

West Henderson Sewer Study

Bermuda Basin

City of Henderson

24 May 2019



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Introduction

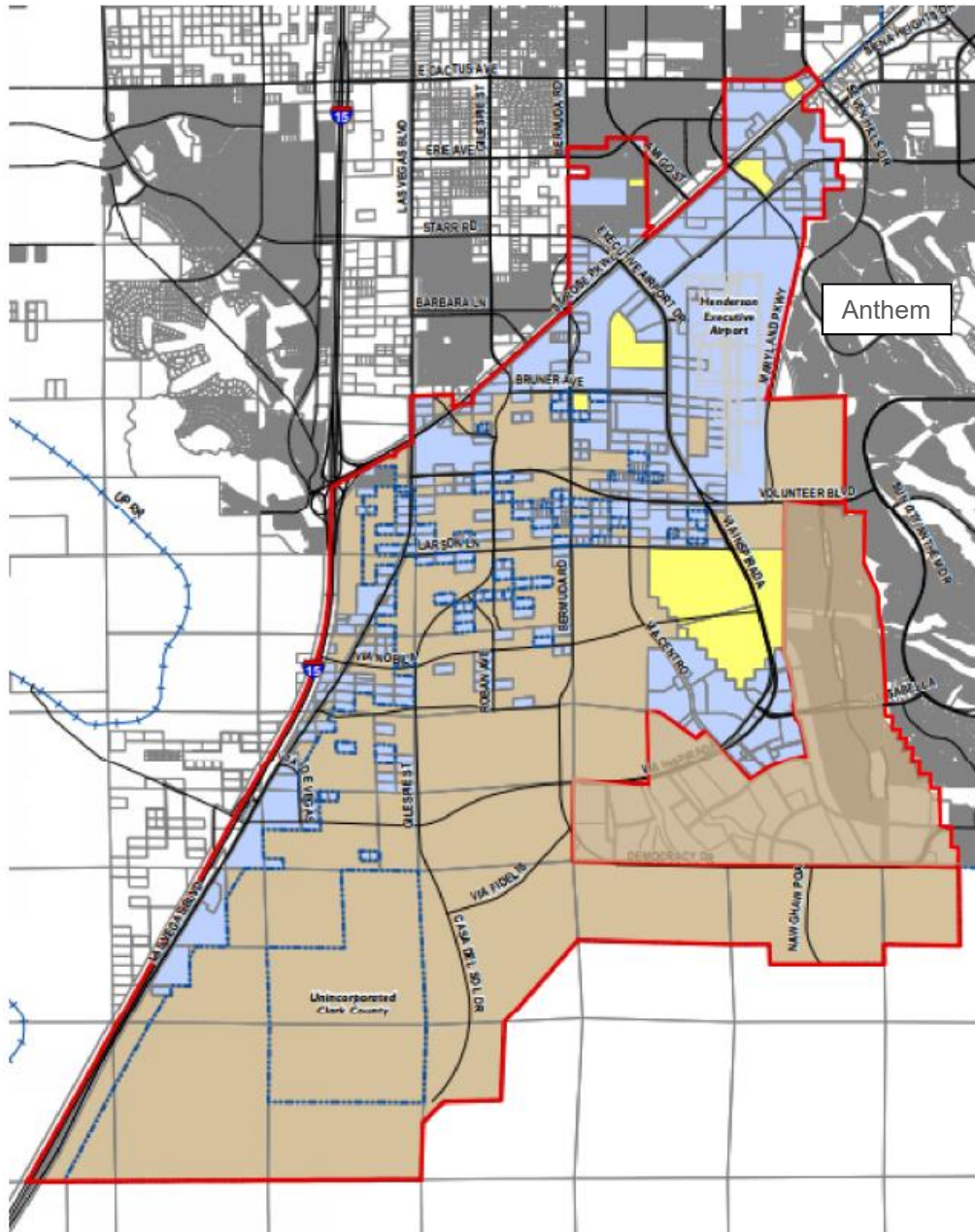
The West Henderson planning area consists of approximately 12,100 acres as identified in the City of Henderson's (City) 2017 Public Facility Needs Assessment. In order to determine the cost of the sewer backbone infrastructure to serve this area, the City needs to update the sewer master plan for the West Henderson planning area.

This report will provide the engineering basis for determining the size of the sewer infrastructure in the Bermuda Basin.

1. West Henderson Land Use

As stated above, the West Henderson planning area consists of approximately 12,100 acres. The area is located south of St. Rose Parkway, east of Interstate I-15 and west of the Anthem development as shown on Figure 1.

Figure 1 - West Henderson Planning Area



The West Henderson Land Use Plan was supplied by the City in the form of a GIS (geographic information system) map, which includes land use types shown in Table 1.

Table 1 - West Henderson Land Use Types

ID	Land Use Type
NT1	Neighborhood Type 1
NT2	Neighborhood Type 2
NT3	Neighborhood Type 3
NT4	Neighborhood Type 4
PC	Planned Community
PS	Public / Semi Public
NC	Neighborhood Commercial
COM	Commercial
HC	Highway Commercial
EC	Employment Center
TC	Tourist Commercial
UC	Urban Center
MU	Gateway Mixed Use
TOD	Transit Oriented Development
CO/RD	Office / Research & Development
LBI	Light Business / Industry
IND	Industrial
BI	Business / Industry

In the June 2017 West Henderson Land Use Plan Update, various Residential/Neighborhood Types were given densities or ranges of density. The following Land Use Types for residential were present in the areas for the Bermuda Basin:

Neighborhood Type 1: 4 units per gross acre

Neighborhood Type 2: 2 to 8 units per gross acre

Neighborhood Type 3: 8 to 16 units per gross acre

Neighborhood Type 4: 16 to 36 units per gross acre

Assumed densities used for the sewer analysis are presented in Table 2.

Table 2 - Residential Densities

Type of Development	Units per Gross Acre
Neighborhood Type 1	4
Neighborhood Type 2	6
Neighborhood Type 3	12
Neighborhood Type 4	26

