DRAINAGE ADDENDUM FOR
MASTER DEVELOPMENT DRAINAGE PLAN FOR
GOLD HILL MESA AMENDMENT AND
GOLD HILL MESA FILING 9 &10
PRELIMINARY/FINAL DRAINAGE REPORT
COLORADO SPRINGS, COLORADO

JUNE 2019

Prepared For:

GOLD HILL NEIGHBORHOOD, LLC
142 S. RAVEN MINE DRIVE
COLORADO SPRINGS, COLORADO
(719) 633-2202

Prepared By:

TERRA NOVA ENGINEERING, INC.
721 S. 23RD STREET
Colorado Springs, CO 8090
(719) 635-6422

Job No. 1713.00

DRAINAGE ADDENDUM FOR MASTER DEVELOPMENT DRAINAGE PLAN FOR GOLD HILL MESA AMENDMENT AND GOLD HILL MESA FILING 9 &10 PRELIMINARY/FINAL DRAINAGE REPORT

ENGINEER'S STATEMENT:

This report and plan for the final drainage design of "Gold Hill Mesa Filing 9 &10" was prepared by me (or under my direct supervision) andis correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that City of Colorado Sprigs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or emissions on my part in preparing this report.

Quentin N. Armijo, P.E. 37170 — 6/12/19
Quentin N. Armijo, P.E. 37170 — Date

COLORADO REGISTERED QUENTIN N. ARMIJO 37170 PROFESSIONAL ENGINEER
Seal

DEVELOPER'S STATEMENT:

Gold Hill Neighborhood, LLC hereby certifies that the drainage facilities for Gold Hill Mesa Filing 9 &10 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Gold Hill Mesa Filing 9 &10, guarantee that the final drainage design review will absolve Gold Hill Neighborhood, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Gold Hill Neighborhood, LLC
Name of Developer

Stephanie D. Edwards 6/12/2019
Authorized Signature — Date

Stephanie Edwards
Printed Name

Vice President
Title

142 S Raven mine Drive Colorado Springs, CO 80904
Address

City of Colorado Springs Statement:

Filed in accordance with Section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended.

Jonathan B. Adelberger
For City Engineer

06/24/2019
Date

June 11, 2019

City of Colorado Springs
Subdivision Engineering Review Team
30 S. Nevada, Suite 401
Colorado Springs, CO 80903

Attn: Mr. Jonathan Scherer

RE: Drainage Addendum for Master Development Drainage Plan for Gold Hill Mesa Amendment and Gold Hill Mesa Filing 9 &10 Preliminary/Final Drainage Report

Dear Mr. Scherer:

This letter is submitted for the Gold Hill Mesa Filing No. 9 & 10 subdivision as an addendum to the original Master Development Drainage Plan for Gold Hill Mesa Amendment and Gold Hill Mesa Filing 9 &10 Preliminary/Final Drainage Report. The intent of this Drainage Addendum is to update the Hydraulic Grade Line Calculations. The public storm for Gold Hill Mesa Filing No. 9 & 10 were previously studied in the "Master Development Drainage Plan for Gold Hill Mesa Amendment and Gold Hill Mesa Filing 9 &10 Preliminary/Final Drainage Report, prepared by Terra Nova Engineering, Inc., June 2018. This report was submitted at the time for the Development Plan for both Filings 9 & 10 and the Final Plat for Filing 9. The property is located in the east half of Section 14 and west half of section 13, Township 14 South, Range 67 West of the 6th Principal Meridian in the city of Colorado Springs, Colorado, southeast of the intersection of US Highway 24 and 21st Street. (See vicinity map) More specifically, the site is bounded to the north and east by undeveloped Gold Hill Mesa open space, to the south by Gold Hill Mesa Filing No. 9, and the west by Gold Hill Mesa Filing No. 6.

In the final public storm sewer design for Gold Hill Mesa Filing No. 9, Pipe run 1 a public 24" RCP in the original design was changed to a public 19" x 30" elliptical pipe to obtain more cover over the pipe. The Hydraulic Grade Line Calculations were revised slightly due to the change in pipe and the new ones have been attached.

In Gold Hill Mesa Filing No. 10 the slope and pipe sizes changed from the original drainage report submittal due to a more detailed final design of Pipe runs 5A, 5 & 6. This final design was re-ran in the UDSEWER program for new HGL calculations.

