SUMMARY REPORT
Low-Impact Development (LID) Planning for the City of Homer

June 25, 2020

Prepared For:

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ALASKA

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This project has been funded wholly or in part by the United States EPA under assistance agreement number 00J84604 to the Department of Environmental Conservation through the Alaska Clean Water Actions (ACWA) program. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial product mentioned in this document.

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Executive Summary

This document provides a planning level review of the potential benefits of integrating green infrastructure or Low-Impact Development (LID) controls into future City of Homer stormwater drainage master plans and site development regulations.

Low-Impact Development includes a variety of controls or practices that mimic natural drainage processes to manage stormwater on the individual lot level. These LID controls typically retain rain water on-site where it can slowly be released or infiltrate into the ground rather than allowing peak runoff to enter directly into storm drains which could potentially contribute to flooding and pollution problems.

Historically, as cities and their surrounding areas grow in population and urbanize, a corresponding increase in pollutants are found at storm drain outfalls. City storm drain systems developed under traditional scenarios must often correct these issues by the addition of large oil-grit separators, storm drain pipes, detention systems, and/or sedimentation basins to remove the sediments that convey the pollutants. These systems are typically more expensive and less effective at cleaning water than LID controls.

The rough order-of-magnitude estimates developed for this study indicate that there would be a positive economic benefit to City of Homer tax payers should LID practices be required as part of new site development. LID is also environmentally friendly. Green infrastructure is designed to filter out contaminants before they reach the receiving waters (in this case Kachemak Bay) in a more cost effective manner than traditionally developed storm drain infrastructure.

Introduction

The City of Homer was awarded an Alaska Clean Water Action (ACWA) Grant by the Alaska Department of Environmental Conservation (ADEC) to study the benefits of integrating green infrastructure referred to in this report as Low-Impact Development (LID) techniques into a stormwater drainage master plan. Low-Impact Development capitalizes on the natural process of water filtration, retention and dispersal in order to control stormwater runoff in an environmentally friendly manner. Low-Impact Development practices include bioswales, bio-retention basins, permeable pavements and rain gardens.

LID techniques can reduce peak flows, thus reducing the size and cost of traditional storm drain systems and the cost of water quality treatment controls.

This project is an initial step for the City of Homer toward stewardship planning and pollution prevention regarding the area's valuable receiving waters. As community growth and development is expected to increase in Homer, implementing a plan that safeguards the area's valuable waterways has become an increasingly important issue.

This summary report covers the first three ADEC Grant project tasks summarized below:

- **Task 1 – Basin Delineation.** This task identifies the major watershed drainage basins in or adjacent to the City of Homer.
- **Task 2 – Estimate Future Runoff Volumes.** This task estimates the future runoff volumes per drainage basin for a scenario in which all properties within the drainage basins are fully developed according to their existing land use zoning.
- **Task 3 – Low Impact Development.** This task estimates the cost to implement a storm drain system with LID, then compares it to the cost of the traditional development storm drain system from Task 2. A green infrastructure demonstration project will also be constructed at the new police department as part of this task.

Task 1 - Basin Delineation

To measure the extent of Homer's stormwater infrastructure needs, the first requirement is to define and delineate drainage basins in the area. This is accomplished using techniques within a Geographic Information System (GIS) where individual basins are identified by hydro-analysis of a digital elevation model (DEM) of the Homer area. Elevation and slope characteristics determine stream locations and associated outlets, thus refining the delineation of individual basins. Basins partially or wholly outside city limits have also been delineated but only those portions that directly contribute to runoff volume within the City will be evaluated for this project. The Homer Spit was not included in this basin delineation effort because the flat topography produces numerous small basis that have relatively low runoff volumes.

Additional refinement of the basins was performed to aggregate smaller basins around defined USGS stream flow lines which represent the historical flow paths and low point of the basins. This aggregation work step simplified the basins for this planning level analysis. Typically as an area urbanizes, these stream flow lines become the location were storm drain mainlines are installed. Each basins perimeter was also evaluated relative to the location of existing storm drain systems and culverts to make sure there were no overlap between these two features as a quality control step to properly define the basin areas.

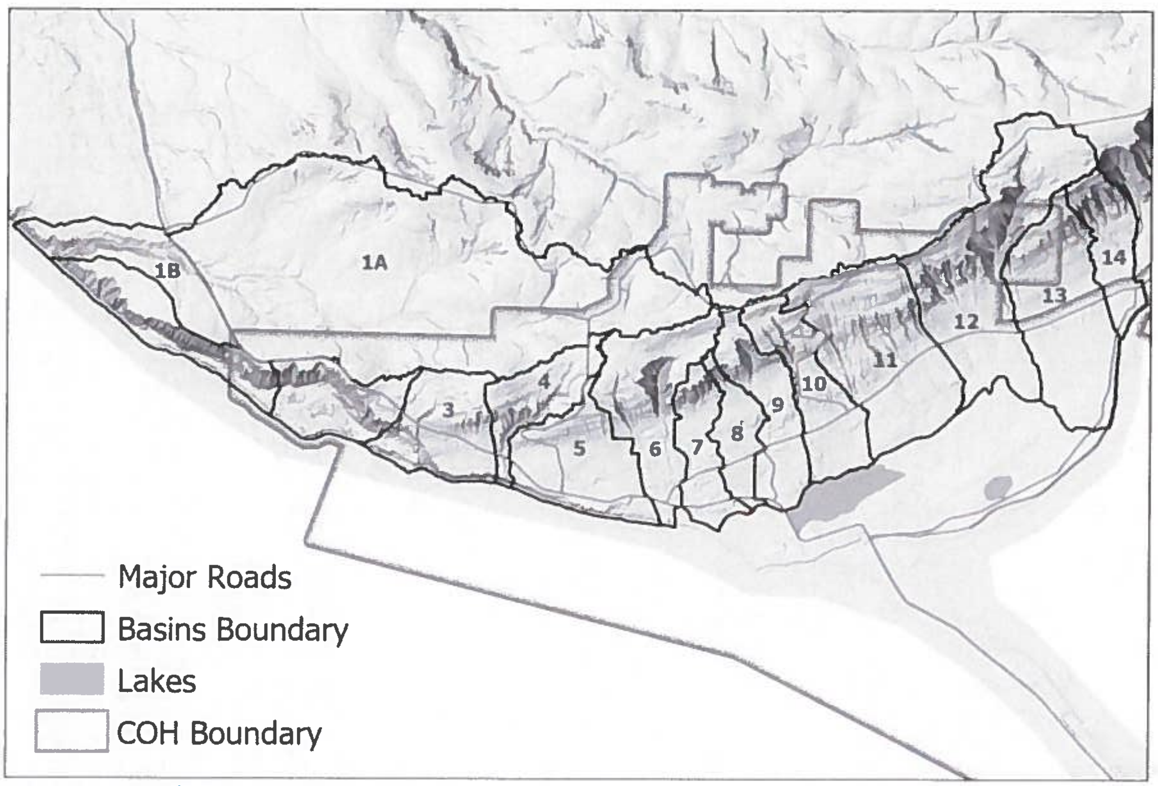


Figure 1 – City of Homer Drainage Basins

Table 1 below summarizes the basin areas developed for this planning study.

Table 1 - City of Homer Drainage Basin Areas

Basin	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13	14
Area (Acres)	3,483	436	402	483	329	560	616	307	229	422	475	930	1,145	827	320

Task 2 - Estimate Future Runoff Volumes

Natural Resources Conservation Service (NRCS) TR-55 hydrology methods were used to develop runoff volumes and peak flow rates for each basin defined in Task 1. We examined a future scenario where the feasibly developable properties within the City of Homer are fully developed according to their existing land use zoning. The NRCS TR-55 hydrology method requires data to define each basin by its runoff curve number, time of concentration, and drainage channel reaches.

Appendix A contains summary tables that show the data used and calculated for each basin. The sections below describe the general concepts and methods used to collect and calculate the basin characteristics. The runoff volume and flow rate results will be used to estimate the costs to convey and treat stormwater both with and without LID for each basin.

A. Impermeable Surfaces

Impervious surfaces are ground surfaces that are impenetrable to water. In urban and semi-urban areas, impermeable surfaces such as roads, parking lots, sidewalks and roofs prevent storm-water from being absorbed into the ground - as would naturally occur in an undeveloped setting. This results in faster runoff and higher peak runoff rates. For this project we calculated the area of existing impervious surfaces per drainage basin to establish a baseline for future studies and to verify that the future development planning scenario used a higher impervious percentage than the existing condition.

To determine which parts of the existing ground are pervious and impervious, we used a color infrared imagery dataset (CIR) produced for the City of Homer by GeoNorth Information Systems using 2017 satellite Worldview imagery. The CIR imagery was the primary image dataset used in conjunction with a 16-bit true color image dataset derived from the Worldview satellite image which gave more depth in color to check classifications, e.g. pervious beach gravel versus impervious road pavement.

Five pixel classes were defined from the satellite CIR image, each correlating to varying saturation of land types by water and reflecting light. From the five pixel classes one class was identified and designated to represent impervious surfaces. This pixel class was analyzed in GIS to quantify all impervious areas within each drainage basin.

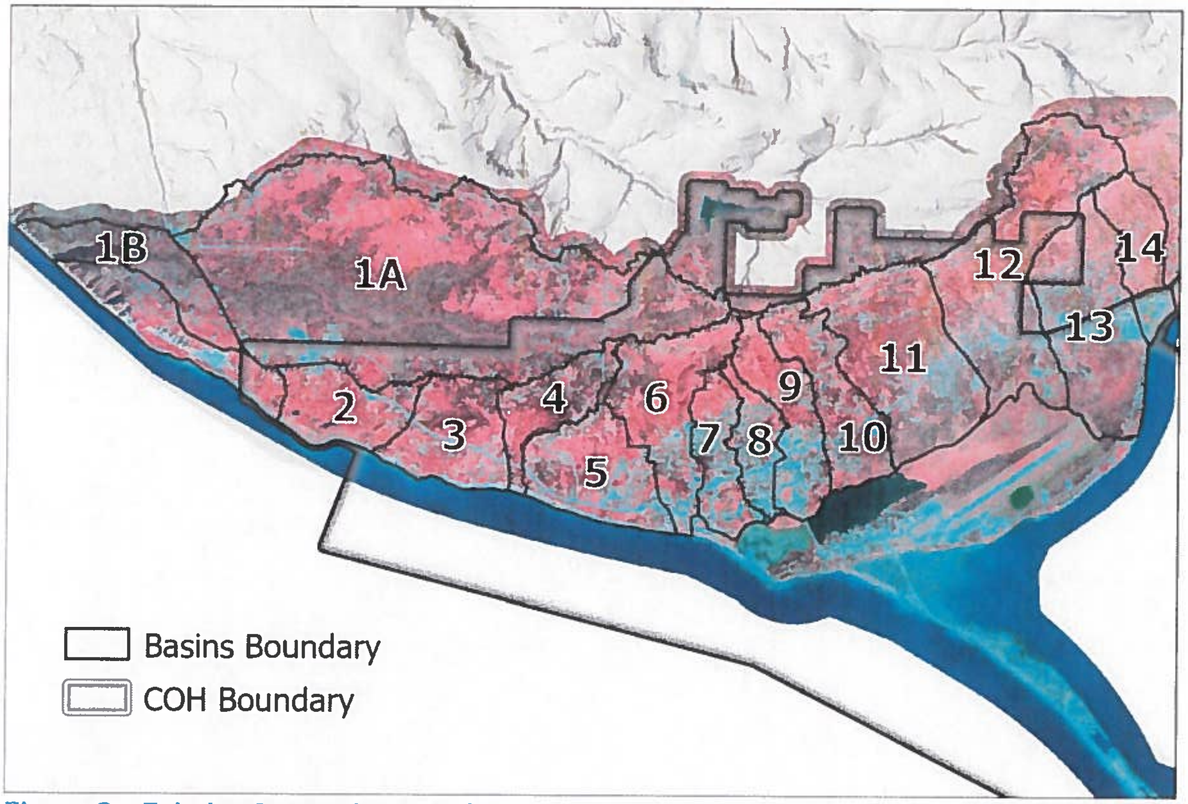


Figure 2 – Existing Impervious Surfaces

The infrared imagery above shows the contrast between impermeable and permeable surfaces in and around Homer. Red represents the vegetation of undeveloped areas where water is able to infiltrate the ground. Blue areas represent impervious surfaces such as roads, roofs, and parking lots.

Table 2 – Existing Impervious Surfaces as Percent of Basin Area

Basin	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13	14
% Impervious	4%	4%	6%	5%	6%	14%	10%	25%	29%	21%	10%	7%	5%	15%	11%

The development of this impervious surface layer sets an existing condition baseline. This impervious baseline can be used in future hydrologic studies and was used in this planning study as a tool to ensure that the future development scenario used impervious values greater than current values (as would be expected).

B. Zoning Area

The City of Homer's land use zoning areas were used with this project to forecast the nature of future development within the City.

Zoning types that are defined by the Homer City Code (Title 21 Zoning and Planning, Division II Zoning Districts, chapter 21.12-21.34) were used to determine how undeveloped lots are zoned for future development. The Homer City Code provided information on how large buildings can be, which helps forecast impermeable roof surface maximum values and estimate full development for each zoning type.

C. Hydrologic Soil Groups

The Natural Resources Conservation Service (NRCS) classifies their mapped soil groups based on estimates of runoff potential. There are four hydrologic soil groups A, B, C, and D. Group A soils have the highest infiltration rates, absorbs the most water, typically consist of sands and gravels, and have the lowest runoff potential. Group B soils have moderately low runoff potential when wet and are well drained. Group B soils have moderately high runoff potential when wet and water flow is somewhat restricted. Group D soils have a very slow infiltration rate, absorb the least water, consist of silts and clay, and have a high runoff potential.

In the City of Homer the two primary hydrologic soil groups are Group B soils having a moderate infiltration rate and Group D soils having a very slow infiltration rate. The selection of Low Impact Development practices that rely on infiltration will be less effective in Group D soils than Group B soils although practices such as amending the soil within LID controls to increase water absorption can help.

Group B soils are generally located on the bluff face and below the bluff. Group D soils are located mainly above the bluff. Homer Spit soils are not delineated on the NRCS map, but generally consist of well graded sand with relatively high infiltration rates that would typically be classified as Group A soils.

The detailed NRCS Hydrologic Soil Map are provided in Appendix B.

D. Steep Slope Development Restriction

The project's digital elevation model was analyzed to create a GIS layer that identifies areas within the City that have slopes greater than or equal to 30%. These steep slope areas are too steep to responsibly develop, and we have assumed that these areas would be excluded from future development and left in their natural state. A summary of the excluded areas with slopes greater than or equal to 30% by basin for each zoning type is provided in Table 3 below. This restriction lowered the composite runoff curve numbers to achieve a more reasonable estimation of future development.

Table 3 – Steep Slope Areas Excluded from Development by Basin and Land Type

Basin Slope Areas ≥ 30 %			
Basin	High density urban (acre)	Urban Residential (acre)	Rural Residential (acre)
1A	0.2	0.0	4.6
1B	0.0	0.0	0.0
2	8.2	0.0	63.0
3	0.0	0.0	67.3
4	0.0	0.0	48.5
5	8.2	2.4	14.2
6	1.4	0.5	70.3
7	1.0	0.4	22.6
8	0.2	0.2	7.9
9	0.6	0.7	37.4
10	0.1	0.3	30.0
11	0.0	0.0	82.5
12	0.0	0.0	126.0
13	0.6	0.0	13.4
14	0.0	0.0	0.5

E. Composite Runoff Curve Numbers

Composite runoff curve numbers were developed for each basin for use with the NRCS TR-55 hydrology method. A runoff curve number (CN) defines how much rainfall will be absorbed and /or runoff from a given area; values typically range from 98 to 30. The NRCS developed these values by measuring runoff from various types of land plots to develop the empirical values. High value CN's represent impervious land surfaces. For example, building roofs and paved parking lots have a CN of 98 and are completely impervious, whereas a densely vegetated wetland with storage capacity to absorb water would be closer to 30. Because there are many types of land within each basin, composite curve numbers were generated for each basin using a weighted area average.

See the tables in Appendix A for the composite CN calculations per-basin.

F. Rainfall

Estimates of rainfall for this study were obtained from point precipitation frequency estimates developed by National Oceanic and Atmospheric Administration (NOAA) as documented within their publication NOAA Atlas 14, Volume 7, Version 2. The precipitation data selected for this study is from the Homer Airport gage (Station ID 50-3665). A storm duration of 24 hours was selected, as this duration is required for use with NRCS hydrology methods of developing stormwater runoff volumes and peak flow rates. Table 4 below summarizes the rainfall depths for a range of average recurrence intervals. Appendix C – NOAA Atlas 14 Rainfall Data contains the full data set from NOAA.

Table 4 – NOAA Atlas 14 Precipitation for Homer AP Station ID 50-3665

Average Recurrence Interval (years) & Storm Duration (hours)	NOAA Atlas 14, Precipitation Depth (Inches)
1 Year - 24 hour	1.330
2 Year - 24 hour	1.630
5 Year - 24 hour	2.060
10 Year - 24 hour	2.410
25 Year - 24 hour	2.920
50 Year - 24 hour	3.340
100 Year - 24 hour	3.780

SOURCE:
HTTPS://HDSC.NWS.NOAA.GOV/HDSC/PFDS/PFDS_PRINTPAGE.HTML?ST=AK&STA=50-3665&DATA=DEPTH&UNITS=ENGLISH&SERIES=PDS

G. Traditional Stormdrain Development Volume

Traditional drainage development and water management systems consist of impervious developments that drain to water-tight structures (pipes and manholes) that collect and transport storm-water away from its origin.

This system is an effective measure to cope with runoff during most storm events, but it does have water quality drawbacks. For instance, contaminants present in the urban environment are more readily transported via these hardened corridors, increasing the potential for pollutants to enter water-bodies. No treatment occurs in the pipes and manholes. Also, lack of infiltration can lead to costly erosion issues downstream from higher peak flows. One historic way to deal with the concentrated pollutants is to build structural stormwater controls such as sedimentation basins and oil grit separators that allow the sediments to settle out of the water column at the outlet of the storm drain system.

Table 5 below presents the storm water volumes, peak flow rates, and calculated storm drain diameters for traditional development. The 1 year – 24 hour volume was used for sizing of the sedimentation basins and the 10 year- 24 hour peak flow was used to size the storm drains.

Table 5 – Basin Traditional Development Volumes, Flows, and Storm Drain Main Sizes

Basin	Area (Acres)	Future Peak Volume, 1 Year-24 hour Design Storm (ft3)	Future Peak Volume, 10 Year-24 hour Design Storm (ft3)	Future Peak Flow Rate, 10 Year-24hour Design Storm (ft3 / sec)	Future No LID SD Diameter Required For 10-year-24Hr Peak Flow (Inches) *
1A	3,483	285,432	4,042,757	87	36
1B	436	17,986	418,825	9	18
2	402	10,509	348,369	8	18
3	483	82,350	723,835	31	24
4	329	45,155	454,479	15	18
5	560	332,583	1,484,742	107	36
6	616	181,764	1,162,620	49	30
7	307	351,983	1,167,190	88	36
8	229	318,437	972,428	105	36
9	422	316,884	1,267,116	96	36
10	475	189,687	1,031,462	30	24
11	930	274,238	1,754,107	51	30
12	1,145	237,924	1,857,326	67	30
13	827	553,871	2,336,095	183	42
14	320	146,942	744,303	60	30

**Assumes average slope of pipe to be 4%.*

Table 6 below shows the estimated costs calculated per basin to install storm drain sized with a diameter to accommodate traditional development flows and a sedimentation basin at the system outlet.

