MOA and ADOT&PF
2014 Low Impact Development
Project Performance Monitoring Report

Prepared for:

The Municipality of Anchorage

Prepared by:

AWR ENGINEERING

And

HDR Alaska

January 2015

Table of Contents

List of Figures:

List of Tables:

List of Appendices:

1. Introduction and Project Description

AWR Engineering, LLC and HDR Alaska are assisting the Municipality of Anchorage (MOA) with monitoring and reporting requirements for five Low Impact Development (LID) pilot projects. The pilot project construction, monitoring, and reporting are required per the current MOA and Alaska Department of Transportation and Public Facilities (ADOT&PF) Alaska Pollutant Discharge Elimination System (APDES) permit.

Three of the pilot projects presented in this report are owned by ADOT&PF; two of these are parking lot retrofit projects. The ADOT&PF previously completed two additional pilot projects, which were presented in the 2013 Low Impact Development Project Performance Monitoring Report.

Two of the pilot projects presented in this report are owned by the MOA; these two are both parking lot retrofits and were also included in the 2013 Low Impact Development Project Performance Monitoring Report. A summary of the 2013 and 2014 LID reporting is presented in Table 1.

Table 1: MOA and ADOT&PF LID Projects Summary

Facility Owner	Project Title	2013 LID Report	2014 LID Report	Parking Lot Retrofit	Public-Private Partnership
ADOT&PF Projects	West Dowling Road Extension	✓			
	Muldoon Road Pedestrian Improvements	✓			
	New Seward Highway, Dowling to Tudor		✓		
	Ship Creek Hatchery Rain Gardens		✓	✓	
	West Dowling Parking Lot Rain Garden		✓	✓	
MOA Projects	Russian Jack Springs Park Parking Lot	✓	✓	✓	
	Taku Lake Rain Garden	✓	✓	✓	
	Commercial Fishering Bank Rain Garden	✓		✓	✓

1.1. APDES Reporting Requirements

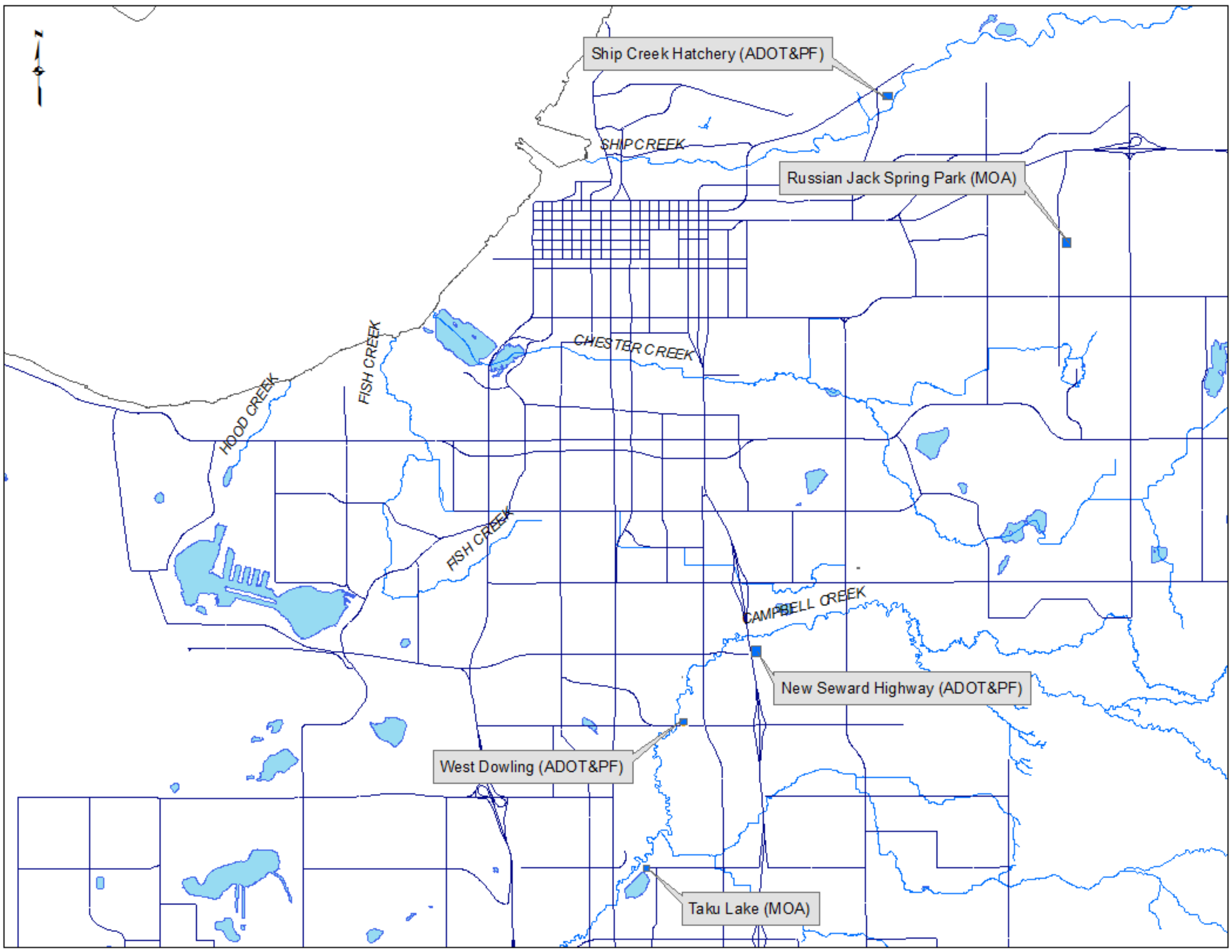
The current APDES permit requires that the performance of each LID pilot project be monitored and documented. The permit requires that changes in runoff quantities be calculated or modeled for each of the pilot projects and, for new construction projects, compared to a theoretical case of the project constructed without LID practices. The analysis requirements include preparing runoff hydrographs to characterize peak runoff rates and volumes, discharge rates and volumes, and duration of discharge volumes. The evaluation must include quantification and description of each type of land cover contributing to surface runoff for each pilot project, including area, slope, vegetation type and condition (for pervious surfaces), and nature of impervious surfaces (see page 15 of the APDES permit in Appendix A for additional information).

This report presents the required monitoring results for the three ADOT&PF LID pilot projects. The analysis requirements for the two MOA-owned projects were presented in the 2013 Low Impact Development Project Performance Monitoring Report, but the MOA continued visual monitoring of their two parking lot retrofits during 2014 and those results are presented in this report.

1.2. General Description of Pilot Projects

This report presents information regarding the LID features, the monitoring process, and monitoring results for each project as required by the APDES permit. A map of project locations in the Anchorage area is shown in Figure 1 below.

Figure 1: Project Locations



1.2.1. ADOT&PF Projects

ADOT&PF constructed the New Seward Highway Improvements, the Ship Creek Hatchery Rain Gardens, and the West Dowling Rain Garden projects as LID projects for monitoring and reporting. The New Seward Highway project provides stormwater infiltration of small rainfall events and detention of larger events through a combination of check dams in vegetated swales and an on-site infiltration pond. The West Dowling Rain Garden is located next to Campbell Creek and captures stormwater runoff from a parking lot adjacent to West Dowling Road. The Ship Creek Hatchery rain gardens are situated next to Ship Creek and capture stormwater runoff from the parking lot that serves the hatchery.

1.2.2. MOA Projects

The MOA presented detailed monitoring results of the Taku Lake Rain Garden and Russian Jack Springs Park Parking Lot in 2013 and have continued visual monitoring of these sites. The Taku Lake Rain Garden consists of a large bioretention area (rain garden) that accepts water from the adjacent Taku Lake parking lot, providing infiltration of small rainfall events and treatment and detention of larger events. The Russian Jack Springs Park Parking Lot includes both porous asphalt and a connected subsurface infiltration gallery that, together, accept runoff from the entire parking lot.

2. Rainfall Data

Rainfall data for characterization of storm event magnitude, duration, and distribution was obtained from the National Climatic Data Center (NCDC) which is a section of the National Oceanic and Atmospheric Administration. Because the LID sites discussed in this report are distributed across Anchorage, rainfall data from two recording stations were analyzed, and data from the station closest to each site were used in the site analysis. The two recording stations used were Anchorage International Airport (ANC) and Merrill Field Airport (MRI). These sites were selected based on proximity to the LID sites and on reliability of the data.

The MOA APDES permit requires onsite management of stormwater runoff generated from the 90th percentile rainfall event, which is categorized as 0.52 inches of rainfall in a 24-hour period, preceding 48 hours of no precipitation. This event is referred to throughout this report as “the water quality event.” During the analysis period, which was July through October of 2014, this exact event was not recorded. However, several events that were similar or exceeded this event did occur. Because the water quality event is typically the design threshold, this analysis looked at performance during events equal to or in excess of that event. Although LID facilities are designed to accept events up to and smaller than the water quality event, performance during smaller events can often be concluded by examination of performance during more notable events. In order to represent a variety of rainfall storm conditions, three events were selected for performance analysis of the LID facilities.

1. Event 1 occurred on July 24 and 25
    a. At ANC, this event resulted in 1.46 inches of rainfall in a 24-hour period. This event was preceded by at least 48 hours of no measurable precipitation. Note that the MOA’s 10-year, 24-hour design event is 1.77 inches.
    b. At MRI, this event resulted in 0.64 inches of rainfall in a 24-hour period. This event was preceded by at least 48 hours of no measurable precipitation.
2. Event 2 occurred on August 24 and 25
    a. At ANC, this event resulted in 0.89 inches of rainfall in a 24-hour period. Approximately 0.1 inches of rain fell in the preceding 14 hours.

   b. At MRI, this event resulted in 0.78 inches of rainfall in a 24-hour period. Approximately 0.1 inches of rain fell in the 14 hours preceding this event.

3. Event 3 occurred on October 11
   a. At ANC, this event resulted in 0.56 inches of rain in a 24-hour period. This event was preceded by 0.25 inches of rain the previous day (24-hours).
   b. At MRI, this event resulted in 0.69 inches of rain in a 24-hour period. Approximately 0.06 inches of rain fell in the preceding 24 hours.

Rainfall hyetographs for each of these events are presented in Figures 2 through 4 below. Supporting data is including in Appendix B.

Figure 2: Event 1 July 24-25, 2014 Rainfall Hyetograph

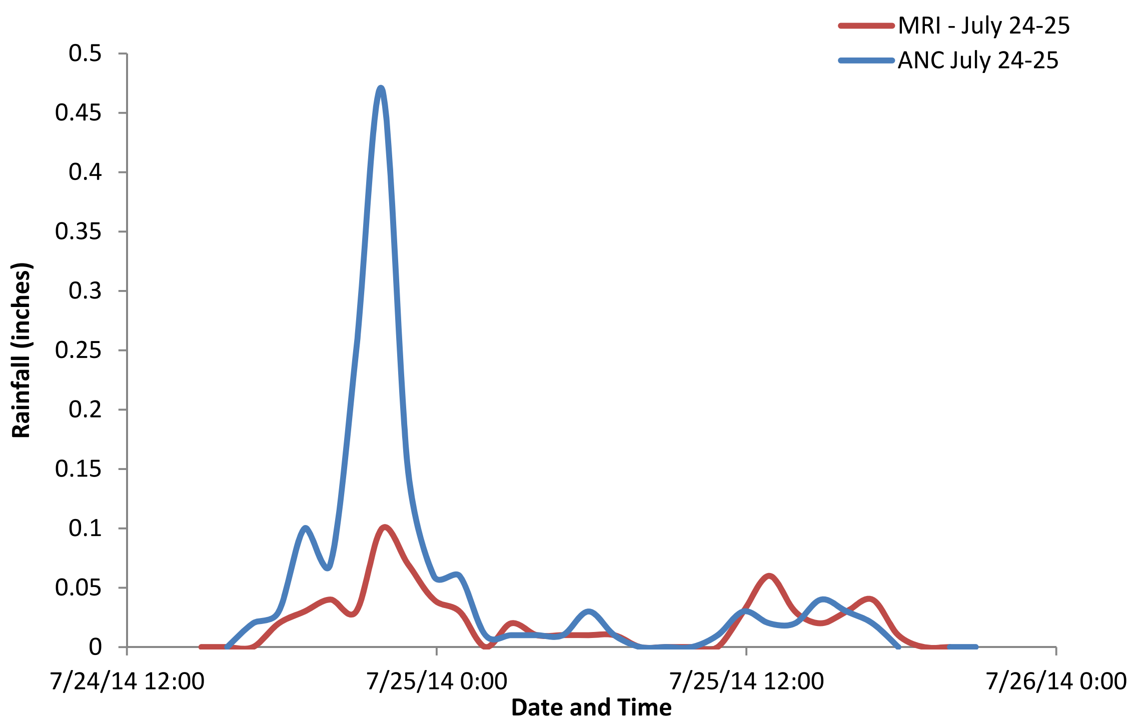


Figure 3: Event 2 August 24-25, 2014 Rainfall Hyetograph

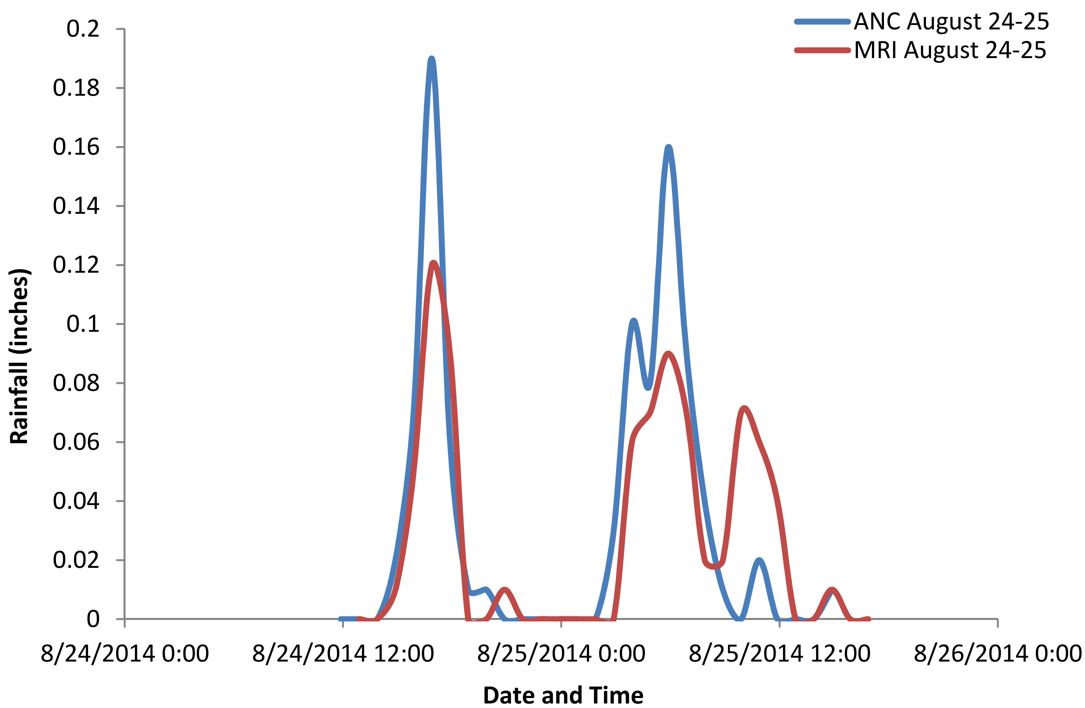
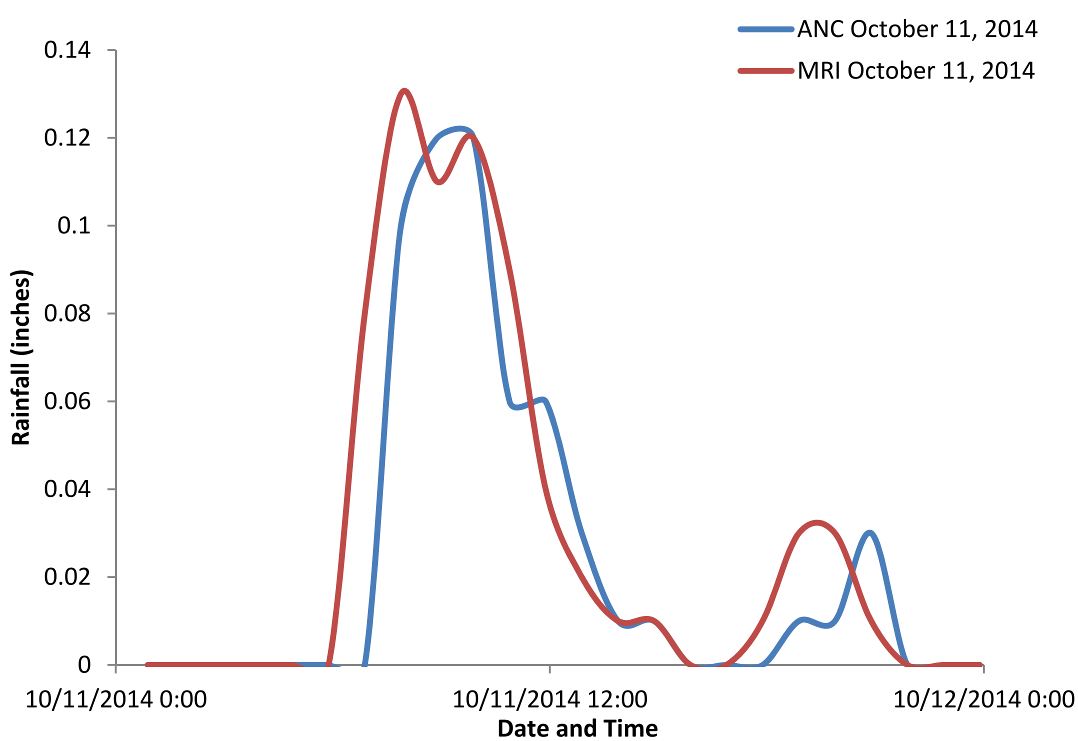


Figure 4: Event 3 October 11, 2014 Rainfall Hyetograph



3. New Seward Highway Improvements from Dowling Rd to Tudor Rd (ADOT&PF)

The New Seward Highway (NSH) is located in Anchorage and serves as one of the city's primary north-south roadway corridors. The New Seward Highway Improvements Project, constructed from 2013-2014, expanded the existing roadway corridor from a four-lane road to a six-lane road and reconstructed portions of the frontage roads. The majority of the project lies in the Campbell Creek watershed, and the highway crosses Campbell Creek via a bridge located north of International Airport Drive and south of Tudor Rd. A small portion of the Tudor-NSH intersection lies within the Fish Creek watershed. Fish Creek crosses Tudor Rd. via a piped storm drain near this intersection. Both Campbell Creek and Fish Creek are listed as Impaired Water Bodies in the APDES permit.

The project's hydrologic designers identified 10 project-scale drainage basins in the project area. The monitoring and reporting focused on the area called Basin 4 in the project's Drainage Analysis Report by CH2M Hill dated July 2011. Basin 4 is located immediately south of Campbell Creek and has an area of 9.4 acres, 6.7 of which is impervious surface. The basin's land use is comprised of the highway, the highway frontage roads, and the surrounding ditches and medians. Based on the project's Drainage Analysis Report, the topography of Basin 4 is fairly flat, with average slopes of approximately 0.3 percent.

If LID had not been incorporated into this project, surface runoff from Basin 4 would discharge directly to Campbell Creek. However, as an LID pilot project, surface runoff from Basin 4 is routed via a series of pipes and vegetated ditches to an infiltration pond located near the intersection of Brayton Drive and Alpenhorn Ave. The infiltration pond is designed to capture and infiltrate the runoff generated from the water quality event. Larger events are designed to overflow from the pond to a vegetated ditch that discharges to Campbell Creek. Figure 5 below shows an overview of the retention basin area, and Exhibits 1 and 2 in Appendix C show the retention basin design layout and the associated drainage area.

Figure 5: NSH Site Overview

3.1. Infiltration Pond Details

The NSH retention basin is approximately 150 feet long and 45 feet wide, with gentle side slopes and an approximate average depth of two feet. (See Figure 6 below.) The basin is vegetated with grasses, and riprap is present near the inlet and outlet. The basin inlet is a 24-inch diameter culvert on the southwest side of the basin, and the outlet is a small earthen berm on the north side. The outlet berm is overtopped when the basin exceeds capacity.

Figure 6: NSH Retention Basin

3.2. Monitoring and Reporting Plan

In order to monitor the performance of the retention basin, HDR installed monitoring equipment to record data from July 21 through October 17 of 2014. The monitoring equipment included a v-notch weir and a pressure transducer located at both the inlet and the outlet. See Figure 7 below. The pressure transducers were set at a known depth below the weir notch and were calibrated to record the depth of water flowing over the notch. By recording the basin's inflow and outflow, the impact of the retention basin can be measured and compared to a theoretical case of the project constructed with no LID. For the theoretical case of no LID, it was assumed that all water entering the retention basin would continue to Campbell Creek. In reality, a small amount of infiltration may take place in the vegetated ditch in this scenario, but that amount is difficult to quantify in a theoretical situation with the available project information.

Figure 7: Retention Basin Outlet (left) and Inlet (right)

3.2.1.Hydrograph Development

Inflow and outflow hydrographs were developed based on readings from the pressure transducers. Pressure transducer readings for both the inlet and outlet were taken every minute during the recording period. The recorded depth of water over the v-notch weir was used to compute a flow rate using the following standard equation for a 90-degree, v-notch weir.

$$Q = 2.49\ h^{2.48}$$

Where:

Q = discharge over weir in cubic feet per second
h = head on the weir in feet

Inflow, outflow, and rainfall were examined for the recording period, and the results showed that outflow from the basin occurred only twice during the recording period. To more closely examine the basin performance, inflow and outflow hydrographs were developed for a total of four rainfall events. These included Event 2 and Event 3 described in Section 2. The performance of the basin during Event 1 was not analyzed due to instrument errors during this time. In addition to Events 2 and 3, the basin performance was also analyzed for the two storm events that produced basin outflow. These events, numbered Event 4 and Event 5, are detailed below. Rainfall data for these events were taken only from ANC because it is closer in proximity than MRI.

1. Event 4 occurred September 12-14 and resulted in 0.66 inches of rain in a 24-hour period. The majority of this event occurred around midnight on September 13, but to capture the rainfall pattern, it was necessary to include a small amount of data from September 12 and 14 as well. This event was preceded by 0.24 inches of rain on September 9, 0.47 inches on September 10, 0.01 inches on September 11, and 0.09 inches on September 12.
2. Event 5 occurred September 19-20 and resulted in 0.69 inches of rainfall in a 24-hour period. This event was preceded by 0.33 inches of rain on September 9. A preceding 24-hour period of no rain had not occurred since Event 4.

The above events are categorized into 24-hour rainfall events for consistency with both permit requirements and the other analyses in this report. However, the September rainfall event could also be thought of as a storm event that occurred from September 9-20 and resulted in 3.03 inches of rainfall in this 12-day period. Graphs of both scenarios are provided in Figures 8 through 10. Supporting data is including in Appendix B.

Figure 8: Event 4 September 13-14, 2014 Rainfall Hyetograph

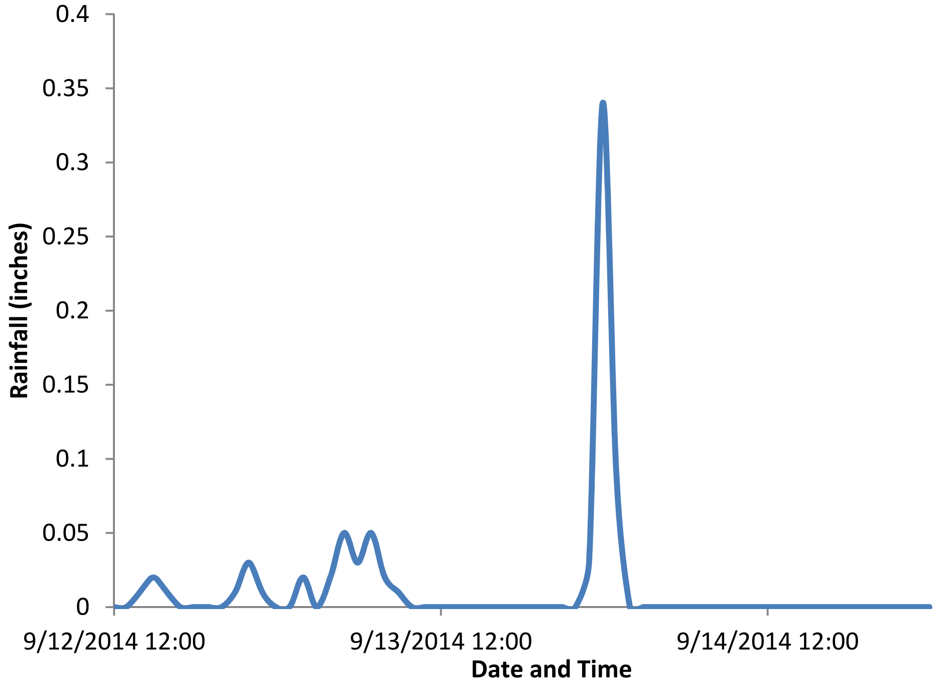


Figure 9: Event 5 September 19-20, 2014 Rainfall Hyetograph

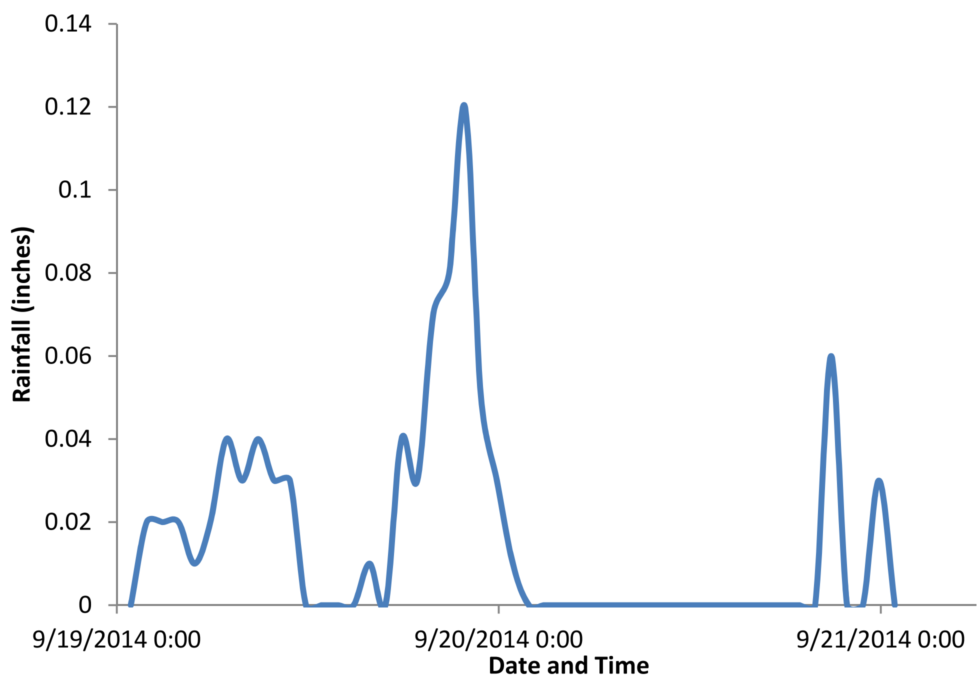
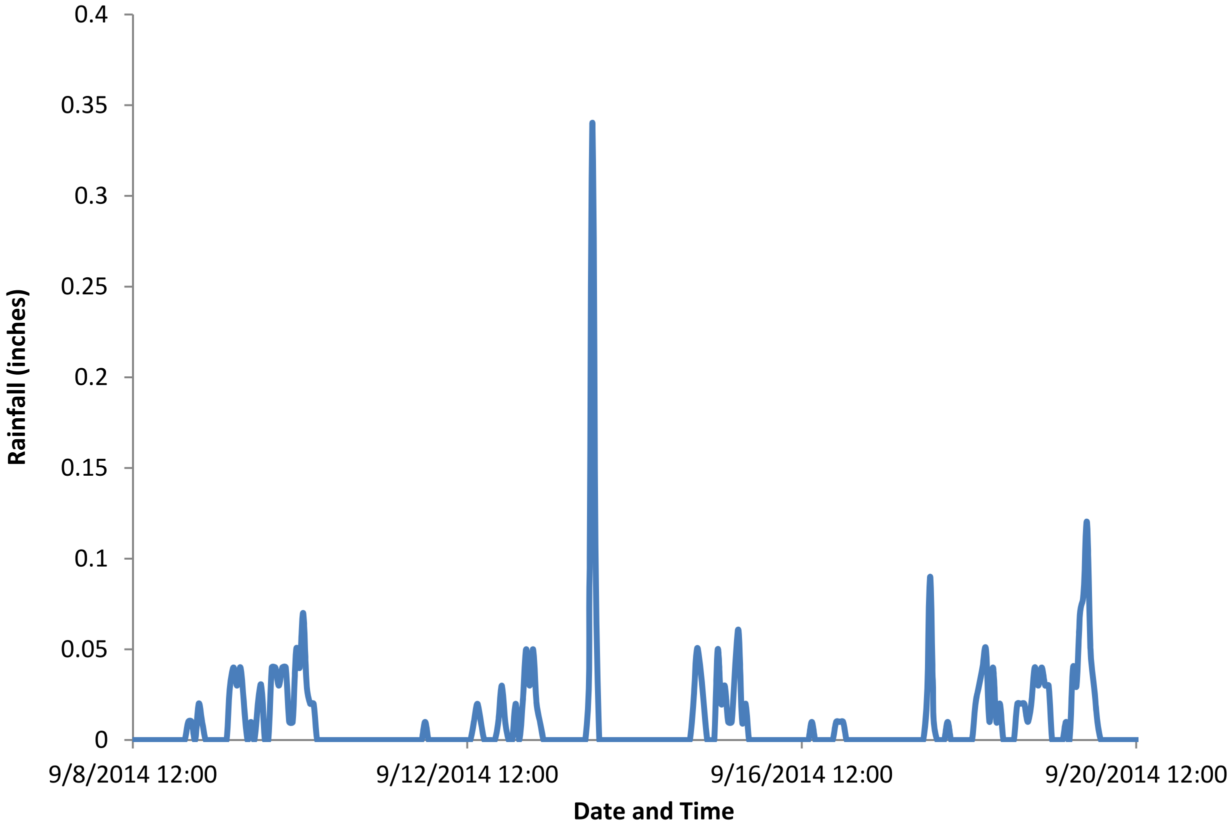


Figure 10: September 9-20, 2014 Rainfall Hyetograph



3.3. Results

Analysis of the data showed that the retention basin did not produce an outflow hydrograph for Events 2 and 3. In both cases, the entire event was captured by the basin. Inflow hydrographs for these events are shown in Figures 11 and 12. Supporting data is including in Appendix D.