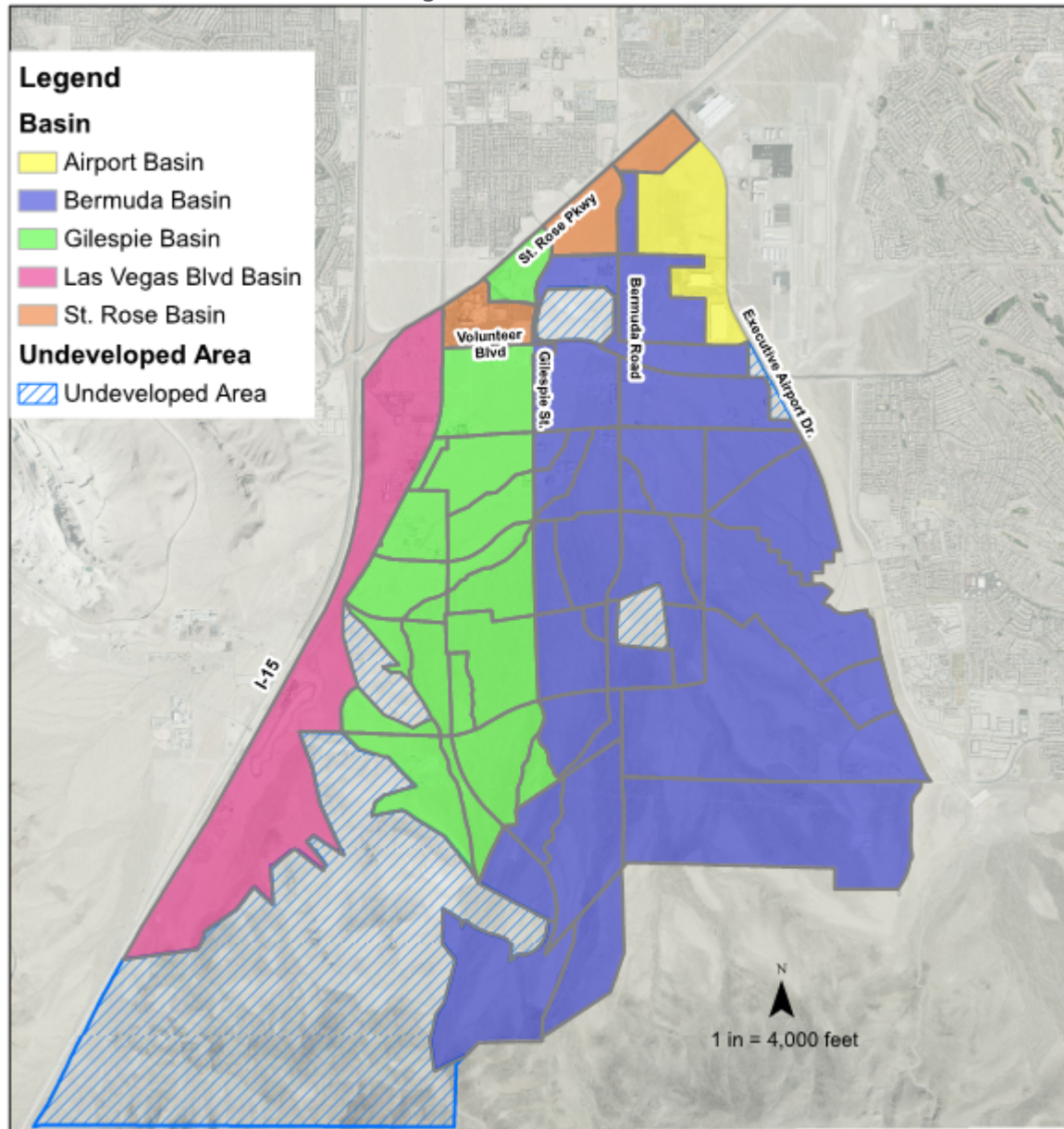
Major sewer basins in West Henderson, which are named according to the street name of the corresponding sewer alignment, include the Bermuda Basin, Giles pie Basin, St. Rose Basin, Las Vegas Boulevard Basin and Executive Airport Basin. Areas are shown on Figure 2.

Table 3 provides an estimate of the tributary acreage for each of the major sewer basins related to West Henderson.

Table 3 - Basin Areas

Basin	Area (Acres)
Bermuda	4,135
Giles pie	1,490
St. Rose	155
Las Vegas Blvd.	860
Executive Airport	250

Figure 2 - Sewer Basins



2. Constraints

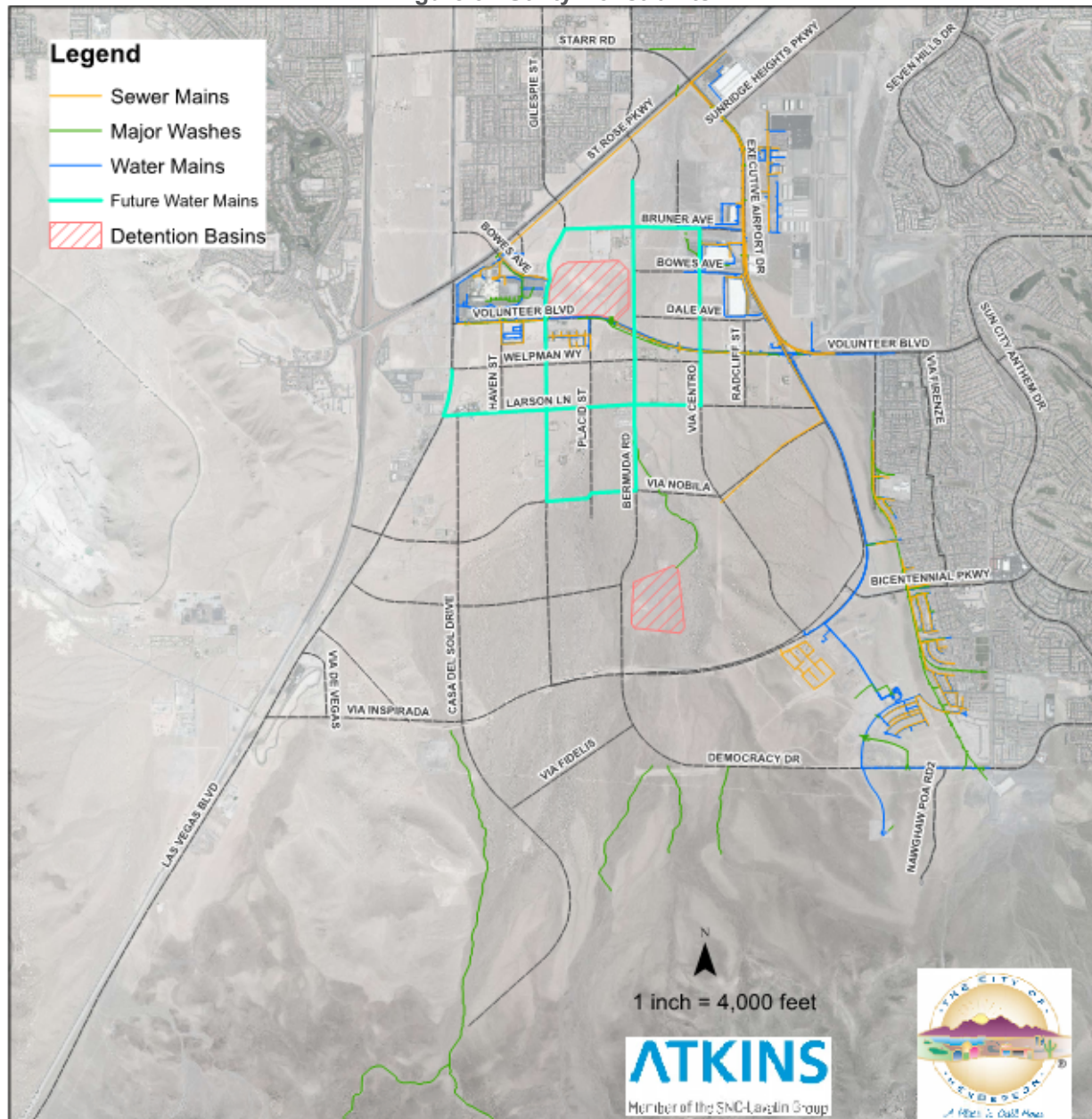
Utility constraints for the proposed Bermuda Sewer include facilities for storm drainage and water distribution, as shown on Figure 3.

In the study area there are numerous existing washes that will affect the depth of proposed sewer infrastructure. There are also existing and future detention basins that will affect future alignments. The Pittman North Detention Basin Outfall Channel is under construction on the west side of the proposed Bermuda Sewer just north of Bowes Avenue. Parcels west of Bermuda Road adjacent to the outfall channel are unable to access the Bermuda Sewer because it is on the other side of the outfall channel. A parallel sewer, which will cross the outfall channel further north, is required to serve these parcels.

A future detention basin, the North Bermuda Detention Basin, is located northeast of the intersection of Bermuda Road and Via Inspirada.

There are existing water lines and sewer lines in Volunteer Boulevard. Future pipelines are also being planned for this area.

Figure 3 - Utility Constraints



3. Wastewater Flow Projections

Wastewater flow projections are developed by applying standard wastewater contribution rates for average daily flow to the planning units from Chapter 1.