Table 6 – Traditional Development Capital Cost Per Basin

Basin	Length of SD Main (ft)	Estimated Length of 18" Diameter Branch & Inlet Pipes (ft)	SD Main Pipe Diameter from Table 5 (in)	Inlet and Manhole Structure Costs	Pipe, Earthwork, and Pavement Costs	Sedimentation/ Detention Basin	Traditional Development Capital Cost Per Basin
1A	2825	1130	36	$158,200	$796,910	$2,351,500	$3,306,610
1B	100	800	18	$10,000	$73,600	$148,200	$231,800
2	400	200	18	$28,000	$63,400	$86,600	$178,000
3	400	400	24	$10,000	$105,000	$678,500	$793,500
4	300	300	18	$9,000	$59,100	$372,000	$440,100
5	5100	1800	36	$285,600	$1,420,100	$2,740,000	$4,445,700
6	5600	2500	30	$313,600	$1,470,600	$1,497,500	$3,281,700
7	11800	3000	36	$660,800	$3,196,000	$2,899,800	$6,756,600
8	16200	2800	36	$907,200	$4,286,200	$2,623,400	$7,816,800
9	1000	1900	36	$112,000	$397,600	$2,610,600	$3,120,200
10	100	1700	24	$5,600	$149,500	$1,562,700	$1,717,800
11	3900	1700	30	$218,400	$1,021,000	$2,259,300	$3,498,700
12	3900	1400	30	$218,400	$997,900	$1,960,100	$3,176,400
13	6600	1000	42	$369,600	$1,888,800	$4,563,000	$6,821,400
14	1000	200	30	$56,000	$243,700	$1,210,600	$1,510,300
						Total:	$47,095,700

Task 3: Low Impact Development

Low Impact Development takes advantage of naturally-occurring systems to treat stormwater runoff. Unlike traditional drain and pipe, LID management of stormwater begins where water hits the ground. By utilizing vegetation, soils that drain water readily, and graded depressions, runoff is slowed, filtered, and retained until it can be returned to the environment via infiltration and evaporation or slowly released after the rainfall event. A well-planned LID infrastructure system can improve local water quality, protect its aquatic ecosystems, and prevent urban flooding.

Existing Low Impact Development

Larger private and public facilities in Homer are currently required to install green infrastructure to detain runoff. See the library, City Hall, Kachemak Bay College Campus (and now the Police Station) for examples. Even though Homer does not currently have a drainage plan, there are a few LID features already present in the community, including:

A. Bio-swales

Vegetated linear depressions that slow and filter stormwater. Road side ditches can be constructed as bioswales and there are bio-swales in place on Homer area roads as well as the library.

B. Rain gardens

Shallow vegetated depressions that retain runoff until it evaporates or infiltrates back into the round. See City Hall and Kachemak Bay College Campus for examples.

C. Retention Basins

Engineered green depressions that capture and temporarily store runoff and encourage infiltration and evaporation. Again, see City Hall and Kachemak Bay College Campus for examples.

D. Land Conservation

Natural spaces left undeveloped within and around urban areas allow for filtration and retention of storm-water runoff. The City has developed and identified these areas with the zoning district.

Low Impact Development Cost Estimates

The average cost to install LID infrastructure on a per project basis varies widely. Soil types and local climate can either enhance or inhibit various types of green infrastructure. For this project we have examined typical green infrastructure controls to provide an estimated cost for installation for each control and to provide recommendations for use of each control within the City of Homer.

Additional LID stormwater controls are presented below along with estimated typical costs and recommendations to consider for use of each control within the City of Homer.

Table 7 – LID Stormwater Controls

LID Control Name	Process	Comments	Typical Cost	Recommended?
Rain barrel/cistern	Storage	Small-scale runoff collectors keep water around for later re-use or slow release.	$70 to $250 each	Yes, if captured water is infiltrated or otherwise used on site.
Bioretention (rain gardens)	Infiltration	Exposes runoff water to plant roots for uptake, can be under-drained and still effective. Some bioretention facilities are designed to infiltrate	$5 to $9 per c.f.	Yes, if infiltration is incorporated into the design. Biofiltration should provide volume reduction.
Infiltration Trench	Infiltration	Must be properly engineered in adequate soils; proper maintenance essential	$6/100 LF	Yes, in areas of Group B soils.
Permeable Pavers	Infiltration	Includes a number of paving and block methods, or simple parking on reinforced grassed surfaces.	$10/sq. ft.	Not generally recommended unless in very low traffic area that will not be an active snow removal area or subject to heavy vehicle turning movements.
Detention/Infiltration Basin/ Wetland/pond storage	Infiltration / Evapotranspiration	Combination of standing water surface and vegetative root exposure yields volume reductions.	$8 per c.f.	Yes, at lower elevations or where wetlands are naturally occurring. Infiltration basins should be reserved for Group B soils or constructed as detention / sedimentation basins.
Bioswales or Vegetated swales	Evapotranspiration / Conveyance	Provides water a chance to soak into the ground and be filtered as it flows.	$0.83 per c.f. or $3 to $15 per sq. Ft.	Yes, though swales typically achieve limited volume reduction unless designed with check dams and developed on Group B soils
Filter strips	Infiltration/ Conveyance	Variation of vegetated swale with side slope protection.	$2.16 per c.f.	Yes, where Group B soils are present or if it is found that an engineered soil can provide cost effective treatment.

LID cost estimates for this study were created by estimating the cost to construct and maintain LID controls. The existing LID infrastructure solutions selected for cost analysis include rain gardens, bio-swales, and bio-retention basins.

We estimated the cost to implement green infrastructure elements for several groups of zoning types on a per acre basis according to Table 8. These cost per acre values were then extrapolated to produce a potential cost-per-basin to provide each undeveloped lot with these LID controls.

Table 8 – Estimated LID Cost Per Acre by Zone Type

$/acre	LID Control Features Assumed	Development Type - Zoning Map Classifications
$ 6,033	Rain Gardens, Bio-retention, bio-swales	High density urban: General Commercial, Central Business District, Industrial, etc.
$ 3,375	Rain Gardens, Rain Barrels	Urban Residential
$ 750	Rain Gardens, Rain Barrels	Rural Residential, East End Mixed Use
$ 0	Land Conservation	Open Space Rec, Conservation

Costs from the recent LID implementation were developed using known costs from the Homer police station LID implementation.

E. Stormwater Retention Requirement

As the population of the City of Homer and the Kenai Peninsula Borough grow to meet the definition of an "urbanized area" or "urban place" the Clean Water Act will require permitting of stormwater discharges. Typically the State will issue a General Permit for Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) on behalf of the EPA. Nationally, MS4 permits are issued with a requirement that new development or redevelopment projects retain precipitation from all rainfall events less than or equal to the 90th or 95th percentile rainfall event. For this project we examined the 90th percentile depth which is typically applied to MS4 permits in Alaska. The 90th percentile rainfall depth is a threshold depth where 90 percent of recorded runoff producing rainfalls are less than or equal to this depth. Use of the 90th percentile criterium results in retention of the majority of annual precipitation to maximize water quality benefits yet does not result in unreasonably large retention volumes requirements by using higher percentiles.

We examined 30 years of data from the Homer Airport gage (Station ID 50-3665) as shown in Appendix D. Rainfall data that were less than or equal to a tenth of an inch were removed from the data set as it typically would not produce runoff. Snowfall and hail events were also removed because runoff from these events is delayed. Table 9 below provides the rainfall depths that correspond to exceedance probability percentiles in five percent increments.

Table 9 – 1988 to 2018 Daily Rainfall Depths & Exceedance Probability Percentiles

Exceedance Probability Percentile	Rainfall Depth (inches)
0%	0.11
5%	0.11
10%	0.12
15%	0.14
20%	0.15
25%	0.16
30%	0.17
35%	0.18
40%	0.20
45%	0.21
50%	0.23
55%	0.25
60%	0.28
65%	0.31
70%	0.35
75%	0.39
80%	0.45
85%	0.50
90%	0.60
95%	0.78
100%	2.88

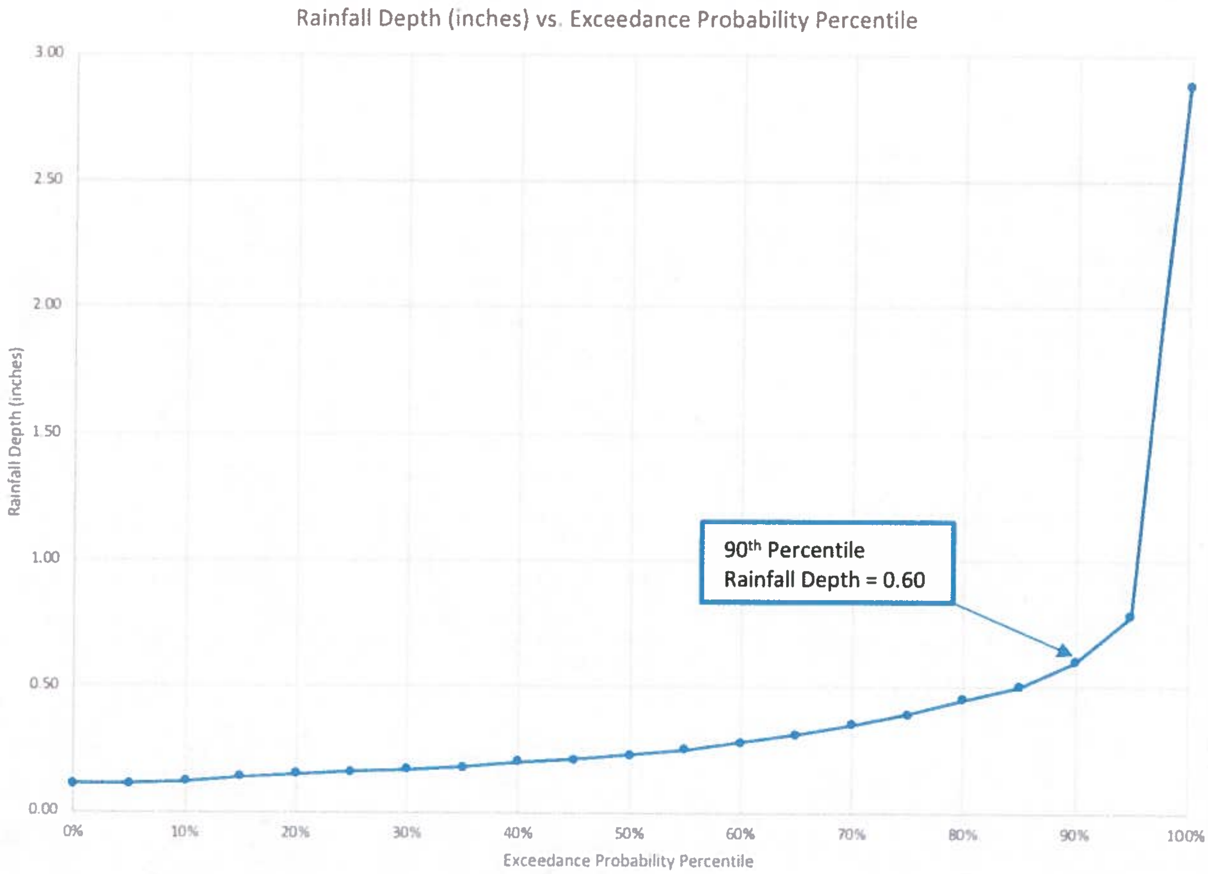


Figure 3 – 1988 to 2018 Daily Rainfall Depths vs Exceedance Probability Percentiles

Figure 3 above graphically depicts the data from Table 9. Note the inflection point in the curve and steep increase in rainfall depth between the 90th and 100th percentile. The resultant 90th percentile rainfall depth for the Homer Airport gage was found to be 0.60 inches.

Using this depth a Water Quality Treatment Volume can be calculated. For a simple example that ignores infiltration, development of a one acre site would require retention of [1 acre] x [43560 acres per cubic foot] x [0.6 inches of runoff] [1/12 foot per inch] = 2,178 cubic feet of storage.

It should also be noted that Homer City Code (HCC) 21.75.010 already requires on-site storage and a Storm Water Plan for several development scenarios. The code requires that post development stormwater discharge rate shall not exceed the pre development peak discharge rate for the ten year frequency storm event. This Peak Discharge Rate criteria requires developers to provide on-site storage to detain the difference between the pre and post peak flows.

The difference between a LID Water Quality Treatment Volume and a storage volume required to control a Peak Discharge Rate is that the LID Water Quality Treatment Volume must be retained on site and not released. Whereas the water detained for Peak Discharge Rate control may be gradually released into the storm drain system. It is common to have both of these criteria required for site developments. Engineers are then tasked with designing for the larger volume that controls.

F. LID Capital Cost Per Basin

Constructing LID infrastructure in a drainage basin does not eliminate the need for storm drains. LID infrastructure reduces, but does not eliminate site runoff as volume in excess of the Water Quality Treatment Volume will still reach the system. In estimating the cost of storm drains with LID infrastructure incorporated into future development this study assumes that 25% of each basin would be developed or re-developed with LID controls to retain 0.6 inches of runoff, thereby reducing the peak flows and the required diameter of the future storm drain sized for a 10-year 24-hour storm. Table 10 below provides both the LID and storm drain (SD) costs.

Table 10 – LID Development Capital Cost Per Basin

Basin	Length of SD Main (ft)	Estimated Length of 18" Diameter Branch & Inlet Pipes (ft)	SD Main Pipe Diameter with LID (in)	Inlet and Manhole Structure Costs	Pipe, Earthwork, and Pavement Costs	LID Rain garden, Bio-swale, Bio-retention Cost /Basin	LID Development Capital Cost Per Basin
1A	2825	1130	24	$158,200	$610,800	$690,800	$1,459,800
1B	100	800	18	$10,000	$73,600	$100	$83,700
2	400	200	18	$28,000	$63,400	$231,900	$323,300
3	400	400	18	$10,000	$78,800	$310,900	$399,700
4	300	300	18	$9,000	$59,100	$210,500	$278,600
5	5100	1800	24	$285,600	$1,084,200	$1,098,700	$2,468,500
6	5600	2500	18	$313,600	$863,300	$927,200	$2,104,100
7	11800	3000	24	$660,800	$2,418,700	$1,169,600	$4,249,100
8	16200	2800	30	$907,200	$3,913,000	$846,200	$5,666,400
9	1000	1900	24	$112,000	$331,700	$1,071,400	$1,515,100
10	100	1700	18	$5,600	$142,900	$824,100	$972,600
11	3900	1700	24	$218,400	$854,000	$766,500	$1,838,900
12	3900	1400	24	$218,400	$830,900	$434,400	$1,483,700
13	6600	1000	30	$369,600	$1,583,400	$701,500	$2,654,500
14	1000	200	18	$56,000	$135,200	$7,700	$198,900
					Total		$25,696,900

G. Capital Cost Comparison

Table 11 below provides a simple comparison of the total capital costs of future Traditional Development from Table 6 to the cost of future LID from Table 10.

Table 11 – Traditional Development vs LID Cost Per Basin

Basin	Traditional Hard Infrastructure Cost	LID / Green Infrastructure Cost
1A	$3,306,610	$1,459,800
1B	$231,800	$83,700
2	$178,000	$323,300
3	$793,500	$399,700
4	$440,100	$278,600
5	$4,445,700	$2,468,500
6	$3,281,700	$2,104,100
7	$6,756,600	$4,249,100
8	$7,816,800	$5,666,400
9	$3,120,200	$1,515,100
10	$1,717,800	$972,600
11	$3,498,700	$1,838,900
12	$3,176,400	$1,483,700
13	$6,821,400	$2,654,500
14	$1,510,300	$198,900
Totals	$47,095,700	$25,696,900

Clearly the difference between these capital costs show that implementing LID will be cost effective. The primary items driving the cost differences between the two options are the high cost of addressing water quality with sedimentation basins and the size difference in required storm drain diameters between the two development scenarios.

The capital costs above are just one aspect of cost of managing stormwater for the City. Operations and maintenance (O&M) costs are also a factor to consider as the implementation of LID typically results in less maintenance required to remove sediment from the City storm drain system and to repair erosion damage from higher peak flow events. On the next page (Table 12) we examine the net present value of implementing each scenario and the associated annual O&M costs.

H. Net Present Value of LID Implementation

This comparison assumes that at some point in the future, the City's capital development program would complete an upgrade of the City's storm drain infrastructure either with or without LID. The accumulative total capital cost is shown in year zero. The analysis below looks at 30 years of Operations and maintenance (O&M) costs after the systems are constructed. A discount factor of 2% was used to account for inflation.

Table 12 – Net Present Value of Implementing LID

Year	Traditional Development		LID		Cost Savings	Discount Factor	Present Value
	O&M % *	Initial Capital Cost Calc. O&M Cost	O&M % *	Initial Capital Cost & Calc. O&M Cost	Trad. Cost - LID Cost	At 2%	
0		$47,095,700		$25,696,900	$21,398,800	1.00	$21,398,800
1	0.50%	$235,479	0.25%	$64,242	$171,236	0.98	$167,879
2	0.50%	$235,479	0.25%	$64,242	$171,236	0.96	$164,587
3	0.50%	$235,479	0.25%	$64,242	$171,236	0.94	$161,360
4	0.50%	$235,479	0.25%	$64,242	$171,236	0.92	$158,196
5	0.50%	$235,479	0.25%	$64,242	$171,236	0.91	$155,094
6	1.00%	$470,957	0.50%	$128,485	$342,473	0.89	$304,106
7	1.00%	$470,957	0.50%	$128,485	$342,473	0.87	$298,143
8	1.00%	$470,957	0.50%	$128,485	$342,473	0.85	$292,297
9	1.00%	$470,957	0.50%	$128,485	$342,473	0.84	$286,566
10	1.00%	$470,957	0.50%	$128,485	$342,473	0.82	$280,947
11	2.00%	$941,914	0.75%	$192,727	$749,187	0.80	$602,544
12	2.00%	$941,914	0.75%	$192,727	$749,187	0.79	$590,729
13	2.00%	$941,914	0.75%	$192,727	$749,187	0.77	$579,146
14	2.00%	$941,914	0.75%	$192,727	$749,187	0.76	$567,790
15	2.00%	$941,914	0.75%	$192,727	$749,187	0.74	$556,657
16	3.00%	$1,412,871	1.25%	$321,211	$1,091,660	0.73	$795,215
17	3.00%	$1,412,871	1.25%	$321,211	$1,091,660	0.71	$779,623
18	3.00%	$1,412,871	1.25%	$321,211	$1,091,660	0.70	$764,336
19	3.00%	$1,412,871	1.25%	$321,211	$1,091,660	0.69	$749,349
20	3.00%	$1,412,871	1.25%	$321,211	$1,091,660	0.67	$734,656
21	3.50%	$1,648,350	1.50%	$385,454	$1,262,896	0.66	$833,228
22	3.50%	$1,648,350	1.50%	$385,454	$1,262,896	0.65	$816,890
23	3.50%	$1,648,350	1.50%	$385,454	$1,262,896	0.63	$800,873
24	3.50%	$1,648,350	1.50%	$385,454	$1,262,896	0.62	$785,170
25	3.50%	$1,648,350	1.50%	$385,454	$1,262,896	0.61	$769,774
26	4.00%	$1,883,828	1.75%	$449,696	$1,434,132	0.60	$857,008
27	4.00%	$1,883,828	1.75%	$449,696	$1,434,132	0.59	$840,204
28	4.00%	$1,883,828	1.75%	$449,696	$1,434,132	0.57	$823,729
29	4.00%	$1,883,828	1.75%	$449,696	$1,434,132	0.56	$807,578
30	4.00%	$1,883,828	1.75%	$449,696	$1,434,132	0.55	$791,743
* O&M Cost/Year displayed as % of Total Capital Cost						NPV =	$38,514,213

I. Conclusion

This planning level analysis of the benefits of Low Impact Development indicates that there would be a positive economic benefit to the City of Homer should LID practices be incorporated into future stormwater drainage master plans. Low Impact Development is not only environmentally friendly, it can often save taxpayer's money in the long run compared to the more traditional development of storm drain infrastructure. There are benefits both in terms of capital costs as well as ongoing maintenance and operations costs.

