7.0 SEDIMENTATION/SILTATION (STREAM BOTTOM DEPOSITS)

During the 2002 SWQB intensive water quality survey in the Canadian Watershed (Part 1), impairment due to excessive sedimentation/siltation (previously listed as impairment due to Stream Bottom Deposits [SBD]) was confirmed for Mora River [NM-2306.A_000] (Hwy 434 to headwaters) and Sapello River [NM-2305.3.A_20] (Mora River to Manuelitas Creek).

7.1 Target Loading Capacity

Target values for this Sedimentation/Siltation TMDL will be determined based on 1) the presence of numeric criteria or appropriate numeric translator to a narrative standard, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. This TMDL is also consistent with New Mexico's antidegradation policy.

The state of New Mexico has developed and adopted a narrative criterion for "bottom deposits." The current general narrative criterion for the deposition of material on the bottom of a stream channel is specifically found in Paragraph (1) of Subsection A of 20.6.4.13 of the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC):

> ***A. Bottom Deposits and Suspended or Settleable Solids:***
> ***(1)*** *Surface waters of the state shall be free of water contaminants including fine sediment particles (less than two millimeters in diameter), precipitates or organic or inorganic solids from other than natural causes that have settled to form layers on or fill the interstices of the natural or dominant substrate in quantities that damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.*

Clean stream bottom substrates are essential for optimum habitat for many fish and aquatic insect communities. The impact of fine sediment deposits is well documented in the literature. Impairment occurs when critical habitat components, such as spawning gravels and cobble surfaces, are physically covered by fines thereby decreasing intergravel oxygen and reducing or eliminating the quality and quantity of habitat for fish, macroinvertebrates, and algae (Chapman and McLeod 1987, Lisle 1989, Waters 1995). An increased sediment load is often the most important adverse effect of activities on streams, according to a monitoring guidelines report (USEPA 1991). This impact is largely a mechanical action that severely reduces the available habitat for macroinvertebrates and fish species that utilize the streambed in various life stages. Minshall (1984) cited the importance of substratum size to aquatic insects and found that substratum is a primary factor influencing the abundance and distribution of insects. Aquatic detritivores also can be affected when their food supply either is buried under sediments or diluted by increased inorganic sediment load and by increasing search time for food (Relyea et al. 2000). In addition, sediment loads that exceed a river's sediment transport capacity often trigger changes in stream morphology (Leopold et al. 1964). Streams that become overwhelmed with sediment often go through a period of accelerated channel widening and streambank erosion before returning to a stable form (Schumm 1977, Knighton 1984). These morphological changes

tend to accelerate erosion, thereby reducing habitat diversity and placing additional stress on designated aquatic life uses.

The SWQB Sediment Workgroup evaluated a number of methods described in the literature that would provide information allowing a direct assessment of the impacts to the stream bottom substrate. In order to address the narrative criteria for bottom deposits, SWQB compiled techniques to measure the level of sedimentation of a stream bottom. These procedures are presented in Appendix C of the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report* (NMED/SWQB 2004b), which is online at http://www.nmenv.state.nm.us/swqb/links.html. The purpose of the protocol is to provide a reproducible quantification of the narrative criteria for bottom deposits. A final set of monitoring procedures was implemented at a wide variety of sites during the 2002 monitoring season. These procedures included conducting pebble counts (to determine percent (%) fines), stream bottom cobble embeddedness, geomorphologic measurements, and the collection and enumeration of benthic macroinvertebrates. The SWQB is in the process of reviewing the sedimentation assessment protocol in order to improve it in the future, and will solicit input on revisions and improvements to this protocol.

Excessive stream bottom deposits impact a stream's health by reducing the interstitial space and subsequently reducing intergravel dissolved oxygen, which adversely impact the macroinvertebrate population by reducing the stream's spawning and rearing potential. From a channel morphology vantage point, increasing cobble embeddedness reduces channel roughness (Manning's "n"), thus reducing instream bed friction, which ultimately leads to further channel instability. By addressing sources of suspended sediment (i.e. watershed disturbances) that contribute to instream total suspended solids (TSS), there should be an improvement in biological community and reduction in the amount of embeddedness overtime, thus improving overall stream health.

