

CONCEPT DRAINAGE REPORT

FOR THE

Proposed

ASH PLACE SUBDIVISION

Located in the City of Spokane, Washington

November 2024
WCE W.O. No. 2023-3505

Prepared by:

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Spokane Valley, WA 99206
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This report has been prepared by the staff of WCE under the direction of the undersigned professional engineer whose seal and signature appear hereon.



Ryan M. Andrade, P.E.

GENERAL

The proposed Ash Place Preliminary Plat proposes the development of 20 attached, single-family residential lots (townhomes) within the Residential Single Family (RSF) zone of the City of Spokane. Within the RSF zone, the lots range in size from approximately 1,388 ft² to over 4,191 ft² located on approximately 1.32 acres. The site lies within the City of Spokane, WA, it is in-between Ash Street & Ash Place, just south of Liberty Avenue. The site lies in the SE ¼ of Section 1, T. 25 N., R 42 E., W.M. and is located within the Critical Aquifer Recharge Area. A vicinity map is attached. The proposed project is anticipated to construct east/west and north/south alleys as a part of development. Lastly, the site has steep slopes at 30% or above for a portion of the site.

PURPOSE and ANALYSIS METHODOLOGY

The purpose of this concept drainage report is to determine the storm drainage facilities that will be required to treat and dispose of the increase in storm water runoff created by development of the vacant lands for the new development. For this project and per Chapter 5 of the SRSM, the rational method of analysis will be used.

A final storm drainage analysis may include an SCS method per Chapter 5, and an NRCS Type IA 24-hour storm may be used for sizing flow control facilities. Because the site has limited infiltration, a Water Budget analysis may also be provided to verify pond sizes proposed as a result of this analysis can meet the evaporation standards should pond bottoms and infiltration become ineffective.

Site stormwater facilities will be designed to treat and dispose of the 2-, 25-, and 100-year storms as required by the SRSM.

As proposed all internal roadways/alleys are proposed to be developed with crowned roadways, catch basins and pipes to a pond/swale located south end of the project site. As proposed all stormwater will be captured and treated in detention pond(s) and released at or below the pre-developed rate. If required for various analyses the Intensity, Duration, and Frequency (IDF) curves from the Spokane, Medical Lake, Reardon, Cheney, and Rockford intensity curves as modified by the Spokane Regional Storm Manual (SRSM) may use bowstring calculations to determine basin flows for reference for the Rational storm. The 2-, 10-, 25-, 50- and 100-year rainfall intensity iso-pluvials from the Spokane Regional Stormwater Manual may be used for both TR-55 and HEC-22 calculations for a HydroCAD stormwater model.

As noted, for this concept report all basins will use the rational method to determine peak discharge and runoff volumes.

TOPOGRAPHY

The site is considered to have a “hilly” terrain site with existing slopes on site ranging averaging between 0% and over 30% west to east with varying levels north and south. As shown on the preliminary plat map, the proposed road system will generally follow contours, and the roads will be graded north/south & east/west to maintain storm water flows to generally follow the lay of the land.

SOILS

Geologic maps indicate the soils in this area consist primarily of loess with an influence of volcanic ash over residuum and/or colluvium derived from basalt. According to the Natural Resources Conservation Service (NRCS) Soil Survey of Spokane County, Washington, the site soils are classified as Northstar-Rock outcrop-Rockly complex (3117) and Speigle-Rock outcrop complex (2053).

The west half of the project site is mapped as Northstar-Rock outcrop-Rockly complex. The Northstar-Rock outcrop-Rockly soil profile is described as extremely cobbly ashy loam to very gravelly ashy loam to extremely gravelly loam to bedrock. The Speigle-Rock outcrop complex, located in the east half of the project is described as cobbly ashy loam to very gravelly ashy loam to very cobbly loam to extremely gravelly loam to extremely cobbly sandy loam. Both soil types are categorized by NRCS as well-drained and are derived from loess mixed & with an influence of volcanic ash over residuum and/or colluvium derived from basalt.

Based on our field observations and on our previous geotechnical experience in the vicinity of the site, the on-site soils appear to be consistent with the soil mapping.

Hydrologic Soil Group = B & C

The stormwater runoff may be treated within bio-detention swales/ponds and released at 0.05 cfs, well below the pre-developed rate. Recommended design rates shall be based on the onsite testing and include a factor of safety of 2.5. All stormwater management features shall be designed in accordance with the SRSM.

Swales/ponds constructed in natural soils within the proposed project should be sized using equation 6-1b and 6-1d in the SRSM based on the permeability testing results.

Equations 6-1b and 6-1d

- | |
|---|
| <ul style="list-style-type: none">• $V = 1815AP^{1.53}$ (6-1b)• $V = 1815A$ (6-1d) |
|---|

For this analysis, sizing will be per the Rational Method for Detention Ponds with release of excess stormwater into the City stormwater system downstream at 0.05 cfs, well below the pre-developed rate. A final drainage report may utilize a CN/SCS method to maintain the discharge at or below the development condition, or as allowed by the SRSM.

DRAINAGE NARRATIVE

BASIN SUMMARY – Pre-Developed

The existing site is 1.32 Acres +/- in size. The drainage from this site is generally from west to east, Pre Basin-A, includes the whole project site. The basin has varying slopes, from shallow to steep (over 30%) with no observed drainages other than sheet flow operating as a shallow concentrated type of flow that is present on site and generally as discussed in the SRSM and the SCS manual. Most, if not all, of Pre Basin-A flows offsite over the existing sidewalk and down the curb & gutter and into the City existing stormwater system to this day.

Table 1. Pre-Developed Basin Summary Table

Pre Basin	Area (sf)				RM Rate (cfs)				
	Imp	Pervious	Offsite	Total	2-yr	10-yr	25-yr	50-yr	100-yr
A	0	57,590	0	57,590	1.12	2.08	2.63	3.05	3.48

BASIN SUMMARY – Post-Developed Narrative

The post-developed site is separated and designated into 3 basins (Basins 1 through 3) based upon their anticipated storage and discharge locations, as shown on the attached basin map. The following are narratives on the various basins and where and how the water is treated and discharged.

POST Basin 1

This basin is located through the center of the project and includes the two alleys & front half of the proposed buildings and collects and consolidates drainage from the developed condition. For Post Basin 1 the following summarizes the intent of the overall design.

- All sheetflow runoffs will be conveyed overland to street gutters & catch basins & pipe and enter a bio-detention and treatment swale, Pond 1.
- All stormwater in Pond 1 will be treated by 18-inches of treatment soil and then discharged to the existing City municipal stormwater system at a rate of 0.05 cfs through the use of a perforated drain pipe (underneath the pond bottom) and catch basin with an orifice tee inside the catch basin metering the outflow at the specified rate.
- For this analysis, it was presumed that all generated stormwaters will be maintained on site, with overflow to the existing City stormwater system.
- A summary section follows the basin narratives.

