Wrangell Area Watersheds Assessment

February 2019

SOUTHEAST ALASKA WATERSHED COALITION

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Southeast Alaska Watershed Coalition

The Southeast Alaska Watershed Coalition (SAWC) is a network of community-based organizations and efforts focused on informed community watershed management in Southeast Alaska. We value the long-term sustainability of Southeast Alaska's communities and wise management of the region's watersheds. We believe our work is important because healthy and productive watersheds are the life-blood of our region's communities, natural resource-based economies, subsistence lifestyle, and overall quality of life. We work to build the capacity of the region's communities to implement local and collaborative approaches to the management, development, and stewardship of the region's watersheds.

SAWC was formed by a collective of Southeast Alaska watershed councils in 2005. These citizen-lead organizations recognized that by building a network of professionals and community leaders they would be more effective at sharing resources, implementing projects on the ground, and fostering awareness and stewardship of the many watersheds in southeast. SAWC's core objective is to build a regional voice that promotes community watershed stewardship. SAWC does this by bolstering the capacity of communities throughout Southeast Alaska to implement local and collaborative approaches to the management, development and stewardship of the region's watersheds.

SAWC is not a land or resource management entity in itself and does not, through this assessment, seek to make management decisions regarding the listed resources and relevant stakeholders. Rather, we hope that with this information, we can establish partnerships with stakeholders to act collaboratively on issues impacting the health of these resources and work together for the sustained health of the community of Wrangell and its surrounding watersheds.

More information about the Southeast Alaska Watershed Coalition can be found at www.alaskawatershedcoalition.org or by calling (907) 205-4028

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Executive Summary

As the community of Wrangell continues to grow and develop, the City and Borough of Wrangell and its residents have sought to identify and prioritize local aquatic resources to better plan for future land development and strategize potential restoration-based mitigation opportunities. In an effort to support the informed management of Wrangell's watersheds and aquatic resources, the Southeast Alaska Watershed Coalition (SAWC) has undertaken the Wrangell Area Watersheds Assessment.

The purpose of the Wrangell Area Watersheds Assessment was to compile a dataset and report outlining key aquatic resources within the City and Borough of Wrangell, including an assessment of the current habitat condition of key aquatic resources, identification of sites that could benefit from restoration treatment, and outlining watershed management challenges and opportunities.

The community of Wrangell and its surrounding area are directly connected to and impacted by the health of its watershed resources. Maritime industry, local public health, and subsistence lifestyles are all directly tied to the natural resources of this area. The proper management and conservation of these resources will bolster the health of Wrangell's community, economy, and public health for generations to come.

This assessment and report focuses primarily on watersheds within the boundary of City and Borough Lands, with some data collected on relevant resources on nearby State and Federal lands on Wrangell Island. Fieldwork was conducted over the summer and fall of 2018. This report offers a preliminary overview on the habitat condition of identified resources as well as recommendations for best management practices, stewardship, mitigation, restoration, and conservation opportunities to benefit local watershed resources.

This project was carried out with financial and technical support from the US Fish and Wildlife Service's Coastal Program, in partnership with the Wrangell Cooperative Association, and the US Forest Service, and with financial support from the Charlotte Martin Foundation.

SAWC is greatly appreciative to all of the funders, partners, and stakeholders, and that helped to make this project possible.

Project Approach

SAWC prioritized assessment sites based on ecological, social, and economic considerations rather than focusing on specific habitat types or conducting an exhaustive review of a discrete landscape features. Priority sites were selected based on coordination with local stakeholders including the City and Borough of Wrangell and the Wrangell Cooperative Association.

Survey and assessment were completed at a reconnaissance level; identifying and prioritizing key aquatic resources through desktop review, mapping the resource, taking detailed notes and photographs, and recording restoration or enhancement opportunities. Additional survey methodologies were conducted at some sites and the methodologies used and data collected are available upon request.

While some limited stream surveys were conducted on Tongass National Forest lands, priority was given to non-federal lands that have been impacted by development, road construction, and/or resource extraction. Figure 1 shows land ownership and maps of the watersheds assessed.

Resources that inform this assessment and report include the Alaska Department of Fish and Game's (ADFG) Anadromous Waters Catalog, the ADFG and US Forest Service fish passage inventory databases, AK ShoreZone coastal habitat maps and data, and existing and historical local survey and assessments.

This report contains:

> **Management Areas:** Urban development often leads to a common suite of stream and riparian habitat problems: pavement and buildings prevent water infiltration into soils, resulting in stormwater runoff that carries sediment and pollutants to streams and the coast. The loss of riparian vegetation along streams further limits the capacity of the watershed to slow water movement and filter out pollutants, and this loss results in degraded fish, invertebrate, bird, and mammal habitat. Additionally, when roads are constructed across streams, structures that pass water under the roads can be impassable to fish and may prevent them from accessing habitat. Finally, climate change is likely to create to additional stress on these already degraded ecosystems. In the following summary and detailed management sections, we group recommendations for enhancing and protecting Wrangell area aquatic resources into these four topic areas.
>
> **Site Surveys:** An overview of habitat conditions and stewardship recommendations for each watershed and wetland that was assessed.
>
> **Mitigation Opportunities:** An overview of compensatory mitigation and opportunities for meeting the community of Wrangell's mitigation needs.

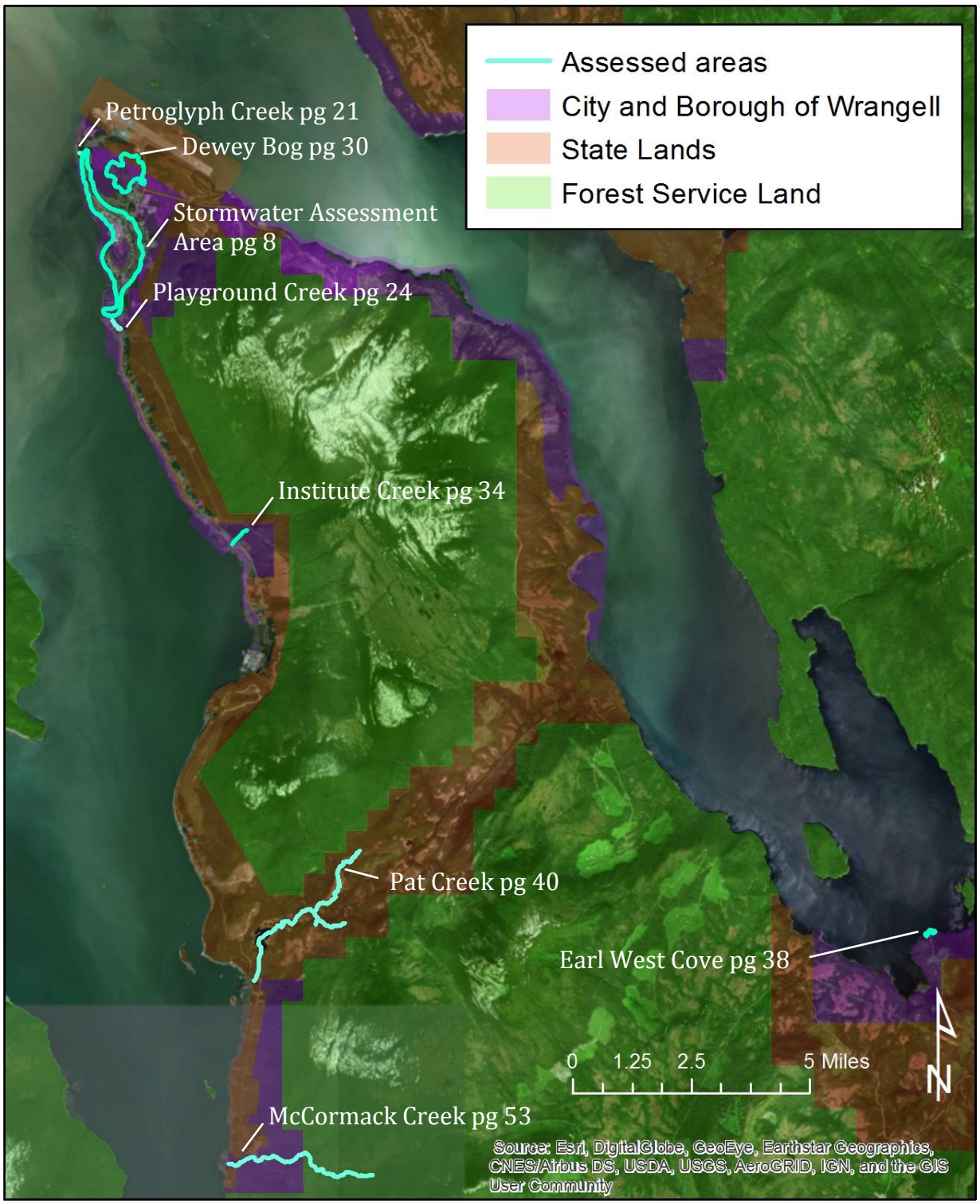


Figure 1: Overview of the Wrangell Area Watersheds Assessment

Summary Recommendations

Following are general recommendations for consideration on the management of Wrangell area watershed resources. More detailed survey and management information can be found in latter sections of this report.

Stormwater:

- Complete community stormwater mapping and water quality assessment.
- Implement stormwater control measures to reduce negative impacts to coastal resources.

Riparian Zone Management:

- Research, develop, and propose a city ordinance to preserve at least a fifty foot riparian buffer along anadromous streams.

Fish Passage:

- Assess and remediate identified 'red pipes' impacting fish passage on anadromous streams.

Climate change:

- Protect or enhance riparian vegetation to provide shade along streams to mitigate the potential effects of climate change on stream temperatures.
- Identify and protect areas where groundwater is recharged (snow and rain infiltrate the soil and become groundwater) and discharged into streams.

The following restoration and protection opportunities are offered for each watershed and wetland inventoried. Further survey, management information, and recommendations can be found in latter sections of this report.

Petroglyph Creek:

- Improve riparian habitat by planting native species on streambanks near residential trailer court.
- Improve fish passage at Evergreen Avenue crossing by addressing perched culvert.

Playground Creek:

- Construct rain garden at City Park bathhouse site to manage stormwater runoff into Playground Creek.
- Improve riparian habitat near bathhouse site by planting native species to re-vegetate streambank.
- Address red pipe culverts at Zimovia Highway crossing that impact fish passage. Consider replacing culvert at City Park crossing.

Dewey Bog:

- Restrict access of off-road vehicles to sensitive wetland habitat to prevent additional impacts and allow trails to re-vegetate.

Institute Creek:

- Add soil and plant riprap streambanks with native species such as willow or salmonberry to create aquatic insect habitat and provide a buffer for stormwater management.

Earl West Cove:

- Research, develop, and implement a stream setback ordinance to protect salmon habitat and riparian areas as this site is developed.

Pat Creek Watershed:

- Improve in-stream fish habitat with the placement of large wood structures to increase size and frequency of large woody debris in logged sections of Pat Creek.

Management Area: Stormwater Management

Stormwater consists of rain or snowmelt that originates on impervious surfaces like streets, parking lots, and buildings. Stormwater from urban areas can contain a variety of pollutants including heavy metals, fertilizers, fecal coliforms, petroleum hydrocarbons, litter, sediment, and deicing chemicals. When stormwater enters a water body, such as a stream, lake or the ocean, these pollutants can reduce water quality and harm aquatic life. Additionally, since impervious surfaces tend to greatly increase runoff rates, stormwater can increase flood risk and alter habitat for aquatic organisms by causing erosion and sedimentation.

A wide variety of stormwater control measures (SCM) are available to reduce or eliminate the adverse impacts of stormwater on water bodies. The most effective measures filter pollutants from runoff and promote infiltration to prevent flooding. In order to choose and locate the most effective SCMs, understanding where stormwater originates, how it is conveyed, and the location of discharge points (i.e. outfalls) is necessary. Mapping stormwater systems is the first step in developing this understanding.

Methods

The SAWC began a stormwater mapping effort in the City of Wrangell in October 2018 (Fig. 2). The goal of this effort was to identify where stormwater originates and where stormwater is discharged into streams and the ocean. The maps can be used to identify where stormwater is having the greatest impacts on water quality and aquatic resources.

On October 9 and 11, 2018, SAWC staff visited a portion of the Wrangell townsite on foot to identify and geographically locate the various infrastructure components that comprise stormwater systems: catch basins, vaults (manholes), oil-water separators (OWS), ditches, and pipes. Catch basins collect runoff, typically from curbs/gutters; vaults are junction spaces for multiple pipes; oil-water separators are designed to remove oils and settleable solids from runoff; and ditches and pipes convey stormwater between other system components or discharge stormwater to receiving waters. A stormwater system consists of the various interconnected components that convey water to a particular outfall (end of pipe or ditch).

A handheld GPS unit was used to obtain a geographic coordinate for each stormwater component, with the exception of pipes. When pipe outlets/inlets were visible, the direction of stormwater flow was noted. Runoff flow-paths on streets and in ditches were sometimes noted. Construction designs were available for some parts of the project area and these were used to map systems that were not visited in-person or to confirm the location of stormwater components and flow directions. Stormwater system maps were created in GIS. Figure 2 provides an example of how stormwater systems are depicted in GIS.

Results

Streets, roads, and associated parking lots where stormwater systems were mapped in October 2018 were located in three primary areas (Fig. 2):

1. Evergreen Ave. (between Second St. and 5th Ave., Fig. 3)
2. Town Center (Fig. 4)
   - Peninsula St.
   - Case Ave.
   - Front St.
   - Zimovia Hwy.-Church St.-Second St. (between Berger St. and Evergreen Ave.)
   - Shakes St.
   - Reid St.-McKinnon St. (between Mission St. and Church St.)
   - Lynch St.
   - Brueger St.
   - Outer Dr.
   - Campbell Dr.
   - Stikine Ave.
3. Heritage Harbor (Fig. 5)

Stormwater systems in Wrangell collect runoff from urban areas and discharge the water into streams that flow to the ocean, or into the ocean directly. Of the systems that have been mapped to date, most runoff is discharged directly to the ocean, although the precise location of most ocean-outfall pipes has yet to be located and mapped. The stormwater systems that remain to be mapped in Wrangell townsite will be visited in 2019.

Most stormwater runoff originating in the town center area is discharged into Reliance Harbor and the nearshore waters south of the Ferry Terminal. This area is used by forage fish and a wide variety of benthic invertebrates, which are important food for predatory fish, harbor seals, diving ducks, and wading birds. Further, sustained use of this coastal area is incredibly important for the continued economic well-being of Wrangell, and ensuring this coastal zone is not contaminated with pollutants will promote public health. The types and amounts of stormwater pollutants entering these areas is not known, nor are the potential impacts of these pollutants on the various species that use the area.