Target Setting

In setting TMDL targets for the Mora and Sapello Rivers, the State uses a reference watershed approach when developing TMDLs for sediment. The reference waterbodies for these TMDLs are Rio la Casa at the inactive USGS gage 7-2148 and the Sapello River at Highway 518. Both reference sites are in the Mora subwatershed.

Rio la Casa at the inactive USGS gage 7-2148 was chosen as the benthic macroinvertebrate reference station for the Mora River at Cleveland near Bridge on Church Rd. Likewise, Sapello River at Highway 518 was chosen as the benthic macroinvertebrate reference station for the Sapello River at Emplazado. The reference and study sites are in the same ecoregion (Southern Rockies) and have similar geomorphic characteristics as displayed in Table 7.1. Benthic macroinvertebrate samples and pebble counts were collected at both stations according to methods described by Barbour et al. (1999) and Wohlman (1954).

Collection of benthic macroinvertebrates involved the compositing of three individual kick net samples taken from a riffle at each sampling location. Each kick involved the disturbance of approximately one-third of a square meter of substrate for one minute into a 500-micron mesh

net. The rapid bioassessment protocol (RBP) metrics were applied to a 300-organism subsample of the composite sample at each site (Barbour et al. 1999).

Selection of those metrics that are particularly suited to the delineation of sediment impacts highlights the degree of impairment. Ephemeroptera/Plecoptera/Tricoptera (EPT) taxa, the number of sediment adapted organisms, taxa richness, and Hilsenhoff's Biotic Index (HBI) all indicate some degree of impairment attributable to sedimentation (Table 7.2). Select results of the pebble count and benthic macroinvertebrate surveys are shown in Table 7.2.

Table 7.1 Geomorphic Characteristics of Benthic Macroinvertebrate Sampling Sites

	Mora River		Sapello River	
Dimensions	**Reference Site[(a)]**	**Study Site[(b)]**	**Reference Site[(c)]**	**Study Site[(d)]**
Cross-section Area (sq. ft.)	27.8	53.1	59.2	n/a
Width (feet)	17.4	29.5	34.1	n/a
Maximum Depth (feet)	2.4	2.5	2.4	n/a
Mean Depth (feet)	1.6	1.8	1.7	n/a
Width:Depth Ratio	10.9	16.4	19.6	n/a
Entrenchment Ratio	5.75	1.27	1.77	n/a

Notes:
[(a)] Reference Site = Rio la Casa at inactive USGS gage 7-2148 (2002 Data)
[(b)] Study Site = Mora River at Cleveland by Bridge on Church Rd. (2002 Data)
[(c)] Reference Site = Sapello River at Highway 518 (2006 Data)
[(d)] Study Site = Sapello River at Emplazado (2006 Data)
n/a = not available

Table 7.2 Pebble Count and Benthic Macroinvertebrate Results

	Mora River			Sapello River		
Results	**Reference Site[(a)]**	**Study Site[(b)]**	**Percent of Reference**	**Reference Site[(c)]**	**Study Site[(d)]**	**Percent of Reference**
Pebble count						
% Fines (< 2 mm)	15	51	240%	40	56	40%
D50	75.9 mm	0.1 mm	—	32 mm	0.59 mm	—
D84	181 mm	76 mm	—	190 mm	44 mm	—
Benthic metrics						
Ephemeroptera/ Plecoptera/ Tricoptera Taxa	15	17	—	9	5	—
Taxa Richness	32	36	—	22	16	—
Hilsenhoff's Biotic Index	4.101	6.23	—	4.32	5.09	—
Total Biologic Score	40	26	65%	40	26	65%
Total Habitat Score (out of a possible 200)	176	96	55%	121	n/a	n/a

Notes:
[(a)] Reference Site = Rio la Casa at inactive USGS gage 7-2148 (2002 Data)
[(b)] Study Site = Mora River at Cleveland by Bridge on Church Rd. (2002 Data)
[(c)] Reference Site = Sapello River at Highway 518 (2006 Data)
[(d)] Study Site = Sapello River at Emplazado (2006 Data)
mm = Millimeters — = Not applicable
n/a = not available

In establishing a target for the Mora and the Sapello Rivers, NMED considered several factors. First, a recent District of Columbia Court of Appeals decision (*Friends of the Earth, Inc. v. EPA et al*), has now made it necessary for TMDLs to include "*daily load*" calculation. Currently the Clean Water Act Section 303(d)(1)(C) requires that TMDLs be established for pollutants which are, "suitable for calculation." In this case it is impossible to calculate a "*daily load*" for stream bottom deposits. Secondly, the Mora subwatershed (Figure 7.1) has both natural processes and watershed disturbances (both anthropogenic and non-anthropogenic) that contribute to sediment deposition. Therefore, this TMDL will focus on reducing TSS.

