ED MCCARTHY, P.E., PS
Hydrology ▪ Hydraulics ▪ Engineering

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RENTON, WA 98059
(425) 271-5734

February 18, 2016

Mr. Boyd Benson, PE
City Engineer
City of Duvall
15535 Main Street NE
Duvall, WA 98019

Re: Rio Vista – Wetland Hydrology Analysis
Duvall, Washington

Dear Mr. Benson:

This letter is intended to support the Rio Vista plat that is currently under city review. In response to the city's information request, dated August 7, 2015, I've conducted a hydrologic analysis of the wetland that is located north of NE 143rd Place on the Rio Vista site (Figure 1). The Category III wetland is identified as Wetland A within the proposed plat (Wetland Resources, Inc., July 7, 2015). I used the King County Runoff Time Series v6.00 (KCRTS) hydrologic model to compare predevelopment hydrology in the wetland to that predicted to occur after the proposed the Rio Vista project has been completed.

Wetland B, also a Category III wetland, is located partially in the southern portion of the site. The wetland extends offsite to the south and west. The effects of the project on this wetland have not been of concern because the proposed development represents an insignificant tributary area to the wetland. The wetland's hydrology is mainly sourced from direct rainfall, drainage from the ditch along NE 143rd Place, runoff from forested areas to the west and south, and stormwater from adjacent subdivisions.

Rio Vista Project

The Rio Vista site is located north of NE 143rd Place and west of 272nd Place NE. Wetland A is located in the central portion of the site and drains to a channel that flows to the north (Figure 2). The proposal for development includes constructing a single-family residential plat with road, utility and drainage improvements. Runoff collected from the developed area will be conveyed to two stormwater vaults. The East Vault is located to the east of the wetland and the West Vault is located to the west of the wetland (Figure 3) (Land Development Advisors, April 2015). Each of the vaults has a control structure that discharges to the wetland. The vaults are designed to meet Conservation Flow Control standards.

Wetland A is a depressional wetland with a Category III rating (Wetland Resources, Inc., July 7, 2015) and has been disturbed, most notably with a drainage ditch bisecting the wetland. A reconnaissance of the wetland was conducted on February 16, 2016. Photos of

the wetland are presented in Attachment B. At the time of the site visit, a small amount of water (approximately 10 gallons per minute) was flowing in the onsite drainage ditch in a northerly direction. The flow rate leaving the wetland in the northerly outlet channel was considerably higher, at an estimated rate of over 100 gallons per minute.

Method of Analysis

A hydrologic assessment of tributary basins was conducted to characterize the flow regime to the wetland. The basin areas draining to the wetland were delineated using best available topography. For onsite tributary areas, the project's topographic base map was used. For offsite portions of the wetland's tributary areas, aerial topography with 5-foot contour intervals was used. Key locations in the basin were field-checked.

The areas of the basins were broken down into categories of land cover type and hydrologic soil group. Categories of land cover types included forest, pasture, landscape, wetland, and impervious. These areas were delineated using a color aerial photograph from King County Water and Land Resource Department (KCWLRD, 2005). Hydrologic soil groups included Group C/D, which are characterized as being poorly drained soil with a relatively high amount of surface runoff. The hydrologic soil groups were based on those pre-designated to mapped soils series (SCS, 1973).

The wetland generally slopes downward from south to north. An excavated drainage ditch bisects the wetland, collecting and conveying excess surface water from the wetland to its outlet to the north (Figure 2). Water leaves the wetland through infiltration, surface discharge to the northerly channel outlet and evapotranspiration.

The hydrology of the wetland was evaluated and compared for two scenarios including i) predeveloped conditions and ii) proposed developed conditions. For most comparisons, forested conditions were assumed for the predeveloped conditions to allow an assessment of the site's natural hydrology as a benchmark. However, existing cover types were used to compare the predicted average annual runoff volume to the wetland for predeveloped and developed conditions.
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Data for the wetland's basins were input to the KCRTS hydrologic model. KCRTS is a continuous hydrologic model that develops runoff time series for a 50-year period of rainfall record (October 1948 through September 1998). A rainfall correction factor of 0.85 was applied to calibrate the rainfall data for the Landsburg area rain gage to the site. The program's 50-year historic time series runoff files were used in the simulations. The KCRTS program generates statistical reports for several hydrologic parameters including peak flow rates for estimated return periods, flow durations, wetland stage and other data useful in evaluating wetland hydrology.

Wetland Hydrology Management Guidelines (King County DDES, January 1, 2012) were used in assessing effects of the proposed Rio Vista development on the wetland's

hydrology. The basic analysis procedure outlined in Appendix A of the *Wetland Hydrology Management Guidelines* was used in assessing the wetlands' hydrology.

In particular, wetland inflow durations were assessed for predeveloped and proposed developed conditions for Wetland A. Flow durations were calculated and compared for the four seasons of the year including spring, summer, fall and winter. For purposes of this study, spring is defined as extending from February 1 through May 31, summer extending from June 1 through August 31, fall extending from September 1 through November 30 and winter extending from December 1 through January 31. To better evaluate the distribution of water introduced to the relatively large wetland, the KCRTS model was set up to evaluate flow durations to both the south half and north half of the wetland (Figure 2).

Peak flow rates to each half of the wetland were evaluated for both predeveloped and developed conditions. Inflow hydrographs to the south half and north half of the wetland were also simulated and compared for an average year of precipitation.

Because the wetland is generally sloped and the potential for ponding is limited to the north end of the wetland, near the outlet, a stage analysis would provide only limited usefulness and was not conducted.

Simulation Results

Under predeveloped basin conditions, a total area of 11.55 acres was measured to drain to Wetland A (Figure 2; Table A.1). Under proposed developed conditions, the basin area to the wetland is slightly increased with a portion of NE 143rd Place draining to the west vault, bringing the total area to 11.90 acres (Figure 3; Table A.1).

A listing for the KCRTS time series generation of contributing basin areas is provided in Attachment A.2. Hydrologic effects of the proposed development on wetland hydrology, in terms of peak inflow rates and wetland flow durations are described below.

<u>Measures to Supplement Wetland Hydrology</u>

Under proposed developed conditions, discharge from the proposed stormwater vaults will be dispersed in a level spreader at the edge of Wetland A's buffer. The primary discharge locations are located in the north portion of the wetland. To improve the distribution of stormwater to the wetland, the following additional measures were evaluated in the hydrologic analysis:

- A secondary discharge outlet from the East Vault to the southern portion of the wetland was included in the simulations. In total, two flow control structures would regulate discharge from the East Vault to the wetland's buffer. A structure discharging to the north half of the wetland would include only the bottom orifice as documented in the stormwater vault design (Land Development Advisors,

April 2015). A structure discharging to the south half of the wetland would include the second and third orifices, the riser notch, and the overflow riser.

- Sheet flow dispersion from landscaped slopes and the backyards of lots that flow towards the wetland was included in the simulations. Runoff from an approximately 25-foot width of landscape area would sheet flow to the wetland's buffer and be uniformly distributed across the wetland.

Peak Wetland Inflow Rates

The average annual rainfall for the 50-year period of simulation record was 37.6 inches with a minimum amount of 23.8 inches in 1952 and a maximum amount of 54.6 inches in 1950 (Figure 4).

Predicted inflow hydrographs to Wetland A, for both predeveloped and developed conditions, are shown in Figures 5A and 5B for an average year of precipitation. These figures illustrate the seasonal patterns of inflow to the wetland. The hydrographs for predeveloped conditions and developed conditions reasonably align over the wide range of precipitation.

Peak inflow rates to Wetland A were calculated in the both the south and north portions of the wetland for a range of return periods, including 2-, 5-, 10-, 25- and 50-year frequencies for both predeveloped and developed conditions (Figures 6 and 7; Tables A.3.1 through A.3.4). Overall, the net effect of the proposed development reduced peak flow rates to each portion of the wetland for return periods ranging from the 2-year to 50-year return periods. The historic time series in KCRTS does not include a storm with a 100-year return period and as a result does not provide a reliable estimate of the 100-year discharge rate from the stormwater vaults.

Wetland Flow Durations

Seasonal flow durations to the wetland under proposed developed conditions are compared to those for predeveloped conditions in Figures 8 through 11. A flow duration bracket of 25 percent is shown in each figure. Selection of the 25 percent bracket was arbitrary and has been included to facilitate relative comparisons of flow durations among the various seasons. The 25 percent brackets do not reflect any regulatory requirements.

Flow durations to the southern portion of the wetland for proposed developed conditions were lower than those for predeveloped conditions for all seasons. Flow durations under developed conditions consistently fell just below the lower 25 percent bracket for predeveloped flows. This predicted decrease in flow durations can largely be attributed to a diversion of inflow away from the southern portion of the wetland that occurs under proposed developed conditions. Adding the secondary outfall from the East Vault to the buffer of the southern portion of the wetland, and dispersing runoff from adjacent landscape areas to the buffer improved the flow durations.

Developed flow durations to the northern portion of the wetland were for the most part within the 25 percent bracket for predeveloped conditions for all seasons (Figures 12 through 15). Flow durations for developed conditions generally exceeded the upper 25 percent bracket at a relatively low flow rate of about 0.20 cubic foot per second. Most of the water discharging to the wetland from the stormwater vaults to the wetland buffer would occur at a similarly low flow rate.

Wetland Inflow Volume

The average annual runoff volume to the wetland was computed to be 18.0 acre-feet for the 50-year simulation period assuming existing cover types in the contributing basins (Table A.1). Under proposed developed conditions, the average annual runoff volume to the wetland was computed to be 31.7 acre-feet.

Conclusions

As would be anticipated, the proposed development is predicted to change the distribution and volumes of runoff to the wetland. In my opinion, the proposed drainage plan will be adequate to support the wetland's hydrology. Below is a summary of factors that have led me to this opinion:

- A reduction in tributary flow to the southern half of the wetland, under developed conditions, will be mitigated by dispersing landscape areas to the wetland's buffer and by providing a secondary level spreader outlet from the east stormwater vault to the buffer in the southern portion of the wetland. The site plan shown in Figure 3 will likely change before final approval of the project is received and the exact quantity of areas dispersed may need to be adjusted. Providing at least 60 percent of the dispersion area shown in Figure 3 would meet the intent of the design mitigation analyzed in this study. Areas identified as being appropriate for sheet flow dispersion include Lots 38, 55-60, and portions of the stormwater vault tracts.

- Flow durations to both the south and north portions of the wetland will be reduced under proposed developed conditions. Therefore, the predicted increased runoff volume to the northern portion of the wetland will occur at relatively low flow rates, emulating natural inflow patterns.

- The proposed project will redistribute the inflow of water to Wetland A. The average annual runoff volume to the southern half of the wetland will be reduced while that to the northern half of the wetland will be increased. The drainage ditch network in the wetland collects and removes a significant portion of excess water[1] from the wetland. The drainage ditch will regulate the wetland's hydrology by removing excess water from the north portion of the wetland under developed

[1] In this context, "excess water" refers to water that would potentially pond on the surface or maintain a saturated upper soil profile.

conditions. In general, the effects of development on the wetland's hydrology, for both the south and north portions of the wetland, will be moderated by the drainage ditch.