Note that this report does not quantify items such as social and environmental benefits which, if considered, would only reinforce the benefits presented. Potential environmental benefits include cleaner water at storm drain outfalls, source water protection for wells, and reduced urban temperatures. Potential benefits to the community are also possible from increased property values that are enhanced by trees, plants, and vegetated landscapes.

Appendix A – Basin Runoff Calculation Tables

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	1A	Area: 3483.22 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
General Commercial 1	B		92	3.25	0.09%	0.09
General Commercial 1	B	Too steep to develop	55	0.01	0.00%	0.00
General Commercial 1	D		95	25.44	0.73%	0.69
General Commercial 2	D	Too steep to develop	58	0.21	0.01%	0.00
Rural Residential	B		68	369.09	10.60%	7.21
Rural Residential	B	Too steep to develop	58	2.53	0.07%	0.04
Rural Residential	C		79	230.23	6.61%	5.22
Rural Residential	C	Too steep to develop	58	1.53	0.04%	0.03
Rural Residential	D		84	90.25	2.59%	2.18
Rural Residential	D	Too steep to develop	55	0.58	0.02%	0.01
Rural Residential	U	Gravel Pit	89	0.65	0.02%	0.02
Open Space Rec	B		55	0.03	0.00%	0.00
Open Space Rec	D		58	10.21	0.29%	0.17
Outside Zoning	U	Gravel Pit	89	4.40	0.13%	0.11
Outside Zoning	U	Too steep to develop	55	0.81	0.02%	0.01
Outside Zoning	C	Assume future Rural Res.	79	7.35	0.21%	0.17
Outside Zoning	C	Too steep to develop	58	0.31	0.01%	0.01
Outside Zoning	D	Assume future Cons. Area	58	793.02	22.77%	13.20
Outside Zoning	D	Too steep to develop	58	3.34	0.10%	0.06
Outside Zoning	B	Assume future Rural Res.	68	1919.54	55.11%	37.47
Outside Zoning	B	Too steep to develop	58	20.45	0.59%	0.34
					0.00%	0.00
					0.00%	0.00
Basin Existing % Impervious = 4%			Total Area:	3483.22 Ac	Total Weighted CN or C:	67

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	72	0.082		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					**Subtotal, Sheet Flow Tt:**	**0.22**
Shallow Flow	Forest with heavy ground litter	0.06	1699	0.082	0.57	0.832
Tt=L/V/3600; V = 33kS^0.5	Forest with heavy ground litter	0.06	1126	0.077	0.55	0.568
k value, landcover factor					**Subtotal, Shallow Flow Tt:**	**1.40**
Channel Flow	Stream Channel	0.040	26683	0.017	3.20	2.32
Tt=L/V/3600;	4.70	8.88	Trap	2H : 1V	0.53	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	**2.32**
					Total Tt, hours:	**3.94**

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.023	4	285,432	18
2 Year-24hr (P2)	1.630	0.075	15	944,122	18
5 Year-24hr	2.060	0.193	47	2,434,845	30
10 Year-24hr	2.410	0.320	87	4,042,757	36
25 Year-24hr	2.920	0.546	180	6,900,379	42
50 Year-24hr	3.340	0.762	280	9,631,471	48
100 Year-24hr	3.780	1.012	399	12,793,632	60

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.023	0.000	-	-	18
2 Year-24hr (P2)	1.630	0.075	0.000	-	-	18
5 Year-24hr	2.060	0.193	0.043	7	538,232	18
10 Year-24hr	2.410	0.320	0.170	33	2,146,144	24
25 Year-24hr	2.920	0.546	0.396	92	5,003,766	36
50 Year-24hr	3.340	0.762	0.612	158	7,734,858	42
100 Year-24hr	3.780	1.012	0.862	243	10,897,019	48

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	1B	Area: 436.15 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Rural Residential	B		68	0.11	0.03%	0.02
Outside Zoning	B	Assume future Rural Res.	68	297.98	68.32%	46.46
Outside Zoning	B	Too steep to develop	55	40.42	9.27%	5.10
Outside Zoning	D	Assume future Cons. Area	58	82.59	18.94%	10.98
Outside Zoning	D	Too steep to develop	55	0.99	0.23%	0.12
Outside Zoning	U	Tidal Flats, Sea Cliffs	58	8.14	1.87%	1.08
Outside Zoning	U	Too steep to develop	55	5.92	1.36%	0.75
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	4%		Total Area:	436.15 Ac	Total Weighted CN or C:	65

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	62	0.062		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Cultivated straight row	0.274	4052	0.070	2.39	0.471
Tt=L/V/3600; V = 33kS^0.5	Cultivated straight row	0.274	3598	0.073	2.44	0.410
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.88
Channel Flow	Stream Channel	0.040	8815	0.059	1.84	1.33
Tt=L/V/3600;	0.59	6.42	Trap	2H : 1V	0.09	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	1.33
					Total Tt, hours:	2.43

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.011	0	17,986	18
2 Year-24hr (P2)	1.630	0.052	1	81,564	18
5 Year-24hr	2.060	0.152	4	240,290	18
10 Year-24hr	2.410	0.265	9	418,825	18
25 Year-24hr	2.920	0.470	21	744,097	24
50 Year-24hr	3.340	0.670	36	1,060,256	24
100 Year-24hr	3.780	0.903	54	1,430,325	30

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.011	0.000	-	-	18
2 Year-24hr (P2)	1.630	0.052	0.000	-	-	18
5 Year-24hr	2.060	0.152	0.002	0	2,806	18
10 Year-24hr	2.410	0.265	0.115	2	181,342	18
25 Year-24hr	2.920	0.470	0.320	9	506,614	18
50 Year-24hr	3.340	0.670	0.520	17	822,772	18
100 Year-24hr	3.780	0.903	0.753	28	1,192,841	24

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	2	Area: 401.61 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Conservation	B		58	4.66	1.16%	0.67
Conservation	B	Too steep to develop	55	27.69	6.89%	3.79
Conservation	D		58	114.61	28.54%	16.55
Conservation	D	Too steep to develop	40	5.23	1.30%	0.52
Conservation	U	Tidal Flats, Sea Cliffs	58	5.30	1.32%	0.77
Conservation	U	Too steep to develop	40	3.97	0.99%	0.40
General Commercial 1	B		92	18.43	4.59%	4.22
General Commercial 1	B	Too steep to develop	55	8.08	2.01%	1.11
General Commercial 1	D		95	2.34	0.58%	0.55
General Commercial 1	D	Too steep to develop	58	0.15	0.04%	0.02
Rural Residential	B		68	101.59	25.30%	17.20
Rural Residential	B	Too steep to develop	55	59.39	14.79%	8.13
Rural Residential	D		84	37.03	9.22%	7.75
Rural Residential	D	Too steep to develop	58	2.25	0.56%	0.32
Rural Residential	U	Tidal Flats, Sea Cliffs	58	3.46	0.86%	0.50
Rural Residential	U	Too steep to develop	55	1.38	0.34%	0.19
Outside Zoning	U	Tidal Flats, Sea Cliffs	58	6.05	1.51%	0.87
Outside Zoning	U	Too steep to develop	55	0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	6%		Total Area:	401.61 Ac	Total Weighted CN or C:	64

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor [1] / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape [2]	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 [3]	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Dense Grass (lawns)	0.24	120	0.084		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	3346	0.183	2.14	0.434
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	3011	0.203	2.26	0.370
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.80
Channel Flow	Stream Channel	0.040	3144	0.020	1.52	0.58
Tt=L/V/3600;	0.45	2.84	Trap	2H : 1V	0.16	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.58
					Total Tt, hours:	1.60

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.007	0	10,509	18
2 Year-24hr (P2)	1.630	0.042	1	60,650	18
5 Year-24hr	2.060	0.133	3	194,281	18
10 Year-24hr	2.410	0.239	8	348,369	18
25 Year-24hr	2.920	0.434	19	633,047	18
50 Year-24hr	3.340	0.626	35	912,310	24
100 Year-24hr	3.780	0.851	55	1,241,109	30

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.007	0.000	-	-	18
2 Year-24hr (P2)	1.630	0.042	0.000	-	-	18
5 Year-24hr	2.060	0.133	0.000	-	-	18
10 Year-24hr	2.410	0.239	0.089	1	129,692	18
25 Year-24hr	2.920	0.434	0.284	7	414,371	18
50 Year-24hr	3.340	0.626	0.476	14	693,634	18
100 Year-24hr	3.780	0.851	0.701	25	1,022,432	24

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	3	Area: 482.81 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Rural Residential	B		68	281.62	58.33%	39.66
Rural Residential	B	Too steep to develop	55	49.45	10.24%	5.63
Rural Residential	D		84	116.52	24.13%	20.27
Rural Residential	D	Too steep to develop	58	5.49	1.14%	0.66
Rural Residential	U	Tidal Flats, Sea Cliffs	58	16.39	3.39%	1.97
Rural Residential	U	Too steep to develop	55	12.30	2.55%	1.40
Outside Zoning	U	Tidal Flats, Sea Cliffs	58	1.04	0.22%	0.12
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	5%		Total Area:	482.81 Ac	Total Weighted CN or C:	70

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]	Stem Vegitation	0.4	78	0.096		0.22
						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Short grass pasture	0.213	2129	0.093	2.14	0.276
Tt=L/V/3600; V = 33kS^0.5	Short grass pasture	0.213	1813	0.096	2.18	0.231
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.51
Channel Flow	Stream Channel	0.040	3896	0.190	5.75	0.19
Tt=L/V/3600;	0.67	3.19	Trap	2H : 1V	0.21	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.19
					Total Tt, hours:	0.91

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.047	1	82,350	18
2 Year-24hr (P2)	1.630	0.118	4	206,944	18
5 Year-24hr	2.060	0.264	14	462,010	18
10 Year-24hr	2.410	0.413	31	723,835	24
25 Year-24hr	2.920	0.670	69	1,174,749	30
50 Year-24hr	3.340	0.911	106	1,596,207	36
100 Year-24hr	3.780	1.185	150	2,077,059	42

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.047	0.000	-	-	18
2 Year-24hr (P2)	1.630	0.118	0.000	-	-	18
5 Year-24hr	2.060	0.264	0.114	2	199,120	18
10 Year-24hr	2.410	0.413	0.263	7	460,944	18
25 Year-24hr	2.920	0.670	0.520	21	911,859	24
50 Year-24hr	3.340	0.911	0.761	42	1,333,317	24
100 Year-24hr	3.780	1.185	1.035	76	1,814,169	30

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	4	Area: 329.06 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Rural Residential	B		68	195.29	59.35%	40.36
Rural Residential	B	Too steep to develop	55	44.55	13.54%	7.45
Rural Residential	C		79	50.07	15.22%	12.02
Rural Residential	C	Too steep to develop	57	0.47	0.14%	0.08
Rural Residential	D		84	32.48	9.87%	8.29
Rural Residential	D	Too steep to develop	58	0.75	0.23%	0.13
Rural Residential	U	Tidal Flats, Sea Cliffs	58	2.71	0.82%	0.48
Rural Residential	U	Too steep to develop	55	2.69	0.82%	0.45
Outside Zoning	U	Tidal Flats, Sea Cliffs	58	0.05	0.02%	0.01
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	6%		Total Area:	329.06 Ac	Total Weighted CN or C:	69

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]	Stem Vegitation	0.4	31	0.015		0.22
						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	1339	0.023	0.77	0.485
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	1171	0.032	0.90	0.360
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.85
Channel Flow	Stream Channel	0.040	7280	0.117	4.00	0.51
Tt=L/V/3600;	0.52	2.96	Trap	2H : 1V	0.18	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.51
					Total Tt, hours:	1.57

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet		Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.038	1	45,155		18
2 Year-24hr (P2)	1.630	0.102	2	122,329		18
5 Year-24hr	2.060	0.239	7	284,978		18
10 Year-24hr	2.410	0.380	15	454,479		18
25 Year-24hr	2.920	0.627	32	749,283		24
50 Year-24hr	3.340	0.860	51	1,026,788		30
100 Year-24hr	3.780	1.126	72	1,344,896		30

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.038	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.102	0.000	-	-	-	18
5 Year-24hr	2.060	0.239	0.089	1	105,804	105,804	18
10 Year-24hr	2.410	0.380	0.230	4	275,306	275,306	18
25 Year-24hr	2.920	0.627	0.477	12	570,110	570,110	18
50 Year-24hr	3.340	0.860	0.710	23	847,614	847,614	24
100 Year-24hr	3.780	1.126	0.976	39	1,165,722	1,165,722	24

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY						
Name:	5	Area: 560.16 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
Rural Residential	B		68	156.09	27.87%	18.95
Rural Residential	B	Too steep to develop	55	6.95	1.24%	0.68
Rural Residential	C		79	3.46	0.62%	0.49
Rural Residential	D		84	186.46	33.29%	27.96
Rural Residential	D	Too steep to develop	58	0.45	0.08%	0.05
Rural Residential	U	Tidal Flats, Sea Cliffs	58	5.79	1.03%	0.60
Rural Residential	U	Too steep to develop	55	6.82	1.22%	0.67
Central Business District	D		95	9.37	1.67%	1.59
Central Business District	D	Too steep to develop	58	0.31	0.06%	0.03
Central Business District	U	Tidal Flats, Sea Cliffs	58	3.27	0.58%	0.34
Central Business District	U	Too steep to develop	58	0.09	0.02%	0.01
Gateway Business District	D		95	55.03	9.82%	9.33
Gateway Business District	D	Too steep to develop	5	1.22	0.22%	0.01
Gateway Business District	U	Tidal Flats, Sea Cliffs	58	14.21	2.54%	1.47
Gateway Business District	U	Too steep to develop	55	6.60	1.18%	0.65
Urban Residential	B		72	4.34	0.77%	0.56
Urban Residential	B	Too steep to develop	55	0.00	0.00%	0.00
Urban Residential	D		86	87.32	15.59%	13.41
Urban Residential	D	Too steep to develop	58	0.71	0.13%	0.07
Urban Residential	U	Tidal Flats, Sea Cliffs	58	9.98	1.78%	1.03
Urban Residential	U	Too steep to develop	55	1.69	0.30%	0.17
					0.00%	0.00
					0.00%	0.00
Basin Existing % Impervious =	14%		Total Area:	560.16 Ac	Total Weighted CN or C:	78

Time of Concentration (within Subbasin Routing)						
General Parameters:	Surface Cover	n or k, Roughness Factor (1)	L, Flow Length, ft	S, Longitudinal Slope, ft/ft	Average Velocity ft/s	Travel time, Tt, hrs
Channel Parameters:	Cross Section Area, sq ft	Wetted Perimeter, ft	Channel Shape (2)	Channel Side Slope, H:1 (3)	R, Hydraulic Radius, ft	
Sheet Flow Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]	Stem Vegitation	0.4	136	0.296		0.22
						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	2256	0.157	1.99	0.315
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	2051	0.141	1.88	0.303
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.62
Channel Flow	Stream Channel	0.040	1568	0.142	9.19	0.05
Tt=L/V/3600;	3.02	5.69	Trap	2H : 1V	0.53	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.05
					Total Tt, hours:	0.88

Future Basin Runoff Summary no LID					
NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.164	10	332,583	18
2 Year-24hr (P2)	1.630	0.292	28	594,430	24
5 Year-24hr	2.060	0.518	67	1,054,143	30
10 Year-24hr	2.410	0.730	107	1,484,742	36
25 Year-24hr	2.920	1.072	174	2,180,232	42
50 Year-24hr	3.340	1.377	232	2,799,729	48
100 Year-24hr	3.780	1.713	298	3,483,729	54

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated							
NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.164	0.014	0	27,576	27,576	18
2 Year-24hr (P2)	1.630	0.292	0.142	3	289,423	289,423	18
5 Year-24hr	2.060	0.518	0.368	15	749,136	749,136	18
10 Year-24hr	2.410	0.730	0.580	32	1,179,735	1,179,735	24
25 Year-24hr	2.920	1.072	0.922	79	1,875,225	1,875,225	30
50 Year-24hr	3.340	1.377	1.227	133	2,494,722	2,494,722	42
100 Year-24hr	3.780	1.713	1.563	198	3,178,722	3,178,722	42

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	6	Area: 616.37 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
Open Space Rec	B		58	12.56	2.04%	1.18
Open Space Rec	B	Too steep to develop	55	2.59	0.42%	0.23
Open Space Rec	D		58	23.26	3.77%	2.19
Open Space Rec	D	Too steep to develop	58	0.27	0.04%	0.03
Residential Office	B		72	6.92	1.12%	0.81
Residential Office	B	Too steep to develop	55	0.10	0.02%	0.01
Residential Office	D		86	28.09	4.56%	3.92
Residential Office	D	Too steep to develop	58	0.31	0.05%	0.03
Urban Residential	B		72	1.14	0.18%	0.13
Urban Residential	B	Too steep to develop	55	0.25	0.04%	0.02
Urban Residential	D		86	66.07	10.72%	9.22
Urban Residential	D	Too steep to develop	58	0.23	0.04%	0.02
Rural Residential	B		68	241.10	39.12%	26.60
Rural Residential	B	Too steep to develop	55	69.57	11.29%	6.21
Rural Residential	C		79	73.42	11.91%	9.41
Rural Residential	C	Too steep to develop	70	0.56	0.09%	0.06
Rural Residential	D		84	35.55	5.77%	4.84
Rural Residential	D	Too steep to develop	58	0.18	0.03%	0.02
Central Business District	B		92	0.36	0.06%	0.05
Central Business District	D		95	50.69	8.22%	7.81
Central Business District	D	Too steep to develop	58	0.89	0.14%	0.08
Central Business District	U	Tidal Flats, Sea Cliffs	58	2.12	0.34%	0.20
Central Business District	U	Too steep to develop	55	0.14	0.02%	0.01
Basin Existing % Impervious =	10%		Total Area:	616.37 Ac	Total Weighted CN or C:	73

