Technical Report No. 12-08

Haines Highway Mile 25 to the Border: 2012 Mitigation Monitoring

by

Joseph P. Hitselberger

November 2012

Alaska Department of Fish and Game **Division of Habitat**

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

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November 2012

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Cover Photos: (1) Culvert CV-12 outlet. (2) Coho salmon (*Oncorhynchus kisutch)* captured from stream channel CH-18. Copyright Alaska Department of Fish and Game. Photos by Joseph Hitselberger.

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EXECUTIVE SUMMARY

The Alaska Department of Transportation and Public Facilities (ADOT&PF) reconstructed portions of the Haines Highway between Mileposts 25 and 40 (the U.S./Canada border) to improve public safety. Within the project area, the Klehini River and its tributaries support a number of salmonid species, including: Chinook (*Oncorhynchus tshawytscha)*, chum (*O. keta)*, pink (*O. gorbuscha)* and coho (*O. kisutch)* salmon; Dolly Varden char (*Salvelinus malma)*; and cutthroat trout (*O. clarkia;* Johnson and Blanche 2011).

ADOT&PF created 22.6 acres of wetlands, 3945 lineal feet of relocated stream, and 10,000 lineal feet of new stream to mitigate the impacts of the reconstruction project on fish and wildlife resources and habitats. The highway reconstruction and mitigation projects were completed in 2001. The Alaska Department of Fish and Game (ADF&G) completed a 10-year monitoring evaluation in 2011 (Hitselberger and Kern 2011) to determine if ADOT&PF had achieved their mitigation objectives. Most wetlands, stream channels and culverts were built to specification and were stable, achieving the mitigation objectives that were outlined in the original mitigation plan (Inter-Fluve Inc. 2000).

In 2012, ADF&G resurveyed the sites where compliance with the mitigation objectives was unknown; stream channels CH-16 and CH-18, and culverts CV-9, CV-10, CV-11, CV-12 and CV-13. The 2012 survey documents these mitigation sites all meet or exceed the mitigation objectives. Anadromous fish presence is not documented above culverts CV-11 or CV-12, but there is no evidence this is due to culvert design or installation. Instead, natural barriers downstream of the two culverts restrict upstream passage and anadromous fish have not been documented beyond the barrier for the last three years.

Key words: Haines Highway, mitigation monitoring, mitigation objectives, stream relocation, highway reconstruction, wetlands, stream channels, culvert, natural barrier, stream channels

INTRODUCTION

ADOT&PF committed to monitoring the mitigation sites described in the Executive Summary for the reconstructed portions of the Haines Highway between Mileposts 25 and 40 for up to 10 years after construction, beginning in 2000. An analysis of the data will allow ADOT&PF to determine if the mitigation objectives outlined in the original mitigation plan (Inter-Fluve Inc. 2000) are met, and to document the long-term effectiveness of the mitigation techniques for use in future mitigation designs.

The ADF&G Division of Habitat agreed to conduct the fieldwork for the mitigation monitoring. The 2011 monitoring report (Hitselberger and Kern 2011) identifies seven mitigation sites that required additional monitoring in 2012. This report provides monitoring information for those seven mitigation sites.

PURPOSE

Determine if the mitigation objectives for the Haines Highway reconstruction are met. Document the long-term effectiveness of the mitigation program for use in future mitigation design.

LOCATION

Mitigation sites are located between milepost 25 and the U.S./Canada border at milepost 40 along the Haines Highway, near Haines, Alaska (Figure 1).

METHODS

The major indicator of project success is salmonid use of all 7 mitigation sites. We conducted fieldwork in May, June, and August, when rising water levels allow juvenile salmonid access to the mitigation sites. We trapped juvenile salmonids using the methods described in Magnus et al. (2006) using two-piece galvanized steel minnow traps (42×23 cm, 22 mm openings, 6.4 mm mesh; Aquatic Eco-Systems; Apopka, FL) baited with cured salmon eggs contained in a punctured or opened plastic bag (118 ml Whirl-Pak; Nasco, Fort Atkinson, WI). We also used a LR-24 Electrofisher (Smith-Root; Vancouver, Wa) to immobilize and capture juvenile fish. We identified juveniles according to Pollard et al. (2006) and then released them back into the water body from which they were captured. Fish captured by electrofishing were allowed to recover before being released back in to the water body.

MITIGATION SITES

Table 1–Mitigation Sites Monitored in this study.

