

**RT-GPS Mapping of Fish
Habitat and Fish Distribution
Of Cheewhat Lake Tributaries;
S2 (and Distributary S1), S3
S4 and S5, September 2001.**

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**Nuu-chal-nulth Tribal Council
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Table of Contents

1.0 Introduction	2
2.0 Study Area.....	3
3.0 Methods.....	3
3.1 Fish Habitat Mapping with RT-DGPS.....	3
3.2 Fish Use Assessment:	5
3.3 Habitat Maps	5
3.4 Photographs of Fish Habitat.....	6
4.0 Results.....	6
4.1 Habitat Condition	6
5.0 Discussion	7
6.0 Recommendations.....	8
7.0 References	9

1.0 Introduction

Cheewhat Lake lies within the traditional territory of the Ditidaht First Nation and is of great importance to the Ditidaht people as a source of food fish for societal and ceremonial purposes. Knowledge from a historical and cultural perspective is extensive. Numerous documents exist that discuss the importance of the Cheewhat watershed to the Ditidaht people (Wright et al 1992). Documentation on techniques used to harvest salmon and where harvesting took place on the Cheewhat River are also available (Wright et al 1992). The Ditidaht Nation utilized resources (plants and animals) in and around the Cheewhat River but little information can be found that shows the Ditidaht actually used resources in Cheewhat Lake other than the cedar found along the shoreline which was used for building canoes. During this study evidence of cedar being used for building canoes was geo-referenced in the flood plain between tributary S2 and S1 (Sheet #1 and Plates 2.34, 2.35 and 2.36).

From 1985 to 1997, Fisheries and Oceans Canada monitored juvenile and adult sockeye and coho abundance. Assessment of habitat condition was completed at a reconnaissance level by Parks Canada in 1975 and 1992 (Mudry and Green 1976 and Wright et al 1992) and detailed assessment of Tributaries S2 (and distributary S1), S3, S4 and S5 in 1995 (Johannes et al 1996). The Cheewhat watershed supports populations of sockeye, coho, chum salmon and steelhead and cutthroat trout.

British Columbia Forest Products (now Timber West) logged the Northeast end of Cheewhat Lake to the reserve boundary in 1984 and MacMillan Bloedel (now Weyerhaeuser Co.) logged the East Side of Cheewhat Lake between 1986 and 1992 also to the reserve boundary. Logging the upper reaches of S2 above the reserve boundary has had a significant impact on spawning and rearing fish habitat. Increased peak flows in the headwaters of S2, S3 and S4 and logging the riparian forest has caused channel widening, channel aggrading and loss of channel structure.

Maps of the Cheewhat Lake watershed have proven to be inaccurate in depicting the location and amount of fish habitat. Misinterpretation of the aerial photographs used to generate the existing TRIM map base creates most of the inaccuracies. Dense vegetation obscures the location of channels, which generally leads to inaccurate plotting of the stream location. To achieve a better understanding of the extent of fish habitat in the Cheewhat watershed, RT-GPS surveys were executed to map the extent and condition of accessible fish habitat. The output will identify watershed condition, factors that limit fish production and rehabilitation opportunities in priority areas.

This study was funded by Fisheries Renewal B.C. through the Regional Aquatic Management Society. The objectives of this project were to:

1. Provide RIC Standards training using GPS Technology to Ditidaht Fisheries personnel.
2. Provide training for Ditidaht Fisheries personnel on RT-DGPS fish habitat mapping techniques.
3. Map the four tributary streams to Cheewhat Lake, S2 (and distributary S1), S3, S4 and S5.
4. Generate maps of the tributaries with habitat features.
5. Assess habitat for industrial related impacts and rehabilitation opportunities.

2.0 Study Area

Cheewhat Lake is located on the Southwest coast of Vancouver Island, approximately 75 km. South of Port Alberni, B.C. Much of the watershed lies within Pacific Rim National Park Reserve (Fig. 1). The lake is short and oval in shape (approximately 2.1 km long with a maximum width of 1.2 km) and is oriented north to south. The lake consists of one shallow basin with a surface area of 152 ha and a mean and maximum depth of 9.0 and 20.0 m respectively (Rutherford et al 1986). Cheewhat Lake is situated approximately 5.0 m. above sea level.

The Cheewhat River originates at Cheewhat Lake and flows in a Southwest direction for approximately 4.75 km where it joins the Pacific Ocean. The river is low gradient and is influenced by tidal fluctuations, which affect water levels of the river for a distance of approximately 3.3 km upstream of the river mouth. The Cheewhat River is a deep slow moving river called the “River of Urine” by the local Indians (Sierra Club of British Columbia, 1974).

The Cheewhat River is influenced by high annual rainfall (exceeding 250 cm), which causes extreme variability in both water level and flow. There are four tributary streams entering Cheewhat Lake, S2, S3, S4 and S5. S2 branches approximately 300 m from the stream mouth, this branch is distributary to the mainstem, S2, and is referred to as S1 (Fig. 2). Most of the fish habitat is located in old growth forest conditions.

3.0 Methods

Cheewhat Lake tributaries were surveyed September 12, 2001 to September 21, 2001.

3.1 Fish Habitat Mapping with RT-DGPS

Prior to mapping Cheewhat Lake fish habitat, Ditidaht Fisheries personnel received RIC Standards training and certification using GPS Technology. Ditidaht Fisheries Crews received additional training in the use of RT-DGPS for mapping fish habitat and fish distribution. Under the supervision of the GPS instructor and/or the contract Biologist, trainees mapped tributaries to Cheewhat

Lake with a Trimble Pro XLR GPS receiver (Plate 1.21). RT-GPS (± 1.0 m accuracy) was used to reference the following:

- ❑ The start and stop of each habitat unit.
- ❑ Bankfull widths of the habitat unit.
- ❑ Features, such as debris jams, potential and permanent barriers to fish migration, roads, bridges, culverts, camps, fish fence locations and, access trails.
- ❑ Locations where fish were observed and/or where minnow traps were set. Fish use was determined to a barrier to fish migration or when stream gradient was $>20\%$.
- ❑ Locations of spawn survey counting markers used to map distributions of spawning salmon. On both S-1 and S-2 numbered markers (slow moving vehicle signs) had been previously installed. Markers were spaced approximately 30 m apart on both S-1 and S-2.

A data dictionary was developed for assessing fish habitat to control the collection of features (objects) and attributes (information about the objects). The dictionary is structured to ensure that information collected in the field is complete and relevant with output requirements. This also increases the efficiency in the field by providing a menu selection data entry form. The data dictionary consists of the following:

- A list of feature names, which are classified as either a point, line or area feature (polygon).
- A list of attributes for each feature in the dictionary. The attributes provide a description of the feature. For example attributes for a culvert would include the diameter, the location of the inlet and outlet, length and comments as to if the culvert is a barrier to fish passage.

Examples of feature layers are;

- Count Station – references location of counting station markers.
- Habitat Unit breaks (i.e. Transition from a riffle to a pool).
- Stream Feature (culverts, bridges, debris jams).
- Photo Site (attributes include the film roll #, frame #, azimuth the photograph was taken and a brief comment).
- Physical parameters (i.e. Flow site, temperature recorded).
- Fish observations (# observed, species and life stage).
- Side channel.
- Gravel Bar line.
- Point Generic - identifies a feature not defined in the dictionary. Information entered in the comment field defines the feature.

Table 1 lists the type of instruments used in assessment of the Cheewhat Lake tributaries.

Table 1. List of Equipment Used for Mapping Selected areas of the Cheewhat Lake watershed.

Type of Equipment Used
Trimble Pro-XR GPS Receiver
Bushnell Laser Binoculars
Sonin Electronic Distance Measurer
Hip chain
30 meter tape measure
Clinometer
Suunto compass
Pentax ZOOM 90 – WR camera

Information from the surveys was used to generate 1:20,000, and 1:10,000 overview maps as well as 1:1,000 detailed maps. The shoreline, contours and roads on the Cheewhat Lake watershed maps are from TRIM (July 1987 aerial photography).

3.2 Fish Use Assessment:

During the GPS surveys of Cheewhat Lake fish habitat and fish observations were also referenced with the GPS receiver. The number, species (when possible) and life stage (juvenile or adult) were logged as a point feature. Information on fish use is based on visual observations and limited minnow trapping conducted by the field crew. Observers noted the presence/absence of juvenile and adult fish. Information of fish observations is identified on the individual map sheets.

Adult fish distribution and abundance by species is reported in Lane et al 2002.

3.3 Habitat Maps

Upon completion of the GPS surveys, maps of the tributaries were created first as CAD drawings and then imported into Arcview GIS 3.2 for completion. Once completed the information was transferred to 1:20,000 Digital TRIM map sheets 92C.067 and 92C.077. Before the information was transferred to digital TRIM, map sheets 92C.066, 92C.067 and 92C.077 were stitched together using Arcview GIS 3.2 software to create one map sheet of the study area.

There are 15 map sheets for this project:

- An overview map at a scale of 1:20,000, which shows the location of Cheewhat Lake (Cheewhat Overview #1).
- An overview map at a scale of 1:10,000, which shows Cheewhat Lake and tributary areas mapped with RT-DGPS. This map also functions as an index to show what sections of tributaries mapped the other 13-map sheets represent (Cheewhat Overview #2).
- Ten map sheets at a scale of 1:1,000 which represent sections of S1 and S2 in more detail. This map scale shows fish observations, counting station marker locations, photo points, habitat units (riffles, pools, glides and cascades) and features such as debris jams, trails, roads and culverts (Cheewhat S1 & S2 Sheet #'s 1 to 10).
- One map sheet for each of the tributaries S3, S4 and S5 (Cheewhat S3, Cheewhat S4 and Cheewhat S5) at a scale of 1:1,000.

The map sheets are in Adobe Acrobat pdf format and can be printed onto 11" x 17" waterproof paper for fieldwork. The 1:1,000 sheets can be used in the field for data collection purposes.

3.4 Photographs of Fish Habitat

When possible representative photographs of fish habitat were taken. In many areas much of the channel is obscured by vegetation or dense canopy provided inadequate light condition for good photographs. Some of the photographs do not provide good representation of the habitat and in some cases all that can be

seen is vegetation. Photo points are represented by  which shows the orientation (upstream, downstream or cross-stream view) of the photograph and

the roll and frame number. For example  1.19 is roll 1 frame 19. There are no photographs of S3 due to a camera malfunction.

4.0 Results

4.1 Habitat Condition

For details on assessment of tributaries and off channel habitat refer to Overview #2 and Map Sheets 1 to 10 and Table 2.

4.2 Distributions and Relative Abundance of Anadromous and Resident Salmonids

Information on fish abundance and distribution of adult sockeye and coho salmon is presented in Lane et al 2002. The upper limit of adult sockeye and coho salmon distribution is the cascade section above counting marker M17 (Sheet

#2). Prior to 1995 no fish were observed above the barrier (M.C. Wright Pers. Comm.). In 1986 and 1987 visual assessment above the barrier found no fish use. It is suspected that after the barrier at M16 collapsed in 1989 cutthroat trout accessed the area above the barrier and have colonized this area since.

The highest densities of juvenile fish (predominantly coho) were observed in S2 below M10 and in S1 (Overview #2 and Sheets 1 and 2). High densities (>500) of coho fry were also observed off of the mouth of S2 and S3. Low densities of fry were observed in S3, S4 and S5.

Cutthroat trout in S2 above M17 + 50 were distributed through out S2 and its tributaries (Sheets 2 to 10). Densities were low with usually less than 10 cutthroat being observed at any given time. Trapping above the barrier confirmed that fish being observed were cutthroat trout, this was also confirmed in 1995 (Johannes et al 1996).

5.0 Discussion

Fish habitat in Cheewhat Lake tributaries has been impacted by logging above the National Park reserve boundary. The greatest impacts to fish habitat have been through removal of the riparian forest in this area. Although the lower 1.9 km of S2 (including distributary S1) is in unlogged old growth forest, fish habitat in this area has been negatively impacted as a result of upslope logging. A dam-break flood below the barrier on S2 (1989) caused significant damage to fish habitat in S2 (Wright et al 1992). The area between M15 and M16 was buried beneath material from a sediment wedge built up behind a debris jam at M16. LWD from the jam was transported downstream to the confluence of S2 and S1 creating a new debris jam. The presence of the jam affected the flow patterns in S1 and S2, which had an effect on fish distribution below this point. In some years the position of the jam would deflect most of the flow down S2 leading to high fish use between the lake and M10 (Sheet #'s 1 and 2). Overtime the debris jam continued to shift affecting the flows in S2 and S1 with S1 in some years having higher flows and increased spawning activity. Since monitoring ceased in 1997 there is evidence that the jam has decreased in size but still effects flow patterns in S2 and S1 below the confluence. During the 2001 study most of the flow was deflected down S1 which also supported the majority (>70%) of the spawning sockeye (Lane et al 2002). S1 was impacted the least by past logging practices. S2 has experienced extensive habitat degradation over the past 15 years.

