Habitat Assessment of the Lower Eklutna River

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INTRODUCTION

A habitat assessment of the Lower Eklutna River and Thunderbird Creek located in Chugiak, Alaska was conducted August 21-24, 2006. The survey began at the mouth of the Eklutna River in the Knik Arm of Upper Cook Inlet and continued to approximately a quarter mile above the Lower Eklutna Dam. It also included Thunderbird Creek from its confluence with Eklutna River to the falls. The length of assessment totaled 5 miles of river channel. Elijah Donat MS, Environmental Engineer and William Prisciandaro, BS Fisheries Biologist were in charge of the data collection, processing, and analysis.

The goal of the survey was to assess the habitat available to salmon. The goal of this report is to evaluate the current habitat conditions and recommend options for the enhancement of habitat for all species of salmon. Data included in this document was presented to the Army Corps of Engineers (ACOE) and the Eklutna River Watershed Council on December 8, 2006 and discussed prior to draft document preparation (Attachment A).

WATERSHED OVERVIEW

The Eklutna River is approximately 12 miles in length from its mouth at the Cook Inlet to the former outlet of Eklutna Lake. The river mouth is on the Upper Knik Arm of Cook Inlet at N61.27.258 W149.25.121 +/-9 ft. The river drains from the glacial Chugach terrane, with the peninsular terrane to the west. It then passes through metamorphosed basalts and cherts of an early Jurassic volcanic chain. The river then enters the Upper Cook Inlet after passing through one kilometer of elevated tidal mudflats. Thunderbird Creek is the only significant tributary to the Eklutna River below the Lower Eklutna Dam. Due to water diversion from Eklutna Lake, Thunderbird Creek is currently the main source of water in the river. Eklutna River historically drained a watershed of 174 square miles. The river currently drains a watershed of 55 square miles with the remaining 119 square miles diverted at the lake (Figure 1). The watershed varies from a tidal wetland consisting of mostly grasses and sedges to mountain sides covered with a mixed forest. The Alaska Department of Fish and Game anadromous stream catalogue number is 247-50-10175 and states five species of Pacific salmon use the river. Thunderbird Creek is catalogued as 247-50-10175-202.

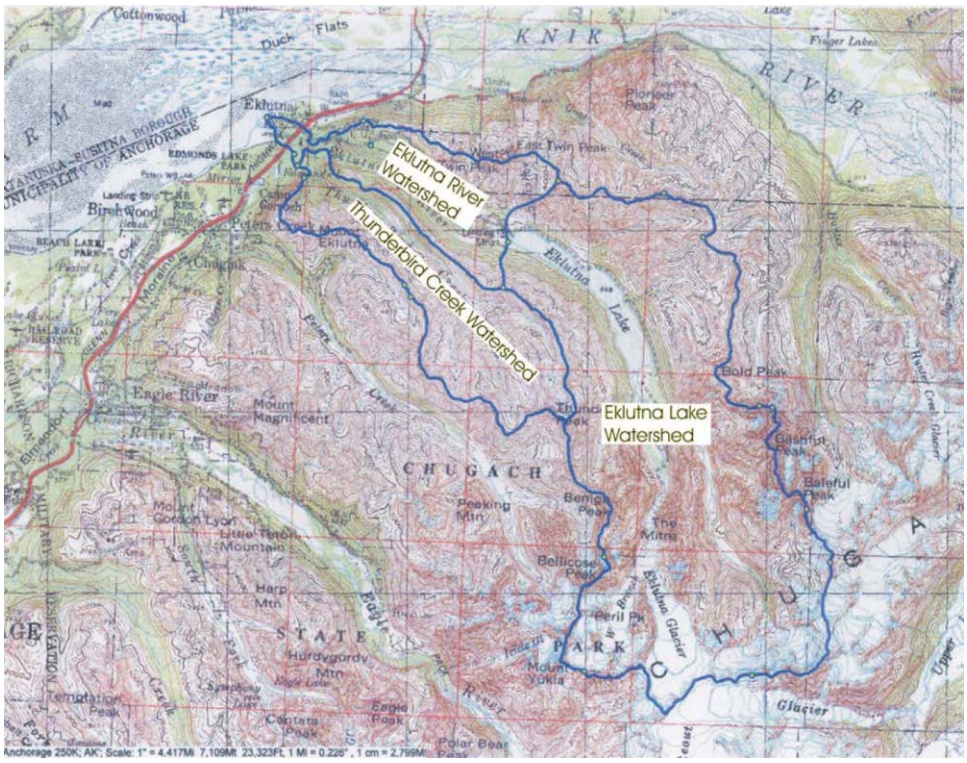


Figure 1. Eklutna Watershed

Native Village of Eklutna (NVE) is the last of eight traditional Athabascan villages in the Anchorage area. It is located in Southcentral Alaska, along the Knik Arm of the Upper Cook Inlet, 25 miles northeast of Anchorage. The village and surrounding area maintain a "rural" character, which the Tribe strives to perpetuate. Subsistence helps connect Eklutna villagers with each other and their traditionally used lands. NVE members strongly support pursuits to preserve their traditional lands, air, water, animals, birds, fish and plants.

According to traditional knowledge documented by Tribal elders, the Eklutna River was once a primary subsistence site for the Eklutna Denai'na Athabascan Village, offering bountiful salmon runs. The river is central to the village cultural identity, subsistence economy, and responsible natural resources development plans. The river today has been severely degraded as salmon habitat, although all Alaska salmon species are still present. Many problems result from low flow. An assessment is needed to determine habitat potential for the river and lake, and to consider removal of the dam in order to return some of the flow to the river.

Unless access to the lake for sockeye is restored and determined to be suitable for spawning and rearing this species has little potential in the system. While king and coho persist in the system they are limited by overwintering, rearing and spawning habitat. Pink and chum salmon are best adapted to the current systems because their lifecycles do not require rearing habitat or overwintering. The NVE is pursuing ecosystem level research, as well as negotiation and planning approaches toward river restoration goals.

The Eklutna River watershed has been impacted by a series of development projects. The Lower Eklutna Dam, built in the 1920's for power generation, is one-mile above the village. No longer used, it still blocks all fish passage upriver. This dam was abandoned after the Eklutna Lake Dam, 8 miles up from the lower dam at the mouth of the lake, was completed in 1955. This new dam replaced an earthen dam built in conjunction with the Lower Eklutna Dam in the 1920's. Currently, the Snettisham Purchase Agreement of 1989 allows this dam to stop the outflow of 100% of the lake water. This water is then used for power generation (about 430 cubic feet per second (cfs)), and for Municipality of Anchorage water use (about 70 cfs).

Eklutna Lake contains 15.5 miles of shoreline, 3,162 surface acres, and a volume, at 860 feet elevation, equaling 366,048 acre-feet. The river regenerates to around 10% of its historical flow by the time it passes Eklutna Village. Thunderbird Creek contributes about 85% of this flow at its confluence with the river below the Lower Eklutna Dam. Gravel mining in the lower river, most recently by the former Federal Railroad in the 1980s, left 2/3 of a square mile of denuded landscape. The river has reclaimed this area. A complex pond system partially connected to the river, has formed as a result of the gravel mining, along with tidal and groundwater influences. These pools provide summer rearing habitat for juvenile salmon and staging habitat for osmoregulation in adult salmon (Figure 2).

METHODS

The habitat inventory conducted in Eklutna River follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual (CSSHRM)* (Flosi et al., 1998). This manual formally explains and describes the California Department of Fish and Game's ground level approach to restoration of fishery resources and standardizes the descriptive terminology and technical methods (Attachment A). The manual has been used on the Pacific coast to assist in developing salmon habitat restoration techniques. ACOE requested this method because it defines channel characteristics and identifies potential restoration opportunities aimed at increasing spawning and freshwater survival of rearing juveniles. In addition to the *CSSHRM* methods, residual pool depth was calculated to assess pool depth independent of flow. The habitat inventory was conducted by a two-person team August 21-24, 2006, walking from the mouth of the Eklutna River to approximately a quarter mile above the Lower Eklutna Dam. The assessment includes an analysis by reach of the habitat conditions based on the habitat types.

SAMPLING STRATEGY

The field protocol was conducted as specified in the *CSSHRM.* Some modifications were introduced to obtain a more detailed dataset. These modifications to the field protocol include a complete census of habitat units and a photolog by habitat unit.

The census of all habitat units was a professional judgment made in the field in order to describe more accurately the features of each habitat unit. This is a variation from the 10% sampling size proposed in the *CSSHRM*, which calls for the selection of one habitat unit to be randomly selected off of each habitat unit form and all parameters measured. The census conducted produced a complete set of measurements for each of the habitat units encountered within the survey.

A photolog was produced to illustrate all habitat units by reach. A photolog showing unit numbers and habitat type descriptions is included in Attachment A and D. This will assist in identifying sources of materials for later restoration efforts. It will also facilitate comparisons under different flow regimes to show what features appear and disappear as flow changes.

Habitat Assessment Components

The habitat assessment has two components: the delineation of channel types and the inventory of habitat units. Data sets for both components were collected using standard field forms and standard field equipment (Attachment B). The channel type delineation included data on channel entrenchment, bankfull width, sinuosity, substrate composition and water slope gradient. A channel type form was filled out at the beginning of the survey and each time the channel type changed. The habitat inventory included data collection on habitat types, temperature, embeddedness, flow, shelter, substrate composition, bank composition and canopy cover.

Channel Type Delineation

Channel typing was conducted following the *CSSHRM* which was derived from Rosgen (1994). Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations (Attachment B). Five parameters were measured to determine channel type:

- **Water slope gradient**: Gradient was calculated using USGS maps because of sinuosity and gradients generally below 2%.
- **Entrenchment**: The ratio between flood-prone width and bankfull width.
- **Width/depth ratio**: The ratio of the bankfull width to the mean bankfull depth.
- **Substrate composition**: The most common particle found on the bed of the stream measured at the velocity crossover. Substrate composition for each habitat unit was also assessed at areas throughout the unit.
- **Sinuosity**: The ratio between stream length and valley length. Sinuosity can be estimated from a 7.5 minute topographical map by measuring the lengths of the valley and the stream.

Habitat Typing

Habitat typing uses the 24 habitat classification types defined by McCain et al. (1990). Habitat units are numbered sequentially and assigned a type selected from a standard list of 24 habitat types (Attachment B3). Eklutna River habitat typing used standard basin level measurement criteria. The parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet.

Temperature

Both water and air temperature were measured and recorded throughout the survey. Both temperatures were taken in degrees Celsius at the middle of the habitat unit and within one foot of the water surface.

Flow

Flow for the river system was obtained from the United State Geological Service (USGS) stage gauge located at the Old Glenn Highway Bridge, Latitude 61°27'01", Longitude 149°22'02" NAD27, which was installed by the USGS in May of 2002.

Embeddedness

The depth of embeddedness in pool tail-out areas was visually estimated by the percent of surrounded or buried in fine sediment. The values were recorded using the following ranges: 0 - 25%, 26 - 50%, 51 - 75%, and 76 - 100%.

Instream Shelter Rating

Instream shelter is composed of those elements within a wetted stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy and allow separation of territorial units to reduce density related competition for prey. Percent of unit cover is the percentage of a unit occupied by several types of cover. Cover is classified into nine types and includes small woody debris, large woody debris, aquatic vegetation, terrestrial vegetation, bedrock ledges, bubble curtains, boulders, root mass and undercut banks. A standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover (Attachment B4). From this, an instream shelter rating can be calculated by multiplying the shelter value by the percent of cover. Thus, instream shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream. Mean shelter ratings were calculated by reach for flatwater and pool habitat types (Attachment B3).

Substrate Composition

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all habitat units, dominant and sub-dominant substrate elements were estimated using a list of seven size classes (silt, sand, gravel, small cobble, large cobble, boulders, and bedrock) and recorded as percentages. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

Canopy Density
Canopy density relates to the amount of stream shaded from the sun and was estimated from the center of every habitat unit. In addition, the area of canopy was estimated into percentages of coniferous or deciduous trees.

Bank Composition
Banks were described based on their dominant substrate composition (bedrock, boulder, cobble/gravel, and silt/clay/sand) and based on their dominant vegetation type (grass, brush, deciduous trees, coniferous trees, or no vegetation). These factors were evaluated because they influence the ability of river banks to withstand flows. The dominant composition type and the dominant vegetation type for both the right and left banks at each habitat unit were recorded in the habitat inventory form. Additionally, the percent of each bank side covered by specific vegetation (including downed trees, logs, and root wads) was estimated and recorded.

Biological Inventory

No biological inventory was conducted as part of this project although observed living and dead fish and wildlife were documented. NVE conducted fish counts for the years of 2002 through 2003 and a summary of that data is located in Attachment B.

Data Results

The habitat unit inventory dataset is summarized by reach using Microsoft Excel spreadsheets and includes several calculations to characterize the habitat units by reach. A summary of data for each reach is included in Attachment C2. A reach summary table is provided at the end of each reach result.

Charts of several parameters measured were created for comparison of reaches. The charts include:

- Level IV Habitat Types by Percentage Total Length by Reach (Attachment C – Chart 1)
- Level IV Habitat Types by Percent Occurrence by Reach (Attachment C – Chart 2)
- Level IV Habitat Types by Percentage Area by Reach (Attachment C – Chart 3)
- Level II Habitat Types by Percent Occurrence by Reach (Attachment C – Chart 4)
- Level II Habitat Types by Percentage Total Length by Reach (Attachment C – Chart 5)
- Level II Habitat Types by Percentage Area by Reach (Attachment C – Chart 6)
- Pool Depth by Reach (Attachment C – Chart 7)
- Substrate Composition in Pool Tail-outs by Reach (Attachment C – Chart 8)
- Percentage Dominant Bank Composition by Reach (Attachment C – Chart 9)
- Percentage Dominant Bank Vegetation by Reach (Attachment C – Chart 10)

The entered field data and raw field data sheets are located on CD in Attachment A.

The channel delineation dataset is summarized in Table 1, which is based on data collected in the Standard Stream Channel Type Form.

Analysis of Habitat Assessment Results

The length of stream surveyed was 25,309 feet, with the survey ending 1,782 feet upstream of the Lower Eklutna Dam. The survey also included the first reach of Thunderbird Creek which measured 1,080 feet. The Eklutna River was then divided into 6 distinct reaches (Figure 2) based on changes documented in the physical characteristics (Table 1) and then divided into 111 habitat units. A photolog is included featuring each habitat unit of the reaches discussed below (Attachment A).

Table 1. Channel Delineation Summary by Reach

	Reach 1	Reach 2	Reach 3	Reach 4	Thunderbird Creek Reach 1	Reach 5	Reach 6
Single/Multiple Channel	Single	Multiple	Multiple	Single	Single	Single	Single
Entrenchment	1.26	1.21	1.7	5.7	1.52	1.3	3.9
Width/Depth	16	24.84	40.4	29.3	14	46.6	11.4
Gradient	<1	<1	<1	<1	1	<1	<1
Substrate	Silt/Clay	Silt/Clay	Cobble	Cobble	Cobble	Silt/Clay	Sand
Sinuosity	1.28	1.36	1.16	1.04	1.15	1.04	1.16

The Eklutna River system changes from a single channel to a multichannel river and then back to a single channel as one moves from the mouth upstream. The entrenchment of the river remains consistent throughout with the exception of Reach 4. It contains the largest amount of flow in the most constrained area of the river. The width/depth ratio of the channel changes depending on how constrained the channel is within the reaches. Reach 1 and Thunderbird Creek Reach 1 show the lowest ratio values because of the constraints of the channel allowing for very little movement of the channel. Gradient of the entire system stays around 1 percent or less. The substrate of the river is directly influenced by the tides and obstructions found within the system. Reach 1 and 2 have a silt substrate from the tidal deposition of silt. Reaches 3, Reach 4, and Thunderbird Creek Reach 1 have a cobble substrate from the movement of materials down the canyon. Reach 5 and 6 have a silt and sand substrate because the Lower Eklutna Dam has inhibited the transportation of material to Reach 5 and the Upper Eklutna Dam stopped the natural flow regime which would deposit gravels in Reach 6. Sinuosity values are consistent throughout the Eklutna system with a small increase in the lower braided sections of the river.

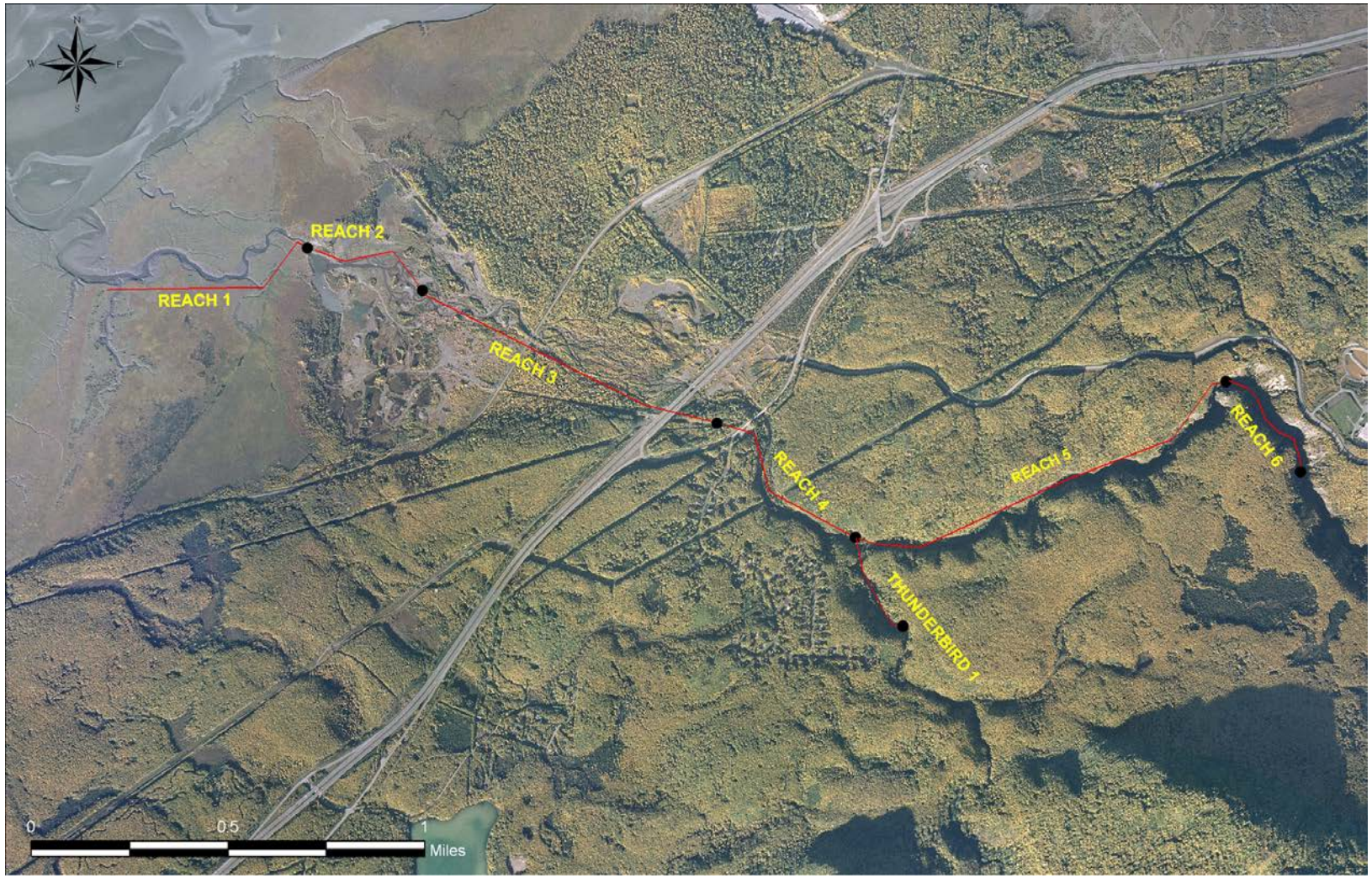


Figure 2. Aerial Photograph of Lower Eklutna System

Reach 1

Reach 1 measures 3,720 feet, covering an area of 182,010 ft^2 from the mouth of the river up to and not including the lower ponds (Figure 2 and 3). This reach is defined by the large tidal range of the Upper Cook Inlet where tides often range up to 30 feet. Reach 1 is made up of runs and glides by area, 73% and 27% respectively, with a dominant substrate and bank composition of silt (Table 2). There is no instream shelter in this reach. Reach 1 is tidally influenced, has no stable banks and there is no vegetation present (Figure 3). This reach contained no shelter values for any habitat type. This section of the river is used mostly for the passage of fish into the system to spawn and migration of juveniles out into Cook Inlet. It is possible that some juvenile salmon could rear and that pink salmon could spawn in the upper portion of this reach. The highly dynamic tidally influenced banks make for no needed restoration in this reach.

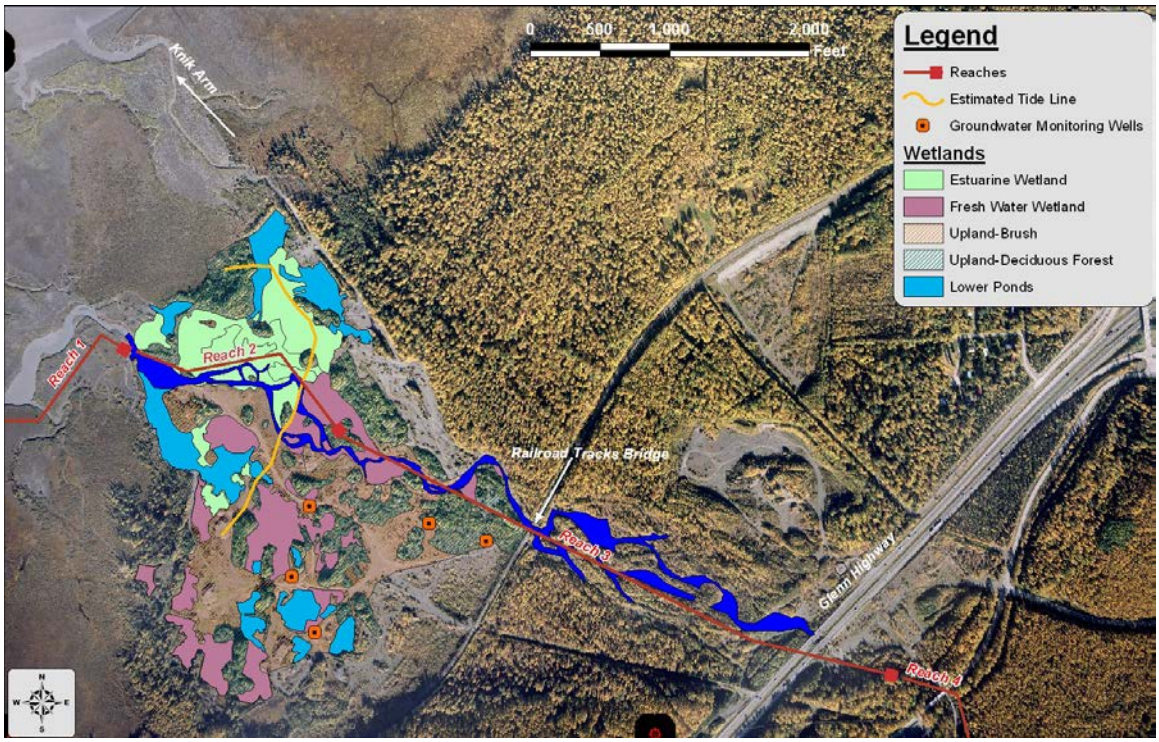


Figure 3. Lower Eklutna System showing ponds and monitoring wells
An enlarged version of Figure 3 is located in Attachment B

Table 2. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 1

Habitat Type	Habitat Units	Habitat Percent Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Averages	Mean Residual Depth (ft)	Mean Shelter Rating
Run	3	60%	2,680	893	49	1.70	N/A	N/A	44, 377	133,130	N/A	0
Glide	2	40%	1,040	520	47	1.85	N/A	N/A	24,440	48,880	N/A	0
Total	5	100%	3,720							182,010		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 4. Reach 1 Unit 2 run area showing silt dominated banks barren of vegetation.

Reach 2

Reach 2 measures 3,496 feet including the length of all side channels, covering an area of 212,860 ft^2 from the lower ponds to the area of highest tidal reach (Figure 2 and 3). This section is made up of mostly glides, six (6), and runs, three (3). It contains a large pond area considered an edgewater which helps to dissipate the effect of the high tides. Adult salmon use this area as a holding area before they move upstream to spawn. The ponds are also used as a feeding area for juvenile salmon. There are two edgewaters in this reach; they comprise 50% of the area, with runs 26%, glides 22%, and corner pools 2% (Table 3). Instream shelter is limited to one unit having a rating of 5. The channels within this reach have relatively stable silt banks vegetated 100% by grasses with wetlands that are inundated during high water events providing shelter and rearing habitat for juvenile

salmon (Figure 4). There are two (2) corner pools near the upper end of the reach with depths of 2.5-3 feet both with cobble tail-outs. The residual depth of these pools range between 1.5 and 2.5 feet. This area has a main substrate of silt due to tidal influence and the low gradient.

Table 3. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 2

Habitat Types	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Average	Mean Residual Pool Depth (ft)	Mean Shelter Rating
Glide	6	22%	1,813	302	28	1	N/A	N/A	7,703	46,220	N/A	0
Run	3	26%	513	171	83	2	N/A	N/A	18,747	56,240	N/A	0
Edgewater	2	50%	930	465	80	1	N/A	N/A	53,400	106,800	N/A	0
Corner pool	2	2%	240	120	15	3	4	2	1,800	3,600	2	2.5
Total	**13**	**100%**	**3,496**							**212,860**		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 5. Reach 2 Unit 8.2.2.2 typical glide area showing dominate bank vegetation of grass.

Reach 3

Reach 3 measures 8,154 feet including the length of all side channels, covering an area of 250,615 ft^2 and extending from the area of highest tidal reach to just above the new Glenn Highway Bridge (Figure 2 and 3). The boundaries of this reach were determined based on the substrate changes from the previous reach and the change to a defined bank system in the reach following. This reach is made up of mostly low gradient riffles,

eleven (11), and runs, twelve (12), together contributing 91% of the area in this reach (Figure 5 and 6). The lower section of Reach 3 showed a mean instream shelter rating of 8 and the upper section a mean stream shelter rating of 29. During lower flows there are two main channels through this reach. During high flow events the channel quickly moves within the bankless flood plain into the forested area. The dominant substrate in this reach is cobble. The cobble becomes more embedded in the upper portion of this reach. The upper portion of this reach is forested with unstable channels. The lower portion presents more stable channels. Reach 3 is dominated by a cobble bank substrate and a dominant bank vegetation of deciduous trees and grass each comprising nearly 50% of the vegetation. This reach has no pools.

Table 4. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 3

Habitat Type	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Average	Mean Residual Depth (ft)	Mean Shelter Rating
Run	12	44%	2475	206	25.833	1.2	N/A	N/A	5328	63938	N/A	19
Low Grade Riffle	11	41%	4439	404	40.636	1.0	N/A	N/A	16399	180385	N/A	58
Glide	2	7%	780	390	15.000	0.5	N/A	N/A	5850	11700	N/A	0
Corner pool	1	4%	60	60	15.000	2.6	4	2	900	900	2	10
Pocket Water	1	4%	400	400	25.000	2.0	N/A	N/A	10000	10000	N/A	15
Total	**27**	**100%**	**8154**							**266922**		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 6. Lower Reach 3 Unit 11 area showing grass bank composition.