Next Steps

1. *Complete stormwater mapping in the project area in 2019.*
2. *Map streams and other water bodies in the project area in 2019.*
3. *Confirm accuracy of maps with the assistance of City of Wrangell public works staff.*
4. *Review existing water/sediment quality data from streams and nearshore waters in the project area.*
5. *Identify additional water/sediment quality studies that would help assess stormwater runoff impacts on aquatic resources.*
6. *Identify the type and location of SCMs that can be constructed to manage stormwater.*

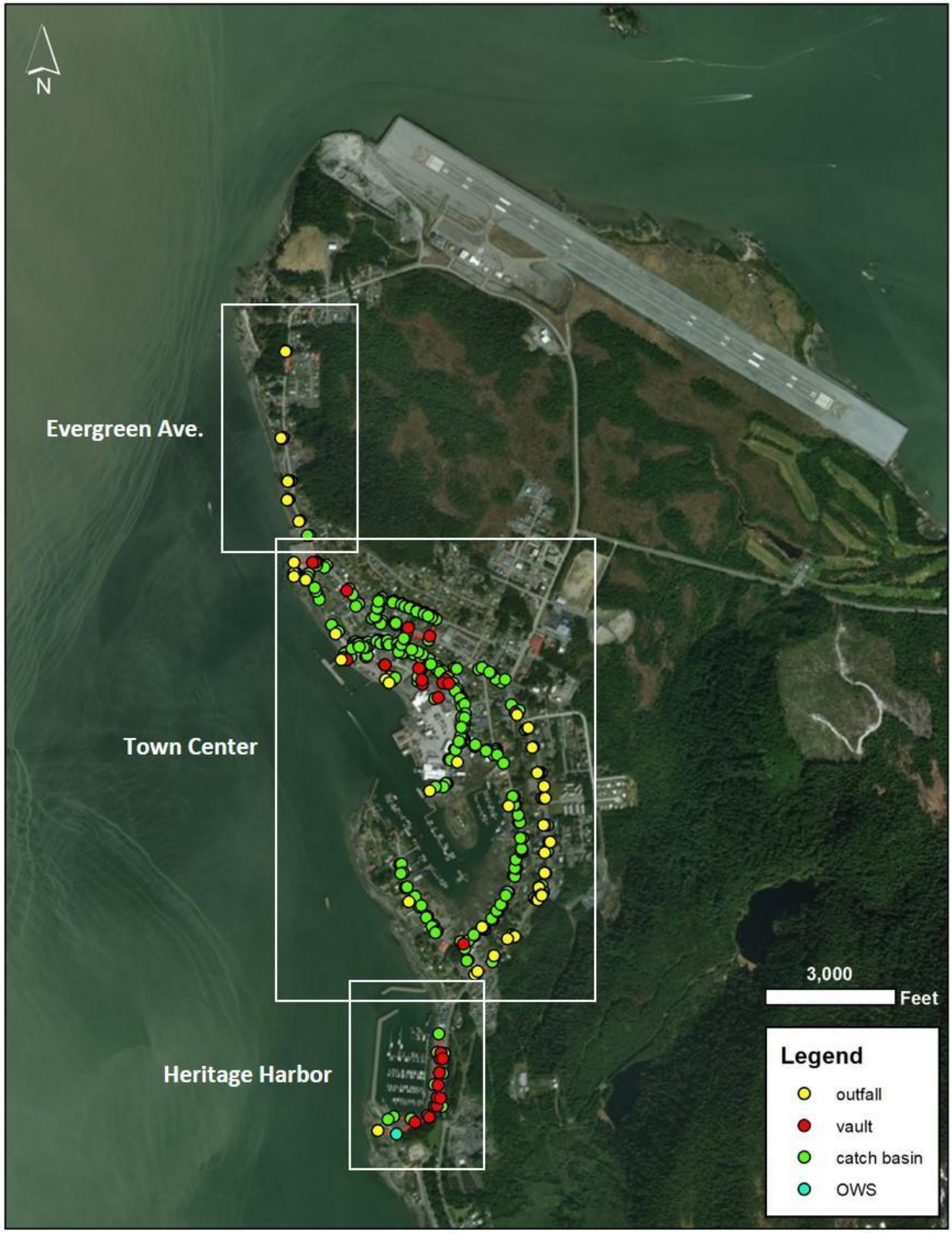


Figure 2. Overview map of stormwater sites assessed. OWS stands for Oil-Water Separator.

Figure 3. A close-up view of stormwater systems in the downtown area of Wrangell (Note: some systems are incompletely mapped at this time).

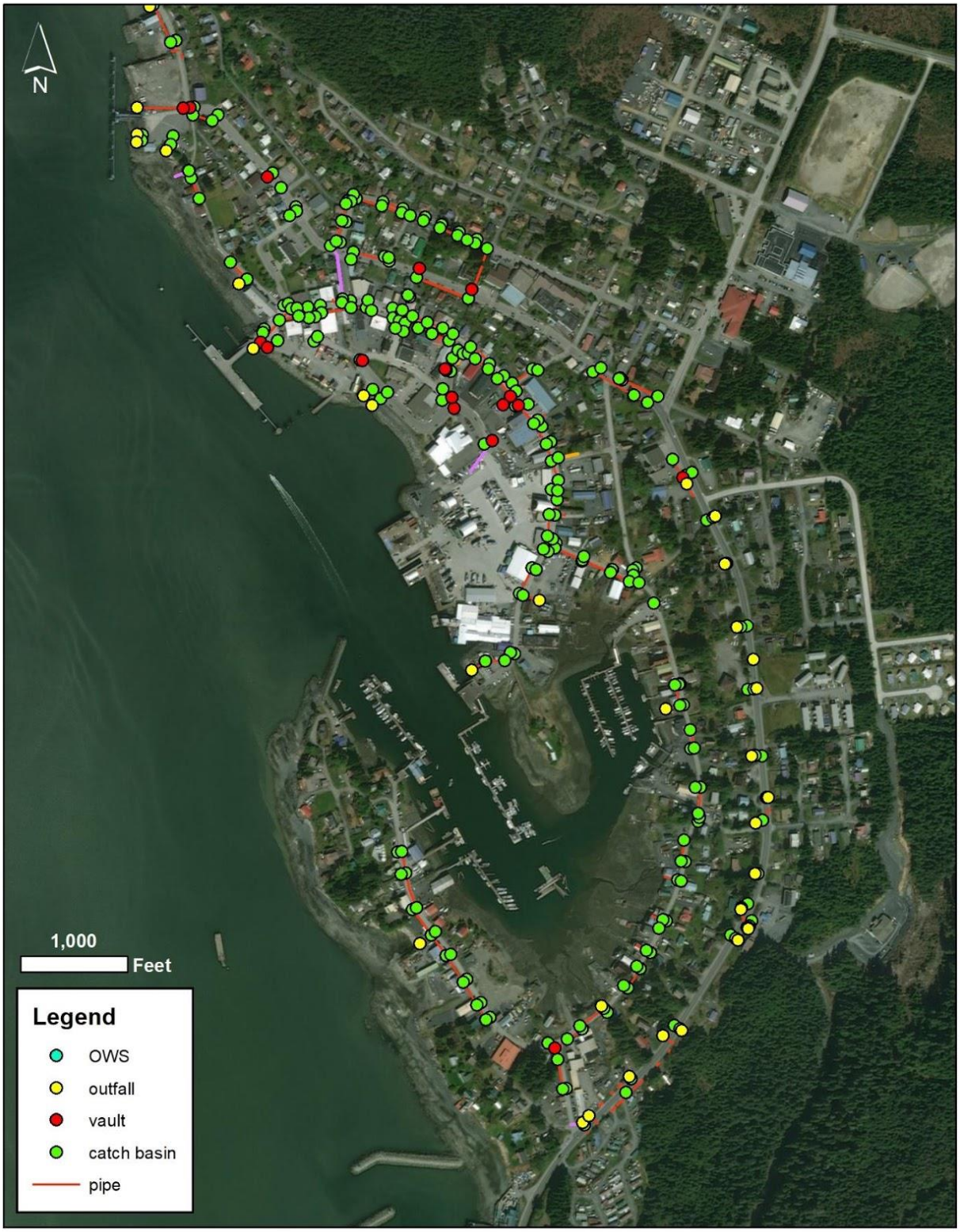


Figure 4. Stormwater systems in town center area of Wrangell. (Note: some systems are incompletely mapped at this time). OWS stands for Oil-Water Separator.

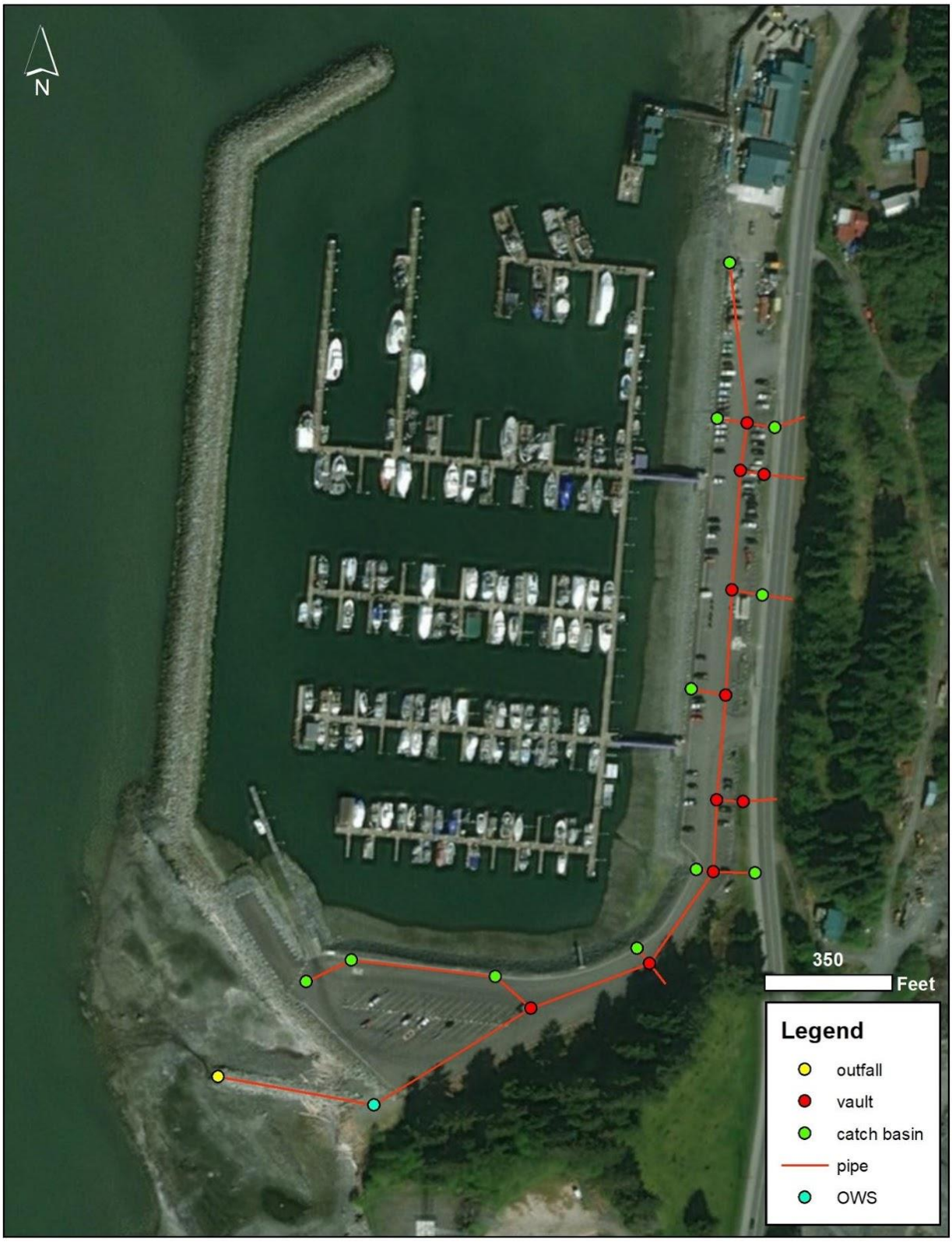


Figure 5. Heritage Harbor stormwater system. OWS stands for Oil-Water Separator.

Management Area: Riparian Zone Management

Riparian zones are where water and land meet, such as stream banks and lake shores. Intact riparian zones serve several functions that contribute to healthy water systems including:

- Providing cover and food resources for terrestrial invertebrates, birds, and mammals.
- Supplying a source of large woody debris to streams, which provides complex habitat that is important for fish and invertebrates.
- Shading streams to maintain cool water temperatures necessary for salmon and other aquatic organisms.
- Delivering leaf litter, organic debris, and terrestrial invertebrates, which are sources of food for fish and aquatic invertebrates.
- Filtering runoff and stormwater.
- Protecting streambanks from erosion.

Development that occurs near streams and waterways can cause disruption to streambanks and riparian vegetation. Figure 6 shows examples of different buffer distances recommended for specific riparian functions. Depending on the extent of riparian vegetation removal, many of the ecological benefits that riparian zones provide may be partially or completely lost. For example, Wrangell's Playground Creek has been impacted by development near the stream (Figure 7), and we recommend re-vegetation of the riparian buffer to help intercept stormwater runoff.

Many communities throughout the State of Alaska and the U.S. have implemented ordinances that create stream setbacks or buffers to allow for community growth and development that minimizes impacts to riparian habitat and local watershed health. In urban and developed areas, stream setbacks or buffers are corridors of limited use or development adjacent to streams. They are often established to ensure the values and functions of riparian areas are protected for the benefit of wildlife and landowners. Currently, the City and Borough of Wrangell's Municipal Code does not maintain any stream buffer or setback ordinance or requirements. There are no municipal protections in place to ensure that impacts to riparian areas are minimized during development. SAWC recommends the development and implementation of a stream setback ordinance based on recommended buffer widths (at least fifty feet width from anadromous streams) that encourages sustainable community development that protects aquatic habitat functions. The proposed developments in the newly acquired Earl West Cove parcel and along Institute Creek are examples of situations where a stream buffer would be practical and beneficial. Figure 8 highlights the anadromous streams near the community of Wrangell.

The City and Borough of Juneau (CBJ), for example, has streamside setbacks for anadromous streams established in city ordinance. The CBJ streamside setbacks prohibit

development within 50 ft. of the banks of anadromous streams [CBJ 49.70.310(a)(4)] and disturbance within 25 ft. of the banks of anadromous streams [CBJ 49.70.310(b)(1)].