The alteration of the hydrology of S2 and its tributaries has occurred through loss of buffering provided by mature forest cover in upper S2, S2.1, S2.1.1, S2.1.2 and S2.2, resulting in an exaggerated hydrograph. Stabilization of the lower reaches of S2 will only occur through natural processes over a long period of time unless transport of sediment is reduced. Assessment for rehabilitation of upper S2 (Cheewhat Sheet #'s 5 and 6) suggests that further transport of

sediment from this area could be reduced by redeveloping this section of the stream by removing excess bed material, re-establishing a defined channel and complexing the impacted area with LWD. The channel segment will focus flows in S2 instead of some of the flow going to Spruce Lake, which now occurs during periods of high flow. As a result of riparian logging the logged channel banks have experienced increased erosion resulting in increased sediment loading in the channel. Alder is common along the channel banks in this area. The root networks of deciduous trees are not as resistant to erosion as conifers. To increase bank stability riparian treatments for conifer release will be required.

The low gradient areas below S2 -M6 are transport limited at most flows, and act as long-term sediment storage sites. Increased peak flows and transport of sediment have led to reduced pool capacity, channel widening, channel aggrading and avulsions. Fish habitat (Lake to Rossander Mainline) has experienced significant sediment depositions, which has in-filled, pools and side channels. The degradation of fish habitat in S2 and its tributaries (i.e. S2.1) (reduced pool volume, loss of LWD (area above the National Park Reserve boundary), eroding banks, aggraded spawning habitat) has reduced the quality and quantity of rearing and spawning habitat. The nature and severity of impacts in the upslope areas of S2 and its tributaries may be sufficient to preclude rehabilitation in S2 until an assessment of upslope instability is made. At this time we suspect that bank failure as a result of streamside logging is the primary source of sediment. Eroding banks were evident in the area above and below the Rossander Mainline logging road (see Sheet #6).

6.0 Recommendations

1. Further assessment of the upslope areas >20% gradient is required to determine the source of sediment deposited in S2 below the Rossander Mainline logging road.
2. A geo-technical assessment of the upslope areas along the east side of Cheewat Lake should be considered to determine the risk of doing instream works in S2 below the Rossander Mainline Logging road.
3. Re-define S2 below the Rossander Mainline if risk to instream works from hillslope erosion is considered to be low.
4. Look at the recovery of the riparian zone above the park boundary to determine if a prescription to promote growth of conifers is required to increase the rate of recovery.
5. Berm the right bank of S2 below the Rossander Mainline to keep flows confined to S2 instead of flowing toward Spruce Lake.
6. Assess tributaries that flow into the Cheewat River for logging impacts.
7. A more detailed assessment of fish use and distribution should be considered for upper S2 above the upper limit of anadromous fish distribution.
8. Look at the feasibility of creating access for anadromous fish above the cascade/falls barrier.
9. Assess fish habitat in upper S2 during the fall and winter.

10. Assess incubation success in fish habitat above the barrier.
11. Continue to monitor habitat condition in S1 and S2 below the barrier.

7.0 References

Johannes, M .R. S., M. C. Wright, K. D. Hyatt, C. J. Miller, H. Stiff, T. L. Wright. 1996. Stream-Fish Habitat Condition Assessments, Cheewhat S2 Creek, Clayoquot Sound: Kennedy-Muriel Watershed Restoration Project: File to Reference: KWRP Sre 20-95. Kennedy-Muriel Watershed Restoration Project, Northwest EcoSysTem Institute and Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6.

Johannes, M .R. S., M. C. Wright, K. D. Hyatt, C. J. Miller, H. Stiff, T. L. Wright. 1996. Stream-Fish Habitat Condition Assessments, Cheewhat S1 Creek, Clayoquot Sound: Kennedy-Muriel Watershed Restoration Project: File to Reference: KWRP Sre 20-95. Kennedy-Muriel Watershed Restoration Project, Northwest EcoSysTem Institute and Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C. V9R 5K6.

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The Sierra Club of British Columbia. 1974. The West Coast Trail and Nitinat Lakes. J.J. Douglas Ltd. North Vancouver, B.C. 84 pp.

Wright, M.C., K.J. Gertken and T.L. Wright. 1992. Environment Canada Reconnaissance Level Aquatic Resources Inventory and Literature Search of Four Lakes in the Nitinat Area 1992. Report prepared for Environment Canada Pacific Rim National Park. M.C. Wright and Associates Technical Report.

Table 2. Habitat Assessment of Cheewhat lake Tributaries, 2001.

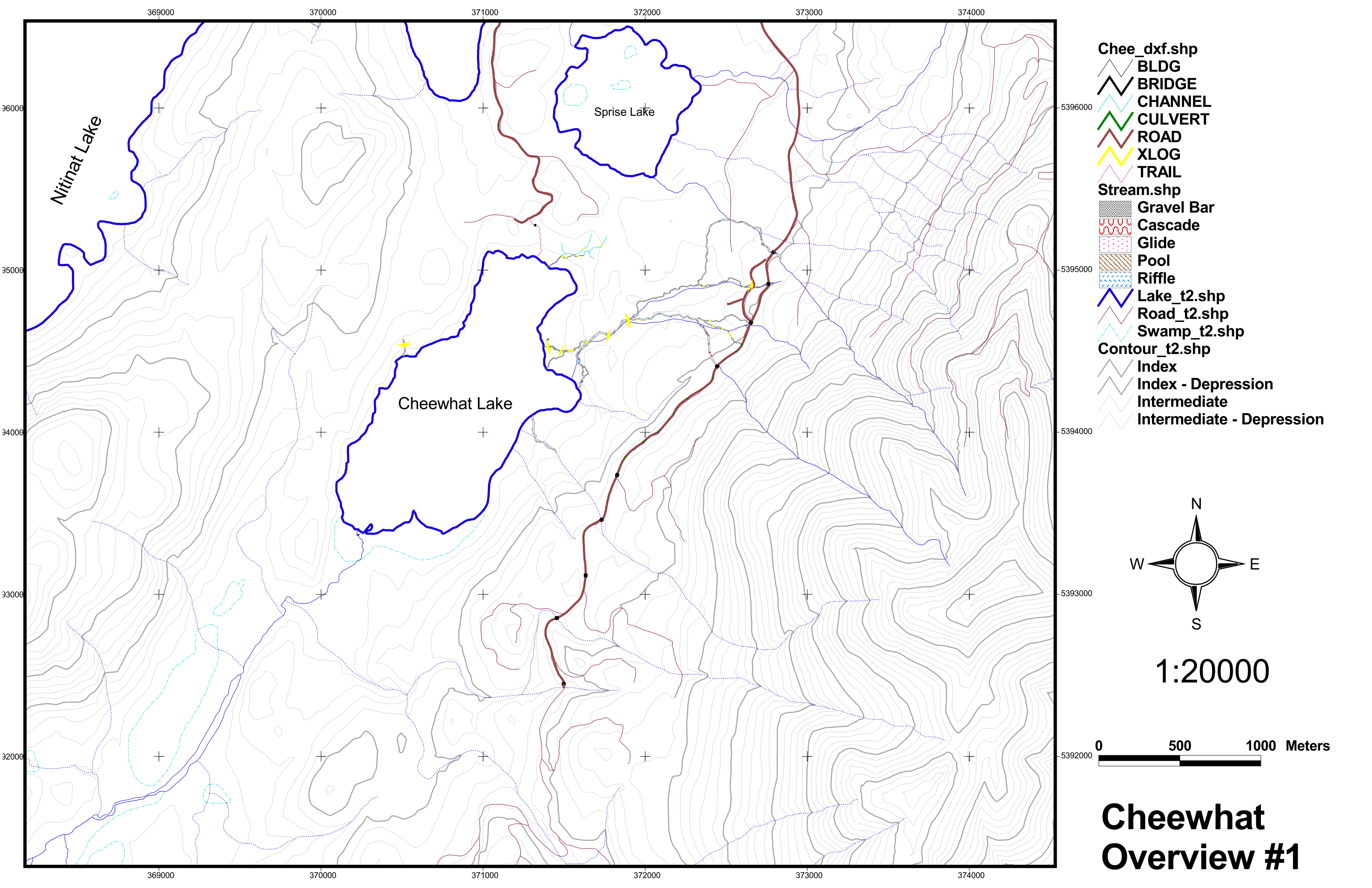
Tributary	Location	Habitat Description	Habitat Impairment	Rehabilitation opportunities and additional information required
S-1	S1 is distributary to S2 and flows into the east side of Cheewhat Lake. Overview #2 and Sheets #1 and #2	S1 has good habitat diversity and is bordered by old growth forest and flood plain. Mean gradient varied from 2% to 5%. Bank height is generally low and none are sufficient to contain the stream during periods of flood. Instream cover comprised primarily of LWD and cutbanks. S1 is characterized by riffle pool glide habitat. Most pools are associated with LWD or rootwads. Substrate varied from predominantly gravel and fines to cobble and gravel. S1 supports spawning sockeye, coho and chum (infrequent use) salmon and steelhead and cutthroat trout, and is used as rearing habitat by juvenile coho, steelhead and cutthroat trout. Changes in channel morphology in S2 affect S1. A debris jam that developed at the confluence of S2 and S1 affects flows in both channels. In 2002 most of the flow was deflected into S1.	Logging impacts: low. Increases in peak flows may have increased bedload movement.	1. Could consider modifying the debris jam at M10 to split the flow between S1 and S2 to reduce the effects of increased peak flows as a result of upslope logging. 2. Maps should be updated in 3 to 5 years. 3. Monitor fish use, adult and juvenile.
S1.1	S1.1 is distributary to S1 and flows into the eastside of Cheewhat Lake. Overview #2 and Sheet #1	S1.1 is predominantly glide pool habitat with a mean gradient of 2%. Substrate was mainly gravel with high fine content in the lower 50 m. The lower 50 m was dewatered with 2 isolated pools. Coho fry were observed throughout with >100 observed in the glide approximately 100 m upstream of the mouth. This channel has good spawning and rearing habitat. The channel is aggraded in the lower 50 m.	Logging impacts: impacts are low for this channel. Increases in peak flows may have increased bedload movement.	1. Monitor fish use, adult and juvenile
S – 2	Mouth to S-2 Fence. S-2 flows into the east side of Cheewhat Lake. Overview #2, Sheet #1	This area is low gradient (<1.0%) with gravel and sand substrate. The banks are low and are bordered by old growth forest and flood plain. This area is severely aggraded and de-waters during low flow periods; there is no rearing capacity in this section of channel. This channel segment also experiences high deposition of sediment from upstream sources. Incubation success could be affected as a result of aggrading and the subsequent de-watering during the incubation period. Impact would be at its highest during fry emergence.	Logging impacts: This section of S2 is low gradient and a sediment storage area. Flows are generally insufficient to transport deposited material out into the lake. An increase in sediment transport from upstream sources has led to increases in material deposited in this area. The pool below the S2 fence has < 50% of its pre-logging volume. Increased peak flows from harvesting in upper S2 and its tributaries have affected the channels downstream of the harvested area.	1. Monitor fish use.

