Wastewater Study

SOUTHBRIDGE EXPANSION
PRELIMINARY
WASTEWATER ~~SEWER~~ BASIS OF DESIGN REPORT

SCOTTSDALE, ARIZONA

Please see the next page(s) for the case file review comments.

PRELIMINARY Basis of Design Report
- ☐ ACCEPTED
- ☑ ACCEPTED AS NOTED
- ☐ REVISE AND RESUBMIT

Reviewed by carollo
On behalf of the Scottsdale Water Resources Planning and Engineering Department

DISCLAIMER: If accepted, the preliminary approval is granted under the condition that a final basis of design report will also be submitted for city review and approval (Typically during the DR and PP case). The final report shall incorporate further water or sewer design and analysis requirements as defined in the city design standards and policy manual and address those items noted in the preliminary review comments)both separate and included herein). The final report shall be submitted and approved prior to the plan review submission. For questions and clarifications contact the Water Resources Planning and Engineering Department at 480-321-5685

REVIEWER: Brian Bernard
EMAIL: Bbernard@carollo.com
DATE 08/16/19

By:

Gookin Engineers, Ltd.
4203 N. Brown Avenue
Scottsdale, AZ 85251

Registered Professional Engineer (Civil)
CERTIFICATE NO.
35743
EDWARD
GOOKIN
DATE SIGNED
7-25-19
ARIZONA U.S.A.

Expiration Date on P.E. seal is missing

September 21, 2018

Revised July 25, 2019

22-ZN-2018

SOUTHBRIDGE EXPANSION

CASE FILE 22-ZN-2018 - WASTEWATER BOD REPORT

CAROLLO ENGINEER'S CASE FILE REVIEW COMMENTS - 08/16/2019

Ordinance Issures:

1. Developers are required to install at their expense, all improvements necessary to provide wastewater service to their development. This includes any Sanitary Sewer lines, lift stations, force mains or other facilities, and the payment of all required fees. Refer to the Scottsdale Revised Code (SRC), Section 49-73.
2. Sewer line extensions (all property for which sewer service is desired shall, as a minimum requirement of service, be provided with, as a portion of the City system, a minimum of one-half of an eight inch sewer main for the entire frontage of the parcel, which will require providing lines on both frontages of the property if the property is a corner parcel, or all frontages of the property if multiple frontages occur per SRC Sec. 49-219 and DSPM Sec. 7-1.400.) may be required along the property's frontages.

Policy and Design Related Issues:

3. The Infrastructure Phasing Plan description on page 8 of the Wastewater BOD report is not sufficient. Per DSPM Section 7-1.200, Wastewater Master Plans is required for phased developments and was submitted separately. As a minimum in the BOD, specify how the phased construction will be conducted in more specific detail and include the project Master Plan in the final BOD through an Appendix.
4. The Wastewater BOD report included sewer hydraulic analysis per DSPM Sections 7-1.201/202 for off-site flows. Any off-site improvements that may be required shall be the responsibility of the developer. Detailed information of the proposed off-site improvements is to be included in the final wastewater BOD.
5. Per DSPM 7-1.000 a Professional Engineer (civil or sanitary) currently registered in the State of Arizona is required to analyze the wastewater generation from a proposed development and determine its impact on the city's wastewater collection system. The BOD engineer's seal does not indicate an expiration date.
6. Include written permission from the COS Water Resources staff confirming that permission has been granted to exceed the d/D of 0.65 and d/D of 0.70 in the pipe segments referenced in pages 15 and 16 of the BOD.
7. Report Covers must include the Developer/Owner's name, address, and phone number.
8. Page 3 of the BOD, revise text in the Introduction narrative to accurately reflect that average and peak sewer flows per the current design standards can be conveyed within the existing City sewer infrastructure at all times in accordance with the City of Scottsdale Standards and Policies.
9. Page 3 of the BOD - Existing Conditions and Proposed Conditions, state the existing and proposed pipeline sizes, material types, and strength classes per DSPM 7-1.201/202.
10. Page 3 of the BOD - Proposed Conditions, describe in more detail, and also reference the project phasing on page 8 and the Master Plan Appendix.
11. Page 3 of the BOD - Proposed Conditions, state the type, and methodology of the existing sewer abandonment.
12. Pages 4 - 8 of the BOD, in the Sewer Demand Calculation tables, please revise the term "Average Day Water Demands" in the table headings to "Average Day Sewer Demands" throughout.