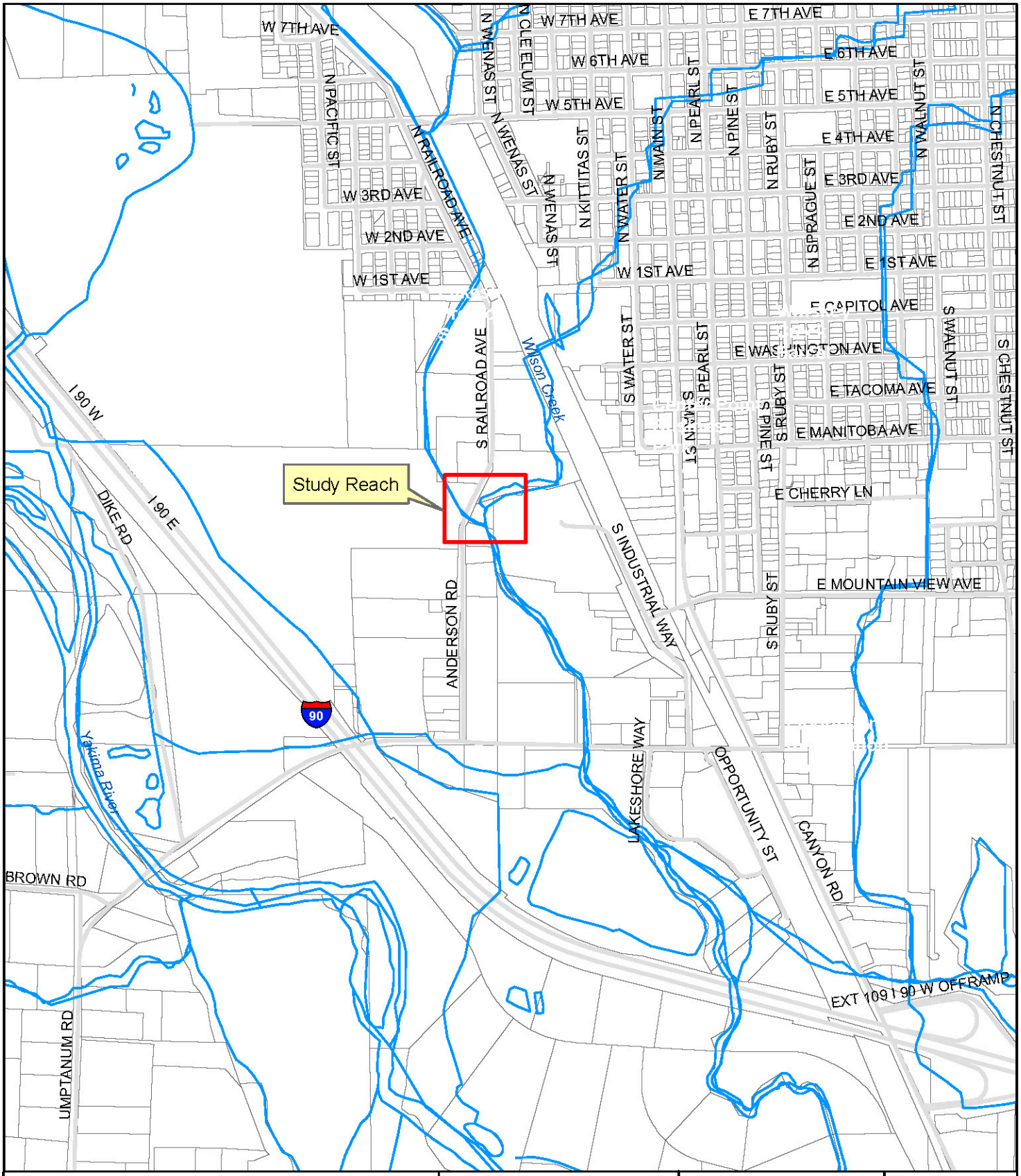
- The distribution of inflow to the wetland is not uniform for either predeveloped or proposed developed conditions. The wetland is relatively large with topographic variability that likely effects local soil moisture conditions. In areas of the wetland not directly affected by the drainage ditch, for instance, surface roughness likely plays a role in storing and infiltrating precipitation into the wetland's soils. Direct rainfall is an important source of wetland hydrology and will not be changed by the proposed development.

Limitations

This report was prepared for use by Rio Vista, LLC for the Rio Vista project. This report is not intended for use by others, except as authorized by Rio Vista, LLC. Hydrologic modeling results are in part based on King County's KCRTS model. The data used in the modeling reflect the condition of the wetland and contributing basins at the time of the study and may have since changed. Other data used in my analysis were collected and analyzed using published methods according to generally accepted practices. If the conditions, upon which my analysis is based, change in the future, I reserve the right to modify my conclusions or recommendations. Within the limitations of scope, schedule and budget, my services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Sincerely,

Edward J. McCarthy, Ph.D., P.E.



Vicinity Map

Ellensburg Shop Access Floodplain Study

Ellensburg, Washington

1,200 Feet

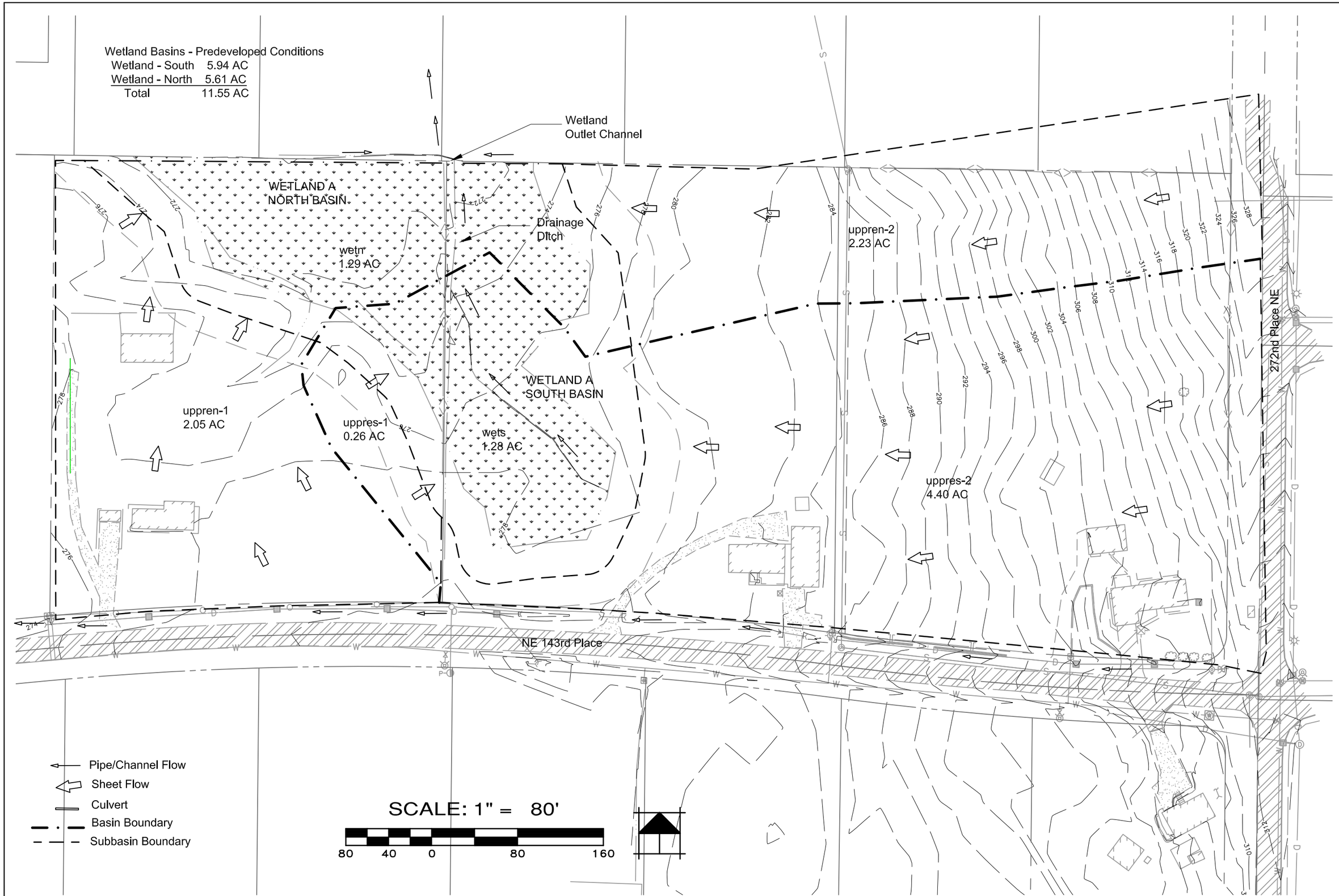
Ed McCarthy, PE, PS

9957 171st Avenue SE
Renton, Washington 98059
Phone: (425) 271-5734

Proj. No.

Date 2/29/16

Figure 1



NO.	REVISIONS	DATE

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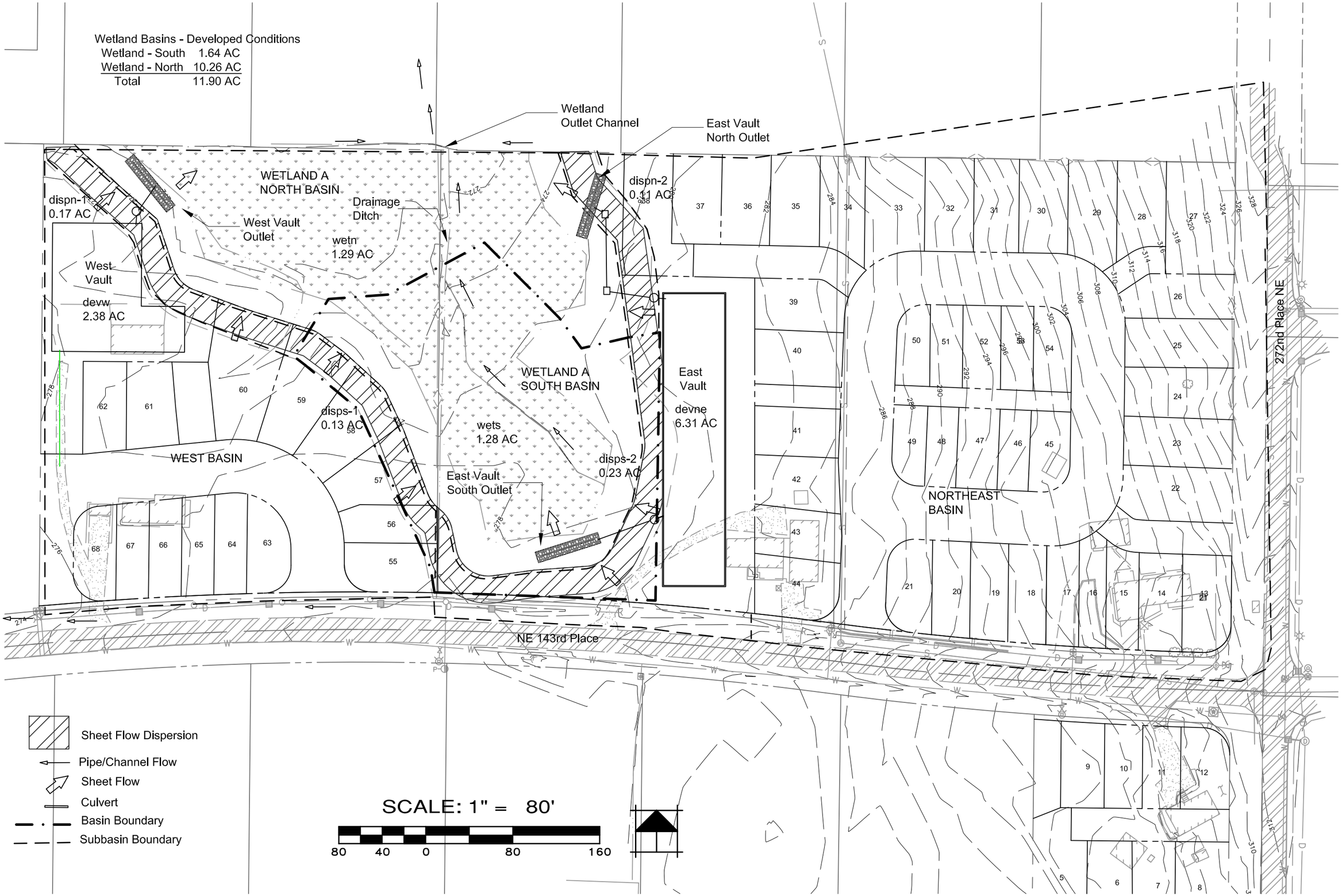
Rio Vista Wetland Hydrology

