SAN JUAN RIVER BASIN
SEDIMENTATION/SILTATION (STREAM BOTTOM DEPOSIT) IMPAIRMENT DETERMINATIONS
FOR THE
2004-2006 CLEAN WATER ACT INTEGRATED §303(D)/ §305(B) LIST OF ASSESSED WATERS

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TABLE OF CONTENTS

1.0 PROJECT INTRODUCTION

1.1 Background

Clean stream bottom substrates are essential for optimum habitat for many fish and aquatic insect communities. 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, macro invertebrates, and algae (Chapman and McLeod 1987, Lisle 1989, Waters 1995). In addition, sediment loads that exceed a river's sediment transport capacity often trigger changes in stream morphology (Leopold and Wolman 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 state of New Mexico has developed and adopted a narrative stream bottom deposit (SBD) 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* (MNWQCC 2001):

> 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.*

To assess attainment of this narrative standard, SWQB previously developed a SBD protocol applicable to small, wadeable streams (Appendix D of NMED/SWQB 2004).

1.2 Objectives

In 2002, SWQB applied for and received a Clean Water Act 104b3 grant to develop a protocol for determination of Sedimentation/Siltation (SBD) impairment in large southwest rivers. The San Juan and Animas Rivers were chosen as case studies for this protocol. These two rivers have historic SBD listings on the state of New Mexico Clean Water Act Section 303(d) List of Impaired Waters. Because these listings were on the 1998 list, they are also considered to be part of the consent decree (Forest Guardians v. Browner CIV. NO. 96-0826 LH). Accordingly, verification or de-listing of impairments, as well as any subsequent Total Maximum Daily Load (TMDL) planning documents, are due by the end of 2004.

The USDA National Sedimentation Lab (NSL) was contracted through a Joint Powers Agreement to provide technical support on the project. The NSL has provided the research component necessary to develop sedimentation protocols for several states around the country. They have also been working with USEPA to develop suspended sediment and bed material TMDL protocols. The NSL's specific study objectives were to (Heins *et al*. 2004):

- Develop a bed-sediment protocol for discriminating between "background" and "impacted" conditions
- Quantify the narrative stream-bottom deposit standard
- Identify the dominant source of fine sediment found on the bed of the San Juan and Animas Rivers

This protocol which evolved from the NSL study represents a repeatable, quantitative assessment procedure for determining whether New Mexico's narrative SBD standard is being attained in various river reaches in the San Juan River basin:

1) determining fine sediment benchmarks for the ecoregion and basin level, and
2) comparing bed material characteristics between the stream reach of concern to these fine sediment benchmarks

This protocol is not designed to determine exact sources, locations, quantities, or causes of excess stream bottom sediment. This protocol is applicable to non-sandy bottom lotic systems (defined as >50% cobble/boulder) with wadeable representative riffle areas.

2.0 PROJECT APPROACH

This section provides a brief synopsis of the NSL study. The entire study and results are detailed in the NSL report (Heins *et al*. 2004). The overall study approach was to determine bed-material conditions in stable reaches of the region and the local study area to use as a measure of "reference" bed-material condition. The study approach the NSL developed with input from the SWQB relied primarily on a rapid geomorphic assessment approach and concurrent collection of bed material data to determine the amount of embeddedness in terms of percent (%) fines. This expanded geomorphic approach was intended to specifically address the later portion of New Mexico's narrative SBD criteria mentioned above, namely "*…or significantly alter the physical or chemical properties of the bottom.*" By performing a pebble count as a measure of cobble embeddedness, the stream bottom can be characterized as an aquatic habitat, compared to a reference condition or fine sediment benchmark, and then evaluated for impairment due to sedimentation (stream bottom deposits).

2.1 Reach Definitions

Five reaches on the San Juan River and Animas River were intensively studied. The reach definitions match the State of New Mexico Clean Water Act Integrated Section 303(d)/305(b) historic SBD listings and are as follows (Figure 2.1):
- Reach 1 – San Juan River (Navajo Nation boundary at Hogback to Animas River)
- Reach 2 – San Juan River (Animas River to Cañon Largo)
- Reach 3 – San Juan River (Cañon Largo to Navajo Dam)
- Reach 4 – Animas River (San Juan River to Estes Arroyo)
- Reach 5 – Animas River (Estes Arroyo to Colorado border)

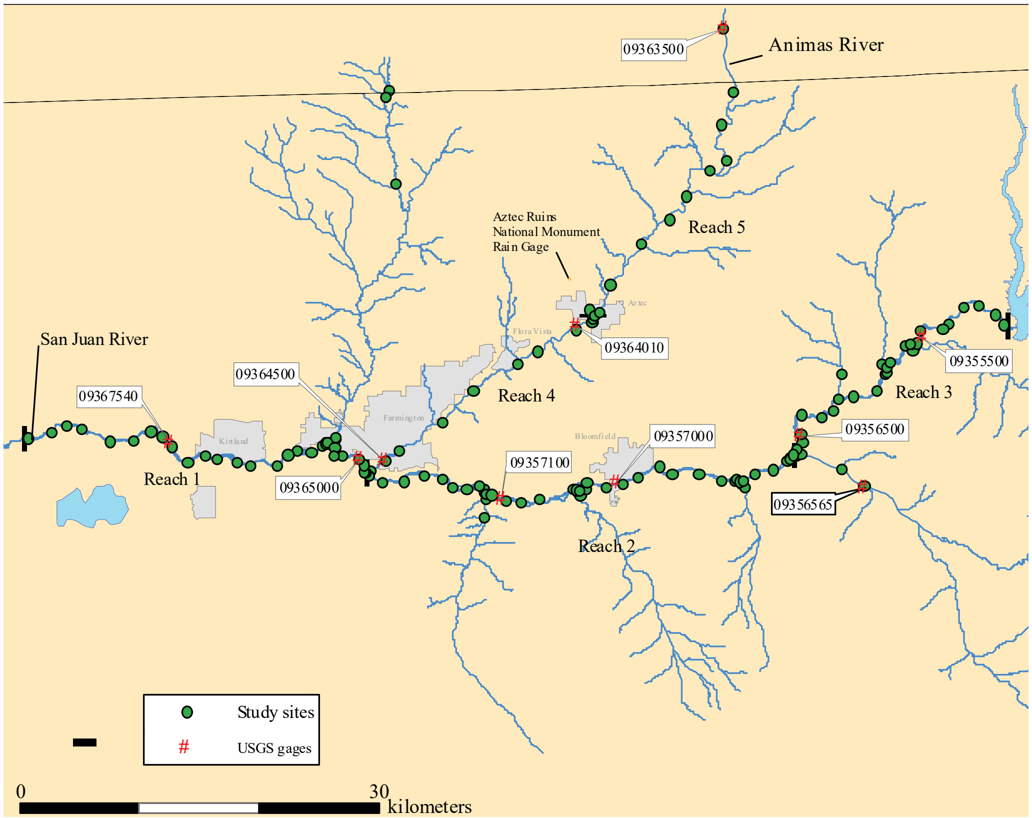

Figure 2.1 Map of San Juan and Animas Rivers study reaches and sites (Heins *et al.* 2004)

2.2 Ecoregion and Basin Study Design

In order to assess a river reach for impairment due to stream bottom deposits, an eco-regionally or basin-wide reference condition must be determined. Under this protocol, this reference condition serves as a quantitative target to which a study river reach may be statistically compared and evaluated. Characteristics that cannot change over time should be used as primary attributes of similarity between reference and study sites. Examples of similar attributes are elevation, geology, precipitation patterns, and hydrology. These characteristics of similarity between a reference and study site can be ensured through the use of ecoregion designations. Omernik (1987) developed Level III ecoregions for the United States Environmental Protection Agency (USEPA). The ecoregion used in the San Juan Basin case study was Ecoregion 22: Arizona/New Mexico Plateau (Figure 2.2). This ecoregion study design is critical assessment because stream characteristics vary dramatically across different regions and watersheds (Barbour *et al.* 1996).

