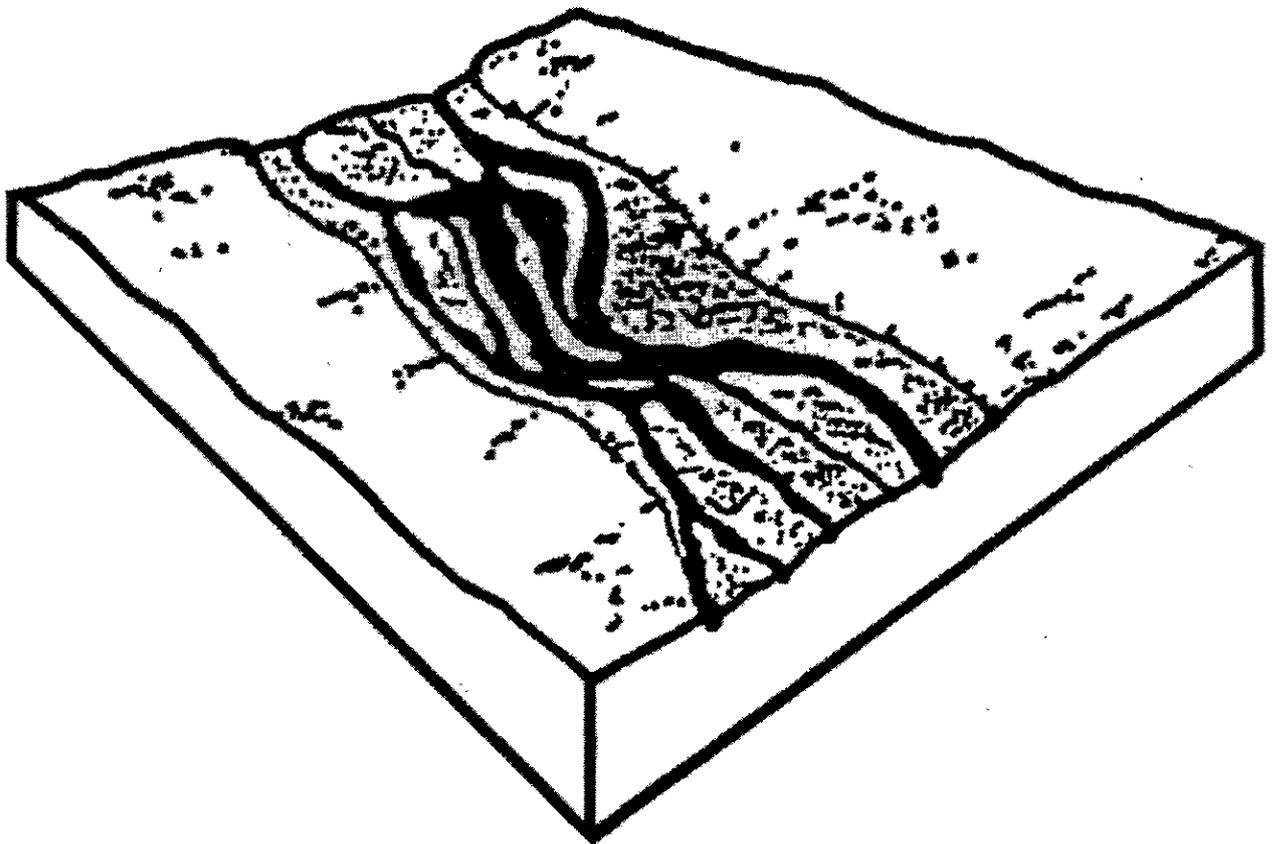


GLACIAL OUTWASH PROCESS GROUP

This process group includes GO1 (glacial side channel), GO2 (large meandering), GO3 (large braided), GO4 (moderate width), and GO5 (cirque channel) glacial outwash channel types. These are generally valley or lowland streams, with the exception of high elevation, cirque basin channel types (GO5). Mountain glacier meltwater is the source of runoff to these streams. Consequently, these streams carry extremely high sediment loads and turbid water. Glacial outwash channel types are alluvial channels with stream gradients usually less than three percent. Riparian areas are wide and may extend for more than a thousand meters in large braided outwash plain river systems.

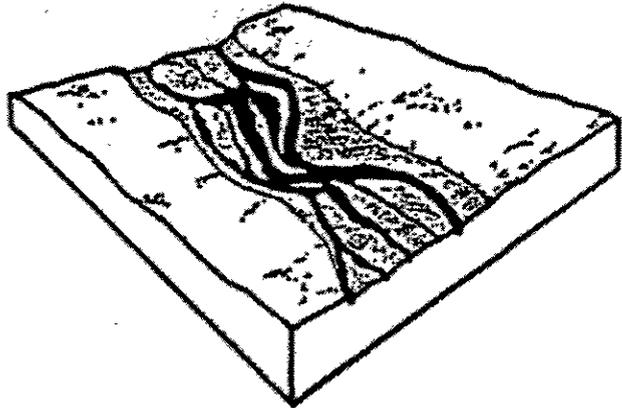


GLACIAL OUTWASH FLOOD PLAIN SIDE CHANNEL

Channel Mapping Symbol: GO1 (Formerly D8)

