5.0 SEDIMENTATION/SILTATION (STREAM BOTTOM DEPOSITS)

During the 2001 SWQB intensive water quality survey in the Upper Rio Grande Watershed (Part 2), impairment of the aquatic community due to excessive Sedimentation/Siltation (Stream Bottom Deposits) was documented at Embudo Creek (Rio Grande to Canada de Ojo Sarco) (SWQB Stations 4 and 5). Consequently, this assessment unit was listed on the 2004-2006 Integrated CWA §303(d)/§305(b) list for Sedimentation/Siltation.

5.1 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 "bottom deposit" standard. The current general narrative standard for the deposition of material on the bottom of a stream channel is specifically found in Section 20.6.4.12(A) of the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC):

> ***Bottom Deposits:*** *Surface waters of the state shall be free of water contaminants from other than natural causes that will settle and damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.*

The impact of fine sediment deposits is well documented in the literature. 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).

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 2004d), 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 2001 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 target levels involved the examination of developed relationships between % fines and biological score as compared to a reference site. Using existing data from NM, a strong relationship (r^2=0.75) was established between embeddedness and the biological scores using data collected in 1998 (NMED/SWQB 2004d). A strong correlation (r^2= 0.719) was also found when relating embeddedness to % fines. Although these correlations were based on a limited data set, TMDL studies on other reaches, including those in the Cimarron Basin, the Jemez Basin, and the Rio Guadalupe, have shown this relationship to be consistent. These relationships show that at the desired biological score of at least 70, the target embeddedness for fully supporting a designated use would be 45% and the target fines would be 20% (NMED/SWQB 2004d). Since this relationship is based on NM streams, 20% was chosen for the target value for % fines.

The Santa Cruz River at USGS gage 08291000 was chosen as the benthic macroinvertebrate reference station for the Embudo Creek at Hwy 68 bridge near Dixon at USGS gage (SWQB Station 4). They are both in ecoregion 22 and have similar geomorphic characteristics as displayed in Table 5.1. Benthic macroinvertebrate samples and pebble counts were collected at both stations (Barbour et al. 1999, Wohlman 1954).

Table 5.1 Geomorphic Characteristics of Benthic Macroinvertebrate Sampling Sites

Dimensions	Reference Site[(a)]	Study Site[(b)]
Cross-section Area (feet)	25.3	69.5
Width (feet)	23.0	31.6
Maximum Depth (feet)	1.60	3.10
Mean Depth (feet)	1.10	2.20
Width:Depth Ratio	20.9	14.4
Entrenchment Ratio	1.34	1.63

Notes:
[(a)] Reference Site = Santa Cruz River at USGS gage 08291000
[(b)] Study Site = Embudo Creek at Hwy 68 bridge near Dixon at USGS gage

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 5.2). Select results of the pebble count and benthic macroinvertebrate surveys are shown in Table 5.2.

Table 5.2 Pebble Count and Benthic Macroinvertebrate Results

Results	Reference Site[(a)]	Study Site[(b)]	Percent of Reference
Pebble count			
% Fines (< 2 mm)	25%	24%**	96%
D50	26.5 mm	57.3 mm	—
D84	331 mm	128 mm	—
Benthic metrics			
Standing Crop (number/square meter)	1,410	688	—
Ephemeroptera/ Plecoptera/ Tricoptera Taxa	15	6	—
Taxa Richness	25	18	—
Hilsenhoff's Biotic Index	4.17	4.60	—
Total Biologic Score	64	42	65%
Total Habitat Score (out of a possible 200)	179	137	77%

Notes:
[(a)] Reference Site = Santa Cruz River at USGS gage 08291000
[(b)] Study Site = Embudo Creek at Hwy 68 bridge near Dixon at USGS gage
mm = Millimeters
— = Not applicable
**This AU goes through episodes of heavy sedimentation followed by scouring. During previous surveys, the cobble was 100% embedded with sand.

