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Title **Evaluation of Aquatic Macroinvertebrate Communities and Habitats in Sandia Canyon**

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Introduction

This evaluation of aquatic macroinvertebrate communities and habitats was part of the biological investigations planned by the Los Alamos National Laboratory (LANL or the Laboratory) Environmental Programs–Water Stewardship Program for the Sandia Canyon watershed, as documented in LANL (2007). This plan indicated that rapid bioassessments using US Environmental Protection Agency (EPA) protocols (Barbour et al. 1999) would be conducted at sites in Sandia Canyon with persistent flow. The habitat assessments included in the protocol provide background information about physical aspects of site condition, and the aquatic macroinvertebrate community evaluations provide information about biological responses to site condition.

Methods

We performed habitat assessments and sampled aquatic macroinvertebrates at four study reaches in Sandia Canyon (S-2W, S-2E, S-3E, and E of S-3E; Table 1).

Table 1. Reach locations, descriptions, and dates for habitat assessments and macroinvertebrate sampling.

Location and description of reach	Reach ID	Date Sampled
Sandia Canyon upstream (west) of cattail wetland near sample location SA-00007	S-2W	November 14, 2007
Sandia Canyon downstream (east) of cattail wetland near gaging stating E123	S-2E	November 14, 2007
Sandia Canyon off East Jemez Road near sample location SA-600427	S-3E	November 14, 2007
Sandia Canyon off East Jemez Road near temporary gaging station D123.8	E of S-3E	November 2, 2007

For habitat evaluations, we sampled in a 50-m reach at each site using the US EPA Rapid Bioassessment Protocol (RBP) for high-gradient streams (Barbour et al. 1999). The RBP habitat assessment involves scoring each site based on 10 parameters related to habitat quality, including watershed characteristics, riparian vegetation, instream features, aquatic vegetation, and benthic substrate (Appendix A). The scores for each parameter are summed to arrive at an overall habitat assessment score for a site. We also used portions of the Arizona Department of Environmental Quality's site assessment protocol (Appendix B) to provide complementary information about physical characteristics and habitat at the sites.

We sampled all four sites with a Hess sampler and submitted macroinvertebrate samples to a taxonomic laboratory (Jacobi Environmental Consulting) for sorting and identification. The Hess sampler provides data that can be analyzed using the New Mexico Environment Department's (NMED's) unpublished Stream Condition Index (SCI), which is a statistically validated multi-metric index for estimating stream condition based on various characteristics of macroinvertebrate assemblages (e.g., diversity, number of taxa). The SCI compares test sites to a reference condition, which is based on a group of minimally impacted reference sites that are physically, chemically, and biologically similar to the test sites and that account for the natural variability in aquatic communities among sites (Reynoldson et al. 1997, Hughes 1995). The reference condition for the SCI is based on historical data from New Mexico streams (Jacobi 2006: personal communication).

Results

Habitat assessment scores and macroinvertebrate sample data are presented in Tables 2–4. Detailed information for macroinvertebrate samples can be found in Appendix C. Results for individual sites are presented below. Comparisons to samples collected a short distance upstream at the head of Sandia Canyon (approximately 25 m west of the fill-bridge and culvert) and a site located between S-2E and S-3E are shown in Table 4 (Henne and Buckley 2005, unpublished data).

West of the Sandia Wetland (S-2W)

Site S-2W is located at the upstream (west) end of the cattail wetland in Sandia Canyon and downstream (east) of a fill-bridge and culvert. Flow at the site is perennial and dominated by effluent discharge at the head of the canyon. Vegetation cover consists primarily of herbaceous ground cover and understory shrubs, with no shading of the channel by larger trees. A rubble landfill immediately upstream and developed areas in Technical Area 3 likely impact the site with storm water and sediment runoff. Refuse is common along the stream bank.

The water was clear and odorless. Filamentous algae covered approximately 1% to 5% of the streambed. Floating algae and algal slime were not observed.

Habitat at the site was rated as suboptimal due to lack of complexity in the velocity/depth regime, significant sediment deposition, low flow, and exposure of streambed habitats. The substrate available for colonization by macroinvertebrates was also limited due to lack of stable habitats and embedded substrate.