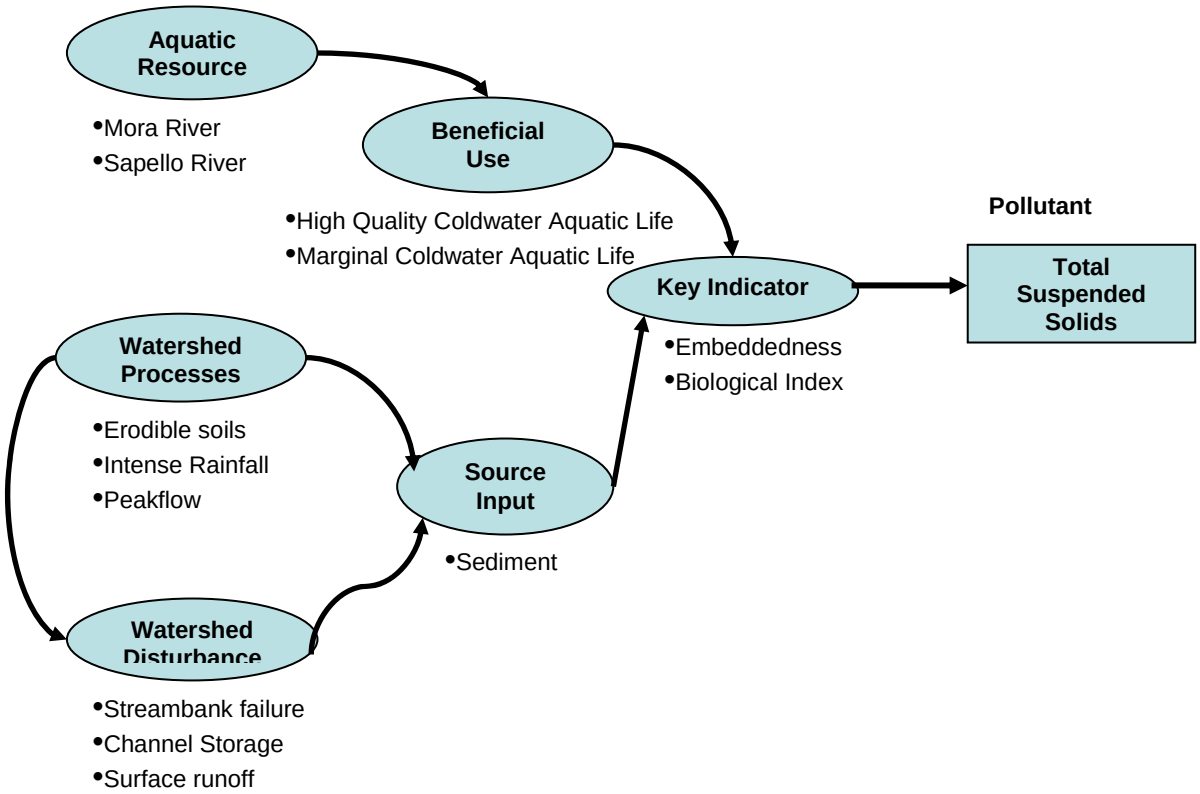

Figure 7.1 Sediment Issues and TMDL Target Setting

In examining the existing water quality data for the Mora and Sapello Rivers, limited streamflow, TSS, and turbidity data was available (Table 7.3). Analyzing the water quality data by station was impracticable because the data were limited. Therefore, the data were aggregated and an analysis was performed on the entire data set which represents the entire segment.