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	83	0.111		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Short pasture grass	0.213	3986	0.078	1.96	0.565
Tt=L/V/3600; V = 33kS^0.5	Short pasture grass	0.213	3062	0.076	1.94	0.438
k value, landcover factor					Subtotal, Shallow Flow Tt:	1.00
Channel Flow	Stream Channel	0.040	9248	0.082	5.48	0.47
Tt=L/V/3600;	1.61	4.35	Trap	2H : 1V	0.37	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.47
					Total Tt, hours:	1.69

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.081	3	181,764	18
2 Year-24hr (P2)	1.630	0.173	9	386,444	18
5 Year-24hr	2.060	0.347	26	777,083	24
10 Year-24hr	2.410	0.520	49	1,162,620	30
25 Year-24hr	2.920	0.809	90	1,809,147	36
50 Year-24hr	3.340	1.073	129	2,401,714	36
100 Year-24hr	3.780	1.372	174	3,068,911	42

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.081	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.173	0.023	0	50,830	50,830	18
5 Year-24hr	2.060	0.347	0.197	6	441,469	441,469	18
10 Year-24hr	2.410	0.520	0.370	16	827,007	827,007	18
25 Year-24hr	2.920	0.809	0.659	37	1,473,534	1,473,534	24
50 Year-24hr	3.340	1.073	0.923	66	2,066,101	2,066,101	30
100 Year-24hr	3.780	1.372	1.222	105	2,733,297	2,733,297	36

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	7	Area: 307.23 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
Residential Office	B		72	12.16	3.96%	2.85
Residential Office	B	Too steep to develop	55	0.16	0.05%	0.03
Residential Office	D		86	56.31	18.33%	15.76
Residential Office	D	Too steep to develop	58	0.20	0.07%	0.04
Urban Residential	B		72	4.08	1.33%	0.96
Urban Residential	B	Too steep to develop	55	0.27	0.09%	0.05
Urban Residential	D		86	41.75	13.59%	11.69
Urban Residential	D	Too steep to develop	58	0.11	0.04%	0.02
Open Space Rec	D		58	0.21	0.07%	0.04
Open Space Rec	U	Tidal Flats	58	0.57	0.19%	0.11
Rural Residential	B		68	40.04	13.03%	8.86
Rural Residential	B	Too steep to develop	55	22.55	7.34%	4.04
Rural Residential	D		84	3.44	1.12%	0.94
Rural Residential	D	Too steep to develop	58	0.03	0.01%	0.01
Central Business District	B		92	0.90	0.29%	0.27
Central Business District	D		95	90.05	29.31%	27.84
Central Business District	D	Too steep to develop	58	0.61	0.20%	0.12
Central Business District	U	Tidal Flats	58	2.91	0.95%	0.55
Town Center	D		95	30.80	10.03%	9.52
Town Center	D	Too steep to develop	58	0.08	0.03%	0.02
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	25%		Total Area:	307.23 Ac	Total Weighted CN or C:	84

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	66	0.071		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	2788	0.194	2.21	0.351
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	2047	0.239	2.45	0.232
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.58
Channel Flow	Ex. SD	0.024	6146	0.050	5.88	0.29
Tt=L/V/3600;	2.11	3.83	Pipe	n/a	0.55	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.29
					Total Tt, hours:	1.09

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.316	20	351,983	18
2 Year-24hr (P2)	1.630	0.495	36	551,687	24
5 Year-24hr	2.060	0.787	64	877,307	30
10 Year-24hr	2.410	1.047	88	1,167,190	36
25 Year-24hr	2.920	1.451	128	1,617,918	36
50 Year-24hr	3.340	1.800	163	2,007,694	42
100 Year-24hr	3.780	2.178	202	2,429,388	48

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.316	0.166	2	184,696	184,696	18
2 Year-24hr (P2)	1.630	0.495	0.345	7	384,400	384,400	18
5 Year-24hr	2.060	0.787	0.637	19	710,020	710,020	18
10 Year-24hr	2.410	1.047	0.897	38	999,903	999,903	24
25 Year-24hr	2.920	1.451	1.301	75	1,450,631	1,450,631	30
50 Year-24hr	3.340	1.800	1.650	109	1,840,408	1,840,408	36
100 Year-24hr	3.780	2.178	2.028	147	2,262,101	2,262,101	42

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY						
Name:	8	Area: 228.89 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
Residential Office	D		86	5.30	2.32%	1.99
Residential Office	D	Too steep to develop	58	0.01	0.00%	0.00
Urban Residential	B		72	0.18	0.08%	0.06
Urban Residential	D		86	110.78	48.40%	41.62
Urban Residential	D	Too steep to develop	58	0.23	0.10%	0.06
Conservation	D		58	3.01	1.32%	0.76
Conservation	D	Too steep to develop	58	0.01	0.00%	0.00
Rural Residential	B		68	18.81	8.22%	5.59
Rural Residential	B	Too steep to develop	55	7.80	3.41%	1.87
Rural Residential	D		84	10.90	4.76%	4.00
Rural Residential	D	Too steep to develop	58	0.10	0.04%	0.03
Central Business District	D		95	70.63	30.86%	29.31
Central Business District	D	Too steep to develop	58	0.24	0.10%	0.06
Town Center	D		95	0.89	0.39%	0.37
Town Center	D	Too steep to develop	58	0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	29%		Total Area:	228.89 Ac	Total Weighted CN or C:	86

Time of Concentration (within Subbasin Routing)						
General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegetation	0.4	81	0.104		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Short pasture grass	0.213	832	0.147	2.69	0.086
Tt=L/V/3600; V = 33kS^0.5	Short pasture grass	0.213	317	0.205	3.18	0.028
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.11
Channel Flow	Stream Channel	0.040	7881	0.095	9.09	0.24
Tt=L/V/3600;	5.15	7.28	Trap	2H : 1V	0.71	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.24
					Total Tt, hours:	0.57

Future Basin Runoff Summary no LID					
NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.383	27	318,437	24
2 Year-24hr (P2)	1.630	0.580	47	482,120	30
5 Year-24hr	2.060	0.895	77	743,364	30
10 Year-24hr	2.410	1.170	105	972,428	36
25 Year-24hr	2.920	1.594	148	1,324,530	42
50 Year-24hr	3.340	1.957	185	1,626,316	42
100 Year-24hr	3.780	2.348	222	1,950,837	48

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated							
NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.383	0.233	2	193,806	193,806	18
2 Year-24hr (P2)	1.630	0.580	0.430	7	357,489	357,489	18
5 Year-24hr	2.060	0.895	0.745	24	618,733	618,733	24
10 Year-24hr	2.410	1.170	1.020	47	847,797	847,797	30
25 Year-24hr	2.920	1.594	1.444	90	1,199,899	1,199,899	36
50 Year-24hr	3.340	1.957	1.807	128	1,501,686	1,501,686	36
100 Year-24hr	3.780	2.348	2.198	168	1,826,206	1,826,206	42

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	9	Area: 421.97 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Residential Office	D		86	30.20	7.16%	6.15
Residential Office	D	Too steep to develop	58	0.03	0.01%	0.00
Open Space Rec	D		58	0.90	0.21%	0.12
Open Space Rec	U	Water, fresh	98	3.26	0.77%	0.76
Conservation	D		58	2.72	0.64%	0.37
Conservation	U	Water, fresh	98	1.37	0.32%	0.32
Rural Residential	B		68	112.55	26.67%	18.14
Rural Residential	B	Too steep to develop	55	36.35	8.61%	4.74
Rural Residential	D		84	64.63	15.32%	12.87
Rural Residential	D	Too steep to develop	58	1.02	0.24%	0.14
Central Business District	D		95	100.72	23.87%	22.68
Central Business District	D	Too steep to develop	58	0.55	0.13%	0.08
Central Business District	U	Water, fresh	98	1.13	0.27%	0.26
Urban Residential	B		72	5.36	1.27%	0.91
Urban Residential	B	Too steep to develop	55	0.07	0.02%	0.01
Urban Residential	D		86	59.93	14.20%	12.21
Urban Residential	D	Too steep to develop	58	0.65	0.15%	0.09
Urban Residential	U	Tidal Flats	58	0.53	0.13%	0.07
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
					0.00%	0.00
Basin Existing % Impervious =	21%		Total Area:	421.97 Ac	Total Weighted CN or C:	80

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegetation	0.4	72	0.083		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	1639	0.204	2.27	0.201
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	1411	0.222	2.36	0.166
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.37
Channel Flow	Stream Channel	0.040	9194	0.082	7.65	0.33
Tt=L/V/3600;	3.90	6.40	Trap	2H : 1V	0.61	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.33
					Total Tt, hours:	0.92

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.207	12	316,884	18
2 Year-24hr (P2)	1.630	0.352	30	538,813	24
5 Year-24hr	2.060	0.599	64	918,145	30
10 Year-24hr	2.410	0.827	96	1,267,116	36
25 Year-24hr	2.920	1.190	148	1,823,282	42
50 Year-24hr	3.340	1.510	194	2,313,575	42
100 Year-24hr	3.780	1.861	246	2,851,071	48

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.207	0.057	1	87,121	87,121	18
2 Year-24hr (P2)	1.630	0.352	0.202	4	309,051	309,051	18
5 Year-24hr	2.060	0.599	0.449	15	688,383	688,383	18
10 Year-24hr	2.410	0.827	0.677	32	1,037,353	1,037,353	24
25 Year-24hr	2.920	1.190	1.040	74	1,593,519	1,593,519	30
50 Year-24hr	3.340	1.510	1.360	119	2,083,813	2,083,813	36
100 Year-24hr	3.780	1.861	1.711	170	2,621,308	2,621,308	42

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	10	Area: 474.64 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
Residential Office	B		72	1.30	0.27%	0.20
Residential Office	D		86	37.62	7.93%	6.82
Residential Office	D	Too steep to develop	58	0.06	0.01%	0.01
General Commercial 2	D		95	0.85	0.18%	0.17
General Commercial 2	U	Tidal Flats	58	0.02	0.00%	0.00
Open Space Rec	U	Water, fresh	98	0.04	0.01%	0.01
Rural Residential	B		68	228.84	48.21%	32.79
Rural Residential	B	Too steep to develop	55	29.48	6.21%	3.42
Rural Residential	D		84	29.15	6.14%	5.16
Rural Residential	D	Too steep to develop	58	0.52	0.11%	0.06
Urban Residential	B		72	0.00	0.00%	0.00
Urban Residential	D		86	144.52	30.45%	26.19
Urban Residential	D	Too steep to develop	58	0.34	0.07%	0.04
Urban Residential	U	Tidal Flats	58	1.90	0.40%	0.23
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	10%		Total Area:	474.64 Ac	Total Weighted CN or C:	75

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	48	0.037		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Forest with heavy ground litter	0.076	6738	0.142	0.95	1.980
Tt=L/V/3600; V = 33kS^0.5	Forest with heavy ground litter	0.076	6542	0.146	0.96	1.897
k value, landcover factor					Subtotal, Shallow Flow Tt:	3.88
Channel Flow	Stream Channel	0.040	2961	0.046	4.33	0.19
Tt=L/V/3600;	1.82	4.58	Trap	2H : 1V	0.40	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.19
					Total Tt, hours:	4.29

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (In) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.110	4	189,687	18
2 Year-24hr (P2)	1.630	0.216	8	372,128	18
5 Year-24hr	2.060	0.411	18	707,662	18
10 Year-24hr	2.410	0.599	30	1,031,462	24
25 Year-24hr	2.920	0.909	49	1,565,918	30
50 Year-24hr	3.340	1.190	67	2,049,952	30
100 Year-24hr	3.780	1.504	87	2,590,520	36

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (In) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.110	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.216	0.066	2	113,687	113,687	18
5 Year-24hr	2.060	0.411	0.261	8	449,221	449,221	18
10 Year-24hr	2.410	0.599	0.449	15	773,020	773,020	18
25 Year-24hr	2.920	0.909	0.759	28	1,307,477	1,307,477	24
50 Year-24hr	3.340	1.190	1.040	44	1,791,510	1,791,510	24
100 Year-24hr	3.780	1.504	1.354	63	2,332,079	2,332,079	30

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	11	Area: 929.95 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
Urban Residential	D		86	6.06	0.65%	0.56
General Commercial 2	D		95	22.28	2.40%	2.28
General Commercial 2	D	Too steep to develop	58	0.01	0.00%	0.00
Rural Residential	B		68	479.26	51.54%	35.04
Rural Residential	B	Too steep to develop	55	81.06	8.72%	4.79
Rural Residential	D		84	330.07	35.49%	29.81
Rural Residential	D	Too steep to develop	58	1.39	0.15%	0.09
Rural Residential	U	Urban Land	86	5.92	0.64%	0.55
Rural Residential	U	Too steep to develop	55	0.03	0.00%	0.00
Conservation	D		58	3.19	0.34%	0.20
Outside Zoning	B	Assume future Rural Res.	68	0.68	0.07%	0.05
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	7%		Total Area:	929.95 Ac	Total Weighted CN or C:	73

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegitation	0.4	131	0.273		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Forest with heavy ground litter	0.076	6001	0.167	1.02	1.626
Tt=L/V/3600; V = 33kS^0.5	Forest with heavy ground litter	0.076	5546	0.152	0.98	1.574
k value, landcover factor					Subtotal, Shallow Flow Tt:	3.20
Channel Flow	Stream Channel	0.040	4032	0.036	4.45	0.25
Tt=L/V/3600;	2.67	5.39	Trap	2H : 1V	0.49	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.25
					Total Tt, hours:	3.67

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.081	5	274,238	18
2 Year-24hr (P2)	1.630	0.173	12	583,048	18
5 Year-24hr	2.060	0.347	30	1,172,426	24
10 Year-24hr	2.410	0.520	51	1,754,107	30
25 Year-24hr	2.920	0.809	90	2,729,556	36
50 Year-24hr	3.340	1.073	126	3,623,593	36
100 Year-24hr	3.780	1.372	168	4,630,228	42

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.081	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.173	0.023	1	76,691	76,691	18
5 Year-24hr	2.060	0.347	0.197	11	666,068	666,068	18
10 Year-24hr	2.410	0.520	0.370	23	1,247,749	1,247,749	24
25 Year-24hr	2.920	0.809	0.659	48	2,223,198	2,223,198	30
50 Year-24hr	3.340	1.073	0.923	77	3,117,235	3,117,235	30
100 Year-24hr	3.780	1.372	1.222	115	4,123,870	4,123,870	36

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	12	Area: 1144.62 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
East End Mixed Use	D		86	102.99	9.00%	7.74
East End Mixed Use	D	Too steep to develop	58	0.05	0.00%	0.00
General Commercial 2	D		95	10.39	0.91%	0.86
Rural Residential	B		68	155.22	13.56%	9.22
Rural Residential	B	Too steep to develop	55	121.67	10.63%	5.85
Rural Residential	D		84	237.71	20.77%	17.44
Rural Residential	D	Too steep to develop	58	4.35	0.38%	0.22
Conservation	D		58	12.60	1.10%	0.64
Outside Zoning	B	Assume future Rural Res.	68	383.96	33.54%	22.81
Outside Zoning	B	Too steep to develop	55	73.50	6.42%	3.53
Outside Zoning	D	Assume future Rural Res.	84	41.16	3.60%	3.02
Outside Zoning	D	Too steep to develop	58	1.02	0.09%	0.05
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious = 5%			Total Area:	1144.62 Ac	Total Weighted CN or C:	71

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Dense Grass (lawn)	0.24	66	0.025		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	2080	0.052	1.15	0.503
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	1826	0.059	1.21	0.418
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.92
Channel Flow	Stream Channel	0.040	13468	0.093	6.12	0.61
Tt=L/V/3600;	1.81	4.57	Trap	2H : 1V	0.40	
V = [1.49/n][R^2/3][S^1/2]					0.00	0.00
Manning's "n" for Channel Flow	0.00	0.00		0H : 1V	0.00	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.61
					Total Tt, hours:	1.75

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.057	3	237,924	18
2 Year-24hr (P2)	1.630	0.135	11	560,881	18
5 Year-24hr	2.060	0.290	33	1,205,166	24
10 Year-24hr	2.410	0.447	67	1,857,326	30
25 Year-24hr	2.920	0.715	134	2,970,056	42
50 Year-24hr	3.340	0.963	200	4,003,062	48
100 Year-24hr	3.780	1.246	276	5,176,290	48

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.057	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.135	0.000	-	-	-	18
5 Year-24hr	2.060	0.290	0.140	8	581,921	581,921	18
10 Year-24hr	2.410	0.447	0.297	22	1,234,080	1,234,080	24
25 Year-24hr	2.920	0.715	0.565	54	2,346,810	2,346,810	30
50 Year-24hr	3.340	0.963	0.813	97	3,379,816	3,379,816	36
100 Year-24hr	3.780	1.246	1.096	161	4,553,044	4,553,044	42

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	13	Area: 827.48 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00
Land Use / Zoning	**Hydrologic Soil Group**	**Slope, ft/ft or Cover Condition**	**NRCS CN**	**Area, acres**	**Area in percent**	**Weighted CN**
East End Mixed Use	D		86	277.14	33.49%	28.80
East End Mixed Use	D	Too steep to develop	58	0.57	0.07%	0.04
General Commercial 2	D		95	63.53	7.68%	7.29
Rural Residential	B		68	85.66	10.35%	7.04
Rural Residential	B	Too steep to develop	55	12.03	1.45%	0.80
Rural Residential	D		84	60.70	7.34%	6.16
Rural Residential	D	Too steep to develop	58	0.64	0.08%	0.04
Rural Residential	U	Tidal Flats	58	4.77	0.58%	0.33
Rural Residential	U	Too steep to develop	58	0.69	0.08%	0.05
Outside Zoning	B	Assume future Rural Res.	68	200.39	24.22%	16.47
Outside Zoning	B	Too steep to develop	55	19.61	2.37%	1.30
Outside Zoning	D	Assume future Rural Res.	84	100.67	12.17%	10.22
Outside Zoning	D	Too steep to develop	58	0.68	0.08%	0.05
Outside Zoning	U	Tidal Flats	58	0.40	0.05%	0.03
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	15%		Total Area:	827.48 Ac	Total Weighted CN or C:	79

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor [1] / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape [2]	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 [3]	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow	Stem Vegetation	0.4	118	0.224		0.22
Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4]						0.00
"n" Value for Overland and Sheet Flow					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	1404	0.202	2.25	0.173
Tt=L/V/3600; V = 33kS^0.5	Woodland	0.152	459	0.248	2.50	0.051
k value, landcover factor					Subtotal, Shallow Flow Tt:	0.22
Channel Flow	Stream Channel	0.040	8051	0.155	11.19	0.20
Tt=L/V/3600;	4.62	6.92	Trap	2H : 1V	0.67	
V = [1.49/n][R^2/3][S^1/2]	Stream Channel	0.040	3150	0.022	5.45	0.16
Manning's "n" for Channel Flow	9.48	9.75	Trap	0H : 1V	0.97	
					0.00	0.00
	0.00	0.00		0H : 1V	0.00	
					Subtotal, Channel Flow Tt:	0.36
					Total Tt, hours:	0.80