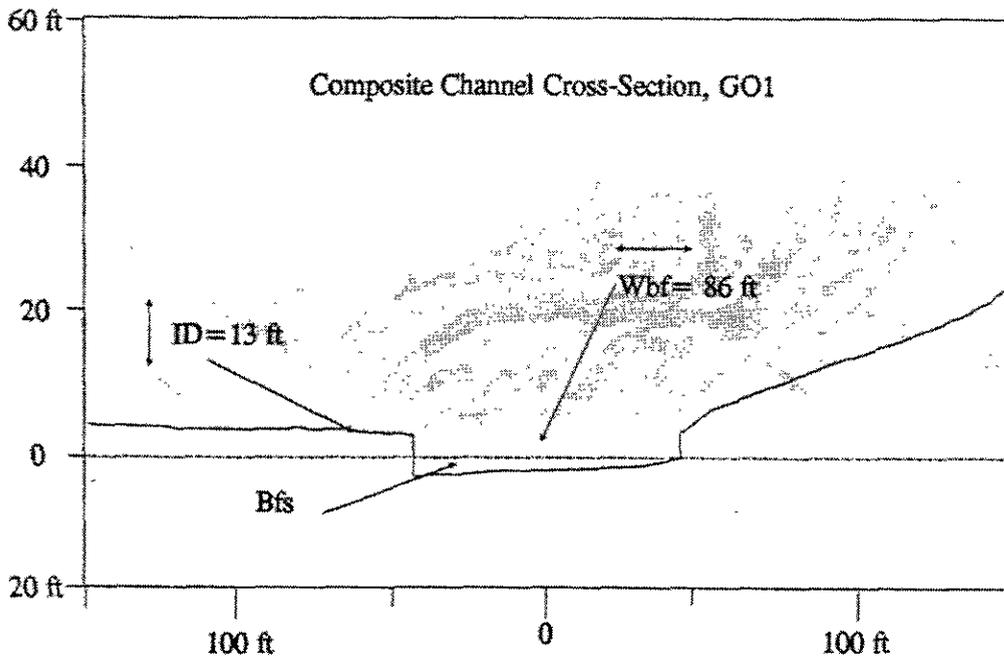
PHYSICAL CHARACTERISTICS

Geographic Setting: The GO1 channel type is usually situated within the broad, glacial valley or foreland landform. The GO1 channel is a side channel that bisects the glacial river terrace and is connected to the main GO2 or GO3 river.



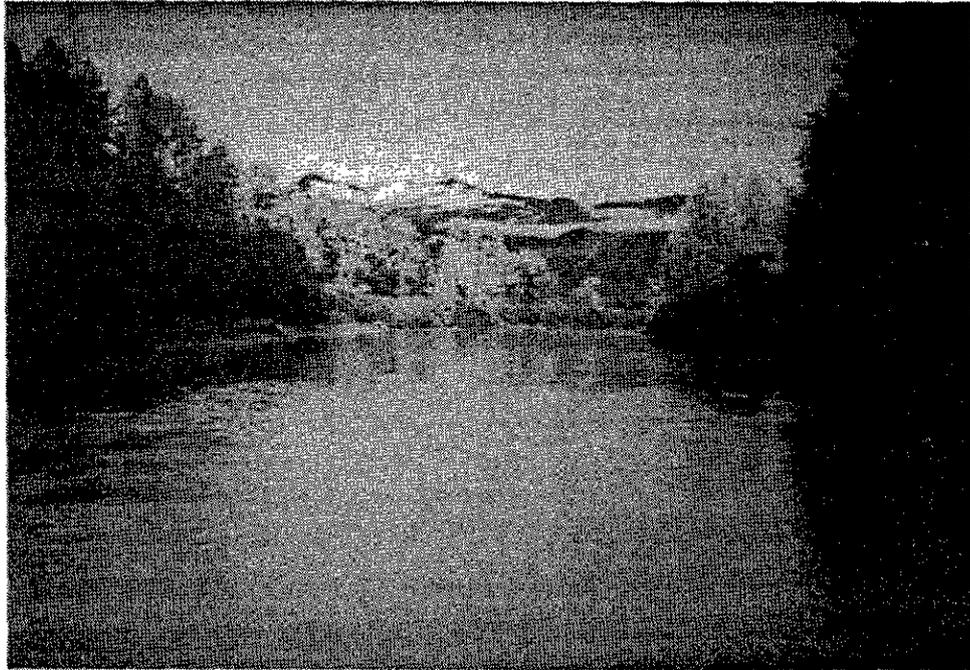
Similar Channel Types: GO2, PA4

Channel Structure



- Stream Gradient:0-1%, mean = 1%
- Incision Depth:0-4 m (13 ft)
- Bankfull Width:.....10-200 m (33-660 ft), mean = 26 m (86 ft)
- Dominant Substrate:Sand to coarse gravel
- Stream Bank Composition:Silt, sand, gravel alluvium
- Sideslope Length:Not significant, except in glacial moraine deposits
- Sideslope Angle:Not significant, except in glacial moraine deposits
- Channel Pattern:.....Single to multiple channels, sinuous
- Drainage Basin Area:.....N/A

INCHANNEL PHOTO: GO1



NO. 100 (20) 100
NO. 100 (20) 100

LANDSCAPE PHOTO: GO1



GLACIAL OUTWASH PROCESS GROUP

Riparian Vegetation: The riparian plant community is dominated by nonforested Sitka alder, willow, and cottonwood plant communities. The Sitka spruce series is also a significant riparian vegetation component. The nonforested plant communities occur adjacent to the stream 78 percent of the time.

Plant Association Series	% Cover
Nonforest	73%
Sitka Spruce	20%
Sitka Spruce-Cottonwood	7%

Channel Type Phases: N/A

MANAGEMENT CONSIDERATIONS

Hydrologic Function: GO1 channels function as both sediment transport and storage systems. Low gradient, contained channels with high flow volumes have moderate stream energy. Sloughing of the fine textured stream banks can be a common occurrence. GO1 inlets and outlets are normally connected to larger glacial outwash channels (GO3), therefore, stream velocity and stream stage are controlled by the mainstem river.

Aquatic Habitat Capability

Large Woody Debris	Insufficient data
Available Spawning Area (ASA)	Insufficient data
Available Rearing Area (ARA)	Insufficient data

Indicator Species Ratings

MIS	ASA	ARA
Coho	MOD	HIGH
Pink	NEG	NEG
Chum	MOD	NEG
Sockeye	MOD	MOD
Chinook	MOD	MOD
Dolly Varden	LOW	LOW
Steelhead	NEG	NEG

These channels are associated with the GO3 large glacial riverine systems and are generally accessible to anadromous fish. ASA decreases and ARA increases as the GO1 channel departs from the mainstem glacial channel. Flow velocities decrease and the number of side channel pools increase (30% of active water with a mean depth of 0.61 meters [1.2 feet] downstream from the GO1 junction with the main channel. Chinook and chum salmon will spawn in moderate densities where stream velocity and substrate are adequate, and in areas where groundwater upwelling occurs. Chinook salmon juveniles will frequently rear in these channels, and rearing coho will occasionally use stream bank habitat with shrub cover. Sockeye salmon will spawn and rear where side channel pools are large or backwater sloughs are nearby. Dolly Varden char will also occasionally spawn and rear in GO1 channels.

Riparian Management Considerations

Concern for Management of:

Large Woody Debris	MOD
Sediment Retention	LOW
Stream Bank Sensitivity	HIGH
Sideslope Sensitivity	N/A
Flood Plain Protection.....	HIGH
Culvert Fish Passage	HIGH

Although natural sources of inchannel large woody debris are generally low in GO1 side channels, stable debris accumulations are key habitat features for rearing chinook salmon and, to some extent, coho.