Site ID	Type	Year Completed	Year Monitored
WT-5	Wetland	2000 & 2001	2004, 2005, 2006, 2011
WT-6	Wetland	2001	2004, 2005, 2006, 2011
CH-12	Stream Channel	2000	2004, 2005, 2006, 2011
CH-13	Stream Channel	2000	2004, 2005, 2006, 2011
CH-14	Stream Channel	2001	2004, 2005, 2006, 2011
CH-15	Stream Channel	2000	2004, 2005, 2006, 2011
CH-16	Stream Channel	2001	2004, 2005, 2006, 2011, 2012
CH-17	Stream Channel	2001	2004, 2005, 2006, 2011
CH-18	Stream Channel	2000	2004, 2005, 2006, 2011, 2012
CV-6	Culvert	2000	2004, 2005, 2006, 2011
CV-7	Culvert	2006	2004, 2005, 2006, 2011
CV-8	Culvert	2000	2004, 2005, 2006, 2011
CV-9	Culvert	2000	2004, 2005, 2006, 2011, 2012
CV-10	Culvert	2000 & 2001	2004, 2005, 2006, 2011, 2012
CV-11	Culvert	2000 & 2001	2004, 2005, 2006, 2011, 2012
CV-12	Culvert	2000	2004, 2005, 2006, 2011, 2012
CV-13	Culvert	2000	2004, 2005, 2006, 2011, 2012

