INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT

HANNAH RIDGE AT FEATHERGRASS
FILINGS 5, 6 & 7

October 2018

A detention maintenance agreement is needed for Filing No. 5.

Prepared for:
ELITE PROPERTIES OF AMERICA, INC.
6385 CORPORATE DRIVE
COLORADO SPRINGS, CO 80919

Prepared by:
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SF-18-038
SF-18-039
SF-18-040

Job no. 1116.05

total flow within the pipe at this location is given by **Pipe Run 9 (Q_5 = 17 cfs and Q_{100} = 44 cfs).** The emergency overflow route at this location is in the southerly direction over the crown of Electronic Drive towards Design Point 8.

Design Point 8 (Q_5 = 3 cfs and Q_{100} = 7 cfs) collects developed flows from Basin M. At this sump condition, a 10' Type R sump inlet will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and be conveyed via a 36" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 10 (Q_5 = 20 cfs and Q_{100} = 49 cfs).** The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the Grand Prix cul-de-sac.

Design Point 9 (Q_5 = 9 cfs and Q_{100} = 19 cfs) and **Design Point 10** (Q_5 = 2 cfs and Q_{100} = 5 cfs) collect developed flows from Basins OS-5, N and O. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 36" RCP storm sewer in an easterly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 12 (Q_5 = 10 cfs and Q_{100} = 23 cfs).** The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the natural channel. **Pipe Run 13 (Q_5 = 30 cfs and Q_{100} = 71 cfs)** represents the combined pipe flows from Pipe Runs 10 and 12. This 42" RCP storm sewer will route these developed flows directly into Pond 1. This pond inflow is designated later in this report as the westerly pond inflow.

See revised map and text

Basin OS-1 (Q_5 = 0.6 cfs and Q_{100} = 1.3 cfs) develops flows from the existing Akers Dr. roadway, north of the highpoint, that will continue to drain in a northerly direction as curb and gutter flow. **Basin C** (Q_5 = 0.5 cfs and Q_{100} = 1 cfs) develops flows from the existing Akers Dr. parkway landscape area adjacent to the roadway that will sheet flow into the road and continue to travel in a southerly direction. **Basin G** (Q_5 = 0.7 cfs and Q_{100} = 1.4 cfs) develops flows from a small portion of the proposed lots and roadway that cannot be collected on-site. These minor flow will continue to drain in a northerly direction directly into Winslow Park Dr. **Basin B** (Q_5 = 2 cfs and Q_{100} = 4 cfs), **Basin** H (Q_5 = 1 cfs and Q_{100} = 2 cfs) and **Basin P** (Q_5 = 2 cfs and Q_{100} = 4 cfs) develop flows from the rear yards of the proposed lots that cannot be reasonably collected by Pond 1. These areas are mainly landscaped backyards with any impervious areas

There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility. Or adjust the overall plan accordingly.

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HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Individual on-site developed basin design used for inlet sizing and storm system routing was calculated using the Rational Method. Full-Spectrum detention pond modeling developed using UD-Detention spreadsheet ver. 3.07, Urban Drainage and Flood Control District.

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.

This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed impervious areas (roof tops, patios) will sheet flow across landscaped yards and through open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.

2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the front yards, these flows will travel via curb and gutter within the public streets and eventually public storm systems. These collected flows are then routed directly to the full-spectrum detention facility on-site (Pond 1). Where developed flows are not able to be routed to public streets (rear yards), sheet flows will travel towards the natural drainage channel within the open space corridor. This corridor will be protected with rip-rap and erosion control matting as required to reduce velocities to erosive levels.

Non-Erosive

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3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in the proposed full-spectrum permanent Extended Detention Basin (Pond 1) designed per current El Paso County drainage criteria.

4. **Consider need for Industrial and Commercial BMPs**: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative has been submitted along with the grading and erosion control plan. Details such as site specific source control construction BMP's as well as permanent BMP's were detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C0752F, with effective dates of March 17, 1997 (See Appendix).

EROSION CONTROL PLAN

The Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request that the Erosion Control Plan and cost estimate be submitted in conjunction with the Overlot Grading Plan and construction assurances posted prior to obtaining a grading permit.

DRAINAGE & BRIDGE FEES

This site lies within the Sand Creek Drainage Basin. The fees are calculated using the following impervious acreage method approved by El Paso County. All three Filings are re-plats of previously platted tracts within Filing 1. However, these tracts were designated as future development and no fees were paid at time of original platting. Thus, the percent imperviousness for each Filing is calculated below based on the following acreages:

There needs to be a section that discusses the upstream abandoned Chicago and Rock Island Pacific railroad embankment and the concrete box. Please clearly state in this report:
A. What the hazard is. (the amount of ponding, box and/or embankment failure, etc.)
B. The importance that the box culvert and embankment are periodically observed and maintained and who is responsible for this work.