POST Basin 2

This basin is located through the eastern half of the development and includes the majority of the unimproved/pervious, hilly portion of the development. The basin includes the back half of the proposed buildings along the east side of the north/south alley. For Post Basin 2 the following summarizes the intent of the overall design.

- All sheetflow runoffs will be conveyed downstream, overland to existing Ash Street and into the existing City municipal stormwater system.
- For this analysis, offsite flows in the post-developed condition will be substantially less than that of the pre-developed condition. For example, in the 25- & 100-year pre-developed condition the offsite flows are approximately 2.63 & 3.48 cfs respectively. The post-development offsite flows for this Basin 2 are approximately 1.19 & 1.57 cfs respectively, therefore, generating a much lesser impact downstream.
- A summary section follows the basin narratives.

POST Basin 3

This basin is located through the west side of the development and includes a portion of the unimproved/pervious, flatter portion of the development. The basin includes the back half of the proposed buildings along the west side of the north/south alley. For Post Basin 3 the following summarizes the intent of the overall design.

- All sheetflow runoffs will be conveyed downstream, overland to existing Ash Place and into the existing City stormwater system.
- For this analysis, it was presumed that all generated stormwaters will be maintained on site within the backyards & landscaped areas of each lot, with emergency overflows to the existing City stormwater system only in the frozen-ground condition.
- A summary section follows the basin narratives.

PGIS CHECK

While this project is intended to be a bioretention pond design, the intent as described, due to shallow bedrock/refusal & poor infiltration rates due to said refusal on the project site, is NOT to install drywells and to use gravel galleries underneath the swale.

The Final drainage report is anticipated to include flooded width calculations, all flooded widths for the design storms, provide appropriate non flooded widths for access and fire. Because the pond on this project has some minor infiltration capacity and as this project is in the moderate susceptible part of CARA, Table 2 below lists the pond requirements by basin, a weighted 'C' calculation is in the appendix and summarized below.

Table No. 2 – Weighted C and Pond and Basin Summary

Post Basin	Total Area (sf)	Impervious Area (sf)	Pervious Area (sf)	Weighted 'C'	Required Pond Vol. (cf)	Provided Pond Vol. (cf)
1	23,880	19,285	4,595	0.76	804	914
2	24,205	3,600	20,605	0.64	0	0
3	9,505	3,600	5,905	0.43	0	0

As this is a concept report, the provided pond area as described within the table is an estimate of the treatment volume that may be provided in the designated areas. As can be seen, overall, the project provides or is anticipated to provide the required treatment volume per the SRSM.

POND DESIGN

In Post Basin 1, the increase in stormwater and PGIS on the various roads/alleys will be treated/stored within the onsite bio-detention pond. In the case that stormwater overflows the onsite pond, the stormwater will discharge offsite into the existing City municipal stormwater system as allowed per City guidelines by design deviation request.

In order to ensure that any stormwater overflowing the onsite pond will be released at the allotted rate of 0.05 cfs, the stormwater will be equipped with a properly sized overflow structure (an orifice tee within a catch basin). The overflow structure requires that the stormwater entering the structure to crest the rim of the structure and filling the structure for release via an orifice. The orifice will be size appropriate to allow stormwater to be released at the maximum discharge rate of 0.05 cfs.

Though the project site is not anticipated to encounter any stormwater issues, in the event that there are heavy rain periods, the ability to discharge offsite into the existing City municipal stormwater system provides assurance that the project site will not inundate and negatively impact surrounding properties with excess stormwater.

Table No. 3 –Pond Volume Summary

Basin/ Pond	Pond Volume Summary		
	100-YR Required Storage Volume (cf)	Provided Storage Volume (cf)	Overflow Basin
1	1,472	1,495	Ex. City System

As shown in Table 3, Pond 1 is anticipated to hold the required volume per the rational method for the 100-year storm event. What is not included is the anticipated discharge via the pond/swale bottom.

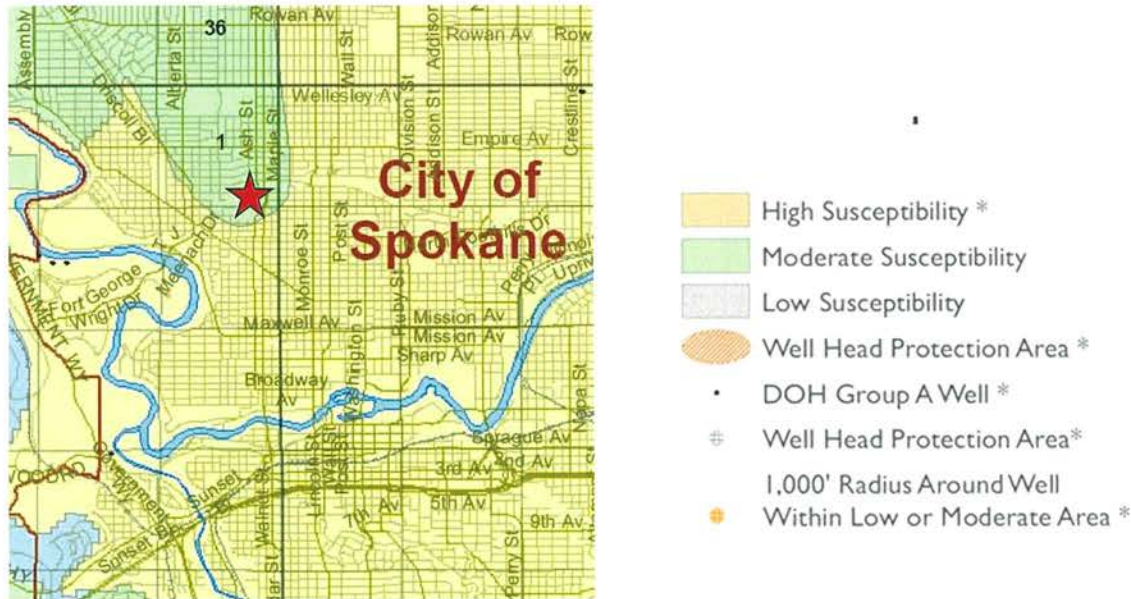
CONCLUSION

This report demonstrates that per the rational method that the anticipated increase in stormwater from the development can capture, detain, treat, and discharge the proposed storm water design for this system to meet SRSM requirements.