Figure 11: Event 2 August 24-25 NSH Basin Inflow Hydrograph (No outflow)

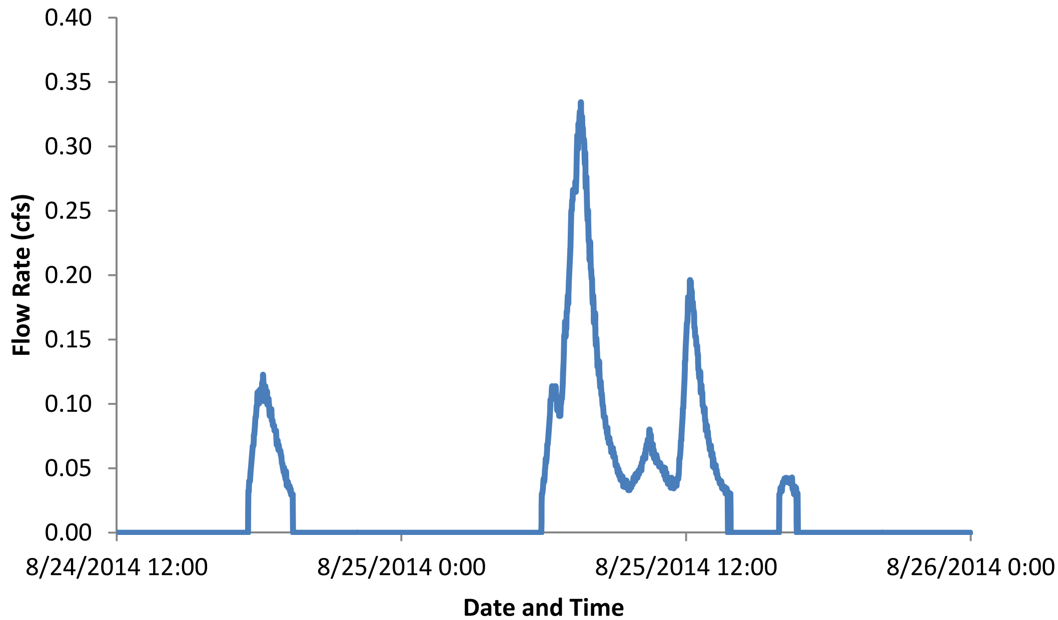
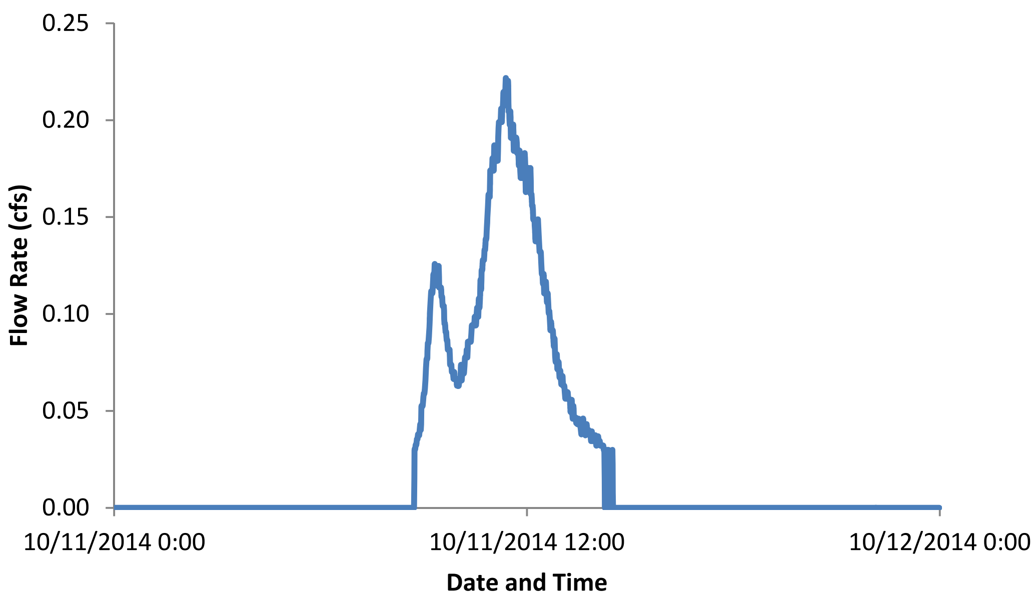


Figure 12: Event 3 October 11 NSH Basin Inflow Hydrograph (No outflow)



Inflow and outflow hydrographs for Events 4 and 5 are presented in Figures 13 and 14 below. It is noteworthy that these are the only two basin outflow events that occurred during the reporting period. Hydrographs for the entire period of September 9-20 are also shown in Figure 15.

Figure 13: Event 4 September 12-14 NSH Basin Inflow and Outflow Hydrographs

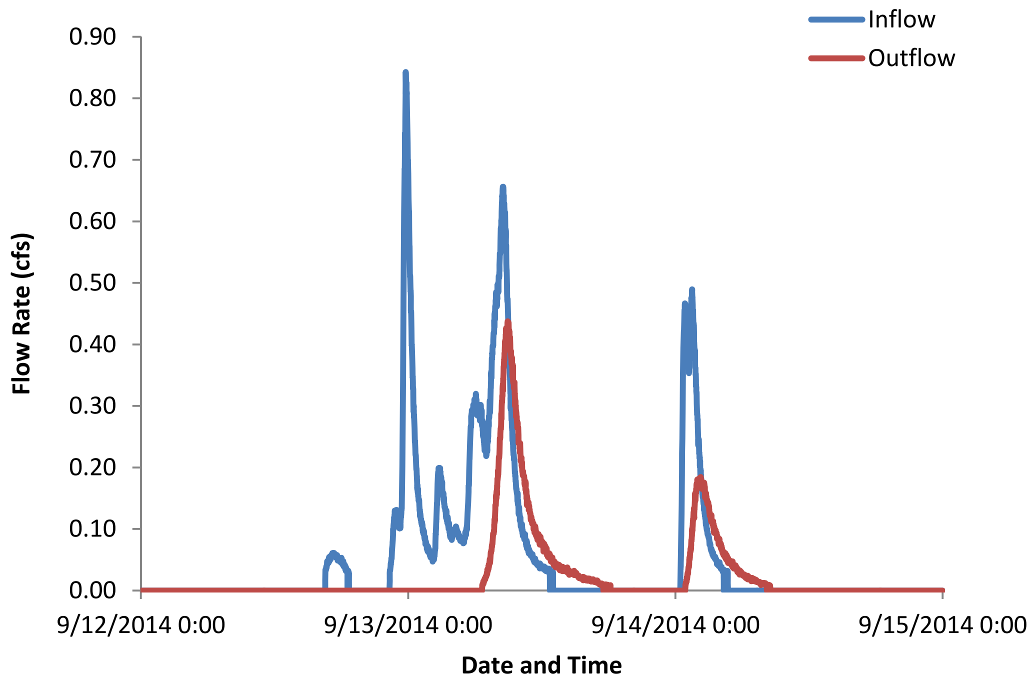


Figure 14:Event 5 September 19-20 NSH Basin Inflow and Outflow Hydrographs

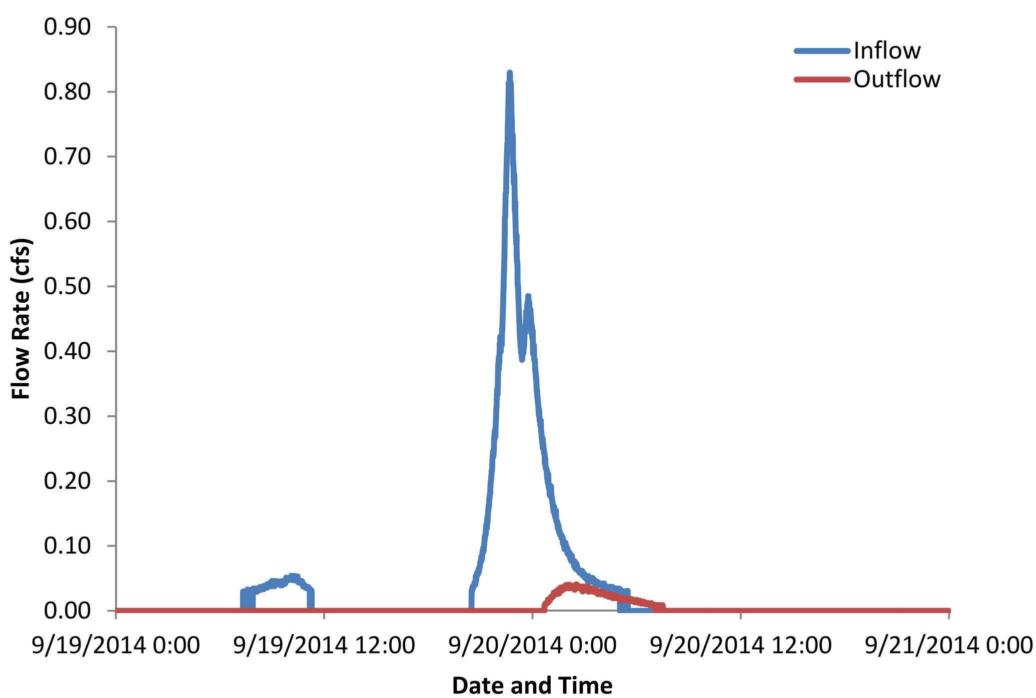
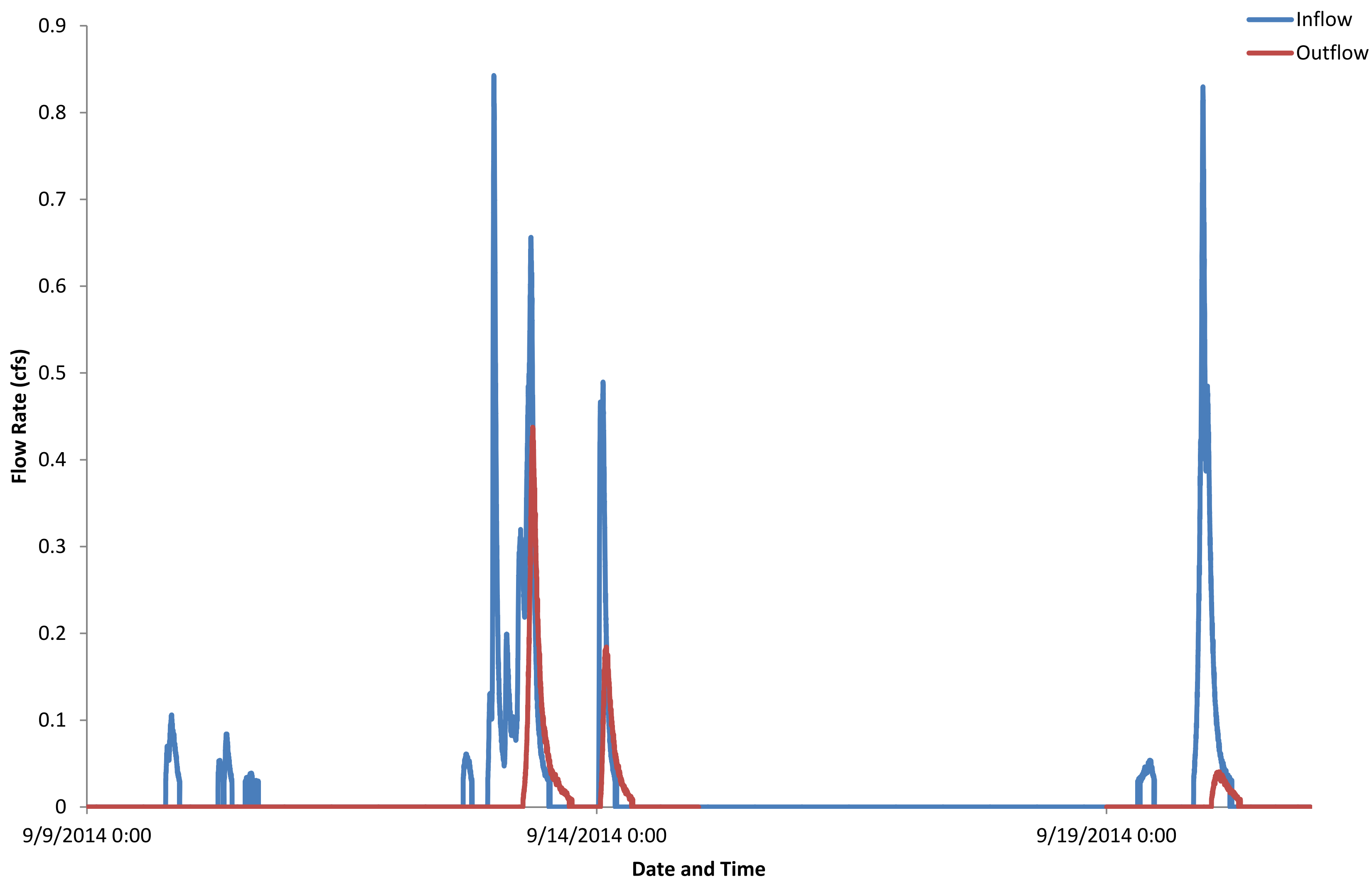


Figure 15: September 9-20 NSH Basin Inflow and Outflow Hydrographs



A table summarizing each of the events discussed above is provided in Table 2.

Table 2: NSH Retention Basin Performance Summary

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
Event 1, July 24-25	No Data					
Event 2, Aug 24-25	3,508	0	100%	0.33	0.00	100%
Event 3, October 11	2,070	0	100%	0.22	0.00	100%
Event 4, September 12-14	13,990	6,031	57%	0.84	0.44	48%
Event 5, September 19-20	7,194	560	92%	0.83	0.04	95%
September 4-20	28,514	6,592	77%	0.84	0.44	48%

3.4. Conclusions and Recommendations for Future Projects

The monitoring results show that the NSH retention basin is performing well. Results indicate that it has significantly exceeded its design intent, which was to capture runoff generated from the water quality event.

The storage volume of the retention basin is largely dependent on the elevation of the earthen outfall, which was modified during construction and is thus not reflected in design documents. The original design outlet was a culvert, similar to the inlet, with a set elevation. The set elevation of the culvert outlet provided the design storage volume. The culvert was removed during construction and replaced with an earthen berm. The elevation of the berm and thus the as-built volume of the basin is not known, but based on plan view dimensions, it is estimated to be approximately 13,500 cubic feet or less. The project's drainage analysis report does not provide an estimated design capacity, but it does include the results of two percolation tests performed for the basin. Two percolations tests were performed with average results of 2.1 inches per hour and 6.3 inches per hour. These are fairly average to moderately slow infiltration rates for the Anchorage area. It is also interesting to note that the NSH basin was used as a sediment trap for stormwater runoff during construction. This is not recommended for infiltration facilities, and project construction personnel report that collected sediment was not removed from the basin prior to project completion. Based on this fact, it is expected that actual infiltration rates in the NSH infiltration basins may be slower than initial testing indicated. It is not known if a factor of safety was applied to the tested infiltration rates during design.

Although using infiltration facilities as a sediment trap during construction is not recommended, this case demonstrates that even with moderate or slow infiltration rates, infiltration facilities can be successful. The monitoring results show that for the rainy period from September 9-20, the basin discharged only 6,592 cubic feet of the 28,514 that entered the basin. With an assumed basin volume of 13,500 cf, the results indicate that 8,422 cf of runoff was infiltrated during this time. It is also noteworthy that during the September 12-14 event that produced 0.66 inches of rain in 24 hours, half of that volume (0.33 inches) fell within one hour. It is estimated that the inflow rate during this time (0.84 cfs) exceeded the infiltration rate of the basin and that the basin was not empty due to the preceding eight days of rain, resulting in the discharge seen in Figure 13. This is further demonstrated by the fact that a similar peak flow of 0.84 cfs entered the basin on September 20, but resulted in a much lower discharge event. The basin is expected to have recovered both storage volume and infiltrative capacity during the lighter rain events that occurred from September 14-20. The duration of peak flow during the September 20 discharge was also shorter than that of September 13.

These monitoring results indicate that retention or infiltration basins are a good choice for LID applications in Anchorage where sufficient space is available. They are fairly simple to design, and can provide significant water volume and peak flow reduction for small to mid-size rain events. This project also demonstrates that this type of LID facility can work well for linear roadway projects under the right conditions. The following recommendations are provided for consideration when using this feature for future projects.

1. Ensure that the basin is constructed as-designed or that modifications to the basin's design are approved by the designer. Small changes, like omitting an outlet culvert, can have a large impact on the facility performance if the modifications fail to consider the overall facility function.
2. Consider the relationship between outlet elevation, side slope angle, and bottom width to maximize storage volume.
3. Follow the example of this basin and keep the design depth shallow if infiltration is expected. Depths in excess of two feet can cause compaction of the underlying soils with a resulting reduction in infiltrative capacity.
4. Follow the example of this basin and provide dense vegetation cover and scour protection at the inlets and outlets. The vegetation not only stabilizes the soil for the facility, it also promotes infiltration by penetrating the subgrade with roots, allowing water to infiltrate more freely, and it improves capacity by providing evapotranspiration.

4. Ship Creek Hatchery Rain Gardens (ADOT&PF)

The parking lot of the Ship Creek Hatchery was reconstructed as part of the project that converted the old site into a hatchery in 2011. The hatchery is located immediately adjacent to Ship Creek, which is listed as an impaired water body in the MOA/ADOT&PF APDES permit. The entire site design is centered around minimizing direct stormwater runoff to Ship Creek. The topography of the site's green areas are contoured to capture water, and flat curbs are used in lieu of traditional curbs around parking lot landscape features to allow stormwater from pavement to flow into the landscaping. The site includes two rain gardens, which are the focus of this monitoring and reporting discussion. The two rain gardens are shown in Figures 16 and 17.

Figure 16: Hatchery West Rain Garden

Figure 17: Hatchery East Rain Garden

4.1. Rain Garden Details

The project's two rain gardens collect runoff from the hatchery's large parking lot, a total of approximately 18,850 square feet. Approximately 10,600 square feet of the parking lot drains to the western rain garden, which has a design storage capacity of 3,100 cubic feet, and approximately 8,250 square feet drains to the eastern rain garden, which has a design storage capacity of 3,200 cubic feet. The slope of the parking area is roughly 2%, and stormwater runoff enters both rain gardens as sheet flow from the adjacent asphalt. The rain gardens are designed to accept and infiltrate small, frequent storm events and bypass larger events. Water that enters the rain gardens but is not infiltrated is allowed to overflow the earthen sides of the gardens toward the south. Overflow water is directed to Ship Creek via overland flow. Both rain gardens are fully vegetated with grass-like vegetation. The rain garden sizes and drainage basins are shown in Exhibit 3 in Appendix C. The overall layout of the hatchery site is presented in Figure 18 below.

Figure 18: Hatchery Site Overview

4.2. Monitoring and Reporting Plan

To quantify the performance of the rain gardens, inflow and outflow hydrographs were developed for each of the rainfall events discussed in Section 2. Rainfall data from Merrill Field was used since that recording station is in close proximity to the hatchery site.

4.2.1. Hydrograph Development

Inflow hydrographs were developed using the EPA's Storm Water Management Model (SWMM) Version 5.0. SWMM produces hydrographs using the non-linear reservoir method based on user-defined rainfall parameters, soil conditions, and basin features.

Outflow from the rain gardens was based on comparison of the inflow volume to the design storage capacity, and was verified by visual inspection during or following the rain events.

If LID had not been incorporated into this project, surface runoff from the parking area would have been routed directly to Ship Creek. Because the entire hatchery site layout is designed with LID in mind, it is difficult to estimate how stormwater would have been routed to Ship Creek in a traditional development scenario. For the purposes of this report, it is assumed that the runoff would have been collected using traditional inlets and piped storm drains that would discharge to the creek. In this way, the hypothetical case of no LID can be assumed to be the same as the inflow hydrographs.

4.3. Results

The monitoring and computation results show that the rain gardens did not discharge stormwater for the three events analyzed. The inflow hydrographs for the west and east rain gardens are shown in Figures 19 and 20 respectively. For simplicity, hydrographs for each of the three rainfall events are shown on the same graph.

Figure 19: Hatchery West Rain Garden Inflow Hydrographs (No Outflow)

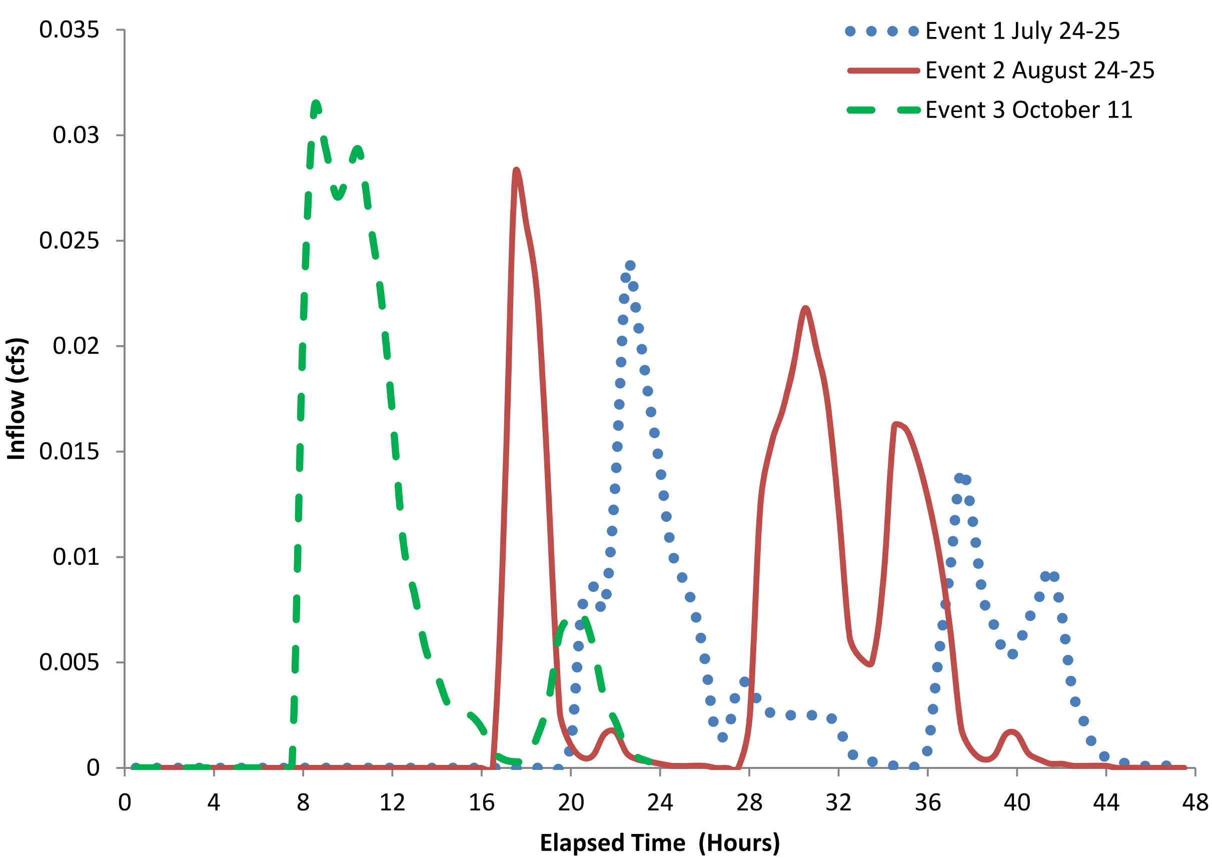


Figure 20: Hatchery East Rain Garden Inflow Hydrographs (No Outflow)

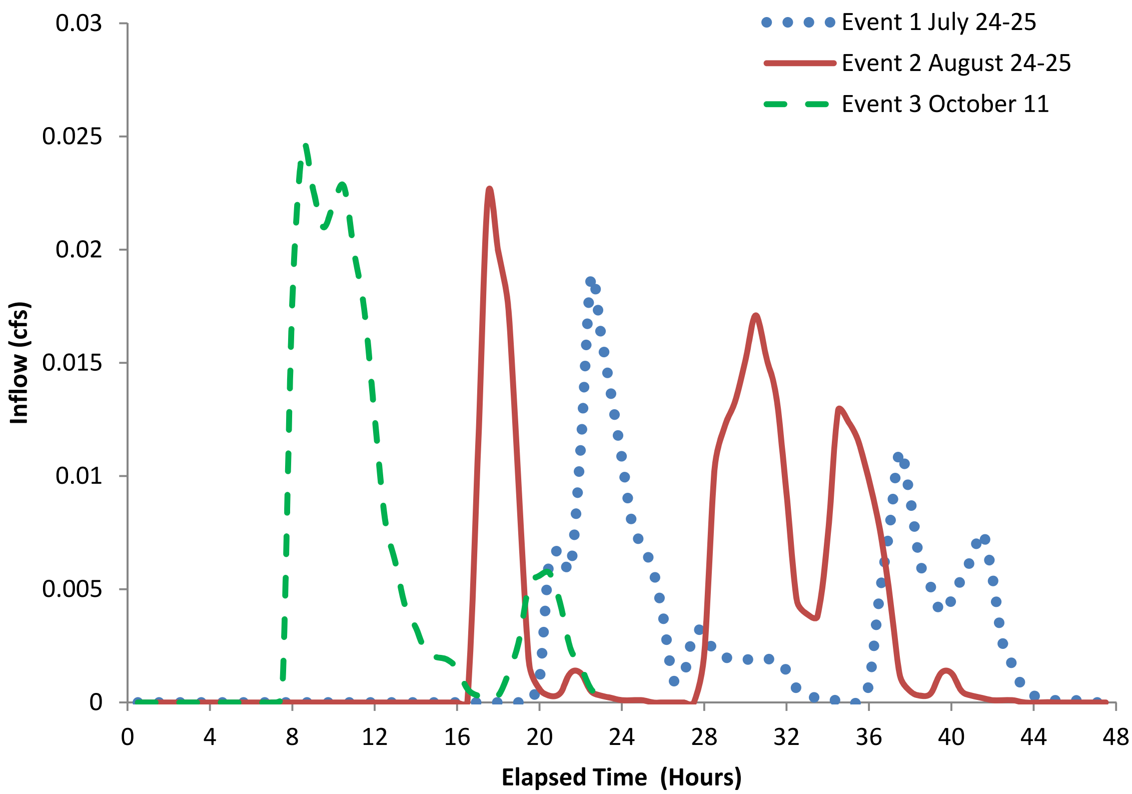


Table 3 provides a summary of inflow volumes and peak flows for the west rain garden under each of the three rainfall events, and Table 4 provides the same data for the east rain garden. Modeling output reports are included in Appendix E.

