .93317).

STATISTICAL SIGNIFICANCE OF BMP TRENDS

Two different statistical analyses were performed on the following categories:

- Forester Involved in Sale or Activity
- Logger Attended BMP Training
- Landowner Familiar with BMPs
- BMPs in Timber Sale Contract
- Landowner Member of Forest Organization
- Timber Delivered to SFI^{SM} Mill
- Landowner Lived in a Non-Metropolitan Area
- Landowner Was Not Absentee

The first statistical analysis was a parametric two sample t-test, which was included because of the large sample size. This percentage data had to undergo an arcsin square root transformation prior to analysis. Percentage data must be transformed because they are not normally distributed, which invalidates the normality assumption of the parametric test. A non-parametric test (Wilcoxon) was also performed to add greater statistical validity. To determine statistical significance, the resulting *P* value was compared to the level of significance. The *P* value is the probability of observing a value

of the test statistic as contradictory (or more) to the null hypothesis as the computed value of the test statistic. In these tests, a 0.05 (5%) level of significance was used. For the two implementation ratings to be significantly different, the *P* value must be lower than the level of significance. The implementation ratings for the "yes" and the "no" answers were calculated to be significantly different in all of these categories. See Table 12.

Table 12. Results of Statistical Tests Determining Statistically Significant Differences.

	% Implementation		Parametric *P* value	Non Parametric *P* value	Level of Significance	Statistically Different?
	Yes	No				
Forester Involved	94.1	87.3	.0010	.0009	0.05	Yes
Logger Attended BMP Training	93.5	84.0	< .0001	.0006	0.05	Yes
Landowner Familiar with BMPs	93.9	86.2	< .0001	.0001	0.05	Yes
BMPs in Contract	94.2	84.0	< .0001	< .0001	0.05	Yes
Landowner Member of Forest Organization	93.1	88.8	.0165	.0168	0.05	Yes
Timber Delivered to SFI^{SM} Mill	95.5	89.5	.0002	.0009	0.05	Yes
Landowner Lived in a Non-Metro area	92.9	86.4	.0015	.0016	0.05	Yes
Landowner Was Not Absentee	93.4	87.3	.0005	.0006	0.05	Yes

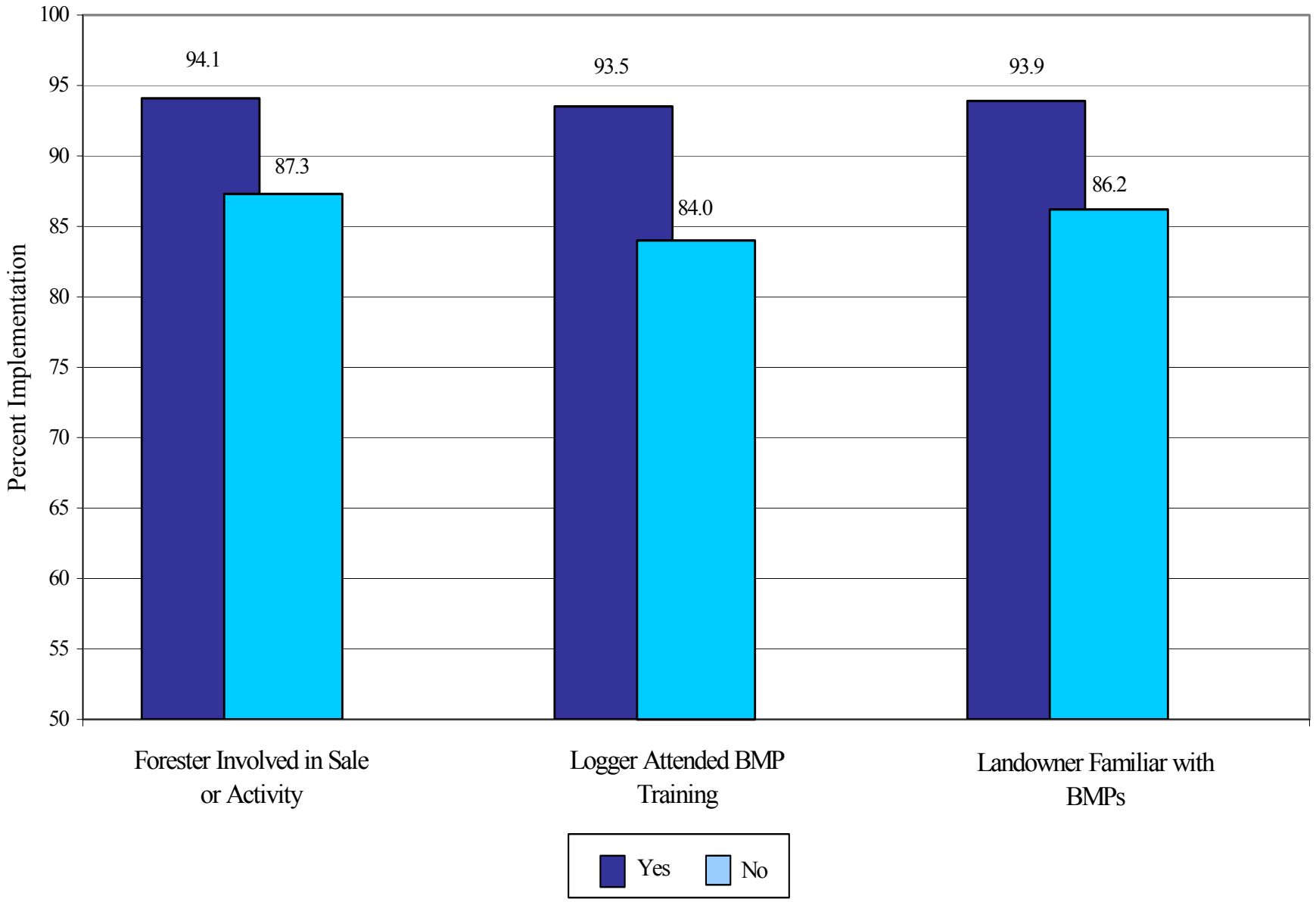
Forester Involved in the Sale or Activity

BMP implementation was higher when a professional forester was involved in the sale or activity. One hundred two sites were identified as having a professional forester involved and had an implementation rating of 94.1%. Sites in which there was no forester involvement had a BMP implementation rating of 87.3%. See Figure 13.