Seventeen macroinvertebrate taxa were present in the sample collected at the site (Table 3). Of these, five taxa are considered to be tolerant. The mayfly *Baetis caelestis* comprised 63% of the individuals in the sample. The SCI rated the site as severely impaired.

East of the Sandia Wetland (S-2E)

Site S-2E is located downstream of the cattail wetland in Sandia Canyon. Samples were collected in a reach from the head cut downstream to where the stream banks become bedrock. A weir is located at the head of the reach. Vegetation in the reach is dominated by ground cover (approximately 60% coverage) and bare dirt (approximately 40%). Flow at the site is effluent fed perennial with daily variation in discharge related to effluent loading. Refuse was present in the stream channel and along the banks. The water had a clear to light brown color and was odorless. Laid-over grasses to a width of 3 to 5 m indicated recent high flows. The streambed was approximately 30% covered by filamentous algae, and a thin layer of algal slime was noted.

Habitat at S-2E was scored as suboptimal (Table 2) due to lack of stabile habitat for colonization, embeddedness of the streambed substrate, heavy sediment deposition, lack of complexity in the velocity/depth regime, low flow, and lack of vegetative protection of the stream banks.

Nineteen macroinvertebrate taxa were present in the sample, with 8 (42%) of the taxa classified as tolerant. Tolerant individuals comprised 14% of the sample. The sample was numerically dominated by the mayfly *Baetis caelestis* (34% of the individuals in the sample) and the chironomid *Diamesa* sp. (27% of the individuals in the sample). The SCI rated the site as

severely impaired.

Sandia Canyon off East Jemez Road near sample location SA-600427 (S-3E)

The channel at S-3E is deeply incised, with a vertical-walled bench indicating the original channel elevation located approximately 5 to 8 ft above the current channel. The banks and old sandbars of the current channel are well vegetated, but the old banks have extensive erosion. The water was clear with a slight odor of sewage. Filamentous algae covered approximately 5% of the streambed, and a thin layer of algal slime was also present. Vegetation in the reach includes a 30% cover of riparian trees, 20% cover of woody shrubs and vegetation 0.5 m to 5 m in height, 40% ground cover (<0.5 m), and 60% bare dirt.

The habitat score at site S-3E indicted suboptimal conditions for aquatic life due to lack of stable substrate for colonization, embeddedness of the streambed substrate, lack of complexity in the velocity/depth regime, sediment deposition, flow status, bank stability, and impact in the riparian zone due to proximity of the road.

The SCI score for site S-3E indicated severe impairment. Fifteen macroinvertebrate taxa were present in the biological sample. Of these, 20% of taxa (3) and almost 50% of the individuals are classified as tolerant. Of the 198 tolerant individuals in the sample, 194 (98%) were blackflies in the genus *Simulium*.

Sandia Canyon off East Jemez Road near temporary gaging station D123.8 (E of S-3E)

The stream banks in reach E of S-3E have significant areas of erosion and lack vegetative protection. Vegetation cover in the E of S-3E reach includes a canopy of riparian trees >5 m in height (approximately 50% cover), 60% cover of understory vegetation from 0.5 to 5 m high, 40% ground cover, and 30% bare dirt. Refuse was common at the site. The water was clear and odorless. Filamentous and floating algae were not present.

The habitat score for E of S-3E indicated suboptimal conditions for aquatic life. The reach scored low for sediment deposition, channel flow status, bank stability, bank vegetative protection, and proximity to East Jemez Road.

The SCI rated the site as severely impaired. Ten different taxa were present in the macroinvertebrate sample, three of which are considered tolerant. The mayfly *Baetis caelestis* numerically dominated the sample, comprising 67% of the individuals collected.

Table 2. Habitat assessment scores.