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see additional text now added.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.14	0.15	0.16	0.17	0.17	0.18	0.08	25	0.5	7.3	230	1.0%	2.0	1.9	9.2	3.35	4.25	4.96	5.66	6.37	7.13	0.5	0.6	1.3
OS-2	0.22	0.23	0.25	0.26	0.27	0.28	0.08	25	0.5	7.3	320	1.0%	2.0	2.7	10.0	3.30	4.13	4.82	5.51	6.20	6.93	0.7	1	2
OS-3	0.01	0.02	0.04	0.07	0.08	0.09	0.08	100	10	8.6					8.6	3.47	4.35	5.08	5.80	6.53	7.31	0.02	0.1	0.7
OS-4	0.07	0.27	0.51	0.85	1.02	1.19	0.08	180	10	14.0					14.0	2.89	3.62	4.22	4.83	5.43	6.08	0.2	1	7
OS-5	0.29	0.30	0.31	0.32	0.32	0.33	0.08	10	0.2	4.6	470	2.8%	3.3	2.3	7.0	3.72	4.67	5.45	6.23	7.01	7.84	1.1	1	3
A	1.52	1.68	1.83	2.03	2.15	2.22	0.43	100	2	9.6	750	1.5%	2.4	5.1	14.7	2.83	3.55	4.14	4.73	5.32	5.96	4	6	13
B	0.31	0.34	0.38	0.42	0.44	0.46	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	2	4
C	0.08	0.09	0.10	0.11	0.12	0.12	0.43	20	0.4	4.3					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.3	0.5	1
D	2.18	2.41	2.63	2.91	3.08	3.19	0.43	100	2	9.6	575	4.0%	4.0	2.4	12.0	3.08	3.85	4.50	5.14	5.78	6.47	7	9	21
E	0.37	0.41	0.45	0.50	0.53	0.55	0.43	50	1	6.8	375	2.7%	3.3	1.9	8.7	3.46	4.34	5.06	5.78	6.51	7.28	1	2	4
F	0.14	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8					6.8	3.75	4.71	5.49	6.28	7.06	7.90	0.5	0.7	1.4
G	0.15	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8	60	1.5%	2.4	0.4	7.2	3.68	4.62	5.39	6.16	6.93	7.76	0.5	0.7	1.4
H	0.16	0.17	0.19	0.21	0.22	0.23	0.43	30	0.6	5.3					5.3	4.06	5.09	5.94	6.79	7.64	8.55	1	1	2
I	Not Used																							
J	2.07	2.28	2.49	2.76	2.92	3.02	0.43	100	2	9.6	850	1.5%	2.4	5.8	15.4	2.78	3.48	4.06	4.64	5.22	5.84	6	8	18
K	1.40	1.55	1.69	1.87	1.98	2.05	0.43	100	2	9.6	425	1.5%	2.4	2.9	12.5	3.03	3.79	4.42	5.06	5.69	6.37	4	6	13
L	0.80	0.89	1.08	1.20	1.27	1.31	0.43	100	2	9.6	510	2.5%	3.2	2.7	12.3	3.05	3.82	4.46	5.09	5.73	6.41	3	4	8
M	0.66	0.73	0.80	0.88	0.94	0.97	0.43	50	1	6.8	475	1.5%	2.4	3.2	10.0	3.29	4.12	4.81	5.50	6.19	6.92	2	3	7
N	1.99	2.19	2.40	2.66	2.81	2.91	0.43	100	2	9.6	975	2.0%	2.8	5.7	15.4	2.78	3.48	4.07	4.65	5.23	5.85	6	8	17
O	0.47	0.52	0.56	0.62	0.66	0.68	0.43	50	1	6.8	575	2.0%	2.8	3.4	10.2	3.27	4.10	4.78	5.47	6.15	6.88	1.6	2	5
P	0.30	0.33	0.36	0.40	0.42	0.44	0.43	50	6	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.2	2	4
Q	0.40	0.57	0.77	1.04	1.19	1.32	0.08	260	5	23.9					23.9	2.26	2.82	3.29	3.76	4.23	4.73	1	2	6