Logging Contractor Attended BMP Workshop

Logging contractor familiarity with BMPs influenced implementation. Texas Forest Service BMP Project staff offers a BMP workshop in which contractors are made more aware of BMPs and water quality. One hundred twenty-five inspections identified the logging contractor as having attended the formal BMP training, with an implementation of 93.5%. Sites in which there was no attendance by the logger at the formal BMP training had an implementation rating of 84.0%. It was unknown if the logger had attended a BMP workshop on 19 sites. See Figure 13.

Figure 13. Overall Implementation by Various Types of Involvement.



Landowner Familiarity with BMPs

Landowner familiarity with BMPs also influenced BMP implementation. Sites whose owners were not familiar with BMPs (45) had an overall implementation rating of 86.2%, while sites whose owners were familiar with BMPs (111) had an implementation rating of 93.9%. See Figure 13.

BMPs in Timber Sale Contract

BMPs were included in the timber sale contract, if applicable, on 118 sites. Implementation on sites with BMPs included in the contract was 94.2%, while implementation on tracts without BMPs in the contract was 84.0%. See Figure 14.

Landowner Member of Forest Organization

Membership in forest organizations (Texas Forestry Association, county landowner associations, trade associations, etc.) can have an impact on implementation. Private landowners who are members of these organizations are generally more involved in the forestry practices that are conducted on their property. Landowners were identified as being members of forest organizations on 87 sites and had an implementation rating of 93.1%, while implementation for nonmembers was 88.8%. See Figure 14.

Timber Delivered to SFI^{SM} Mill

BMP implementation was higher on sites in which the receiving mill was known to be a SFI^{SM} participant. This occurrence was documented on 57 sites with an implementation rating of 95.5%, compared to an 89.5% implementation rating on 99 sites in which the timber went to other mills or the receiving mill was unknown. See Figure 14.

Landowner Lived in a Non-Metropolitan Area (population < 50,000)

Landowners who live in metropolitan areas are typically far removed from their East Texas timberland and are generally not exposed to forestry information. BMP implementation was higher on sites where the landowner lived in a non-metropolitan area. This trend was documented on 128 sites with an implementation rating of 92.9%, compared to an 86.4% implementation rating on 28 sites. See Figure 15.

Landowner Was Not Absentee

BMP implementation is traditionally lower on sites owned by absentee landowners (landowners who live outside the county where their property is located). This is due in part because these landowners are generally not familiar with their property, may not know what operations are occurring, and may be unfamiliar with BMPs. It was determined that absentee landowners owned 42 sites with an implementation rating of 87.3%, compared to an implementation rating of 93.4% on 114 sites in which the landowner was not absentee. See Figure 15.

Figure 14. Overall Implementation by Various Categories.