Figure 7. Upper Reach 3 Unit 14.2.2.2 low gradient riffle flowing through thick cover.

Reach 4

Reach 4 measures 2,625 feet, covering an area of 118,150 ft^2 from just above the New Glenn Highway Bridge to the confluence of Thunderbird Creek (Figure 2). It is a single channel that is characterized by two (2) glides, four (4) low gradient riffles, and five (5) runs. They represent 41%, 31% and 27% of the area in this reach respectively. Instream shelter ratings for this reach ranged from 2-60. The mean instream shelter rating for flatwater is 13. This area has a well defined bank with no pools. The reach now contains little area for adult fish to hold up and rest during high flows or to provide rearing habitat. The reach is dominantly vegetated by deciduous trees and a large supply of boulders from rockslides (Figure 7). This reach has no pools.

Table 5. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 4

Habitat Type	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Averages	Mean Residual Depth (ft)	Mean Shelter Rating
Run	5	45%	770	154	42	1.6	N/A	N/A	6468	32340	N/A	9
Low Grade Riffle	4	36%	915	229	43	1.5	N/A	N/A	9722	38888	N/A	25
Glide	2	18%	940	470	50	1.1	N/A	N/A	23500	47000	N/A	22
Total	**11**	**100%**	**2625**							**118228**		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 8. Reach 4 Unit 24 a typical glide area with boulders and a dominate bank vegetation of deciduous trees.

Thunderbird Creek Reach 1

Thunderbird Creek Reach 1, starts at the confluence with Eklutna River and extends to the waterfall, measuring 1,080 feet, covering an area of 37,700 ft^2 (Figure 2). This reach is a single steep run, 71% by area, with two (2) pools. Both pools were immeasurable for characteristics because of stream depth and current velocities in the two (2) pool habitat units. Mean instream shelter ranges from 0-30 in this reach. Banks are composed of cobble and are vegetated with deciduous trees (Figure 8). The channel has a moderate gradient with a dominant substrate of cobble and ends with an impassible waterfall that forms a plunge pool. No residual pool depths were calculated based on the inability to measure pool tail crest depth of the two (2) pools within this reach.

Table 6. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 1 Thunderbird Creek

Habitat Type	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Averages	Mean Residual Depth (ft)	Mean Shelter Rating
Steep Run	2	40%	815	408	33	2.0	N/A	N/A	13244	26488	N/A	13
Pocket Water	1	20%	175	175	40	1.8	N/A	N/A	7000	7000	N/A	30
Step Pool	1	20%	50	50	50	N/A	N/A	N/A	2500	2500	N/A	0
Plunge Pool	1	20%	40	40	40	2.7	3	N/A	1600	1600	N/A	25
Total	**5**	**100%**	**1040**							**35988**		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 9. Thunderbird Creek Reach 1 Unit 32 overhead view of a step run area with a dominate bank vegetation of deciduous trees.

Reach 5

Reach 5 measures 5,532 feet, covering an area of 145,430 ft^2 from the confluence with Thunderbird Creek to the Lower Eklutna Dam (Figure 2). Reach 5 is a low gradient meandering channel containing the largest complexity of habitat types within the survey area. This reach is dominated by low gradient riffles, fourteen (14), and runs, seven (7), by area, 26% and 32% respectively. The mean instream shelter rating for this reach ranges from 6-15. Pools compose 25% of the reach by area. Six of the nine pools were 2-3 feet deep. The residual depth of the nine pools averaged 2 feet deep for measurable pools within this reach. Four pools contained a dominate tail-out of silt/sand and three pools contained tail-outs of cobble/gravel. The reach is dominantly vegetated by deciduous trees with banks composed of cobble (Figure 9).

Table 7. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 5

Habitat Type	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Averages	Mean Residual Depth (ft)	Mean Shelter Rating
Low Grade Riffle	14	35%	1795	128	27	0.6	N/A	N/A	3416	47824	N/A	6
Run	7	18%	676	97	25	0.8	N/A	N/A	2387	16707	N/A	15
Glide	6	15%	724	121	25	0.9	N/A	N/A	3017	18100	N/A	12
Lateral Scour Bedrock Pool	6	15%	502	84	20	1.4	3	0.95	1701	10207	2.05	0
Pocket Water	2	5%	305	153	20	0.9	N/A	N/A	3050	6100	N/A	8
Plunge Pool	1	3%	60	60	35	N/A	N/A	N/A	2100	2100	N/A	0
Midchannel Pool	1	3%	40	40	22	1.0	2.7	0.7	880	880	2	0
Dammed Pool	1	3%	380	380	60	0.8	2	N/A	22800	22800	N/A	45
Cascade	1	3%	160	160	10	3.5	N/A	N/A	1600	1600	N/A	20
High Grade Riffle	1	3%	90	90	10	1.2	N/A	N/A	900	900	N/A	10
Total	**40**	**100%**	**4732**									

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 10. Reach 5 Unit 42 typical run showing a large cobble substrate with deciduous trees and grass dominated banks.

Reach 6

Reach 6 extends ten (10) habitat units for a total of 1,782 feet, covering an area of 20,120 ft^2 above the Lower Eklutna Dam. The dam blocks all fish passage (Figure 2). Suggested stream surveys of the remainder of Reach 6 and up to Eklutna Lake are discussed in the recommendations. This reach is a meandering channel made up of five (5) runs, and four (4) glides, 50% and 47% by area respectively, with dominant substrates of cobble and sand (Figure 10). Mean instream shelter ratings for this reach range from 3-7. This reach has no pools.

Table 8. Summary of Pool, Riffle, and Flatwater Habitat Types for Reach 6

Habitat Type	Habitat Units	Habitat % Occurrence	Total Length (ft)	Mean Length (ft)	Mean Width (ft)	Mean Depth (ft)	Mean Max Depth (ft)*	Mean Depth Pool Tail Crest (ft)	Mean Area (ft)2	Total Area (ft)2 Mean of Averages	Mean Residual Depth (ft)	Mean Shelter Rating
Glide	5	50%	772	154	13	0.9	N/A	N/A	1976	9882	N/A	7
Run	4	40%	960	240	13	0.8	N/A	N/A	3000	12000	N/A	3
Low Grade Riffle	1	10%	50	50	12	1.0	N/A	N/A	600	600	N/A	5
Total	**10**	**100%**	**1782**							**22482**		

*Max Depth, Pool Tail Crest Depth, and Residual Depth are only for pool habitats

Figure 11. Reach 6 Unit 77 typical run showing grass and deciduous tree bank vegetation.

Flow

Flow for the study period ranged from 97 cfs to 240 cfs. This data was collected from the stage gauge located at the Old Glenn Highway Bridge. This represented the highest flows recorded since the installation of the stage gauge in May of 2002. Average flows from 2002-2005 are about 45 cfs for this time period. Data collected for this report defines habitat characteristics present during the survey. These characteristics change with differences in flow. As a result, photos, past assessments and the knowledge of the NVE Land and Environment Director, Marc Lamoreoux must be considered to understand conditions of the river at varied flows. A benefit of sampling during an unusually high flow event is that it permitted collection of data on conditions that restoration improvements could be engineered to withstand. These characteristics are considered in the recommendations section of this document.

Temperature

The air temperature during the survey period was 17-18 degrees Celsius. The water temperature for the survey period was 7 degrees Celsius.

BIOLOGICAL INVENTORY RESULTS

The biological inventory included the following observations;

Reach 1	1 dead King, 1 dead Sockeye, 1 dead beaver
Reach 2	4 live Chum, 2 live Pink, One 8ft X 12ft beaver lodge
Reach 3	6 live Chum, 3 live Pinks
Reach 4	2 live Pink, 12 dead Pink, signs of bear
Reach 1 Thunderbird Creek	None
Reach 5	1 Dolly Varden, one 12ft X 20ft beaver lodge, signs of bear, 1 dead moose near dam

NVE has conducted fish counts for the years of 2002 thru 2003 and a summary abstract of that data is located in Attachment B.

RECOMMENDATIONS

Recommendations are provided for improvement of salmon habitat in Eklutna River by reach. The sustainability of salmon populations depends on proper habitat. The adult and juvenile life stages of each salmon species require unique conditions. Channel types are used to define these unique conditions. The *CSSHRM* produces broad recommendations for all five species as a whole for 41 different channel types, and states;

> Although the process of habitat evaluation and basic restoration techniques are generally similar for California salmonids, their habitat preferences are frequently dissimilar. Therefore, applications must be selected that are suitable for the specific target species and life stage (xvii).

The channel types defined in this habitat assessment are based on high flow and are not representative of the river at normal flows. Flow observed during the survey provided valuable information for the design of restoration when used with previous photos and habitat assessments conducted at lower flows. The Native American Fish and Wildlife Society offered trainings 3 times a year for four years to prepare tribal staff to conduct physical habitat assessments; although no official report was published the tribe owns these data in addition to photos which span the last 6 years. In combination these data provide sufficient information to design habitat restoration structures based on the current flow regime featuring zero flow from the lake and draining a 55 square mile watershed. The restoration techniques provided by the *CSSHRM* are provided in Part 7 of the manual which is included in Attachment A. For areas that a mean instream shelter rating of less than 80 was calculated it is recommended by the *CSSHRM* that shelter is added to the reach. This value was considered when the addition of rock and woody debris is suggested in the following recommendations.

Reach 1 has large tidal range, silt substrate and would not be conducive to any habitat restoration due to its dynamic nature. This reach provides fish passage for incoming adult and outgoing juvenile salmon.

Restoration for Reach 2 and the lower portions of Reach 3 can be discussed together based on the similarities of the reaches. This area extends from the lower ponds to above

the railroad bridge at habitat units 14.1.4 and 14.2.2. This area is suitable for spawning improvements for chum, pink, coho, and king that could include the installation of large woody debris or rock structures to facilitate the development of more pools and productive spawning habitat. Rearing improvements for king and coho would require the enhancement of over wintering habitat for the juvenile life stages. Deep ponds could be designed to support over wintering and provide sufficient aquatic and bank vegetation for summer rearing coho and king. Improvements could be engineered by connecting the river to the existing ponds, man made ponds, or instream ponds. Engineered instream pools could be placed in areas of natural upwelling to help maintain open water areas during the winter.

The lower ponds of Reach 2, just above dominant tidal influence, are presently providing summer rearing habitat. As these ponds mature, rearing habitat will improve until the point that the pond has filled. Currently, the upper reaches of the ponds have developed successful macrophytic populations which provide excellent shelter and feeding habitat. While these ponds could be improved by increased shelter value and improved bank vegetation, dredging is not recommended. Prior site assessment by the Natural Resource Conservation Service, State Biologist Bill Wood, has identified dredging as an option to improve rearing and overwintering habitat. However, dredging would require transport and disposal of silt. The area is actively influenced by tidal events and is filling with tidal and river sediment. Due to this instability, habitat improvements are not recommended because they are not likely to provide measurable benefits before they would need to be dredged again. Further, the habitat that would be impacted to improve the ponds is functional summer rearing habitat for coho and king salmon that is otherwise limited in the system.

Recommendations are not made for the upper portion of Reach 3 because of unstable channels. These channels consist of constantly changing banks and to ensure the success of restoration efforts channelization would be required. This is not recommended because the area currently provides summer rearing habitat for coho and king. The existing habitat has excellent shelter from predators and provides a significant contribution of forest debris contributing to productive feeding habitat.

Reach 4 and Reach 1 of Thunderbird Creek are long straight stretches of the river with a small amount of holding habitat for adult salmon. Spawning and rearing improvements in this area for chum, pink, coho, and king could include the installation of large woody debris and rock structures to create pools.

Reach 5 features more complex habitat structures that already include a large amount of woody debris and a large number of pools. The Lower Eklutna Dam has depleted this area of much needed gravel leaving some areas with a bedrock surface. Gravel substrate is needed to support rearing and spawning salmon in this reach. Gravel is available behind the Lower Eklutna Dam. To transport the substrate the dam could be notched and an increased flow from the lake or other sources could be added to flush gravel to areas below the dam. Charles F. Cobb, the State of Alaska Dam Safety Engineer, looked at the safety of removing the dam and determined it safe to remove or leave the Lower Eklutna

Dam in its present state. This adaptive management technique could be employed and monitored over time. Any negative impacts from the notching could be mitigated by sealing the notch after redirecting the minor amount of flow involved. Notching will concentrate the hydraulic force to better transport larger particles downstream. Further, notching could be accomplished incrementally to minimize the potential of any dramatic changes. An increase of flow to this area could also help with the flushing of fines that have degraded the little available substrate within this reach.

Reach 6 begins at the 68 ft tall Lower Eklutna Dam. The dam prevents salmon passage and is filled with substrate. Removal of the Lower Eklutna Dam and release of flows from Eklutna Lake sufficient to transport substrate to a gradient that permits salmon passage would allow for anadromous salmon to access this reach. The constraints of the canyon and the reduced flow make a bypass channel or fish ladder not a feasible means of allowing fish to pass this barrier.

The survey area in the assessment had mean shelter ratings below the level of 80 which the *CSSHRM* determined to be the lower limit in determining areas that would benefit from added shelter. This level is used in California in areas where shelter can provide water cooling benefits through shade areas. This value should be lower for Alaska based on the fact that temperatures are not usually a limiting factor for a salmon stream. Shelter is still needed for cover from predation for both adults and juveniles. Actual shelter throughout the survey could be increased with the addition of large woody debris and rock structures as talked about in the reach discussion above.

Recommendations for further research to improve salmon habitat in the Eklutna River include;

- Assessment of fisheries habitat potential presented by removal of the Lower Eklutna Dam and subsequent return of some flows from Eklutna Lake.
- Author and implement design for installing habitat restoration structures in habitat deficient Reaches 2-5 and Reach 1 of Thunderbird Creek using available materials and following part 7 of the *CSSHRM*
- Investigation of groundwater table in Reaches 2 and 3 to support pond design (Figure 3)
- Design ponds and/or instream pools to support king and coho rearing and overwintering habitat

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual,* 3rd edition. California Department of Fish and Game, Sacramento, California.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.

Attachments

Attachment A

1. PowerPoint Presentation of results provided December 8, 2006
2. Photolog
3. California Salmonid Stream Habitat Restoration Manual
4. Raw Data
5. Electronic files of this report

Attachment B

1. Data Collection Sheets
2. Data Collection Equipment
3. Level IV Habitat Types
4. Shelter Values

Attachment C

1. Aerial Map of Lower Eklutna System
2. Reach Summary
3. Charts
4. Summary of NVE Fish Counts

Attachment D

1. Photolog
2. Channel Delineation Forms
3. Habitat Inventory Forms
4. Field Drawings

Attachment A

A1. PowerPoint Presentation of results December 8, 2006

A2. Photolog

A3. *CSSHRM*

A4. Raw Data

A5. Electronic files of this report

Attachment B

B1. Data Collection Sheets

STREAM CHANNEL TYPE WORK SHEET

Form # ___ of ___

Channel Type _____ Channel Change Location (Habitat Unit#)_____
Cross-Section Location (Habitat Unit#) _____ Date _____/_____/_____
Stream_____
T____R____S____ Surveyors_____
Quad_____Lat ___ ___ ___ Long ___ ___ ___

Single Thread Channel _____ (Y/N) Multiple Channel _____ (Y/N)

Bankfull Width (W_{bkf}) = _____ (ft.)

Transect Recording Box

Dist.																			
Depth																			
Sub.																			

Sum of Depths:_____

Dominant Substrate Determination:

	Substrate:	Number	
1.	Bedrock	= _____	
2.	Boulder (>10")	= _____	(Circle Most
3.	Cobble (2.5 - 10")	= _____	Frequent
4.	Gravel (0.08 - 2.5")	= _____	Occurrence)
5.	Sand (<0.08)	= _____	
6.	Silt / Clay	= _____	

Entrenchment Determination:

Step 1: Maximum Bankfull Depth _____ x 2 = _____ (W_{pp} Elev.)

Step 2: Determine Flood-Prone Width at W_{pp} Elevation = _____ (W_{pp})

Step 3: Flood-Prone Width (W_{pp}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{pp} _____ (ft.) / _____ (ft.) = _____ (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths _____ / No. Depths _____ = Mean Bankfull Depth (d_{bkf}) ____

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf}_____ (ft.) / d_{bkf} _____ (ft.) = _____ (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

Stream Length _____ / Valley Length _____ = Sinuosity _____

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL _____ (ft.) - USL _____ (ft.) / (D) ____ (ft.) = _____

HABITAT INVENTORY DATA FORM Form # ___of___

Date ___/___/___ Stream Name _____ T___R___S___

Surveyors _____Lat._____ Lon._____

Quad._____Channel Type___ Reach #___Flow_____

Time _____ Water Temp _____ Air Temp _____Page Length_____Total Length_____

****

Habitat Unit Number										
Habitat Unit Type										
Side Channel Type										
Mean Length										
Mean Width										
Mean Depth										
Maximum Depth										
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value										
%Unit Covered										
% undercut bank										
% swd (d<12")										
% lwd (d>12")										
% root mass										
% terr. vegetation										
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay										
B) Sand (<0.08")										
C) Gravel (0.08-2.5")										
D) Sm. Cobble (2.5-5")										
E) Lg. Cobble (5-10")										
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate										
PERCENT TOTAL CANOPY										
% Broadleaf Trees										
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition										
Rt. Bank Dominant Veg.										
% Rt. Bank Vegetated										
Lt. Bank Composition										
Lt. Bank Dominant Veg										
% Lt. Bank Vegetated										

Attachment B

B2. Data Collection Equipment

Data Collection Equipment

- Stream Channel Work Sheet
- Habitat Inventory Data Forms
- Pencils
- Plastic Flagging
- Topographic and Aerial Maps
- Digital Camera
- Thermometer
- Stopwatch
- Stadia Rod
- Fiberglass open reel tape 200 feet
- Flow Meter
- Hand Level
- Compass
- Hip chain and thread
- GPS

Attachment B

B3. Level IV Habitat Types

LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

Attachment B

B4. Shelter Values

Instream Shelter Complexity Values

Value of 0
No shelter

Value of 1
One to five boulders
Bare undercut bank or bedrock ledge
Single piece of large wood (>12" diameter and 6' long) defined as large woody debris (LWD)

Value of 2
One or two pieces of LWD associated with any amount of small wood (<12" diameter) defined as small woody debris (SWD)
Six or more boulders per 50 feet
Stable undercut bank with root mass, and less than 12" undercut
A single root wad lacking complexity
Branches in or near the water
Limited submersed vegetative fish cover
Bubble curtain

Value of 3
Combinations of (must have at least two cover types):
LWD/boulders/root wads
Three or more pieces of LWD combined with SWD
Three or more boulders combined with LWD/SWD
Bubble curtain combined with LWD or boulders
Stable undercut bank with greater than 12" undercut, associated with root mass or LWD
Extensive submersed vegetative fish cover

Attachment C

C1. Aerial Photograph of Lower Eklutna River System

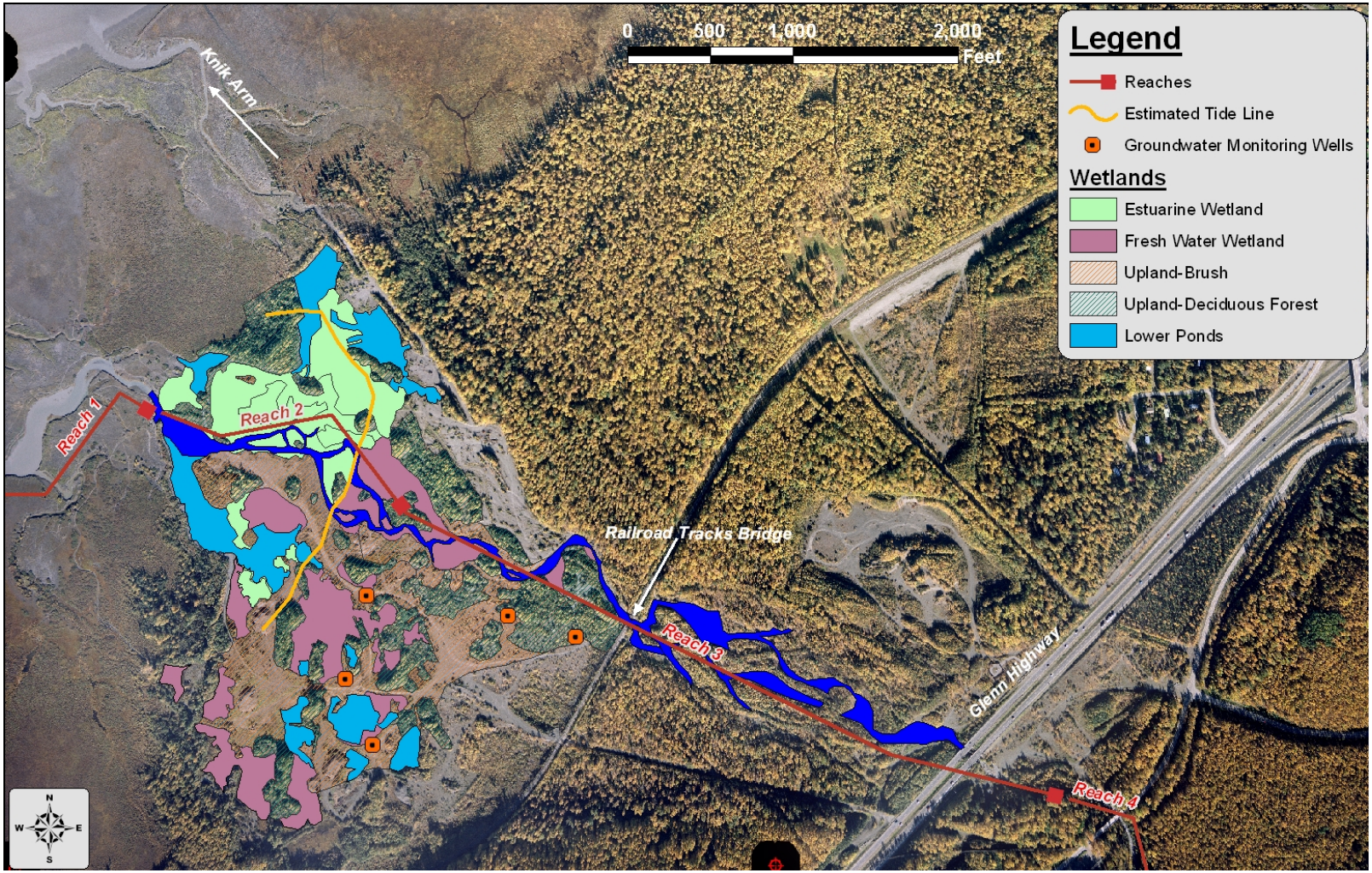


Figure 12. Aerial Photograph of the Lower Eklutna River System

Attachment C

C2. Reach Summary

Reach Summary

Stream Name: Eklutna River/Thunderbird Creek
Sample Date: August 21-24, 2006
Stream Length: 25309 ft Eklutna River/ 1080 ft Thunderbird Creek
Stream Area: 929185 ft^2 Eklutna River/ 37700 ft^2 Thunderbird Creek
Location of Mouth Eklutna: Latitude N 61.27.258 Longitude W 149.25.121 +/-9ft
Location of Mouth Thunderbird Creek: Latitude N 61.26.735 Longitude W 149.21.517 +/-26ft

Summary by Reach

Reach 1

Channel Type: F6
Description: Entrenched meandering riffle/pool channel on low gradient with high width depth ratio; silt/clay channel.
Single or Braided Reach: Single
Channel Length: 3720ft (15%total river length)
Mean Width: 48.2ft
Area of Reach: 182010 ft^2 (20% total river area)
Min/max mean depth of riffles: 1.8ft/3ft
Max and Average depth of pools: 0/0
Number of Pools: 0
Dominate Bank Composition: Silt
Dominate Bank Vegetation: None
Dominate Substrates: Silt/Gravel
Dominate Shelter: None
Average Canopy Cover per Unit: 0%
Fish Seen Within Reach: King Salmon, Sockeye both dead on bank

Reach 2

Channel Type: DA6
Description: Multiple channels, narrow and deep with expansive well vegetated floodplain and associated wetlands; very gentle relief with high variable sinuosities; stable stream banks; silt/clay channel.
Single of Braided Reach: Braided
Channel Length: 3496ft includes all side braids (14% total river length)
Mean Width: 46.54
Area of Reach: 212860 ft^2 (23% total river area)
Min/max mean depth of riffles: 1ft/3.1ft
Max and Average depth of pools: 4.5ft/4.25ft
Number of Pools: 2
Dominate Bank Composition: Silt
Dominate Bank Vegetation: Grass
Dominate Substrates: Silt/Sand
Dominate Shelter: Terrestrial Vegetation
Average Canopy Cover per Unit: 1.5%
Fish Seen Within Reach: Chum Salmon, Pink Salmon

Reach 3

Channel Type: D3
Description: Multiple channels with longitudinal and transverse bars; very wide channel with eroding banks; cobble channel.
Single or Braided Reach: Braided
Channel Length: 8154ft includes all side braids (32% total river length)
Mean Width: 32.11ft
Area of Reach: 250615 ft^2 (27% total river area)
Min/max mean depth of riffles: 0.7ft/5ft
Max and Average depth of pools: 4ft/4ft
Number of Pools: 1
Dominate Bank Composition: Cobble/Gravel
Dominate Bank Vegetation: Deciduous Trees
Dominate Substrate: Gravel/Small Cobble
Dominate Shelter: Small Woody Debris
Average Canopy Cover per Unit: 42%
Fish Seen Within Reach: Pink Salmon, Chum Salmon

Reach 4

Channel Type: C3
Description: Low gradient, meandering, point-bar, riffle/pool alluvial channels with broad, well defined floodplain, cobble channel.
Single or Braided Reach: Single
Channel Length: 2625ft (10% total river length)
Mean Width: 43.64ft
Area of Reach: 118150 ft^2 (13% total river area)
Min/max mean depth of riffles: 1.5ft/2.5ft
Max and Average depth of pools: 0/0
Number of Pools: 0
Dominate Bank Composition: Cobble/Gravel
Dominate Bank Vegetation: Grass
Dominate Substrates: Small Cobble/Large Cobble
Dominate Shelter: Small Woody Debris
Average Canopy Cover per Unit: 34%
Fish Seen Within Reach: Pink Salmon

Reach 1 Thunderbird Creek

Channel Type: B3
Description: Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; cobble channel.
Single or Braided Reach: Single
Channel Length: 1080ft
Mean Width: 39ft
Area of Reach: 37700 ft^2
Min/max mean depth of riffles: 2.2ft/2.5ft
Max and Average depth of pools: 3ft/3ft one pool immeasurable
Number of Pools: 2
Dominate Bank Composition: Cobble/Gravel
Dominate Bank Vegetation: Deciduous Trees
Dominate Substrates: Small Cobble/Large Cobble
Dominate Shelter: Terrestrial Vegetation
Average Canopy Cover per Unit: 55%
Fish Seen Within Reach: None

Reach 5

Channel Type: F6
Description: Entrenched meandering riffle/pool channel on low gradient with high width depth ratio; silt/clay channel.
Single or Braided Reach: Single
Channel Length: 5532ft (22% total river length)
Mean Width: 24.75ft
Area of Reach: 145430 ft^2 (16% total river area)
Min/max mean depth of riffles: 0.4ft/4ft
Max and Average depth of pools: 4.6ft/2.8ft
Number of Pools: 7
Dominate Bank Composition: Cobble/Gravel
Dominate Bank Vegetation: Grass
Dominate Substrates: Silt/Large Cobble
Dominate Shelter: Terrestrial Vegetation/Large Woody Debris
Average Canopy Cover per Unit: 35%
Fish Seen Within Reach: Dolly Varden