Parameter	Reach ID			
	S-2W	S-2E	S-3E	E of S-3E
Epifaunal Substrate & Cover	11	6	8	15
Embeddedness	14	8	8	14
Velocity/Depth Regime	8	11	10	15
Sediment Deposition	6	4	4	8
Channel Flow Status	10	10	10	10
Channel Alteration	18	18	20	18
Frequency of Riffles	13	16	16	18

Parameter	Reach ID			
	S-2W	S-2E	S-3E	E of S-3E
Bank Stability				
Left Bank	7	7	5	4
Right Bank	7	6	5	4
Vegetative Bank Protection				
Left Bank	8	5	8	5
Right Bank	8	5	8	5
Riparian Vegetative Zone				
Left Bank	10	8	5	6
Right Bank	10	8	10	10
Habitat Assessment Score	130 - suboptimal	112 - suboptimal	117 - suboptimal	132 - suboptimal

Table 3. Macroinvertebrate sample abundance and taxa tolerance information.

	Reach ID			
	S-2W	S-2E	S-3E	E of S-3E
Percent of sample processed	100	100	100	100
Number of individuals identified	1827	298	402	213
Number of tolerant individuals (tolerance value = 7–10)	528	43	195	24
Number of taxa	17	19	15	10
Number of tolerant taxa (tolerance value = 7–10)	5	8	3	3
Stream Condition Index	Severely impaired	Severely impaired	Severely impaired	Severely impaired

Table 4. SCI and habitat ratings for prior sampling locations in Sandia Canyon

Sample Date	SCI Rating	
	Upstream of S-2W	Between S-2E and S-3E
March 1996†	--	Severely impaired
July 2001	Severely impaired	Moderately impaired
October 2001	Severely impaired	Severely impaired
May 2002	Severely impaired	Moderately impaired
October 2002	Severely impaired	Severely impaired
May 2003	Severely impaired	Moderately impaired
November 2003	Moderately impaired	Severely impaired
November 2004	Severely impaired	Severely impaired
May 2005	Severely impaired	Severely impaired
October 2005	Severely impaired	Severely impaired
Habitat Score	Optimal/suboptimal	Optimal/suboptimal

† NMED sample

Discussion

The most abundant taxon (*Baetis caelestis*) in the samples collected at S-2W, S-2E, and E of S-3E had not been identified from collections at LANL prior to the Sandia Canyon and Pajarito Canyon studies (Jacobi 2008: personal communication), although it is possible that it had been present before but classified as a different species. Little information is available about the life history of *Baetis caelestis*, but other species in this genera are swimmers that migrate easily through drift and are found in erosional and depositional habitats. Some baetid mayflies (esp. *B. tricaudatis*) are pioneer or "weedy" species that are among the first taxa to recolonize sites soon after disturbance (Wissemann 2002, author's observations).

Similarly, *Simulium* sp., which dominated the sample at site S-3E, is a poor competitor that has been shown to benefit from frequent disturbance due to flooding (Ward 1991: 294). The heavy stream bank erosion and deep channel incision at this site suggest that high flows occur frequently.

The presence of filamentous algae at site S-2E downstream of the wetland suggests organic enrichment, and the lack of tree canopy at that site would help stimulate algal growth. In turn, high numbers of the chironomid *Diamesa* sp. at this site could be a result of the algae, which is a possible food source for this species.

Habitat assessments at all of the sites rated higher than the SCI. This result suggests that water and/or sediment quality, as opposed to habitat limitations, could be impairing aquatic life at the sample sites. Poor water quality is likely due to the effluent discharged into the stream and storm water runoff from nearby developed areas. Sediments can also be contaminated by these sources as well as by legacy waste. Poor SCI scores and relatively high habitat scores have also been found in Sandia Canyon at other monitoring sites outside of this study area (Table 4).

Conclusions

Additional data about water and sediment quality are needed to evaluate the inconsistency between the habitat assessment and macroinvertebrate SCI scores. Poor water quality should be investigated as a primary cause of aquatic community impairment, which occurs even at the head of the canyon where physical habitat conditions are very good. This site receives almost all of its water from effluent. Sediment deposition related to non-point source pollution and storm water runoff affected all of the sample locations and is another likely cause of the impairment of the aquatic communities in Sandia Canyon.

Acknowledgments

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Appendix A: US EPA Rapid Bioassessment Protocol (RBP) for high gradient streams

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS

STREAM NAME	LOCATION
STATION #_____ RIVERMILE_____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE _____ TIME _____ AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal		Poor
1. Epifaunal Substrate & Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).		Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Adapted from EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition, 1999.