Per Page 3-6 of the SRSM, there are additional items that need to be addressed; these areas are as follow:

Critical Area Discussion:

- There are no DNR streams on site
- The soil types are Type B and should not be considered “erodible soils”,
- There are no identified susceptible species present on site, please refer to the SEPA Checklist prepared for this project, not attached, see City of Spokane Planning.
- The site is in the Critical Aquifer Recharge Area and moderate susceptibility area



Perpetual Maintenance of Facilities:

The proposed storm drainage system will be a system of street flow and catch basins & pipes within public or private roads and as such will be owned by the Jurisdiction. The pond will be maintained in a Tract within the plat and will be maintained by the project HOA.

Offsite Easements:

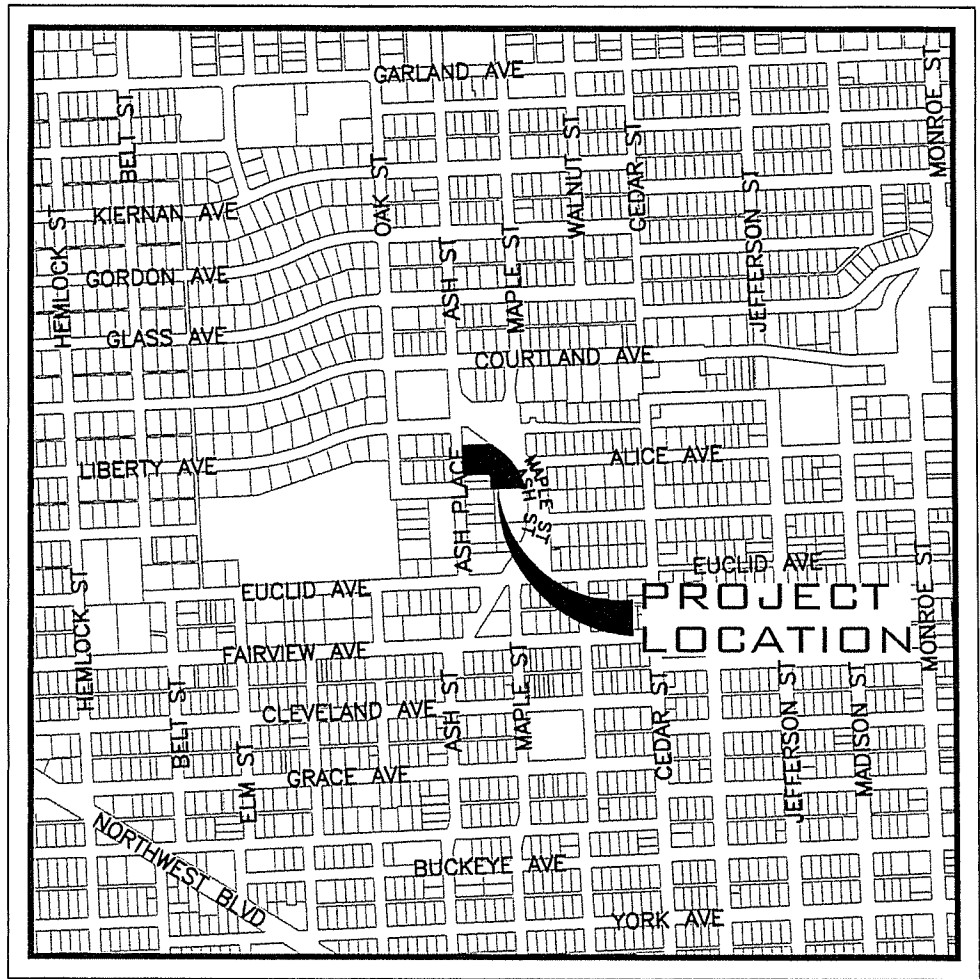
None are required at this time, if any are required these will be pursued at the time of final design.

Regional Facilities:

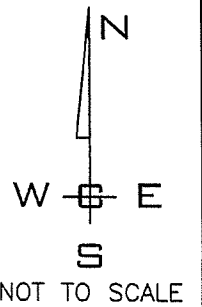
This project is not a part of any City of Spokane regional system.

APPENDIX

1. VICINITY MAP
2. ASH PLACE PRELIMINARY PLAT
3. PRE AND POST BASIN MAPS
4. BASIN AND WEIGHTED 'C' SPREADSHEET
5. POND VOLUME CALC SHEET
6. BOWSTRINGS
7. GEOTECHNICAL REPORT



VICINITY MAP



PROJ #: 23-3505
 DATE: 09/24/24
 DRAWN: RMA
 APPROVED: TRW

CONCEPT DRAINAGE REPORT
ASH PLACE
 3242 N ASH PLACE
 SPOKANE, WASHINGTON

WCE
 WHIPPLE CONSULTING ENGINEERS
 21 SOUTH PINES ROAD
 SPOKANE VALLEY, WASHINGTON 99206
 PH: 509-893-2617 FAX: 509-926-0227

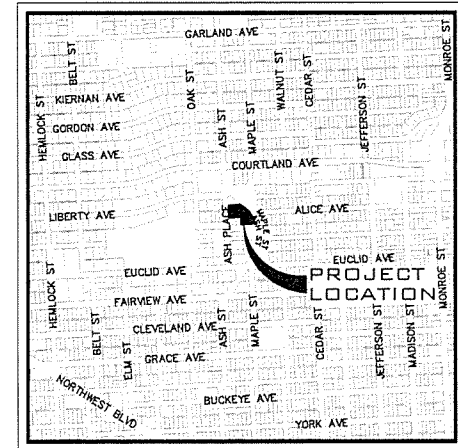
FIGURE 1

VICINITY MAP

PRELIMINARY PLAT ASH PLACE A REPLAT OF DRUMHELLER SPRING ADD. AND KELLEY SHORT PLAT LOCATED IN A PORTION OF THE SE 1/4, SEC 01, T 25 N, R 42 E, W.M. SPOKANE COUNTY, WA

**UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811**
CALL TWO BUSINESS DAYS
BEFORE YOU DIG

SLOPES TABLE				
NUMBER	MIN. SLOPE	MAX. SLOPE	2d AREA (sf)	COLOR
1	30%	115%	17,000.68	



VICINITY MAP

SITE DATA		
PARCEL NUMBER	25014.4207 25014.4701 25014.4702	
REPLATED PORTIONS OF DRUMHELLER SPRING ADDITION AND KELLEY SHORT PLAT		
ZONING	RSF	
PROJECT AREA	SF	AC
	57,590.01	1.32
NUMBER OF LOTS	20	
NUMBER OF TRACTS	3	
PROPOSED DENSITY DATA		
GROSS DENSITY	15.13	
NET DENSITY	18.61	
	SF	AC
AREA OF LOTS	45,863.13	1.05
AREA OF TRACTS	5,007.14	0.11
AREA OF ALLEY TRACT	6,719.74	0.15
MIN LOT AREA	1,280.00	0.03
IMPERVIOUS AREAS		
	SF	
PAVEMENT	6,370.57	
CONCRETE	7,733.09	
BUILDING	15,528.00	
TOTAL IMPERVIOUS AREA	29,631.66	
PERCENTAGE OF IMPERVIOUS	51%	
SERVICE PROVIDERS		
FIRE DISTRICT	CITY OF SPOKANE	
WATER SERVICE	CITY OF SPOKANE	
SANITARY SEWER SERVICE	CITY OF SPOKANE	