Reach 6

Channel Type: E5
Description: Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio; sand channel.
Single or Braided Reach: Single
Channel Length: 1782 (7% total river length)
Mean Width: 12.6
Area of Reach: 20120 ft^2 (2% total river area)
Min/max mean depth of riffles: 1ft/2.2ft
Max and Average depth of pools: 0/0
Number of Pools: 0
Dominate Bank Composition: Cobble/Gravel
Dominate Bank Vegetation: Grass
Dominate Substrates: Small Cobble/Sand
Dominate Shelter: Terrestrial Vegetation
Average Canopy Cover per Unit: 18%
Fish Seen Within Reach: None

Attachment C

C3. Charts

Chart 1

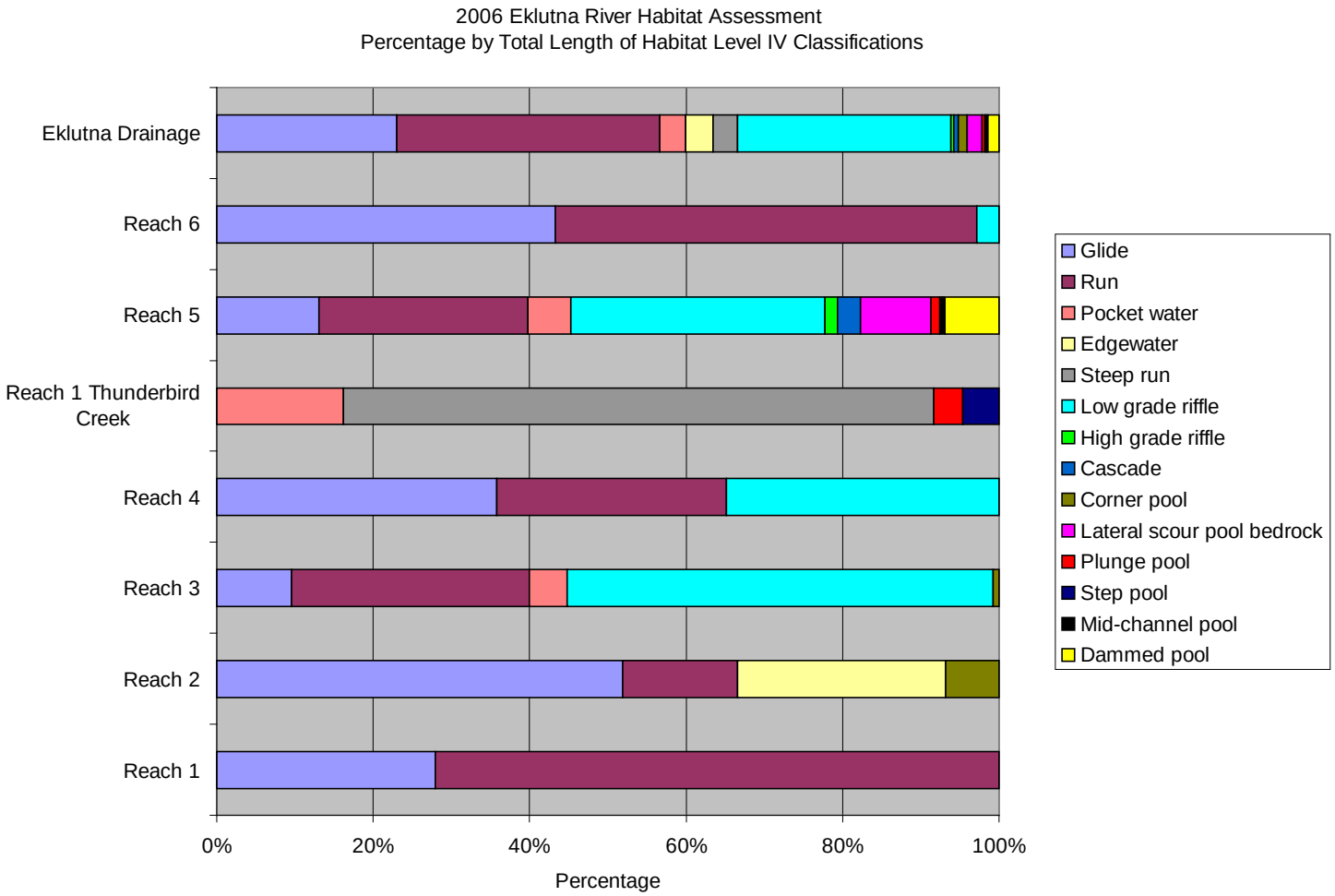

2006 Eklutna River Habitat Assessment
Percentage by Total Length of Habitat Level IV Classifications
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
Glide
Run
Pocket water
Edgewater
Steep run
Low grade riffle
High grade riffle
Cascade
Corner pool
Lateral scour pool bedrock
Plunge pool
Step pool
Mid-channel pool
Dammed pool

Chart 2

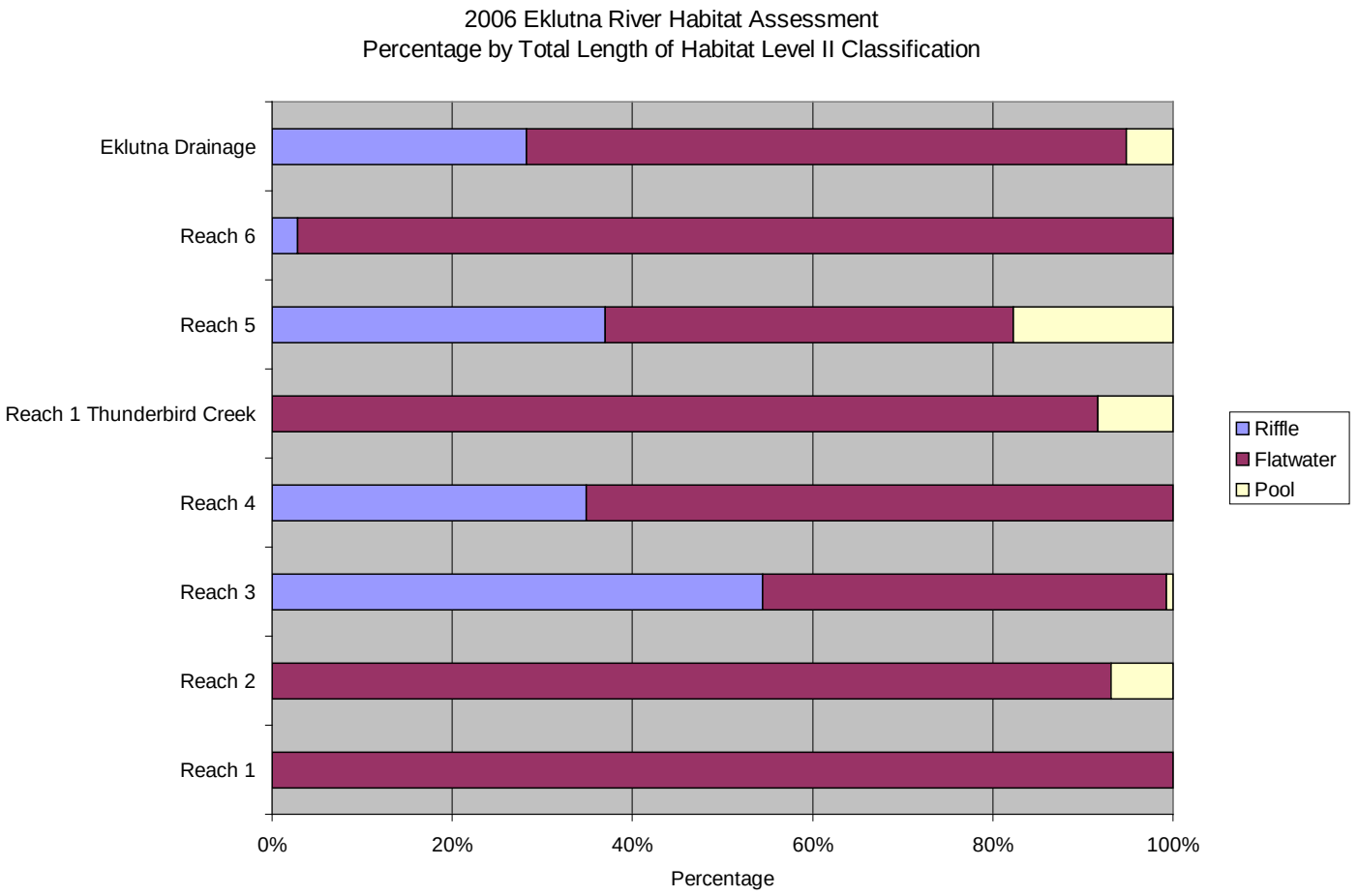

2006 Eklutna River Habitat Assessment
Percentage by Total Length of Habitat Level II Classification
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
Riffle
Flatwater
Pool

Chart 3

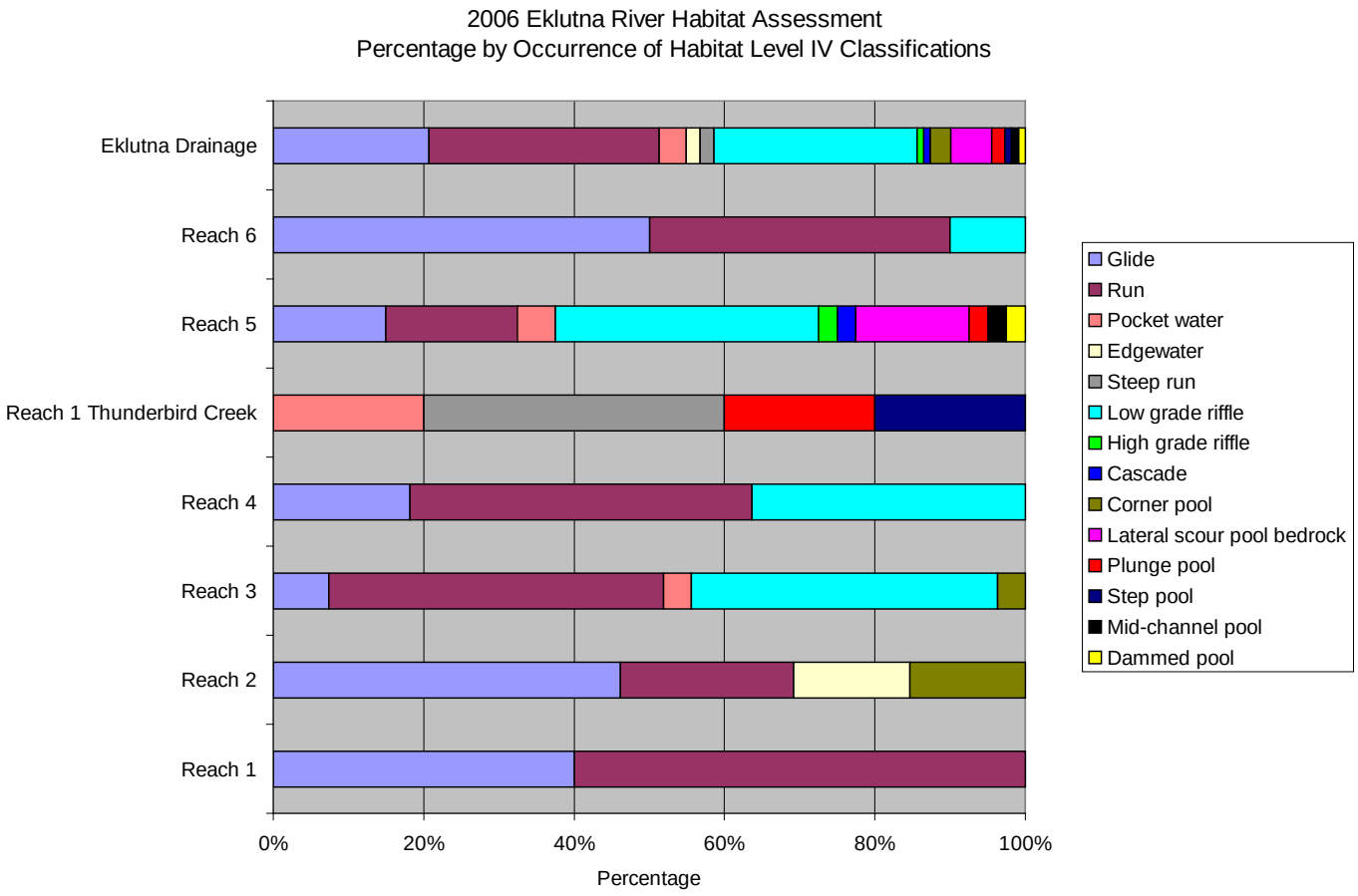

2006 Eklutna River Habitat Assessment
Percentage by Occurrence of Habitat Level IV Classifications
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
Glide
Run
Pocket water
Edgewater
Steep run
Low grade riffle
High grade riffle
Cascade
Corner pool
Lateral scour pool bedrock
Plunge pool
Step pool
Mid-channel pool
Dammed pool

Chart 4

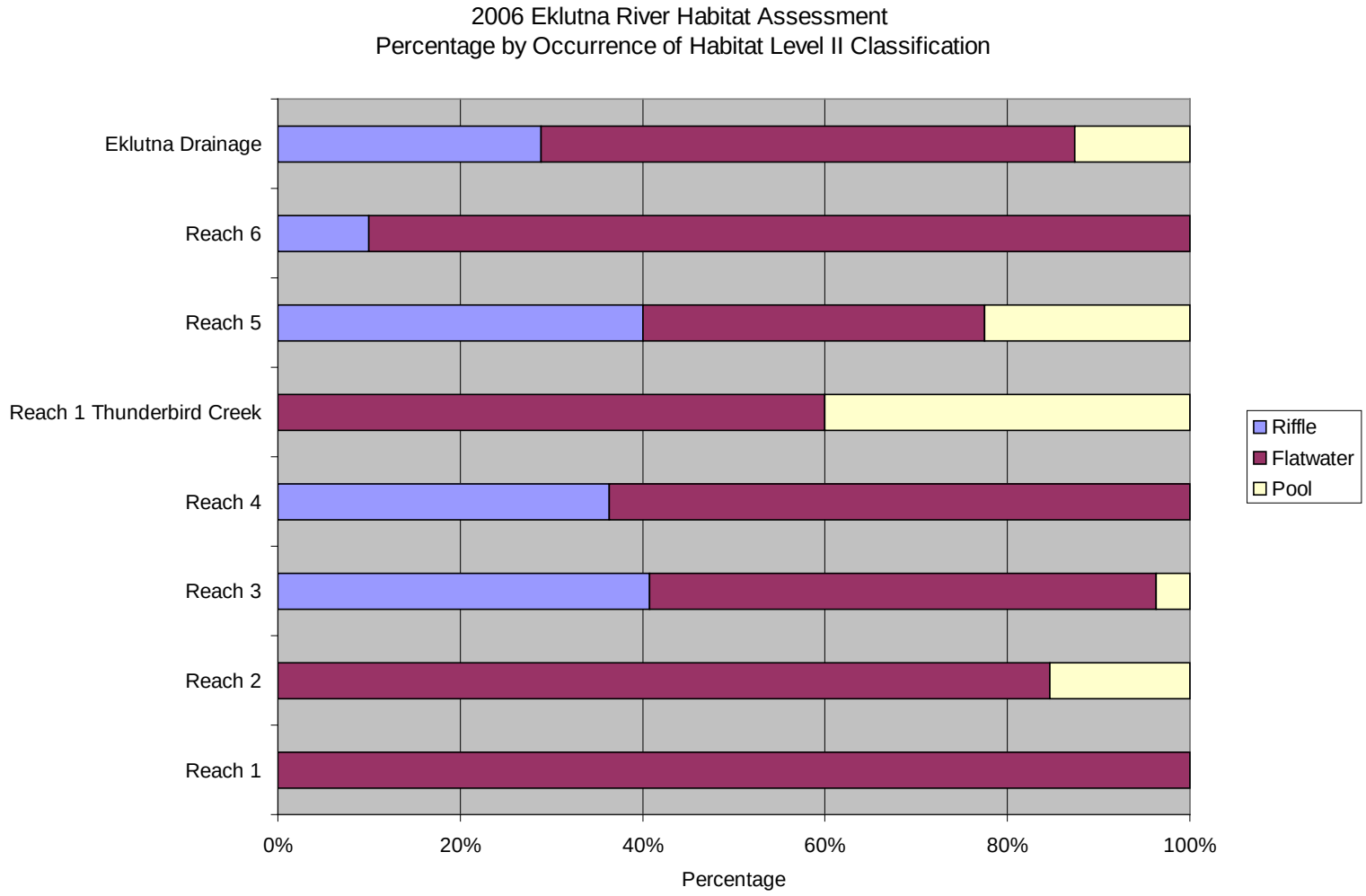

2006 Eklutna River Habitat Assessment
Percentage by Occurrence of Habitat Level II Classification
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
Riffle
Flatwater
Pool

Chart 5

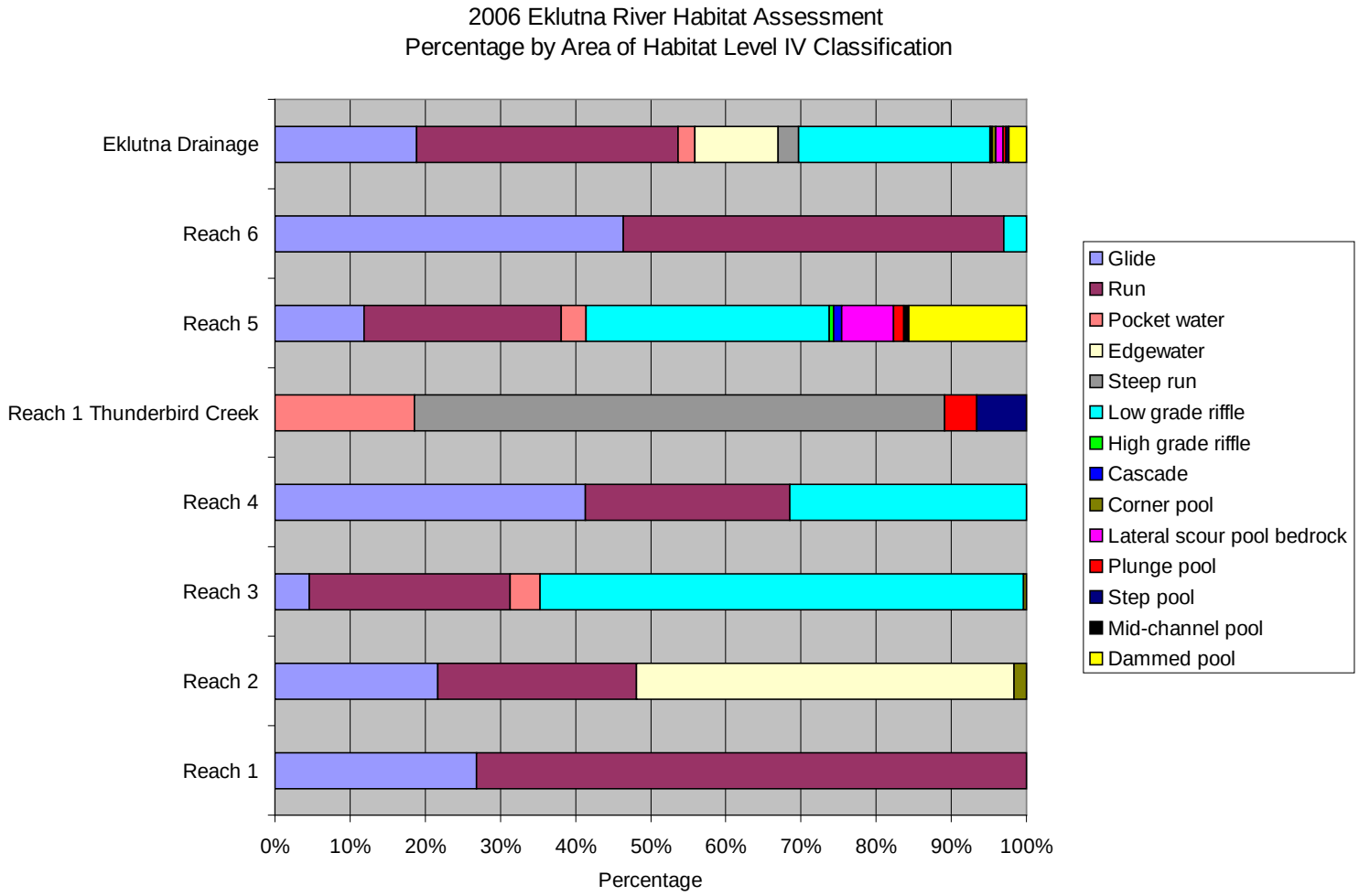

2006 Eklutna River Habitat Assessment
Percentage by Area of Habitat Level IV Classification
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage
Glide
Run
Pocket water
Edgewater
Steep run
Low grade riffle
High grade riffle
Cascade
Corner pool
Lateral scour pool bedrock
Plunge pool
Step pool
Mid-channel pool
Dammed pool

Chart 6

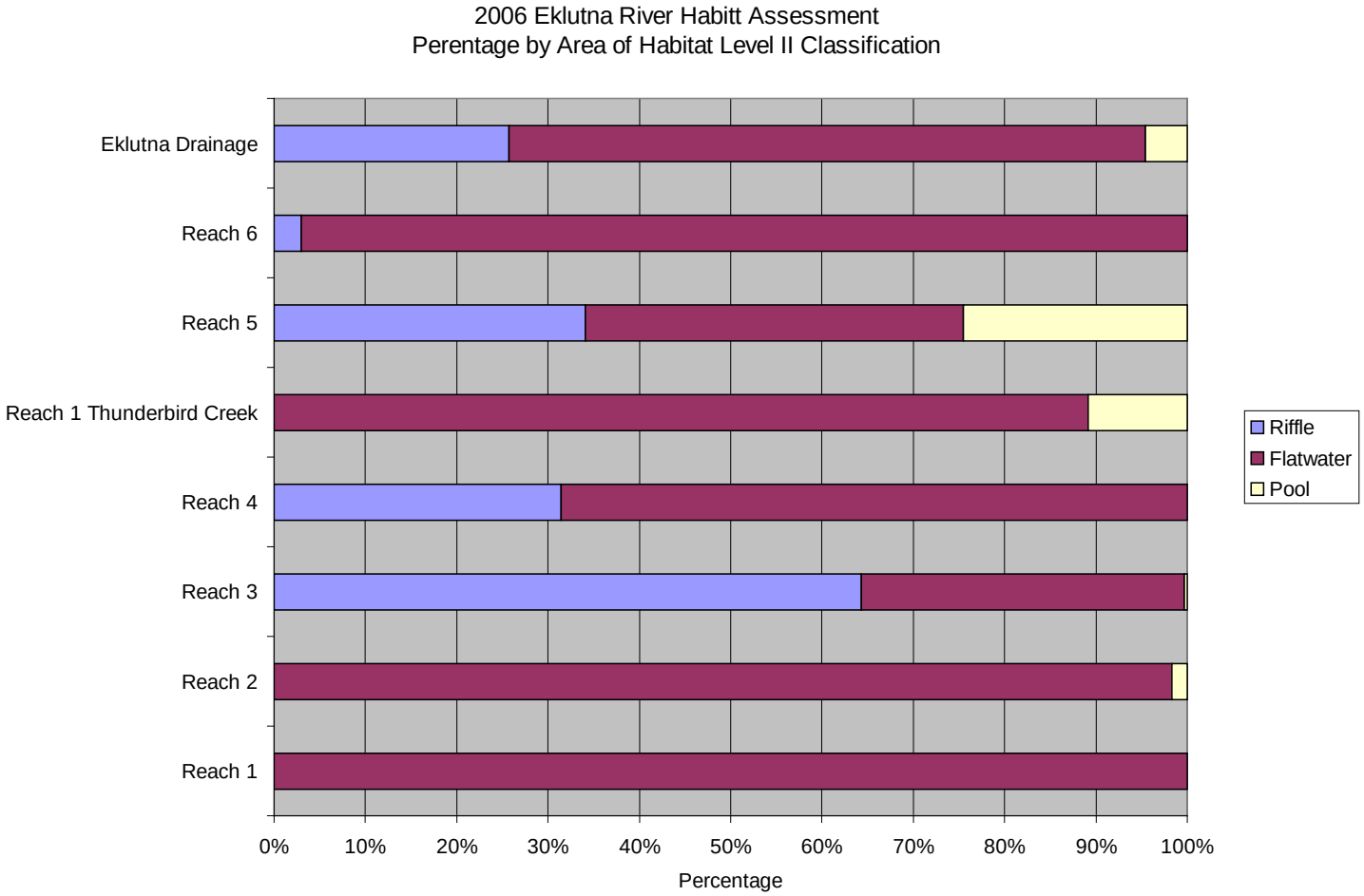

2006 Eklutna River Habitt Assessment
Perentage by Area of Habitat Level II Classification
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage
Riffle
Flatwater
Pool

Chart 7

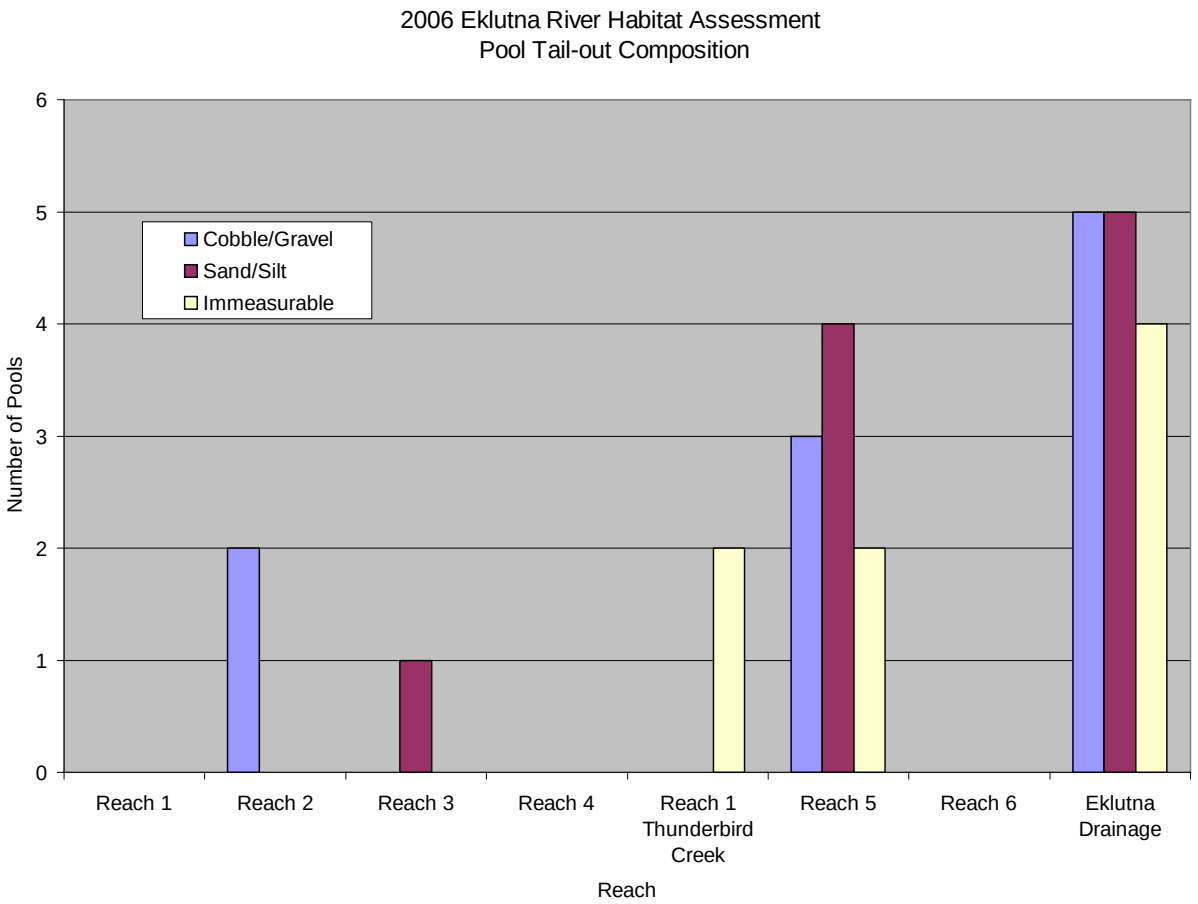

2006 Eklutna River Habitat Assessment
Pool Tail-out Composition
Number of Pools
0
1
2
3
4
5
6
Cobble/Gravel
Sand/Silt
Immeasurable
Reach 1
Reach 2
Reach 3
Reach 4
Reach 1 Thunderbird Creek
Reach 5
Reach 6
Eklutna Drainage
Reach

