

# **Wilson Road Corridor Flooding:** **An Overview of the December 2020 Storm** **Event, Drainage History, and Recommended** **Future Flood Mitigation**

Todd Boris, PE  
53 Wilson Road, Gustavus, Alaska  
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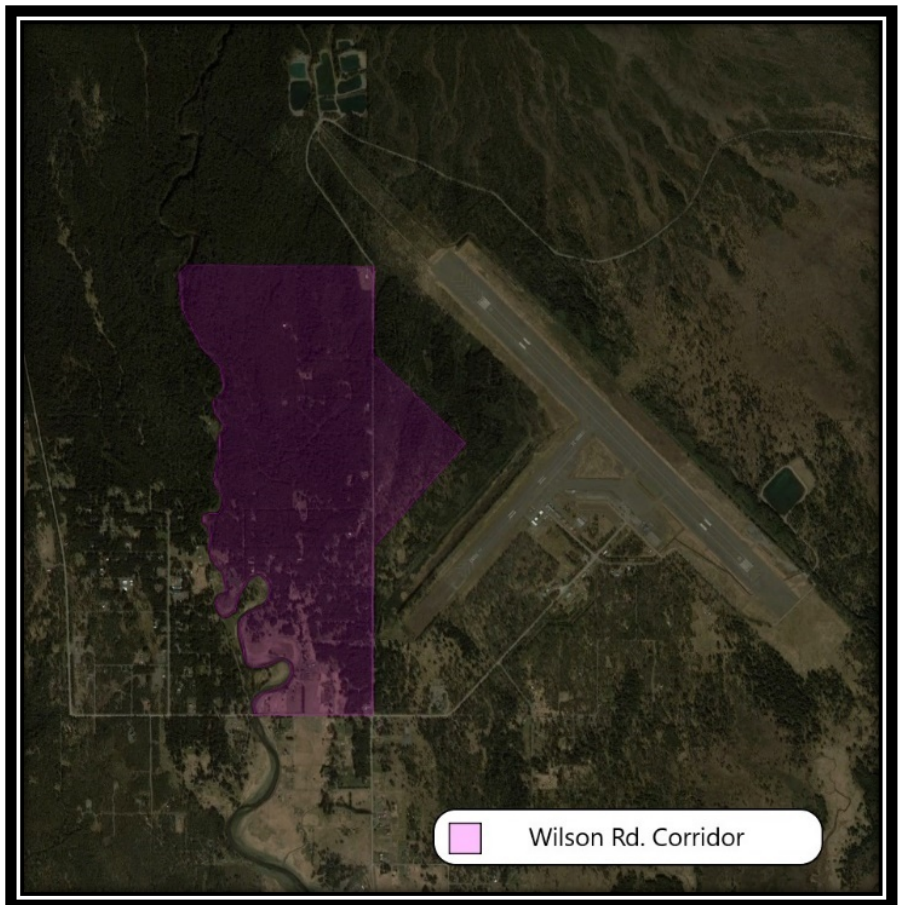
# 1. Introduction / Background

Gustavus, Alaska is located on a large outwash plain deposited as glaciers retreated up Glacier Bay. The terrain is uniquely flat for Southeast Alaska, with prolific forests of Sitka spruce where the deep soils are well drained. The area is also included in a temperate rain forest ecoregion known for its cool, wet climate. The relatively flat terrain combined with frequent and sometimes intense rainfall makes the area susceptible to overflow and flooding. For this reason, properly maintained drainage ways are paramount for the health, safety, and sustainability of the community.

The Wilson Road corridor is largely residential subdivisions bounded by the Alaska Department of Transportation’s airport to the east and north, the Salmon River to the west, and Gustavus Road to the south. Streets within in the corridor include:

- Faraway Road
- White Drive
- Parker Drive
- Harry Hall Drive
- River Bend Drive
- Chase Drive
- Icy Drive
- Jensen Road
- Hemlock Road
- Wilson Road

Flooding events have occurred within the Wilson Road corridor throughout the past few decades according to local witnesses. These events were mostly confined to flooding of Wilson Road, occurring approximately every ten years. However, the frequency, magnitude, and extent of these floods has notably increased within the past decade (substantial floods occurring in 2017, 2018, and 2020).



The frequency and severity of flooding has increased for residents within the Wilson Road corridor. This report offers a brief explanation of the flooding cause and offers solutions to mitigate flooding from future storm events.