Peak flows were calculated using the ASCE (American Society of Civil Engineers) peaking factor. The following are criteria used in developing the wastewater flow projections:

- Average Flow = 250 gpd/ERU for residential or per Table 4 - Wastewater Contribution Rates for non-residential
- Peaking Factor = $[(\text{Average Flow in million gallons per day (MGD)})^{-0.0956}] 2.6186$

- Peak Dry Weather Flow = [(Average Flow in MGD)^{0.9044}] 2.6186
- Peak Wet Weather Flow = Peak Dry Weather Flow * 1.25
- Maximum depth/Diameter (d/D) = 0.75 with peak wet weather flow.
- Manning's n value = 0.013
- Downstream pipes sizes are equal to or greater diameter

Table 4 - Wastewater Contribution Rates

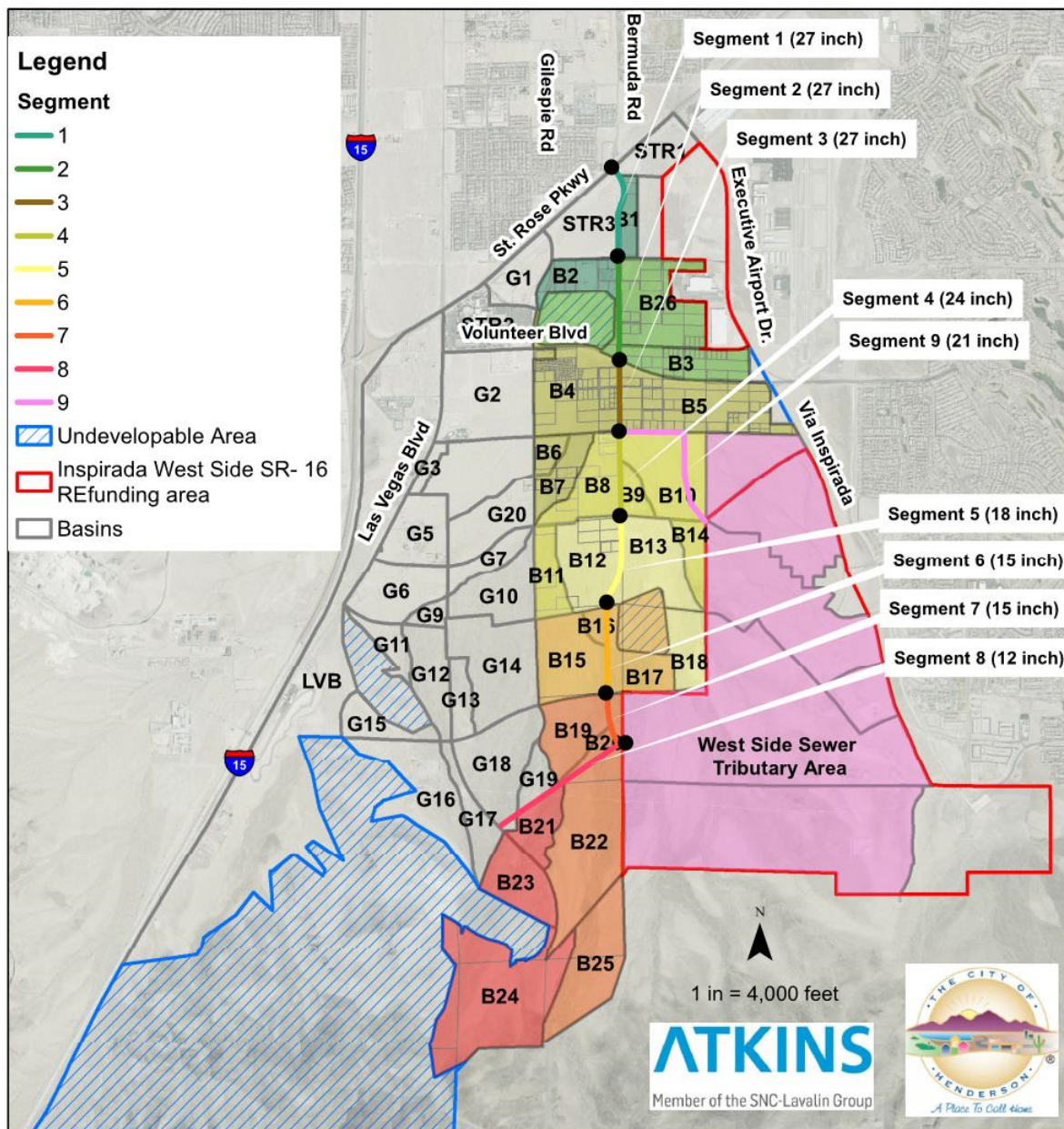
Code	Description	ERU Equivalent Residential Unit (ERU/unit)	Sewer Contribution Rate	Unit
DRL	Downtown Low Density Residential	1.0	0	gal/day/ERU
DRM	Downtown medium density residential	1.0	0	gal/day/ERU
DR	Downtown high density residential	0.7	0	gal/day/ERU
DHC	Downtown highway commercial		2,000	gal/day/acre
DCC	Downtown core commercial		2,000	gal/day/acre
DP	Downtown public/semi-public		2,000	gal/day/acre
RNP-1	Rural neighborhood preservation 1 du/ac	1.0	0	gal/day/ERU
RNP-2	Rural neighborhood preservation 2 du/ac	1.0	0	gal/day/ERU
VLDR	Very low density residential	1.0	0	gal/day/ERU
LDR	Low density residential	1.0	0	gal/day/ERU
MDR	Medium density residential	0.7	0	gal/day/ERU
HDR	High density residential	0.7	0	gal/day/ERU
NT1	Neighborhood type 1	1.0	0	gal/day/ERU
NT2	Neighborhood type 2	1.0	0	gal/day/ERU
NT3	Neighborhood type 3	1.0	0	gal/day/ERU
NT4	Neighborhood type 4	0.7	0	gal/day/ERU
PC	Planned community	1.0	0	gal/day/ERU
PS	Public/semi public		2,000	gal/day/acre
NC	Neighborhood commercial		2,000	gal/day/acre
COM	Commercial		2,000	gal/day/acre
HC	Highway commercial		2,000	gal/day/acre
EC	Employment center		2,000	gal/day/acre
TC	Tourist commercial		2,000	gal/day/acre

UC	Urban center		4,000	gal/day/acre
MU	Gateway mixed use		3,000	gal/day/acre
TOD	Transit oriented development		2,000	gal/day/acre
CO/RD	Office/research & development		2,000	gal/day/acre
LBI	Light business/industry		2,000	gal/day/acre
IND	Industrial		3,000	gal/day/acre
BI	Business/industry		2,000	gal/day/acre

The major sewer basins are further divided into sub-basins as shown on Figure 4. Bermuda Basin sub-basins have a B prefix such as B1, B2, etc. and Giles pie Basin sub-basins have a G prefix, etc. The sewer pipe is divided in nine segments as follows:

- Segment 1 – Bermuda Road from St. Rose Parkway to Bruner Avenue – 2,660 feet
- Segment 2 – Bermuda Road from Bruner Avenue to Volunteer Boulevard – 3,175 feet
- Segment 3 – Bermuda Road from Volunteer Boulevard to Larson Lane – 2,170 feet
- Segment 4 – Bermuda Road from Larson Lane to Via Nobila – 2,590 feet
- Segment 5 – Bermuda Road from Via Nobila and to the south 2,900 feet – 2,900 feet
- Segment 6 – Bermuda Road from 2,900 feet south of Via Nobila to Via Inspirada – 2,660 feet
- Segment 7 – Bermuda Road from Via Inspirada to Via Fidelis – 1,610 feet
- Segment 8 – Via Fidelis from Giles pie Road to Bermuda Road – 2,400 feet
- Segment 9 – Larson Lane and Via Centro – 5,250 feet

Figure 4 - Bermuda Sewer Segments and Tributary Sub-basins



Wastewater flow projections, and the allocation of such, are shown in Table 5.