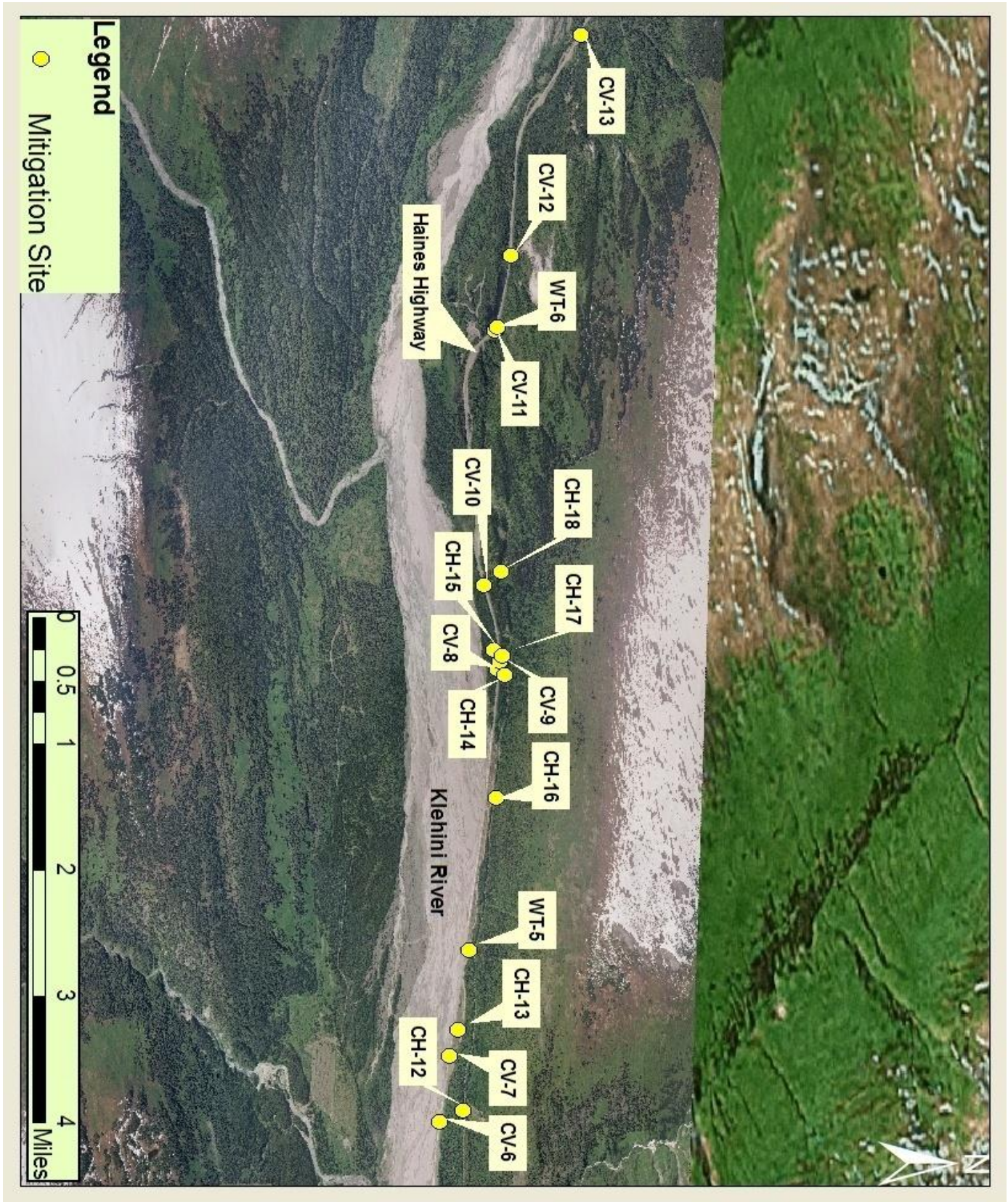

Figure 1.– Location of mitigation sites.

PROJECT PERMIT SUMMARY

US Army Corps of Engineers

- Permit No. 2-920515 10/1995 (modified 6/10/98, 6/11/99 and 7/7/00)
- Authorization D-920515 for Nationwide Permit 3- slope repair 6/21/00
- Permit No. 2-920515 10/26/99 (modified 1/26/00)

Alaska Department of Environmental Conservation

- Certificate of Reasonable Assurance 10/23/95
- Approval to Open Burn 11/2/98
- NPDES Storm Water General Permit # AKRI OA 704
- Letter of No Objection- Storm Water Management Plan No. 2021-WW-266-017 10/11/99

Alaska Department of Fish and Game

- Fish Habitat Permit FG-98-I(J)-35 4/20/98
- Fish Habitat Permit FG-98-I(J)-36 4/20/98 (amended 6/7/99, 9/21/99 and 7/7/00)
- Fish Habitat Permit FG-98-I(J)-52 6/26/98 (amended 11/18/98, 9/21/99 and 5/5/00)
- Fish Habitat Permit FG-99-I(J)-13 4/16/99
- Fish Habitat Permit FG-99-I(J)-54 10/25/99 (amended 11/15/99, 1/11/00 and 1/12/00)
- Fish Habitat Permit FG-99-I(J)-55 10/25/99 (amended 11/15/99, 2/15/00 and 3/13/00)
- Fish Habitat Permit FG-99-I(J)-56 10/25/99 (amended 11/15/99)
- Fish Habitat Permit FG-99-I(J)-57 10/25/99 (amended 11/15/99)
- Fish Habitat Permit FG-00-I(J)-03 1/5/00 (amended 1/7/00 and 1/28/00)
- Fish Habitat Permit FG-00-I(J)-08 3/13/00
- Fish Habitat Permit FG-01-I(J)-20 5/25/01

Alaska Department of Natural Resources

- Park Use Permit SEP 95-5-7
- Temporary Water Use Permit #SE95-16
- Temporary Water Use Permit #TWUP-J99-10 10/6/99
- Material Sale contract ADL#106605 9/30/99
- Final Consistency Determination ID No. AK9505-06JJ 10/2/95
- Final Consistency Determination 9/30/99

STREAM CHANNELS

Mitigation Site CH-16
Location: 59.4392, -136.2663
Date Surveyed: 5/10/12

Description

A 24 in diameter culvert was removed from the abandoned highway. Spring Pond Creek (Stream No. 115-32-10250-2077-3136-4002) originally flowed through the culvert from an uphill pond to a smaller pond near the old highway embankment. Spring Pond Creek is cataloged for coho salmon and cutthroat trout rearing. Originally, flows from the lower pond discharged into 37 Mile Creek (Stream No. 115-32-10250-2077-3136) as undefined seeps through the streambank, and fish passage was undocumented. Stream channel CH-16 is two sections; one upstream section connecting the two ponds, and one downstream section conveying flow into 37 Mile Creek.

During the 2011 survey, both sections of CH-16 were dry (Figure 2). There was no sampling effort for adult or juvenile salmonids within the stream channel. Surface water was only present in the upper pond, where an adult Dolly Varden char was observed. During the 2011 survey, it was not clear if design features of the channel contributed to the seasonal flows of Spring Pond Creek. Therefore, it was recommended that ADF&G biologists return to survey the site during a period of high water so it can be determined if a modification is required (Hitselberger and Kern, 2011).

