Regional Operational Plan SF.1J.2013.17

Operational Plan: Thorne River Streamgage

by

Jason Hass

November 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN SF.1J.2013.17

THORNE RIVER STREAMGAGE

by

Jason Hass

Alaska Department of Fish and Game, Sport Fish Division, Douglas

Alaska Department of Fish and Game
Sport Fish Division

November 2013

The Regional Operational Plan Series was established in 2012 to archive and provide public access to operational plans for fisheries projects of the Divisions of Commercial Fisheries and Sport Fish, as per joint-divisional Operational Planning Policy. Documents in this series are planning documents that may contain raw data, preliminary data analyses and results, and describe operational aspects of fisheries projects that may not actually be implemented. All documents in this series are subject to a technical review process and receive varying degrees of regional, divisional, and biometric approval, but do not generally receive editorial review. Results from the implementation of the operational plan described in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author if you have any questions regarding the information provided in this plan. Regional Operational Plans are available on the Internet at: http://www.adfg.alaska.gov/sf/publications/

Jason Hass,
Alaska Department of Fish and Game, Division of Sport Fish,
PO Box 110024, Douglas, AK 99824-0020

This document should be cited as:
Hass, J. 2013. Thorne River streamgage. Alaska Department of Fish and Game, Division of Sport Fish, Regional Operational Plan ROP.SF.1J.2013.17, Anchorage.

Signature Page

Project Title:	Thorne River Streamgage
Project leader(s):	Jason Hass
Division, Region and Area:	Sport Fish, Region 4
Project Nomenclature:	
Period Covered:	08/23/2013 to 12/01/2018 -
Field Dates:	08/23/2013 to 10/01/2017
Plan Type:	Category I

Approval

Title	Name	Signature	Date
Project leader	Jason Hass	Jason Hass	11/20/2013
Research Coordinator	Joe Klein	Joseph P Klein	11/21/2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PICTURES

LIST OF APPENDICES

ABSTRACT

This project will collect the streamflow data necessary to file reservations of water on four reaches within the Thorne River watershed. These reservations of water will protect instream flows necessary for anadromous fish habitat, migration, and propagation. A streamgage was installed on the Thorne River and three discharge stations were established on tributaries to the Thorne River on August 23, 2012. The streamgage and discharge stations will be visited at least six times per year over a range of streamflows. The streamgage and discharge stations will remain in operation until September 30, 2017 or until five complete water years of streamflow data have been collected. Streamflow data from the streamgage will be reduced into a continuous streamflow record for the Thorne River. Instantaneous discharge measurements taken at the discharge stations will be regressed against corresponding discharge values at the streamgage to estimate a record of continuous streamflow at the discharge stations. The streamflow data will be used to file reservation of water applications with the Department of Natural Resources to protect streamflows in the Thorne River, Goose Creek, Rio Beaver, and the North Thorne River.

Keywords: Thorne River, Goose Creek, Rio Beaver, North Thorne River, reservation of water, instream flow, streamgage, discharge

PURPOSE

Alaska's rivers and lakes support some of North America's most viable and productive salmon fisheries. Over 17,000 streams, rivers, or lakes have been identified throughout the state as being important for spawning, rearing or migration of anadromous fish (Klein 2012). Fish migration, spawning, rearing, and ultimately production in these water bodies are dependent upon sufficient seasonal quantities of water. Demand for water to support hydroelectric power generation, petroleum production, mining, water supply (including out-of-state export), residential, forestry, agriculture, and other projects have the potential to modify the naturally occurring instream flows to which fish have adapted to and are dependent upon (Poff et al. 1997).

The Fish and Game Act requires the Alaska Department of Fish and Game (ADF&G), to "...manage, protect, maintain, improve, and extend the fishery resources of the state in the interest of the economy and general well-being of the state" (Alaska Statute 16.05.020; AS). One mechanism ADF&G uses to fulfill its mandate is to reserve water in rivers and lakes for fish and wildlife. An appropriation of water that remains within a river is legally defined under Alaskan law (AS 46.15.145) and regulations (11 AAC 93.970) as a reservation of water. To reserve water, an application with supporting data and analyses must be submitted to the Alaska Department of Natural Resources (DNR). A minimum of five years of mean daily flow data is recommended by DNR to quantify instream flow requirements within an application. A reservation of water application must contain supporting data and analyses that demonstrate the need for the amount of water being requested.

The State of Alaska Legislature amended the Alaska Water Use Act in 1980 to allow instream flows to be legally reserved by a private individual, group, or government agency in order to maintain specific flow rates in a river or volumes and water levels in a lake during specified time periods for one or a combination of four types of uses:

- protection of fish and wildlife habitat, migration, and propagation;
- recreation and parks purposes;
- navigation and transportation purposes; and
- sanitary and water quality purposes.

Priority dates for reservation of water applications are based on the date that they are accepted by the DNR. Alaska water law is based on the doctrine of prior appropriation also known as "first in time first in right". According to the rules of prior appropriation, the right to the full volume of water is first given to the appropriator who has the earliest priority date to beneficially use the water. Senior water right holders have a legal standing to assert their rights against conflicting uses of water from others who do not have a water right or who are junior in priority.

In 2004, the Thorne River was selected through a process of regional staff scoping by Region 1 ADF&G Division of Sport Fish staff as a candidate for a reservation of water (Klein 2012). The streamflow data necessary to file a reservation of water does not exist for the Thorne River. This project will collect the streamflow data necessary to file four reservation of water applications with the DNR to reserve streamflows within four reaches of the Thorne River watershed.

This operational plan serves to provide project-specific information and rationale to supplement the Surface-Water Data Manual for the Statewide Aquatic Resources Coordination Unit (SARCU; Klein 2013).

OBJECTIVE

The objective of this project is to collect the streamflow data necessary to file four reservation of water applications to reserve instream flows within one reach of the Thorne River and three reaches on tributaries to the Thorne River. Two tasks are necessary to complete this objective and include:

Tasks

1. Install and operate a stream gaging network to quantify streamflows within the Thorne River watershed. The network includes one streamgage and three discharge stations that can be correlated to the streamgage to obtain five years of streamflow records for each study reach; and

2. Complete and file four reservation of water applications for four reaches within the Thorne River watershed in order to protect anadromous fish habitat, migration, and propagation.

METHODS

STUDY AREA

The Thorne River is located 50 miles northwest of Ketchikan on Prince of Wales Island (Figure 1). The Thorne River has been catalogued by ADF&G as Anadromous Waters Catalog (AWC) stream number 102-70-10580 (Johnson and Blanche 2012) and has approximately 113 miles of anadromous waters. The river supports populations of coho (*Oncorhynchus kisutch*), pink (*O. gorbuscha*), chum (*O. keta),* and sockeye salmon (O. kisutch), steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*), and Dolly Varden char (*Salvelinus malma*).