# 2. Gustavus Airport East-Side Diversion

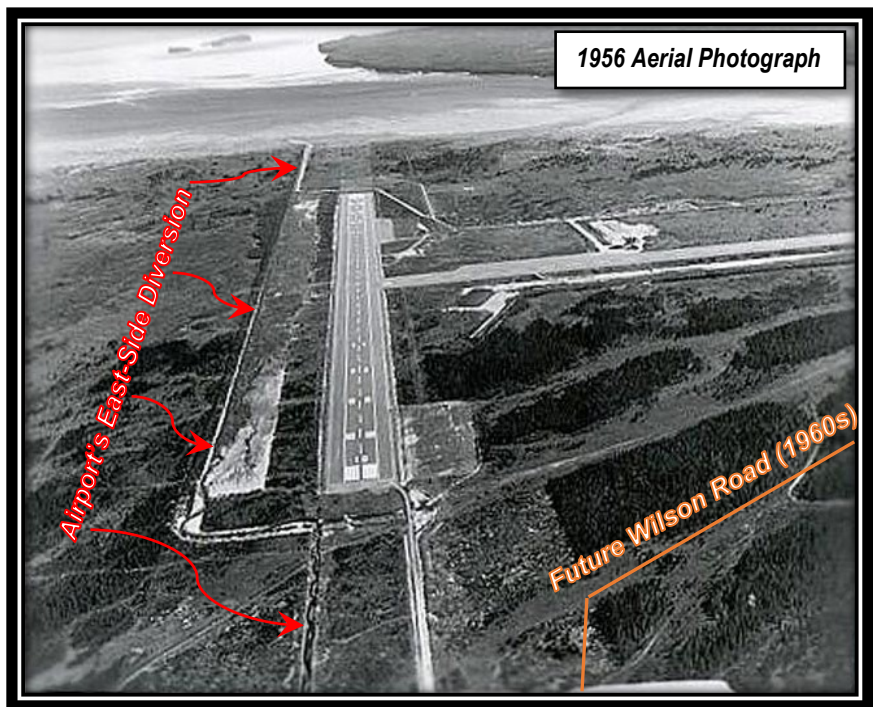
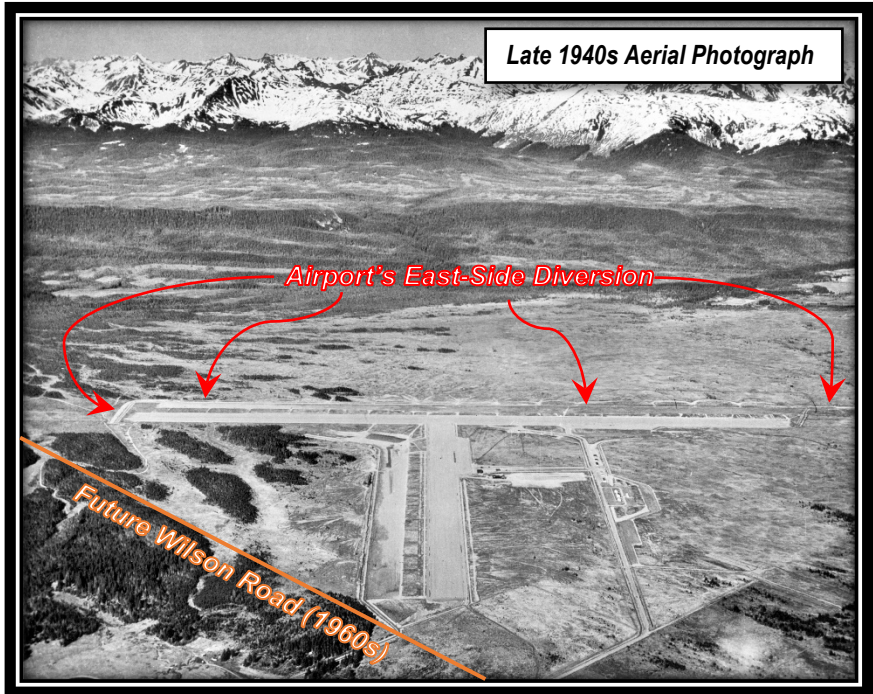
The Gustavus airfield was originally constructed by the United States Army in 1941 as part of the Aleutian campaign to aid in defending North America during World War II. After the campaign

ended, the military airfield was turned over and completed by the Civil Aeronautics Administration (CAA), which later became the Federal Aviation Administration (FAA). As a condition of statehood, Alaska became the airport's current owner in 1959. Throughout the lifespan of the Gustavus airport, numerous projects have upgraded, improved, and extended the facility's capacity.

During the original construction of the military airfield in the 1940s, three main diversions were constructed to drain the soil and protect airfield from flooding. The longest diversion was excavated from the north end of runway 11/29, along the east side of the runway until the diversion extended to tidelands to the southeast. The airport's east-side diversion would intercept, capture, and re-direct runoff and overflow originating from Excursion Ridge that would have otherwise flowed through the airfield on its way to the Salmon River. Controlling surface runoff through the east-side diversion not only protected the airport but would eventually allow development of the Wilson Road corridor.

Through the years, the military airfield was upgraded to a year-round airport for civilian aircraft. The airfield was raised above the surrounding terrain for additional flood protection and the gravel

runways and aprons were paved with asphalt concrete. The east-side airport diversion would also be extended beyond the north end of runway 11/29 to the present location of Gustavus' gravel pits, channeling additional surface water to tideland for further flood protection.





The Alaska Omnibus Act of 1959, which granted statehood to Alaska, required the FAA administrator to transfer to the state all airports constructed and operated by the FAA, including all land, buildings, structures, facilities, and equipment associated with the Gustavus airport. The new state balked at the requirement to take over the airports. Fearing the cost of operating the airports and the need for upgrades to handle jet aircraft, the state argued against assuming responsibility but ultimately failed to persuade the FAA.

In 1960, maintenance and operations of the Gustavus airport was begrudgingly transferred to the Alaska Department of Transportation (ADOT). Despite initial reluctance, the ADOT continued to improve the airport's capability by extending runway 11/29, adding a runway safety area, and constructing taxiways to improved general aviation aprons including hardstands for large jet aircraft. The latest improvement is scheduled to begin in the Spring of 2021. A contract awarded to SECON in the amount of \$20,212,680 will repave the airport and expand the general aviation apron including creation of new ditches within the airport campus.

In each of these improvements, the airport water diversions have largely been neglected. Maintenance to ensure the diversions worked properly has been repeatedly deferred. The water diversions have slowly come into a state of disrepair since ownership and operations was transferred to the ADOT. One long-time local Wilson Road corridor resident reports the east-side diversion has not been significantly maintained during his Gustavus tenure starting in 1974 – nearly 50 years ago. Costs associated with maintaining the water diversions along with the fact the airport is less prone to flooding because its elevation is higher than surrounding terrain most likely contribute to ADOT's reluctance (and potential negligence) in maintaining the water diversions.

The airport's east-side diversion has filled in through sedimentation since it was initially excavated. Alder and cottonwood trees now thrive on the diversion's banks. Willow bushes, sediment, fallen logs, and aquatic vegetation choke off the diversion's capacity and strangle the diversion's effectiveness to control water



flowing through the facility. A few photos of the airport's east-side diversion are presented as exhibits to the drainage facility's typical condition.

Witnesses reported the diversion intercepts, captures, and re-directs little, if any, of the runoff and overflow coming from the upland drainage. One witness reported a culvert crossing the diversion was partially full while Wilson Road flooded in 2018, highlighting the ineffectiveness of the diversion's current and poor condition. Stormwater bypassed the diversion and flowed uncontrolled; flooding the Wilson Road corridor.



In 2009, the ADOT's airport manager, Michael Pedersen, provided the ADOT information for an environmental impact assessment of an upcoming project at the Gustavus Airport. In the assessment published in 2011, the ADOT refers to the diversion as the "Stream" because of its association with providing habitat for anadromous fish.

*"The existing Stream alignment was excavated in 1940 and is primarily straight with two 90-degree bends. During summer months the Stream may dry and during the rainy season it can flood; however, stream level is most dependent on groundwater flows."* [emphasis added]

This excerpt from the project's environment assessment suggests the ADOT was aware of the diversion's potential to flood. More telling is the ADOT's reliance on airport manager's information which described prior flood events within the Wilson Road corridor.

