
Appendix D

Maps of 2007 Habitat Units

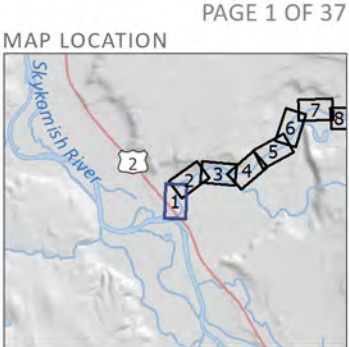
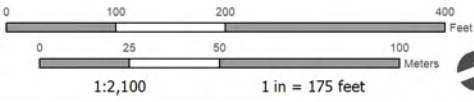


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

Glide Low gradient riffle Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016





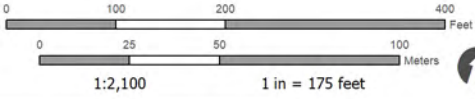
SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Glide
- Low gradient riffle
- Island

Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



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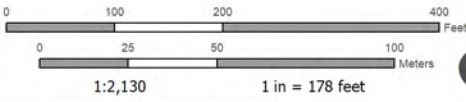
SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

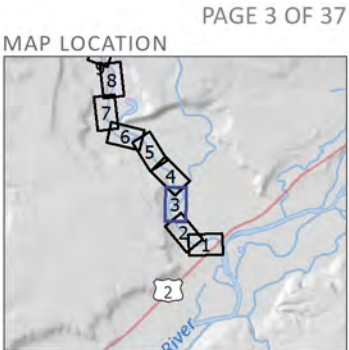
- Glide
- Low gradient riffle
- Island

Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



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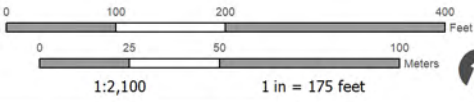




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Low gradient riffle
 - Island
 - Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



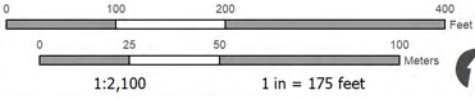


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

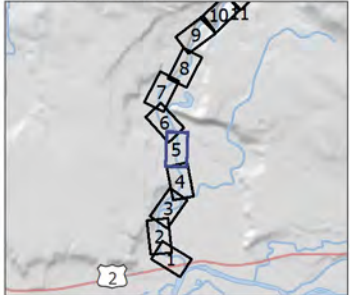
- Glide
- Island
- Low gradient riffle
- Main channel pool
- Rapid
- Adjacent tile

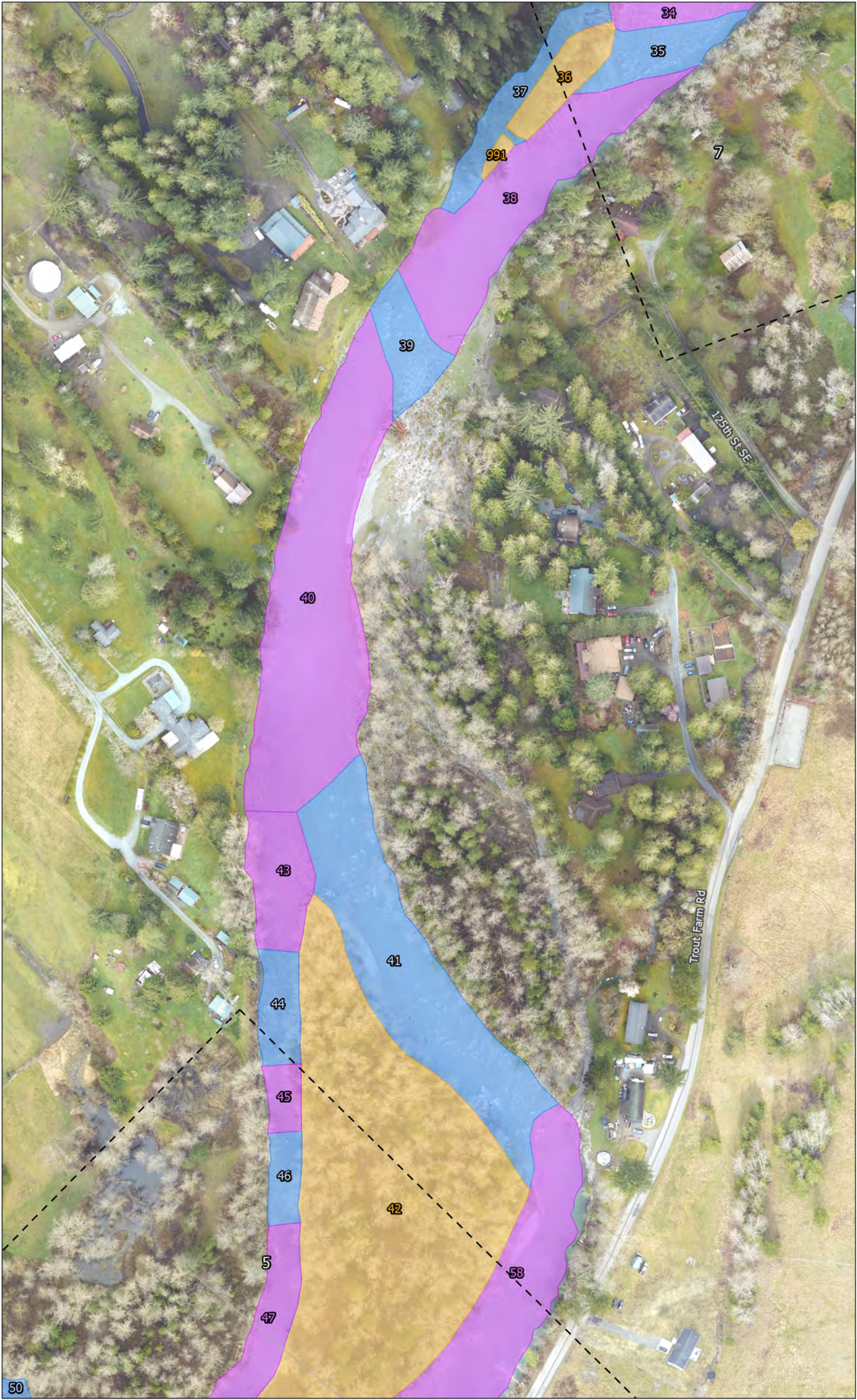
DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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MAP LOCATION