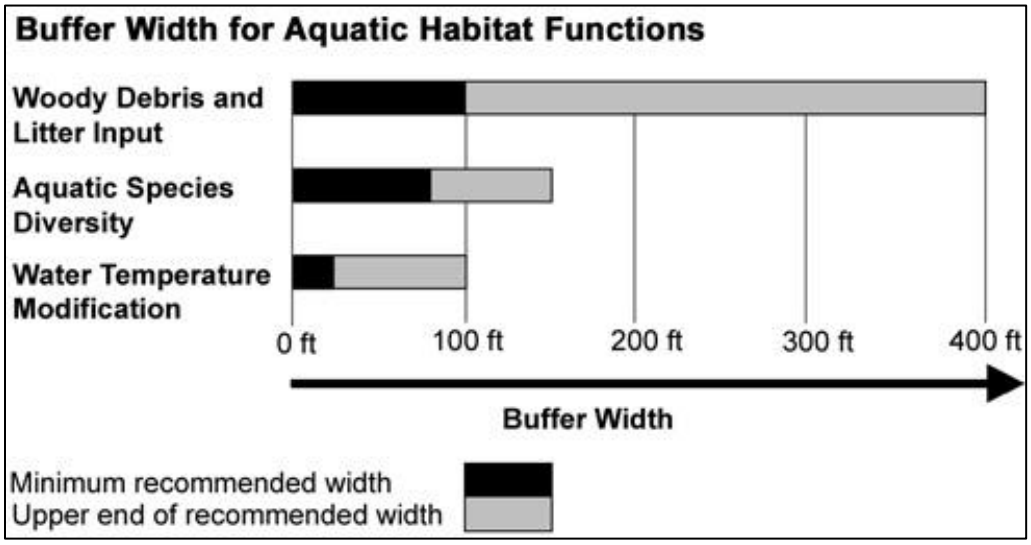


Figure 6. Conservation buffer: design guidelines for buffers, corridors, and greenways. From Bentrup, G. 2008, Gen. Tech. Rep. SRS-109. Asheville, NC: USDA Forest Service, Southern Research Station.

Figure 7. Riparian habitat on Playground Creek has been impacted by development near the stream.

Management Area: Fish Passage

As roads, ditches, and culverts funnel and divert water from its natural path, habitat may become unavailable to fish because of human-created barriers. Fish need to be able to pass safely upstream to spawning grounds and downstream to access feeding and overwintering habitat.

Common obstructions to fish passage include improperly constructed drainage ditches, culverts that are degraded, undersized, perched, or installed at in too steep of a gradient, and buildup of naturally occurring debris or refuse in culverts or drainage ditches. As the community of Wrangell continues to grow and develop its lands and natural resources, it is important to consider fish passage in strategic planning to ensure fish habitat remains connected and accessible for resident and migratory fish populations.

The State of Alaska Department of Fish and Game (ADFG) conducts regular assessments for fish passage on state and city roads and maintains an inventory of culverts and their condition on the Fish Passage Inventory Database. The map below (Fig. 8) indicates culverts and fish passage sites identified and inventoried by ADFG and the US Forest Service, with each color corresponding to the condition rating assigned by assessors. The map displays sites inventoried on Borough, State, and Forest Service lands. Streams mapped and identified within the ADFG's Anadromous Waters Catalog are displayed, denoting streams with a recorded presence of anadromous fish.

Wrangell's roads have several stream crossings that likely impact fish passage. These 'red pipes' present an opportunity to improve access and connectivity to fish passage through replacement, repair, or modification of impacted culvert and ditch sites. This red pipe distinction warrants additional survey and assessment to determine appropriate solutions to ensure proper fish passage, including these culverts that impact salmon:

- Petroglyph Creek Crossing of Evergreen Avenue, ADF&G Fish Passage Site Number: 10203293.
- Playground Creek Crossing of Zimovia Highway, ADF&G Fish Passage Site Number: 10203312
- Tributary to Shoemaker Bay Crossing of Zimovia Highway, ADF&G Fish Passage Site 10203509
- Tributary to Pats Creek Crossing of Zimovia Highway, ADF&G Fish Passage Site Number: 10203279
- DNR forest road crossing of a Pat Creek tributary, not assessed for fish passage, constriction rating likely red; 56.359400, -132.304343

Appendix I shares regional examples of strategies for improving fish passage.

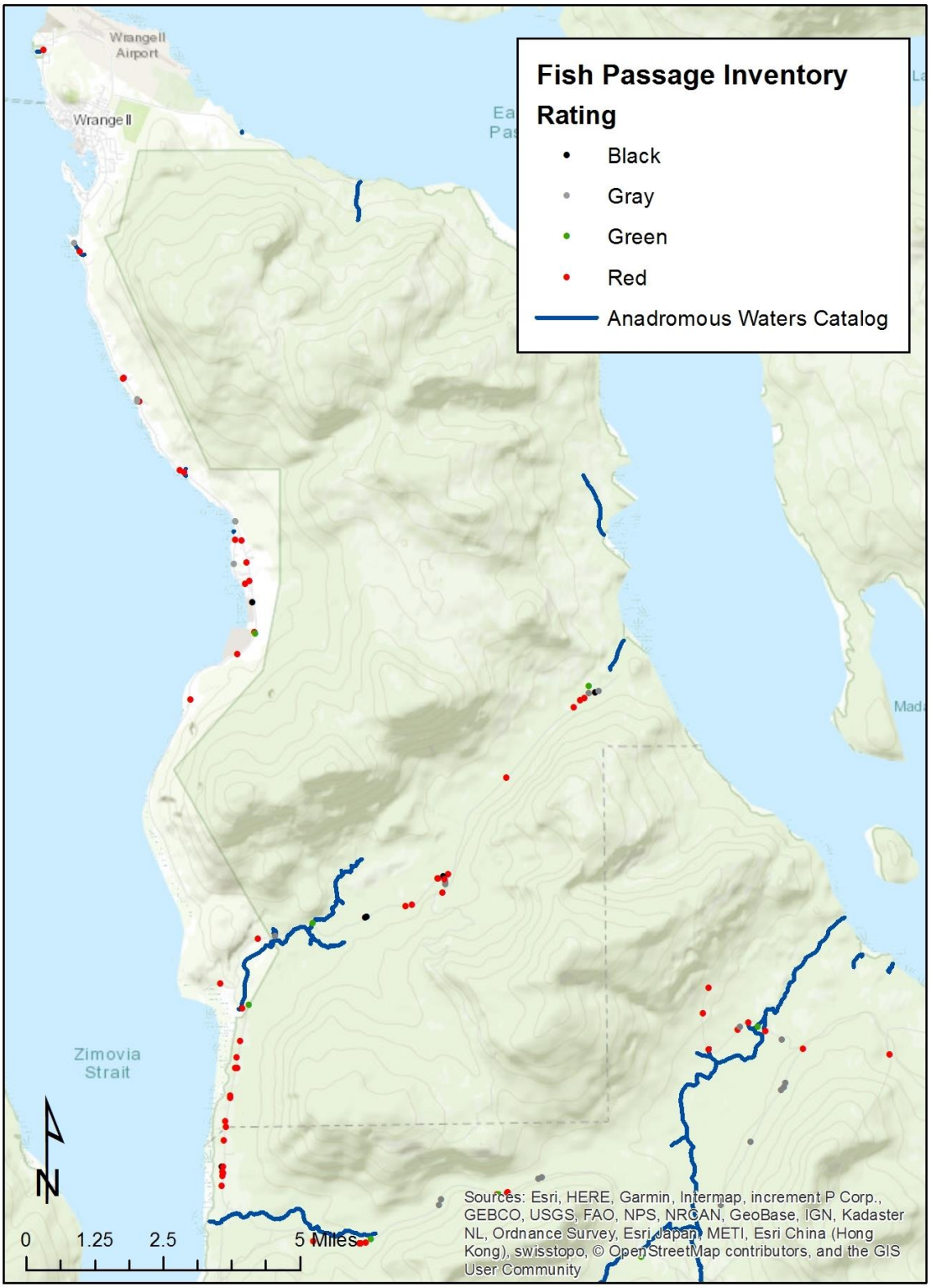


Figure 8. Surveyed fish passage structures in the ADFG Fish Passage Inventory (state and city roads) and US Forest Service inventory (US Forest Service roads). Structures are color-coded by rating: Red indicates a fish passage barrier, grey indicates a partial barrier, or a structure at risk of becoming a barrier, green indicates no fish passage problems, and black indicates more data is needed to make a determination.

Management Area: Stream Temperature and Climate Change Impacts Assessment

Salmon are cold-water species that depend on cool stream water for spawning, egg incubation, juvenile rearing, and migration. Climate change may reduce the hospitality of stream habitat by increasing stream temperatures into ranges that are stressful for salmon or even contribute to mortality events. SAWC conducted a preliminary assessment of potential climate change effects on salmon habitat via increasing water temperatures in two streams near Wrangell, Pat Creek and McCormack Creek. Stream temperatures were monitored hourly from mid-July through September, 2018 in both streams. The Alaska Department of Environmental Quality has set criteria for salmon spawning, egg incubation, and fry rearing at 13 °C, and juvenile rearing and migration at 15 °C, although temperatures in many streams naturally exceed these values. During the summer of 2018, mid-day stream temperatures were above 13 °C from approximately mid-July to mid-August, and peaked over 15 °C during late July and early August in both streams (Figs. 12-13).

Based on projections for future air temperatures for Wrangell from the Scenarios Network for Alaska and Arctic Planning (SNAP) and findings from previous research (Winfree et al, 2018) (Table 1), we estimated potential increases in summer stream temperatures for both locations for the end of the century (2090-2099) (Table 1, Figs. 12-13). The lower bounds reflect projections based on a mid-range emissions scenario (RCP 6.0), and the upper bounds reflect projections based on a high-range emissions scenario (RCP 8.5). The projected temperature increase of approximately 1 °C would significantly lengthen the amount of time that mean daily temperatures exceed recommended maximum values for spawning, egg incubation, and rearing in both streams (Figs. 12-13).

Mitigating Impacts from Climate Change

While it is difficult to predict exactly how increasing temperatures might affect salmon in the future, our analysis indicates that stream temperatures in the Wrangell area could increase to levels that are potentially harmful to salmon during part of the summer. In addition to direct effects on salmon metabolism and behavior, increasing temperatures may alter the productivity and community composition in streams, with implications for the timing and amount of food available for rearing salmon. The presence of cold-water refugia within a watershed may limit adverse effects of increasing temperatures on salmon. Protecting or enhancing riparian vegetation to provide shade along streams is one step that can be taken to mitigate the potential effects of climate change on stream temperatures.

Additionally, areas where groundwater enters streams can provide cold-water refugia, so identifying and protecting areas where groundwater is recharged (snow and rain infiltrate the soil and become groundwater) and discharged into streams may be another key to limiting negative effects of climate change on salmon habitat.

Table 1: Projected increases in mean air temperature for the Wrangell area and summer stream temperatures for Pat and McCormack Creeks from current conditions to the end of the century. Ranges reflect a mid-range emissions scenario (RCP6.0) and high emissions scenario (RCP8.5). The projected stream temperature increases are based on summer sensitivity values for the watersheds (based on findings in Winfree et al, 2018).

Projected increase in mean temperature by 2090-2099 (°C)			
	June	July	August
Wrangell (air)	2.35-3.7	2.5-3.65	2.1-4.25
Pat Creek (water)	0.7-1.0	0.7-1.0	0.6-1.2
McCormack Creek (water)	0.6-1.0	0.7-1.0	0.6-1.1

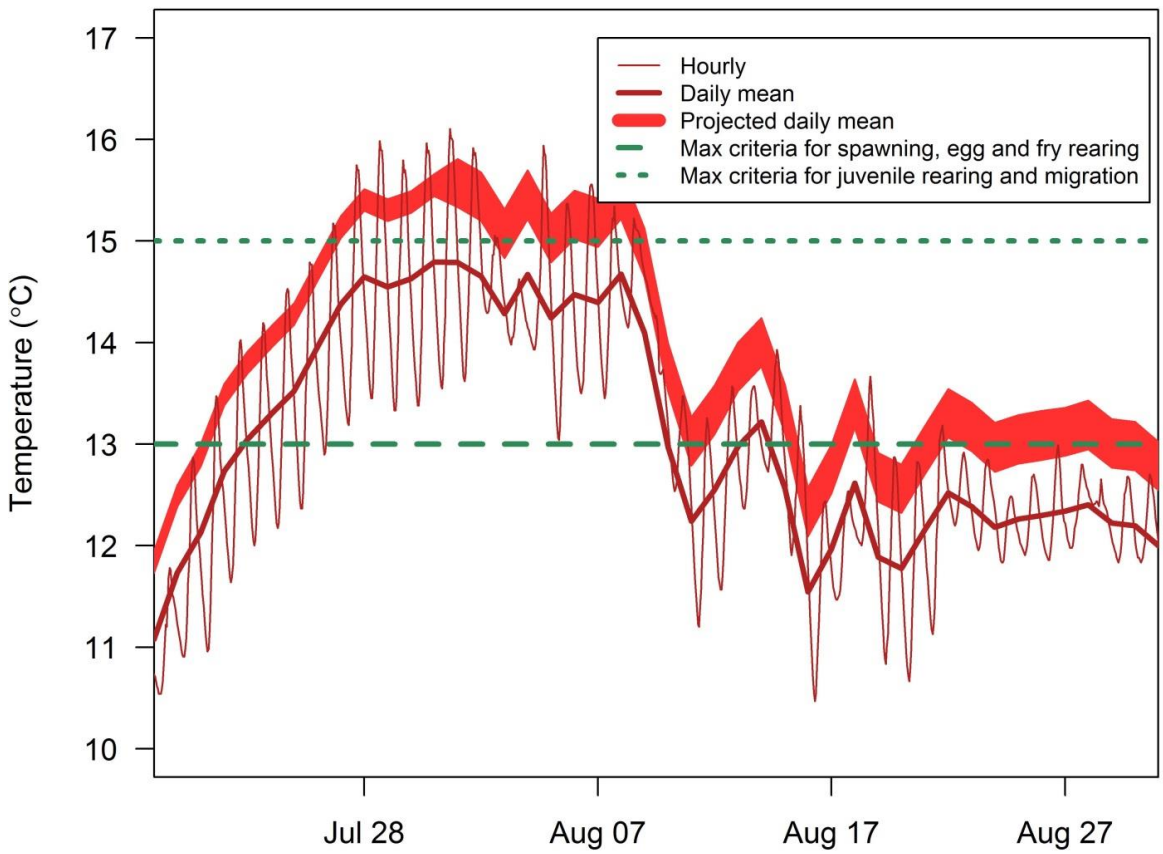


Figure 12: Hourly and mean daily temperatures measured in McCormack Creek, and a range of projected mean daily temperatures based on mid-range and high emissions scenarios. Alaska Department of Environmental Quality water quality criteria for temperature for salmon in various life stages are shown as green dotted lines.