Stream banks are commonly composed of fine (sands and silt), loosely consolidated alluvium. Riparian shrub and forest vegetation is a very important factor for maintaining stream bank stability in GO1 channels. Maintenance of stream bank sensitivity is an important management concern (BMPs 12.7, 13.16).

These streams are usually one component of very extensive glacial flood plain complexes. Adjacent sloughs, small tributaries, beaver ponds, and wetlands are important fish and wildlife habitats. Protection of these flood plain and wetland values is a primary management concern (BMPs 12.4-12.6, 13.8, 13.15, 14.13).

GO1 channel types provide refuge habitat for juvenile salmonids. Therefore, maintenance of unrestricted upstream migration through drainage structures is a key management concern (BMP 14.17).

These are classified as Value Class I streams. A minimum 100 foot timber harvest buffer is required along both banks of these streams (Tongass Timber Reform Act, 1991).

Riparian Management Opportunities:

Sport Fish Potential..... LOW
 Enhancement Opportunities Beaver Introduction

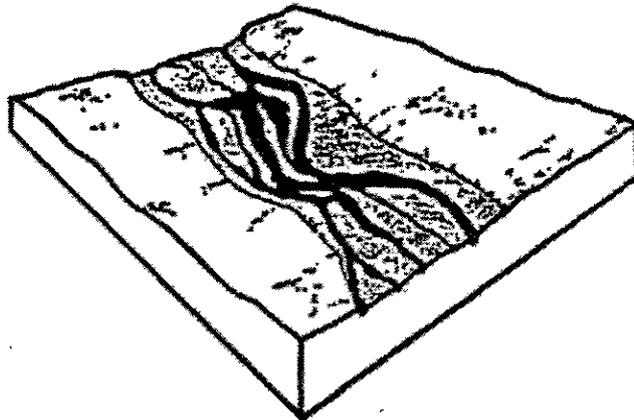
Encourage and manage beaver colonization to maximize fish rearing capability.

LARGE MEANDERING GLACIAL OUTWASH CHANNEL

Channel Mapping Symbol: GO2 (Formerly D4)

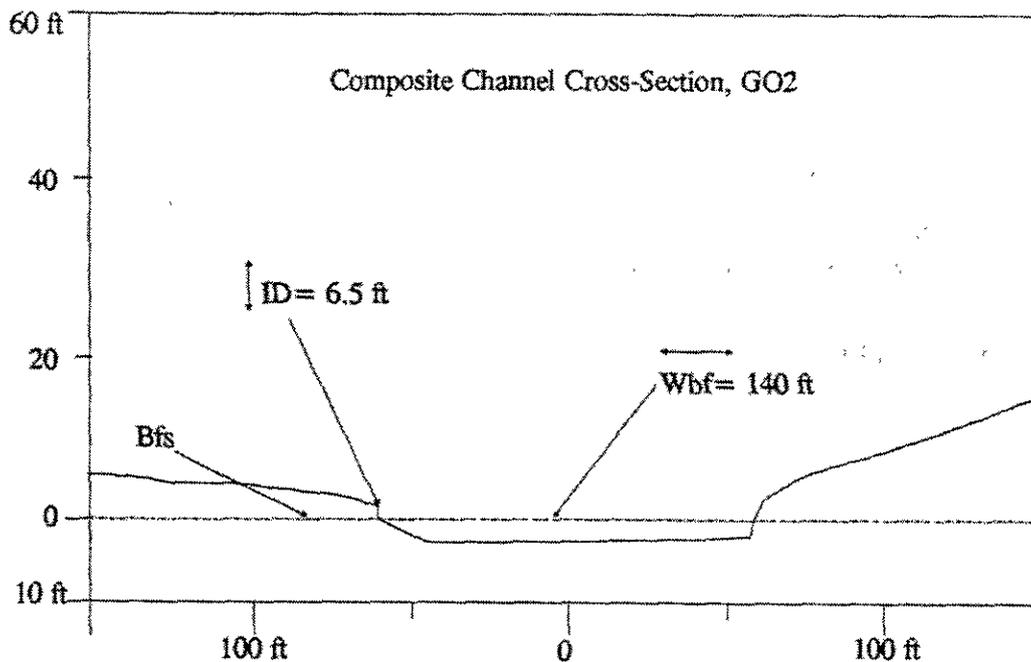
PHYSICAL CHARACTERISTICS

Geographic Setting: The GO2 streams occur in middle to lower valley positions in large drainage basins. Valleys are U-shaped, with large, discontinuous flood terraces adjacent to GO2 streams. Flood plains are the typical adjacent landform in broad valley bottom areas, but inclusions of lowland and hill landforms can occur. These channels are often found at the outlet of glacial lakes.