To determine ecoregion bed sediment values, the NSL sampled several stations throughout Ecoregion 22 with direct funding from the USEPA Office of Water. To further define the reference condition for the San Juan basin study, the NSL also determined reference bed sediment values specific to the Animas and San Juan Rivers. This was possible in part because there were 92 sampling stations on the San Juan River and 21 stations on the Animas River. This high number of sites allowed statistical confidence in reference condition determination at a basin scale. In addition, two sites were sampled upstream and downstream of twelve tributaries confluences or, if no riffles were present, at 300 and 600 m away to measure changes in bed material characteristics as a result to tributary input. The tributaries themselves were also sampled at 300 m and 600 m upstream of the confluence with the mainstem. All sampling occurred in October and November 2003 (Heins *et al*. 2004).

Figure 2.2 Ecoregion 22 (Omerik 1987)

2.3 Rapid Geomorphic Assessments

Rapid Geomorphic Assessments (RGA) were conducted at all sites to determine relative channel stability, and assess whether sites were stable (stage I or VI) or unstable (stage II, III, IV, or V) (Figure 2.3a). Channel stability was assessed through examination of nine process-related geomorphologic indicators including primary bed material, degree of incision, streambank erosion, presence of riparian vegetative cover, and occurrence of bank accretion (Heins *et al*. 2004).

2.4 Embeddedness Measurements

Physical measurements or indicators of the stream bottom need to take into account those attributes or characteristics that potentially promote the best physical habitat or environment for aquatic life independent of water quality (Plafkin *et al.* 1989). More specifically, substrate that is plentiful, sufficiently large and varied, and is not surrounded or buried by fines appears to offer the best attributes for habitat suitability for many aquatic organisms adapted to such conditions.

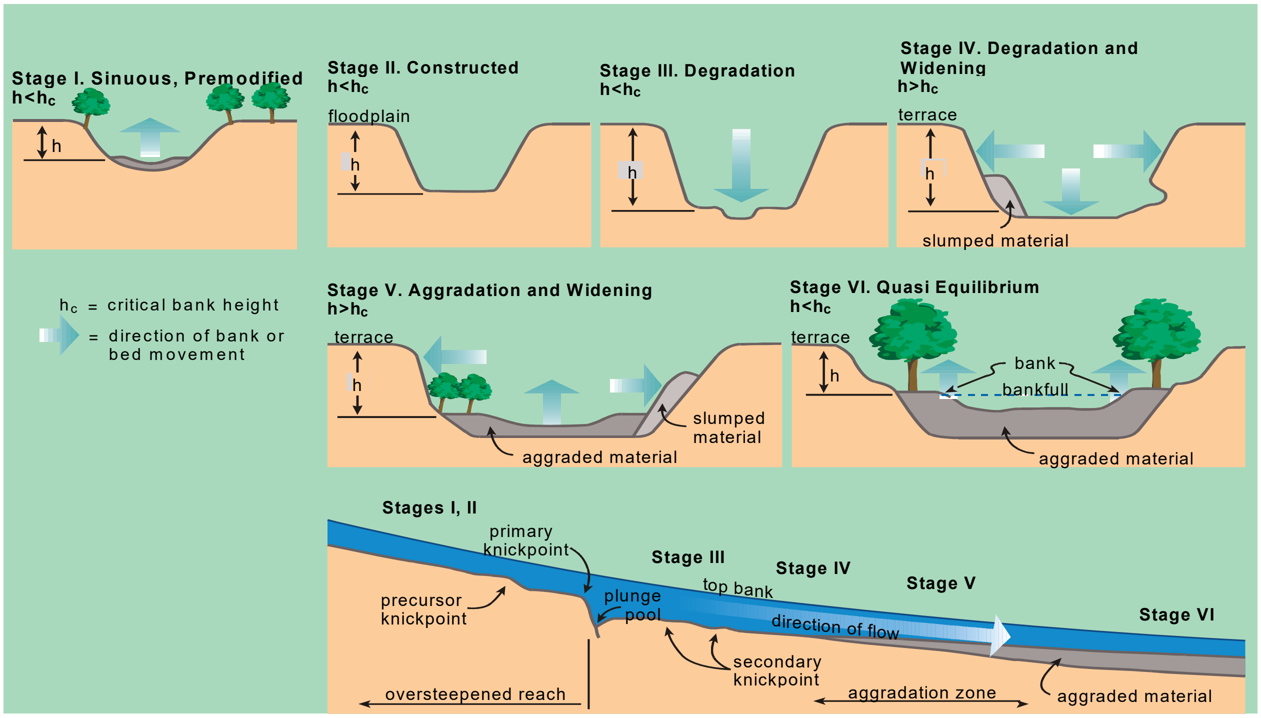

Figure 2.3a Six stage Channel Evolution Model (Simon and Hupp, 1986)

Although sufficient and varied sizes of stream bottom substrate are necessary for biological colonization, protection, and reproduction, its full potential may not be realized if the substrate surfaces are surrounded by fine sediment. In streams with a large amount of sediment and insufficient sediment transport capacity, the coarser particles often become surrounded or partially buried by fine sediment. Embeddedness quantitatively measures the extent to which larger particles are surrounded or buried by fine sediment (McDonald *et al*., 1991). Embeddedness is defined as the percentage of fine material amidst a coarser matrix (finer than 2mm [sands, silts and clays] most often used). Therefore, this approach that utilizes embeddedness measures applies to streambeds composed of 50% or more coarse materials (i.e., gravel and cobbles).