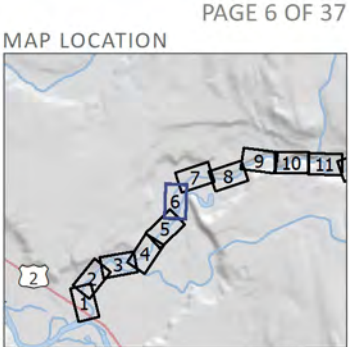
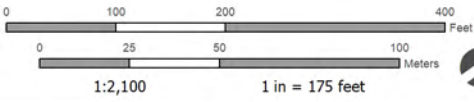
SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Glide
- Low gradient riffle
- Island

Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016

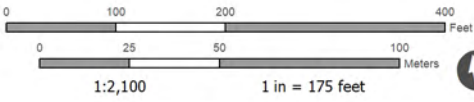




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Low gradient riffle
 - Island
 - Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016

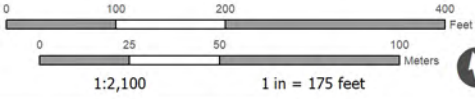




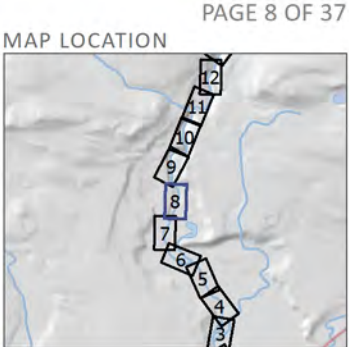
SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Low gradient riffle
 - Island
 - Main channel pool
 - Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



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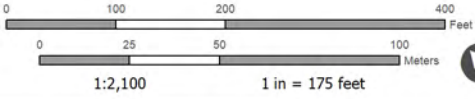




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|---|---|---|
| ■ Cascade | ■ Main channel pool | Adjacent tile |
| ■ Glide | ■ Rapid | |
| ■ Low gradient riffle | | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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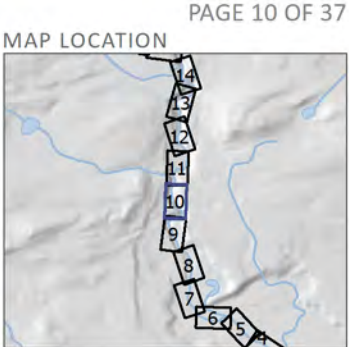
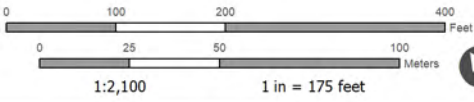




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|---|---|---|
| ■ Cascade | ■ Main channel pool | Adjacent tile |
| ■ Glide | ■ Rapid | |
| ■ Low gradient riffle | | |

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



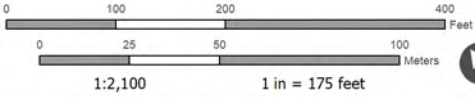


SULTAN RIVER HABITAT UNITS (2007)

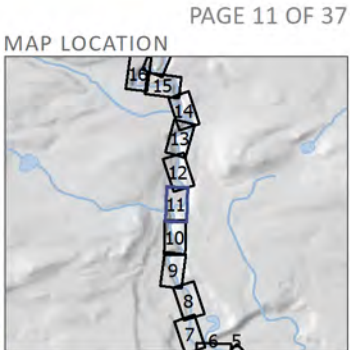
Habitat Types
(labeled with NSO ID)

