

APPENDIX D

Stream and Habitat Mitigation Plan



Technical Memorandum

Project Name:

Regarding: Haines Highway Conceptual Mitigation Opportunities

From: Dan Miller and Mark Sogge

Date: July 30, 2009,

Revised: September 17, 2010
January 6, 2012

Background

This memorandum provides a description of each of the mitigation sites shown in the companion graphics Haines Highway – MP 3.5 to 25.3 Conceptual Mitigation Opportunities dated October 28, 2009. The purpose of this narrative and plan set is to describe the potential mitigation opportunities related to the proposed realignment and widening of the Haines Highway.

A number of environmental and habitat specific tasks have been completed on the Haines Highway project. DOWL HKM has completed a Wetlands Delineation Report (2006) for the highway corridor. Inter-Fluve has completed a Stream and Habitat Inventory (2006) of stream crossings of the highway and locations where the Chilkat River and side channels flow along the road embankment. Inter-Fluve has also completed a draft Hydrology and Hydraulics Report (2009) of stream culvert crossings of the highway; assessment of Chilkat River and side channels where they flow near the road embankment; and, preliminary design of fish passage culverts. The reader is directed to these respective reports for details.

Through these various studies and focused consideration of mitigation opportunities along the project corridor, a number of sites with opportunities to enhance or create aquatic habitats along the project corridor were identified. The opportunities were discussed with DOT&PF staff and first presented to an IDIT in July 2006, and again in March 2009. These opportunities have undergone additional field evaluation and preliminary survey. The following is a discussion of mitigation opportunity concepts as shown on the companion plan set. These were developed based on existing stream reference conditions and professional judgment of the project team and DOT&PF staff. Rough planning level construction estimates are included.

These conceptual designs will undergo further refinement during the creation of construction ready design documents. Additional design work will require the involvement of personnel that possess expertise in engineering, fisheries biology, and fluvial geomorphology. The designs will consider, at a minimum, biology, hydrology, hydraulics, topography, sediment transport, and

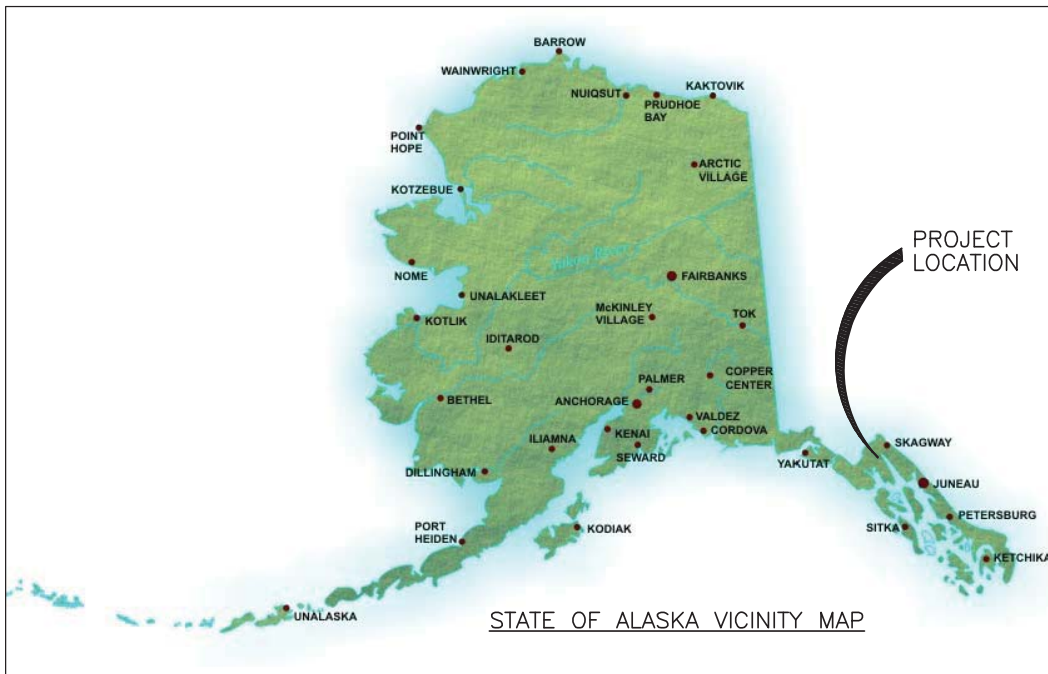
fluvial geomorphology. The intent of the designs will be to create a complex habitat which is appropriate to each site's geomorphic conditions and is as naturally sustainable as possible.

State of Alaska Department of Transportation and Public Facilities

Haines Highway - MP 3.5 to MP 25.3 Conceptual Mitigation Opportunities

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PRELIMINARY

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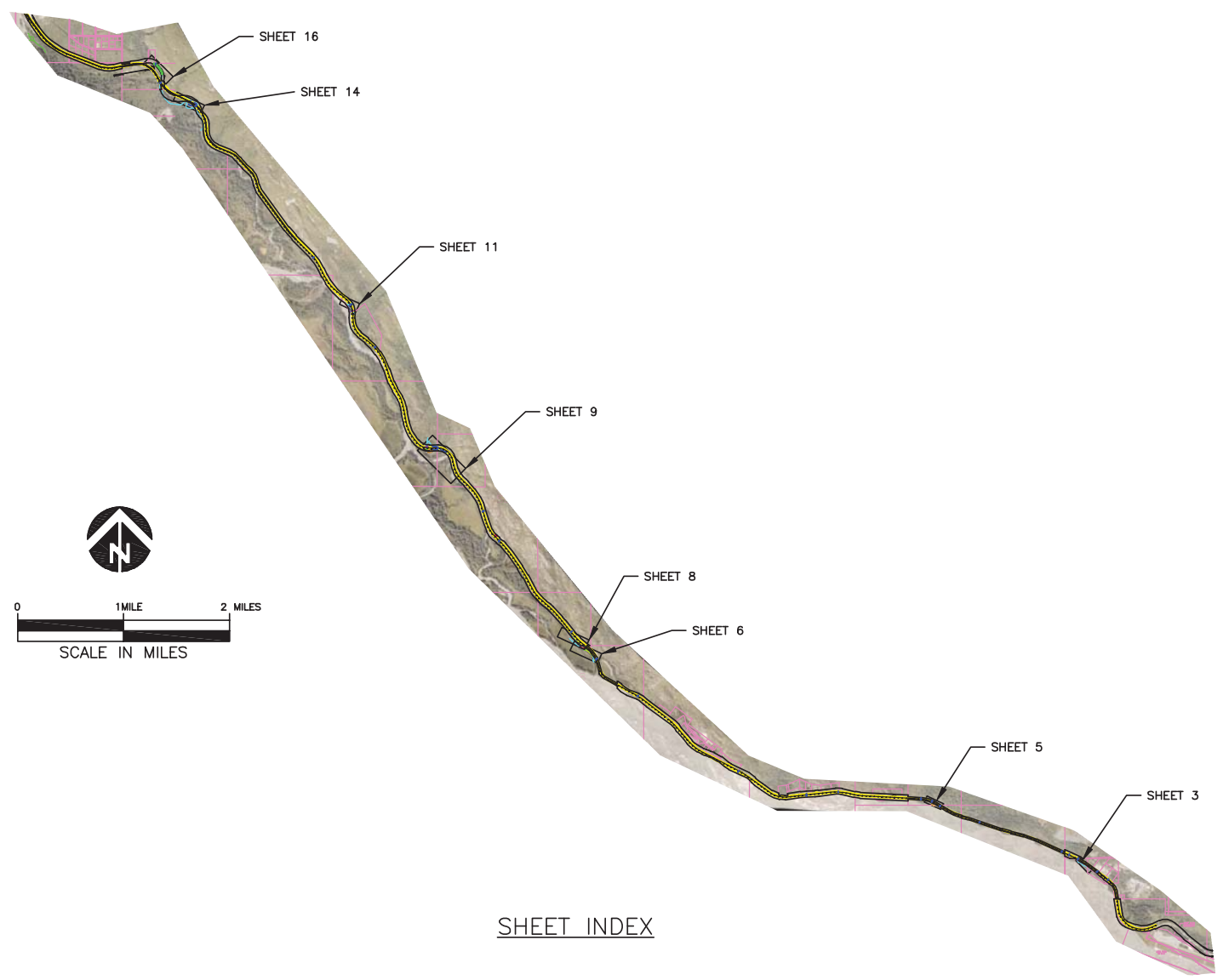
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Conceptual Mitigation Opportunities
Cover, Sheet Index and Vicinity Map

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SHEET INDEX

NO.	BY	DATE	REVISION DESCRIPTION
1	DM	1/5/12	

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Conceptual Mitigation Opportunities
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Station 240+38

This site is shown on Sheets 3 and 4. The stream passes through a 24 inch culvert then flows approximately 150 to 250 feet along the toe of the existing road embankment before diffusing through the forest to join up with a well defined slough channel. The left bank is maintained by DOT&PF and has limited riparian vegetation.

The proposed plan is to move the stream off the road embankment toe by the creation of approximately 200 feet of new stream. The new stream would be directed through the forest and join up with the existing slough channel. The marsh like condition of the forest would not be changed with flow continuing to diffuse through a complex flow pattern. Construction would be selectively conducted in order to preserve root structure as a component of the new stream, matching the conditions in the existing stream. Supplemental woody debris would be incorporated into the channel at selected locations. The new stream will provide rearing habitat for juvenile fish.

A rough planning level construction cost for this option is \$40,000.

Table 1. Habitat Loss and Gain at Station 240+38

Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
24" culvert; channel 150-250' length along highway toe of slope; left bank has limited riparian vegetation.	Create 200' of new channel away from highway toe of slope; woody debris added, riparian vegetation encouraged on both banks, rearing habitat. New Tier 2 fish passage culvert.