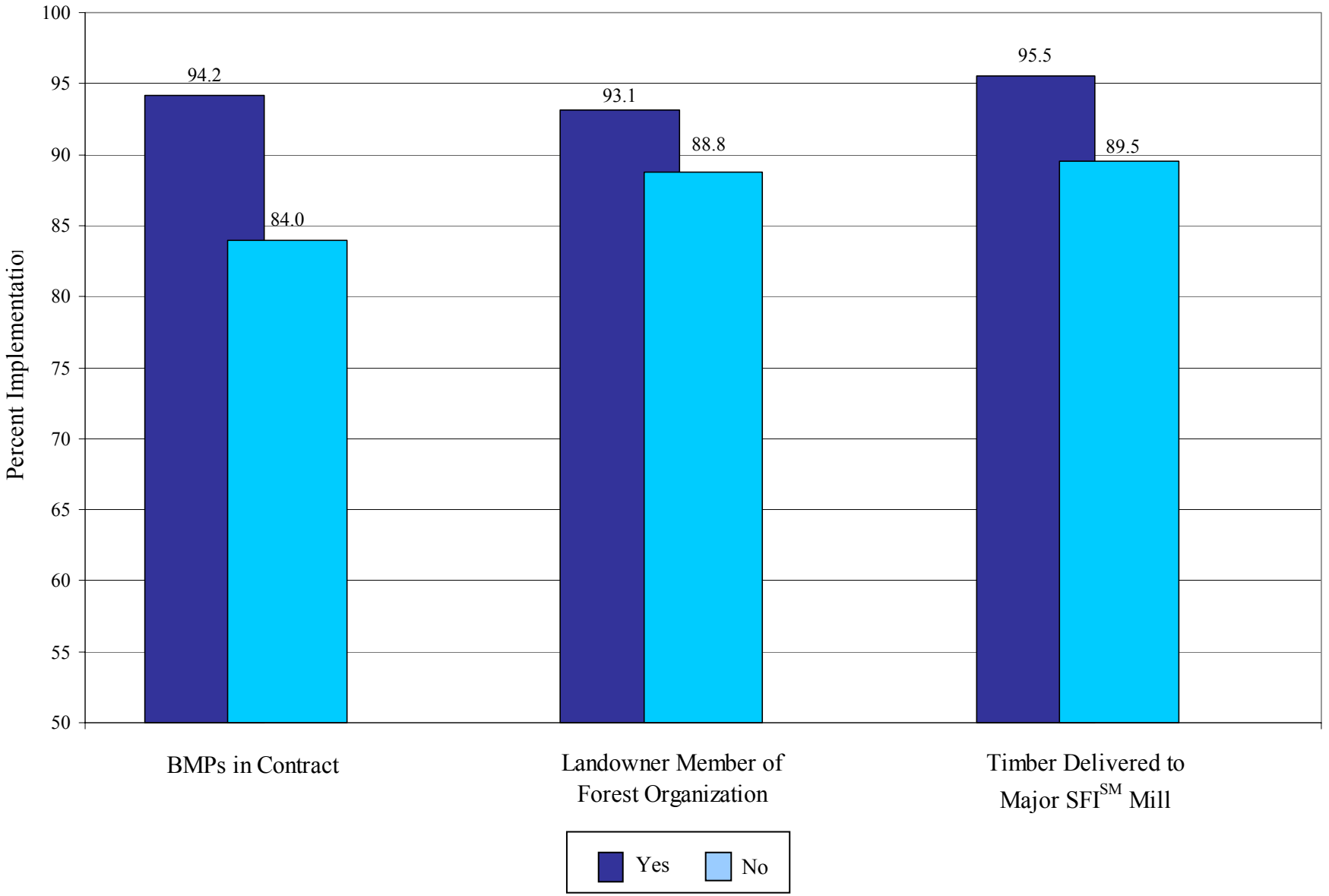
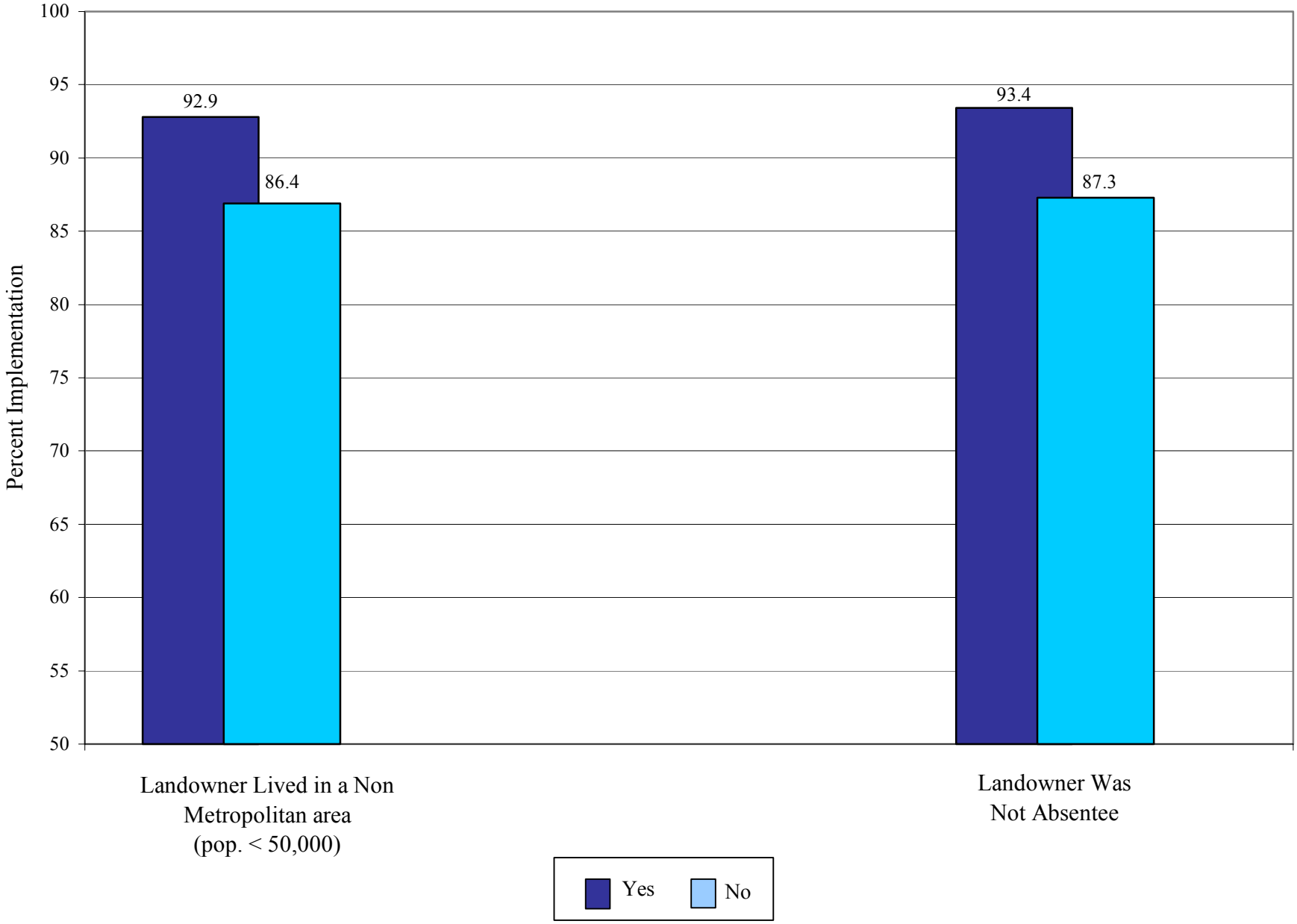


Figure 15. Overall Implementation by Various Categories.



DISCUSSION

As mentioned in the monitoring checklist section of this report, a new approach to reporting the percent implementation has been initiated. This new method was field tested extensively. Tracts were also scored the original way at the time of monitoring to see how the new method compared to the old. The results provided confidence in using the new reporting method.