13. Page 8 of the BOD, in the "Net Demand" table, revise column 1 to read "Existing Demand" instead of "Replaced Demand" to align with the written description given above.
14. Page 9 of the BOD, state the Manning's Coefficient used for the hydraulic calculations and the basis for the coefficient selection (pipe material type).
15. Page 9 of the BOD, "the existing 8" sewer at 0.45% slope has an available capacity of…"
16. Page 10 of the BOD, state here, or in the Area 1 narrative that the Manning's Coefficient of 0.013 is being used and why.
17. Page 11 of the BOD, for the Connection #3 analysis, consider using a consistent measurement of slope units throughout - 1/8 "inch" per foot, or by slope percent, as used in the remainder of the hydraulic calculations.

Technical Corrections to be Resolved:

18. For all Exhibits, clearly indicate any new or existing utility easements within the limits of the proposed development site
19. Exhibit 2 - give approximate sizes in acres for each designated site.
20. Exhibit 3 - include Engineer's information and a table that summarizes and designates the A - E area key and corresponding Area/Exhibits to follow. Describe the purpose of callout boxes #1 - #9.
21. Exhibit 4 - denote sub-areas A1 - A3 to match with Exhibit 3. Include square footage of each principal area of the proposed development. Include sight vision triangles on the site plan to give indication of right-of-way spacing and landscaping layout. Coordinate tree/plantings so as not to be installed within the horizontal excavation limits for future maintenance or repair of the buried utilities.
22. Exhibit 5 - same general comments as Exhibit 4.
23. Exhibit 6 - same general comments as Exhibit 4.
24. Exhibit 7 - provide Key Notes to callout proposed facilities, sewer wyes, manholes, catch basins, cleanouts, grease traps, sand separators, manhole rim/invert information, benchmarks, etc.
25. Exhibit 7 - the existing sewer to be abandoned and removed is to be hauled off-site for proper disposal in compliance with regulatory requirements.
26. Exhibit 7 - sewer "taps" are to be made using wyes of the same pipe material and strength class.
27. Exhibit 8 - provide Key Notes to callout proposed facilities, such as sewer wyes, manholes, catch basins, cleanouts, grease traps, sand separators, manhole rim/invert information, benchmarks, etc.
28. Exhibit 8 - the existing sewer to be abandoned and removed is to be hauled off-site for proper disposal in compliance with regulatory requirements.
29. Exhibit 8 - sewer "taps" are to be made using wyes of the same pipe material and strength class.
30. Exhibit 9 - provide Key Notes to callout proposed facilities, sewer wyes, manholes, catch basins, cleanouts, grease traps, sand separators, manhole rim/invert information, benchmarks, etc.
31. Exhibit 9 - the existing sewer to be abandoned and removed is to be hauled off-site for proper disposal in compliance with regulatory requirements.
32. Exhibit 9 - sewer "taps" are to be made using wyes of the same pipe material and strength class.
33. Exhibit 9 - the two 8-inch sewer "taps" (wyes) on 70th Place should have at least 6-feet of straight sewer separation between them.
34. Exhibit 10 - provide Key Notes to callout proposed facilities, sewer wyes, manholes, catch basins, cleanouts, grease traps, sand separators, manhole rim/invert information, benchmarks, etc.
35. Exhibit 10 - the existing sewer to be abandoned and removed is to be hauled off-site for proper disposal in compliance with regulatory requirements.
36. Exhibit 10 - what pipe material is being proposed for the 8-inch sewer "taps" that is to connect to the existing 16-inch DIP sewer? Is the connection be proposed with a wye or a tee?

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SOUTHBRIDGE EXPANSION
PRELIMINARY
SEWER BASIS OF DESIGN REPORT

INTRODUCTION

Existing Zoning?

The Southbridge Expansion Project is a mixed use development project generally located between Scottsdale Road and just west of Goldwater Boulevard, along the south side of the Arizona Canal and along the north side of 5th Avenue. The total area is approximately 6.5 acres.

This report will provide calculations to determine the average and peak volumes of sewer demand that can be expected from the project site and if it can be handled by the current infrastructure to a level that is satisfactory to the City of Scottsdale.

can be conveyed within the existing City sewer infrastructure in accordance with the City of Scottsdale Standards and Policies

EXISTING CONDITIONS

The Triangle, Scottsdale Marketplace and Southbridge [illegible] combination of office, retail, commercial, and restaurant use. The easterly side of the Rose Garden site is a public parking lot. There is a small vacant parcel on the west end. Exhibit 1 is a vicinity map of the site.

Existing sewer infrastructure includes recent upgrades to the system by the City of Scottsdale to accommodate large anticipated uses in this area. This includes a 12 inch main along 5th Avenue between Goldwater Boulevard and Stetson Drive. See Exhibit 2 for a quarter section map with improvement areas shown.

State pipeline material type

PROPOSED CONDITIONS

This mixed use development is laid out as 4 separate sites with various uses. These uses are summarized below under the proposed sewer demand tables. The use categories are taken from the City of Scottsdale DS&PM, Figure 7-1.2. The category for Pool was added for the hotel based on comments from City staff.