Table 7.3 Available Water Quality Data for the Mora and Sapello Rivers

	Number of Samples		
Mora River (Hwy 434 to headwaters)	TSS	Turbidity	Flow
Mora River at Chacon 0.6 miles above gage	9	9	8
Mora River at Cleveland by bridge on Church Rd.	9	9	9
Total Available Data	18	18	17
Sapello River (Mora River to Manuelitas Creek)	TSS	Turbidity	Flow
Sapello River at Hwy 161 (near Watrous)	8	8	8
Sapello River at Highway 518	9	9	9
Total Available Data	17	17	17

The segment-specific or use-specific turbidity values from the 2002 State of New Mexico Surface Water Quality Standards were used to obtain target values for each assessment unit. Based on the 2002 State standards, it was determined that a turbidity value of 25 NTU is the target that should be protective of the high quality coldwater aquatic use in the Mora River and the marginal coldwater aquatic use in the Sapello River. Remembering that in order to calculate a load in pounds per day (lb/day), TSS is used as a surrogate for stream bottom deposits. Figures 7.2 and 7.3 depict the relationship between TSS and turbidity for the Mora River and Sapello River, respectively ($R^2 = 0.28$; $R^2 = 0.34$).

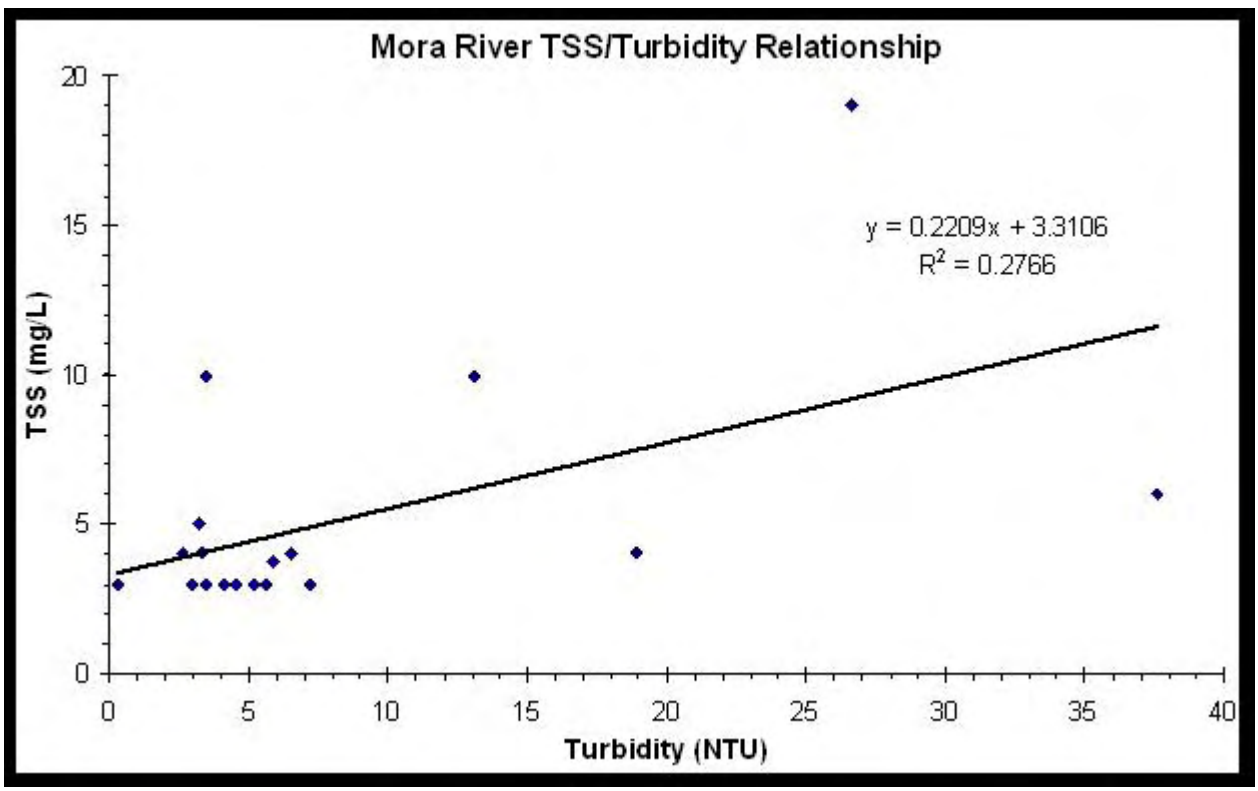

Figure 7.2 Mora River TSS vs. Turbidity Relationship

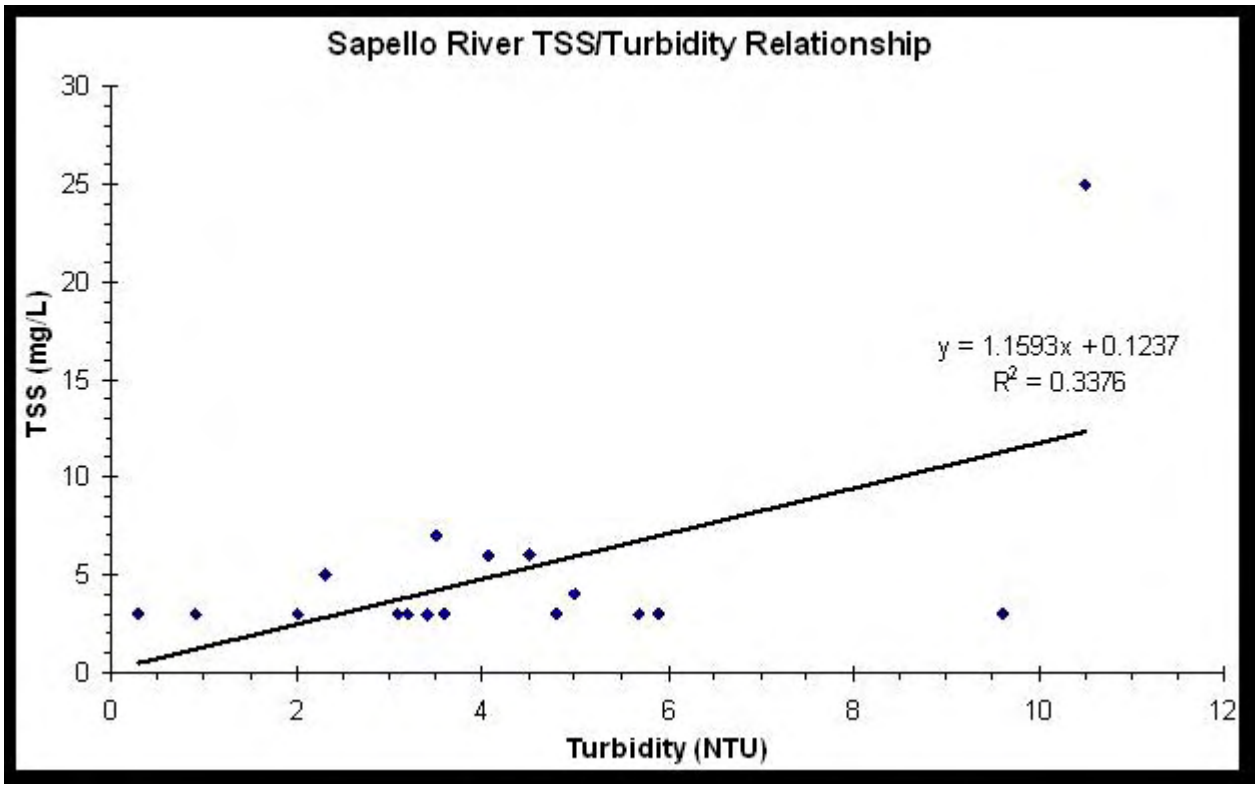

Figure 7.3 Sapello River TSS vs. Turbidity Relationship

The data shows that 28% of the variability in turbidity is explained by TSS in the Mora River and 34% of the variability is explained by TSS in the Sapello River. In addition, Pearson correlation coefficient was used to assess whether a statistical association existed between TSS and turbidity. Pearson correlation coefficient measures the strength and direction of a *linear* relationship between *X* and *Y* variables. Like other numerical measures, the population correlation coefficient is "ρ" (the Greek letter "rho") and the sample correlation coefficient is denoted by *r*.

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

When examining the entire data set, the data for the Mora River shows a positive association between TSS and turbidity (r = 0.53). Additionally, the data for the Sapello River shows a positive association between TSS and turbidity (r = 0.58). The relationship between TSS and turbidity show that potential sources of suspended sediment impact both TSS and turbidity.