Because of the change in the reporting method the results from this new method *cannot* be directly compared to Rounds 1-3). Consider the following example. BMP implementation on publicly owned land is currently at 98.3%. It was 100% for the first three rounds. Did implementation actually decrease? Previously a tract *passed*, or was considered to have followed the BMP guidelines, if it received a *Fair*, *Good*, or *Excellent* score. Not all public tracts received an *Excellent*; however, they all passed and were in compliance. The average score on public tracts was 100% on previous rounds since all individual tracts were in compliance with the recommended guidelines.

The new method of computing overall implementation reflects the percent of BMP implementation on a single tract. For example, consider that on a particular tract, under the new method, the score is 85%. Using the original method, it is likely that the tract would have received at least a Fair. Previously that tract would have been added with all other *Fair*, *Good*, and *Excellent* scores, and then divided by the total number of tracts to determine overall implementation rates. It is now factored in individually as an 85%. Every tract would have had to receive a 100% under the new system to monitor at that previous level of implementation.

A brief discussion of the previous rounds of monitoring is provided to give a historical perspective on BMP monitoring in Texas.

OVERALL IMPLEMENTATION – Rounds 1, 2, 3, 4, and 5

Round 1 of BMP implementation monitoring, completed in 1992, yielded an overall implementation rate of 88.2%. Round 2, which was completed in 1995, showed an overall implementation rate of 87.4%. Round 3 of monitoring, completed in 1998, showed overall implementation with voluntary BMPs at 87.3%. Round 4 of BMP implementation monitoring, completed in 1999, introduced a new method of monitoring BMP implementation. Using the original method, the overall implementation rate was 90.0%. Under the new method, the overall BMP implementation rate was 88.6%. This same approach was taken for Round 5, with monitoring completed in 2002. Using the original method, overall BMP implementation was 90.7%, compared to 91.5% under the new method.

BMP implementation on industry land had steadily increased from 89.6% in Round 1 to 95.1% in Round 2 to 98.4 % in Round 3. Round 4 marked the introduction of the new method. Implementation increased from 94.2% in Round 4 to 96.1% in Round 5. This substantial increase documents the diligence of forest industry in using voluntary BMPs.

BMP implementation on publicly owned land has increased from 93.3% in Round 1 to 100% in Round 2, and maintained its 100% implementation through Round 3 using the original method. Implementation on public lands went from 97.9% using the new method in Round 4 to 98.4% in Round 5.

In Round 1 of monitoring, implementation on family forest owners was 86.3%. During Round 2, implementation was 82.9% and decreased to 76.3% in Round 3. However, in Round 4, family forest owner implementation made an upward shift to 81.2% using the new method, and even higher in Round 5 to 86.4%.

OVERALL IMPLEMENTATION – Round 6

BMP implementation on public land for Round 6 was 98.3% with no significant risks to water quality identified. Implementation on industry land during this time period was 95.7% with three significant risks, while implementation on corporate land was 96.0% with one significant risk. Family forest owners received an implementation rating of 88.7% with 17 significant risks. This resulted in an overall BMP implementation of 91.7% with a total of 21 significant risks over all ownership categories. See Table 13.

Table 13. Percent Implementation by Ownership, Rounds 4 -6, New Method.

	Round 4	Round 5	Round 6
Family Forest Owner	81.2	86.4	**88.7**
Corporate	-	-	**96.0**
Industry	94.2	96.1	**95.7**
Public	97.9	98.4	**98.3**
Overall	88.6	91.5	**91.7**

BMP implementation on family forest owners lagged behind other ownerships and accounted for 17 of the 21 significant risks. Family forest owners are generally less involved in forest management, only infrequently sell timber, may be absentee, and may lack technical knowledge necessary to implement BMPs. It is important to note that the average size of the harvested family forest owner tract was smaller than the industrial tracts. This lower level of implementation occurred on smaller tracts while the higher level of BMP implementation occurred on larger tracts of land.

Scores for this sixth round of monitoring were also calculated using the original method. Table 14 shows these results and compares all six rounds using the original method. Implementation on family forest owners improved since the previous monitoring period with industry and public lands again at the 100% level.

Table 14. Percent Implementation by Ownership, All Six Rounds, Original Method.

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Family Forest Owner	86.3	82.9	76.3	79.1	81.1	86.3
Corporate	-	-	-	-	-	100.0
Industry	89.6	95.1	98.4	98.6	100.0	100.0
Public	93.3	100.0	100.0	100.0	100.0	100.0
Overall	88.2	87.4	87.3	90.0	90.7	90.4

The majority of the public, corporate, and industry tracts that were monitored installed BMPs that met or exceeded the recommended guidelines. Even though the implementation rates for these groups is less than 100% using the new method, no public, corporate, or industry tracts received less than a passing score using the original method.

Area Weighted BMP Implementation

Traditionally, monitoring sites have been weighted equally when determining percent implementation scores. This method is good for determining overall BMP implementation across the state or for a particular landowner category. However, it does not provide this information on a landscape scale like the area weighted BMP implementation method. Using this approach, larger tracts are weighted more heavily than smaller tracts, primarily because they have a greater opportunity to impact water quality.

The results from Round 6 were reanalyzed using the above-mentioned approach. BMP implementation scores actually increased for the family forest owner, industry, and overall. See Table 15.

Table 15. Area Weighted Percent Implementation by Ownership, Round 6.

Landowner Type	**Area Weighted % Implementation**
Family Forest Owner	89.6
Corporate	96.0
Industry	95.9
Public	97.7
Overall	92.5

CONCLUSION

Positive statistical correlations between landowner familiarity with BMPs, forester involvement, logging contractor training in BMPs, and BMP implementation were shown. This demonstrates the importance for family forest owners to involve a forester and a knowledgeable logging contractor to ensure BMP implementation.