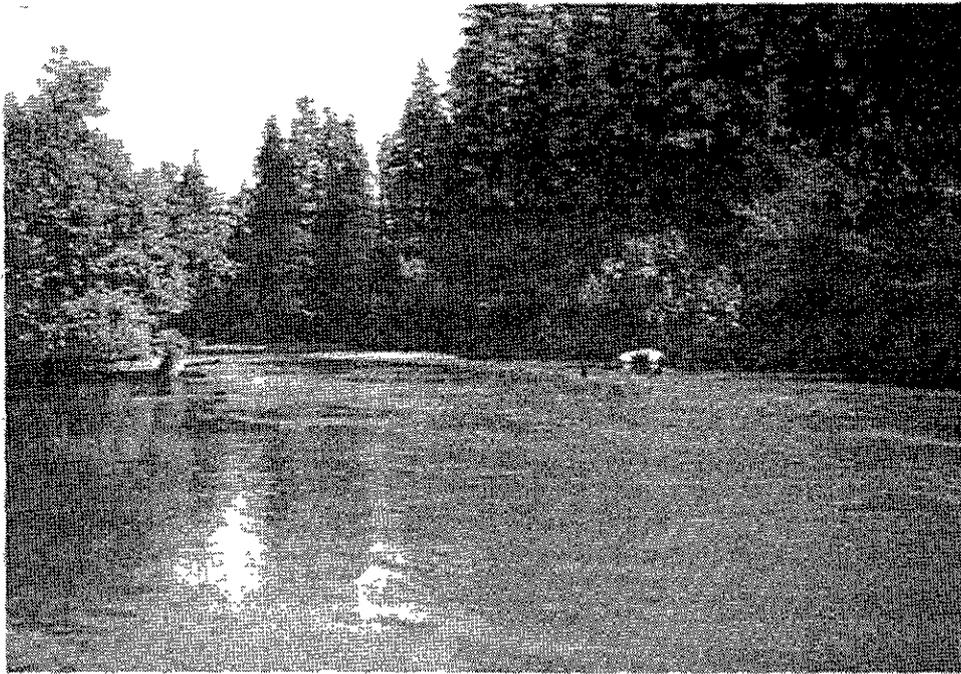
Similar Channel Types: GO3, GO4

Channel Structure



- Stream Gradient: < 3%, mean = 2%
- Incision Depth: < or = 4 m (13 ft), mean = 2 m (6.5 ft)
- Bankfull Width: Variable, mean = 42 m (140 ft)
- Dominant Substrate: Coarse gravel to small boulder
- Stream Bank Composition: Alluvium
- Sideslope Length: Not significant. Exception may be where GO2 channels cut through remnant glacial moraine deposits.
- Sideslope Angle: Not significant
- Channel Pattern: Single, sinuous
- Drainage Basin Area: > 51.8 km² (20 mi²)

INCHANNEL PHOTO: GO2



Riparian Vegetation: The riparian plant community is dominated by nonforested Sitka alder, willow, and salmonberry plant communities, which occur adjacent to the stream 64 percent of the time. Mountain hemlock series and Sitka spruce-cottonwood series are the predominant forest communities.

Plant Association Series	% Cover
Nonforest	57%
Mountain Hemlock.....	11%
Sitka Spruce-Cottonwood.....	11%
Sitka Spruce.....	10%
Western Hemlock.....	8%

Channel Type Phases: N/A

MANAGEMENT CONSIDERATIONS

Hydrologic Function: GO2 streams are transport channels that carry high sediment loads. They are more sediment transport oriented than other channel types in the Glacial Outwash Process Group. These are moderate energy streams due to flow containment and a mean gradient of two percent. Large woody debris accumulations are moderately frequent features that help to retain bedload sediment.

Aquatic Habitat Capability

Large Woody Debris	3500 ft ³ /1000 linear ft
Available Spawning Area (ASA).....	Insufficient data
Available Rearing Area (ARA).....	Insufficient data

GLACIAL OUTWASH PROCESS GROUP

Indicator Species Ratings

MIS	ASA	ARA
Coho.....	LOW	LOW
Pink.....	NEG	NEG
Chum.....	MOD	NEG
Sockeye.....	MOD	LOW
Chinook.....	MOD	MOD
Dolly Varden.....	LOW	LOW
Steelhead.....	NEG	NEG

These channels are usually accessible to anadromous species. Because the substrate consists of larger material (20% gravel, 52% rubble, 18% boulders), ASA is generally low. Spawning chinook and chum salmon use these channels in moderate amounts, as do sockeye salmon when lakes or side sloughs are present in the drainage. Rearing chinook salmon and Dolly Varden char make use of the minimal ARA (3%) consisting of pools (3% of active water) having a mean depth of 0.24 meters (0.8 feet). Because of the shallowness of pools, these channels probably do provide critical overwintering habitat. Coho salmon rear in clear water, off-channel, and side channel areas that flow into GO2 channels.

Riparian Management Considerations

Concern for Management of:

Large Woody Debris	MOD
Sediment Retention	LOW
Stream Bank Sensitivity	MOD
Sideslope Sensitivity	LOW
Flood Plain Protection Need	MOD
Culvert Fish Passage.....	N/A

The influence of large woody debris on channel stability and fish productivity in GO2 channel types is moderate. Stable in-channel debris generally consists of trees anchored to stream banks or large debris jams at meanders. Most of the limited rearing habitat is keyed to this large woody debris. Maintenance of large woody debris is therefore a key riparian management concern (BMP 12.6).

Stream banks in GO2 channels are moderately susceptible to erosion. They are composed of unconsolidated alluvium, therefore, the banks are easily undermined by high velocity currents. These channel stability concerns should be considered when locating and designing stream crossings (BMPs 14.2, 14.3). Bridge abutments can accelerate bank erosion when GO2 channels are constricted (BMP 14.17). Riparian vegetation is integral in maintaining bank stability and the protection of sensitive alluvial soils in GO2 channels (BMP 13.8).

Riparian areas associated with GO2 channel segments are generally less than 61 meters (200 feet) wide. Flood plain side channels and sloughs, though infrequent, are often very important fish rearing areas. Management activities should maintain flood plain values and functions (BMPs 12.6, 13.15, 14.13).

These are classified as Value Class I streams. A minimum 100 foot timber harvest buffer is required along both banks of these streams (Tongass Timber Reform Act, 1991).

Riparian Management Opportunities:

Sport Fish PotentialLOW

Enhancement OpportunitiesBeaver Introduction

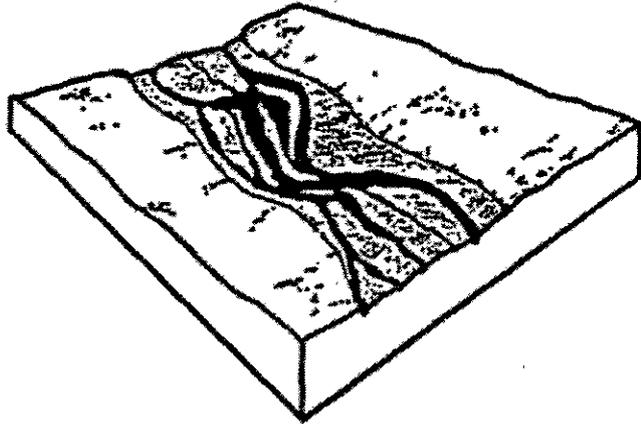
Encourage introduction and management of beaver populations to increase rearing habitat associated with side channels and sloughs.