Chart 8

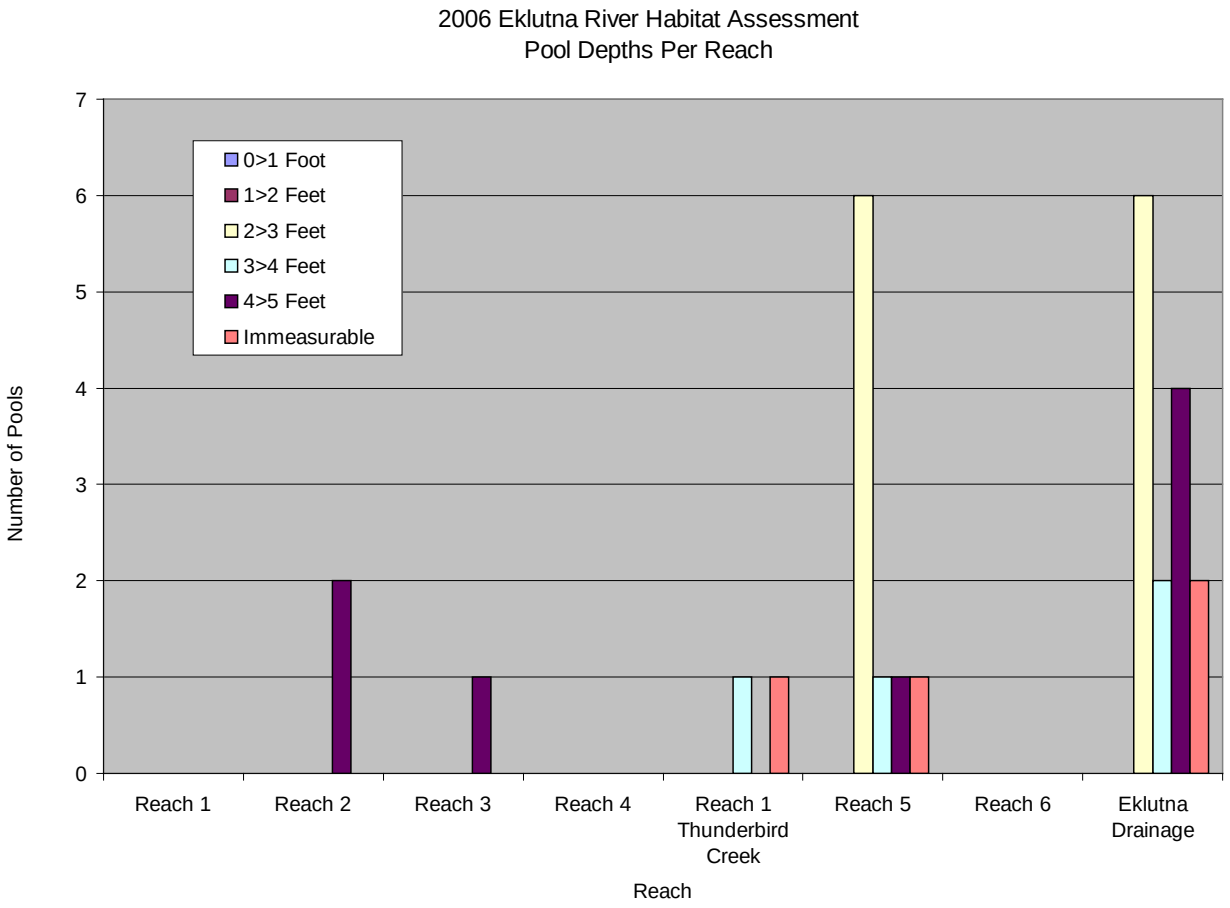

2006 Eklutna River Habitat Assessment
Pool Depths Per Reach
Number of Pools
0
1
2
3
4
5
6
7
0>1 Foot
1>2 Feet
2>3 Feet
3>4 Feet
4>5 Feet
Immeasurable
Reach 1
Reach 2
Reach 3
Reach 4
Reach 1 Thunderbird Creek
Reach 5
Reach 6
Eklutna Drainage
Reach

Chart 9

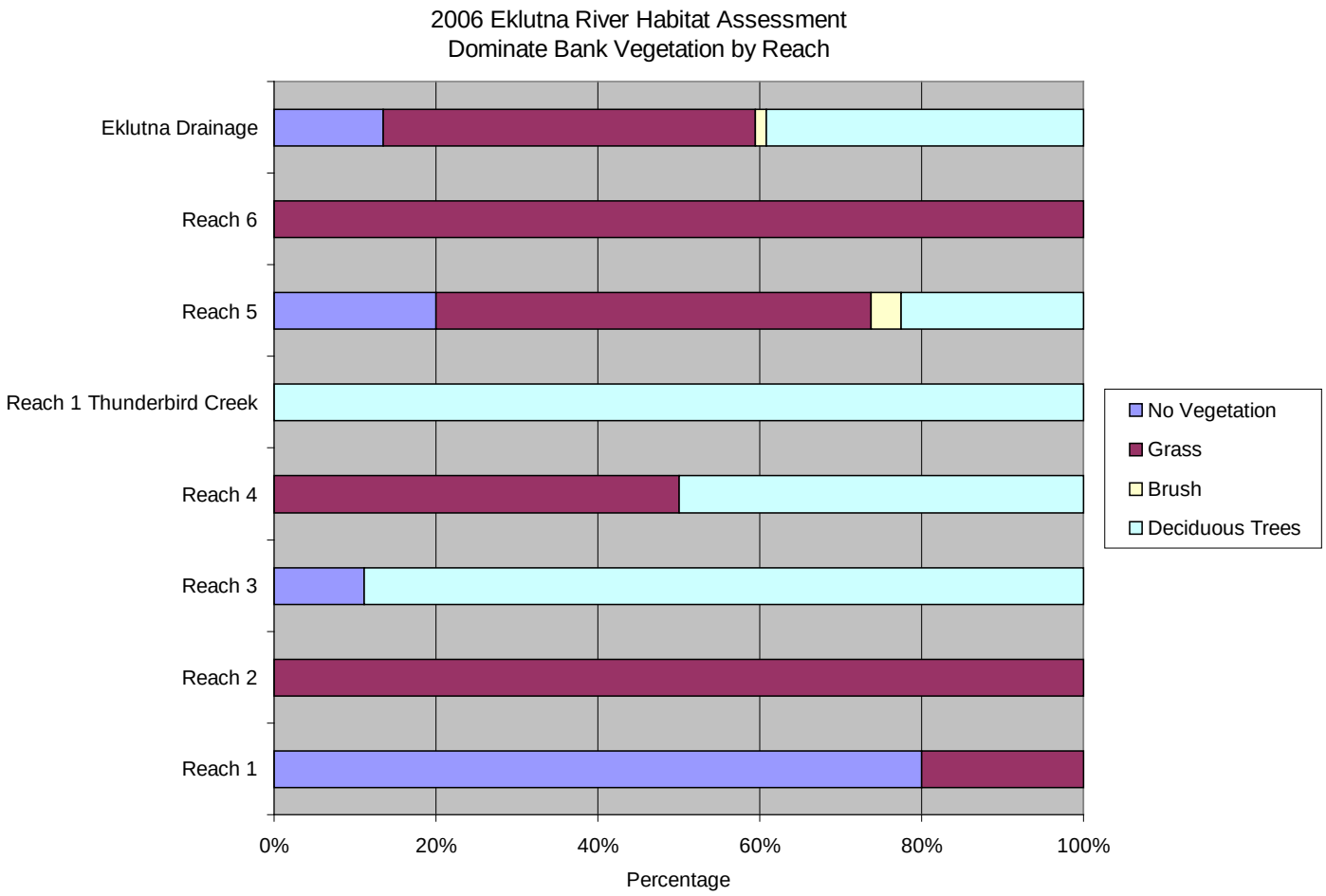
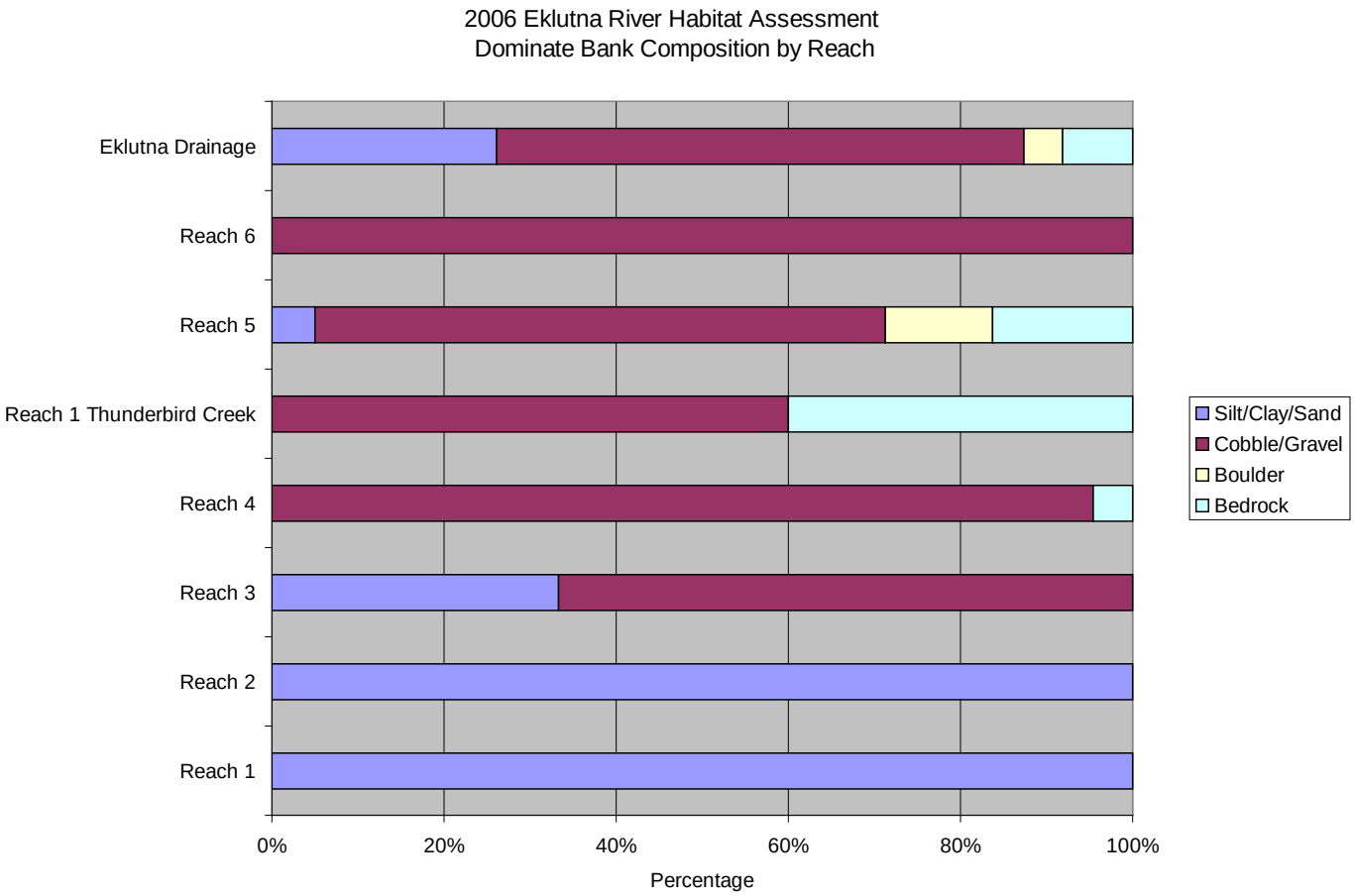

2006 Eklutna River Habitat Assessment
Dominate Bank Vegetation by Reach
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
No Vegetation
Grass
Brush
Deciduous Trees

Chart 10


2006 Eklutna River Habitat Assessment
Dominate Bank Composition by Reach
Eklutna Drainage
Reach 6
Reach 5
Reach 1 Thunderbird Creek
Reach 4
Reach 3
Reach 2
Reach 1
0%
20%
40%
60%
80%
100%
Percentage
Silt/Clay/Sand
Cobble/Gravel
Boulder
Bedrock

Attachment C

C4. Summary of NVE Fish Counts

Summary of NVE Fish Counts

From data collected by the Native Village of Eklutna for the years 2002 and 2003, the areas that salmon are currently using for spawning can be hypothesized. Reach 1 did not have any data because the fish counts started at the beginning of Reach 2. In Reach 2, fish are regularly seen in large numbers. Reach 2 is used as a holding area after the salmon have pushed up through the major tidal area of Reach 1 via Cook Inlet. In Reach 3 Chum salmon were the only salmon counted. Their numbers were very low and did not peak during any one time period. Reach 4 saw the largest numbers of king, coho, pink, and sockeye during daily counts in 2003. Reach 4 is mainly a straight stretch of river with little area for holding of fish or rearing. Reach 5 recorded the largest number of any type salmon at one time. In this reach chum salmon have numbered up to 500 at peak times during August.

Attachment D

D1. Photolog

Mouth of Eklutna River Facing Cook Inlet

Reach 1 Unit 1
Glide
REACH 2
UNIT 1

Reach 1 Unit 2
Run

Reach 1 Unit 3
Glide

Reach 1 Unit 4
Run

Reach 1 Unit 4 Side Tributary

Reach 1 Unit 5
Run

Reach 2 Unit 6
Run

Reach 2 Unit 7
Edgewater

Reach 2 Unit 8
Glide

Reach 2 Unit 8 Overflow

Reach 2 Unit 8.1
Glide

Reach 2 Unit 8.2
Glide

Reach 2 Unit 8.2.1
Corner Pool

Reach 2 Unit 8.2.1.1
Run

Reach 2 Unit 8.2.1.2
Edgewater

Reach 2 unit 8.2.2.1
Glide

Reach 3 Unit 9
Low Gradient Riffle

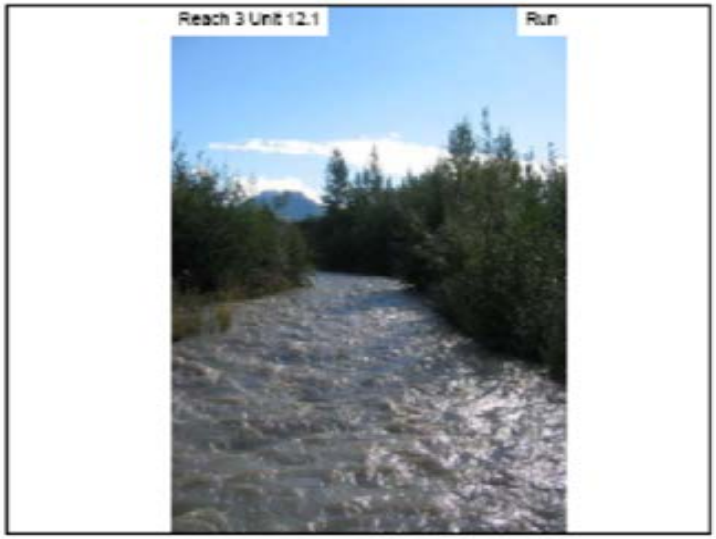
Reach 3 Unit 10
Corner Pool

Reach 3 Unit 11
Run

Reach 3 Unit 11.1
Pocket Water

Reach 3 Unit 11.2
Glide

Reach 3 Unit 12
Run


Reach 3 Unit 12.1
Run

Reach 3 Unit 12.2
Run

Reach 3 Unit 13
Low Gradient Riffle

Reach 3 Unit 13.1
Run

Reach 3 Unit 13.2
Run

Reach 3 Unit 14
Run

Reach 3 Unit 14.1
Low Gradient Riffle

Reach 3 Unit 14.1.1
Low Gradient Riffle

Reach 3 Unit 14.1.2
Run

Reach 3 Unit 14.1.3
Glide

Reach 3 Unit 14.1.4
Low Gradient Riffle

Reach 3 Unit 14.2
Run

Reach 3 Unit 14.2.1
Run

Reach 2 Unit 14.2.2
Low Gradient Riffle

Reach 3 Unit 14.2.2.1
Low Gradient Riffle

Reach 3 Unit 14.2.2.2
Low Gradient Riffle

Reach 3 Unit 14.2.3
Low Gradient Riffle

Reach 3 Unit 15
Low Gradient Riffle

Reach 3 Unit 16
Run

Reach 3 Unit 17
Low Gradient Riffle

Reach 3 Unit 18
Run

Reach 4 Unit 19
Low Gradient Riffle

Reach 2 Unit 20
Run

Reach 4 Unit 21
Low Gradient Riffle

Reach 4 Unit 21 Flow Gauge

Reach 4 Unit 22
Run

Reach 4 Unit 23
Low Gradient Riffle

Reach 4 Unit 24
Glide

Reach 4 Unit 25
Run

Reach 4 Unit 26
Glide

Reach 4 Unit 27
Run

Reach 4 Unit 28
Low Gradient Riffle

Reach 4 Unit 29
Run

Reach 1 Thunderbird Falls Unit 30
Steep Run

Reach 1 Thunderbird Falls Unit 31
Plunge Pool

Reach 1 Thunderbird Fall Unit 32
Steep Run

Reach 1 Thunderbird Falls Unit 33
Pocket Water

Reach 1 Thunderbird Falls Unit 34
Step Pool

Reach 5 Unit 35
Glide

Reach 6 Unit 36
Low Gradient Riffle

Reach 5 Unit 37
Mid Channel Pool

Reach 5 unit 38
Low Gradient Riffle

Reach 5 Unit 39
Glide

Reach 5 Unit 40
Run

Reach 5 Unit 41
Low Gradient Riffle

Reach 5 Unit 42
Run

Reach 5 Unit 42 Depth Gauge

Reach 5 Unit 43
Low Gradient Riffle

Reach 5 Unit 44
Glide

Reach 5 Unit 45
Low Gradient Riffle

Reach 5 Unit 46
Run

Reach 5 Unit 47
Low Gradient Riffle

Reach 5 Unit 48
Lateral Scour Pool Bedrock

Reach 5 Unit 49
Run

Reach 5 Unit 50
Low Gradient Riffle

Reach 5 Unit 51
Lateral Scour Pool Bedrock

Reach 5 Unit 52
Low Gradient Riffle

Reach 5 Unit 53 Lateral Scour Pool Bedrock

Reach 5 Unit 54 Low Gradient Riffle

Reach 5 Unit 55 Glide

Reach 5 Unit 56 Low Gradient Riffle

Reach 5 Unit 57
Lateral Scour Pool Bedrock

Reach 5 Unit 59
Low Gradient Riffle

Reach 5 Unit 59
Lateral Scour Pool Bedrock

Reach 5 Unit 60
Low Gradient Riffle

Reach 5 Unit 61
Lateral Scour Pool Bedrock

Reach 5 Unit 62
Pocket Water

Reach 5 Unit 63
Glide

Reach 5 Unit 64
Run

Reach 5 Unit 65
Low Gradient Riffle

Reach 5 Unit 66
Run

Reach 5 Unit 67
Glide

Reach 5 Unit 68
Pocket Water

Reach 6 Unit 69
Cascade

Reach 6 Unit 70
Run

Reach 6 Unit 71
High Gradient Riffle

Reach 6 Unit 72
Dammed Pool

Reach 5 Unit 73
Low Gradient Riffle

Reach 5 Unit 74
Plunge Pool

Reach 6 Unit 75
Run

Reach 6 Unit 76
Glide

Reach 6 Unit 77
Run

Reach 6 Unit 78
Glide

Reach 6 Unit 79
Run

Reach 6 Unit 80
Glide

Reach 6 Unit 81
Run

Reach 6 Unit 82
Glide

Reach 6 Unit 83
Low Gradient Riffle

Reach 6 Unit 84 End Of Survey
Glide

Attachment D

D2. Stream Channel Delineation Forms

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 1 of 7

Channel Type F6 Channel Change Location (Habitat Unit#) 5 to 6

Cross-Section Location (Habitat Unit#) 4 Date 8/21/06

Stream Eklutna River

T ___ R ___ S ___ Surveyors WRP ED

Quad ___ Lat N61 27 318 Long W149 24 678

Single Thread Channel Y (Y/N) Multiple Channel N (Y/N)

Bankfull Width (W_{bkf}) = 68 (ft.)

Transect Recording Box

Dist.	1	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66
Depth	.5	1.1	2.8	3.8	4.8	5	5.4	5.2	5.2	5.2	5.3	5.3	5.3	5	4.9	4.9	5.2	5.3	5.1	4.6	3.9	2.5	1.6
Sub.	6	6	6	6	6	6	3	3	3	3	3	3	3	3	3	3	6	6	6	6	6	6	6

Sum of Depths 97.9

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= ___ (Circle Most
3.	Cobble (2.5 - 10")	= 10 Frequent
4.	Gravel (0.08 - 2.5")	= ___ Occurrence)
5.	Sand (<0.08)	= ___
6.	Silt / Clay	= 13

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 6.8 x 2 = 13.6 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 86 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment

W_{FP} 86 (ft.) / 68 (ft.) = 1.26 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 97.9 / No. Depths 23 = Mean Bankfull Depth (d_{bkf}) 4.25

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio

W_{bkf} 68 (ft.) / d_{bkf} 4.25 (ft.) = 16 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

Stream Length ___ / Valley Length ___ = Sinuosity ___

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient

DSL ___ (ft.) - USL ___ (ft.) / (D) ___ (ft.) = ___

Didn't do b/c of tidal flow

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 2 of 7

Channel Type DA6 Channel Change Location (Habitat Unit#) 8 to 9

Cross-Section Location (Habitat Unit#) 8.2 Date 8/22/06

Stream Eklutna River

T___ R___ S___ Surveyors WRP ED

Quad ___ Lat ___ Long ___

Single Thread Channel N (Y/N) Multiple Channel Y (Y/N)

Bankfull Width (W_{bkf}) = 28 (ft.)

Transect Recording Box

Dist.	5	6.3	7.5	9	10.3	11.5	13	14.3	15.5	17	18.3	19.5	21	22.5	23.5	25	26.5	28	29.5	31	32.5	33
Depth	1	1.4	1.6	1.5	1.4	1.3	1.2	1.2	1	1	1	1	1	1	1	1.1	1.2	1.1	1	1.1	.9	.9
Sub.	4	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

Sum of Depths ___

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= ___ (Circle Most
3.	Cobble (2.5 - 10")	= ___ Frequent
4.	Gravel (0.08 - 2.5")	= 3 Occurrence)
5.	Sand (<0.08)	= ___
6.	Silt / Clay	= 19

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 1.6 x 2 = 3.2 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 34 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 34 (ft.) / 28 (ft.) = 1.21 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 24.8 / No. Depths 22 = Mean Bankfull Depth (d_{bkf}) 1.127

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 28 (ft.) / d_{bkf} 1.127 (ft.) = 24.84 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

~~Stream Length~~ ___ / ~~Valley Length~~ ___ = ~~Sinuosity~~ ___

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL ___ (ft.) - USL ___ (ft.) / (D) ___ (ft.) = <1%

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 3 of 7

Channel Type D3 Channel Change Location (Habitat Unit#) 18 to 19

Cross-Section Location (Habitat Unit#) 14 Date 8/23/06

Stream Eklutna River

T ___ R ___ S ___ Surveyors WRP ED

Quad ___ Lat 061 27 169 Long 149 23 099

Single Thread Channel N (Y/N) Multiple Channel 4 (Y/N)

Bankfull Width (W_{bkf}) = 40 (ft.)

Transect Recording Box

Dist.	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Depth	0	.2	.3	.5	.5	.7	1	.8	.8	1.1	1.2	1.3	1.3	1.5	1.5	1.8	1.8	1.9	1.6	.5	0
Sub.	3	3	3	3	3	3	5	3	3	3	4	4	4	4	4	3	3	3	3	3	3

Sum of Depths 20.8

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= ___ (Circle Most
3.	Cobble (2.5 - 10")	= 15 Frequent
4.	Gravel (0.08 - 2.5")	= 5 Occurrence)
5.	Sand (<0.08)	= 1
6.	Silt / Clay	= ___

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 1.9 x 2 = 3.8 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 69 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 69 (ft.) / 40 (ft.) = 1.7 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 20.8 / No. Depths 21 = Mean Bankfull Depth (d_{bkf}) .99

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 40 (ft.) / d_{bkf} .99 (ft.) = 40.4 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

~~Stream Length~~ ___ / ~~Valley Length~~ ___ = ~~Sinuosity~~ ___

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL 4.1 (ft.) - USL 5.6 (ft.) / (D) 270 (ft.) = 0.5 %

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 4 of 7

Channel Type C3 Channel Change Location (Habitat Unit#) 29 to 30

Cross-Section Location (Habitat Unit#) 21 Date 8 / 24 / 07

Stream Eklutna River

T ___ R ___ S ___ Surveyors WRP ED

Quad ___ Lat ___ Long ___

Single Thread Channel 4 (Y/N) Multiple Channel N (Y/N)

Bankfull Width (W_{bkf}) = 36 (ft.)

Transect Recording Box

Dist.	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	56	
Depth	.2	.6	.9	1.5	1.7	1.4	1.6	1.7	1.4	1.3	1.5	1.6	1.6	1.7	1.2	1.3	1	.9	.2	
Sub.	3	3	3	3	3	3	4	3	3	3	2	3	2	3	3	3	4	4	3	

Sum of Depths 23.3

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= 2 (Circle Most
3.	Cobble (2.5 - 10")	= 14 Frequent
4.	Gravel (0.08 - 2.5")	= 3 Occurrence)
5.	Sand (<0.08)	= ___
6.	Silt / Clay	= ___

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 1.7 x 2 = 3.4 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 206 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 206 (ft.) / 36 (ft.) = 5.7 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 23.3 / No. Depths 19 = Mean Bankfull Depth (d_{bkf}) 1.23

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 36 (ft.) / d_{bkf} 1.23 (ft.) = 29.3 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

Stream Length ___ / Valley Length ___ = Sinuosity ___

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL ___ (ft.) - USL ___ (ft.) / (D) ___ (ft.) = <1%

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 5 of 7

Channel Type B3 Channel Change Location (Habitat Unit#) _____

Cross-Section Location (Habitat Unit#) 30 Date 8 / 24 / 06

Stream Thunderbird Creek

T ___ R ___ S ___ Surveyors WRP ED

Quad _____ Lat ___ ___ ___ Long ___ ___ ___

Single Thread Channel Y (Y/N) Multiple Channel N (Y/N)

Bankfull Width (W_{bkf}) = 21 (ft.)

