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Title

Evaluation of Aquatic Macroinvertebrate Communities and Habitats in the Pajarito Watershed

Prepared by Lisa Henne, ENV-EAQ

Los Alamos
NATIONAL LABORATORY

Los Alamos, New Mexico 87545

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Editing by Hector Hinojosa, Group IRM-CAS

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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 Pajarito Canyon watershed, as documented in LANL (2006). This plan indicated that rapid bioassessments using US Environmental Protection Agency (EPA) protocols (Barbour et al. 1999) would be conducted at sites in the Pajarito Canyon watershed 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 three study reaches in the Pajarito Canyon watershed (PA-4, PAS-2E, and TW-2E; Table 1). Site AW-1 was not sampled due to lack of water.

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

Location and description of reach	Reach ID	Date Sampled
Pajarito Canyon wetlands west of NM 4, near Gate 2 and near weather station	PA-4	May 13, 2008
South fork of Pajarito Canyon ("Starmer's Gulch"), upstream of E242 gaging station	PAS-2E	May 13, 2008
Twomile Canyon downstream of confluence with north fork	TW-2E	May 14, 2008
Anchor West basin below Technical Area 08 and Anchor Ranch Road	AW-1	Not sampled - dry

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 did not perform the RBP for the Pajarito wetland site (PA-4) because the habitat evaluation criteria in the RBP do not apply to wetlands.

Our work plan specified that a Hess sampler be used for macroinvertebrate sampling where sufficient water depth and velocity permitted its use. 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). The SCI was

developed using macroinvertebrate data from Hess samples and is only valid for evaluating samples collected using the same method. Because of the possibility of encountering low-flow conditions, our work plan specified that dip net samples would be collected in the event that the Hess could not be used. Dip net samples are useful for determining taxonomic composition at a site and can be used to sample a greater variety of habitats than a Hess sampler, but cannot be reliably evaluated with the SCI or other macroinvertebrate metrics.

We sampled site PAS-2E with a Hess sampler. We were unable to use the Hess sampler due to insufficient flow at sites TW-2E and PA-4 and, instead, collected macroinvertebrate samples in the 50-m reach using a D-frame aquatic dip net (0.3 m wide with a 500-µm mesh). Per Barbour et al. (1999), sampling was semi-quantitative with effort standardized by taking 20 sweeps or "jabs" of the dip net at each site. In order to avoid bias in the types of substrates sampled, we first visually identified the types of habitats present (riffles, runs, pools, submerged vegetation) and estimated their percentage in the reach. We then sampled those habitats in approximate proportion to their occurrence. Macroinvertebrate samples were submitted to a taxonomic laboratory (Jacobi Environmental Consulting) for sorting and identification.

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.

Pajarito Wetlands (PA-4)

Site PA-4 is a wetland with pools and multiple channels. Vegetation cover at the site consists of mostly grasses and shrubs with little shade over the channel. Evidence of elk presence (tree damage, scat) was noted but the site does not appear to be excessively impacted by grazing. Pajarito Road is located approximately 75 m upslope and likely impacts the site with storm water and sediment runoff. Refuse from the road is common. A dirt road crosses the channel at the downstream end of the study site. A debris line indicated flooding at the site but appeared to be at least two months old. There was no evidence of recent flooding.

The water was odorless and dark brown with an oily sheen. Tadpoles were present in pools. Filamentous algae covered approximately 70% of the streambed and mats of floating algae were abundant. Submerged macrophytes covered approximately 30% of the active channel.

Twelve macroinvertebrate taxa were present in the sample collected at the site, but seed shrimp (Ostracoda – 52%) and predacious diving beetles (*Agabinus* sp. – 34%) numerically dominated the sample. Over 93% of the individuals and 75% of the taxa in the sample had high tolerance values (Table 3).

South Fork of Pajarito Canyon (PAS-2E)

The south fork of Pajarito Canyon ("Starmer's Gulch") has a perennial spring-fed channel with a moderate amount of organic debris (tree branches, leaf packs, etc.) affecting the active channel. Habitat at the site was rated overall as suboptimal with individual habitat parameter scores falling within the marginal condition category for sediment deposition and bank stability and the suboptimal category for epifaunal substrate and available cover, embeddedness, and

velocity/depth regime. The water was slightly milky and odorless, and a slight amount of algae was present. There was no evidence of recent flooding, but we noted undercutting banks and channel incision have increased since previous years, which suggests high flow events.