*"This same Stream has repeatedly caused flooding adjacent and upstream of the airport. Flooding adjacent of the airport included water nearly overtopping the stream banks, and flooding upstream of the airport included overflowing Wilson Road (Pedersen, Personal Communication, 2009)."*

The airport manager's report included in the nearly ten-year-old ADOT environmental assessment provide insight about the airport's east-side diversion and the ADOT's neglect to perform important facility maintenance impacting adjacent public interests. The diversion's construction in the 1940s was documented, but the assessment is silent on whether subsequent maintenance work was performed. Any prior work performed on the anadromous fish "Stream" would likely have been

described in the assessment. A rationale conclusion would suggest any maintenance on the diversion occurred long enough in the past to have been forgotten by the ADOT or has not occurred at all.

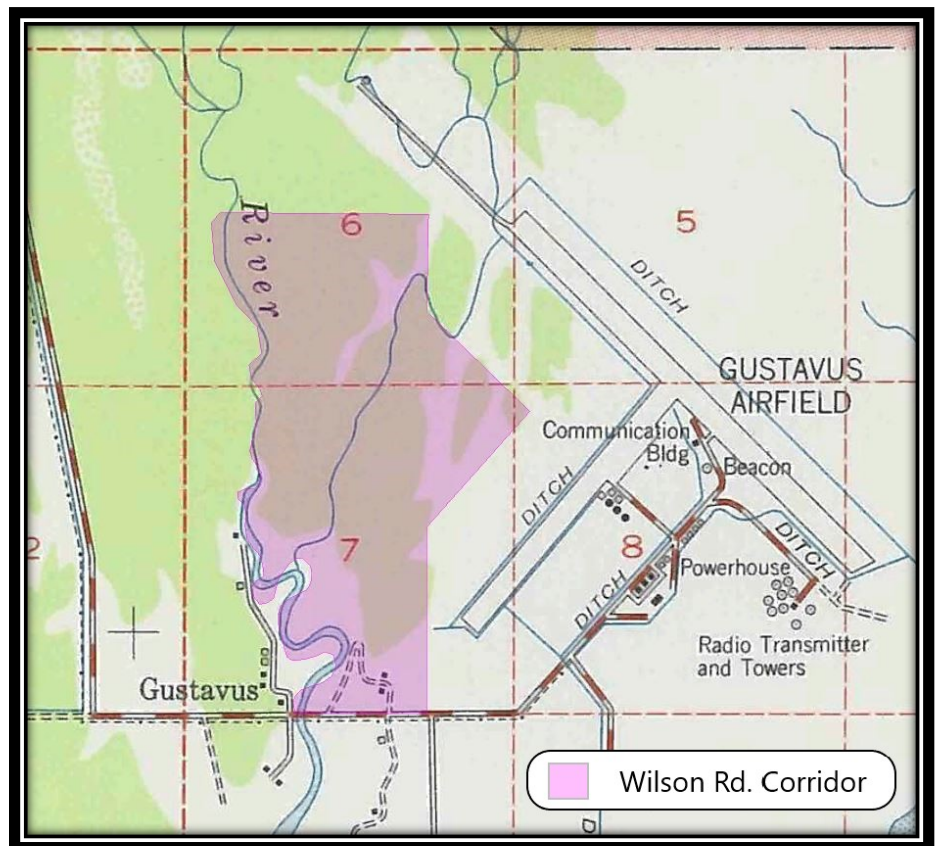
Fish habitat provided by the “Stream” is reliant on continually draining a ground water source. Lowering ground water is known to impact meadows and can alter dominate plant species in an area. Specific observed impacts of draining ground water from the area will be presented in the next section.

Flooding has occurred repeatedly along the Wilson Road corridor due to the “Stream” as explicitly stated in the environmental assessment. Unfortunately, the ADOT overlooked at least two recent opportunities to include maintenance of the airport’s east-side diversion in construction contracts awarded in 2011 and 2020.

### 3. Wilson Road Corridor Drainage Impacts

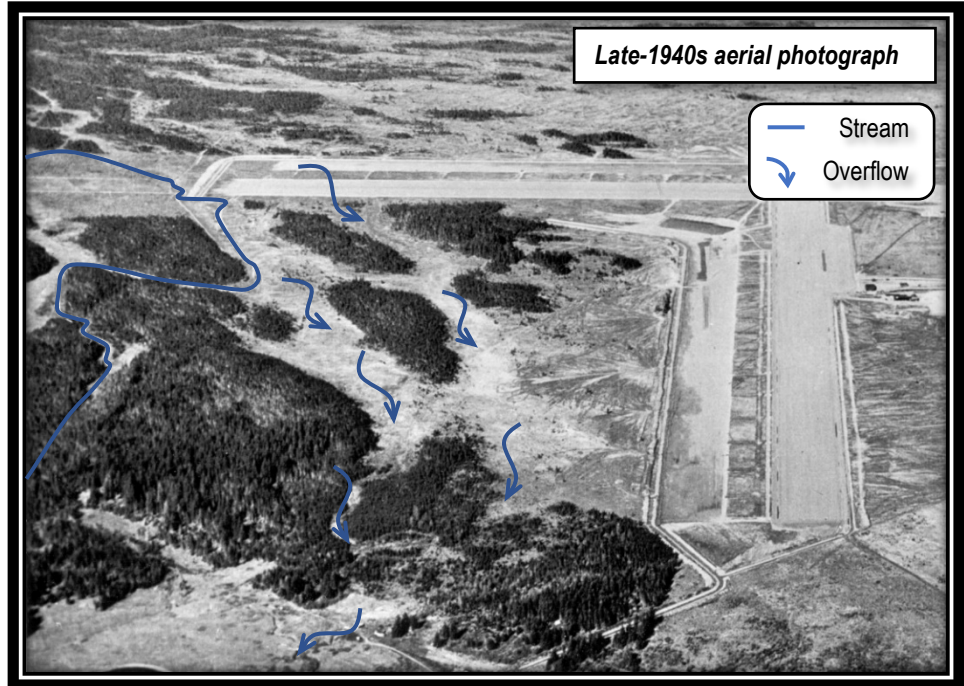
Before construction of the airfield, a stream crossed the northern end of runway 11/29 and meandered through the Wilson Road corridor before emptying into the Salmon River near the end of River Bend Road. Abundant meadows occurred in areas where native soils were too saturated by high ground water to support tree growth. These meadows acted as floodplains allowing runoff and overflow to flow nearly unimpeded into the Salmon River near the current location of Harry Hall Drive and Parker Drive, respectively.