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Parameters to be evaluated broader than sampling reach

Total Score

Adapted from EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition, 1999.

Appendix B: Arizona Department of Environmental Quality site assessment protocol

SAMPLE LOCATION

Date: (dy/mo/yr): _____ Sample Time: _____

Stream Name: _____ Site Name: _____

Site Description: _____

Field Crew: _____ Program:_____

POST SAMPLING RECOMMENDATIONS

(Notes about flow regime, relocating site, site access, sample types, analysis parameters, etc.)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

FIELD OBSERVATIONS

Precipitation (Circle one): None Light Moderate Heavy

Previous precipitation (24 hr) (Circle one): None Light Moderate Heavy

Could cover (%): _____

FIELD MEASUREMENTS

Air T (°C): _____ Turbidity (NTU): _____

Water T (°C): _____ D.O. (mg/l):_____ D.O. % Sat.:_____ Conductivity (µmos/cm):_____ pH: _____

Samples Collected **Sample Time: _____** **QC Sample (Y/N):_____**

Water Collection Method:	**Parameter Sets:**	**Biological Samples:**	
____ Composite	____ Inorganics	**Macroinvertebrates:**	**Macroinvertebrates:**
____ Grab	____ Nutrients	___ Riffle (field split____)	___ Edge (field split____)
	____ Total Metals	___ Pool (field split____)	___ Other (field split____)
	____ Dissolved Metals	**Algae:**	**Algae:**
	____ Bacteria	___ Diatoms, Riffle	___ Filamentous, Riffle
	____ Radiochemicals	___ Diatoms, Pool	___ Filamentous, Pool
	____ Parasites/Viruses	___ Diatoms, Artificial Substrate	___ Filamentous, composite
	____ Other _____		

ADDITIONAL SAMPLE NOTES

GENERAL SITE CHARACTERISTICS

General Appearance in the Stream Reach (Check all that apply)

____ No refuse visible

____ Small volume refuse (e.g. cans, paper) rare

____ Small volume refuse common

_____ Large Volume refuse (e.g. tires, carts) rare

_____ Large Volume refuse common

General Appearance of the Stream Bank along the Reach (Check all that apply)

____ No refuse visible

____ Small volume refuse (e.g., cans, paper) rare

____ Small volume refuse common

_____ Large Volume refuse (e.g., tires, carts) rare

_____ Large Volume refuse common

Water Appearance (Check all that apply)

____ Clear

____ Milky

____ Turbid

____ Light Brown

____ Dark Brown

____ Oily Sheen

____ Reddish

____ Greenish

____ Other _____

Water Odor (Check all that apply)

____ None

____ Sewage

____ Chlorine

____ Fishy

____ Rotten Eggs

____ Other _____

Appearance at Water's Edge (Check one)

____ No evidence of salt crusts

____ White crusty deposits rare

_____ Numerous white crusty deposits localized

_____ Banks covered with white crusty deposits

Fish (Based on observation)

1. Abundant Comments: _____

2. Rare Comments: _____

3. Absent Comments: _____

Crayfish (Based on observation)

1. Abundant Comments: _____

2. Rare Comments: _____

3. Absent Comments: _____

Recent (past 2 months) flood or long term drought evidence (Check all that apply)

_____ No recent flood evidence

_____ Fresh debris line

_____ Grasses laid over

_____ Recent flood even greater than baseflow:

< bankfull width

> bankfull width – estimated width _____

____ Fresh debris suspended in bushes/trees

____ Other _____

____ Drought Conditions Prevailing

Flow Regime (Check one)

___ Perennial stream channel. Surface water persists all year long.

___ Intermittent stream channel. One which flows only seasonally or sporadically. Surface sources include springs, snow melt and flows that reappear along various locations of a reach, then run subterranean (interrupted).

___ Subterranean stream channel. Flows parallel to and near the surface for various seasons; subsurface flow which follows the streambed.