LEGAL DESCRIPTION

PARCEL # 25014.4207
DRUMHELLER SPRING ADDITION LOTS 4, 5, 6, 8, 9 & 10 BLK 3 TOGETHER WITH N1/2 VAC DALTON AVE S OF & ADJ TO LT 10 (VAC ORD #C-27577) EXC PTN THEREOF DEEDED FOR ASH ST

PARCEL # 25014.4701
01-25-42: KELLY FINAL CITY SHORT PLAT 222-233 (AFN 7249860) LOT 1

PARCEL # 25014.4702
01-25-42: KELLY FINAL CITY SHORT PLAT 222-233 (AFN 7249860) LOT 2

NOTES

- 30% SLOPES FOUND ON PROPERTY SEE PLAN VIEW
- NO ERODIBLE SOILS FOUND ON PROPERTY
- * PROPOSED DENSITY BASED ON SMC 17C.400.010.C.5: NOTWITHSTANDING MAXIMUM DENSITY STANDARDS IN TABLE 17C.110-3, LOTS THAT CONFORM TO THE APPLICABLE DEVELOPMENT STANDARDS OF THIS SECTION (17C.400.010) SHALL BE CONSIDERED TO MEET THE MAXIMUM DENSITY REQUIREMENTS.
- FRONT, SIDE AND REAR SETBACKS TO BE CONSISTENT TO ORDINANCE NO. C36232 (OR ADOPTED CODE AT TIME OF PERMIT)
- SEE SHEET PP2 FOR EXISTING EASEMENT INFORMATION

ADJACENT PROPERTY DATA		
PARCEL #	OWNER	PLAT DATA
25014.4305	CULVER, JOHNNY 1532 W ALICE AVE, SPOKANE, WA, 99205	DRUMHELLER SPRING ADDITION
25014.4606	WHIPPS, RICHARD L 3203 N MAPLE ST, SPOKANE, WA, 99205	DRUMHELLER SPRING ADDITION
25014.4601	TESKE, THEODORE D & KATHRYN A 3138 N ASH PL, SPOKANE, WA, 99205	DRUMHELLER SPRING ADDITION
25014.2202	SPOKANE, CITY OF 808 W SPOKANE FALLS BLVD, SPOKANE, WA, 99201	SPRING HILL ADDITION
25014.2111	FERRER, RAFAEL/SCHMIDT, MARY LOU 1210 ALKI AVE SW UNIT 501, SEATTLE, WA, 98116	SPRING HILL ADDITION
25014.2101	FERRER ETAL, R G 1210 ALKI AVE SW UNIT 501, SEATTLE, WA, 98116	SPRING HILL ADDITION
25014.4201	SATTERFIELD, SHARON L 3252 N ASH PL, SPOKANE, WA, 99205	DRUMHELLER SPRING ADDITION

ENGINEER/CONTACT SURVEYOR OWNER/DEVELOPER
 WHIPPLE CONSULTING ENGINEERS 21 SOUTH PINES GROVE ROAD LLC
 SPOKANE VALLEY, WA 99206 SPOKANE VALLEY, WA 99206
 PHONE: 893-2617 SPOKANE VALLEY, WA 99201-2116
 CONTACT: TODD WHIPPLE, P.E. CONTACT: BRETT A. GRIFFITH, P.L.S.

SCALE:

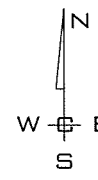
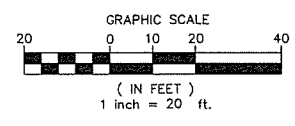
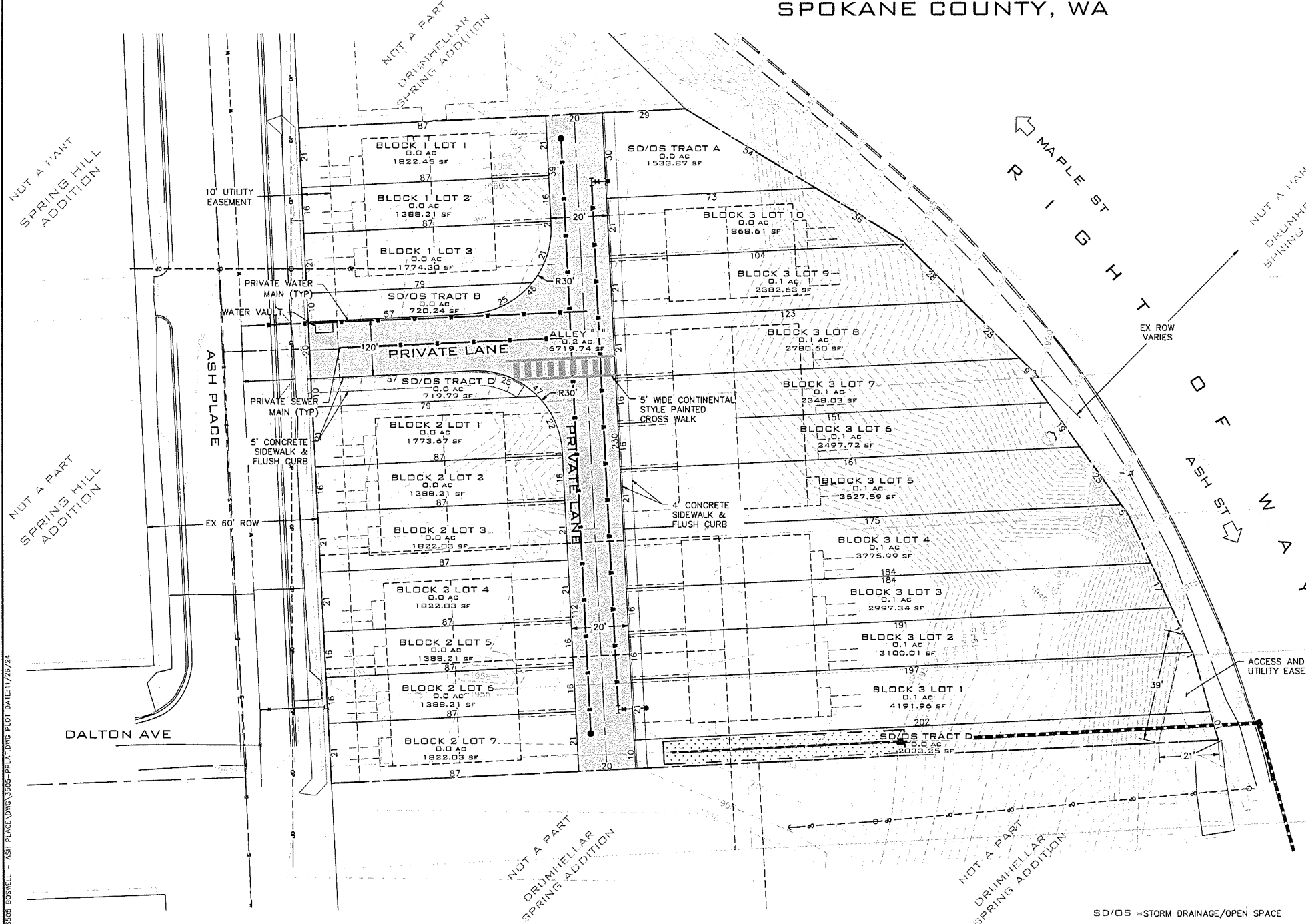
HORIZONTAL:
1"=20'
VERTICAL:
N/A

