# Appendix I

# Water Quality

# Appendix F

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## Water Quality Modeling

Water quality modeling developed specifically for the National Forests in Mississippi was applied to Analysis Unit 22. Implementation instructions for this evaluation are provided in Cumulative Effects Analysis for Water Quality and Associated Beneficial Uses, National Forests in Mississippi, November 1999. This document provides a model for analyzing potential cumulative effects on water quality based upon past, present, and anticipated future activities. The model uses a spreadsheet to evaluate these activities in order to estimate the amount of siltation occurring in the watershed, and to estimate cumulative effects within the measurable impact area for this project.

The Council on Environmental Quality handbook, Considering Cumulative Effects Under the Environmental Policy Act, sets the standard for analyzing cumulative effects of a project. The initial process (scoping) of determining how cumulative effects are to be analyzed is identified as a four-step process. With respect to siltation and impacts on aquatic habitats, these steps are as follows:

Step 1: Identify cumulative effects issues. -- Siltation and its impacts on aquatic habitats are identified as an issue in the Mississippi Land and Resource Management Plan (Forest Plan). This is also an internal issue monitored by the implementation and review of "Best Management Practices" and other stream protection mitigations. The issue was also raised during the public scoping for the Analysis Unit 22 Project Area. Therefore, it is identified as a cumulative effects issue.

Step 2: Establish the geographic scope for the analysis. -- Council on Environmental Quality guidelines indicate the importance of establishing and limiting the geographic boundaries for Analysis Unit 22. Limitation is based upon the "project impact zone". This zone will vary depending upon the resource area being considered. In general terms, this is the zone in which the impacts of a particular action can be measured or have a noticeable impact. For Analysis Unit 22, the geographic area consists of the area around the Royal Chapel area which drains to its entry point at the Homochitto River.

The impact zone would not include the Homochitto or Mississippi Rivers. The Homochitto River carries a relatively heavy sediment load from ongoing headcutting. This headcutting is the result of stream canalization performed by the Corps of Engineers to the west of the National Forest Boundary and dredging in the Mississippi River. The higher energy gradient created by these processes has resulted in headcutting and bank erosion as the Homochitto River watershed tries to reestablish equilibrium.

The basis for determining the impact zone for the effects related to siltation and the quality of aquatic habitat is whether or not Analysis Unit 22, with mitigation, could reasonably result in measurable changes to the types and populations of species which use and are supported by a stream or river. While there is sufficient potential that this could occur in the creeks within Analysis Unit 22, the effects of headcutting on stream structure and the sediment load currently present in the Homochitto River are the primary impacts affecting aquatic habitats in the drainage system. Limitations or effects upon aquatic habitats and the types of habitat present in the Homochitto River are the results of that process. The type of aquatic habitat present in the Homochitto River is not the same as the type of habitat present in drainage system of Analysis Unit 22.

All creeks carry a base level of silt resulting from natural geological processes, such as mass wasting and bank erosion. Base load silt from drainage systems eventually flushes into the Homochitto River whether or not a project occurs in the drainage. Small additions to base load siltation from proposed actions in Analysis Unit 22, along with other actions taking place within the Homochitto River watershed, are unlikely to be measurable against the much higher impact of the headcutting. Withholding this project and other projects on the Homochitto National Forest might result in very slight reductions in sediment load in the Homochitto River, but the amount is not significant in light of the effects of headcutting and bank erosion. Therefore, the affected creeks' entry into the Homochitto River is the appropriate limit of the project impact zone.

Step 3: Establish the time frame for the analysis. -- Research and monitoring have indicated that 3 years is the reasonable time frame when siltation from vegetative management activities can occur. Most of the impact occurs within the first year, and sites return to base flow levels by the end of the third year. Therefore, to be considered in this cumulative effects analysis, events must have occurred within three years of the Analysis Unit 22 Project or must follow the project within three years.

Step 4: Identify other actions affecting the resources, ecosystems, and human communities of concern. -- The District used its Geographic Information System database and stand records of Forest Service lands to identify other actions. Activity was just completed in compartment 278 of the Brushy Creek Watershed.

Aerial photographs and direct observation were used to determine past activities on private lands. There was no means to determine ongoing, incomplete activities. These were accounted for under estimated future actions on private lands.

