Voluntary Compliance with Forestry Best Management Practices in East Texas

Results from Round 2 of BMP Compliance Monitoring

by

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PREPARED IN COOPERATION WITH THE
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EXECUTIVE SUMMARY

A Best Management Practices (BMP) monitoring program, which evaluated the level of compliance and effectiveness of forestry BMPs based on the program used in a FY90 EPA Section 319 Grant to the Texas Forest Service, was implemented. A total of 135 sites on which silvicultural activities occurred were evaluated between September, 1992 and November, 1995. These sites were a representative sample of the forestry activities that occurred in East Texas during that time period.

Overall BMP compliance of the sites monitored was 87.4%. To be considered "in compliance," a site must be rated Fair, Good, or Excellent. Compliance with BMPs varied by forest land ownership, type of operation, landowner and silvicultural contractor knowledge of BMPs, level of forester involvement, and other site factors. Generally, compliance was highest on sites:

- managed by forest industry or USDA Forest Service
- where a forester was involved
- where the landowner and silvicultural contractor were familiar with BMPs.

Compliance was generally lowest on sites:

- owned by non-industrial private forest (NIPF) landowners
- where a forester was not involved
- where the landowner and silvicultural contractor were not familiar with BMPs.

Major deficiencies noted during the evaluations were:

PERMANENT ROADS
- Failure to stabilize stream crossings

TEMPORARY ROADS
- Lack of waterbars or other diversion structures
- Incorrect stream crossings
- Failure to restore and stabilize stream crossings

STREAMSIDE MANAGEMENT ZONES
- Lack of SMZs where needed
- Thinning excessively in SMZs

Compliance monitoring was also helpful in evaluating BMP effectiveness. When implemented correctly, BMPs are effective in controlling nonpoint source pollution. Failures observed were generally due to lack of use or improper installation of BMPs, not because of correctly installed BMPs that were ineffective. One weakness identified was lack of specific BMP guidelines for forest wetland areas. Therefore, a new set of guidelines, *Texas Best Management Practices for Forest Wetlands* was created and distributed.

While overall BMP compliance (87.4%) during this "Round 2" monitoring appears to decline slightly from the results of "Round 1" (88.2% - See the Texas Forest Service October, 1992, publication *Voluntary Compliance with Forestry Best Management Practices in East Texas)*, a higher proportion of NIPF sites and a lower proportion of industry sites were monitored. Sites under NIPF ownership generally have a lower rate of compliance than industry sites. BMP compliance on forest industry sites increased in "Round 2" to 95.1% compared to 89.6% compliance in "Round 1".

Likewise, compliance on public sites increased, from 93.3% in "Round 1" to 100% in "Round 2." The major weakness in compliance is on NIPF sites. Results show, however, that compliance is higher when both logging contractor and landowner are familiar with BMPs. Continued education is clearly the key to improving compliance in this ownership category.

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BACKGROUND AND OBJECTIVES

The Clean Water Act of 1987 called for states to establish a program for development and implementation of voluntary Best Management Practices. The Act also required states to develop methods for determining "BMP effectiveness," including a measure of BMP compliance.

The Texas Silvicultural Nonpoint Source Pollution Project requires that a monitoring program be conducted to document the level of voluntary utilization of BMPs and effectiveness of BMPs in reducing NPS pollution from silvicultural activities. Objectives of the monitoring program, funded by a FY91 Section 319(h) Grant from the EPA to the Texas Forest Service BMP Project, are to:

1) Measure the degree of compliance with BMP standards by forest landowners, silvicultural contractors, forest industry, and government agencies

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

This report discusses the findings of the BMP compliance monitoring for 135 sites monitored between September 1, 1992, and November 30, 1995. These data represent "Round 2" of BMP compliance monitoring conducted by the Texas Forest Service. Please see the Texas Forest Service October, 1992, publication *Voluntary Compliance with Forestry Best Management Practices in East Texas* for "Round 1" compliance monitoring results.

DISTRIBUTION AND SELECTION OF COMPLIANCE MONITORING SITES

In order to get a valid estimate of overall compliance with Forestry Best Management Practices in East Texas, compliance monitoring sites were distributed regionally within East Texas and among forest land ownership categories. Sites were intended to be representative of the distribution of all silvicultural activities in East Texas. The distribution of monitoring sites was based on estimated annual timber harvest for each county based on the annual Texas Forest Service Publication*, Texas Forest Resource Harvest Trends*. See Table 1.

Table 1. Distribution of Compliance Monitoring Sites by County.

County	1993 Average Annual Harvest (cubic feet)	Target # of sites	Completed # Sites
Anderson	11,918,849	2	2
Angelina	34,484,104	9	9
Bowie	6,879,725	2	2
Cass	27,669,000	8	8
Chambers	3,303,901	1	1
Cherokee	27,009,675	7	7
Franklin-Titus	3,574,445	1	1
Grimes	5,183,090	1	1
Hardin	25,574,587	10	8
Harris	7,261,836	1	0
Harrison	19,698,299	5	5
Henderson	N/A	1	1
Houston	23,078,579	5	5
Jasper	42,572,267	9	8
Jefferson	1,518,848	1	0
Liberty	20,872,951	7	6
Marion	14,024,279	4	4
Montgomery	28,013,889	5	4

Morris-Camp	6,596,957	1	1
Nacogdoches	26,246,483	6	6
Newton	28,925,219	7	7
Orange	10,416,099	2	1
Panola	21,952,430	3	3
Polk	25,047,561	9	5
Rusk	24,114,663	4	4
Sabine	16,274,285	4	4
San Augustine	18,937,993	5	5
San Jacinto	14,174,700	4	4
Shelby	27,727,353	5	5
Smith	9,323,121	3	3
Trinity	16,708,819	5	5
Tyler	30,158,385	6	3
Upshur	14,460,486	2	2
Walker	20,597,459	4	4
Wood	40,043,110	1	1
Total	618,343,447	150	135

QUALITY CONTROL

To eliminate bias, compliance monitoring sites were selected in a random manner using several methods to identify sites, including aerial detection and information from Texas Forest Service (TFS) field personnel. All monitoring evaluations were conducted by one or both of two trained foresters assigned full-time to the TFS BMP Project. Use of only two inspectors, who monitor sites jointly to maintain and improve consistence and fairness, provides better quality control.