PROJ #: 23-3505
DATE: 11/26/24
DRAWN: SLS
REVIEWED: TRW



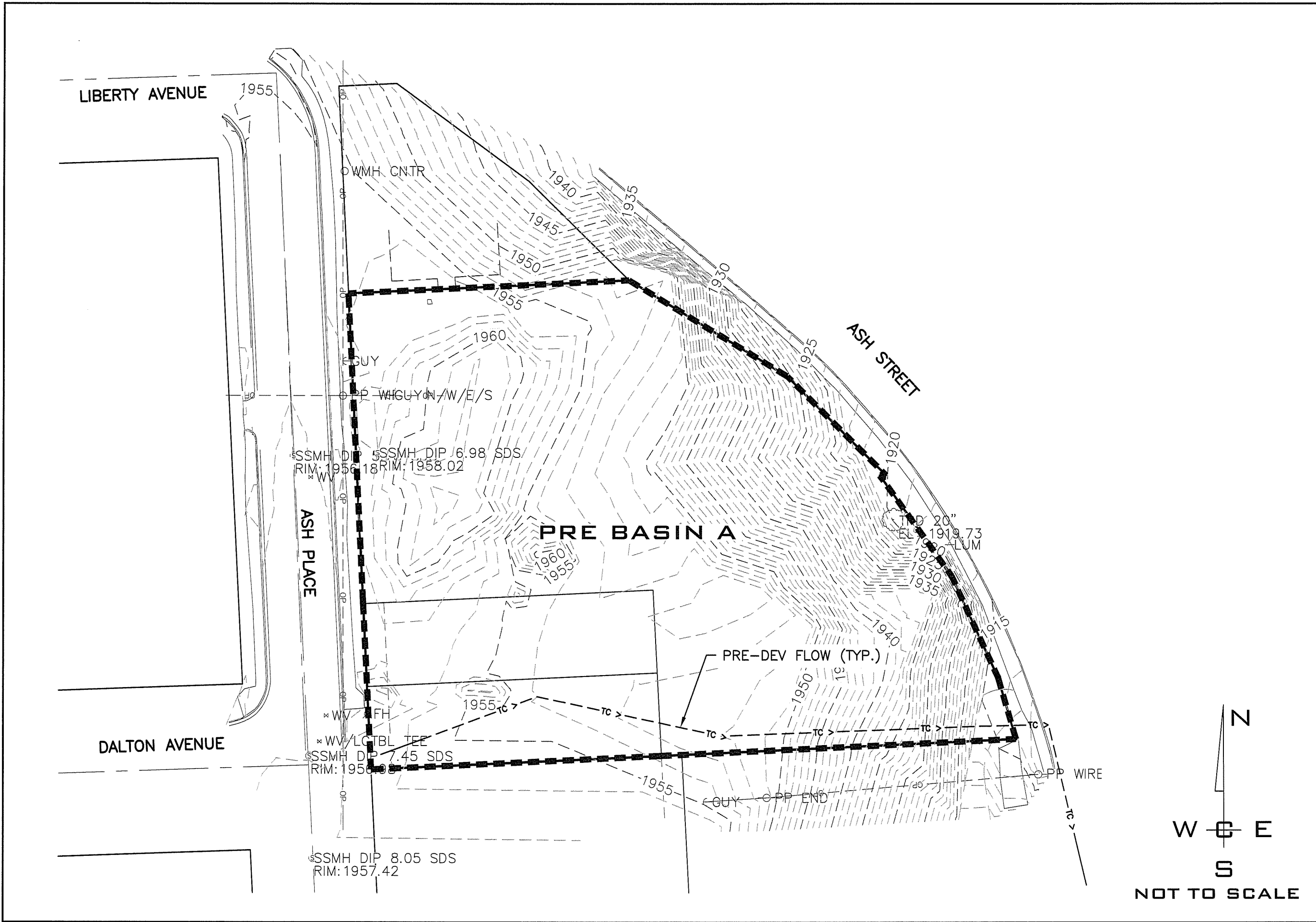
**ASH PLACE
PRELIMINARY PLAT
3242 N ASH PL
SPOKANE, WA**

**SHEET
PP1
JOB NUMBER
23-3505**



NO.	DATE	BY	REVISIONS

P:\WCE_WORK\2023\WCE PROJECTS\2023-3505\Boswell - Ash Place\DWG\3505-PP1\AT.dwg, 11/26/2024 2:15:48 PM, rmdtradie, DWG To PDF.pc3, 1:1