Current United States Geological Survey (USGS) topography map Juneau B-6 is based on aerial photography taken in 1948 (shortly after the airfield’s construction). The map shows the historic stream traversing the Wilson Road corridor as a thin blue line while the meadows appear in white between the green forested areas.



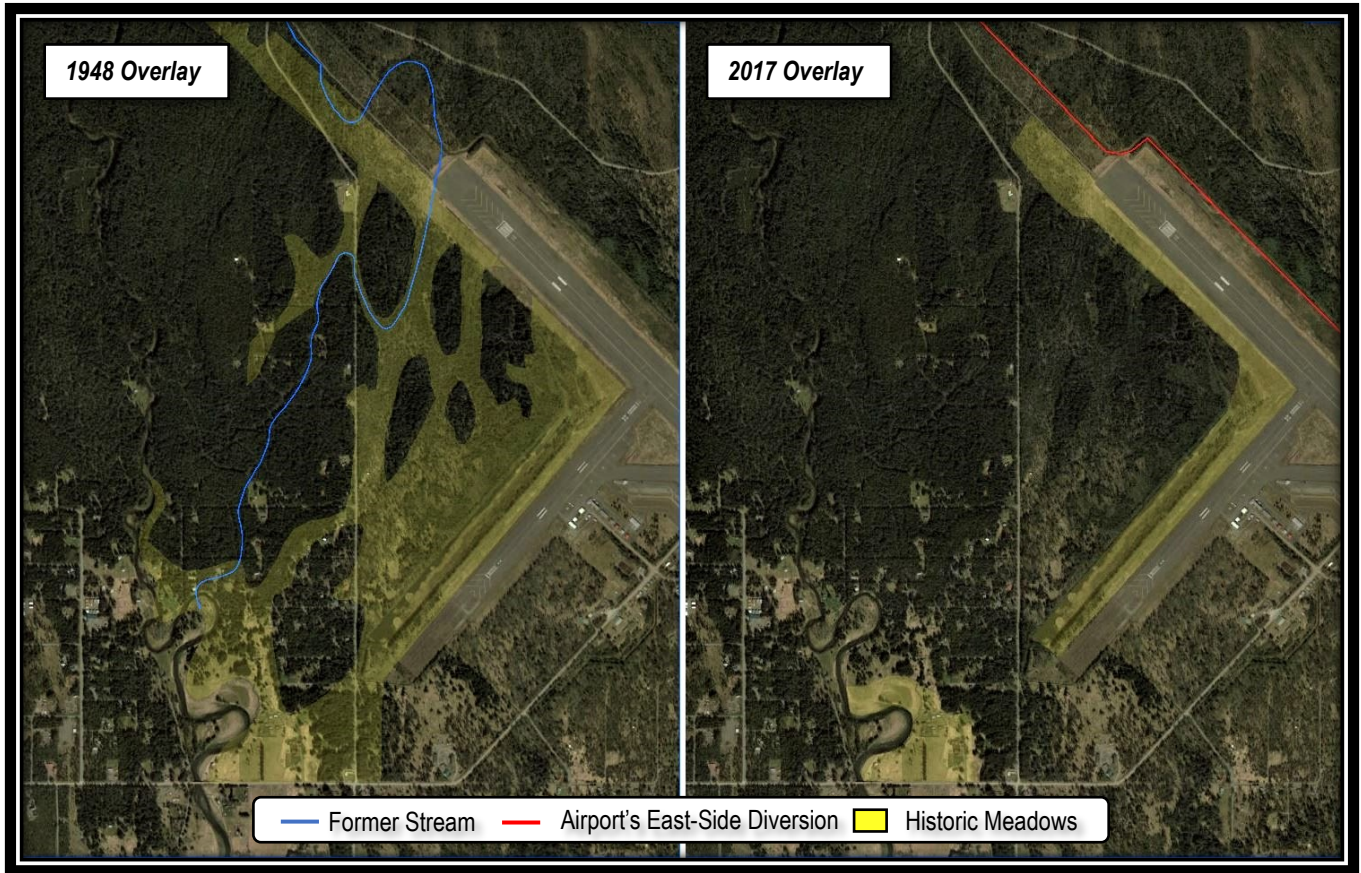


A late-1940s aerial photograph of the Gustavus airport also shows the stream and meadows prior to lengthening the east-side diversion. A blue line has been drawn on the photograph to highlight the stream's location. Blue arrows signify overflow through the meadows prior to the airfield construction.



Construction of the east-side drainage diversions changed the flow of water through the Wilson Road corridor. Ground water levels lowered and the stream that flowed into the Salmon River disappeared when the diversion was extended to the Gustavus gravel pits' current location. This change had profound impacts on dominate plant species, turning meadows (floodplains) into forests. Ultimately, the natural hydrogeomorphic features of the corridor would permanently change.

In the altered ecosystem, a thick forest of spruce, pine, and alder grew to fill the drainage within the corridor. Comparing the area's drainage features and vegetation in 1948 to 2017 displays the magnitude to which the diversion altered the area's landscape. Moss, trees, and eighty years of forest debris accumulation make the former stream channel indiscernible from the surrounding landscape. The prolific natural meadows have disappeared from the corridor except for the southernmost corner near the Salmon River.



Without the airport’s east-side diversion, development of the Wilson Road corridor may have turned out differently. The alteration of the ecosystem by drying out the land encouraged development of the area. The first roads in the Wilson Road corridor were haphazardly built and located by necessity to access the area’s timber. These logging roads were abandoned when Wilson Road was built in the 1960s. Other roads soon crisscrossed and subdivided the area to satisfy demands for residential development. This human activity further altered the landscape. In some places, former meadows (floodplains) were filled and the stream channel was leveled for homes, yards, and driveways. Nature’s response to a changed environment coupled with the scars of development have permanently destroyed the area’s hydraulic features to efficiently drain stormwater.

#### 4. December 2020 Storm Event

Flooding within the Wilson Road corridor has become an all-too-common occurrence, flooding three times (2017, 2018, and 2020) during the past four years. Each flood event originated with a Pacific storm typical for the temperate rainforest’s fall rainy season.

The 2017 flood covered Wilson Road and inundated adjacent properties and structures after 2.75 inches of rain fell on October 27th. Luckily, the 2017 storm had a relatively light punch, limiting the extent of the flood surge. Precipitation ended within three days allowing floodwater to recede and the area to dry out.