The Thorne River is located within the coastal temperate rainforest of Southeast Alaska. The climate of this area is characterized by mild winters and cool wet summers. The forest is primarily Sitka spruce and western hemlock with a large yellow cedar component. The majority of the Thorne River watershed is within the Tongass National Forest. Two small portions of the watershed, one near Goose Creek and one around Control Lake are state of Alaska land.

The Thorne River begins in the central portion of Prince of Wales Island at a series of lakes in an area commonly referred to as the Honker Divide. The river flows in a southeasterly direction from this area before eventually empting into Thorne Bay on the east side of Prince of Wales Island. The Thorne River intercepts five sizable tributaries between the Honker Divide and saltwater. These tributaries include Control Creek at river mile (RM) 9, Rio Roberts at RM 7.8, North Thorne River at RM 6.2, Beaver Creek at RM 5.9, and Goose Creek at RM 4.0. State Highway 929 (Thorne Bay Rd), connecting the communities of Thorne Bay and Craig, crosses the Thorne River at River Mile (RM) 1.8 and continues along the southern portion of the Thorne River watershed (Figure 2).

The watershed has diverse combination of topography. The area surrounding the Honker Divide and North Thorne River has little relief and is composed of low elevation lakes and lowlands. The topography of the eastern and southern portion of the watershed is composed of high gradient mountainous terrain with peaks reaching 2500 feet above mean sea level. The Thorne River watershed has a drainage area of approximately 166 square miles.

The Thorne River is a popular fishery for sport anglers, subsistence users, and outdoor recreation enthusiasts. The sport fishing, wildlife watching, and canoeing along the Thorne River portion of the Honker Divide Canoe Route are popular attractions for Prince of Wales residents and visitors. Much of the upper portions of the watershed, including the Honker Divide, are a part of the Thorne River Roadless area. This area is a relatively undeveloped corridor that extends from the Karta Wilderness Area through the Rio Roberts watershed and the Honker Divide, and into the Calder Holbrook Land Use Designation (LUD) II area on the northwest tip of Prince of Wales Island (USDA 2003).

STUDY DESIGN

Following the approach and guidelines set forth in Klein (2013) and the DNR Handbook (DNR 1985), four reaches (Reaches A – D, Figure 3) within the Thorne River watershed were selected for instream flow protection. Reach A begins at the downstream end of the Thorne River at mean lower low water and extends upstream approximately 5.3 river miles (RM) to the confluence with Goose Creek (AWC stream number 102-70-10580-2017). Reach B begins at the downstream end of Goose Creek and extends upstream approximately 1.8 RM to the outlet of Angel Lake. Reach C begins at the downstream end of Rio Beaver (AWC stream number 102-70-10580-2023) and extends upstream approximately 2.6 RM to the State Highway 929 Road Bridge. Reach D begins at the downstream end of the North Thorne River, AWC stream number 102-70-10580-2026, and extends upstream approximately 8.1 RM to the USFS Road number 3016 Bridge. Streamflow data will be collected within each of these reaches. No major tributaries enter these tributaries within their respective reaches. Therefore, streamflow characteristics within each reach are considered to be relatively uniform. Each of these four reaches are important habitat for fish spawning, incubation, rearing, and passage life phases (Johnson and Blanche 2012; S. McCurdy, ADFG, Fishery Biologist, Craig, Alaska, 2011, personal communication; M, Minnillo, ADFG, Habitat Biologist, Craig, Alaska, 2011, personal communication)

In order to collect the seasonal and long-term streamflow data necessary to file a reservation of water application for each reach, ADF&G will operate a streamgaging network following the protocols set forth in Klein (2013). A streamgaging network consists of an index streamgage that is operated over a long-period of time (typically many years), and an associated network of semipermanent stations (e.g. streamgages, staff gages, instantaneous discharge measurements, etc.) which are operated concurrently on nearby reaches, tributaries, and sometimes streams, if hydrologically similar.

The first step to establish a streamgaging network is to establish a streamgage. In general, the streamgage is located near the mouth of the drainage basin for various reasons; it is the largest flow in the drainage basin for measurement, typically provides easy access, and the flow at this point is a combination of all the flow within the drainage basin. A suitable site for the streamgage (streamgage 13501) was found on the Thorne River in the middle section of Reach A, at 55°42’21” North 132°37’34” West, just downstream of the State Highway 929 Road Bridge (Figures 2 and 3; Picture 1). Streamgage 13501 was installed on August 23, 2012. This gage will be used to describe hydrologic conditions in Reach A.

To describe hydrologic conditions within Reaches B, C, and D discharge stations have been established within each reach. At a minimum, six instantaneous discharge measurements per year will be collected at each of these discharge stations. The relationship between streamgage 13501 and theses discharge stations will be used to estimate streamflows within Reaches B, C, and D.

Streamgage 13501 and the discharge stations will remain in operation until September 30, 2017. This will provide five complete water years of streamflow records for the index streamgage 13501 and five complete water years of estimated streamflow records for the discharge stations. After one complete water year of streamflow data has been collected and analyzed, a reservation of water application will be completed and submitted to the DNR for Reach A of the Thorne River. After two complete water years of streamflow data has been collected and analyzed, reservation of water applications will be completed and submitted to DNR for Reaches B, C, and D in accordance with SARCU policy for extending streamflow records (Klein 2013). All four applications will be updated and an amendment filed with DNR after all five water years of streamflow data have been collected. Instream flow requests will attempt to mimic the natural hydrograph of mean daily flows and will be based on the flow duration method (Annear 2004)

DATA COMPILATION AND COLLECTION

Biologic Data Compilation

Fish distribution and periodicity data will be compiled and summarized from scientific literature, local ADF&G biologists, the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*, its associated Atlas (Johnson and Blanche 2012), and the Division of Sport Fish Statewide Harvest Survey publication. With the help of Ketchikan area fishery biologists, a fish periodicity chart (Table 1) that includes all fish species present in each reservation reach and details the timing of life history phases, will be finalized and included in the reservation of water application.

Hydrologic Data Collection

Hydrologic data collection for Thorne River will follow U.S. Geological Survey (USGS) standards as described in Klein (2013). All scientific equipment will be calibrated and maintained according to manufacturer specifications and USGS standards. ADF&G employees Jason Hass, Jarrod Sowa, and Shawn Johnson and DNR employee Terry Schwarz will perform all field duties with funding provided by the Alaska Sustainable Salmon Fund.