LARGE BRAIDED GLACIAL OUTWASH CHANNEL

Channel Mapping Symbol: GO3 (Formerly D5)

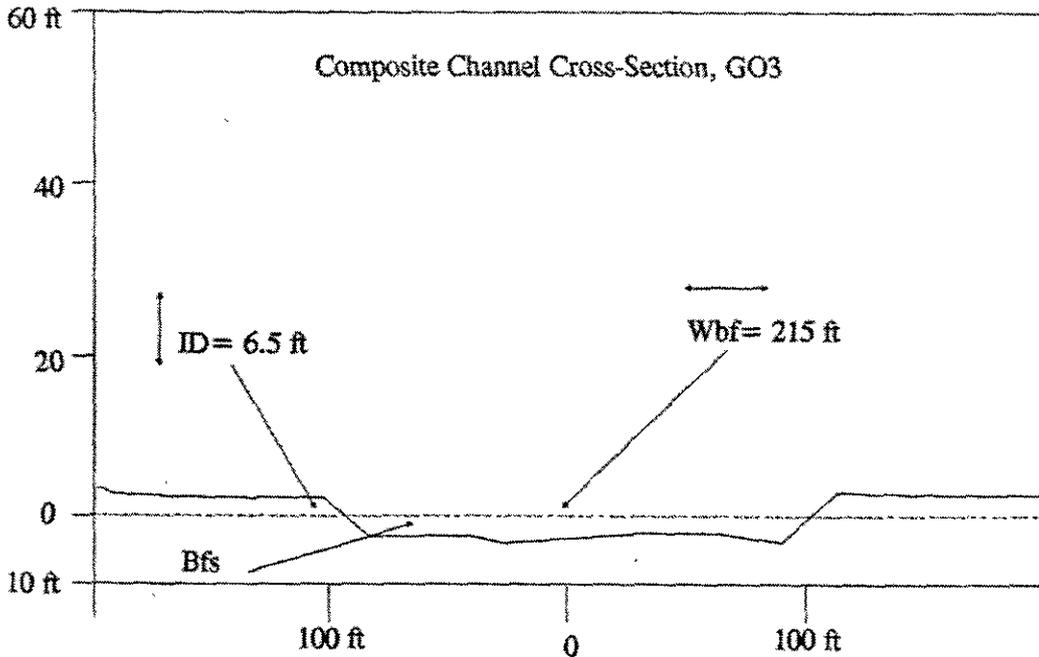
PHYSICAL CHARACTERISTICS

Geographic Setting: GO3 channels occur in very, large, glacial drainage basins. They are located in broad, glacial valley bottoms or on outwash plains. Large flood plains occur adjacent to these channels.



Similar Channel Types: GO4, ES5

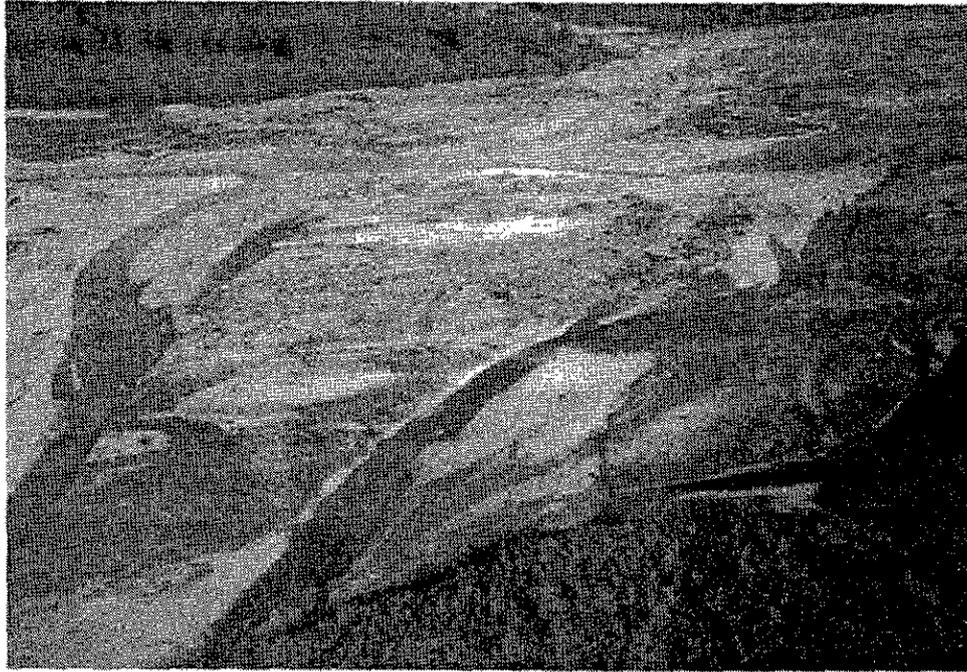
Channel Structure



- Stream Gradient: < 3%, mean = 2%
- Incision Depth: < or = 2 m (6.5 ft)
- Bankfull Width: 60-300 m (200 ft to > 1000 ft), mean = 65 m (215 ft)
- Dominant Substrate: Coarse gravel to large cobble
- Stream Bank Composition: Alluvium
- Sideslope Length: Not significant, flat flood plain landform
- Sideslope Angle: Not significant
- Channel Pattern: Braided, very wide
- Drainage Basin Area: > 51.8 km² (> 20 mi²)

Riparian Vegetation: The riparian plant communities are dominated by nonforested Sitka alder and willow shrub communities and the Sitka spruce-cottonwood/alder plant association. The nonforested communities occur immediately adjacent to the stream 73 percent of the time.

INCHANNEL PHOTO: GO3



Plant Association Series	% Cover
Nonforest	71%
Sitka Spruce-Cottonwood.....	16%
Sitka Spruce.....	7%
Mountain Hemlock.....	6%

Channel Type Phases: N/A

MANAGEMENT CONSIDERATIONS

Hydrologic Function: The GO3 channels function as sediment deposition systems. These low gradient, uncontained channels have low stream energy. GO3 channels have extremely large sediment loads, resulting in a braided channel network and extensive flood plain. Peak flow events occur during the summer melt period and during the early fall rainy season.

Aquatic Habitat Capability

Large Woody Debris	900 ft ³ /1000 linear ft
Available Spawning Area (ASA).....	Insufficient data
Available Rearing Area (ARA).....	Insufficient data

GLACIAL OUTWASH PROCESS GROUP

Indicator Species

<u>MIS</u>	<u>ASA</u>	<u>ARA</u>
Coho.....	MOD	MOD
Pink.....	LOW	NEG
Chum.....	MOD	NEG
Sockeye.....	MOD	MOD
Chinook.....	MOD	MOD
Dolly Varden.....	LOW	LOW
Steelhead.....	NEG	NEG

GO3 channels are usually accessible to anadromous species. Typically, they provide migration routes to salmon spawning areas in clear water tributaries. Chinook, chum, and sockeye salmon use spawning habitat in portions of the main channel. Spawning capability is limited by fine sediment in gravel spawning beds. Sockeye and chum salmon tend to select gravels where upwelling groundwater is present. Primarily sockeye and chinook utilize rearing areas associated with sloughs, sidechannel pools, and stream bank habitat. Coho and Dolly Varden char rear in low numbers in these channels.