Forest industry also played a significant role in increasing BMP implementation. This occurred primarily because of its support of the Texas Forest Service BMP Program and participation in the SFI^{SM}. Water quality protection is obviously a top priority for the forest industry, as evident by requiring all contractors to attend BMP training workshops and including BMPs in their timber sale contracts.

Special programs and incentives, advocated by Texas Forest Service, are also beginning to have an effect on BMP implementation. The Texas Reforestation and Conservation Act of 1999 encouraged landowners to leave a streamside management zone when harvesting timber by giving them special property tax incentives for doing so. The water quality management plan program recognizes landowners for protecting water quality through BMPs.

Using the new method of site evaluation, overall BMP implementation increased to a new all time high. This level was achieved despite having a record setting amount of rainfall in 2004 (approximately 75 inches). Most notable is the family forest owner, who increased their BMP implementation by 12.4% since Round 3. This increase demonstrates that the already-implemented education and training strategies geared towards loggers, landowners, and foresters were the driving force behind the increases in implementation.

Although BMP implementation has increased, there is still room for improvement. The past round of monitoring noted a deficiency in restoring and stabilizing stream crossings on temporary roads and removing logging debris from streams. Considerable improvement was made in reducing the number of significant risks to water quality from the previous round; however, there still is work to do in this area. Continuing effective educational programs for family forest owners, providing technical assistance to the forestry community on BMPs, and conducting BMP training for loggers can minimize the potential water quality impacts from silvicultural operations.

Appendix

Implementation Monitoring Checklist

Evaluation Criteria

Summary of Results

TEXAS FOREST SERVICE

The Texas A&M University System

TEXAS BMP MONITORING CHECKLIST

Site ID: 1

I. General Landowner and Tract Information

Owner Type: ☐ N ☐ A ☐ I ☐ P

County | TFS Block and Grid | Region

Latitude | Longitude

Forester Type | Name

Timber Buyer | Logging Contractor

Activity | Acres Affected

Estimated Date of Activity | Date of Inspection

Inspector | Accompanied by

Landowner:

Name | Address | City | State | Zip | Phone | E-mail:

II. Site Characteristics

Terrain: ☐ Flat ☐ Hilly ☐ Steep

Erodibility hazard: ☐ Low ☐ Medium ☐ High

Type stream present: ☐ Perennial ☐ Intermittent

Watershed Code: HUC

Distance to nearest permanent water body: ☐ < 300' ☐ 300 - 800' ☐ 800 - 1600' ☐ 1600' +

Predominant soil series /texture: ☐ Clay ☐ Clay Loam ☐ Loam ☐ Sandy Loam ☐ Sand

III. Permanent Roads

	YES	NO	NA/NN	Sig. Risk
1. Respect sensitive areas, such as SMZs, steep slopes, and wet areas	☐	☐	☐	☐
2. Meet grade specifications by having slopes between two and ten percent	☐	☐	☐	☐
3. Rutting within allowable specs of less than six inches deep for not more than fifty feet	☐	☐	☐	☐
4. Well drained with appropriate structures to minimize soil movement	☐	☐	☐	☐
5. Wing ditches, waterbars, and water turnouts do not dump into streams	☐	☐	☐	☐
6. Reshaped and/or stabilized to minimize soil movement	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

BMPs present: ☐ RD ☐ WD ☐ WB ☐ RE ☐ OC ☐ PL ☐ RS ☐ CU ☐ BR ☐ LW

IV. Skid Trails/Temporary (secondary) Roads

	YES	NO	NA/NN	Sig. Risk
1. Slopes less than 15% and laid out on contour of land	☐	☐	☐	☐
2. Respect sensitive areas, such as SMZs, steep slopes, and wet areas	☐	☐	☐	☐
3. Well drained with appropriate water control structures to effectively reduce erosion	☐	☐	☐	☐
4. Stabilized to minimize soil movement	☐	☐	☐	☐
5. Rutting within allowable specs of less than six inches deep for not more than fifty feet	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

BMPs present: ☐ RD ☐ WD ☐ WB ☐ RE ☐ OC ☐ PL ☐ RS ☐ CU ☐ BR ☐ LW

V. Stream Crossings

	YES	NO	NA/NN	Sig. Risk
On Permanent Roads				
1. Stabilized stream banks, crossings at right angles, and no evidence of washouts	☐	☐	☐	☐
2. Wing ditches, waterbars, and water turnouts do not dump into streams	☐	☐	☐	☐
3. Stream free of sediment	☐	☐	☐	☐
4. Number of crossings minimized	☐	☐	☐	☐
On Temporary Roads				
5. Number of crossings minimized	☐	☐	☐	☐
6. Stream crossings correct to minimize potential erosion in the stream channel	☐	☐	☐	☐
7. Approaches at right angles to minimize bank disturbance	☐	☐	☐	☐
8. Stream crossings restored and stabilized by removing temporary crossings	☐	☐	☐	☐
9. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

BMPs Present ☐ CU ☐ BR ☐ LW

VI. Streamside Management Zones

	YES	NO	NA/NN	Sig. Risk
1. Present on permanent stream	☐	☐	☐	☐
2. Present on intermittent stream	☐	☐	☐	☐
3. SMZ adequately wide by leaving fifty feet on both sides of the stream	☐	☐	☐	☐
4. Thinning within allowable specs by leaving 50 square feet of BA	☐	☐	☐	☐
5. SMZ integrity honored by keeping skidders, roads, landings, and firebreaks out	☐	☐	☐	☐
6. Stream clear of debris, such as tops, limbs, and debris	☐	☐	☐	☐
7. SMZ free of roads and landings	☐	☐	☐	☐
8. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