Access

Access to the Thorne River most of the year is not a problem. Alaska Airlines has daily flights from Juneau to Ketchikan. There are also daily scheduled flights between Ketchikan and Prince of Wales Island communities via small fixed wing planes. Once on the island, a four wheel drive vehicle can be rented to access the gage and discharge sites. The Thorne River streamgage and all the discharge stations, with the exception of the North Thorne River discharge station can be accessed directly by State Highway 929. The North Thorne River discharge station can be accessed by turning north off of State Highway 929 onto USFS Road 3015 and then turning west onto USFS Road 3016.

The USGS maintains a real time streamgage on Staney Creek (#15081497; approximately 18 miles northwest) near Klawock which can be used to determine general river conditions at the Thorne River and subsequently site visit timing.

Gaging Station

Stage and water temperature will be measured at streamgage 13501 using an Insitu© Level Troll 500 pressure transducer housed in a 1-1/4” pipe that is secured to the stream bank with custom pipe brackets and 5/8” rebar (Picture 5). The pressure transducer was programmed at the time of installation, on August 23, 2012, to measure stage and water temperature every fifteen minutes on the quarter hour in Alaska Standard Time format.

Typically, ADF&G installs a staff gage in the gage pool and the pressure transducer is programmed to read the same as the staff gage. In an effort to get a more precise stage reading and also make the streamgage site more aesthetically pleasing, it was decided to not install a staff gage. In lieu of a staff gage, water surface elevations (WSE) will be surveyed using an auto level every field visit. Three survey reference marks (RMs) were established near the transducer (Figure 4) to establish the gage datum. The first RM (RM1) is a stainless steel expansion bolt installed in bedrock and has been assigned an arbitrary elevation of 10 feet (Picture 6). WSE in relation to RM 1 was determined by differential surveying techniques at the time of the transducer installation. At this time, the transducer was set to read the surveyed WSE. The transducer and surveyed WSE are compared at each site visit to determine if the surveyed WSE is being represented correctly by the transducer. If a difference greater than 0.03 feet is observed, protocols described in Klein (2013) or manufacturer guidelines will be followed to correct the problem.

Two additional RMs (named RM2 and RM3) were established near the gage site to monitor possible changes in the elevation of RM1. These RM’s are galvanized lag bolt driven into nearby spruce trees (Picture 7 and 8). The differences in the elevations of these RM’s in relation to RM1 were measured using standard differential surveying techniques following USGS protocols (Kenney 2010). The RM elevations will be surveyed at least once a year and also at the time of gage removal.

To measure discharge at streamgage 13501, a Teledyne-RDI Streampro© Acoustic Doppler Current Profiler (ADCP) will be used. One person will cross the nearby bridge to the opposite bank and a throw bag will be used to get the rope used to tow the Streampro© across the discharge transect. This same technique will be used to measure discharge at the discharge stations during unwadable flows. When the discharge transects are wadeable, a Price AA or Pygmy velocity meter will be used to measure discharge.

To define the stage-discharge relationship, discharge measurements will be taken approximately 600 feet upstream of streamgage 13501, at least six times a year over a range of low to high flows and during different seasons for the period the gage is operational. To date, five instantaneous discharge measurements have been collected (Table 2).

Discharge Stations

To estimate streamflows within reaches B, C, and D, discharge stations have been established in each respective reach (Figure 3). Each stations location was selected for its accessibility and to ensure they are describing hydrologic conditions within their respective reaches. Instantaneous discharge measurements will be taken at each station at least five times a year over a range of low to high flows and during different seasons for the period of operation.

A discharge transect was established near a bridge at each discharge station with uniform depth, velocity, and angle of flow. Goose Creek discharge station (13503; Picture 2) is located near the downstream end of Reach B, at 55°41’12” North 132°38’07” West. Rio Beaver discharge station (13504; Picture 3) is located at the upper boundary of Reach C, at 55°41’15” North 132°43’45” West. North Thorne River discharge station (13502; Picture 4) is located at the upper boundary of Reach D at 55°46’07” North 132°41’27” West.

Discharge at the discharge stations will most commonly be measured using a Price AA or pygmy velocity meter. When flows are unwadable, an ADCP will be used with a technique similar to discharge measurements taken at streamgage 13501. To date, four instantaneous discharge measurements have been collected at discharge stations 13503 and 13504 and five instantaneous discharge measurements have been collected at 13502 (Tables 3, 4, and 5).

Biologic Data Collection

At this time, biological data will not being collected within the Thorne River watershed. If it is determined that biological data are lacking or need further refinement, protocols will be developed to collect the necessary data and either an amendment or new operational plan will be prepared.

Field Safety

Staying safe will be the primary concern while in the field setting. Before leaving the office to visit the Thorne River, a coworker in the office setting will be briefed on the exact itinerary of the field crew. A satellite phone with and emergency contact phone numbers and a first aid kit will be stowed in a waterproof container and will be carried into the field on all site visits. Personal floatation devices will be worn by all staff when within 100 feet of waterbodies deeper than two feet. All field staff will also be equipped with an emergency throwbag and knife. In the event of a life threatening emergency or staff disappearance, the satellite phone will be used notify the Alaska State Troopers in Klawock at (907) 755-2291 or the US Coast Guard at their Search and Rescue Emergency phone number, 1-800-478-5555. In addition to these precautions, practices detailed in the ADF&G Standard Operating Procedures (SOP) II-700, II-410, II-750, II-770, and II-780 will be followed. Signed verification forms for all employees participating in field activities will be kept in the project files.

DATA REDUCTION

Stage and water temperature data will be transferred from the transducer to a Rugged Reader© Pocket PC then uploaded to a personal desktop computer. The stage data will then be converted to Excel or comma delimited text files and entered into the Water Information System Kisters Inc. (WISKI©) hydrologic software package. Discharge measurements and observed staff gage readings will be entered into the BIBER© component of WISKI©. Electronic copies of field notes, photographs, and level summary records will be stored in folders associated with the gaging station name and number on the WISKI© dedicated server. Further data reduction details are provided in Klein (2013).

DATA ANALYSIS

Analyses of streamgage 13501 data will be performed following USGS standards and protocols and will include: development of a stage-discharge rating, discharge measurement summaries, associated shift analysis if applicable, a table of applied datum and gage-height corrections, mean daily flow computations for each day of record, mean monthly flow for each month of record, and a station description.

After two complete water years of streamflow data have been collected and analyzed, a simple linear regression model will be used to estimate the relationship between streamflows at streamgage 13501 and the discharge stations. Instantaneous discharge measurements taken at stations will be regressed against corresponding 15 minute discharge values from streamgage 13501, as described in Klein (2013). Then the mean daily discharge values from streamgage 13501 will be entered into the estimated regression parameters to predict mean daily flow at the respective discharge stations.