PLAN VIEW: PROPOSED CONDITIONS 240+38

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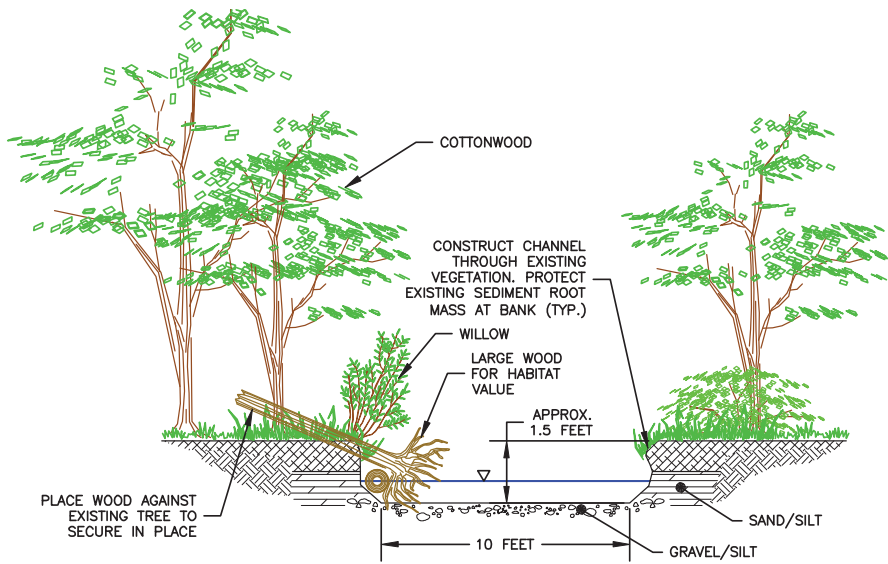
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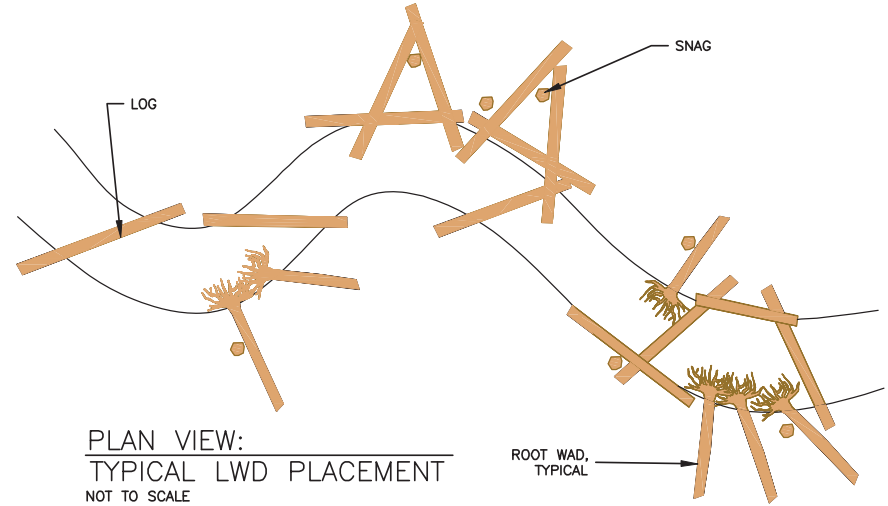
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Conceptual Mitigation Opportunities
Site 240+38

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TYPICAL SECTION: SITE 240+38
NOT TO SCALE



PLAN VIEW:
TYPICAL LWD PLACEMENT
NOT TO SCALE

1	DM	1/5/12	
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Conceptual Mitigation Opportunities
Site 240+38

Station 319+13

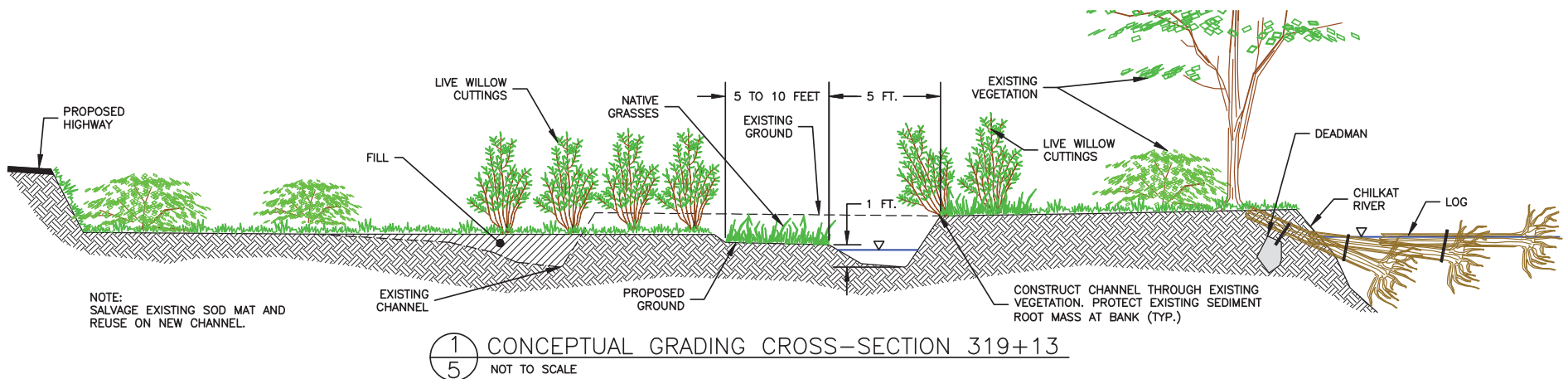
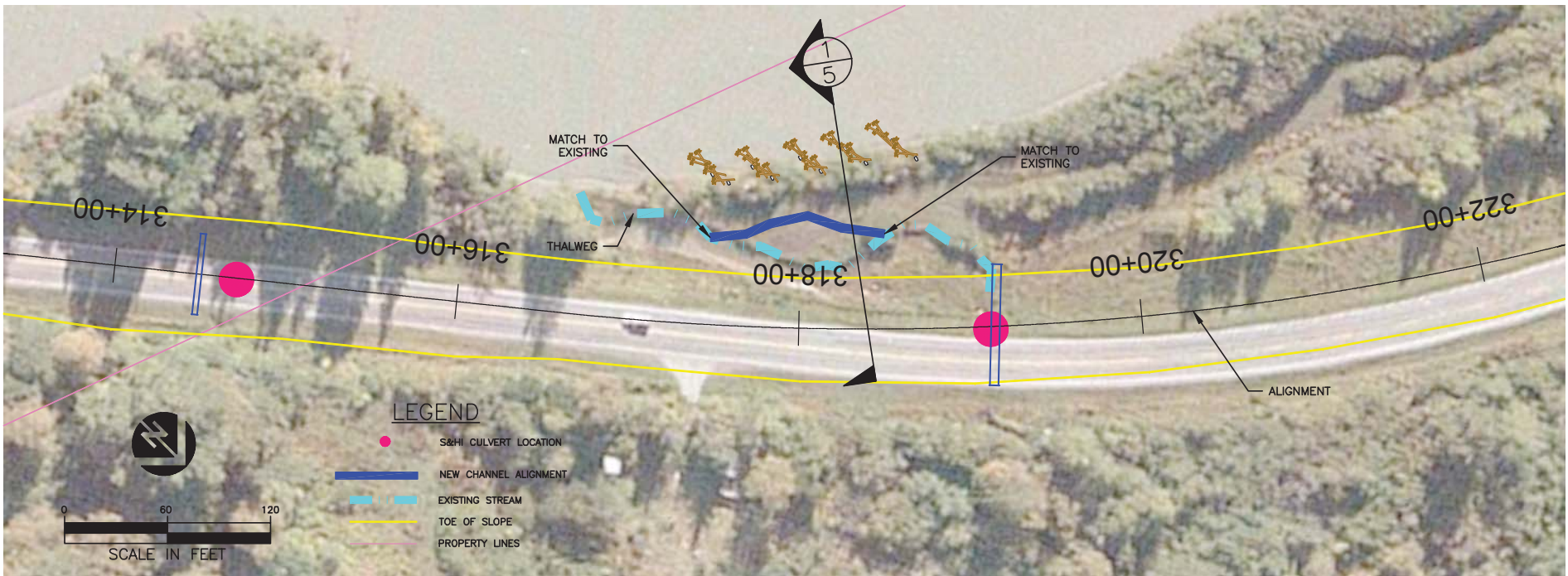
This location is shown on Sheet 5. The stream passes through a 36 inch culvert then flows approximately 225 feet primarily along the toe of the existing road embankment. The left bank is maintained by DOT&PF and has limited riparian vegetation.

The proposed plan is to reconstruct the section of the stream that will be most directly impacted by the changes in road alignment and the widening. Approximately 100 feet of new stream will be created. The new stream will be located along a narrow terrace between the highway and the river. There is risk of the Chilkat River eroding laterally and capturing this new stream. It is proposed that this erosion threat be addressed by the installation of a series of anchored log structures designed to minimize erosion and possibly encourage the creation of an extended river bank. Willows will be planted along the stream to provide riparian habitat and along the river bank to provide additional bank stability.

A rough planning level construction cost for this option is \$45,000.

Table 2. Habitat Loss and Gain at Station 319+13

Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
36" culvert; channel is 225' along highway toe of slope (100' directly impacted by new alignment); left bank with limited riparian vegetation.	Create 100' of new channel away from highway toe of slope; willow plantings along channel and river to encourage riparian habitat growth and provide additional river bank stability. New Tier 1 fish passage culvert.



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Conceptual Mitigation Opportunities
Site 319+13

Station 512+24

This location is shown on Sheet 6 and 7. Presently the stream flows through a relic side channel of the Chilkat River and along approximately 1000 feet along the toe of the existing road embankment. This stream floods the full width of the relic side channel and flows very slowly through the thick aquatic vegetation. This area is classified as an Herbaceous Swamp in the Wetlands Delineation Report and the vegetation is primarily swamp horsetail (*Equisetum fluviatile*) and sedges (*Carex sp.*). There is no defined stream channel. The water depth within the channel is influenced by the stage of the Chilkat River, and the stream often has the appearance of more of a slough than an actively flowing stream. The left bank is maintained by DOT&PF and has limited riparian vegetation.

The proposed plan is to relocate the stream away from the road embankment toe by the creation of approximately 1000 feet of new stream. The new stream would be routed along the alignment of a relic gravel bar and through a slot in the existing cottonwood forest. Some cottonwood trees will have to be removed to provide adequate width for the channel construction. There are no known eagle nests in this area and during a 2009 field visit with personnel from the Alaska Department of Natural Resources, Parks Division none of the trees proposed for removal were seen as important eagle perching trees. These trees can be utilized to provide woody debris within the new stream channel. The new channel cross section matches the existing channel conditions and will revegetate and function in a similar manner. The grade of the channel will allow the continued backwatering of the stream. The well vegetated, deep clear water habitat will provide ideal rearing habitat for juvenile fish.

Sheet 7 shows two options for creating the new channel using either biodegradable fabric encapsulated soil lifts or woody debris to form the banks. A combination of these two methods would provide shoreline habitat diversity. The placement of woody debris within the channel will provide initial cover for juvenile fish, with the primary cover resulting from the establishment of a well vegetated channel. The vegetation will determine the primary flow path through the broad channel. Existing vegetation on the new stream banks will be left undisturbed to the extent possible in order to provide immediate healthy riparian conditions. Willow will be planted where existing vegetation is not present.