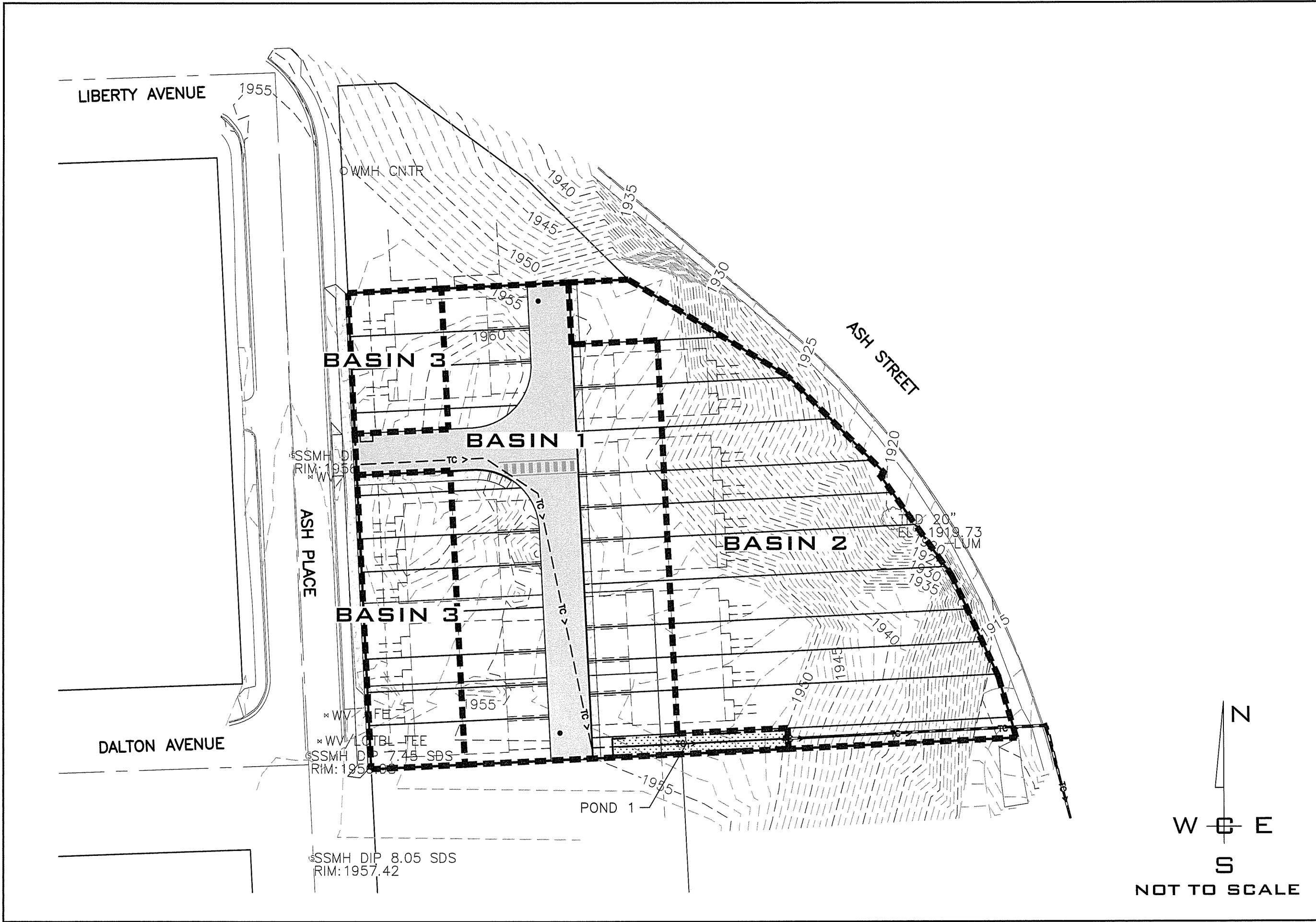
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PROJ #: 23-3505
DATE: 11/26/24
DRAWN: RMA
APPROVED: TRW

PRE-DEVELOPMENT BASIN MAP
ASH PLACE
3242 N ASH PLACE
SPOKANE, WASHINGTON

SHEET
1
OF
2



PROJ #: 23-3505
 DATE: 11/26/24
 DRAWN: RMA
 APPROVED: TRW

POST-DEVELOPMENT BASIN MAP
ASH PLACE
 3242 N ASH PLACE
 SPOKANE, WASHINGTON

SHEET
 2
 OF
 2

11/26/2024 WCE No. 23-3505 Project Name Ash Place
 Imp 0.9 Intensity from SRSM eqn. 5-13, per Table 5-7, Assumes Tc = 5 min
 Per 0.15 I (2 yr) = 1.418 inches I (10 yr) = 2.619 inches
 Earth 0.6 Table 5-5 I (25 yr) = 3.319 inches I (50 yr) = 3.843 inches
 I (100 yr) = 4.381 inches

NOTE:

SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD

Basin	Total sf	Access/Parking /Street (sf)	Sidewalk sf	Adj. SW sf	Buildings sf	Total Impervious	Total Pervious	Weighted "C"	PGIS sf	1815 A				Q=CIA (cfs)			
										Pond Area (sf)	Pond Vol (cf)	2 yr	10 yr	25 yr	50 yr	100 yr	
PRE A	57,590	0	0	0	0	57,590	0	0.60	0	0	0	0	1.12	2.08	2.63	3.05	3.48
Pre Total	57,590	0	0	0	0	57,590	0	0.60	0	0	0	0	1.12	2.08	2.63	3.05	3.48
Post Onsite Flow																	
POST 1	23,880	6,485	0	5,600	7,200	19,285	4,595	0.76	19,285	1,607	804	0.59	1.08	1.37	1.59	1.81	
POST 2	24,205	0	0	0	3,600	3,600	20,605	0.64	0	0	0	0.51	0.94	1.19	1.38	1.57	
POST 3	9,505	0	0	0	3,600	3,600	5,905	0.43	0	0	0	0.13	0.25	0.31	0.36	0.41	
TOTAL	57,590	6,485	0	5,600	14,400	26,485	31,105	-	19,285	1,607	804	1.23	2.27	2.88	3.33	3.80	

PEAK FLOW CALCULATION
25-Year Design Storm

PROJECT: **Ash Place**
 BOWSTRING METHOD
 DETENTION BASIN
 DESIGN

PROJECT: **Spokane**
 Rainfall Intensity Coefficients for

BASIN: 1

DESIGNER: **RMA**
 DATE: 24-Sep-24

Tot. Area 23,880 SF 0.55 Acres
 Imp. Area 19,285 SF C= 0.9
 Perv. Area 4,595 SF C= 0.15
 Wt. C = 0.76 PGIS Area = 19,285

$M_{25} = 9.09$
 $N_{25} = 0.626$
 Flow (weighted c) Qwc= 1.37 cfs
 Flow (time of concentration) Qtc= 1.37 cfs

WCE, Applicable Travel Time Ground Cover Coefficients

Type of Cover	K (ft/min)
Short Pasture	420
Nearly Bare Ground	600
Small Roadside Ditch/ Grass	900
Paved Area (use for parking lots)	1200
Gutter - 4 inches deep	1500
Gutter - 6 inches deep	2400
Pipe - 12-inch PVC/DI	3000
Pipe - 15/18-inch PVC/DI	3900
Pipe - 24-inch PVC/DI	4700