Runoff as described in the Master Development Drainage Plan for Gold Hill Mesa Amendment and Gold Hill Mesa Filing 9 &10 Preliminary/Final Drainage Report will be the same quantities and follow the same drainage patterns. Attached in the appendix are the revised Hydraulic Grade Line Calculations that show the final design of the Public Storm Sewer for Gold Hill Mesa Filing Nos. 9 & 10 and should supersede the calculations in the original report on file.

Sincerely,
TERRA NOVA ENGINEERING, INC.

Quentin Armijo, P.E.
Senior Project Manager

N:\jobs\1713.00\drainage\Drainage Addendum 9 & 10.doc

HGL CALCULATIONS

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
6/12/2019 10:59:07 AM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPE RUNS 1 & 2, 5-YEAR

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.25
Maximum Rural Overland Len. (ft): 100
Maximum Urban Overland Len. (ft): 100
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6152.95

Manhole Input Summary:

	Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6156.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 2	6157.20	13.20	0.00	5.53	0.80	0.70	100.00	2.00	520.00	2.83
PIP RUN 1	6157.20	6.70	0.00	2.78	0.80	0.70	100.00	2.00	520.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	6.65	1.99	86.08	13.20	
PIPE RUN 2	5.75	3.06	8.81	7.16	31.65	6.65	1.99	86.08	13.20	
PIP RUN 1	5.75	3.06	8.81	7.16	15.91	2.22	3.01	46.53	6.70	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)

PIPE RUN 2	76.61	6151.10	1.5	6152.25	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIP RUN 1	29.34	6152.75	2.0	6153.34	0.013	1.32	0.00	ELLIPSE	19.00 in	30.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 2	50.37	10.26	14.66	5.54	10.48	8.64	1.90	Supercritical	13.20	0.00	
PIP RUN 1	32.08	11.78	10.94	4.74	7.39	8.06	2.13	Supercritical	6.70	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 2	13.20	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
PIP RUN 1	6.70	ELLIPSE	19.00 in	30.00 in	18.00 in	18.00 in	19.00 in	30.00 in	2.72	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6152.95

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
PIPE RUN 2	6151.10	6152.25	0.00	0.00	6152.95	6153.47	6153.13	0.81	6153.95
PIP RUN 1	6152.75	6153.34	0.12	0.00	6153.60	6154.25	6154.38	0.22	6154.60

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

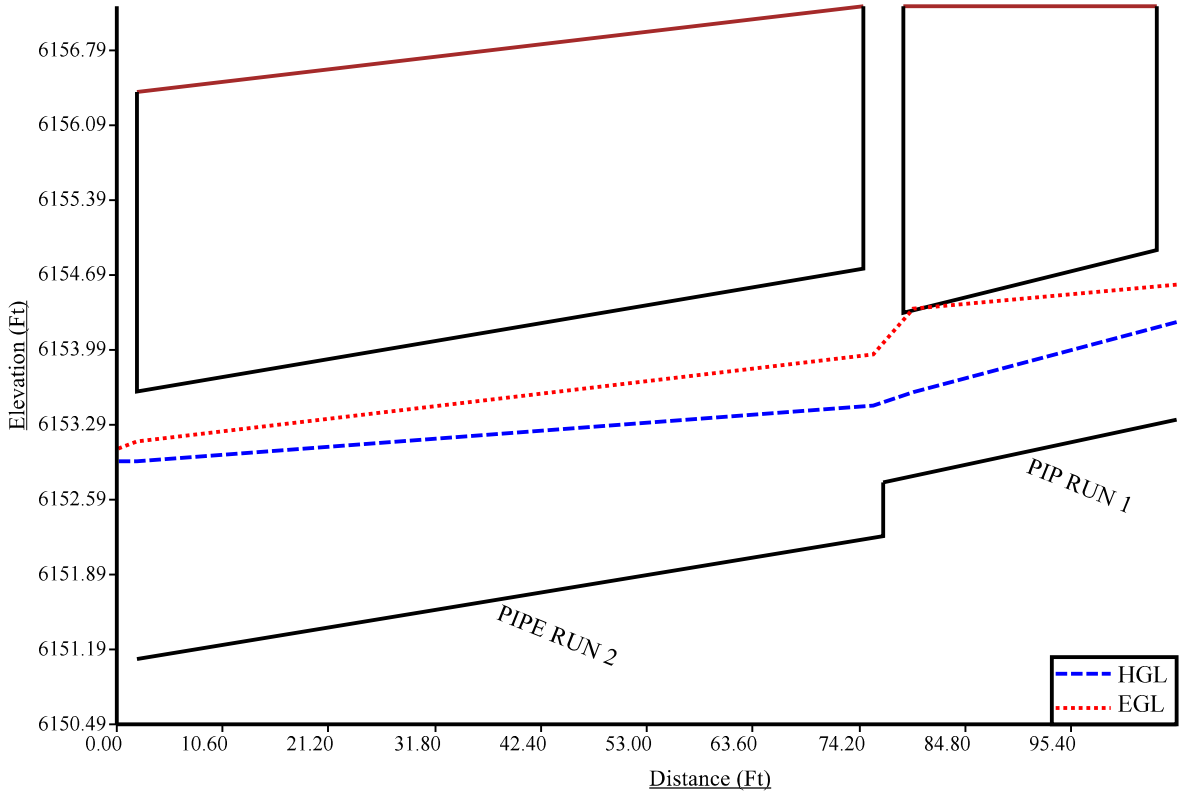
The trench side slope is 1.0 ft/ft
The minimum trench width is 4.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE RUN 2	76.61	3.50	6.00	6.08	9.10	6.09	2.51	8.40	5.74	2.16	107.25	
PIP RUN 1	29.34	3.50	6.00	6.08	9.23	5.24	2.57	8.05	4.65	1.99	34.56	Sewer Too Shallow