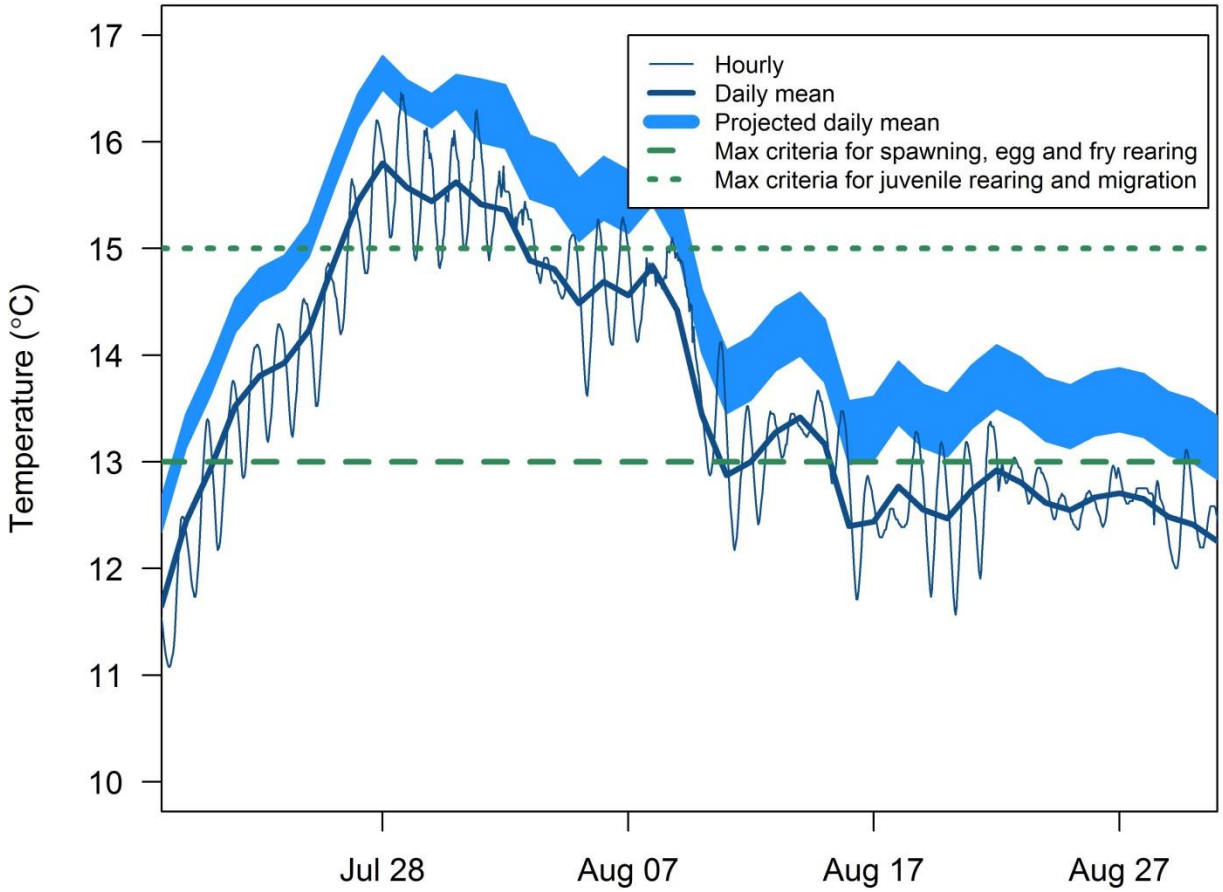


Figure 13. Hourly and mean daily temperatures measured in Pat Creek, and a range of projected mean daily temperatures based on mid-range and high emissions scenarios. Alaska Department of Environmental Quality water quality criteria for temperature for salmon in various life stages are shown as green dotted lines.

References

Scenarios Network for Alaska and Arctic Planning, University of Alaska. 2019. Snap Community Charts. Retrieved Jan 14, 2019 from http://ckan.snap.uaf.edu/dataset/community-charts-temperature-and-precipitation.

Winfree, M. M., Hood, E., Steufer, S. L., Schindler, D. E. , Cline, T. J., Arp, C. D., and Pyare, S. (2018) Landcover and geomorphology influence streamwater temperature sensitivity in salmon bearing watersheds in Southeast Alaska, *Environmental Research Letters*, 13(6), doi: 10.1088/1748-9326/aac4c0.

Site Survey: Petroglyph Creek

Location: 56.4818 -132.3915
USGS-8 Digit HUC: 19010202
ADFG Anadromous Waters Catalog Stream ID: 108-40-10278
Land Ownership: City and Borough of Wrangell

Petroglyph Creek (previously unnamed) is a small anadromous stream located on the north end of the Wrangell town site and the north tip of Wrangell Island. The stream follows the outer edge of a residential trail court, crosses beneath Evergreen Avenue, and flows through a wooded area before reaching the tidal zone near a park at Petroglyph Beach State Historic Site. SAWC staff conducted a reconnaissance level assessment from the stream outlet to upstream of the residential trailer court (Fig. 14).

Figure 14. Map of Petroglyph Creek

Fish Use
Petroglyph Creek is listed in the ADFG Anadromous Waters Catalog for rearing coho salmon (Johnson, 2018). Dolly Varden and cutthroat trout have also been observed in the stream (Legere, 2013).

Existing Habitat Condition
The headwaters of the stream meet from a series of drainages among dense, brushy forest. Below this forested thicket the stream frames the northern edge of a residential trailer court. Residential lots have been filled and developed up to the edge of the riparian area, constricting the channel. As a result the stream has begun to incise on this reach. The average wetted width of this reach of stream is approximately 5 ft., with a mild gradient.


Figure 15: View of forested reach, looking upstream, below Evergreen Ave.

Below the residential area the stream flows beneath Evergreen Ave. through a large culvert. This culvert has been surveyed by the Alaska Department of Fish and Game (ADFG) and entered into the Fish Passage Inventory Database with a red rating, indicating that the culvert likely restricts fish passage. The fish passage survey, completed in 2014, indicates a perched culvert inlet and culvert gradient rating of red.

From the road the stream flows relatively undisturbed through a forested area of primarily alder and spruce in a step pool channel formation, before reaching the tidal zone at the edge of Petroglyph Beach State Historic Site. From a reconnaissance level assessment, this lower reach of the stream appears to maintain complex habitat with ample woody debris interacting with the stream, several pools, and a well-vegetated riparian area.

Human Impacts
The stream experiences some impacts from its proximity to the residential trailer court. The stream has begun to incise along the reach that borders this residential area, and may experience some inputs of stormwater sediment and pollutants from adjacent parking areas and residential roads. The stream may also receive some stormwater inputs from where it crosses beneath Evergreen Avenue.

Figure 16. The stream flows along the northern border of Evergreen residential trailer court. View looking downstream as left bank becomes steep.

Opportunities

Due to the close proximity of filled residential lots near the stream, opportunities for restoration on the upper reach are limited.

Private landowners on the reach of stream that frames the residential trailer court may improve riparian habitat by planting native species such as willow or salmonberry on stream banks to stabilize erosion and create a buffer to reduce stormwater impacts.

Fish passage at the road crossing may be improved through maintenance or replacement of the existing perched culvert. Further survey and design are required for an adequate treatment prescription for this site.

Site Survey: Playground Creek

Location: 56.453493 -132.38354
USGS-8 Digit HUC: 19010202
ADFG Anadromous Waters Catalog Stream ID: 108-40-10282
Land Ownership: City and Borough of Wrangell

Playground Creek is a small stream located just south of the Wrangell town site. The stream runs alongside a cemetery, crosses under Zimovia Highway, continues through the widely used local City Park, and crosses beneath the parking area before meandering out over the tidal zone. SAWC staff conducted a reconnaissance level assessment of from the outlet of the stream to the falls above Zimovia Highway in July of 2018 (Fig. 17).

Figure 17. Playground Creek. Blue line indicates Anadromous Waters Catalog layer. Waypoints collected during 2018 SAWC survey.

Fish Use
Playground Creek is listed in the ADFG Anadromous Waters Catalog for rearing coho salmon (Johnson, 2018). Dolly Varden char and cutthroat trout have also been observed in the stream. Many juvenile fish were visible throughout the lower portion stream at the time of SAWC's survey in July 2018.

Existing Habitat Condition
Park roads, parking, and infrastructure have impacted stream and riparian habitat impacts as it passes through City Park near its outlet. Riparian areas within this stretch of stream have been cleared and mowed.

Within the park, the stream passes through one large culvert that has begun to cave in (Figs. 18-19). This culvert was assessed and inventoried by the Alaska Department of Fish and Game in 2014 and included in the Fish Passage Inventory Database with a rating of grey, which indicates the culvert may impact fish passage. The fish passage survey notes the potential issues of compound gradient in the pipe, subsidence or gradual collapse, and culvert gradient rating of red.

Above this culvert, the stream follows a stretch of forested park space with ample shade from riparian willow and salmonberry, several pools, and some large woody debris interacting with the stream. Average stream wetted width within this reach is approximately 15 ft. and gradient is mild.


Figure 18. Playground Creek flows through a culvert beneath the entrance to City Park. Culvert outlet pictured.

The stream passes under Zimovia Highway via two side-by-side culverts, one of which is activated only at high flows (Fig. 21). These culverts were assessed and inventoried by ADFG as part of the Fish Passage Inventory Database. Both culverts were given a rating of 'red', which indicates that the culverts likely restrict fish passage. Assessment of culvert ID 1 indicates the culvert is poorly aligned, culvert inlet is perched, outfall height and gradient are not adequate, and culvert constriction ratio may limit passage. Assessment of culvert ID 2 indicates similar passage issues.

Upstream of the highway the stream follows a roadside ditch before it passes through a forested area at a steep gradient, above which is a naturally occurring rock wall and waterfall that presents a natural barrier to fish passage. A large amount of woody debris is present within the stream and interacts with the stream throughout this reach, and the substrate is composed of large cobbles.

Figure 19. Inlet of the large culvert beneath entrance to City Park. Riparian area has been cleared and mowed. Slope above small drain pipe funnels stormwater directly into stream.

Figure 20. A small tributary enters Playground Creek on the reach that flows through a forested area of City Park. Picture taken at a time of low flow, July 2018.

Figure 21. Culverts 1 (left) & 2 (right) at Zimovia Highway crossing

Figure 22. Above Zimovia Hwy. Increased gradient, large cobble substrate, larger alluvial fan floodplain, large wood interacts with stream.

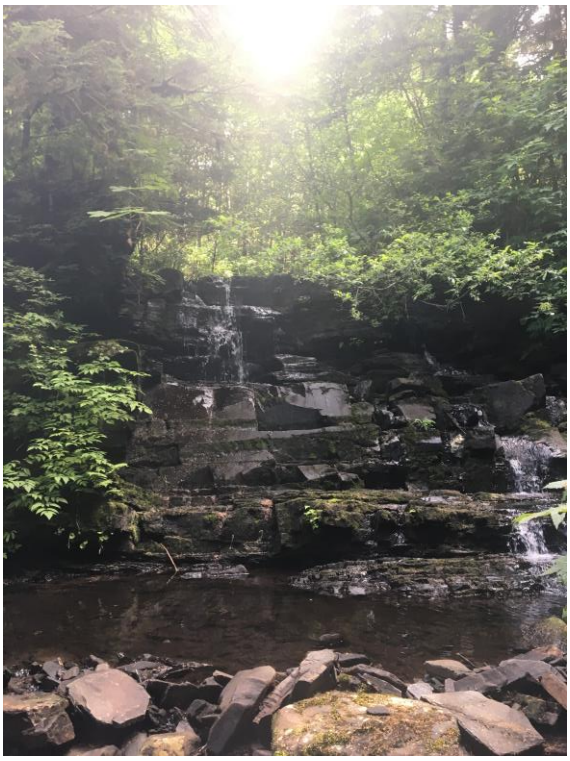


Figure 23. End of survey area. Steep rock waterfall creates a natural barrier to fish passage.

Human Impacts:
Playground Creek passes through a heavily used section of City Park where the stream experiences some negative impacts from surrounding infrastructure. The topography of the road entrance to City Park allows stormwater runoff from Zimovia Highway to flow along the driveway entrance, picking up sediment and pollutants before depositing directly into the stream, posing a threat to water quality. A bathhouse for the park equipped with flushing toilets is situated near the stream at the point of stormwater entry and the ground surrounding this bathhouse have been cleared and are regularly mowed, stripping vegetation from the stream's riparian area in this section (Figs. 19, 24-25). Stormwater and sediment deposition also pose a threat to water quality where the stream crosses beneath Zimovia Highway.

Figure 24. Entrance to City Park from Zimovia Highway. Bathhouse is located near Playground Creek riparian area. Stormwater runs from highway, through park entrance, across lawn pictured, and into stream.

Opportunities

Opportunities to improve habitat conditions and/or reduce threats to watershed health include:

- Installation of Green Infrastructure BMP such as a rain garden or bioswale to manage stormwater runoff through City Park and into Playground Creek. A rain garden planted with native vegetation could capture contaminated runoff and filter out sediments and pollutants before allowing water to percolate back into the stream, thereby improving water quality. Construction of a rain garden at this highly-visited site would also provide an excellent opportunity to educate and inform the public on best practices for living and recreating near salmon streams to protect habitat and water quality.

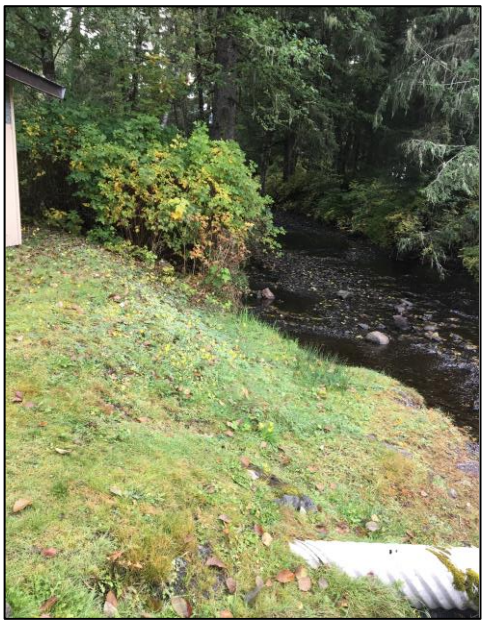


Figure 25. Riparian area near City Park bath house

- Re-vegetation of riparian areas that have been degraded. Streambanks near the park's bathhouse facility, and near the proposed site of a Green Infrastructure BMP, could be easily planted with native vegetation (Figs. 24-25) such as willow, alder, or salmonberry to provide streambank stabilization, shade, and habitat complexity along this reach of stream.

- Replacement and/or repair of culverts impacting fish passage on Playground Creek may allow for improved habitat condition and improved fish passage.

Site Survey: Dewey Bog

Location: 56.476086 -132.377891
Land Ownership: City and Borough of Wrangell

John Hudson and Angie Flickinger of the Southeast Alaska Watershed Coalition conducted a function and value assessment (Wetland Ecosystem Services Protocol for Southeast Alaska, WESTPAK-SE) of Dewey Bog in Wrangell, Alaska on October 8, 2018. Dewey Bog (so-named for this assessment) is located on the north end of Wrangell Island in southeastern Alaska. The wetland is part of a larger wetland complex bisected by Airport Loop Road. The assessment area (AA) consisted of a 76-acre forested peatland located on the west side of Airport Loop Road (Fig. 26). This wetland is bordered by the Wrangell Airport to the north, Mount Dewey to the west, and the Wrangell town site to the south. The wetland is owned by the City of Wrangell.