Figure 2. Predeveloped Basins

DATE 2/18/16
DESIGNED
DRAWN



NO.	REVISIONS	DATE

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Rio Vista Wetland Hydrology

Figure 3. Developed Basins

DATE 2/18/16
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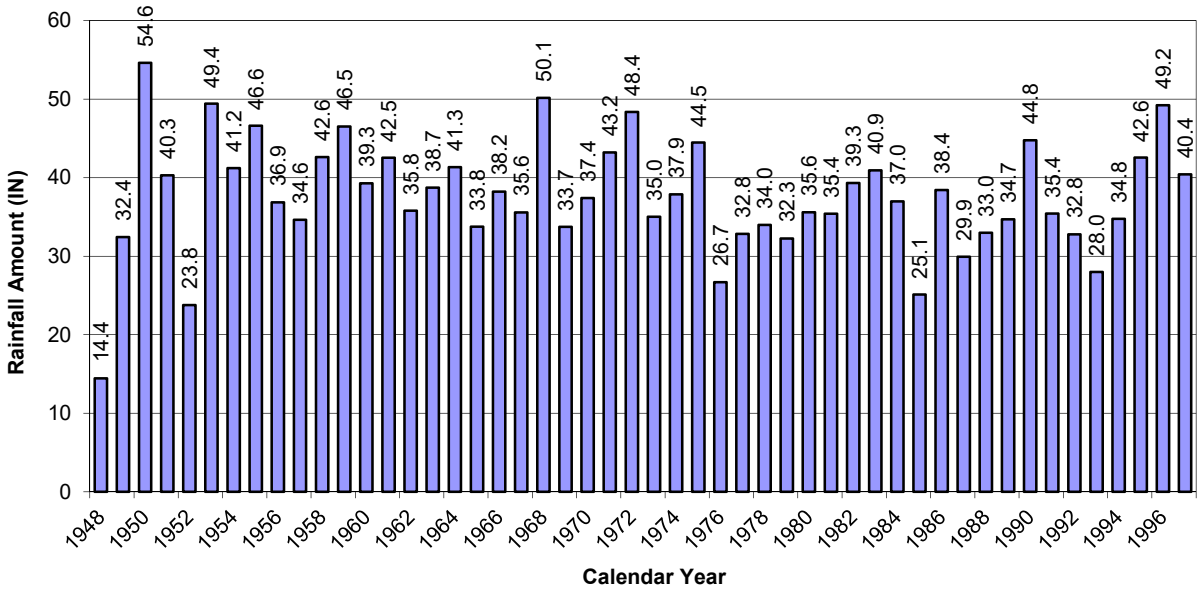


Figure 4. Annual precipitation amounts for Duvall.

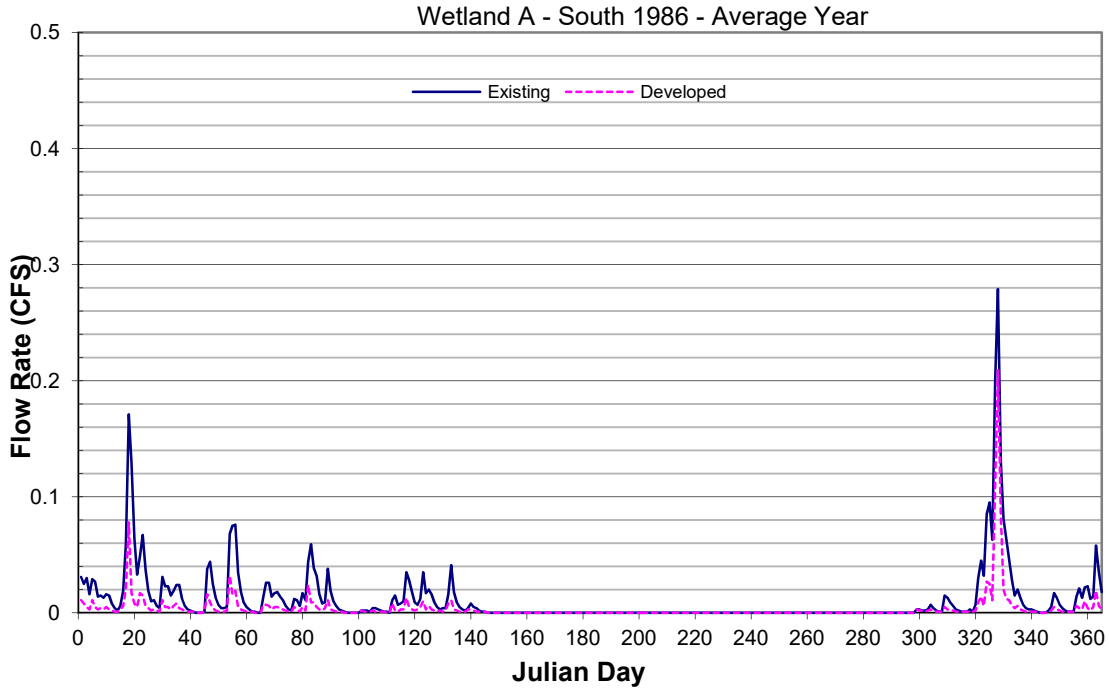


Figure 5A. Wetland A – south portion - inflow hydrograph for an average year.

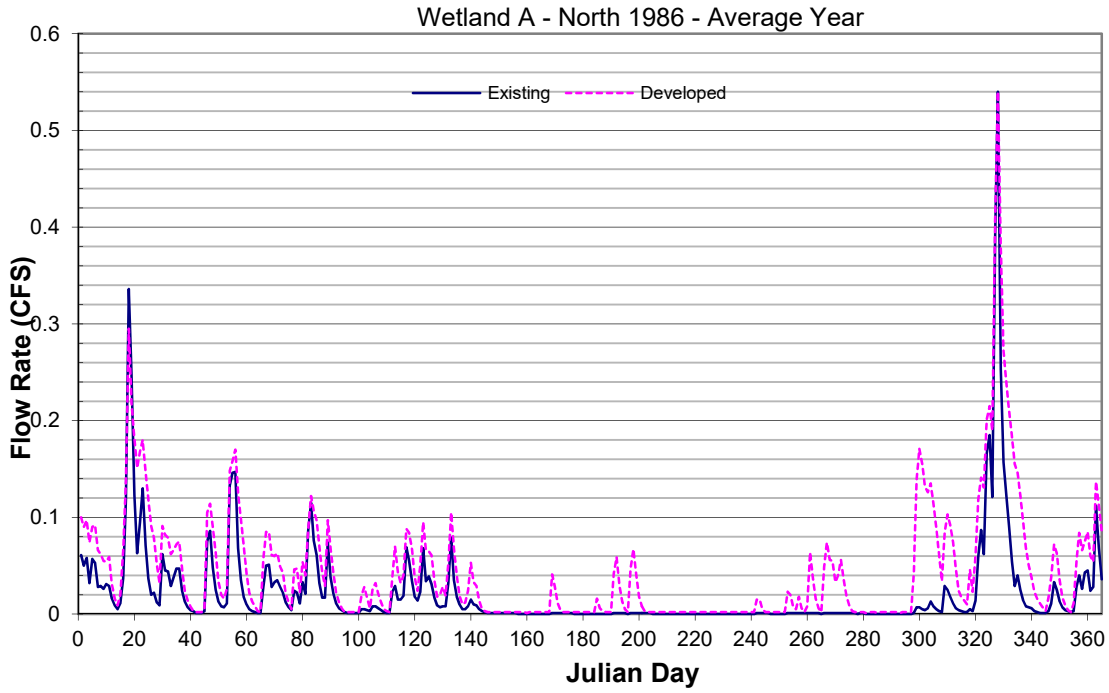
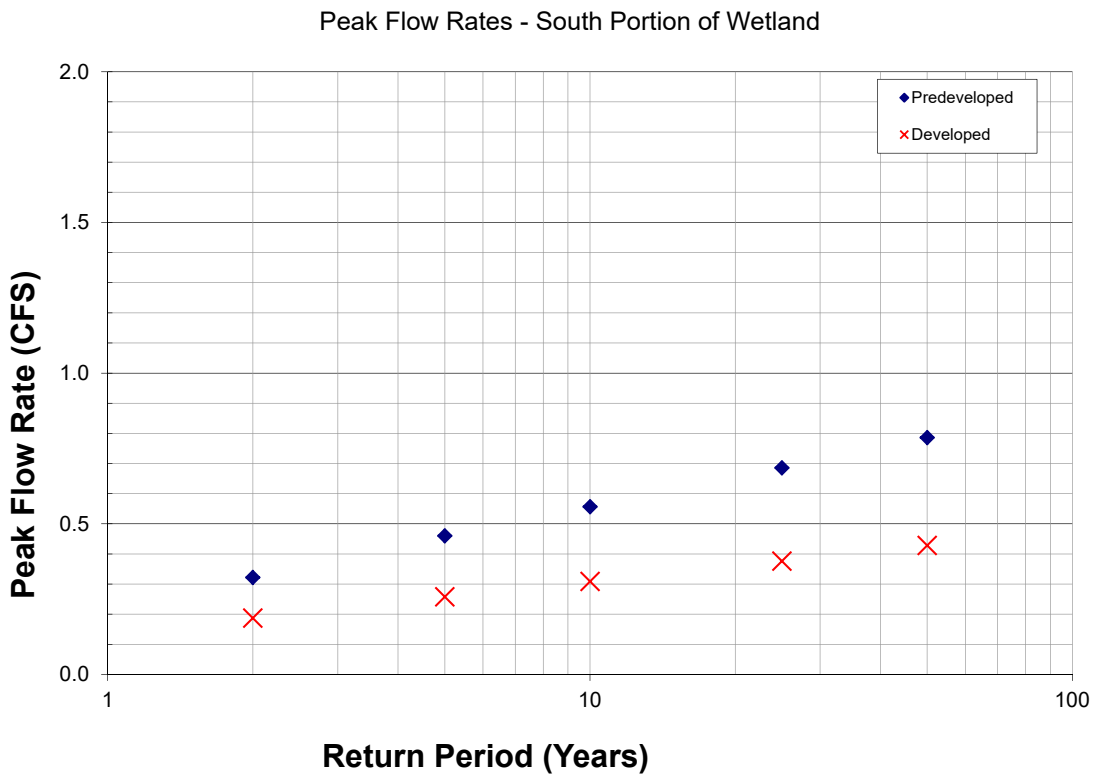
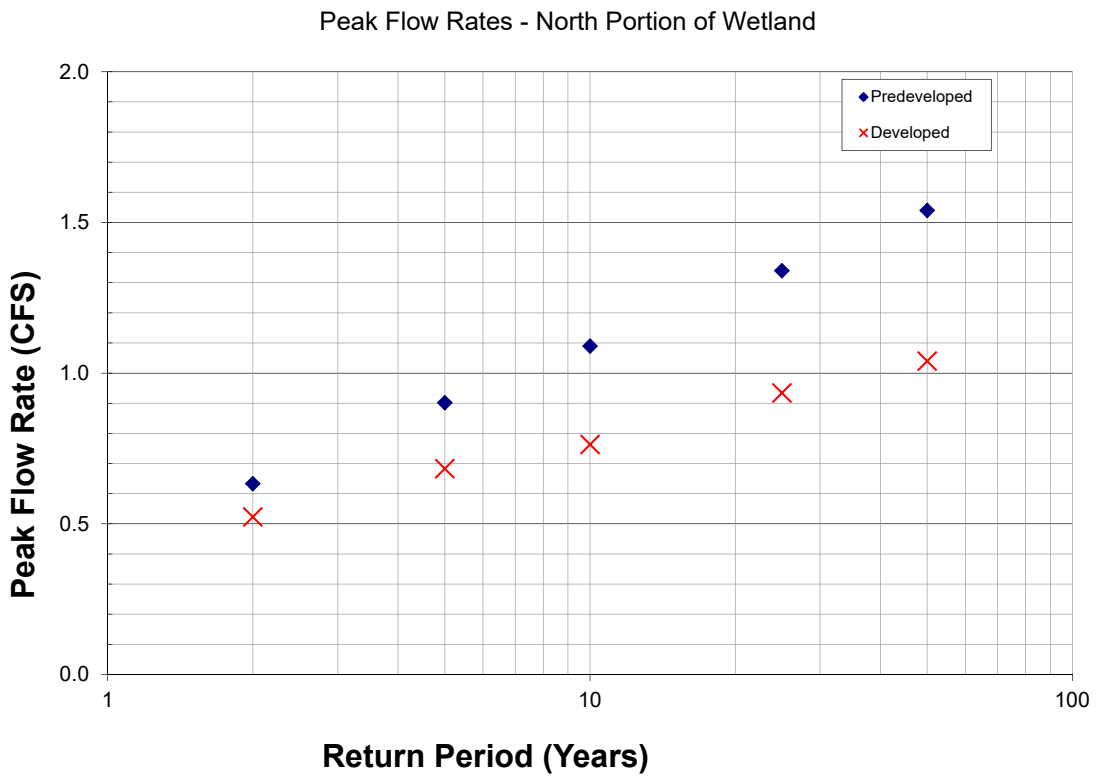


Figure 5B. Wetland A – north portion - inflow hydrograph for an average year.