Riparian Management Considerations

Concern for Management of:

Large Woody Debris	MOD
Sediment Retention	LOW
Stream Bank Sensitivity	HIGH
Sideslope Sensitivity	N/A
Flood Plain Protection Need	HIGH
Culvert Fish Passage.....	N/A

Large wood accumulations have moderate influence on instream habitat in GO3 channel types. Most stable wood accumulations are located along channel margins, sloughs, or side channels. Pool and bank cover associated with large woody debris is particularly important for rearing chinook and sockeye salmon.

Stream banks are naturally susceptible to erosion. Flood flows are poorly contained. Channel aggradation and scour processes are very active due to the extremely large sediment loads. Riparian management should emphasize stream bank protection (BMPs 13.16, 14.13, 14.17). Main stem stream crossings are generally not feasible.

Flood plain protection is a primary management concern for GO3 riparian areas (BMPs 12.6, 13.8, 13.15). Side channels, sloughs and adjacent wetland are typically very extensive. The numerous tributary streams and beaver ponds on GO3 outwash plains are extremely important for fish rearing and spawning. Riparian vegetation is an important factor mitigating potentially destructive flood flows.

Roads constructed across flood plain tributaries must allow unrestricted fish migration from main stem channels (BMP 14.17).

These are classified as Value Class I streams. A minimum 100 foot timber harvest buffer is required along both banks of these streams (Tongass Timber Reform Act, 1991).

Riparian Management Opportunities:

Sport Fish Potential.....LOW

Enhancement OpportunitiesSpawning Channels and Large Wood Placement

Sport fishing is limited due to poor accessibility and turbid waters.

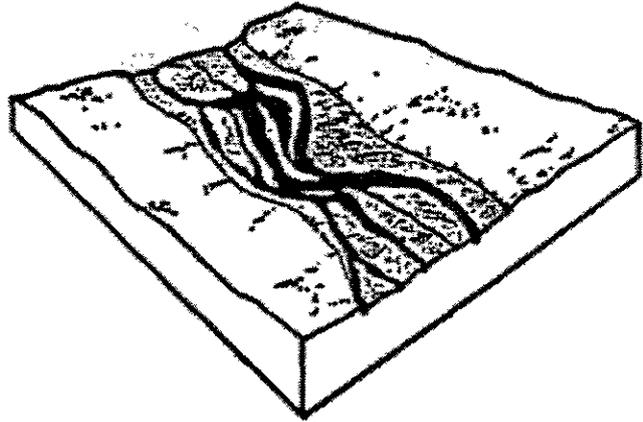
Spawning channel sites can often be located adjacent to GO3 channels. Sources of spawning gravel and shallow ground water are common. Provisions for protecting spawning channel installations from major flooding events should be incorporated into project plans.

Large wood structures can be utilized to improve limited inchannel rearing habitat. However, local sources of suitable large wood pieces are often lacking.

MODERATE WIDTH GLACIAL CHANNEL
Channel Mapping Symbol: GO4 (Formerly D3)

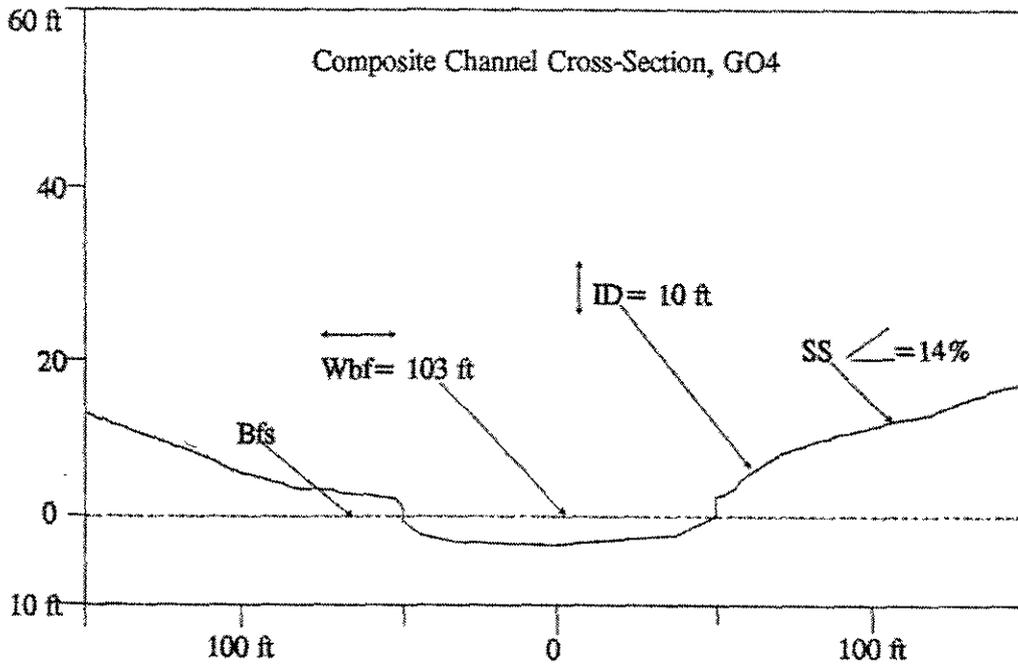
PHYSICAL CHARACTERISTICS

Geographic Setting: The GO4 channel type occurs in the mid to upper valley position in glacial watersheds. Adjacent flood terrace areas are primarily composed of glacial outwash or till. Large valley glaciers and snowfields occur upstream of the GO4 channel type. Snow avalanche cones and subalpine mountainslopes typically occur adjacent to GO4 channels.



Similar Channel Types: GO2, GO5

Channel Structure



- Stream Gradient:2-6%, mean = 4%
- Incision Depth:< or = 4 m (13 ft), mean = 3 m (10 ft)
- Bankfull Width:.....Variable, mean = 31 m (103 ft)
- Dominant Substrate:Coarse gravel to small boulder
- Stream Bank Composition:Alluvium or mixed
- Sideslope Length:Variable length
- Sideslope Angle:Mean = 14% (8 degrees)
- Channel Pattern:.....Single or multiple
- Drainage Basin Area:.....13-52 km² (5-20 mi²)

INCHANNEL PHOTO: GO4



Riparian Vegetation: The riparian plant community is dominated by nonforested alder and willow shrub plant communities.