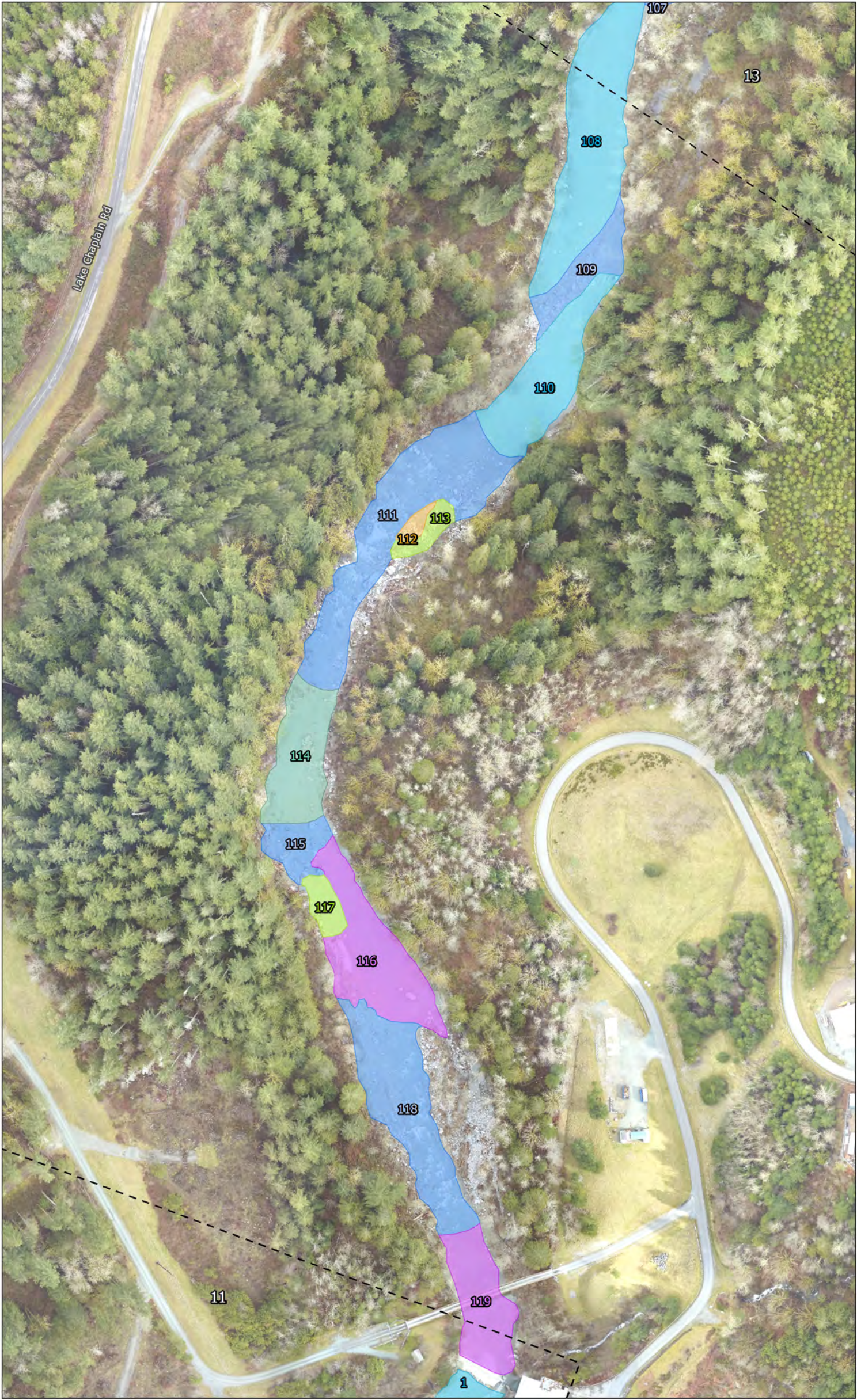
- | | | |
|---|--|--|
| ■ Cascade | ■ Main channel pool | ┌ Adjacent tile |
| ■ Glide | ■ Rapid | |
| ■ Low gradient riffle | | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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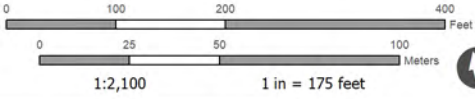




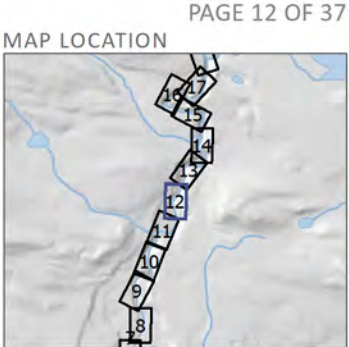
SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|-----------|---------------------|---------------|
| Backwater | Low gradient riffle | Adjacent tile |
| Glide | Main channel pool | |
| Island | Scour pool | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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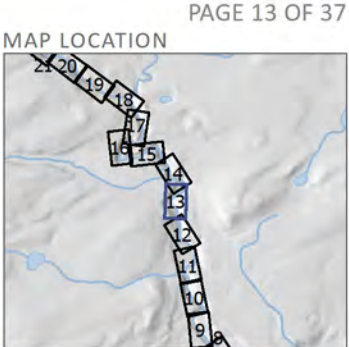
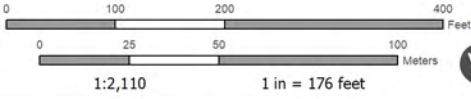


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Glide
- Island
- Low gradient riffle
- Main channel pool
- Scour pool
- Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016

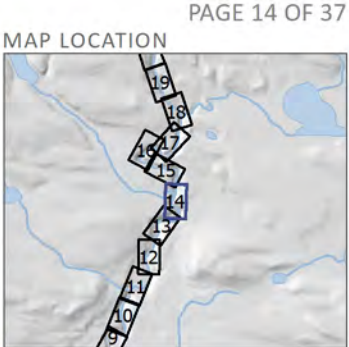
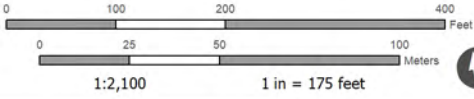