Figure 26: Dewey Bog Assessment Area

Existing Habitat Condition
The AA is relatively flat in its eastern half and gently sloping to the west in its western half. Stands of cedar and hemlock border the AA, which consists of peatland containing widely scattered shore pine. There are several ponds of varying sizes in the AA; some of the ponds are connected by flowing surface water.

The Dewey Bog AA had an overall rating of 'lower', largely because it does not directly contribute to fish habitat. It had "moderate" functional ratings for habitat for songbirds, raptors, mammals, pollinators, amphibians, and aquatic invertebrates, and "moderate" and "high" value ratings associated with public use and subsistence and provisioning services, respectively. The WESPAK-se methodology results can be found here.

Figure 27. Pond in northwestern quadrant of the AA. View looking west.

Human Impacts
Several off-road vehicle trails traversing the AA have damaged plants and soil (Figs. 28-29), which has altered local hydrology by converting groundwater into surface flows of water.

Opportunities
Restricting access of off-road vehicles to sensitive wetlands habitat would prevent additional impacts and allow trails to re-vegetate.

Figure 28. Off-road vehicle trail in northern half of AA. View looking southeast.

Figure 29. Pond and off-road vehicle trail in northern half of the AA. View looking northwest.

Figure 30. Northwestern quadrant of the AA. View looking east.

Site Survey: Institute Creek

Location: 56.416236, -132.345579
USGS-8 Digit HUC: 19010202
Land Ownership: City and Borough of Wrangell, State of Alaska, U.S. Forest Service

Institute Creek is a steep, fast moving stream that flows off of a mountain about 5 miles from the Wrangell town site, crosses beneath Zimovia Highway, and meets the tidal zone between the Shoemaker boat harbor and Shoemaker Park recreation area. Where the stream flows through US Forest Service land, a recreational boardwalk trail crosses the stream several times. SAWC staff conducted a reconnaissance level assessment of accessible reaches of Institute Creek (Fig. 31).

Figure 31. Map of surveyed area of Institute Creek.

Fish Use
Institute Creek has not been listed as an anadromous fish stream within the Anadromous Waters Catalog. No fish were identified at the time of survey.

Existing Habitat Condition
Institute Creek is a steep gradient, fast flowing stream. Substrate is dominated by large cobbles and boulders (Fig. 32). The reach of stream that flows beneath Zimovia Highway and through Shoemaker Park features little riparian habitat, with large riprap fill and minimal vegetation. Above the highway the riparian area is densely forested with willow, alder, and conifer species (Fig. 33).

Figure 32. Rebecca Bellmore takes a waypoint on the lower reach of Institute Creek. Shoemaker Park bathhouse is pictured in the background.

Figure 33. Institute Creek above Zimovia Highway.

Human Impacts
The stream may experience some impacts to water quality from stormwater entering the stream where is crosses beneath Zimovia Highway and at the entrance to Shoemaker Park. Riprap fill for Shoemaker Park and surrounding infrastructure has created stable banks with minimal riparian habitat.

Opportunities
Bare riprap in the lower reach's riparian area could be planted with native species such as willow or salmonberry to create aquatic insect habitat and provide a buffer for stormwater management (Fig. 34).

Figure 34. Riprap streambank as the stream crosses between Shoemaker Harbor and Shoemaker Park

Site Survey: Earl West Cove

Location: 56.350368, -132.134136
USGS-8 Digit HUC: 19010202
Land Ownership: City and Borough of Wrangell

The City and Borough of Wrangell recently acquired a parcel of land at Earl West Cove on the east side of Wrangell Island (Fig. 35). The Southeast Alaska Watershed Coalition conducted a reconnaissance level assessment of this area and previously mapped streams (Fig. 36).

The shoreline along the city's newly acquired parcel by Earl West Cove is in fairly undisturbed condition, except for the log transfer facility at the end of the road. The biological community along the beach and intertidal area includes dunegrass, barnacles, rockweed, green and red algae, blue mussels, and soft brown kelp. Earl West Cove itself is a physically protected estuary with tidal flats that may be used as rearing area by Coho from Earl West Creek and five other nearby anadromous streams, which have all been documented as having rearing Coho.

Any future developments in this area should consider proximity to streams, especially those mapped within the anadromous waters catalog known to provide habitat for salmon species. Implementation of a stream buffer or setback requirement would help to protect salmon spawning, rearing, and overwintering habitat in streams near Earl West Cove.

Figure 35: Earl West Cove

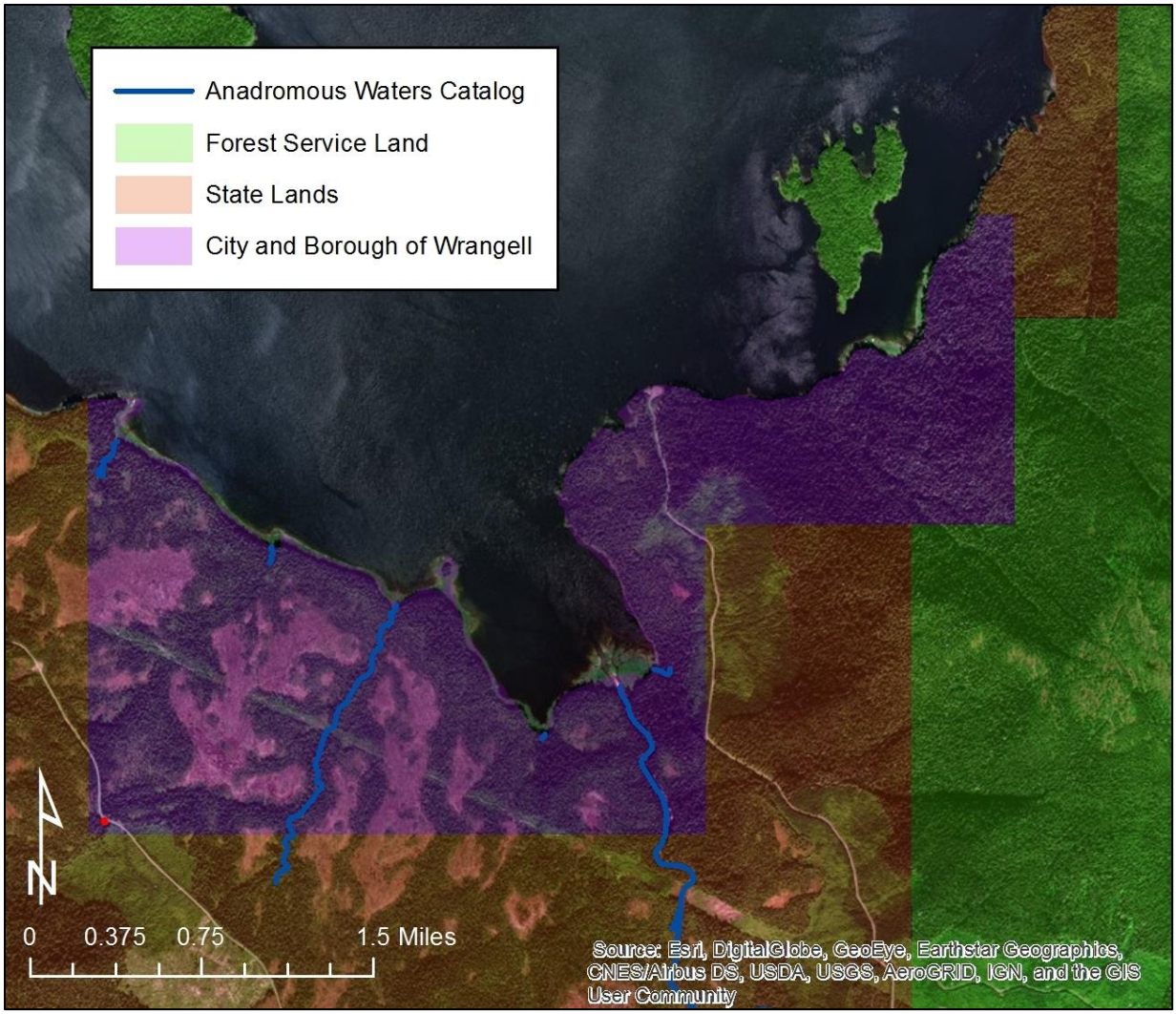


Figure 36: Earl West Cove land ownership boundaries and anadromous waters.

Site Survey: Pat Creek Watershed

Location: 56.353836, -132.323707
USGS-8 Digit HUC: 19010202
Land Ownership: State of Alaska, US Forest Service

The Pat Creek watershed spans 13,900 acres, one third of which is managed by the State of Alaska while the remaining area is managed by the US Forest Service. Much of the valley bottom in the Pat Creek watershed was logged in the 1960s, 70s, and 90s; about 2,000 acres of timber on federal lands was harvested during that time (Fig. 37). These lands were transferred to the state of Alaska in 1991 and are presently managed by the Alaska Department of Natural Resources (ADNR) Division of Forestry and the Alaska Mental Health Trust Authority.

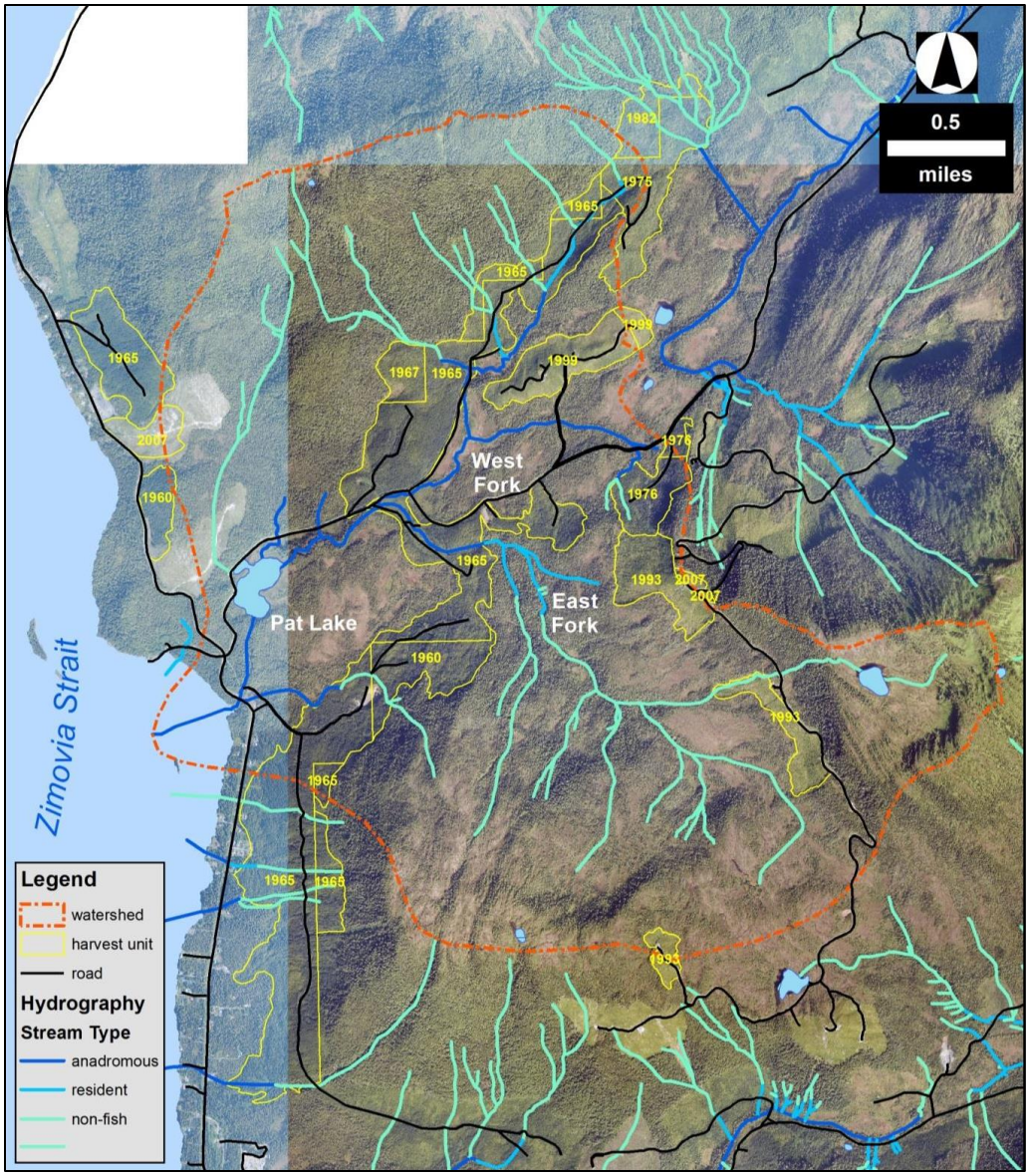


Figure 37. Dates and locations of timber harvest on the Pat Creek watershed.

In 2014 SAWC, with support from the US Fish & Wildlife Service and the US Forest Service, conducted a reconnaissance-level assessment of the Pat Creek watershed (Fig. 38). The purpose of this assessment was to improve understanding of existing conditions in the watershed, including stream habitat conditions, and to identify opportunities for improving water quality and riparian and instream habitat.

Figure 38. SAWC & USFS crew assess fish habitat condition on Pat Creek.

Tier II stream habitat surveys conducted on the lower West and East Forks of Pat Creek indicated that the size and frequency of woody debris (an important component of high quality fish habitat) was lower in harvested reaches surveyed than in unharvested streams of similar channel type and size. The surveys also indicated a potential restriction on floodplain connectivity within the watershed, possibly due to relic logging roads within the floodplain. A comprehensive report from this watershed assessment is available for review at:
http://www.alaskawatershedcoalition.org/wp-content/uploads/2015/05/Pat_Creek_Recon_Report_final.pdf

As a result of these reconnaissance-level survey indications, with support from the US Fish and Wildlife Service, SAWC contracted the services of Inter-Fluve, a firm specializing in investigations, design, and restoration of rivers, lakes and wetlands, to complete a more comprehensive site assessment and develop a conceptual design to restore fish habitat on impacted reaches of the East & West forks of Pat Creek watershed. In the spring of 2018, Inter-Fluve completed final site surveys for design of an in-stream habitat restoration project on Pat Creek. A full technical memorandum outlining project concepts developed by SAWC and Inter-Fluve in detail is available here.

Figure 39: SAWC staff survey riparian areas on the main stem of Pat Creek

Proposed Habitat Restoration: Large Wood Placement on West Fork & Main Stem, Pat Creek

A large wood addition project is proposed for Pat Creek based on field observations, experience, survey, and hydraulic model output. Placing large wood within the West Fork and mainstem will increase the number of key pieces of large wood and provide complex fish rearing habitat over the next several decades. The logged forest stands need time for the existing trees to mature and be available for wood recruitment in the creek. Addition of wood now will provide habitat for the intervening decades. Opportunities exist to improve key piece large wood material using whole trees or by constructing bank buried log jams (Figs 40-41).