Plant Association Series	% Cover
Nonforest	77%
Sitka Spruce.....	7%
Mountain Hemlock.....	6%
Mixed Conifer	5%
Sitka Spruce-Cottonwood.....	5%

Channel Type Phases: N/A

MANAGEMENT CONSIDERATIONS

Hydrologic Function: GO4 channels are moderate energy streams that transport large sediment loads. Moderate gradient and large size substrate material are indicative of moderate stream power. Some inchannel retention of fine gravels and sand may occur. Bedload transport is predominantly coarse gravel and cobble particle fractions. Peak flows occur in the spring/summer melt period and in the early fall. A high suspended glacial silt load is also characteristic of GO4 channels.

Aquatic Habitat Capability

Large Woody Debris	< 500 ft ³ /1000 linear ft
Available Spawning Area (ASA)	Avg = 5% for 12 sites
Available Rearing Area (ARA).....	Avg = 5% for 12 sites

GLACIAL OUTWASH PROCESS GROUP

Indicator Species Ratings

MIS	ASA	ARA
Coho.....	LOW	LOW
Pink.....	NEG	NEG
Chum.....	LOW	NEG
Sockeye.....	LOW	NEG
Chinook.....	LOW	LOW
Dolly Varden.....	MOD	MOD
Steelhead.....	NEG	NEG

Downstream barriers frequently make GO4 channels inaccessible to anadromous species. Typically, they get little use from spawning salmon. Rearing coho and chinook juveniles also infrequently use the available rearing area. Dolly Varden char may spawn in the rubble (39%) and gravel (19%) substrate, and rear in side channel pools, and the occasional pool associated with large woody debris. These channels provide little overwintering habitat.

Riparian Management Considerations

Concern for Management of:

Large Woody Debris	LOW
Sediment Retention	MOD
Stream Bank Sensitivity	MOD
Sideslope Sensitivity	LOW
Flood Plain Protection Need	MOD
Culvert Fish Passage.....	LOW

Retention of fine gravel and sand is moderate to low. Moderate gradients contribute to good flushing of fine bedload sediments.

Stream bank sensitivity is moderate for GO4 channel segments. Bank composition is dominantly poorly sorted alluvium that is readily eroded by high velocity flows. High sediment loads in GO4 channels result in naturally high rates of channel aggradation and scouring.

Flood plain riparian vegetation contributes greatly to channel stability and reduces channel erosion during flood events. Riparian management should emphasize protection of sensitive channels (BMPs 13.16, 14.17) and alluvial soils (BMPs 12.6, 13.8).

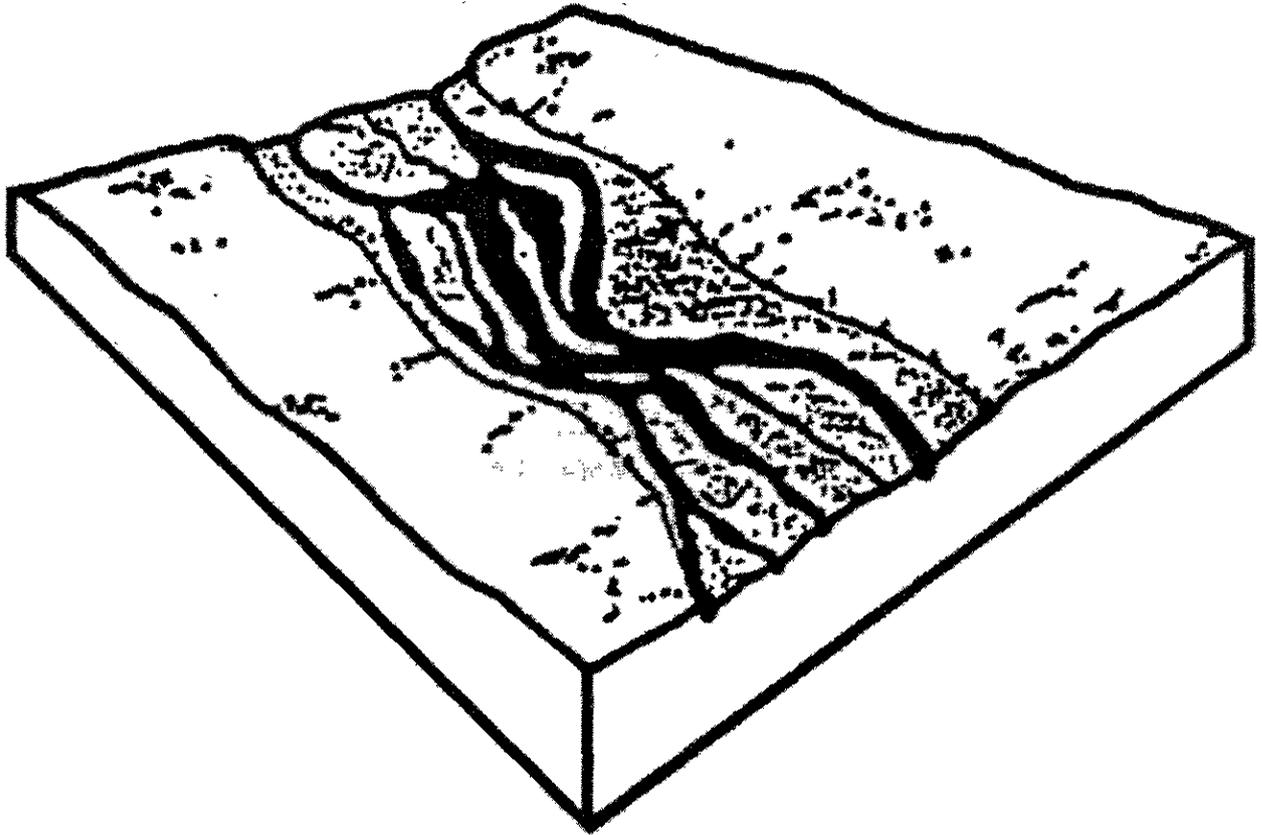
These are classified as Value Class I or II streams. A minimum 100 foot timber harvest buffer is required along both banks of these streams (Tongass Timber Reform Act, 1991).

Riparian Management Opportunities:

Sport Fish Potential	LOW
Enhancement Opportunities	Large Wood Placement and Spawning Channels

There may be limited opportunities for developing spawning channels adjacent to GO4 channels. In addition, if sources of large wood are available, large wood structures can be used to improve limited rearing habitat.