Return Period (Years)	Peak Inflow Predeveloped (CFS)	Peak Inflow Developed (CFS)
2	0.32	0.19
5	0.46	0.26
10	0.56	0.31
25	0.69	0.38
50	0.79	0.43

Figure 6. Wetland A – southern portion – peak flow rates for selected return periods.



Return Period (Years)	Peak Inflow Predeveloped (CFS)	Peak Inflow Developed (CFS)
2	0.63	0.52
5	0.90	0.68
10	1.09	0.76
25	1.34	0.93
50	1.54	1.04

Figure 7. Wetland A – northern portion – peak flow rates for selected return periods.

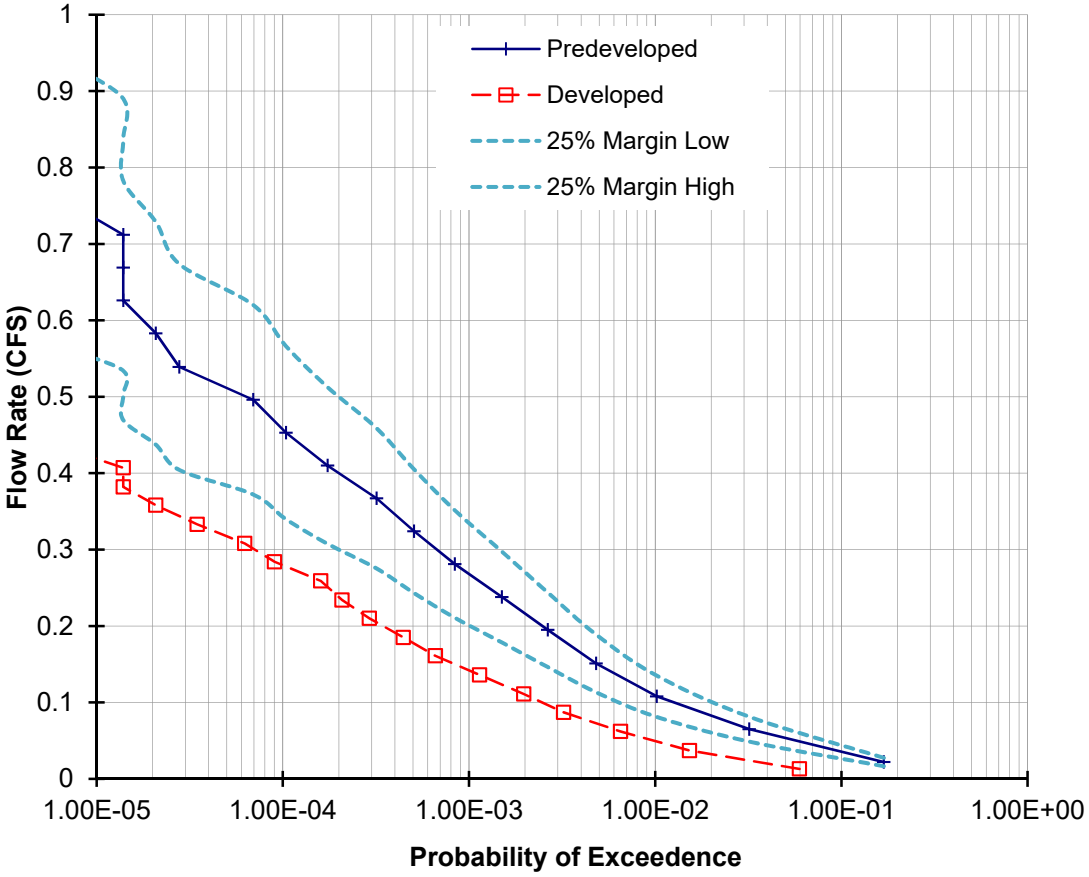


Figure 8. Wetland A – southern portion – flow durations for spring months – February 1 through May 31.

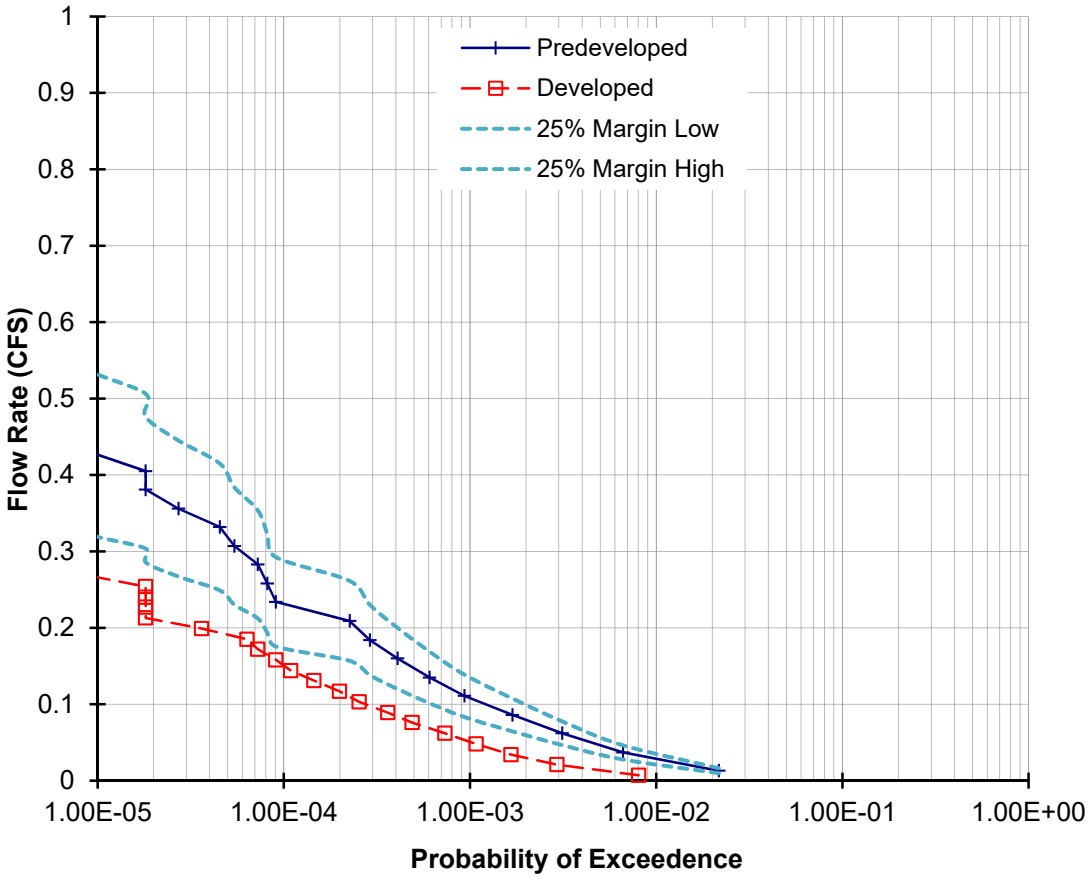


Figure 9. Wetland A – southern portion – flow durations for summer months – June 1 through August 31.

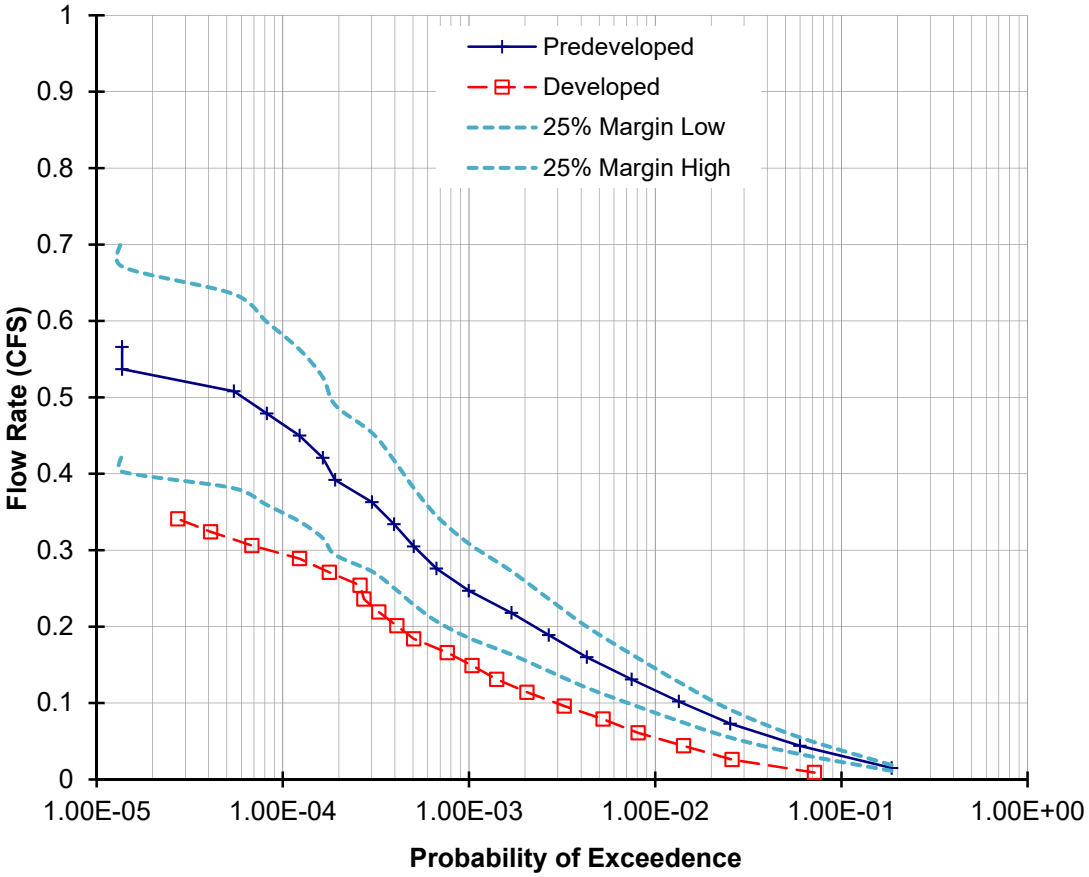


Figure 10. Wetland A – southern portion – flow durations for fall months – September 1 through November 30.

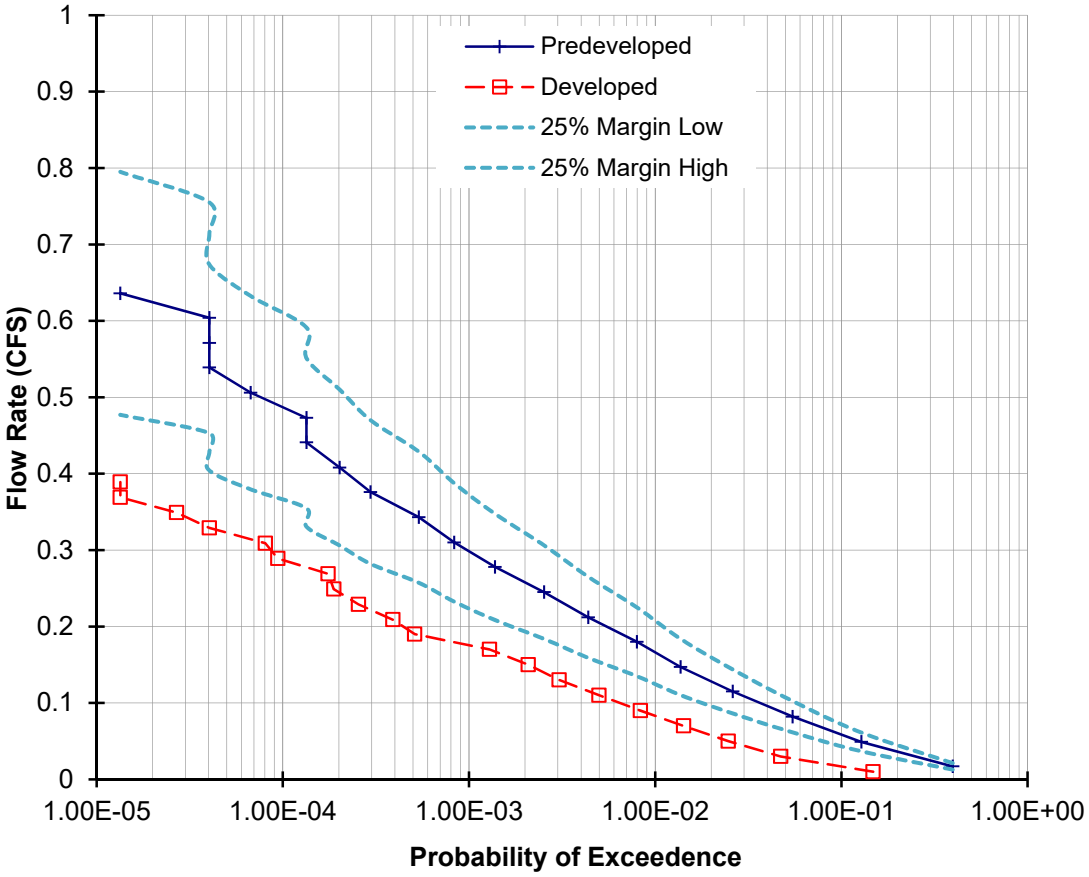


Figure 11. Wetland A – southern portion – flow durations for winter months – December 1 through January 31.