Reaches	Offsite	also applicable for Pre-Developed Tc
Reach 1	0.00	
Length	420.00	
Slope (ft/ft)	0.0400	bc sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 2	Finished Lot from House to Street	
Length	0.00	
Slope (ft/ft)	420.00	bc sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	300.00	
Slope (ft/ft)	0.0200	bc sure this is decimal equivalent slope 0.0000
Travel Time	0.88	Minutes
Reach 4	Pipe Flow/Pipe Reach One (only need one if no Dia change)	
Length	130.00	
Slope (ft/ft)	0.0300	12-inch Pipe minimum
Travel Time	0.25	Average Slope for total pipe run
Reach 5	Pipe Flow/Add additional pipe reaches for other Dia	
Length	0.00	
Slope (ft/ft)	0.0200	Average Slope for total pipe run
Travel Time	0.00	Minutes
Sum of Tc	1.13	Minutes
Tc for Analysis	5.00	Minutes

Whippler Consulting Engineers

Time Increment (min) 10
 Time of Conc. (min) 5.00
 Outflow (cfs) 0.05
 Design Year Flow 25
 Area (acres) 0.55
 Impervious Area (sq ft) 19,285
 'C' Factor 0.76
 Area * C 0.414
 PGIS Area 19,285

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q (cfs)	Devel (cu ft)	Vol. In (cu ft)	Vol. Out (cu ft)	Storage (cu ft)
5.00	300	3.32	1.37	553	15	538	
15	900	1.67	0.69	693	45	648	
25	1500	1.21	0.50	804	75	729	
35	2100	0.98	0.41	896	105	791	
45	2700	0.84	0.35	974	135	839	
55	3300	0.74	0.31	1043	165	878	
65	3900	0.67	0.28	1105	195	910	
75	4500	0.61	0.25	1161	225	936	
85	5100	0.56	0.23	1214	255	959	
95	5700	0.53	0.22	1263	285	978	
105	6300	0.49	0.20	1309	315	994	
115	6900	0.47	0.19	1352	345	1007	
125	7500	0.44	0.18	1394	375	1019	
135	8100	0.42	0.17	1433	405	1028	
145	8700	0.40	0.17	1470	435	1035	
155	9300	0.39	0.16	1506	465	1041	
165	9900	0.37	0.15	1541	495	1046	
175	10500	0.36	0.15	1574	525	1049	
185	11100	0.35	0.14	1607	555	1052	
195	11700	0.33	0.14	1638	585	1053	
205	12300	0.32	0.13	1668	615	1053	
215	12900	0.32	0.13	1697	645	1052	
225	13500	0.31	0.13	1726	675	1051	
235	14100	0.30	0.12	1754	705	1049	
245	14700	0.29	0.12	1781	735	1046	
255	15300	0.28	0.12	1807	765	1042	
265	15900	0.28	0.11	1833	795	1038	
275	16500	0.27	0.11	1858	825	1033	
285	17100	0.26	0.11	1882	855	1027	
295	17700	0.26	0.11	1906	885	1021	
305	18300	0.25	0.10	1930	915	1015	
315	18900	0.25	0.10	1953	945	1008	
325	19500	0.24	0.10	1976	975	1001	
335	20100	0.24	0.10	1998	1005	993	
345	20700	0.23	0.10	2020	1035	985	
355	21300	0.23	0.09	2028	1065	963	
365	21900	0.22	0.09	2045	1095	950	
375	22500	0.22	0.09	2048	1125	923	
385	23100	0.22	0.09	2102	1155	947	

Time (min) 385
 Time Inc. (sec) 23700
 Intens. (in/hr) 0.21
 Q (cfs) 0.09
 Devel (cu ft) 2058
 Vol. In (cu ft) 1185
 Vol. Out (cu ft) 1215
 Storage (cu ft) 873

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q (cfs)	Devel (cu ft)	Vol. In (cu ft)	Vol. Out (cu ft)	Storage (cu ft)
405	24300	0.21	0.09	2110	1215	895	
415	24900	0.20	0.08	2058	1245	813	
425	25500	0.20	0.08	2108	1275	833	
435	26100	0.19	0.08	2048	1305	743	
445	26700	0.19	0.08	2095	1335	760	
455	27300	0.18	0.07	2029	1365	664	
465	27900	0.18	0.07	2073	1395	678	
475	28500	0.17	0.07	1999	1425	574	
485	29100	0.17	0.07	2041	1455	586	
495	29700	0.16	0.07	1960	1485	475	
505	30300	0.16	0.07	1999	1515	484	
515	30900	0.15	0.06	1910	1545	365	
525	31500	0.15	0.06	1947	1575	372	
535	32100	0.14	0.06	1851	1605	246	
545	32700	0.14	0.06	1885	1635	250	
555	33300	0.13	0.05	1781	1665	116	
565	33900	0.13	0.05	1813	1695	118	
575	34500	0.12	0.05	1702	1725	-23	
585	35100	0.12	0.05	1731	1755	-24	
595	35700	0.11	0.05	1612	1785	-173	
605	36300	0.11	0.05	1640	1815	-175	
615	36900	0.10	0.04	1513	1845	-332	
625	37500	0.10	0.04	1538	1875	-337	
635	38100	0.09	0.04	1404	1905	-501	
645	38700	0.09	0.04	1426	1935	-509	
655	39300	0.08	0.03	1285	1965	-680	
665	39900	0.08	0.03	1305	1995	-690	
675	40500	0.07	0.03	1156	2025	-869	
685	41100	0.07	0.03	1173	2055	-862	
695	41700	0.06	0.02	1017	2085	-1068	
705	42300	0.06	0.02	1031	2115	-1084	
715	42900	0.05	0.02	868	2145	-1277	
725	43500	0.05	0.02	880	2175	-1295	
735	44100	0.04	0.02	709	2205	-1496	
745	44700	0.04	0.02	719	2235	-1516	

"1815A" TREATMENT REQUIREMENTS

Minimum "1815A" Volume Required 804 cu ft
 Provided Treatment Volume - Min. 914 cu ft

STORAGE REC. - 25 YEAR DESIGN STORM

Maximum Storage Required by Bowstring 1,053 cu ft
 Provided Pond Storage Volume to Inlet - Min. 1,495 cu ft
 Provided Drywell/Gallery Storage Volume 0 cu ft
Total Provided Volume 1,495 cu ft

PEAK FLOW CALCULATION
100-Year Design Storm

PROJECT: **Ash Place**

BOWSTRING METHOD
DETENTION BASIN
DESIGN

PROJECT: Ash Place
BASIN: 1
DESIGNER: RMA
DATE: 24-Sep-24

Rainfall Intensity Coefficients for **Spokane**
taken from Table 5-7 SRSM

$M_{100} = 12.33$
 $N_{100} = 0.643$
Flow (weighted c)
Qwc= 1.81 cfs
Flow (time of concentration)
Qtc= 1.81 cfs