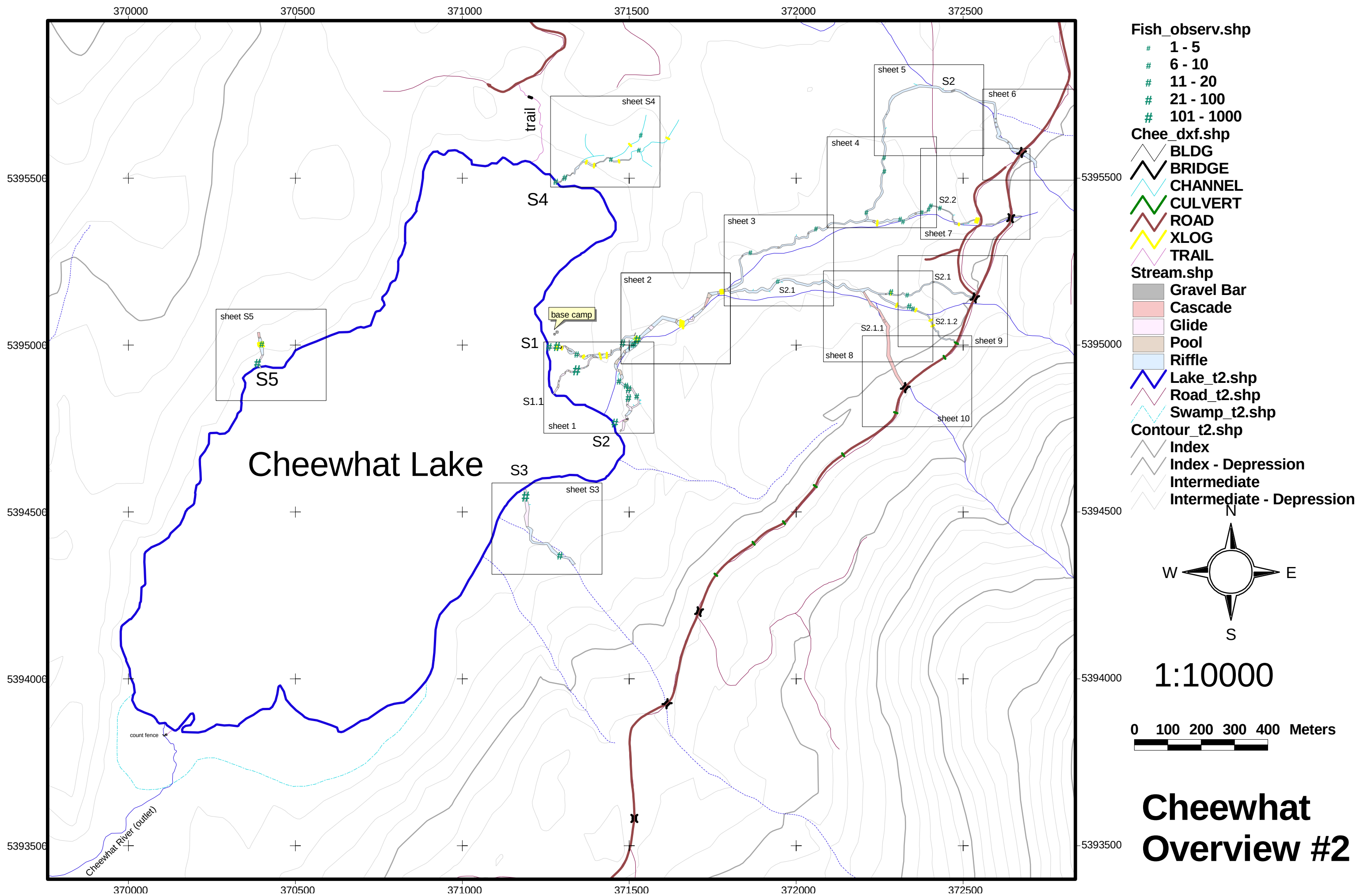
S - 2	S-2 Fence to M-10 and S2S, Overview #2, Sheets 1 and 2	This area has a mean gradient of 2.1% (range 0.5 to 4.0 %) with gravel, sand and cobble substrate. The channel is bordered by old growth forest and comprised of riffle/pool, glide/pool habitat. Instream cover is comprised of LWD, cutbanks and tree roots. Cutbanks are extensive with some extending >10 m. under the forest floor. Habitat quantity and quality is rated as moderate for spawning and rearing. Of the entire anadromous habitat in S1 and S2 this area of S2 has experienced the greatest impacts from logging the upslope areas (including the riparian zone) of S2 and its tributaries.	Logging Impacts: Increased peak flows from harvesting in upper S2 and its tributaries have affected the channels downstream of the harvested area. The effects of increased peak stream flows has been an increase in bedload movement, channel aggrading, avulsions, bank erosion and infilling of pools. In some areas pools have been in-filled while in other areas pool volume has been reduced.	1. Need to address impacts in upslope areas.
S2	S2-M10 to S2-M17+50. Overview #2, Sheet 2.	This section of S2 has a mean gradient of 4.0% (range: 1.0 to 10%) with dominant and subdominant substrate composition varying from gravel/cobble to boulder/gravel. This section of channel is bordered by old growth forest and is primarily riffle habitat. Habitat quality and quantity for rearing is low for pool dependent species (coho and cutthroat) and mod-high for riffle dependent species (steelhead). Spawning habitat quality and quantity was mod-high from M10 to M14 and low M14 to M17. Instream cover is comprised of boulders, LWD and overhanging vegetation. LWD frequency is poor, but given the higher gradient in this section LWD probably has limited function in channel structure, where as from M10 to M14 LWD would be important in creating and maintaining fish habitat (ie. scour pools). In general bank height is sufficient to contain the stream during periods of flood. Above M14 cascades/riffles/glides and pools characterize the channel. The cascade above M17 is the upper limit of anadromous fish distribution. From M16 to M17+ 50m is in a bedrock canyon. The cascade is step pool habitat with a gradient > 40% (maximum gradient was 60% at the upstream end of the cascade). Prior to 1989 the upper limit of fish distribution was M16, there was no fish use (anadromous or resident) above this point. In 1989 the first barrier to fish migration (3.0m high debris jam and 50 m sediment wedge upstream of the debris jam) collapsed during a severe storm event. Since this event cutthroat trout have colonized the area above M17 + 50m. The presence of cutthroat was first observed in 1995. No anadromous fish have been observed in this area.	Logging impacts in this area include increased input of sediment, infilling of pools and loss of functional LWD. The most significant impact in this area was when the dam-break flood in 1989. The transport of materials from above M16 buried all habitat between M15 and M16, infilled pools downstream of M15 and created a debris jam at M10 that has affected flow patterns in lower S2 and S1 since. Although the channel between M15 and M16 is showing signs of recovery, it will take years possibly decades before this area is as productive for spawning and rearing as it was pre logging.	Should investigate whether it is feasible to create access for anadromous fish to fish habitat upstream of the cascade at M17+50.
S2	Area above M17 + 50m to the Rosander Mainline logging road. Overview 2, Sheets 3, 4, 5 and 6.	This area starts immediately above the bedrock controlled cascade. Habitat in this 1.5 km stretch of channel is predominantly riffle. In aggraded sections flow was subsurface (Photo points 1.26, 1.27 and 1.28). Pool frequency is low and pools are generally small (<3 m long) and shallow (<0.5 m deep). Riparian vegetation and streamside shrubs (ie salal) provide good crown cover in the old growth section of upper S2 (end of Sheet #4). Above the National Park Reserve Boundary riparian vegetation is predominantly Alder and shrubs (ie salmon berry). Cutthroat trout were visually observed in S2 to the end of Map Sheet #4. Minnow traps set in S-2 (See Map Sheet #4) confirmed fish observed visually were Cutthroat Trout. Substrate varies from gravel/ cobble, cobble/gravel to boulder/cobble. The area above and immediately below the Rosander Main wood culvert is high gradient with predominantly boulder substrate (Photo Points 1.30 and 1.31 and Sheets 5 and 6)	Logging Impacts: High. Severe aggradation, channel widening, channel shifting, infilling of pools, loss of bank stability from logging of channel banks. Inadequate riparian vegetation for bank stability. Loss of functioning LWD.	A prescription should be developed to address the logging impacts below the Rosander Mainline. The channel should be redefined with a series of riffles and pools. The right bank should be stabilized to keep flows from flowing toward Sprise Lake. A geo-technical assessment of the area should be done to determine the source(s) of sediment and determine if upslope areas are stable enough to proceed with instream works below the Rosander Mainline logging road. A riparian prescription to promote growth of conifers should be developed. For example thinning stands of alders and some planting of conifers may be required.

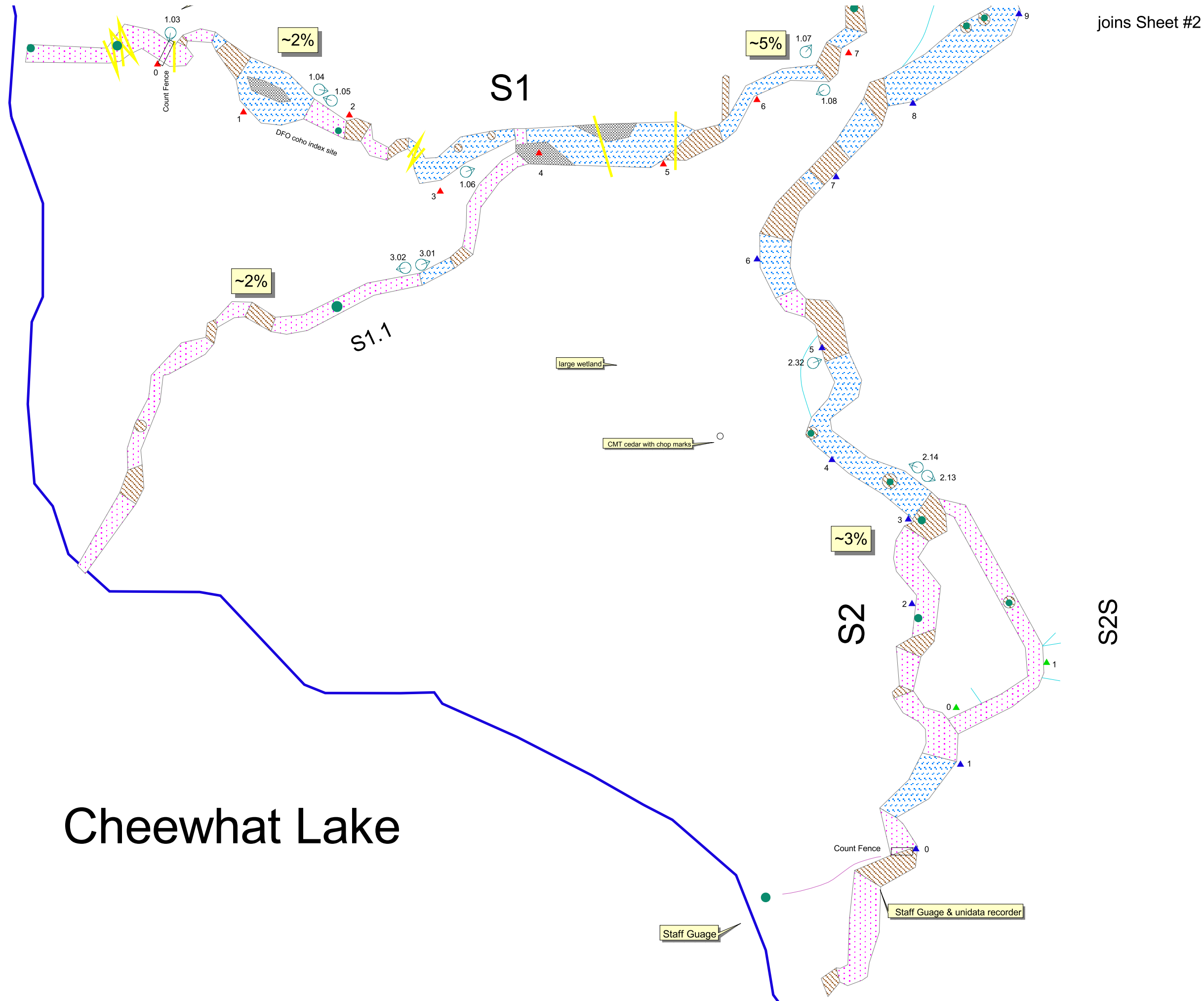
S2.1	Mouth to Rosander Mainline. Overview 2, Sheets 3, 8 and 9	S2.1 is a tributary to S2. The tributary is high energy. The confluence of this tributary and S2 is located above the upper limit of anadromous fish distribution (Cheewhat Overview #2 and Sheets 3, 8 and 9). The channel is predominantly riffle with a few small pools. In aggraded sections flow was subsurface (photo point 1.17). Substrate varies from cobble/boulder to boulder/cobble. Mean gradient varied from 7% to 12%. Cutthroat trout were distributed throughout this tributary. The upper limit of fish distribution is the Rosander Mainline logging road.	Logging impacts in this tributary include increased input of sediment and infilling of pools.	
S2.1.1	Flows into S2.1 left bank. Overview #2, Sheets 8 and 10.	This is a high gradient boulder cascade with a mean gradient of 19%. This channel was de-watered at the time of the survey and has limited fish value.	Stream flow in this tributary is sufficient to transport all sediment and debris contributed to this channel to fish habitat downstream. Proposed logging in the upslope area of this tributary must consider the potential impacts of sediment transport to fish habitat downstream.	
S2.1.2	Flows into S2.1 left bank. Overview #2, Sheets 8 and 10.	This tributary is high gradient (approximately 14%) riffle/ cascade habitat with a few small pools. Cutthroat trout were observed in this tributary. See sheet #8 for locations of fish observations. This tributary has limited fish value. Substrate is predominantly boulder and cobble.	Logging impacts: Increase in channel sediment from original logging of the channel banks.	
S2.2	Flows into S2 left bank. Overview #2, Sheets 4 and 7.	This tributary has a mean gradient of 10% and is predominantly riffle habitat with a few small pools (<4.0 m long and <0.75 m deep). Substrate is gravel/cobble in the lower section of the channel and changes to boulder/cobble as we moved upstream toward the Rosander Mainline Logging road. Riparian vegetation would have limited function in limiting lateral erosion in the logged area. Riparian vegetation above the confluence with S2 is old growth and therefore adequate to limit bank erosion. Cutthroat trout were found distributed throughout this channel to below the old spur road. Access above this point would be impeded by poor culverting in the spur road. Above the Rosander mainline logging road the gradient climbs to >20%. There were numerous ground water sources entering this tributary.	Logging impacts include minor bank erosion and infilling of pools. Poor culverting on the spur road impedes passage of fish.	The spur road should be de-activated at the creek crossing.
S3	S3 drains into the east side of Cheewhat Lake. Overview #2 Sheet Cheewhat S3	Cheewhat S3 is predominantly riffle/glide habitat in the lower 180m and above this habitat is predominantly step pool morphology. Glide habitat was deep (> 1.0m) in the lower section. The glide section has some small pool and short riffle habitat dispersed throughout. For purposes of this project the locations of small habitat units were not referenced due in part to difficulty in getting GPS fixes in some areas. S3 supports small populations of spawning sockeye and spawning and rearing coho salmon and cutthroat trout. The lower 180 meters flows through a flood plain while the area above is confined by bedrock. LWD in the lower 180 m is important in formation of pools. The area surveyed is in old growth forest. Water depths in riffle habitat was shallow (<15cm) and pools were < 0.5m in depth. Mean gradient was approximately 1.0% for the glide section and 10% for the riffle section. Substrate varied from gravel and sand in lower areas of channel to boulder and cobble in the upper sections of the area surveyed. In general, the stream habitat is limited in both spawning and rearing	Logging impacts are channel aggrading, channel widening and infilling of pools in the lower 180 m. Impacts are the result of upslope logging and increased peak flows.	