A small stream that currently enters the slough near station 523+75 will not be directly affected by the realignment of the channel as designed. It will continue to flow into the slough at its present location. Juvenile fish will be able to access this stream in the manner they currently do.

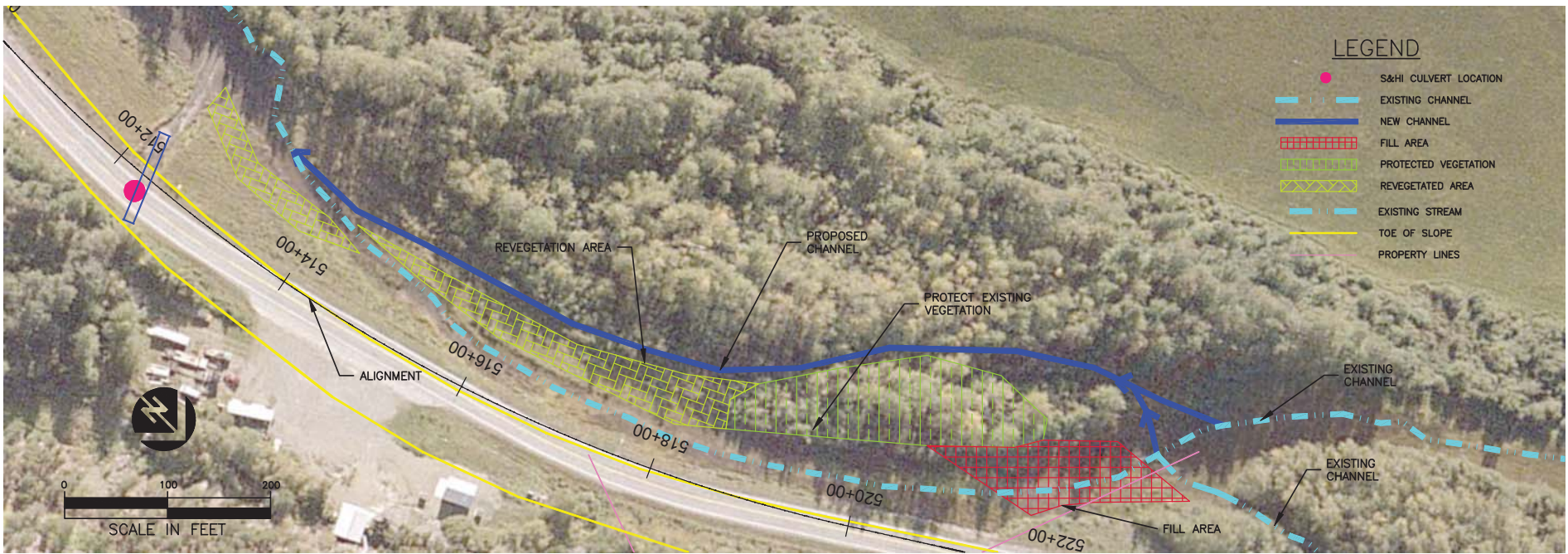
Some of the material excavated from the new stream alignment will be utilized to create a channel block across the current slough and to direct flows into the new stream. Excess material from the realignment project could potentially be used for this fill as well with the need to add a fine grained material core to limit excess drainage considered during the

design phase.

A rough planning level construction cost for this option is \$150,000.

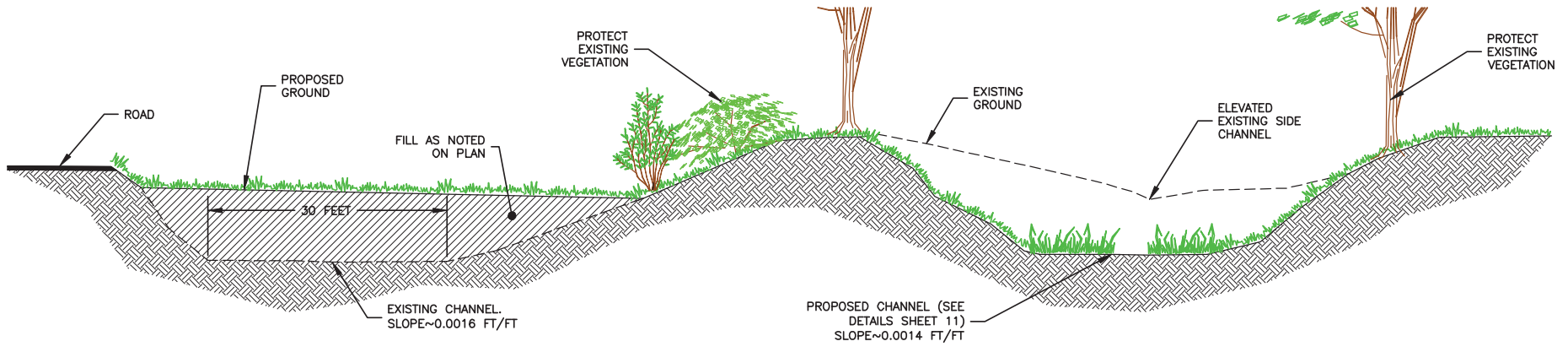
Table 3. Habitat Loss and Gain at Station 512+24

Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
1000' of stream follows relic side channel of river along toe of existing road embankment; at high water, slow flows through thick aquatic vegetation (swamp horsetail and sedges), slough-like; limited riparian vegetation on left bank.	Create 1000' of new stream channel away from highway toe of slope; located on relic gravel bar for substrate, placement of woody debris, low gradient deep water channel will provide rearing habitat. New Tier 1 fish passage culvert will be installed.



- LEGEND**
- S&H CULVERT LOCATION
 - EXISTING CHANNEL
 - NEW CHANNEL
 - ▨ FILL AREA
 - ▨ PROTECTED VEGETATION
 - ▨ REVEGETATED AREA
 - EXISTING STREAM
 - TOE OF SLOPE
 - PROPERTY LINES

PLAN VIEW



TYPICAL SECTION: CUT/FILL LOOKING DOWNSTREAM SITE 512+24
NOT TO SCALE

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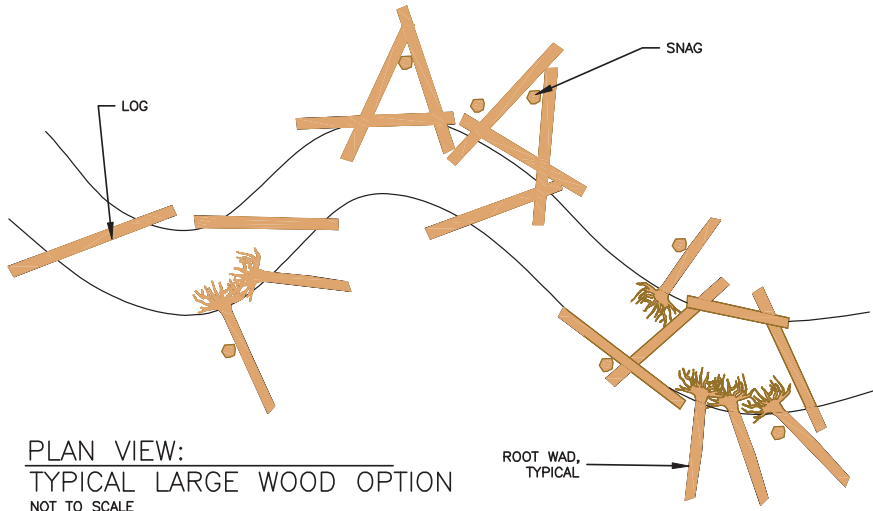
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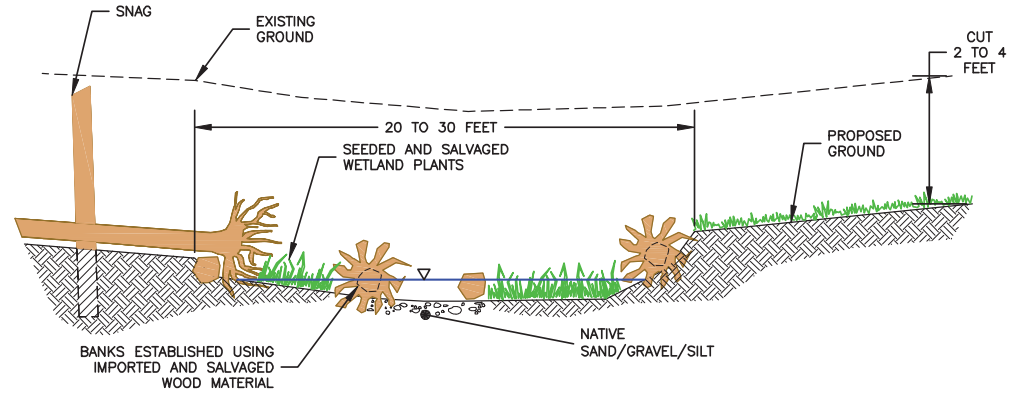
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Site 512+24

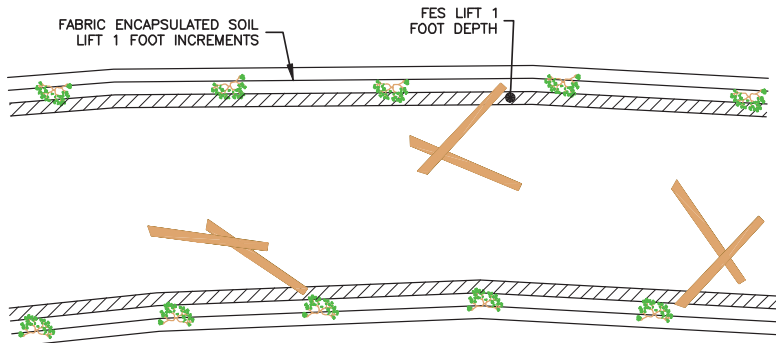
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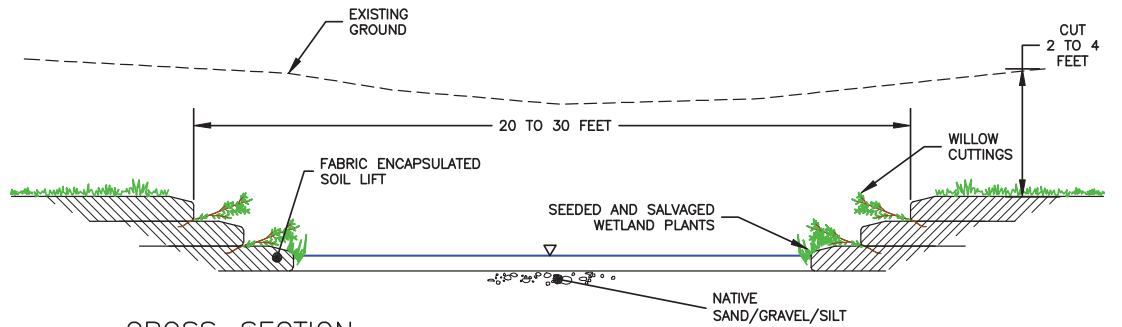
PLAN VIEW:
TYPICAL LARGE WOOD OPTION
NOT TO SCALE