The severity of the next year’s flood event (2018) was a magnitude greater and more protracted. On October 15, 2018 after 3.67 inches of rain, Wilson Road once again became a conduit for floodwater and nearby properties were inundated. Storms continued moving over the area for the next nine days, pumping more moisture into the flooded system. Wilson Road was spared a repeat flood in 2019 due to a severe drought gripping the entire Southeast Alaska panhandle.

In days prior to the December 2020 storm event, weather forecasters warned of an atmospheric river that would train moisture over Southeast for multiple consecutive days. Around midnight on December 1, 2020 the event started. Areawide flooding enveloped the Wilson Road corridor the next day after rain gauges recorded 2.16 inches had accumulated within the prior 24 hours. The storm would not relent, unloading an additional 3.73 inches of rain on December 2nd. The flood surge eventually crested sometime during the early morning hours on December 3rd, but the storm continued to pump moisture into the watershed for an additional six days. At the height of the flood, residents located along Chase Drive and Hemlock Road reported the Salmon River elevation remained approximately eight feet lower than the flood level in adjacent neighborhoods, confirming the flood event was not caused by flooding of the Salmon River. As of the date of this report, flooding persists in parts of the Wilson Road corridor, 12 days since the rain started falling.

A trend is developing with each passing storm. The magnitude and severity of each recent flood event is more extensive and protracted than its predecessor. The 2020 storm event flooded properties that had not appreciably flooded in recent memory and caused damage that had not been witnessed before. However, the storm events associated with each of the recent floods were not particularly unusual for Gustavus. National Oceanic and Atmospheric Administration (NOAA) weather data for each significant storm event for the past 46 years is presented in Table 4.1 with observations provided by one long-time local resident.

| <i>Period</i>         | <i>Precipitation Amount</i> | <i>Duration</i> | <i>Intensity</i> | <i>Observation</i> |
|-----------------------|-----------------------------|-----------------|------------------|--------------------|
| <b>October, 1978</b>  | 11.47”                      | 15 days         | 1.86”/day        | Flooding           |
| <b>October, 1979</b>  | 9.71”                       | 4 days          | 3.71”/day        | No Flooding        |
| <b>January, 1984</b>  | 3.76”                       | 1 day           | 3.76”/day        | No Flooding        |
| <b>February, 1988</b> | 3.87”                       | 2 days          | 1.99”/day        | Flooding           |
| <b>November, 1988</b> | 3.77”                       | 2 days          | 2.17”/day        | No Flooding        |
| <b>October, 1994</b>  | 5.41”                       | 2 days          | 4.05”/day        | Flooding           |
| <b>October, 1998</b>  | 5.86”                       | 5 days          | 1.97”/day        | No Flooding        |
| <b>December, 1999</b> | 4.76”                       | 2 days          | 3.10”/day        | No Flooding        |
| <b>November, 2005</b> | 10.59”                      | 8 days          | 2.17”/day        | No Flooding        |
| <b>October, 2017</b>  | 3.65”                       | 2 days          | 2.75”/day        | Flooding           |
| <b>October 2018</b>   | 4.86”                       | 2 days          | 3.67”/day        | Flooding           |
| <b>December, 2020</b> | 7.35”                       | 3 days          | 3.73”/day        | Flooding           |

The watershed seems to have accommodated similar-sized storms better a few decades ago than at present time. The October 1979 storm event compares well with the December 2020 event in regard to rainfall intensity, duration, and total precipitation produced, yet the 1979 season did not produce flooding on Wilson Road. Furthermore, the January 1984 and December 1999 storms had very similar rainfall intensity compared to the December 2020 storm and flooding was not caused by these storms either.

Prior to 2017, flooding occurred about every 14 years and was caused by 1) intense rainfall rates around 4.00 inches per day, 2) repeated storm events on well saturated soils, or 3) rain combined with snow melt over frozen ground. Recent floods (2017, 2018, and 2020) demonstrated that Wilson Road can be flooded with a little over two inches of rain within a 24-hour period. These floods have also been reoccurring on a nearly one-year cycle.





## 5. Flooding – Nature’s Attempt to Re-establish Waterways

The December 2020 storm event indicates the airport’s east-side diversion was no longer capable of diverting stormwater. Unable to flow down the diversion, water overran the Wilson Road/Rink Creek culvert. Like numerous prior floods, stormwater flowed uncontrolled down Wilson Road, but this event was different. Floodwater had far reaching impacts on parts of the Wilson Road corridor that have not been appreciably flooded in recent memory.

Water collecting in the upper reaches of the watershed flowed directly south through unsullied natural meadows toward the gravel pits at Wilson Road/Rink Creek Road. Prior to the airfield’s construction, stormwater would have drained into the former stream with excess flowing through meadows until eventually reaching the Salmon River.

Shortly after construction, the airport’s east-side diversion likely captured and redirected floodwater safely around the airport’s perimeter. NOAA weather data suggests a series of intense storms throughout the 1940s would have tested the diversion’s effectiveness. Photos from 1948 of the airport’s southwest diversion (paralleling present-day Faraway Drive) show water draining from the airport campus and erosion caused by high flow periods.

Through time and neglect, the diversion would gradually loose





effectiveness. Only the largest storms would overwhelm the diversion at first. The ensuing floods would be modest by today's standards. Progressively more water would end up escaping the diversion as its capacity diminished. Flooding within the Wilson Road corridor would progressively worsen in response.

Today, stormwater backs up in the diversion, spills out, and begins to reestablish its path to the Salmon River. However, an altered ecosystem presents an obstacle to the water's historic path. The



The former stream bed and meadows are no longer the floodwater's preference. Wilson Road presents a clear, smooth, and nearly straight path for the water to flow. Since Wilson Road does not intercept the Salmon River, floodwater branches down each subdivision road in its quest to find the river, filling remnants of its former meadows (floodplains) and stream bed in the process. Some of the floodwater finds the river near River Bend Drive, Parker Drive, and Faraway Drive. The remaining floodwater enters an area excavated for the airfield's construction (the duck ponds) then flows around the airport's southwest corner, eventually emptying into Glen's Ditch.

During the December 2020 storm event, floodwater entered its former meadows and the old stream bed but backwatered without an unobstructed path to an outlet. Emergent forests within the former meadows (floodplains) and development over the old stream bed left floodwater no direct means into the Salmon River. Water was reported 10-inches deep and flowing south at six knots on Wilson Road during the height of the flood. Homes and property occupying the former meadows and stream bed were inundated with floodwater up to three feet in depth. Property owners throughout the Wilson Road corridor reported floodwater entering structures, overtaking wells, and swamping septic systems and electric transformers. Parked vehicles near the end of Jensen Road and along Hemlock Road were partially submerged by floodwater.