The following hydrologic analyses will be used to describe hydrologic conditions within Reaches A to D:

Reservation Reach	Hydrologic Analyses Used	Stream Reach
A	Streamflow data from streamgage 13501	Thorne River
B	Estimated streamflow based on relationship between 13501 and 13503	Goose Creek
C	Estimated streamflow based on relationship between 13501 and 13504	Rio Beaver
D	Estimated streamflow based on relationship between 13501 and 13502	North Thorne River

Seasonal instream flow requests for reaches A – D identified within the Thorne River watershed will attempt to mimic the natural hydrograph using the flow duration method as described in Annear (2004).

SCHEDULES AND DELIVERABLES

Activity	Completion Date
Site Scoping	Completed
Gage installation	Completed on 8/23/2012
Site Visits (download stage data, perform discharge measurement)	At least 6 times a year at range of low to high flows, during different seasons, and when repairs and maintenance are required
Complete Surface Water Records for Water Year	February 28, following end of water year
Reservation of water application for Reach A submitted to DNR	6/1/2014
Reservation of water applications for Reaches B, C, and D submitted to DNR	6/1/2015
Field data collection complete	10/1/2017
Data analyses completed	5/1/2018
Amend reservation of water applications	06/1/2018
Draft FDS Report submitted to supervisor	12/1/2018

RESPONSIBILITIES

Jason Hass, Habitat Biologist II

Duties: Project manager. Responsible for study design, data collection, reduction, and administration of project responsibilities. Responsible for preparation and review of operational plan, reservation of water application, and FDS report.

Jarrod Sowa, Habitat Biologist III

Duties: Assist with management, coordination, and administration of project responsibilities. Provides biologic and hydrologic technical assistance. Assist with preparation and review of operational plan, reservation of water application, and FDS report.

Shawn Johnson, Habitat Biologist III

Duties: Assist with management, coordination, and administration of project responsibilities. Provides biologic and hydrologic technical assistance. Assist with preparation and review of operational plan, reservation of water application, and FDS report.

Terry Schwarz, Hydrologist II

Duties: Assist with field responsibilities and logistics. Provides hydrologic technical assistance.

REFERENCES

Annear, T., I. Chisholm, H. Beecher, A. Locke, and 12 other authors. 2004. Instream flows for riverine resource stewardship, revised edition. Instream Flow Council. Cheyenne, WY.

DNR (Alaska Department of Natural Resources). 1985. State of Alaska instream flow handbook; a guide to reserving water for instream use. Alaska Department of Natural Resources, Division of Land and Water Management, Water Management Section, Anchorage.

Johnson, J. and P. Blanche. 2012. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Southeastern Region, Effective June 1, 2012. Alaska Department of Fish and Game, Special Publication No. 12-07, Anchorage.

Klein, J. 2012. Instream flow protection in Alaska, 2011. Alaska Department of Fish and Game, Special Publication No. 12-11, Anchorage.

Klein, J. 2013. Surface-water data manual for the statewide aquatic resources coordination unit. Alaska Department of Fish and Game, Special Publication No. 13-05, Anchorage.

Kenney, T. A. 2010. Levels at gaging stations. U. S. Department of Interior, U.S. Geological Survey Techniques and Methods 3-A19, Reston, VA. http://pubs.usgs.gov/tm/tm3A19/

Poff, N.L., J.D. Allen, M.B. Bain, J.R. Karr, K.L. Prestergaard, B. Richter, R. Sparks, and J. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. Bioscience 47:769-784.

Rantz, S. E., and others. 1982. Measurement and computation of streamflow: Volume 1 and 2. Geological Survey Water-Supply Paper 2175, Reston, Va.

USDA Forest Service. 2003. Tongass Roadless Area Evaluation for Wilderness Recommendations Finial Supplemental EIS. Appendix C – Part 2. R10-MB-481c. USDA Forest Service, Alaska Region.

TABLES, FIGURES, AND PICTURES

Table 1.–Example fish periodicity table for the Thorne River.

Coho Salmon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage			XX	XXXX	XXXX	XX						
Adult Passage								XXXX	XXXX	XXXX	XX	
Spawning								XX	XXXX	XXXX	XXXX	XX
Incubation	XXXX	XXXX	XXXX	XXXX				XX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Pink Salmon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fry Passage			XX	XXXX	XXXX	XX						
Adult Passage							XXXX	XXXX	XXXX			
Spawning							XX	XXXX	XXXX	XX		
Incubation	XXXX	XXXX	XXXX	XXXX	XX		XX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing				XXXX	XX							

Chum Salmon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fry Passage			XX	XXXX	XXXX	XX						
Adult Passage							X	XXXX	XXXX	XX		
Spawning								XXXX	XXXX	XXX		
Incubation	XXXX	XXXX	XXXX	XXXX				XXXX	XXXX	XXXX	XXXX	XXXX
Rearing				XXXX	XX							

Sockeye Salmon	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Smolt Passage					XX	XXXX	XXXX					
Adult Passage					X	XXXX	XXXX	XXXX	X			
Spawning							XXXX	XXXX	XXXX	X		
Incubation	XXXX	XXXX	XXXX	XXXX	XXXX		XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Based upon professional judgment of ADF&G biologists

Smolt passage is for juvenile emigration to estuarine/marine environment

Adult passage: for salmon is immigration: for trout, char, and other species, immigration and emigration.

Incubation life phase includes time of egg deposition to fry emergence

? = Data not available or timing is incomplete

-continued-

Table 1.–Page 2 of 2

Cutthroat Trout	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt passage *			XXXX	XXXX	XXXX							
Adult passage			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	
Spawning				XXX	XXXX	XX						
Incubabtion				XXX	XXXX	XXXX	XXXX	XX				
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Steelhead Trout	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage				XX	XXXX	XXXX						
Adult Passage Up				XXXX	XXXX	XXXX						
Adult Passage Down					XXXX	XXXX	XX					
Spawning				XX	XXXX	XXXX						
Incubation				XX	XXXX	XXXX	XXXX	XXXX				

Dolly Varden Char	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt passage *			XXXX	XXXX	XXXX							
Adult passage			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	
Spawning									XX	XXXX	XX	
Incubabtion	XXXX	XXXX	XXXX	XXXX	XX				XX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

* DV and CT smolt defined as those fish undergoing initial emigration
Based upon professional judgment of ADF&G biologists
Smolt passage is for juvenile emigration to estuarine/marine environment
Adult passage: for salmon is immigration: for trout, char, and other species, immigration and emigration.
Incubation life phase includes time of egg deposition to fry emergence
? = Data not available or timing is incomplete

Table 2.–Streamgage 13501, Thorne River, discharge measurement summary.