CROSS-SECTION:
NEW CHANNEL CONSTRUCTION – LARGE WOOD OPTION
NOT TO SCALE



PLAN VIEW:
TYPICAL FABRIC LIFT OPTION
NOT TO SCALE



CROSS-SECTION:
NEW CHANNEL CONSTRUCTION – FABRIC LIFT OPTION
NOT TO SCALE

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Station 530+70

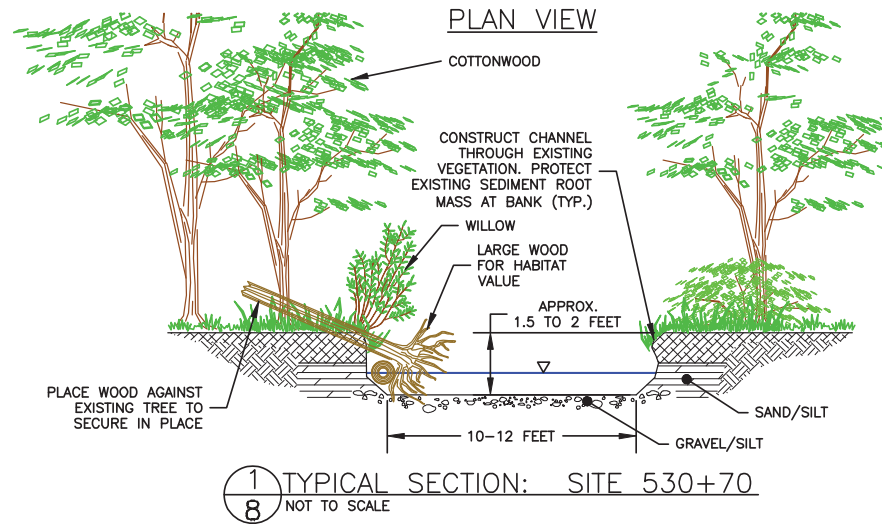
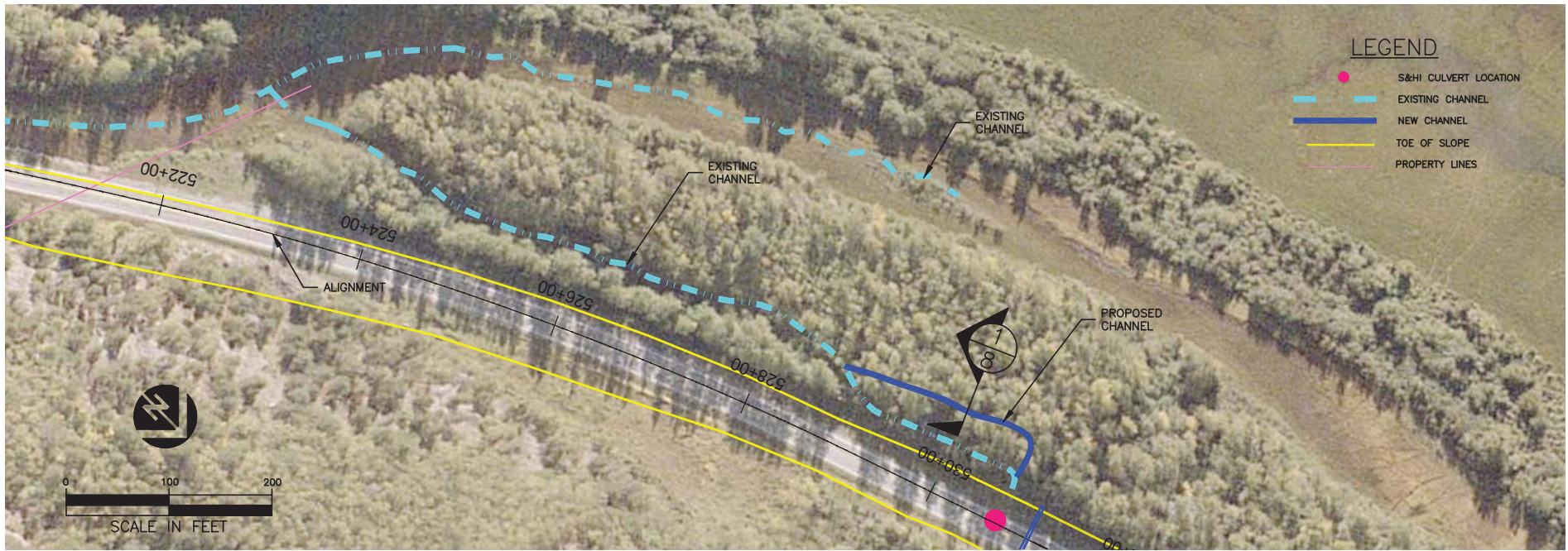
This location is shown on Sheet 8. The stream passes through a 24 inch culvert then flows approximately 200 feet along the toe of the existing road embankment. The left bank is maintained by DOT&PF and has limited riparian vegetation.

The proposed plan is to relocate the stream off the road embankment toe by the creation of approximately 200 feet of new stream. The new stream would initially run perpendicular to the highway, then curve through the forest and join up with the existing stream. Construction would be selectively conducted in order to preserve root structure as a component of the new stream. Supplemental woody debris would be incorporated into the channel. The stream will function as juvenile rearing habitat and provide access to the productive rearing pond on the mountain side of the highway.

A rough planning level construction cost for this option is \$25,000 not including the culvert crossing.

Table 4. Habitat Loss and Gain at Station 530+70

Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
24" culvert; 200' of stream channel is located along highway toe of slope; left bank has limited riparian vegetation.	Create 200' of new stream channel away from highway toe of slope; placement of woody debris, rearing habitat. New Tier 1 fish passage culvert.



1
8 TYPICAL SECTION: SITE 530+70
NOT TO SCALE

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Conceptual Mitigation Opportunities
Site 530+70

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Station 647+20 and 653+00

This location is shown on Sheets 9 and 10. The stream currently intersects the highway at station 653+00 and then splits, with the primary flow running along the toe of the slope toward the existing culverts at station 647+20. The portion of the current stream alignment that runs along the road upstream of station 677+00 dates from the November 2005 flood event. Prior to that event, the stream turned southward several hundred feet upstream of the highway and did not intersect the road fill until near station 677+00. The recently established section of stream is still actively forming a channel. The stream passes through twin 36 inch culverts then meanders along approximately 650 feet along the toe of the existing road embankment. The left bank of the stream downstream of the culvert is maintained by DOT&PF and has limited riparian vegetation.

The proposed plan is two fold. On the uphill side of the road the plan calls for the creation of a new stream channel that will capture the remaining flows between the culvert at station 647+20 and the old stream channel at 677+00. This channel will be located in the edge of the forest just beyond the toe of the road fill. The channel will be constructed in a manner to preserve as much of the existing riparian habitat and root structures as possible. The stream will feed into the new culverts at station 647+20 and flow into the existing stream channel, which will be modified as is described in the next section.

The main flow of the stream will be directed through a proposed new culvert located at station 653+00. The routing of this stream across the highway at this location provides for the opportunity to construct a significant length of new stream channel. For the first 250-300 feet of this new stream channel two options are presented. Option 1 directs the stream through a mature cottonwood forest and directly across a hump of topography along the distal end of the alluvial fan. This stream section will be of fairly steep gradient, and will not provide much habitat for rearing fish. Option 2 has a shorter steep section (approximately 100 feet) and then a 200 foot section of stream that winds along the toe of the fan and is designed to replicate the form and function of the highly productive stream that presently exists downstream of the existing culvert at station 647+20. This stream is very sinuous, with well vegetated, often undercut banks. It is composed of a series of deep pools separated by glides. Woody debris is present and often provides the structure for the formation of the pools. This alignment exits the ROW for about 150 feet. Fate of high flows within and exiting the marshy area would be determined during design. The potential exists for the new stream to avulse the constructed channel in this area and carve a new channel through the marsh towards the Chilkat River. A conceptual design and proposed location for placement of large woody debris to address this potential is shown in the attached drawings. Sediment deposition at the transition to the lower gradient reach of the new channel is anticipated and details will be addressed during design.

Downstream from the confluence of Option 1 and 2, the stream will continue to meander through the wetland habitat for approximately 500 feet until it intersects with the existing

stream near the culvert outlet at station 647+20. The new channel will utilize existing vegetation for riparian habitat and the meanders will be designed to take advantage of existing root structures to the extent possible. Supplemental woody debris will be incorporated into the channel.

Between station 647+20 and the outlet of the stream at the Chilkat River the existing stream will be left intact unless the road fill directly impinges upon it. In this case, new meander sections of the stream will be created that emulate the impacted sections. These meanders will be designed to mimic the existing form of the stream, and will reconnect undisturbed reaches.

A rough planning level construction cost for this option is approximately \$200,000 total not including the culvert crossing. The cost for the uphill and downhill stream channels is approximately \$45,000 and \$155,000, respectively.