Future activities on public lands within the 3-year time frame of overlapping impacts are either currently planned or are in the planning process and can be readily estimated. These future activities would include planned treatments of areas within the Analysis Unit 22 Project as well as planned treatments of areas designated in the First Thinning Environmental Assessment, which was implemented before Analysis Unit 22.

Future activities on private lands are estimated based upon current use or condition of the existing timber. Much of the private land in the upper portions of the watershed is managed for commercial forestry. These lands have been heavily cut and will not support harvests within the planning period. Mature forests are estimated on an area-by-area basis. Lands in non-forest are estimated to continue at their current use.

Determining Model Parameters:

There were three model parameters which merit discussion. The model divided lands into those over 20% slope and those under 20% slope. Thinning activities were defined as light, medium, and heavy. Analysis of future activities outside Analysis Unit 22 but within the impact zone was not clearly defined.

Slope:

Slope was analyzed by three means. United States Geological Survey Digital Elevation Models were run using the ArcInfo Geographic Information System program. Resolution limitations and the relatively short stretches of steep slopes on the District resulted in no slopes over 20% being identified within the watershed. Topographical layers in the District's geographic information system database have every fifth line (100 feet) labeled. The 20-foot contours are not attributed, limiting computer analysis. Using a hand scale was also evaluated. However, as with the digital elevation model information, side slopes tend to be steep but of relatively short length. Very few areas scaled to greater than 20% slope within a typical test area. Experience from observations and measurements on the district showed these methods to clearly underestimate slope effect.

Soil type descriptions on the District indicate where slopes of over 20% are present. More than 50% of the Federal land base fell within this category. However, this does not imply that all slopes within those type-mapped areas are 20% or greater. In fact, a number of broad ridges with roads that has no slopes greater than 10 percent are included in these type-mapped areas. Using soil types grossly over-estimates the percentage of slopes over 20%.

Federal ownership tends to encompass more of the steep land than is found on private lands. Private lands generally occupy the wide ridges and wide flood plains. Therefore, two assumptions were made relative to slopes. On National Forest lands, 30% of the land base was estimated to have slopes over 20%. It was the Interdisciplinary Team's estimate that this represented an upper limit estimate and probably over-estimated potential erosion. This was considered preferable to under-estimating this factor. Substantial private land was in agriculture, pasture, or was forested, but lay within the drainage system floodplain and had little or no slope. Ten percent appeared to be an appropriate figure for private lands with slopes over 20%.

Thinning Intensity:

Some of the thinnings within the watershed were first thinnings. These thinnings remove substantial basal area but have very low impact on soils or siltation. Monitoring actions sited

within the body of the Environmental Analysis indicates that less than 1%-dispersed disturbance occurs as a result of first thinning. The equipment used in these thinning operations is lighter than that used for regeneration and intermediate thinning harvests. Therefore, all first thinnings were considered "light thinnings" based upon the actual on-the-ground impacts.

Intermediate thinnings are very light with respect to stem and basal area removal. Typically, because of the fertility of soils on the Homochitto, only 3 to 6 sawtimber trees and a dozen pulpwood trees are removed per acre. Dispersed disturbance remains below 1%. However, the equipment used is larger and skidding large logs results in some additional ground impact when compared to first thinnings. Therefore, intermediate thinnings were considered "medium impact thinnings" even though they might be considered light based upon the numbers of trees removed.

Selection of Future Activities:

The model is unclear as to the input of activities planned beyond the same year as activities in Analysis Unit 22. However, thinnings anticipated within three years of the sale were added as future activities concurrent with the Project Area. This over- estimated the intensity of overlapping impacts but was considered preferable to under estimating these impacts.

Estimating future activities on private lands, which might occur in the next three years, was more tenuous. Blocks of forest were individually evaluated. Much of the private forestland within the watershed has been harvested in the past 20 years. Stumpage prices dropped sharply in 1998, and there appears to be little incentive to harvest at this time. Estimates were based upon the appearance of the tract and whether or not it appeared to need thinning, or whether it was 40 years or older.