Glacial Outwash Process Group

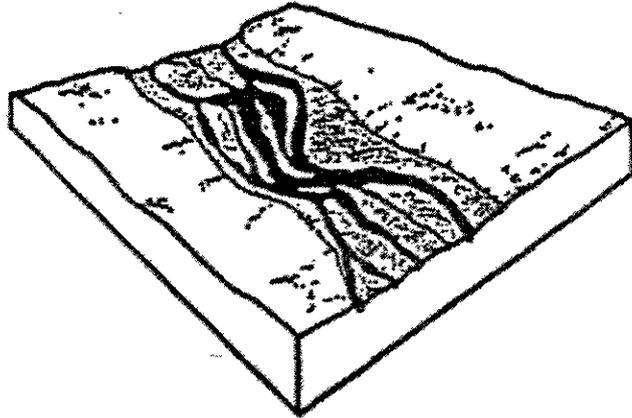


CIRQUE CHANNEL

Channel Mapping Symbol: GO5 (Formerly D1)

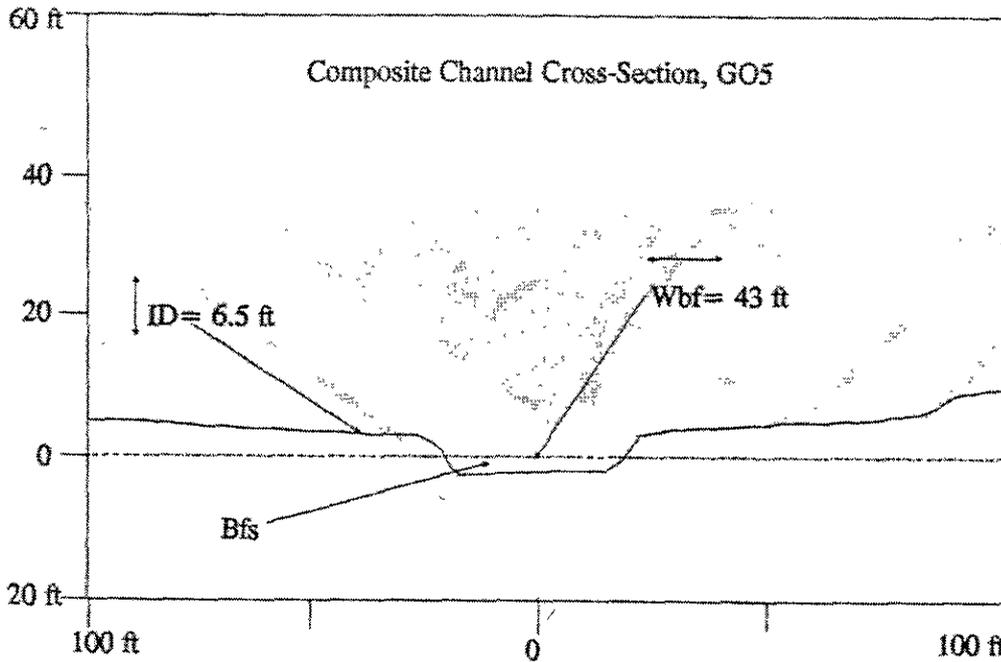
PHYSICAL CHARACTERISTICS

Geographic Setting: GO5 streams occur in alpine cirque basins or hanging valley floors. Runoff is derived from the meltwater discharge of a mountain glacier or perennial snow fields. Adjacent valley sideslopes are usually steep and avalanche prone.



Similar Channel Types: AF8, GO4

Channel Structure



- Stream Gradient: < 6%, mean = 3%
- Incision Depth: < or = 2 m (6.5 ft)
- Bankfull Width: Variable, mean = 13 m (43 ft)
- Dominant Substrate: Broad range of substrate material, from bedrock to silt
- Stream Bank Composition: Alluvium or colluvium
- Sideslope Length: Not significant
- Sideslope Angle: Not significant
- Channel Pattern: Single to braided, normally single at the higher gradient upper end and braided at the lower gradient downstream end.
- Drainage Basin Area: < 13 km² (< 5 mi²)

INCHANNEL PHOTO: GO5



Riparian Vegetation: The riparian plant community is dominated by nonforested alpine meadow, Sitka alder, and willow plant communities, with mountain hemlock/cassiope as the dominant forest plant association. The nonforested plant associations occur along the stream 83 percent of the time.

Plant Association Series	% Cover
Nonforest.....	86%
Mountain Hemlock.....	12%

Channel Type Phases: N/A

MANAGEMENT CONSIDERATIONS

Hydrologic Function: GO5 channels have moderate stream energy and relatively large sediment loads. Some deposition of gravel and sand occurs at the low gradient terminus of the channel. Large clast substrate may result from mass wasting processes on adjacent steep mountainslopes. Poorly contained channel segments typically have a braided channel pattern.

Aquatic Habitat Capability

Large Woody Debris	N/A
Available Spawning Area (ASA).....	N/A
Available Rearing Area (ARA).....	N/A

GLACIAL OUTWASH PROCESS GROUP

Indicator Species Ratings

MIS	ASA	ARA
Coho.....	NEG	NEG
Pink.....	NEG	NEG
Chum.....	NEG	NEG
Sockeye.....	NEG	NEG
Chinook.....	NEG	NEG
Dolly Varden.....	NEG	NEG
Steelhead.....	NEG	NEG

These channels are generally inaccessible to anadromous and resident species due to downstream barriers. Fish use is insignificant.

Riparian Management Considerations

Concern for Management of:

Large Woody Debris	N/A
Sediment Retention	MOD
Stream Bank Sensitivity	MOD
Sideslope Sensitivity	LOW
Flood Plain Protection.....	LOW
Culvert Fish Passage.....	N/A

These streams temporarily retain sediment delivered from snow avalanche and mountain glacier runoff.

Stream banks are composed of unconsolidated colluvial and alluvial sediments. Lateral channel migration and stream braiding is common in GO5 channel types. Stream channel disturbances can accelerate natural stream bank instability (BMPs 12.7, 14.13, 14.17).

These are classified as Value Class III streams.

Riparian Management Opportunities:

Sport Fish Potential	LOW
Enhancement Opportunities	Resident Fisheries

When these channels feed from deep cirque lakes, there may be potential to create resident cutthroat and grayling spawning habitat.