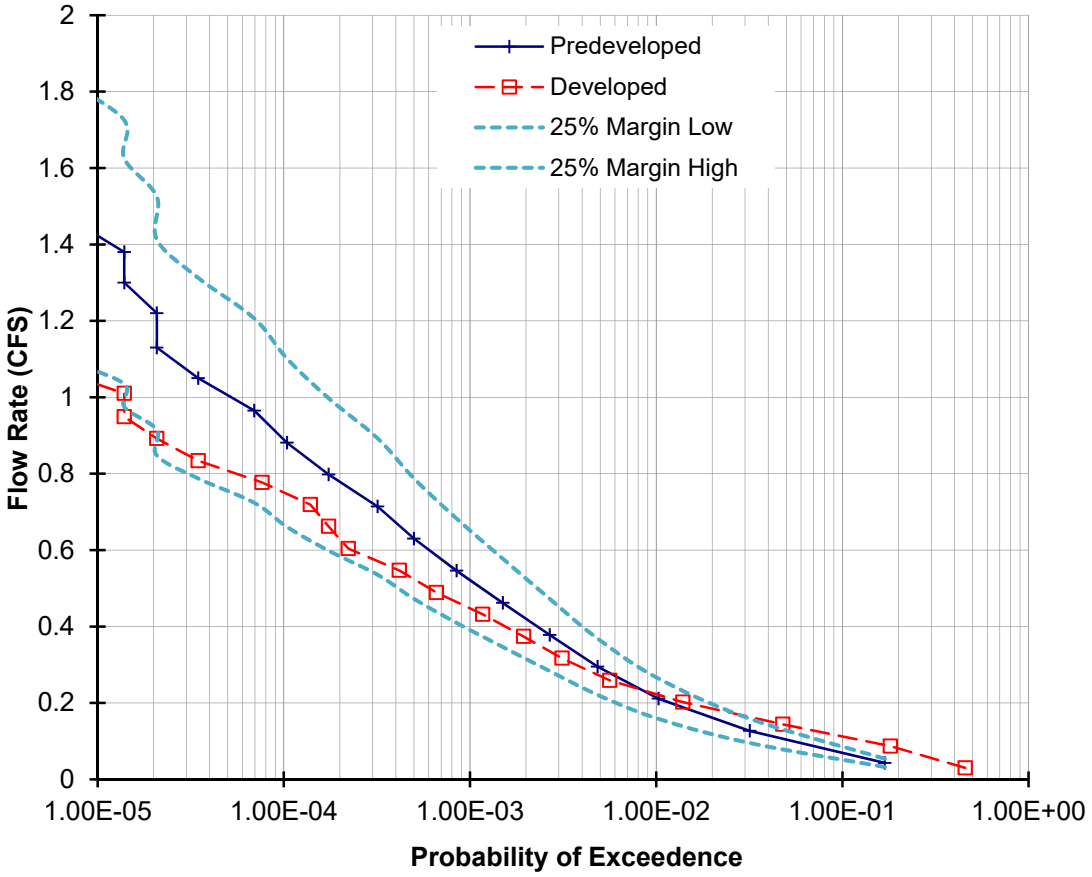


Figure 12. Wetland A – northern portion – flow durations for spring months – February 1 through May 31.

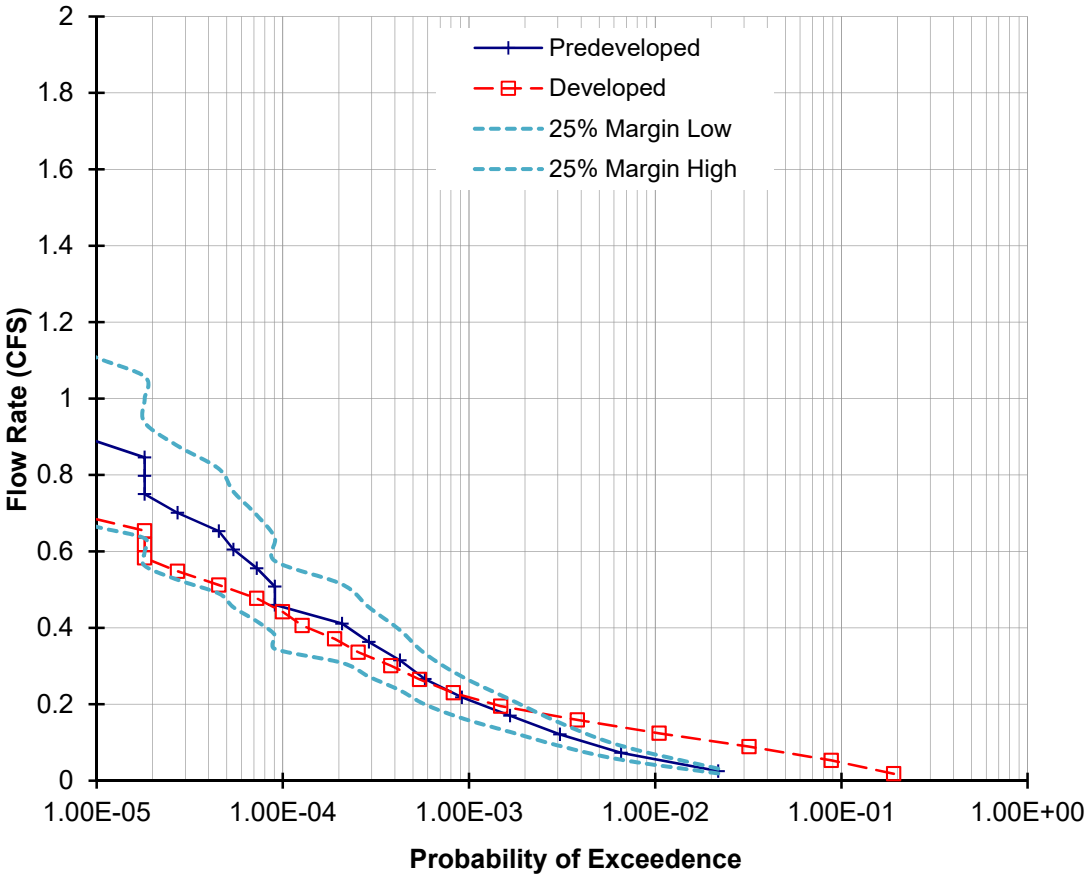


Figure 13. Wetland A – northern portion – flow durations for summer months – June 1 through August 31.

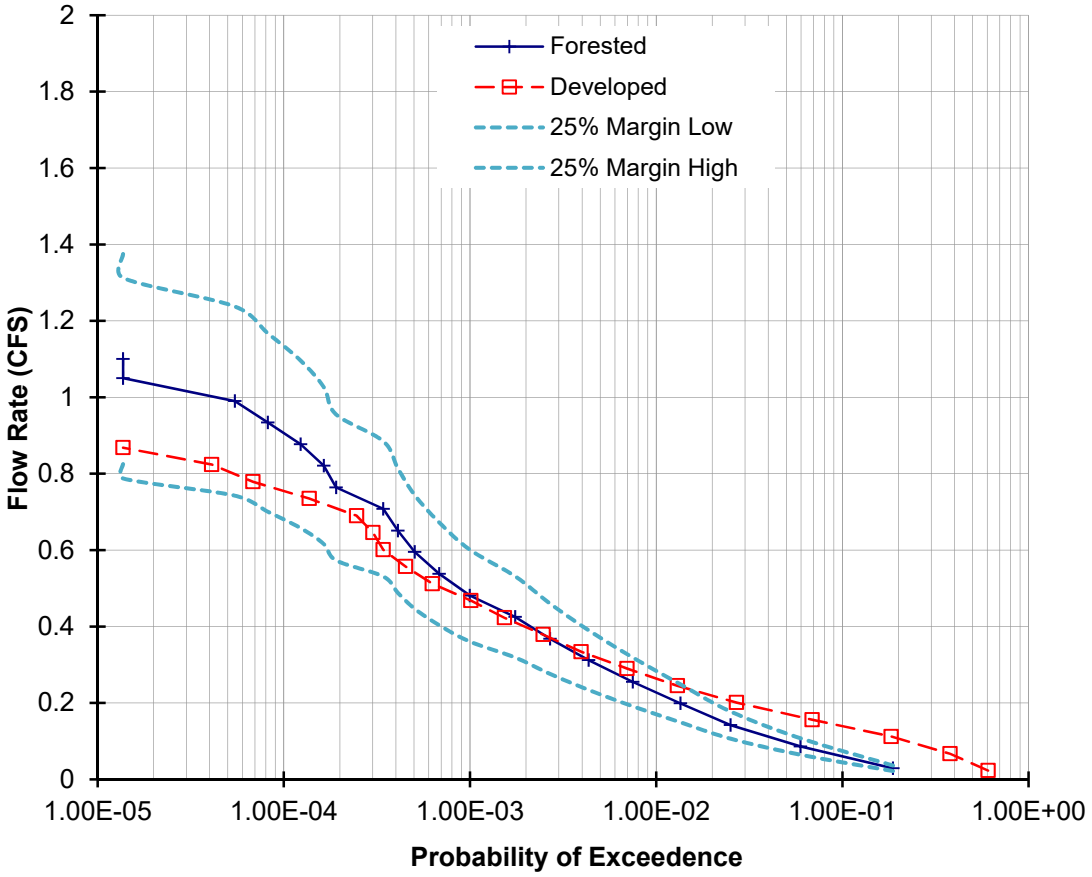


Figure 14. Wetland A – northern portion – flow durations for fall months – September 1 through November 30.