Chapman and McLeod (1987) suggest that geometric particle size and percent of the bed surface covered by fines should both be used to define habitat quality. These two criteria can be ascertained by performing a modified Wolman pebble count (Wolman 1954). At each site, the channel width was measured and bed particles were selected at regular intervals over several transects across the channel perpendicular to flow (Heins *et al*. 2004). The intermediate axis of each selected particle was measured and tallied using standard Wentworth size classes (Bunte and Abt 2001). Bed-material bulk samples of fines were also collected for particle size sieving back in the laboratory. The pebble count procedure provided not only particle size distributions (D50, D84, etc.) and percent class sizes (i.e., % sand, % gravel, % cobble, etc.), but offered a relatively fast and statistically reliable method for obtaining this information. In this study, embeddedness measurements included the whole channel vs. the wetted perimeter in order to generate data that were independent of water level at the time of measurement and to match procedures used in the rest of the ecoregion (Heins *et al*. 2004).

During the study, a square grid was also used as a surrogate measurement for embeddedness to quantify percent surface fine deposits in shallow reaches (Heins *et al*. 2004). This measurement was impractical at sites that were deep, fast, or turbid. Since this measurement could not be taken at every site, pebble counts were utilized to determine reference embeddedness conditions.

2.5 Results

2.5.1 Rapid Geomorphic Assessments

Stages of channel stability were determined at all sites utilizing the RGA approach. This approach was also used to identify reaches of high sediment production (Heins *et al*. 2004). Stable (stage I or VI), gravel-dominated (i.e., >50% cobble/boulder) sites were identified as candidate reference sites for the determination of reference condition. Sites where the bed material was composed of more than 50% sand were not included in the determination of reference condition, even if they were from stable (stage I or VI) sites. Stages of channel evolution, as well as individual criteria from the RGA form, were plotted longitudinally to examine the extent of various processes. All sites in Reach 3 were classified as stable (stage VI), the majority of sites in Reach 2 were classified as unstable (stage V – actively widening with aggrading beds), and the majority of sites in Reach 1 were classified as stable with some widening sections (stage V) (Figure 2.3b).

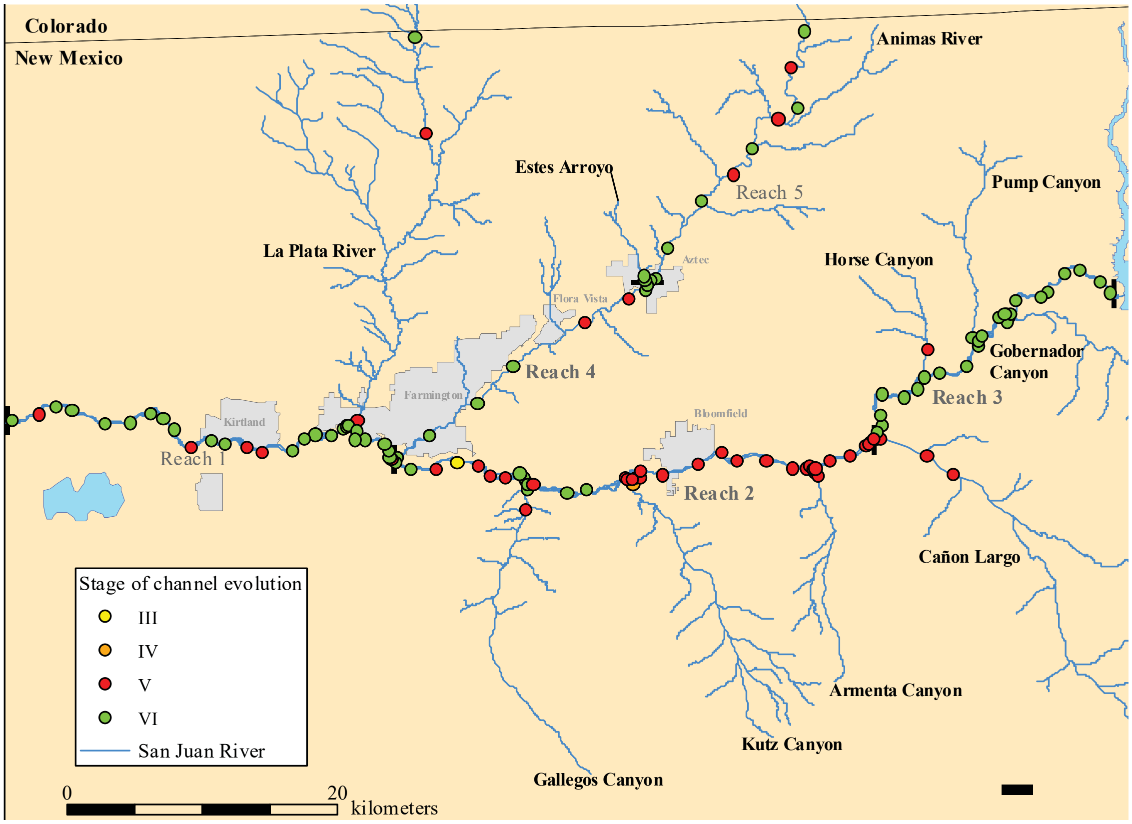

Figure 2.3b Stage of channel evolution for the San Juan River and tributaries

2.5.2 Embeddedness

Data from the pebble counts and particle size analysis were used to determine the % fines (defined as the percentage of particles with an intermediate axis <2 mm) at each site. These were plotted over river kilometer to examine any potential longitudinal trends in relationship to tributary confluences and flow diversion structures (Figures 2.4 and 2.5).

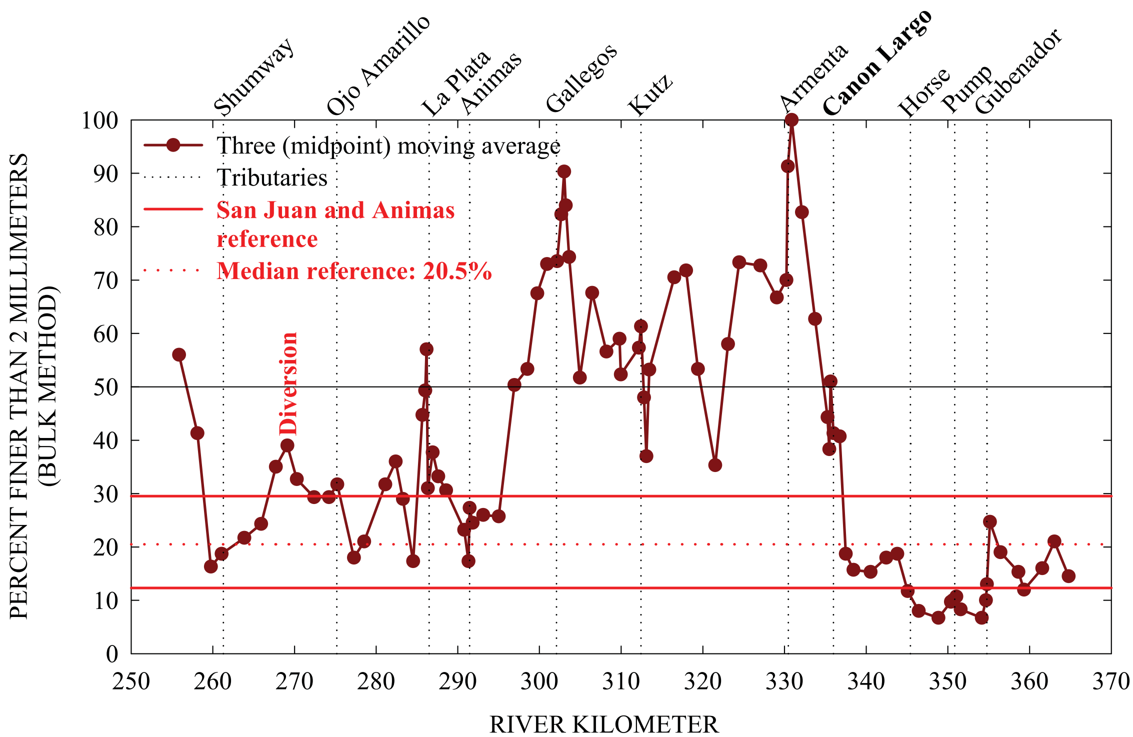

Figure 2.4 Bed material % fines on the San Juan River (adapted from Heins *et al*. 2004)