Table 3: Hatchery West Rain Garden Performance Summary

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
Event 1, July 24-25	521	0	100%	0.02	0.00	100%
Event 2, Aug 24-25	654	0	100%	0.03	0.00	100%
Event 3, October 11	565	0	100%	0.03	0.00	100%

Table 4: Hatchery East Rain Garden Performance Summary

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
Event 1, July 24-25	406	0	100%	0.02	0.00	100%
Event 2, Aug 24-25	509	0	100%	0.02	0.00	100%
Event 3, October 11	440	0	100%	0.02	0.00	100%

The hatchery rain gardens were visually inspected on July 25, August 25, and October 11 to observe performance during or immediately following significant rain events. In each case, overflow or signs of recent overflow was not observed. These observations support the data presented in Tables 3 and 4 above.

The rain gardens were also inspected on October 15, in order to determine if water was completely draining out of the rain garden in a reasonable amount of time. During the October 15 site visit, no ponded water was observed in either rain garden. Site visit summaries are provided in Appendix F.

4.4. Conclusions and Recommendations for Future Projects

The monitoring results show that the rain gardens are performing well. Both gardens have notably more capacity that necessary to accept and infiltrate the water quality event. Generally, the three analyzed rainfall events produced notably less surface runoff volume than the storage capacity of the rain gardens (3,100 cf for the west garden and 3,200 cf for the east garden). Even without considering rain garden infiltration, it is not surprising that outflow was not observed. In addition to water quality benefits, these rain gardens are also providing attenuation of peak flows for larger storm events.

The hatchery rain gardens are also unique in that they are designed to utilize the site's topography and green space, and actually function more like landscaped depressions or "ponds" than traditional rain gardens. By adding these unique design features, the rain gardens provide not only stormwater benefits, but aesthetic benefits and even wildlife habitat. Figure 21 below shows geese observed on the west pond during a monitoring visit.

Figure 21: Geese on Hatchery West Rain Garden

This type of site design and the use of site contouring to create rain gardens or shallow basins for stormwater management is an excellent use of LID application in Anchorage. This type of site design is recommended wherever adequate space is available. If a receiving system is not immediately adjacent to the site, as it is in this case, this type of design could include overflow field inlets that connect to piped systems or overflow could be directed to conveyance ditches.

5. West Dowling Parking Lot Rain Garden (ADOT&PF)

The West Dowling parking lot is located on the north side of West Dowling Rd, west of the intersection of West Dowling Rd and the Old Seward Highway. The parking lot is immediately adjacent to Campbell Creek and provides public parking access for users of the popular Campbell Creek trail. The area was re-constructed when West Dowling Road was widened in 2012. (The roadway widening project was an LID pilot project included in the 2013 LID monitoring report.) The parking lot reconstruction included the addition of a rain garden to provide water quality treatment and retention of parking lot runoff generated from small storm events.

5.1. Rain Garden Details

The parking lot rain garden is designed to intercept parking lot runoff instead of allowing it to flow directly to nearby Campbell Creek. The rain garden accepts runoff from both the parking lot and a portion of the access drive for a total of approximately 8,600 square feet of impervious surface with gentle slopes generally less than two percent. The rain garden is located on the north side of the parking lot. Water enters the rain garden via sheet flow from the parking lot. Water that enters the rain garden but is not infiltrated is allowed to overflow the earthen sides of the gardens toward the west. Overflow water is directed to Campbell Creek via overland flow and natural swales. The rain garden is approximately 84 feet long with a width that varies from 0 to 20 feet as the rain garden shape tapers toward the east. The design storage volume is 375 cubic feet. The rain garden size and drainage basin are shown in Exhibit 4 in Appendix C. The parking lot and rain garden shown in the figure below.

Figure 22: West Dowling Rain Garden and Parking Lot

5.2. Monitoring and Reporting Plan

To quantify the performance of the rain garden, inflow and outflow hydrographs were developed for each of the rainfall events discussed in Section 2. Rainfall data from the ANC recording station was used based on proximity to the site.

5.2.1.Hydrograph Development

Inflow hydrographs were developed using EPA SWMM Version 5.0. Outflow from the rain gardens was based on the results of visual observations and comparison of the inflow volume to the design storage capacity.

If LID had not been incorporated into this project, it is assumed that surface runoff from the parking area would have been routed either directly to Campbell Creek via overland flow, or to a collection system along West Dowling Road that would then discharge to Campbell Creek. For the purposes of this report, it is assumed that the runoff would have been collected using traditional inlets and piped storm drains that would discharge to the creek. In this way, the hypothetical case of no LID can be assumed to be the same as the inflow hydrographs.

5.3. Results

The visual monitoring and computation results show that the rain garden did not discharge stormwater for the three events analyzed. The inflow hydrographs are shown in Figure 23. For simplicity, hydrographs for each of the three rainfall events are shown on the same graph.

Figure 23: West Dowling Rain Garden Inflow Hydrographs (No Outflow)

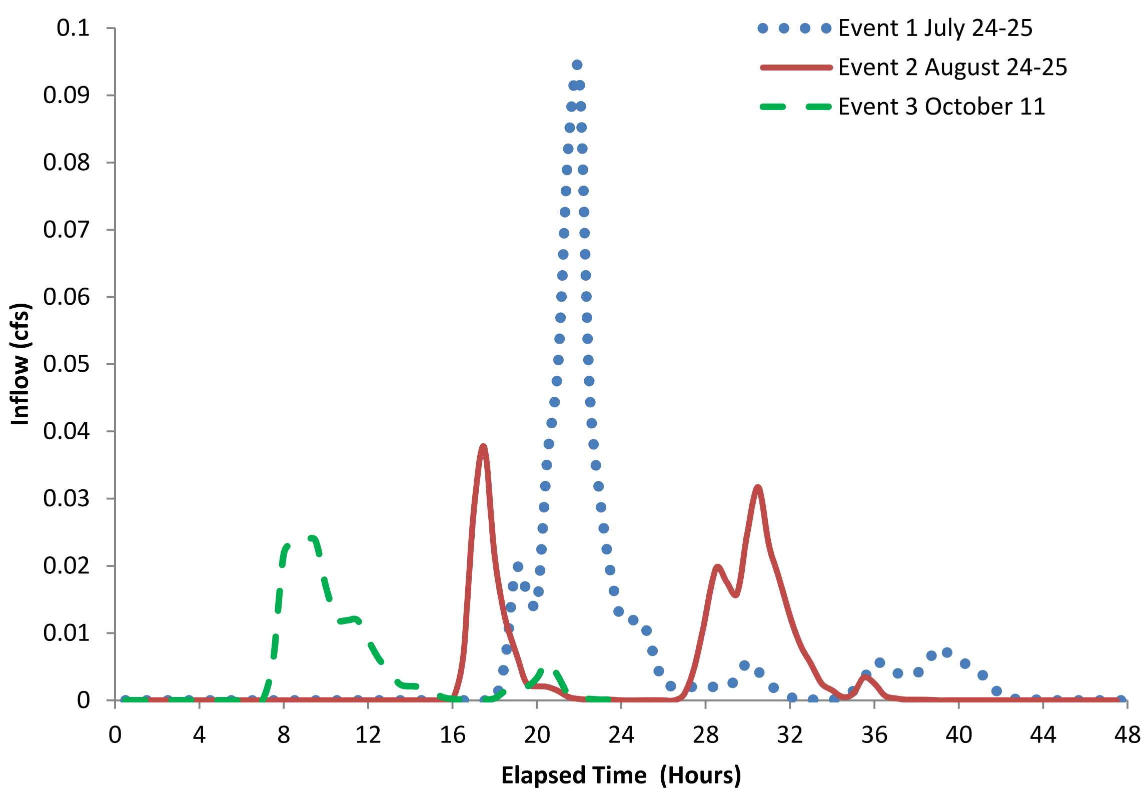


Table 5 provides a summary of inflow volumes and peak flows for the rain garden under each of the three rainfall events. Modeling output reports are included in Appendix E.

Table 5: West Dowling Rain Garden Performance Summary

Storm Event	Runoff Volume			Peak Flow		
	Inflow (cf)	Outflow (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cfs)	Percent Decrease
Event 1, July 24-25	1,011	0	100%	0.09	0.00	100%
Event 2, Aug 24-25	603	0	100%	0.04	0.00	100%
Event 3, October 11	366	0	100%	0.02	0.00	100%

As shown in the table, the inflow exceeded the design storage volume of 375 cf for each of the three rain events analyzed. Infiltration testing was completed during the rain garden design, and results indicate that the underlying soils were able to percolate at a rate of 45 inches per hour. (See Exhibit 5 in Appendix C.) This infiltration rate is expected to be slowed by the topsoil and vegetation in the rain garden, but still provides the rain garden with a fast infiltration rate. Based on the result of visual monitoring, it is expected that all inflow from the events analyzed was infiltrated and the design storage volume was not utilized. The rain garden was visually inspected on July 25, August 25, and October 11. During each of the inspections, ponded water was not observed in the rain garden and signs of recent overflow were not apparent. Site visit summaries are provided in Appendix F.

5.4. Conclusions and Recommendations for Future Projects

Based on the monitoring results discussed above, the West Dowling rain garden is performing very well. It is expected that the rain garden is capable of capturing and infiltrating events exceeding the MOA 10-year, 24-hour event. Future projects with similar soil conditions should consider the rain garden proximity to drinking water wells. If the rain garden were in close proximity to a drinking water well, high infiltration rates may need to be slowed to ensure proper treatment of runoff.

6. Taku Lake Rain Garden (MOA)

Although quantitative monitoring for the Taku Lake Rain Garden was reported in the 2013 LID Project Performance Monitoring Report, the Taku Lake Rain Garden was visually monitored during the summer of 2014 to determine ongoing performance of the rain garden during notable rain events.

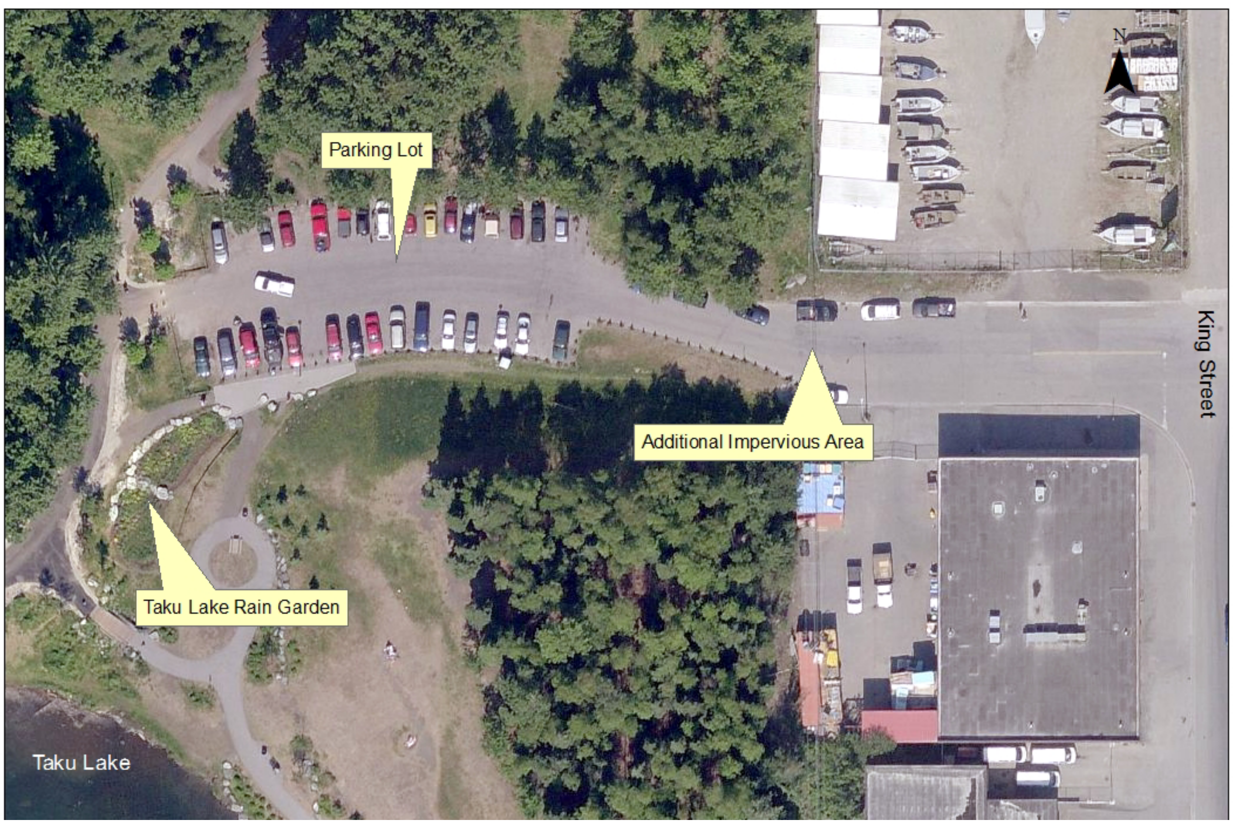
The Taku Lake Rain Garden project was completed by the MOA as part of an effort to improve a localized drainage and flooding problem at the Taku Lake parking lot. Taku Lake is located in Anchorage, north of Dimond Boulevard and west of King Street. The Campbell Creek trail is adjacent to the lake, and the area is popular year-round for recreational activities including walking, running, skiing, biking, and motorized miniature boats. The paved parking lot is approximately 12,150 square feet, and runoff from the parking lot and surrounding area originally flowed directly into Taku Lake via overland flow. The west portion of the parking lot was experiencing localized flooding and seasonal glaciation due to poor grading and drainage. The MOA needed to repair this deficiency and saw an opportunity to concurrently improve the runoff quality and decrease runoff quantity into Taku Lake by incorporating LID into the repair. The MOA designed and constructed a large rain garden on the southwest side of the parking lot to intercept overland flow before it discharges to Taku Lake. The general project area is shown in Figure 24.

6.1. Rain Garden Details

The Taku Lake Rain Garden is approximately 1,400 square feet, and is located approximately 60 feet from the normal edge of water of Taku Lake. The local average groundwater table is approximately five feet below the surface at the rain garden location. The rain garden consists of approximately 1.3 feet of amended topsoil on top of 2.3 feet of large drain rock. The drain rock is surrounded by geotextile separation fabric. A four-inch diameter perforated drain pipe was installed one foot from the bottom of the rain garden to collect excess water that is not infiltrated into the native subgrade. The perforated drain pipe discharges at the west end of the rain garden near the edge of Taku Lake. The MOA planted a variety of native vegetation in the rain garden including wildflowers, ferns, and grasses. The perimeter of the rain garden is lined with large rock boulders. The rain garden has approximately one foot of surface freeboard.

The rain garden was designed to accept runoff from smaller, more frequent rainfall events. Water beyond the design capacity is either collected in the subdrain or is allowed to overflow from the rain garden and flow into the lake via overland flow. Figure 24 below shows the rain garden and its contributing area.

Figure 24: Taku Lake Rain Garden Site



6.2. Visual Monitoring and Results

Visual inspections of the Taku Lake rain garden were completed during or following each of the rain events discussed in Section 2.

The monitoring results showed that the rain garden is performing well. It continues to provide infiltration and storage for small rain events, and filtration and detention of larger events. Outflow from the rain garden's underdrain was only observed once, during the site visit on July 25. The July 24-25 event produced 1.46 inches of rain, and rain garden outflow is expected under these circumstances.

The vegetation in the rain garden was somewhat overgrown with grasses, small trees, and other plants that have taken root there. Although this is not visually appealing, it is expected to enhance hydrologic performance by providing increased evapotranspiration and deeper roots for improved infiltration. Figure 25 below provides updated pictures of the rain garden. Additional photos are included in the site visit reports in Appendix F.

Figure 25: Taku Lake Rain Garden

7. Russian Jack Springs Park Parking Lot (MOA)

Although quantitative monitoring for the Russian Jack Springs Park (RJSP) parking lot was reported in the 2013 LID Project Performance Monitoring Report, the RJSP parking lot was visually monitored during the summer of 2014 to document ongoing performance of the parking lot's LID features.

The RJSP parking lot is located at 821 Pine Street in Anchorage, which is south of 6th Avenue, and north of Debarr Road. The parking was retrofitted in 2012-2013 to provide improved parking and safer pedestrian facilities for park users. The project was a joint effort between WMS and the MOA Parks and Recreation Department (Parks). The RJSP parking lot is used in the summer months for access to the softball fields located north and south of the parking lot and the soccer fields to the east. It is also used year-round for access to the park's popular trail system. The parking lot LID features include porous asphalt and an underground infiltration gallery. Additional information and technical descriptions of the LID features are in presented in the *MOA 2013 Low Impact Development Project Performance Monitoring Report*. An overview of the RJSP site is shown in Figure 26 below.

Figure 26: RJSP Parking Lot Layout

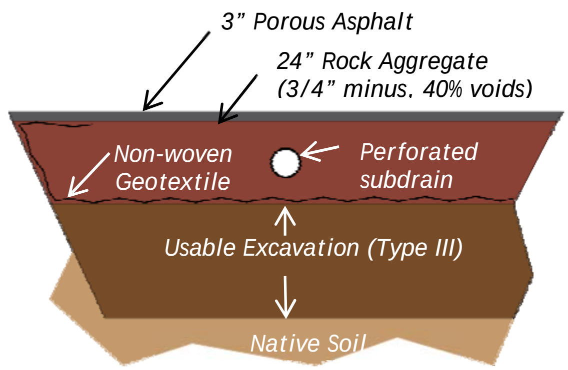
7.1. LID Feature Details

7.1.1. Porous Asphalt

The new parking lot and surrounding sidewalks are approximately 44,400 square feet. The parking lot is a combination of traditional asphalt pavement and porous asphalt pavement. There are three sections of porous asphalt totaling 14,288 square feet or approximately 32 percent of the parking lot area (see Figure 26 above). The project designers worked with Parks maintenance personnel to determine the ideal placement of the porous asphalt for improved long-term performance of the asphalt. If porous asphalt is regularly snowplowed and then sanded for traction, it requires vacuum sweeping to prevent the fine sand particles from clogging the voids in the asphalt (the plowing itself is not expected to be problematic for porous asphalt, but plowing and sanding is usually performed in conjunction.) Parks' ability to maintain the asphalt is limited to their existing maintenance equipment, and the porous asphalt is not able to be vacuum swept. For this reason, project designers located the asphalt in portions of the parking lot that will not be opened for winter use, and therefore will not be sanded.

A typical section for the RJSP porous asphalt is provided in Figure 27.

Figure 27: Typical Porous Asphalt Section



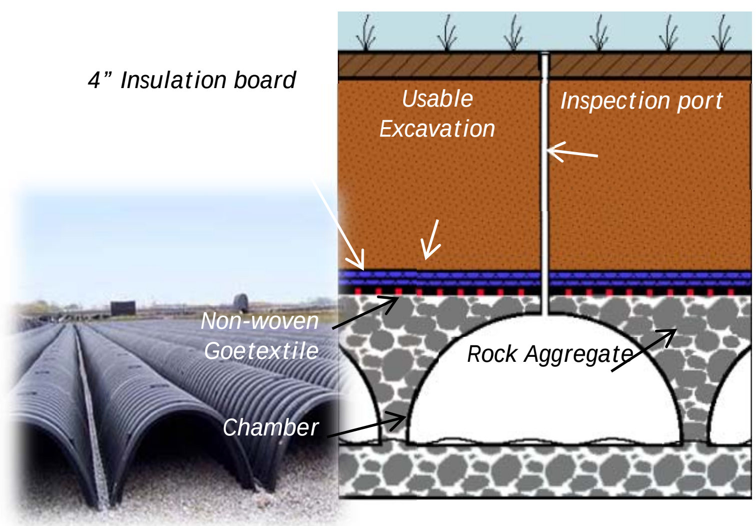
Two of the three porous asphalt sections were installed with a perforated subdrain near the top of the asphalt's structural section. One section was installed without the subdrain in order to compare the performance of the two types. The porous asphalt was designed to store and infiltrate up to the 10-year, 24-hour rainfall event without contributing flow to the infiltration gallery. In the event that the asphalt's structural section should become filled with water in excess of this amount, water would be collected in the subdrain pipe and directed away from the asphalt. The subdrain pipes are routed to the subsurface infiltration gallery (see details below) via an on-site storm drain system.

A shallow monitoring well is installed in each section of porous asphalt in order to monitor the water levels in the asphalt structural section.

7.1.2. Subsurface Infiltration Gallery

Runoff from the non-porous asphalt and any excess water collected in the perforated subdrain under the porous asphalt is directed to the subsurface infiltration gallery. The gallery is a Contech ChamberMaxx system made up of five individual storage chambers. These chambers are designed to store and infiltrate water as soil capacity becomes available. A typical section and associated photo of the subsurface infiltration gallery are provided in Figure 28.

Figure 28: Typical Infiltration Gallery Section



The gallery was installed with inspection ports to monitor the water levels in each individual chamber. The chamber system does not have a secondary outlet. Combined with the porous asphalt storage area, it was designed to accept rain events up to the 100-year, 24-hour event.

7.2. Visual Monitoring

The visual monitoring for the RJSP parking lot is described below, and site visit reports with photos are included in Appendix F.

7.2.1. Porous Asphalt

Following each of the rainfall events discussed in Section 2 and on October 15th, the monitoring wells in the porous asphalt were checked for standing water depths. The observed depths are presented in Table 6.

Table 6: RJSP Porous Asphalt Monitoring Well Data Summary

Date	Standing Water Depth (inches)		
	Center MW	North MW	West MW
7/25/2014	3.5	2	Not checked
8/25/2014	Less than 1	40	Less than 1
10/11/2014	6	41	4
10/15/2014	6	34.5	Not checked

The center, north, and west monitoring wells have casing depths of 80 to 85 inches, which extends below the asphalt structural sections. The observed depths of standing water presented above indicate that the perforated pipes in the central and western sections of porous asphalt were not flowing. There was a significant difference between the standing water depths in the north well and the other two wells. There are two possible conditions that could be causing this difference. Infiltration test results completed during design varied by parking lot location, and the native soil under the north porous asphalt section may infiltrate water more slowly than the other sections. Alternatively, the bottom of the monitoring well in this location may be within a pocket of local groundwater. The groundwater table was observed to be relatively shallow in this location during construction, and fluctuations in groundwater depths are expected following rainfall events. Without longer-term monitoring, the exact cause is not known, but the water level in the north well is not expected to be problematic and does not appear to be impacting asphalt performance.

The visual monitoring results presented concerns related to parking lot use and ongoing maintenance. Prior to the beginning of formal monitoring, and for the first month of the monitoring periods, the wood-chip mulch from the parking lot's landscape planters was observed to be scattered across the parking lot and the porous asphalt. The mulch was then driven over and walked on, grinding it into the asphalt pores. During a site coordination meeting with Parks on August 5, 2014 regarding the mulch problem, several areas of surface ponding on the porous asphalt were observed. This indicates that the asphalt pores in these locations were filled with particulates, and water was not able to flow through the asphalt. Parks corrected the problem as soon as time and funding became available. The wood-chip mulch was replaced with rock mulch in five locations, and two locations that had been mulched were converted to grass. The parking lot was also swept to remove as much surface debris as possible.

The rock mulch has prevented the problem from worsening, and the sweeping appears to have improved the asphalt performance. Surface ponding was observed at only one location, adjacent to a landscape planter, during subsequent site visits. The impacted portion of the porous asphalt is small, and does not appear to be impacting the performance of the parking lot as a whole. The condition could potentially be remedied by vacuum sweeping the parking lot, if funding and appropriate equipment were available.

Slight raveling and shallow ruts were observed on the porous asphalt in high-use parking stalls on the center and north porous asphalt sections. The rutting is expected to be from repeated loading in the same location, and the raveling is expected to be from turning tire traffic. The potential for rutting and raveling may have been increased due to the unusually warm 2014 summer temperatures in Anchorage. Warmer temperatures may loosen the asphalt binder, making the surface more susceptible to raveling.

7.2.2. Infiltration Gallery

The infiltration gallery was inspected to obtain standing water depths following each of the rain events described in Section 2. Water level observations were obtained via the system's inspection ports, shown in Figure 28 above. Standing water was not observed during the monitoring period.