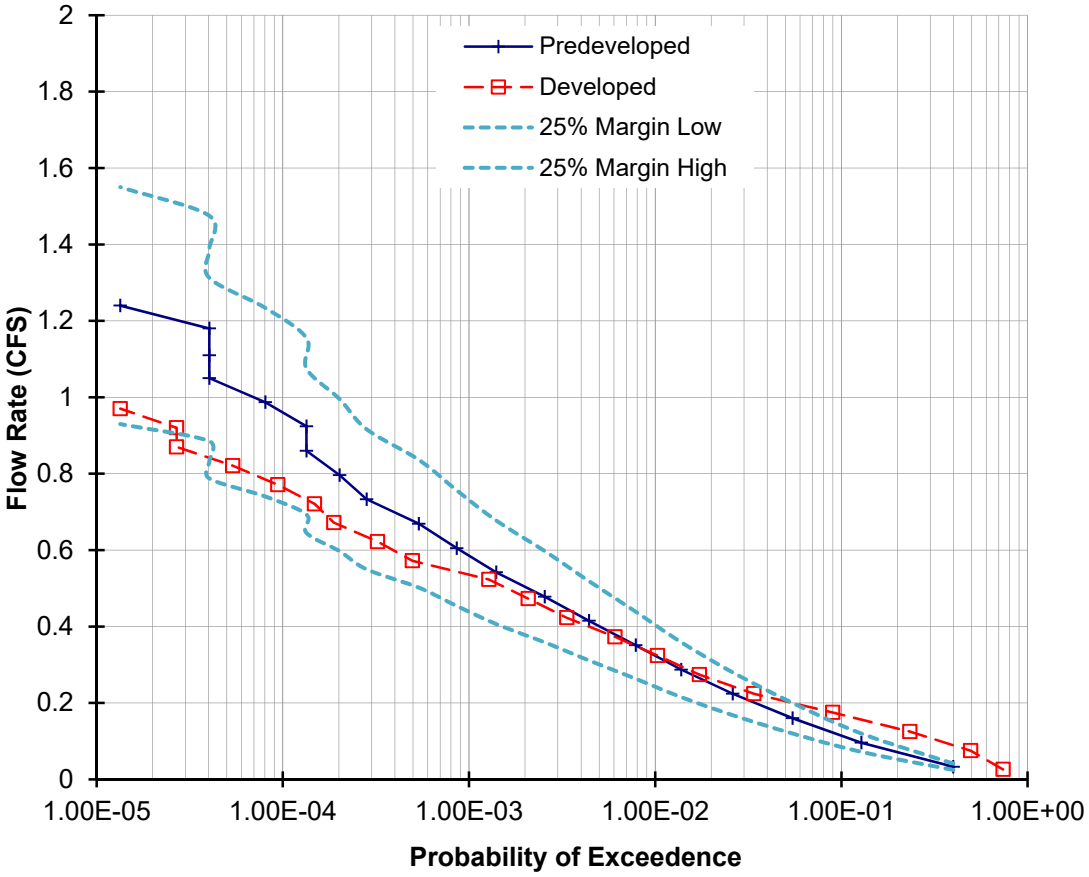


Figure 15. Wetland A – northern portion – flow durations for winter months – December 1 through January 31.

References

King County DDES, January 1, 2012. *Critical Areas Mitigation Guidelines. Appendix A – Wetland Hydrology Management Guidelines.* Renton, Wash.

King County Department of Natural Resources, 2009. *King County Surface Water Design Manual*. Seattle.

King County Department of Natural Resources, January 1999. *King County Runoff Time Series (KCRTS) – Hydrologic Simulation Model for Implementing the Runoff-Files Methodology – Computer Software Reference Manual*. Seattle.

Land Development Advisors, April 2015. *Preliminary TIR – Rio Vista – Vicinity NE 143rd Place and 272nd Place NE. Duval WA.* Bellevue, Wash.

U.S. Department of Agriculture, Soil Conservation Service, 1973. *Soil Survey of King County Area, Washington.* Seattle.

Wetland Resources, Inc., July 7, 2015. *Sensitive Area Study and Conceptual Mitigation Plan for Rio Vista – Duvall, WA.* Everett, Wash.

Attachment A.1. Wetland Basin Areas

Table A.1.1. Wetland A Basin Areas under Predeveloped and Developed Conditions

Wetland A Tributary Areas - Predeveloped Conditions

Basin	Basin ID	Forest (AC)	Pasture (AC)	Landscape (AC)	Wetland (AC)	Impervious (AC)	Total (AC)
South Portion of Wetland							
Wetland/Buffer	*wets*				1.28		1.28
Upland - West Basin	*uppres*	0.26					0.26
Upland - NE Basin	*uppres*	4.40					4.40
Subtotal		4.66			1.28		5.94
North Portion of Wetland							
Wetland/Buffer	*wetn*				1.29		1.29
Upland - West Basin	*uppren*	2.05					2.05
Upland - NE Basin	*uppren*	2.27					2.27
Subtotal		4.32			1.29		5.61
Total		8.98	-	-	2.57	-	11.55

Wetland A Tributary Areas - Developed Conditions

Basin	Basin ID	Forest (AC)	Pasture (AC)	Landscape (AC)	Wetland (AC)	Impervious (AC)	Total (AC)
South Portion of Wetland							
Wetland/Buffer	*wets*				1.28		1.28
Landscape Disp.	*disps*	0.36					0.36
East Vault Discharge	*devne*	(flow rates from orifices 2 and 3 of outlet structure)					
Subtotal		0.36		-	1.28	-	1.64
North Portion of Wetland							
Wetland/Buffer	*wetn*				1.29		1.29
Landscape Disp.	*dispn*	0.28					0.28
West Vault Discharge	*devw*			0.30		2.08	2.38
East Vault Discharge	*devne*			1.00		5.31	6.31
Subtotal		0.28	-	1.30	1.29	7.39	10.26
Total		0.64	-	1.30	2.57	7.39	11.90

Note: Time series *devne* is routed through east vault and *devw* is routed through west vault prior to discharging to the wetland.

Wetland A Tributary Areas - Existing Conditions

Basin	Basin ID	Forest (AC)	Pasture (AC)	Landscape (AC)	Wetland (AC)	Impervious (AC)	Total (AC)
South Portion of Wetland							
Wetland/Buffer	*wets*				1.28		1.28
Upland - West Basin	*upexs*		0.26				0.26
Upland - NE Basin	*upexs*	2.78	1.02			0.60	4.40
Subtotal		2.78	1.28	-	1.28	0.60	5.94
North Portion of Wetland							
Wetland/Buffer	*wetn*				1.29		1.29
Upland - West Basin	*upexn*		1.90			0.15	2.05
Upland - NE Basin	*upexn*	0.86	1.17			0.24	2.27
Subtotal		0.86	3.07	-	1.29	0.39	5.61
Total		3.64	4.35	-	2.57	0.99	11.55

Note: Existing cover types used to calculate predeveloped runoff volume to wetland.

Attachment A.2. KCRTS Inputs

```
                                KCRTS Command
                                -------------
                            CREATE a new Time Series
                            ------------------------
                        Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : uppren.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                     Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60H.rnf   :
Till Forest             4.32 acres
                      --------------
         Total Area :    4.32 acres
Peak Discharge:  0.484 CFS at 11:00 on Sep 17 in 1997
                                         Storing Time Series File:uppren.tsf   :
                              Time Series Computed

                                KCRTS Command
                                -------------
                        Enter the Analysis TOOLS Module
                        -------------------------------

                            Analysis Tools Command
                            ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                   Loading Stage/Discharge curve:uppren.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:uppren.tsf           Mean=  -0.819 StdDev=  0.226
  Project Location:Landsburg                    Skew=  0.095
                               Frequencies & Peaks saved to File:uppren.pks   :

                            Analysis Tools Command
                            ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                         Loading Time Series File:uppren.tsf   :
Computing Interval Locations
Computing Flow Durations
                     Durations & Exceedence Probabilities to File:uppren.dur   :

                            Analysis Tools Command
                            ----------------------
                            RETURN to Previous Menu
                            -----------------------

                                KCRTS Command
                                -------------
                            CREATE a new Time Series
                            ------------------------
                        Production of Runoff Time Series
```

```
    Project Location : Landsburg
     Computing Series : uppres.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60H.rnf   :
Till Forest             4.66 acres
                     --------------
         Total Area :    4.66 acres
Peak Discharge:  0.522 CFS at 11:00 on Sep 17 in 1997
                                         Storing Time Series File:uppres.tsf   :
                             Time Series Computed

                                 KCRTS Command
                                 -------------
                        Enter the Analysis TOOLS Module
                        -------------------------------

                            Analysis Tools Command
                            ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                   Loading Stage/Discharge curve:uppres.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:uppres.tsf           Mean=  -0.786 StdDev=  0.226
  Project Location:Landsburg                    Skew=  0.102
                               Frequencies & Peaks saved to File:uppres.pks   :

                            Analysis Tools Command
                            ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                         Loading Time Series File:uppres.tsf   :
Computing Interval Locations
Computing Flow Durations
                    Durations & Exceedence Probabilities to File:uppres.dur   :

                            Analysis Tools Command
                            ----------------------
                            RETURN to Previous Menu
                            -----------------------

                                 KCRTS Command
                                 -------------
                           CREATE a new Time Series
                           ------------------------
                      Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : wetn.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAWL60H.rnf   :
```

```
Wetland                 1.29 acres
                     --------------
         Total Area :    1.29 acres
Peak Discharge:  0.340 CFS at  0:00 on Feb  9 in 1996
                                          Storing Time Series File:wetn.tsf   :
                            Time Series Computed

                                KCRTS Command
                                -------------
                        Enter the Analysis TOOLS Module
                        -------------------------------

                            Analysis Tools Command
                            ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                     Loading Stage/Discharge curve:wetn.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:wetn.tsf             Mean=  -0.752 StdDev=  0.131
  Project Location:Landsburg                    Skew=  0.338
                                Frequencies & Peaks saved to File:wetn.pks   :

                            Analysis Tools Command
                            ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                          Loading Time Series File:wetn.tsf   :
Computing Interval Locations
Computing Flow Durations
                      Durations & Exceedence Probabilities to File:wetn.dur   :

                            Analysis Tools Command
                            ----------------------
                            RETURN to Previous Menu
                            -----------------------

                                KCRTS Command
                                -------------
                           CREATE a new Time Series
                           ------------------------
                       Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : wets.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAWL60H.rnf   :
Wetland                 1.28 acres
                     --------------
         Total Area :    1.28 acres
Peak Discharge:  0.337 CFS at  0:00 on Feb  9 in 1996
                                          Storing Time Series File:wets.tsf   :
                            Time Series Computed
```

```
                                KCRTS Command
                                -------------
                         Enter the Analysis TOOLS Module
                         -------------------------------

                             Analysis Tools Command
                             ----------------------
                       Compute PEAKS and Flow Frequencies
                       ----------------------------------
                                     Loading Stage/Discharge curve:wets.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:wets.tsf             Mean=  -0.755 StdDev=  0.131
  Project Location:Landsburg                    Skew=  0.338
                                Frequencies & Peaks saved to File:wets.pks   :

                             Analysis Tools Command
                             ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                         Loading Time Series File:wets.tsf   :
Computing Interval Locations
Computing Flow Durations
                       Durations & Exceedence Probabilities to File:wets.dur   :

                             Analysis Tools Command
                             ----------------------
                             RETURN to Previous Menu
                             -----------------------

                                KCRTS Command
                                -------------
                            CREATE a new Time Series
                            ------------------------
                        Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : devw.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60H.rnf   :
Till Grass              0.30 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60H.rnf   :
Impervious              2.08 acres
                     --------------
         Total Area :    2.38 acres
Peak Discharge:   1.65 CFS at 11:00 on Sep 17 in 1997
                                         Storing Time Series File:devw.tsf   :
                              Time Series Computed

                                KCRTS Command
                                -------------
                         Enter the Analysis TOOLS Module
```

```
                        -------------------------------

                            Analysis Tools Command
                            ----------------------
                       Compute PEAKS and Flow Frequencies
                       ----------------------------------
                                     Loading Stage/Discharge curve:devw.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:devw.tsf             Mean=  -0.218 StdDev=  0.132
  Project Location:Landsburg                    Skew=  0.642
                                  Frequencies & Peaks saved to File:devw.pks   :

                            Analysis Tools Command
                            ----------------------
                      Compute Flow DURATION and Exceedence
                      ------------------------------------
                                        Loading Time Series File:devw.tsf   :
Computing Interval Locations
Computing Flow Durations
                       Durations & Exceedence Probabilities to File:devw.dur   :

                            Analysis Tools Command
                            ----------------------
                            RETURN to Previous Menu
                            -----------------------

                                 KCRTS Command
                                 -------------
                           CREATE a new Time Series
                           ------------------------
                        Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : devne.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60H.rnf   :
Till Grass              1.00 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60H.rnf   :
Impervious              5.31 acres
                     --------------
         Total Area :    6.31 acres
Peak Discharge:   4.34 CFS at 11:00 on Sep 17 in 1997
                                          Storing Time Series File:devne.tsf   :
                             Time Series Computed

                                 KCRTS Command
                                 -------------
                       Enter the Analysis TOOLS Module
                       -------------------------------

                            Analysis Tools Command
                            ----------------------
```

```
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                    Loading Stage/Discharge curve:devne.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:devne.tsf            Mean=   0.195 StdDev=  0.134
  Project Location:Landsburg                    Skew=  0.648
                               Frequencies & Peaks saved to File:devne.pks   :

                            Analysis Tools Command
                            ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                      Loading Time Series File:devne.tsf   :
Computing Interval Locations
Computing Flow Durations
                     Durations & Exceedence Probabilities to File:devne.dur   :

                            Analysis Tools Command
                            ----------------------
                            RETURN to Previous Menu
                            -----------------------

                                 KCRTS Command
                                 -------------
                           CREATE a new Time Series
                           ------------------------
                       Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : dispn.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60H.rnf   :
Till Forest             0.28 acres
                     --------------
         Total Area :    0.28 acres
Peak Discharge:  0.031 CFS at 11:00 on Sep 17 in 1997
                                      Storing Time Series File:dispn.tsf   :
                              Time Series Computed

                                 KCRTS Command
                                 -------------
                        Enter the Analysis TOOLS Module
                        -------------------------------

                            Analysis Tools Command
                            ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                    Loading Stage/Discharge curve:dispn.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:dispn.tsf            Mean=  -2.007 StdDev=  0.224
```

```
  Project Location:Landsburg                    Skew=  0.142
                                Frequencies & Peaks saved to File:dispn.pks   :

                           Analysis Tools Command
                           ----------------------
                     Compute Flow DURATION and Exceedence
                     ------------------------------------
                                         Loading Time Series File:dispn.tsf   :
Computing Interval Locations
Computing Flow Durations
                     Durations & Exceedence Probabilities to File:dispn.dur   :

                           Analysis Tools Command
                           ----------------------
                           RETURN to Previous Menu
                           -----------------------

                                KCRTS Command
                                -------------
                              CREATE a new Time Series
                              ------------------------
                       Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : disps.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60H.rnf   :
Till Forest             0.36 acres
                     --------------
         Total Area :    0.36 acres
Peak Discharge:  0.040 CFS at 11:00 on Sep 17 in 1997
                                         Storing Time Series File:disps.tsf   :
                              Time Series Computed

                                KCRTS Command
                                -------------
                       Enter the Analysis TOOLS Module
                       -------------------------------

                           Analysis Tools Command
                           ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                   Loading Stage/Discharge curve:disps.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:disps.tsf            Mean=  -1.897 StdDev=  0.224
  Project Location:Landsburg                    Skew=  0.130
                                Frequencies & Peaks saved to File:disps.pks   :

                           Analysis Tools Command
                           ----------------------
                     Compute Flow DURATION and Exceedence
```

```
                    ------------------------------------
                                        Loading Time Series File:disps.tsf   :
Computing Interval Locations
Computing Flow Durations
                    Durations & Exceedence Probabilities to File:disps.dur   :

                           Analysis Tools Command
                           ----------------------
                           RETURN to Previous Menu
                           -----------------------

                                KCRTS Command
                                -------------
                          CREATE a new Time Series
                          ------------------------
                      Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : devse.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60H.rnf   :
Till Grass              0.40 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60H.rnf   :
Impervious              1.28 acres
                     --------------
         Total Area :    1.68 acres
Peak Discharge:   1.13 CFS at 11:00 on Sep 17 in 1997
                                        Storing Time Series File:devse.tsf   :
                            Time Series Computed

                                KCRTS Command
                                -------------
                        Enter the Analysis TOOLS Module
                        -------------------------------

                           Analysis Tools Command
                           ----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                     Loading Stage/Discharge curve:devse.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:devse.tsf            Mean=  -0.406 StdDev=  0.138
  Project Location:Landsburg                    Skew=  0.670
                                 Frequencies & Peaks saved to File:devse.pks   :

                           Analysis Tools Command
                           ----------------------
                    Compute Flow DURATION and Exceedence
                    ------------------------------------
                                        Loading Time Series File:devse.tsf   :
Computing Interval Locations
Computing Flow Durations
```

```
                    Durations & Exceedence Probabilities to File:devse.dur   :

                           Analysis Tools Command
                           -----------------------
                           RETURN to Previous Menu
                           ------------------------

                                KCRTS Command
                                -------------

                                      -

                                KCRTS Command
                                -------------
                          CREATE a new Time Series
                          ------------------------
                      Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : wetexis.tsf
Regional Scale Factor :    0.85
            Data Type : Historic
Creating Hourly Time Series File
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60H.rnf   :
Till Forest             3.64 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LATP60H.rnf   :
Till Pasture            4.35 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAWL60H.rnf   :
Wetland                 2.57 acres
                    Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60H.rnf   :
Impervious              0.99 acres
                     --------------
         Total Area :   11.55 acres
Peak Discharge:   2.81 CFS at 11:00 on Sep 17 in 1997
                                         Storing Time Series File:wetexis.tsf   :
                              Time Series Computed

                                KCRTS Command
                                -------------
                       Enter the Analysis TOOLS Module
                       -------------------------------

                           Analysis Tools Command
                           -----------------------
                      Compute PEAKS and Flow Frequencies
                      ----------------------------------
                                  Loading Stage/Discharge curve:wetexis.tsf   :
          Flow Frequency Analysis      LogPearson III Coefficients
          -------------------------------------------------------
  Time Series File:wetexis.tsf          Mean=  -0.040 StdDev=  0.165
  Project Location:Landsburg                    Skew=  0.925
                              Frequencies & Peaks saved to File:wetexis.pks   :

                           Analysis Tools Command
                           -----------------------
```

```
                    Compute Flow DURATION and Exceedence
                    ------------------------------------
                                     Loading Time Series File:wetexis.tsf   :
Computing Interval Locations
Computing Flow Durations
                  Durations & Exceedence Probabilities to File:wetexis.dur   :

                          Analysis Tools Command
                          ----------------------
                          RETURN to Previous Menu
                          -----------------------

                               KCRTS Command
                               -------------
                            eXit KCRTS Program
                            ------------------
```