VII. Site Preparation

Site preparation method

Regeneration method

	YES	NO	NA/NN	Sig. Risk
1. Respect sensitive areas by preventing site prep intrusion	☐	☐	☐	☐
2. No soil movement on site, especially broad scale sheet erosion	☐	☐	☐	☐
3. Firebreak erosion controlled to prevent potential erosion	☐	☐	☐	☐
4. SMZ integrity honored by preventing site prep intrusion	☐	☐	☐	☐
5. Windrows on contour / free of soil to minimize soil disturbance	☐	☐	☐	☐
6. No chemicals off site or entering water bodies	☐	☐	☐	☐
7. Machine planting on contour rather than up and down steep slopes	☐	☐	☐	☐
8. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

VIII. Landings

	YES	NO	NA/NN	Sig. Risk
1. Locations free of oil / trash and properly disposed of	☐	☐	☐	☐
2. Located outside of SMZ to minimize traffic and erosion in the SMZ	☐	☐	☐	☐
3. Well drained location to mimimize puddling, soil degradation, and soil movement	☐	☐	☐	☐
4. Number and size minimized	☐	☐	☐	☐
5. Respect sensitive areas, including SMZs, steep slopes, and wet areas	☐	☐	☐	☐
6. Restored / stabilized by back blading, spreading bark, or seeding to minimize erosion	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

IX. Wetlands (may or may not be jurisdictional)

	YES	NO	NA/NN	Sig. Risk
1. Avoid altering hydrology of site by minimizing ruts and soil compaction	☐	☐	☐	☐
2. Road drainage structures installed properly to maintain flow of water	☐	☐	☐	☐
3. Mandatory road BMPs followed	☐	☐	☐	☐
Section Total	0	0		0
Percent Compliance	N/A			

X. Overall Compliance

	YES	NO	NA/NN	Sig. Risk
III. Permanent Roads	0	0	☑	0
IV. Skid trails/Temporary Roads	0	0	☑	0
V. Stream Crossings	0	0	☑	0
VI. Streamside Management Zones	0	0	☑	0
VII. Site Preparation	0	0	☑	0
VIII. Landings	0	0	☑	0
IX. Wetlands	0	0	☑	0
Overall Total	0	0		
Total Significant Risk				0
Percent Compliance	#Error			

Needs Improvement		Pass		
☐ No Effort	☐ Poor	☐ Fair	☐ Good	☐ Excellent

Follow Up Questions

	YES	NO	NA/NN	
Was activity supervised by landowner or representative?	☐	☐	☐	
Who?				
Was landowner familiar with BMPs?	☐	☐	☐	
Has logger attended BMP Workshop?	☐	☐	☐	
Were BMPs included in the contract?	☐	☐	☐	
Is landowner a member of TFA? Landowner Association? Other?	☐	☐	☐	
Organization				
Is remediation planned by landowner (if needed)?	☐	☐	☐	Date

Comments (Explain observed actions in the field check. Make recommendations.)

Map/Sketch Area (on back if needed)

Evaluation Criteria for BMP Monitoring Checklist
Texas Forest Service BMP Project

I. General Landowner and Tract Information

County: TFS county code.
TFS Block and Grid: Enter only entry point if multiple blocks or grids.
Latitude and Longitude:
Forester Type: Professional, i.e. consultant, industry, etc.
Forester Name: First and last name.
Timber Buyer: First and last name or corporation name.
Logging Contractor: First and last name or business name.
Activity: Type activity occurring, e.g. harvesting, site preparation, etc.
Acres Affected: Acres affected by activity.
Estimated Date of Activity: Quarter and year activity appears to have occurred. Use first entry if multiple entries.
Date of inspection: mmddyy.
Inspector: Name of TFS forester doing BMP inspection.
Accompanied by: Name of landowner, industry or consulting forester, logger, etc. who is present during the inspection.
Owner Type: Family Forest (N), Absentee (A), Industry (I), Public (P).
Name, Address, City, Zip, and Phone: Contacts for the landowner.

II. Site Characteristics

Terrain: Check only one; Flat, Hilly, or Steep.
Erodibility hazard: Check only one; Low, Medium, or High.
Type stream present: Perennial or Intermittent.
Distance to nearest permanent water body: Distance to nearest blue line stream or lake.
Predominant soil series: Series number from Soil Survey data (if available).
Predominant soil texture: Check only one; Clay, Clay Loam, Loam, Sandy Loam, or Sand.

III. Permanent Roads

1. Respect sensitive areas: Do roads avoid wet areas, SMZs, steep slopes if an alternative exist, erosion prone areas if an alternative exists, etc.?
2. Roads meet grade specs: Pertains to new roads or roads which are substantially reworked. Are roads within 2-10 percent grade except for short distances? Are roads on contour? Are ridge tops avoided?
3. Rutting within allowable specs: Is the road free of ruts in excess of 6 inches deep for more than 50 feet?
4. Well drained with appropriate structures: Are roads constructed so that water will quickly drain from them to minimize soil movement?
5. Ditches do not dump into streams: Are water turn outs and water bars venting far enough from the stream to prevent sediment from entering the stream channel?
6. Roads reshaped and stabilized: If needed, are roads reworked to minimize soil movement?

BMPs present: Which types of BMPs were used? rolling dips (RD), wing ditches (WD), water bars (WB), revegetate (RE), on contour (OC), proper placement (PL), reshaping (RS), culverts (CU), bridge (BR), low water crossing (LW).