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Rapid
 - Low gradient riffle
 - Scour pool
 - Main channel pool
 - Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



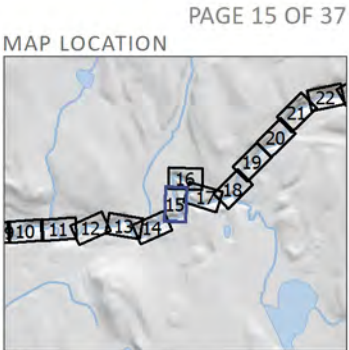
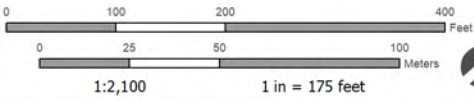


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Island
- Rapid
- Low gradient riffle
- Scour pool
- Main channel pool
- Adjacent tile

DATA SOURCES
Imagery: SNO PUD 2020
Roads, rivers, waterbodies: ESRI 2016



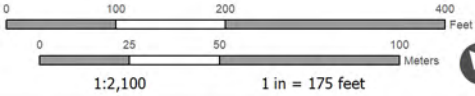


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Low gradient riffle
- Rapid
- Adjacent tile
- Main channel pool

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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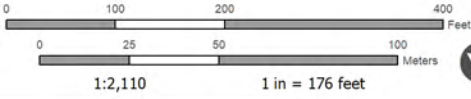


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- | | | |
|---|---|---|
| ■ Cascade | ■ Main channel pool | Adjacent tile |
| ■ Glide | ■ Rapid | |
| ■ Island | ■ Scour pool | |
| ■ Low gradient riffle | | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016

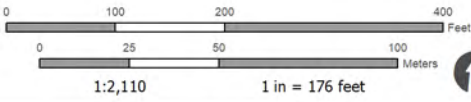




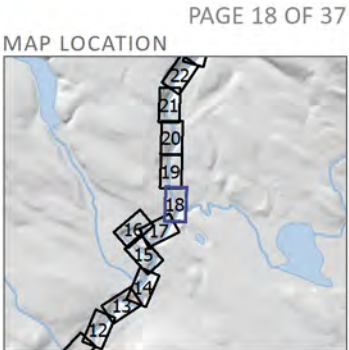
SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Cascade
 - Main channel pool
 - Adjacent tile
 - Low gradient riffle
 - Rapid

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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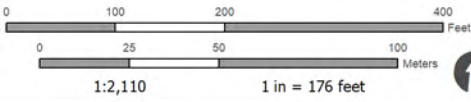




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Cascade
 - Main channel pool
 - Low gradient riffle
 - Rapid
 - Adjacent tile

DATA SOURCES
Imagery: SNO-PUD 2020
Roads, rivers, waterbodies: ESRI 2016



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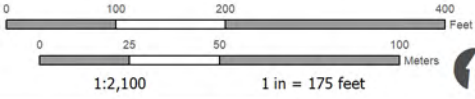




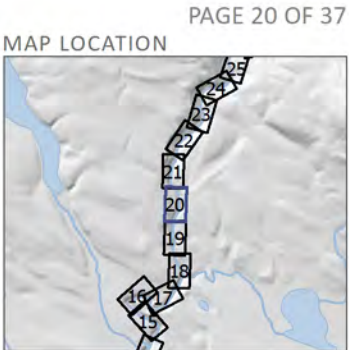
SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Rapid
 - Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



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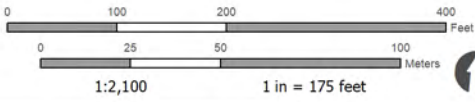


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- | | | |
|---------------------|-------------------|---------------|
| Backwater | Main channel pool | Adjacent tile |
| Cascade | Rapid | |
| Glide | Scour pool | |
| Low gradient riffle | | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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MAP LOCATION

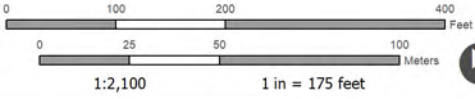




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|-----------|---------------------|---------------|
| Backwater | Low gradient riffle | Adjacent tile |
| Cascade | Main channel pool | |
| Glide | Rapid | |

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016

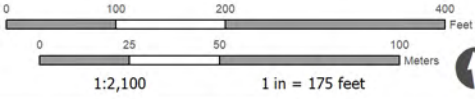




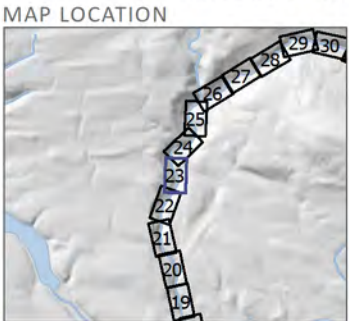
SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Main channel pool
 - Adjacent tile
 - Low gradient riffle
 - Scour pool