Call out the project phasing on page 8

Exhibits 3 – 6 show the various buildings overlaid on an aerial photograph. Exhibits 7 - 10 show a preliminary Sewer utility layout. This will include a new stretch of 8" sewer along 6th Avenue to service a portion of the Triangle Site, the Retail site, and some offsite existing uses that need to be reconnected to the sewer. An existing sewer in the Triangle Site will be abandoned. An existing sewer along the canal bank behind the Southbridge West Site and the Rose Garden Site will be abandoned. A short stretch of 8" pipe will be upgraded to 10" in Stetson Road. An 8" section in Stetson Road will be upgraded to 12". A length of 12" pipe will be upgraded to 15" in Stetson Road and 5th Avenue. The 16" sewer in Goldwater Avenue will be upgraded to 18".

State sewer pipe material type

Type of abandonment? Filled, removed, capped?

Gookin Engineers has been informed by City Staff that a project adjacent to the Fashi[illegible] also under review, with tributary flows to the Goldwater Sewer. Gookin Engineers was provided a

copy of this project's wastewater Basis of Design report, and has been instructed to consider these flows in the Goldwater sewer from 5th Avenue until it connects to the sewer in Miller Road.

SEWER DEMAND CALCULATIONS

The following table shows the calculations of the existing sewer demand to be replaced. Areas of use are shown based on land use from the Maricopa County Assessor.

Sewer Demands

Existing Demand Being replaced							
Triangle Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Retail	26,174	SF	3.0	0.5	13,087	39,261	27
Restaurant	11,265	SF	6.0	1.2	~~13,518~~	~~81,108~~	~~56~~
TOTAL					**26,605**	**120,369**	**84**

Does not match previous submittal

Southbridge West Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Retail	31,213	SF	3.0	0.5	15,607	46,820	33
Restaurant	0	SF	6.0	1.2	0	0	0
TOTAL					**15,607**	**46,820**	**33**

Marketplace Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Retail	20,057	SF	3.0	0.5	10,029	30,086	21
Single Family Residence	1	ea	4.0	250.0	250	1,000	1
TOTAL					**10,279**	**31,086**	**22**

The following tables show the proposed sewer demand.

1A. Triangle Site - Hotel Tower				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	9,700	SF	6.0	1.2	11,640	69,840	**49**
Retail/Commercial	0	SF	3.0	0.5	0	0	**0**
Office	0	SF	3.0	0.4	0	0	**0**
Residential	0	Units	4.5	140.0	0	0	**0**
Hotel Rooms	200	Units	4.5	380.0	76,000	342,000	**238**
TOTAL					**87,640**	**411,840**	**286**
Pool - extra for peak flow	1	ea					**100**
Total with Pool							**386**

1B. Triangle Site - Residential Tower				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial	0	SF	3.0	0.5	0	0	**0**
Office	0	SF	3.0	0.4	0	0	**0**
Residential	184	Units	4.5	140.0	25,760	115,920	**81**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOTAL					**25,760**	**115,920**	**81**

1C. Triangle Site – Mixed Use Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial	25,820	SF	3.0	0.5	12,910	38,730	**27**
Office	119,040	SF	3.0	0.4	47,616	142,848	**99**
Residential	0	Units	4.5	140.0	0	0	**0**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOTAL					**60,526**	**181,578**	**126**

UNIT/SF VALUES PROVIDED HERE DO NO MATCH UP UTILITY PLAN EXHIBIT VALUES: EXHIBIT VALUES MARKED IN ORANGE BELOW

2. Scottsdale Marketplace Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial 58682	13,170	SF	3.0	0.5	6,585	19,755	**14**
Office	0	SF	3.0	0.4	0	0	**0**
Residential	21	Units	4.5	140.0	2,940	13,230	**9**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOTAL					**9,525**	**32,985**	**23**

3A. Southbridge West Site - East Tower				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial 75605	19,390	SF	3.0	0.5	9,695	29,085	**20**
Office	0	SF	3.0	0.4	0	0	**0**
Residential 177	136	Units	4.5	140.0	19,040	85,680	**60**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOGETHER **TOTAL**					**28,735**	**114,765**	**80**

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3B. Southbridge West - West Tower				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial	8,310	SF	3.0	0.5	4,155	12,465	**9**
Office	0	SF	3.0	0.4	0	0	**0**
Residential	58	Units	4.5	140.0	8,120	36,540	**25**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOTAL					**12,275**	**49,005**	**34**
Pool - extra for peak flow	1	ea					**100**
Total with Pool							**134**