MONITORING CHECKLIST

The Texas BMP Monitoring Checklist used was the same checklist used in previous monitoring ("Round 1" of compliance monitoring, done between July 1, 1991 and August 31, 1992). The Monitoring Checklist is comprised of 73 questions. A sample checklist along with an explanation of each question is provided in the Appendix. To simplify the checklist, each question was worded so that a positive answer was recorded with a "Yes" while a negative answer, indicating a departure from BMP recommendations or a negative water quality impact, was a "No." This allowed readers to quickly determine any problem areas identified during an inspection.

PRE-INSPECTION CONTACTS

Forest landowners were contacted prior to the inspection of the site to obtain permission for entry onto the property. During this initial contact, the TFS employee explained the program and invited the landowner or his/her representative to join the BMP forester during the compliance monitoring. Sites were not monitored if the landowner denied access. In many instances, industry foresters accompanied the BMP forester during the compliance monitoring on industry land. This provided opportunities for valuable information exchange on BMP installations, including one-on-one training for the industry forester as well as feedback to the BMP forester.

POST-INSPECTION CONTACTS

Landowners, logging contractors, and timber buyers (where applicable and identifiable) were provided with a copy of the completed BMP Monitoring Checklist, along with a cover letter explaining the BMP Project and interpreting the checklist.

RESULTS

Between September 1, 1992, and November 30, 1995, two TFS BMP foresters evaluated BMP compliance on 135 sites, totaling over 16,000 acres, throughout East Texas. The monitoring effort was much more time consuming than anticipated during the planning stage. Especially significant was the time required for initial landowner contact and gathering background information. In many cases, the landowner was present during the evaluation, which provided opportunities for extensive one-on-one training and feedback. Tabulated results by question on the monitoring form for all sites monitored are found in the Appendix.

SITE CHARACTERISTICS

The 135 monitoring sites were well distributed both geographically and by ownership, as shown in Figure 1. Forty-one (30.4%) of the 135 sites were owned by forest industry. Eighty-eight sites (65.2%) were owned by non-industrial private forest (NIPF) landowners, including 77 sites owned by small NIPF landowners (owners of less than 1000 acres) and 11 by large NIPF landowners (owners of more than 1000 acres). Six sites (4.4%) were owned by the public.

The majority of sites (83.7%) were monitored after a regeneration harvest, including 97 clearcuts and 16 partial harvests (such as diameter cuts, seedtree cuts, shelterwood, or selection harvests). Nineteen thinning and three site preparation (only) operations were evaluated. In 39 cases, the site preparation evaluation was included in elements of the preceding timber harvest operation.

Professional foresters (industry, private or government) were involved in planning and/or implementation of the operation on 94 (69.6%) of the sites. On 52 sites, the forester was employed by forest industry. Private consultants were involved on 36 (26.6%) of the sites, while Federal foresters were involved in 5 (3.7%) of the sites.

Terrain classification and soil erodibility were recorded from the Natural Resources Conservation Service (NRCS) soil survey, if available, or estimated by the forester. Forty-three sites (31.9%) were on flat terrain with 80 (59.3%) on hilly terrain and 12 (8.9%) on steep terrain. Fifty-six (42.1%) sites had low erodibility soils, 65 sites (48.9%) medium erodibility, and 12 (9.0%) were on high erodibility soils. Soil data for two sites was not available.

Of the 135 sites, 56 (41.5%) had either a perennial or perennial and intermittent stream on the tract, 42 (31.1%) had an intermittent stream only, and 37 (27.4%) had no streams on the tract. Fifty-nine sites (43.7%) had no permanent water within 800 feet of the operation, while 76 sites (56.3%) were within 800 feet of permanent water.

PERMANENT ROADS

Permanent roads were evaluated for compliance with 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 of the landowner. Permanent roads were inspected on 88 (65.2%) of the 135 sites. See Table 2.

Table 2. Compliance with Specific BMPs Relating to Permanent Roads.

BMP	Yes	No	N/A	% Compliance
Avoid sensitive areas	82	6	47	93.2%

Meet grade specifications	84	4	47	95.5%
Stream crossing stabilized	21	15	99	58.3%
Rutting within allowable specs	79	4	52	95.2%
Ditches do not dump into streams	58	8	69	87.9%
Specific BMPs used	56	26	53	68.3%
BMPs effective	52	4	79	92.9%
Stream free of sediment	49	17	69	74.2%

It is important to note that non-use of a specific BMP does not necessarily imply lack of compliance with BMPs. Often, there are many alternative methods that could be applied in a given instance. The value of the evaluation of whether specific BMPs were used is that it indicates whether efforts were made to use at least one of the more commonly recommended BMPs.

SKID TRAILS & TEMPORARY ROADS

Skid trails and temporary roads were evaluated on 109 of the 135 monitoring sites. Skid trails are routes through the forestry activity area by which logs are skidded or dragged to a permanent road or central loading point (called a landing or set). Temporary roads generally are not designed to carry long-term traffic and are usually closed after the forestry activity is complete. See Table 3.

Table 3. Compliance with Specific BMPs Relating to Skid Trails and Temporary Roads.