Mitigation Objective

The mitigation objective for stream channel CH-16 is to restore a segment of Spring Pond Creek from a culvert to an open channel. There is no commitment to establish fish passage but the channel is expected to improve passage from preproject conditions.

Observations

During our survey, surface water was present in both the upper and lower stream channels. Water was flowing between the two ponds, and the lower section of CH-16 was conveying flow into 37 Mile Creek (Figure 3). We electrofished the lower section of stream channel CH-16, capturing one Dolly Varden char (45 mm).

Recommendation

The mitigation objective for stream channel CH-16 has been achieved. Stream channel CH-16 has restored a segment of Spring Pond Creek from a culvert to an open channel. The upstream section does connect the two ponds, and the downstream section conveys flow into 37 Mile Creek. Seasonal flows do limit fish passage and use of the channel, however design features of CH-16 do not restrict fish passage. There are no modifications required to achieve the mitigation objective.

Figure 2.–Lower section of CH-16 10/10/2011.

Figure 3.–Lower section of CH-16 5/10/2012.

Mitigation Site CH-18
Location: 59.4404, -136.2923
Date Surveyed: 5/10/12, 6/13/12, 6/14/12

Description

Stream channel CH-18 is a 150 ft long channel that was created to replace a section of 37½ Mile Creek (Stream No. 115-32-10250-2077-3136-4018) that was filled in to construct the new highway embankment. The channel is directly upstream of culvert CV-10, and drains 37½ Mile Pond (Stream No. 115-32-10250-2077-3136-4018-0010).

During the 2011 survey the water level in CH-18 was very low (Figure 4), and salmonids were not observed or captured in the stream channel. It was recommended that habitat biologists return to survey the channel when water levels are expected to be higher and a more thorough fish survey can be done (Hitselberger and Kern 2011).

Mitigation Objective

The mitigation objective for stream channel CH-18 is to replace the habitat covered by fill.

Observations

The water level in stream channel CH-18 was higher during our 5/10/12 survey (Figure 5). We electrofished the stream channel and 37½ Mile Pond, however no fish were observed or captured while electrofishing. Baited minnow traps were placed in the upper section of stream channel CH-18 on 6/13/12, and were set for 24 hours. Four juvenile coho salmon (40–60 mm) were captured when the traps were retrieved on 6/14/12.

Recommendation

Stream channel CH-18 does provide anadromous fish habitat and passage from culvert CV-10 to 37 ½ Mile Pond. Based on our observations, the mitigation objective for stream channel CH-18 has been achieved. Without knowing what type of habitat was covered by fill during the reconstruction project, there are no modifications recommended for stream channel CH-18.

Figure 4.–Stream Channel CH-18 10/10/11.

Figure 5.–Stream Channel CH-18 5/10/12.

CULVERTS

Mitigation Site CV-9
Location: 59.4392, -136.2819
Dates Surveyed: 5/10/12

Description

Culvert CV-9 is a 126 ft long, 14 ft 3 in × 9 ft 7 in aluminum structural plate pipe arch culvert. The culvert is located on 37 Mile Creek, connecting stream channels CH-14 and CH-15. Approximately 1.5 ft of class I riprap topped with 0.5 ft of gravel was placed in the culvert. A bypass channel located near the inlet to CV-9 (stream channel CH-15) limits flood flows through the culvert.

Observations from the 2011 survey indicate that water velocity appears to slightly increase through the culvert, but there is no evidence of streambed scouring within the culvert. The increased water velocity through culvert CV-9 may create a juvenile fish passage barrier. The 2011 report recommended that culvert CV-9 be surveyed again during higher water (Hitselberger and Kern 2011).

Mitigation Objective

The mitigation objective for culvert CV-9 is to provide adequate passage for fish upstream and downstream for all flows up to the design flow.

Observations

The water level in culvert CV-9 was higher during our 5/10/12 survey then it was during the 2011 survey. Water velocity appeared to increase through the culvert; however, it was not measured. Streambed material within culvert CV-9 is stable is comprised of spawning sized gravel (Kondolf and Wolman, 1993) and no evidence of streambed scouring was observed. The average bank-full width measured above culvert CV-9 is 19.6 ft (Figure 6). The average bank-full width measured below culvert CV-9 is 25 ft (Figure 7). These values were calculated from measurements taken at 20, 40, and 60 ft above and below culvert CV-9.