Table 5 - Wastewater Flow Projections

BASIN/ PARCEL	CATEGORY	DENSITY	LANDUSE	AREA (acres)	UNITS	AVE. FLOW (GPD)	TOTAL IN BASIN (GPD)	ERU IN SUBBASIN
B1							155293.5269	621.17
	1 MDR	12	NT3	0.00	0.00	0.16		
	2 HDR	26	NT4	0.62	16.15	2825.38		
	3 HDR	26	NT4	3.52	91.52	16015.42		
	BI	0	BI	0.00		3.35		
	4 COM	0	UC	19.24		76960.00		
	5 BI	0	EC	29.74		59489.22		
B2							125959.07	503.84
	1 HDR	26	NT4	4.18	108.68	19019.00		
	2 MDR	12	NT3	2.41	28.92	7230.00		
	3 MDR	12	NT3	2.95	35.40	8850.00		
	4 BI	0	BI	0.00		0.01		
	5 BI	0	BI	0.00		0.05		
	6 MDR	12	NT3	4.35	52.20	13050.00		
	7 COM	0	NC	1.82		3640.00		
	8 COM	0	NC	0.00		0.00		
	9 PS	0	PS	28.88		57760.00		
	10 MDR	12	NT3	5.47	65.64	16410.00		
B3							227722.8754	910.89
	1 BI	0	BI	0.04		80.74		
	2 BI	0	BI	0.39		770.19		
	3 HDR	26	NT4	14.30	371.72	65060.19		
	4 COM	0	COM	8.96		17918.69		
	5 MDR	12	NT3	16.21	194.53	48632.11		
	6 PS	0	PS	14.21		28429.01		
	7 BI	0	EC	33.42		66841.95		
B4							241698.4834	966.79
	1 MDR	12	NT3		0.00	0.00		
	2 MDR	12	NT3		0.00	0.00		
	3 COM	0	UC	0.01		28.96		
	4 PS	0	PS	2.24		4484.84		
	5 COM	0	COM	5.87		11738.21		
	6 MDR	12	NT3		0.00	0.00		
	7 LDR	6	NT2	99.14	594.83	148706.93		
	8 PS	0	PS	15.24		30481.24		
	9 PS	0	PS	23.13		46258.29		
B5							426309.2978	1705.24
	1 PS	0	PS	0.75		1495.74		
	2 PS	0	PS	1.13		2264.40		
	3 MDR	12	NT3	0.12	1.42	354.59		
	4 HDR	26	NT4	19.11	496.76	86932.46		
	5 LDR	6	NT2	39.46	236.74	59184.01		
	6 MDR	12	NT3	28.60	343.15	85788.44		
	7 COM	0	COM	10.38		20760.47		
	8 PS	0	PS	8.10		16209.35		
	9 BI	0	EC	76.66		153319.84		
B6							39561.48175	158.25
	1 MDR	12	NT3	4.84	58.07	14516.68		
	2 LDR	6	NT2	13.58	81.46	20365.44		
	3 COM	0	COM	2.34		4679.36		
B7							78392.52924	313.57
	1 MDR	12	NT3	1.79	21.48	5369.51		
	2 LDR	6	NT2	35.61	213.68	63426.51		
	3 PS	0	PS	5.37		10735.03		
	4 PS	0	PS	1.73		3464.63		
	5 COM	0	COM	2.55		5090.32		
	6 COM	0	NC	0.16		312.51		
B8							188005.5328	752.02
	1 LDR	6	NT2	20.77	124.63	31157.77		
	2 LDR	6	NT2	1.13	6.78	1695.83		
	3 PS	0	PS	44.79		89578.93		
	4 PS	0	PS	4.00		8009.33		
	5 MDR	12	NT3	0.11	1.37	343.67		
	6 COM	0	NC	4.85		9692.83		
	7 MDR	12	NT3	2.34	28.13	7033.29		
	8 MDR	12	NT3	11.48	137.76	34440.25		
	9 COM	0	NC	3.03		6053.63		
B9							60671.84209	242.69
	1 MDR	12	NT3	0.11	1.33	331.83		
	2 PS	0	PS	27.68		55368.20		
	3 MDR	12	NT3	1.66	19.89	4971.82		

Table 5 – Wastewater Flow Projections Continued

BASIN/ PARCEL	CATEGORY	DENSITY	LANDUSE	AREA (acres)	UNITS	AVE, FLOW (GPD)	TOTAL IN BASIN (GPD)	ERU IN SUBBASIN
B10							281580.6011	1126.32
	1 BI		0 BI	13.74		27485.49		
	2 COM		0 UC	0.10		409.37		
	3 PS		0 PS	0.00		5.57		
	4 PS		0 PS	0.04		88.38		
	5 HDR	26	NT4	1.41	36.55	6395.81		
	6 BI		0 BI			0.00		
	7 MDR	12	NT3	0.68	8.18	2044.69		
	8 PS		0 PS	115.06		230110.34		
	9 MDR	12	NT3	4.98	59.71	14926.62		
	10 BI		0 EC	0.06		114.33		
B11							96663.44208	386.65
	1 COM		0 COM	5.73		11467.69		
	2 LDR	6	NT2	43.83	262.96	65741.17		
	3 PS		0 PS	5.28		10566.82		
	4 COM		0 NC	4.44		8887.77		
B12							170991.1469	683.96
	1 COM		0 COM	2.45		4903.85		
	2 LDR	6	NT2	80.34	482.04	120610.50		
	3 PS		0 PS	15.40		30800.47		
	4 PS		0 PS	0.82		1647.50		
	5 PS		0 PS	6.56		13128.83		
B13							246451.1125	985.80
	1 COM		0 COM	0.26		516.65		
	2 MDR		0 NT3	0.00	0.04	11.12		
	3 LDR	6	NT2	6.74	40.42	10104.53		
	4 MDR	12	NT3	7.77	93.18	23295.52		
	5 PS		0 PS	103.16		206321.07		
	6 HDR	26	NT4	1.36	35.44	6202.22		
B14							126840.6318	507.36
	1 HDR	26	NT4	5.45	141.61	24782.22		
	2 COM		0 NC	3.83		7653.89		
	3 MDR	12	NT3	16.27	195.27	48817.36		
	4 PS		0 PS	2.10		4191.60		
	5 HDR	26	NT4	9.10	236.55	41395.55		
B15							221043.3093	884.17
	1 COM		0 COM	106.38		212769.94		
	2 COM		0 COM	2.22		4430.33		
	3 COM		0 NC	0.49		989.30		
	4 PS		0 PS	0.02		49.97		
	5 LDR	6	NT2	1.68	10.10	2524.99		
	6 LDR	6	NT2	0.19	1.12	278.78		
B16							34973.52468	139.89
	1 COM		0 COM	17.49		34973.52		
B17							136130.4312	544.52
	1 COM		0 COM	67.30		134609.41		
	2 PS		0 PS	0.44		875.08		
	3 MDR	8	PC	0.30	2.43	607.34		
	4 LDR	6	NT2	0.03	0.15	38.61		
B18							118250.9008	473.00
	1 COM		0 COM	58.30		116594.57		
	2 MDR		0 NT3	0.03	0.31	76.37		
	3 MDR	8	PC	0.12	0.97	243.70		
	4 MDR	12	NT3	0.02	0.30	74.26		
	5 PS		0 PS	0.36		722.88		
	6 HDR	26	NT4	0.12	3.08	539.13		
B19							132651.6229	530.61
	1 COM		0 COM	0.14		279.94		
	2 COM		0 NC	1.62		3233.23		
	3 PS		0 PS	20.31		40621.53		
	4 PS		0 PS	14.22		28441.01		
	5 LDR	6	NT2	9.12	54.73	13681.88		
	6 LDR	6	NT2	29.65	177.93	44481.49		
	7 LDR	6	NT2	0.58	3.46	866.10		
	8 LDR	4	NT1	1.05	4.19	1046.46		
B20							49536.08275	198.14
	1 PS		0 PS	22.45		44893.82		
	2 LDR	6	NT2	0.02	0.11	27.03		
	3 LDR	4	NT1	4.62	18.46	4615.23		
B21							97227.38749	388.91
	1 PS		0 PS	42.71		85414.41		
	2 LDR	4	NT1	11.76	47.03	11756.77		
	3 LDR	4	NT1	0.06	0.22	56.20		

Table 5 – Wastewater Flow Projections Continued

[illegible]

4. Sewer Analysis

The profile of a portion of the proposed sewer in Bermuda Road from approximately 600 feet south to 1,200 feet north Bruner Avenue will prevent certain parcels west of Bermuda Road from connecting into the pipeline because of a storm drain that is west of the sewer line. For various reasons, groups of parcels are excluded from the Bermuda Basin. The parcels shown below in Table 6 will require a parallel sewer to St. Rose and are not included in the calculation of ERUs for the Bermuda alignment.