Total earth volume for sewer trenches = 142 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PR 1-2 5-YEAR


6156.79
6156.09
6155.39
6154.69
6153.99
6153.29
6152.59
6151.89
6151.19
6150.49
Elevation (Ft)
0.00
10.60
21.20
31.80
42.40
53.00
63.60
74.20
84.80
95.40
Distance (Ft)
PIP RUN 1
PIPE RUN 2
HGL
EGL

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
6/12/2019 10:53:44 AM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPE RUNS 1 & 2, 100-YEAR

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.25
Maximum Rural Overland Len. (ft): 100
Maximum Urban Overland Len. (ft): 100
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6152.95

Manhole Input Summary:

	Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6156.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 2	6157.20	26.40	0.00	5.53	0.80	0.80	100.00	2.00	520.00	2.83
PIP RUN 1	6157.20	13.20	0.00	2.78	0.80	0.80	100.00	2.00	520.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	6.65	3.97	29.78	26.40	
PIPE RUN 2	4.31	3.06	7.37	7.62	33.69	6.65	3.97	29.78	26.40	
PIP RUN 1	4.31	3.06	7.37	7.62	16.94	2.22	5.94	13.86	13.20	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)

PIPE RUN 2	76.61	6151.10	1.5	6152.25	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIP RUN 1	29.34	6152.75	2.0	6153.34	0.013	1.32	0.00	ELLIPSE	19.00 in	30.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 2	50.37	10.26	21.02	7.19	15.42	10.38	1.81	Supercritical	26.40	0.00	
PIP RUN 1	32.08	11.78	15.59	6.00	10.62	9.71	2.09	Pressurized	13.20	29.34	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 2	26.40	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIP RUN 1	13.20	ELLIPSE	19.00 in	30.00 in	18.00 in	18.00 in	19.00 in	30.00 in	2.72	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6152.95

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
PIPE RUN 2	6151.10	6152.25	0.00	0.00	6152.95	6154.00	6154.06	0.74	6154.80
PIP RUN 1	6152.75	6153.34	0.48	0.00	6154.92	6155.02	6155.28	0.10	6155.38