Figure 6.–Culvert CV-9 inlet 5/10/12.

Figure 7.–Culvert CV-9 outlet 5/10/12.

Recommendation

The mitigation objective for culvert CV-9 has been achieved. Anadromous fish have been documented both upstream and downstream of the culvert, demonstrating that the culvert provides adequate fish passage. Bank-full width measurements indicate that the water velocity may increase through the culvert, however there is no evidence that the culvert limits fish passage.

Mitigation Site CV-10
Location: 59.4373, -136.2908
Date Surveyed: 5/10/12, 6/13/12, 6/14/12

Description

Culvert CV-10 is a 100 ft long, 54 in wide corrugated metal pipe (CMP). The culvert is located on 37½ Mile Creek, directly downstream of stream channel CH-18. Approximately 1.0 ft of class I riprap topped with 0.5 ft of gravel was placed in the culvert.

During the 2011 survey, the water level was too low to determine if culvert CV-10 was providing adequate fish passage. Anadromous fish presence was documented directly below the culvert during the 2011 survey (Hitselberger and Kern 2011).

Mitigation Objective

The mitigation objective for culvert CV-10 is to provide adequate passage for fish upstream and downstream for all flows up to the design flow.

Observations

The culvert appears to be installed to the design specifications, and water is flowing from stream channel CH-18 through the culvert. Streambed material within the culvert is stable, and the water velocity remains unchanged through the CMP. We electrofished upstream of the culvert in stream channel CH-18 and 37½ Mile Pond, however no fish were observed or captured while electrofishing. Baited minnow traps were placed in the upper section of stream channel CH-18 on 6/13/12, and were set for 24 hours. Four juvenile coho salmon (40–60 mm) were captured when we retrieved the traps on 6/14/12 (Figure 8).

Figure 8.–Coho salmon captured above CV-10.

Recommendation

The mitigation objective for culvert CV-10 has been achieved. The culvert provides adequate passage for fish upstream and downstream.

Mitigation Site CV-11
Location: 59.4385, -136.3195
Date Surveyed: 5/10/12, 6/13/12, 6/14/12, 8/5/12, 8/6/12

Description

Culvert CV-11 is a 100 ft long, 9 ft wide CMP. The culvert is located on 37 Mile Creek, adjacent to wetland WT-6. Approximately 2.0 ft of class I riprap topped with gravel was placed in the culvert.

Baited minnow traps were set upstream and downstream of the culvert during the 2011 survey; no fish were observed or trapped. Evidence of sediment movement through the culvert was documented, as well as the stream flow concentrating on the river-right side of the culvert. It was recommended that habitat biologists return to resurvey the culvert (Hitselberger and Kern 2011).

Mitigation Objective

The mitigation objective for culvert CV-11 is to provide adequate passage for fish upstream and downstream for all flows up to the design flow.

Observations

The culvert appears to be installed to the design specifications; however ice and snow limited our 5/10/12 survey (Figure 9). No fish were observed or captured while electrofishing above the culvert. Baited minnow traps were placed up and downstream of the culvert on 6/13/12. They were retrieved on 6/14/12 with no fish were captured. On 8/5/12, six baited minnow traps were placed downstream of culvert CV-11 in a large pond (Figure 10). This pond is also directly downstream of culvert CV-12. Minnow traps were retrieved on 8/6/12 with no fish captured in the pond. However, multiple Dolly Varden char (350–400 mm) were documented during a rod and reel survey of the pond that same day.

Figure 9.–CV-9 inlet 5/10/12.

Figure 10.–Pond below CV-11 8/5/12.

Due to the lack of anadromous fish in this portion of 37 Mile Creek, we conducted a survey downstream of the pond on 8/9/12. A large beaver dam complex was located just downstream of the pond (Figure 11). The first beaver dam measured approximately 4.5 ft above the water line. The pool below the dam was clogged with woody debris, and we were unable to record the maximum depth of the pool. The Alaska Forest Resources & Practices Regulations (Alaska FRPA, 2007) identify an anadromous fish barrier when the unobstructed pool depth is less than 1.25 times the jump height (Table 1). This beaver dam is an anadromous fish barrier because of the obstructed pool directly below the beaver dam.

Table 2.–Anadromous Fish Block, 11 AAC 95.265(g) Table A.