Twelve macroinvertebrate taxa were present in the sample, with two tolerant taxa present. Individuals from tolerant taxa comprised less than 1% of the sample. The sample was numerically dominated by *Baetis caelestis* mayflies (61%) and stoneflies in the genus *Amphinemura* (26%). The NMED SCI score rated the site as comparable to reference based on the macroinvertebrate community composition. Comparisons to previous years are shown in Table 4 (Henne and Buckley 2005, unpublished data). Impairment during 2003–2005 was due to very low flow periods caused by drought conditions.

Twomile Canyon (TW-2E)

The sampling location in Twomile Canyon is an intermittent stream channel with shallow pools and very low flow. The water was odorless, clear in the channel, and milky in the pools. No algae was observed. A debris line and bent-over grasses extending approximately two meters beyond bankfull indicated a recent flood event. Refuse was common along the banks but not in the channel.

Habitat at the site was rated as suboptimal. Individual habitat parameter scores for velocity depth regime, sediment deposition, and channel flow status were rated as marginal. Scores for epifaunal substrate and available cover, embeddedness, and bank stability fell within the suboptimal range.

Twenty macroinvertebrate taxa were identified in the sample collected at this site. Twelve of the 20 taxa and 64% of the individuals were midges (family Chironomidae). Fifteen percent of the individuals and 30% of the taxa in the sample had high tolerance values (Table 3).

Table 2. Habitat assessment scores. Habitat assessments were not performed for PA-4 (Pajarito wetlands) because habitat evaluation criteria do not apply to wetlands.

Parameter	Reach ID		
	PA-4	PAS-2E	TW-2E
Epifaunal Substrate & Cover	N/A – wetland site	12	12
Embeddedness	--	12	12
Velocity/Depth Regime	--	14	8
Sediment Deposition	--	9	10
Channel Flow Status	--	18	8
Channel Alteration	--	20	20
Frequency of Riffles	--	20	16
Bank Stability			
Left Bank	--	5	6
Right Bank	--	5	8
Vegetative Bank Protection			
Left Bank	--	6	9
Right Bank	--	8	9

Table 2. (continued)

Parameter	Reach ID		
	PA-4	PAS-2E	TW-2E
Riparian Vegetative Zone			
Left Bank	--	10	10
Right Bank	--	10	10
Habitat Assessment Score		**149 – Suboptimal**	**138 – Suboptimal**

Table 3. Macroinvertebrate sample abundance and taxa tolerance information.

	Reach ID		
	PA-4	PAS-2E	TW-2E
Percent of sample processed	100	75	100
Number of individuals identified	274	203	131
Estimated total number of individuals in entire sample	274	271	131
Number of tolerant individuals (tolerance value greater than 7)	256	2	19
Number of taxa	12	12	20
Number of tolerant taxa (tolerance value greater than 7)	9	2	6

Table 4. SCI ratings for PAS-2E (south fork of Pajarito Canyon).

Sample Date	SCI Rating
July 1994	Comparable to reference
July 2001	Comparable to reference
November 2001	Comparable to reference
Fall 2002	Flow inadequate for sampling
May 2003	Moderately impaired
November 2004	Moderately impaired
May 2005	Severely impaired
October 2005	Moderately impaired
May 2008	Comparable to reference

Discussion

Pajarito Wetlands (PA-4)

The field observations and high percentage of tolerant individuals and taxa in the PA-4 macroinvertebrate sample suggest an impaired condition at that site with wetting and drying cycles. The most abundant taxa in the sample (ostracodes) are benthic crustaceans that inhabit an extremely wide range of aquatic habitats, including temporary and intermittent waters (Thorp and Covich 1991: 691, 699). Ostracodes can have 1–10 generations per year (Wisseman 2002). Ostracode eggs are able to withstand extreme physical and chemical conditions, including drying, and later life stages can enter a torpid state that allows the organisms to survive dry periods (Thorpe and Covich 1991: 703). *Agabinus*, the second most abundant taxa, are air-breathing predacious beetles with a high tolerance for impaired conditions.