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



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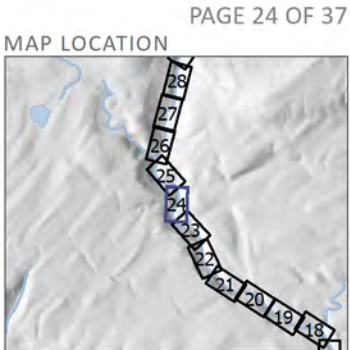
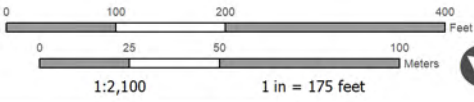




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|---|--|--|
| Glide | Main channel pool | Adjacent tile |
| Island | Rapid | |
| Low gradient riffle | Scour pool | |

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



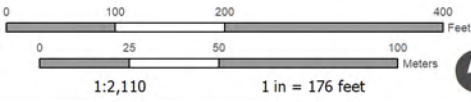


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Glide
- Rapid
- Low gradient riffle
- Scour pool
- Main channel pool
- Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



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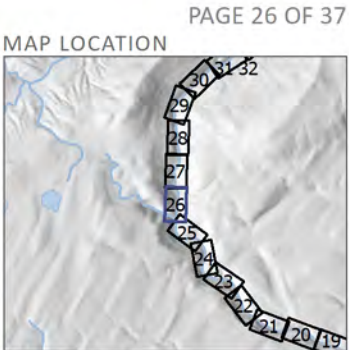
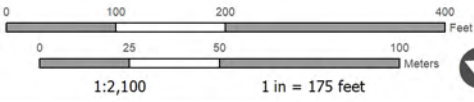


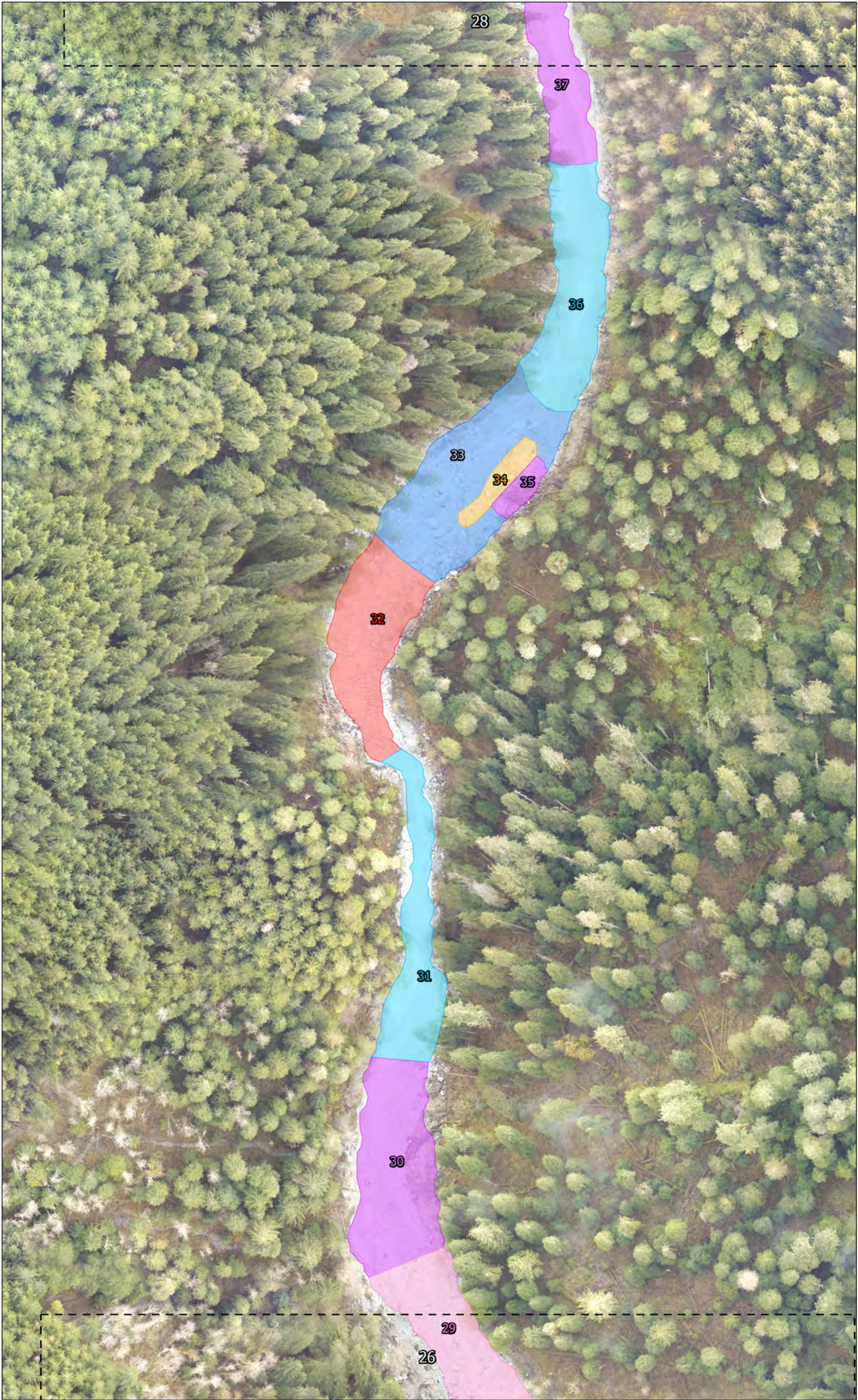


SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Glide
 - Rapid
 - Low gradient riffle
 - Scour pool
 - Main channel pool
 - Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016