Using the TSS/Turbidity relationship from Figures 7.2 and 7.3 and a turbidity target of 25 NTU, the TSS concentrations required to achieve NM water quality standards are:

- Mora River (Hwy 434 to headwaters)

$$(0.2209 \text{ x } 25 \text{ NTU}) + 3.3106 \cong 8.83 \text{ mg/L of TSS}$$

- Sapello River (Mora River to Manuelitas Creek)

$$(1.1593 \text{ x } 25 \text{ NTU}) + 0.1237 \cong 29.1 \text{ mg/L of TSS}$$

7.2 Flow

Sediment transport in a stream varies as a function of flow. As flow increases, the amount of sediment being transported increases. This TMDL is calculated at specific flows, however it is often necessary to calculate a critical flow for a portion of a watershed where there is no active flow gage as in the Mora and Sapello Rivers. 4Q3 derivations for ungaged streams were based on analysis methods described by Waltemeyer (2002). In this analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 feet in elevation). The following statewide regression equation is based on data from 50 gaging stations with non-zero discharge (Waltemeyer 2002):

$$4Q3 = 1.2856 \times 10^{-4} \; DA^{0.42} \; P_w^{\;3.16} \qquad \text{(Eq. 1)}$$

where,

4Q3 = Four-day, three-year low-flow frequency (cfs)
DA = Drainage area (mi^2)
P_w = Average basin mean winter precipitation (inches)

The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively, for this regression equation (Waltemeyer 2002). The following regression equation for mountainous regions above 7,500 feet in elevation is based on data from 40 gaging stations with non-zero discharge (Waltemeyer 2002):

$$4Q3 = 7.3287 \times 10^{-5} \; DA^{0.70} \; P_w^{\;3.58} \; S^{1.35} \qquad \text{(Eq. 2)}$$

where,

S = Average basin slope (percent).

The average SEE and coefficient of determination are 94 and 66 percent, respectively, for this regression equation (Waltemeyer 2002). The 4Q3 for the Mora River was estimated using the regression equation for mountainous regions because the mean elevation for this assessment unit

was above 7,500 feet in elevation. The 4Q3 for the Sapello River was estimated using the statewide regression equation because the mean elevation for this assessment unit was less than 7,500 feet in elevation (Table 7.4).

Table 7.4 Calculation of 4Q3 Low-Flow Frequencies

Assessment Unit	**Average Elevation (ft.)**	**Drainage Area (mi^2)**	**mean winter precipitation (in.)**	**Average basin slope (percent)**	**4Q3 (cfs)**
Mora River (Hwy 434 to headwaters)	8927	144.49	11.3	26.0	2.276
Sapello River (Mora River to Manuelitas Creek)	7050	289.3	6.5	---	0.515

The 4Q3 values were converted from cubic feet per second (cfs) to units of million gallons per day (MGD) as follows:

$$_____ \frac{\text{ft}^3}{\text{sec}} \times 1{,}728 \frac{\text{in}^3}{\text{ft}^3} \times 0.004329 \frac{\text{gal}}{\text{in}^3} \times 86{,}400 \frac{\text{sec}}{\text{day}} \times 10^{-6} = _____ \text{MGD}$$

It is important to remember that the TMDL itself is a value calculated at a defined critical condition, and is calculated as part of planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow.

7.3 Calculations

Target loads for stream bottom deposits (expressed as TSS) are calculated based on the critical flow, the water quality criterion, and a conversion factor (8.34) that is a used to convert milligram per liter (mg/L) units to pounds per day (lbs/day) (see Appendix A for Conversion Factor Derivation). The target loading capacity is calculated using **Equation 4**. The results are shown in Table 7.5.

Critical Flow (mgd) x Criterion (mg/L) x 8.34 = Target Loading Capacity (Eq. 4)

Table 7.5 Calculation of Target Loads for TSS (Sedimentation/Siltation surrogate)

Assessment Unit	4Q3 Flow (MGD)	TSS (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)
Mora River (Hwy 434 to headwaters)	1.471	8.83*+	8.34	108+
Sapello River (Mora River to Manuelitas Creek)	0.333	29.1^+	8.34	80.8+

Notes:
* The TSS value was calculated using the relationship established between TSS and turbidity in Figure 7.2 (y=0.2209x + 3.3106, R^2=0.28) using the turbidity standard of 25 NTU for the X variable.
^ The TSS value was calculated using the relationship established between TSS and turbidity in Figure 7.3 (y=1.1593x + 0.1237, R^2=0.34) using the turbidity standard of 25 NTU for the X variable.
+ Values rounded to three significant figures.