The visual monitoring presented a concern related to the longevity of the infiltration gallery. Prior to the beginning of formal monitoring, and for the first month of the monitoring periods, the area to the east of the parking lot was contributing notable quantities of muddy water onto the parking lot and into the infiltration gallery. The situation was caused by unauthorized vehicles being driven over the area, creating deep ruts and destroying the grass. The situation was reported to Parks, and it was corrected to the best of their ability. Porta potties were placed across the drive access location to prevent future vehicle access, and the area was re-seeded. Unfortunately, because the final grade of this area is not in conformance with the design plans, water will continue to flow onto the parking lot and into the infiltration gallery. Until the vegetation is stable, sediment will be transported with the runoff. This is expected to be problematic during snow melt in the spring of 2015.

The infiltration gallery did not show signs of decreased performance from the sediment loading during the monitoring period.

7.3. Results and Recommendations

Generally, the RJSP parking lot is still performing well. Both the porous asphalt and the infiltration gallery are exceeding design expectations, as indicated by the water depth measurements discussed above. Following each of the rain events analyzed, water level measurements indicate that the porous asphalt did not come close to contributing water to the infiltration gallery. The infiltration gallery was able to infiltrate water at or close to the rate of inflow for each of the events analyzed, as indicated by the lack of standing water observed in the storage chambers. To prevent future problems, the parking lot should continue to be carefully maintained, and observed problematic conditions should be remedied immediately to minimize the impacts. Based on the 2014 monitoring, the following considerations and recommendations are provided for future projects that incorporate porous asphalt or infiltration galleries. Additional recommendations are presented in the 2013 Low Impact Development Project Performance Monitoring Report.

1. Wood-chip mulch should not be used adjacent to porous asphalt or other types of porous surfaces. This is particularly important for parks or other high-use public facilities that are generally not supervised.

2. Porous asphalt performance may decrease over time if it is not vacuum swept.

3. Attention to detail during construction is critical for the long-term performance of infiltration facilities. LID site design tends to incorporate the entire site and is not limited to isolated facilities. In this case, the area east of the parking lot was not designed to contribute water toward the parking lot. Modifying the grade on the east side seemed like a minor and cost-saving change during construction, but has resulted in ongoing performance concerns for the infiltration facilities. It is recommended that continuous or frequent construction inspection be provided by an inspector familiar with both LID construction considerations and the overall intent and function of the project being constructed.

   Additionally, LID designs in Anchorage should consider the fact that contractors may not be familiar with LID construction concepts. Keeping designs as simple as possible and providing a construction sequencing plan to the contractor may help ensure that the design intent is maintained.

4. For public-use facilities like parks, barricades such as bollards or gates are needed to block vehicle access to areas that are not intended as drivable surfaces.

Appendix A: APDES Permit Excerpt

c) **Green Infrastructure/Low Impact Development (LID) Strategy and Pilot Projects.** Within one year of the effective date of this permit, the permittees must develop a strategy to provide incentives for the increased use of LID techniques in private and public sector development projects within both the MOA and ADOT&PF jurisdictions. The strategy must outline the methods of evaluating the Green Infrastructure/LID pilot projects described below. Permittees must begin implementation of the Green Infrastructure/LID Strategy and pilot projects within two years of the effective date of this permit.

(i) Beginning with the 4th Year Annual Report, the permittees must report on and evaluate the status of five pilot projects that use LID concepts for on-site control of water quality. Projects must involve managing runoff from at least 10,000 square feet of impervious surface. At least three of the five LID pilot projects must be ADOT&PF-owned locations. Parking lot retrofits as required in Part II.B.2.c.vi may be used as pilot projects. At least two of the pilot sites must address drainage areas greater than five acres in size. At least one pilot project must be located in the Chester Creek, Fish Creek, Campbell Creek, or Little Campbell Creek watersheds.

(ii) The permittees must monitor the performance of each pilot project and report the results beginning with the 4th Year Annual Report. The permittees must calculate or model changes in runoff quantities for each of the pilot project sites in the following manner:

- For retrofit projects, changes in runoff quantities shall be calculated as a percentage of 100% pervious surface before and after implementation of the LID practices.

- For new construction projects, changes in runoff quantities shall be calculated for development scenarios both with LID practices and without LID practices.

- The permittees must measure runoff flow rate and subsequently prepare runoff hydrographs to characterize peak runoff rates and volumes, discharge rates and volumes, and duration of discharge volumes. The evaluation must include quantification and description of each type of land cover contributing to surface runoff for each pilot project, including area, slope, vegetation type and condition for pervious surfaces, and nature of impervious surfaces.

- The permittees must use these runoff values to evaluate the overall effectiveness of various LID practices and to develop recommendations for future LID practices addressing appropriate use, design, type, size, soil type and operation and maintenance practices. The permittees must use the recommendations to update their final LID criteria, as necessary, and utilize the information obtained through the LID pilot studies to revise the Storm Water Design Criteria Manual(s) no later than five years from the effective date of this permit.

(iii) **Rain Gardens.** Within four years of the effective date of this permit, the permittees must evaluate the effectiveness of rain gardens located in one neighborhood and one public-private community partnership. If feasible, pilot projects should be located within a TMDL watershed listed in Table II.C. The permittees must quantitatively evaluate the effectiveness of the rain gardens as outlined in Part II.B.2.c.ii above.

(iv) **Riparian Zone Management.** Within five years from the effective date of this permit, the permittees must identify and prioritize riparian areas appropriate for permittee acquisition and protection. Prior to the expiration date of this permit, the permittees must examine the feasibility of reconstructing MS4 outfalls, and must disconnect at least one major MS4 outfall from discharging from receiving waters using vegetated swales or other appropriate techniques.

(v) **Repair of Public Streets, Roads or Parking Lots.** When public streets, roads or parking lots are repaired as defined in Part VII, the permittees must evaluate the feasibility of incorporating runoff reduction techniques into the repair using canopy interception, soil amendments, evaporation, rainfall harvesting, engineered infiltration, rain gardens, infiltration trenches, extended filtration and/or evapotranspiration and/or any combination of the aforementioned practices. Where such practices are found to be feasible, the permittees must consider the use of such practices in the design and repair. These requirements apply only to projects whose design is started after the effective date of this permit. Beginning in the 4th Year Annual Report, the permittees must document and list the locations of street, road and parking lot repair work completed within the last 12 month period that has incorporated such runoff reduction practices.

(vi) **Parking Lot Retrofits.** Prior to the expiration date of this permit, each permittee must retrofit at least two public facility parking lots with infiltration, evapotranspiration or reuse techniques designed to retain 100% of the parking lot runoff from the 90th percentile, 24 hour rainfall event. Each retrofit site must be located in a watershed draining to an impaired receiving water listed in Table II.C. The permittees must quantitatively measure the effectiveness of

Appendix B: Rainfall Data

Hourly Rainfall Data from the National Climatic Data Center

Date and Time	ANC Rainfall (in)	MRI Rainfall (in)
7/24/2014 0:53	0	0
7/24/2014 1:53	0	0
7/24/2014 2:53	0	0
7/24/2014 3:53	0	0
7/24/2014 4:53	0	0
7/24/2014 5:53	0	0
7/24/2014 6:53	0	0
7/24/2014 7:53	0	0
7/24/2014 8:53	0	0
7/24/2014 9:53	0	0
7/24/2014 10:53	0	0
7/24/2014 11:53	0	0
7/24/2014 12:53	0	0
7/24/2014 13:53	0	0
7/24/2014 14:53	0	0
7/24/2014 15:53	0	0
7/24/2014 16:53	0.02	0
7/24/2014 17:53	0.03	0.02
7/24/2014 18:53	0.1	0.03
7/24/2014 19:53	0.07	0.04
7/24/2014 20:53	0.25	0.03
7/24/2014 21:53	0.47	0.1
7/24/2014 22:53	0.15	0.07
7/24/2014 23:53	0.06	0.04
7/25/2014 0:53	0.06	0.03
7/25/2014 1:53	0.01	0
7/25/2014 2:53	0.01	0.02
7/25/2014 3:53	0.01	0.01
7/25/2014 4:53	0.01	0.01
7/25/2014 5:53	0.03	0.01
7/25/2014 6:53	0.01	0.01
7/25/2014 7:53	0	0
7/25/2014 8:53	0	0
7/25/2014 9:53	0	0
7/25/2014 10:53	0.01	0
7/25/2014 11:53	0.03	0.03
7/25/2014 12:53	0.02	0.06
7/25/2014 13:53	0.02	0.03
7/25/2014 14:53	0.04	0.02
7/25/2014 15:53	0.03	0.03
7/25/2014 16:53	0.02	0.04
7/25/2014 17:53	0	0.01
7/25/2014 18:53	0	0
7/25/2014 19:53	0	0
7/25/2014 20:53	0	0
7/25/2014 21:53	0	0
7/25/2014 22:53	0	0
7/25/2014 23:53	0	0

Date and Time	ANC Rainfall (in)	MRI Rainfall (in)
8/24/2014 0:53	0	0
8/24/2014 1:53	0	0
8/24/2014 2:53	0.02	0
8/24/2014 3:53	0.05	0.05
8/24/2014 4:53	0	0
8/24/2014 5:53	0	0
8/24/2014 6:53	0	0
8/24/2014 7:53	0	0.01
8/24/2014 8:53	0.02	0.01
8/24/2014 9:53	0.01	0.01
8/24/2014 10:53	0	0.01
8/24/2014 11:53	0	0
8/24/2014 12:53	0	0
8/24/2014 13:53	0	0
8/24/2014 14:53	0.02	0.01
8/24/2014 15:53	0.07	0.05
8/24/2014 16:53	0.19	0.12
8/24/2014 17:53	0.06	0.09
8/24/2014 18:53	0.01	0
8/24/2014 19:53	0.01	0
8/24/2014 20:53	0	0.01
8/24/2014 21:53	0	0
8/24/2014 22:53	0	0
8/24/2014 23:53	0	0
8/25/2014 0:53	0	0
8/25/2014 1:53	0	0
8/25/2014 2:53	0.03	0
8/25/2014 3:53	0.1	0.06
8/25/2014 4:53	0.08	0.07
8/25/2014 5:53	0.16	0.09
8/25/2014 6:53	0.09	0.07
8/25/2014 7:53	0.04	0.02
8/25/2014 8:53	0.01	0.02
8/25/2014 9:53	0	0.07
8/25/2014 10:53	0.02	0.06
8/25/2014 11:53	0	0.04
8/25/2014 12:53	0	0
8/25/2014 13:53	0	0
8/25/2014 14:53	0.01	0.01
8/25/2014 15:53	0	0
8/25/2014 16:53	0	0
8/25/2014 17:53	0	0
8/25/2014 18:53	0	0
8/25/2014 19:53	0	0
8/25/2014 20:53	0	0
8/25/2014 21:53	0	0
8/25/2014 22:53	0	0
8/25/2014 23:53	0	0

Date and Time	ANC Rainfall (in)	MRI Rainfall (in)
10/11/2014 0:53	0	0
10/11/2014 1:53	0	0
10/11/2014 2:53	0	0
10/11/2014 3:53	0	0
10/11/2014 4:53	0	0
10/11/2014 5:53	0	0
10/11/2014 6:53	0.1	0.08
10/11/2014 7:53	0.12	0.13
10/11/2014 8:53	0.12	0.11
10/11/2014 9:53	0.06	0.12
10/11/2014 10:53	0.06	0.09
10/11/2014 11:53	0.03	0.04
10/11/2014 12:53	0.01	0.02
10/11/2014 13:53	0.01	0.01
10/11/2014 14:53	0	0.01
10/11/2014 15:53	0	0
10/11/2014 16:53	0	0
10/11/2014 17:53	0.01	0.01
10/11/2014 18:53	0.01	0.03
10/11/2014 19:53	0.03	0.03
10/11/2014 20:53	0	0.01
10/11/2014 21:53	0	0
10/11/2014 22:53	0	0
10/11/2014 23:53	0	0

Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)
9/4/2014 0:53	0	9/6/2014 0:53	0	9/8/2014 1:53	0
9/4/2014 1:53	0	9/6/2014 1:53	0	9/8/2014 2:53	0
9/4/2014 2:53	0	9/6/2014 2:53	0	9/8/2014 3:53	0
9/4/2014 3:53	0	9/6/2014 3:53	0	9/8/2014 4:53	0
9/4/2014 4:53	0	9/6/2014 4:53	0	9/8/2014 5:53	0
9/4/2014 5:53	0	9/6/2014 5:53	0	9/8/2014 6:53	0
9/4/2014 6:53	0	9/6/2014 6:53	0	9/8/2014 7:53	0
9/4/2014 7:53	0	9/6/2014 7:53	0	9/8/2014 8:53	0
9/4/2014 8:53	0	9/6/2014 8:53	0	9/8/2014 9:53	0
9/4/2014 9:53	0	9/6/2014 9:53	0	9/8/2014 10:53	0
9/4/2014 10:53	0	9/6/2014 10:53	0	9/8/2014 11:53	0
9/4/2014 11:53	0	9/6/2014 11:53	0	9/8/2014 12:53	0
9/4/2014 12:53	0.03	9/6/2014 12:53	0	9/8/2014 13:53	0
9/4/2014 13:53	0.06	9/6/2014 13:53	0	9/8/2014 14:53	0
9/4/2014 14:53	0.06	9/6/2014 14:53	0	9/8/2014 15:53	0
9/4/2014 15:53	0.06	9/6/2014 15:53	0	9/8/2014 16:53	0
9/4/2014 16:53	0.04	9/6/2014 16:53	0	9/8/2014 17:53	0
9/4/2014 17:53	0.05	9/6/2014 17:53	0	9/8/2014 18:53	0
9/4/2014 18:53	0.05	9/6/2014 18:53	0	9/8/2014 19:53	0
9/4/2014 19:53	0.07	9/6/2014 19:53	0	9/8/2014 20:53	0
9/4/2014 20:53	0.02	9/6/2014 20:53	0	9/8/2014 21:53	0
9/4/2014 21:53	0.02	9/6/2014 21:53	0	9/8/2014 22:53	0
9/4/2014 22:53	0.05	9/6/2014 22:53	0	9/8/2014 23:53	0
9/4/2014 23:53	0.04	9/6/2014 23:53	0	9/9/2014 0:53	0
9/5/2014 0:53	0.01	9/7/2014 0:53	0	9/9/2014 1:53	0
9/5/2014 1:53	0	9/7/2014 1:53	0	9/9/2014 2:53	0
9/5/2014 2:53	0	9/7/2014 2:53	0	9/9/2014 3:53	0.01
9/5/2014 3:53	0	9/7/2014 3:53	0	9/9/2014 4:53	0.01
9/5/2014 4:53	0.04	9/7/2014 4:53	0	9/9/2014 5:53	0
9/5/2014 5:53	0.08	9/7/2014 5:53	0	9/9/2014 6:53	0.02
9/5/2014 6:53	0.08	9/7/2014 6:53	0	9/9/2014 7:53	0.01
9/5/2014 7:53	0.06	9/7/2014 7:53	0	9/9/2014 8:53	0
9/5/2014 8:53	0.04	9/7/2014 8:53	0	9/9/2014 9:53	0
9/5/2014 9:53	0.02	9/7/2014 9:53	0	9/9/2014 10:53	0
9/5/2014 10:53	0.02	9/7/2014 10:53	0	9/9/2014 11:53	0
9/5/2014 11:53	0.02	9/7/2014 11:53	0	9/9/2014 12:53	0
9/5/2014 12:53	0.02	9/7/2014 12:53	0	9/9/2014 13:53	0
9/5/2014 13:53	0.01	9/7/2014 13:53	0	9/9/2014 14:53	0
9/5/2014 14:53	0	9/7/2014 14:53	0	9/9/2014 15:53	0.03
9/5/2014 15:53	0	9/7/2014 15:53	0	9/9/2014 16:53	0.04
9/5/2014 16:53	0	9/7/2014 16:53	0	9/9/2014 17:53	0.03
9/5/2014 17:53	0.01	9/7/2014 17:53	0	9/9/2014 18:53	0.04
9/5/2014 18:53	0.01	9/7/2014 18:53	0	9/9/2014 19:53	0.02
9/5/2014 19:53	0	9/7/2014 19:53	0	9/9/2014 20:53	0
9/5/2014 20:53	0.01	9/7/2014 20:53	0	9/9/2014 21:53	0.01
9/5/2014 21:53	0	9/7/2014 21:53	0	9/9/2014 22:53	0
9/5/2014 22:53	0	9/7/2014 22:53	0	9/9/2014 23:53	0.02
9/5/2014 23:53	0	9/8/2014 0:53	0	9/10/2014 0:53	0.03

Hourly Rainfall Data from the National Climatic Data Center

Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)
9/10/2014 1:53	0	9/12/2014 1:53	0	9/14/2014 1:53	0
9/10/2014 2:53	0	9/12/2014 2:53	0	9/14/2014 2:53	0
9/10/2014 3:53	0.04	9/12/2014 3:53	0	9/14/2014 3:53	0
9/10/2014 4:53	0.04	9/12/2014 4:53	0	9/14/2014 4:53	0
9/10/2014 5:53	0.03	9/12/2014 5:53	0	9/14/2014 5:53	0
9/10/2014 6:53	0.04	9/12/2014 6:53	0	9/14/2014 6:53	0
9/10/2014 7:53	0.04	9/12/2014 7:53	0	9/14/2014 7:53	0
9/10/2014 8:53	0.01	9/12/2014 8:53	0	9/14/2014 8:53	0
9/10/2014 9:53	0.01	9/12/2014 9:53	0	9/14/2014 9:53	0
9/10/2014 10:53	0.05	9/12/2014 10:53	0	9/14/2014 10:53	0
9/10/2014 11:53	0.04	9/12/2014 11:53	0	9/14/2014 11:53	0
9/10/2014 12:53	0.07	9/12/2014 12:53	0	9/14/2014 12:53	0
9/10/2014 13:53	0.03	9/12/2014 13:53	0.01	9/14/2014 13:53	0
9/10/2014 14:53	0.02	9/12/2014 14:53	0.02	9/14/2014 14:53	0
9/10/2014 15:53	0.02	9/12/2014 15:53	0.01	9/14/2014 15:53	0
9/10/2014 16:53	0	9/12/2014 16:53	0	9/14/2014 16:53	0
9/10/2014 17:53	0	9/12/2014 17:53	0	9/14/2014 17:53	0
9/10/2014 18:53	0	9/12/2014 18:53	0	9/14/2014 18:53	0
9/10/2014 19:53	0	9/12/2014 19:53	0	9/14/2014 19:53	0
9/10/2014 20:53	0	9/12/2014 20:53	0.01	9/14/2014 20:53	0
9/10/2014 21:53	0	9/12/2014 21:53	0.03	9/14/2014 21:53	0
9/10/2014 22:53	0	9/12/2014 22:53	0.01	9/14/2014 22:53	0
9/10/2014 23:53	0	9/12/2014 23:53	0	9/14/2014 23:53	0
9/11/2014 0:53	0	9/13/2014 0:53	0	9/15/2014 0:53	0
9/11/2014 1:53	0	9/13/2014 1:53	0.02	9/15/2014 1:53	0
9/11/2014 2:53	0	9/13/2014 2:53	0	9/15/2014 2:53	0
9/11/2014 3:53	0	9/13/2014 3:53	0.02	9/15/2014 3:53	0
9/11/2014 4:53	0	9/13/2014 4:53	0.05	9/15/2014 4:53	0.02
9/11/2014 5:53	0	9/13/2014 5:53	0.03	9/15/2014 5:53	0.05
9/11/2014 6:53	0	9/13/2014 6:53	0.05	9/15/2014 6:53	0.04
9/11/2014 7:53	0	9/13/2014 7:53	0.02	9/15/2014 7:53	0.02
9/11/2014 8:53	0	9/13/2014 8:53	0.01	9/15/2014 8:53	0
9/11/2014 9:53	0	9/13/2014 9:53	0	9/15/2014 9:53	0
9/11/2014 10:53	0	9/13/2014 10:53	0	9/15/2014 10:53	0
9/11/2014 11:53	0	9/13/2014 11:53	0	9/15/2014 11:53	0.05
9/11/2014 12:53	0	9/13/2014 12:53	0	9/15/2014 12:53	0.02
9/11/2014 13:53	0	9/13/2014 13:53	0	9/15/2014 13:53	0.03
9/11/2014 14:53	0	9/13/2014 14:53	0	9/15/2014 14:53	0.01
9/11/2014 15:53	0	9/13/2014 15:53	0	9/15/2014 15:53	0.01
9/11/2014 16:53	0	9/13/2014 16:53	0	9/15/2014 16:53	0.04
9/11/2014 17:53	0	9/13/2014 17:53	0	9/15/2014 17:53	0.06
9/11/2014 18:53	0	9/13/2014 18:53	0	9/15/2014 18:53	0.01
9/11/2014 19:53	0	9/13/2014 19:53	0	9/15/2014 19:53	0.02
9/11/2014 20:53	0	9/13/2014 20:53	0	9/15/2014 20:53	0
9/11/2014 21:53	0	9/13/2014 21:53	0	9/15/2014 21:53	0
9/11/2014 22:53	0	9/13/2014 22:53	0.03	9/15/2014 22:53	0
9/11/2014 23:53	0.01	9/13/2014 23:53	0.34	9/15/2014 23:53	0
9/12/2014 0:53	0	9/14/2014 0:53	0.09	9/16/2014 0:53	0

Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)	Date and Time	ANC Rainfall (in)
9/16/2014 1:53	0	9/18/2014 1:53	0.01	9/20/2014 1:53	0
9/16/2014 2:53	0	9/18/2014 2:53	0	9/20/2014 2:53	0
9/16/2014 3:53	0	9/18/2014 3:53	0	9/20/2014 3:53	0
9/16/2014 4:53	0	9/18/2014 4:53	0	9/20/2014 4:53	0
9/16/2014 5:53	0	9/18/2014 5:53	0.01	9/20/2014 5:53	0
9/16/2014 6:53	0	9/18/2014 6:53	0	9/20/2014 6:53	0
9/16/2014 7:53	0	9/18/2014 7:53	0	9/20/2014 7:53	0
9/16/2014 8:53	0	9/18/2014 8:53	0	9/20/2014 8:53	0
9/16/2014 9:53	0	9/18/2014 9:53	0	9/20/2014 9:53	0
9/16/2014 10:53	0	9/18/2014 10:53	0	9/20/2014 10:53	0
9/16/2014 11:53	0	9/18/2014 11:53	0	9/20/2014 11:53	0
9/16/2014 12:53	0	9/18/2014 12:53	0	9/20/2014 12:53	0
9/16/2014 13:53	0	9/18/2014 13:53	0.02	9/20/2014 13:53	0
9/16/2014 14:53	0.01	9/18/2014 14:53	0.03	9/20/2014 14:53	0
9/16/2014 15:53	0	9/18/2014 15:53	0.04	9/20/2014 15:53	0
9/16/2014 16:53	0	9/18/2014 16:53	0.05	9/20/2014 16:53	0
9/16/2014 17:53	0	9/18/2014 17:53	0.01	9/20/2014 17:53	0
9/16/2014 18:53	0	9/18/2014 18:53	0.04	9/20/2014 18:53	0
9/16/2014 19:53	0	9/18/2014 19:53	0.01	9/20/2014 19:53	0
9/16/2014 20:53	0	9/18/2014 20:53	0.02	9/20/2014 20:53	0.06
9/16/2014 21:53	0.01	9/18/2014 21:53	0	9/20/2014 21:53	0
9/16/2014 22:53	0.01	9/18/2014 22:53	0	9/20/2014 22:53	0
9/16/2014 23:53	0.01	9/18/2014 23:53	0	9/20/2014 23:53	0.03
9/17/2014 0:53	0	9/19/2014 0:53	0		
9/17/2014 1:53	0	9/19/2014 1:53	0.02		
9/17/2014 2:53	0	9/19/2014 2:53	0.02		
9/17/2014 3:53	0	9/19/2014 3:53	0.02		
9/17/2014 4:53	0	9/19/2014 4:53	0.01		
9/17/2014 5:53	0	9/19/2014 5:53	0.02		
9/17/2014 6:53	0	9/19/2014 6:53	0.04		
9/17/2014 7:53	0	9/19/2014 7:53	0.03		
9/17/2014 8:53	0	9/19/2014 8:53	0.04		
9/17/2014 9:53	0	9/19/2014 9:53	0.03		
9/17/2014 10:53	0	9/19/2014 10:53	0.03		
9/17/2014 11:53	0	9/19/2014 11:53	0		
9/17/2014 12:53	0	9/19/2014 12:53	0		
9/17/2014 13:53	0	9/19/2014 13:53	0		
9/17/2014 14:53	0	9/19/2014 14:53	0		
9/17/2014 15:53	0	9/19/2014 15:53	0.01		
9/17/2014 16:53	0	9/19/2014 16:53	0		
9/17/2014 17:53	0	9/19/2014 17:53	0.04		
9/17/2014 18:53	0	9/19/2014 18:53	0.03		
9/17/2014 19:53	0	9/19/2014 19:53	0.07		
9/17/2014 20:53	0	9/19/2014 20:53	0.08		
9/17/2014 21:53	0	9/19/2014 21:53	0.12		
9/17/2014 22:53	0	9/19/2014 22:53	0.05		
9/17/2014 23:53	0.02	9/19/2014 23:53	0.03		
9/18/2014 0:53	0.09	9/20/2014 0:53	0.01		

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA (final)