	Species Requirements (in feet)				
Criterion	Coho	Steelhead	Sockeye	Chinook	Pink/Chum
Maximum Fall Height. A blockage may be presumed if fall height in feet exceeds:	11	13	10	11	a) 4 with deep jump pool b) 3 without pool
Pool depth. A blockage may be presumed if the unobstructed water column depth in feet within the pool is less than:	1.25 × jump height, except that no minimum pool depth exists for falls as follows: a) less than 4 in the case of coho and steelhead; and b) less than 2 in the case of other anadromous fish species.				
Steep channel. A blockage may be presumed at the upper end of the reach if channel steepness in feet is equal to or greater than the following without resting places for fish:	>225 at 12 percent gradient >100 at 16 percent gradient >50 at 20 percent gradient >25 at 24 percent gradient				>100 at 9% gradient

Recommendation

The major indicator of project success is salmonid use of the mitigation sites. Anadromous fish have not been documented above culvert CV-11 during this survey because of a natural anadromous fish passage barrier downstream. There is no evidence that suggests design and installation features of culvert CV-11 restrict up and downstream fish passage. This culvert has been designed and installed to specifications that are intended to achieve the mitigation objective.

Figure 11.–Beaver dam downstream of culvert CV-11 and CV-12.

Mitigation Site CV-12
Location: 59.4408, -136.3284
Date Surveyed: 5/10/12, 6/13/12, 6/14/12

Description

Culvert CV-12 is a 58 ft 6 in long by 13 ft 3 in by 6 ft 9 in aluminum box culvert (Figure 12 and 13). The culvert is located on Stream No. 115-32-10250-2077-3136-4053. Approximately 1.0 ft of streambed material was placed in the culvert.

During the 2011 survey baited minnow traps were set near the culvert inlet and outlet. No fish were observed or trapped during the survey. It was recommended that habitat biologists return to resurvey the culvert (Hitselberger and Kern 2011).

Mitigation Objective

The mitigation objective for culvert CV-12 is to provide adequate passage for fish upstream and downstream for all flows up to the design flow.

Observations

The culvert is installed to the design specifications, and streambed material (sand) within the culvert is stable. Water velocity through the culvert does not change and there is no indication that the culvert represents a fish passage barrier. No fish were observed or captured while electrofishing above the culvert on 5/10/12. Baited minnow traps were placed up and downstream of the culvert on 6/13/12. They were retrieved on 6/14/12 and no fish were captured.

Recommendation

During this survey, anadromous fish were not documented above culvert CV-12 because of a downstream anadromous fish barrier (Figure 14). The culvert is designed and installed to specifications and there are no modifications needed to provide adequate passage for fish upstream and downstream.

Figure 12.–CV-12 outlet 6/13/12.

Figure 13.–Upstream of CV-12 6/13/12.