Date	Start Time	End Time	Made By	Width(ft)	Area (ft2)	Mean Vel (ft/s)	Q (cfs)	Staff Gage Stage Start	Staff Gage Stage End	Number of Sections	Quality	Control	Velocity Meter Used
08/24/12	13:01	13:24	JTH, JJS, TCS	48	192	0.96	185	3.865	3.845	198	Fair	Clear	ADCP
10/10/12	10:17	10:37	JTH, JJS	42	180	0.70	126	3.610	3.610	226	Fair	Clear	ADCP
01/18/13	9:08	10:55	JTH, JJS	60	508	6.5	3300	8.510	8.320	323	Poor	Clear	ADCP
04/08/13	11:44	11:54	JTH, JJS, TCS	52	292	1.8	530	4.620	4.615	101	Fair	Clear	ADCP
06/19/13	11:18	11:32	JTH, JJS, SLJ	47	216	0.57	123	3.580	3.580	121	Fair	Clear	ADCP

Table 3.–Discharge Station 13503, Goose Creek, discharge measurement summary.

Date	Start Time	End Time	Made By	Width(ft)	Area (ft2)	Mean Vel (ft/s)	Q (cfs)	Number of Sections	Quality	Velocity Meter Used
10/10/12	13:19	13:54	JTH, JJS	44	30	0.56	17	28	Fair	Pygmy
01/17/13	16:01	16:18	JTH, JJS	92	284	1.8	516	237	Fair	ADCP
04/08/13	14:09	14:39	JTH, JJS, TCS	49	51	1.1	58	29	Fair	AA
06/19/13	13:38	14:10	JTH, JJS, SLJ	38	29	0.33	9.5	30	Fair	Pygmy

Table 4.–Discharge Station 13504, Rio Beaver, discharge measurement summary.

Date	Start Time	End Time	Made By	Width(ft)	Area (ft2)	Mean Vel (ft/s)	Q (cfs)	Number of Sections	Quality	Velocity Meter Used
10/10/12	14:13	14:54	JTH, JJS	23	24	0.53	13	30	Poor	Pygmy
01/18/13	13:15	13:23	JTH, JJS	48	50	2.6	128	119	Poor	ADCP
04/08/13	14:58	15:51	JTH, JJS, TCS	34	30	1.2	37	28	Poor	AA
06/19/13	14:30	15:05	JTH, JJS, SLJ	24	23	0.45	10	30	Poor	Pygmy

Table 5.–Discharge Station 13502, North Thorne River, discharge measurement summary.

Date	*Start Time*	*End Time*	*Made By*	*Width(ft)*	*Area (ft2)*	*Mean Vel (ft/s)*	*Q (cfs)*	*Number of Sections*	*Quality*	*Velocity Meter Used*
08/24/12	15:13	15:24	JTH, JJS, TCS	40	167	0.26	43	191	Fair	ADCP
10/10/12	12:00	12:44	JTH, JJS	55	32	0.92	29	37	Poor	Pygmy
01/18/13	11:56	12:09	JTH, JJS	45	236	1.3	297	148	Fair	ADCP
04/08/13	13:09	13:16	JTH, JJS, TCS	46	226	0.47	107	78	Fair	ADCP
06/19/13	12:41	12:53	JTH, JJS, SLJ	45	204	0.23	46	129	Poor	ADCP

Figure 1.–Thorne River area map.

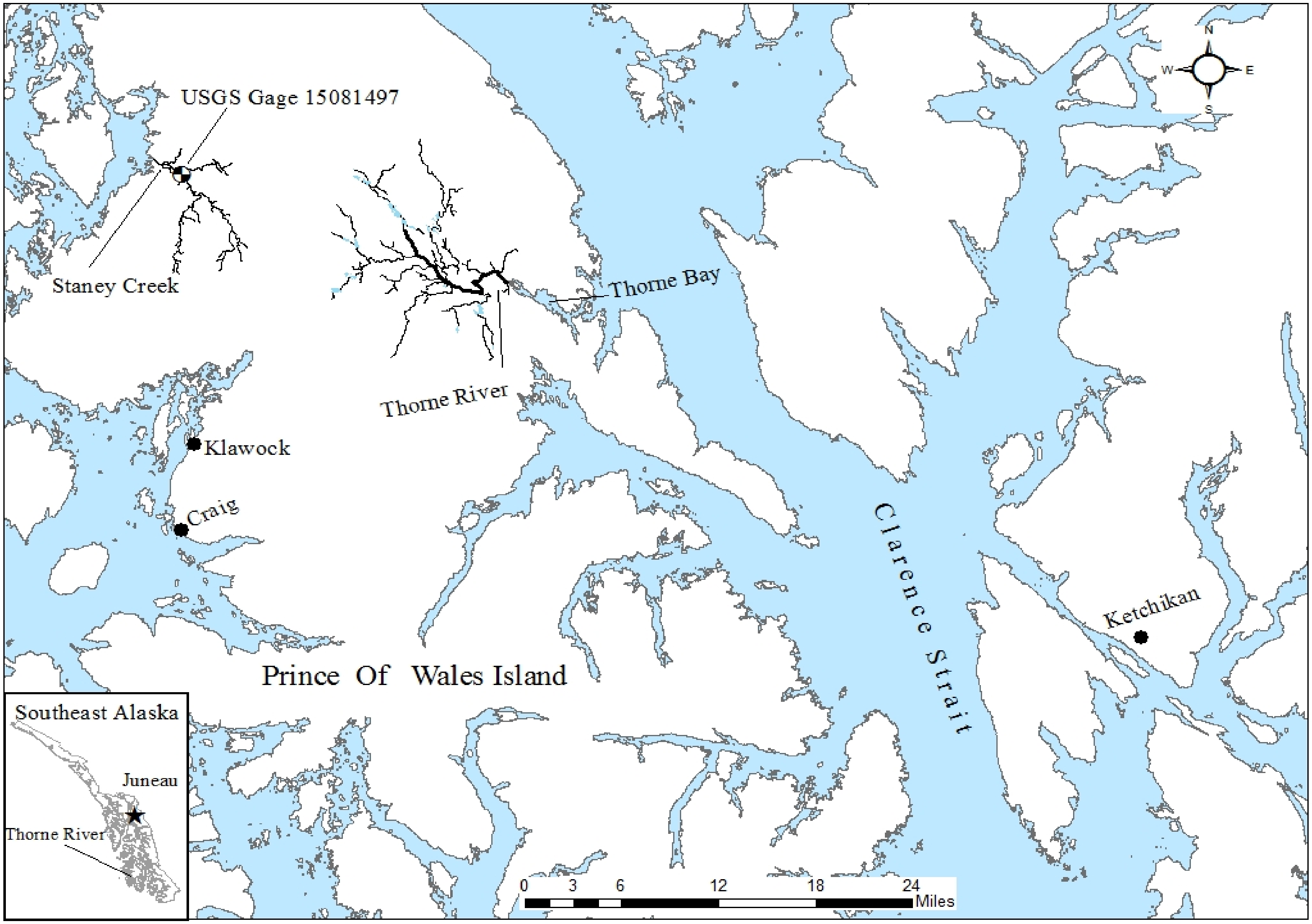


Figure 2.–Thorne River map with tributaries labeled.