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

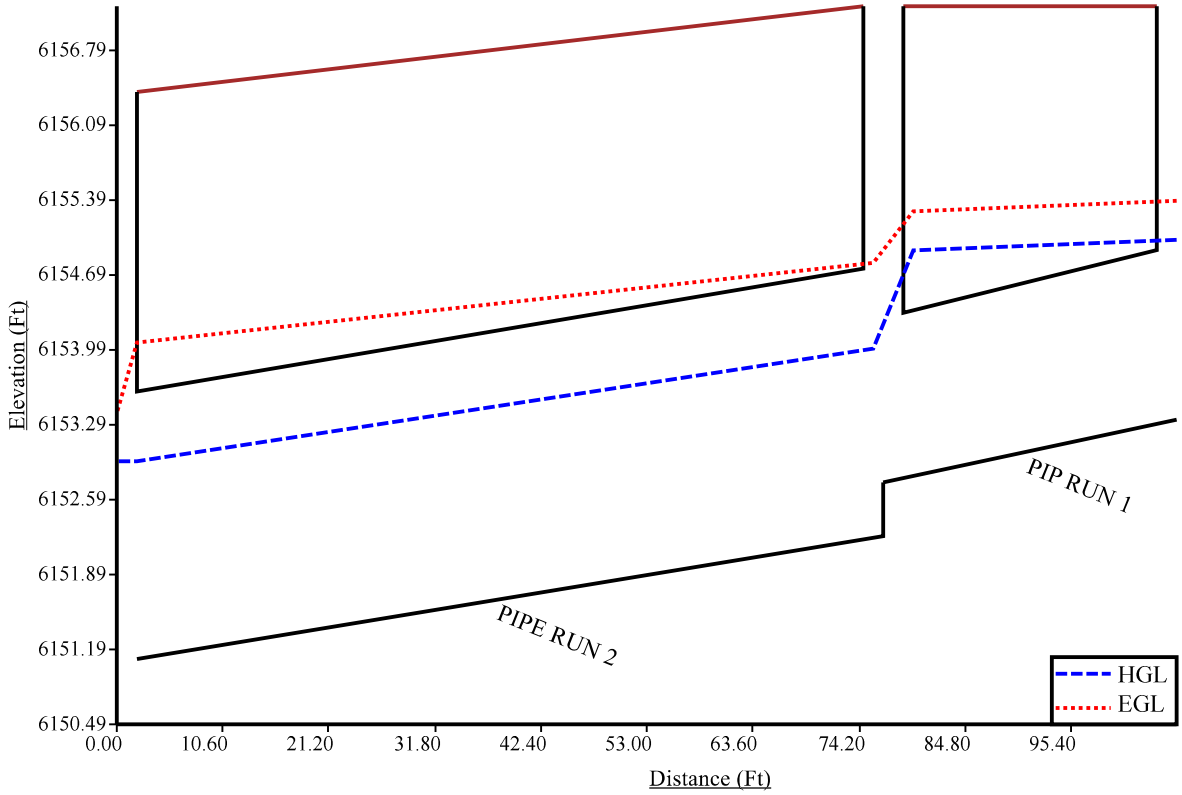
The trench side slope is 1.0 ft/ft
The minimum trench width is 4.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE RUN 2	76.61	3.50	6.00	6.08	9.10	6.09	2.51	8.40	5.74	2.16	107.25	
PIP RUN 1	29.34	3.50	6.00	6.08	9.23	5.24	2.57	8.05	4.65	1.99	34.56	Sewer Too Shallow

Total earth volume for sewer trenches = 142 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PR1-2 100-YEAR



Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
6/12/2019 11:57:55 AM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPE RUNS 5A, 5 & 6, 5-YEAR

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6134.50

Manhole Input Summary:

	Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6152.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 6	6151.12	20.40	0.00	11.39	0.80	0.70	100.00	2.00	500.00	2.83
PIPE RUN 5	6151.12	13.70	0.00	5.69	0.80	0.70	100.00	2.00	500.00	2.83
PIPE RUN 5A	6159.20	6.90	0.00	3.16	0.80	0.70	100.00	2.00	500.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE RUN 6	5.75	2.94	8.69	NaN	NaN	16.19	1.26	NaN	20.40	
PIPE RUN 5	5.75	2.94	8.69	NaN	NaN	7.08	1.94	NaN	13.70	
PIPE RUN 5A	5.75	2.94	8.69	NaN	NaN	2.53	2.73	NaN	6.90	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element	Sewer	Downstream	Slope	Upstream	Mannings	Bend	Lateral	Cross	Rise	Span