Table 6 - Parcels Tributary to St. Rose Sewer

Parcel	Name	Acreage	Land Use
191-04-801-006	Western Henderson	3.81	UC
191-04-801-005	Western Henderson	4.37	UC
191-04-801-003	Western Henderson	4.37	UC
191-04-801-012	Western Henderson	50.43	UC
191-04-801-008	Western Henderson	4.37	UC
191-04-801-007	Western Henderson	4.19	UC
191-04-703-001	Western Henderson	0.97	UC
191-04-703-002	Western Henderson	1	UC
191-04-703-003	Western Henderson	1.04	UC
191-04-703-004	Western Henderson	0.77	UC

The parcels shown in Table 7 will require a parallel sewer line in Bermuda and will connect into the Bermuda Sewer in Basin 1 where the storm drain alignment allows for connection.

Table 7 - Parcels Tributary to Segment 1 via Parallel Sewer

Parcel	Name	Acreage	Land Use
191-09-501-005	Keith Evans -Lion habitat	4.37	NT3
191-09-501-002	Crystal Capital	1.9	NT3
191-09-501-003	Keith Evans -Lion habitat	1.76	NT3
191-09-601-005	USA Portion for LVVWD facility	28.88	PS
191-09-501-001	Paradise Oasis	5	NT3
191-09-501-008	D F & L M LLC	2.08	NT3
191-09-501-009	D F & L M LLC	2.08	NT3
191-09-501-007	E K M LLC	1.93	NT4
191-09-501-006	E K M LLC	2.07	NT4

The ERUs of parcels shown in Table 8 are existing developments that will flow into the Gilesapie Sewer and are not included in the calculation of ERUs and flows for the Bermuda alignment. Parcels in Table 8 were originally in sub-basin B4.

Table 8 - Parcels Tributary to Gilesapie Sewer

Parcel	Name	Acreage	Land Use
191-09-701-001	205 Volunteer LLC	4.3	COM
Various APN	Single Family Development	14.56	NT2

SewerCAD was used to model the flows projected for the Bermuda Sewer. The average flows were applied to selected manholes according to Table 9.

Table 9 - Wastewater Flow Allocation

Basin	Sub-basins in each Basin	Total in Sub-basin (gpd)	ERUs in Sub-basin	ERUs for Basin	Manhole
1	B1	155,294	621	1,125	6A
	B2	125,959	504		
2	B26	1,105	1,105	2,016	12
	B3	227,723	911		
3	B4	241,698	967	3,144	21
	B5	426,309	1,705		
	B6	39,561	158		
	B7	78,393	314		
4	B8	188,006	752	3,015	26
	B9	60,672	243		
	B10	281,581	1,126		
	B11	96,663	387		
	B14	126,841	507		
	B12	170,991	684		
5	B13	246,451	986	2,143	33
	B18	118,251	473		
6	B15	221,043	884	1,569	36

	B16	34,974	140		
	B17	136,130	545		
7				1,922	39
	B20	49,536	198		
	B22	297,680	1,191		
	B25	626	3		
	B19	132,652	531		
8				2,382	40
	B21	97,227	389		
	B23	140,410	562		
	B24	357,865	1,431		
9					
	B27	184,923	740	9,040	103
	Inspirada		8,300		
Grand Total				26,355	

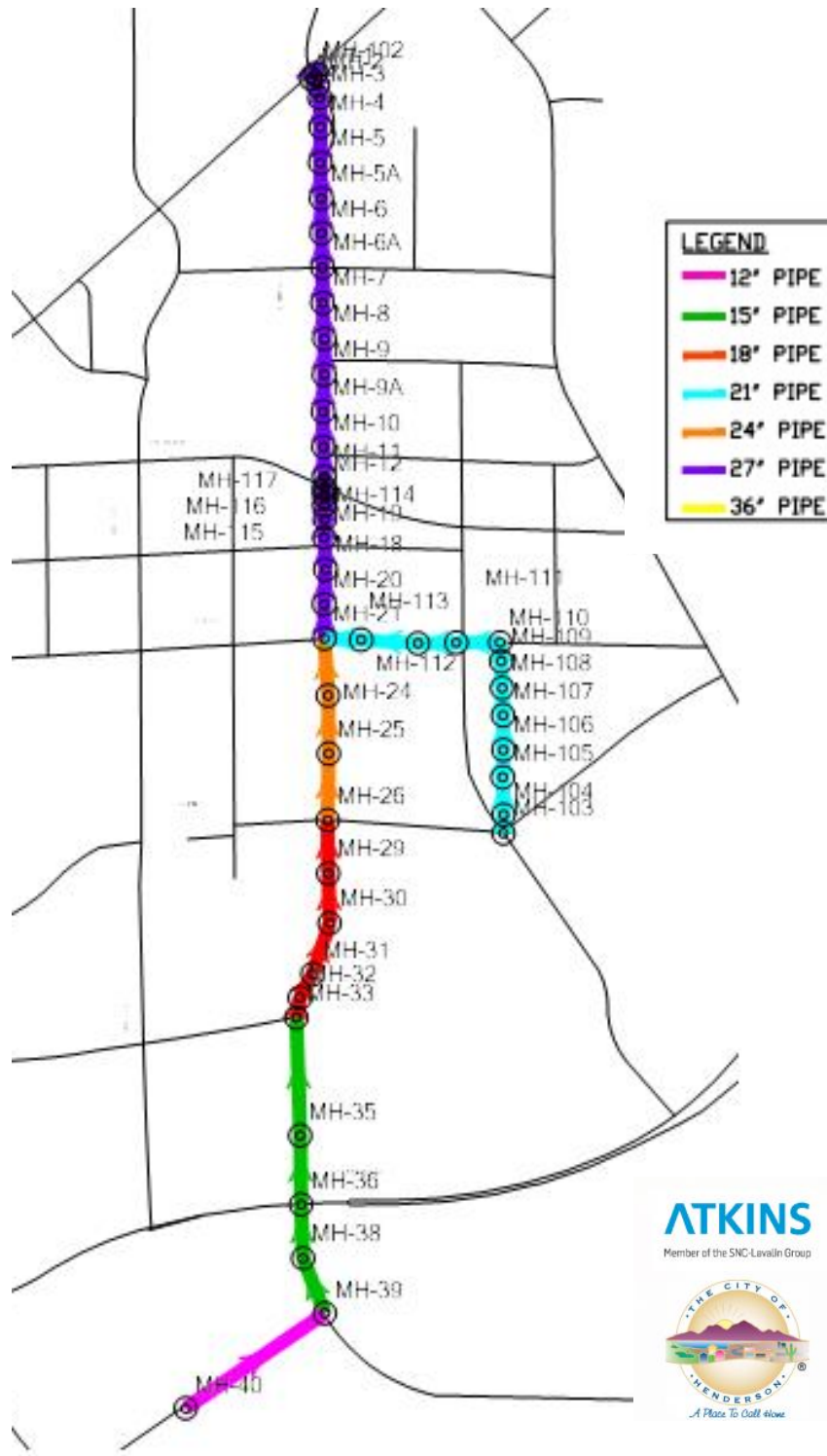
Table 10 shows the pipe diameters and ERUs for each segment of the Bermuda Sewer.