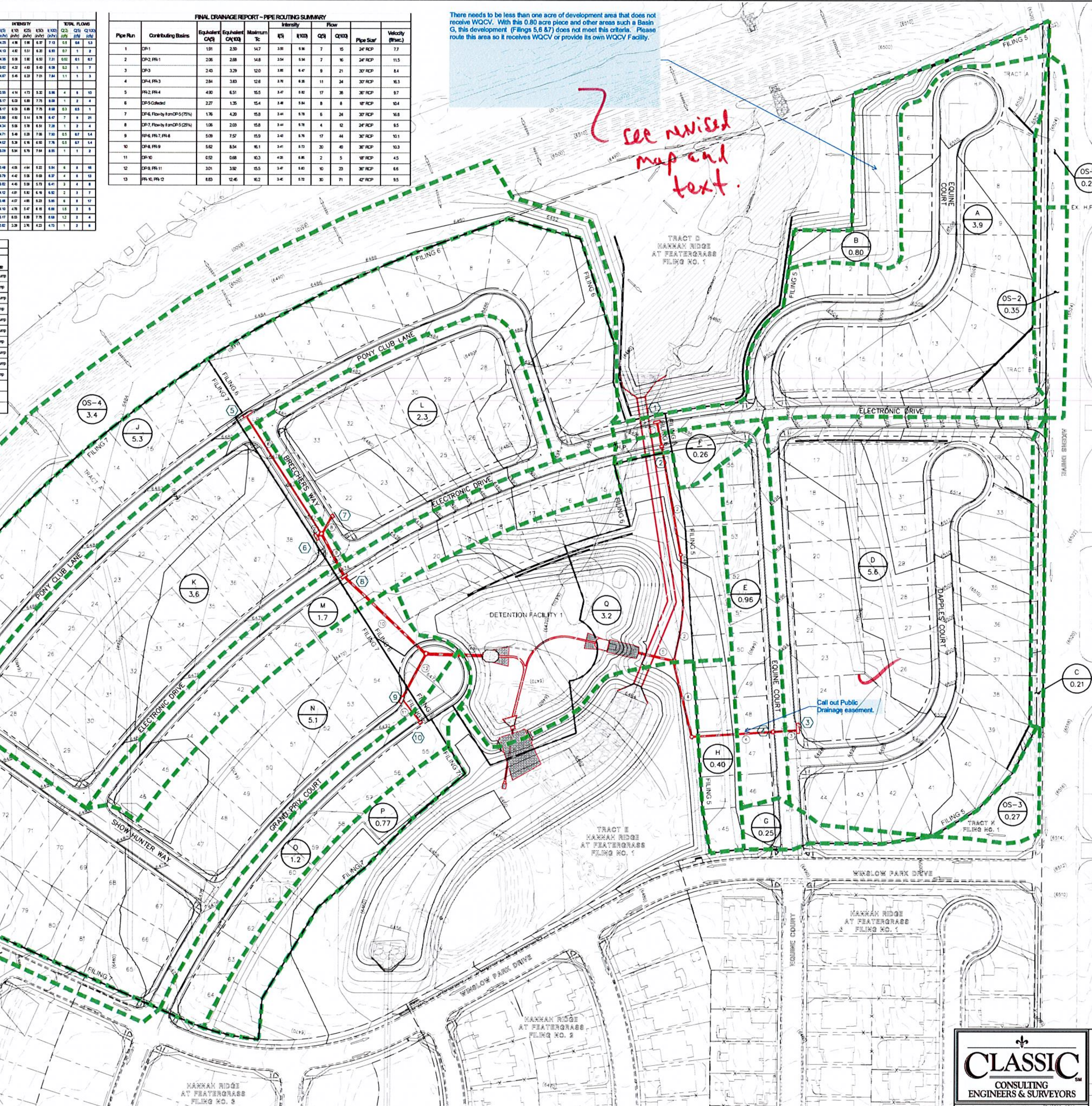
FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

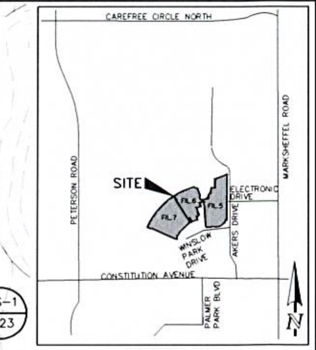
Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Inlet Size
1	A, OS-2	1.91	2.50	14.7	3.55	5.96	7	15	10' Type R Sump
2	F	0.15	0.18	6.8	4.71	7.90	0.7	1.4	5' Type R Sump
3	D, OS-3	2.43	3.29	12.0	3.85	6.47	9	21	15' Type R Sump
4	E	0.41	0.55	8.7	4.34	7.28	2	4	5' Type R Sump
5	OS-4, J	2.55	4.21	15.4	3.48	5.84	9	25	15' Type R Sump
6	K, DP-5 Flowby (75%)	1.76	4.20	15.8	3.44	5.78	6	24	10' Type R Sump
7	L, DP-5 Flowby (25%)	1.06	2.03	15.8	3.44	5.78	4	12	5' Type R Sump
8	M	0.73	0.97	10.0	4.12	6.92	3	7	10' Type R Sump
9	N, OS-5	2.49	3.23	15.4	3.48	5.85	9	19	10' Type R Sump
10	O	0.52	0.68	10.2	4.10	6.88	2	5	5' Type R Sump
ELY INFLOW TO POND	DP1 - DP4	4.90	6.51	15.5	3.47	5.82	17	38	
WLY INFLOW TO POND	DP5 - DP-10	8.83	12.46	16.2	3.40	5.72	30	71	
TOTAL INFLOW TO POND	OS-2, OS-3, OS-4, OS-5, A, D, E, F, J, K, L, M, N, O, Q	See UD-Detention Spreadsheet					44	103	