Name	Length (ft)	Invert (ft)	(%)	Invert (ft)	n	Loss	Loss	Section	(ft or in)	(ft or in)
PIPE RUN 6	59.24	6144.56	1.0	6145.15	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 5	29.34	6145.34	2.6	6146.10	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 5A	360.54	6147.15	2.2	6155.08	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE RUN 6	41.13	8.38	18.40	6.46	14.93	8.36	1.49	Supercritical	20.40	0.00	
PIPE RUN 5	66.32	13.51	14.94	5.61	9.25	10.65	2.51	Supercritical	13.70	0.00	
PIPE RUN 5A	15.62	8.84	12.20	5.41	8.37	8.57	2.06	Supercritical	6.90	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PIPE RUN 6	20.40	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 5	13.70	CIRCULAR	30.00 in	30.00 in	18.00 in	18.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 5A	6.90	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6134.50

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 6	6144.56	6145.15	0.00	0.00	6145.80	6146.68	6146.89	0.44	6147.33
PIPE RUN 5	6145.34	6146.10	0.16	0.00	6146.84	6147.51	6147.87	0.00	6147.87
PIPE RUN 5A	6147.15	6155.08	0.31	0.00	6147.85	6156.10	6148.99	7.57	6156.55

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

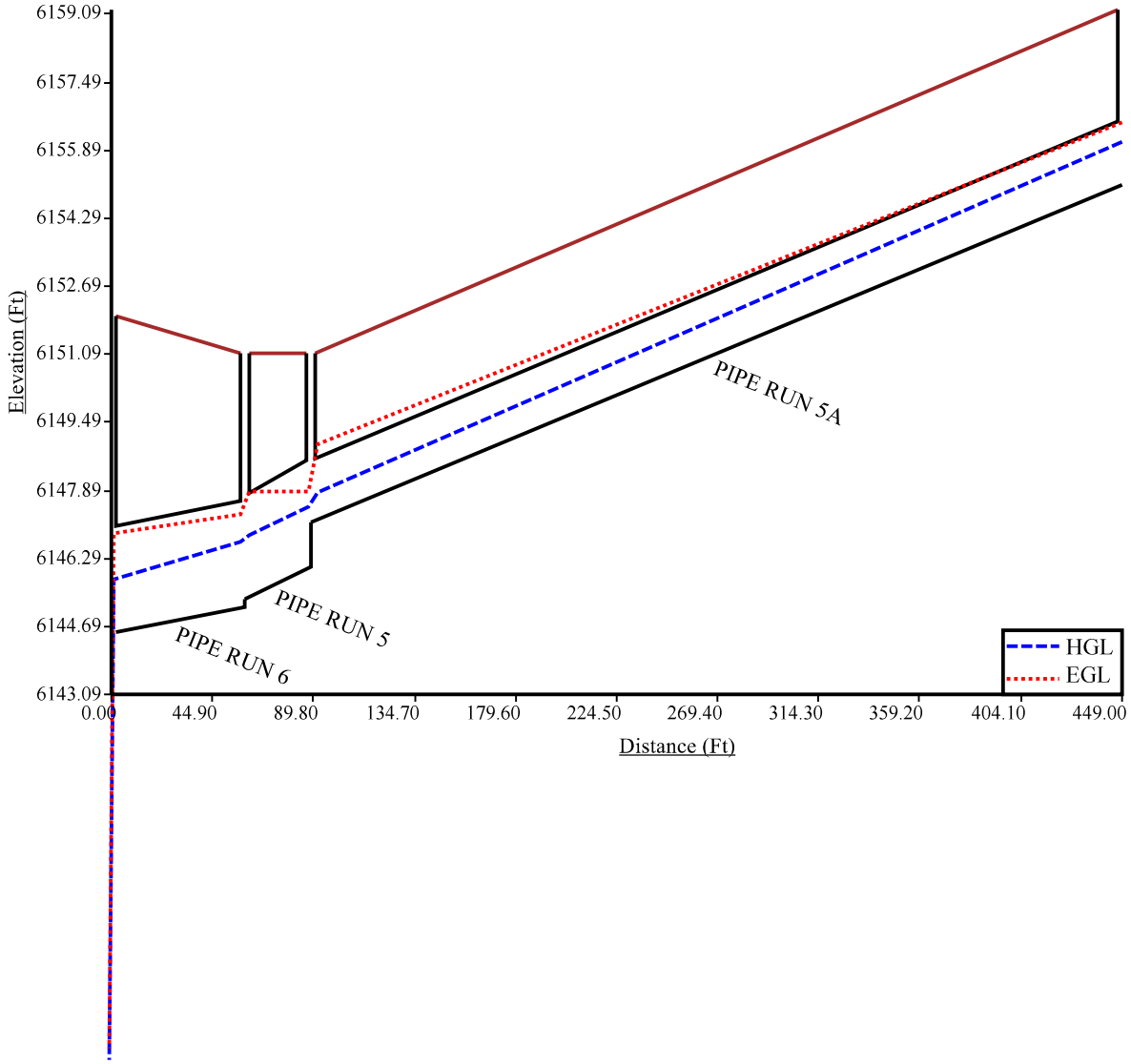
The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 6	59.24	3.50	6.00	6.08	13.38	8.23	4.65	10.44	6.76	3.18	119.90	
PIPE RUN 5	29.34	3.50	6.00	6.08	10.07	6.57	2.99	8.54	5.81	2.23	43.91	
PIPE RUN 5A	360.54	2.50	4.00	4.92	7.44	4.51	2.26	7.74	4.66	2.41	325.16	