Table 10 - Bermuda Sewer Segments

Segment	Description	Pipeline Length (ft)	Diameter (in)	Direct ERUs	Cumulative ERUs
1	St. Rose to Bruner	2,660	27	1,125	26,355
2	Bruner to Volunteer	3,175	27	2,016	25,230
3	Volunteer to Larson	2,170	27	3,144	23,214
4	Larson to Via Nobila	2,590	24	3,015	11,030
5	Via Nobila to south for 2900 FT	2,900	18	2,143	8,015
6	2900 South of Via Nobila to Via Inspirada	2,660	15	1,569	5,873
7	Via Inspirada to Via Fidelis	1,610	15	1,922	4,304
8	Via Fidelis- Bermuda to Gillespie	2,400	12	2,382	2,382
9	Larson Lane and Via Centro	5,250	21	9,040	9,040
	Totals	25,415		26,355	

Reports are attached showing the output tables for manholes, pipes, and outflow for average flow and peak wet weather flow. Pipe diameters for the Bermuda Sewer are shown in Figure 5.

Figure 5 - Bermuda Sewer Pipe Diameters



Appendix SewerCAD Data



West Henderson

FlexTable: Conduit Table

Active Scenario: Average Flow

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculate d) (ft/ft)	Diameter (in)	Manning's n	Flow (MGD)	Velocity (ft/s)	d/D	Capacity (Design) (MGD)
P-39	MH-40	2,653.00	MH-39	2,618.00		2,398.7	0.0146	12.0	0.013	0.60	4.36	0.314	2.54
P-34	MH-35	2,568.00	MH-33	2,535.00		1,678.5	0.0197	15.0	0.013	1.47	6.14	0.341	5.34
P-35	MH-36	2,586.00	MH-35	2,568.00		980.3	0.0184	15.0	0.013	1.47	5.99	0.348	5.16
P-37	MH-38	2,600.00	MH-36	2,586.00		766.3	0.0183	15.0	0.013	1.08	5.48	0.296	5.15
P-38	MH-39	2,618.00	MH-38	2,600.00		841.7	0.0214	15.0	0.013	1.08	5.80	0.284	5.57
P-28	MH-26	2,484.00	MH-29	2,494.00		757.1	0.0132	18.0	0.013	2.00	5.72	0.346	7.12
P-29	MH-29	2,494.00	MH-30	2,509.00		707.7	0.0212	18.0	0.013	2.00	6.78	0.305	9.01
P-30	MH-30	2,509.00	MH-31	2,525.00		766.5	0.0209	18.0	0.013	2.00	6.75	0.307	8.95
P-31	MH-31	2,525.00	MH-32	2,530.00		379.4	0.0132	18.0	0.013	2.00	5.72	0.346	7.11
P-32	MH-33	2,535.00	MH-32	2,530.00		287.5	0.0174	18.0	0.013	2.00	6.31	0.322	8.16
P-109	MH-103	2,561.90	MH-104	2,559.23	190.7	261.7	0.0140	21.0	0.013	2.26	5.97	0.293	11.05
P-110	MH-104	2,559.23	MH-105	2,548.66	501.5	535.4	0.0211	21.0	0.013	2.26	6.91	0.263	13.56
P-111	MH-105	2,548.66	MH-106	2,538.06	494.0	388.0	0.0215	21.0	0.013	2.26	6.95	0.262	13.68
P-112	MH-106	2,538.06	MH-107	2,527.46	494.0	491.2	0.0215	21.0	0.013	2.26	6.95	0.262	13.68
P-113	MH-107	2,527.46	MH-108	2,516.86	494.0	389.8	0.0215	21.0	0.013	2.26	6.95	0.262	13.68
P-114	MH-108	2,516.86	MH-109	2,506.26	494.0	381.6	0.0215	21.0	0.013	2.26	6.95	0.262	13.68
P-115	MH-109	2,506.26	MH-110	2,495.99	426.8	268.3	0.0241	21.0	0.013	2.26	7.24	0.255	14.49
P-116	MH-110	2,495.99	MH-111	2,484.53	494.0	623.7	0.0232	21.0	0.013	2.26	7.14	0.257	14.22
P-117	MH-111	2,484.53	MH-112	2,477.61	494.0	542.9	0.0140	21.0	0.013	2.26	5.97	0.292	11.05
P-118	MH-112	2,477.61	MH-113	2,470.70	494.0	811.5	0.0140	21.0	0.013	2.26	5.96	0.293	11.04
P-119	MH-113	2,470.70	MH-21	2,464.38	451.6	524.8	0.0140	21.0	0.013	2.26	5.97	0.293	11.05
P-23	MH-21	2,464.38	MH-24	2,468.00		812.3	0.0045	24.0	0.013	2.76	4.13	0.364	8.90
P-24	MH-25	2,472.00	MH-24	2,468.00		826.9	0.0048	24.0	0.013	2.76	4.26	0.356	9.27
P-25	MH-26	2,484.00	MH-25	2,472.00		947.5	0.0127	24.0	0.013	2.76	6.02	0.277	15.00
P-2	MH-3	2,355.55	MH-2	2,351.61	262.6	186.6	0.0150	27.0	0.013	6.59	8.09	0.354	22.36
P-3	MH-4	2,363.25	MH-3	2,355.75	500.0	414.7	0.0150	27.0	0.013	6.59	8.09	0.354	22.35
P-4	MH-5	2,370.95	MH-4	2,363.45	500.0	508.1	0.0150	27.0	0.013	6.59	8.09	0.354	22.35
P-7	MH-8	2,403.61	MH-7	2,399.06	500.0	509.4	0.0091	27.0	0.013	6.31	6.67	0.396	17.41

West Henderson

FlexTable: Conduit Table

Active Scenario: Average Flow

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculate d) (ft/ft)	Diameter (in)	Manning's n	Flow (MGD)	Velocity (ft/s)	d/D	Capacity (Design) (MGD)
P-8	MH-9	2,408.36	MH-8	2,403.81	499.8	512.0	0.0091	27.0	0.013	6.31	6.67	0.396	17.42
P-10	MH-11	2,421.90	MH-10	2,418.06	422.3	422.5	0.0091	27.0	0.013	6.31	6.67	0.396	17.41
P-11	MH-12	2,423.40	MH-11	2,422.10	142.9	138.7	0.0091	27.0	0.013	6.31	6.67	0.396	17.41
P-17	MH-18	2,449.98	MH-19	2,442.78	494.0	457.4	0.0146	27.0	0.013	5.80	7.73	0.334	22.03
P-18	MH-19	2,442.78	MH-114	2,428.63	373.2	262.9	0.0379	27.0	0.013	5.80	10.89	0.261	35.54
P-19	MH-20	2,457.18	MH-18	2,449.98	494.0	497.2	0.0146	27.0	0.013	5.80	7.73	0.334	22.03
P-20	MH-21	2,464.38	MH-20	2,457.18	494.0	483.6	0.0146	27.0	0.013	5.80	7.73	0.334	22.03
P-99	MH-10	2,417.86	MH-9A	2,413.31	499.9	502.4	0.0091	27.0	0.013	6.31	6.67	0.396	17.41
P-100	MH-9A	2,413.11	MH-9	2,408.56	500.1	526.0	0.0091	27.0	0.013	6.31	6.67	0.396	17.41
P-101	MH-5A	2,378.65	MH-5	2,371.15	500.0	506.0	0.0150	27.0	0.013	6.59	8.09	0.354	22.35
P-102	MH-6	2,386.35	MH-5A	2,378.85	500.0	496.5	0.0150	27.0	0.013	6.59	8.09	0.354	22.35
P-103	MH-6A	2,394.05	MH-6	2,386.55	500.0	489.6	0.0150	27.0	0.013	6.59	8.09	0.354	22.35
P-104	MH-7	2,398.86	MH-6A	2,394.25	500.0	502.6	0.0092	27.0	0.013	6.31	6.70	0.394	17.53
P-105	MH-2	2,351.41	MH-1	2,351.01	26.8	140.6	0.0149	27.0	0.013	6.59	8.07	0.355	22.29
P-107	MH-102	2,349.67	O-1	2,349.63	3.2	152.6	0.0140	27.0	0.013	6.59	7.89	0.361	21.60
P-108	MH-1	2,350.81	MH-102	2,349.75		86.0	0.0123	27.0	0.013	6.59	7.54	0.373	22.22
P-121	MH-115	2,426.33	MH-116	2,424.57	194.2	140.3	0.0091	27.0	0.013	5.80	6.51	0.379	17.38
P-122	MH-114	2,428.63	MH-115	2,426.33	65.9	189.1	0.0349	27.0	0.013	5.80	10.57	0.266	34.10
P-123	MH-116	2,424.57	MH-117	2,423.96	12.9	84.2	0.0473	27.0	0.013	5.80	11.77	0.247	39.69
P-124	MH-117	2,423.96	MH-12	2,423.40	33.9	48.9	0.0165	27.0	0.013	5.80	8.09	0.323	23.46