7.4 Waste Load Allocations and Load Allocations

7.4.1 Waste Load Allocation

There are no individually permitted point source facilities or Municipal Separate Storm Sewer System (MS4) storm water permits in this assessment unit. Sediment may be a component of some (primarily construction) storm water discharges so these discharges should be addressed.

In contrast to discharges from other industrial storm water and individual process wastewater permitted facilities, storm water discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the National Pollutant Discharge Elimination System (NPDES) construction general storm water permit (CGP) for construction sites greater than one acre requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) that includes identification and control of all pollutants associated with the construction activities to minimize impacts to water quality. In addition, the current CGP also includes state specific requirements to implement Best Management Practices (BMPs) that are designed to prevent to the maximum extent practicable, an increase in sediment, or a parameter that addresses sediment (e.g., total suspended solids, turbidity, siltation, stream bottom deposits, etc.) and flow velocity during and after construction compared to pre-construction conditions. In this case, compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Other industrial storm water facilities are generally covered under the current NPDES Multi-Sector General Storm Water Permit (MSGP). This permit also requires preparation of an SWPPP that includes identification and control of all pollutants associated with the industrial activities to minimize impacts to water quality. In addition, the current MSGP also includes state specific requirements to further limit (or eliminate) pollutant loading to water quality impaired/water quality limited waters from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired. In this case, compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

Individual WLAs for the General Permits were not possible to calculate at this time in this watershed using available tools. Loads that are in compliance with the General Permits from facilities covered are therefore currently calculated as part of the watershed load allocation (LA).

7.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL following **Equation 5**:

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 5)}$$

The MOS is estimated to be 25% of the target load calculated in Table 7.6. Results are presented in Table 7.7. Additional details on the MOS chosen are presented in Section 7.7.

Table 7.7 Calculation of TMDL for TSS (Sedimentation/Siltation surrogate)

Assessment Unit	WLA (lbs/day)	LA (lbs/day)	MOS (25%) (lbs/day)	TMDL (lbs/day)
Mora River (Hwy 434 to headwaters)	0	81.0[+]	27.0[+]	108[+]
Sapello River (Mora River to Manuelitas Creek)	0	60.6[+]	20.2[+]	80.8[+]

Notes:
[+] Values rounded to three significant figures.

The extensive data collection and analyses necessary to determine background sediment loads for the Mora and Sapello watersheds was beyond the resources available for this study. Therefore, it is assumed that a portion of the load allocation is made up of natural background loads.

7.5 Identification and Description of Pollutant Source(s)

Pollutant sources that could contribute to these reaches are listed in Table 7.9.

Table 7.9 Pollutant source summary

Pollutant	Magnitude	Location	Probable Sources[(b)]
Point Source			
None	0%	---	0%
Nonpoint Source			
Sedimentation	51%[(a)]	Mora River (Hwy 434 to headwaters)	100% Natural Sources; Rangeland Grazing; Silviculture Harvesting
Sedimentation	56%[(a)]	Sapello River (Mora River to Manuelitas Creek)	100% Source Unknown

Notes:

(a) The magnitude is equal to the measured load expressed as percent fines. Fines are defined as particles less than 2 millimeters (mm) in diameter.

(b) From the 2006-2008 Integrated CWA §303(d)/§305(b) List. This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.

Probable sources of sedimentation for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

7.6 Linkage of Water Quality and Pollutant Sources

Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter. TSS can include a wide variety of material, such as silt and clay, decaying plant and animal matter, plankton, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. Suspended solids absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen (warmer water holds less oxygen than cooler water). Photosynthesis also decreases, since less light penetrates the water. Reduced rates of photosynthesis causes less dissolved oxygen to be released into the water by plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die. As the plants are decomposed, bacteria will use up even more oxygen from the water. Some cold water species, such as trout, are especially sensitive to changes in dissolved oxygen resulting in fish kills.

TSS can also destroy aquatic habitat because suspended solids settle to the bottom and can eventually blanket the river bed. Suspended solids can smother the eggs of fish and aquatic insects, and can suffocate newly-hatched insect larvae. Suspended solids can also harm fish directly by clogging gills, reducing growth rates, lowering resistance to disease, and preventing egg and larval development. Changes to the aquatic environment may result in a diminished food sources and increased difficulties in finding food. Natural movements and migrations of aquatic populations may be disrupted. In addition, settling sediments can fill in spaces between rocks which could have been used by aquatic organisms for homes.