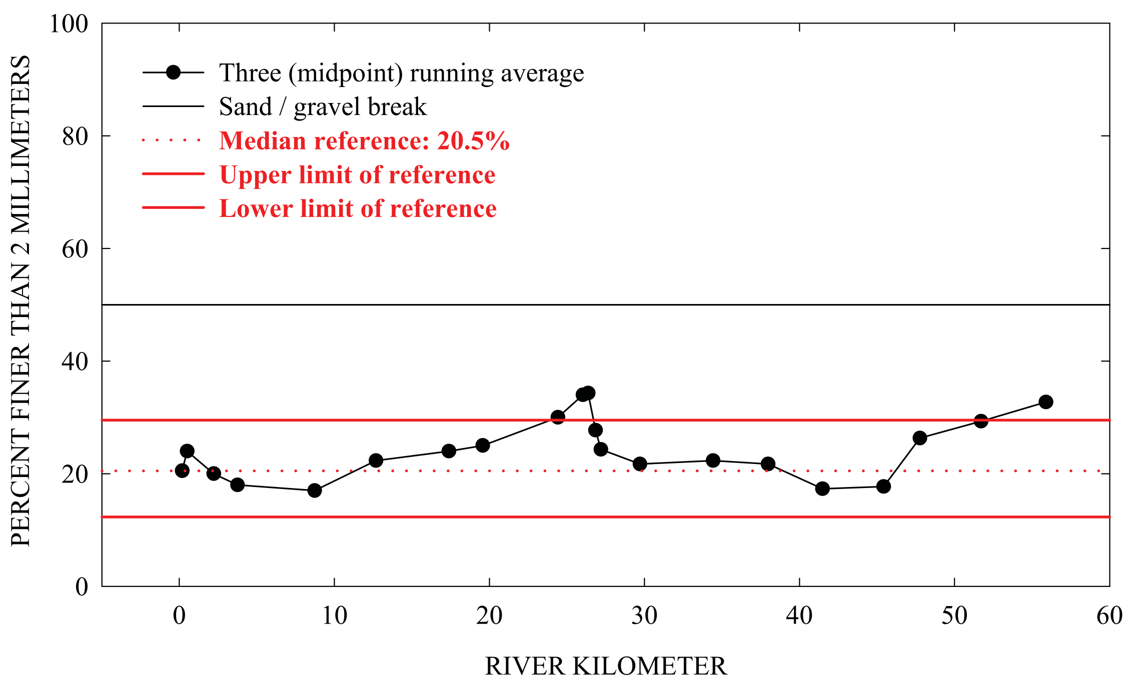

Figure 2.5 Bed material % fines on the Animas River (adapted from Simon presentation to San Juan Watershed Group April 2004)

2.5.3 Determination of Bed-Material Reference Values

Reference values for coarse-material dominated sites for Ecoregion 22, the San Juan and Animas Rivers combined, the San Juan and Animas Rivers independently, and the San Juan River only excluding Reach 3 were developed using % fines data determined from the pebble count and bulk sampling data. The NSL defined the reference value as the median percentage of bed sediment finer than 2 mm (i.e, % fines) at stable sites (stage I or VI) which had >50% coarse material (Heins *et al*. 2004). The median was selected instead of the mean because the data was log-normally distributed. All data from stage I or VI sites within 5 km of dams were removed from the calculations. All values are included in Table 2.1 for comparison.

Table 2.1 Reference bed sediment values based on stable coarse-bed sites (adapted from Heins *et al*. 2004)

Dataset	**% fines (< 2 mm)**		
	Lower quartile (25th percentile)	**Median (reference)**	**Upper quartile (75th percentile)**
San Juan and Animas Rivers (all stage I or VI sites except sites less than 5 km downstream of a dam)	**12.8**	**20.5**	**29.5**
San Juan River only (all stage I or VI sites except sites less than 5 km downstream of Navajo Dam)	11.5	20.0	28.5
San Juan River only (all stage I or VI sites below the confluence with Cañon Largo)	21.0	26.0	33.0
Animas River only (all stage I or VI sites)	19.3	22.5	29.5
Ecoregion 22	0.25	15.5	21.5

All of these values are consistent with previous research in other parts of the country. In a study of 562 streams located in four northwestern states, Relyea *et al.* (2000) suggested that changes to invertebrate communities as a result of fine sediment (2mm or less) occur between 20-35% fines. Oregon Department of Environmental Quality has drafted a proposed fine sediment impairment benchmark protocol with 75th percentile values ranging between 10.9 and 29.1 % fines, and the 90th percentile values ranging between 14.6 and 32.7 % fines depending on the ecoregion. They are proposing to use the 90th percentile values as their fine sediment benchmark (Douglas Drake, OR DEQ, personal communication). New Mexico's existing protocol for assessing SBD in small wadeable streams notes that sites with 20 or less % fines should be noted as non-impaired regardless of the percent increase in % fines from a reference site (NMED/SWQB 2004). Accordingly, previous total maximum load (TMDL) documents prepared by SWQB have utilized a target of 20% fines (see http://www.nmenv.state.nm.us/swqb/links.html for examples).

The % fines varied considerably by reach. To reflect this variability, the box plots in Figure 2.6 were produced using data from all sites in each reach vs. just those with > 50% coarse material. Note that Reach 3 (Cañon Largo to Navajo Dam) possesses a substantially lower percentage of bed material finer than 2 mm than other reaches due to the sediment barrier effect of the dam. The median values and inter quartile ranges of coarse-material sites are also displayed.