BMP	Yes	No	N/A	% Compliance
Slopes less than 15%	105	4	26	96.3%
Rutting within allowable specs	98	11	26	89.9%
Waterbars evident	21	68	46	23.6%
Waterbars working	14	6	115	70.0%
Stream crossings minimized	49	15	71	76.6%
Stream crossings correct	17	26	92	39.5%
Stream crossings restored & stabilized	6	35	94	14.6%
Specific BMPs used	34	59	42	36.6%
Stream free of sediment	50	30	55	62.5%

STREAMSIDE MANAGEMENT ZONES

Streamside management zones (SMZs) are recommended on all perennial and intermittent streams. All sites with either perennial or intermittent streams were evaluated for the presence and adequacy of SMZs. Streams were present on 98 of the 135 sites. Of these 98 sites, 89 (90.8%) had SMZs. SMZs were most common on perennial streams. Of the 56 monitoring sites with perennial streams as the highest order stream present, 43 (76.8%) had an SMZ. Of the 66 monitoring sites with intermittent streams, 46 (69.7%) had an SMZ. See Table 4.

Table 4. Compliance with Specific BMPs Relating to SMZs.

BMP	Yes	No	N/A	% Compliance
Present on permanent stream	43	13	79	76.8%
Present on intermittent stream	46	20	69	69.7%
Adequately wide	57	30	48	65.5%
Thinning within allowable specs	53	30	52	63.9%
Integrity honored	55	32	48	63.2%
Stream clear of debris	60	36	39	62.5%
Free of roads and landings	69	21	45	76.7%
Stream free of sediment	70	27	38	72.2%

SITE PREPARATION

Thirty-nine sites were evaluated for compliance with site preparation BMPs and the impact of these activities on water quality. A variety of site preparation techniques were evaluated, including 25 sites with some combination of shearing, piling, and/or burning. Drum chopping was evaluated on seven sites. Five sites involved application of herbicide only, while two sites were disked or bedded. See Table 5.

Table 5. Compliance with Specific BMPs relating to Site Preparation.

BMP	Yes	No	N/A	% Compliance
No soil movement on site	38	1	96	97.4%
Firebreak erosion controlled	23	1	111	95.8%
SMZ integrity honored	20	3	112	87.0%
Windrows on contour/free of soil	9	0	126	100%
No chemicals off site	9	0	126	100%
BMPs used	10	6	119	62.5%

Stream free of sediment	24	1	119	96.0%

LANDINGS

Landings, sometimes called sets, are areas where logs are gathered, delimbed, bucked to length, and loaded onto log trucks. Landings are areas of concentrated activity and can become a water quality issue if drainage is not properly controlled. Landings were evaluated on 120 sites. One hundred ten sites (91.6%) were free of oil and trash. Ninety-seven of 98 sites (98.9%) had landings that were located outside the SMZ. On 118 sites (98.3%), landings were located in a well-drained location. Two of five sites (40%) which had landings that required restoration and/or stabilization were restored and/or stabilized.

OVERALL COMPLIANCE WITH BMPs

BMP foresters used a 5-level grading scale to provide an indicator of overall compliance with BMPs as an indication of the impact of the silvicultural activity on water quality. The five grades are as follows:

1. **NO EFFORT** – Substantial erosion and water quality degradation as a result of operations. Sedimentation evident in streams. Non-compliance with several BMPs that were needed with a resulting adverse impact on water quality. Poor attitude evident about the job.

2. **POOR** – Some effort made at installing BMPs. Generally poor quality construction or no substantial effort at certain locations which now suffer from erosion and stream sedimentation. Substantial lack of BMPs in a particular emphasis such as roads, skid trails, or SMZs, with significant problems as a result.

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

4. **GOOD** – (1) BMPs generally installed correctly. Guidelines followed. Allows for some failure of devices or failure to observe guidelines, but with light consequences. (2) Good quality operation which requires no BMPs and has few problems.

5. **EXCELLENT** – (1) BMPs installed correctly. Guidelines followed. (2) Some BMPs implemented even though they might not have been "required." Few if any problems exist.

These ratings, though subjective in nature, provide a "feel" for the level of BMP compliance versus the need for BMPs on the particular tract, as well as the visible impact of the forestry activity on water quality.

Overall BMP compliance, sites receiving a "Passing" grade of Fair, Good, or Excellent, was 87.4%. Of the 135 sites evaluated, 7 (5.2%) received an Excellent rating; 79 (58.5%) received a Good rating; 32 (23.7%) received a Fair rating; 12 (8.9%) received a Poor rating; and 5 (3.7%) received a No Effort rating. See Figure 2.

COMPLIANCE BY SITE CHARACTERISTICS

Ownership

BMP compliance varied by ownership category. The public ownership category fared best, with 100% of the 6 sites in compliance (receiving a Fair, Good, or Excellent rating). Significantly, 83.3% of publicly-owned sites received a rating of Good or Excellent. In Texas, most publicly-owned forest land is managed by

the USDA Forest Service, the U.S. Army Corps of Engineers, and the State. See Figure 3 for geographical distribution of sites by compliance rating. Figure 4 shows compliance ratings by ownership.

Forty-one sites owned by forest industry had an overall BMP compliance of 95.1%, with 36 of the 41 (87.8%) receiving a rating of Good or Excellent.

Non-industrial private forest (NIPF) landowners with ownership of more than 1000 acres (large NIPF) had a passing rate of 91.7%. Small NIPF landowners had the lowest level of BMP compliance at 81.9%. All 5 No Effort sites were on small NIPF ownership.

Type of Activity

Four types of silvicultural activities were monitored: regeneration harvests, partial regeneration cuts, thinning, and site preparation. It is important to note that only three sites were evaluated for site preparation only (although site preparation was often evaluated along with a regeneration harvest). See Table 6.

Table 6. Overall Compliance with BMPs by Type of Operation.