Future Basin Runoff Summary no LID

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.184	19	553,871	18
2 Year-24hr (P2)	1.630	0.321	52	964,620	30
5 Year-24hr	2.060	0.558	118	1,675,918	36
10 Year-24hr	2.410	0.778	183	2,336,095	42
25 Year-24hr	2.920	1.130	289	3,395,192	54
50 Year-24hr	3.340	1.443	382	4,333,632	54
100 Year-24hr	3.780	1.786	488	5,366,050	60

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.184	0.034	1	103,308	103,308	18
2 Year-24hr (P2)	1.630	0.321	0.171	6	514,057	514,057	18
5 Year-24hr	2.060	0.558	0.408	25	1,225,355	1,225,355	24
10 Year-24hr	2.410	0.778	0.628	54	1,885,532	1,885,532	30
25 Year-24hr	2.920	1.130	0.980	134	2,944,629	2,944,629	42
50 Year-24hr	3.340	1.443	1.293	222	3,883,070	3,883,070	48
100 Year-24hr	3.780	1.786	1.636	326	4,915,487	4,915,487	54

BASIN CHARACTERIZATION AND DISCHARGE SUMMARY

Name:	14	Area: 320.02 Ac	Pre / Post Development?:	Post / Future Dev.	Orographic fctr:	1.00

Land Use / Zoning	Hydrologic Soil Group	Slope, ft/ft or Cover Condition	NRCS CN	Area, acres	Area in percent	Weighted CN
East End Mixed Use	D		86	43.44	13.57%	11.67
East End Mixed Use	D	Too steep to develop	58	0.18	0.06%	0.03
East End Mixed Use	U	Tidal Flats	58	2.03	0.63%	0.37
East End Mixed Use	U	Too steep to develop	55	0.54	0.17%	0.09
Rural Residential	B		68	0.43	0.13%	0.09
Rural Residential	B	Too steep to develop	55	0.32	0.10%	0.05
Rural Residential	D		84	8.90	2.78%	2.34
Rural Residential	D	Too steep to develop	58	0.11	0.03%	0.02
Rural Residential	U	Tidal Flats	58	0.85	0.27%	0.15
Rural Residential	U	Too steep to develop	55	0.09	0.03%	0.02
Outside Zoning	B	Assume future Rural Res.	68	72.07	22.52%	15.31
Outside Zoning	B	Too steep to develop	55	50.25	15.70%	8.64
Outside Zoning	D	Assume future Rural Res.	84	139.30	43.53%	36.56
Outside Zoning	D	Too steep to develop	58	1.26	0.39%	0.23
Outside Zoning	U	Tidal Flats	58	0.25	0.08%	0.05
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
				0.00	0.00%	0.00
Basin Existing % Impervious =	11%		Total Area:	320.02 Ac	Total Weighted CN or C:	76

Time of Concentration (within Subbasin Routing)

General Parameters: / Channel Parameters:	Surface Cover / Cross Section Area, sq ft	n or k, Roughness Factor (1) / Wetted Perimeter, ft	L, Flow Length, ft / Channel Shape (2)	S, Longitudinal Slope, ft/ft / Channel Side Slope, H:1 (3)	Average Velocity ft/s / R, Hydraulic Radius, ft	Travel time, Tt, hrs
Sheet Flow Tt=[0.007(nL)^0.8]/[(P2)^0.5(S)^0.4] "n" Value for Overland and Sheet Flow	Stem Vegetation	0.4	94	0.142		0.22 0.00
					Subtotal, Sheet Flow Tt:	0.22
Shallow Flow	Woodland	0.152	540	0.314	2.81	0.053
Tt=L/V/3600; V = 33kS^0.5 k value, landcover factor	Woodland	0.152	42	0.357	3.00	0.004
					Subtotal, Shallow Flow Tt:	0.06
Channel Flow Tt=L/V/3600; V = [1.49/n][R^2/3][S^1/2] Manning's "n" for Channel Flow	Stream Channel 1.67	0.040 4.42	7814 Trap	0.134 2H : 1V	7.12 0.38	0.30
	0.00	0.00		0H : 1V	0.00 0.00	0.00
	0.00	0.00		0H : 1V	0.00 0.00	0.00
					Subtotal, Channel Flow Tt:	0.30
					Total Tt, hours:	0.58

Future Basin Runoff Summary no LID

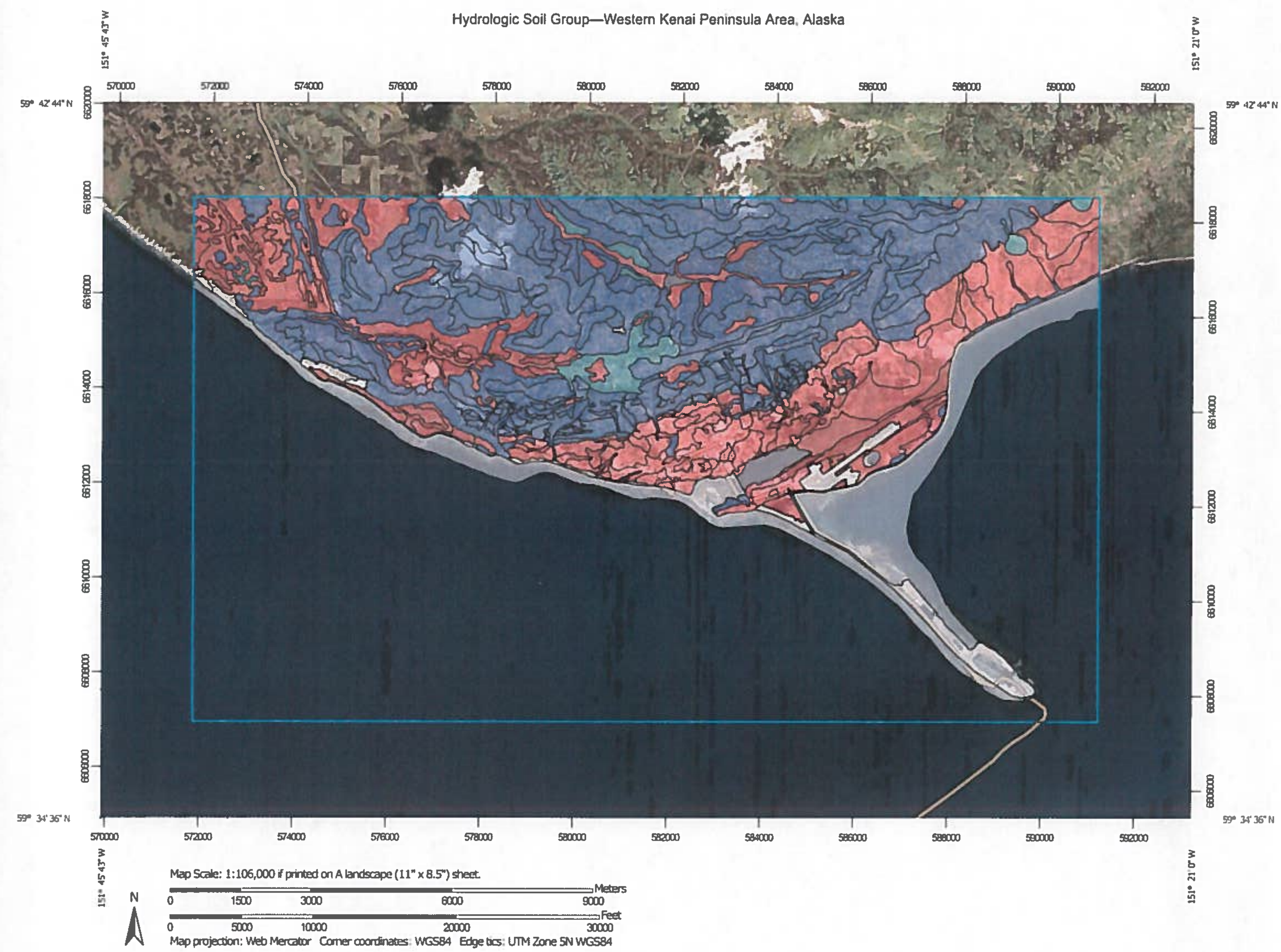
NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.126	4	146,942	18
2 Year-24hr (P2)	1.630	0.240	12	278,614	18
5 Year-24hr	2.060	0.445	35	516,812	24
10 Year-24hr	2.410	0.641	60	744,303	30
25 Year-24hr	2.920	0.962	103	1,116,999	36
50 Year-24hr	3.340	1.250	142	1,452,615	42
100 Year-24hr	3.780	1.572	186	1,825,970	42

Future Basin Runoff Summary with LID and First 0.6-inches of Rainfall Infiltrated

NRCS Type I, Storm Frequency & Duration	NOAA Atlas 14, Precipitation (Inches)	Q, Runoff, Inches	Q, Runoff After 25% of properties Retaining 0.6", Inches	Peak Discharge, cfs	Total Storm Volume, cubic feet	Total Storm Volume, cubic feet	Pipe Dia (in) Req'd @ 4% Slope, flowing full (18" Min.)
1 Year-24hr	1.330	0.126	0.000	-	-	-	18
2 Year-24hr (P2)	1.630	0.240	0.090	1	104,363	104,363	18
5 Year-24hr	2.060	0.445	0.295	6	342,561	342,561	18
10 Year-24hr	2.410	0.641	0.491	14	570,052	570,052	18
25 Year-24hr	2.920	0.962	0.812	39	942,748	942,748	24
50 Year-24hr	3.340	1.250	1.100	72	1,278,365	1,278,365	30
100 Year-24hr	3.780	1.572	1.422	114	1,651,719	1,651,719	36

Appendix B – NRCS Hydrologic Soil Map

Hydrologic Soil Group—Western Kenai Peninsula Area, Alaska



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Western Kenai Peninsula Area, Alaska
Survey Area Data: Version 18, Oct 22, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 1, 1999—Dec 31, 2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
503	Badland, sea cliffs		75.4	0.1%
504	Badland, sea cliffs-Typic Cryorthents complex, very steep		125.1	0.2%
505	Beaches		35.6	0.1%
506	Beluga silt loam, 0 to 4 percent slopes	D	861.6	1.6%
507	Beluga silt loam, 4 to 8 percent slopes	D	1,329.2	2.5%
508	Beluga silt loam, 8 to 15 percent slopes	D	136.1	0.3%
509	Beluga-Mutnala complex, 0 to 8 percent slopes	D	366.4	0.7%
510	Beluga-Smokey Bay complex, 4 to 8 percent slopes	D	1,071.0	2.0%
511	Beluga-Smokey Bay complex, 8 to 15 percent slopes	D	499.1	0.9%
516	Benka silt loam, 25 to 60 percent slopes	B	36.8	0.1%
530	Chunilna mucky silt loam, 0 to 4 percent slopes	D	23.2	0.0%
531	Chunilna mucky silt loam, 4 to 8 percent slopes	D	517.1	1.0%
535	Clunie peat, 0 to 2 percent slopes	D	188.5	0.4%
536	Coal Creek silt loam, 0 to 4 percent slopes	D	0.1	0.0%
538	Coal Creek silt loam, 8 to 15 percent slopes	D	360.0	0.7%
541	Cohoe silt loam, 8 to 15 percent slopes	B	134.1	0.3%
558	Doroshin mucky peat, 0 to 4 percent slopes	D	42.4	0.1%
559	Doroshin mucky peat, 4 to 8 percent slopes	D	41.0	0.1%
563	Gravel pits		5.8	0.0%
569	Island silt loam, 4 to 8 percent slopes	B	99.5	0.2%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
570	Island silt loam, 8 to 15 percent slopes	B	55.1	0.1%
572	Island silt loam, forested, 0 to 8 percent slopes	B	146.5	0.3%
573	Kachemak silt loam, 4 to 8 percent slopes	B	2,153.7	4.1%
574	Kachemak silt loam, 8 to 15 percent slopes	B	2,637.9	5.0%
575	Kachemak silt loam, 15 to 25 percent slopes	B	1,644.3	3.1%
576	Kachemak silt loam, 25 to 35 percent slopes	B	908.4	1.7%
577	Kachemak silt loam, 35 to 45 percent slopes	B	498.6	0.9%
583	Kachemak silt loam, forested, 4 to 8 percent slopes	B	550.3	1.0%
584	Kachemak silt loam, forested, 8 to 15 percent slopes	B	257.2	0.5%
585	Kachemak silt loam, forested, 15 to 25 percent slopes	B	52.7	0.1%
611	Killey and Moose River soils, 0 to 2 percent slopes	D	1.8	0.0%
618	Mutnala silt loam, 4 to 8 percent slopes	B	864.2	1.6%
619	Mutnala silt loam, 8 to 15 percent slopes	B	307.3	0.6%
620	Mutnala silt loam, 15 to 25 percent slopes	B	258.2	0.5%
621	Mutnala silt loam, 25 to 45 percent slopes	B	258.1	0.5%
622	Mutnala silt loam, 45 to 60 percent slopes	B	89.4	0.2%
623	Mutnala-Starichkof-Slikok association, undulating to hilly	D	535.7	1.0%
641	Qutal silt loam, 4 to 8 percent slopes	C	482.8	0.9%
647	Redoubt silt loams, moderately steep and gently sloping	B	239.8	0.5%
650	Salamatof and Doroshin peats, 0 to 2 percent slopes	D	12.6	0.0%
651	Salamatof peat, 0 to 4 percent slopes	D	344.2	0.6%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
653	Slikok peat, 4 to 8 percent slopes	D	36.0	0.1%
657	Smokey Bay silt loam, 8 to 15 percent slopes	C	73.1	0.1%
673	Spenard peat, 0 to 4 percent slopes	D	145.7	0.3%
674	Spenard peat, 4 to 8 percent slopes	D	778.1	1.5%
675	Spenard peat, 8 to 15 percent slopes	D	186.0	0.4%
676	Starichkof and Doroshin soils, 0 to 4 percent slopes	D	556.9	1.0%
677	Starichkof peat, 0 to 4 percent slopes	D	221.4	0.4%
678	Starichkof peat, 4 to 8 percent slopes	D	7.9	0.0%
688	Tidal flats		3,300.5	6.2%
695	Truuli muck, 0 to 4 percent slopes	C	25.5	0.0%
700	Tuxedni silt loam, warm, 0 to 8 percent slopes	B	39.5	0.1%
701	Typic Cryaquents, 0 to 2 percent slopes	D	58.2	0.1%
703	Typic Cryorthents, 100 to 150 percent slopes	B	1,646.2	3.1%
704	Urban land		576.6	1.1%
705	Water, fresh		220.4	0.4%
Totals for Area of Interest			**53,063.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C – NOAA Atlas 14 Rainfall Frequency & Duration Data

NOAA Atlas 14, Volume 7, Version 2 HOMER AP
Station ID: 50-3665
Location name: Homer, Alaska, USA*
Latitude: 59.65°, Longitude: -151.4833°
Elevation:
Elevation (station metadata): 64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Douglas Kane, Sarah Dietz, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Svetlana Stuefer, Amy Tidwell, Carl Trypaluk, Dale Unruh, Michael Yekta, Erica Betts, Geoffrey Bonnin, Sarah Heim, Lillian Hiner, Elizabeth Lilly, Jayashree Narayanan, Fenglin Yan, Tan Zhao

NOAA, National Weather Service, Silver Spring, Maryland
and
University of Alaska Fairbanks, Water and Environmental Research Center

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.085 (0.062-0.119)	0.104 (0.075-0.148)	0.133 (0.093-0.194)	0.158 (0.108-0.235)	0.191 (0.128-0.292)	0.217 (0.142-0.339)	0.242 (0.155-0.385)	0.276 (0.174-0.448)	0.321 (0.198-0.535)	0.355 (0.215-0.603)
10-min	0.115 (0.084-0.161)	0.140 (0.100-0.199)	0.179 (0.125-0.261)	0.212 (0.145-0.315)	0.256 (0.171-0.391)	0.291 (0.190-0.454)	0.325 (0.208-0.517)	0.371 (0.233-0.602)	0.431 (0.265-0.718)	0.477 (0.289-0.810)
15-min	0.134 (0.098-0.188)	0.164 (0.118-0.233)	0.210 (0.147-0.306)	0.248 (0.170-0.369)	0.300 (0.200-0.459)	0.340 (0.222-0.530)	0.381 (0.244-0.606)	0.434 (0.273-0.705)	0.505 (0.311-0.841)	0.558 (0.338-0.948)
30-min	0.178 (0.130-0.249)	0.218 (0.156-0.310)	0.278 (0.195-0.405)	0.329 (0.226-0.489)	0.398 (0.266-0.608)	0.452 (0.296-0.705)	0.505 (0.324-0.804)	0.576 (0.362-0.935)	0.670 (0.412-1.12)	0.741 (0.449-1.26)
60-min	0.244 (0.178-0.342)	0.298 (0.214-0.424)	0.381 (0.267-0.555)	0.450 (0.309-0.669)	0.545 (0.364-0.833)	0.619 (0.405-0.966)	0.692 (0.444-1.10)	0.789 (0.496-1.28)	0.918 (0.565-1.53)	1.01 (0.615-1.72)
2-hr	0.343 (0.250-0.480)	0.420 (0.301-0.597)	0.537 (0.376-0.783)	0.635 (0.436-0.945)	0.768 (0.513-1.17)	0.872 (0.571-1.36)	0.974 (0.625-1.55)	1.11 (0.699-1.80)	1.29 (0.795-2.15)	1.43 (0.865-2.43)
3-hr	0.441 (0.322-0.617)	0.540 (0.388-0.768)	0.691 (0.484-1.01)	0.817 (0.561-1.22)	0.990 (0.661-1.51)	1.12 (0.734-1.75)	1.25 (0.803-1.99)	1.43 (0.898-2.32)	1.66 (1.02-2.77)	1.84 (1.11-3.12)
6-hr	0.680 (0.496-0.952)	0.831 (0.597-1.18)	1.06 (0.744-1.55)	1.26 (0.862-1.87)	1.52 (1.02-2.33)	1.73 (1.13-2.69)	1.93 (1.24-3.07)	2.20 (1.38-3.57)	2.56 (1.58-4.26)	2.83 (1.71-4.81)
12-hr	0.973 (0.709-1.36)	1.19 (0.855-1.69)	1.52 (1.06-2.21)	1.78 (1.22-2.65)	2.16 (1.44-3.30)	2.46 (1.61-3.83)	2.76 (1.77-4.40)	3.15 (1.98-5.11)	3.66 (2.25-6.10)	4.04 (2.45-6.87)
24-hr	1.33 (1.19-1.51)	1.63 (1.43-1.87)	2.06 (1.77-2.42)	2.41 (2.04-2.88)	2.92 (2.41-3.56)	3.34 (2.71-4.14)	3.78 (3.02-4.78)	4.32 (3.39-5.55)	5.02 (3.86-6.59)	5.55 (4.20-7.41)
2-day	1.67 (1.49-1.90)	2.02 (1.77-2.32)	2.53 (2.18-2.97)	2.97 (2.51-3.54)	3.60 (2.98-4.40)	4.14 (3.37-5.15)	4.73 (3.78-5.98)	5.46 (4.29-7.02)	6.43 (4.94-8.44)	7.15 (5.41-9.55)
3-day	1.88 (1.68-2.14)	2.26 (1.99-2.60)	2.83 (2.43-3.32)	3.31 (2.80-3.95)	4.03 (3.33-4.92)	4.65 (3.78-5.78)	5.33 (4.26-6.74)	6.21 (4.88-7.98)	7.36 (5.66-9.67)	8.23 (6.23-11.0)
4-day	2.06 (1.84-2.34)	2.47 (2.17-2.84)	3.07 (2.64-3.61)	3.59 (3.04-4.29)	4.37 (3.62-5.34)	5.05 (4.10-6.27)	5.79 (4.63-7.32)	6.75 (5.31-8.68)	8.02 (6.17-10.5)	8.98 (6.79-12.0)
7-day	2.58 (2.29-2.92)	3.05 (2.68-3.51)	3.76 (3.23-4.41)	4.36 (3.69-5.21)	5.27 (4.36-6.43)	6.04 (4.91-7.51)	6.89 (5.51-8.71)	7.98 (6.27-10.3)	9.41 (7.24-12.4)	10.5 (7.94-14.0)
10-day	2.99 (2.66-3.39)	3.52 (3.09-4.05)	4.31 (3.71-5.06)	4.98 (4.21-5.94)	5.97 (4.94-7.29)	6.81 (5.53-8.46)	7.73 (6.18-9.77)	8.88 (6.98-11.4)	10.4 (8.00-13.7)	11.6 (8.74-15.4)
20-day	4.24 (3.78-4.82)	4.97 (4.37-5.72)	6.03 (5.19-7.09)	6.91 (5.85-8.25)	8.19 (6.78-10.0)	9.26 (7.52-11.5)	10.4 (8.31-13.1)	11.8 (9.27-15.2)	13.6 (10.5-17.9)	15.0 (11.4-20.0)
30-day	5.42 (4.82-6.15)	6.34 (5.57-7.29)	7.65 (6.59-8.99)	8.73 (7.39-10.4)	10.3 (8.50-12.6)	11.6 (9.39-14.4)	12.9 (10.3-16.3)	14.5 (11.4-18.7)	16.6 (12.8-21.8)	18.2 (13.8-24.3)
45-day	6.91 (6.15-7.84)	8.09 (7.11-9.31)	9.76 (8.40-11.5)	11.1 (9.40-13.3)	13.0 (10.8-15.9)	14.5 (11.8-18.1)	16.2 (12.9-20.4)	18.0 (14.1-23.1)	20.4 (15.7-26.9)	22.3 (16.9-29.8)
60-day	7.94 (7.07-9.01)	9.35 (8.22-10.8)	11.3 (9.74-13.3)	12.9 (10.9-15.4)	15.0 (12.4-18.4)	16.7 (13.6-20.8)	18.5 (14.8-23.4)	20.5 (16.1-26.3)	23.1 (17.7-30.3)	25.0 (18.9-33.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) values and may be higher than currently valid PMP values.