NOAA, National Climatic Data Center

Month: 07/2014

Station Location: TED STEVENS ANCHORAGE INTL AIRPORT (26451)
ANCHORAGE, AK

Lat. 61.169 Lon. -150.027

Elevation(Ground): 120 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	65	54	60	2	48	53	5	0	0328	2239	RA	0	M	0.0	T	29.91	30.05	3.1	23	6.3	20	180	15	160	01
02	72	52	62	4	50	56	3	0	0329	2238		0	M	0.0	0.00	29.73	29.88	3.1	25	4.3	15	250	13	250	02
03	76*	58	67*	9	50	57	0	2	0331	2237		0	M	0.0	0.00	29.68	29.83	3.2	22	5.0	20	210	14	220	03
04	75	56	66	8	50	57	0	1	0332	2236		0	M	0.0	0.00	29.65	29.80	2.6	23	4.7	18	180	13	210	04
05	73	59	66	8	52	58	0	1	0333	2235		0	M	0.0	0.00	29.62	29.77	8.1	18	10.1	30	150	22	150	05
06	60	56	58	0	52	55	7	0	0335	2234	RA	0	M	0.0	0.07	29.82	29.96	1.3	30	4.4	22	140	17	130	06
07	65	53	59	1	48	54	6	0	0337	2232	RA	0	M	0.0	T	29.81	29.95	8.1	15	9.2	35	160	23	160	07
08	67	57	62	3	49	54	3	0	0338	2231		0	M	0.0	0.00	29.80	29.95	2.9	22	5.2	22	200	10	240	08
09	62	52	57	-2	51	54	8	0	0340	2230	RA BR	0	M	0.0	0.12	29.88	30.02	0.6	21	4.3	28	160	16	130	09
10	58	54	56*	-3	52	54	9	0	0342	2228	RA BR	0	M	0.0	0.52	29.59	29.74	5.0	35	5.3	16	330	12	330	10
11	66	54	60	1	50	54	5	0	0344	2226	RA	0	M	0.0	0.02	29.51	29.67	5.1	16	10.4	33	150	23	160	11
12	69	56	63	4	47	53	2	0	0346	2225	RA	0	M	0.0	T	29.75	29.90	3.0	22	8.4	29	220	21	150	12
13	67	49	58	-1	47	53	7	0	0348	2223	RA	0	M	0.0	0.12	30.02	30.16	7.0	17	8.1	39	170	18	140	13
14	65	52	59	0	48	52	6	0	0350	2221		0	M	0.0	0.00	30.15	30.29	2.8	23	5.6	24	170	12	280	14
15	69	48*	59	0	48	53	6	0	0352	2219		0	M	0.0	T	30.07	30.22	1.9	30	2.5	10	320	7	260	15
16	69	55	62	3	50	55	3	0	0354	2217		0	M	0.0	0.00	29.98	30.14	1.8	25	4.9	23	190	14	190	16
17	65	56	61	2	50	55	4	0	0356	2215		0	M	0.0	0.00	29.82	29.97	2.8	26	6.0	28	160	12	300	17
18	66	55	61	2	49	54	4	0	0359	2213		0	M	0.0	0.00	29.60	29.76	2.9	28	4.6	25	180	15	180	18
19	69	55	62	3	48	54	3	0	0401	2211	RA	0	M	0.0	0.09	29.49	29.64	9.1	18	9.3	31	180	17	190	19
20	69	51	60	1	48	53	5	0	0403	2209	RA	0	M	0.0	0.07	29.62	29.78	2.1	35	5.8	28	190	14	350	20
21	71	53	62	3	43	52	3	0	0405	2207		0	M	0.0	M	29.88	30.01	1.5	33	3.5	14	030	9	250	21
22	66	50	58	-1	48	53	7	0	0408	2205		0	M	0.0	T	29.78	29.92	4.9	27	6.2	24	190	15	220	22
23	68	56	62	3	48	54	3	0	0410	2202	RA	0	M	0.0	T	29.69	29.84	5.1	15	8.1	32	170	20	150	23
24	68	55	62	3	50	54	3	0	0413	2160	RA BR	0	M	0.0	1.15	29.67	29.81	6.6	20	9.9	32	180	16	250	24
25	60	53	57	-2	51	53	8	0	0415	2157	RA BR	0	M	0.0	0.31	29.67	29.83	1.5	35	4.6	14	340	12	340	25
26	69	52	61	2	49	53	4	0	0417	2155		0	M	0.0	0.00	29.73	29.88	1.5	26	3.6	21	230	12	180	26
27	69	51	60	1	47	53	5	0	0420	2153		0	M	0.0	T	29.78	29.93	4.1	15	8.1	32	160	21	140	27
28	66	53	60	1	49	53	5	0	0422	2150	RA BR	0	M	0.0	0.52	29.86	30.00	6.6	14	9.2	28	140	18	240	28
29	69	51	60	1	50	54	5	0	0425	2148	BR	0	M	0.0	0.00	29.82	29.97	1.0	29	6.1	17	220	14	220	29
30	74	54	64	5	51	57	1	0	0427	2145		0	M	0.0	0.00	29.98	30.13	4.0	20	6.8	30	170	16	140	30
31	67	55	61	2	51	55	4	0	0430	2142		0	M	0.0	0.00	30.16	30.30	4.8	27	6.2	23	190	12	290	31
	67.5	53.7	60.6		49.2	54.2	4.3	0.1	<-----Monthly Averages | Totals----->				M	0.0	2.99	29.79	29.94	2.2	20	6.3	<Monthly Average				
	2.1	1.5	1.8	<-----------Departure From Normal----------->											1.16										

Degree Days	Monthly Total	Monthly Departure	Season to Date Total	Season to Date Departure
Heating:	134	-60	134	-60
Cooling:	4	2	4	2

Greatest 24-hr Precipitation: 1.44 Date: 24-25

Greatest 24-hr Snowfall: 0.0 Date: M

Greatest Snow Depth: 0 Date: M

Sea Level	Pressure	Date	Time (LST)
Maximum	30.35	31	1130
Minimum	29.57	19	1953

Number of Days with -------->

Max Temp >=90: 6	Min Temp <=32: 0	Precipitation >=.01 inch: 10
Max Temp <=32: 0	Min Temp <=0 : 0	Precipitation >=.10 inch: 6
Thunderstorms : 0	Heavy Fog : 0	Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER3

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

(final)

NOAA, National Climatic Data Center

Month: 08/2014

Station Location: TED STEVENS ANCHORAGE INTL AIRPORT (26451)
ANCHORAGE, AK

Lat. 61.169 Lon. -150.027

Elevation(Ground): 120 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	66	55	61	2	50	55	4	0	0433	2140		0	M	0.0	0.00	30.06	30.21	3.5	29	4.0	16	300	13	290	01
02	68	52	60	1	49	54	5	0	0435	2137		0	M	0.0	0.00	29.91	30.06	4.1	29	5.1	13	290	10	300	02
03	71*	56	64*	5	51	56	1	0	0438	2134	RA	0	M	0.0	0.07	29.79	29.94	2.5	12	6.0	32	160	18	150	03
04	63	55	59	0	54	56	6	0	0440	2132	RA BR	0	M	0.0	0.13	29.60	29.76	0.8	09	2.7	15	170	10	160	04
05	67	51	59	0	48	54	6	0	0443	2129		0	M	0.0	0.00	29.70	29.86	8.2	16	9.2	37	170	23	150	05
06	68	57	63	4	49	55	2	0	0445	2126		0	M	0.0	0.00	29.80	29.95	5.6	18	8.7	32	170	20	140	06
07	65	55	60	2	48	53	5	0	0448	2123	RA	0	M	0.0	0.01	29.61	29.75	5.1	14	6.9	33	160	21	150	07
08	61	55	58	0	50	54	7	0	0450	2120	RA	0	M	0.0	T	29.45	29.61	4.3	29	4.7	16	250	13	240	08
09	67	54	61	3	51	55	4	0	0453	2118	RA	0	M	0.0	0.02	29.45	29.60	2.1	20	4.2	18	160	14	150	09
10	69	56	63	5	53	57	2	0	0456	2115	RA	0	M	0.0	0.04	29.49	29.64	1.7	16	2.1	14	130	8	140	10
11	69	57	63	5	50	56	2	0	0458	2112	RA	0	M	0.0	0.01	29.55	29.70	10.5	14	11.2	32	150	20	160	11
12	62	54	58	0	52	55	7	0	0501	2109	RA	0	M	0.0	0.08	29.49	29.64	2.0	31	2.9	14	310	12	330	12
13	65	55	60	2	52	55	5	0	0503	2106	RA	0	M	0.0	0.29	29.47	29.62	1.3	10	5.7	30	170	16	150	13
14	65	53	59	2	51	54	6	0	0506	2103	RA	0	M	0.0	0.02	29.47	29.61	1.2	15	6.9	32	160	20	150	14
15	64	53	59	2	48	53	6	0	0509	2100	RA	0	M	0.0	0.12	29.50	29.66	12.8	15	13.0	32	160	21	150	15
16	64	53	59	2	47	52	6	0	0511	2057	RA	0	M	0.0	0.01	29.48	29.62	4.3	15	7.8	38	170	23	150	16
17	65	52	59	2	49	53	6	0	0514	2054	RA	0	M	0.0	T	29.47	29.62	1.8	22	3.1	21	200	10	250	17
18	67	53	60	3	50	55	5	0	0516	2051		0	M	0.0	0.00	29.73	29.88	1.4	26	4.3	21	170	10	310	18
19	69	51	60	4	51	55	5	0	0519	2048		0	M	0.0	0.00	29.83	29.97	0.9	26	4.1	12	200	8	200	19
20	62	52	57	1	51	54	8	0	0521	2045	FG+	0	M	0.0	0.00	29.93	30.08	2.2	28	3.6	13	290	9	300	20
21	68	54	61	5	52	55	4	0	0524	2042	RA FG+ FG BR	0	M	0.0	T	30.01	30.16	1.2	28	2.3	14	210	10	210	21
22	64	51	58	2	51	54	7	0	0527	2039		0	M	0.0	T	30.04	30.19	2.7	27	3.9	14	290	12	300	22
23	62	50	56	0	51	54	9	0	0529	2036	RA FG+ BR	0	M	0.0	T	29.99	30.13	1.9	18	4.8	32	170	18	150	23
24	59	53	56	1	50	53	9	0	0532	2033	RA BR	0	M	0.0	0.46	29.65	29.80	2.1	03	3.0	14	040	10	040	24
25	61	52	57	2	49	52	8	0	0534	2030	RA BR	0	M	0.0	0.54	29.51	29.67	4.8	16	6.0	26	180	14	160	25
26	63	48	56	1	47	52	9	0	0537	2027	RA BR	0	M	0.0	0.01	29.72	29.86	3.0	16	4.4	23	170	12	180	26
27	61	53	57	2	48	52	8	0	0539	2024	RA	0	M	0.0	0.16	29.67	29.81	9.8	14	10.9	35	160	24	150	27
28	58	52	55	1	50	52	10	0	0542	2021	RA	0	M	0.0	0.39	29.52	29.67	1.9	35	4.6	14	140	10	330	28
29	62	50	56	2	47	51	9	0	0544	2018	RA	0	M	0.0	0.16	29.42	29.58	2.3	31	4.0	14	350	12	360	29
30	62	43	53	-1	37	45	12	0	0547	2014		0	M	0.0	0.00	29.44	29.58	3.9	36	4.8	15	360	12	360	30
31	61	42*	52*	-2	37	45	13	0	0549	2011		0	M	0.0	0.00	29.55	29.70	1.4	30	4.1	13	010	9	010	31
	64.5	52.5	58.5		49.1	53.4	6.3	0.0	<-----Monthly Averages | Totals----->				M	0.0	2.52	29.65	29.80	1.6	17	5.5	<Monthly Average				
	1.0	2.5	1.8	<-----------Departure From Normal----------->											-0.73										

Greatest 24-hr Precipitation: 0.89 Date: 24-25

Greatest 24-hr Snowfall: 0.0 Date: M

Greatest Snow Depth: 0 Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	30.29	01	0053
Minimum	29.54	30	1953

Degree Days	Monthly Total	Departure	Season to Date Total	Departure
Heating:	196	-60	330	-120
Cooling:	0	0	4	2

Number of Days with -------->

- Max Temp >=90: 1
- Max Temp <=32: 0
- Thunderstorms : 0
- Min Temp <=32: 0
- Min Temp <=0 : 0
- Heavy Fog : 3
- Precipitation >=.01 inch: 17
- Precipitation >=.10 inch: 8
- Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER3

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)

NOAA, National Climatic Data Center

Month: 09/2014

Station Location: TED STEVENS ANCHORAGE INTL AIRPORT (26451)
ANCHORAGE, AK

Lat. 61.169 Lon. -150.027

Elevation(Ground): 120 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure (inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	60	37	49	-4	38	45	16	0	0552	2008		0	M	0.0	0.00	29.74	29.89	3.6	17	5.3	26	180	18	180	01
02	65	56	61*	8	45	52	4	0	0554	2005		0	M	0.0	0.00	29.71	29.86	13.2	17	13.6	37	150	23	170	02
03	64	46	55	2	41	49	10	0	0557	2002	RA	0	M	0.0	T	29.85	29.99	4.5	03	5.7	17	180	12	030	03
04	51	44	48	-4	42	46	17	0	0559	1959	RA BR	0	M	0.0	0.55	29.77	29.91	5.0	35	5.2	16	340	13	350	04
05	54	48	51	-1	48	49	14	0	0602	1956	RA BR	0	M	0.0	0.43	29.67	29.83	4.1	36	4.4	12	360	9	360	05
06	62	49	56	4	47	51	9	0	0604	1952		0	M	0.0	0.00	29.75	29.89	1.6	28	3.2	15	360	12	350	06
07	61	42	52	0	40	46	13	0	0607	1949		0	M	0.0	0.00	29.81	29.96	2.1	01	3.7	17	350	12	360	07
08	58	45	52	1	45	49	13	0	0609	1946	RA	0	M	0.0	T	29.84	29.99	1.7	04	2.6	10	050	8	050	08
09	56	51	54	3	49	51	11	0	0612	1943	RA BR	0	M	0.0	0.24	29.86	30.00	3.0	32	3.1	12	330	9	330	09
10	57	50	54	3	50	51	11	0	0614	1940	RA	0	M	0.0	0.47	29.88	30.04	1.4	08	1.6	9	150	7	160	10
11	66*	45	56	6	47	51	9	0	0617	1937	MIFG	0	M	0.0	0.01	29.95	30.09	1.7	15	4.1	18	160	14	150	11
12	61	53	57	7	51	53	8	0	0619	1933	RA BR	0	M	0.0	0.09	29.65	29.80	5.5	31	6.5	24	140	17	140	12
13	61	51	56	6	50	53	9	0	0622	1930	RA BR	0	M	0.0	0.57	29.54	29.70	2.2	25	4.5	24	160	16	240	13
14	61	49	55	6	45	50	10	0	0624	1927	RA	0	M	0.0	0.09	29.50	29.65	3.5	13	5.2	25	150	16	150	14
15	55	50	53	4	47	49	12	0	0627	1924	RA	0	M	0.0	0.38	29.46	29.61	1.6	08	3.2	20	150	14	150	15
16	57	49	53	4	46	49	12	0	0629	1921	RA	0	M	0.0	0.04	29.54	29.68	2.0	13	3.8	23	160	17	150	16
17	53	48	51	3	45	48	14	0	0632	1918	RA	0	M	0.0	0.02	29.20	29.33	5.3	31	5.5	16	290	14	290	17
18	50	48	49	1	45	47	16	0	0634	1914	RA	0	M	0.0	0.33	28.89	29.05	6.3	36	6.4	17	010	14	360	18
19	53	49	51	3	47	48	14	0	0637	1911	RA DZ BR	0	M	0.0	0.69	29.10	29.26	0.6	24	3.6	23	170	10	180	19
20	59	46	53	6	44	48	12	0	0639	1908	RA BCFG	0	M	0.0	0.10	29.43	29.56	7.8	15	8.4	33	160	17	150	20
21	57	45	51	4	39	46	14	0	0642	1905	RA	0	M	0.0	T	29.36	29.50	3.2	34	6.8	28	160	16	330	21
22	53	37	45	-1	30	39	20	0	0644	1902		0	M	0.0	0.00	29.48	29.65	2.2	03	5.0	16	020	10	040	22
23	56	38	47	1	37	43	18	0	0647	1859		0	M	0.0	0.00	29.73	29.86	0.9	19	3.2	14	160	9	160	23
24	55	33	44	-2	36	41	21	0	0649	1855	BR	0	M	0.0	0.00	29.73	29.88	1.2	29	2.1	9	220	8	280	24
25	56	32	44	-1	33	39	21	0	0652	1852	MIFG	0	M	0.0	0.00	29.76	29.91	0.5	11	0.8	8	160	7	310	25
26	57	32	45	0	33	39	20	0	0654	1849	MIFG	0	M	0.0	0.00	29.65	29.80	2.3	05	3.0	13	060	9	050	26
27	57	40	49	5	34	41	16	0	0657	1846		0	M	0.0	0.00	29.43	29.59	2.1	03	3.5	16	350	13	350	27
28	55	34	45	1	30	39	20	0	0659	1843		0	M	0.0	0.00	29.46	29.61	0.3	32	2.9	15	030	10	050	28
29	52	34	43	0	28	39	22	0	0702	1840		0	M	0.0	0.00	29.68	29.83	7.9	34	9.2	32	340	23	330	29
30	51	32*	42*	-1	23	35	23	0	0704	1836		0	M	0.0	0.00	30.03	30.17	2.6	04	4.3	18	010	12	020	30
	57.1	43.8	50.4		41.2	46.2	14.3	0.0	<-----Monthly Averages | Totals----->				M	0.0	4.01	29.62	29.76	0.7	01	4.7	<Monthly Average				
	2.0	1.8	1.8	<-----------Departure From Normal----------->											1.02										

Greatest 24-hr Precipitation: 0.92 Date: 04-05

Greatest 24-hr Snowfall: 0.0 Date: M

Greatest Snow Depth: 0 Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	30.27	30	2253
Minimum	28.98	18	1835

Degree Days	Monthly Total	Monthly Departure	Season to Date Total	Season to Date Departure
Heating:	429	-65	759	-185
Cooling:	0	0	4	2

Number of Days with -------->

Max Temp >=90: 0	Min Temp <=32: 3	Precipitation >=.01 inch: 14
Max Temp <=32: 0	Min Temp <=0 : 0	Precipitation >=.10 inch: 9
Thunderstorms : 0	Heavy Fog : 0	Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER3

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

(final)

NOAA, National Climatic Data Center

Month: 10/2014

Station Location: TED STEVENS ANCHORAGE INTL AIRPORT (26451)
ANCHORAGE, AK

Lat. 61.169 Lon. -150.027

Elevation(Ground): 120 ft. above sea level

Date	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Sun			Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees							Date
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling	Sunrise LST	Sunset LST	Significant Weather	1200 UTC Depth	1800 UTC Water Equiv	2400 LST Snow Fall	2400 LST Water Equiv	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	max 5-second Dir	max 2-minute Speed	max 2-minute Dir	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	51*	29	40	-3	25	33	25	0	0707	1833		M	M	M	0.00	30.10	30.25	1.0	06	2.5	8	050	7	030	01
02	50	32	41	-1	26	34	24	0	0709	1830		M	M	M	T	29.68	29.82	2.7	03	3.6	15	040	12	030	02
03	45	38	42	0	27	35	23	0	0712	1827	RA BR	M	M	M	0.04	29.11	29.29	3.9	01	5.0	20	350	15	340	03
04	44	38	41	0	33	37	24	0	0714	1824	RA	M	M	M	T	29.35	29.50	6.1	02	7.5	18	350	15	350	04
05	44	36	40	-1	22	33	25	0	0717	1821		M	M	M	0.00s	29.33	29.47	9.2	35	10.1	28	350	20	350	05
06	44	33	39	-1	17	31	26	0	0719	1818		M	M	M	0.00	29.81	29.96	5.9	01	6.4	20	360	16	350	06
07	40	26	33	-7	16	27	32	0	0722	1814		M	M	M	0.00	29.95	30.08	4.1	36	5.1	17	010	14	350	07
08	37	25	31	-8	14	26	34	0	0725	1811		M	M	M	0.00	29.75	29.90	6.9	02	7.3	17	030	14	040	08
09	40	27	34	-5	18	29	31	0	0727	1808	RA SN	M	M	M	T	29.21	29.35	12.3	36	12.4	28	010	18	360	09
10	40	34	37	-1	32	35	28	0	0730	1805	RA	M	M	M	0.25	28.80	28.99	7.4	36	7.5	16	350	14	350	10
11	45	39	42	4	37	39	23	0	0732	1802	RA DZ BR	M	M	M	0.56	29.04	29.20	0.5	28	4.0	18	210	12	220	11
12	43	37	40	3	35	38	25	0	0735	1759		M	M	M	0.00	29.33	29.45	5.0	02	5.5	20	180	12	040	12
13	50	37	44*	7	34	39	21	0	0737	1756		M	M	M	0.00	29.39	29.54	1.0	34	3.4	17	010	13	330	13
14	46	31	39	3	27	34	26	0	0740	1753		M	M	M	0.00	29.36	29.51	3.3	02	3.7	21	010	15	040	14
15	44	29	37	2	27	33	28	0	0743	1750		M	M	M	0.00	29.34	29.49	1.9	34	2.0	12	340	8	010	15
16	43	36	40	5	32	36	25	0	0745	1747		M	M	M	T	29.35	29.50	1.4	02	1.5	13	040	12	040	16
17	49	34	42	8	30	36	23	0	0748	1744		M	M	M	0.00	29.23	29.37	4.8	01	5.0	18	040	15	350	17
18	45	30	38	4	28	34	27	0	0751	1741		M	M	M	0.00	29.13	29.28	1.2	03	1.4	9	020	7	010	18
19	42	27	35	2	27	32	30	0	0753	1738	RA SN BR	M	M	M	0.07	29.00	29.15	1.3	14	2.5	13	190	8	170	19
20	38	33	36	3	32	33	29	0	0756	1735	RA SN BR	M	M	M	0.28	28.90	29.07	0.0	04	2.6	10	350	8	340	20
21	41	30	36	4	28	33	29	0	0758	1732		M	M	M	T	29.13	29.26	4.7	36	4.9	15	340	10	340	21
22	40	25	33	1	26	30	32	0	0801	1729		M	M	M	0.00	29.18	29.34	2.9	15	4.1	29	170	10	160	22
23	39	23	31	0	21	27	34	0	0804	1726		M	M	M	0.00	29.54	29.68	0.5	11	1.1	9	330	7	010	23
24	36	24	30	-1	24	28	35	0	0807	1723	SN	M	M	M	T	29.67	29.83	2.3	36	2.6	12	350	9	350	24
25	37	25	31	1	25	29	34	0	0809	1720		M	M	M	0.00	29.72	29.86	1.4	33	1.6	9	320	7	350	25
26	33	22	28	-2	24	27	37	0	0812	1717	FG+ FZFG BR	M	M	M	0.00	29.77	29.93	1.0	04	2.0	10	040	9	040	26
27	31	21	26	-3	20	24	39	0	0815	1714	FZFG BR	M	M	M	0.00	29.75	29.89	2.2	03	2.3	10	040	8	050	27
28	32	18	25	-4	14	22	40	0	0817	1711		M	M	M	T	29.42	29.58	3.9	03	5.2	15	360	10	030	28
29	30	18	24	-4	15	22	41	0	0820	1708		M	M	M	Ts	29.47	29.64	2.8	03	3.4	14	020	12	040	29
30	30	18	24	-4	16	22	41	0	0823	1706		M	M	M	0.00	29.36	29.50	1.4	32	2.5	15	170	9	330	30
31	30	16*	23*	-4	17	22	42	0	0825	1703	SN	M	M	M	T	29.09	29.26	4.5	01	4.8	16	030	13	050	31
	40.6	28.7	34.7		24.8	31.0	30.1	0.0	<-----Monthly Averages | Totals----->				M	M	1.20	29.39	29.55	3.1	01	4.3	<Monthly Average				
	0.1	-0.4	-0.1	<-----------Departure From Normal----------->											-0.83										

Degree Days Monthly Season to Date

	Monthly Total	Monthly Departure	Season to Date Total	Season to Date Departure
Heating:	933	-3	1692	-188
Cooling:	0	0	4	2

Greatest 24-hr Precipitation: 0.70s Date: 10-11
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	30.30	01	0705
Minimum	28.91	10	0749

Number of Days with -------->

Max Temp >=90: 0
Max Temp <=32: 5
Thunderstorms : 0

Min Temp <=32: 20
Min Temp <=0 : 0
Heavy Fog : 1

Precipitation >=.01 inch: 5
Precipitation >=.10 inch: 3
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER3

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)

NOAA, National Climatic Data Center

Month: 07/2014

Station Location: MERRILL FIELD AIRPORT (26409)
ANCHORAGE, AK

Lat. 61.216 Lon. -149.855

Elevation(Ground): 138 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	66	55	61	M	47	53	4	0	-	-	RA	M	M	M	T	29.90	30.05	4.2	25	5.6	14	270	12	270	01
02	74	56	65	M	49	56	0	0	-	-		M	M	M	T	29.72	29.88	3.1	30	4.1	15	290	12	270	02
03	75	60	68	M	49	57	0	3	-	-		M	M	M	0.00	29.68	29.83	1.6	24	4.4	13	270	10	270	03
04	76	57	67	M	50	57	0	2	-	-		M	M	M	0.00	29.65	29.80	2.8	31	3.9	15	290	9	320	04
05	79*	58	69*	M	50	58	0	4	-	-		M	M	M	0.00	29.62	29.78	4.4	23	5.6	23	220	17	210	05
06	62	56	59	M	53	55	6	0	-	-	RA BR	M	M	M	0.14	29.81	29.96	2.6	31	3.6	13	260	9	270	06
07	66	54	60	M	49	54	5	0	-	-	RA	M	M	M	0.01	29.80	29.96	2.4	20	3.7	20	200	14	200	07
08	67	57	62	M	49	55	3	0	-	-	RA	M	M	M	T	29.80	29.95	2.6	25	4.6	14	250	9	210	08
09	63	56	60	M	50	55	5	0	-	-	RA	M	M	M	0.11	29.88	30.02	2.2	31	2.8	12	280	9	280	09
10	59	54	57	M	53	54	8	0	-	-	RA	M	M	M	0.33	29.59	29.74	1.5	34	2.7	9	320	8	340	10
11	69	54	62	M	50	55	3	0	-	-	RA	M	M	M	0.01	29.50	29.67	2.8	27	3.8	16	280	12	280	11
12	69	56	63	M	47	53	2	0	-	-		M	M	M	Ts	29.75	29.90	2.0	27	4.5	17	210	12	270	12
13	67	51	59	M	46	53	6	0	-	-	RA	M	M	M	0.13	30.01	30.16	2.7	20	5.0	22	200	16	200	13
14	65	51	58	M	46	52	7	0	-	-		M	M	M	0.00	30.14	30.29	3.2	26	4.6	16	270	13	270	14
15	70	51	61	M	46	53	4	0	-	-		M	M	M	0.00	30.06	30.22	2.1	29	2.8	13	280	10	300	15
16	71	58	65	M	50	56	0	0	-	-		M	M	M	0.00	29.98	30.13	3.6	29	4.4	15	270	12	260	16
17	66	56	61	M	49	54	4	0	-	-		M	M	M	0.00	29.81	29.96	3.8	29	4.6	15	270	13	280	17
18	68	56	62	M	48	55	3	0	-	-		M	M	M	0.00	29.60	29.76	3.7	28	5.3	24	200	17	200	18
19	69	53	61	M	48	54	4	0	-	-	RA	M	M	M	0.14	29.49	29.65	9.6	19	9.5	231s	220	21	190	19
20	71	51	61	M	47	52	4	0	-	-	RA	M	M	M	0.25	29.62	29.78	2.4	36	4.0	17	360	13	290	20
21	71	49*	60	M	44	52	5	0	-	-		M	M	M	0.00	29.87	30.01	1.6	30	2.3	10	280	8	270	21
22	67	52	60	M	48	53	5	0	-	-		M	M	M	T	29.78	29.92	3.2	27	3.9	16	280	14	270	22
23	69	57	63	M	48	54	2	0	-	-		M	M	M	0.00	29.68	29.84	1.0	33	3.7	12	200	9	210	23
24	68	56	62	M	50	55	3	0	-	-	RA BR	M	M	M	0.33	29.67	29.81	3.8	26	5.8	22	280	17	270	24
25	60	54	57*	M	51	54	8	0	-	-	RA BR	M	M	M	0.31	29.67	29.83	2.8	36	3.1	14	320	10	320	25
26	69	54	62	M	49	54	3	0	-	-		M	M	M	0.00	29.73	29.88	1.4	31	3.3	13	290	10	290	26
27	70	52	61	M	46	53	4	0	-	-		M	M	M	0.00	29.78	29.93	0.8	21	3.0	13	210	12	200	27
28	65	54	60	M	48	53	5	0	-	-	RA BR	M	M	M	0.45	29.86	30.01	0.9	22	3.5	20	270	14	280	28
29	71	51	61	M	51	55	4	0	-	-	BR HZ	M	M	M	0.00	29.82	29.97	2.6	36	4.5	13	010	9	290	29
30	77	54	66	M	50	57	0	1	-	-		M	M	M	0.00	29.96	30.13	3.6	26	4.8	18	260	15	260	30
31	68	57	63	M	50	55	2	0	-	-		M	M	M	0.00	30.16	30.30	4.0	27	4.6	17	280	14	280	31
	M	M	M		48.7	54.4	3.5	0.3	<-----Monthly Averages | Totals----->				M	M	M	M	M	2.0	27	4.3	<Monthly Average				
	M	M	M	<-----------Departure From Normal----------->											M										