In 2018, SAWC was awarded funding through Alaska Sustainable Salmon Fund, as well as the US Fish and Wildlife Service to complete construction of the proposed habitat restoration project in the West Fork and mainstem of Pat Creek.

Construction of this project will utilize second growth spruce trees available near the road running adjacent to the stream. SAWC is currently working with the landowner, the Alaska Department of Natural Resources, and the Alaska Department of Fish and Game to obtain necessary in permits for the project. Project implementation is expected to take place during the summer of 2019.

Figure 40. Large wood placement concept overview.

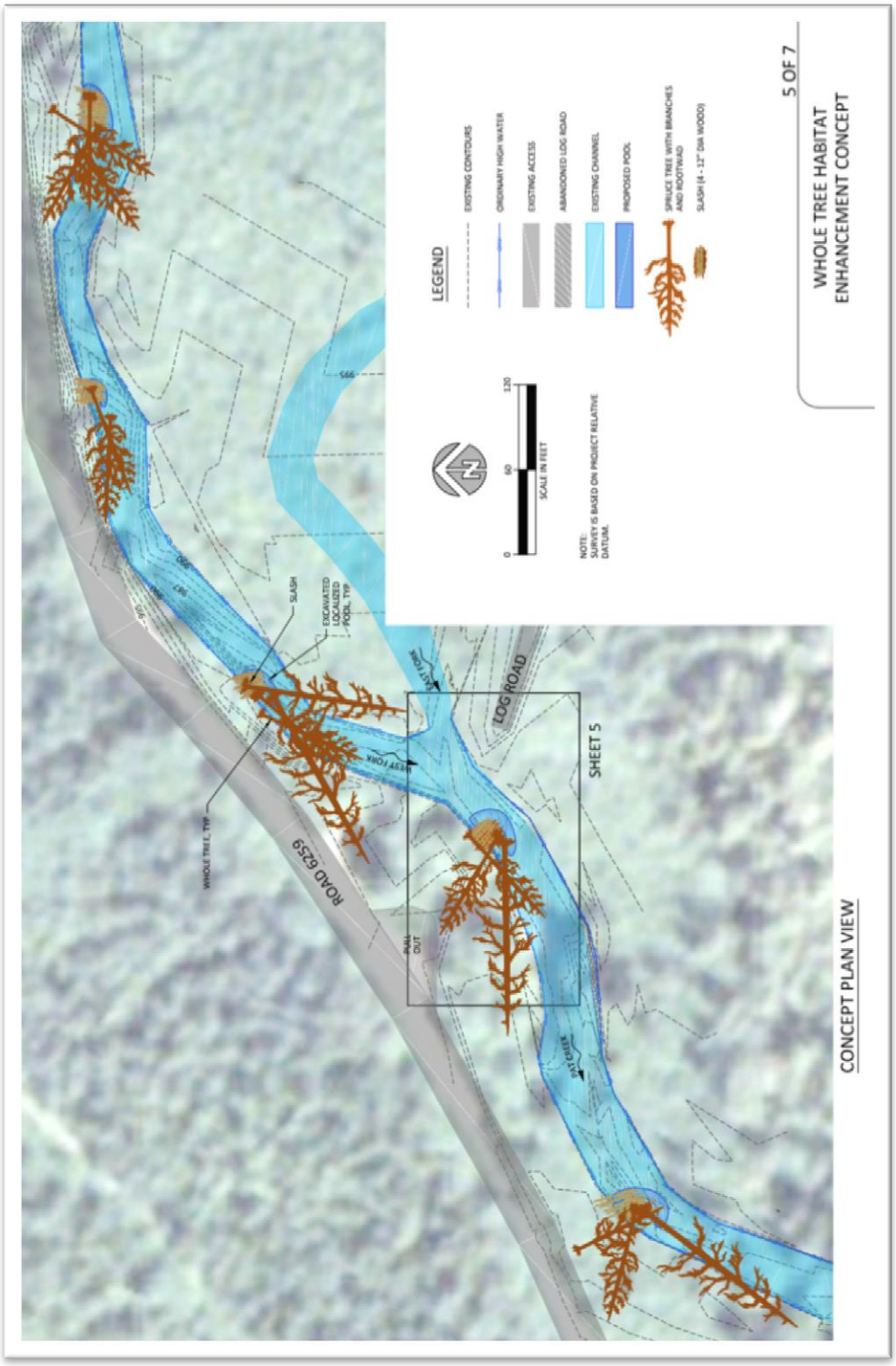
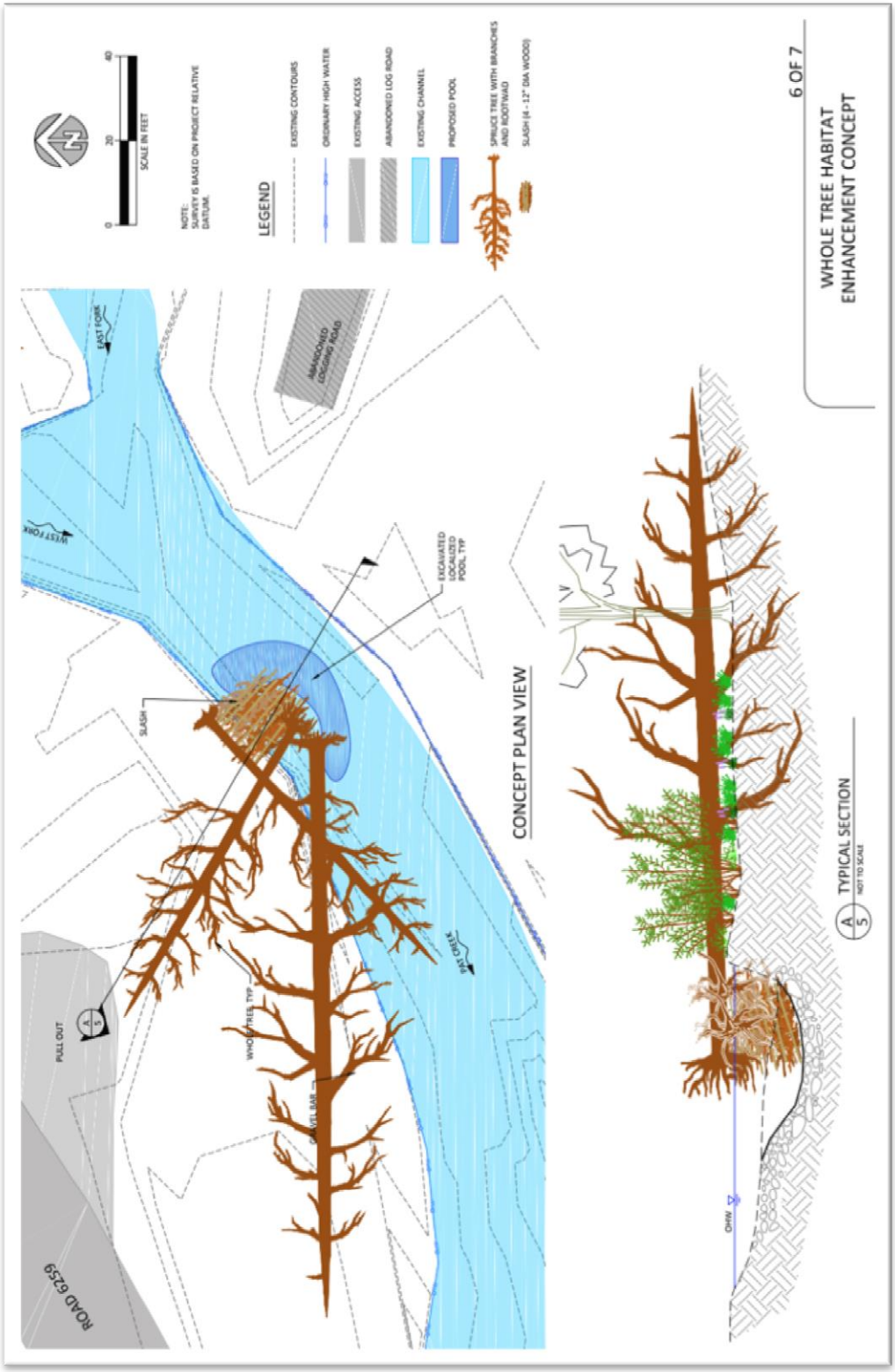


Figure 41. Whole tree habitat enhancement concept.



Mitigation Opportunities: The Southeast Alaska Mitigation Fund

Aquatic Resource Mitigation

In the temperate rainforest environment of Southeast Alaska, wetlands, streams, and estuaries make up a large and important portion of the region's landscape; these aquatic resources perform many valuable ecosystem functions including providing fish and wildlife habitat, water storage, and water filtration. Land development and other human activities that require dredging, filling, and construction on wetlands and surface waters can significantly impact the functions and values of these aquatic resources. As these activities are sometimes necessary for a community to grow and develop, the Clean Water Act and River and Harbors Act has measures in place to regulate such activities, in an effort to achieve no net loss of our nation's wetland functions and values in the face of unavoidable impacts.

Regulated by the Army Corps of Engineers, developments that impact important aquatic resource like wetlands, streams, and tidelands must:

- *Avoid Impacts*. An example of this may be choosing a different site to develop.
- *Minimize Impacts*. An example of this may be building up rather than out, impacting less area.
- *Mitigate Impacts*. Compensatory mitigation is the enhancement, restoration, creation and/or preservation of aquatic resources to offsets unavoidable impacts to wetland, streams, or tidal areas.

More information on the detailed processes of mitigation and regulations can be found through the Army Corps of Engineers (www.poa.usace.army.mil), the Regulatory In-Lieu Fee and Banking Information Tracking System RIBITS (https://ribits.usace.army.mil/ribits), and through the Environmental Protection Agency (https://www.epa.gov/cwa-404/compensatory-mitigation-alaska).

The Southeast Alaska Mitigation Fund

Run by the Southeast Alaska Watershed Coalition, the Southeast Alaska Mitigation Fund (SAMF) is an In-lieu Fee mitigation program that fosters opportunities for communities to grow and develop while maintaining healthy and intact aquatic ecosystems. SAWC develops, assesses, and implements aquatic resource restoration, creation, and enhancement projects and sells "mitigation credits" to offset impacts to resources in other areas. It is the first restoration based In-Lieu Fee mitigation program in Alaska, and it

calculates mitigation needs based on changes in ecological functional through science based assessments and mitigation plans.

The SAMF seeks to utilize the regulatory systems in place under the Clean Water Act to restore important aquatic resources, while building up a restoration economy in Southeast Alaska that keeps restoration and mitigation dollars circulating in Southeast Alaskan communities. To achieve this, we work one-on-one with developers, landowners, and municipal governments to assess opportunities and develop plans for future mitigation needs.

Determining what compensatory mitigation may be needed for a development requires careful consideration of the impacted site as well as the location, scale, habitat type, and other details of a potential mitigation opportunity. For this reason, SAWC encourages developers and those seeking mitigation opportunities to contact regulators and mitigation providers early and often. For more information on the Southeast Alaska Mitigation Fund, visit: http://www.alaskawatershedcoalition.org/aquatic-resource-mitigation-2/

Mitigation Opportunities: Coastal Protections

Like many communities in Southeast Alaska, Wrangell is situated between steep mountains and the ocean, with the coast dotted with docks, harbors, and an airport. While these flat areas are ideal location for community development, they are also incredibly important to the natural resources that sustain our communities. Eelgrass beds, kelp forests, and tidal flats are necessary habitat for the fish, crab, and shellfish targeted for commercial, sport, and subsistence activities.

While restoration of coastal areas is a common activity in other parts of the country, the science and practice of coastal restoration is still developing in Southeast Alaska. Technical and cost challenges often limit the removal of filled coastal areas for restoration. As a result of these challenges, mitigation options for coastal wetland and estuaries are more limited, yet the need for mitigation is great because our communities rely upon considerable marine-based industry.

Mitigation opportunities for coastal development impacts do currently exist in the form of preservation. The Cities of Juneau and Sitka have both faced coastal mitigation challenges, and identified unique solutions through work with the Southeast Alaska Land Trust. For example, Juneau's Auk Nu Cove, an important eelgrass area that was at risk of development, was placed in a conservation easement to compensate for the loss of eelgrass habitat in the construction of a loading dock. Similarly, impacts from Sitka's Airport expansion were mitigated by the preservation of tidal kelp and eelgrass beds in

nearby Crescent Bay (Fig. 42). Both examples required close collaboration between the city and the State of Alaska, as tidelands are managed by the State. These sites are extremely high value habitat and now serve as a protected public open space.

Figure 42. Eel grass and kelp beds in Sitka's Crescent Bay. Photo from the Southeast Alaska Land Trust.

Wrangell's Unique Coastal Environment

With highly productive fishing and crabbing grounds surrounding the island, Wrangell boasts some world class and high ecological value coastal areas. The nearby Stikine River delta is one of Southeast Alaska's most significant estuaries, highly valued for its role as a nursery for fish and shellfish and as a migratory stopover for birds and waterfowl.

Detailed assessments of coastal areas in Southeast Alaska are somewhat limited, and site level assessment of Wrangell's coastline was outside the scope of this assessment project. SAWC recommends the review of the following resources for stakeholders looking to plan development, preservation, restoration, or stewardship of Wrangell's coastal areas:

- *ShoreZone and Near Shore Fish Atlas:* This interactive mapping tool shows imagery of all the coastlines in Southeast Alaska as well as habitat and fish data collected by NOAA scientist in near shore surveys: www.shorezone.org
- *Wrangell Coastal Zone Management Plan*. While Alaska's coastal zone management program is no longer operational, Wrangell developed a coastal zone management plan that is useful in providing background information on important coastal uses, community needs, and areas warranting protection. This plan identified "Areas Meriting Special Attention," including noting the need to allow for future community development in Wrangell Harbor Waterfront District, and noting that special

management may be necessary to protect recreational and fisheries values for the Stikine River and Delta, Fools Inlet, and Thom's Place.

- *Ecological Atlas of Southeast Alaska*. Audubon Alaska's ecological atlas provides a wealth of information about the ecology of Southeast Alaska, and it highlights Wrangell's Stikine Delta, Thoms Place/Zimovia Straits, and the Bradfield River Delta as estuaries of significance: http://ak.audubon.org/conservation/ecological-atlas-southeast-alaska.