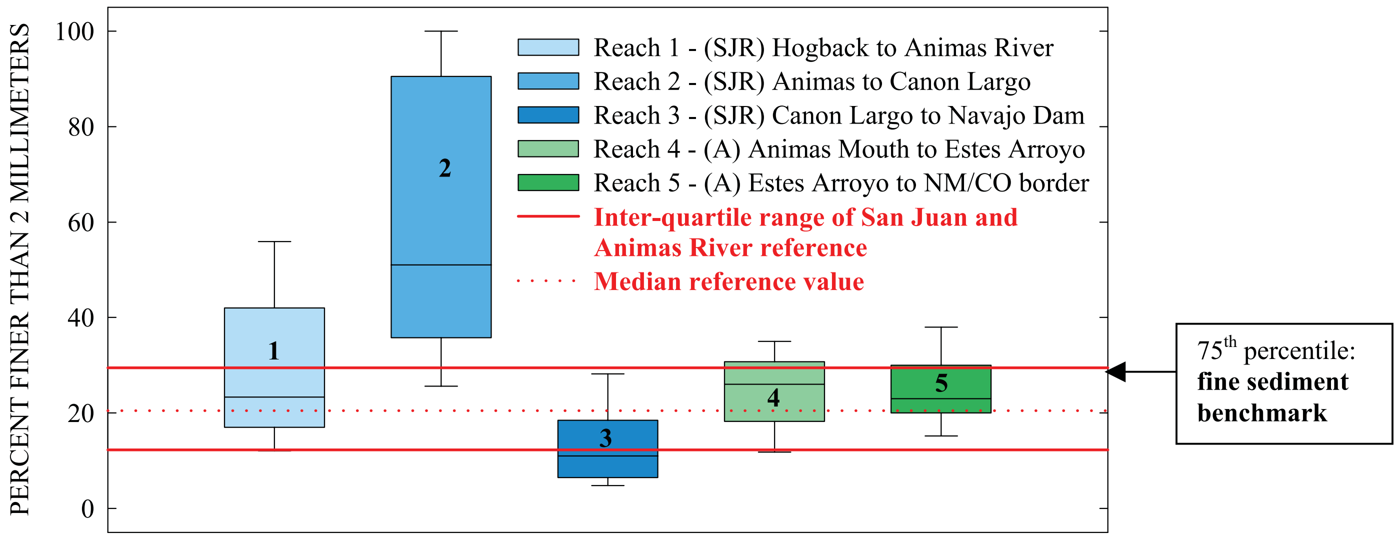

Figure 2.6. Percent (%) fines box plots for all study sites and proposed fine sediment benchmark based on coarse-material sites (adapted from Heins *et al*. 2004)

3.0 IMPAIRMENT EVALUATION

3.1 General Procedure

Percent (%) fines data will be the primary dataset used to determine whether or not the narrative SBD standard is being attained. In this study, the distribution of the % fines was determined to be log-normal, so medians and quartiles were used to define the central tendencies of the data. If the data were normally distributed, means with confidence intervals have been the appropriate statistics.

The **fine sediment benchmark** used to determine impairment will be the 75th percentile of the %fines measured at reference sites (see Table 2.1 and Figure 2.6). The sample site % fines, or the median value for % fines when data from multiple sites are available as were in this study, will be determined for each reach (i.e., assessment unit) of concern. If the value (point or median depending on data availability) for % fines for the reach is below the fine sediment benchmark (i.e., the 75th percentile of the reference condition), the reach will be listed as Fully Supporting for Sedimentation/Siltation (SBD). If the median value for % fines for the reach is above the 75th percentile of the reference condition, the reach will be listed as Non Supporting for Sedimentation/Siltation (SBD).

3.2 San Juan and Animas River Assessments

Because the San Juan and Animas Rivers are unique in the Ecoregion 22 due to their flow volume and channel dimensions, adequate data were collected to develop a reference condition specific to these rivers. The median %fines value for each reach, the fine sediment benchmark (defined as the

75th percentile of the % fines at reference sites on both the San Juan and Animas Rivers excluding sites within 5 km downstream of Navajo Dam), and the subsequent assessment conclusions for each reach are displayed in Table 2.2.

Table 2.2 Proposed degree of Aquatic Life Use support in San Juan and Animas Rivers based on comparison to the fine sediment benchmark

Assessment Unit	Median of all sites in assessment unit^	Fine Sediment Benchmark (75th percentile of all sites with >50% coarse material)*	Degree of Aquatic Life Use Support for Sedimentation (SBD)
Reach 1 – San Juan River (Navajo Nation boundary at Hogback to Animas River)	23	29.5	Fully Supporting
Reach 2 – San Juan River (Animas River to Cañon Largo)	52	29.5	Non Supporting
Reach 3 – San Juan River (Cañon Largo to Navajo Dam)	12	29.5	Fully Supporting
Reach 4 – Animas River (San Juan River to Estes Arroyo)	26	29.5	Fully Supporting
Reach 5 – Animas River (Estes Arroyo to Colorado border)	23	29.5	Fully Supporting

NOTES:
^= Medians were calculated using all sties in the assessment unit (vs. only coarse-dominated sites). These values are displayed as the center-line in the box plots on Figure 2.6 as well.
*= Reference condition for San Juan and Animas Rivers determined using all stable (stage I or VI) coarse-dominated sites except those within 5km of Navajo Dam

3.2.1 Biological Data and Biorelevance

In New Mexico's SBD protocol for small wadeable streams, confirmation of stream bottom deposit impairment takes place when a stream site is biologically assessed (Appendix D of NMED/SWQB 2004). This biological assessment requires that biological relevance is verified by comparing benthic macroinvertebrate community measurements to an appropriate "reference site." The San Juan and Animas River approach presented in this protocol does not rely on the use of benthic macroinvertebrates to verify sedimentation (SBD) conclusions because a reliable reference site or condition for benthic macroinvertebrate communities in the San Juan River could not be identified or defined within the scope of this project. Protocols for reliable bioassessment of non-wadeable portions of large rivers are still in development. Another challenge in identifying a reference condition was the drastic change in community composition resulting from Navajo Dam. Because the dam was installed in 1963 prior to the development of the Clean Water Act, the resultant over abundance of chironomidae larvae in the reach below the dam and the subsequent development of a world class coldwater trout fishery are deemed to be "existing." These benthic macroinvertebrate conditions do not represent a reference condition for the San Juan River basin. Additionally, it is not necessary to prove biorelevance because the later part of the narrative standard states: "*…or significantly alter the physical or chemical properties of the bottom.*" Therefore, this expanded geomorphic approach is adequate to determine impairment status. Several previous reports and studies have identified biological condition and concerns in the San Juan River (Blanchard et al. 1993, Simpson and Lusk 1999, Bliesner and Lamarra 2000).

Even so, limited benthic macroinvertebrate data are available from sample collection during 2003. The results are attached as Appendix A. Using standard protocols and evaluation indices defined in our existing SBD protocol for small wadeable streams, the stations "Animas River above NM border on Southern Ute Reservation" and "San Juan River below Soaring Eagle Lodge HWY 173" were chosen as "best available" reference condition for three sites on the Animas River and three sites on the San Juan River, respectively. The Animas River data indicates slight reduction in biological score at the "@ Aztec above WWTP" and "@ Boyd Park in Farmington" sites and no reduction at the "@ Flora Vista" site. These reductions in biological score could be the result of other causes of impairment besides sedimentation. For example, the upper Animas River (Reach 5) is listed for temperature and the lower Animas River (Reach 4) is listed for nutrients. Benthic macroinvertebrate assessment of the San Juan sites indicates no or slight impairment as compared to the selected reference site. This conclusion may be influenced by the lack of an appropriate reference site due to the effects of the dam or problems in applying New Mexico's current benthic macroinvertebrate stream assessment protocols to larger rivers.