S4	Drains into the north end of Cheewhat Lake. Overview #2 and Sheet Cheewhat S4.	<p>S4 is a small drainage that is predominantly riffle habitat with a few small pools and glides dispersed throughout. There were numerous small pools too small to map that showed signs of infilling. Overall pool quality was poor. Mean gradient was 5.0% (range 0.5% to 15.0%). This channel provides limited amounts of spawning and rearing habitat and is in general of poor quality. Substrate composition was predominantly large and small gravel in the lower section of the channel and small cobble/gravel above 0+160 m. Instream cover was primarily overhanging vegetation and cutbanks with some LWD distributed throughout. Coho and cutthroat use this channel for spawning and rearing. Observations of fish use show this channel to support only small populations of fish. Very few fish were observed during the survey.</p> <p>S4 fish habitat is in general of poor quality as it lacks many of the important habitat features (deep pools and LWD) important to pool dependent fish species such as coho salmon and cutthroat trout. Riparian zone in the surveyed area is old growth forest.</p> <p>Three groundwater fed tributaries drain into S4. Accessible habitat was rated as poor and gradients increased to >20% over a short distance.</p> <p>The upslope areas of the drainage have been logged above the Pacific Rim National Park Reserve.</p>	Logging impacts in the surveyed areas of S4 are low-moderate. Impacts include channel aggrading and infilling of pools.	Complexing the mainstem should be considered.
S5	Drains into the west side of Cheewhat Lake. Overview #2 and Sheet Cheewhat S5	<p>S5 is a small sub-basin in the Cheewhat Lake watershed. The mean gradient of the area surveyed was 7%. This tributary has approximately 105 m of accessible fish habitat. Accessible fish habitat is riffle glide habitat with one pool at the base of the cascades, which is the upper limit of fish distribution. Gradient above the cascade is >45%. In general the channel provides good rearing habitat but very limited spawning potential.</p>	No logging impacts	

**Attachment I –
Cheewhat Lake Fish Habitat Maps**







joins Sheet #2

Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- BLDG
- BRIDGE
- CHANNEL
- CULVERT
- ROAD
- XLOG
- TRAIL

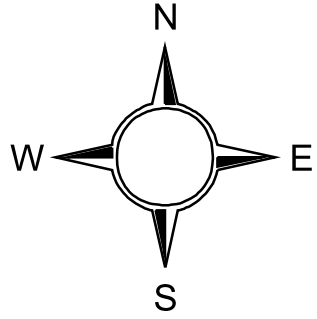
Count.shp

- S1
- S2
- S2S

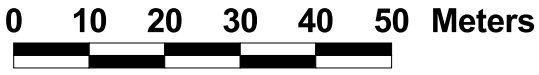
Photo.shp

Stream.shp

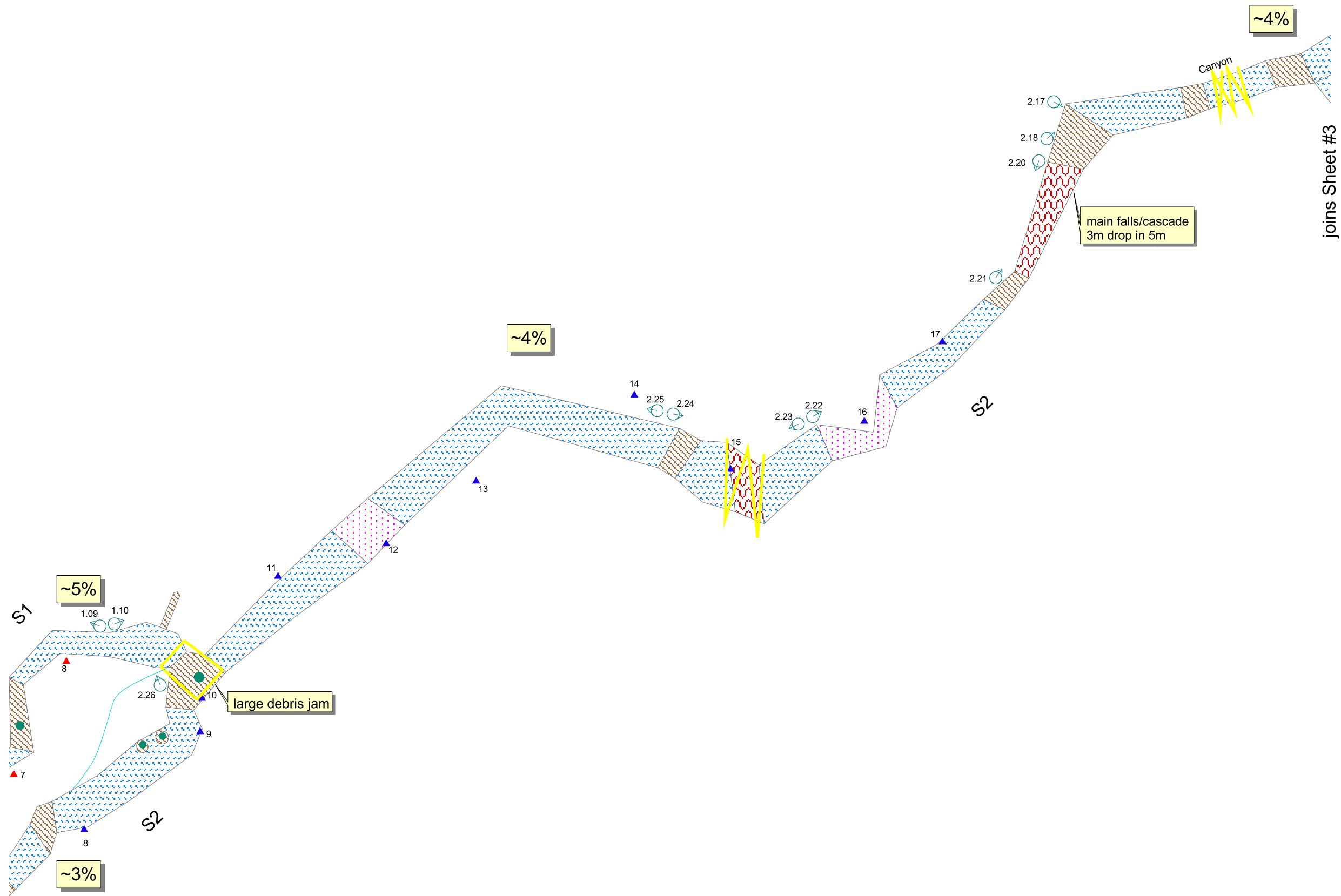
- Gravel Bar
- Cascade
- Glide
- Pool
- Riffle
- Lake_t2.shp
- Road_t2.shp
- Swamp_t2.shp