___ Ephemeral stream channel. Flows only in response to precipitation.

Flow Variability (Check one)

_____ Seasonal variation in stream flow dominated primarily by **snowmelt** runoff.

_____ Seasonal variation in stream flow dominated primarily by **stormflow** runoff.

_____ Uniform stage and associated stream flow due to **spring fed condition.**

_____ **Regulated stream flow** due to diversions, dam release, dewatering, etc.

_____ **Altered flows** due to development such as urban streams, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

AQUATIC PLANTS

Filamentous Algae

Estimated percent of filamentous algae bed throughout study reach: _____ % cover

Floating Algae

Are any detached clumps or mats of algae floating downstream?

1. Abundant Comments: _____

2. Rare Comments: _____

3. Absent Comments: _____

Algal Slime (not filamentous)

Are the submerged rocks, bedrock, woody material in the stream coated with a layer of algal slime? May be slippery to the touch, but no readily visible.

1. Abundant – thick -coating Comments: _____

2. Rare- thin-coating Comments: _____

3. Absent Comments: _____

Percent macrophytes covering stream-bed throughout the reach:_____ % cover

Description of algae/macrophytes in reach (emergent and submergent):

EMBEDDEDNESS

(Estimate the percent Embeddedness of 10 cobbles along each of the three riffle transects. Select three different riffles within the reach wherever possible. Begin and end transect at edges of riffle, don't include edge particles of the wetted width.

Count sand and fines as 100% embedded and bedrock and hardpan as 0% embedded. Gravel is selected from a patch of gravel is considered 100% embedded.)

											Average % Embeddedness
Transect #1											
Transect #2											
Transect #3											

ORGANIC DEBRIS/CHANNEL BLOCKAGES (IN ACTIVE CHANNEL)

___ No organic debris or channel blockages

___ Infrequent debris, what's present consists of small, floatable

___ Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.

___ Numerous debris mixture of medium to large sizes – affecting up to 30% of the area of the active channel.

___ Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.

___ Extensive, large debris dams either continuous, or influencing over 50% or channel area. Forces water onto flood plain even with moderate flows. Generally presents a fish migration blockage.

___ Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.

___ Beaver dams – Frequent. Back water occurs between dams – stream flow velocities reduced between dams.

___ Beaver dams- abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, avulsion, and degradation, etc.

___ Man-made structures – diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

Mark single most appropriate description

RIPARIAN VEGETATION COVER: (Record the % cover of each vegetation type. Consider each vegetative layer separately with a score of 0-100% for each)

Riparian Vegetation Cover	**Percent Cover**
Canopy of riparian trees (>5m height)	
Understory of woody shrubs, samplings, herbs, grasses & forbs (0.5 to 5 m high)	
Ground cover of woody shrubs seedlings, herbs, grasses & forbs (<0.5 m high)	
Barren, bare dirt	