There is no history of immediate harvest as soon as sawtimber size is reached on private lands. Therefore, harvest estimates were pro-rated based upon the best estimates of a forester using photographic analysis. As a general comment on potential changes in age class distributions, the number of acres available to grow from early seral to pulpwood size classes and from pulpwood into sawtimber outweighed harvest potential. Private forests in Analysis Unit 22 are likely to grow older on the average over the next 10 years.

Discussion of Results: The analysis spreadsheet, resulting input, and computing analysis data is attached to this appendix. The model is based upon the best available "delivery ratio" information and determines the severity of impact based on the percentage increase in disturbance over "pre-European" levels. The model indicates that, based upon current land usage, baseline disturbance levels are 378% above pre-European levels. When present, planned, and anticipated activities were added, disturbance levels were calculated at approximately 388% for all alternatives. The threshold at which adverse impacts are considered to occur is 1650% of "pre-European" levels. No alternative evaluated exceeded the threshold. The model indicates that no adverse cumulative impacts would occur as a result of this project or cumulatively with other activities occurring within the affected watershed.

Conclusion: The estimated disturbance is more than 1000% under the threshold that would be expected to adversely impact or have a cumulative effect on water quality and aquatic habitats. If siltation and aquatic habitats were the only management consideration, there would appear to be additional opportunity to address forest health needs through additional regeneration of aging pine stands. However, a variety of other considerations and mitigations limited the range of reasonable and legal alternatives.

This conclusion is born out by recent studies on the Homochitto Forest that include Brushy Creek. In 1996, Brushy Creek was surveyed by Johnson and McWhirter. At that time, all eight of the management indicator species for southwestern Mississippi streams of this classification were found to be present. The study analyzed species richness and species diversity under Margalef's Index and the Shannon Weiner Index, respectively. The Index of Biotic Integrity (IBI) was also calculated. The aquatic habitat of Brushy Creek was rated as "good to excellent" as a result of this study.

Data collected in three other studies, which were broadly based upon streams within the Homochitto drainage, include: Ebert and Hartfield (1981); Ebert, et al. (1985); Seehorn (1975). Historical records from the University of Southern Mississippi fish database (Ross) also record appropriate management indicator species for streams (including Brushy Creek) on the Homochitto National Forest.

These studies occurred during and immediately after a period of elevated activity within the watershed. Due particularly to harvest activities on private commercial lands within the watershed and somewhat more intensive activities on Forest Service lands from 1970 through the mid 1990's, these studies measured stream quality during a period of greater disturbance than is now present. The current level of activity is expected to be much lower than that over the last 2½ decades. Therefore, baseline data that includes periods of more extensive activity shows that Brushy has maintained very high quality aquatic habitat throughout.

With respect to activities on Forest Service lands, implementation of standard "Best Management Practices" required by the Forest Plan and its amendments represents the mitigation applied. The conclusion that can be drawn from these baseline studies is that the validity of the model is verified, and that the implementation of standard mitigation, in the form of "Best Management Practices" and other Forest Plan mitigations are effective in reducing siltation and maintaining the quality of the aquatic habit. Neither direct nor cumulative impacts are likely to adversely affect the watershed in Analysis Unit 22.

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|---|---|---|---|---|
| Watershed | **AU-22** | Acres | Percent increase above baseline | Percent increase above PreEuropean baseline |
| Predicted Year for Implementation | **2003** | | | |
| FS | | **28,480.0** | | |
| Private | | **29,280.0** | | |
| Total | | **57,760.0** | | |
| | **Current** | **PreEuropean** | | |
| Past Activities (Baseline) | Tons/Yr **44,449** | Tons/Yr **9,294** | | **378.3** |
| Present Activities (Commited) | | **448** | | |
| Alternative | **Proposed Action** | | | |
| Future Activities | | **534** | | |
| Predicted Percent Increase | | | **2.20828** | **388.821** |
| Alternative | **Maximum Regeneration** | | | |
| Future Activities | | **577** | | |
| Predicted Percent Increase | | | **2.30639** | **389.290** |
| Alternative | **No Herbicide** | | | |
| Future Activities | | **534** | | |
| Predicted Percent Increase | | | **2.20828** | **388.821** |
| Alternative | **Thin Only** | | | |
| Future Activities | | **482** | | |
| Predicted Percent Increase | | | **2.09132** | **388.262** |