1:1000



**Cheewhat
S1 & S2
Sheet #1**



Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- BLDG
- BRIDGE
- CHANNEL
- CULVERT
- ROAD
- XLOG
- TRAIL

Count.shp

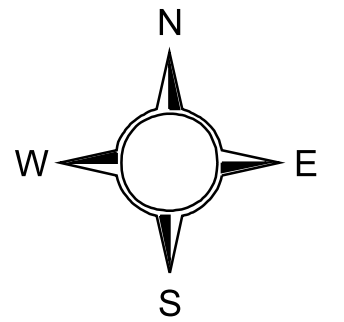
- S1
- S2
- S2S

Photo.shp

Stream.shp

- Gravel Bar
- Cascade
- Glide
- Pool
- Riffle

- Lake_t2.shp
- Road_t2.shp
- Swamp_t2.shp

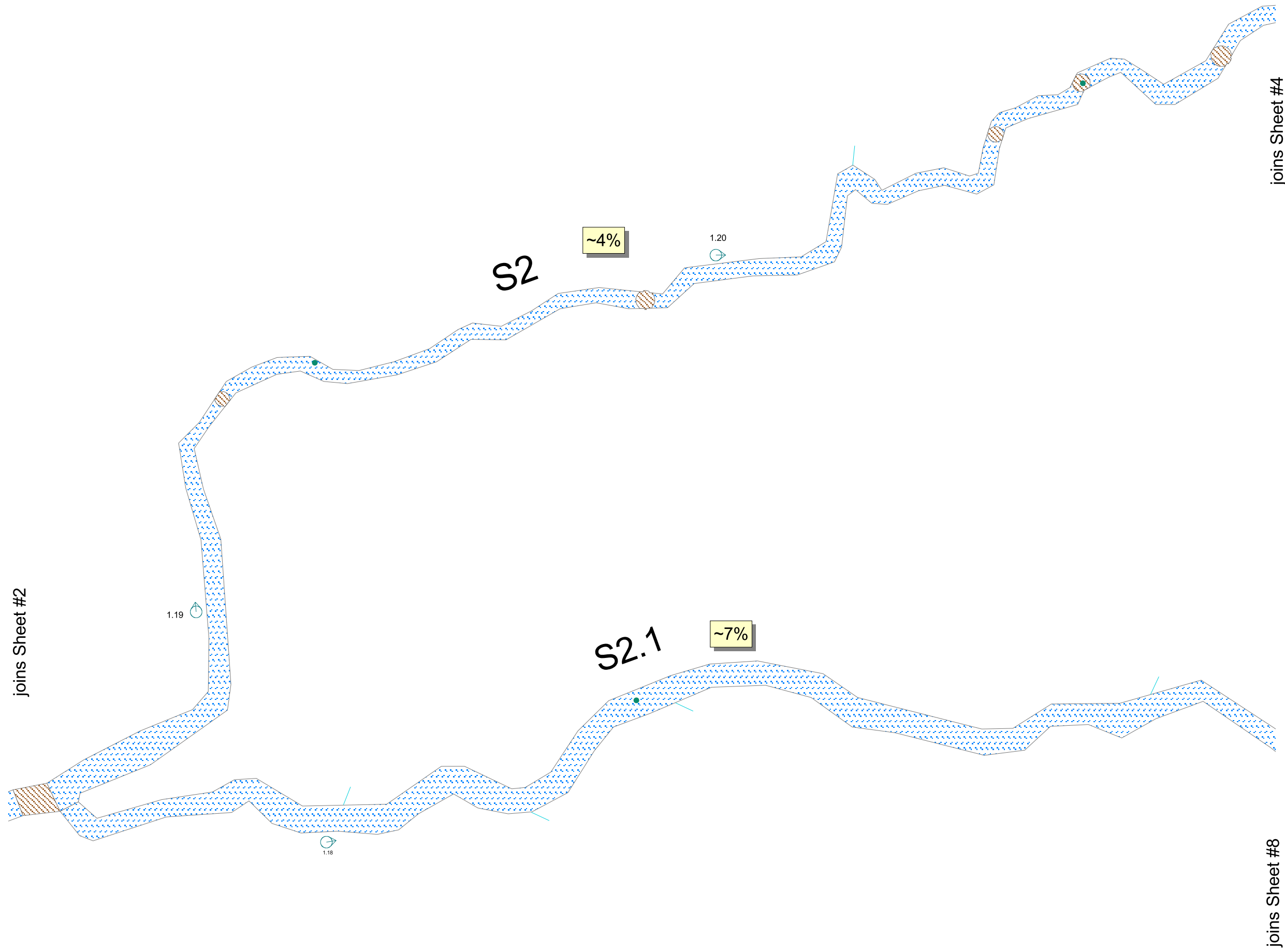


1:1000

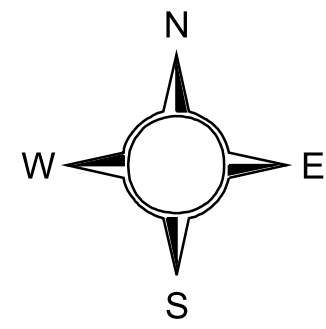
0 10 20 30 40 50 Meters

**Cheewhat
S1 & S2
Sheet #2**

joins Sheet #1



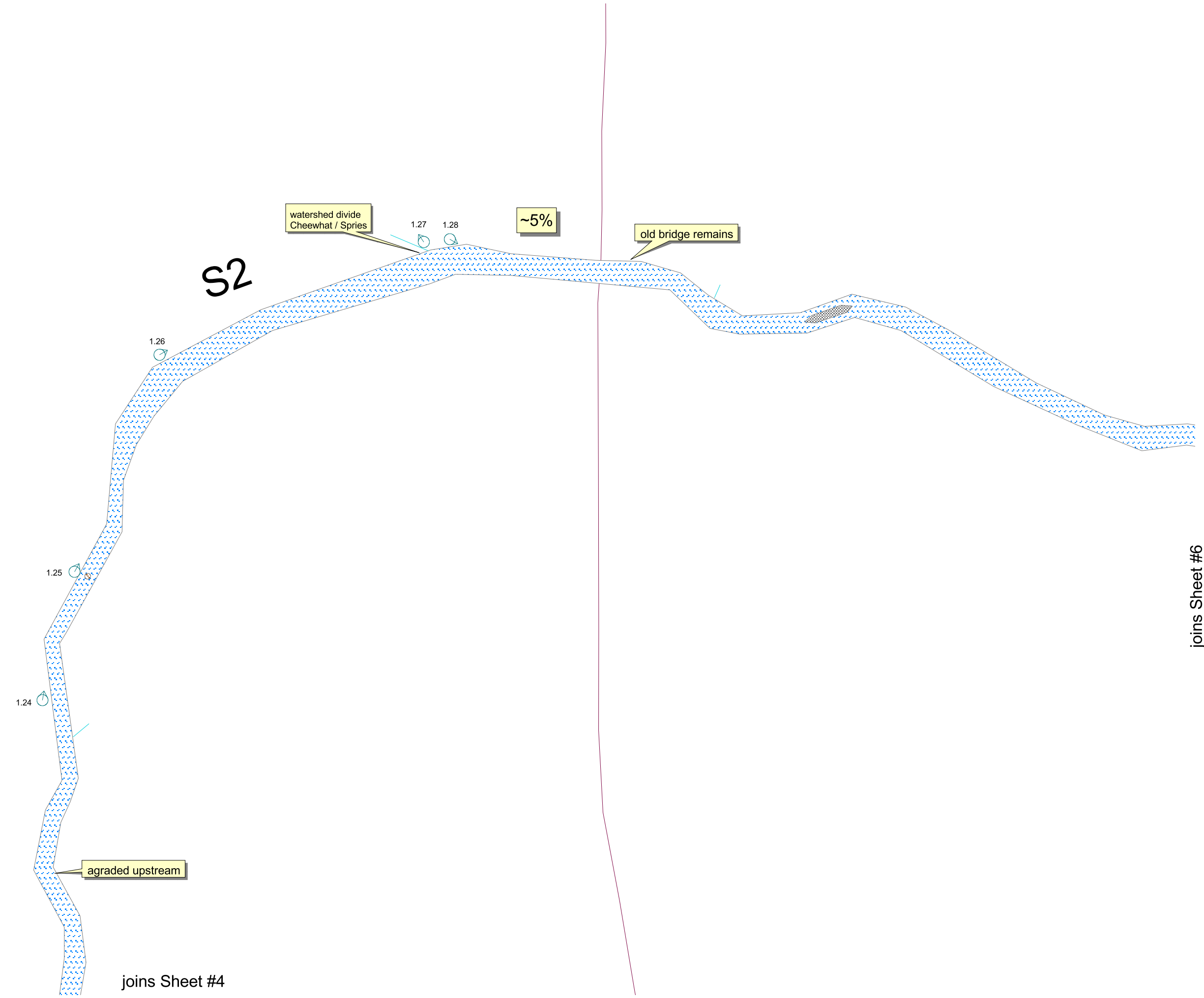
- Fish_observ.shp**
- 1 - 5
 - 6 - 10
 - 11 - 20
 - 21 - 100
 - 101 - 1000
- Chee_dxf.shp**
- BLDG
 - BRIDGE
 - CHANNEL
 - CULVERT
 - ROAD
 - XLOG
 - TRAIL
- Count.shp**
- S1
 - S2
 - S2S
- Photo.shp**
- Stream.shp**
- Gravel Bar
 - Cascade
 - Glide
 - Pool
 - Riffle
- Lake_t2.shp**
- Road_t2.shp**
- Swamp_t2.shp**



1:1000



Cheewhat S1 & S2 Sheet #3

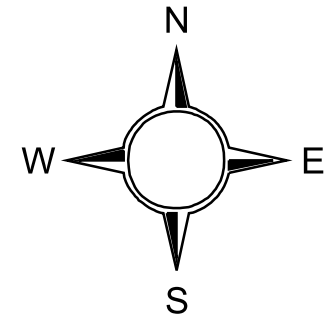


- Fish_observ.shp
- 1 - 5
 - 6 - 10
 - 11 - 20
 - 21 - 100
 - 101 - 1000

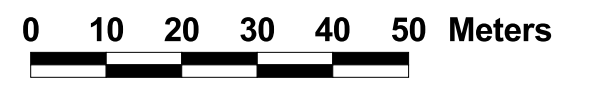
- Chee_dxf.shp
- BLDG
 - BRIDGE
 - CHANNEL
 - CULVERT
 - ROAD
 - XLOG
 - TRAIL

- Count.shp
- S1
 - S2
 - S2S

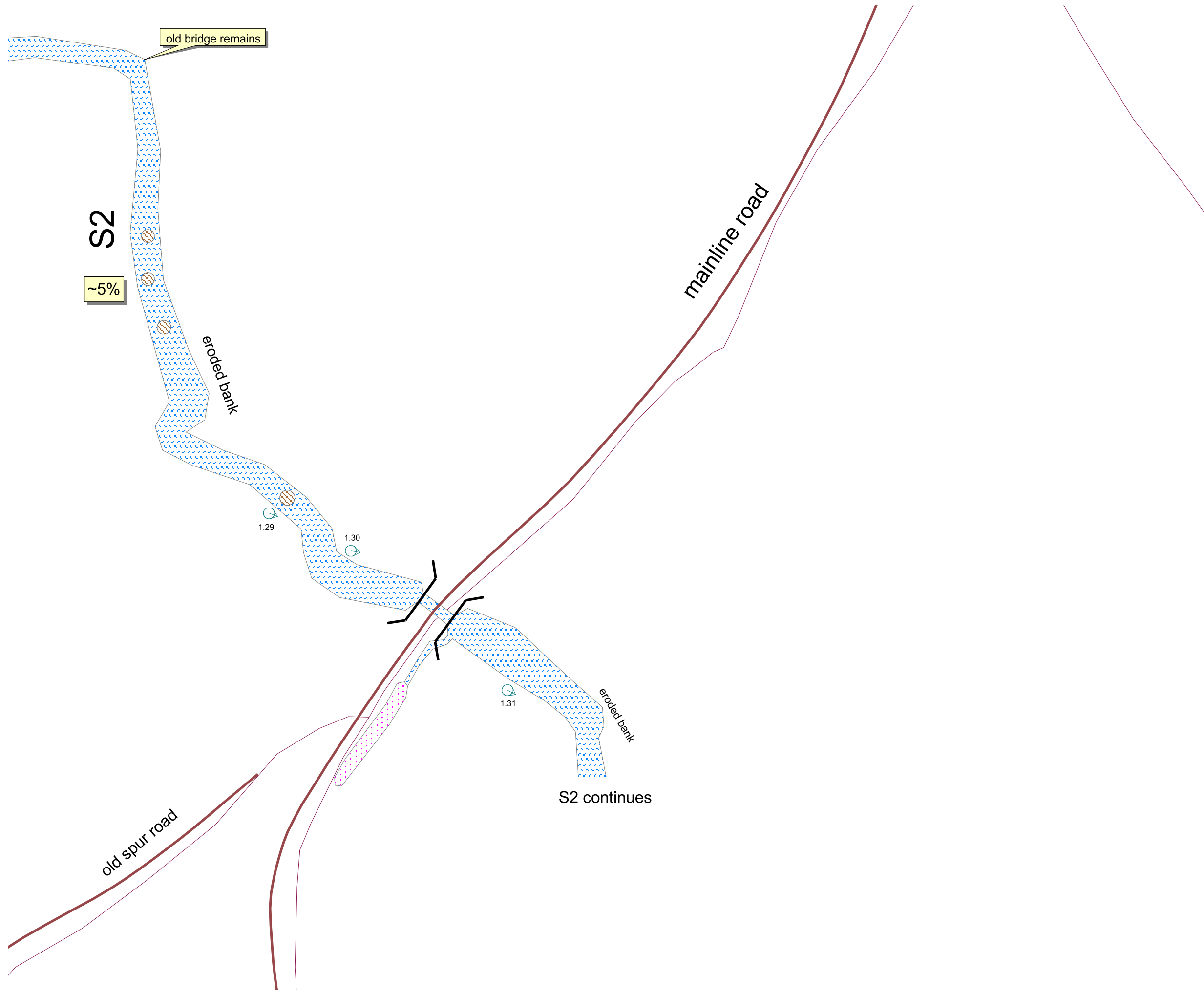
- Photo.shp
- Stream.shp
- Gravel Bar
 - Cascade
 - Glide
 - Pool
 - Riffle
- Lake_t2.shp
- Road_t2.shp
- Swamp_t2.shp



1:1000



Cheewhat S1 & S2 Sheet #5



Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- BLDG
- BRIDGE
- CHANNEL
- CULVERT
- ROAD
- XLOG
- TRAIL

Count.shp

- S1
- S2
- S2S

Photo.shp

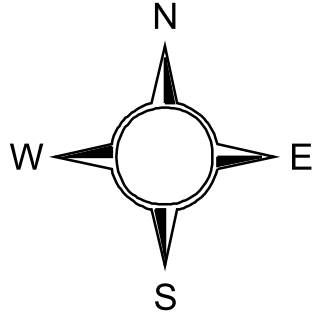
Stream.shp

- Gravel Bar
- Cascade
- Glide
- Pool
- Riffle

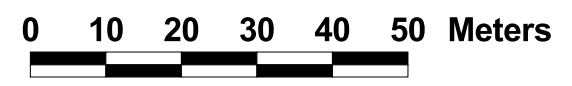
Lake_t2.shp

Road_t2.shp

Swamp_t2.shp



1:1000



Cheewhat

S1 & S2

Sheet #6

joins Sheet #6

S2

old spur road

mainline road

S2.2 continues

S2.2

~10%

3.01

Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- 
- BLDG
BRIDGE
CHANNEL
CULVERT
ROAD
XLOG
TRAIL

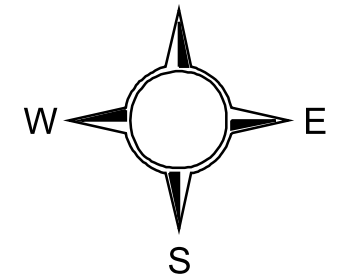
Count.shp

- ▲ S1
- ▲ S2
- ▲ S2S



- Stream.shp**
-  **Gravel Bar**
-  **Cascade**
-  **Glide**
-  **Pool**
-  **Riffle**
-  **Lake_t2.shp**
-  **Road_t2.shp**
-  **Swamp_t2.shp**