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Pipe Size*	Velocity (ft/sec.)
1	DP-1	1.91	2.50	14.7	3.55	5.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	14.8	3.54	5.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	12.0	3.85	6.47	9	21	30" RCP	8.4
4	DP-4, PR-3	2.84	3.83	12.6	3.78	6.35	11	24	30" RCP	16.3
5	PR-2, PR-4	4.90	6.51	15.5	3.47	5.82	17	38	36" RCP	9.7
6	DP-5 Collected	2.27	1.35	15.4	3.48	5.84	8	8	18" RCP	10.4
7	DP-6, Flow-by from DP-5 (75%)	1.76	4.20	15.8	3.44	5.78	6	24	30" RCP	16.8
8	DP-7, Flow-by from DP-5 (25%)	1.06	2.03	15.8	3.44	5.78	4	12	24" RCP	9.5
9	RP-6, PR-7, PR-8	5.09	7.57	15.9	3.43	5.76	17	44	36" RCP	10.1
10	DP-8, PR-9	5.82	8.54	16.1	3.41	5.73	20	49	36" RCP	10.3
11	DP-10	0.52	0.68	10.3	4.08	6.85	2	5	18" RCP	4.5
12	DP-9, PR-11	3.01	3.92	15.5	3.47	5.83	10	23	36" RCP	6.6
13	PR-10, PR-12	8.83	12.46	16.2	3.40	5.72	30	71	42" RCP	9.5

There needs to be less than one acre of development area that does not receive WQCV. With this 0.80 acre piece and other areas such a Basin G, this development (Filings 5,6 &7) does not meet this criteria. Please route this area so it receives WQCV or provide its own WQCV Facility.





VICINITY MAP
N.T.S.

FLOOD PLAIN STATEMENT:
NO PORTION OF THIS SITE IS LOCATED WITHIN A FEMA FLOODPLAIN AS DETERMINED BY THE FLOOD INSURANCE RATE MAPS (F.I.R.M.) MAP NUMBERS 08041C 0752F, WITH EFFECTIVE DATES OF MARCH 17, 1997 (SEE APPENDIX).

NOTES:
THIS MAP IS FOR DRAINAGE PURPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.

POND DESIGN DATA:
TRIBUTARY ACREAGE = 37.5 AC. @ 60% IMP
WQCV REQ. = 0.74 AC-FT
EURV REQ. = 2.44 AC-FT

RELEASE:
Q5 = 0.85 cfs @ WSE = 6467.21 (2.6 AC-FT)
Q100 = 38 cfs @ WSE = 6468.90 (4.4 AC-FT)

EMERGENCY SPILLWAY ELEV. = 6469.00
EMERGENCY OVERFLOW ELEV. = 6469.87

N

60 30 0 60 120
SCALE: 1" = 60'

LEGEND

- EXISTING GROUND CONTOUR — 6650
- PROPOSED FINISHED CONTOUR — 6650
- SUBDIVISION BOUNDARY
- LOT LINE
- PROPOSED BASIN BOUNDARY
- EXISTING FLOW DIRECTION
- DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- LOW POINT/HIGH POINT — LP/HP
- BASIN IDENTIFIER / AREA IN ACRES — DD 1.41
- PIPE RUN — 1
- DESIGN POINT — 3

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HANNAH RIDGE AT FEATHERGRASS
FILING NO. 5, 6 AND 7
FINAL DRAINAGE REPORT
PROPOSED CONDITIONS DRAINAGE MAP

DESIGNED BY MAW	SCALE	DATE 08/27/18	
DRAWN BY KC	(H) 1"= 60'	SHEET 1 OF 1	
CHECKED BY	(V) 1"= N/A	JOB NO. 1116.05	