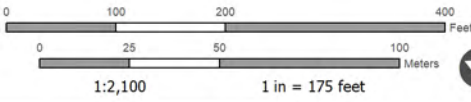




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|--|---|--|
| ■ Cascade | ■ Low gradient riffle | ┌ Adjacent tile |
| ■ Glide | ■ Main channel pool | |
| ■ Island | ■ Rapid | |

DATA SOURCES
Imagery: SNO-PUD 2020
Roads, rivers, waterbodies: ESRI 2016



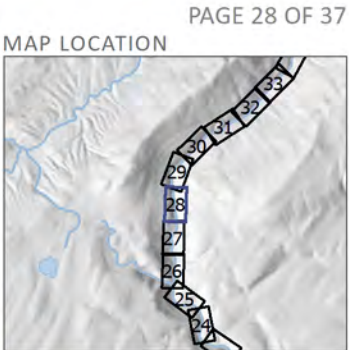
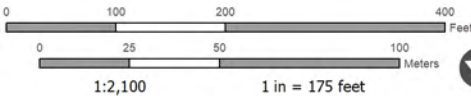


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Rapid
- ┌─┐ Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



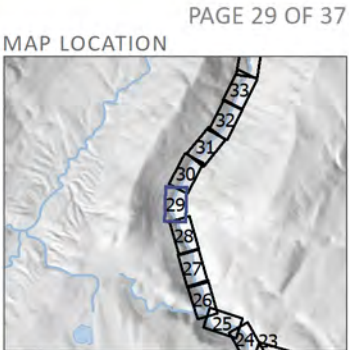
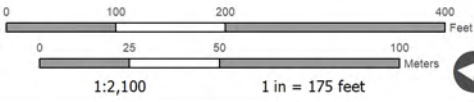


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Backwater
 - Cascade
 - Glide
 - Main channel pool
 - Rapid
- Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016