3.2.2 Discussion of Cañon Largo and Navajo Reservoir Operations

New Mexico's existing bottom deposits narrative water quality standard includes the phrase "*…from other than natural causes…*" Therefore, the degree to which sediment delivery and transport from Cañon Largo and other ephemeral tributary is a natural phenomenon, has been exacerbated by human activities, or is the result of a combination of both should be considered. The dominant source of fine sediment found on the bed of the San Juan in Reach 2 is Cañon Largo (see Figure 2.4). Upstream of the confluence of Cañon Largo and the San Juan River, the % fines on the bed ranged from 6 to 15%. Downstream of the confluence, the % fines steadily increased to 100% within 5 km of the confluence. This pattern is a clear indication of sediment loads from Cañon Largo and the subsequent impact on bed-material conditions in Reach 2 (Heins *et al*. 2004).

There is evidence that the San Juan River above Cañon Largo before the installation of the dam in 1962 had a high suspended sediment load (Heins *et al*. 2004). This is not surprising given the geology of the San Juan Basin combined with the high occurrence of intense, convective summer storms. The geology in the watershed contributes to the amount of sediment available for transport. The San Juan River sediment load originates from the highly erodible sedimentary rock and aolian sand deposits (Holden 1999). This large, active sediment load in the lower river plays an important role in the formation and maintenance of instream habitat. Intense summer and fall precipitation events contribute to the amount of sediment transported into the mainstem of the San Juan River. Prior to installation of the dam, the San Juan River was characteristic of other large southwest rivers, exhibiting large spring runoff and low base flows (Bliesner and Lamarra 2000). Large, temporary increases in flow and sediment were common during intense, convective summer and fall precipitation events. High sediment input during summer and fall storm events, combined with a loss of sediment transport due to the effects of Navajo Dam, filled low-velocity habitats with sediment. This situation has the potential to adversely impact aquatic species such as the endangered Colorado pikeminnow and razorback sucker by reducing the availability and quality of aquatic habitat during crucial growth periods (Holden 1999). Objective 4.2 of the San Juan River Basin Recovery Implementation Plan (SJRIP) to identify, protect, and restore habitats for these two fish species (Bliesner and Lamarra 2000).

During the SJRIP study period in the 1990s, various dam release scenarios were tested to determine potential impacts on aquatic habitat and sediment dynamics in the San Juan River. The conclusions of the SJRIP study and other factors lead to the development of proposed changes to dam operations (USBOR 2002). In the preferred alternative, the dam operations would be modified to mimic the natural hydrograph (5000 cfs spring release with 250 baseflow) when anticipated inflow predictions and current reservoir storage allow as determined by the San Juan Model Operating Rule Decision Tree (decision matrix). Among other goals, the peak flow recommendations were designed to meet the flow recommendations for the endangered fish and provide temporary cleaning of cobbles. Past dam operations did not generate flows sufficient to transport sediment through the system as indicated by measured sediment accumulation between spring runoff events (Holden 1999).

Even though Cañon Largo is the primary source of excessive fine sediment loads and storm events during the summer and fall are the primary source of sediment transport from ephemeral tributaries, the anthropogenic influence of the dam and dam operations are contributing to impairment in Reach 2. Therefore, it cannot be stated that sediment impairment in the San Juan River is completely due to natural causes. There are land use activities that may also be contributing additional amounts of sediment to the river. Cattle grazing does occur in various riparian area along the San Juan River. This land use practice can destabilize erodible banks which could deliver additional amounts of fine sediment to the river. There is also an abundance of unimproved roads in the San Juan River basin associated with oil and gas development.

USEPA's integrated listing guidance includes Category 4B which states (USEPA 2003):

> *Category 4B: Impaired for one or more designated uses, but does not require development of a TMDL because other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future. Consistent with the regulation under 130.7(b)(i),(ii), and (iii), AUs are listed in this subcategory where other pollution control requirements required by local, state, or federal authority are stringent enough to implement any water quality standard (WQS) applicable to such waters.*

The intent of this category was to acknowledge that the preparation of a TMDL would be redundant if some required pollution control measure was scheduled to take effect in the near future and would guarantee the water quality standard of concern would be meet. USEPA Region 6 has determined that Reach 2 of the San Juan River does not fall under Category 4B because the Navajo Reservoir Operations Final Environmental Impact Statement with the preferred alternative is not yet in place. Spring releases are only required when adequate water is available based on anticipated inflow predictions and current reservoir storage. Spring releases did not occur in 2002, 2003, or 2004 based on the decision matrix. Therefore, Reach 2 will be categorized as Category 5A and scheduled for TMDL development.

3.3 LaPlata Assessment Units

The LaPlata River was also examined during the study NSL study. In accordance to our existing SBD protocol for small wadeable streams, a standard 100-count pebble count and concurrent benthic macroinvertebrate kick samples were taken at three locations: LaPlata River @ Colorado state line (LP1), LaPlata River @ LaPlata (LP2), and LaPlata River @ gage above San Juan River (LP3). Benthic macroinvertebrate results are in Appendix A. Assessment conclusions based on the New Mexico state benchmark of 20% fines that has been used in previous TMDLs, the assessment process detailed in SWQB's small wadeable streams protocol, (NMED/SWQB 2004) and the assessment process proposed as a result of the NSL study (i.e., 75th percentile for Ecoregion 22) are all displayed in Table 2.3 for comparison purposes. The Ecoregion fine sediment target was generated with data from small streams as well as the San Juan and Animas Rivers, so its utility in determining impairment in small wadeable streams was examined.

Table 2.3 Proposed degree of Aquatic Life Use support in LaPlata River

Assessment unit	% fines at sampling station(s)	Change in % fines (as percent increase over %fines at reference site±)	Change in biological condition (as percentage of reference site±)	% fines sediment benchmark	Degree of Aquatic Life Use Support for SBD
Reach 6 – LaPlata River (San Juan River to McDermott Arroyo)	30 (LP3)	1000% (LP3)	46% (LP3)	21.5* 20.0^	Not Supporting
Reach 7 – LaPlata River (McDermott Arroyo to Colorado border)	2 (LP1) 3 (LP2)	0% (LP1) ref (LP2)	53% (LP1) ref (LP2)	21.5* 20.0^	ºFully Supporting

NOTES:
* = Fine sediment benchmark for Ecoregion 22 determined to be the 75th percentile of %fines at all coarse-bottomed stable (stage I or VI) sites except those within 5km of dams.
^ = Fine sediment benchmark based on state benchmark in existing SBD TMDLs.
± = The lower site (LP2) was used as the reference station. For example, the change in % fines at station LP3 (30% fines) as compared to reference station LP2 (3% fines) is 1500% (30% / 3% x 100 = 1000%). The sample collected at the upper site (LP1) was heavily dominated by chironomidae and simuliidae.
º = Using the existing SBD protocol for small streams, the conclusion is Fully Supporting for SDB (sedimentation) but Not Supporting for Benthic Macroinvertebrate Bioassessments.