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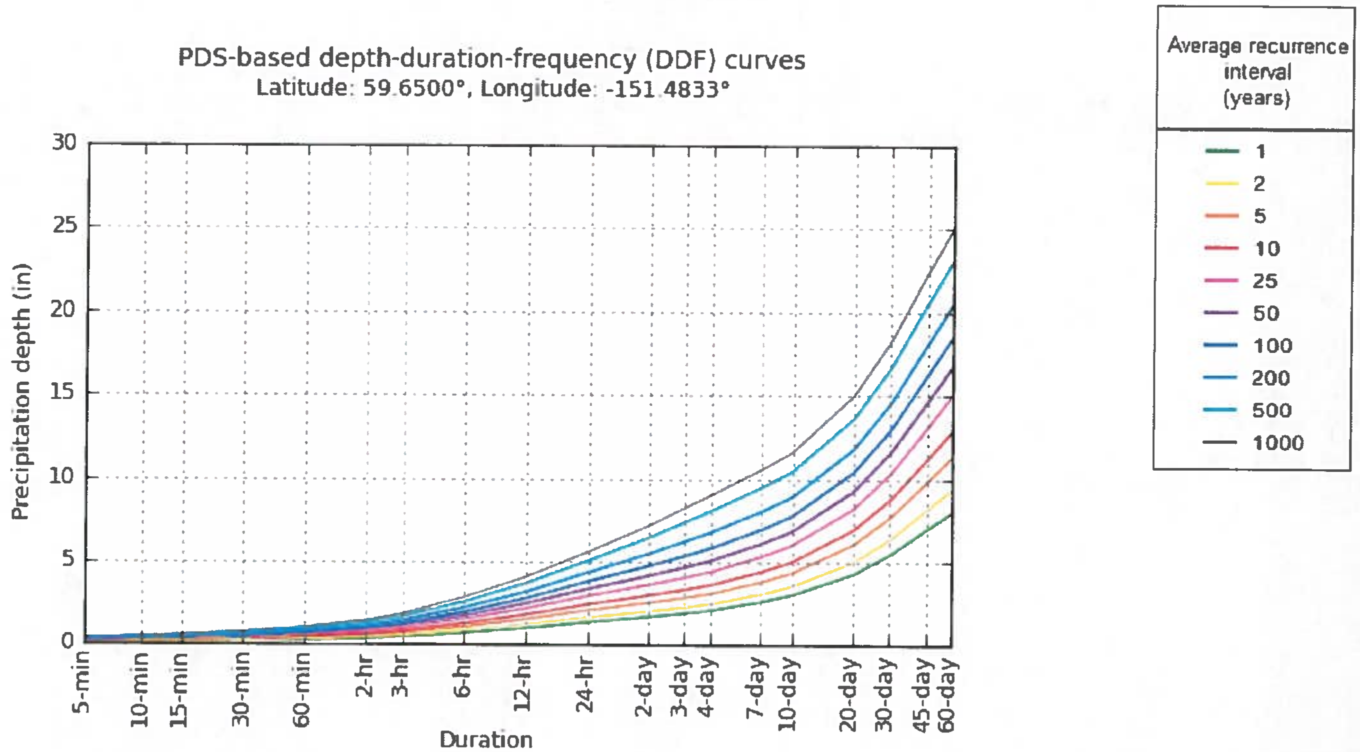
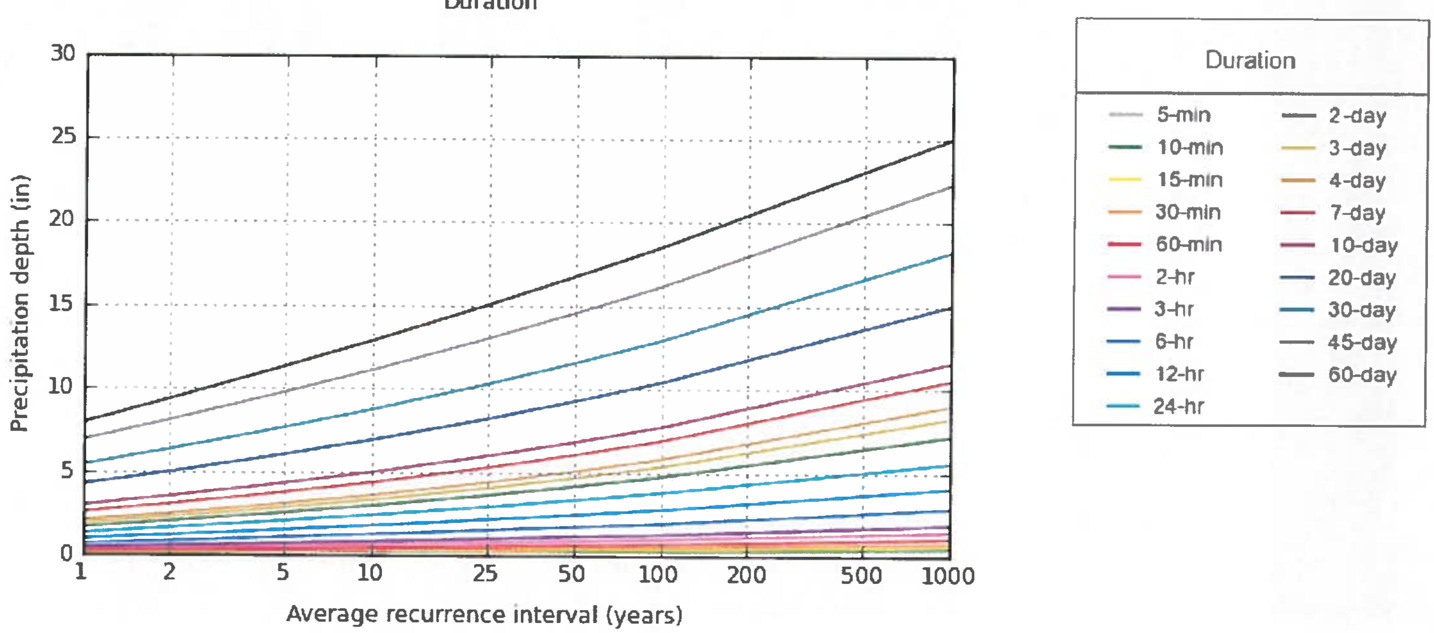
PF graphical





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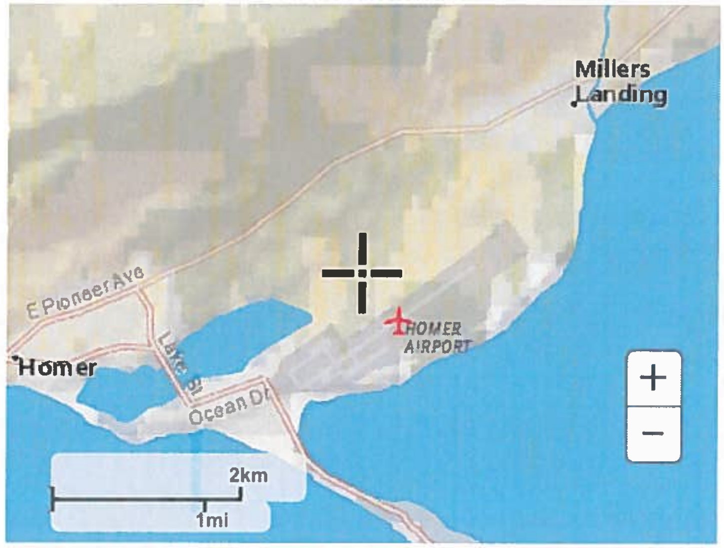
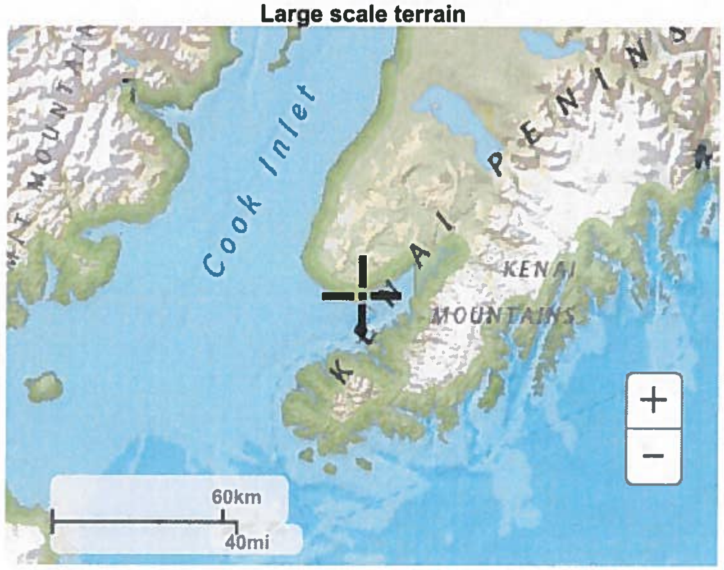
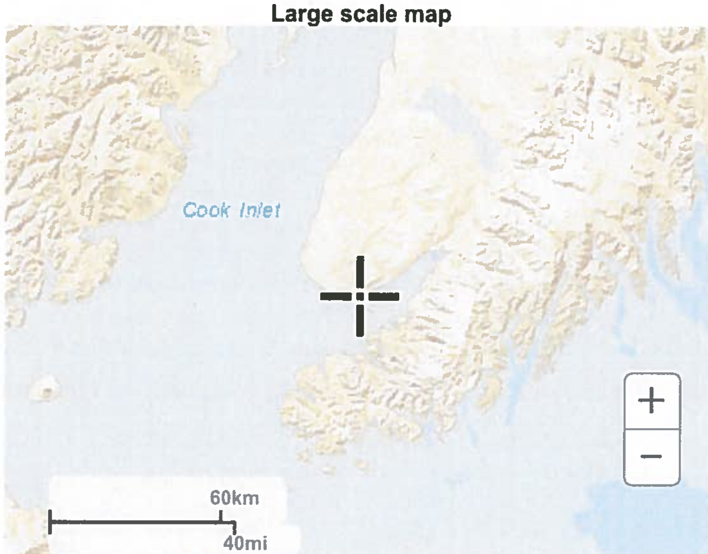
Small scale terrain



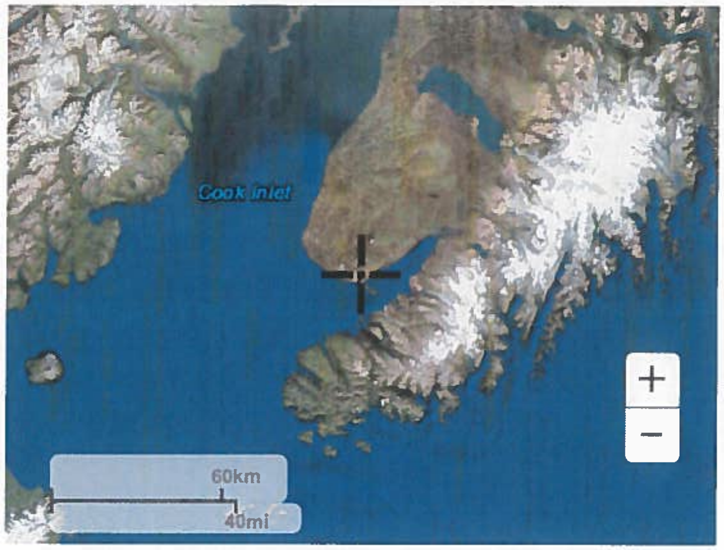
Large scale terrain



Large scale map



Large scale aerial



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NOAA Atlas 14, Volume 7, Version 2
Location name: Homer, Alaska, USA*
Latitude: 59.65°, Longitude: -151.4833°
Elevation: 24.54 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Douglas Kane, Sarah Dietz, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Svetlana Stuefer, Amy Tidwell, Carl Trypaluk, Dale Unruh, Michael Yekta, Erica Betts, Geoffrey Bonnin, Sarah Heim, Lillian Hiner, Elizabeth Lilly, Jayashree Narayanan, Fenglin Yan, Tan Zhao

NOAA, National Weather Service, Silver Spring, Maryland
and
University of Alaska Fairbanks, Water and Environmental Research Center

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.02** (0.744-1.43)	**1.25** (0.900-1.78)	**1.60** (1.12-2.33)	**1.90** (1.30-2.82)	**2.29** (1.54-3.50)	**2.60** (1.70-4.07)	**2.90** (1.86-4.62)	**3.31** (2.09-5.38)	**3.85** (2.38-6.42)	**4.26** (2.58-7.24)
10-min	**0.690** (0.504-0.966)	**0.840** (0.600-1.19)	**1.07** (0.750-1.57)	**1.27** (0.870-1.89)	**1.54** (1.03-2.35)	**1.75** (1.14-2.72)	**1.95** (1.25-3.10)	**2.23** (1.40-3.61)	**2.59** (1.59-4.31)	**2.86** (1.73-4.86)
15-min	**0.536** (0.392-0.752)	**0.656** (0.472-0.932)	**0.840** (0.588-1.22)	**0.992** (0.680-1.48)	**1.20** (0.800-1.84)	**1.36** (0.888-2.12)	**1.52** (0.976-2.42)	**1.74** (1.09-2.82)	**2.02** (1.24-3.36)	**2.23** (1.35-3.79)
30-min	**0.356** (0.260-0.498)	**0.436** (0.312-0.620)	**0.556** (0.390-0.810)	**0.658** (0.452-0.978)	**0.796** (0.532-1.22)	**0.904** (0.592-1.41)	**1.01** (0.648-1.61)	**1.15** (0.724-1.87)	**1.34** (0.824-2.23)	**1.48** (0.898-2.52)
60-min	**0.244** (0.178-0.342)	**0.298** (0.214-0.424)	**0.381** (0.267-0.555)	**0.450** (0.309-0.669)	**0.545** (0.364-0.833)	**0.619** (0.405-0.966)	**0.692** (0.444-1.10)	**0.789** (0.496-1.28)	**0.918** (0.565-1.53)	**1.01** (0.615-1.72)
2-hr	**0.172** (0.125-0.240)	**0.210** (0.150-0.298)	**0.268** (0.188-0.392)	**0.318** (0.218-0.472)	**0.384** (0.256-0.587)	**0.436** (0.286-0.680)	**0.487** (0.312-0.775)	**0.556** (0.350-0.902)	**0.646** (0.398-1.08)	**0.714** (0.432-1.21)
3-hr	**0.147** (0.107-0.205)	**0.180** (0.129-0.256)	**0.230** (0.161-0.335)	**0.272** (0.187-0.405)	**0.330** (0.220-0.504)	**0.373** (0.244-0.582)	**0.417** (0.267-0.664)	**0.476** (0.299-0.772)	**0.553** (0.340-0.922)	**0.612** (0.370-1.04)
6-hr	**0.114** (0.083-0.159)	**0.139** (0.100-0.197)	**0.178** (0.124-0.259)	**0.210** (0.144-0.312)	**0.254** (0.170-0.388)	**0.288** (0.189-0.449)	**0.322** (0.207-0.513)	**0.367** (0.231-0.597)	**0.427** (0.263-0.712)	**0.473** (0.286-0.803)
12-hr	**0.081** (0.059-0.113)	**0.099** (0.071-0.141)	**0.126** (0.088-0.183)	**0.148** (0.101-0.220)	**0.179** (0.120-0.274)	**0.204** (0.133-0.318)	**0.229** (0.147-0.365)	**0.261** (0.164-0.424)	**0.304** (0.187-0.506)	**0.336** (0.203-0.570)
24-hr	**0.056** (0.049-0.063)	**0.068** (0.060-0.078)	**0.086** (0.074-0.101)	**0.100** (0.085-0.120)	**0.122** (0.101-0.148)	**0.139** (0.113-0.173)	**0.158** (0.126-0.199)	**0.180** (0.141-0.231)	**0.209** (0.161-0.275)	**0.231** (0.175-0.309)
2-day	**0.035** (0.031-0.039)	**0.042** (0.037-0.048)	**0.053** (0.045-0.062)	**0.062** (0.052-0.074)	**0.075** (0.062-0.092)	**0.086** (0.070-0.107)	**0.099** (0.079-0.125)	**0.114** (0.089-0.146)	**0.134** (0.103-0.176)	**0.149** (0.113-0.199)
3-day	**0.026** (0.023-0.030)	**0.031** (0.028-0.036)	**0.039** (0.034-0.046)	**0.046** (0.039-0.055)	**0.056** (0.046-0.068)	**0.065** (0.053-0.080)	**0.074** (0.059-0.094)	**0.086** (0.068-0.111)	**0.102** (0.079-0.134)	**0.114** (0.086-0.153)
4-day	**0.021** (0.019-0.024)	**0.026** (0.023-0.030)	**0.032** (0.028-0.038)	**0.037** (0.032-0.045)	**0.046** (0.038-0.056)	**0.053** (0.043-0.065)	**0.060** (0.048-0.076)	**0.070** (0.055-0.090)	**0.084** (0.064-0.110)	**0.094** (0.071-0.125)
7-day	**0.015** (0.014-0.017)	**0.018** (0.016-0.021)	**0.022** (0.019-0.026)	**0.026** (0.022-0.031)	**0.031** (0.026-0.038)	**0.036** (0.029-0.045)	**0.041** (0.033-0.052)	**0.047** (0.037-0.061)	**0.056** (0.043-0.074)	**0.062** (0.047-0.083)
10-day	**0.012** (0.011-0.014)	**0.015** (0.013-0.017)	**0.018** (0.015-0.021)	**0.021** (0.018-0.025)	**0.025** (0.021-0.030)	**0.028** (0.023-0.035)	**0.032** (0.026-0.041)	**0.037** (0.029-0.048)	**0.043** (0.033-0.057)	**0.048** (0.036-0.064)
20-day	**0.009** (0.008-0.010)	**0.010** (0.009-0.012)	**0.013** (0.011-0.015)	**0.014** (0.012-0.017)	**0.017** (0.014-0.021)	**0.019** (0.016-0.024)	**0.022** (0.017-0.027)	**0.025** (0.019-0.032)	**0.028** (0.022-0.037)	**0.031** (0.024-0.042)
30-day	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.011** (0.009-0.012)	**0.012** (0.010-0.014)	**0.014** (0.012-0.017)	**0.016** (0.013-0.020)	**0.018** (0.014-0.023)	**0.020** (0.016-0.026)	**0.023** (0.018-0.030)	**0.025** (0.019-0.034)
45-day	**0.006** (0.006-0.007)	**0.007** (0.007-0.009)	**0.009** (0.008-0.011)	**0.010** (0.009-0.012)	**0.012** (0.010-0.015)	**0.013** (0.011-0.017)	**0.015** (0.012-0.019)	**0.017** (0.013-0.021)	**0.019** (0.015-0.025)	**0.021** (0.016-0.028)
60-day	**0.006** (0.005-0.006)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.010** (0.009-0.013)	**0.012** (0.009-0.014)	**0.013** (0.010-0.016)	**0.014** (0.011-0.018)	**0.016** (0.012-0.021)	**0.017** (0.013-0.023)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not

checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
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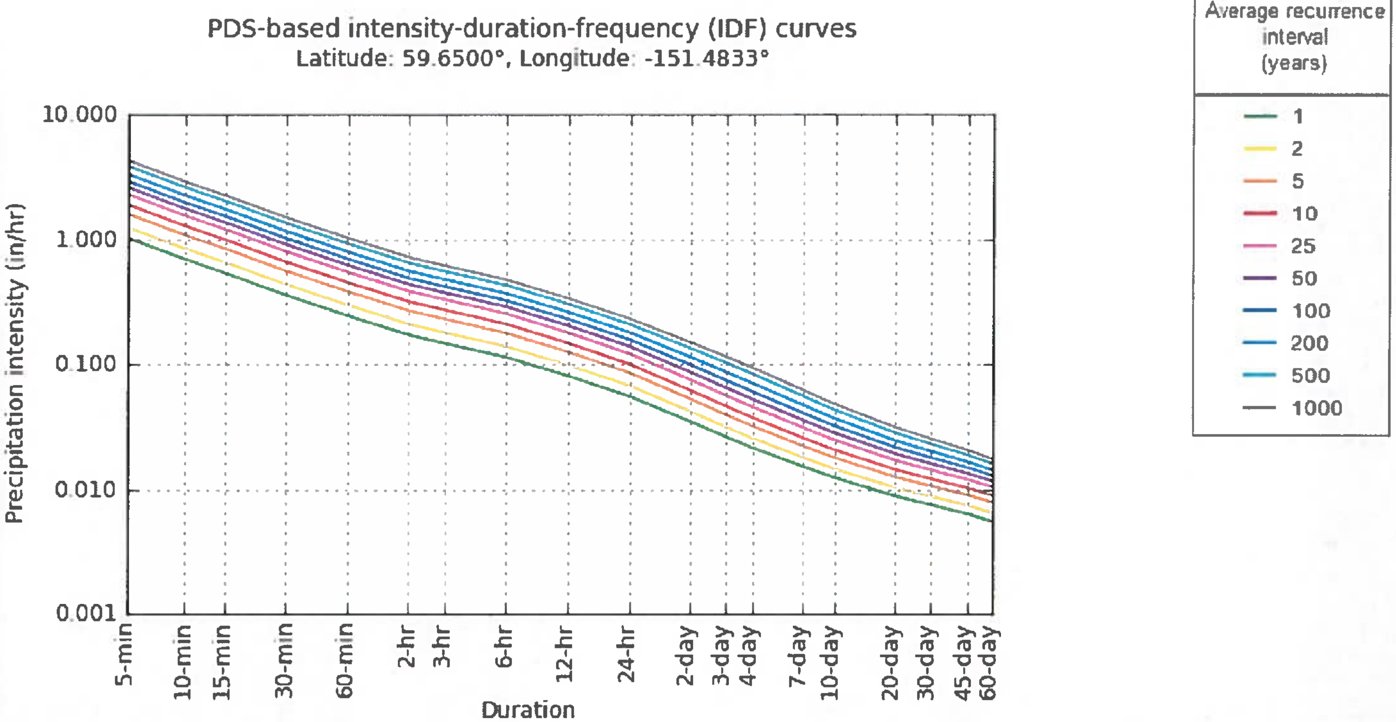
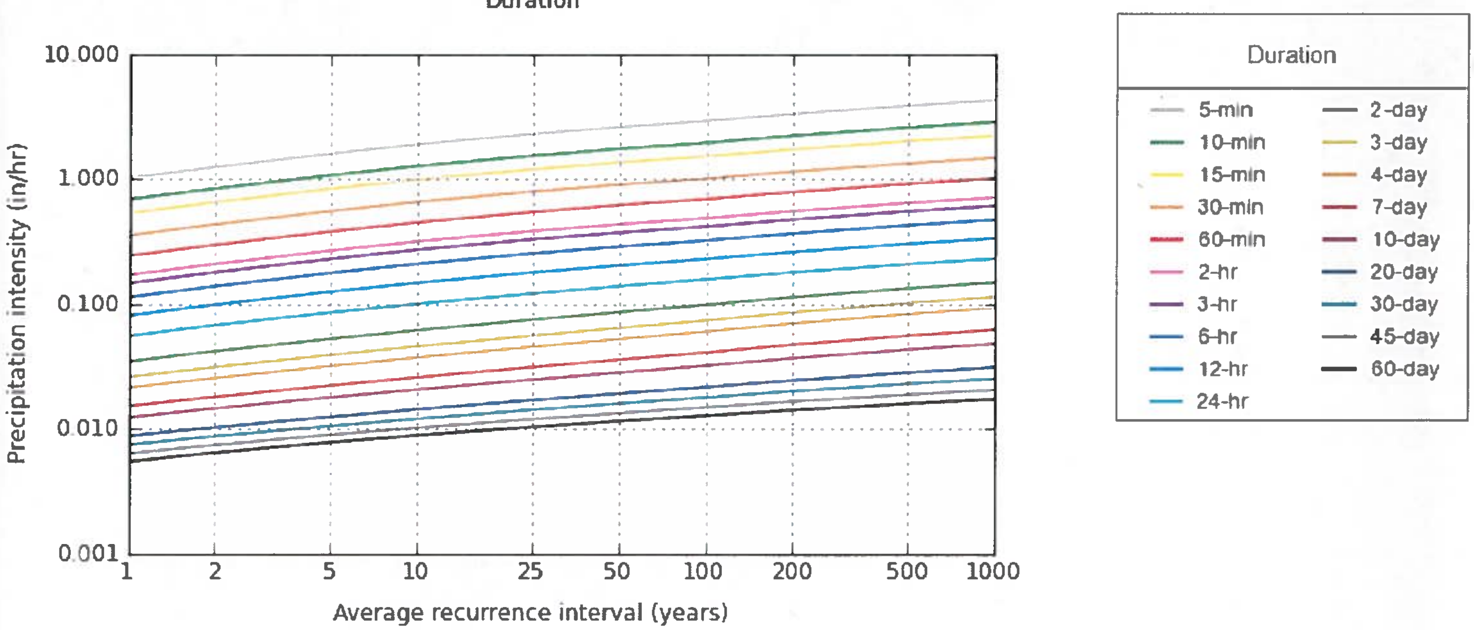
PF graphical





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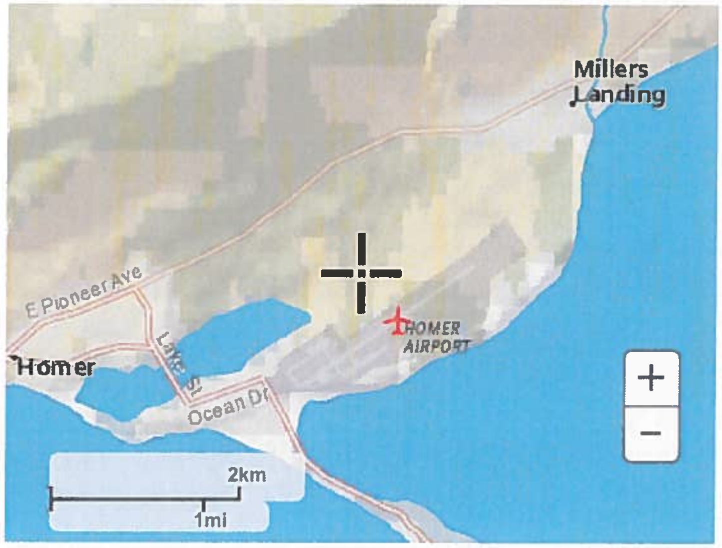
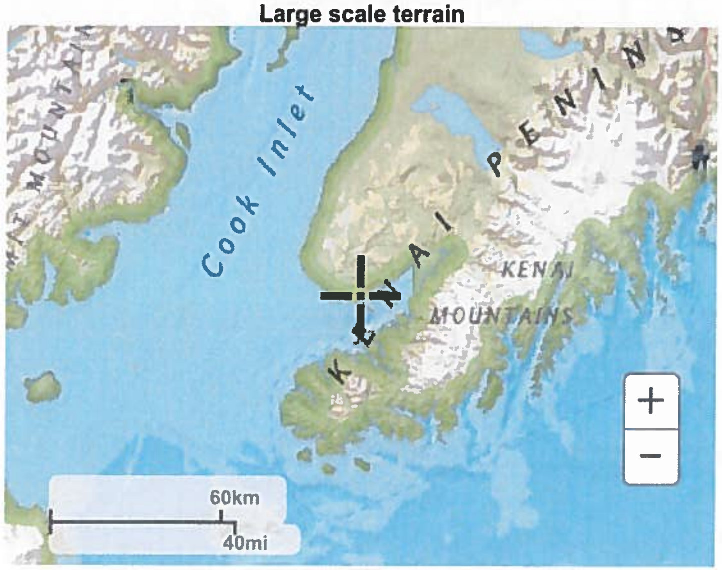
Small scale terrain



Large scale terrain



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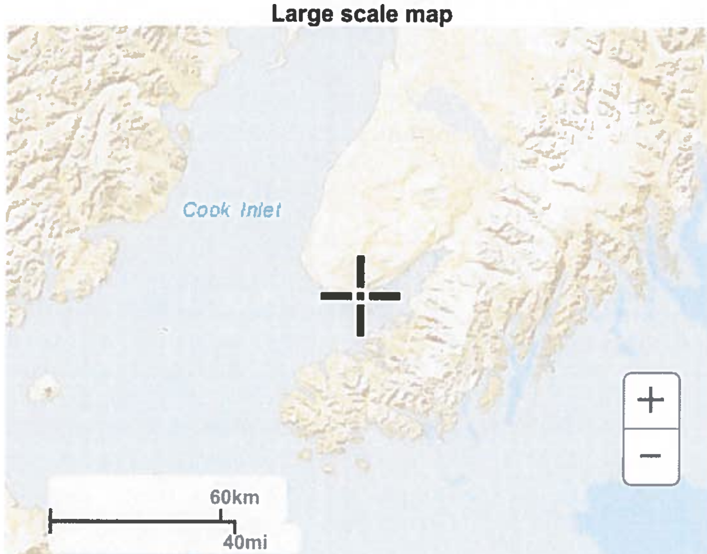
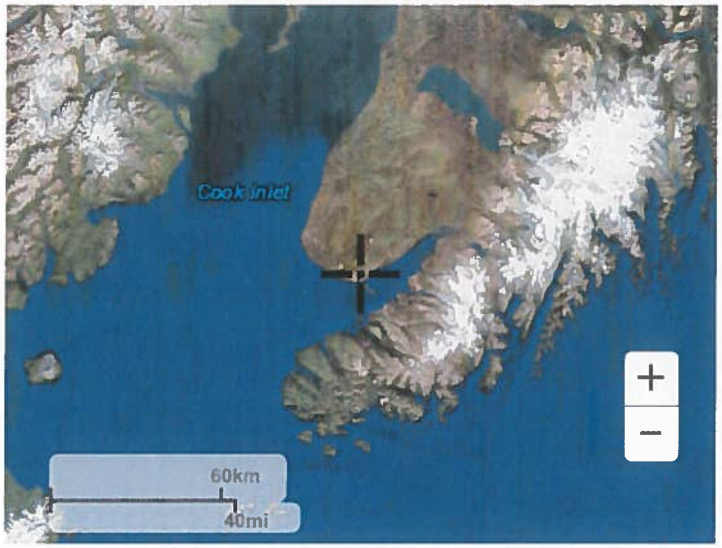


Large scale aerial



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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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Appendix D – Daily Rainfall Data Homer Airport, AK US (GHCND:USW00025507)

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
1998/10/13	0.11
1999/05/27	0.11
1999/06/28	0.11
1999/07/20	0.11
1999/09/18	0.11
1999/10/2	0.11
2000/09/20	0.11
2000/11/23	0.11
2001/07/3	0.11
2001/10/9	0.11
2002/01/6	0.11
2002/07/15	0.11
2002/10/18	0.11
2002/10/30	0.11
2003/02/9	0.11
2003/08/16	0.11
2003/09/25	0.11
2004/05/25	0.11
2004/08/19	0.11
2004/09/11	0.11
2004/10/26	0.11
2005/08/2	0.11
2005/10/8	0.11
2005/12/7	0.11
2006/09/14	0.11
2006/10/16	0.11
2007/07/25	0.11
2011/09/17	0.11
2011/10/16	0.11
2011/10/20	0.11
2012/08/26	0.11
2014/08/12	0.11
2014/08/15	0.11
2014/08/16	0.11
2015/01/13	0.11
2015/12/31	0.11
2016/01/5	0.11
2016/01/27	0.11
2016/03/4	0.11
2016/03/29	0.11
2016/05/9	0.11
2017/01/31	0.11
2017/09/12	0.11
2017/11/28	0.11
2018/08/19	0.11
1998/07/5	0.12
1998/09/7	0.12
1998/09/23	0.12
1998/10/19	0.12
1999/05/10	0.12

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
1999/07/15	0.12
1999/08/22	0.12
2001/08/25	0.12
2001/09/12	0.12
2002/01/1	0.12
2002/07/14	0.12
2002/08/15	0.12
2002/11/20	0.12
2002/11/24	0.12
2002/11/25	0.12
2003/02/25	0.12
2004/06/17	0.12
2004/10/27	0.12
2004/11/20	0.12
2004/12/15	0.12
2004/12/16	0.12
2004/12/17	0.12
2005/01/2	0.12
2005/08/21	0.12
2005/10/5	0.12
2006/05/6	0.12
2006/09/5	0.12
2007/06/9	0.12
2007/08/16	0.12
2007/10/1	0.12
2011/02/9	0.12
2011/07/11	0.12
2013/08/16	0.12
2013/09/21	0.12
2013/11/26	0.12
2014/01/6	0.12
2014/01/8	0.12
2014/06/6	0.12
2014/06/7	0.12
2014/11/29	0.12
2015/02/20	0.12
2015/09/6	0.12
2015/10/8	0.12
2015/11/22	0.12
2016/05/1	0.12
2017/01/27	0.12
2017/02/12	0.12
1998/11/1	0.13
1999/04/19	0.13
1999/07/25	0.13
1999/09/29	0.13
2000/06/20	0.13
2000/10/15	0.13
2001/10/3	0.13
2002/10/17	0.13

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2002/10/25	0.13
2003/10/8	0.13
2004/02/8	0.13
2012/09/2	0.13
2012/09/8	0.13
2013/05/2	0.13
2013/05/13	0.13
2013/07/5	0.13
2013/09/24	0.13
2014/03/14	0.13
2014/07/26	0.13
2014/09/5	0.13
2014/09/18	0.13
2014/10/9	0.13
2014/12/31	0.13
2015/02/14	0.13
2015/03/15	0.13
2015/04/16	0.13
2015/09/13	0.13
2015/10/16	0.13
2016/03/19	0.13
2016/06/11	0.13
2016/09/24	0.13
2017/07/15	0.13
2017/08/26	0.13
2018/01/14	0.13
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2018/08/25	0.13
2018/11/17	0.13
2018/12/29	0.13
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1998/05/21	0.14
2000/09/13	0.14
2000/09/24	0.14
2001/07/11	0.14
2001/08/4	0.14
2001/09/7	0.14
2002/08/31	0.14
2002/10/24	0.14
2002/11/30	0.14
2003/06/26	0.14
2003/07/1	0.14
2003/09/29	0.14
2004/11/10	0.14
2005/09/4	0.14
2006/06/12	0.14
2007/07/10	0.14
2011/05/17	0.14
2011/09/21	0.14
2012/05/26	0.14

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2012/12/9	0.14
2013/04/6	0.14
2013/10/11	0.14
2013/12/5	0.14
2014/02/18	0.14
2014/08/8	0.14
2014/12/22	0.14
2015/11/9	0.14
2015/12/13	0.14
2015/12/14	0.14
2016/03/11	0.14
2016/04/6	0.14
2016/08/17	0.14
2017/07/26	0.14
2017/08/18	0.14
2017/09/1	0.14
2017/10/26	0.14
2018/07/15	0.14
2018/08/10	0.14
2018/12/15	0.14
2018/12/28	0.14
1998/07/3	0.15
1998/08/24	0.15
1999/08/15	0.15
1999/08/20	0.15
2000/10/25	0.15
2001/09/19	0.15
2001/10/5	0.15
2002/04/19	0.15
2002/08/11	0.15
2002/09/23	0.15
2002/10/15	0.15
2002/11/4	0.15
2002/11/28	0.15
2003/02/10	0.15
2003/09/9	0.15
2004/12/1	0.15
2005/03/9	0.15
2005/10/3	0.15
2005/10/20	0.15
2005/12/16	0.15
2007/09/22	0.15
2011/09/13	0.15
2012/07/3	0.15
2013/10/31	0.15
2014/05/28	0.15
2014/07/9	0.15
2014/08/3	0.15
2015/01/8	0.15
2015/09/9	0.15