Type of Operation	BMP Compliance
Regeneration harvest (clearcut)	85.5%
Regeneration harvest (partial cut)	87.6%
Thinning	94.8%
Site preparation (only)	100%

Professional Forester Involvement

Monitoring results indicate that BMP compliance was higher when a professional forester was involved. Ninety-four sites were identified as having a professional forester involved and had a BMP compliance rating of 94.7%. Sites in which there was no or unknown forester involvement had a BMP compliance rating of 70.7%. Figure 5 shows compliance ratings by forester involvement.

Landowner Familiarity with BMPs

Landowner familiarity with BMPs seems to influence overall BMP compliance. Sites with landowners who were not familiar with BMPs had an overall compliance rating of 80.4%, while sites with landowners who were familiar with BMPs had a compliance rating of 94.2%. Seventy of 135 landowners were identified as being familiar with BMPs, while 56 were not. Landowner familiarity was unknown on 9 sites. Only 24 of 55 NIPF landowners (43.6%) were identified as being familiar with BMPs.

Silvicultural Contractor Familiarity with BMPs

Logging and other silvicultural contractor familiarity with BMPs also seems to influence overall compliance. While contractor familiarity was identified on only 87 of the 135 tracts, results show that BMP compliance was higher when contractors were familiar with BMPs (97.3%) versus not familiar (46.2%).

Terrain

Monitoring sites were classified by BMP foresters as Flat, Hilly, or Steep. BMP compliance on Flat sites was 93%; on Hilly sites, 88.7%; and on Steep sites, 58.3%. This trend of increased compliance with flatter terrain is to be expected since less erosion and less adverse effect on water quality is likely.

Erodibility

Monitoring sites were identified as Low, Medium, or High soil erodibility. BMP compliance on Low erodibility sites was 92.9%; on Medium erodibility sites, 83.0%; and on High erodibility sites, 85.6%.

Distance to Permanent Water

Monitoring sites were evaluated for distance to nearest permanent water. BMP compliance on 61 sites with permanent water less than 300 feet away was 85.3%. On 15 sites with permanent water 300 to 800 feet away, compliance was 80.0%. Fourteen sites were 800 to 1600 feet from permanent water. BMP compliance on these sites was 92.8%. Of the 45 sites in which permanent water was greater than 1600 feet away, BMP compliance was 91.1%.

BMPs in Timber Sale Contract

Inspectors determined whether BMP use was included in the timber sale contract on 90 sites. Compliance on sites with BMPs included in the contract was 98.5%, while compliance on tracts without BMPs included in the contract was 66.6%.

DISCUSSION

The compliance rating system, though subjective in nature, provides an overall feel of the level of BMP use versus the need for BMPs and the overall visible impact on water quality. It should be noted that a Fair or even Good rating does not necessarily reflect implementation of specific BMPs on a particular site. These ratings may have been applied to a site where few or no specific BMPs were installed if the site was such that few BMPs were called for and the resultant impact on water quality was judged to be minor. Likewise, a Poor rating does not necessarily mean that no specific BMPs were implemented on a site. Sites may have received a Poor rating even if some effort was made at installing BMPs, but they were generally of poor quality or absent in certain locations.

Compliance to specific BMPs varied widely. Major deficiencies noted for specific categories are as follows:

PERMANENT ROADS

- Failure to stabilize stream crossings

TEMPORARY ROADS

- Lack of waterbars or other water-diversion structures
- Incorrect stream crossings
- Failure to restore and stabilize stream crossings

STREAMSIDE MANAGEMENT ZONES

- Lack of SMZs on intermittent streams
- Thinning excessively in SMZs
- Failure to remove logging debris from stream channels

Stream crossings are the most significant problem in terms of water quality impact. Use of brush and dirt crossings without restoration and stabilization are major deficiencies that will receive priority attention in the future.

OVERALL COMPLIANCE – "Round 1" Versus "Round 2"

One hundred sixty-two sites were monitored between July 1, 1991 and August 31, 1992, under an EPA FY90 Section 319(h) Grant to the Texas Forest Service Best Management Practices Project. (See Texas Forest Service publication *Voluntary Compliance with Forestry Best Management Practices in East Texas,* October, 1992). Overall compliance in the "Round 1" of compliance monitoring was 88.2%. Overall compliance under "Round 2" is 87.4%. While it appears that BMP compliance actually decreased slightly, this bears further discussion.

In "Round 1" 41.4% of sites monitored were on industry land, compared to only 30.4% of sites on industry land during "Round 2." Conversely, "Round 1" monitoring data included 49.4% NIPF sites, compared to 65.2% NIPF sites in the "Round 2." Since it has been established that NIPF sites generally rate lowest on BMP compliance, the higher percentage of NIPF sites monitored in "Round 2" brought down the overall compliance average.

Noteworthy here is that BMP compliance on industry land increased to 95.1% in "Round 2" from 89.6% in "Round 1". This substantial increase documents the diligence of forest industry in using the voluntary BMPs.

Publicly-owned land BMP compliance also increased, from 93.3% in "Round 1" to 100% in "Round 2." Five of six public sites were owned and managed by the USDA Forest Service, and all received ratings of Good or Excellent.

Sites owned by large (ownership of more than 1000 acres) NIPF landowners had an overall compliance rating of 91.7% in "Round 1," compared to 91.0% in "Round 2." Small NIPF ownership decreased in overall BMP compliance, going from 85.2% in the "Round 1" to 81.9% in "Round 2".

CONCLUSIONS

BMP compliance on public lands is superior. The Good or Excellent ratings on all five USDA Forest Service tracts show their commitment to protect water quality, their high standards in road construction, and their stringent harvesting contract specifications and enforcement.