West Henderson
FlexTable: Manhole Table
Active Scenario: Average Flow

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total In) (MGD)	Flow (Total Out) (MGD)
817	MH-1	2,374.30	2,350.81	6.59	6.59
818	MH-2	2,374.30	2,351.41	6.59	6.59
820	MH-3	2,376.83	2,355.55	6.59	6.59
822	MH-4	2,384.06	2,363.25	6.59	6.59
824	MH-5	2,389.41	2,370.95	6.59	6.59
826	MH-6	2,402.63	2,386.35	6.59	6.59
828	MH-7	2,412.96	2,398.86	6.31	6.31
830	MH-8	2,416.30	2,403.61	6.31	6.31
832	MH-9	2,422.97	2,408.36	6.31	6.31
834	MH-10	2,436.19	2,417.86	6.31	6.31
836	MH-11	2,441.50	2,421.90	6.31	6.31
838	MH-12	2,444.58	2,423.40	5.80	6.31
849	MH-18	2,459.68	2,449.98	5.80	5.80
851	MH-19	2,452.70	2,442.78	5.80	5.80
854	MH-20	2,468.93	2,457.18	5.80	5.80
856	MH-21	2,478.37	2,464.38	5.02	5.80
862	MH-24	2,481.00	2,468.00	2.76	2.76
864	MH-25	2,488.00	2,472.00	2.76	2.76
866	MH-26	2,494.00	2,484.00	2.00	2.76
872	MH-29	2,513.00	2,494.00	2.00	2.00
874	MH-30	2,524.00	2,509.00	2.00	2.00
876	MH-31	2,540.00	2,525.00	2.00	2.00
878	MH-32	2,545.00	2,530.00	2.00	2.00
880	MH-33	2,550.00	2,535.00	1.47	2.00
884	MH-35	2,578.00	2,568.00	1.47	1.47
886	MH-36	2,598.00	2,586.00	1.08	1.47
890	MH-38	2,616.00	2,600.00	1.08	1.08
892	MH-39	2,634.00	2,618.00	0.60	1.08
894	MH-40	2,668.00	2,653.00	0.00	0.60
1007	MH-9A	2,429.74	2,413.11	6.31	6.31
1010	MH-5A	2,396.55	2,378.65	6.59	6.59
1013	MH-6A	2,408.15	2,394.05	6.31	6.59
1021	MH-102	2,371.05	2,349.67	6.59	6.59
1031	MH-103	2,569.31	2,561.90	0.00	2.26
1032	MH-104	2,568.36	2,559.23	2.26	2.26
1034	MH-105	2,558.08	2,548.66	2.26	2.26
1036	MH-106	2,546.56	2,538.06	2.26	2.26
1038	MH-107	2,535.32	2,527.46	2.26	2.26
1040	MH-108	2,525.43	2,516.86	2.26	2.26
1042	MH-109	2,515.41	2,506.26	2.26	2.26
1044	MH-110	2,504.74	2,495.99	2.26	2.26
1048	MH-111	2,496.46	2,484.53	2.26	2.26
1049	MH-112	2,492.85	2,477.61	2.26	2.26
1050	MH-113	2,487.58	2,470.70	2.26	2.26
1051	MH-114	2,447.79	2,428.63	5.80	5.80

West Henderson
FlexTable: Manhole Table
Active Scenario: Average Flow

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total In) (MGD)	Flow (Total Out) (MGD)
1052	MH-115	2,447.24	2,426.33	5.80	5.80
1054	MH-116	2,444.03	2,424.57	5.80	5.80
1056	MH-117	2,444.09	2,423.96	5.80	5.80

West Henderson
FlexTable: Outfall Table
Active Scenario: Average Flow

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (MGD)
896	O-1	2,371.05	2,349.63	2,350.62	6.59

West Henderson

FlexTable: Conduit Table

Active Scenario: Peak Flow (Wet Weather)

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculate d) (ft/ft)	Diameter (in)	Manning's n	Flow (MGD)	Velocity (ft/s)	d/D	Capacity (Design) (MGD)
P-39	MH-40	2,653.00	MH-39	2,618.00		2,398.7	0.0146	12.0	0.013	2.05	5.99	0.638	2.54
P-34	MH-35	2,568.00	MH-33	2,535.00		1,678.5	0.0197	15.0	0.013	4.63	8.18	0.671	5.34
P-35	MH-36	2,586.00	MH-35	2,568.00		980.3	0.0184	15.0	0.013	4.63	7.96	0.688	5.16
P-37	MH-38	2,600.00	MH-36	2,586.00		766.3	0.0183	15.0	0.013	3.50	7.49	0.570	5.15
P-38	MH-39	2,618.00	MH-38	2,600.00		841.7	0.0214	15.0	0.013	3.50	7.96	0.542	5.57
P-28	MH-26	2,484.00	MH-29	2,494.00		757.1	0.0132	18.0	0.013	6.13	7.57	0.668	7.12
P-29	MH-29	2,494.00	MH-30	2,509.00		707.7	0.0212	18.0	0.013	6.13	9.11	0.570	9.01
P-30	MH-30	2,509.00	MH-31	2,525.00		766.5	0.0209	18.0	0.013	6.13	9.06	0.573	8.95
P-31	MH-31	2,525.00	MH-32	2,530.00		379.4	0.0132	18.0	0.013	6.13	7.56	0.668	7.11
P-32	MH-33	2,535.00	MH-32	2,530.00		287.5	0.0174	18.0	0.013	6.13	8.44	0.608	8.16
P-109	MH-103	2,561.90	MH-104	2,559.23	190.7	261.7	0.0140	21.0	0.013	6.84	8.03	0.538	11.05
P-110	MH-104	2,559.23	MH-105	2,548.66	501.5	535.4	0.0211	21.0	0.013	6.84	9.37	0.476	13.56
P-111	MH-105	2,548.66	MH-106	2,538.06	494.0	388.0	0.0215	21.0	0.013	6.84	9.43	0.474	13.68
P-112	MH-106	2,538.06	MH-107	2,527.46	494.0	491.2	0.0215	21.0	0.013	6.84	9.43	0.474	13.68
P-113	MH-107	2,527.46	MH-108	2,516.86	494.0	389.8	0.0215	21.0	0.013	6.84	9.43	0.474	13.68
P-114	MH-108	2,516.86	MH-109	2,506.26	494.0	381.6	0.0215	21.0	0.013	6.84	9.43	0.474	13.68
P-115	MH-109	2,506.26	MH-110	2,495.99	426.8	268.3	0.0241	21.0	0.013	6.84	9.83	0.459	14.49
P-116	MH-110	2,495.99	MH-111	2,484.53	494.0	623.7	0.0232	21.0	0.013	6.84	9.71	0.463	14.22
P-117	MH-111	2,484.53	MH-112	2,477.61	494.0	542.9	0.0140	21.0	0.013	6.84	8.03	0.537	11.05
P-118	MH-112	2,477.61	MH-113	2,470.70	494.0	811.5	0.0140	21.0	0.013	6.84	8.03	0.538	11.04
P-119	MH-113	2,470.70	MH-21	2,464.38	451.6	524.8	0.0140	21.0	0.013	6.84	8.03	0.538	11.05
P-23	MH-21	2,464.38	MH-24	2,468.00		812.3	0.0045	24.0	0.013	8.19	5.38	0.701	8.90
P-24	MH-25	2,472.00	MH-24	2,468.00		826.9	0.0048	24.0	0.013	8.19	5.57	0.680	9.27
P-25	MH-26	2,484.00	MH-25	2,472.00		947.5	0.0127	24.0	0.013	8.19	8.09	0.499	15.00
P-2	MH-3	2,355.55	MH-2	2,351.61	262.6	186.6	0.0150	27.0	0.013	17.99	10.42	0.636	22.36
P-3	MH-4	2,363.25	MH-3	2,355.75	500.0	414.7	0.0150	27.0	0.013	17.99	10.42	0.636	22.35
P-4	MH-5	2,370.95	MH-4	2,363.45	500.0	508.1	0.0150	27.0	0.013	17.99	10.42	0.636	22.35
P-7	MH-8	2,403.61	MH-7	2,399.06	500.0	509.4	0.0091	27.0	0.013	17.29	8.42	0.746	17.41