Transect Recording Box

Dist.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
Depth	.1	1.2	1.6	1.5	1.8	1.9	1.7	2.1	2	2.1	1.9	1.8	1.3	1.7	1.6	1.6	1.4	1.3	1	.2
Sub.	3	3	3	3	4	3	3	3	3	3	4	3	2	3	4	4	3	2	3	3

Sum of Depths 29.8

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= 2 (Circle Most
3.	Cobble (2.5 - 10")	= 14 Frequent
4.	Gravel (0.08 - 2.5")	= 4 Occurrence)
5.	Sand (<0.08)	= ___
6.	Silt / Clay	= ___

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 2.1 x 2 = 4.2 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 32 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 32 (ft.) / 21 (ft.) = 1.52 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 29.8 / No. Depths 20 = Mean Bankfull Depth (d_{bkf}) 1.49

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 21 (ft.) / d_{bkf} 1.49 (ft.) = 14 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

Stream Length _____ / Valley Length _____ = Sinuosity _____

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient

DSL _____ (ft.) - USL _____ (ft.) / (D) _____ (ft.) = _____

Could not be instream to take measurements bk. of fl.

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 6 of 7

Channel Type F6 Channel Change Location (Habitat Unit#) 74 to 75

Cross-Section Location (Habitat Unit#) 42 Date 8 / 24 / 06

Stream Eklutna River

T ___ R ___ S ___ Surveyors WRP ED

Quad ___ Lat ___ Long ___

Single Thread Channel Y (Y/N) Multiple Channel N (Y/N)

Bankfull Width (W_{bkf}) = 28 (ft.)

Transect Recording Box

Dist.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Depth	0	0	.3	.3	.6	.7	.8	.8	.8	.8	.8	.8	.7	.7	.6	.3	.9	.8	.9	.9	.8	.7	.9
Sub.	3	3	6	6	6	6	6	3	6	6	6	6	6	6	3	2	6	3	6	6	6	6	3

23	24	25	26	27	28
.9	.9	.4	.3	.1	0
3	3	6	6	6	6

Sum of Depths 17.4

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= ___
2.	Boulder (>10")	= 1 (Circle Most
3.	Cobble (2.5 - 10")	= 8 Frequent
4.	Gravel (0.08 - 2.5")	= ___ Occurrence)
5.	Sand (<0.08)	= ___
6.	Silt / Clay	= 20

Entrenchment Determination:

Step 1: Maximum Bankfull Depth .9 x 2 = 1.8 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 37 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 37 (ft.) / 28 (ft.) = 1.3 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 17.4 / No. Depths 29 = Mean Bankfull Depth (d_{bkf}) .6

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 28 (ft.) / d_{bkf} .6 (ft.) = 46.6 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

Stream Length ___ / Valley Length ___ = Sinuosity ___

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL ___ (ft.) - USL ___ (ft.) / (D) ___ (ft.) = 1%

STREAM CHANNEL TYPE WORK SHEET

Form 2

Form # 7 of 7

Channel Type E5 Channel Change Location (Habitat Unit#) _____

Cross-Section Location (Habitat Unit#) 78 Date 8/24/06

Stream Eklutna River

T ____ R ____ S ____ Surveyors WRP ED

Quad _____ Lat ___ ___ ___ Long ___ ___ ___

Single Thread Channel Y (Y/N) Multiple Channel N (Y/N)

Bankfull Width (W_{bkf}) = 9 (ft.)

Transect Recording Box

Dist.	0	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	
Depth	.2	.4	.4	.8	.8	.9	1	1	1	1.1	1.1	.9	.8	1	1.1	.9	.8	.7	.2	
Sub.	5	5	5	4	5	5	4	4	5	5	4	5	4	5	5	4	5	5	5	

Sum of Depths 15.1

Dominant Substrate Determination:

	Substrate:	Number
1.	Bedrock	= _____
2.	Boulder (>10")	= _____ (Circle Most
3.	Cobble (2.5 - 10")	= _____ Frequent
4.	Gravel (0.08 - 2.5")	= 6 Occurrence)
5.	Sand (<0.08)	= 13
6.	Silt / Clay	= _____

Entrenchment Determination:

Step 1: Maximum Bankfull Depth 1.1 x 2 = 2.2 (W_{FP} Elev.)

Step 2: Determine Flood-Prone Width at W_{FP} Elevation = 35 (W_{FP})

Step 3: Flood-Prone Width (W_{FP}) / Bankfull Width (W_{bkf}) = Entrenchment
W_{FP} 35 (ft.) / 9 (ft.) = 3.9 (Entrenchment)

Width/Depth Determination:

Step 1: Sum of Depths 15.1 / No. Depths 19 = Mean Bankfull Depth (d_{bkf}) .79

Step 2: Bankfull Width (W_{bkf}) / Mean Bankfull Depth (d_{bkf}) = Width/Depth Ratio
W_{bkf} 9 (ft.) / d_{bkf} .79 (ft.) = 11.4 (W/D Ratio)

Sinuosity Determination (Only For A or G Types):

~~Stream Length~~ _____ / Valley Length _____ = Sinuosity _____

Water surface slope Determination:

Downstream Level - Upstream Level / Distance (D) = Energy Gradient
DSL _____ (ft.) - USL _____ (ft.) / (D) ____ (ft.) = <1%

Attachment D

D3. Habitat Inventory Forms

Form 1

HABITAT INVENTORY DATA FORM

Date 8/21/06 Stream Name Eklutna River Form # 1 of 14
Surveyors LDRP ED T R S
Quad. Lat. Lon.
Time 900 Water Temp 7.0 Air Temp 19 Channel Type E/c Reach # 1 Flow
Page Length 3720 Total Length 3720
****

Habitat Unit Number	1	2	3	4	5					
Habitat Unit Type	glide	run	glide	run	run					
Side Channel Type										
Mean Length	590	290	450	1280	1110					
Mean Width	47	47	47	58	50					
Mean Depth	1.7	2	2	1.8	1.3					
Maximum Depth	2	2.7	3	3	1.8					
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	0	0	0	0	0					
%Unit Covered	0	0	0	0	0					
% undercut bank										
% swd (d<12")										
% lwd (d>12")										
% root mass										
% terr. vegetation										
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	95	35	45	50	20					
B) Sand (<0.08")										
C) Gravel (0.08-2.5")	5	60	50	50	50					
D) Sm. Cobble (2.5-5")		5	5							
E) Lg. Cobble (5-10")										
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate										
PERCENT TOTAL CANOPY	0	0	0	0	0					
% Broadleaf Trees										
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	4	4	4	4					
Rt. Bank Dominant Veg.	9	9	9	9	5					
% Rt. Bank Vegetated	0	0	0	0	50					
Lt. Bank Composition	4	4	4	4	4					
Lt. Bank Dominant Veg	9	9	9	9	5					
% Lt. Bank Vegetated	0	0	0	0	50					

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/22/06 Stream Name Eklutna River Form # 2 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time 800 Water Temp 7 Air Temp 19 Channel Type Pale Reach # 2 Flow
Page Length 2978 Total Length 6698
****

Habitat Unit Number	6	7	8	8.1	8.2	8.2.1	8.2.1.1	8.2.1.2	8.2.1.3	8.2.1.4
Habitat Unit Type	run	edge	glide	glide	glide	cr Pool	run	edge	c pool	run
Side Channel Type										
Mean Length	245	870	150	1000	545	120	80	60	120	186
Mean Width	200	120	65	15	30	15	20	40	15	30
Mean Depth	2	2	2	1	1.4	3	2.0	0.7	2.5	1.6
Maximum Depth	3.1	3	2.4	1.2	1.7	4	2.5	1	4.5	2
Depth Pool Tail Crest						25			2	
Pool Tail Embeddedness						50			50	
Pool Tail Substrate						gravel			gravel	
SHELTER RATING										
Shelter Value	0	8	8	8	8	1	8	8	8	0
%Unit Covered	0	8	8	8	8	5	8	8	8	0
% undercut bank										
% swd (d<12")										
% lwd (d>12")										
% root mass										
% terr. vegetation										
% aqua. vegetation						100				
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	80	80	80	90	90		20	100		
B) Sand (<0.08")	20	20	20	10	10	60	80			
C) Gravel (0.08-2.5")						40			100	80
D) Sm. Cobble (2.5-5")										20
E) Lg. Cobble (5-10")										
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	0	0	0	0	0	0	0	0
PERCENT TOTAL CANOPY	0	0	0	0	0	0	0	0	0	20
% Broadleaf Trees										100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	4	4	4	4	4	4	4	4	4
Rt. Bank Dominant Veg.	5	5	5	5	5	5	5	5	5	5
% Rt. Bank Vegetated	80	100	100	100	100	100	100	100	100	100
Lt. Bank Composition	4	4	4	4	4	4	4	4	4	4
Lt. Bank Dominant Veg	5	5	5	5	5	5	5	5	5	5
% Lt. Bank Vegetated	80	100	100	100	100	100	100	100	100	100

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/22/06 Stream Name Eklutna River Form # 3 of 14

Surveyors WRP ED T R S

Quad. Lat. Lon.

Time Water Temp 7 Air Temp 19 Channel Type DNC Reach # 2 Flow

Page Length 518 Total Length 7216

****

Habitat Unit Number	8.2.2	8.2.1	8.2.2							
Habitat Unit Type	glide	glide	glide							
Side Channel Type										
Mean Length	270	108	140							
Mean Width	30	15	10							
Mean Depth	1	0.9	0.9							
Maximum Depth	1.5	1.4	1.4							
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	0	0	0							
%Unit Covered	0	0	0							
% undercut bank										
% swd (d<12")										
% lwd (d>12")										
% root mass										
% terr. vegetation										
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	40	40	40							
B) Sand (<0.08")	60	60	60							
C) Gravel (0.08-2.5")										
D) Sm. Cobble (2.5-5")										
E) Lg. Cobble (5-10")										
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	0							
PERCENT TOTAL CANOPY	0	0	0							
% Broadleaf Trees										
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	4	4							
Rt. Bank Dominant Veg.	5	5	5							
% Rt. Bank Vegetated	100	100	100							
Lt. Bank Composition	4	4	4							
Lt. Bank Dominant Veg	5	5	5							
% Lt. Bank Vegetated	100	100	100							

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/22/06 Stream Name Eklutna River Form # 4 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time Water Temp 7 Air Temp 18 Channel Type D3 Reach # 3 Flow
Page Length 985 Total Length 9201

Habitat Unit Number	9	10	11	11.1	11.2	12	12.1	12.2	13	13.1
Habitat Unit Type	lgr	cpool	run	pocket	glide	run	run	run	lgr	run
Side Channel Type										
Mean Length	180	60	140	400	400	140	80	100	400	85
Mean Width	25	15	15	25	5	50	15	20	60	15
Mean Depth	1.3	2.6	1.3	2	0.4	1.5	0.7	0.5	0.8	1.3
Maximum Depth	2	4	1.7	5	0.7	2	1	1	2	2
Depth Pool Tail Crest		2								
Pool Tail Embeddedness		75								
Pool Tail Substrate		silt								
SHELTER RATING										
Shelter Value	1	1	8	3	0	0	0	1	3	3
%Unit Covered	5	10	8	5	0	0	8	5	5	15
% undercut bank										
% swd (d<12")				80				100	100	30
% lwd (d>12")				20						70
% root mass										
% terr. vegetation	100	100								
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay										
B) Sand (<0.08")										
C) Gravel (0.08-2.5")	70	70	70	50	70	70	70	70	70	60
D) Sm. Cobble (2.5-5")	30	30	30	50	30	30	30	30	30	30
E) Lg. Cobble (5-10")										10
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	0	0	0	0	0	0	0	0
PERCENT TOTAL CANOPY	15	60	20	20	60	15	15	15	15	45
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	4	4	4	3	3	3	3	3	3
Rt. Bank Dominant Veg.	5	5	7	7	7	7	7	7	7	7
% Rt. Bank Vegetated	100	100	100	100	100	100	100	100	100	100
Lt. Bank Composition	4	4	4	4	3	3	3	3	3	3
Lt. Bank Dominant Veg	5	7	7	7	7	7	7	7	7	7
% Lt. Bank Vegetated	100	100	100	100	100	100	100	100	100	100

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/22/00 Stream Name Eklutna River Form # 5 of 14
Surveyors LWRP ED T R S
Quad. Lat. Lon.
Time Water Temp 7 Air Temp 18 Channel Type D3 Reach # 3 Flow
Page Length 3434 Total Length 12635
****

Habitat Unit Number	13.2	14	14.1	14.1.1	14.1.2	14.1.3	14.1.4	14.2	14.2.1	14.2.2
Habitat Unit Type	run	run	lgr	lgr	run	glide	lgr	run	run	lgr
Side Channel Type										
Mean Length	100	500	314	300	340	380	840	450	150	60
Mean Width	15	30	50	20	15	25	15	30	20	40
Mean Depth	1.7	1.5	0.8	0.7	0.7	0.6	1	1.2	1.3	1
Maximum Depth	2.5	2.5	1.5	1	1	1	2	2	1.6	2.5
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	2	1	0	0	0	0	3	0	1	3
%Unit Covered	3	2	0	0	0	0	40	0	5	40
% undercut bank										
% swd (d<12")	100	100					90		70	70
% lwd (d>12")										
% root mass										
% terr. vegetation							10		30	30
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay				5	5	5				60
B) Sand (<0.08")				5	5	5				
C) Gravel (0.08-2.5")	60	10	10				40	5	30	40
D) Sm. Cobble (2.5-5")	30	50	90	90	90	90	60	50	60	
E) Lg. Cobble (5-10")	10	40						45	10	
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	5	0	0	0	0	0	0	0
PERCENT TOTAL CANOPY	25	20	25	25	40	40	95	15	40	95
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	3	3	3	3	3	3	3	4	4
Rt. Bank Dominant Veg.	7	7	7	7	7	7	7	7	7	7
% Rt. Bank Vegetated	100	80	100	100	100	100	100	80	60	90
Lt. Bank Composition	3	3	3	3	3	3	3	3	4	4
Lt. Bank Dominant Veg	7	7	7	7	7	7	7	7	7	7
% Lt. Bank Vegetated	100	80	100	100	100	100	100	80	60	90

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/22/06 Stream Name Eklutna River Form # 6 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time Water Temp 7 Air Temp 18 Channel Type D3 Reach # 3 Flow
Page Length 2735 Total Length 5370
****

Habitat Unit Number	14.22.1	14.222	14.23	15	16	17	18			
Habitat Unit Type	lgr	lgr	lgr	lgr	run	lgr	run			
Side Channel Type										
Mean Length	490	920	8600	275	160	200	230			
Mean Width	20	22	25	150	60	60	25			
Mean Depth	1	1	1.5	1.0.1	1	1.4	1.5			
Maximum Depth	1.6	1.6	2	1.4	2.5	1.6	2.7			
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	3	3	3	2	3	2	2			
%Unit Covered	40	40	40	5	50	5	10			
% undercut bank										
% swd (d<12")	70	70	70	80	4					
% lwd (d>12")					1					
% root mass					4					
% terr. vegetation	30	30	30	20	90	100	100			
% aqua. vegetation					5					
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	60	60	60							
B) Sand (<0.08")				20		5				
C) Gravel (0.08-2.5")	40	40	40	40	50	25	5			
D) Sm. Cobble (2.5-5")				40	50	70	65			
E) Lg. Cobble (5-10")							30			
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	0	15	0	5	5			
PERCENT TOTAL CANOPY	95	95	95	10	10	10	70			
% Broadleaf Trees	100	100	100	100	100	100	100			
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	4	4	3	3	3	3			
Rt. Bank Dominant Veg.	7	7	7	7	5	7	7			
% Rt. Bank Vegetated	90	90	90	100	50	100	80			
Lt. Bank Composition	4	4	4	3	3	3	3			
Lt. Bank Dominant Veg	7	7	7	7	5	7	7			
% Lt. Bank Vegetated	90	90	90	100	50	80	80			

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/23/06 Stream Name Eklutna River Form # 7 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time 800 Water Temp Air Temp Channel Type C3 Reach #4 Flow
Page Length 2505 Total Length 17875
****

Habitat Unit Number	19	20	21	22	23	24	25	26	27	28
Habitat Unit Type	lgr	run	lgr	run	lgr	glide	run	glide	run	lgr
Side Channel Type										
Mean Length	145	130	370	200	200	290	100	650	220	200
Mean Width	20	30	20	45	80	45	45	55	40	45
Mean Depth	2	1.4	1.8	1.4	1	1.2	1.4	0.9	1.7	1.2
Maximum Depth	2.5	1.6	2.5	2.4	1.5	1.6	1.7	1.6	2.2	2.2
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	2	1	2	2	3	2	1	2	2	2
%Unit Covered	10	2	5	3	20	10	5	12	2	5
% undercut bank										
% swd (d<12")			80	100	80		100	80	90	5
% lwd (d>12")					5					
% root mass										
% terr. vegetation	100	100	20			100		20		95
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")					15				10	
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay										
B) Sand (<0.08")										
C) Gravel (0.08-2.5")					10			30		10
D) Sm. Cobble (2.5-5")		20		60	30	40	30	60	30	60
E) Lg. Cobble (5-10")	60	80	60	40	60	60	70	10	60	30
F) Boulder (>10")	40		40						10	
G) Bedrock										
% Exposed Substrate	0	0	0	0	0	0	0	0	0	0
PERCENT TOTAL CANOPY	45	50	20	50	25	40	50	25	30	25
% Broadleaf Trees	100	100	100	100	100	100	90	100	70	100
% Coniferous Trees							10		30	

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	3	3	3	3	3	3	3	3	3
Rt. Bank Dominant Veg.	7	7	7	7	7	5	5	5	5	5
% Rt. Bank Vegetated	50	40	40	50	50	85	30	70	80	90
Lt. Bank Composition	3	3	3	3	3	3	3	3	1	3
Lt. Bank Dominant Veg	7	7	7	7	5	7	5	7	5	5
% Lt. Bank Vegetated	75	40	70	50	70	35	40	50	10	90

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/23/06 Stream Name Eklutna River Form # 8 of 14
Surveyors WRP ED T___R___S___
Quad.___ Lat.___ Lon.___
Time 1000 Water Temp ___ Air Temp ___ Channel Type C3 Reach # 4 Flow___
Page Length 160 Total Length 17995
****

Habitat Unit Number	29										
Habitat Unit Type	RW										
Side Channel Type											
Mean Length	120										
Mean Width	50										
Mean Depth	1.9										
Maximum Depth	2.1										
Depth Pool Tail Crest											
Pool Tail Embeddedness											
Pool Tail Substrate											
SHELTER RATING											
Shelter Value	3										
%Unit Covered	10										
% undercut bank											
% swd (d<12")	35										
% lwd (d>12")	35										
% root mass											
% terr. vegetation	30										
% aqua. vegetation											
% bubble curtain											
% boulders (d>10")											
% bedrock ledges											

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay											
B) Sand (<0.08")											
C) Gravel (0.08-2.5")	10										
D) Sm. Cobble (2.5-5")	30										
E) Lg. Cobble (5-10")	60										
F) Boulder (>10")											
G) Bedrock											
% Exposed Substrate											
PERCENT TOTAL CANOPY											
% Broadleaf Trees											
% Coniferous Trees											

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3										
Rt. Bank Dominant Veg.	5										
% Rt. Bank Vegetated	80										
Lt. Bank Composition	3										
Lt. Bank Dominant Veg	5										
% Lt. Bank Vegetated	50										

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Thunderbird Falls Creek Form # 9 of 14
Surveyors WRP ED T___R___S___
Quad.___ Lat.___ Lon.___
Time 1200 Water Temp ___ Air Temp ___ Channel Type B3 Reach # 1 Flow___
Page Length 1050 Total Length 1080
****

Habitat Unit Number	30	31	32	33	34					
Habitat Unit Type	strun	plung	strun	pocket	st pool					
Side Channel Type										
Mean Length	400	40	415	175	50					
Mean Width	25	40	40	40	50					
Mean Depth	2	2.7	1.9	1.8	um					
Maximum Depth	2.5	3	2.5	2.2	um					
Depth Pool Tail Crest		um			um					
Pool Tail Embeddedness		um			um					
Pool Tail Substrate		um			um					
SHELTER RATING										
Shelter Value	1	1	2	3	0					
%Unit Covered	5	25	10	10	0					
% undercut bank										
% swd (d<12")			35	30						
% lwd (d>12")		100								
% root mass										
% terr. vegetation	100		65							
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")				70						
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay										
B) Sand (<0.08")					5					
C) Gravel (0.08-2.5")	10	10		10	5					
D) Sm. Cobble (2.5-5")	80	80	80		3					
E) Lg. Cobble (5-10")	10	10	10	60	8					
F) Boulder (>10")			10	10	5					
G) Bedrock				20	5					
% Exposed Substrate	0	0	0	10	2					
PERCENT TOTAL CANOPY										
% Broadleaf Trees										
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	3	3	1	1					
Rt. Bank Dominant Veg.	7	7	7	7	7					
% Rt. Bank Vegetated	100	100	20	20	0					
Lt. Bank Composition	3	3	3	1	1					
Lt. Bank Dominant Veg	7	7	7	7	7					
% Lt. Bank Vegetated	20	60	20	0	0					

BANK COMPOSITION TYPE
1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Eklutna River Form # 10 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time Water Temp Air Temp Channel Type EG Reach # 5 Flow
Page Length 1110 Total Length 19105
****

Habitat Unit Number	35	36	37	38	39	40	41	42	43	44
Habitat Unit Type	glide	lgr	mid pool	lgr	glide	run	lgr	run	lgr	run
Side Channel Type										
Mean Length	100	80	40	50	81	86	30	40	120	113
Mean Width	15	25	22	40	40	20	35	23	40	35
Mean Depth	.8	.7	1	.6	.7	.8	.3	.6	.6	.7
Maximum Depth	1.3	1.6	2.7	1.3	1	1.7	.4	1.1	1	1.1
Depth Pool Tail Crest			.7							
Pool Tail Embeddedness			20							
Pool Tail Substrate			(cobble/gravel)							
SHELTER RATING										
Shelter Value	2	2	0	0	3	3	2	2	1	0
%Unit Covered	20	15	0	0	10	25	5	5	5	0
% undercut bank										
% swd (d<12")	25			2	30					
% lwd (d>12")										
% root mass					70	100	100	100		
% terr. vegetation	75	100							100	
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay		15	30			30	5	35		40
B) Sand (<0.08")			10							
C) Gravel (0.08-2.5")					30				5	
D) Sm. Cobble (2.5-5")				20	40	30	80		30	20
E) Lg. Cobble (5-10")	85	65	40	80	30	40	15	50	60	40
F) Boulder (>10")	5	20	20					15	5	
G) Bedrock	10									
% Exposed Substrate	0	10	0	0	0	0	0	0	35	0
PERCENT TOTAL CANOPY	30	30	40	25	30	30	30	30	40	65
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	2	4	3	3	3	3	3	3	4
Rt. Bank Dominant Veg.	7	5	5	5	5	7	5	5	5	5
% Rt. Bank Vegetated	100	100	30	100	100	90	20	100	90	40
Lt. Bank Composition	3	2	3	3	3	3	3	3	3	3
Lt. Bank Dominant Veg	7	5	5	5	5	5	5	5	7	5
% Lt. Bank Vegetated	100	100	50	100	100	80	90	100	100	100

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Eklutna River Form # 11 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time Water Temp Air Temp Channel Type FL Reach # 5 Flow
Page Length 1240 Total Length 20345
****

Habitat Unit Number	45	46	47	48	49	50	51	52	53	54
Habitat Unit Type	lgr	run	lgr	ls pool	c	lgr	ls pool	lgr	ls pool	lgr
Side Channel Type										
Mean Length	25	90	90	90	90	30	85	320	95	325
Mean Width	15	20	25	20	20	20	20	28	22	25
Mean Depth	.5	1	.4	1	.7	.5	1	.6	1.8	.7
Maximum Depth	.7	2	.8	2.4	1.2	.9	2.5	1.2	3.9	1.3
Depth Pool Tail Crest				1			1		1.3	
Pool Tail Embeddedness				75			75		100	
Pool Tail Substrate				cobble/ gravel			cobble/ gravel		silt/ sand	
SHELTER RATING										
Shelter Value	0	0	1	0	0	1	0	0	0	0
%Unit Covered			5			3				
% undercut bank										
% swd (d<12")						100				
% lwd (d>12")			100							
% root mass										
% terr. vegetation										
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay				60			60	60	60	
B) Sand (<0.08")										
C) Gravel (0.08-2.5")										
D) Sm. Cobble (2.5-5")	10	10	10	20						10
E) Lg. Cobble (5-10")	80	50	80		50	50	20	20	20	60
F) Boulder (>10")	10	10	10		20	20				30
G) Bedrock				20	30	30	20	20	20	
% Exposed Substrate	0	0	0	0	0	0	0	0	0	0
PERCENT TOTAL CANOPY	65	55	50	50	50	60	30	90	45	45
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	4	3	3	1	3	3	3	3	1	3
Rt. Bank Dominant Veg.	5	7	7	9	5	5	5	6	9	7
% Rt. Bank Vegetated	40	40	100	0	60	60	70	80	0	80
Lt. Bank Composition	3	3	3	4	3	3	1	3	3	3
Lt. Bank Dominant Veg	5	5	7	5	5	5	9	6	5	7
% Lt. Bank Vegetated	100	100	100	30	80	60	0	80	80	80

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Eklutna River Form # 12 of 14
Surveyors WRP ED T R S
Quad. Lat. Lon.
Time Water Temp Air Temp Channel Type F4 Reach # 5 Flow
Page Length 992 Total Length 21337
****

Habitat Unit Number	55	56	57	58	59	60	61	62	63	64
Habitat Unit Type	glide	lgr	lspool	lgr	lspool	lgr	lspool	pocket	glide	run
Side Channel Type										
Mean Length	90	65	50	30	60	120	122	25	180	250
Mean Width	20	15	20	30	25	30	15	20	15	50
Mean Depth	.7	.8	1.6	.8	.9	.6	1.8	.8	1.6	1
Maximum Depth	1.3	1.4	2.6	1.2	2	1	4.6	2.2	4	4
Depth Pool Tail Crest			.8		.8		.8			
Pool Tail Embeddedness			75		75		100			
Pool Tail Substrate			silt/sand		silt/sand		silt/sand			
SHELTER RATING										
Shelter Value						1	0	1	0	1
%Unit Covered						5		10		2
% undercut bank										
% swd (d<12")								50		100
% lwd (d>12")										
% root mass										
% terr. vegetation						100				
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")										
% bedrock ledges								50		

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	90		60	20	100	60	100		80	20
B) Sand (<0.08")										
C) Gravel (0.08-2.5")			5						10	
D) Sm. Cobble (2.5-5")									10	
E) Lg. Cobble (5-10")	10	50		40		40				60
F) Boulder (>10")		50	35	40				80		20
G) Bedrock								20		
% Exposed Substrate	0	0	0	0	0	0	0	30	0	0
PERCENT TOTAL CANOPY										
% Broadleaf Trees										
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	3	3	3	3	3	1	2	3	3
Rt. Bank Dominant Veg.	5	7	9	5	5	5	9	5	5	5
% Rt. Bank Vegetated	80	75	90	90	80	60	0	50	70	80
Lt. Bank Composition	3	3	1	1	1	3	3	2	1	3
Lt. Bank Dominant Veg	7	7	9	9	9	7	7	5	9	5
% Lt. Bank Vegetated	70	75	0	15	10	60	70	20	0	80

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Eklutna River Form # 13 of 14

Surveyors WRP ED T___ R___ S___

Quad._____ Lat._____ Lon._____

Time _____ Water Temp _____ Air Temp _____ Channel Type F6 Reach # 5 Flow_____

Page Length 2190 Total Length 2352

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Habitat Unit Number	65	66	67	68	69	70	71	72	73	74
Habitat Unit Type	lgr	run	glide	pocket	cascade	run	hgr	dam pool	lgr	plunge
Side Channel Type										
Mean Length	260	150	160	280	160	400	90	380	250	60
Mean Width	20	20	25	15	10	20	10	60	25	35
Mean Depth	.6	.7	.8	.9	3.5	.8	1.2	.8	1.3	um
Maximum Depth	1	1.2	2	2.4	4	1.2	2.5	2	2.2	um
Depth Pool Tail Crest								um		um
Pool Tail Embeddedness								um		um
Pool Tail Substrate								um		um
SHELTER RATING										
Shelter Value	1	2	1	1	2	1	2	3	3	0
%Unit Covered	5	5	2	5	10	5	5	15	5	0
% undercut bank										
% swd (d<12")		30				25	25		50	
% lwd (d>12")										
% root mass										
% terr. vegetation		70	75			75	25	100		
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")	100		25	100	100		50		50	
% bedrock ledges										
SUBSTRATE COMPOSITION (Select the two most dominant compositions)										
A) Silt/Clay	30	20	50	10		30		100		
B) Sand (<0.08")										
C) Gravel (0.08-2.5")			10							
D) Sm. Cobble (2.5-5")										
E) Lg. Cobble (5-10")	70	70		50						
F) Boulder (>10")		10		40	100	70				
G) Bedrock			40				100			
% Exposed Substrate	5	0	2	10	50	0	5	0	20	0
PERCENT TOTAL CANOPY	15	20	15	20	0	20	15	15	10	5
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										
BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below										
Rt. Bank Composition	1	3	2	3	2	3	2	2	1	1
Rt. Bank Dominant Veg.	9	5	5	5	9	5	9	7	9	9
% Rt. Bank Vegetated	10	100	70	100	0	60	0	20	5	0
Lt. Bank Composition	3	3	1	3	2	3	2	2	3	1
Lt. Bank Dominant Veg	5	5	9	5	9	6	7	7	5	9
% Lt. Bank Vegetated	70	100	5	100	0	75	15	20	60	0

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

VEGETATION TYPES

5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

**********COMMENTS**********

Form 1

HABITAT INVENTORY DATA FORM

Date 8/24/06 Stream Name Eklutna River Form # 14 of 14

Surveyors WRP ED T R S

Quad. Lat. Lon.