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2015/12/3	0.15
2015/12/26	0.15
2016/06/10	0.15
2016/08/1	0.15
2017/10/6	0.15
2017/12/5	0.15
1998/08/21	0.16
1999/07/13	0.16
1999/10/19	0.16
2000/07/5	0.16
2000/12/24	0.16
2001/09/18	0.16
2002/07/26	0.16
2002/11/6	0.16
2003/04/15	0.16
2003/11/7	0.16
2003/12/4	0.16
2004/04/29	0.16
2004/06/16	0.16
2004/07/27	0.16
2004/10/19	0.16
2005/04/22	0.16
2005/04/23	0.16
2005/08/28	0.16
2006/08/16	0.16
2011/08/1	0.16
2011/08/22	0.16
2011/09/15	0.16
2012/08/1	0.16
2012/09/23	0.16
2013/05/16	0.16
2014/01/14	0.16
2014/05/31	0.16
2014/06/1	0.16
2014/08/23	0.16
2014/09/9	0.16
2014/12/1	0.16
2015/10/29	0.16
2016/01/28	0.16
2016/03/20	0.16
2016/05/8	0.16
2016/09/16	0.16
2016/10/17	0.16
2017/12/2	0.16
2018/03/9	0.16
2018/06/28	0.16
2018/07/14	0.16
1998/05/27	0.17
2000/07/20	0.17
2000/10/7	0.17

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2001/03/11	0.17
2001/07/12	0.17
2001/09/24	0.17
2001/12/29	0.17
2002/08/19	0.17
2003/05/10	0.17
2003/08/22	0.17
2003/10/26	0.17
2003/11/1	0.17
2004/04/16	0.17
2004/10/15	0.17
2005/01/3	0.17
2006/06/14	0.17
2006/10/7	0.17
2007/07/11	0.17
2007/10/4	0.17
2011/04/23	0.17
2011/09/27	0.17
2011/10/5	0.17
2011/10/14	0.17
2013/05/4	0.17
2014/03/17	0.17
2014/07/24	0.17
2014/11/8	0.17
2015/06/5	0.17
2015/07/13	0.17
2016/01/26	0.17
2016/02/23	0.17
2016/09/3	0.17
2017/08/12	0.17
2018/01/16	0.17
2018/06/21	0.17
2018/07/10	0.17
2018/08/11	0.17
1998/10/18	0.18
2000/07/15	0.18
2001/01/13	0.18
2001/03/9	0.18
2002/10/13	0.18
2003/11/8	0.18
2005/08/30	0.18
2005/09/3	0.18
2005/12/28	0.18
2006/08/19	0.18
2006/08/20	0.18
2006/09/9	0.18
2006/09/22	0.18
2007/06/4	0.18
2011/08/20	0.18
2012/05/6	0.18

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2013/06/19	0.18
2013/08/19	0.18
2013/08/22	0.18
2013/10/13	0.18
2014/10/11	0.18
2014/11/18	0.18
2015/07/23	0.18
2015/07/25	0.18
2015/11/8	0.18
2016/03/28	0.18
2016/06/12	0.18
2016/12/16	0.18
2017/12/11	0.18
2018/08/27	0.18
2018/09/16	0.18
1998/07/9	0.19
1998/10/23	0.19
1999/07/18	0.19
1999/09/13	0.19
2000/08/2	0.19
2000/10/6	0.19
2002/05/6	0.19
2003/08/13	0.19
2006/08/26	0.19
2006/10/4	0.19
2011/10/6	0.19
2011/10/7	0.19
2012/09/16	0.19
2013/10/15	0.19
2013/10/16	0.19
2013/12/21	0.19
2014/05/27	0.19
2015/02/15	0.19
2015/09/4	0.19
2015/09/16	0.19
2015/10/6	0.19
2017/12/30	0.19
2018/01/13	0.19
2018/05/10	0.19
2018/12/11	0.19
1998/07/4	0.2
1998/08/20	0.2
2000/07/21	0.2
2000/11/20	0.2
2001/08/16	0.2
2002/09/9	0.2
2002/09/16	0.2
2003/06/5	0.2
2004/10/3	0.2
2005/03/8	0.2

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2006/06/26	0.2
2007/08/2	0.2
2007/09/30	0.2
2011/07/17	0.2
2011/08/18	0.2
2011/09/8	0.2
2011/10/1	0.2
2013/09/9	0.2
2014/07/13	0.2
2015/03/7	0.2
2015/09/11	0.2
2016/09/5	0.2
2018/03/8	0.2
2018/08/3	0.2
2018/10/7	0.2
2018/10/16	0.2
2018/11/11	0.2
1998/05/3	0.21
1999/09/21	0.21
2001/08/3	0.21
2002/07/24	0.21
2003/02/23	0.21
2003/08/14	0.21
2004/10/11	0.21
2005/12/14	0.21
2006/06/16	0.21
2006/08/31	0.21
2012/07/30	0.21
2013/07/1	0.21
2014/09/14	0.21
2014/09/19	0.21
2015/02/16	0.21
2015/04/6	0.21
2015/04/10	0.21
2015/04/12	0.21
2015/09/14	0.21
2015/10/23	0.21
2015/11/3	0.21
2015/12/18	0.21
2015/12/19	0.21
2016/01/17	0.21
2016/06/6	0.21
2016/07/25	0.21
2016/08/22	0.21
2017/01/29	0.21
2017/08/21	0.21
2018/02/12	0.21
2018/05/11	0.21
2018/11/26	0.21
2018/12/8	0.21

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
1998/08/30	0.22
1998/09/24	0.22
1998/09/25	0.22
1999/09/19	0.22
2000/06/7	0.22
2000/09/22	0.22
2000/10/3	0.22
2003/10/5	0.22
2004/09/19	0.22
2005/06/17	0.22
2005/12/9	0.22
2006/08/10	0.22
2006/08/11	0.22
2007/09/3	0.22
2007/10/30	0.22
2012/09/26	0.22
2015/04/18	0.22
2016/02/3	0.22
2016/02/5	0.22
2016/12/15	0.22
2017/10/12	0.22
2018/01/1	0.22
2018/08/6	0.22
2018/08/23	0.22
2018/09/24	0.22
1998/06/3	0.23
1998/06/6	0.23
1998/09/20	0.23
1999/10/5	0.23
2001/08/19	0.23
2002/07/22	0.23
2002/10/11	0.23
2003/06/9	0.23
2003/10/14	0.23
2005/07/25	0.23
2006/10/9	0.23
2011/06/15	0.23
2011/09/4	0.23
2012/08/30	0.23
2012/09/4	0.23
2012/10/14	0.23
2013/05/17	0.23
2014/01/4	0.23
2014/10/20	0.23
2015/11/19	0.23
2016/07/28	0.23
2017/10/8	0.23
2018/09/23	0.23
2018/10/10	0.23
2018/12/22	0.23

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2001/07/15	0.24
2002/08/8	0.24
2002/08/10	0.24
2002/10/28	0.24
2003/08/19	0.24
2003/08/25	0.24
2005/12/15	0.24
2006/08/14	0.24
2012/06/13	0.24
2015/07/12	0.24
2015/08/15	0.24
2016/01/2	0.24
2016/09/12	0.24
2016/10/30	0.24
2016/11/25	0.24
2017/10/25	0.24
2017/12/3	0.24
2018/09/15	0.24
1998/08/25	0.25
1999/08/7	0.25
1999/08/25	0.25
2002/09/1	0.25
2004/09/22	0.25
2004/10/2	0.25
2011/09/5	0.25
2011/12/4	0.25
2013/12/13	0.25
2014/02/7	0.25
2014/04/25	0.25
2014/10/17	0.25
2015/07/22	0.25
2017/05/21	0.25
2017/05/28	0.25
2017/10/1	0.25
2018/08/26	0.25
1998/10/16	0.26
2001/08/18	0.26
2003/06/10	0.26
2004/09/20	0.26
2004/10/4	0.26
2004/11/27	0.26
2006/09/27	0.26
2007/08/22	0.26
2007/10/31	0.26
2013/09/6	0.26
2014/07/10	0.26
2014/08/14	0.26
2014/12/15	0.26
2015/01/16	0.26
2016/08/24	0.26

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2016/09/4	0.26
2017/10/23	0.26
2017/11/29	0.26
2000/11/21	0.27
2002/01/15	0.27
2002/08/12	0.27
2002/08/20	0.27
2002/10/19	0.27
2002/11/19	0.27
2003/06/11	0.27
2006/06/22	0.27
2006/10/1	0.27
2007/08/23	0.27
2007/11/21	0.27
2011/09/29	0.27
2012/12/12	0.27
2012/12/31	0.27
2014/10/10	0.27
2014/12/16	0.27
2016/02/25	0.27
2016/08/25	0.27
2017/09/22	0.27
2018/09/21	0.27
1998/06/7	0.28
1999/12/26	0.28
2000/07/18	0.28
2000/11/17	0.28
2001/04/2	0.28
2003/01/9	0.28
2003/08/26	0.28
2007/11/1	0.28
2011/07/2	0.28
2011/08/6	0.28
2011/09/19	0.28
2013/10/24	0.28
2014/01/12	0.28
2015/08/17	0.28
2016/09/6	0.28
2017/12/4	0.28
2018/01/2	0.28
2018/06/18	0.28
1998/08/6	0.29
1998/08/23	0.29
2000/08/26	0.29
2002/07/18	0.29
2002/07/23	0.29
2005/04/21	0.29
2005/09/5	0.29
2014/06/21	0.29
2015/09/8	0.29

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2016/08/11	0.29
2017/01/20	0.29
2017/09/21	0.29
2017/09/24	0.29
2017/10/4	0.29
2018/11/28	0.29
2018/12/18	0.29
2001/09/4	0.3
2003/10/3	0.3
2004/02/22	0.3
2006/08/15	0.3
2006/09/26	0.3
2007/10/5	0.3
2011/09/28	0.3
2013/01/14	0.3
2013/10/10	0.3
2016/11/21	0.3
2017/02/10	0.3
2018/02/22	0.3
2018/10/15	0.3
1998/07/8	0.31
2001/08/29	0.31
2004/02/13	0.31
2005/04/6	0.31
2012/05/10	0.31
2012/10/6	0.31
2014/08/13	0.31
2016/07/6	0.31
2017/08/29	0.31
2018/12/31	0.31
2004/10/9	0.32
2005/03/13	0.32
2007/04/5	0.32
2007/09/7	0.32
2011/10/21	0.32
2013/09/2	0.32
2016/11/9	0.32
2017/01/30	0.32
2017/10/7	0.32
2017/12/12	0.32
1999/09/17	0.33
2000/07/4	0.33
2000/11/16	0.33
2005/07/19	0.33
2012/08/23	0.33
2012/09/1	0.33
2016/04/16	0.33
2016/08/2	0.33
2017/01/25	0.33
2018/06/29	0.33

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2018/12/2	0.33
2003/10/25	0.34
2004/04/8	0.34
2004/07/26	0.34
2005/06/28	0.34
2014/01/1	0.34
2014/03/11	0.34
2014/08/28	0.34
2014/12/7	0.34
2015/01/14	0.34
2015/08/16	0.34
2017/09/5	0.34
1998/10/12	0.35
2002/10/5	0.35
2002/11/21	0.35
2013/01/12	0.35
2013/04/23	0.35
2014/08/25	0.35
2016/01/9	0.35
2017/09/6	0.35
2017/09/23	0.35
2017/10/5	0.35
2017/10/24	0.35
2018/12/14	0.35
2001/07/21	0.36
2001/07/22	0.36
2001/08/30	0.36
2003/07/2	0.36
2006/09/2	0.36
2007/09/24	0.36
2013/07/7	0.36
2014/11/20	0.36
2018/12/30	0.36
2000/12/10	0.37
2003/05/11	0.37
2003/10/2	0.37
2003/12/9	0.37
2004/02/10	0.37
2006/07/30	0.37
2014/09/15	0.37
2015/04/19	0.37
2015/11/28	0.37
2017/04/6	0.37
2017/07/18	0.37
2018/01/3	0.37
2018/10/20	0.37
1998/07/2	0.38
2005/10/17	0.38
2007/10/29	0.38
2007/11/23	0.38

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2011/08/23	0.38
2014/02/15	0.38
2016/09/14	0.38
2017/05/24	0.38
2017/08/24	0.38
2011/10/2	0.39
2011/10/24	0.39
2011/11/3	0.39
2012/09/20	0.39
2013/11/21	0.39
2016/04/25	0.39
2016/11/10	0.39
1998/06/1	0.4
1999/06/1	0.4
2000/08/29	0.4
2000/12/26	0.4
2013/09/25	0.4
2016/01/25	0.4
2016/02/24	0.4
2016/04/10	0.4
2017/09/27	0.4
2018/04/24	0.4
1998/08/7	0.41
1999/09/12	0.41
2002/09/17	0.41
2004/05/23	0.41
2005/06/18	0.41
2005/12/29	0.41
2014/11/11	0.41
2015/04/17	0.41
1998/05/8	0.42
1999/09/14	0.42
2014/03/13	0.42
2015/04/15	0.42
2015/10/2	0.42
2015/11/27	0.42
2018/10/21	0.42
1999/08/6	0.43
1999/08/27	0.43
2003/08/29	0.43
2006/06/9	0.43
2007/07/22	0.43
2018/01/12	0.43
2018/09/1	0.43
2000/10/13	0.44
2000/10/24	0.44
2000/11/10	0.44
2011/08/19	0.44
2014/05/30	0.44
2014/06/13	0.44

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2014/07/28	0.44
2016/07/22	0.44
2018/11/18	0.44
2005/09/22	0.45
2012/09/21	0.45
2012/12/29	0.45
2013/08/12	0.45
2014/12/14	0.45
2018/05/4	0.45
2001/08/28	0.46
2007/12/10	0.46
2013/08/28	0.46
2013/08/29	0.46
2014/11/1	0.46
2015/10/10	0.46
2018/11/12	0.46
1998/10/20	0.47
1999/05/26	0.47
2004/10/23	0.47
2005/09/27	0.47
2007/01/28	0.47
2011/09/20	0.47
2015/10/18	0.47
2016/08/5	0.47
2016/09/15	0.47
2016/09/21	0.47
2000/07/29	0.48
2000/11/18	0.48
2002/09/30	0.48
2013/12/18	0.48
2014/09/12	0.48
2016/04/9	0.48
2006/08/22	0.49
2015/10/24	0.49
2001/08/17	0.5
2002/11/29	0.5
2003/09/28	0.5
2005/03/10	0.5
2007/04/20	0.5
2012/09/18	0.5
2014/11/7	0.5
2014/11/9	0.5
2015/09/28	0.5
2016/02/20	0.5
2016/11/12	0.5
2017/08/31	0.5
2017/11/19	0.5
2018/10/23	0.5
2001/01/16	0.51
2012/10/5	0.51

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2015/12/30	0.51
1998/09/19	0.52
2013/01/13	0.52
2014/08/24	0.52
2015/09/3	0.52
2017/11/5	0.52
1998/08/5	0.53
2000/12/28	0.53
2004/09/25	0.53
2007/10/25	0.53
2015/11/5	0.53
2000/07/16	0.54
2007/09/12	0.54
2007/09/18	0.54
2007/11/6	0.54
2012/06/24	0.54
2012/09/15	0.54
2013/10/8	0.54
2016/01/4	0.54
1999/10/1	0.55
2003/02/4	0.55
2016/02/28	0.55
2016/12/24	0.55
2000/12/5	0.56
2001/01/7	0.56
2012/06/25	0.56
2012/07/21	0.56
2012/10/3	0.56
2015/12/28	0.56
2017/08/20	0.56
2001/07/5	0.57
2015/09/18	0.57
2015/09/27	0.57
2015/12/27	0.57
2011/08/2	0.58
2007/11/25	0.59
2014/12/29	0.59
2016/02/4	0.59
2016/09/20	0.59
2000/09/10	0.6
2006/08/24	0.6
2013/08/21	0.6
2012/09/19	0.61
2013/11/10	0.61
2017/10/29	0.61
2018/11/25	0.61
2014/09/4	0.62
2016/08/4	0.62
2017/12/7	0.62
2006/08/18	0.63

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2011/08/31	0.63
2016/02/8	0.63
2003/08/11	0.64
2012/08/31	0.64
2016/01/10	0.65
2000/11/19	0.66
2015/04/9	0.66
2016/09/22	0.66
2016/12/25	0.66
2018/10/13	0.67
2014/03/10	0.68
2017/12/15	0.68
2005/09/6	0.69
2015/01/15	0.69
1999/08/12	0.7
2000/09/23	0.7
2004/09/26	0.7
2000/11/28	0.71
2004/09/30	0.71
2013/09/11	0.71
2017/02/16	0.71
2002/11/22	0.72
2003/08/15	0.72
2007/11/22	0.72
2015/03/16	0.72
2018/08/2	0.72
2013/08/11	0.73
2001/01/17	0.74
2001/07/19	0.75
2002/10/29	0.75
2003/10/6	0.75
2015/11/25	0.75
2007/09/8	0.76
2016/09/11	0.76
2004/09/29	0.77
1999/09/30	0.78
2012/09/22	0.78
2017/12/13	0.79
2001/01/14	0.8
2005/09/23	0.8
2013/10/27	0.81
2015/04/7	0.82
1999/09/2	0.83
2001/09/23	0.83
1999/10/8	0.84
2002/12/3	0.84
2011/10/25	0.84
2005/09/16	0.85
2008/02/19	0.85
2017/12/10	0.85

NAME	LATITUDE
HOMER AIRPORT, AK US	59.642
ELEVATION	LONGITUDE
19.5	-151.4908
Start Date	End Date
1988/01/1	2018/12/31
DATE	**PRCP**
2014/01/17	0.87
2004/09/2	0.92
2016/01/1	0.92
2016/10/31	0.94
2017/01/26	0.94
1999/12/21	0.95
2018/11/27	0.97
2005/09/9	0.99
2015/12/25	0.99
2012/12/30	1
1998/08/31	1.03
2000/11/13	1.04
2000/12/29	1.07
2013/10/28	1.07
1999/10/17	1.1
2002/09/24	1.12
2007/11/8	1.14
2015/09/29	1.2
2018/10/12	1.21
2018/12/7	1.21
2016/11/1	1.22
2002/10/22	1.26
2018/06/15	1.27
2016/02/21	1.38
2002/11/5	1.4
2018/09/27	1.47
2007/11/20	1.64
2001/12/26	1.75
2002/11/23	2.09
2002/10/23	2.88

Appendix E – New Police Station - LID Infrastructure Photographs

New Homer Police Station
Low Impact Development Study Grant
Green Infrastructure Construction Photos

New Storm Water DETENTION BASIN - site runoff directed to basin - peak runoff from the site reduced to pre-construction levels

New BIOSWALE - Filters storm water runoff of sediment and pollutants

New RAIN GARDEN - site drainage directed to garden to slow peak storm water and filter sediments

INTERPRETIVE SIGN installed at the New Police Station to help public appreciate value of green infrastructure (low impact development benefits).