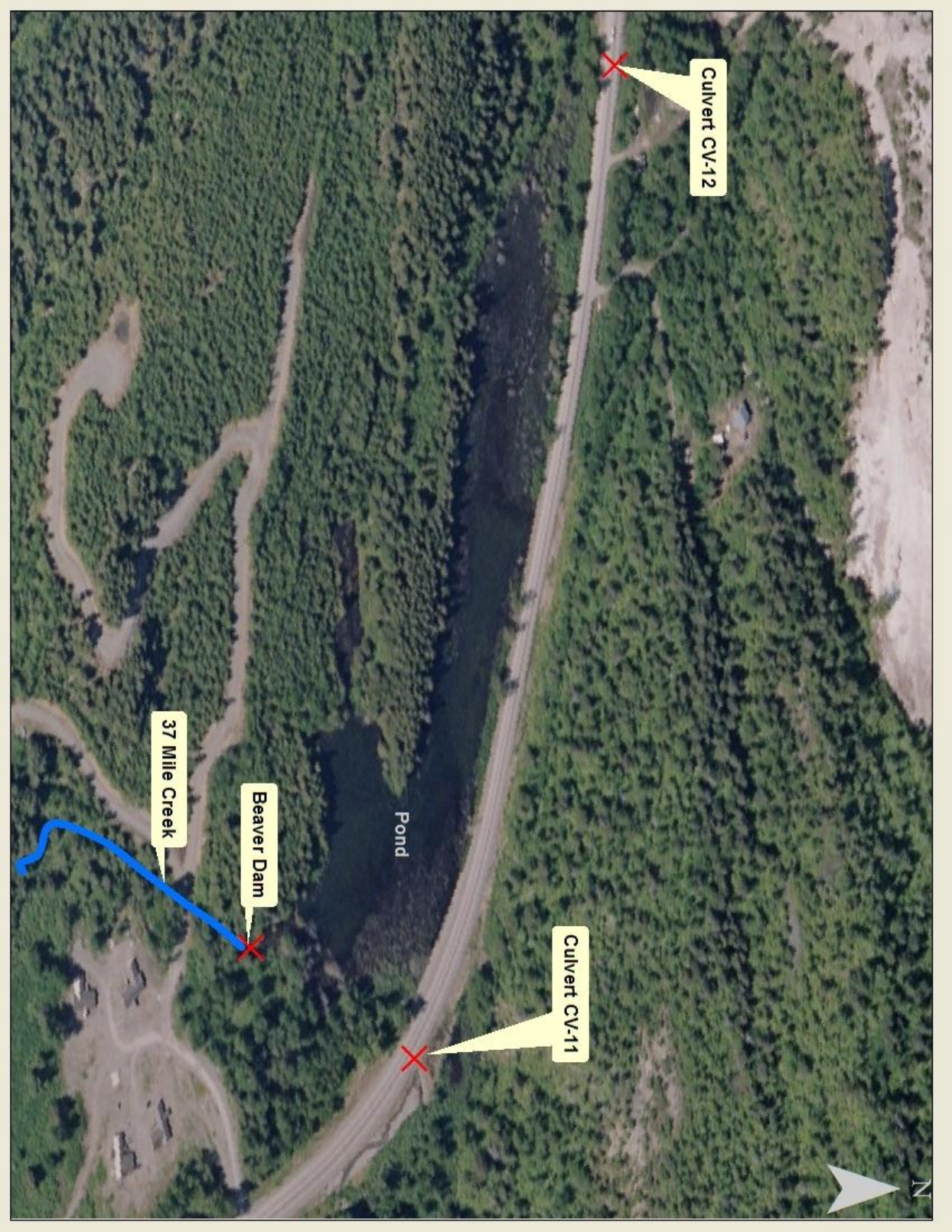

Figure 14.–Location of beaver dam, and Culvert CV-11 and CV-12.

Mitigation Site CV-13
Location: 59.4483, -136.3538
Date Surveyed: 5/10/12, 6/13/12, 6/14/12

Description

Culvert CV-13 is a 100 ft long, 8 by 6 ft aluminum structural plate pipe arch culvert (Figure 15). The culvert is located on 40 Mile Creek (Stream No. 115-32-10250-2077-3180). Due to the steep gradient of the culvert, baffles were installed to improve fish passage.

Dolly Varden char were captured and observed both up and downstream of the culvert during the 2011 survey. There is also anecdotal information that adult coho salmon have been observed moving through the culvert. Anadromous fish were not documented during the 2011 survey and it was recommended that habitat biologists return to survey the culvert to following year.

Mitigation Objective

The mitigation objective for culvert CV-13 is to improve fish passage conditions over the previous culvert. Streambed accumulation behind the baffles helps to achieve this objective.

Observations

The culvert appears to be installed to the design specifications, and streambed material is being deposited behind the baffles in the culvert. On 5/10/12 we electrofished the area directly upstream of culvert CV-13 and captured two coho salmon (30 mm). On 6/13/12 two minnow traps were placed above the culvert and retrieved on 6/14/12 and four Dolly Varden char (60–80 mm) were captured.

Recommendation

The mitigation objective for culvert CV-13 has been achieved, no further monitoring is recommended.

Figure 15.–Culvert CV-13 outlet with baffles.

CONCLUSION

Stream channels are reliant on seasonal water flows to function properly. In 2011, monitoring occurred during a period of low flow and seven sites did not appear to meet their mitigation objectives. In 2012, monitoring occurred during periods of higher water and biologists documented these sites conveying flow and providing anadromous fish habitat when water is available. Our notable findings follow:

- Both of the stream channels achieve the mitigation objectives;
- All five of the culverts achieve the mitigation objectives;
- Coho salmon above CV-10 and CV13 are now documented where anadromous fish were not documented during the previous survey;
- Culvert CV-9 does not create a velocity barrier; and,
- A natural barrier currently blocks anadromous fish from accessing culverts CV-11 and CV-12. These two culverts are built to the design specification and are stable, so should not present a fish passage barrier.

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