Forest industry should be commended for its 95.1% compliance with the voluntary BMPs on their lands. Most major forest products companies now have their own set of BMP guidelines, which are at least as rigorous, often more rigorous, than the state guidelines. Major companies are now conducting their own internal BMP audits. To their further credit, major companies often will not purchase timber from a landowner who will not agree to use BMPs (such as an SMZ) on the sale.

As expected, NIPF landowners continue to lag behind other categories of ownership in BMP compliance. These landowners generally are less intensively involved in forest management, only infrequently sell timber, may be absentee (live away from their forest land), and may lack the technical knowledge to implement BMPs when they are needed. However, results show a positive correlation between landowner

familiarity with BMPs and BMP compliance. Therefore, as landowners become more familiar with BMPs, they are more likely to implement them. Consequently, the Texas Forest Service Best Management Practices Project highly recommends continued landowner education to increase BMP compliance and protect water quality.

Forester involvement in a silvicultural activity positively affects use of BMPs. Compliance of 94.7% with a forester involved versus 70.4% without forester involvement shows the need for NIPF landowners to consult and involve a professional forester, not just a non-forester timber buyer, before they sell their timber.

Logging contractor familiarity with BMPs also is positively correlated with BMP use on silvicultural activities. The notable difference in BMP compliance when the logging contractor is familiar with BMPs (97.3% compliance) versus when a contractor is not familiar (46.2% compliance) demonstrates the success of training logging contractors on BMPs.

Including use of BMPs in a forestry activity contract greatly increases BMP compliance (98.5% versus 66.6%). Unfortunately, many NIPF timber sale contracts do not include use of BMPs. In fact, NIPF timber sales often do not even have a timber sale contract. The Texas Forest Service highly encourages forest landowners to have a sale contract with BMP use included.

Results show that making NIPF landowners aware of the benefits of BMPs hasn't been highly successful. This is due to the difficulty in reaching over 150,000 NIPF landowners with the BMP message. Therefore, concentrating educational efforts on NIPF landowners is probably the most effective method to influence landowners to minimize water quality impacts from silvicultural operations.

BMP EFFECTIVENESS

The second objective of the monitoring program was to evaluate the effectiveness of BMPs as applied in the field and identify weaknesses in the BMP guidelines. Monitoring results show that BMPs themselves are effective means of limiting nonpoint source pollution from silvicultural activities. Shortcomings in BMP effectiveness arose not from poor BMP specifications, but from poor or improper implementation.

One weakness that was identified was lack of specific BMPs for use in forest wetland situations. Therefore, a new publication, *Texas Best Management Practices for Forest Wetlands*, was developed and is being distributed. These guidelines are meant to be used with the *Texas Best Management Practices for Silviculture* handbook (the "Blue Book") on wetland or wetland-like areas. Contact any Texas Forest Service office for a copy.

APPENDIX A

Compliance Monitoring Checklist
Evaluation Criteria
Tabulated Results by Checklist Question

TEXAS BMP MONITORING CHECKLIST

GENERAL

1. County_____ 2. Block/Grid_____
3. Latitude_____ Longitude_____
Forester: 4. _____ 5. _____
6. Timber Buyer _____
7. Logger _____

8. Activity _____
9. Estimated date of activity _____
10. Acres affected _____
11. Inspector _____

LANDOWNER:

12. Owner Type: N L A I P

13. Name _____
14. Address_____
15. City _____ ZIP _____
16. Phone _____

17. Date of Inspection _____
18. Accompanied by:_____

SITE CHARACTERISTICS

19. Terrain: F H S
20. Erodability hazard: L M H
21. Type stream present P I

22. Distance to nearest permanent water body:
<300' 300-800' 800-1600' 1600'+
23. Predominant soil series/texture: _____ / C CL L SL S

PERMANENT ROADS

[ ] NOT APPLICABLE

24. Avoid sensitive areas.	Y N NA
25. Roads meet grade specs.	Y N NA
26. Stabilized stream crossing.	Y N NA
27. Rutting within allowable specs.	Y N NA
28. Ditches do not dump into streams.	Y N NA
29. Were BMP's used.	Y N NA
Type: RD WD WB RE OC PL RS CU BR LW	
30. Were BMP's effective.	Y N NA
31. Stream free of sediment.	Y N NA

SKID TRAILS / TEMPORARY ROADS

[ ] NOT APPLICABLE

32. Slopes less than 15%.	Y N NA
33. Rutting within allowable specs.	Y N NA
34. Water bars evident.	Y N NA
35. Water bars working.	Y N NA
36. Stream crossings minimized.	Y N NA
37. Stream crossings correct.	Y N NA
38. Stream crossings restored & stabilized.	Y N NA
39. Were BMP's used.	Y N NA
Type: RD WD WB RE OC PL RS CU BR LW	
40. Stream free of sediment.	Y N NA

SMZ

[ ] NOT APPLICABLE

41. SMZ present on permanent stream.	Y N NA
42. SMZ present on intermittent stream.	Y N NA
43. SMZ adequately wide.	Y N NA
44. Thinning within allowable specs.	Y N NA
45. SMZ integrity honored.	Y N NA
46. Stream clear of debris.	Y N NA
47. SMZ free of roads and landings.	Y N NA
48. Stream free of sediment.	Y N NA

SITE PREPARATION

[ ] NOT APPLICABLE

49. Site prep method _____	
50. Regeneration method _____	
51. No soil movement on site.	Y N NA
52. Firebreak erosion controlled.	Y N NA
53. SMZ integrity honored.	Y N NA
54. Windrows on contour / free of soil.	Y N NA
55. No chemicals off site.	Y N NA
56. Were BMP's used.	Y N NA
Type: WB RE OC RS	
57. Stream free of sediment.	Y N NA

LANDINGS

[ ] NOT APPLICABLE

58. Locations free of oil / trash.	Y N NA
59. Located outside SMZ.	Y N NA
60. Well drained location	Y N NA
61. Restored, stabilized.	Y N NA

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62. **Overall compliance with Best Management Practices**

NEEDS IMPROVEMENT NO EFFORT POOR

PASS FAIR GOOD EXCELLENT

See Evaluation Criteria for a full description of numbered questions.