The components of a watershed continually change through natural ecological processes such as vegetation succession, erosion, and evolution of stream channels. Intrusive human activity often affects watershed function in ways that are inconsistent with the natural balance. These changes, often rapid and sometimes irreversible, occur when people:

- cut forests
- clear and cultivate land
- remove stream-side vegetation
- alter the drainage of the land
- channelize watercourses
- withdraw water for irrigation
- build towns and cities
- discharge pollutants into waterways.

Factors affecting total suspended solids in a waterway include:

1. Increases or decreases in flow rates
    - land clearing, constructing drainage ditches, and straightening natural water channels may strand fish upstream or dry out recently spawned eggs due to the subsequent low flows
    - fast running water can carry more particles and larger-sized sediment creating an obstacle to the upstream movement of fish
    - heavy rains can pick up sand, silt, clay, and organic particles (such as leaves and soil) from the land and carry it to surface water destroying the aquatic habitat and harming and/or killing the aquatic life
    - during low flow, the sediment that was carried by faster moving water will settle to the bottom of the streambed, which can have detrimental effects on the aquatic community by smothering eggs or suffocating newly hatched larvae and burying the homes of aquatic organisms

2. Soil erosion caused by disturbance of a land surface
    - increases suspended solids in the water
    - reduces transmission of sunlight needed for photosynthesis
    - interferes with animal behaviors dependent on sight (foraging, mating, and escape from predators)
    - impedes respiration (e.g., by gill abrasion in fish) and digestion
    - reduces oxygen in the water

- covers bottom gravel and degrade spawning habitat
- covers eggs, which may suffocate or develop abnormally; fry may be unable to emerge from the buried gravel bed

3. Clearing of trees and shrubs from shorelines
    - destabilizes banks and promote erosion
    - increases sedimentation and turbidity
    - reduces shade and increase water temperature which could disrupt fish metabolism
    - causes channels to widen and become more shallow

Where data gaps exist or the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information.

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 1999). The completed *Pollutant Source(s) Summary Table* in **Appendix B** provides documentation of a visual analysis of probable sources along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of probable sources of impairment in this watershed. Staff completing these forms identify and quantify probable sources of NPS impairments along each reach as determined by field reconnaissance and assessment. It is important to consider not only the land directly adjacent to the stream, which is predominantly privately held, but also to consider upland and upstream areas in a more holistic watershed approach to implementing this TMDL.

The main sources of impairment along the Mora River (Hwy 434 to headwaters) appear to be from natural sources, rangeland grazing, and silviculture harvesting. The main sources of impairment along the Sapello River (Mora River to Manuelitas Creek) appear to be from unknown sources.

7.7 Margin of Safety (MOS)

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint sourceload estimates, and the modeling analysis. The MOS is estimated to be **25%** of the TMDL. This MOS incorporates several factors:

•Errors in calculating nonpoint source loads

A level of uncertainty does exist in the relationship between TSS and turbidity. In this case, the TSS measure does not include bedload and therefore does not account for a complete measure of sediment load. There is also a potential to have errors in measurements of nonpoint source loads due to equipment accuracy, time of sampling, etc. Accordingly, a conservative MOS of **15%** will be assigned to account for uncertainties in calculating nonpoint source loads.

•Errors in calculating flow

Flow estimates were based on USGS gages and field measurements. Techniques used for measuring flow in water have a ±5 percent precision. In addition, there is a potential to have errors in measurements of flow due to equipment accuracy, time of sampling, etc. To be conservative, an additional MOS of **10%** will be included to account for accuracy of flow computations.

7.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during high and low flow seasons in order to ensure coverage of any potential seasonal variation in the system. Fall is a critical time in the life cycle stages of benthic macroinvertebrates in NM. Fall is also generally the low-flow period of the mean annual hydrograph in NM when bottom deposits are most likely to settle and cause impairment, after the summer monsoon season but before annual spring runoff. Thus, the critical condition used for calculating the TMDL was low flow. It is assumed that if critical conditions are met during this time, coverage of any potential seasonal variation will also be met.

7.9 Future Growth

Estimations of future growth are not anticipated to lead to a significant increase in sedimentation that cannot be controlled with BMP implementation in this watershed.