5.2 Flow

No streamflow data are necessary because all loads are specified in % fines.

5.3 Calculations

No calculations were necessary because all loads are specified in % fines. The target loads for bottom deposits are shown in Table 5.3.

Measured load was determined by a pebble count as described in the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2004d). Fines are defined as particles less than 2 millimeters (mm) in diameter. Results are displayed in Table 5.4 and Figure 5.1.

Table 5.3 Calculation of Target Loads for Sedimentation/Siltation

Location	Sedimentation/ Siltation Standards[(a)] (% fines)	Sedimentation/ Siltation Target Load Capacity (% fines)
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	20	20

Notes:
[(a)] This value is based on a narrative standard. The background values for bottom deposits were taken from the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2004d).

Table 5.4 Calculation of Measured Loads for Sedimentation/Siltation

Location	Sedimentation/ Siltation Measured Load (% fines)
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	24

5.4 Waste Load Allocations and Load Allocations

5.4.1 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) 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 wasteload allocations 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.

5.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL following **Equation 2**:

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 2)}$$

The MOS is estimated to be 25 % of the target load calculated in Table 5.3. Results are presented in Table 5.5. Additional details on the MOS chosen are presented in Section 5.6.

Table 5.5 TMDL for Sedimentation/Siltation

Location	WLA (% fines)	LA (% fines)	MOS (25%) (% fines)	TMDL (% fines)
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	0	15	5	20

The extensive data collection and analyses necessary to determine background sediment loads for the Embudo Creek watershed 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. The load reduction necessary to meet the target load was estimated as the difference between the target load allocation (Table 5.5) and the measured load (Table 5.4), shown in Table 5.6.

5.5 Identification and Description of Pollutant Source(s)

Nonpoint pollutant sources that could contribute to the observed load include range grazing (riparian and/or upland); municipal point sources; land disposal; highway/road/bridge

construction; highway maintenance and runoff; crop-related sources; construction. The point source contributions associated with this TMDL were not considered to be applicable.

Table 5.6 Calculation of Load Reduction for Sedimentation/Siltation

Location	LA (% fines)	Measured Load (% fines)	Load Reduction (% fines)
Embudo Creek (Rio Grande to Canada de Ojo Sarco)	15	24	9

5.6 Linkage of Water Quality and Pollutant Sources

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 potential sources of impairment (NMED/SWQB 1999). The completed *Pollutant Source(s) Documentation Protocol* forms in **Appendix B** provide 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 potential sources of impairment in this watershed. Staff completing these forms identify and quantify potential 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 this lower reach appear to be from livestock grazing, channelization, removal of riparian vegetation, natural causes, and off-road vehicles. Agricultural practices such as grazing appear to have contributed to the removal of riparian vegetation and streambank destabilization. This assessment unit goes through episodes of heavy sedimentation and then scouring. During previous surveys, the cobble was 100% embedded with sand. Heavy sediment inputs in Dixon come from roads running perpendicular to the river. Also, dry watercourses in Dixon are used as roads.

5.7 Margin of Safety (MOS)

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and NPS load estimates, and the modeling analysis. For this TMDL, there will be no MOS for point sources since none were documented in this reach. However, the MOS is estimated to be an addition of 25% for sediment caused by NPSs, excluding background. This MOS is based on the uncertainty in the relationship between embeddedness, % fines, and biological score. In this case, the % fines are based on a narrative standard and there are also potential errors in measurement of NPS loads due to equipment accuracy, time of sampling, and other factors. Accordingly, a conservative MOS for Sedimentation/Siltation increases the TMDL by **25%**.

Because flow estimates were not needed for the Sedimentation/Siltation TMDL, an additional MOS is not warranted.

5.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during the fall which is biological index period SWQB has determined is the best time to collect benthic macroinvertebrates in NM (NMED/SWQB 2004d). 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. It is assumed that if critical conditions are met during this time, coverage of any potential seasonal variation will also be met.

5.9 Future Growth

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