Greatest 24-hr Precipitation: M Date: M

Greatest 24-hr Snowfall: M Date: M

Greatest Snow Depth: M Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	M	M	M
Minimum	M	M	M

Degree Days

	Monthly Total	Departure	Season to Date Total	Departure
Heating:	109	M	M	M
Cooling:	10	M	M	M

Number of Days with -------->

Max Temp >=90: M
Max Temp <=32: M
Thunderstorms : 0

Min Temp <=32: M
Min Temp <=0 : M
Heavy Fog : 0

Precipitation >=.01 inch: M
Precipitation >=.10 inch: M
Snowfall >=1.0 inch : M

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER2

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)

NOAA, National Climatic Data Center

Month: 08/2014

Station Location: MERRILL FIELD AIRPORT (26409)
ANCHORAGE, AK

Lat. 61.216 Lon. -149.855

Elevation(Ground): 138 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	68	55	62	M	49	55	3	0	-	-		M	M	M	0.00	30.06	30.20	3.8	28	4.6	18	290	15	260	01
02	69	54	62	M	47	54	3	0	-	-		M	M	M	0.00	29.91	30.06	2.7	28	3.7	13	290	9	270	02
03	72*	57	65*	M	51	57	0	0	-	-	RA	M	M	M	0.04	29.78	29.94	1.9	34	3.0	12	280	10	280	03
04	63	56	60	M	54	57	5	0	-	-	RA	M	M	M	0.13	29.59	29.76	1.7	35	2.5	10	350	8	360	04
05	70	49	60	M	47	54	5	0	-	-		M	M	M	0.00	29.70	29.86	2.6	22	4.6	25	190	18	190	05
06	69	57	63	M	50	55	2	0	-	-		M	M	M	0.00	29.80	29.95	3.4	28	5.9	21	290	14	290	06
07	66	55	61	M	48	54	4	0	-	-	RA	M	M	M	T	29.60	29.75	1.9	31	2.6	10	340	9	330	07
08	62	56	59	M	50	54	6	0	-	-	RA	M	M	M	T	29.44	29.61	2.6	28	3.0	14	280	10	290	08
09	69	55	62	M	51	55	3	0	-	-	RA	M	M	M	T	29.44	M	1.3	26	2.3	12	280	8	230	09
10	70	58	64	M	54	58	1	0	-	-	RA	M	M	M	0.06	29.49	29.64	0.7	27	1.4	8	330	6	230	10
11	71	57	64	M	51	56	1	0	-	-	RA	M	M	M	0.04	29.55	29.70	1.7	31	4.0	13	220	10	200	11
12	62	55	59	M	52	55	6	0	-	-	RA	M	M	M	0.06	29.49	29.64	1.7	31	2.1	12	300	10	280	12
13	66	55	61	M	52	55	4	0	-	-	RA	M	M	M	0.19	29.47	29.62	1.8	34	2.3	9	290	8	290	13
14	66	53	60	M	52	55	5	0	-	-	RA	M	M	M	0.05	29.47	29.61	1.3	32	2.3	28s	300	10	270	14
15	65	54	60	M	49	54	5	0	-	-	RA	M	M	M	0.08	29.49	29.66	0.4	33	3.3	15	170	10	150	15
16	65	54	60	M	48	53	5	0	-	-	RA	M	M	M	T	29.48	29.62	3.4	31	4.5	17	300	15	290	16
17	66	53	60	M	50	54	5	0	-	-	RA	M	M	M	0.04	29.47	29.62	1.8	24	2.7	13	230	8	200	17
18	68	56	62	M	50	55	3	0	-	-		M	M	M	0.00	29.73	29.88	2.8	26	4.4	15	190	10	290	18
19	70	51	61	M	50	55	4	0	-	-		M	M	M	0.00	29.83	29.97	1.8	30	2.5	12	280	9	290	19
20	64	55	60	M	52	55	5	0	-	-		M	M	M	T	29.93	M	2.8	27	M	14	280	12	270	20
21	69	50	60	M	52	55	5	0	-	-	RA FG+ FG BR	M	M	M	0.07	30.01	30.16	1.4	29	2.4	16	180	12	190	21
22	66	52	59	M	51	54	6	0	-	-		M	M	M	T	30.03	30.19	2.5	27	3.8	14	280	12	270	22
23	63	50	57	M	51	54	8	0	-	-	RA FG+ FG BR HZ	M	M	M	0.01	29.98	30.13	1.7	33	2.9	11	330	8	330	23
24	60	53	57	M	51	53	8	0	-	-	RA	M	M	M	0.37	29.64	29.80	2.6	35	3.4	13	350	10	360	24
25	62	51	57	M	50	52	8	0	-	-	RA BR	M	M	M	0.51	29.51	29.68	1.4	15	3.8	14	160	9	220	25
26	63	45	54	M	46	51	11	0	-	-	RA	M	M	M	T	29.71	29.86	0.5	23	2.9	16	210	13	210	26
27	63	53	58	M	49	53	7	0	-	-	RA DZ BR	M	M	M	0.34	29.67	29.82	1.7	35	3.2	11	010	8	300	27
28	59	53	56	M	50	52	9	0	-	-	RA BR	M	M	M	0.33	29.51	29.67	1.7	34	2.3	10	320	8	330	28
29	63	52	58	M	47	51	7	0	-	-	RA	M	M	M	0.14	29.42	29.58	2.4	31	3.6	14	360	12	280	29
30	62	42*	52*	M	38	46	13	0	-	-		M	M	M	0.00	29.43	29.58	3.1	34	4.3	16	340	10	360	30
31	62	43	53	M	36	45	12	0	-	-		M	M	M	0.00	29.55	29.71	1.4	33	3.4	13	300	12	300	31
	63.0	49.9	56.5		49.3	53.7	5.5	0.0	<-----Monthly Averages | Totals----->				M	M	1.77s	29.70	29.84	1.6	30	3.3	<Monthly Average				
	M	M	M	<-----------Departure From Normal----------->											M										

Greatest 24-hr Precipitation: 0.78s Date: 24-25

Greatest 24-hr Snowfall: M Date: M

Greatest Snow Depth: M Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	30.24	23	0317
Minimum	29.53	30	1837

Degree Days

	Monthly Total	Departure	Season to Date Total	Departure
Heating:	169	M	M	M
Cooling:	0	M	M	M

Number of Days with -------->

Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 0

Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 2

Precipitation >=.01 inch: 7s
Precipitation >=.10 inch: 5s
Snowfall >=1.0 inch : M

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER2

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

(final)

NOAA, National Climatic Data Center

Month: 09/2014

Station Location: MERRILL FIELD AIRPORT (26409)
ANCHORAGE, AK

Lat. 61.216 Lon. -149.855

Elevation(Ground): 138 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure (inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	61	37	49	M	36	45	16	0	-	-		M	M	M	0.00	29.73	29.89	3.4	18	4.7	24	180	16	180	01
02	66	57	62*	M	44	52	3	0	-	-		M	M	M	0.00	29.72	29.87	12.2	18	12.3	30	190	20	190	02
03	65	49	57	M	40	49	8	0	-	-	DZ	M	M	M	T	29.85	30.00	4.3	01	5.8	16	010	13	020	03
04	51	46	49	M	43	46	16	0	-	-	RA BR	M	M	M	0.43	29.77	29.91	4.6	36	4.7	15	010	10	010	04
05	55	49	52	M	48	50	13	0	-	-	RA BR	M	M	M	0.45	29.67	29.83	4.5	35	4.6	11	340	8	340	05
06	63	50	57	M	48	51	8	0	-	-	RA BR	M	M	M	T	29.74	29.89	1.2	28	2.3	11	250	9	260	06
07	61	40	51	M	41	47	14	0	-	-		M	M	M	0.00	29.81	29.96	1.1	02	2.2	12	040	9	050	07
08	59	46	53	M	45	49	12	0	-	-	RA	M	M	M	0.01	29.83	29.99	2.1	35	2.5	11	350	8	340	08
09	57	52	55	M	49	51	10	0	-	-	RA	M	M	M	0.25	29.85	30.00	2.5	32	2.7	10	300	8	300	09
10	58	51	55	M	50	52	10	0	-	-	RA	M	M	M	0.31	29.88	30.04	0.8	01	0.9	7	310	6	040	10
11	66*	43	55	M	46	50	10	0	-	-	RA	M	M	M	0.01	29.95	M	2.2	32	3.0	13	310	10	320	11
12	59	53	56	M	51	53	9	0	-	-	RA	M	M	M	0.32	29.65	29.80	3.9	30	4.5	22	280	16	290	12
13	62	52	57	M	50	53	8	0	-	-	RA BR	M	M	M	0.46	29.54	29.70	2.0	27	3.3	14	190	12	190	13
14	62	46	54	M	46	51	11	0	-	-	RA	M	M	M	T	29.50	29.65	1.2	31	2.7	19	130	12	130	14
15	55	48	52	M	47	50	13	0	-	-	RA	M	M	M	0.18	29.46	29.61	2.4	36	3.6	11	020	9	020	15
16	57	48	53	M	46	49	12	0	-	-	RA	M	M	M	0.05	29.54	29.68	2.4	33	2.8	10	340	8	330	16
17	54	47	51	M	45	48	14	0	-	-	RA	M	M	M	0.01	29.18	29.33	2.2	30	3.3	13	300	10	300	17
18	50	48	49	M	46	48	16	0	-	-	RA	M	M	M	0.05	28.89	29.05	4.1	35	4.6	16	010	10	360	18
19	53	50	52	M	48	49	13	0	-	-	RA BR	M	M	M	0.57	29.10	29.26	1.4	23	3.6	22	200	16	210	19
20	61	44	53	M	45	49	12	0	-	-	RA	M	M	M	0.03	29.43	29.57	1.2	31	3.9	20	190	15	190	20
21	57	45	51	M	39	45	14	0	-	-	RA	M	M	M	0.01	29.36	29.50	2.6	33	4.3	20	340	15	330	21
22	54	34	44	M	31	39	21	0	-	-		M	M	M	0.00	29.47	29.65	2.0	01	2.8	12	310	8	350	22
23	56	38	47	M	36	42	18	0	-	-		M	M	M	0.00	29.73	29.87	0.7	28	2.1	12	200	9	200	23
24	56	33	45	M	35	40	20	0	-	-	FG+	M	M	M	0.00	29.72	29.88	1.3	32	2.3	10	280	8	290	24
25	56	32	44	M	32	38	21	0	-	-		M	M	M	0.00	29.75	29.91	0.6	06	1.2	9	300	6	350	25
26	57	31	44	M	31	38	21	0	-	-		M	M	M	0.00	29.65	29.80	2.2	03	2.5	11	350	8	350	26
27	57	35	46	M	32	39	19	0	-	-		M	M	M	0.00	29.43	29.59	1.9	06	2.6	12	010	8	020	27
28	56	34	45	M	30	39	20	0	-	-		M	M	M	0.00	29.45	29.61	0.4	22	2.2	12	040	8	220	28
29	51	33	42	M	27	37	23	0	-	-		M	M	M	0.00	29.67	29.83	3.0	35	5.0	25	350	18	330	29
30	51	31*	41*	M	21	35	24	0	-	-		M	M	M	0.00	30.03	30.17	3.6	04	4.9	16	010	10	030	30
	57.5	43.4	50.5		40.9	46.1	14.3	0.0	<-----Monthly Averages | Totals----->				M	M	3.14s	29.61	29.76	1.1	34	3.6	<Monthly Average				
	M	M	M	<-----------Departure From Normal----------->											M										

Greatest 24-hr Precipitation: 0.83s Date: 04-05
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

Sea Level Pressure		Date	Time (LST)
Maximum	30.28	30	2359
Minimum	28.98	18	1740

Degree Days	Monthly Total	Departure	Season to Date Total	Departure
Heating:	429	M	M	M
Cooling:	0	M	M	M

Number of Days with -------->

- Max Temp >=90: 0
- Max Temp <=32: 0
- Thunderstorms : 0
- Min Temp <=32: 3
- Min Temp <=0 : 0
- Heavy Fog : 1
- Precipitation >=.01 inch: 15
- Precipitation >=.10 inch: 8
- Snowfall >=1.0 inch : M

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER2

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

(final)

NOAA, National Climatic Data Center

Month: 10/2014

Station Location: MERRILL FIELD AIRPORT (26409)
ANCHORAGE, AK

Lat. 61.216 Lon. -149.855

Elevation(Ground): 138 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	max 5-second Dir	max 2-minute Speed	max 2-minute Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	50	28	39	M	23	32	26	0	-	-		M	M	M	0.00	30.09	30.25	0.4	05	1.6	9	290	7	080	01
02	50*	30	40	M	24	33	25	0	-	-		M	M	M	0.00	29.67	29.82	1.7	01	2.4	13	340	9	030	02
03	44	36	40	M	27	34	25	0	-	-	RA	M	M	M	0.08	29.10	29.29	1.5	05	2.2	19	070	15	060	03
04	44	37	41	M	33	37	24	0	-	-	RA	M	M	M	0.01	29.34	29.50	5.1	01	6.0	16	350	12	350	04
05	43	36	40	M	25	34	25	0	-	-	RA	M	M	M	T	29.31	29.47	3.3	34	6.7	21	340	16	340	05
06	45	30	38	M	18	31	27	0	-	-		M	M	M	0.00	29.80	29.96	3.2	02	3.7	15	340	12	340	06
07	40	22	31	M	18	27	34	0	-	-		M	M	M	0.00	29.95	30.08	1.6	03	2.6	11	030	8	040	07
08	36	19	28	M	17	26	37	0	-	-		M	M	M	0.00	29.75	29.91	3.7	03	4.2	15	010	12	020	08
09	41	27	34	M	20	29	31	0	-	-		M	M	M	T	29.20	29.35	9.2	36	9.3	32	010	20	020	09
10	40	33	37	M	33	36	28	0	-	-	RA	M	M	M	0.06	28.80	28.99	4.3	01	4.6	14	360	9	350	10
11	45	39	42	M	38	39	23	0	-	-	RA BR	M	M	M	0.69	29.04	29.20	1.4	18	3.6	14	200	10	200	11
12	41	37	39	M	35	38	26	0	-	-		M	M	M	0.00	29.32	29.45	3.2	02	3.8	14	350	10	030	12
13	49	38	44*	M	36	39	21	0	-	-		M	M	M	0.00	29.38	29.54	0.9	30	2.1	13	180	10	190	13
14	47	28	38	M	28	34	27	0	-	-		M	M	M	0.00	29.36	29.51	0.9	35	1.2	10	350	8	290	14
15	43	30	37	M	29	34	28	0	-	-		M	M	M	0.00	29.34	29.49	0.2	34	0.3	7	310	5	050	15
16	45	36	41	M	33	37	24	0	-	-		M	M	M	T	29.34	29.50	2.1	01	2.2	9	350	8	010	16
17	49	33	41	M	31	37	24	0	-	-		M	M	M	T	29.23	29.37	3.5	01	4.1	14	020	10	330	17
18	44	30	37	M	28	34	28	0	-	-		M	M	M	0.00	29.11	29.28	0.6	05	0.7	6	040	5	020	18
19	43	26	35	M	27	31	30	0	-	-	RA SN BR	M	M	M	0.04	29.00	29.15	0.8	10	1.6	11	310	8	340	19
20	39	33	36	M	32	34	29	0	-	-	SN BR	M	M	M	0.16	28.90	29.07	0.7	02	1.4	9	020	7	330	20
21	42	27	35	M	29	32	30	0	-	-	RA	M	M	M	T	29.12	29.26	3.3	01	3.8	12	340	9	350	21
22	40	22	31	M	24	28	34	0	-	-	MIFG	M	M	M	0.00	29.18	29.34	1.4	18	1.4	11	190	9	180	22
23	39	21	30	M	21	26	35	0	-	-		M	M	M	0.00	29.52	29.68	0.4	11	1.0	8	300	7	300	23
24	37	24	31	M	23	28	34	0	-	-	SN	M	M	M	T	29.67	29.82	1.3	03	1.9	11	350	8	340	24
25	36	28	32	M	27	30	33	0	-	-	SN	M	M	M	T	29.70	29.86	0.3	04	1.1	9	260	7	280	25
26	33	22	28	M	25	28	37	0	-	-	FG+ FZFG BR	M	M	M	0.00	29.77	29.93	1.4	03	1.8	10	010	8	010	26
27	32	20	26	M	20	23	39	0	-	-	FG+ FZFG BR	M	M	M	T	29.74	29.89	1.6	04	2.0	8	360	6	010	27
28	33	17	25	M	15	22	40	0	-	-		M	M	M	0.00	29.41	29.58	3.2	03	4.1	12	040	9	040	28
29	30	16	23	M	15	21	42	0	-	-		M	M	M	0.00	29.47	29.64	1.0	01	2.1	11	340	9	340	29
30	31	17	24	M	17	22	41	0	-	-		M	M	M	0.00	29.36	29.50	0.8	06	1.3	9	330	7	190	30
31	29	15*	22*	M	16	22	43	0	-	-		M	M	M	0.00	29.08	29.26	3.8	01	3.9	13	010	9	010	31
	40.6	27.6	34.1		25.4	30.9	30.6	0.0	<-----Monthly Averages | Totals----->				M	M	1.04s	29.39	29.55	1.8	02	2.9	<Monthly Average				
	M	M	M	<-----------Departure From Normal----------->											M										

Greatest 24-hr Precipitation: 0.69 Date: 11
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

Sea Level	Pressure	Date	Time (LST)
Maximum	30.30	01	0438
Minimum	28.91	10	0720

Degree Days	Monthly Total	Monthly Departure	Season to Date Total	Season to Date Departure
Heating:	950	M	M	M
Cooling:	0	M	M	M

Number of Days with -------->

Max Temp >=90: 0
Max Temp <=32: 4
Thunderstorms : 0

Min Temp <=32: 21
Min Temp <=0 : 0
Heavy Fog : 2

Precipitation >=.01 inch: 6
Precipitation >=.10 inch: 2
Snowfall >=1.0 inch : M

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

Data Version: VER2

Appendix C: Exhibits and Supporting Documents

1. New Seward Highway Retention Basin Details (Provided by ADOT&PF)
2. New Seward Highway Retention Basin Contributing Area (Provided by ADOT&PF)
3. Ship Creek Hatchery Rain Garden Information (Provided by ADOT&PF)
4. West Dowling Rain Garden Information (Provided by ADOT&PF)
5. West Dowling Rain Garden Infiltration Test Results (DOWL HKM, June 2013)

Exhibit 1 - NSH Retention Basin Details

SHEET NO.	TOTAL SHEETS
G02	326
STATE	YEAR
ALASKA	2011

PROJECT DESIGNATION

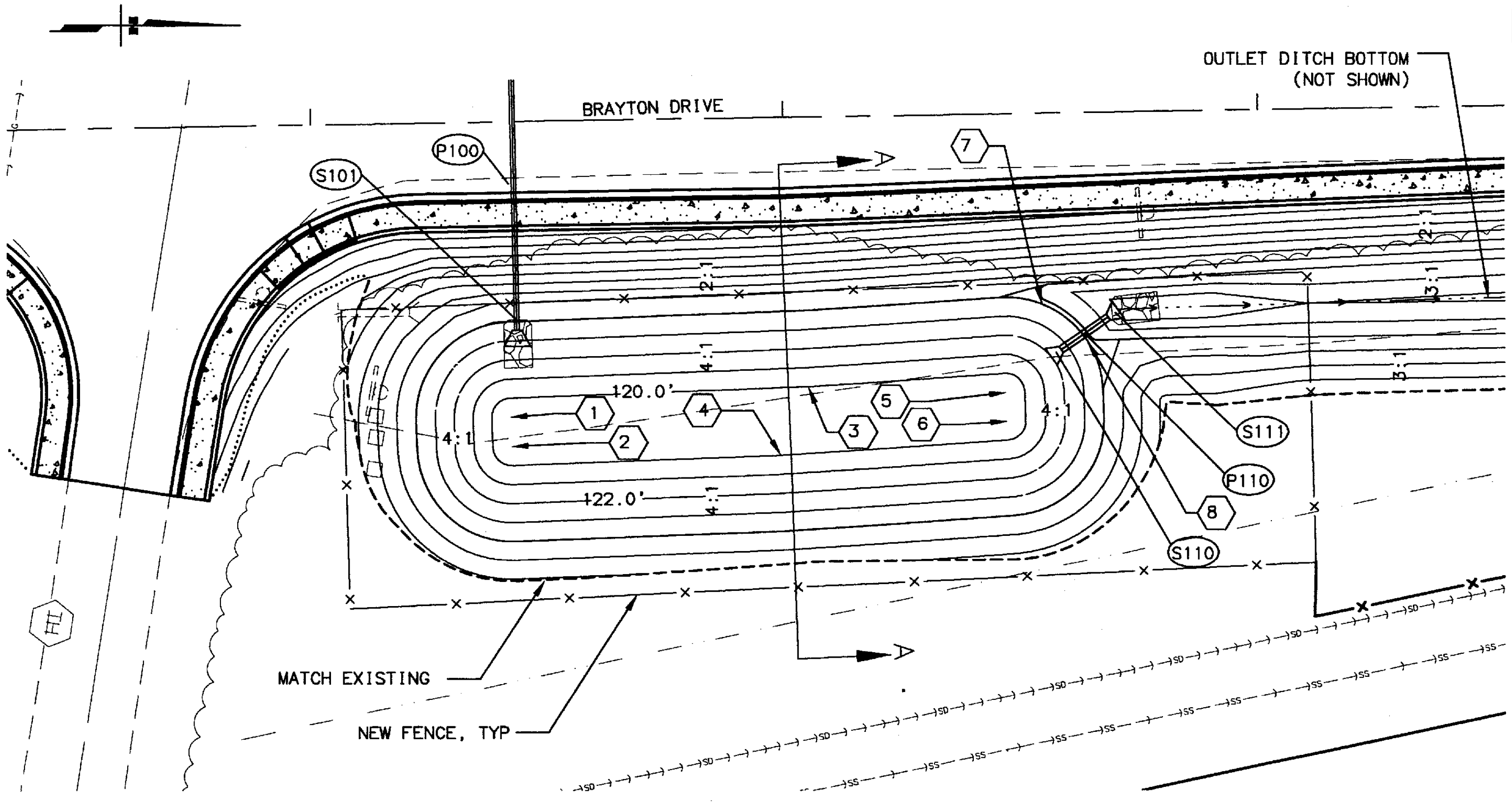
NH-0A3-1(43)/5081

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

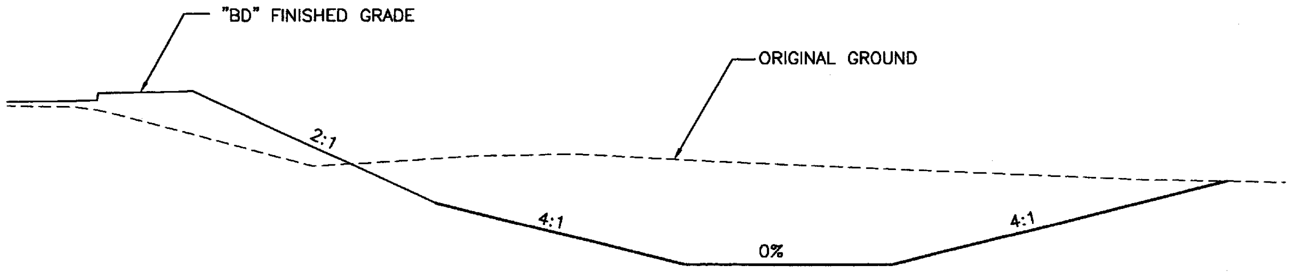
NO.	DATE	DESCRIPTION



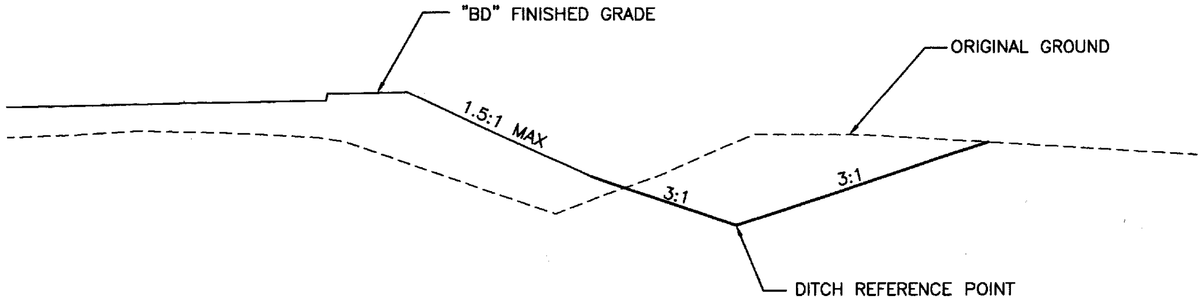
ALPENHORN DRAINAGE BASIN

ALPENHORN DRAINAGE BASIN CONTROL POINTS					
POINT	STATION	OFFSET	DIRECTION	ELEVATION	REMARKS
1	"BD" 5221+41.11	62.17'	RT	120.0'	POND BOTTOM R = 4.0'
2	"BD" 5221+41.25	68.43'	RT	120.0'	POND BOTTOM R = 4.0'
3	"BD" 5222+04.38	56.79'	RT	120.0'	POND BOTTOM
4	"BD" 5221+98.21	71.20'	RT	120.0'	POND BOTTOM
5	"BD" 5222+45.93	58.63'	RT	120.0'	POND BOTTOM R = 4.0'
6	"BD" 5222+46.06	64.70'	RT	120.0'	POND BOTTOM R = 4.0'
7	"BD" 5222+53.85	40.33'	RT	124.0'	TOP OF POND
8	"BD" 5222+62.88	48.02'	RT	124.0'	TOP OF POND

ALPENHORN DRAINAGE BASIN OUTLET DITCH				
"BD" STATION	OFFSET	DIRECTION	ELEVATION	REMARK
5222+75.00	41.50'	RT	122.00	DITCH BOTTOM
5223+00.00	41.13'	RT	121.71	DITCH BOTTOM
5223+25.00	40.76'	RT	121.61	DITCH BOTTOM
5223+50.00	40.35'	RT	121.49	DITCH BOTTOM
5223+75.00	39.95'	RT	121.38	DITCH BOTTOM
5224+00.00	39.55'	RT	121.26	DITCH BOTTOM
5224+25.00	39.15'	RT	121.15	DITCH BOTTOM
5224+50.00	38.75'	RT	121.03	DITCH BOTTOM
5224+75.00	38.35'	RT	120.92	DITCH BOTTOM
5225+00.00	37.94'	RT	120.80	DITCH BOTTOM
5225+25.00	37.54'	RT	120.69	DITCH BOTTOM
5225+50.00	37.14'	RT	120.57	DITCH BOTTOM
5225+75.00	36.74'	RT	120.46	DITCH BOTTOM
5226+00.00	41.28'	RT	119.91	DITCH BOTTOM
5226+25.00	45.82'	RT	119.37	DITCH BOTTOM
5226+50.00	50.36'	RT	118.82	DITCH BOTTOM