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: Nonindustrial (N), Absentee nonindustrial (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 form 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 exist, 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, are 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 to 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.

Site Characteristics (135 Sites Evaluated 16,363 Total Acres)

Owner Type	Forester	Terrain	Erodability	Highest Order Stream Present	Distance to Nearest Permanent Water Body		Type of Activity Monitored #	Acres	
	52 Industry				61	< 300'	97	10,727	Regen Hrv-Clearcut
77 Small NIPF	36 Consultant	43 Flat	56 Low	56 Perennial	15	300-800'	16	1,784	Regen Hrv-Partial
11 Large NIPF	5 Federal	80 Hilly	65 Medium	42 Intermittent	14	800-1600'	19	3,675	Thinning
41 Industry	1 State	12 Steep	12 High	37 None	45	1600'+	3	177	Site Prep
6 Public	41 None/Unknown								

Permanent Roads: 88 Applicable 47 Not Applicable

Skid Trails/Temporary Roads: 109 Applicable 26 Not Applicable

	Yes	No	N/A		Yes	No	N/A
24. Avoid sensitive areas	82	6	47	32. Slopes less than 15%	105	4	26
25. Roads meet grade specifications	84	4	47	33. Rutting within allowable specs	98	11	26
26. Stream crossings stabilized	21	15	99	34. Water bars evident	21	68	46
27. Rutting within allowable specs.	79	4	52	35. Water bars working	14	6	115
28. Ditches do not dump into stream	58	8	69	36. Stream crossings minimized	49	15	71
29. Were BMP's used	56	26	53	37. Stream crossings correct	17	26	92
30. BMP's effective	52	4	79	38. Stream crossings restored & stabilized	6	35	94
31. Stream free of sediment	49	17	69	39. Were BMP's used	34	59	42
				40. Stream free of sediment	50	30	55

Streamside Management Zones: 98 Applicable 37 Not Applicable

	Yes	No	N/A		Yes	No	N/A
41. SMZ present on permanent stream	43	13	79	45. SMZ integrity honored	55	32	48
42. SMZ present on intermittent stream	46	20	69	46. Stream clear of debris	60	36	39
43. SMZ adequately wide	57	30	48	47. SMZ free of roads and landings	69	21	45
44. Thinning within allowable specs	53	30	52	48. Stream free of sediment	70	27	38

Site Preparation: 39 Applicable 96 Not Applicable

49. Site prep method:

1 Shear/Pile/Burn 6 Shear/Pile 10 Shear Only 7 Drum Chop 8 Hot Fire 5 Chemical 2 Disk/Bed 0 Disk Only 0 Sub-Soil

50. Regeneration Method: 5 Mechanical 10 Hand-plant

	Yes	No	N/A		Yes	No	N/A
51. No soil movement on site	38	1	96	54. Windrows on contour/free of soil	9	0	126
52. Firebreak erosion controlled	23	1	111	55. No chemical off site	9	0	126
53. SMZ integrity honored	20	3	112	56. Were BMP's used	10	6	119
				57. Stream free of sediment	24	1	119

Log Sets: 120 Applicable 15 Not Applicable

	Yes	No	N/A		Yes	No	N/A
58. Locations free of oil/trash	110	9	16	60. Well drained location	118	2	15
59. Located outside SMZ	97	1	37	61. Restored, stabilized	1	3	130

62. Overall Compliance with Best Management Practices

Needs Improvement			Pass	
No Effort	Poor	Fair	Good	Excellent
5	12	32	79	7
3.7%	8.9%	23.7%	58.5%	5.2%