N

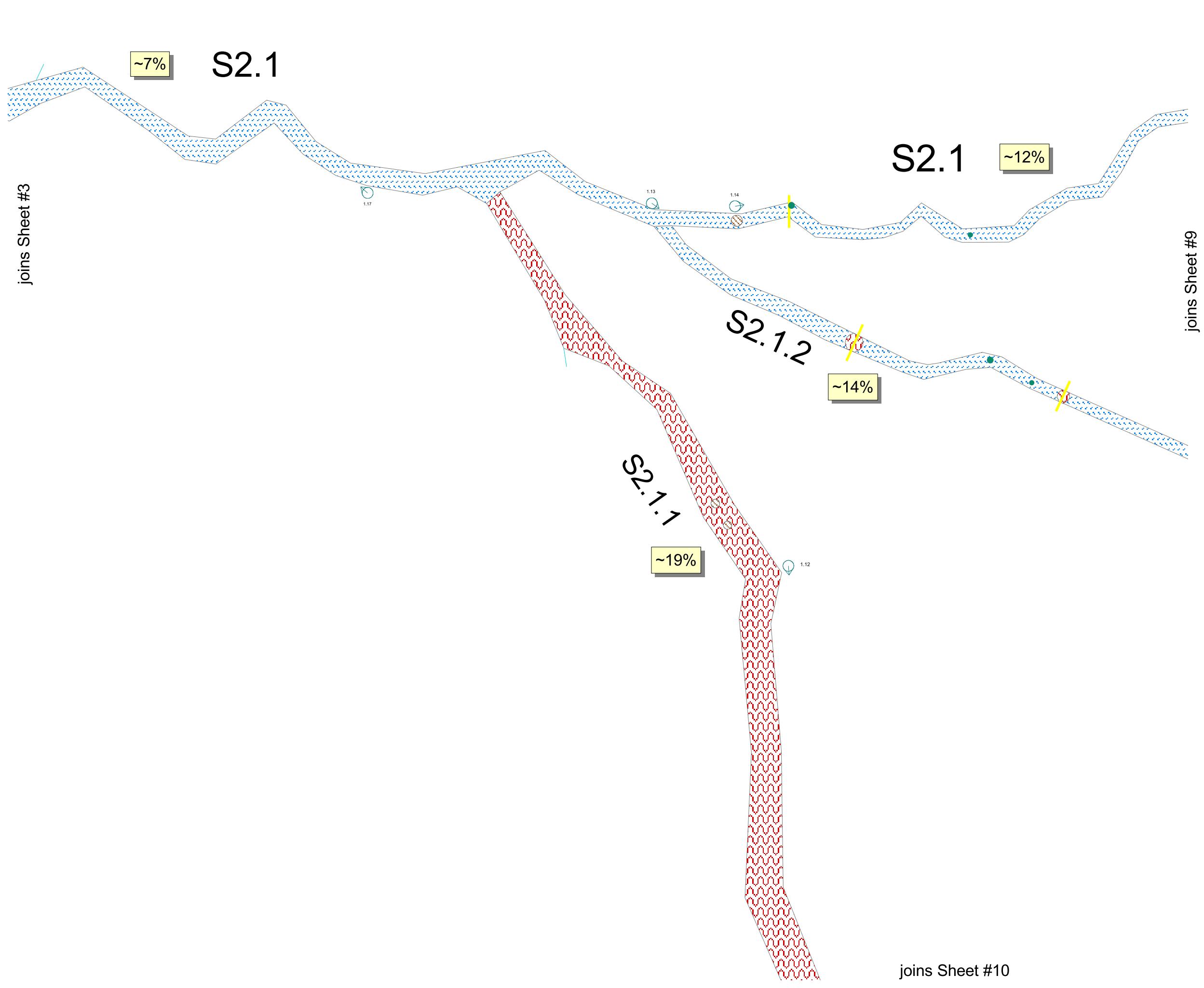


1:1000

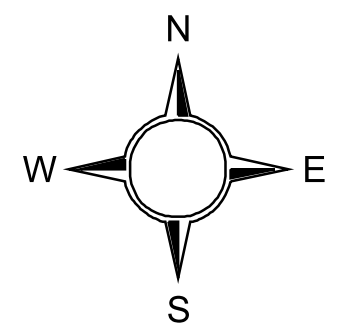
0 10 20 30 40 50 Meters

Cheewhat S1 & S2 Sheet #7

joins Sheet #4



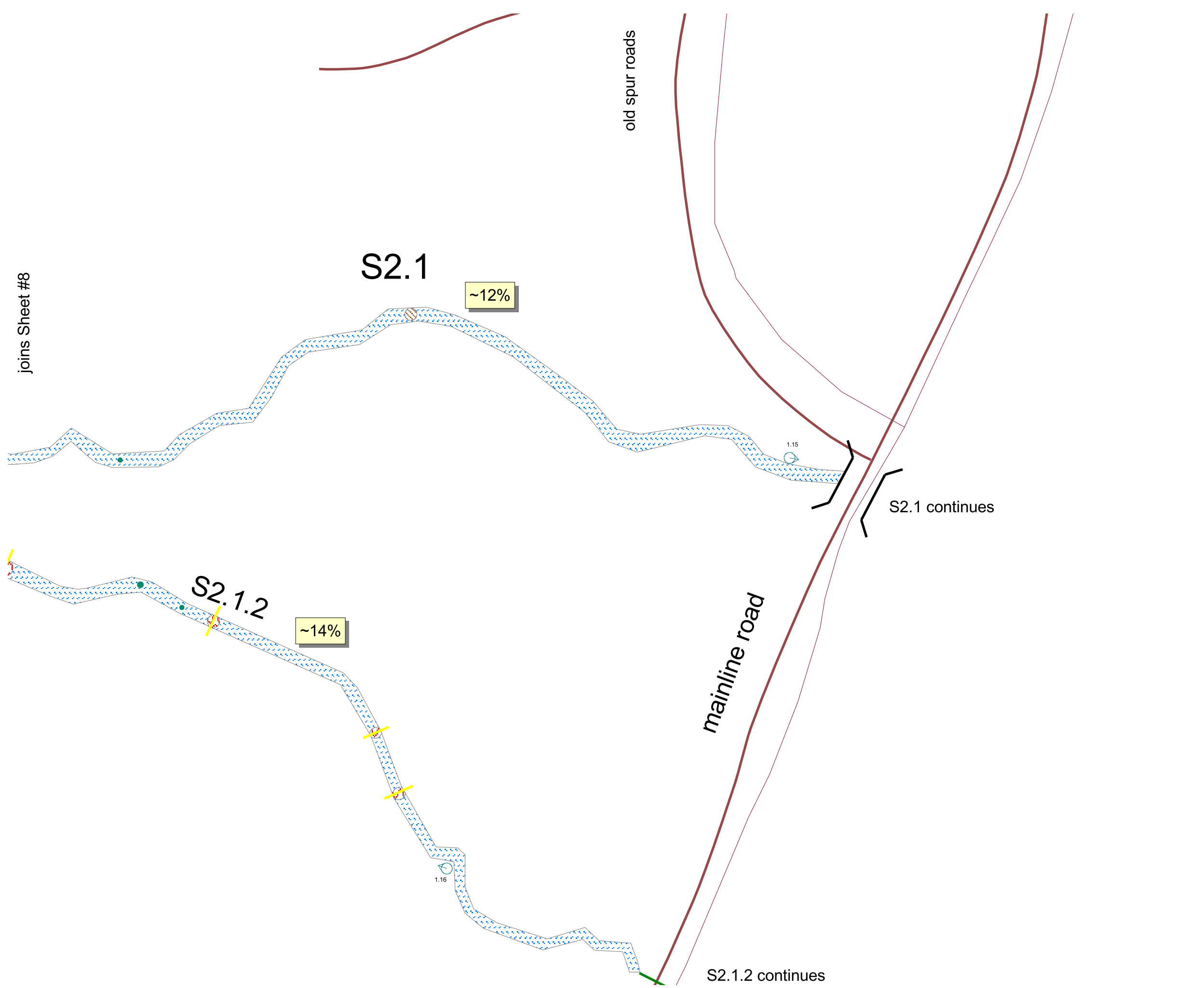
- Fish_observ.shp**
- 1 - 5
 - 6 - 10
 - 11 - 20
 - 21 - 100
 - 101 - 1000
- Chee_dxf.shp**
- BLDG
 - BRIDGE
 - CHANNEL
 - CULVERT
 - ROAD
 - XLOG
 - TRAIL
- Count.shp**
- S1
 - S2
 - S2S
- Photo.shp**
- Stream.shp**
- Gravel Bar
 - Cascade
 - Glide
 - Pool
 - Riffle
- Lake_t2.shp**
- Road_t2.shp**
- Swamp_t2.shp**