IV. Skid Trails/Temporary Roads

1. Slopes less than 15 %: Are skid trails run on or near contour as per guideline recommendations, rather than up and down steep slopes?
2. Respect sensitive areas: Do skid trails and temporary roads avoid wet areas, SMZs, steep slopes if an alternative exists, erosion prone areas if an alternative exists, etc.?

3. Roads well drained with water bars or other water control structures: Were BMPs installed effectively to reduce erosion from the road?
4. Roads stabilized: If needed, were skid trails and temporary roads worked to minimize soil movement?
5. Rutting within allowable specs: Are skid trails and temporary roads free of ruts in excess of 6 inches deep for more than 50 feet?

BMPs present: see section III above.

V. Stream Crossings

On Permanent Roads:

1. Stabilized: Are stream banks and fill stabilized? Are culverts properly sized? Are bridges used where necessary? Are washouts evident? Are crossings at right angles?
2. Ditches do not dump into streams: Are water turn outs and water bars venting far enough from the stream to prevent sediment from entering the stream channel?
3. Stream free of sediment: Has sedimentation from the road into the stream channel been minimized?
4. Number of crossings minimized: Was an effort made to use as few crossings as possible?

On Temporary Roads

5. Number of crossings minimized: Was an effort made to use as few crossings as possible?
6. Stream crossings correct: Is the crossing located so as to minimize the potential erosion in the stream channel? Is the crossing at a right angle to the stream channel?
7. Approaches at right angles: Are approaches at right angles to the stream channel to minimize bank disturbance?
8. Stream crossings restored and stabilized: Have the temporary crossings been removed, excess fill removed from the stream channel and the banks been stabilized against erosion? Has the SMZ been stabilized in the area of the crossing?
9. Stream free of sediment: Has sedimentation from the road into the stream channel been minimized?

BMPs present: Which types of BMPs were used: culverts (CU), bridge (BR), low water crossing (LW)?

VI. Streamside Management Zones

1. Present on permanent stream: Is there an SMZ present on any permanent stream?
2. Present on intermittent stream: Is there an SMZ present on any intermittent stream?
3. SMZ adequately wide: Is the stream being protected from erosion and deposition of sediments? Does the width meet the guidelines recommendations?
4. Thinning within allowable specs: If thinning was done, is the basal area remaining at least 50 square feet? Is there minimal soil disturbance from felling and skidding?
5. SMZ integrity honored: Was an effort made to stay out of the SMZ with skidders, landings, roads, etc. (except for designated stream crossings)? Is the SMZ free of firebreaks?
6. Stream clear of debris: Are tops and limbs removed from permanent and intermittent stream channels? Has any brush or debris pushed into the stream channel been removed?
7. SMZ free of roads and landings: Were guidelines followed in locating roads and landings outside of the SMZ?
8. Stream free of sediment: Has sedimentation reaching the stream channel through the SMZ been minimized?

VII. Site Preparation

Site preparation method: shear/pile/burn, sheer only, drum chop, hot fire, chemical, disk/bed, sub-soil, disk/burn, disking only.

Regeneration method: mechanical, hand, natural, none.

1. Respect sensitive areas. Effort to prevent site prep intrusion into sensitive areas? Effort to prevent heavy equipment intrusion into sensitive areas? Effort to prevent fire intrusion into sensitive areas?
2. No soil movement on site: Is there no soil movement on site? Are rills or gullies prevented? Is there no problem with broad scale sheet erosion?
3. Firebreak erosion controlled: If present, has potential erosion from firebreaks been minimized as per guideline recommendations?
4. SMZ integrity honored: Effort to prevent site prep intrusion into the SMZ? Effort to prevent heavy equipment intrusion into the SMZ? Effort to prevent fire intrusion into the SMZ? Are perennial or intermittent streams free of debris?
5. Windrows on contour/free of soil: Are windrows on contour on hilly lands rather than up and down slopes? Was soil disturbance minimized? Was soil in windrows minimized?
6. No chemicals off site: Does it appear that chemicals were used according to label directions? Have they remained on site and out of water bodies?
7. Machine planting on contour: Are rows on contour on hilly lands rather than up and down slopes?
8. Stream free of sediment: Has sedimentation reaching the stream channel because of site prep activities been minimized?

VIII. Landings

1. Locations free of oil / trash: Any sign of deliberate oil spills on soil? Is trash picked up and properly disposed of?
2. Located outside of SMZ: Was the landing located outside SMZ so as to minimize traffic and erosion in the SMZ?
3. Well drained location: Were the landings located so as to minimize puddling, soil degradation and soil movement?
4. Number and size minimized: Were the number and size of landings kept to a minimum?
5. Respect sensitive areas: Were landings kept out of wet areas, SMZs, steep slopes if an alternative exist, erosion prone areas if an alternative exists, etc.?
6. Restored / stabilized: Has the landing been back bladed or otherwise restored as per guideline recommendations? Has erosion been minimized through spreading bark, etc., seeding, water bars, or other recommended BMP practices?

IX. Wetlands (may or may not be jurisdictional)

1. Avoid altering hydrology of site: Were ruts and soil compaction kept to a minimum?
2. Road drainage structures installed properly: Were BMPs installed to effectively maintain the flow of water and keep erosion to a minimum in the wetland?
3. Mandatory road BMPs followed: Were the 15 federal mandatory BMPs followed?

X. Overall Compliance

Section compliance percentages are determined by dividing the number of questions receiving a "yes" answer by the total applicable questions in each section. Y/(Y+N)

Overall compliance is determined in a similar manner using the totals from all sections combined. Y/(Y+N)

Significant Risk. A significant risk to water quality exists if during a normal rainfall sediment is likely to be delivered to a permanent water body.