Field observations at this site also suggest an impaired condition. Refuse near the channel and the oily sheen on the water is likely due to storm water runoff from road surfaces, and the excessive growth of algae and macrophytes suggests nutrient enrichment. Excessive vegetation

can cause oxygen depletion at night, and lack of shade could raise water temperatures higher than can be tolerated by sensitive taxa.

South Fork of Pajarito Canyon (PAS-2E)

The SCI rating of "comparable to reference" is consistent with earlier results for this location and indicates improvements in habitat conditions since 2002–2005. The most abundant taxon in the sample collected at PAS-2E (*Baetis caelestis*) has not been identified before from collections at LANL (Jacobi 2008: personal communication). Little information is available about the life history of this species, but other species in this genera are swimmers found in erosional and depositional habitats. Many baetids migrate easily through drift, and some species of *Baetis* (esp. *B. tricaudatis*) are one of the first taxa to recolonize sites soon after disturbance (Wissemann 2002, author's observations). The abundance of the stoneflies *Amphinemura* sp. at this site could indicate that flow is intermittent, but the stonefly *Suwalia* sp. emerges in summer and suggests persistent flow (Jacobi 2008: personal communication). Even during very dry years, this site has had at least some flow when visited for sampling (Henne and Buckley 2005, unpublished data).

Twomile Canyon (TW-2E)

The most abundant taxon at this site (*Paramerina* sp.) is a predaceous chironomid (non-biting midge) with intermediate tolerance for poor habitat conditions and 1–10 generations per year. The other midge taxa present at the site vary in their functional feeding groups and tolerance values (ranging from intolerant to moderately tolerant). Most of the chironomid taxa present can have up to 10 generations per year. The dominance of small, multivoltine taxa is consistent with the low flow conditions and lack of habitat complexity observed at the site.

Conclusions

The characteristics of the macroinvertebrate communities at Pajarito wetlands (PA-4) and Twomile Canyon (TW-1E) are consistent with the compromised habitat conditions observed at these sites. At Pajarito wetlands, the dominant taxa can produce multiple generations per year and survive prolonged dry periods and are tolerant to pollution and disturbance. At Twomile Canyon, sediment deposition and low flow could explain the predominance of midges over other taxa.

Because of the lack of information about the functional feeding groups, habit (e.g., swimmer, sprawler, clinger, burrower), and tolerance values for *Baetis caelestis*, the genus values were used in the SCI calculations. The south fork of Pajarito Canyon sample was dominated by this taxon, and, if the characteristics of the species vary considerably from the characteristics of the genus, it would likely change the SCI score for the site. Nevertheless, previous macroinvertebrate samples collected at this site did not contain *Baetis caelestis* but resulted in similar scores indicating minimal disturbance at the site.

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	**Macroinvertibrates:**	**Macroinvertibrates:**
____ 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 stream bed.