1:1000



Cheewhat
S1 & S2
Sheet #8



joins Sheet #8

S2.1

~12%

S2.1.2

~14%

old spur roads

mainline road

S2.1 continues

S2.1.2 continues

Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- BLDG
- BRIDGE
- CHANNEL
- CULVERT
- ROAD
- XLOG
- TRAIL

Count.shp

- S1
- S2
- S2S

Photo.shp

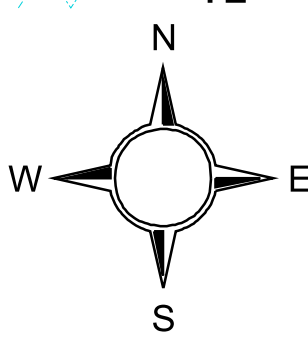
Stream.shp

- Gravel Bar
- Cascade
- Glide
- Pool
- Riffle

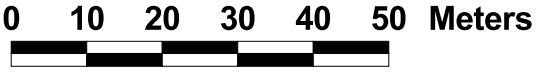
Lake_t2.shp

Road_t2.shp

Swamp_t2.shp

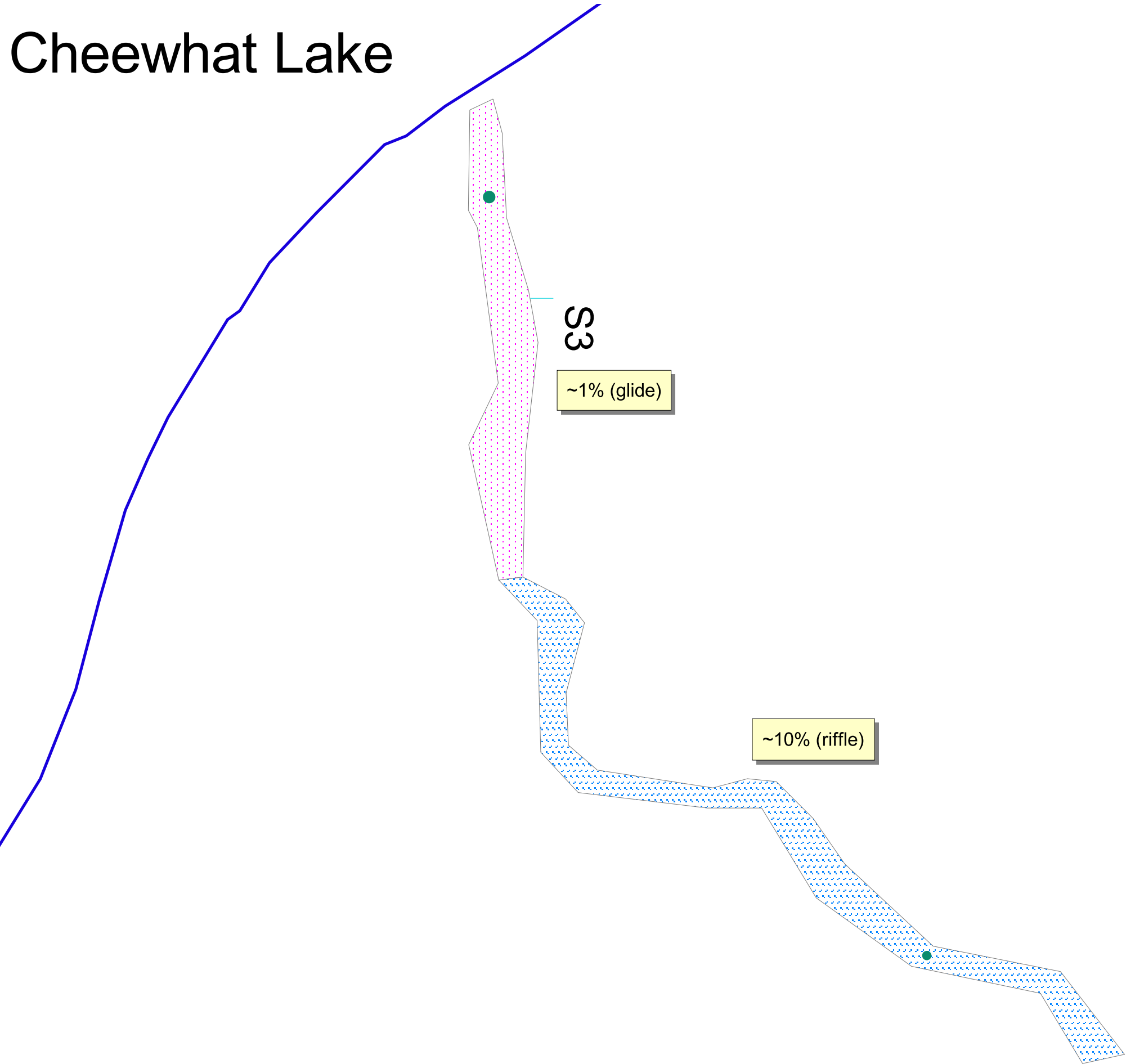


1:1000



Cheewhat
S1 & S2
Sheet #9

Cheewhat Lake



Fish_observ.shp

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 100
- 101 - 1000

Chee_dxf.shp

- BLDG
- BRIDGE
- CHANNEL
- CULVERT
- ROAD
- XLOG
- TRAIL

Count.shp

- S1
- S2
- S2S

Photo.shp

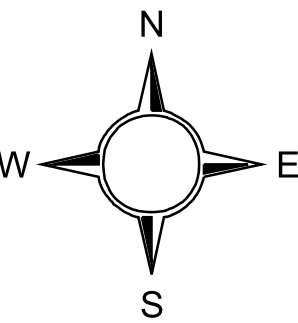
Stream.shp

- Gravel Bar
- Cascade
- Glide
- Pool
- Riffle

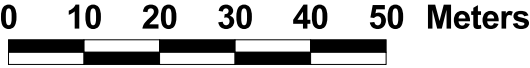
Lake_t2.shp

Road_t2.shp

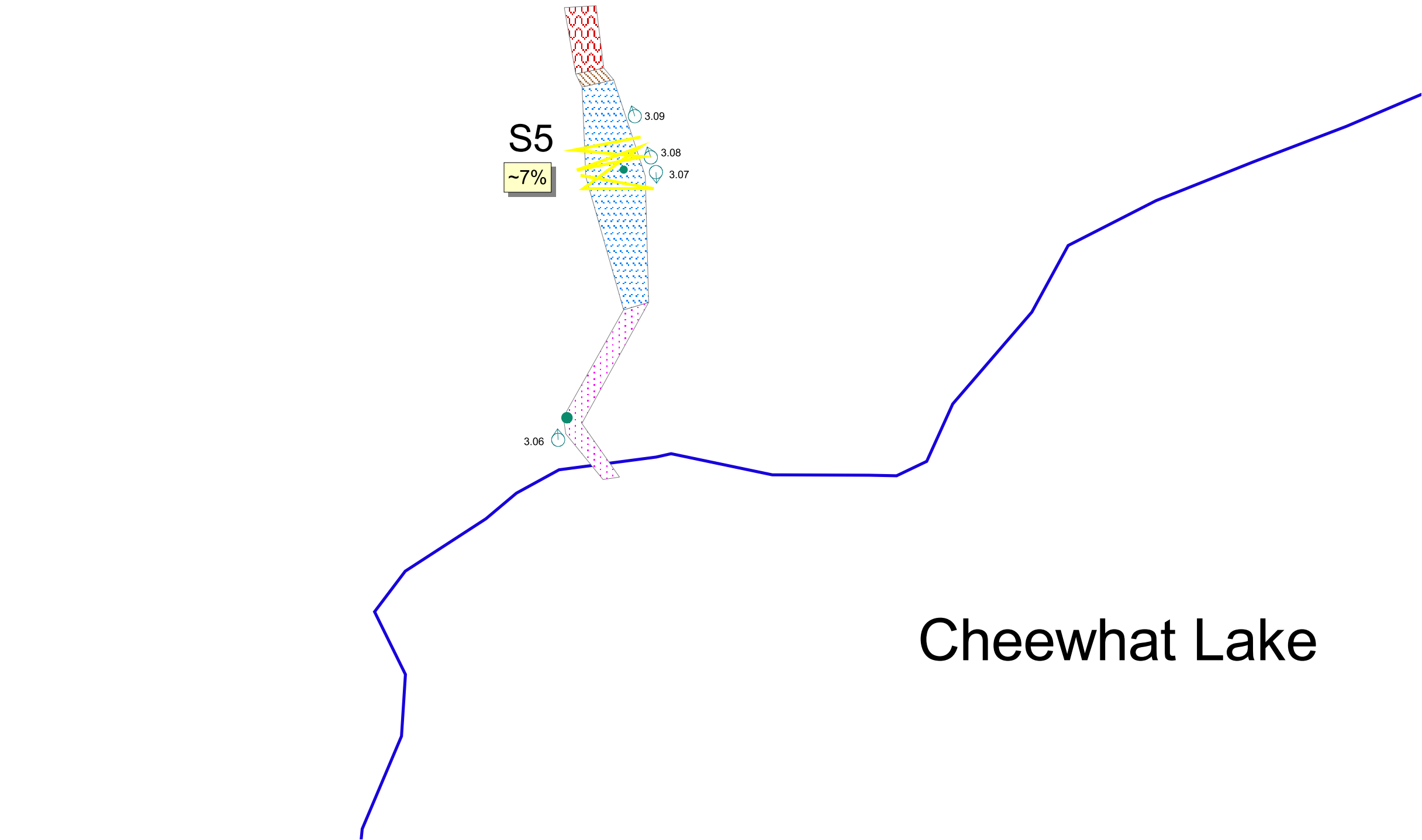
Swamp_t2.shp



1:1000



Cheewhat
S3



- Fish_observ.shp**
- 1 - 5
 - 6 - 10
 - 11 - 20
 - 21 - 100
 - 101 - 1000

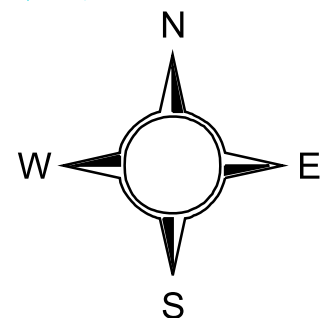
- Chee_dxf.shp**
- BLDG
 - BRIDGE
 - CHANNEL
 - CULVERT
 - ROAD
 - XLOG
 - TRAIL

- Count.shp**
- S1
 - S2
 - S2S

- Photo.shp**

- Stream.shp**
- Gravel Bar
 - Cascade
 - Glide
 - Pool
 - Riffle

- Lake_t2.shp**
- Road_t2.shp
 - Swamp_t2.shp



1:1000



**Cheewhat
S5**

**Attachment II –
Photographs of Cheewhat Lake Fish Habitat**

Location: Cheewhat Lake, old DFO Base Camp	Stream: near S-1	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: manual  1.1	Plate 1.1 Reference:
Description: This photograph was taken looking East at bearing 60° at the old tent platform located near S-1 at Cheewhat Lake. This tent platform remains in this location from an old Department of Fisheries and Oceans Base Camp.		



Plate 1.1

Location: Cheewhat Lake, old DFO Base Camp	Stream: near S-1	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: manual  1.2	Plate 1.2 Reference: Map Sheet #1
Description: This photograph was taken looking 160° at the cookshack located near S-1 at Cheewhat Lake. This building is part of the remains of an old Department of Fisheries and Oceans Base Camp.		



Plate 2.2

Location: Cheewhat Lake	Stream: S-1	 1.03	Map Sheet Reference: Overview Sheet #2
Photo Point: (GPS)			Plate 1.03 Reference: Map Sheet #1
Gradient:			
Description: This photograph was taken looking left to right at the S-1 Fence and the old storage shed.			



Plate 1.03

Location: Cheewhat Lake	Stream: S-1 Photo Point: (GPS)  1.04	Map Sheet Reference: Overview Sheet #2
Gradient: mean 1.0%		Plate 1.04 Reference: Map Sheet #1
Description: This photograph was taken looking upstream towards Counting Station #2. Counting Station #2 is visible on the left.		



Plate 1.04

Location: Cheewhat Lake	Stream: S-1		Map Sheet Reference: Overview Sheet #2
Gradient: mean 1.0%	Photo Point: (GPS) 1.05		Plate 1.05 Reference: Map Sheet #1
Description: This photographs was taken looking downstream at a riffle section of S-1.			



Plate 1.05

Location: Cheewhat Lake	Stream: S-1 Photo Point: (GPS)  1.06	Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%		Plate 1.06 Reference: Map Sheet #1
Description: This photograph was taken looking upstream at riffle/pool habitat between Counting Markers 3 and 4.		



Plate 1.06

Location: Cheewhat Lake	Stream: S-1		Map Sheet Reference: Overview Sheet #2	
Gradient: mean 5.0%	Photo Point: (GPS)		1.07	Plate 1.07 Reference: Map Sheet #1
Description: This photograph was taken looking upstream at a pool associates with rootwads and LWD.				



Plate 1.07

Location: Cheewhat Lake	Stream: S-1 Photo Point: (GPS)  1.08	Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%		Plate 1.08 Reference: Map Sheet #1
Description: This photograph was taken looking downstream at a riffle on S-1.		



Plate 1.08

Location: Cheewhat Lake	Stream: S-1		1.09	Map Sheet Reference: Overview Sheet #2
Gradient: mean 3.0%	Photo Point: (GPS)			Plate 1.09 Reference: Map Sheet #2
Description: This photograph was taken looking downstream at a riffle section on S-1. Overhanging vegetation is visible and consists of ferns, devils club and various mosses and lichens.				



Plate 1.09

Location: Cheewhat Lake	Stream: S-1		Map Sheet Reference: Overview Sheet #2
Gradient: mean 3.0%	Photo Point: (GPS) 1.10		Plate 1.10 Reference: Map Sheet #1
Description: This photograph was taken looking upstream at a riffle on S-1 below the confluence of S-1 and S-2.			



Plate 1.10

Location: Cheewhat Lake	Stream: Upper S-2 at a barrier	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GSP)  1.11 and 1.12	Plate 1.11 Reference: Map Sheet #10
		Plate 1.12 Reference: Map Sheet #8
Description: The following plates show Upper S-2 above the barrier noted on Overview Sheet #2. This photograph was taken looking downstream at Tributary S-2.1.1. This tributary was a long high energy cascade that was de-watered at the time. Plate 1.12 is a photograph looking upstream at the channel on Tributary S-2.1.1. This tributary has limited fish value.		



Plate 1.11.



Plate 1.12.

Location: Cheewhat Lake	Stream: S-2.1		1.13	Map Sheet Reference: Overview Sheet #2
Gradient: mean 12.0%	Photo Poi (GPS)			Plate 1.13 Reference: Map Sheet #8
Description: This photograph was taken looking upstream at a boulder section of S-2.1.				



Plate 1.13

Location: Cheewhat Lake	Stream: S-2.1		Map Sheet Reference: Overview Sheet #2
Gradient: mean 12.0%	Photo Poir (GPS) 1.14		Plate 1.14 Reference: Map Sheet #8
Description: This photograph was taken looking upstream and shows a riffle and a Ditidaht Fisheries Technician.			



Plate 1.14

Location: Cheewhat Lake	Stream: S-2.1		Map Sheet Reference: Overview Sheet #2
	Photo Point: (GPS)		Plate 1.15 Reference: Map Sheet #9
Gradient: mean 12.0%		1.15	
Description: This photograph was taken looking upstream at a riffle and wood culvert on the Rosander Main Logging Road.			



Plate 1.15

Location: Cheewhat Lake	Stream: S-2.1.2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 14.0%	Photo Point: (GPS) 1.16		Plate 1.16 Reference: Map Sheet #9
Description: This photograph was taken looking downstream at a riffle section of S-2.1.2.			



Plate 1.16

Location: Cheewhat Lake	Stream: S-2.1		Map Sheet Reference: Overview Sheet #2
	Photo Point: (GSP) 1.17		Plate 1.17 Reference: Map Sheet #8
Gradient:			
Description: This photograph was taken looking at a de-watered section of S-2.1.			



Plate 1.17

Location: Cheewhat Lake	Stream: S-2.1		Map Sheet Reference: Overview Sheet #2
	Photo Poi (GSP) 1.18		Plate 1.18 Reference: Map Sheet #3
Gradient:			
Description: This photograph was taken looking upstream at S-2.1 and shows boulder/cobble substrate built up behind a piece of LWD. Note the presence of a shallow pool downstream of the LWD.			



Plate 1.18

Location: Cheewhat Lake	Stream: S-2 Photo Point: (GSP)  1.19	Map Sheet Reference: Overview Sheet #2
Gradient:		Plate 1.19 Reference: Map Sheet #3
Description: This photograph was taken looking upstream at a riffle section on S-2 approximately 60 meters upstream of the confluence of S-2.1 and S-2.		



Plate 1.19.

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview Sheet #2
Gradient: mean 4.0%	Photo Point: (GSP)  1.20	Plate 1.20 Reference: Map Sheet #3
Description: This photograph was taken looking upstream at a riffle section on upper S-2.		



Plate 1.20

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 4.0%	Photo Point: (GSP) 1.21		Plate 1.21 Reference: Map Sheet #4
Description: This photograph was taken looking downstream at riffle habitat in S-2.			



Plate 1.21.

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
	Photo Point: (GSP) 1.22		Plate 1.22 Reference: Map Sheet #4
Gradient:			
Description: This photograph shows the dense vegetation at S-2.			



Plate 1.22

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 1.0%	Photo Point: (GPS) 1.23		Plate 1.23 Reference: Map Sheet # 5
Description: This photograph shows pool habitat with large and small gravels and a plunge pool on the downstream end of the riffle. There is good overhanging vegetation and small cuttbanks on both sides of the channel.			



Plate 1.23

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS) 1.24		Plate 1.24 Reference: Map Sheet # 5
Description: This photograph was taken looking upstream at a section of S-2. There has been extensive downcutting. The banks have a good mix of gravel and small cobble substrate.			



Plate 1.24

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2	
	Photo Point: (GPS)		Plate 1.25 Reference: Map Sheet # 5	
Gradient: mean 5.0%				
Description: This photograph was taken looking upstream to show the de-watered pool associated with the root system of a spruce tree on S-2.				



Plate 1.25

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS)		Plate 1.26 Reference: Map Sheet # 5
Description: This photograph shows a severely aggraded area of S-2 which has an accumulation of cobble, gravel cobble and fines over woody debris. The channel has little or no definition and is a major flood plain area. The channel is braided and has been severely impacted by past logging practices. There are indications that a landslide has caused several avulsions. This picture was taken looking upstream.			



Plate 1.26

Location: Cheewhat Lake	Stream: S-2	 1.27	Map Sheet Reference: Overview Sheet #2
Gradient: mean 3.0 to 5.0%	Photo Point: (GPS)		Plate 1.27 Reference: Map Sheet # 5
Description: This photograph was taken looking northwest towards Sprise Lake and shows the area where S-2 splits and part of it flows to Sprise Lake. Cobble and gravel were dispersed throughout this area. Very high flows have occurred in this area and it is severely aggraded. Past logging has had a major impact. Flows are generally sub-surface during low flow periods.			



Plate 1.27

Location: Cheewhat Lake	Stream: S-2	 1.28	Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS)		Plate 1.28 Reference: Map Sheet # 5
Description: This is a high energy area of S-2. There has been signs of down-cutting of the channel. This area has been severely impacted by past logging. A berm could be built to focus flows down S-2 instead of loosing some of the flow to Sprise Lake. A prescription is required.			



Plate 1.28

Location: Cheewhat Lake	Stream: S-2		Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS) 1.29		Plate 1.29 Reference: Map Sheet # 6
Description: This photograph shows a plunge pool on S-2 below the Rosander Mainline. No fish were observed.			



Plate 1.29

Location: Cheewhat Lake	Stream: S-2	 1.30	Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS)		Plate 1.30 Reference: Map Sheet # 6
Description: This photograph was taken looking upstream at the wood culvert on the Rosander Main Logging Road above Cheewhat Lake. The culvert is under sized for the channel. The culvert measurement was 1.5 meters high by 2.9 meters wide.			