Subjective Score:

No Effort: Substantial erosion as a result of operations. Sedimentation in streams. Temporary stream crossings not removed. No SMZ when needed, etc. Poor attitude evident about the job.

Poor: Some effort at installing BMPs. Generally poor quality construction or no effort in certain locations which suffer from erosion, stream sedimentation, etc. Substantial lack of BMPs in a particular emphasis such as roads, skid trails or SMZ.

Fair: (1) Generally a pretty good effort at BMPs. Poor application procedures perhaps. Lack of BMPs in a particular emphasis but with moderate consequences. (2) No BMPs on a site which requires few BMPs but has some resultant minor problems.

Good: (1) BMPs generally installed correctly. Guidelines generally followed. Allows for some failures of BMP devices or failure to observe guidelines but with light consequences. (2) Good quality job which required no BMPs and has few problems.

Excellent: (1) BMPs installed correctly. Guidelines followed. (2) Some BMPs implemented even when they might not have been required. Few, if any, problems exist.

Summary of Responses to BMP Compliance Monitoring Checklist Items, All Sites, Round 6

I. General Landowner and Tract Information

Owner type		Forester type		Activity	
Family Forest Owner	53	Industry	39	Regeneration Harvest	
Absentee	42	Private Consultant	54	Clearcut	85
Corporate	16	Public	9	Partial	9
Industry	36			Thin	55
Public (Fed, State)	9			Site Prep only	7

II. Site Characteristics

Terrain		Erodibility hazard		Type stream present	
Flat	41	Low	55	Perennial	29
Hilly	109	Medium	77	Intermittent	60
Steep	6	High	24	Both	31
				None	36

Distance to nearest permanent water body

< 300'	71
300 - 800'	4
800 - 1600'	0
1600' +	81

Predominant soil series/texture

Clay	0	Sandy loam	103
Clay loam	10	Sand	15
Loam	28		

III. Permanent Roads

	120 applicable	Yes	No	NA/NN	Sig. Risk
1. Respect sensitive areas		119	1	36	0
2. Roads meet grade specs		119	1	36	0
3. Rutting within allowable specs		117	3	36	0
4. Well drained with appropriate structures		101	18	37	1
5. Ditches do not dump into streams		100	1	55	0
6. Roads reshaped and stabilized		97	23	36	1

IV. Skid Trails/Temporary (secondary) Roads

124 applicable

	Yes	No	NA/NN	Sig. Risk
1. Slopes less than 15%	124	0	32	0
2. Respect sensitive areas	113	11	32	1
3. Roads well drained with water bars or other water control structures	103	13	40	0
4. Roads stabilized	107	16	33	2
5. Rutting within allowable specs	102	22	32	1

V. Stream Crossings

On Permanent Roads	31 applicable	Yes	No	NA/NN	Sig. Risk
1. Stabilized		25	6	125	1
2. Ditches do not dump into streams		27	1	128	0
3. Stream free of sediment		27	4	125	0
4. Number of crossings minimized		31	0	125	0
On Temporary Roads	53 applicable				
5. Number of crossings minimized		43	10	103	1
6. Stream crossings correct		45	7	104	0
7. Approaches at right angles		52	0	104	0
8. Stream crossings restored and stabilized		16	36	104	4
9. Stream free of sediment		42	10	104	2

VI. Streamside Management Zones 121 applicable

	Yes	No	NA/NN	Sig. Risk
1. Present on permanent stream	57	1	98	1
2. Present on intermittent stream	81	14	59	0
3. SMZ adequately wide	91	28	37	0
4. Thinning within allowable specs	103	9	44	0
5. SMZ integrity honored	110	4	42	0
6. Stream clear of debris	101	20	35	5
7. SMZ free of roads and landings	114	1	41	0
8. Stream free of sediment	120	1	35	1

VII. Site Preparation 48 applicable

	Yes	No	NA/NN	Sig. Risk
1. Respect sensitive areas	42	6	108	0
2. No soil movement on site	42	3	111	0
3. Firebreak erosion controlled	26	1	129	0
4. SMZ integrity honored	35	1	120	0
5. Windrows on contour/free of soil	14	1	141	0
6. No chemicals off site	29	0	127	0
7. Machine planting on contour	19	1	136	0
8. Stream free of sediment	40	0	116	0

VIII. Landings 120 applicable

	Yes	No	NA/NN	Sig. Risk
1. Locations free of oil/trash	104	16	36	0
2. Located outside of SMZ	113	0	43	0
3. Well-drained location	117	1	38	0
4. Number and size minimized	117	1	38	0
5. Respect sensitive areas	118	0	38	0
6. Restored/stabilized	116	2	38	0

IX. Wetlands 31 applicable

	Yes	No	NA/NN	Sig. Risk
1. Avoid altering hydrology of site	22	3	131	0
2. Road drainage structures installed properly	18	0	138	0
3. Mandatory road BMPs followed	19	0	137	0

X. Overall Compliance

	Yes	No	NA/NN	Sig. Risk
III. Permanent Roads - 93%	653	47	236	2
IV. Skid Trails/Temporary Roads - 90%	548	62	169	4
V. Stream Crossings - 81%	308	74	1022	8
VI. Streamside Management Zones - 91%	777	78	391	7
VII. Site Preparation - 95%	247	13	988	0
VIII. Landings - 97%	685	20	231	0
IX. Wetlands - 95%	59	3	406	0

Follow-up Questions

	Yes	No	NA/NN
Was activity supervised by a professional forester?	102	54	0
Was landowner familiar with BMPs?	111	45	0
Has logger attended BMP workshop?	126	10	20
Were BMPs included in the contract?	118	24	14
Is landowner a member of TFA, LO Assoc., etc.?	85	60	11