The floodwater eventually found ways to drain. Near the old stream's prior outlet at River Bend Drive, floodwater carved a new eight-foot-deep channel to vent water into the Salmon River. Homes and driveways were also damaged near the end of Parker Drive, which historically served as a pathway to drain upstream meadows (floodplains) into the Salmon River. The remaining water flooded areas south of the airport before draining into Glen's Ditch.

Reported flood damage noted on an aerial photograph overlain with historic hydraulic features such as the former stream and meadows (floodplains) can be found in Appendix B with references to specific flood observations.

## 6. Mitigating Future Storm Flooding

Climate change may be responsible for creating more frequent and intense storms, but is not likely a significant contributor to hydrogeomorphic changes within the Wilson Road corridor. The airport's unmaintained east-side diversion is the likely the chief culprit exacerbating the watershed's response to intense, rain soaking storms. The diversion significantly altered the flow of surface and ground water sources, converting meadows and streams within the corridor into forests and developable land for the community. Through years of neglect, the diversion's disrepair is allowing surface water sources to reenter an altered environment in which drainage paths are no longer apparent.

To mitigate the effects of future storm events, two principal strategies should be implemented: 1) maintain current defenses; and 2) harden defenses with new countermeasures. Procrastination and deferring solutions will undoubtedly continue to damage the Wilson Road corridor physically and economically including City of Gustavus infrastructure (i.e., roads, culverts, and bridges), small businesses, and private residences. For this reason, a multipronged approach with a suite of options is presented in this report including maintaining the east-side airport diversion and maintaining or improving Wilson Road drainage.

### *Strategy 1 – Maintain the Current Airport East-Side Diversion*

Imagine if Gustavus' airport, ferry terminal, and roads had not been maintained for 80 years. These facilities would likely be unusable and have reverted back to a semi-natural state. This is the scenario playing out with the airport's east-side diversion. Sedimentation has allowed trees, brush, and aquatic plants to fill the diversion's channel and prevent water from flowing to tidelands.

The airport's east-side diversion has been the Wilson Road corridor's chief line of defense since originally constructed. Nearly all of the diversion is located on airport property with maintenance the responsibility of the ADOT. Instead of maintaining the diversion, the ADOT has opted to raise and extend the airport above the adjacent meadows to mitigate its flood risk. In doing so, the ADOT created a large earthen dike preventing surface water flow through the meadows (floodplains). The northern end of runway 11/29 effectively creates a bow wake in surface water flow, concentrating flow toward Wilson Road.

Maintaining this current defense is an obvious and paramount strategy, but the ADOT has shown a reluctance to do so by opting to protect its physical infrastructure asset at the cost of the community it serves. In each of the last two airport projects (one is currently under an active construction contract), the ADOT was informed by its own managers and engineers of the diversion's condition and contribution to flooding Wilson Road. The ADOT overlooked addressing the problem in each instance. Speculatively, concentrations of Per- and Polyfluoroalkyl Substances (PFAS) in the groundwater at Gustavus Airport may be contributing to the ADOT's current reluctance, but these

substances have yet to be detected on the airport’s northeast side. The ADOT’s current airport contractor cleared and disturbed soils on approximately 18 acres at the north end of runway 11/29 without using specialized construction techniques for handling contaminated materials, suggesting the area is free of PFAS contamination. Nevertheless, testing for PFAS along the east-side diversion would remedy concerns whether soils in the diversion are polluted.

If the City of Gustavus believes maintaining current flood defenses are necessary, then the city council should encourage the ADOT to maintain the east-side diversion. Engaging Governor Dunleavy, Representative Sara Hannan, Senator Jesse Kiehl, and the ADOT’s Commissioner John MacKinnon is likely necessary to resolve the stalemate.

*Strategy 2 – Maintain Wilson Road Drainage*

Wilson Road was built nearly level with the adjacent landscape and with little consideration for drainage other than roadway crown. Puddles form along the road’s periphery even during light to modest rainfall. Ditches were later excavated for about a half mile on the road’s southern portion.

Reportedly after the 1988 flood, one local resident excavated a ditch along the east side of Wilson Road due to concerns regarding his own property being inundated at the corner of Wilson Road and Chase Drive. This ditch drains Wilson Road from its corner with Chase Drive to the duck ponds on airport property. Another, much shorter, ditch was excavated on the west side of Wilson Road in the late 1990s adjacent to a property at the corner of Wilson Road and Chase Drive. A small culvert was installed at the time to link the east and west ditches.

Whether these ditches were sanctioned or not at the time they were originally excavated became moot when the City of Gustavus incorporated in 2004 and took ownership of Wilson Road’s right-of-way. The City now owns these drainage facilities and is responsible for their maintenance.

The ditches seem to improve drainage along Wilson Road during light to moderate surface runoff, but become overwhelmed during flooding events due to its small capacity. However, the benefit of the east-side ditch to help recede floodwater is shown in the photo taken at the Wilson Road/Chase Drive intersection. Unfortunately, the west-side ditch is not as effective (also shown in the photo). The culvert under Wilson Road near Chase Drive had either been