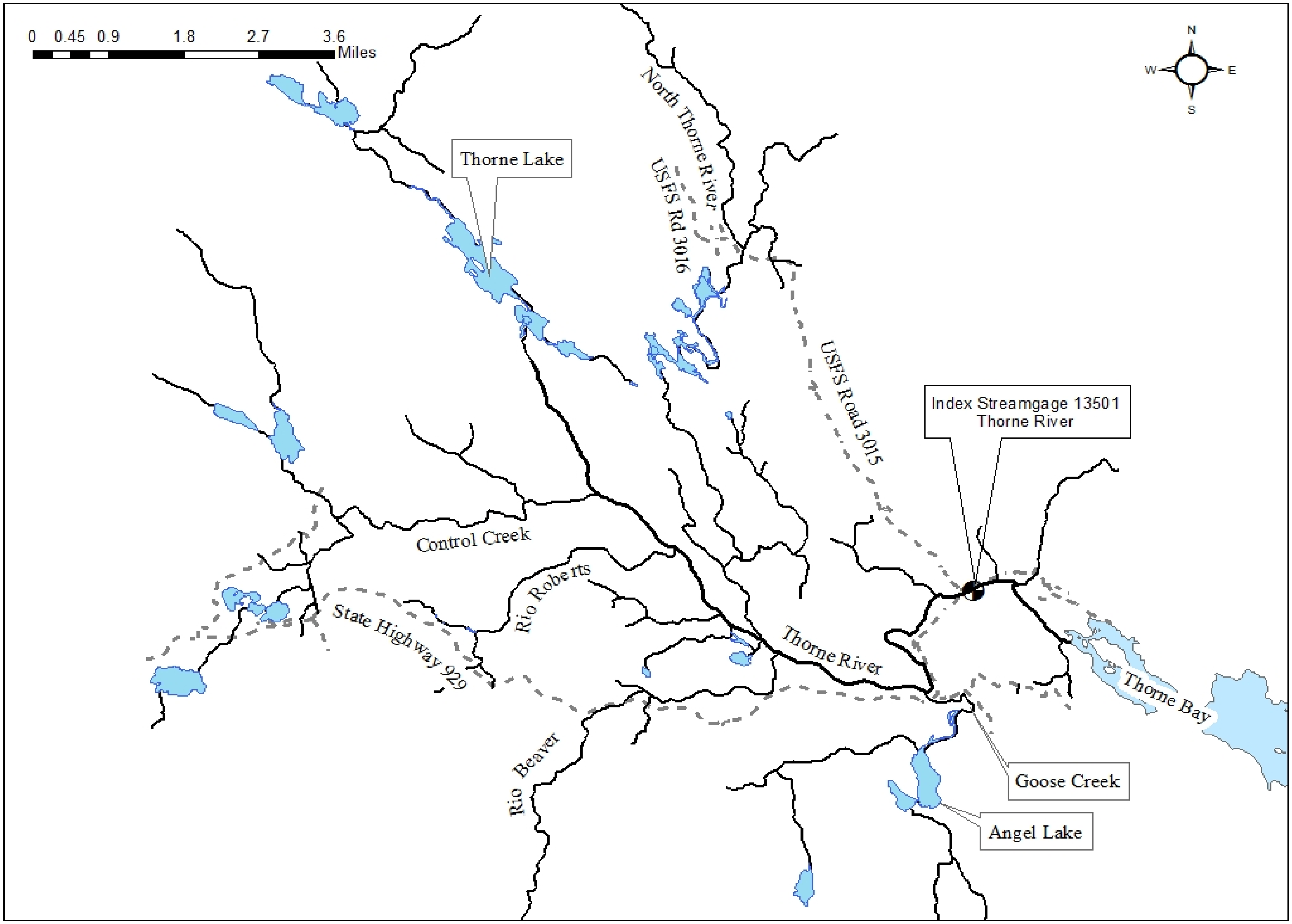


Figure 3.–Thorne River reservation of water reach map with streamgage 13501 and discharge stations labeled.