APPENDIX B

Figures 1 – 5

Figure 1

Site Locations by Ownership Category

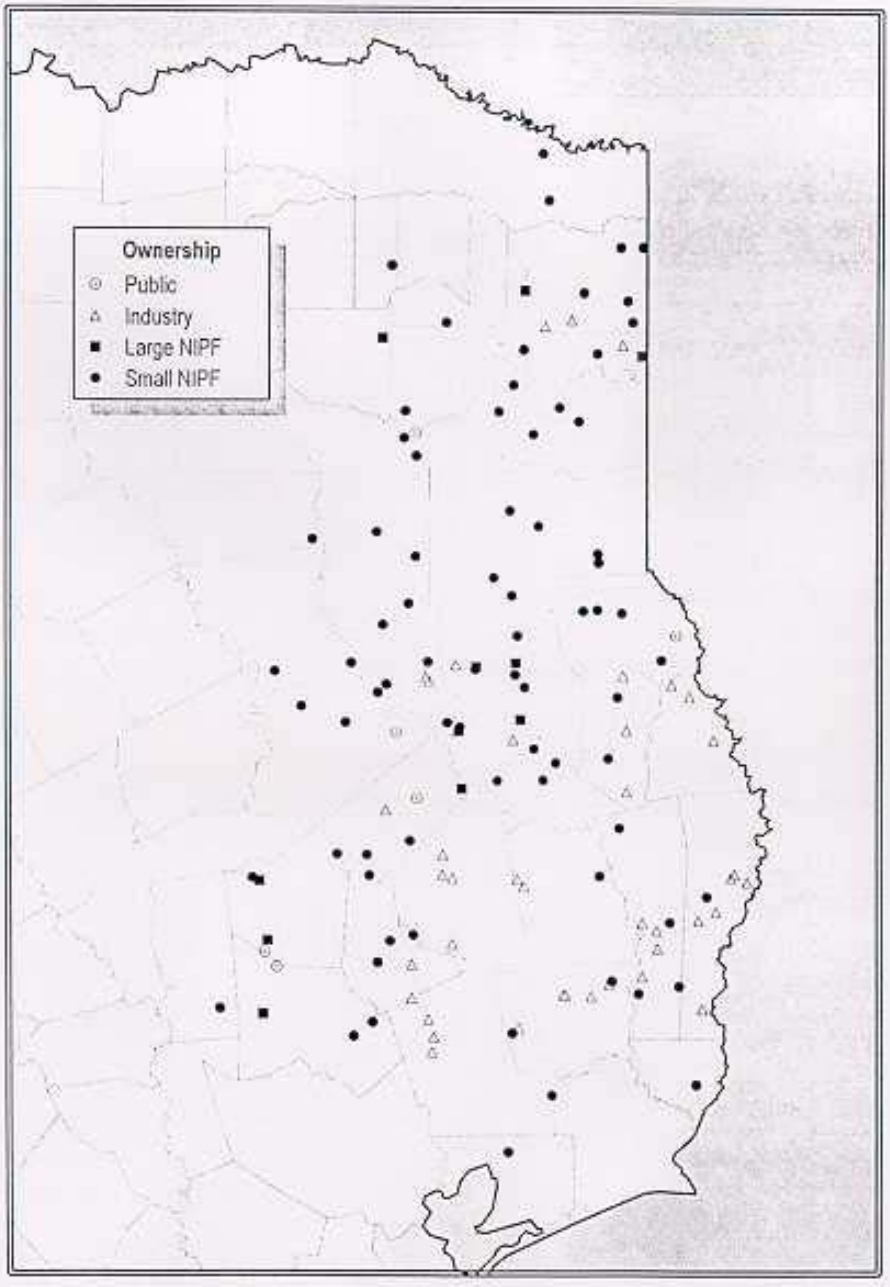


Figure 2
Overall Compliance Ratings – All Categories, All Ownership

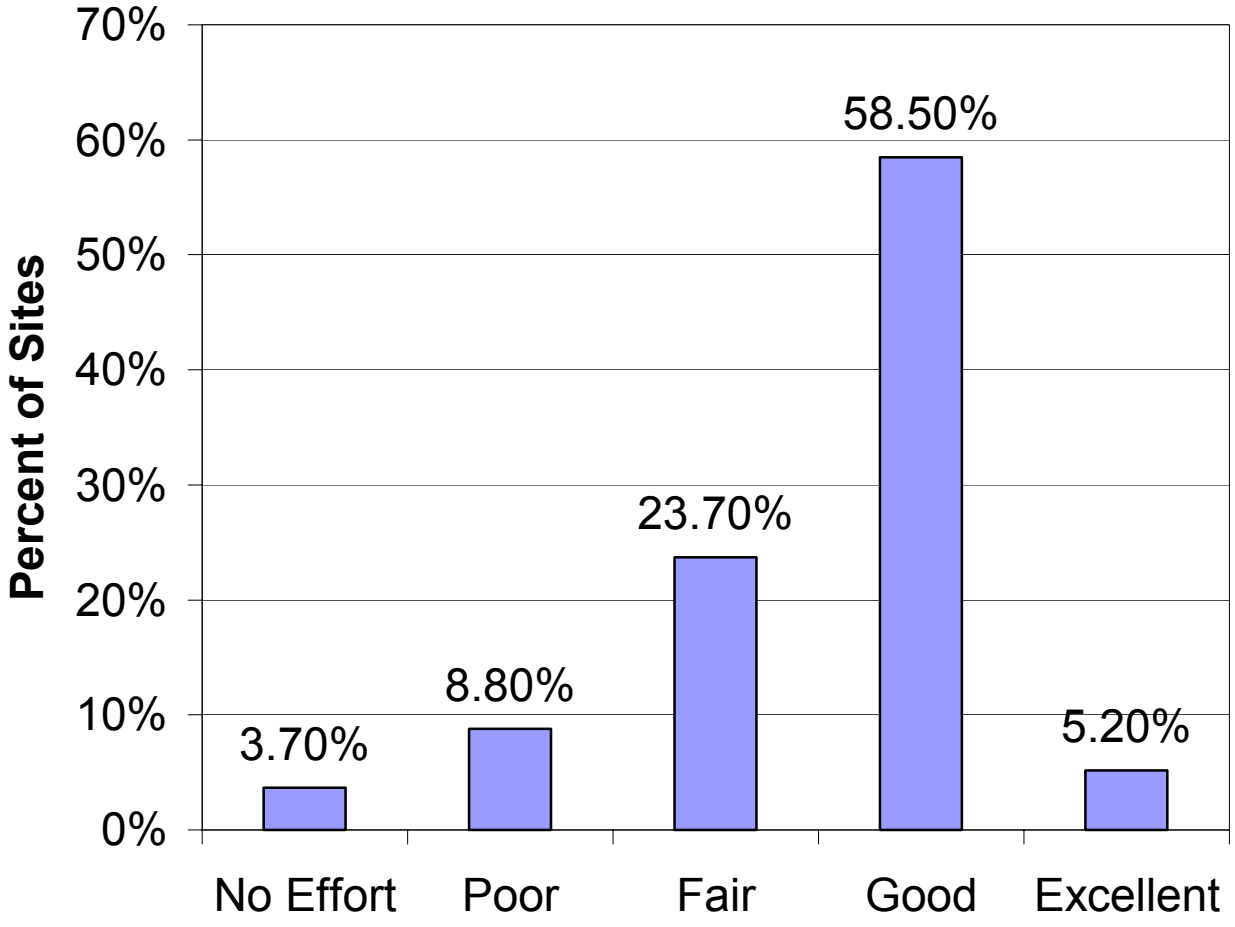


Figure 3

Site Locations by Overall Compliance Rating

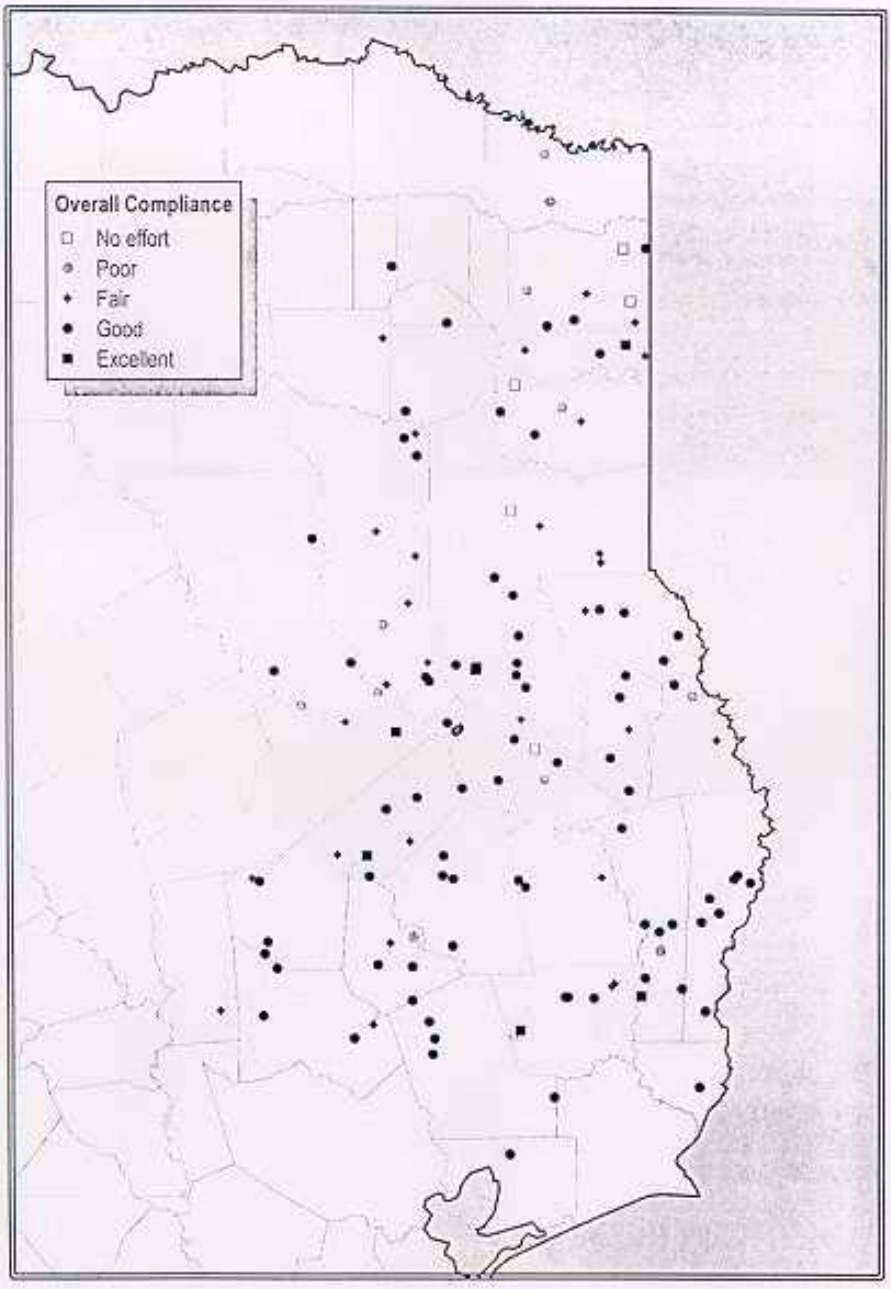