Table 5. Habitat Loss and Gain at Station 647+20 and 653+00

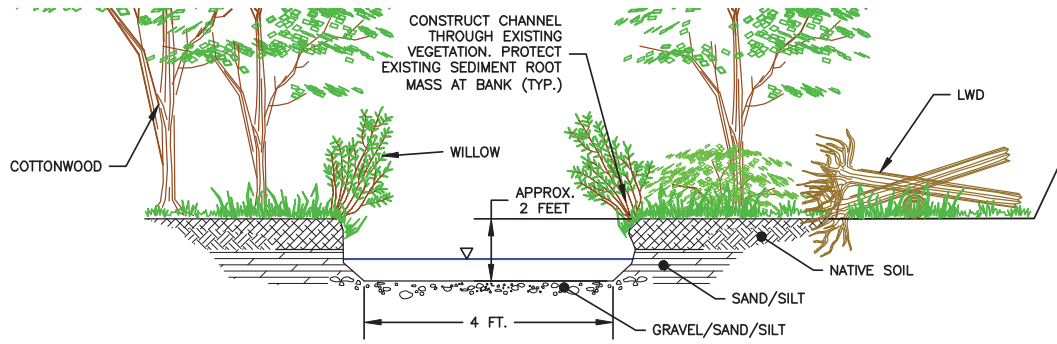
Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
<p>Channel hits highway at 653+00 where it divides, flowing both east and west along the highway toe of slope and crossing the highway at 647+20 (36" CMP) and at 655+50 (24" CMP). Riparian vegetation is limited along highway toe of slope, both upstream of the highway and downstream. The channel downstream of the 655+50 culvert passes through a marsh and exits through a deeply incised channel that resulted from flooding in 2005; the channel is at risk of further down cutting and draining the marsh. The channel downstream of 647+20 is approximately 300', most of which is up against the highway toe of slope.</p>	<p>A new Tier 1 fish passage culvert will be added at 653+00 where the stream currently hits the highway; a new channel upstream of the highway will be created to capture flow along the highway toe of slope that crosses at 647+20; a new Tier 1 fish passage culvert will replace the existing culvert at 647+20. Downstream of the new culvert at 653, two options are considered for creation of a new stream: Option 1 directs stream through mature cottonwood forest for 250-300', fairly steep gradient, not much rearing habitat. Option 2 has a 100' long steep section, then 200' of sinuous, well vegetated channel with undercut banks. Deep pool and glide morphology provide good rearing habitat. Downstream of these two options, another 500' of meandering channel through wetland will also be created, away from the toe of slope.</p>



PLAN VIEW

LEGEND

- S&HI CULVERT LOCATION
- EXISTING CHANNEL
- NEW CHANNEL
- OPTION 1
- OPTION 2
- DERIS FAN
- TOE OF SLOPE
- PROPERTY LINES
- LARGE WOODY DEBRIS
- ▨ CULVERT



1
9
CONCEPTUAL CROSS-SECTION
NOT TO SCALE

1	DM	1/5/12	
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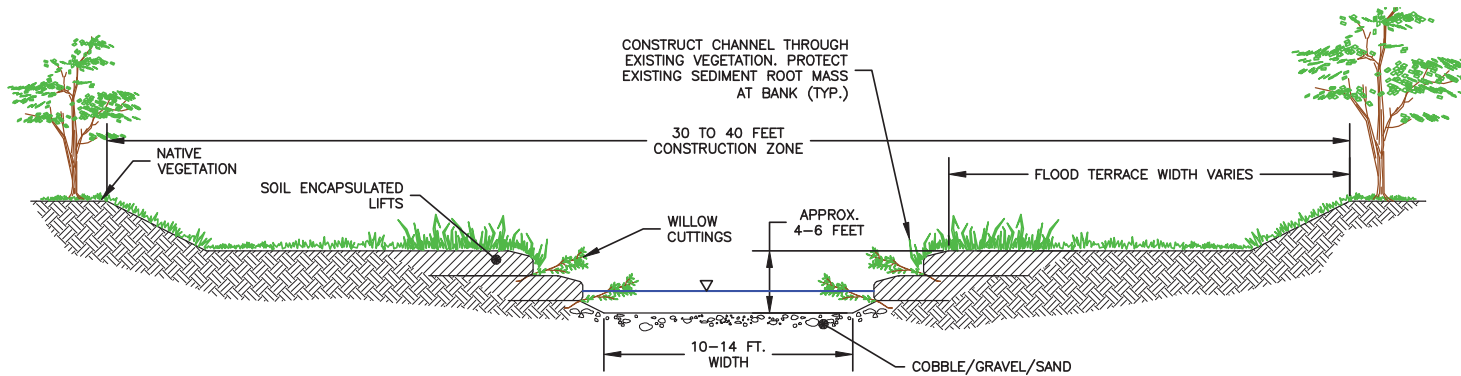
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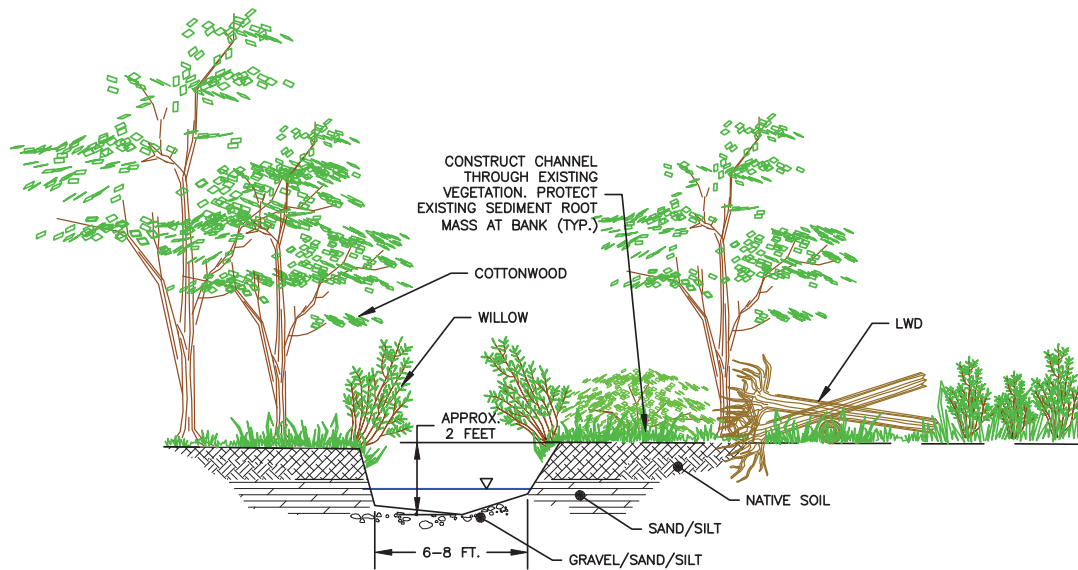


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Conceptual Mitigation Opportunities
Site 647+20



TYPICAL RECONSTRUCTED CHANNEL: OPTION 1
NOT TO SCALE



TYPICAL NATIVE SURFACE AND VEGETATION: OPTION 2
NOT TO SCALE

1	DM	1/5/12	
NO.	BY	DATE	REVISION DESCRIPTION

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Conceptual Mitigation Opportunities
Site 647+20

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Station 736+83

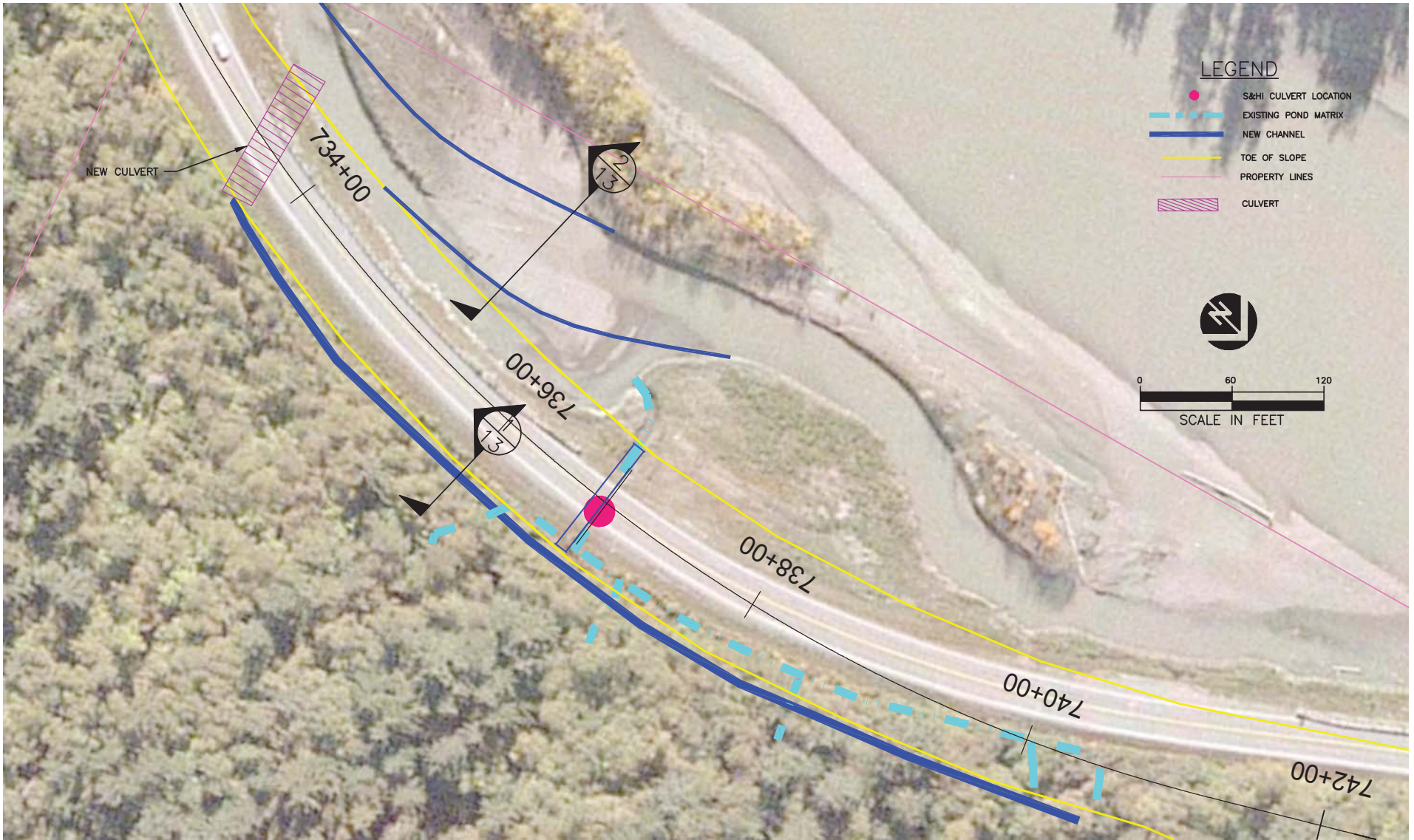
This location is shown on Sheets 11 through 13. The stream passes through a 24 inch culvert then flows approximately 75 feet through a uniform channel. Both banks are maintained by DOT&PF and have limited riparian vegetation.