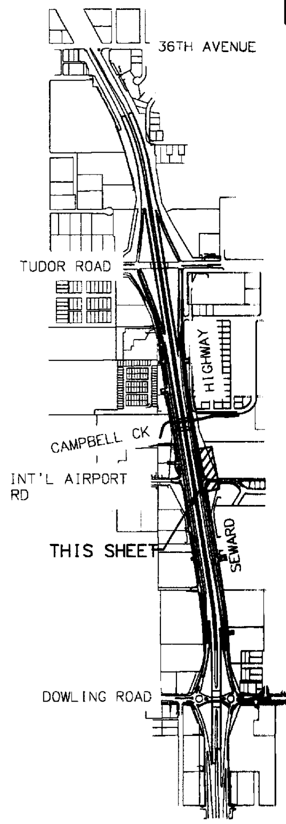
ALPENHORN DRAINAGE BASIN – TYPICAL SECTION A–A
NTS

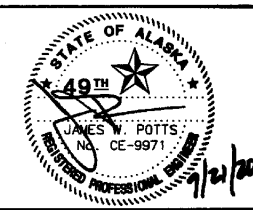


ALPENHORN DRAINAGE BASIN OUTLET DITCH – TYPICAL SECTION
NTS

NOTES:

1. SEE SHEETS D04 AND D05 FOR PIPE AND STRUCTURE TABLES.





STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

SEWARD HIGHWAY
DOWLING ROAD TO TUDOR ROAD

ALPENHORN DRAINAGE
BASIN GRADING PLAN

Exhibit 2: NSH Retention Basin Contributing Area

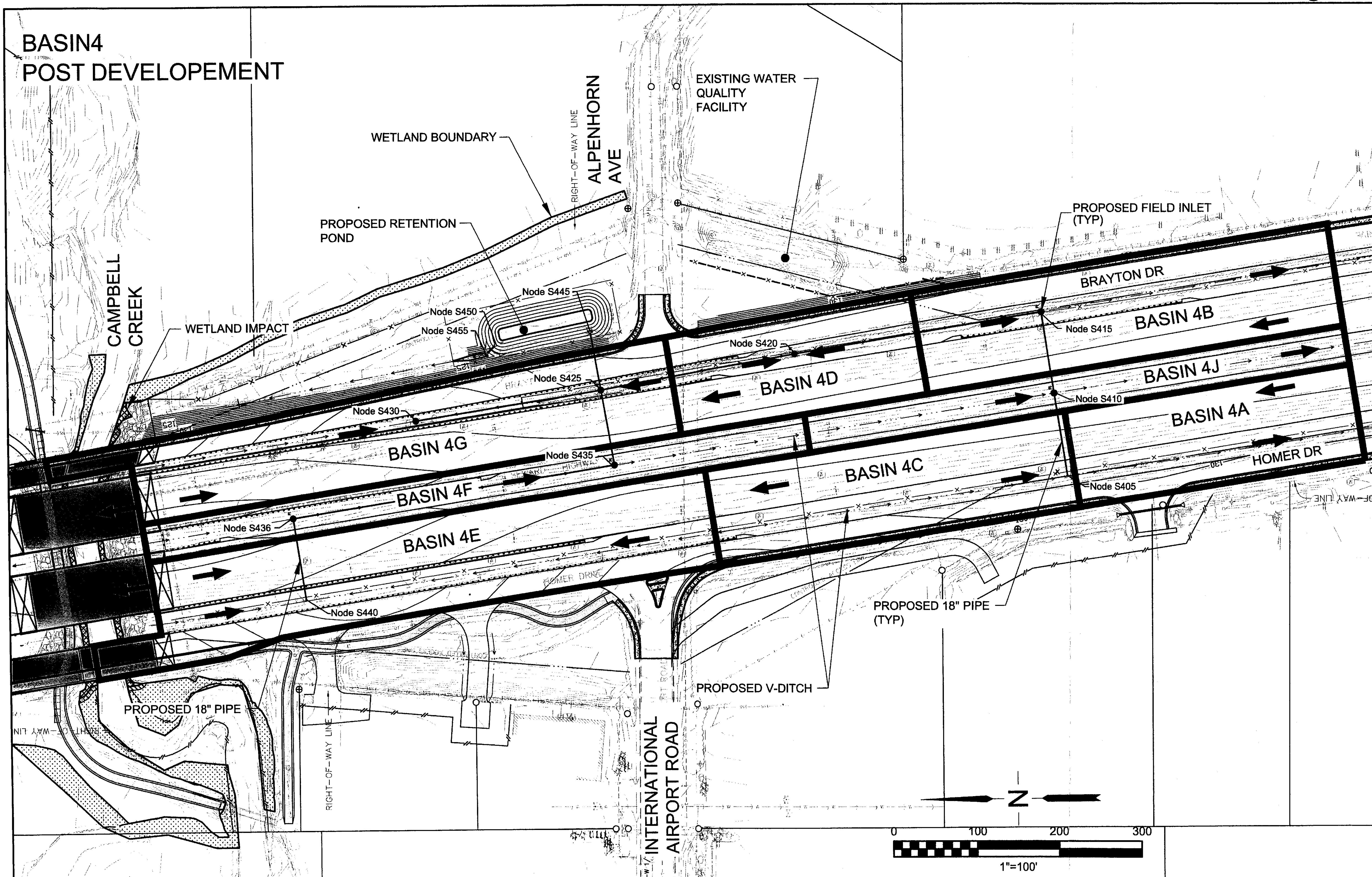
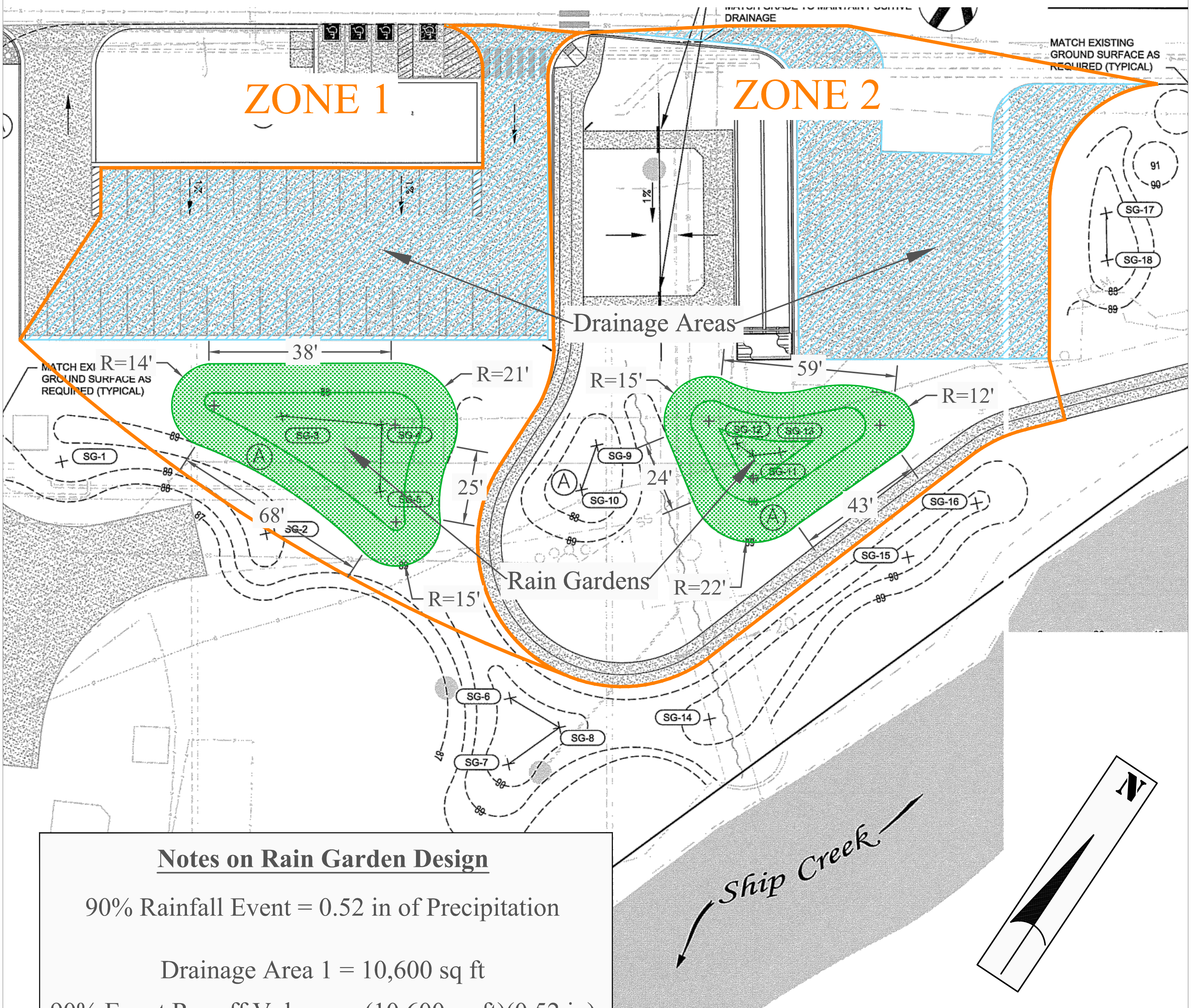


Exhibit 3

SHIP CREEK HATCHERY RAIN GARDEN



Notes on Rain Garden Design

90% Rainfall Event = 0.52 in of Precipitation

Drainage Area 1 = 10,600 sq ft

90% Event Runoff Volume = (10,600 sq ft)(0.52 in)

Minimum (90% Event) Storage Volume = 460 cu ft

Rain Garden 1 Storage Volume = 3,100 cu ft

Drainage Area 2 = 8,250 sq ft

90% Event Runoff Volume = (8,250 sq ft)(0.52 in)

Minimum (90% Event) Storage Volume = 360 cu ft

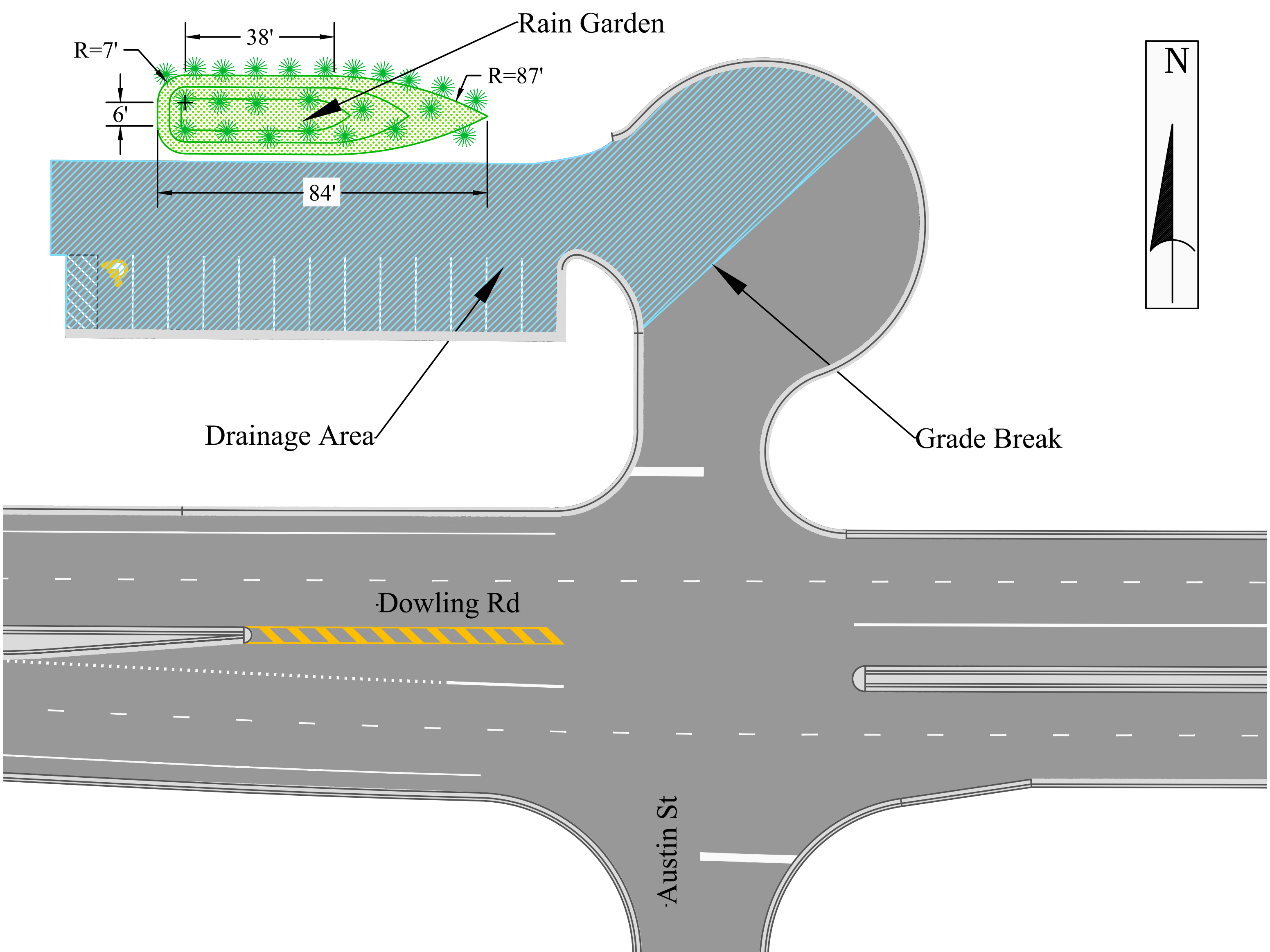
Rain Garden 2 Storage Volume = 3,200 cu ft

CONCEPTUAL DRAWING
LOCATIONS AND DIMENSIONS ARE APPROXIMATE AND MAY NOT REFLECT AS-BUILT CONDITIONS

0 25 50 100
SCALE IN FEET

Exhibit 4

WEST DOWLING ROAD RAIN GARDEN



Notes on Rain Garden Design

90% Rainfall Event = 0.52 in of Precipitation

Drainage Area = 8,600 sq ft

90% Event Runoff Volume = (8,600 sq ft)(0.52 in)

Minimum (90% Event) Storage Volume = 375 cu ft

Rain Garden Storage Volume = 1,500 cu ft

CONCEPTUAL DRAWING
LOCATIONS AND DIMENSIONS ARE APPROXIMATE AND MAY NOT REFLECT AS-BUILT CONDITIONS

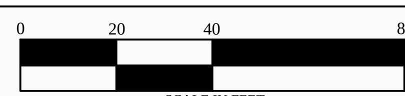


Exhibit 5 - West Dowling Rain Garden Infiltration Test Results

DOWL HKM

☒ 4041 B Street ▪ Anchorage, Alaska 99503
907-562-2000 ▪ 907-563-3953 (fax)
☐ 5368 Commercial Boulevard ▪ Juneau, Alaska 99801
907-780-3533 ▪ 907-780-3535 (fax)
☐ 1225 Tongass Avenue, Suite 4A ▪ Ketchikan, AK 99901
907-220-0682
☐ 104 Center Avenue, Suite 206 ▪ Kodiak, Alaska 99615
907-512-0519
☐ 809 S. Chugach Street, Unit 4 ▪ Palmer, Alaska 99645
907-746-7600 ▪ 907-746-6705 (fax)
☐ 406 North Church Avenue ▪ Tucson, Arizona 85701
520-882-8696 ▪ 520-624-0384 (fax)
☐ 430 W Warner Road, Suite B101 ▪ Tempe, Arizona 85284
480-753-0800 ▪ 480-753-0803 (fax)
☐ 222 N. 32nd Street, Suite 700 ▪ Billings, Montana 59101
406-656-6399 ▪ 406-656-6398 (fax)
☐ 130 North Main Street, Suite 100 ▪ Butte, Montana 59701-2839
406-723-8213 ▪ 406-723-8328 (fax)
☐ 2090 Stadium Drive ▪ Bozeman, Montana 59715
406-586-8834 ▪ 406-586-1730 (fax)
☐ 106 1st Avenue South, Suite A ▪ Great Falls, Montana 59401
406-453-4085 ▪ 406-453-4288 (fax)
☐ 104 East Broadway, Suite G-1 ▪ Helena, Montana 59601
406-442-0370 ▪ 406-442-0377 (fax)
☐ 713 Pleasant ▪ Miles City, Montana 59301
406-234-6666 ▪ 406-234-7065 (fax)
☐ 41 East Broadway ▪ Dickinson, North Dakota 58601
701-300-7014 ▪ 701-300-7015 (fax)
☐ 8420 154th Avenue NE ▪ Redmond, Washington 98052
425-869-2670 ▪ 425-869-2679 (fax)
☐ 1901 Energy Court, Suite 170 ▪ Gillette, Wyoming 82718
307-686-4181 ▪ 307-686-4858 (fax)
☐ 945 Lincoln Street ▪ Lander, Wyoming 82520
307-332-3285 ▪ 307-332-5795 (fax)
☐ 1575 N. 4th Street, Suite 105 ▪ Laramie, Wyoming 82072
307-742-3816 ▪ 307-742-9741 (fax)
☐ 16 W. 8th Street ▪ Sheridan, Wyoming 82801
307-672-9006 ▪ 307-672-5214 (fax)

MEMORANDUM

To:	Mike Gault, AK DOT/PF
From:	Osca Lage
Date:	06-17-13
Project No.:	1122.60047.11
Subject:	West Dowling Road Infiltration Test

In support to the rain garden for West Dowling Road, we conducted an infiltration test on 06-07-13. Prior to performing the test, we excavated a 6 foot deep test pit to collect information about the soils at the site. Based on the test pit, the soils consist of Silty Sand (SM) with 16% fines. Attached are the results of a particle size distribution test performed on a sample collected from the test pit.

The infiltration test was conducted on undisturbed soil at 2 foot of depth. The infiltration rate observed was 45 inches per hour.

Regards,
Oscar Lage

DOWL HKM

Client: ADOT & PF
Project: WDR Construction Support (Dowling)
Work Order: D60047

Particle Size Distribution

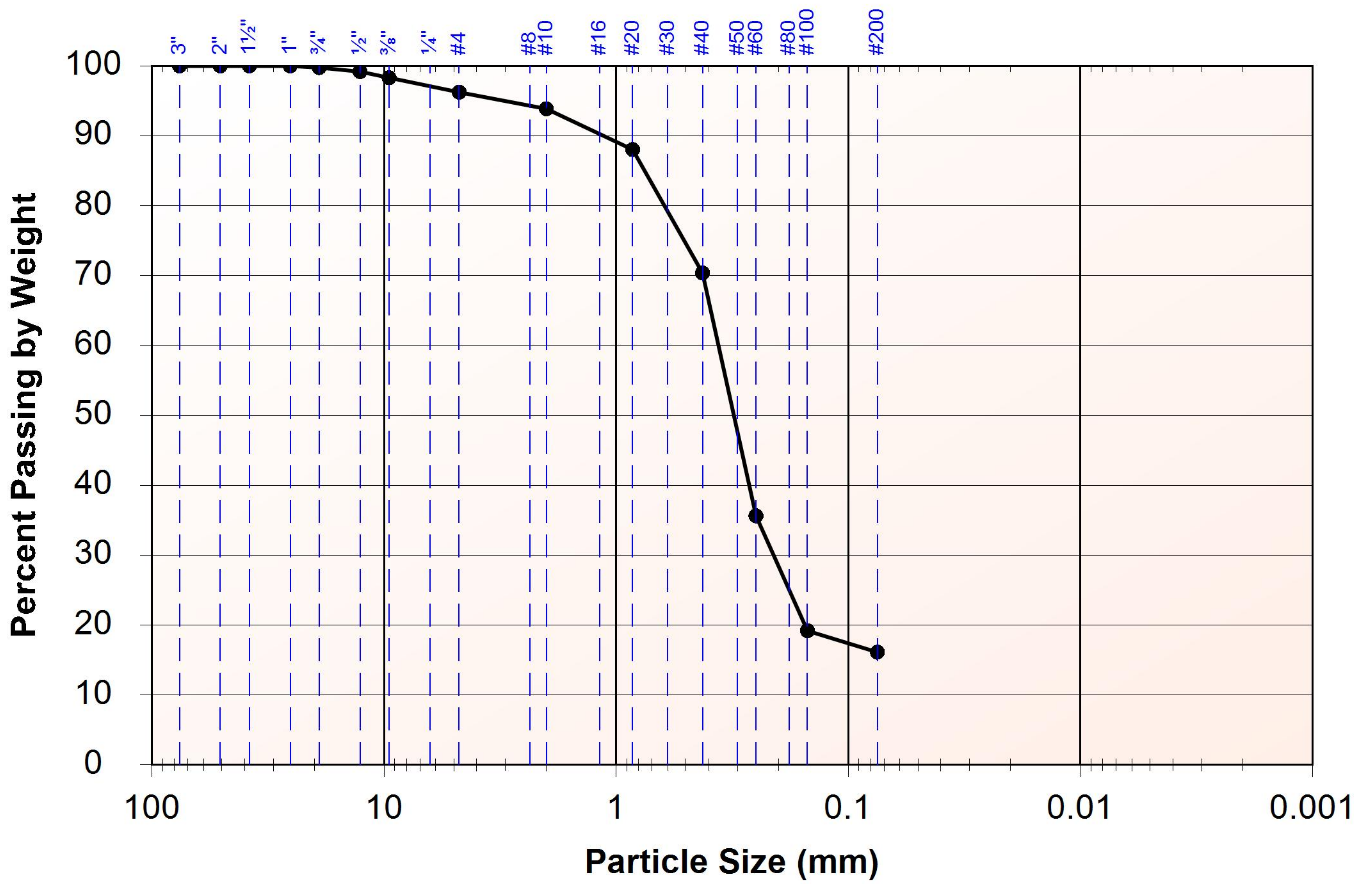
ASTM D422

Lab Number	2013-698
Received	6/7/2013
Reported	6/11/2013

Location: TP-1 0-6 Dowling

Engineering Classification: Silty Sand, SM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	100%	
¾"	100%	
½"	99%	
⅜"	98%	
#4	96%	
Total Weight of Sample 2790.6g		
#10	94%	
#20	88%	
#40	70%	
#60	36%	
#100	19%	
#200	16.1%	
Total Weight of Fine Fraction 389.7g		

Maria E. Kampsen, P.E • 4041 B Street • Anchorage • Alaska • 99503 • 907/562-2000 • Fax 907/563-3953

Appendix D: New Seward Highway Data and Calculations

NSH Inflow and Outflow Sample Data Explanation
Data collected by HDR, Inc. July – October 2014

This appendix provides samples of the inflow and outflow data collected at the NSH retention basin. Readings were taken every minute for the recording period. Due the quantity of resulting data, only samples of the inflow and outflow data are provided in this report.

Data at Basin Inflow Culvert/Weir

A description of the data and/or computations in each column is provided below.

Column A, No.: Sequential number of the data reading by the instrument at the inflow weir.

Column B, Data and Time: Data and time that the data was collected.

Column C, Absolute Pressure: Absolute pressure in pounds per square inch recorded by the instrument at the inflow weir.

Column D, Temp (F): Temperature in degrees Fahrenheit recorded by the instrument at the inflow weir.

Column E, Absolute Barom Pressure (psi): Barometric pressure in pounds per square inch recorded by the instrument at the inflow weir.

Column F, Water Level (ft) Based on Pressure Data: Water level computed and recorded by the instrument at the inflow weir.

Column G, Corrected Water Level (ft): The water level in column F corrected based on visual observations of water level compared to the instrument-computed water level values.

Column H, Basin Inflow (cfs): The computed basin inflow in cubic feet per second. This computation is an "if-then" statement that accounts for the location of the pressure transducer 2-inches below weir notch. If the reading the Column G is greater than 0.16 ft (approximately 2 inches), then the value from Column G is converted to flow rate using the standard v-notch weir equation $Q = 2.49\ h^{2.48}$. If the value is equal to or greater than 0.16 ft, the cell displays a zero flow value.

Column I, Incremental Volume Inflow (cf): Converts the value in Column H to a volume in cubic feet by multiplying the value by 60 seconds. Assumes the flow in Column H was constant for a 60 second period.

Column J, Volume Inflow Total (cf): Sums the incremental volumes in Column I for the duration of the event being analyzed. Only has a value at the beginning of the storm event.

NSH Inflow and Outflow Sample Data Explanation
Data collected by HDR, Inc. July – October 2014

Data at Basin Outflow Weir

A description of the data and/or computations in each column is provided below. Note that only values used for computations or analysis in the report are included in this Appendix.

Column A, No.: Sequential number of the data reading by the instrument at the outflow weir.

Column B, Data and Time: Data and time that the data was collected.

Column C, Absolute Pressure: Absolute pressure in pounds per square inch recorded by the instrument at the outflow weir.

Column D, Temp (F): Temperature in degrees Fahrenheit recorded by the instrument at the outflow weir.

Column E, Absolute Barom Pressure (psi): Barometric pressure in pounds per square inch recorded by the instrument at the outflow weir.

Column F, Water Level (ft) Based on Pressure Data: Water level computed and recorded by the instrument at the outflow weir.

Column G, Corrected Water Level (ft): The water level in column F corrected based on visual observations of water level compared to the instrument-computed water level values.

Column H, Basin Outflow (cfs): The computed basin inflow in cubic feet per second. This computation converts the value in Column G to flow rate using the standard v-notch weir equation $Q = 2.49\ h^{2.48}$.

Column I, Incremental Volume Outflow (cf): Converts the value in Column H to a volume in cubic feet by multiplying the value by 60 seconds. Assumes the flow in Column H was constant for a 60 second period.

Column J, Volume Outflow Total (cf): Sums the incremental volumes in Column I for the duration of the event being analyzed. Only has a value at the beginning of the storm event.