Mitigation Opportunities: Hand Tool Stream Restoration Sites on Wrangell Island

In July and October of 2018, SAWC staff investigated several stream reaches on Wrangell Island that were identified as potential in-stream restoration sites by US Forest Service staff in Petersburg. Potential restoration sites were identified using a GIS to locate Class I and Class II stream reaches in floodplain, moderate-mixed, and alluvial fan channel types located in or near harvest units. The stream channels in these reaches were expected to be in poor condition or the channel conditions were expected to decline in the future due to insufficient large wood recruitment. The analysis identified numerous Class I (anadromous fish) and Class II (resident fish) stream reaches on Wrangell Island (Fig. 43). SAWC staff visited 12 sites that were relatively easy to access from the road system in July and October 2018. Four of the 12 sites that were visited - in 3 different watersheds - were identified as potential restoration sites based on a qualitative assessment of channel conditions, including fish habitat, and other factors such as accessibility and riparian forest conditions. Channel and riparian conditions in one of these four streams, Ward Creek Trib, were quantified according to the SAWC Stream Credit Debit Methodology. SAWC and USFS staff will revisit the four sites to determine feasibility for restoring habitat and other channel functions using hand tools.

These "hand tool" in-stream restoration projects are potential mitigation opportunities for development that impacts streams, requiring "stream credits." These in-stream habitat improvement projects could be conducted through the Southeast Alaska Mitigation Fund, and the number of stream credits produced would be based on the before and after habitat condition of the areas of stream treated. While "hand tool" projects would produce fewer credits than a larger scale project, the sites are easily accessed and construction costs would be comparatively low. The projects could be completed with local labor with SAWC oversight. As a result, restoration at these sites could be easily planned and implemented in a cost-effective way.

As a complete survey was not conducted on watersheds within Tongass National Forest lands on Wrangell Island as part of this assessment, there may be additional in-stream

mitigation opportunities not listed. Based on past and current logging and management activities on Zarembo Island and other nearby areas there may be additional restoration-based mitigation opportunities to explore that may be applicable to mitigation needs in Wrangell.

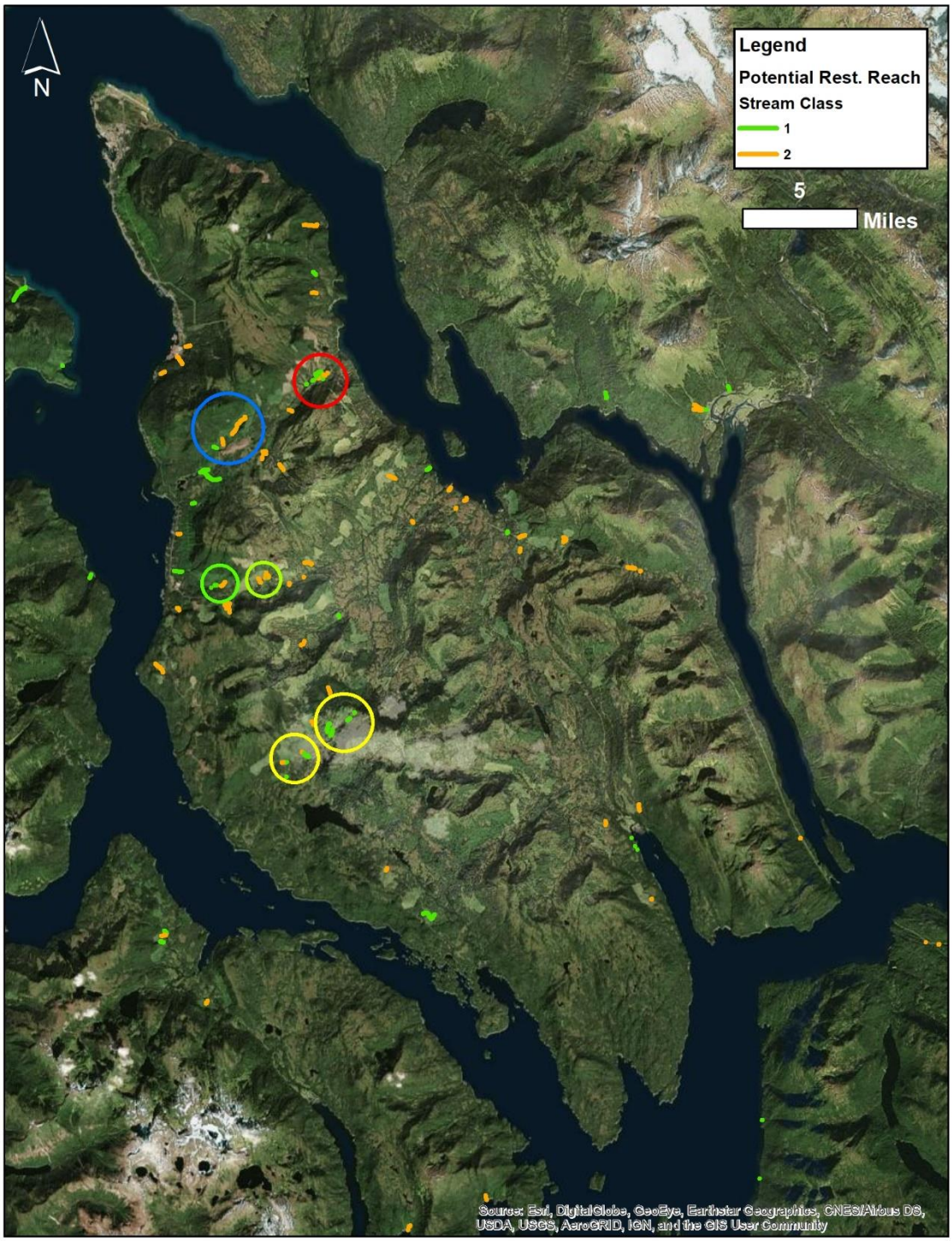


Figure 43. Potential hand tool restoration reaches in Class I and Class II streams on Wrangell Island. SAWC staff visited sites inside circles to ground-truth restoration needs and feasibility in July and October of 2018 (Hermit Creek, red; Pat Creek, blue; McCormack Creek, green; Thoms Creek, yellow).

Field Visits

Hermit Creek

Hermit Creek is an anadromous stream that flows into Blake Channel on the east side of Wrangell Island. SAWC staff attempted to locate three stream reaches on Hermit Creek in July 18, 2018 (Fig. 44). Tribs A and C were not positively located, and may have been dry due to drought conditions. Trib B was located, and in-stream habitat seemed to be in good condition. The channel was constrained and the bed width was about 2.5 feet. There were many pieces of small wood in the stream, possibly slash, and the narrow channel was shaded by riparian plants (Fig. 45). The culvert appeared to be functioning and passable, but no fish were observed during this visit. Another visit during wetter conditions to locate Tribs A and C is warranted.

Figure 45. Tributary B of Hermit Creek. Culvert outlet.

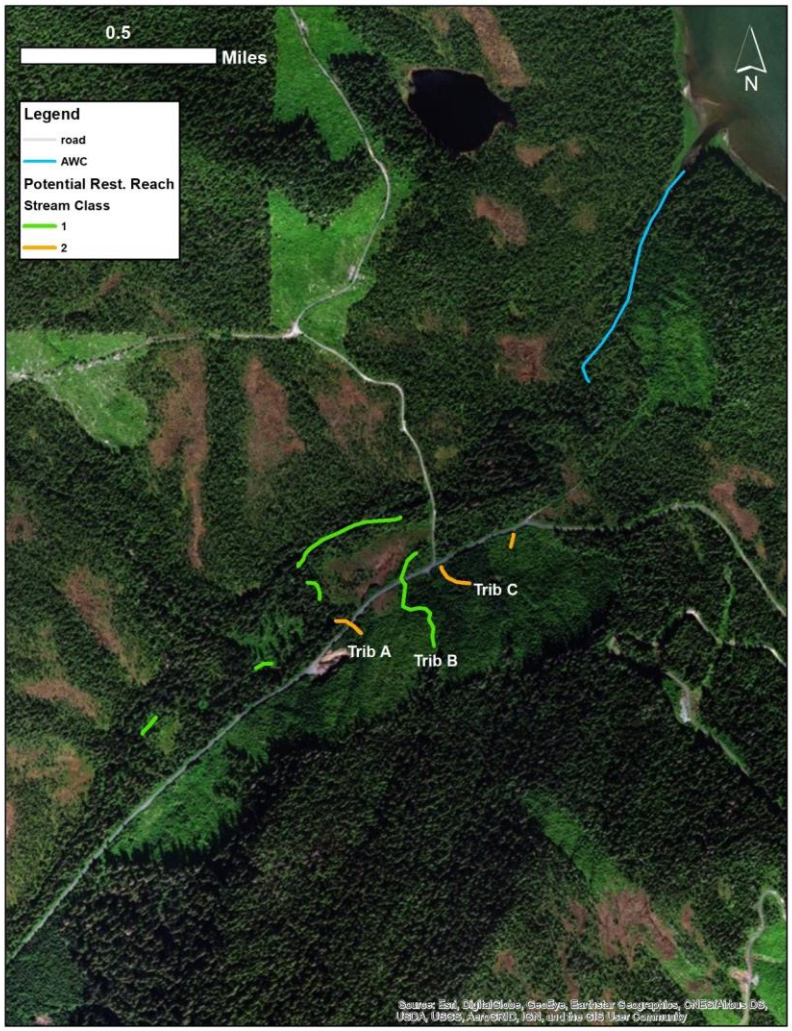


Fig. 44. Potential hand tool restoration reaches in Class I and II streams in the lower Hermit Creek watershed. Labeled reaches were visited in 2018.

Pat Creek

Pat Creek is an anadromous stream on the west side of Wrangell Island that flows into Zimovia Strait. Two tributaries on the West Fork of Pat Creek were investigated on October 11, 2018 (Fig. 46). Both tributaries are on land owned and managed by Alaska Department of Natural Resources (ADNR). Tributary A is on a small alluvial fan and has a bed width of about 4.5 feet. A large fish was spooked while in the lower reaches of the tributary, possibly an adult coho salmon. This site appears to have been partially logged as several old-growth trees were growing on the fan. The lower reach of this stream, which flows from the fan onto the west fork floodplain, are catalogued as coho salmon rearing habitat in the AWC. Resident fish presence upstream of the fan should be confirmed and the stream channel evaluated for possible restoration if fish are present. This site deserves further investigation for restoration potential and feasibility.

Tributary B flows down a landslide. The stream diverts from its original path to the east about 300 feet upstream of Tunnel Road and enters the west fork just upstream of a failing beaver dam. A plugged culvert on this channel was removed by ADNR in 2018. The channel bed width is about 4.5 feet. In Sept. 2017 an ADFG biologist collected cutthroat trout and Dolly Varden char upstream of the road. This site deserves further investigation for restoration potential and feasibility.

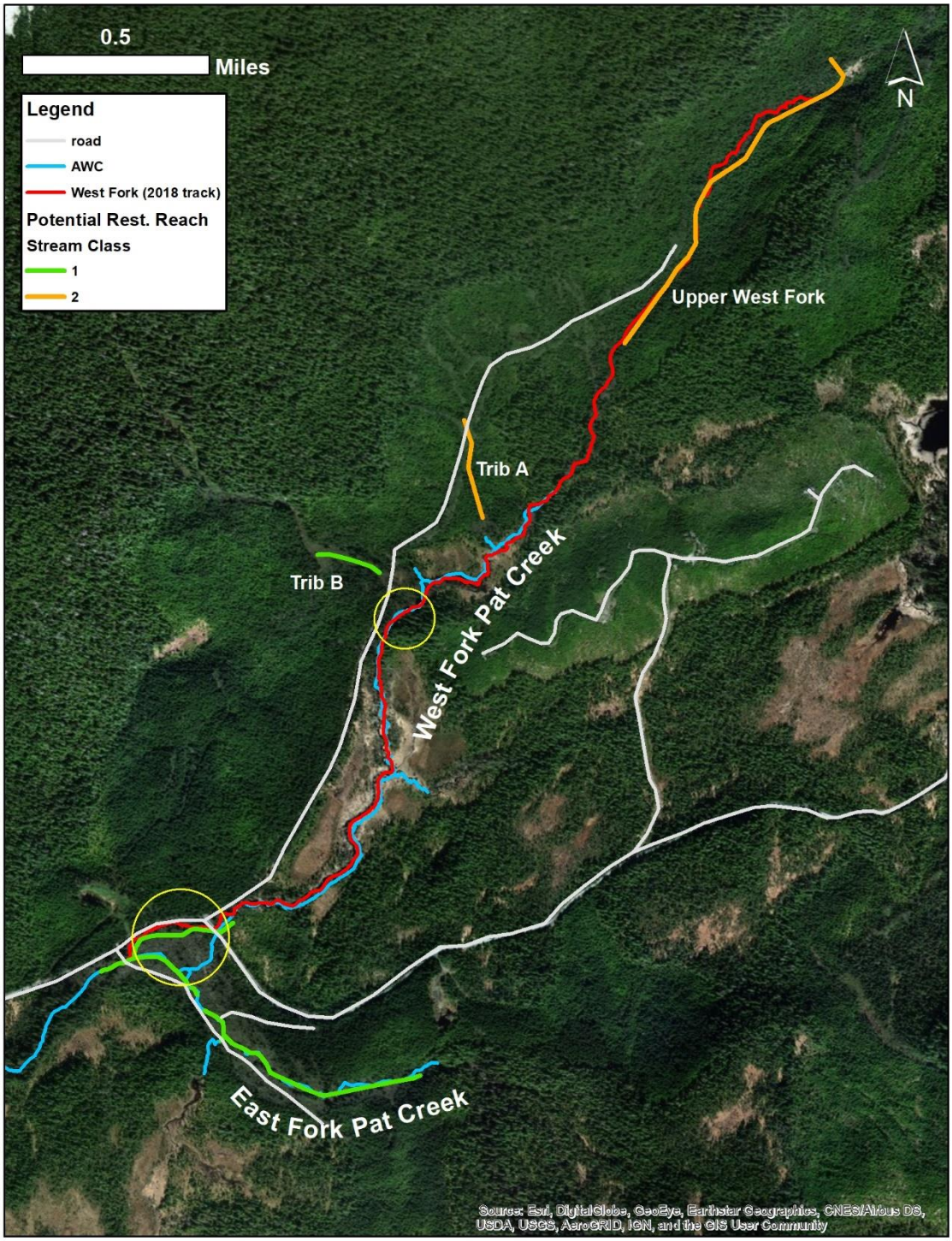


Figure 46. Potential hand tool restoration reaches in Class I and II tributaries of the West Fork of Pat Creek on Wrangell Island that were visited in 2018. Yellow circles identify reaches on the west fork that should be assessed for habitat conditions and possible restoration requiring heavy equipment. A track line of the west fork obtained in October 2018 is depicted in red.

McCormack Creek

McCormack Creek is an anadromous stream on the west side of Wrangell Island that flows into Zimovia Strait (Fig. 47). A potential restoration reach in a tributary (Trib A) on the north side of the main stem was visited on October 10, 2018. About 2,500 feet of channel, including an upstream new-growth reach (Fig. 48) and a downstream old-growth reach (Fig. 49), was evaluated and mapped.