Due to the raising of the highway grade in this area, the proposed plan is to pick up the flows from the numerous waterfalls between station 733+80 and 740+75 and route this water back on line to the new culvert at station 733+80. The culvert will empty directly into a side channel of the Chilkat River, so there will not be any creation of new habitat downstream of the culvert. The culvert will be skewed to better match stream alignment. The newly created 690 foot stream upstream of the culvert will provide rearing habitat for juvenile fish. It will be excavated in a manner to preserve the existing vegetation to the extent possible, but the routing of the stream is limited due to the steep backslope of the mountainside adjacent to the road fill. The approximate gradient of this stream will be 2%, allowing for the construction of a series of pools and riffles.

A rough planning level construction cost for this option is \$100,000 not including the culvert crossing.

Table 6. Habitat Loss and Gain at Station 736+83

Existing Stream Conditions (length)	Proposed Stream Enhancements (length)
24" culvert; stream flows for 75' with uniform channel and limited riparian vegetation on both banks.	New Tier 2 fish passage culvert at 733+80; creation of 690' channel upstream of the highway to capture flows from numerous waterfalls; riffle-pool morphology to provide rearing habitat.



PLAN VIEW

1	DM	1/5/12	
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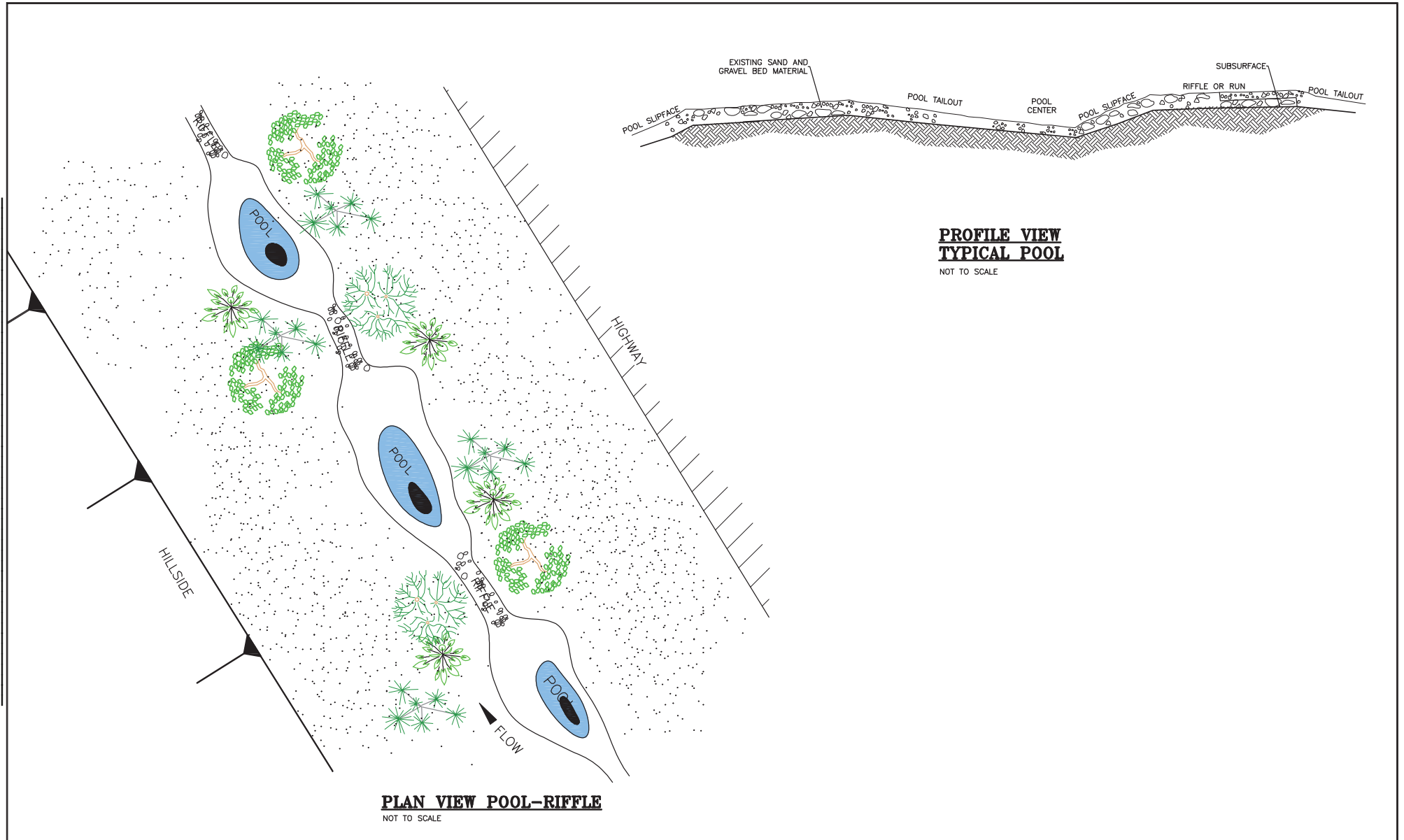
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 Site 736+83

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NO.	BY	DATE	REVISION DESCRIPTION

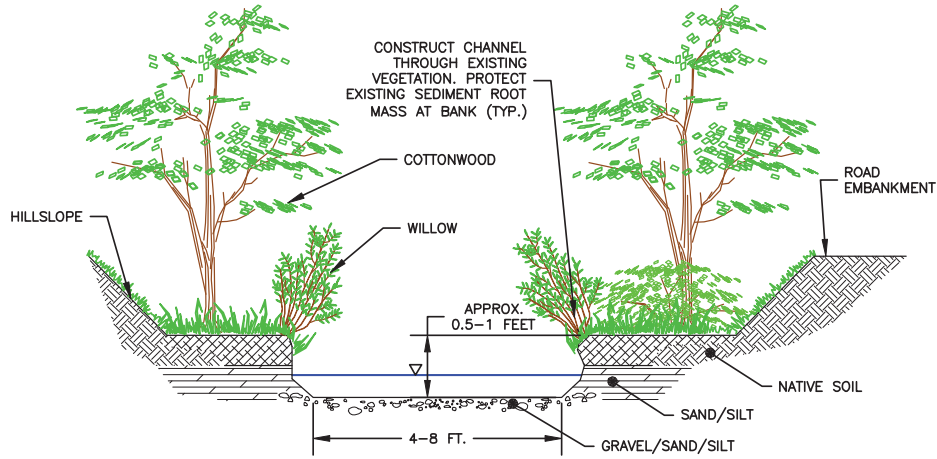
RP	DM, MS	DM
DRAWN	DESIGNED	CHECKED
DM	10/28/09	
APPROVED	DATE	PROJECT

State of Alaska Department of Transportation
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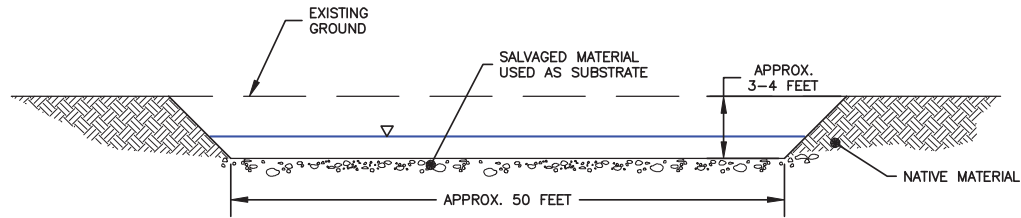


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Conceptual Mitigation Opportunities
Site 736+83



1
13 TYPICAL SECTION: SITE 736+83
NOT TO SCALE



2
13 TYPICAL SECTION: SITE 736+83
NOT TO SCALE

1	DM	1/5/12	
NO.	BY	DATE	REVISION DESCRIPTION

RP	DM, MS	DM
DRAWN	DESIGNED	CHECKED
DM	10/28/09	
APPROVED	DATE	PROJECT

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SHEET

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Station 733+70 to 736+70 Chilkat River Side Channel

This location is shown on Sheets 11 and 13. The new highway alignment in this area results in the filling of a portion of a side channel of the Chilkat River that was identified in the Stream and Habitat Inventory as productive coho and chum spawning habitat. The existing channel runs along the rip rap toe of the existing highway fill.

It is proposed that the adjacent gravel bar be excavated to create a new side channel for the river that matches into the upstream and downstream elevations of the existing side channel. The channel width is based on the width of the existing channel. No material will be imported or placed to form a spawning gravel subgrade. The existing river gravels in the channel will be left in place. The banks of the new channel will be sloped back at a 1:1 slope, and will not be vegetated. The area of the new channel will be entirely flooded during high water events, and revegetation, if it occurs, will be achieved naturally on the areas of the river bar that remain stable.

A rough planning level construction cost for this option is \$50,000.

Table 7. Habitat Loss and Gain at Station 733+70 to 736+70

Existing Stream Conditions	Proposed Stream Enhancements
Productive coho and chum spawning channel along toe of rip rap slope. Embankment fills to impact channel.	A new spawning channel will be excavated from adjacent gravel bar to match upstream and downstream elevations and widths. Existing river gravels will be left in place for spawning.

Station 865+88

This location is shown on Sheets 14 and 15. The stream passes through a 73 inch by 55 inch culvert and flows about 100 feet before discharging into a side channel of the Chilkat River. This site has numerous springs along the toe of the hill slope. Currently these springs are collected in a ditch and routed to a weir and screened inlet to supply a complex of stainless steel salmon egg incubation boxes operated by Northern Southeast Regional Aquaculture Association (NSRAA). Although a stream restoration plan that involved the removal of the boxes and the establishment of an extended stream system utilizing the available flow was considered, it was decided that the incubation boxes would remain in place.

The proposed plan is to relocate the new culvert ahead on line to station 869+75, and to construct a new length of stream channel from the culvert outlet through the forested terrace, and joining with the existing stream outlet. This stream will be approximately 500 feet in length. The stream will be four to six feet in width, and the banks will be either formed by the existing material, utilizing the inherent stability of the existing root mass, or created using fabric wrapped soil lifts. The existing vegetation along the new stream corridor will be protected to the extent possible in order to provide a healthy riparian habitat. Willows will be planted as needed to provide additional vegetation and bank stability. This stream will function primarily as rearing habitat, but will also provide a corridor for the return, and possible harvesting for eggs, of chum salmon to the incubation box site.

Additionally, the plan proposes the enhancement of the existing pool habitat along the east side of the road (mountain side) with woody debris structures. These structures will provide additional cover for rearing fish. The perimeter of the pool will be planted with willows to provide a riparian canopy. The beaver pond that is currently blocked and not available to rearing fish will also be opened and connected to the flowing stream. A short stream section just downstream of the incubation boxes will be constructed to route the stream away from the toe of the new road fill.

A rough planning level construction cost for this option is \$100,000 not including the culvert crossing.