___ 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	

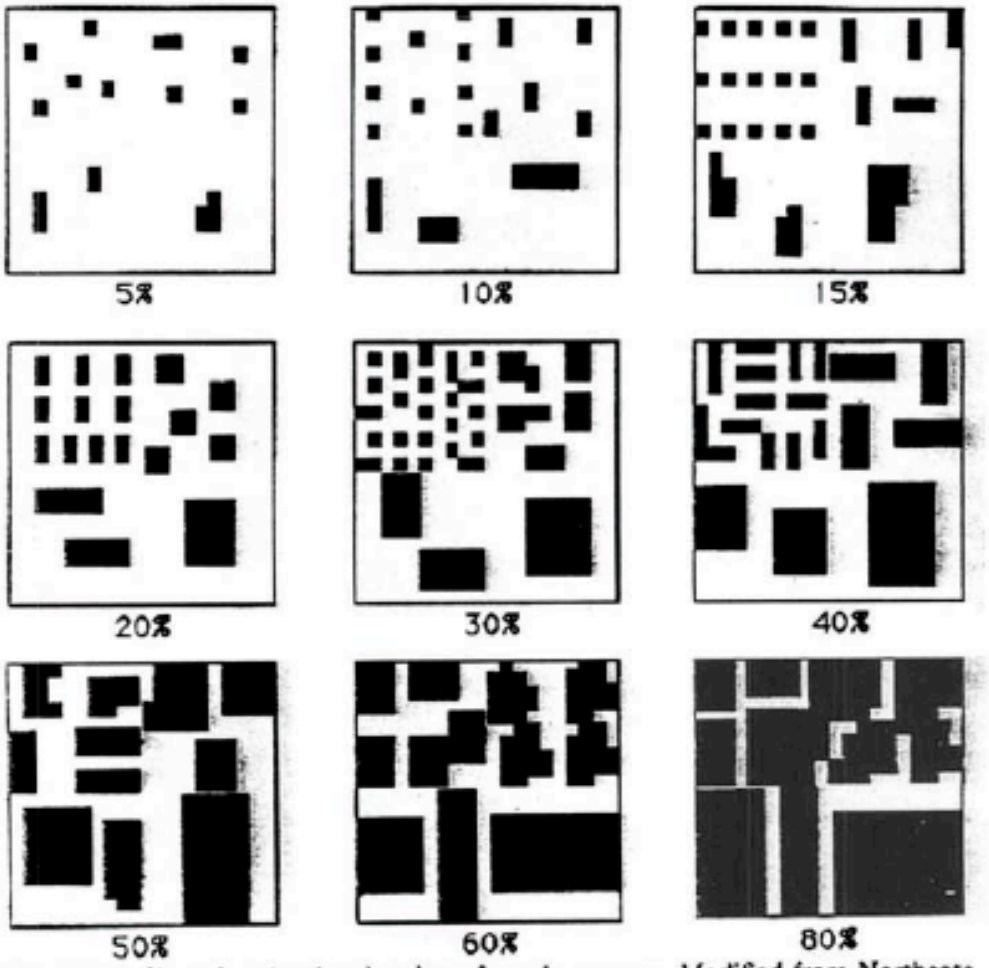

Figure 5.9. Chart for visual estimation of areal coverage. Modified from Northcote (1979) by permission of Rellim Technical Publications

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	Pajarito Wetlands	Twomile Canyon	South Fork Pajarito Canyon
Reach	PA-4	TW-2E	PAS-2E
Date	13-May-08	14-May-08	13-May-08
Sampler	Dip Net	Dip Net	Hess
Taxa			
PLECOPTERA - stoneflies			
Amphinemura sp.			70
Suwallia sp.			1
EPHEMEROPTERA - mayflies			
Callibaetis sp.	1		
Baetis caelestis		28	166
TRICHOPTERA - caddisflies			
Hesperophylax sp.		8	
Hydropsyche sp.			1
COLEOPTERA - beetles			
Agabus sp.	4	1	
Agabinus sp.	94	2	
Oreodytes sp.		2	
Liodessus sp.		4	
Tropisternus sp.	6		
Staphylinidae		1	
DIPTERA - true flies			
Dicranota sp.		1	20
Antocha sp.			1
Culiseta sp.	4		
Aedes sp.	1		
Chironomidae - non-biting midges			
Rheotanypus sp.		1	
Paramerina sp.	11	46	
Diamesa sp.		14	1
Pseudodiamesa sp.		5	3
Odontomesa sp.		1	
Eukiefferiella sp.		1	5
Orthocladius sp.	1	1	
Heterotrissocladius sp.		3	
Parametriocnemus sp.		1	
Paraphaenocladius sp.		1	
Synorthocladius sp.		7	
Micropsectra sp.	6	3	
Chironomus sp.	2		
HEMIPTERA - true bugs			

Cicadellidae			1
OSTRACODA - seed shrimp	142		
ANNELIDA - segmented worms			
Tubificidae	2		
Lumbricidae			1
PLATYHELMINTHES - flatworms			
Tricladida			1
Total taxa	12	20	12
Total number of organisms	274	131	271

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