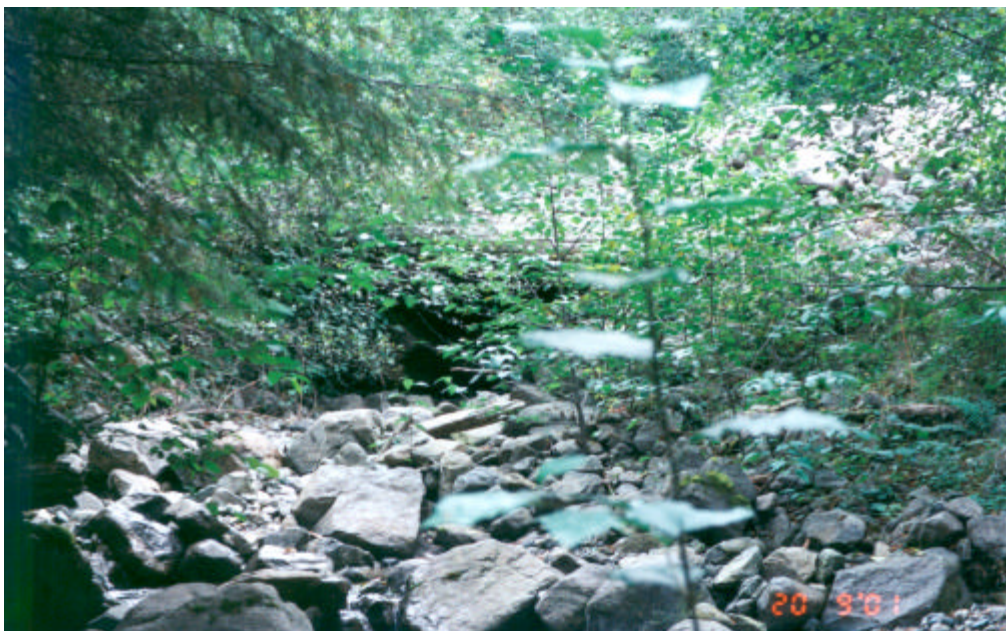


Plate 1.30

Location: Cheewhat Lake	Stream: S-2		1.31	Map Sheet Reference: Overview Sheet #2
Photo Point: (GPS)				Plate 1.31 Reference: Map Sheet # 6
Gradient: mean 8.5%				
Description: This photograph shows a de-watered section of Upper S-2 above the Rosander Main Logging Road. Flow is sub-surface for a distance of 223 meters upstream of the culvert crossing.				



Plate 1.31.

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview #2
Gradient:	Photo Point: (GSP)  2.13 and 2.14	Plate 2.13 Reference: Sheet #1
Description: These photographs were taken upstream of the confluence of S-2 and S-2S (side channel). Plate 2.13 was taken looking downstream at riffle/pool habitat in the side channel. Plate 2.14 was taken looking upstream at a riffle section of lower S-2. Pools in this area have infilled post logging of upper S-2.		Plate 2.14 Reference: Sheet #1



Plate 2.13.



Plate 2.14.

Location: Cheewhat Lake	Stream: S-2.1	Map Sheet Reference: Overview #2
Gradient: mean 7.0%	Photo Point: Manual  2.15	Plate 2.15 Reference: Map Sheet #3
Description: This photograph was taken looking upstream at S-2.1 from the confluence of S-2 and S-2.1. It was taken on a bearing of 120°.		



Plate 2.15.

Location: Cheewhat Lake	Stream: S-2 above the barrier	Map Sheet Reference:
Gradient: mean 4.0%	Photo Point: Manual  2.16	Plate 2.15 Reference:
Description: This photograph was taken looking downstream at S-2 from the confluence of S-2 and S-2.1. This photograph was taken at a bearing of 248 ^o .		



Plate 2.16.

Location: Cheewhat Lake	Stream: S-2 above the barrier	Map Sheet Reference: Overview Sheet #2
Gradient: mean 4.0%	Photo Point: (GPS) A 2.17 and 2.18	Plate 2.17 Reference: Map Sheet #2
Description: Plate 2.17 was taken looking from left to right at a plunge pool above the barrier. Plate 2.18 was taken looking upstream at a pool associated with LWD in S-2 at a bearing of 63 0. Habitat in this area had good complexity with cover in the form of LWD and overhanging vegetation and plunge pools.		Plate 2.18 Reference: Map Sheet #2

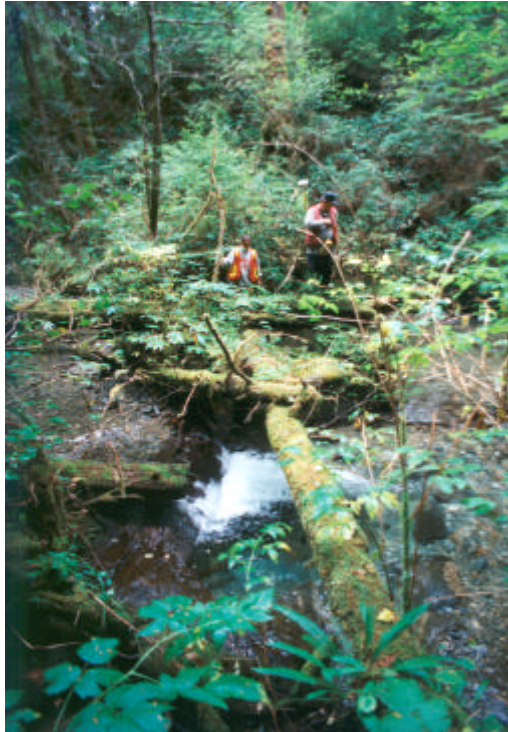


Plate 2.17.



Plate 2.18.

Location: Cheewhat Lake	Stream: S-2 above the barrier	Map Sheet Reference: Overview Sheet #2
Gradient: mean 4.0%	Photo Point: Manual  2.19	Plate 2.19 Reference: Map Sheet #2
Description: Plate 2.19 was taken looking upstream at a plunge pool above the barrier in S-2 at a bearing of 90°. Habitat in this area had good complexity with cover in the form of LWD and overhanging vegetation in the form of LWD and overhanging vegetation and plunge pools.		



Plate 2.19.

Location: Cheewhat Lake	Stream: S-2		2.20	Map Sheet Reference:	Overview Sheet #2
Gradient: mean 6.0%	Photo Poir (GPS)			Plate 2.20 Reference:	Map Sheet #2
Description: This photograph was taken looking downstream from the top of the falls/cascade section of S-2.					



Plate 2.20.

Location: Cheewhat Lake	Stream: S-2 below the barrier	Map Sheet Reference: Overview Sheet #2
Gradient: mean 21.0%	Photo Poir (GPS)  2.21	Plate 2.21 Reference: Map Sheet #2
Description: This photograph was taken looking upstream at the falls/cascade section of S-2. Cutthroat were observed in the pool at the base of this cascade. This section is a bedrock canyon.		



Plate 2.21.

Location: Cheewhat Lake	Stream: S-2 below the barrier	Map Sheet Reference: Overview Sheet #2
Gradient: mean 2.0%	Photo Point: (GPS)  2.22	Plate 2.22 Reference: Map Sheet #2
Description: This photograph was taken looking upstream at the channel in S-2.		



Plate 2.22.

Location: Cheewhat Lake	Stream: S-2 below the barrier	Map Sheet Reference: Overview Sheet #2
Gradient: mean 5.0%	Photo Point: (GPS)  2.23	Plate 2.23 Reference: Map Sheet #2
Description: This photograph was taken looking downstream at a cobble riffle section in S-2 at a bearing of 244 ⁰ .		



Plate 2.23

Location: Cheewhat Lake	Stream: S-2 Photo Point: (GPS)  2.24	Map Sheet Reference: Overview Sheet #2 Plate 2.24 Reference: Map Sheet #2
Gradient: mean 4.0%		
Description:	This photograph was taken looking upstream at a riffle/pool section of S-2.	



Plate 2.24

Location: Cheewhat Lake	Stream: S-2 Photo Point: Manual  2.25	Map Sheet Reference: Overview Sheet #2
Gradient:		Plate 2.25 Reference: Map Sheet #2
Description: This photograph was taken looking upstream at a riffle section of S-2.		



Plate 2.25

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview Sheet #2
Gradient: 3.0 to 4.0% mean	Photo Point: Manual  2.26	Plate 2.26 Reference: Map Sheet #2
Description: This photograph was taken looking downstream at the debris jam at the confluence of S-1 and S-2. The photograph was taken ~ 5.0 meters upstream of the debris jam. The riparian zone consists of first growth cedar and hemlock. Streamside vegetation consists of devils club, salmon berry and fern.		



Plate 2.26.

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview Sheet #2
Gradient: mean 4.0%	Photo Point: Manual  2.27	Plate 2.27 Reference: Map Sheet #2
Description: This photograph was taken looking upstream from the debris jam at marker 10.		



Plate 2.27

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview Sheet #2
	Photo Point: (GPS)  2.28	Plate 2.28 Reference: Map Sheet #2
Gradient:		
Description:	This photograph was taken looking left to right and down onto the debris jam at the confluence of S-1 and S-2.	



Plate 2.28

Frame 29

Location: Cheewhat Lake	Stream:	
	Photo Point:	
Gradient:		
Description: This photograph shows a view of the shoreline of Cheewhat Lake near the mouth of S-4, its shows the Ditidaht crew and the GPS Instructor.		



Plate 29.

Location: Cheewhat Lake	Stream: S-2	Map Sheet Reference: Overview Sheet #2
Gradient: mean 3.0%	Photo Point:	Plate 30 Reference: Map Sheet 1
Description: This photograph was taken looking upstream at the channel from mid channel at marker 5 on S-2.		



Plate 30.

Location: Cheewhat Lake	Stream: Between S-1 and S-2	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)  2.34 and 2.35	Plate 2.34 Reference: Map Sheet #1
		Plate 2.35 Reference: Map Sheet #1
Description: Plate 2.34 provides a view of the cedar stump found at Cheewhat Lake which was felled for carving a canoe. This was found amongst old growth forest. Plate 2.35 shows the same stump from a different perspective. Both photographs show the technician Perry Edgar geo-referencing the stump with GPS.		



Plate 2.34



Plate 2.35

Location: Cheewhat Lake	Stream: Between S-1 and S-2	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)  2.36	Plate 2.36 Reference: Map Sheet #1
Description: A view of the culturally modified tree found at Cheewhat Lake. It is suspected that the tree was felled for making a dug out canoe. Chop marks were evident.		



Plate 2.36.

Location: Cheewhat Lake	Stream: S-2.2		3.01	Map Sheet Reference: Overview Sheet #2
Gradient: mean 10.0%	Photo Point: (GPS)			Plate 3.01 Reference: Map Sheet #7
Description: This photograph was taken looking upstream at a riffle section.				



Plate 3.01

Location: Cheewhat Lake	Stream: S-2.2	 3.02	Map Sheet Reference: Overview Sheet #2
Gradient: mean 10.0%	Photo Point: (GPS)		Plate 3.02 Reference: Map Sheet #4
Description: This photograph was taken looking downstream at S-2.2.			



Plate 3.02

Location: Cheewhat Lake	Stream: S-2.2 Photo Point: (GPS)  3.03	Map Sheet Reference: Overview Sheet #2
Gradient: mean 10.0%		Plate 3.03 Reference: Map Sheet #4
Description: This photograph was taken at the confluence of S-2 and S-2.2 and looks upstream at a shallow riffle section of S-2.		



Plate 3.03

Location: Cheewhat Lake	Stream: Cheewhat River	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)  3.04	Plate 3.04 Reference:
Description: This photograph was taken from the left bank of the Cheewhat River and shows the Cheewhat River Fence.		



Plate 3.04

Location: Cheewhat Lake	Stream: Cheewhat River	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)  3.05	Plate 3.05 Reference:
Description: This photograph was taken from the left bulkhead of the Cheewhat River Fence and looks across the fence to work/storage shed.		



Plate 3.05

Location: Cheewhat Lake	Stream: S-5 Photo Point: (GPS)  3.06	Map Sheet Reference: Overview Sheet #2
Gradient:		Plate 3.06 Reference: Cheewhat S-5
Description: This photograph was taken looking upstream at a glide section of S-5.		



Plate 3.06

Location: Cheewhat Lake	Stream: S-5 Photo Point: (GPS)  3.07	Map Sheet Reference: Overview Sheet #2
Gradient: mean 7.0%		Plate 3.07 Reference: Cheewhat S-5
Description: This photograph was taken looking downstream at a debris jam of S-5.		



Plate 3.07

Location: Cheewhat Lake	Stream: S-5		Map Sheet Reference: Overview Sheet #2
Gradient: mean 7.0%	Photo Point: (GPS) 3.08		Plate 3.08 Reference: Cheewhat S-5
Description: This photograph was intended to be a view looking upstream at the debris jam on S-5.			



Plate 3.08

Location: Cheewhat Lake	Stream: S-5	 3.09	Map Sheet Reference: Overview Sheet #2
Gradient: mean 8.0%	Photo Point: (GPS)		Plate 3.09 Reference: Cheewhat S-5
Description: This photograph was taken looking upstream at a cascade/pool section of s-5. Beyond this point the channel continued to climb. The gradient was estimated at >45.0%.			



Plate 3.09

Location: Cheewhat Lake	Stream:	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: manual  3.10	Plate 3.10 Reference:
Description: This photograph provides a view of Cheewhat lake looking West.		



Plate 3.10

Location: Cheewhat Lake	Stream: S-4	 3.11	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)		Plate 3.11 Reference: Cheewhat Sheet S-4
Description: This photograph was taken at the mouth of S-4.			



Plate 3.11

Location: Cheewhat Lake	Stream: S-4	 3.12	Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS)		Plate 3.12 Reference: Cheewhat Sheet S-4
Description: This photograph was taken to show the dense vegetation along the streambanks of S-4.			



Plate 3.11

Location: Cheewhat Lake	Stream: S-4		Map Sheet Reference: Overview Sheet #2
Gradient:	Photo Point: (GPS) 3.13		Plate 3.13 Reference: Cheewhat Sheet S-4
Description: This photograph shows a riffle/pool section of S-4.			



Plate 3.13