Time 345 Water Temp Air Temp Channel Type E5 Reach # 9 Flow

********** Page Length 1782 Total Length 25309

Habitat Unit Number	75	76	77	78	79	80	81	82	83	84
Habitat Unit Type	run	glide	run	glide	run	glide	run	glide	gr	glide
Side Channel Type										
Mean Length	300	817	540	80	80	80	40	200	50	200
Mean Width	10	10	10	15	15	15	15	15	12	9
Mean Depth	.7	.8	.6	1	1	.9	.8	1	1	1
Maximum Depth	1.4	1.2	2.2	1.3	1.2	1	1.2	1.5	1.3	1.1
Depth Pool Tail Crest										
Pool Tail Embeddedness										
Pool Tail Substrate										
SHELTER RATING										
Shelter Value	1	0	1	2	1	1	0	1	1	1
%Unit Covered	3	0	3	10	5	5	0	5	5	5
% undercut bank										
% swd (d<12")	100		100	100						
% lwd (d>12")										
% root mass										
% terr. vegetation					90	100		100	25	100
% aqua. vegetation										
% bubble curtain										
% boulders (d>10")					10				75	
% bedrock ledges										

SUBSTRATE COMPOSITION (Select the two most dominant compositions)

A) Silt/Clay	50	100	70	50	20	5	5			
B) Sand (<0.08")				50				85	100	100
C) Gravel (0.08-2.5")	50		30		10	20	15			
D) Sm. Cobble (2.5-5")					60	75	80	15		
E) Lg. Cobble (5-10")										
F) Boulder (>10")										
G) Bedrock										
% Exposed Substrate	0	0	0	5	10 5	5	0	0	10	0
PERCENT TOTAL CANOPY	20	20	20	10	20	20	20	15	10	25
% Broadleaf Trees	100	100	100	100	100	100	100	100	100	100
% Coniferous Trees										

BANK COMPOSITION & VEGETATION (See bank and vegetation composition types below

Rt. Bank Composition	3	3	3	3	3	3	3	3	3	3
Rt. Bank Dominant Veg.	5	5	5	5	5	5	5	5	5	5
% Rt. Bank Vegetated	100	100	100	100	100	100	100	100	100	100
Lt. Bank Composition	3	3	3	3	3	3	3	3	3	3
Lt. Bank Dominant Veg	5	5	5	5	5	5	5	5	5	5
% Lt. Bank Vegetated	100	100	100	100	100	100	100	100	100	100

BANK COMPOSITION TYPE

1) Bedrock
2) Boulder
3) Cobble/Gravel
4) Silt/Clay/Sand

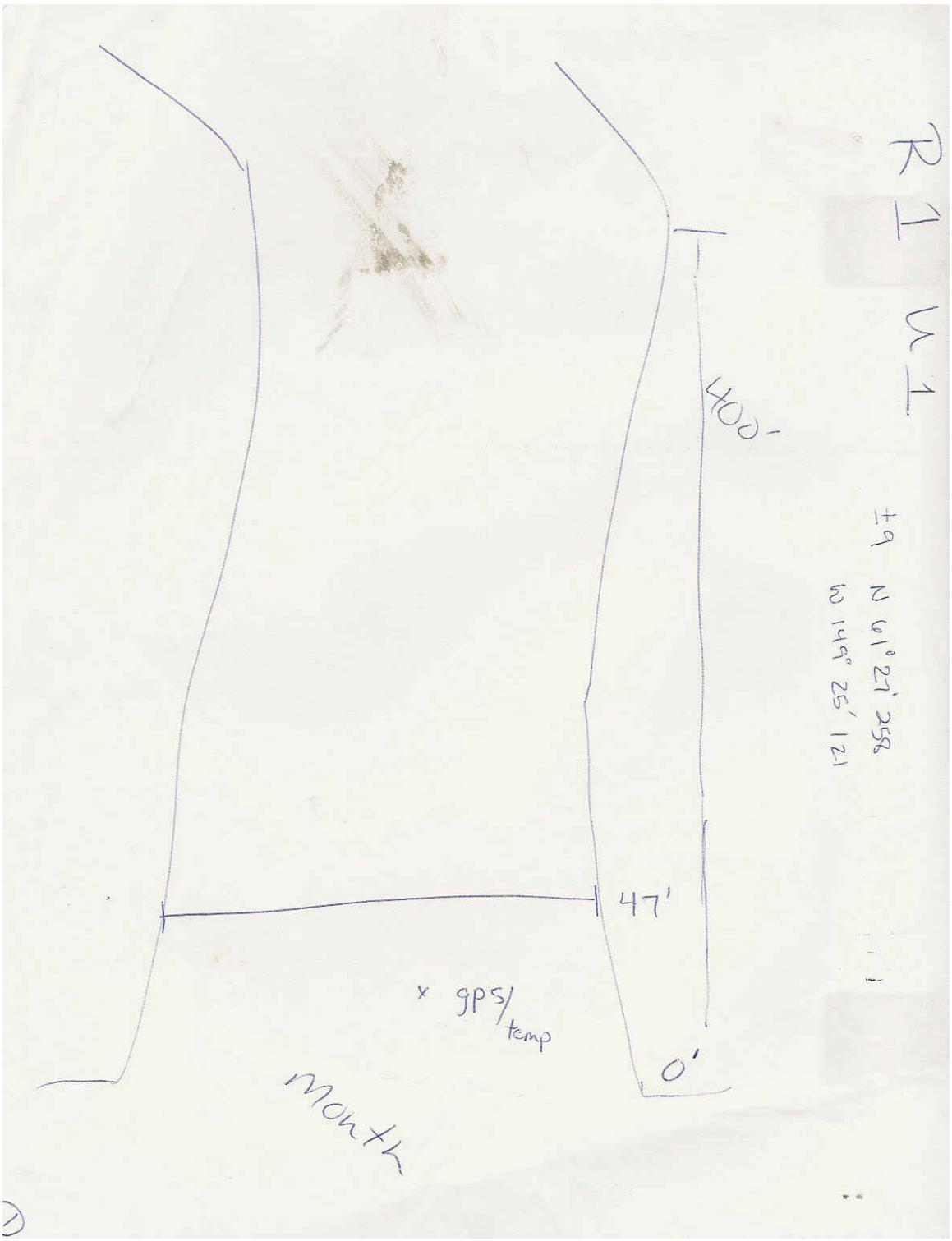
VEGETATION TYPES

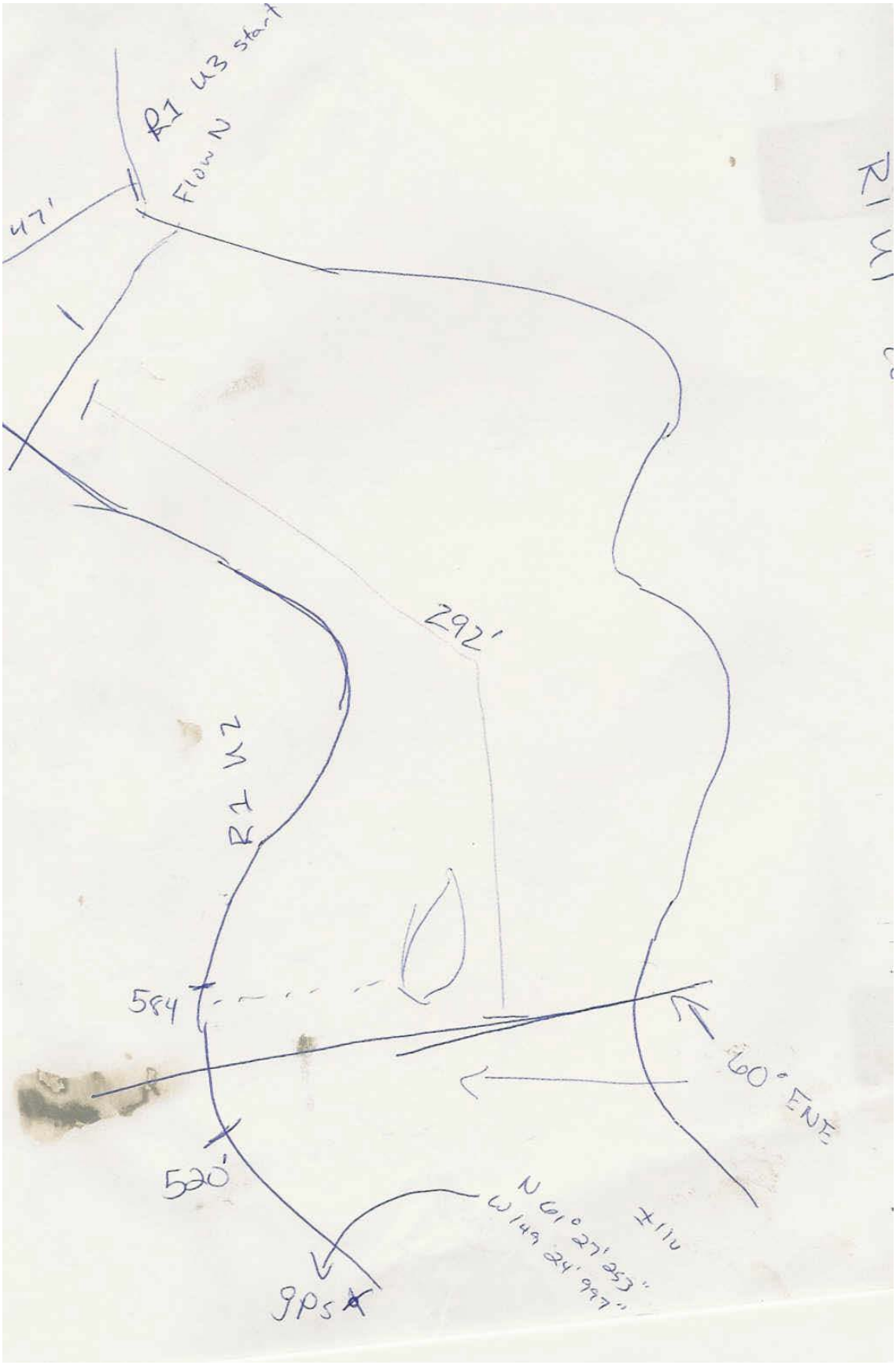
5) Grass
6) Brush
7) Deciduous Trees
8) Coniferous Trees
9) No Vegetation

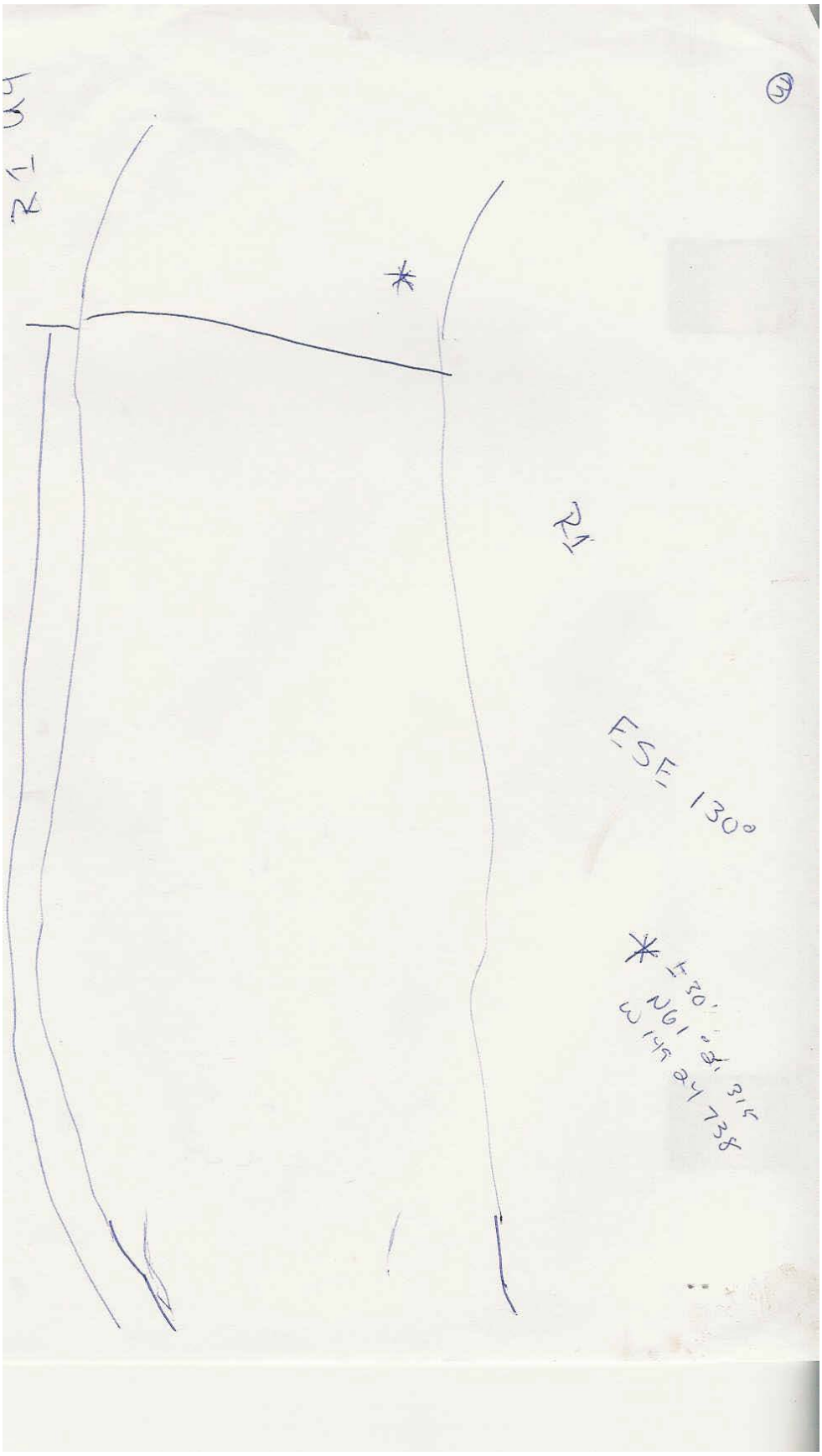
**********COMMENTS**********

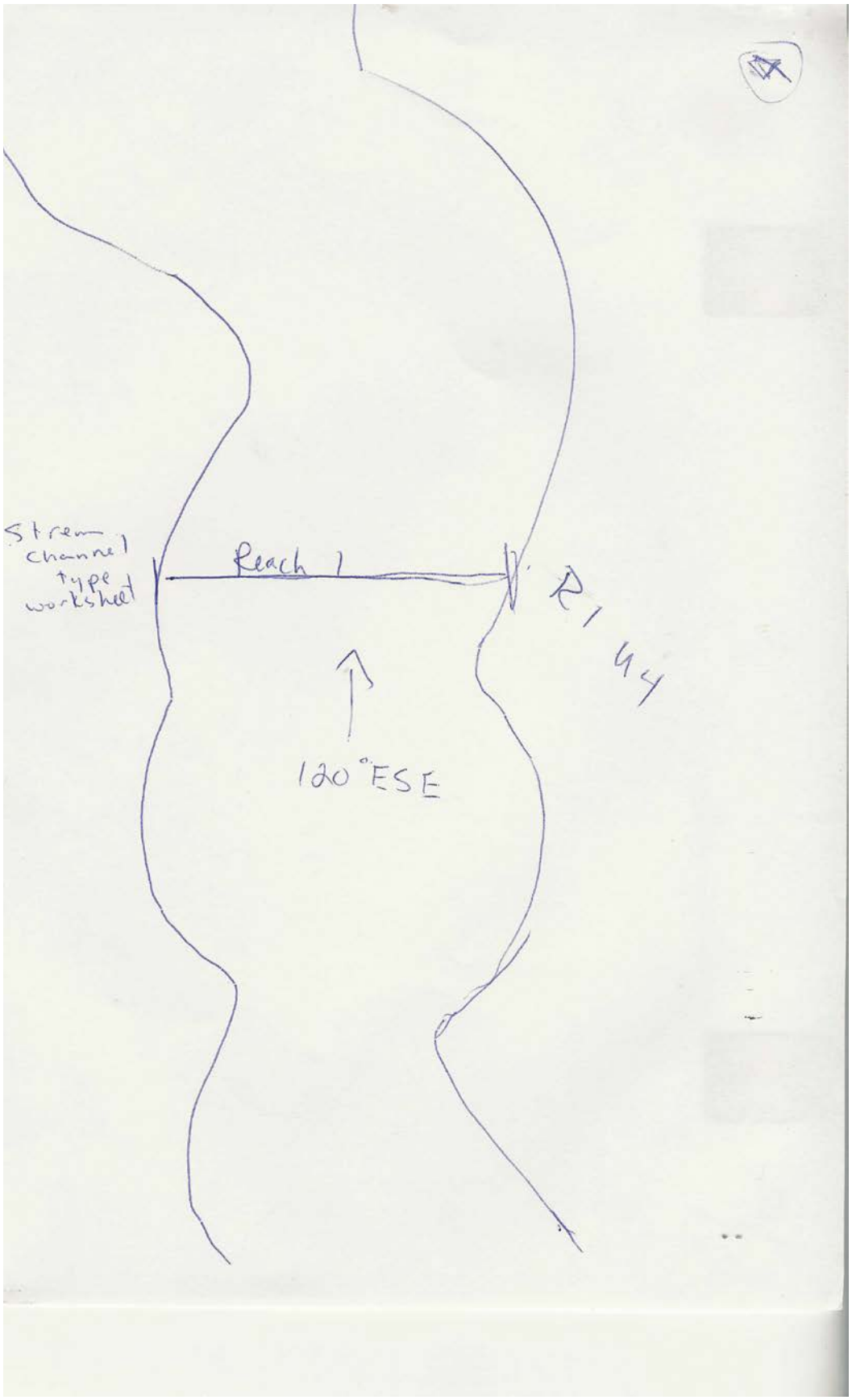
Attachment D

D4. Field Drawings


R 1 U 1
400'
±9
N 61° 27' 258
W 149° 25' 121
47'
x gps/temp
0'
Mouth

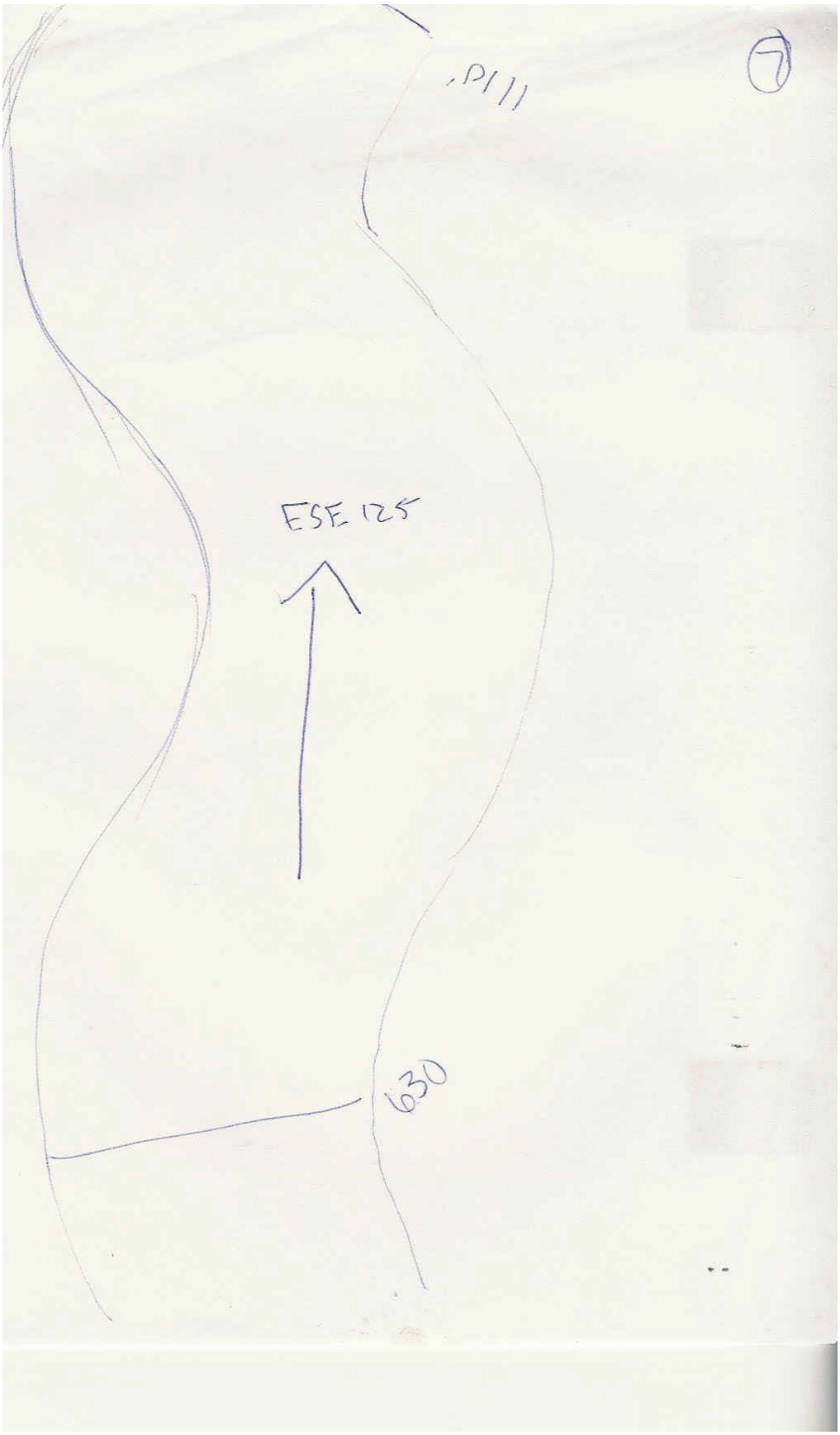

R1 U3 start
Flow N
47'
292'
R1 U2
584
520'
60° ENE
N 61° 27' 253"
W 149 24' 997"
gps