All three approaches used to assess the LaPlata River resulted in the same designated use support conclusions. Utilizing the existing SBD protocol for small streams. Reach 7 should be listed as "Benthic-Macroinvertebrate Bioassessments (Streams)" based on the biological data until the exact cause of impairment can be identified. The dominance by chironomidae and simuliidae combined with a high HBI index may be indicative of a nutrient problem at the station near the Colorado border.

3.4 Assessment Conclusions and Proposed Changes to 2004 Integrated List

Based on the above proposed protocol to assess the San Juan and Animas Rivers, the following changes will be made to the 2004 CWA Integrated §303(d)/§305(b) List of Assessed Waters:

- Reach 1 – San Juan River (Navajo Nation boundary at Hogback to Animas River) – will be changed from Not Supporting to Fully Supporting for Sedimentation/Siltation (SBD)
- Reach 2 – San Juan River (Animas River to Cañon Largo) – will remain listed as Not Supporting for Sedimentation/Siltation (SBD)
- Reach 3 – San Juan River (Cañon Largo to Navajo Dam) – will be changed from Not Supporting to Fully Supporting for Sedimentation/Siltation (SBD)
- Reach 4 – Animas River (San Juan River to Estes Arroyo) – will be changed from Not Supporting to Fully Supporting for Sedimentation/Siltation (SBD)
- Reach 5 – Animas River (Estes Arroyo to Colorado border) – will be changed from Not Supporting to Fully Supporting for Sedimentation/Siltation (SBD)

All three approaches used to assess the LaPlata River resulted in similar designated use support conclusions. Based on these results, the following changes will be made to the 2004 CWA Integrated §303(d)/§305(b) List of Assessed Waters:

- Reach 6 – La Plata River (San Juan River to McDermott Arroyo) – will be noted as Not Supporting for Sedimentation/Siltation (SBD)
- Reach 7 – La Plata River (McDermott Arroyo to Colorado boder) – will be noted as Not Supporting for Benthic-Macroinvertebrate Bioassessments (Streams)

4.0 REFERENCES

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APPENDIX A:

2003 Benthic macroinvertebrate data
for selection stations on the
San Juan, Animas, and LaPlata Rivers (Jacobi, G.Z.)

List of Station Names (Abbreviations) from the San Juan, Animas, and La Plata rivers, 2003.
G. Z. Jacobi

AR1	Animas River, above NM border on Southern Ute Reservation.
AR2	Animas River @ Aztec above WWTP
AR3	Animas River @ Flora Vista
AR4	Animas River @ Boyd Park in Farmington
SJ1	San Juan River below Soaring Eagle Lodge; Hwy 173
SJ2	San Juan River @ Hwy 64 Bridge
SJ3	San Juan River @ Bloomfield Hwy 44 Bridge
SJ4	San Juan River @ Blagg Property above Gallinas Wash
LP1	La Plata River @ Colo. State Line
LP2	La Plata River @ La Plata
LP3	La Plata River @ gage above San Juan River

Table 1. Benthic macroinvertebrates collected from four locations on the Animas River, August 2003.

	Stations			
	AR1 reference	AR2	AR3	AR4
PLECOPTERA - stoneflies				
Claassenia sabulosa	16	23	16	23
EPHEMEROPTERA - mayflies				
Baetis tricaudatus	230	307	358	159
Acentrella insignificans	0	0	303	1124
Heptagenia sp.	47	19	16	16
Traverella sp.	0	0	0	4
Tricorythodes sp.	86	35	47	12
Drunella grandis	0	0	4	0
TRICHOPTERA - caddisflies				
Hydropsyche sp.	1023	844	2455	1587
Hydropsyche oslari	4	0	0	0
Hydroptila sp.	4	0	0	0
Stactobiella sp.	39	43	128	39
Ceraclea sp.	393	78	121	12
Brachycentrus occidentalis	4	0	0	0
DIPTERA - true flies				
Limnophila sp.	23	31	35	16
Simuliidae	156	31	43	82
Chironomidae A	175	311	735	315
Ceratopogonidae	4	0	0	0
Atherix pachypus	311	8	4	0
Chelifera sp.	0	0	4	0
Hemerodromia sp.	0	4	12	8
ODONATA - damsel/dragonflies				
Ophiogomphus sp.	8	0	16	4
Hetaerina sp.	0	0	0	4
COLEOPTERA - beetles				
Zaitzevia parvula	27	0	86	0
Optioservus sp.	0	0	12	0
Heterlimnius corpulentus	113	0	0	0
Microcylloepus sp.	43	58	381	159
LEPIDOPTERA - moths				
Petrophila sp.	31	0	4	0
MOLLUSCA - snails/clams				
Lymnaea sp.	4	0	0	0
Physella sp.	8	0	0	0
ANNELIDA - segmented worms				
Hirudinea	0	4	0	0
Tubificidae	19	0	27	12
ARTHROPODA - other arthropods				
Hydrachnidia A - mites	47	12	117	8
AMPHIPODA - scuds				
Hyalella azteca	0	0	27	0
OSTRACODA - seed shrimp				
Ostracoda	8	0	0	0
Total (numbers/m2)	2823	1808	4951	3584

Table 2. Benthic Marcroinvertebrate bioassessment for four locations on the Animas River, August 2003.

Metric	Stations			
	AR1 reference	AR2	AR3	AR4
Calculated Value				
Standing Crop (No./m2)	2823	1808	4951	3584
No. of Taxa	25	15	23	18
BCI (CTQd)	85.3	82.6	88.4	86.0
HBI	4.80	5.15	5.15	4.80
EPT Index	10	7	9	9
EPT/EPT + Chiron.	0.91	0.81	0.82	0.90
Community Loss	0	0.80	0.35	0.61
% Dominant Taxon	36	47	50	44
Diversity	3.19	2.45	2.62	2.22
Scra./Scra.+Filt. Coll.	0.076	0.022	0.046	0.010
Shredders/Total	0.174	0.092	0.109	0.052
Percent of Reference				
Standing Crop (No./m2)	100	64	175	126
No. of Taxa	100	60	92	72
BCI (CTQd)	100	100	96	99
HBI	100	93	93	100
EPT Index	100	70	90	90
EPT/EPT + Chiron.	100	88	90	99
Scra./Scra.+Filt. Coll.	100	28	59	13
Shredders/Total	100	53	62	30
Score				
Standing Crop (No./m2)	6	6	4	6
No. of Taxa	6	4	6	4
BCI (CTQd)	6	6	6	6
HBI	6	6	6	6
EPT Index	6	2	6	6
EPT/EPT + Chiron.	6	6	6	6
Community Loss	6	4	6	4
% Dominant Taxon	2	0	0	0
Diversity	6	4	4	4
Scra./Scra.+Filt. Coll.	6	2	6	0
Shredders/Total	6	6	6	2
Biological Condition				
Total	62	46	56	44
% of Reference	100	74	90	70
Condition		SI	NI	SI

Table 3. Benthic macroinvertebrates collected from four locations on the San Juan River, September 2003.