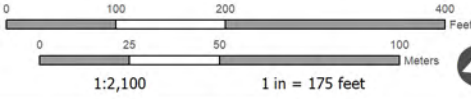




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Rapid
- Adjacent tile

DATA SOURCES
Imagery: SNO-PUD 2020
Roads, rivers, waterbodies: ESRI 2016

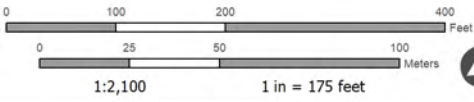


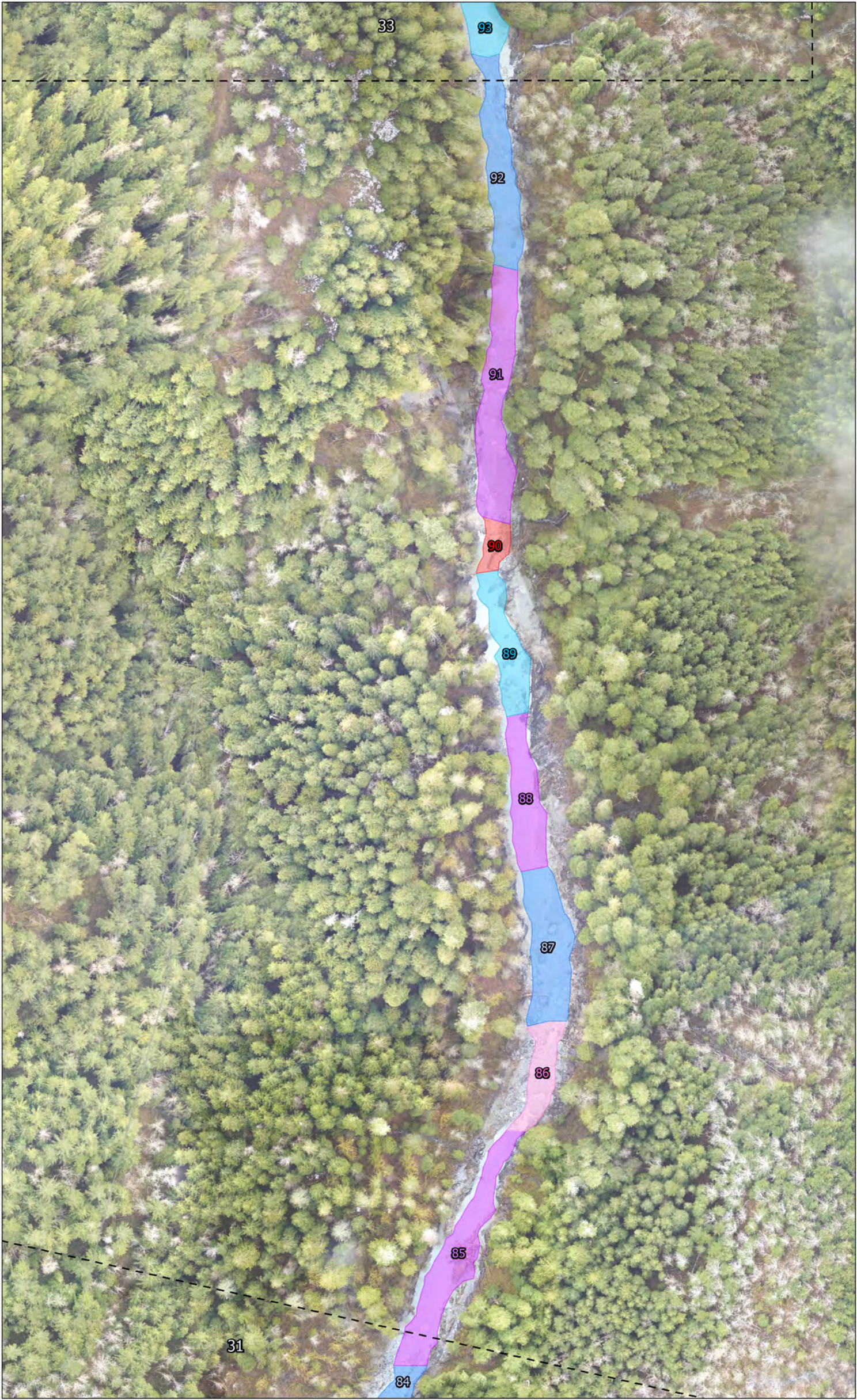


SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Rapid
- Adjacent tile

DATA SOURCES
Imagery: SNOPIUD 2020
Roads, rivers, waterbodies: ESRI 2016



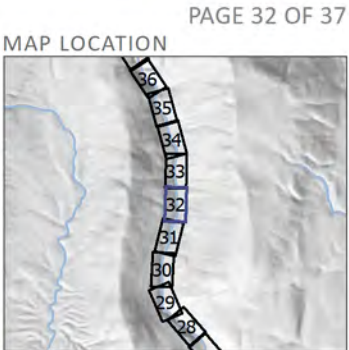
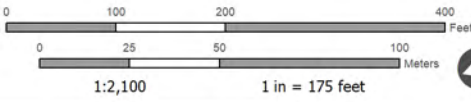


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Rapid
- └─ Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016

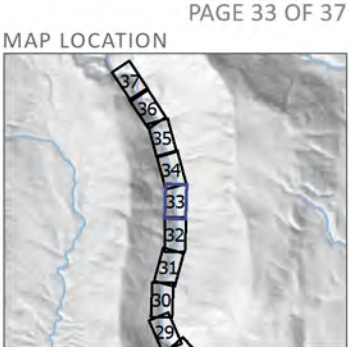
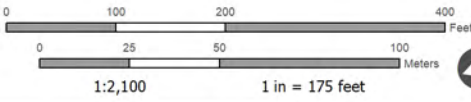




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|---------------------|-------------------|---------------|
| Cascade | Main channel pool | Adjacent tile |
| Glide | Rapid | |
| Low gradient riffle | Scour pool | |

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016

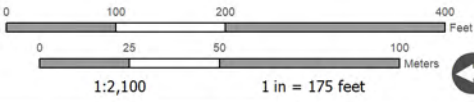




SULTAN RIVER HABITAT UNITS (2007)

- Habitat Types
(labeled with NSO ID)
- | | | |
|---|---|---|
| ■ Cascade | ■ Main channel pool | Adjacent tile |
| ■ Glide | ■ Rapid | |
| ■ Low gradient riffle | ■ Scour pool | |

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



MAP LOCATION



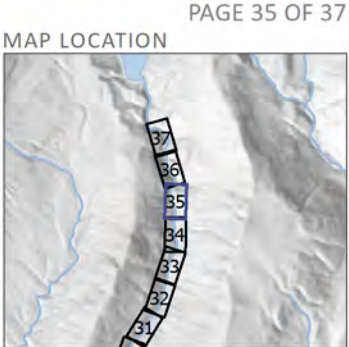
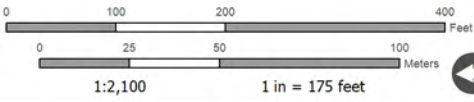


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Backwater
 - Glide
 - Low gradient riffle
 - Main channel pool
 - Scour pool
- ┌─┐ Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



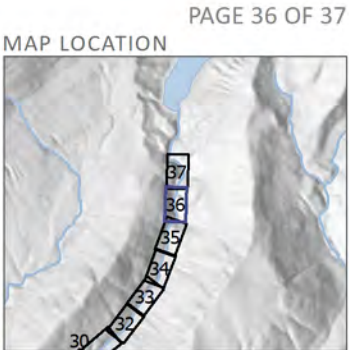
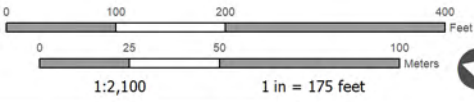


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Glide
 - Low gradient riffle
 - Main channel pool
- Adjacent tile

DATA SOURCES
Imagery: SNOPOD 2020
Roads, rivers, waterbodies: ESRI 2016



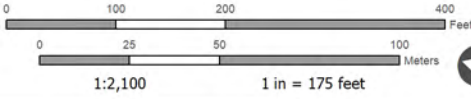


SULTAN RIVER HABITAT UNITS (2007)

Habitat Types
(labeled with NSO ID)