Table 8. Habitat Loss and Gain at Station 865+88

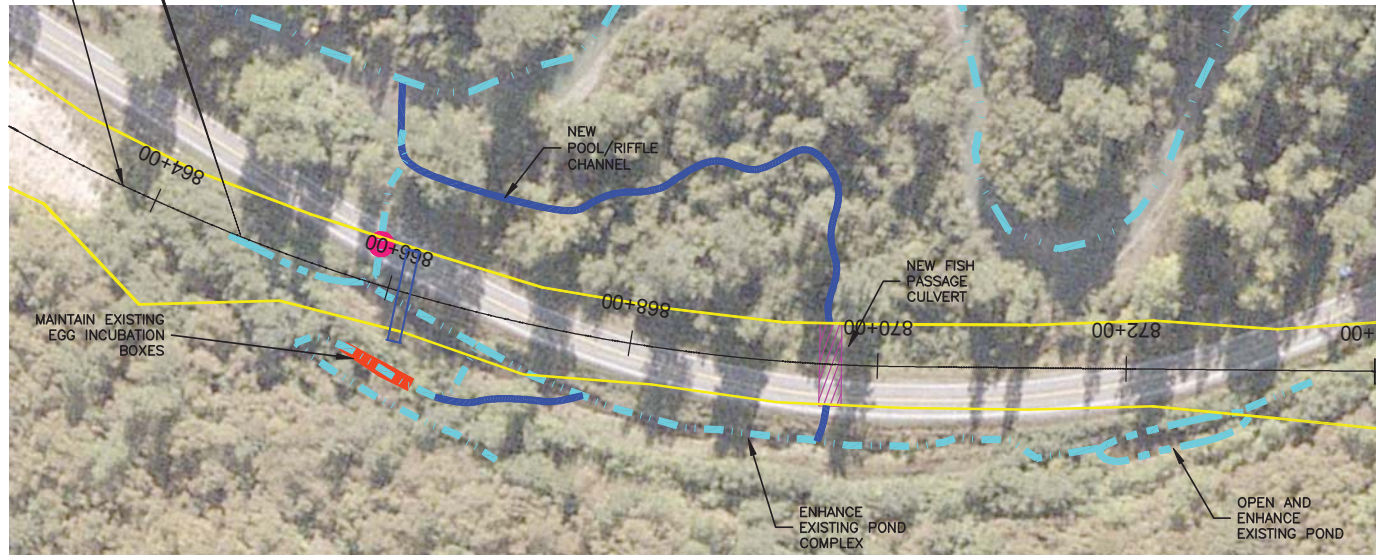
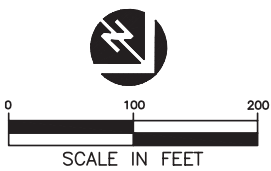
Existing Stream Conditions	Proposed Stream Enhancements
73"x 55" culvert; stream flows 100' downstream of highway to river. Upstream of the culvert there is an existing pond complex fed by numerous springs which are routed through a weir and screened inlet that supplies water to a series of stainless steel salmon egg incubation boxes.	The old culvert will be abandoned and a new Tier 1 fish passage culvert installed at 869+75. The existing pool habitat on the upstream side of the highway will be enhanced by installing woody debris structures and planting the perimeter of the pool with willows.

	<p>An existing beaver pond will be unblocked to allow entry by rearing fish. A short section of stream downstream of the incubation boxes will be constructed to route the water away from the highway toe of slope. Downstream of the culvert, a new 500' stream channel will be created through forested terrace; additional vegetation planting will add to existing to ensure good riparian on both banks for rearing habitat.</p>
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ALIGNMENT

- LEGEND**
- S&HI CULVERT LOCATION
 - - - EXISTING POND MATRIX
 - NEW CHANNEL
 - TOE OF SLOPE
 - ▨ CULVERT



PLAN VIEW – STREAM CREATION TO MAINTAIN EXISTING NSRAA EGG INCUBATION BOXES

NO.	BY	DATE	REVISION DESCRIPTION
1	DM	1/5/12	

RP	DM, MS	DM
DRAWN	DESIGNED	CHECKED
DM	10/28/09	
APPROVED	DATE	PROJECT

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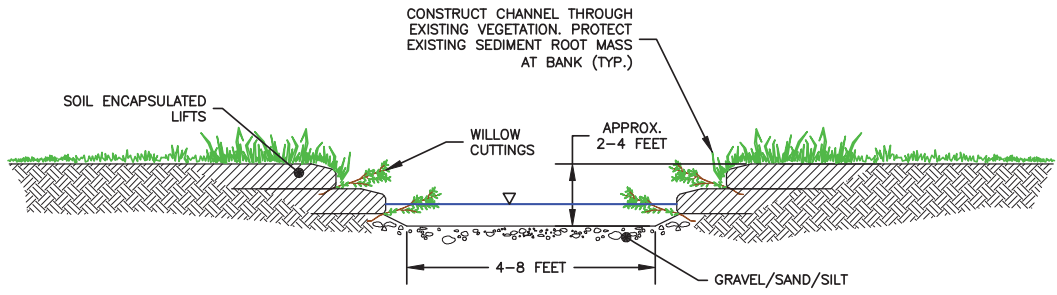


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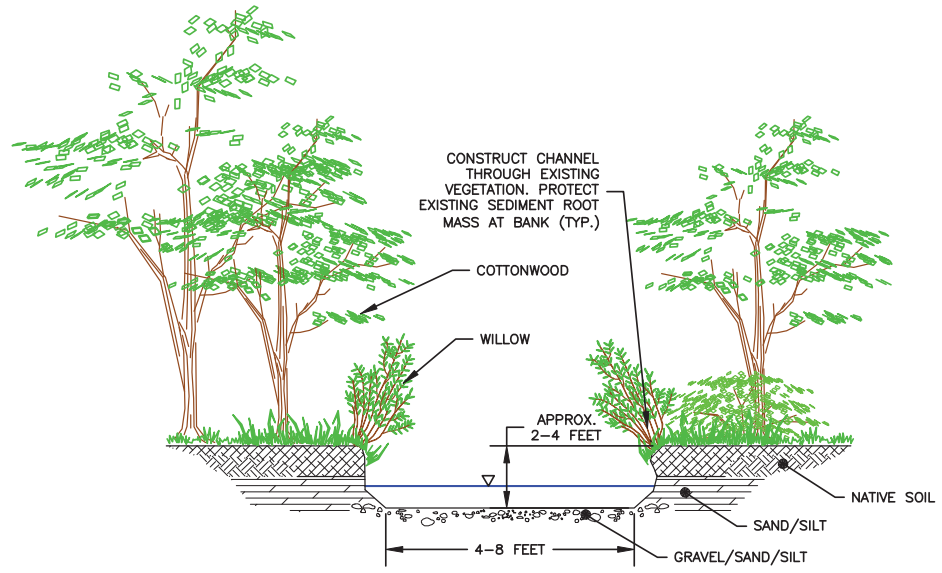
Conceptual Mitigation Opportunities
Site 865+88

SHEET

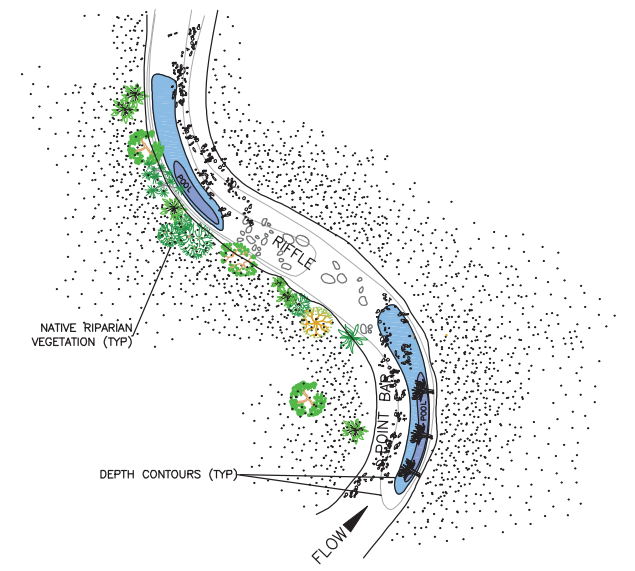
14 of 17



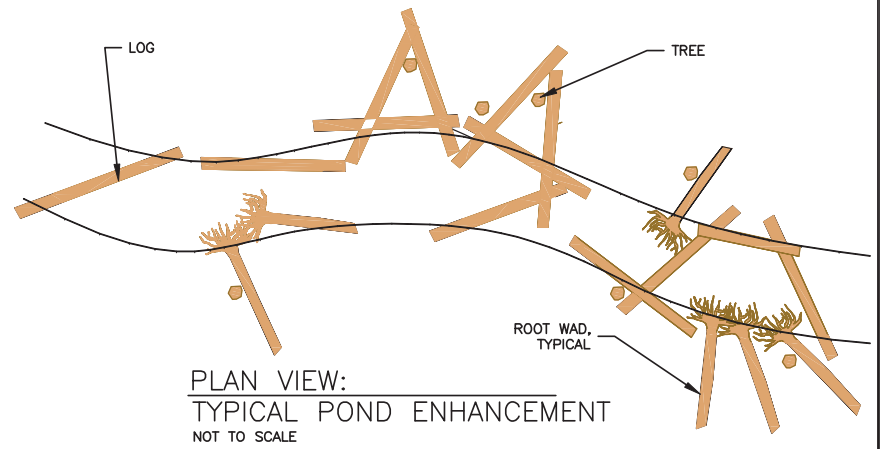
TYPICAL NEW POOL/RIFFLE CHANNEL
NOT TO SCALE



TYPICAL NATIVE SURFACE AND VEGETATION: NEW POOL/RIFFLE CHANNEL
NOT TO SCALE



**PLAN VIEW
POOL-RIFFLE**
NOT TO SCALE



**PLAN VIEW:
TYPICAL POND ENHANCEMENT**
NOT TO SCALE

1	DM	1/5/12	
NO.	BY	DATE	REVISION DESCRIPTION

RP	DM, MS	DM
DRAWN	DESIGNED	CHECKED
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Site 865+88