Tot. Area 23,880 SF 0.55 Acres
Imp. Area 19,285 SF C= 0.9
Perv. Area 4,595 SF C= 0.15
Wt. C = 0.76 PGIS Area = 19,285

BASIN: 1

WCE Applicable Travel Time Ground Cover Coefficients

Type of Cover	K (ft/min)
Short Pasture	420
Nearly Bare Ground	600
Small Roadside Ditch/ Grass	900
Paved Area (use for parking lots)	1200
Gutter - 4 inches deep	1500
Gutter - 6 inches deep	2400
Pipe - 12-inch PVC/DI	3000
Pipe - 15/18-inch PVC/DI	3900
Pipe - 24-inch PVC/DI	4700

Reaches	Offsite	also applicable for Pre-Developed Tc
Reach 1	0.00	
Length	420.00	
K	0.0400	
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 2	Finished Lot from House to Street	
Length	0.00	
K	420.00	
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	300.00	
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000
Travel Time	0.88	Minutes
Reach 4	Pipe Flow Pipe Reach One (only used one if no Dia change)	
Length	130.00	
Slope (ft/ft)	0.0300	Average Slope for total pipe run
Travel Time	0.25	Minutes
Reach 5	Pipe Flow Add additional pipe reaches for other Dia	
Length	0.00	
K	3900.00	15/18-inch Pipe
Slope (ft/ft)	0.0200	Average Slope for total pipe run
Travel Time	0.00	Minutes
Sum of Tc	1.13	Minutes
Tc for Analysis	5.00	Minutes

Whipple Consulting Engineers

Time Increment (min) 10
Time of Conc. (min) 5.00
Outflow (cfs) 0.05
Design Year Flow 50
Area (acres) 0.55
Impervious Area (sq ft) 19285
'C' Factor 0.76
Area * C 0.414
PGIS Area 19,285

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q (cfs)	Devel. (cu ft)	Vol. In (cu ft)	Vol. Out (cu ft)	Storage (cu ft)
5.00	300	4.38	1.81	730	15	715	
15	900	2.16	0.90	897	45	852	
25	1500	1.56	0.64	1033	75	958	
35	2100	1.25	0.52	1143	105	1038	
45	2700	1.07	0.44	1238	135	1103	
55	3300	0.94	0.39	1321	165	1156	
65	3900	0.84	0.35	1396	195	1201	
75	4500	0.77	0.32	1464	225	1239	
85	5100	0.71	0.29	1527	255	1272	
95	5700	0.66	0.27	1585	285	1300	
105	6300	0.62	0.26	1640	315	1325	
115	6900	0.58	0.24	1692	345	1347	
125	7500	0.55	0.23	1741	375	1366	
135	8100	0.53	0.22	1788	405	1383	
145	8700	0.50	0.21	1833	435	1398	
155	9300	0.48	0.20	1875	465	1410	
165	9900	0.46	0.19	1916	495	1421	
175	10500	0.45	0.18	1956	525	1431	
185	11100	0.43	0.18	1994	555	1439	
195	11700	0.42	0.17	2031	585	1446	
205	12300	0.40	0.17	2067	615	1452	
215	12900	0.39	0.16	2101	645	1456	
225	13500	0.38	0.16	2135	675	1460	
235	14100	0.37	0.15	2168	705	1463	
245	14700	0.36	0.15	2200	735	1465	
255	15300	0.35	0.14	2231	765	1466	
265	15900	0.34	0.14	2261	795	1466	
275	16500	0.33	0.14	2290	825	1465	
285	17100	0.33	0.13	2319	855	1464	
295	17700	0.32	0.13	2348	885	1463	
305	18300	0.31	0.13	2375	915	1460	
315	18900	0.31	0.13	2402	945	1457	
325	19500	0.30	0.12	2429	975	1454	
335	20100	0.29	0.12	2455	1005	1450	
345	20700	0.29	0.12	2480	1035	1445	
355	21300	0.28	0.12	2512	1065	1447	
365	21900	0.28	0.12	2532	1095	1437	
375	22500	0.27	0.11	2559	1125	1434	
385	23100	0.27	0.11	2627	1155	1472	

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q (cfs)	Devel. (cu ft)	Vol. In (cu ft)	Vol. Out (cu ft)	Storage (cu ft)
385	23700	0.26	0.11	2597	1185	1412	
395	24300	0.26	0.11	2662	1215	1447	
405	24900	0.25	0.10	2624	1245	1379	
415	25500	0.25	0.10	2687	1275	1412	
425	26100	0.24	0.10	2641	1305	1336	
435	26700	0.24	0.10	2702	1335	1367	
445	27300	0.23	0.10	2649	1365	1284	
455	27900	0.23	0.10	2707	1395	1312	
465	28500	0.22	0.09	2646	1425	1221	
475	29100	0.22	0.09	2702	1455	1247	
485	29700	0.21	0.09	2634	1485	1149	
495	30300	0.21	0.09	2687	1515	1172	
505	30900	0.20	0.08	2611	1545	1066	
515	31500	0.20	0.08	2662	1575	1087	
525	32100	0.19	0.08	2579	1605	974	
535	32700	0.19	0.08	2627	1635	992	
545	33300	0.18	0.08	2537	1665	872	
555	33900	0.18	0.08	2582	1695	887	
565	34500	0.17	0.07	2485	1725	760	
575	35100	0.17	0.07	2528	1755	773	
585	35700	0.16	0.07	2423	1785	638	
595	36300	0.16	0.07	2463	1815	648	
605	36900	0.15	0.06	2350	1845	505	
615	36900	0.15	0.06	2389	1875	514	
625	37500	0.15	0.06	2268	1905	363	
635	38100	0.14	0.06	2304	1935	369	
645	38700	0.14	0.06	2176	1965	211	
655	39300	0.13	0.06	2210	1995	215	
665	39900	0.13	0.06	2074	2025	49	
675	40500	0.12	0.05	2105	2055	50	
685	41100	0.12	0.05	1963	2085	-122	
695	41700	0.11	0.05	1991	2115	-124	
705	42300	0.11	0.04	1841	2145	-304	
715	42900	0.10	0.04	1866	2175	-309	
725	43500	0.10	0.04	1709	2205	-496	
735	44100	0.09	0.04	1732	2235	-503	
745	44700	0.09	0.04				

"1815A" TREATMENT REQUIREMENTS

Minimum "1815A" Volume Required 804 cu ft
Provided Treatment Volume - Min. 914 cu ft

STORAGE REQ. - 100 YEAR DESIGN STORM

Maximum Storage Required by Bowstring 1,472 cu ft
Provided Pond Storage Volume to Inlet - Min. 1,495 cu ft
Provided Drywell/Gallery Storage Volume 0 cu ft

Total Provided Volume 1,495 cu ft