West Henderson

FlexTable: Conduit Table

Active Scenario: Peak Flow (Wet Weather)

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculate d) (ft/ft)	Diameter (in)	Manning's n	Flow (MGD)	Velocity (ft/s)	d/D	Capacity (Design) (MGD)
P-8	MH-9	2,408.36	MH-8	2,403.81	499.8	512.0	0.0091	27.0	0.013	17.29	8.42	0.746	17.42
P-10	MH-11	2,421.90	MH-10	2,418.06	422.3	422.5	0.0091	27.0	0.013	17.29	8.41	0.746	17.41
P-11	MH-12	2,423.40	MH-11	2,422.10	142.9	138.7	0.0091	27.0	0.013	17.29	8.42	0.746	17.41
P-17	MH-18	2,449.98	MH-19	2,442.78	494.0	457.4	0.0146	27.0	0.013	16.04	10.06	0.595	22.03
P-18	MH-19	2,442.78	MH-114	2,428.63	373.2	262.9	0.0379	27.0	0.013	16.04	14.43	0.447	35.54
P-19	MH-20	2,457.18	MH-18	2,449.98	494.0	497.2	0.0146	27.0	0.013	16.04	10.06	0.595	22.03
P-20	MH-21	2,464.38	MH-20	2,457.18	494.0	483.6	0.0146	27.0	0.013	16.04	10.06	0.595	22.03
P-99	MH-10	2,417.86	MH-9A	2,413.31	499.9	502.4	0.0091	27.0	0.013	17.29	8.42	0.746	17.41
P-100	MH-9A	2,413.11	MH-9	2,408.56	500.1	526.0	0.0091	27.0	0.013	17.29	8.41	0.746	17.41
P-101	MH-5A	2,378.65	MH-5	2,371.15	500.0	506.0	0.0150	27.0	0.013	17.99	10.42	0.636	22.35
P-102	MH-6	2,386.35	MH-5A	2,378.85	500.0	496.5	0.0150	27.0	0.013	17.99	10.42	0.636	22.35
P-103	MH-6A	2,394.05	MH-6	2,386.55	500.0	489.6	0.0150	27.0	0.013	17.99	10.42	0.636	22.35
P-104	MH-7	2,398.86	MH-6A	2,394.25	500.0	502.6	0.0092	27.0	0.013	17.29	8.46	0.742	17.53
P-105	MH-2	2,351.41	MH-1	2,351.01	26.8	140.6	0.0149	27.0	0.013	17.99	10.40	0.638	22.29
P-107	MH-102	2,349.67	O-1	2,349.63	3.2	152.6	0.0140	27.0	0.013	17.99	10.14	0.652	21.60
P-108	MH-1	2,350.81	MH-102	2,349.75		86.0	0.0123	27.0	0.013	17.99	9.63	0.683	22.22
P-121	MH-115	2,426.33	MH-116	2,424.57	194.2	140.3	0.0091	27.0	0.013	16.04	8.31	0.703	17.38
P-122	MH-114	2,428.63	MH-115	2,426.33	65.9	189.1	0.0349	27.0	0.013	16.04	13.99	0.458	34.10
P-123	MH-116	2,424.57	MH-117	2,423.96	12.9	84.2	0.0473	27.0	0.013	16.04	15.65	0.420	39.69
P-124	MH-117	2,423.96	MH-12	2,423.40	33.9	48.9	0.0165	27.0	0.013	16.04	10.56	0.572	23.46

West Henderson
FlexTable: Manhole Table
Active Scenario: Peak Flow (Wet Weather)

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total In) (MGD)	Flow (Total Out) (MGD)
817	MH-1	2,374.30	2,350.81	17.99	17.99
818	MH-2	2,374.30	2,351.41	17.99	17.99
820	MH-3	2,376.83	2,355.55	17.99	17.99
822	MH-4	2,384.06	2,363.25	17.99	17.99
824	MH-5	2,389.41	2,370.95	17.99	17.99
826	MH-6	2,402.63	2,386.35	17.99	17.99
828	MH-7	2,412.96	2,398.86	17.29	17.29
830	MH-8	2,416.30	2,403.61	17.29	17.29
832	MH-9	2,422.97	2,408.36	17.29	17.29
834	MH-10	2,436.19	2,417.86	17.29	17.29
836	MH-11	2,441.50	2,421.90	17.29	17.29
838	MH-12	2,444.58	2,423.40	15.91	17.29
849	MH-18	2,459.68	2,449.98	16.04	16.04
851	MH-19	2,452.70	2,442.78	16.04	16.04
854	MH-20	2,468.93	2,457.18	16.04	16.04
856	MH-21	2,478.37	2,464.38	13.87	16.04
862	MH-24	2,481.00	2,468.00	8.19	8.19
864	MH-25	2,488.00	2,472.00	8.19	8.19
866	MH-26	2,494.00	2,484.00	5.95	8.19
872	MH-29	2,513.00	2,494.00	6.13	6.13
874	MH-30	2,524.00	2,509.00	6.13	6.13
876	MH-31	2,540.00	2,525.00	6.13	6.13
878	MH-32	2,545.00	2,530.00	6.13	6.13
880	MH-33	2,550.00	2,535.00	4.49	6.13
884	MH-35	2,578.00	2,568.00	4.63	4.63
886	MH-36	2,598.00	2,586.00	3.39	4.63
890	MH-38	2,616.00	2,600.00	3.50	3.50
892	MH-39	2,634.00	2,618.00	1.93	3.50
894	MH-40	2,668.00	2,653.00	0.00	2.05
1007	MH-9A	2,429.74	2,413.11	17.29	17.29
1010	MH-5A	2,396.55	2,378.65	17.99	17.99
1013	MH-6A	2,408.15	2,394.05	17.22	17.99
1021	MH-102	2,371.05	2,349.67	17.99	17.99
1031	MH-103	2,569.31	2,561.90	0.00	6.84
1032	MH-104	2,568.36	2,559.23	6.84	6.84
1034	MH-105	2,558.08	2,548.66	6.84	6.84
1036	MH-106	2,546.56	2,538.06	6.84	6.84
1038	MH-107	2,535.32	2,527.46	6.84	6.84
1040	MH-108	2,525.43	2,516.86	6.84	6.84
1042	MH-109	2,515.41	2,506.26	6.84	6.84
1044	MH-110	2,504.74	2,495.99	6.84	6.84
1048	MH-111	2,496.46	2,484.53	6.84	6.84
1049	MH-112	2,492.85	2,477.61	6.84	6.84
1050	MH-113	2,487.58	2,470.70	6.84	6.84
1051	MH-114	2,447.79	2,428.63	16.04	16.04

West Henderson
FlexTable: Manhole Table
Active Scenario: Peak Flow (Wet Weather)

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total In) (MGD)	Flow (Total Out) (MGD)
1052	MH-115	2,447.24	2,426.33	16.04	16.04
1054	MH-116	2,444.03	2,424.57	16.04	16.04
1056	MH-117	2,444.09	2,423.96	16.04	16.04

West Henderson
FlexTable: Outfall Table
Active Scenario: Peak Flow (Wet Weather)

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (MGD)
896	O-1	2,371.60	2,349.63	2,351.35	17.99

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