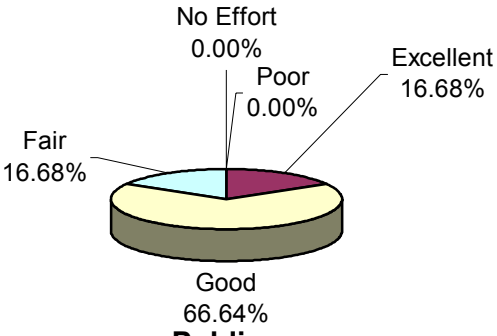
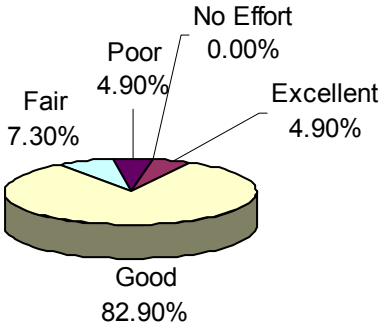


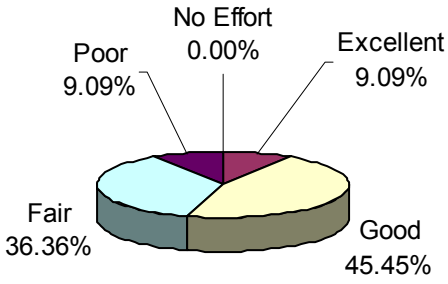
Figure 4
Compliance Ratings by Ownership Category



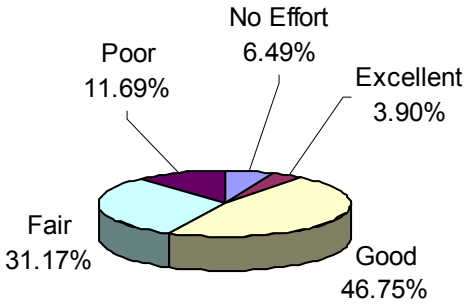
Public



Industry



NIPF (large)



NIPF (small)

Figure 5
Compliance Ratings by Forester Involvement