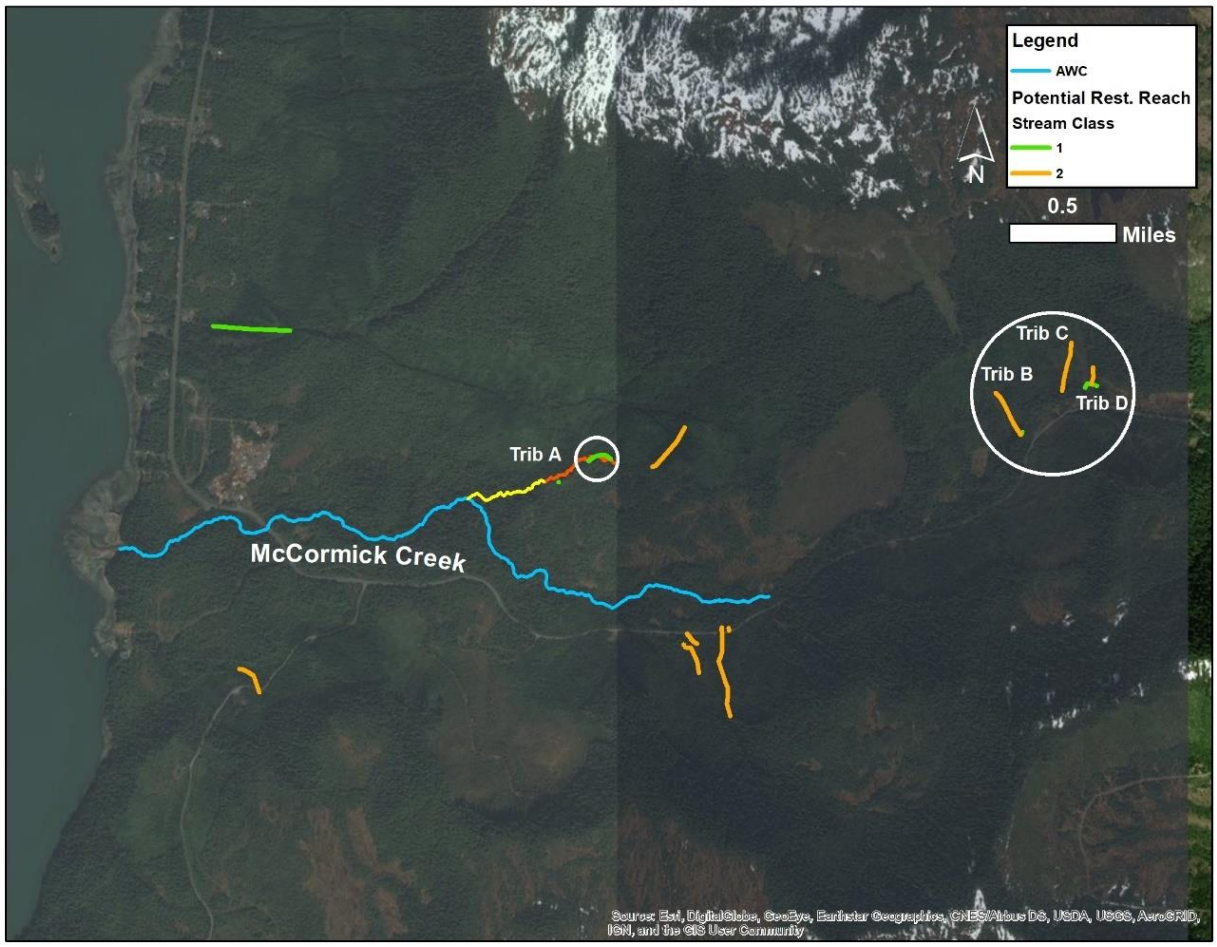


Figure 47: Potential hand tool restoration reaches (in circles) in Class I and II streams in the McCormack Creek watershed on Wrangell Island that were visited in 2018. Yellow (old-growth reach) and red (new-growth reach) lines on Trib A depict the stream reach that was assessed on October 10, 2018.

The bed width of the channel ranges from 8-12 feet. The new growth reach is moderately steep (>3%) with a step-pool channel morphology and substrate dominated by cobbles. Large wood debris was abundant and consisted of old, degraded pieces. Two juvenile cutthroat trout were captured with a hand net. Trees were harvested on both sides of the stream. The riparian forest consisted of widely-spaced Sitka spruce ranging in size from 18" to 24" dbh. This site deserves further investigation for restoration potential and feasibility.

The old-growth reach is a moderate gradient-mixed control channel transitioning to a floodplain type channel. Substrate was dominated by gravels and cobbles. The riparian

forest consisted of widely scattered old-growth conifers and red alder. Most large wood spanning the channel does not appear to interact with low to moderate flows. One juvenile cutthroat trout was captured with a hand net.

Figure 48. Tributary A of McCormack Creek in the new-growth reach. Net width is 9.5 inches.

Staff attempted to locate tributaries B-D on July 18, 2018. Trib D was the only stream that was located. The channel was moderately steep, constrained and narrow (bed width approximately 1.5 feet), contained many pieces of smaller wood (likely slash), and went subsurface approximately 50 m upstream from the confluence with McCormack Creek (Fig. 50). The area had been logged, but the second growth is sparse enough that a deciduous understory is thriving.

Figure 49. Tributary A of McCormack Creek in the old-growth reach. Net width is 9.5 inches.

Figure 50. Tributary D of McCormack Creek, view from below forest understory.

Thoms Creek

Five potential restoration reaches in the Thoms Creek watershed were visited on October 10, 2018 (Fig. 51).

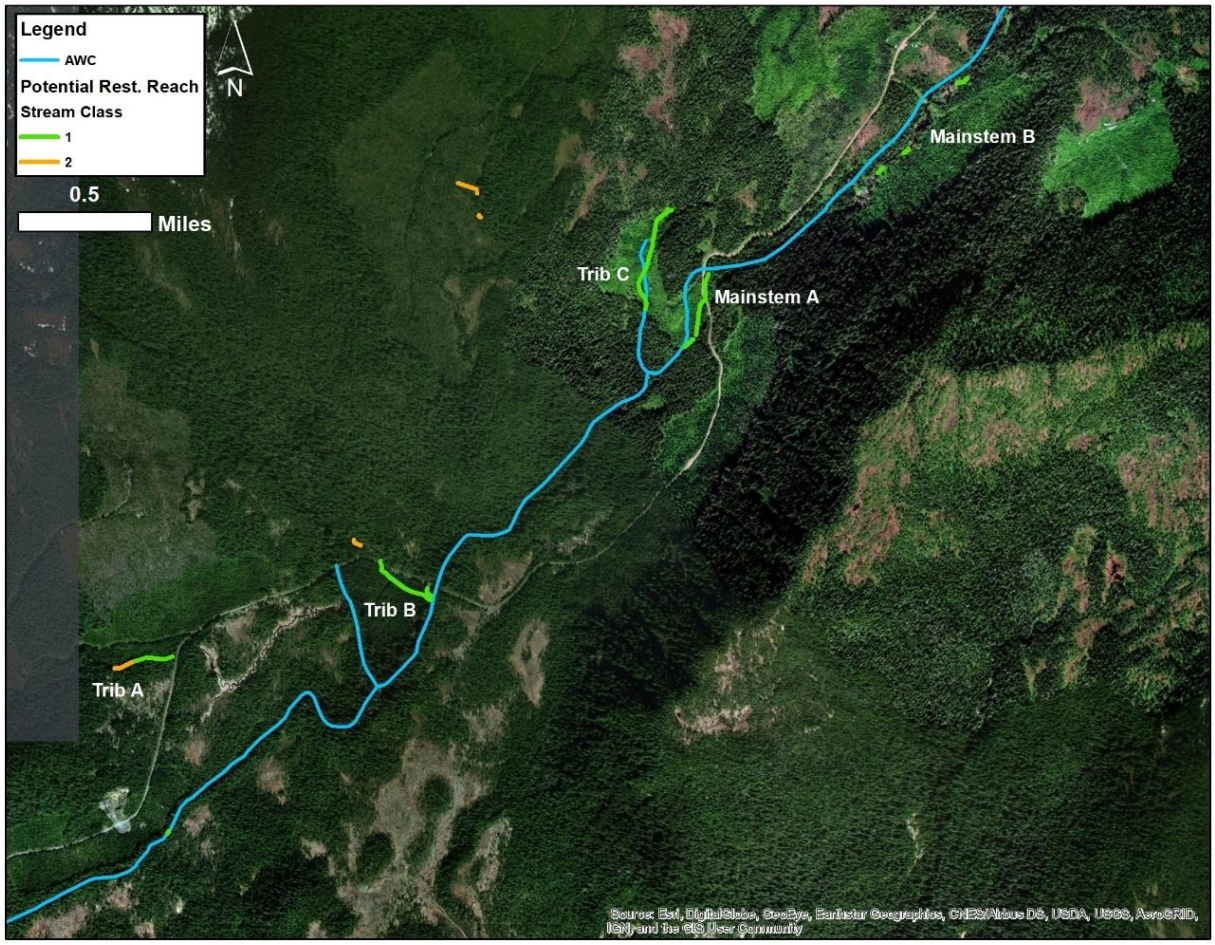


Figure 51. Potential hand tool restoration reaches in Class I and II streams in the Thoms Creek watershed on Wrangell Island that were visited in 2018.

Trib A is a high gradient contained (HCL) channel as determined by SWCA consultants in 2010 (Fig. 52). The stream reach has a bed width of about 6 feet and cobbles are the dominant substrate. The stream runs parallel to the edge of a harvest unit. Most of the old-growth trees within 25 feet of the channel were not cut. Large wood debris does not appear to play a role in pool formation due to the high gradient/incised nature of the channel and large size of the substrate.

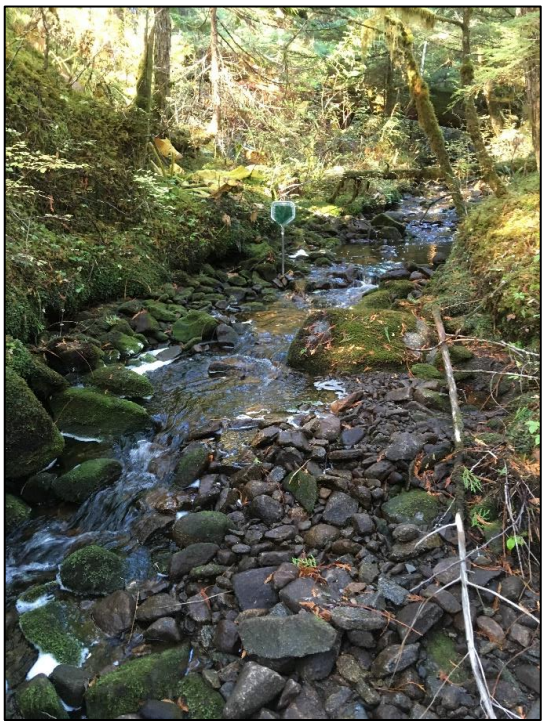


Figure 52. Tributary A in the Thoms Creek watershed.

Figure 53. Tributary B in the Thoms Creek watershed.

Trib B is a small floodplain channel with a bed width of about 4 feet (Fig. 53). Substrate is dominated by sand and silt. The riparian forest consists of numerous species of understory shrubs and a thinned stand of Sitka spruce up to 16" diameter at breast height (dbh). A juvenile Dolly Varden char was collected in this reach. The USFS has documented cutthroat trout, Dolly Varden char, and coho salmon in the stream. A 30 m long reach of this stream was surveyed using the SAWC Stream Credit Debit Methodology results can be obtained upon request. This stream reach deserves further investigation for restoration potential and feasibility.

Figure 54. Tributary C in the Thoms Creek watershed.

Trib C is a Class I stream in the upper Thoms Creek watershed (Fig. 54). The channel bed width is about 13 feet and the streambed is dominated by cobbles and boulders. The stream has a moderate gradient and step-pool channel morphology. Riparian vegetation consists of red alder and young-growth conifer which was thinned recently. Very little large wood was observed in the channel within the harvest unit. Due to the large substrate that dominates the stream bed, wood likely does not play an important role in habitat creation and sediment dynamics in this channel.

Mainstem A is a short reach of the Thoms Creek main channel that flows along the edge of a harvest unit. The Class I stream reach is bisected by a road. The channel upstream of the road has a moderate gradient and substrate is dominated by cobbles and gravels. Downstream of the road the channel is steep and passes through a bedrock canyon. No hand crew restoration opportunities were found in this reach.

The Mainstem B channel reach is a palustrine Class I channel located upstream of the Mainstem A reach (Fig. 55). There are at least 2 active beaver dams in this area. The riparian forest consists of open meadow and old-growth conifers on the west side and young-growth conifers on the east side. The beaver ponds appear to provide high quality fish habitat.

Figure 55. A beaver dam in the upper Thoms Creek main channel at the Mainstem B site.

Appendix I. Regional Examples of Improving Fish Passage

Many fish habitat improvement projects have successfully addressed red pipes throughout Southeast Alaska to improve and increase access to habitat for resident and migratory fish. These projects may be as simple as replacing a failing culvert, or as complex as reconstructing a stream's outlet to allow for unrestricted flow and safe passage.

In 2014, Takshanuk Watershed Council replaced a failing culvert on Cannery Creek, an anadromous stream that flows into Letnikof Cove near the community of Haines (Fig. 9). This culvert had become perched and damaged, only allowing fish passage at tides of 17.6 ft or greater, which is only about 14% of high tides. Replacement of this culvert at a proper height and gradient now allows for fish passage at regular stream flows and tidal intervals, making for improved habitat and a more productive stream.

Figure 9. The failing culvert was replaced with a 95" x 67", 60' long rolled aluminum pipe arch culvert. The culvert placement was lowered to allow for unimpeded fish passage. Photo courtesy of Takshanuk Watershed Council.

In 2018, the Southeast Alaska Watershed Coalition partnered with the US Forest Service and US Fish and Wildlife Service to remove a deteriorating concrete fish ladder at the outlet of Juneau's Picnic Creek at the Lena Point recreation site that held several barriers to safe passage of the stream's resident pink salmon population moving from ocean to stream (Fig. 10).

With the ladder removed, project partners improved a road crossing with a new wider footbridge, and reconstruct stream banks to allow for improved passage within the stream's natural flow patterns. The site now allows for full passage of fish species accessing the stream (Fig. 11).

Figure 10. The outlet of Picnic Creek near Juneau before

Figure 11. Picnic Creek fish passage before construction, during and after construction of fish passage improvements. The culvert and fish ladder are removed, and a wider footbridge is installed to allow for natural stream flow and fish passage. Image from SEALASKA (https://www.sealaska.com/news/item/2018-08-28/sealaska-restores-lena-beach-recreation-area-while-improving-juneau-salmon-run)