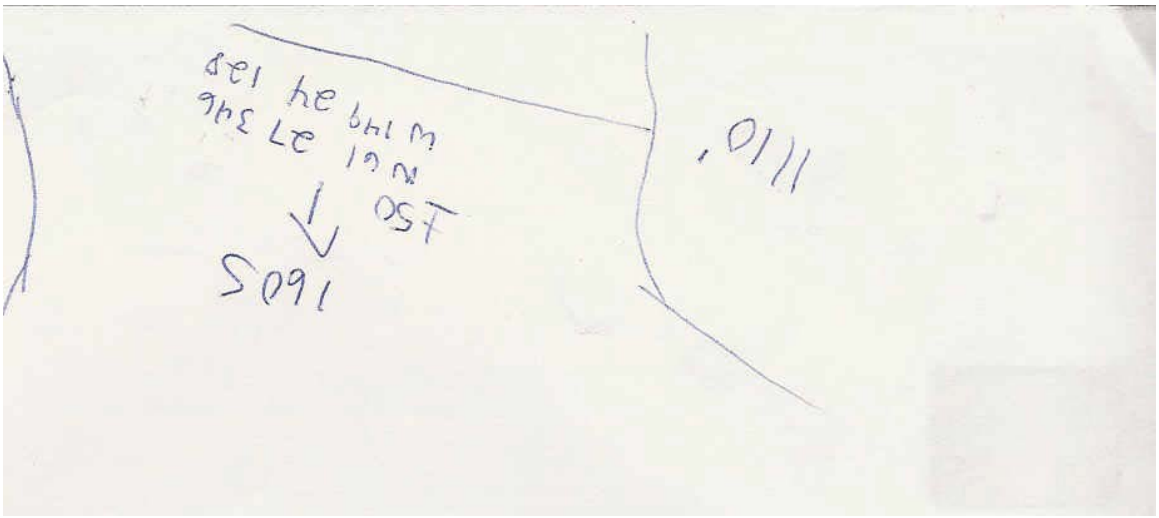

R1
R1
ESE 130°

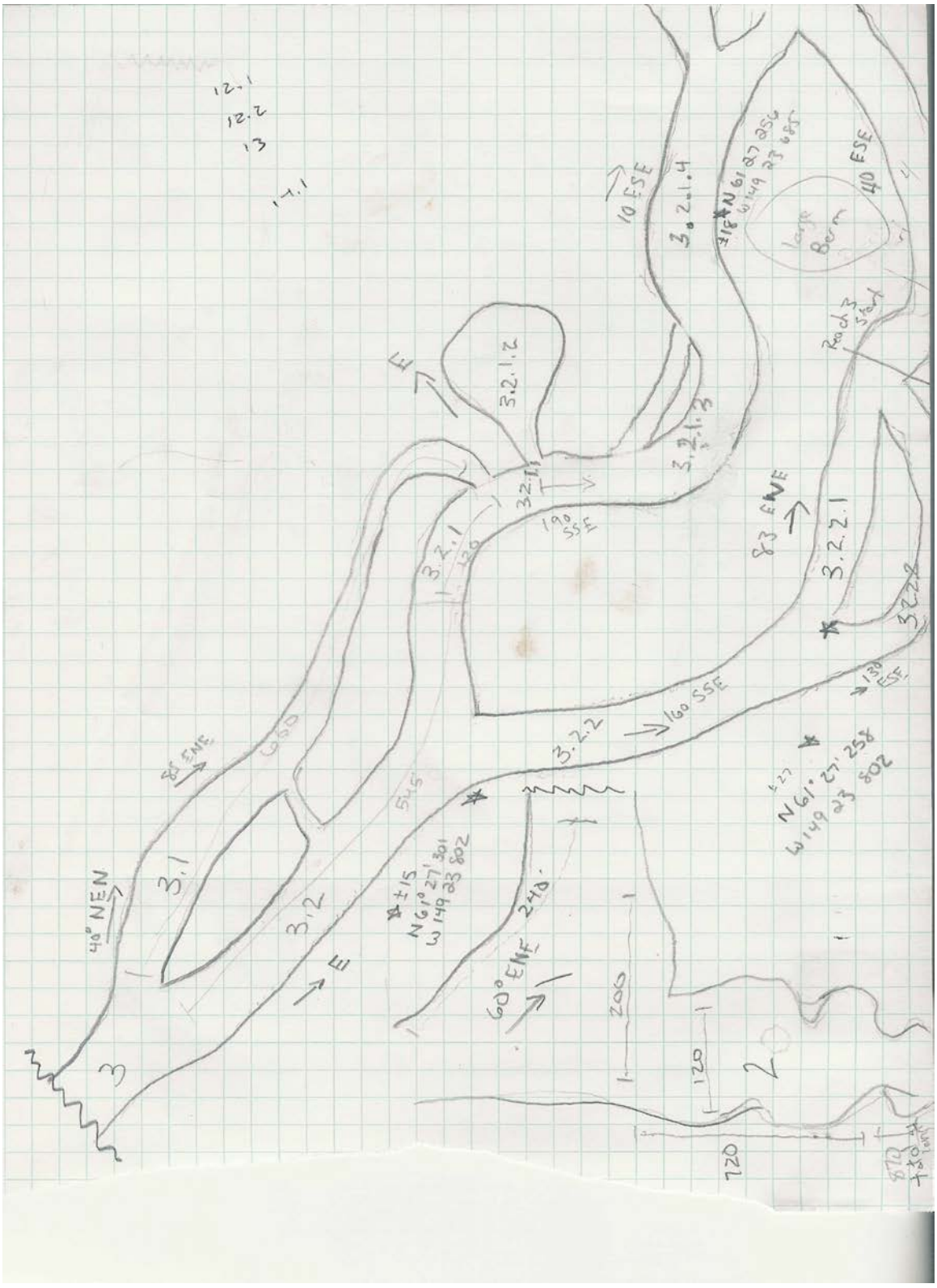

Stream channel type worksheet
Reach 1
R1 44
120° ESE

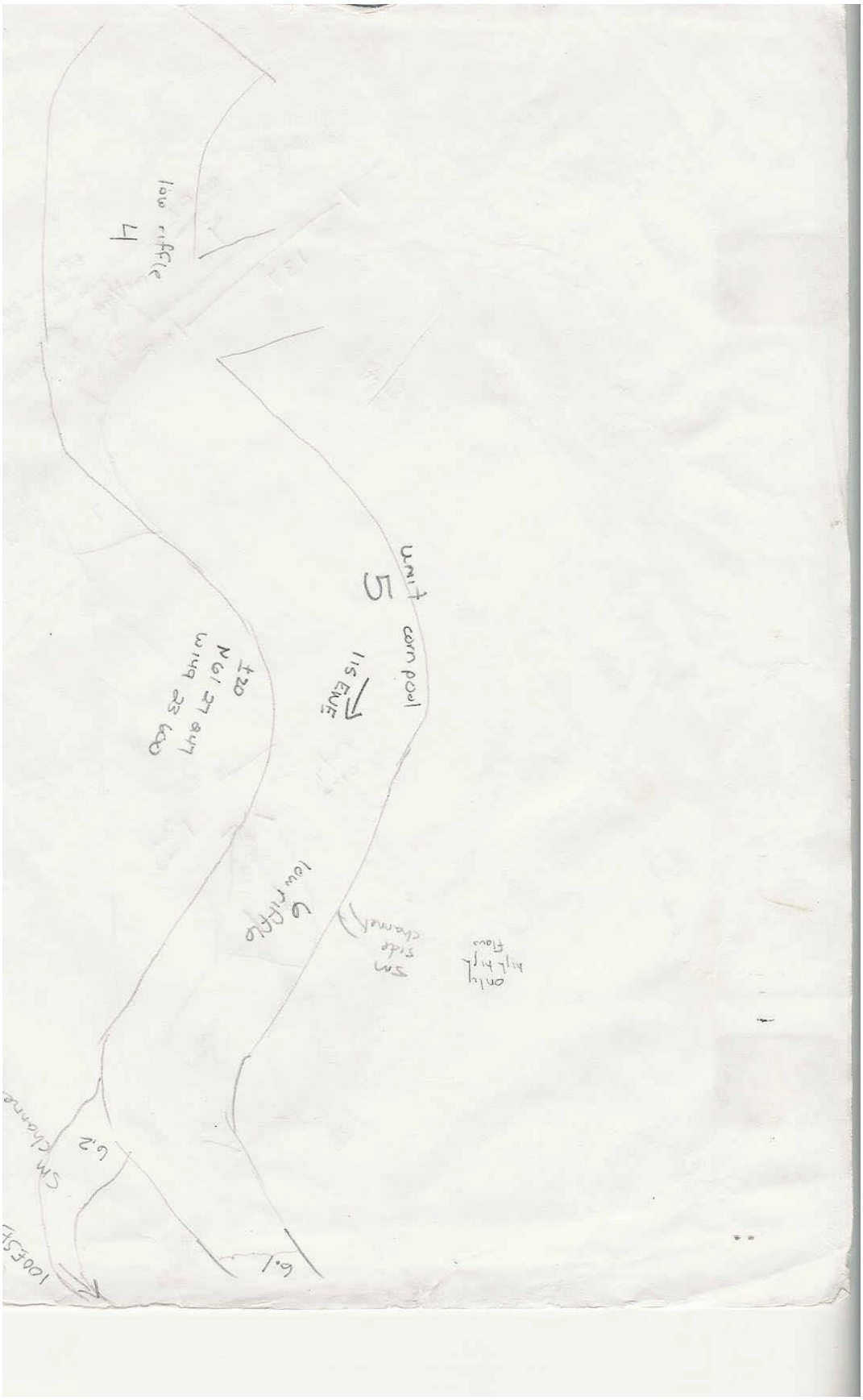
End R1 Unit 4
1280'
NW 320
61° N 27.383
W149 24 435
±18'
984
5

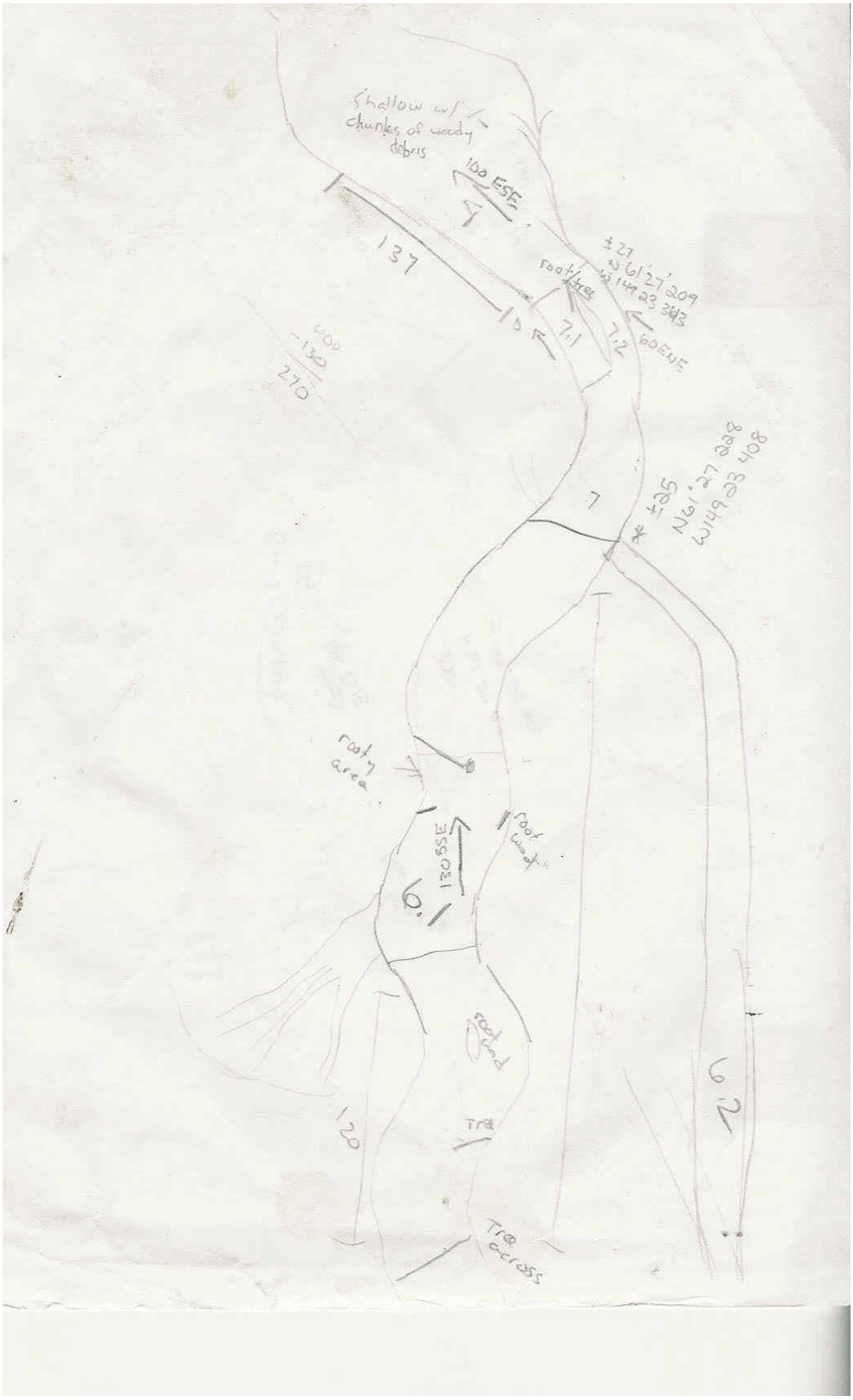
21 AM 5
(9)
SOC.

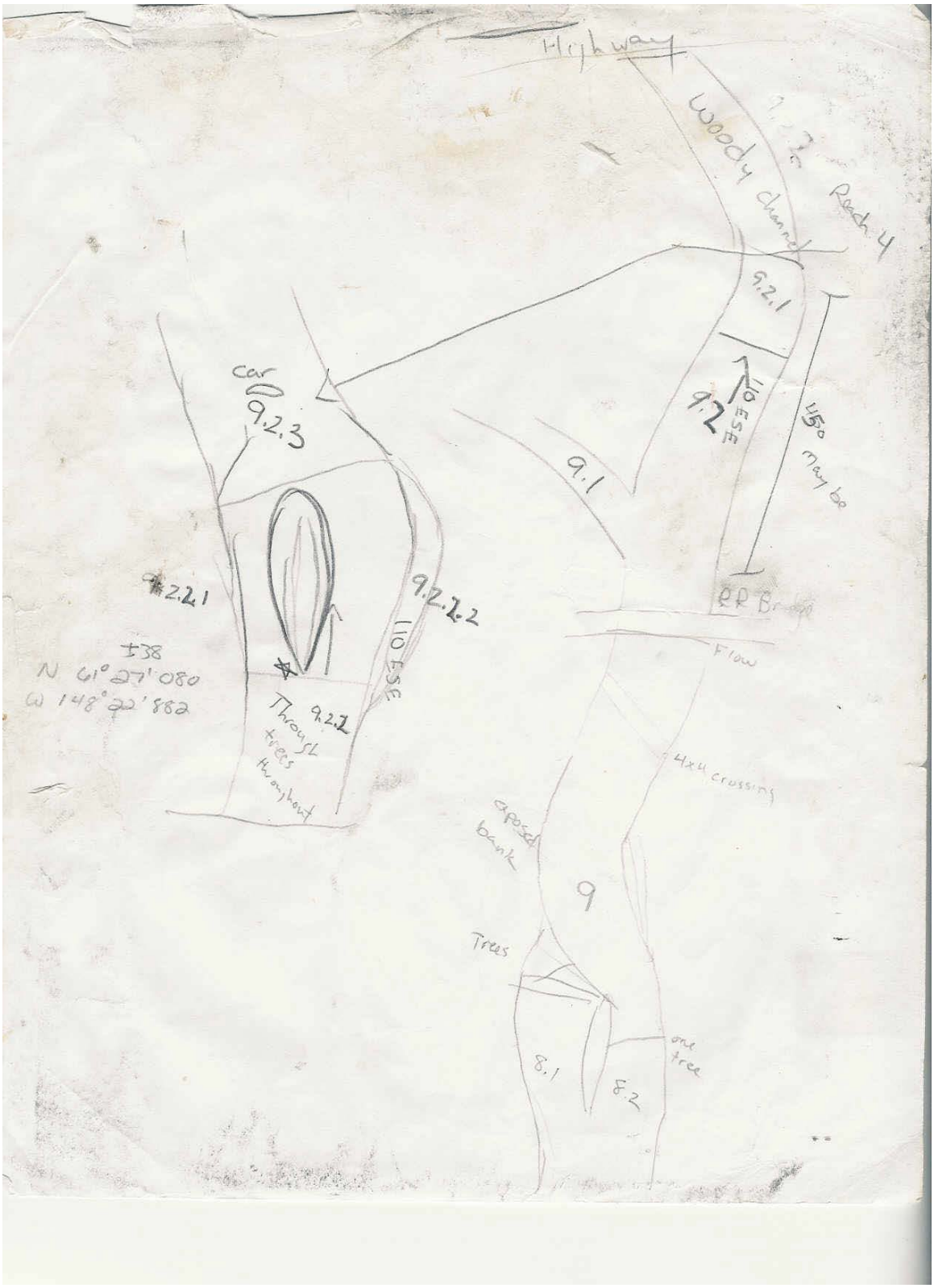

PIII
7
ESE 125
630

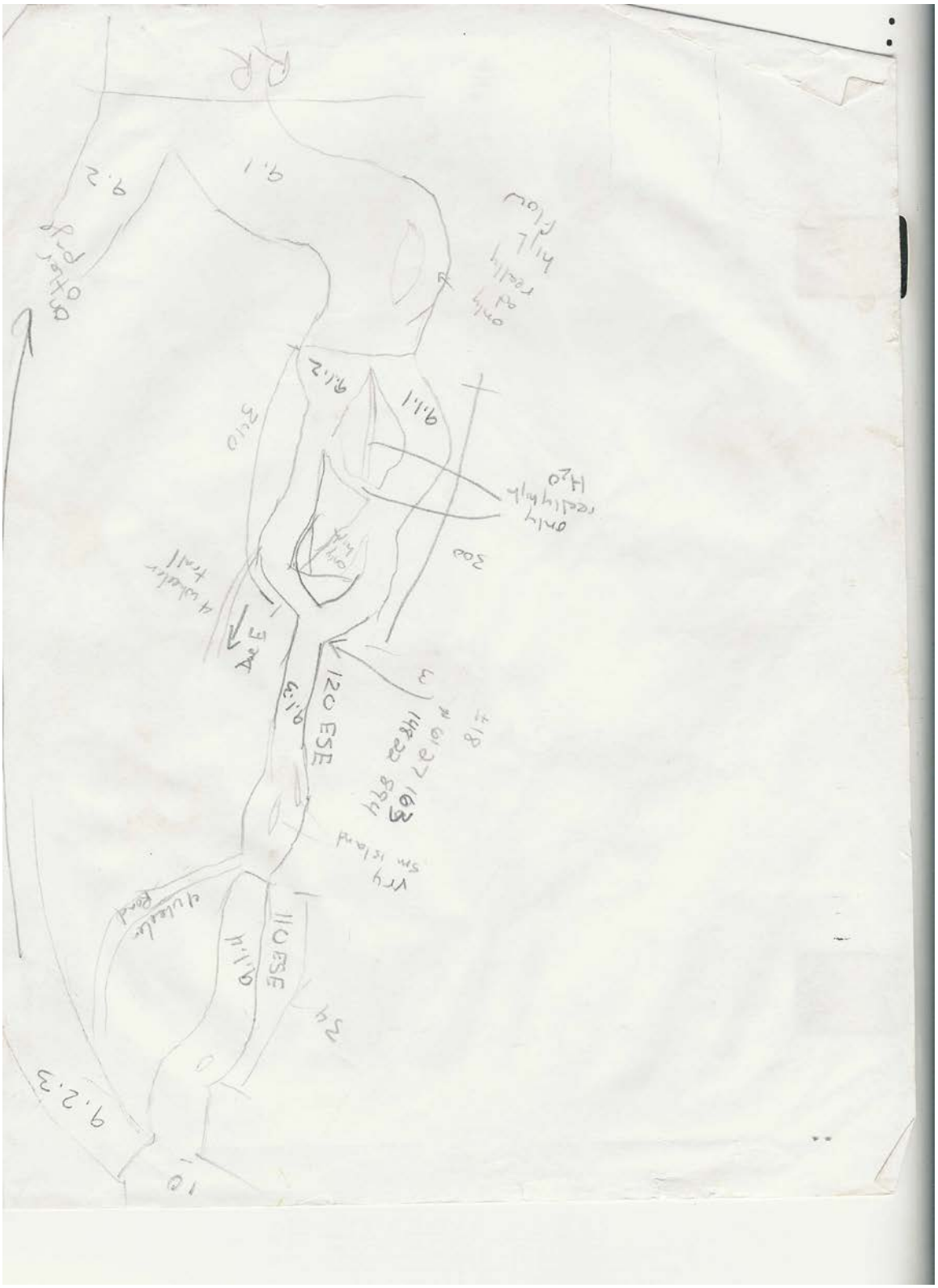


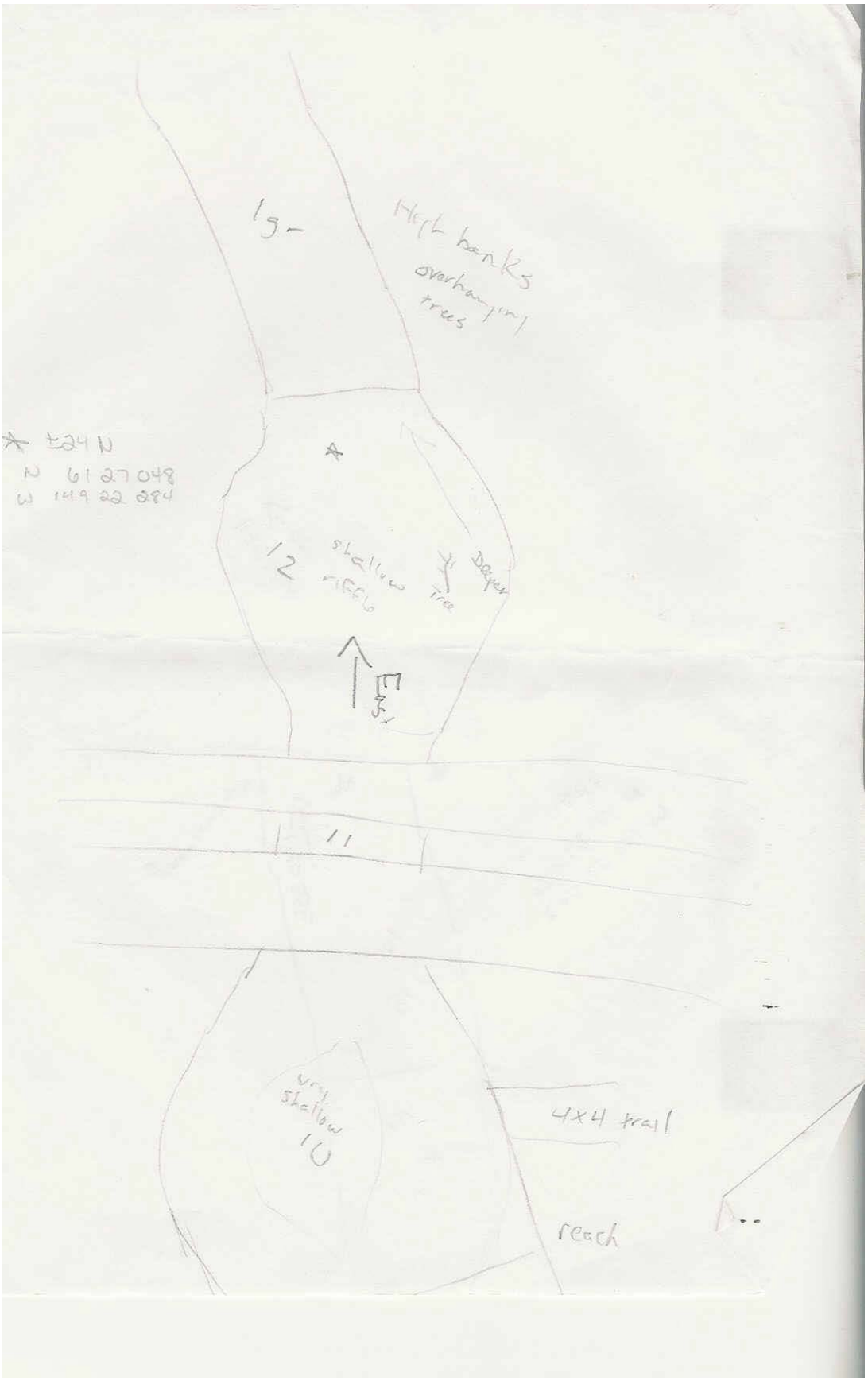

12.1
12.2
13
14.1
10 ESE
3.2.1.4
40 ESE
Large Berm
Reach 3 Start
3.2.1.2
3.2.1.3
3.2.1.1
190 SSE
83 ENE
3.2.2.1
3.2.2
160 SSE
130 ESE
85 ENE
3.1
3.2
40° NEN
60° ENE
240
200
120
720
3
2

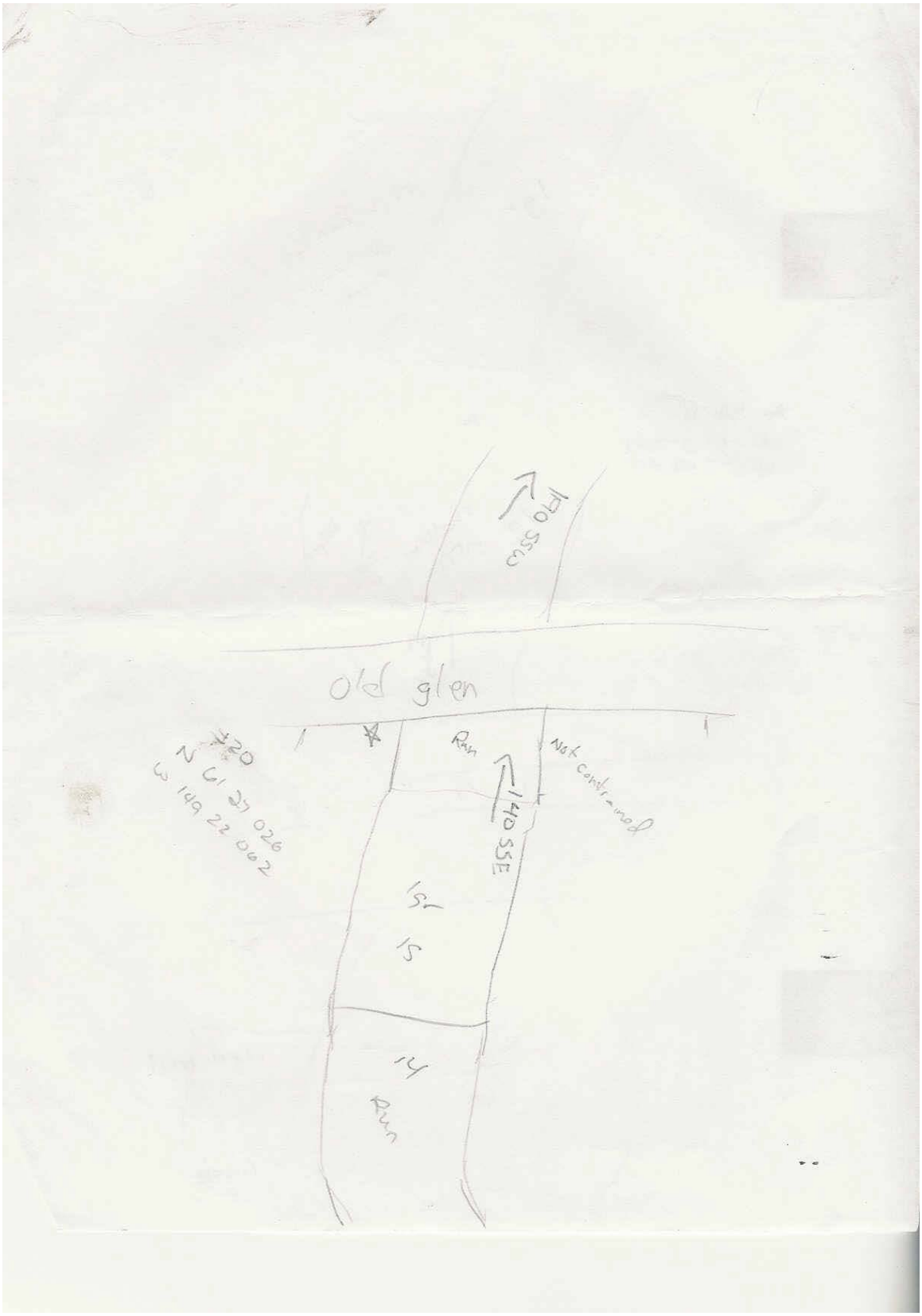

low riffle
4
unit
5
corn pool
11S ENE
6
low riffle
6.2
6.1


Shallow w/ chunks of woody debris
100 ESE
137
root/tree
7.1
7.2
60 ENE
400
-130
270
7
±25
N61°27 228
W149 23 408
rooty area
root wood
130 SSE
6.1
root wood
120
Tree
Tree across
6.2


Highway
Woody channel
9.2.4
Reach 4
9.2.1
car
9.2.3
110 ESE
9.2
9.1
150 may be
9.2.2.1
9.2.2.2
110 ESE
T38
N 61° 27' 080
W 148° 20' 882
9.2.2
Through trees throughout
Flow
4x4 crossing
exposed bank
9
Trees
one tree
8.1
8.2