- Cascade
 - Glide
 - Low gradient riffle
 - Main channel pool
- Adjacent tile

DATA SOURCES
Imagery: SNOFUD 2020
Roads, rivers, waterbodies: ESRI 2016



Appendix E

Example Field Data Collection Forms and Criteria

Reach _____

NSO (cont) _____

BFW Criteria _____

Recorder _____

QC'er _____

[illegible]

Reaches

Operational Reaches

- | | |
|----------|--|
| A | RM 0.0 - 2.7
Confluence with Skykomish River upstream to BPA transmission line crossing |
| B | RM 2.7 - 4.3
BPA transmission line crossing upstream to Jackson Powerhouse |

Process Reaches

- | | |
|----------|--|
| C | RM 4.3 - 9.7
Jackson Powerhouse upstream to City of Everett Diversion Dam |
| D | RM 9.7 - 16.5
City of Everett Diversion Dam upstream to Culmback Dam |

Habitat Unit Codes

Core Unit Types

Riffle	R
Pool	P
Sub-surface flow	SSF
Wetland	W
Obscured	OB
Other	OT

Sub - unit types (Calif. salmonid stream restoration manual)

Pool	MCP	main channel pool	(e.g. trench pool, mid-channel pool, channel conf. pool, step pool)
	SCP	scour pool	(e.g. corner pool, scour enhanced by root wad - log - boulder)
	BKW	backwater pool	

Riffle	LGR	Low gradient riffle
	HGR	High gradient riffle
	GLD	Glide
	CAS	Cascade

Pool forming features (TFW pg 24)

1	LWD log(s)	7	channel bedform
2	LWD rootwad(s)	8	resistant bank
3	LWD jam	9	artificial bank
4	roots of standing trees or stump(s)	10	beaver dam
5	Boulder(s)	11	other / unknown
6	Bedrock		

Unit Category

- 1 primary units: dominant units in the mainchannel
- 2 secondary units: sub-dominant units within the main channel that span less than 50% of the wetted channel width along less than half their channel length
- 3 side channel units: units in smaller clearly defined channels that are separated from main low flow channel (say by an island for example)

LWD Single Pieces

Date _____

Reach

Form # _____ of _____

NSO (cont)

Crew

BFW

Recorder _____

[illegible]

QC'D BY _____ DATE: _____

LWD data sheet debris jams

Sultan River LWD SURVEY

Debris Jams

Date	QC
------	----

Reach

Form # of OC'er

NSO (cont) _____

Recorder _____ Date _____

BFW Criteria

LWD DEBRIS JAMS

[illegible]

LWD Hab Survey Codes

Descriptions

- ZONE 1 defined as the portion of the bankfull channel that is wetted at the time of the survey, regardless of whether the water is flowing or stagnant
- ZONE 2 defined as the area between the bankfull channel edge on both banks, below an imaginary line that connects those points, above the wetted gravel bars channel surface, and includes areas such as dry
- ZONE 3 the area vertically above Zone 2, the bankfull channel
- ZONE 4 area outside of the bankfull channel and Zone 3

LWD Log Criteria

- 1 dead
- 2 the root system (if present) no longer supports the weight of the stem / bole
- 3 minimum diameter of 0.1 meters along 2 meters of its length, AND
- 4 minimum 0.1 meter of length extending into the bankfull channel

LWD Rootwad Criteria

- 1 dead
- 2 root system detached from original position
- 3 minimum diameter of 0.2 meters with a total length <2 meters; AND,
- 4 minimum 0.1 meter of length extending into the bankfull channel

LWD Jam Identification

- 1 minimum 10 qualifying pieces of LWD either physically touching at one or more points, or associated with jam structure
- 2 minimum 0.1 meter of one LWD piece's length extending into the bankfull channel

KEY PIECE CRITERIA

See pg 17 and Appendix C of TFW Large Woody Debris Survey Manual

Sultan River Habitat Survey Wolmann Pebble Count

Date _____

Reach _____

NSO _____

FeatureID _____

BFW (m) _____

	size (mm)	Count	Total #
Mud Silt	<2		
Fine Sand	<2		
Sand	2 - 4		
G	4 - 6		
R	6 - 8		
A	8 - 12		
V	12 - 16		
E	16 - 22		
L	22 - 32		
S	32 - 45		
	45 - 64		
C	64 - 90		
O	90 - 128		
B	128 - 180		
B	180 - 256		
B	256 - 362		
L	362 - 512		
D	512 - 1024		
R	1024 - 2048		
S	2048 - 4096		
Bdrck	Bedrock		

Total =

Comments:

Date _____

Reach _____

NSO _____

Feature# _____

BFW (m) _____

	size (mm)	Count	Total #
Mud Silt	<2		
Fine Sand	<2		
Sand	2 - 4		
G	4 - 6		
R	6 - 8		
A	8 - 12		
V	12 - 16		
E	16 - 22		
L	22 - 32		
S	32 - 45		
	45 - 64		
C	64 - 90		
O	90 - 128		
B	128 - 180		
B	180 - 256		
B	256 - 362		
L	362 - 512		
D	512 - 1024		
R	1024 - 2048		
S	2048 - 4096		
Bdrck	Bedrock		

Total =

Comments:

Comments Log

Sultan River Hab Survey

Aerial Photo Mapping: Landmark / Photo / Comments Log

Date: _____

River Reach:

Form _____ of _____

[illegible]