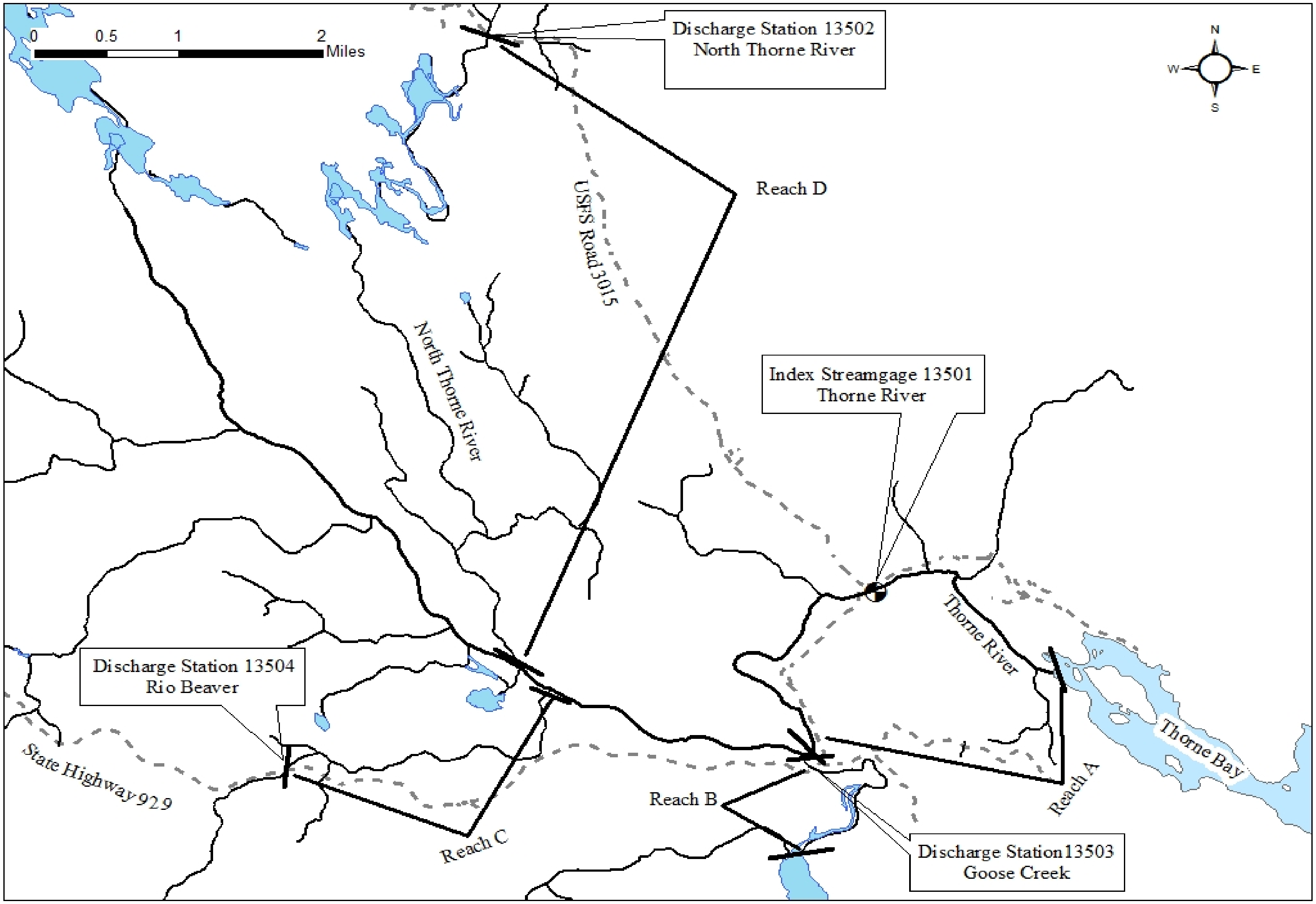
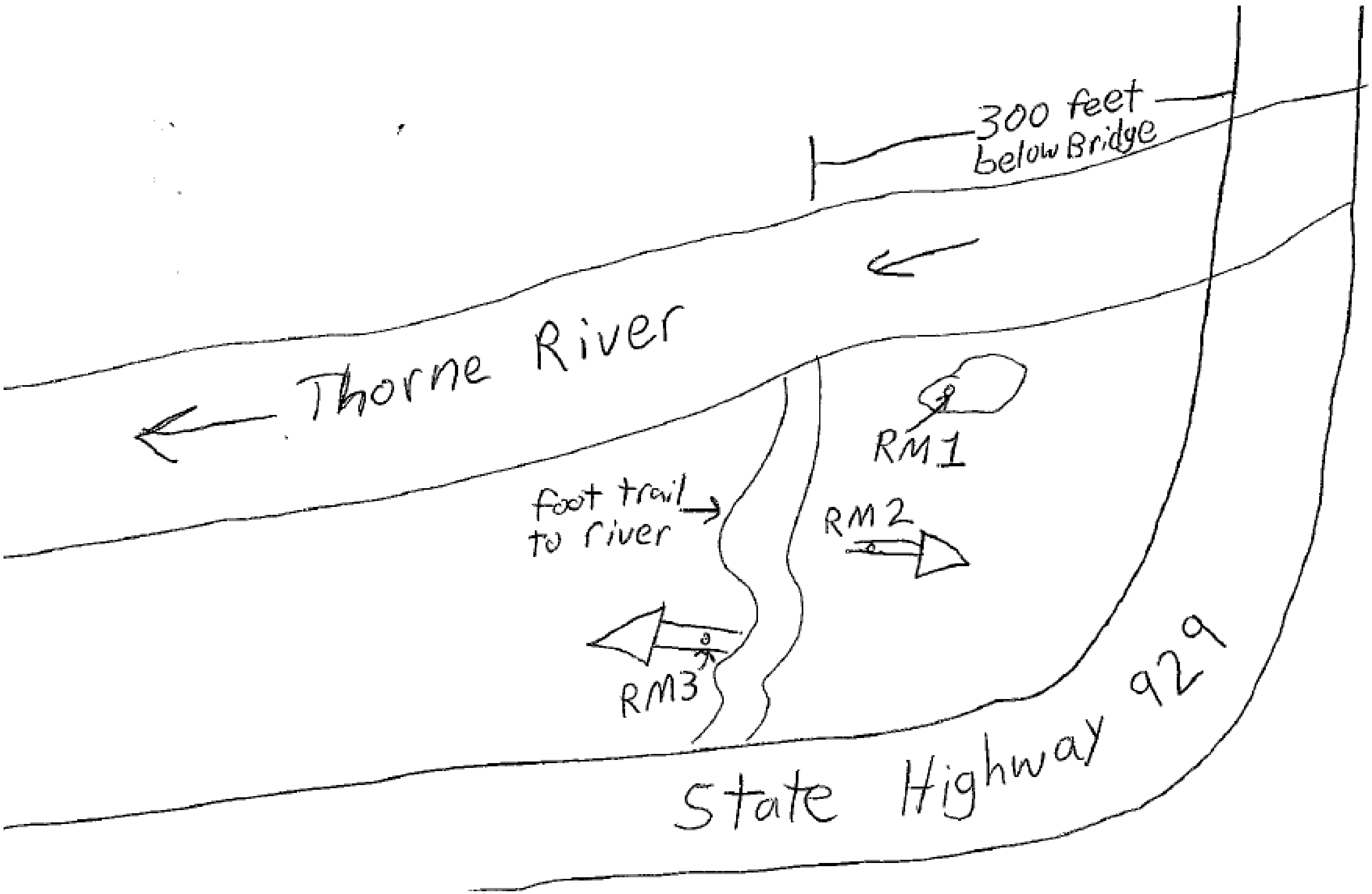