Total earth volume for sewer trenches = 489 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:

PR 5A-6 5Y


6159.09
6157.49
6155.89
6154.29
6152.69
6151.09
6149.49
6147.89
6146.29
6144.69
6143.09
Elevation (Ft)
0.00
44.90
89.80
134.70
179.60
224.50
269.40
314.30
359.20
404.10
449.00
Distance (Ft)
PIPE RUN 5A
PIPE RUN 5
PIPE RUN 6
HGL
EGL

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
6/12/2019 11:53:35 AM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPE RUNS 5A, 5 & 6, 100-YEAR

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6134.50

Manhole Input Summary:

	Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6152.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 6	6151.12	40.40	0.00	11.39	0.80	0.70	100.00	2.00	500.00	2.83
PIPE RUN 5	6151.12	25.60	0.00	5.69	0.80	0.70	100.00	2.00	500.00	2.83
PIPE RUN 5A	6159.20	10.70	0.00	3.16	0.80	0.70	100.00	2.00	500.00	2.83

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE RUN 6	5.75	2.94	8.69	NaN	NaN	16.19	2.50	NaN	40.40	
PIPE RUN 5	5.75	2.94	8.69	NaN	NaN	7.08	3.62	NaN	25.60	
PIPE RUN 5A	5.75	2.94	8.69	NaN	NaN	2.53	4.23	NaN	10.70	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element	Sewer	Downstream	Slope	Upstream	Mannings	Bend	Lateral	Cross	Rise	Span

Name	Length (ft)	Invert (ft)	(%)	Invert (ft)	n	Loss	Loss	Section	(ft or in)	(ft or in)
PIPE RUN 6	59.61	6144.55	1.0	6145.15	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 5	29.34	6145.34	2.6	6146.10	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
PIPE RUN 5A	360.54	6147.15	2.2	6155.08	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE RUN 6	41.13	8.38	25.65	9.04	24.12	9.55	1.15	Supercritical	40.40	0.00	
PIPE RUN 5	36.58	11.64	21.32	8.68	14.79	12.60	2.17	Pressurized	25.60	29.34	
PIPE RUN 5A	15.62	8.84	15.06	6.77	10.94	9.52	1.92	Supercritical Jump	10.70	156.28	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PIPE RUN 6	40.40	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 5	25.60	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PIPE RUN 5A	10.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6134.50

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 6	6144.55	6145.15	0.00	0.00	6146.56	6147.29	6147.98	0.58	6148.56
PIPE RUN 5	6145.34	6146.10	1.36	0.00	6148.89	6149.26	6149.92	0.37	6150.29
PIPE RUN 5A	6147.15	6155.08	0.75	0.00	6150.47	6156.34	6151.04	6.01	6157.05

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 6	59.61	3.50	6.00	6.08	13.39	8.24	4.65	10.44	6.76	3.18	120.71	
PIPE RUN 5	29.34	3.00	4.00	5.50	10.57	6.37	3.53	9.04	5.60	2.77	40.96	
PIPE RUN 5A	360.54	2.50	4.00	4.92	7.44	4.51	2.26	7.74	4.66	2.41	325.16	