Attachment A.3. KCRTS Peak Stages for Wetland A

Table A.3.1. Wetland A Stage – Southern Portion – Predeveloped Conditions

```
 Flow Frequency Analysis      LogPearson III Coefficients
 Time Series File:wetsfor.tsf          Mean=  -0.489 StdDev=  0.181
 Project Location:Landsburg                     Skew=  0.124
```

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.381	17	2/16/49	21:00	0.842	1	89.50	0.989
0.724	2	3/03/50	16:00	0.724	2	32.13	0.969
0.570	6	2/09/51	15:00	0.701	3	19.58	0.949
0.276	30	1/30/52	8:00	0.637	4	14.08	0.929
0.223	45	3/24/53	16:00	0.620	5	10.99	0.909
0.308	26	12/19/53	19:00	0.570	6	9.01	0.889
0.307	27	2/07/55	22:00	0.567	7	7.64	0.869
0.316	24	12/11/55	15:00	0.523	8	6.63	0.849
0.285	28	12/09/56	14:00	0.481	9	5.86	0.829
0.225	44	1/16/58	21:00	0.480	10	5.24	0.809
0.220	46	1/24/59	0:00	0.476	11	4.75	0.789
0.321	23	11/20/59	21:00	0.429	12	4.34	0.769
0.258	34	11/20/60	7:00	0.415	13	3.99	0.749
0.196	47	12/17/61	7:00	0.396	14	3.70	0.729
0.250	38	2/03/63	3:00	0.393	15	3.44	0.709
0.429	12	6/18/64	19:00	0.385	16	3.22	0.690
0.325	21	1/29/65	1:00	0.381	17	3.03	0.670
0.140	49	2/11/66	16:00	0.372	18	2.85	0.650
0.231	42	12/31/66	22:00	0.349	19	2.70	0.630
0.229	43	6/03/68	6:00	0.349	20	2.56	0.610
0.480	10	6/23/69	21:00	0.325	21	2.44	0.590
0.269	32	11/04/69	13:00	0.324	22	2.32	0.570
0.415	13	1/09/71	0:00	0.321	23	2.22	0.550
0.396	14	2/28/72	16:00	0.316	24	2.13	0.530
0.243	39	1/13/73	5:00	0.311	25	2.04	0.510
0.241	41	11/11/73	2:00	0.308	26	1.96	0.490
0.481	9	12/27/74	2:00	0.307	27	1.89	0.470
0.372	18	12/02/75	21:00	0.285	28	1.82	0.450
0.106	50	3/03/77	1:00	0.276	29	1.75	0.430
0.349	20	12/01/77	23:00	0.276	30	1.70	0.410
0.273	31	2/06/79	16:00	0.273	31	1.64	0.390
0.393	15	12/14/79	23:00	0.269	32	1.59	0.370
0.567	7	11/21/80	11:00	0.260	33	1.54	0.350
0.311	25	1/23/82	20:00	0.258	34	1.49	0.330
0.385	16	1/05/83	10:00	0.255	35	1.45	0.310
0.620	5	1/24/84	16:00	0.253	36	1.41	0.291
0.276	29	11/01/84	23:00	0.251	37	1.37	0.271
0.324	22	1/18/86	16:00	0.250	38	1.33	0.251
0.476	11	11/23/86	21:00	0.243	39	1.30	0.231
0.255	35	3/27/88	10:00	0.243	40	1.27	0.211
0.260	33	1/09/89	22:00	0.241	41	1.24	0.191
0.637	4	1/09/90	7:00	0.231	42	1.21	0.171

0.523	8	11/24/90	10:00	0.229	43	1.18	0.151
0.253	36	4/18/92	18:00	0.225	44	1.15	0.131
0.251	37	3/22/93	19:00	0.223	45	1.12	0.111
0.189	48	3/03/94	3:00	0.220	46	1.10	0.091
0.349	19	11/30/94	5:00	0.196	47	1.08	0.071
0.842	1	2/09/96	0:00	0.189	48	1.05	0.051
0.701	3	9/17/97	11:00	0.140	49	1.03	0.031
0.243	40	12/16/97	15:00	0.106	50	1.01	0.011
Computed Peaks				0.890		100.00	0.990
Computed Peaks				0.786		50.00	0.980
Computed Peaks				0.686		25.00	0.960
Computed Peaks				0.557		10.00	0.900
Computed Peaks				0.531		8.00	0.875
Computed Peaks				0.460		5.00	0.800
Computed Peaks				0.322		2.00	0.500
Computed Peaks				0.236		1.30	0.231

Table A.3.2. Wetland A Stage – Southern Portion – Developed Conditions

```
 Flow Frequency Analysis      LogPearson III Coefficients
 Time Series File:wetsdev.tsf          Mean=  -0.723 StdDev=  0.164
 Project Location:Landsburg                    Skew=  0.211
```

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.210	16	2/16/49 21:00	0.482	1	89.50	0.989
0.317	7	3/03/50 16:00	0.390	2	32.13	0.969
0.378	3	2/09/51 15:00	0.378	3	19.58	0.949
0.152	36	1/30/52 8:00	0.342	4	14.08	0.929
0.147	39	3/24/53 16:00	0.329	5	10.99	0.909
0.188	22	12/19/53 20:00	0.324	6	9.01	0.889
0.153	34	2/07/55 16:00	0.317	7	7.64	0.869
0.182	25	12/11/55 15:00	0.306	8	6.63	0.849
0.182	26	12/09/56 14:00	0.278	9	5.86	0.829
0.129	45	1/16/58 20:00	0.269	10	5.24	0.809
0.145	41	9/26/59 15:00	0.259	11	4.75	0.789
0.204	18	11/21/59 2:00	0.228	12	4.34	0.769
0.134	43	11/20/60 5:00	0.224	13	3.99	0.749
0.131	44	12/17/61 7:00	0.223	14	3.70	0.729
0.161	33	2/28/63 21:00	0.213	15	3.44	0.709
0.259	11	6/18/64 19:00	0.210	16	3.22	0.690
0.201	19	11/24/64 4:00	0.205	17	3.03	0.670
0.093	49	2/11/66 16:00	0.204	18	2.85	0.650
0.153	35	12/31/66 22:00	0.201	19	2.70	0.630
0.118	48	2/04/68 0:00	0.200	20	2.56	0.610
0.269	10	6/23/69 21:00	0.189	21	2.44	0.590
0.180	27	11/04/69 13:00	0.188	22	2.32	0.570
0.228	12	1/09/71 0:00	0.188	23	2.22	0.550
0.184	24	2/28/72 16:00	0.184	24	2.13	0.530
0.147	40	1/13/73 1:00	0.182	25	2.04	0.510
0.178	28	11/11/73 2:00	0.182	26	1.96	0.490
0.223	14	12/27/74 2:00	0.180	27	1.89	0.470
0.200	20	12/02/75 21:00	0.178	28	1.82	0.450
0.069	50	3/03/77 1:00	0.177	29	1.75	0.430
0.213	15	12/01/77 23:00	0.174	30	1.70	0.410
0.166	32	2/06/79 16:00	0.168	31	1.64	0.390
0.224	13	12/14/79 23:00	0.166	32	1.59	0.370
0.324	6	11/21/80 11:00	0.161	33	1.54	0.350
0.174	30	1/23/82 20:00	0.153	34	1.49	0.330
0.189	21	1/05/83 10:00	0.153	35	1.45	0.310
0.329	5	1/24/84 16:00	0.152	36	1.41	0.291
0.188	23	11/01/84 23:00	0.152	37	1.37	0.271
0.177	29	1/18/86 16:00	0.149	38	1.33	0.251
0.342	4	11/23/86 21:00	0.147	39	1.30	0.231
0.120	47	2/09/88 12:00	0.147	40	1.27	0.211
0.149	38	1/09/89 22:00	0.145	41	1.24	0.191
0.390	2	1/09/90 8:00	0.143	42	1.21	0.171
0.306	8	11/24/90 6:00	0.134	43	1.18	0.151
0.152	37	4/18/92 0:00	0.131	44	1.15	0.131
0.143	42	3/22/93 19:00	0.129	45	1.12	0.111