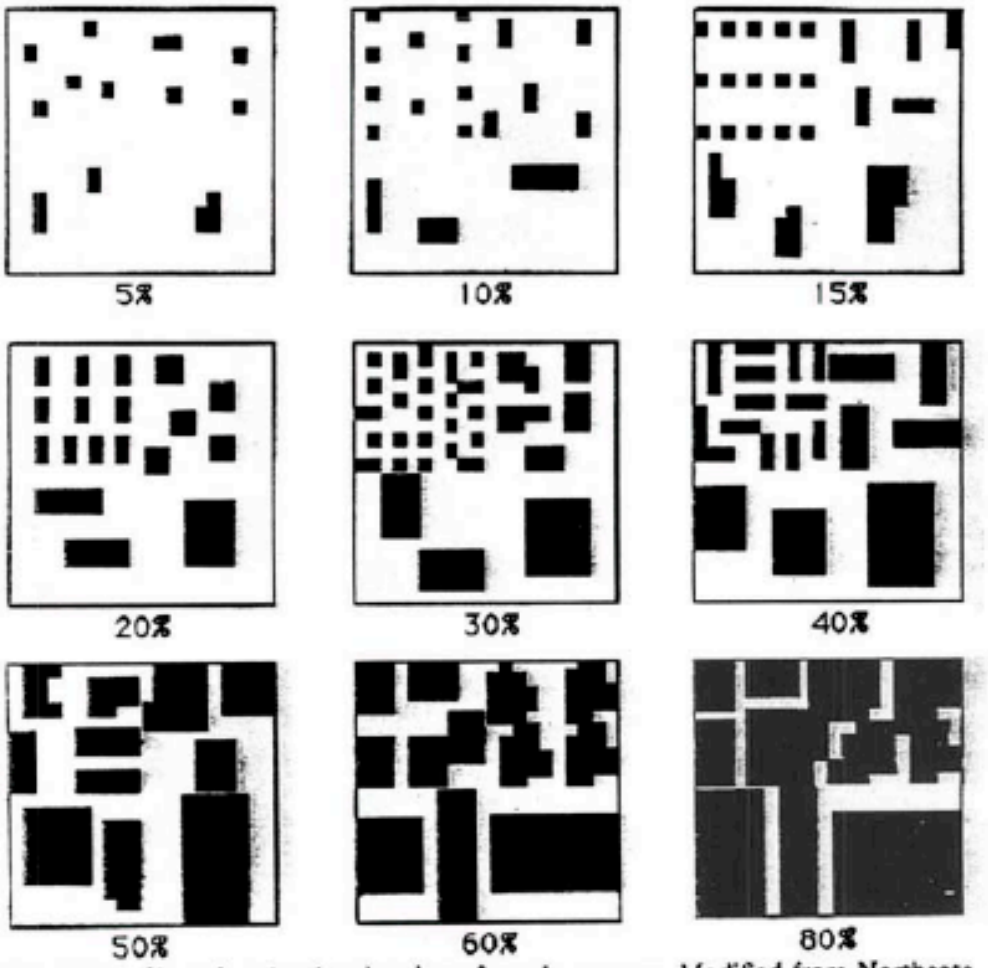

Figure 5.9. Chart for visual estimation of areal coverage. Modified from Northcote (1979) by permission of Rellim Technical Publications

ADDITIONAL FIELD NOTES: (Note: How stream is confined, geomorphic features, streambed structure, habitat variety, dimentation, flood/drought evidence, fish, frogs, other wildlife, channel modifications etc.)

Appendix C: Macroinvertebrate Sample Composition

LANL - Aquatic Macroinvertebrates				
Location	S2W	S2E	S3E	E of S3E
Date	14-Nov-07	14-Nov-07	14-Nov-07	2-Nov-07
Sampler	Hess-3 reps	Hess-3 reps	Hess 3 reps	Hess 3 reps
PLECOPTERA - stoneflies				
Capniidae			2	6
EPHEMEROPTERA - mayflies				
Baetis caelestis	1143	102	129	143
TRICHOPTERA - caddisflies				
Limnephilus sp.			8	
Hydropsyche oslari	3	3	4	9
Hydroptila sp.		2		
COLEOPTERA - beetles				
Agabinus sp.	40	10	1	1
Optioservus sp.			7	24
DIPTERA - true flies				
Tabanus sp.				1
Simulium sp.	215	16	191	22
Muscidae	5	1		
Chironomidae - non-biting midges				
Radotanypus sp.	3	1		
Thienemannmyia gp.	13	1		
Diamesa sp.		79	32	4
Brillia sp.			1	
Pagastia sp.	5			
Cardiocladius sp.	3			
Eukiefferiella spp.	88	4	3	
Orthocladius spp.	15	21	7	
Heterotrissocladius sp.			1	
Parametriocnemus sp.	10	5		
Paraphaenocladius sp.	10	5		
Synorthocladius sp.		2		

LANL - Aquatic Macroinvertebrates				
Location	S2W	S2E	S3E	E of S3E
Date	14-Nov-07	14-Nov-07	14-Nov-07	2-Nov-07
Sampler	Hess-3 reps	Hess-3 reps	Hess 3 reps	Hess 3 reps
***ODONATA* - dragonfly/damselfly**				
Boyeria sp.	3		11	2
Argia sp.	85	4		
LEPIDOPTERA - moths				
Petrophyla sp.	3			
MOLLUSCA - snails/clams				
Physella sp.		8		
Fossaria sp.		1		
ANNELIDA - segmented worms				
Tubificidae	183	1	3	
Megadrilli		32	2	1
Total taxa	1827	298	402	213
Total number of organisms	17	19	15	10

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