	Stations			
	SJ1 reference	SJ2	SJ3	SJ4
PLECOPTERA - stoneflies				
Isogenoides sp.	4	0	0	0
Isoperla sp.	4	34	170	124
EPHEMEROPTERA - mayflies				
Baetis tricaudatus	1680	153	527	296
Acentrella insignificans	175	0	0	128
Heptagenia sp.	19	17	17	0
Traverella sp.	0	0	0	4
Thraulodes sp.	0	0	0	62
Tricorythodes sp.	0	102	153	43
Ephemerella inermis	4	17	51	0
TRICHOPTERA - caddisflies				
Hydropsyche sp.	0	153	833	1311
Arctopsyche grandis	342	0	34	12
Stactobiella sp.	0	17	68	74
Ceraclea sp.	0	0	0	4
Brachycentrus occidentalis	1338	0	0	0
DIPTERA - true flies				
Simuliidae	27	0	0	4
Chironomidae A	16	0	0	8
Caloparyphus sp.	0	0	0	4
Clinocera sp.	0	0	0	4
COLEOPTERA - beetles				
Optioservus sp.	0	0	0	8
COELENTERATA - jellyfish				
Hydrozoa	4	0	0	0
MOLLUSCA - snails/clams				
Physella sp.	16	0	0	0
ANNELIDA - segmented worms				
Tubificidae	381	0	136	16
Tubifex sp.	0	51	0	0
Lumbriculidae	156	0	0	0
PLATYHELMINTHES - flatworms				
Turbellaria	572	0	0	0
ARTHROPODA - other arthropods				
Hydrachnidia A - mites	0	34	34	16
Total (numbers/m2)	4738	578	2023	2118

Table 4. Benthic macroinvertebrate bioassessment for four locations on the San Juan River, September 2003.

Metric	Stations			
	SJ1 reference	SJ2	SJ3	SJ4
Calculated Value				
Standing Crop (No./m2)	4738	578	2023	2118
No. of Taxa	15	9	10	17
BCI(CTQd)	74.1	86.6	80.7	82.3
HBI	3.49	4.65	4.47	4.52
EPT Index	8	7	8	10
EPT/EPT + Chiron.	1.00	1.00	1.00	1.00
Community Loss	0	1.22	0.90	0.47
% Dominant Taxon	35	26	41	62
Diversity	2.48	2.70	2.43	2.04
Scra./Scra.+Filt. Coll.	0.020	0.100	0.019	0.006
Shredders/Total	0.000	0.000	0.000	0.002
Percent of Reference				
Standing Crop (No./m2)	100	12	42	44
No. of Taxa	100	60	66	100
BCI(CTQd)	100	85	91	100
HBI	100	75	78	90
EPT Index	100	87	100	77
EPT/EPT + Chiron.	100	100	100	100
Scra./Scra.+Filt. Coll.	100	100	94	29
Shredders/Total	100	% 1.701412E+38	% 1.701412E+38	100
Score				
Standing Crop (No./m2)	6	0	4	4
No. of Taxa	6	4	4	6
BCI(CTQd)	6	6	6	6
HBI	6	4	4	4
EPT Index	6	4	6	6
EPT/EPT + Chiron.	6	6	6	6
Community Loss	6	4	4	6
% Dominant Taxon	2	4	0	0
Diversity	4	4	4	4
Scra./Scra.+Filt. Coll.	6	6	6	2
Shredders/Total	6	6	6	6
Biological Condition				
Total	60	48	50	50
% of Reference	100	80	83	83
Condition		SI	NI	NI

Table 5. Benthic macroinvertebrates collected from three locations on the La Plata River, November 2003.

	Stations		
	LP2 reference	LP1	LP3
PLECOPTERA - stoneflies			
Perlodidae	0	90	0
EPHEMEROPTERA - mayflies			
Baetis tricaudatus	9	900	0
Tricorythodes sp.	63	0	0
Caenis sp.	0	0	1
TRICHOPTERA - caddisflies			
Hydropsyche sp.	0	60	0
Hydroptila sp.	3	0	0
DIPTERA - true flies			
Simuliidae	63	8040	131
Chironomidae A	147	1110	17
Ceratopogonidae	6	0	0
Caloparyphus sp.	0	0	1
Tabanus sp.	3	0	0
Ephydridae	3	0	0
Limnophora sp.	21	540	22
ODONATA - damsel/dragonflies			
Argia sp.	21	0	0
HEMIPTERA - true bugs			
Cicadellidae	0	30	0
COLEOPTERA - beetles			
Helichus sp.	3	0	0
LEPIDOPTERA - moths			
Petrophila sp.	3	0	1
MOLLUSCA - snails/clams			
Physella sp.	6	0	0
ANNELIDA - segmented worms			
Tubificidae	234	0	5
Lumbriculidae	3	60	0
PLATYHELMINTHES - flatworms			
Turbellaria	36	0	0
ARTHROPODA - other arthropods			
Hydrachnidia A - mites	0	0	2
Total (numbers/m2)	624	10830	180

Table 6. Benthic macroinvertebrate bioassessment for three locations on the La Plata River, 2003.

Metric	Stations LP2 reference	LP1	LP3
Calculated Value			
Standing Crop (No./m2)	624	10830	180
No. of Taxa	16	8	8
BCI(CTQd)	104.1	93.9	108.0
HBI	6.93	6.01	6.27
EPT Index	3	3	1
EPT/EPT + Chiron.	0.34	0.49	0.06
Community Loss	0	1.38	1.38
% Dominant Taxon	38	74	73
Diversity	2.70	1.33	1.37
Scra./Scra.+Filt. Coll.	1.000	0.000	0.000
Shredders/Total	0.010	0.000	0.006
Percent of Reference			
Standing Crop (No./m2)	100	1735	28
No. of Taxa	100	50	50
BCI(CTQd)	100	100	96
HBI	100	100	100
EPT Index	100	100	33
EPT/EPT + Chiron.	100	100	16
Scra./Scra.+Filt. Coll.	100	0	0
Shredders/Total	100	0	57
Score			
Standing Crop (No./m2)	6	0	2
No. of Taxa	6	2	2
BCI(CTQd)	6	6	6
HBI	6	6	6
EPT Index	6	6	0
EPT/EPT + Chiron.	6	6	0
Community Loss	6	4	4
% Dominant Taxon	2	0	0
Diversity	4	2	2
Scra./Scra.+Filt. Coll.	6	0	0
Shredders/Total	6	0	6
Biological Condition			
Total	60	32	28
% of Reference	100	53	46
Condition		MI	MI