NSH Retention Basin
Sample Inflow Data

A	B	C	D	E	F	G	H	I	J
No.	**Date and Time**	**Absolute Pressure (psi)**	**Temp (F)**	**Absolute Barom Presssure (psi)**	**Water Level (ft) Based on Pressure Data**	**Corrected Water Level (ft)**	**Basin Inflow (cfs)**	**Incremental Volume Inflow (cf)**	**Volume Inflow Total (cf)**
11075	9/13/2014 8:34	14.7836	53.973	14.4977	0.5530	0.579	0.64	38.530	
11076	9/13/2014 8:35	14.7836	53.973	14.4977	0.5530	0.579	0.64	38.530	
11077	9/13/2014 8:36	14.7836	53.973	14.5	0.5480	0.574	0.63	37.710	
11078	9/13/2014 8:37	14.7836	53.973	14.5	0.5480	0.574	0.63	37.710	
11079	9/13/2014 8:38	14.7836	53.973	14.5	0.5480	0.574	0.63	37.710	
11080	9/13/2014 8:39	14.7814	53.973	14.5	0.5430	0.569	0.62	36.900	
11081	9/13/2014 8:40	14.7814	53.973	14.5	0.5430	0.569	0.62	36.900	
11082	9/13/2014 8:41	14.7791	53.973	14.5	0.5370	0.563	0.60	35.943	
11083	9/13/2014 8:42	14.7814	53.973	14.5	0.5430	0.569	0.62	36.900	
11084	9/13/2014 8:43	14.7791	53.973	14.5	0.5370	0.563	0.60	35.943	
11085	9/13/2014 8:44	14.7769	53.973	14.5023	0.5270	0.553	0.57	34.380	
11086	9/13/2014 8:45	14.7769	53.973	14.5023	0.5270	0.553	0.57	34.380	
11087	9/13/2014 8:46	14.7769	53.973	14.5	0.5320	0.558	0.59	35.156	
11088	9/13/2014 8:47	14.7725	53.973	14.5	0.5220	0.548	0.56	33.614	
11089	9/13/2014 8:48	14.7702	53.973	14.4977	0.5220	0.548	0.56	33.614	
11090	9/13/2014 8:49	14.768	53.973	14.5003	0.5110	0.537	0.53	31.966	
11091	9/13/2014 8:50	14.7659	53.973	14.5003	0.5060	0.532	0.52	31.233	
11092	9/13/2014 8:51	14.7659	53.973	14.5003	0.5060	0.532	0.52	31.233	
11093	9/13/2014 8:52	14.7635	53.973	14.5003	0.5010	0.527	0.51	30.510	
11094	9/13/2014 8:53	14.7592	53.973	14.5003	0.4910	0.517	0.48	29.094	
11095	9/13/2014 8:54	14.7569	53.973	14.5003	0.4850	0.511	0.47	28.264	
11096	9/13/2014 8:55	14.7547	53.973	14.498	0.4860	0.512	0.47	28.401	
11097	9/13/2014 8:56	14.7547	53.973	14.498	0.4860	0.512	0.47	28.401	
11098	9/13/2014 8:57	14.7503	53.973	14.4958	0.4810	0.507	0.46	27.719	
11099	9/13/2014 8:58	14.748	53.973	14.4958	0.4750	0.501	0.45	26.912	
11100	9/13/2014 8:59	14.7458	53.973	14.4958	0.4700	0.496	0.44	26.251	
11101	9/13/2014 9:00	14.7458	53.973	14.498	0.4650	0.491	0.43	25.600	
11102	9/13/2014 9:01	14.7437	53.973	14.498	0.4600	0.486	0.42	24.958	
11103	9/13/2014 9:02	14.7413	53.973	14.498	0.4550	0.481	0.41	24.326	
11104	9/13/2014 9:03	14.7392	53.973	14.4984	0.4490	0.475	0.39	23.580	
11105	9/13/2014 9:04	14.737	53.973	14.4984	0.4440	0.47	0.38	22.970	
11106	9/13/2014 9:05	14.7347	53.973	14.4984	0.4390	0.465	0.37	22.368	
11107	9/13/2014 9:06	14.7325	53.973	14.4984	0.4340	0.46	0.36	21.777	
11108	9/13/2014 9:07	14.7325	53.973	14.4984	0.4340	0.46	0.36	21.777	
11109	9/13/2014 9:08	14.7325	53.973	14.5006	0.4290	0.455	0.35	21.194	
11110	9/13/2014 9:09	14.728	53.973	14.4984	0.4230	0.449	0.34	20.508	
11111	9/13/2014 9:10	14.728	53.973	14.5006	0.4180	0.444	0.33	19.946	
11112	9/13/2014 9:11	14.7258	53.973	14.5009	0.4120	0.438	0.32	19.284	
11113	9/13/2014 9:12	14.7237	53.973	14.5009	0.4070	0.433	0.31	18.743	
11114	9/13/2014 9:13	14.7192	53.973	14.5009	0.3970	0.423	0.29	17.688	
11115	9/13/2014 9:14	14.7192	53.973	14.4987	0.4020	0.428	0.30	18.211	
11116	9/13/2014 9:15	14.7192	53.973	14.4987	0.4020	0.428	0.30	18.211	
11117	9/13/2014 9:16	14.717	53.973	14.5009	0.3920	0.418	0.29	17.174	
11118	9/13/2014 9:17	14.7148	53.973	14.5009	0.3870	0.413	0.28	16.669	
11119	9/13/2014 9:18	14.7125	53.973	14.4987	0.3870	0.413	0.28	16.669	
11120	9/13/2014 9:19	14.7125	53.973	14.5009	0.3820	0.408	0.27	16.173	
11121	9/13/2014 9:20	14.7103	53.973	14.5009	0.3770	0.403	0.26	15.686	
11122	9/13/2014 9:21	14.7103	53.973	14.5012	0.3760	0.402	0.26	15.589	
11123	9/13/2014 9:22	14.7058	53.973	14.5012	0.3660	0.392	0.24	14.645	
11124	9/13/2014 9:23	14.7058	53.973	14.5012	0.3660	0.392	0.24	14.645	
11125	9/13/2014 9:24	14.7058	53.973	14.499	0.3710	0.397	0.25	15.113	
11126	9/13/2014 9:25	14.7036	53.973	14.5012	0.3610	0.387	0.24	14.186	
11127	9/13/2014 9:26	14.7015	53.973	14.5012	0.3560	0.382	0.23	13.736	
11128	9/13/2014 9:27	14.6993	53.973	14.5012	0.3510	0.377	0.22	13.295	
11129	9/13/2014 9:28	14.6993	53.973	14.5012	0.3510	0.377	0.22	13.295	
11130	9/13/2014 9:29	14.6993	53.973	14.5012	0.3510	0.377	0.22	13.295	
11131	9/13/2014 9:30	14.697	53.973	14.5012	0.3450	0.371	0.21	12.776	
11132	9/13/2014 9:31	14.6948	53.973	14.499	0.3450	0.371	0.21	12.776	
11133	9/13/2014 9:32	14.6948	53.973	14.499	0.3450	0.371	0.21	12.776	
11134	9/13/2014 9:33	14.6926	53.973	14.499	0.3400	0.366	0.21	12.353	
11135	9/13/2014 9:34	14.6926	53.973	14.5012	0.3350	0.361	0.20	11.939	
11136	9/13/2014 9:35	14.6903	53.973	14.5012	0.3300	0.356	0.19	11.533	
11137	9/13/2014 9:36	14.6926	53.973	14.5035	0.3300	0.356	0.19	11.533	
11138	9/13/2014 9:37	14.6903	53.973	14.5035	0.3250	0.351	0.19	11.136	
11139	9/13/2014 9:38	14.6881	53.973	14.5012	0.3250	0.351	0.19	11.136	
11140	9/13/2014 9:39	14.6881	53.973	14.5035	0.3190	0.345	0.18	10.669	
11141	9/13/2014 9:40	14.6881	53.973	14.5035	0.3190	0.345	0.18	10.669	
11142	9/13/2014 9:41	14.6881	53.973	14.5058	0.3140	0.34	0.17	10.290	

NSH Retention Basin
Sample Outflow Data

A	B	C	D	E	F	G	H	I	J
No.	**Date and Time**	**Absolute Pressure (psi)**	**Temp (F)**	**Absolute Barom Presssure (psi)**	**Water Level (ft) Based on Pressure Data**	**Corrected Water Level (ft)**	**Basin Outflow (cfs)**	**Incremental Volume Outflow (cf)**	**Volume Outflow Total (cf)**
11075	9/13/2014 8:34	14.6875	54.15	14.4977	0.509	0.456	0.35516663	21.3099979	
11076	9/13/2014 8:35	14.6897	54.15	14.4977	0.514	0.461	0.36490317	21.8941905	
11077	9/13/2014 8:36	14.692	54.15	14.5	0.514	0.461	0.36490317	21.8941905	
11078	9/13/2014 8:37	14.6942	54.15	14.5	0.519	0.466	0.37479727	22.4878363	
11079	9/13/2014 8:38	14.6942	54.15	14.5	0.519	0.466	0.37479727	22.4878363	
11080	9/13/2014 8:39	14.6964	54.15	14.5	0.524	0.471	0.38484974	23.0909844	
11081	9/13/2014 8:40	14.6964	54.15	14.5	0.524	0.471	0.38484974	23.0909844	
11082	9/13/2014 8:41	14.6987	54.15	14.5	0.529	0.476	0.39506139	23.7036835	
11083	9/13/2014 8:42	14.7009	54.15	14.5	0.534	0.481	0.40543304	24.3259823	
11084	9/13/2014 8:43	14.7009	54.15	14.5	0.534	0.481	0.40543304	24.3259823	
11085	9/13/2014 8:44	14.7009	54.15	14.5023	0.529	0.476	0.39506139	23.7036835	
11086	9/13/2014 8:45	14.7031	54.15	14.5023	0.534	0.481	0.40543304	24.3259823	
11087	9/13/2014 8:46	14.7031	54.15	14.5	0.539	0.486	0.41596548	24.957929	
11088	9/13/2014 8:47	14.7031	54.15	14.5	0.539	0.486	0.41596548	24.957929	
11089	9/13/2014 8:48	14.7031	54.15	14.4977	0.544	0.491	0.42665953	25.5995716	
11090	9/13/2014 8:49	14.7031	54.15	14.5003	0.538	0.485	0.41384609	24.8307655	
11091	9/13/2014 8:50	14.7031	54.15	14.5003	0.538	0.485	0.41384609	24.8307655	
11092	9/13/2014 8:51	14.7052	54.15	14.5003	0.543	0.49	0.42450775	25.4704651	
11093	9/13/2014 8:52	14.7052	54.15	14.5003	0.543	0.49	0.42450775	25.4704651	
11094	9/13/2014 8:53	14.7052	54.15	14.5003	0.543	0.49	0.42450775	25.4704651	
11095	9/13/2014 8:54	14.7031	54.15	14.5003	0.538	0.485	0.41384609	24.8307655	
11096	9/13/2014 8:55	14.7031	54.15	14.498	0.544	0.491	0.42665953	25.5995716	
11097	9/13/2014 8:56	14.7052	54.15	14.498	0.549	0.496	0.43751596	26.2509579	
11098	9/13/2014 8:57	14.7031	54.15	14.4958	0.549	0.496	0.43751596	26.2509579	
11099	9/13/2014 8:58	14.7006	53.97	14.4958	0.543	0.49	0.42450775	25.4704651	
11100	9/13/2014 8:59	14.7029	53.97	14.4958	0.548	0.495	0.43533165	26.1198989	
11101	9/13/2014 9:00	14.7051	53.97	14.498	0.548	0.495	0.43533165	26.1198989	
11102	9/13/2014 9:01	14.7051	53.97	14.498	0.548	0.495	0.43533165	26.1198989	
11103	9/13/2014 9:02	14.7029	53.97	14.498	0.543	0.49	0.42450775	25.4704651	
11104	9/13/2014 9:03	14.7006	53.97	14.4984	0.537	0.484	0.41173316	24.7039895	
11105	9/13/2014 9:04	14.7006	53.97	14.4984	0.537	0.484	0.41173316	24.7039895	
11106	9/13/2014 9:05	14.7029	53.97	14.4984	0.542	0.489	0.42236247	25.341748	
11107	9/13/2014 9:06	14.7006	53.97	14.4984	0.537	0.484	0.41173316	24.7039895	
11108	9/13/2014 9:07	14.7006	53.97	14.4984	0.537	0.484	0.41173316	24.7039895	
11109	9/13/2014 9:08	14.7029	53.97	14.5006	0.537	0.484	0.41173316	24.7039895	
11110	9/13/2014 9:09	14.7006	53.97	14.4984	0.537	0.484	0.41173316	24.7039895	
11111	9/13/2014 9:10	14.7006	53.97	14.5006	0.532	0.479	0.40126513	24.0759078	
11112	9/13/2014 9:11	14.6984	53.97	14.5009	0.526	0.473	0.38891525	23.3349152	
11113	9/13/2014 9:12	14.6984	53.97	14.5009	0.526	0.473	0.38891525	23.3349152	
11114	9/13/2014 9:13	14.6984	53.97	14.5009	0.526	0.473	0.38891525	23.3349152	
11115	9/13/2014 9:14	14.6962	53.97	14.4987	0.526	0.473	0.38891525	23.3349152	
11116	9/13/2014 9:15	14.6939	53.97	14.4987	0.521	0.468	0.37879921	22.7279525	
11117	9/13/2014 9:16	14.6962	53.97	14.5009	0.521	0.468	0.37879921	22.7279525	
11118	9/13/2014 9:17	14.6939	53.97	14.5009	0.516	0.463	0.36884186	22.1305117	
11119	9/13/2014 9:18	14.6939	53.97	14.4987	0.521	0.468	0.37879921	22.7279525	
11120	9/13/2014 9:19	14.6962	53.97	14.5009	0.521	0.468	0.37879921	22.7279525	
11121	9/13/2014 9:20	14.6939	53.97	14.5009	0.516	0.463	0.36884186	22.1305117	
11122	9/13/2014 9:21	14.6939	53.97	14.5012	0.515	0.462	0.36686936	22.0121618	
11123	9/13/2014 9:22	14.6896	53.97	14.5012	0.505	0.452	0.34749028	20.849417	
11124	9/13/2014 9:23	14.6896	53.97	14.5012	0.505	0.452	0.34749028	20.849417	
11125	9/13/2014 9:24	14.6917	53.97	14.499	0.515	0.462	0.36686936	22.0121618	
11126	9/13/2014 9:25	14.6896	53.97	14.5012	0.505	0.452	0.34749028	20.849417	
11127	9/13/2014 9:26	14.6872	53.97	14.5012	0.5	0.447	0.33803526	20.2821157	
11128	9/13/2014 9:27	14.6872	53.97	14.5012	0.5	0.447	0.33803526	20.2821157	
11129	9/13/2014 9:28	14.6872	53.97	14.5012	0.5	0.447	0.33803526	20.2821157	
11130	9/13/2014 9:29	14.6872	53.97	14.5012	0.5	0.447	0.33803526	20.2821157	
11131	9/13/2014 9:30	14.6851	53.97	14.5012	0.495	0.442	0.32873548	19.7241286	
11132	9/13/2014 9:31	14.6851	53.97	14.499	0.5	0.447	0.33803526	20.2821157	
11133	9/13/2014 9:32	14.6829	53.97	14.499	0.495	0.442	0.32873548	19.7241286	
11134	9/13/2014 9:33	14.6851	53.97	14.499	0.5	0.447	0.33803526	20.2821157	
11135	9/13/2014 9:34	14.6829	53.97	14.5012	0.49	0.437	0.31959009	19.1754057	
11136	9/13/2014 9:35	14.6829	53.97	14.5012	0.49	0.437	0.31959009	19.1754057	
11137	9/13/2014 9:36	14.6806	53.97	14.5035	0.479	0.426	0.3000096	18.000576	
11138	9/13/2014 9:37	14.6806	53.97	14.5035	0.479	0.426	0.3000096	18.000576	
11139	9/13/2014 9:38	14.6806	53.97	14.5012	0.484	0.431	0.30881826	18.5290958	
11140	9/13/2014 9:39	14.6806	53.97	14.5035	0.479	0.426	0.3000096	18.000576	
11141	9/13/2014 9:40	14.6806	53.97	14.5035	0.479	0.426	0.3000096	18.000576	
11142	9/13/2014 9:41	14.6784	53.97	14.5058	0.469	0.416	0.2828465	16.9707899	

Appendix E: SWMM Modeling Output

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ JUL-24-2014 00:00:00
Ending Date .............. JUL-25-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00

**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.023         0.640
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.021         0.590
Final Surface Storage ....         0.002         0.051
Continuity Error (%) .....         0.000

**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.021         0.007
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.021         0.007
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000

***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                            Total      Total      Total      Total      Total        Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                   in         in         in         in         in     10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
WestCatch                    0.64       0.00       0.00       0.00       0.59         0.00     0.02   0.921
EastCatch                    0.64       0.00       0.00       0.00       0.59         0.00     0.02   0.922

Analysis begun on:  Wed Nov 19 16:47:18 2014
```

```
Analysis ended on:  Wed Nov 19 16:47:18 2014
Total elapsed time: < 1 sec
```

Ship Creek Hatchery Output - Event 2

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ AUG-24-2014 00:00:00
Ending Date .............. AUG-25-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.028         0.790
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.027         0.740
Final Surface Storage ....         0.002         0.050
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.027         0.009
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.027         0.009
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

--------------------------------------------------------------------------------------------------------
                            Total      Total      Total      Total      Total        Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                   in         in         in         in         in     10^6 gal      CFS
--------------------------------------------------------------------------------------------------------
WestCatch                    0.79       0.00       0.00       0.00       0.74         0.00     0.03   0.937
EastCatch                    0.79       0.00       0.00       0.00       0.74         0.00     0.02   0.937


Analysis begun on:  Wed Nov 19 17:14:15 2014
Analysis ended on:  Wed Nov 19 17:14:15 2014
Total elapsed time: < 1 sec
```

Ship Creek Hatchery Output - Event 3

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ OCT-11-2014 00:00:00
Ending Date .............. OCT-11-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.025         0.690
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.023         0.639
Final Surface Storage ....         0.002         0.051
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.023         0.007
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.023         0.007
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                            Total      Total      Total      Total      Total        Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                   in         in         in         in         in     10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
WestCatch                    0.69       0.00       0.00       0.00       0.64         0.00     0.03   0.926
EastCatch                    0.69       0.00       0.00       0.00       0.64         0.00     0.02   0.926


Analysis begun on:  Wed Nov 19 17:25:11 2014
```

```
Analysis ended on:  Wed Nov 19 17:25:11 2014
Total elapsed time: < 1 sec
```

West Dowling Rain Garden Output - Event 1

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ JUL-24-2014 12:00:00
Ending Date .............. JUL-25-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.024         1.460
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.023         1.411
Final Surface Storage ....         0.001         0.050
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.023         0.008
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.023         0.008
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
WestDowlingRG	1.46	0.00	0.00	0.00	1.41	0.01	0.09	0.966

```
Analysis begun on:  Wed Nov 19 15:03:20 2014
Analysis ended on:  Wed Nov 19 15:03:20 2014
Total elapsed time: < 1 sec
```

West Dowling Rain Garden Output - Event 2

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ AUG-24-2014 00:00:00
Ending Date .............. AUG-25-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.015         0.890
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.014         0.841
Final Surface Storage ....         0.001         0.050
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.014         0.004
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.014         0.004
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                             Total      Total      Total      Total      Total        Total     Peak  Runoff
                            Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                    in         in         in         in         in     10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
WestDowlingRG                 0.89       0.00       0.00       0.00       0.84         0.00     0.04   0.945


Analysis begun on:  Wed Nov 19 15:43:26 2014
Analysis ended on:  Wed Nov 19 15:43:26 2014
Total elapsed time: < 1 sec
```

West Dowling Rain Garden Output - Event 3

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Starting Date ............ OCT-11-2014 00:00:00
Ending Date .............. OCT-11-2014 23:59:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:30:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......         0.009         0.560
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.000         0.000
Surface Runoff ...........         0.008         0.510
Final Surface Storage ....         0.001         0.051
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.008         0.003
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.008         0.003
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                            Total      Total      Total      Total      Total       Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff   Coeff
Subcatchment                   in         in         in         in         in    10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
WestDowlingRG                0.56       0.00       0.00       0.00       0.51        0.00     0.02   0.911


Analysis begun on:  Wed Nov 19 16:07:18 2014
Analysis ended on:  Wed Nov 19 16:07:18 2014
```

```
Total elapsed time: &lt; 1 sec
```

Appendix F: Site Visit Reports

General Information

Number of Sites Visited: 4

Date: July 25, 2014

Weather: Raining

Russian Jack Parking Lot

Approximate Arrival Time: 2:30 pm

Observations:

A soccer game was in progress and the parking lot was nearly full. A notable amount of water was flowing from the parking lot and from the area east of the parking lot into the manhole that leads to the infiltration gallery. The driving access to the area east of the parking lot was blocked by porta-potties. Water from the muddy area east of the rolled curb was flowing under and around the porta-potties and onto the asphalt surface. There was a notable build-up of mud and debris near the curb line.

Mulch from the landscape planters was observed to be strewn across the parking lot. It is being driven on and grinding into the pores of the porous asphalt. Large amounts of mulch is washing into the curb inlets that flow to the infiltration gallery.

Checked for standing water in each of the infiltration gallery monitoring ports. No standing water was observed in any of the ports. One of the caps is broken and the pipe is exposed.

Checked the water level in the north and central monitoring wells of the porous asphalt. The north well had approximately 2 inches of standing water and the central well had approximately 3.5 inches of standing water. The west well was not checked. Both of the checked wells were filled with a putty/grease-like substance that is expected to be bentonite. The cap couldn't be opened without scooping the substance out. Most of it was removed so the well cap could be taken off and the water depth measured.

Some wear or "raveling" of the porous asphalt was observed on the north bay, near the curb line, where turning from the front axis of vehicles would be significant.

Pictures are provided below.

Mulch on the porous asphalt and spilling over from the landscaped areas.

Water upstream of the infiltration gallery, flowing into the parking lot.

Ship Creek Hatchery Rain Garden

Approximate Arrival Time: 3:30 pm

Observations:

The rain gardens can generally be described and grassy depressions that collect and percolate stormwater into the ground. There are three depressed areas used for this purpose. The depressions are collecting runoff from a notably sized parking lot and possibly from the building itself. Two of the depressions on the west side of the parking lot had standing water. In the west most pond, the water was measured to be approximately 4 inches deep.

Generally, the parking lot appears to be well designed from the stormwater standpoint. Water is directed to the grassy areas, and to a small landscaped area, via the asphalt slope and flat, concrete curbs at the edges, instead of raised ones.


West Rain Garden


East Rain Garden

West Dowling Rain Garden

Approximate Arrival Time: 4:30 pm

Observations:

Water from the area parking lot is flowing to the rain garden. The bottom of the rain garden area is rocky. Vegetation has grown in around the rock and on the side slopes of the facility. No standing water was observed in the rain garden. The parking lot and access drive are in need of sweeping.

Taku Lake Rain Garden

Approximate Arrival Time: 4:45 pm

Observations:

Large amounts of water from the parking lot and the access drive were flowing (via channel flow) into the rain garden. Oil sheen on the inflow water was observed. The rain garden vegetation was full and healthy. The bottom of the rain garden was not visible. The outlet pipe was actively flowing. An exact depth of flow was difficult to determine due to ponding in the vegetation at the outlet, but was estimated to be approximately one inch deep.


Water entering rain garden (Left) and rain garden outlet pipe (right)

Runoff from adjacent walkway

General Information

Number of Sites Visited: 4

Date: August 25, 2014

Weather: Lightly raining/Overcast

Russian Jack Parking Lot

Approximate Arrival Time: 12:40 pm

Observations: The inspection began as a significant rainfall event was slowing. The woodchip-mulch had been replaced with rock mulch in the smaller landscape beds, and the larger landscape beds had been hydro-seeded. The parking lot was much cleaner than the previous inspection and looked as though it had been swept. Several rocks had migrated out of the landscaping, but were not broken or appeared to be causing damage. A few small pieces of rock from the porous asphalt were scattered onto the regular asphalt near the west edge of the parking lot. Ponding on the PA was observed in only one location, near the northwest landscape planter.

Water was flowing into the third manhole/inlet and into the infiltration gallery. Water was not actively flowing into the upstream inlet near the curb lines.

Each of the inspection ports in the infiltration gallery were checked; standing water was not observed in any of the ports. A Kleenex and a tree branch were observed inside the port with the broken cap.

The water levels in each of the porous asphalt monitoring wells was checked. The monitoring wells in the central and western sections of porous asphalt had a very small amount of standing water in the bottom of the well, approximately one inch or less. The monitoring well on the northern section of porous asphalt was observed to have 40 inches of standing water. Most of the putty/grease like substance in the top of the western well was removed so that the well cap could be opened.


Parking lot overviews


Left: New rock mulch. Right: ponding on the porous asphalt surface


Left: Runoff from the area to the east of the parking lot. Right: Seeded area that replaced the mulch.

Ship Creek Hatchery Rain Garden

Approximate Arrival Time: 1:50 pm

Observations: Ponded water was observed in both of the rain gardens/grassy depressions. Both locations had ducks in the water. Overflow from the depressions was not observed. The standing water in the western garden, closest to Reeve Blvd was 5 inches in the deepest observed location. In the eastern garden, standing water was 9 inches in the deepest observed location.

West rain garden

East rain garden

West Dowling Rain Garden

Approximate Arrival Time: 2:30 pm

Observations: The rain had stopped and water was not actively flowing into the rain garden at the time of this site visit. No standing water was observed in the rain garden, and the vegetation looks stable.

Rain Garden (above) and Parking Lot (below)

Taku Lake Rain Garden

Approximate Arrival Time: 2:45 pm

Observations:

Standing or ponded water was not observed in the rain garden or at the garden outlet. The outlet pipe was not flowing. Vegetation in the rain garden appeared to be overgrown.


Rain garden

Outlet pipe with no flow

General Information

Number of Sites Visited: 4

Date: October 11, 2014

Weather: Lightly raining/Overcast

Observer: Jason Dusel

Russian Jack Parking Lot

Approximate Arrival Time: 4:45 pm

Observations: The inspection began as a significant rainfall event was slowing. Similar to the last visit, Ponding on the PA was observed near the northwest landscape planter. Slight surface raveling from turning tires was observed in a few locations.

Water was flowing into the far east manhole and into the infiltration gallery. Water was not actively flowing into the upstream inlet near the curb lines. Water from the PA subdrain was not flowing into the manholes.

Each of the inspection ports in the infiltration gallery were checked; standing water was not observed in any of the ports. Several sticks from trees were shoved into the monitoring well with the broken cap. Two of the sticks were removed, but the rest could not be reached. Replaced the broken cap with a new one.

The water levels in each of the porous asphalt monitoring wells was checked. The north well was packed full of the bentonite grease substance again and had to be cleaned out before it could be checked.

- North MW: Water was observed to be 40 inches from the top of the casing, and the total well depth from TOC is 81 inches. (41 inches of standing water.)
- West MW: 4 inches of standing water
- Central MW: 6 inches of standing water

Left: Parking lot overview. Right: ponding on the porous asphalt

Ship Creek Hatchery Rain Garden

Approximate Arrival Time: 6:00 pm

Observations:

Ponded water was observed in both of the rain gardens/grassy depressions. Overflow from the depressions/rain gardens was not observed. The standing water in the western garden, closest to Reeve Blvd was 6 inches in the deepest observed location. In the eastern garden, standing water was 10 inches in the deepest observed location.

Left: West rain garden. Right: East rain garden

West Dowling Rain Garden

Approximate Arrival Time: 6:30 pm

Observations: The rain had slowed to a slight drizzle. No standing water was observed in the rain garden, and the vegetation looks stable.

Rain garden and parking lot

Taku Lake Rain Garden

Approximate Arrival Time: 6:35 pm

Observations: Light rain was falling. Standing or ponded water was not observed in the rain garden or at the garden outlet. The outlet pipe was not flowing.

A picnic table was observed to have been tossed into the lake. Removed it with the help of two park users.

Rain garden

General Information

Number of Sites Visited: 2

Date: October 15, 2014

Weather: Clear

Observer: Janie Dusel

Russian Jack Parking Lot

Approximate Arrival Time: 5:45 pm

This inspection was to check to see if water levels in the PA were receding following the signigicant rain on 10-11-14.

Observations: The water levels in 2 of the porous asphalt monitoring wells was checked.

North MW: 34.5 inches of standing water. (Water was observed to be 46.5 inches from the top of the casing, and the total well depth from TOC is 81 inches.)

Central MW: 6 inches of standing water. (Water was observed to be 78 inches from the TOC and the total well depth is 84 inches.)

Ship Creek Hatchery Rain Garden

Approximate Arrival Time: 6:16 pm

Observations: Both rain gardens had no standing water. The rain gardens' bottom surfaces were soft and slightly muddy, but no standing water was observed.

Left: West rain garden. Right: East rain garden