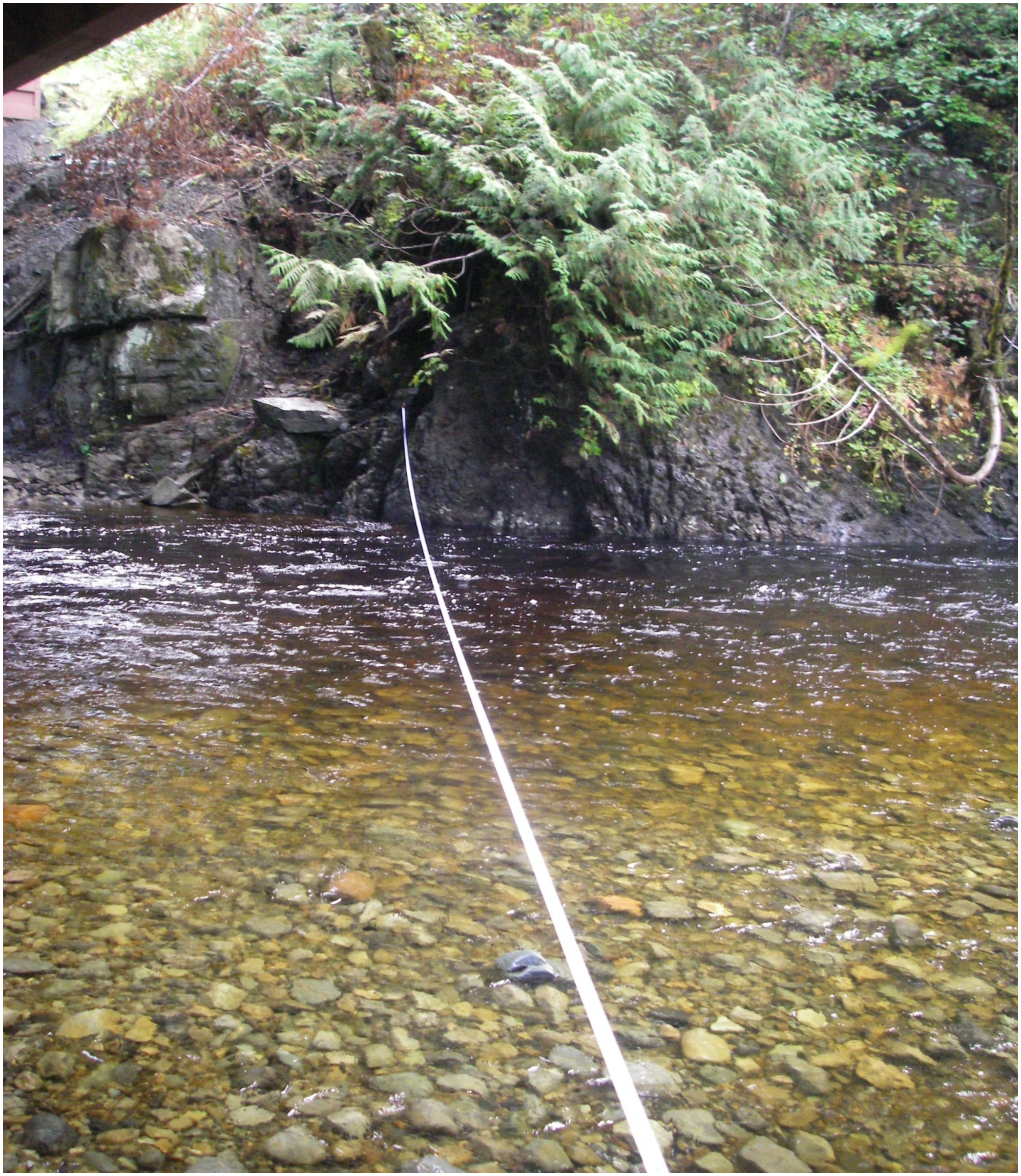
Figure 4.–Streamgage 13501 reference mark map.



Picture 1.–Looking upstream at streamgage 13501 (on river left bank), on August 24, 2013 (185 cfs).

Picture 2.–Looking up at discharge station 13503, on Goose Creek, on October 02, 2013 (234 cfs).

Picture 3.–Looking across at discharge station 13504, on Rio Beaver, on October 02, 2013 (84 cfs).



Picture 4.–Looking downstream at discharge station 13502, on the North Thorne River, on August 24, 2012 (43 cfs).

Picture 5.–Streamgage 13501 housing.

Picture 6.–Streamgage 13501 Reference Mark 1, galvanized expansion bolt in bedrock.

Picture 7.–Streamgage 13501 Reference Mark 2, galvanized lag bolt in tree.

Picture 8.–Streamgage 13501 Reference Mark 3, galvanized lag bolt in tree.

Pre Site Visit Checklist

- ❑ Obtain approval to travel from supervisor via email
- ❑ Contact Watershed Councils or other partners
- ❑ Reserve cabin, air charter, ferry (use STO unless < 4hr notice, or Wings of Alaska)
- ❑ Charge Batteries: camera, Rugged Reader, VHF, Aquacalc
- ❑ Spin test velocity meters
- ❑ Check weather
- ❑ Read last Field Trip Report
- ❑ Review stage data, rating curves, rating table, discharge summary sheet
- ❑ Print rating table, rating curve, benchmark locations, survey notes

Equipment Checklist

- ❑ Velocity meters (Pryce and/or Pygmy)
- ❑ Wading rod
- ❑ Tape measure
- ❑ Aquacalc
- ❑ Headphones
- ❑ Stopwatch
- ❑ Cables to connect Aquacalc to velocity meters
- ❑ Pencils
- ❑ Notebook/Discharge Measurement Sheets
- ❑ Camera
- ❑ Rating Table
- ❑ Stadia Rod, Auto Level, Tripod, Survey Notes
- ❑ Rugged Reader and cable to download data
- ❑ Dessicant
- ❑ Pipe wrenches, pipe goop, misc tools
- ❑ First Aid Kit
- ❑ Watch
- ❑ Extra 9V batteries for Aquacalc
- ❑ 12 gage w/ slugs/bear spray (if needed)
- ❑ Spare parts and oil for velocity meters
- ❑ Calculator

-continued-

Site Visit Checklist

- ❑ Take staff gage reading and photos
- ❑ Inspect site for changes to control, staff gage, channel, etc
- ❑ Take discharge measurement and record exact start/end time on discharge measurement notes sheet
- ❑ Take photos upstream/downstream, across discharge measurement
- ❑ Take staff gage reading after discharge measurement
- ❑ Take picture of control
- ❑ Download datalogger data. Check battery level and memory. View data.
- ❑ Take instantaneous probe reading and compare to staff gage
- ❑ Make sure probe test is running (Running Man)
- ❑ Record all pertinent information on discharge measurement sheet i.e.; weather, site conditions, equipment problems, changes to channel, changes to control, differences between staff gage and probe, work that needs to be completed at next visit, wildlife seen (especially fish activity), etc.
- ❑ Survey benchmarks/staff gage/control/WSE at installation, yearly, at decommission, and if staff gage is suspected to have moved. Make sure to move level and survey all stations again. Check data in the field before leaving and compare with old survey data.

Post Visit Checklist

- ❑ Download data from Aquacalc
- ❑ Download data from Rugged Reader
- ❑ Compare discharge data from Aquacalc to discharge measurement sheet.
- ❑ Make sure all pertinent information is posted to discharge measurements notes sheet.
- ❑ Post discharge measurement data to Shift Analysis sheet.
- ❑ Plot discharge measurement to rating curve.
- ❑ Post discharge measurement data to Flow Summary sheet.
- ❑ Convert stage, water temperature, observed staff gage, discharge measurement data into WISKI compatible format. Import data into WISKI.
- ❑ Review stage data to make sure probe is operating correctly.
- ❑ Post observed staff gage readings and probe readings to Gage Height Corrections Sheet. Difference between the two should be less than or equal to .03ft.
- ❑ Complete Field Trip Report
- ❑ Download and label pictures.