Total earth volume for sewer trenches = 487 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
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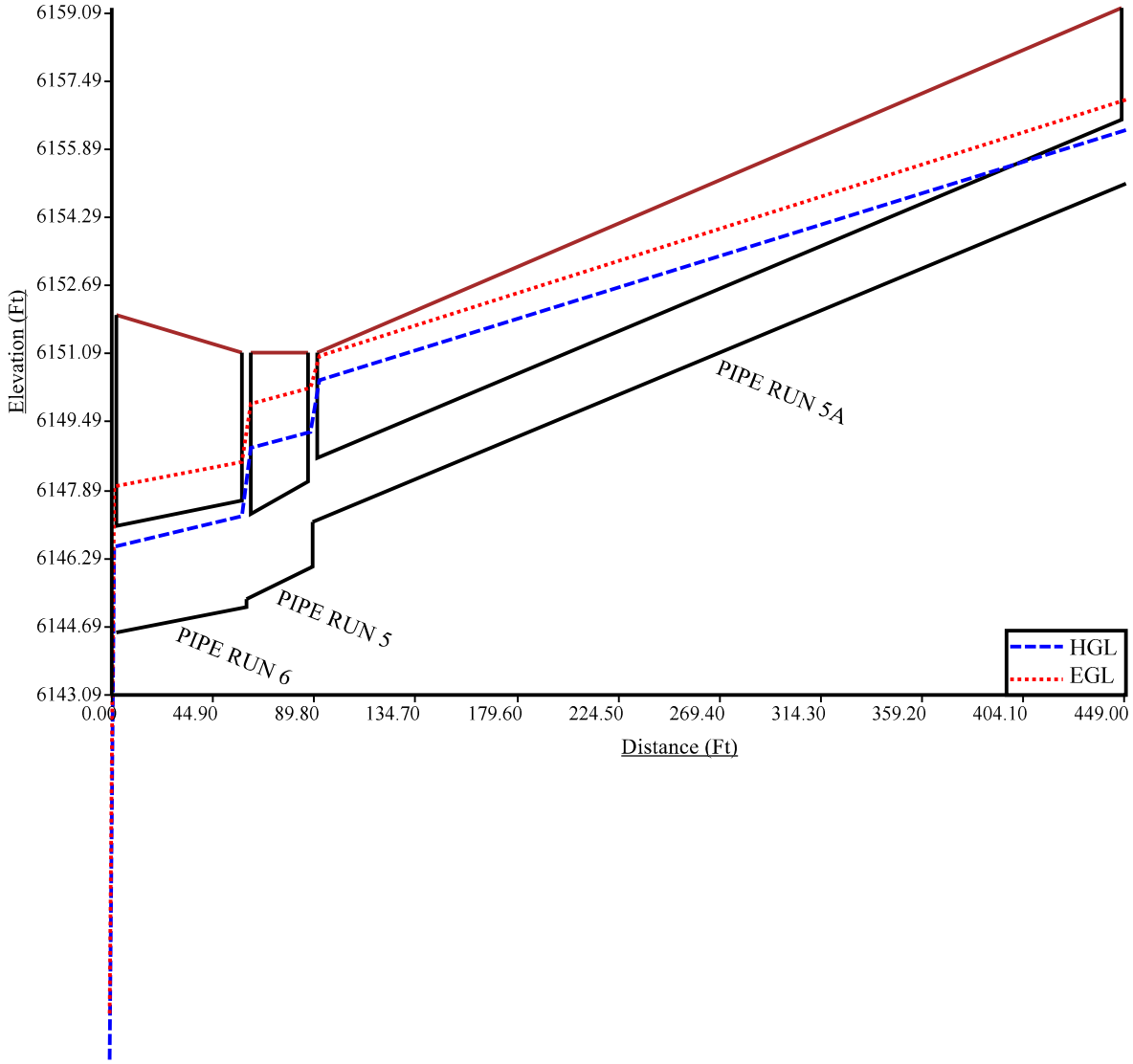
PR 5A-6 100Y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PIPE RUN 5
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HGL
EGL