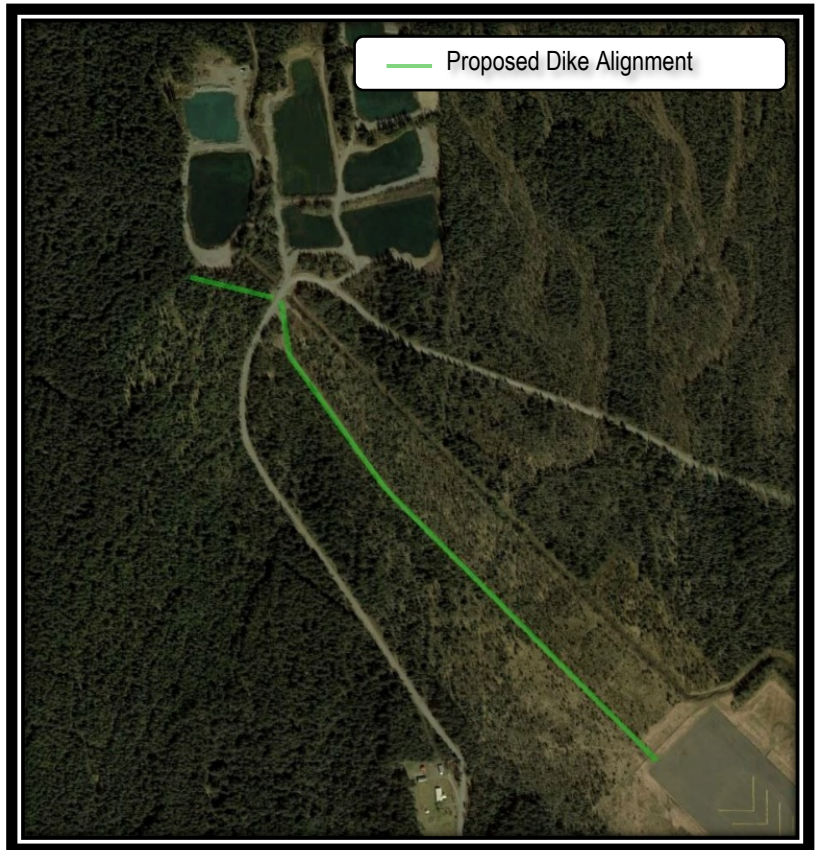


crushed, severed, or both due to its shallow burial. In the December 2020 storm event, hydrostatic pressure from the west-side ditch liquified Wilson Road’s surface course material near the culvert’s severed outlet, blowing out a hole in Wilson Road as a result. A larger deeper buried culvert and clearing obstructions (mostly roadway surface coarse material) from both ditches would likely mitigate some flood risk and damage by draining the roadway and adjacent properties faster.

If interested, the City of Gustavus may be able to leverage State of Alaska emergency funds to repair road damage caused by the December 2020 storm event including replacing the failed culvert that welled up through Wilson Road and excavating flood debris and sedimentation from adjacent ditches.

*Strategy 3 – Create a Hydraulic Dike*

By raising and lengthening runway 11/29 above the surrounding meadows, the ADOT created a nearly two-mile-long dike. Water that would attempt escaping the airport’s east-side diversion would be held in place by the raised runway. A dike raised above the height of the existing landscape connecting runway 11/29’s northern end to a natural rise southwest of the gravel pits would have the same effect. Stormwater would be confined to the diversion and longer be allowed to escape down Wilson Road. Focusing flow through the diversion would likely aid in keeping the diversion clear of sedimentation.



A barrier intended to strengthen flood defenses would prevent surface water from entering the Wilson Road corridor from upstream meadows (floodplains). Portions of the airport’s existing 0.6-mile-long northern service road in proximity to the Wilson Road/Rink Creek culvert could be raised to match the roadway’s crest elevation above the culvert. By tying in the service road in near the culvert, flow would aid in scouring out sedimentation that would threaten to the culvert’s capacity to move water.

To ensure water does not bypass the raised service road on the northwest side of Wilson Road, a new 500 to 700 ft long dike would need to be built. The material necessary to construct this dike would best be comprised of siltier material to stabilize the embankment and prevent water piping through the dike. Silty surface material generally set aside and wasted for gravel pit development could be an

ideal material source for an embankment controlling and holding back the water. Further investigation and field study would be necessary to develop this strategy.

Authorization from the ADOT would be necessary to raise the airport's existing northern service road and construct a new dike since this work would occur on airport property. If the City of Gustavus is interested in pursuing this flood defense countermeasure, a formal request should be made to the ADOT commissioner. The City of Gustavus may also wish to elicit help from its gubernatorial and legislative representation to help the State of Alaska prioritize this pursuit. Again, State of Alaska emergency funds may be available considering the work is related to damage caused by the December 2020 storm event.

Raising Wilson Road would be a similar concept, but the increase in work scope, materials, and costs make this pursuit much less attractive. Floodwater would be confined to the east side of Wilson Road and toward the airport's southwest corner. An improved drainage path would be necessary either through Glen's Ditch to tidewater or parallel to Faraway Drive to the Salmon River. The airport's southwest corner has tested for high concentrations of PFAS in nearby surface and ground water. Special techniques for excavating and handling toxic soils would be necessary and likely cost prohibitive. For this reason, the raising Wilson Road is mentioned as an alternative, but not recommended for additional investigation at this time.

#### *Strategy 4 – Extend Ditches Along Wilson Road*

The ditches along on the southern portion of Wilson Road benefit floodwater recession. Plus, flood damage may have been more severe if the ditches were not present to partially channel and control floodwater. However, these ditches are far too small to completely mitigate the extent of flooding impacts within the corridor. Extending ditches along Wilson Road would marginally benefit stormwater inundation of the roadway by providing an adjacent channel for floodwater to flow rather than the roadway itself. Ditches along Wilson Road would benefit property owners by providing floodwater a path to discharge from the area more quickly when flood recession occurs. This would have the effect of lessening the duration of a flood event. City of Gustavus roads would not sustain as much damage either.

If interested, the City of Gustavus may be able to leverage State of Alaska emergency funds as part of a broader plan to prevent future flood emergencies.

Each of the aforementioned strategies serves to mitigate future flood damage within the Wilson Road corridor. Strategy 1 and 2 focus on resolving decades-long deferred maintenance on existing drainages that have served the Wilson Road corridor for decades. Strategy 3, creates a hydraulic dike and may be the best low-cost solution to end floods within the corridor. Strategy 4, extending Wilson Road's ditches, has been discussed by the City of Gustavus and should continue to be pursued to facilitate floodwater recession. The best permanent solution is to plan and phase a combination of all four strategies.