Station 887+60

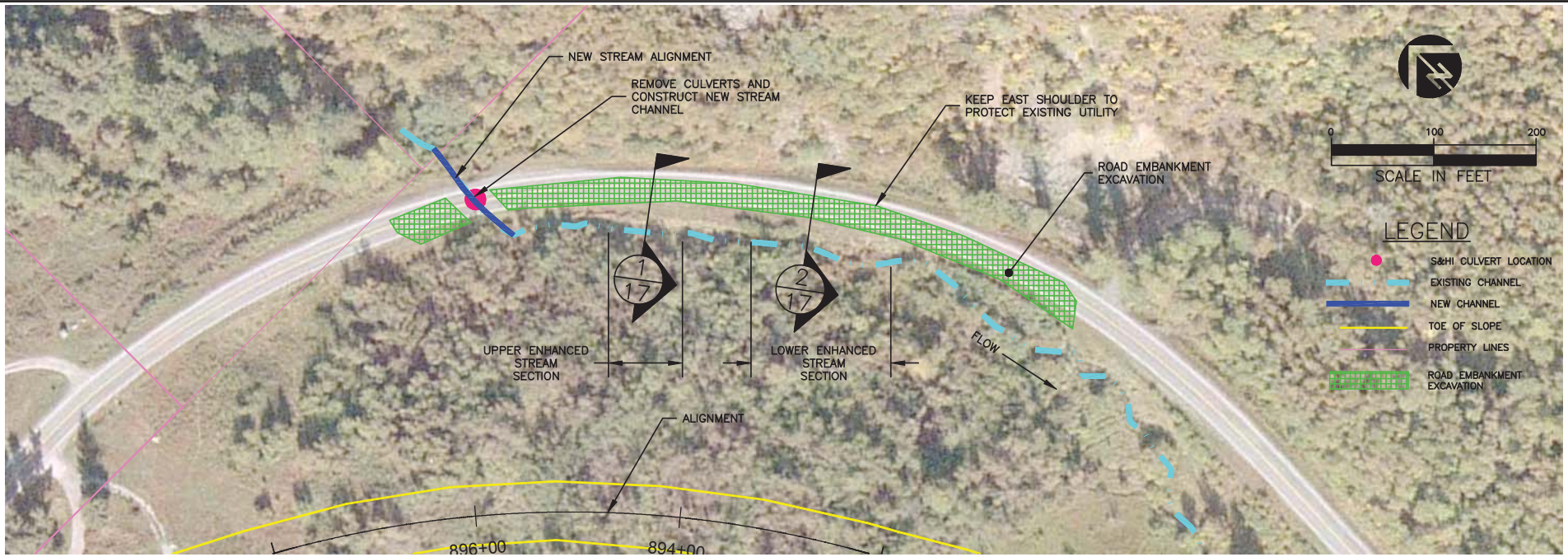
This location is shown on Sheets 16 and 17. The stream, locally known as Horse Farm Creek, passes through twin 36 inch culverts then flows approximately 800 feet along the toe of the maintained by DOT&PF and has limited riparian vegetation.

The proposed final highway alignment crosses this stream very near its confluence with Eighteen Mile Slough. This crossing will involve the placement of a large culvert, and no mitigation opportunities exist in the immediate area of the culvert. However, there are opportunities to enhance the sections of the stream that flow along the toe of the current highway, and removal of the twin 36 inch culverts and re-establishment of an open channel provides additional habitat creation. The proposed plan is to introduce woody debris into two sections of the existing stream, in the locations shown on the accompanying drawings. In addition to directly providing cover and velocity refuge, the introduction of large woody debris into the stream will result in the localized scouring of pools, cause an increase in the amount of undercut bank available for cover, and increase the meander in the straighter section of the stream. The creation of new pool and riffle habitat will increase both spawning and rearing habitat. The removal of the culverts and the construction of a new stream channel and associated floodplain will provide salmon spawning habitat and open access for fish to the upper reaches of the stream system. The existing highway embankment will be partially excavated along a portion of the stream to create a hydrologically connected flood terrace vegetated with native riparian vegetation. Part of the highway embankment along the hillside shoulder will remain in place to provide a corridor for the utilities present in the old gas pipeline.

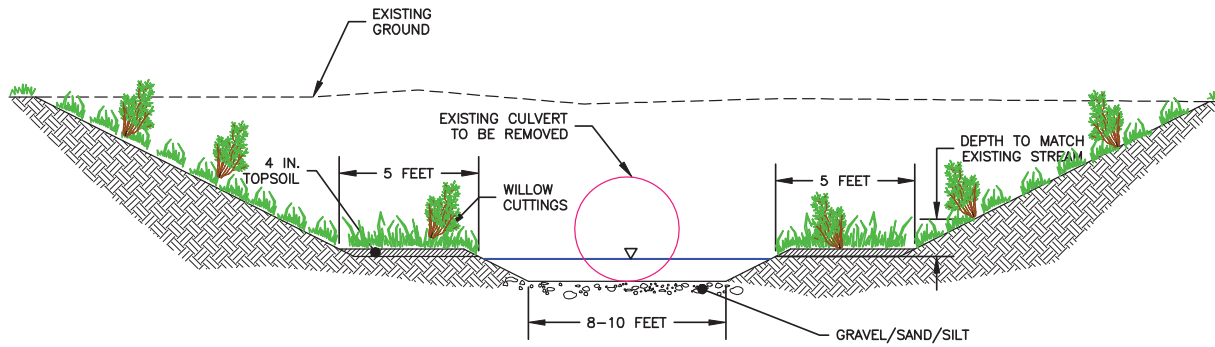
A rough planning level construction cost for this option is \$75,000.

Table 9. Habitat Loss and Gain at Station 887+60

Existing Stream Conditions	Proposed Stream Enhancements
Two 36” culverts at 896+00 on old alignment; downstream flow for 800’ along toe of slope; left bank has limited riparian vegetation.	Remove culverts at 896+00 and create new stream channel across abandoned highway alignment. Install new Tier 1 fish passage culvert at 887+60. Introduce woody debris to existing stream channel to encourage creation of pools and riffles and improve spawning and rearing habitat. A portion of the existing road embankment will be excavated along the stream to create a hydrologically connected flood terrace vegetated with native riparian species.



PLAN VIEW – STREAM ENHANCEMENT



TYPICAL CULVERT REMOVAL
NOT TO SCALE

NO.	BY	DATE	REVISION DESCRIPTION
1	DM	1/5/12	

RP	DM, MS	DM
DRAWN	DESIGNED	CHECKED
DM	10/28/09	
APPROVED	DATE	PROJECT

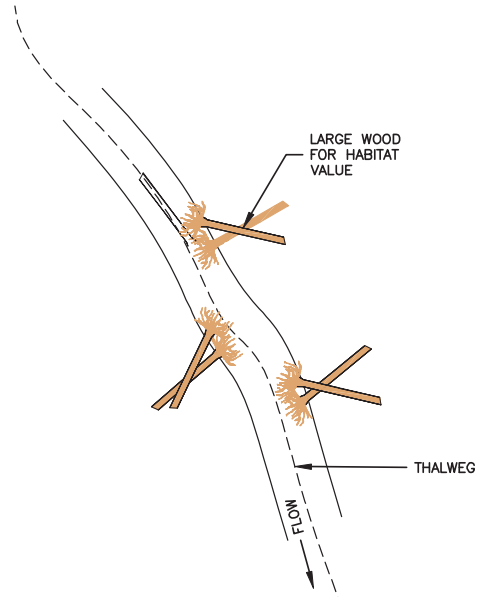
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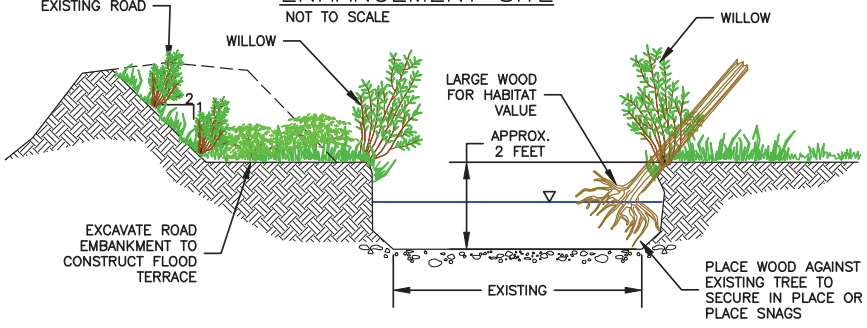
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Site 887+60

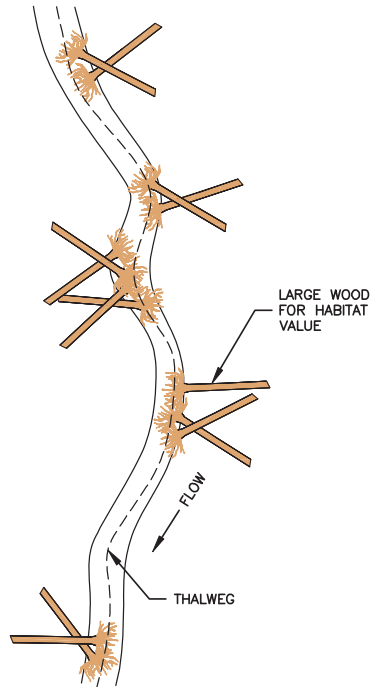
SHEET
16 of 17



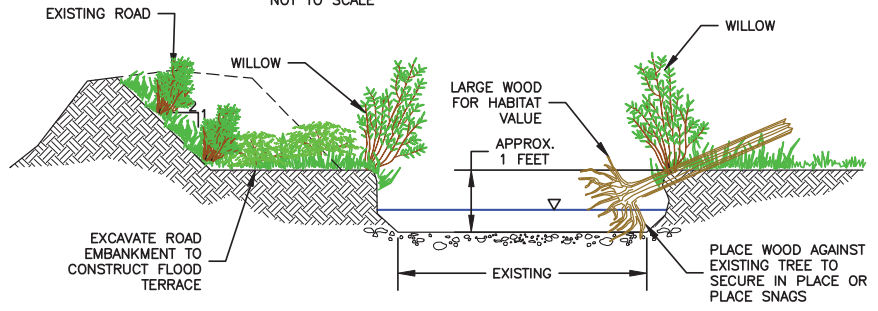
PLAN VIEW: UPPER STREAM
ENHANCEMENT SITE
NOT TO SCALE



1
17
TYPICAL SECTION: UPPER STREAM
ENHANCEMENT SITE
NOT TO SCALE



PLAN VIEW: LOWER STREAM
ENHANCEMENT SITE
NOT TO SCALE



2
17
TYPICAL SECTION: LOWER STREAM
ENHANCEMENT SITE
NOT TO SCALE

1	DM	1/5/12	
NO.	BY	DATE	REVISION DESCRIPTION

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DRAWN	DESIGNED	CHECKED
DM	10/28/09	
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