0.123	46	3/03/94	3:00	0.123	46	1.10	0.091
0.205	17	11/30/94	5:00	0.120	47	1.08	0.071
0.482	1	2/09/96	0:00	0.118	48	1.05	0.051
0.278	9	1/03/97	0:00	0.093	49	1.03	0.031
0.168	31	12/16/97	15:00	0.069	50	1.01	0.011
Computed Peaks				0.481		100.00	0.990
Computed Peaks				0.428		50.00	0.980
Computed Peaks				0.376		25.00	0.960
Computed Peaks				0.309		10.00	0.900
Computed Peaks				0.295		8.00	0.875
Computed Peaks				0.258		5.00	0.800
Computed Peaks				0.187		2.00	0.500
Computed Peaks				0.142		1.30	0.231

Table A.3.3. Wetland A Stage – Northern Portion – Predeveloped Conditions

```
 Flow Frequency Analysis      LogPearson III Coefficients
 Time Series File:wetnfor.tsf          Mean=  -0.195 StdDev=  0.180
 Project Location:Landsburg                    Skew=  0.121
```

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.750	17	2/16/49 21:00	1.65	1	89.50	0.989
1.41	2	3/03/50 16:00	1.41	2	32.13	0.969
1.11	6	2/09/51 15:00	1.36	3	19.58	0.949
0.543	30	1/30/52 8:00	1.25	4	14.08	0.929
0.441	45	3/24/53 16:00	1.21	5	10.99	0.909
0.608	26	12/19/53 19:00	1.11	6	9.01	0.889
0.602	27	2/07/55 22:00	1.11	7	7.64	0.869
0.621	24	12/11/55 15:00	1.03	8	6.63	0.849
0.564	28	12/09/56 14:00	0.944	9	5.86	0.829
0.443	44	1/16/58 21:00	0.940	10	5.24	0.809
0.432	46	1/24/59 0:00	0.934	11	4.75	0.789
0.630	23	11/20/59 21:00	0.847	12	4.34	0.769
0.506	34	11/20/60 7:00	0.816	13	3.99	0.749
0.387	47	12/17/61 7:00	0.776	14	3.70	0.729
0.492	38	2/03/63 3:00	0.773	15	3.44	0.709
0.847	12	6/18/64 19:00	0.753	16	3.22	0.690
0.639	21	1/29/65 1:00	0.750	17	3.03	0.670
0.277	49	2/11/66 16:00	0.732	18	2.85	0.650
0.458	42	12/31/66 22:00	0.688	19	2.70	0.630
0.447	43	6/03/68 6:00	0.687	20	2.56	0.610
0.944	9	6/23/69 21:00	0.639	21	2.44	0.590
0.532	32	11/04/69 13:00	0.638	22	2.32	0.570
0.816	13	1/09/71 0:00	0.630	23	2.22	0.550
0.776	14	2/28/72 16:00	0.621	24	2.13	0.530
0.480	40	1/13/73 5:00	0.612	25	2.04	0.510
0.479	41	11/11/73 2:00	0.608	26	1.96	0.490
0.940	10	12/27/74 2:00	0.602	27	1.89	0.470
0.732	18	12/02/75 21:00	0.564	28	1.82	0.450
0.211	50	3/03/77 1:00	0.547	29	1.75	0.430
0.687	20	12/01/77 23:00	0.543	30	1.70	0.410
0.539	31	2/06/79 16:00	0.539	31	1.64	0.390
0.773	15	12/14/79 23:00	0.532	32	1.59	0.370
1.11	7	11/21/80 11:00	0.513	33	1.54	0.350
0.612	25	1/23/82 20:00	0.506	34	1.49	0.330
0.753	16	1/05/83 10:00	0.499	35	1.45	0.310
1.21	5	1/24/84 16:00	0.496	36	1.41	0.291
0.547	29	11/01/84 23:00	0.493	37	1.37	0.271
0.638	22	1/18/86 16:00	0.492	38	1.33	0.251
0.934	11	11/23/86 21:00	0.481	39	1.30	0.231
0.499	35	3/27/88 10:00	0.480	40	1.27	0.211
0.513	33	1/09/89 22:00	0.479	41	1.24	0.191
1.25	4	1/09/90 7:00	0.458	42	1.21	0.171
1.03	8	11/24/90 10:00	0.447	43	1.18	0.151
0.496	36	4/18/92 18:00	0.443	44	1.15	0.131
0.493	37	3/22/93 19:00	0.441	45	1.12	0.111

0.372	48	3/03/94	3:00	0.432	46	1.10	0.091
0.688	19	11/30/94	5:00	0.387	47	1.08	0.071
1.65	1	2/09/96	0:00	0.372	48	1.05	0.051
1.36	3	9/17/97	11:00	0.277	49	1.03	0.031
0.481	39	12/16/97	15:00	0.211	50	1.01	0.011
Computed Peaks				1.74		100.00	0.990
Computed Peaks				1.54		50.00	0.980
Computed Peaks				1.34		25.00	0.960
Computed Peaks				1.09		10.00	0.900
Computed Peaks				1.04		8.00	0.875
Computed Peaks				0.902		5.00	0.800
Computed Peaks				0.633		2.00	0.500
Computed Peaks				0.465		1.30	0.231

Table A.3.4. Wetland A Stage – Northern Portion – Developed Conditions

```
 Flow Frequency Analysis      LogPearson III Coefficients
 Time Series File:wetndev.tsf          Mean=  -0.276 StdDev=  0.134
 Project Location:Landsburg                    Skew=  0.273
```

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.572	20	2/16/49 22:00	1.13	1	89.50	0.989
0.764	8	3/03/50 16:00	0.971	2	32.13	0.969
0.924	3	2/09/51 15:00	0.924	3	19.58	0.949
0.435	35	1/30/52 8:00	0.869	4	14.08	0.929
0.379	47	3/24/53 16:00	0.856	5	10.99	0.909
0.504	27	12/19/53 20:00	0.819	6	9.01	0.889
0.478	30	2/07/55 22:00	0.772	7	7.64	0.869
0.530	24	12/11/55 15:00	0.764	8	6.63	0.849
0.494	28	12/09/56 14:00	0.742	9	5.86	0.829
0.397	44	1/16/58 21:00	0.690	10	5.24	0.809
0.406	42	9/26/59 15:00	0.655	11	4.75	0.789
0.596	14	11/21/59 2:00	0.632	12	4.34	0.769
0.451	34	11/20/60 7:00	0.627	13	3.99	0.749
0.388	45	12/17/61 7:00	0.596	14	3.70	0.729
0.422	38	2/03/63 3:00	0.595	15	3.44	0.709
0.655	11	6/18/64 19:00	0.590	16	3.22	0.690
0.547	22	1/29/65 1:00	0.588	17	3.03	0.670
0.290	49	1/05/66 17:00	0.582	18	2.85	0.650
0.401	43	12/31/66 22:00	0.580	19	2.70	0.630
0.384	46	6/03/68 6:00	0.572	20	2.56	0.610
0.690	10	6/23/69 21:00	0.550	21	2.44	0.590
0.492	29	11/04/69 13:00	0.547	22	2.32	0.570
0.632	12	1/09/71 0:00	0.545	23	2.22	0.550
0.580	19	2/28/72 16:00	0.530	24	2.13	0.530
0.431	37	1/13/73 5:00	0.519	25	2.04	0.510
0.463	32	11/11/73 2:00	0.516	26	1.96	0.490
0.588	17	12/27/74 2:00	0.504	27	1.89	0.470
0.595	15	12/02/75 21:00	0.494	28	1.82	0.450
0.252	50	3/03/77 1:00	0.492	29	1.75	0.430
0.590	16	12/15/77 18:00	0.478	30	1.70	0.410
0.469	31	2/06/79 16:00	0.469	31	1.64	0.390
0.627	13	12/14/79 23:00	0.463	32	1.59	0.370
0.856	5	11/21/80 11:00	0.457	33	1.54	0.350
0.516	26	1/23/82 20:00	0.451	34	1.49	0.330
0.582	18	1/05/83 10:00	0.435	35	1.45	0.310
0.819	6	1/24/84 16:00	0.433	36	1.41	0.291
0.550	21	11/01/84 23:00	0.431	37	1.37	0.271
0.519	25	1/18/86 16:00	0.422	38	1.33	0.251
0.869	4	11/23/86 21:00	0.418	39	1.30	0.231
0.418	39	3/27/88 10:00	0.415	40	1.27	0.211
0.433	36	1/09/89 22:00	0.406	41	1.24	0.191
0.971	2	1/09/90 8:00	0.406	42	1.21	0.171
0.772	7	11/24/90 6:00	0.401	43	1.18	0.151
0.415	40	4/18/92 1:00	0.397	44	1.15	0.131
0.406	41	3/22/93 21:00	0.388	45	1.12	0.111

0.356	48	3/03/94	3:00	0.384	46	1.10	0.091
0.545	23	11/30/94	5:00	0.379	47	1.08	0.071
1.13	1	2/09/96	0:00	0.356	48	1.05	0.051
0.742	9	1/03/97	0:00	0.290	49	1.03	0.031
0.457	33	12/16/97	15:00	0.252	50	1.01	0.011
Computed Peaks				1.15		100.00	0.990
Computed Peaks				1.04		50.00	0.980
Computed Peaks				0.934		25.00	0.960
Computed Peaks				0.792		10.00	0.900
Computed Peaks				0.763		8.00	0.875
Computed Peaks				0.683		5.00	0.800
Computed Peaks				0.523		2.00	0.500
Computed Peaks				0.418		1.30	0.231

Attachment B. Photos of Wetland A

Attachment B: Photos of Wetland A

▼ Photo Number 1	
Date of Photo:	2-16-16
Location:	Western portion of Wetland A, looking north.
Description:	The wetland has been disturbed by past activity such as grazing. Much of the wetland is covered with dense briars.

▼ Photo Number 2	
Date of Photo:	2-16-16
Location:	Central portion of Wetland A, looking north.
Description:	An overgrown drainage ditch bisects the wetland. A flow rate of approximately 10 gpm was observed in the ditch at the time of the site visit.

Attachment B: Photos of Wetland A

▼ Photo Number 3	
Date of Photo:	2-16-16
Location:	Western portion of Wetland A.
Description:	Areas of the wetland with higher surface roughness were observed to have a shallow depth of standing water.

▼ Photo Number 4	
Date of Photo:	2-16-16
Location:	Outlet channel from Wetland A. Photo taken from neighboring property looking south.
Description:	A low-gradient open channel is the wetland's outlet and conveys drainage between two residential parcels located north of the wetland. A flow rate of over 100 gpm was observed in the channel at the time of the site visit.