## Appendices

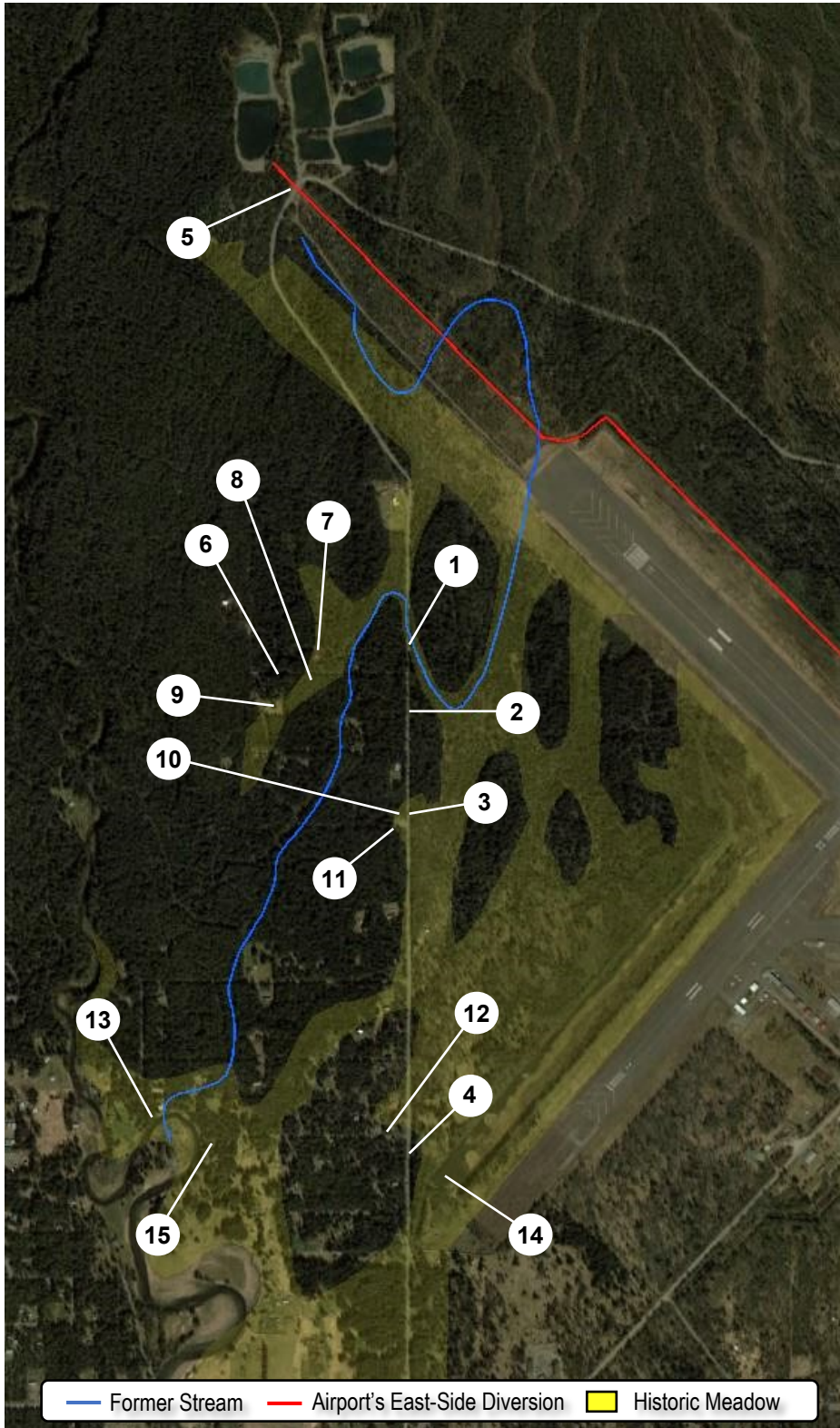
### ***Appendix A – The Author***

Todd Boris is a professional civil engineer (Alaska license AELC10809) with 21 years of experience designing and constructing hydraulic structures such as bridges and culverts in throughout Alaska. He earned his Bachelor of Science degree in civil engineering with an emphasis in structural engineering from North Dakota State University – Fargo, North Dakota in 1997 and a Master of Science degree in civil engineering with an emphasis in structural engineering from Iowa State University – Ames, Iowa in 1999.

For full disclosure, Todd currently practices engineering at the Alaska Department of Transportation, Southcoast Region but has authored this report on his personal behalf. Todd is not representing the views of the State of Alaska nor the Alaska Department of Transportation on this matter.



### Appendix B – December 2020 Storm Observations



1. Wilson Road Flooding near Hemlock Road
2. Wilson Road flooding near Jensen Road
3. Wilson Road flooding near Chase Drive
4. Wilson Road damage near Dock Ponds Trail
5. Wilson Road flooding near the gravel pits
6. Flooding on Hemlock Road
7. Flooded home on Hemlock Road
8. Flooded home and vehicles on Hemlock Road
9. Flooded home on Hemlock Road
10. Flooded home on Wilson Road
11. Chase Drive flooding
12. Home flooded on Parker Drive
13. Erosion near home on River Bend Drive
14. Flooded duck ponds near Wilson Road
15. Washed out driveway on Parker Drive





*Figure 1 - Wilson Road Flooding near Hemlock Road (December 2020)*



*Figure 2 - Wilson Road Flooding near Jensen Road (December 2020)*



*Figure 3 - Wilson Road Flooding Near Chase Drive (December 2020)*



*Figure 4 - Wilson Road Damage Near Dock Ponds Trail (December 2020)*



*Figure 5 - Wilson Road Flooding Near Gravel Pits (October 2018)*



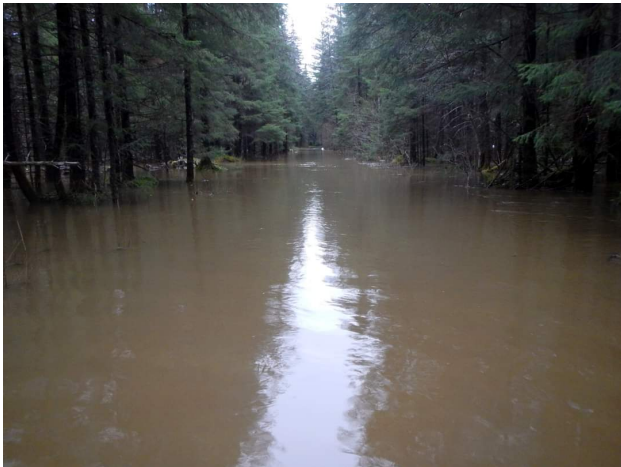


Figure 6 - Flooding on Hemlock Road (December 2020)



Figure 7 - Flooded Home on Hemlock Road (December 2020)



Figure 8 - Flooded Home and Vehicles on Hemlock Road (December 2020)



Figure 9 - Flooded Home on Hemlock Road (December 2020)



Figure 10 - Flooded Home on Wilson Road (December 2020)



Figure 11 - Chase Driveway Flooding (December 2020)





*Figure 12 - Home flooded on Parker Drive*



*Figure 13 - Erosion near home on River Bend Drive*



*Figure 14 - Flooded duck ponds near Wilson Road*



*Figure 15 - Washed out driveway on Parker Drive*