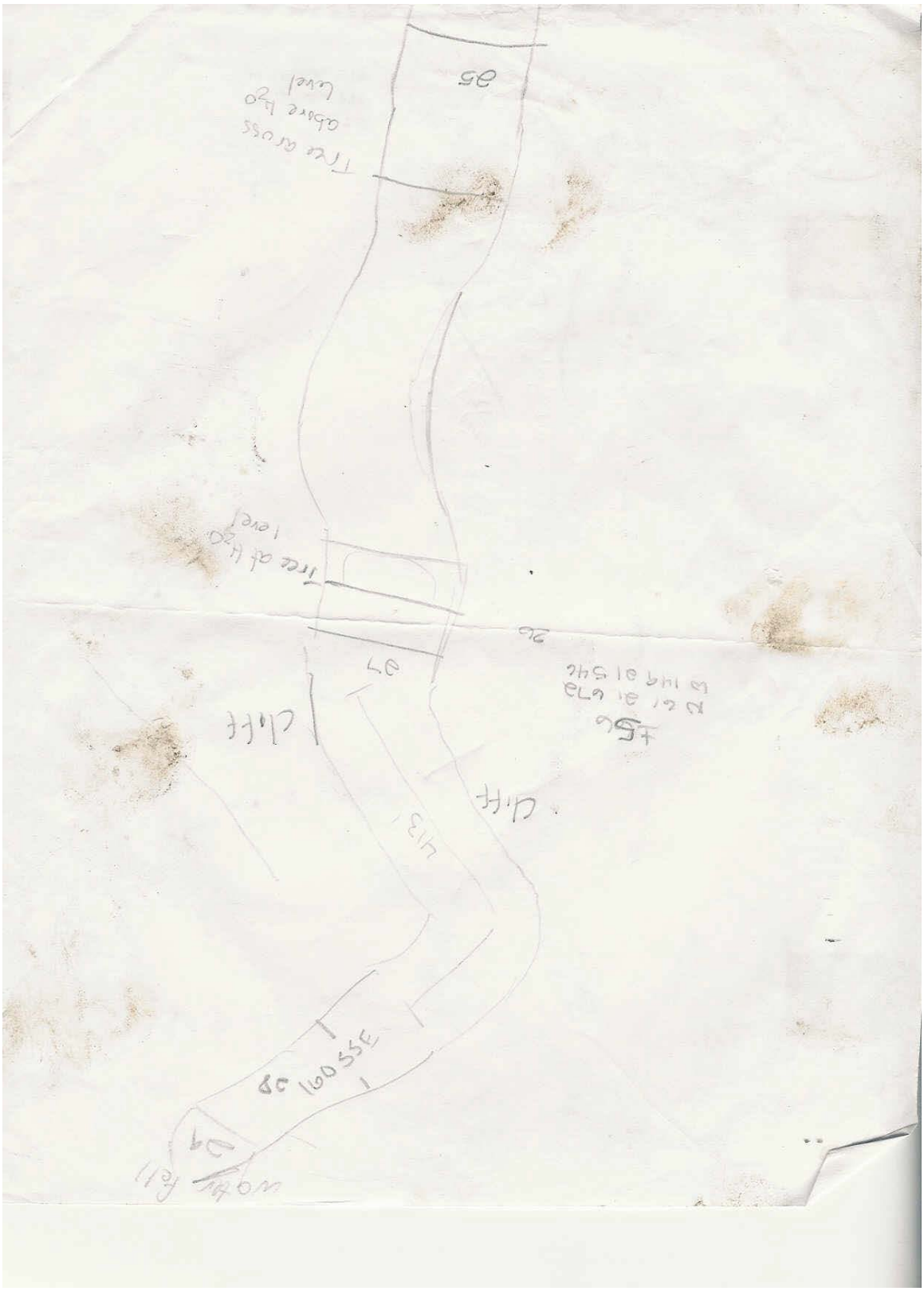

RR
9.2
9.1
9.1.2
9.1.1
9.1.3
9.1.4
9.2.3
120 ESE
110 ESE
4 wheeler trail
only really high H2O
only really high flow
Vry sm island
4 wheeler Pond
300
3
24
10

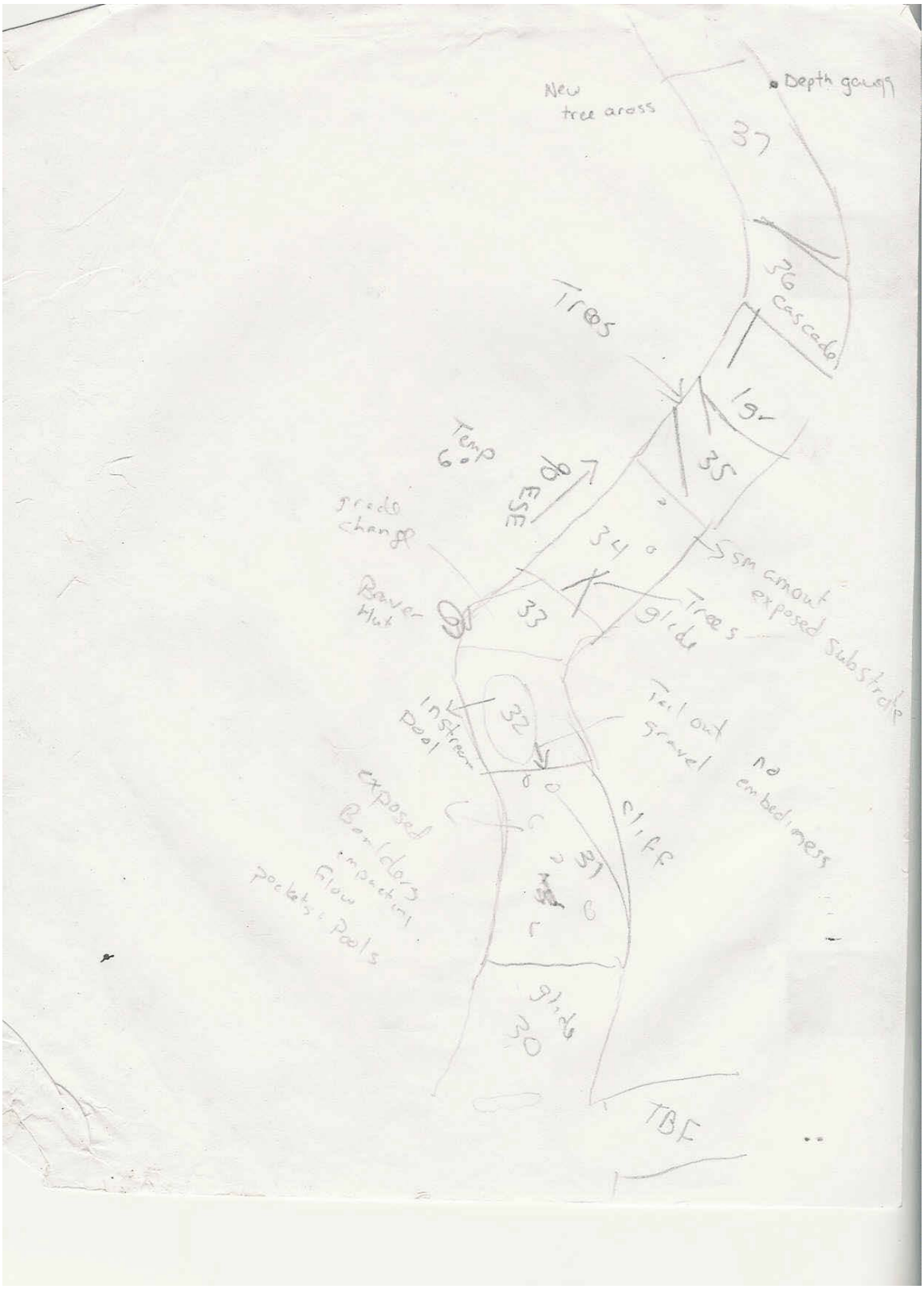

lg-
High banks
overhanging
trees
±24 N
N 61 27 048
W 149 22 084
12
shallow
riffle
Deep
tree
11
very
shallow
10
4x4 trail
reach

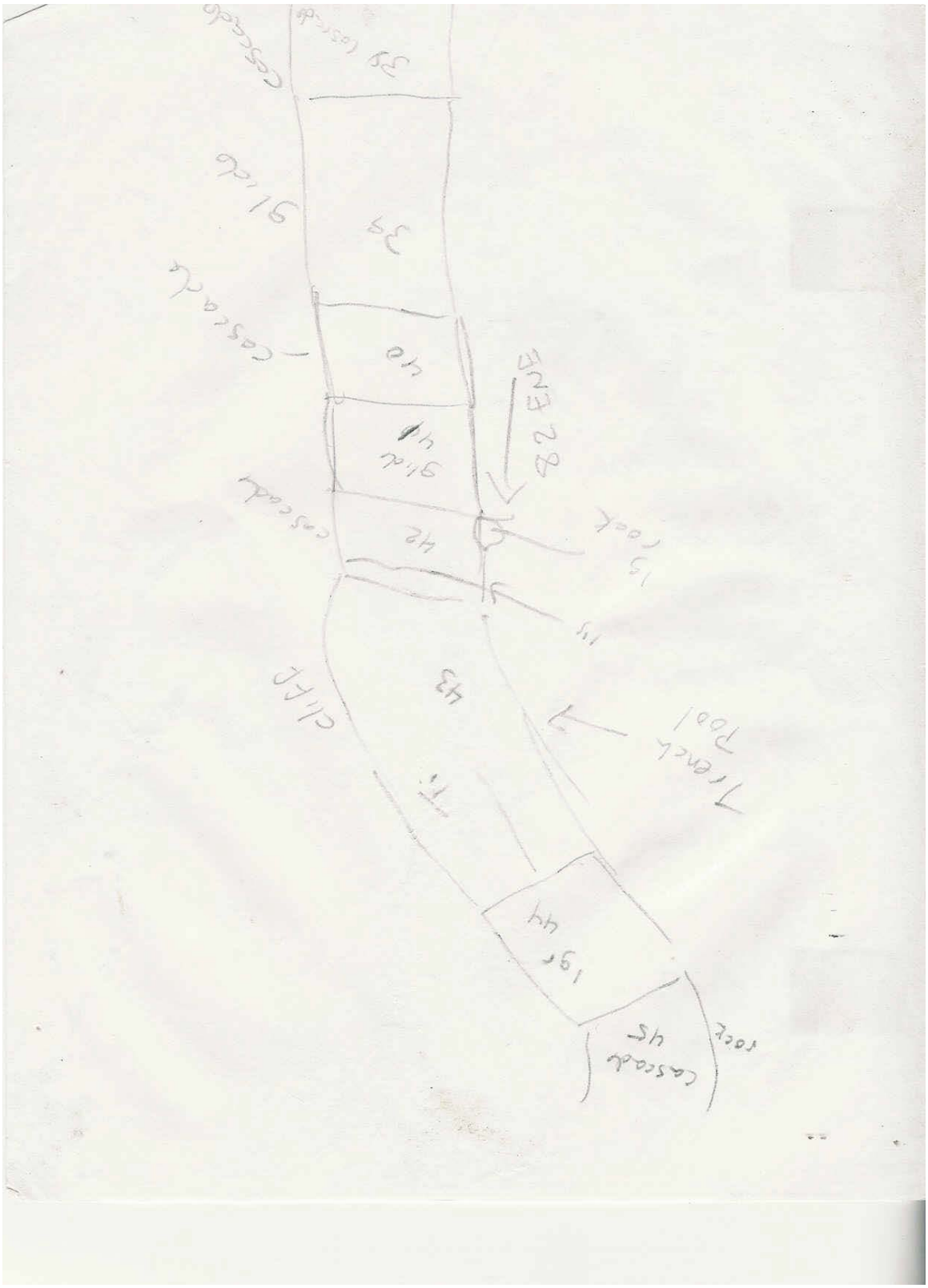

170 SSW
old glen
Run
Not contained
140 SSE
#20
N 61 27 026
W 149 22 062
1gr
15
14
Run

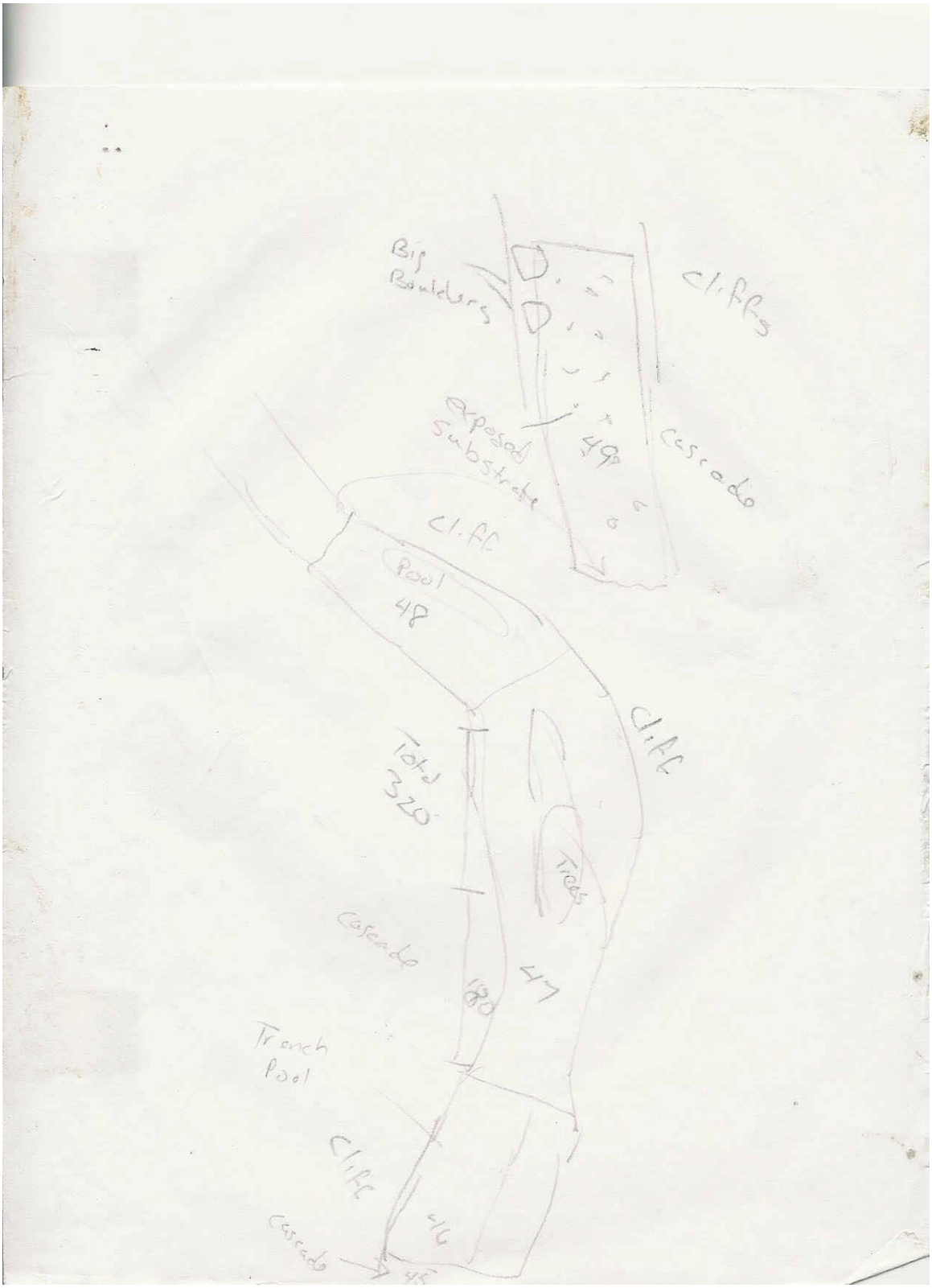
run short
20
Cliff
sm boulder pile
Cliff
19
1gr
land slide
large boulder
rocks
run
18
woody debris
17

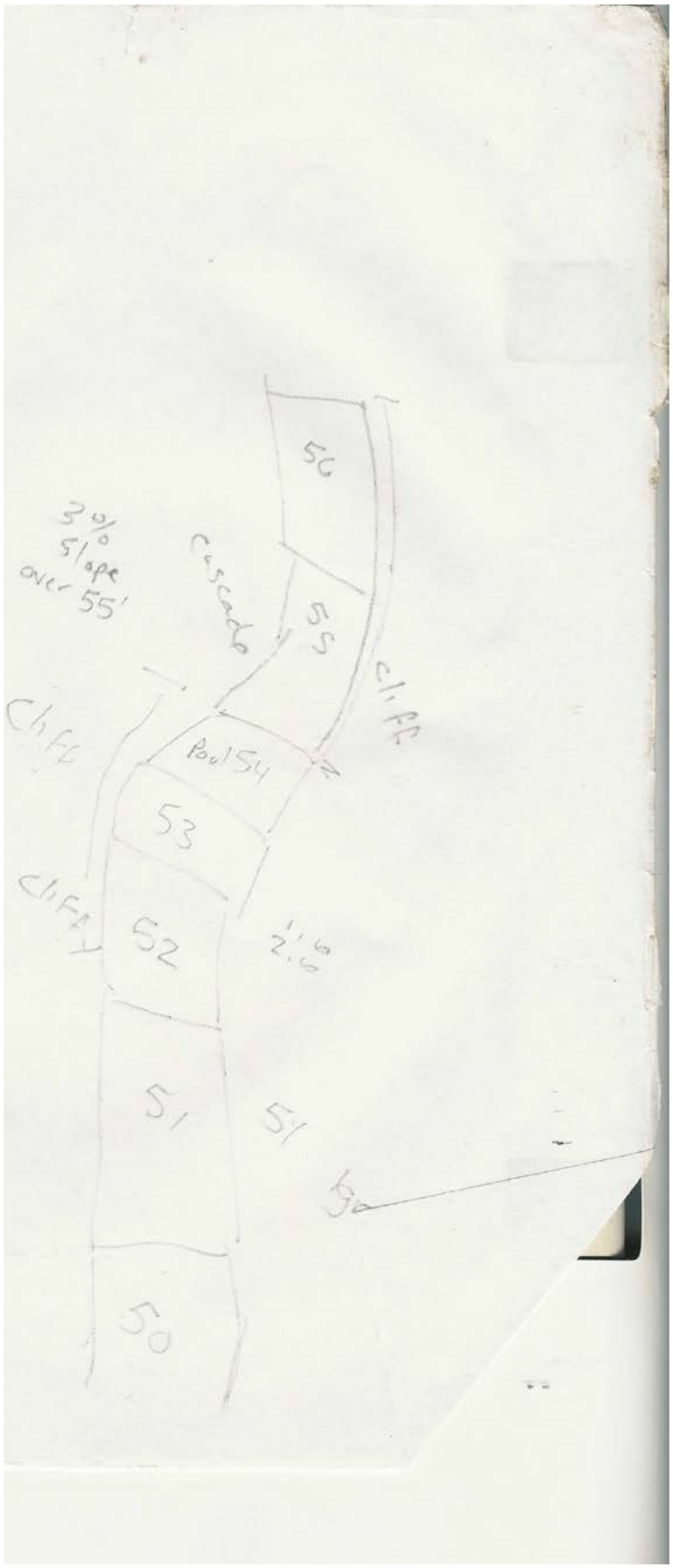
Rock 7
Thunder Falls
Other side
Beach 6

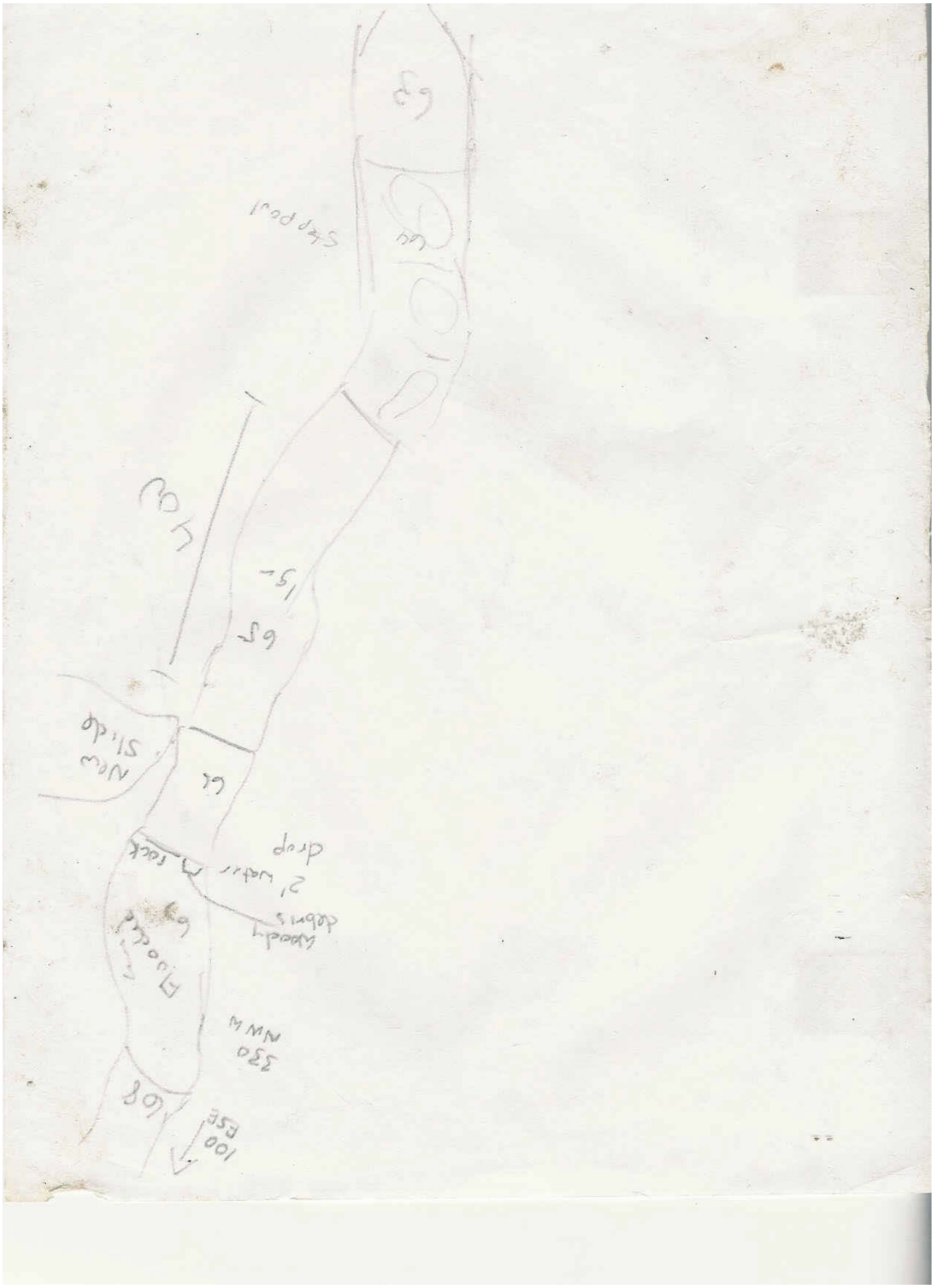

Tree at H2O level
Tree across above H2O level
cliff
cliff
water fell

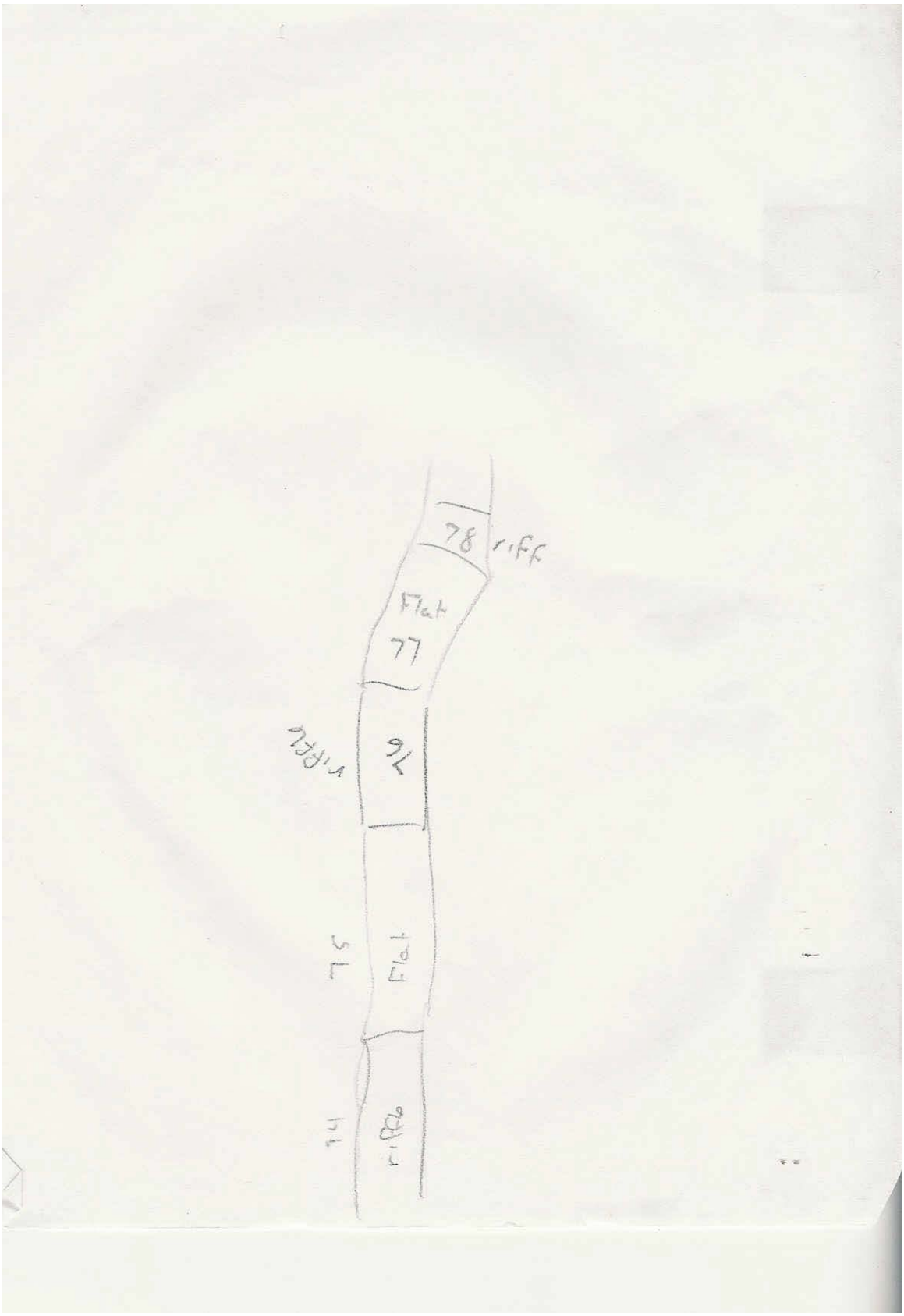

New tree across
Depth gauge
37
36
cascade
Trees
19
35
Temp 6°
ESE
grade change
34
Beaver Hut
33
Trees
glide
exposed substrate
32
instream pool
Tail out gravel
no embedimess
exposed Boulders impacting flow
pockets: Pools
cliff
31
glide
30
TBF


39 cascade
39
40
82 ENE
42
43
Trench Pool
44
45
cascade
rock


Big Boulders
Cl. Rks
Exposed Substrate
49
Cascade
Cl. Ft
Pool
48
Cl. Ft
Total 320'
Trees
Cascade
47
Trench Pool
Cl. Ft
46
Cascade


56
3%
slope
over 55'
cascade
55
cliff
Cliff
Pool 54
53
Cliffy
52
1.6
2.6
51
51
50




78
riff
Flat
77
76
riffle
Flat
riffle