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4. Rose Garden Site				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Use (GPM)
Restaurant	0	SF	6.0	1.2	0	0	**0**
Retail/Commercial 0	10,427	SF	3.0	0.5	5,214	15,641	**11**
Office	0	SF	3.0	0.4	0	0	**0**
Residential 118	171	Units	4.5	140.0	23,940	107,730	**75**
Hotel Rooms	0	Units	4.5	380.0	0	0	**0**
TOTAL					**36,452**	**182,804**	**86**
Pool - extra for peak flow	1	ea					**100**
Total with Pool							**186**

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These demands are not replaced, rather to be added to the proposed demands

The following table shows the calcul[illegible]emand to be ~~replaced~~. Areas of use are shown based on land use from the [illegible] These numbers appear to be larger than the actual demand, because the combined peak flow of the 5th Avenue sewer is larger than the measured peak flow in the Goldwater Sewer.

Existing Off-Site Demand							
Northern Stetson Buildings				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Office	78,984	SF	3.0	0.4	31,594	94,781	66
Restaurant	13,112	SF	6.0	1.2	15,734	94,406	66
TOTAL					**47,328**	**189,187**	**131**

Southern Stetson Buildings				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Office	36,761	SF	3.0	0.4	14,704	44,143	31
TOTAL					**14,704**	**44,143**	**31**

THIS MAKES NO SENSE. THE EXISTING FLOWS THAT SHOULD HAVE BEEN CALCULATED ARE FOR THE EXISTING BUILDINGS THE PROPOSED DEVELOP. WILL REPLACE. THEN THOSE FLOWS COULD BE NETTED OUT OF THE PROPOSED FLOWS

Buildings East of Marketplace				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Retail	9,410	SF	3.0	0.5	4,705	14,115	10
Restaurant	2,400	SF	6.0	1.2	2,880	17,280	12
TOTAL					**7,585**	**31,395**	**22**

Buildings West of Marketplace				~~Average Day Water Demands~~ in Gallons Per Day (GPD)			
Land Use	Values		Peak Factors	Total Demand	Total Use	Peak Use	Peak Flow (GPM)
Retail	12,485	SF	3.0	0.5	6,243	18,728	13
Restaurant	5,484	SF	6.0	1.2	6,581	39,485	27
TOTAL					**12,823**	**58,212**	**40**

Net demand on the sewer is based on the difference between Proposed Demand and Existing Demand, since the existing uses are already included in the sewer flow monitoring required by the City. Then the Existing Off-site Demand is added.

Net Demand	Existing				
Connection Point	~~Replaced~~ Demand	Proposed Demand	Existing Off-Site Demand	Net Demand	
Connection 1	84	126	131	173	GPM
Connection 2	0	81	31	112	GPM
Connection 3	22	409	22	409	GPM
Existing Connection 1	0	0	40	40	GPM
Connection 4	33	214	0	181	GPM
Connection 5	0	186	0	186	GPM

THIS MAKES NO SENSE. THE EXISTING FLOWS THAT SHOULD HAVE BEEN CALCULATED ARE FOR THE EXISTING BUILDINGS THE PROPOSED DEVELOP. WILL REPLACE. THEN THOSE FLOWS COULD BE NETTED OUT OF THE PROPOSED FLOWS.

~~INFRASTRUCTURE~~ PHASING PLAN

The proposed infrastructure improvements in Goldwater Boulevard will be simultaneous to the construction of the first site which uses this sewer and which requires upsizing of the sewer. The proposed improvements along 5th Avenue, Stetson Drive, and 6th Avenue will be constructed simultaneously with the demolition of the existing structures. This phasing will limit the disruption to local businesses, causing road restrictions to the least number of businesses.

Include phasing description on the project introduction and add project Master Plan to the BOD as an Appendix

Typical, specify if the sewer slopes used in the analyses are field verified or from as-built drawings. QS maps do not have invert elevations for all sewer segments analyzed in this report.

SEWER HYDRAULIC CALCULAT

Sewer flow monitoring has been performed to determine current flows in the sewer in Goldwater at 3rd Avenue. A flow summary is attached as Exhibit 12. Gookin Engineers was provided with flow data on Scottsdale road near Goldwater, and on Earll Road near Miller by City Staff.

9 sections of sewer were analyzed to determine existing capacity, and proposed usage. The capacities were examined using Manning's equation per the DSPM, with a 65% full pipe 12" and under, and 70% full above 12". These areas are:

1. Connection 1 - Existing 8" Stetson Sewer from North end of Hotel Triangle to midpoint manhole AGREE - OKAY

This sewer has very offsite flows, shown above as the Northern Stetson Buildings. The Mixed Use building of the Triangle Site is tributary to this sewer, adding a net 42 GPM peak flow. This calculation is shown in the table of Sewer Demand as Connection 1. This is a total of 173 GPM.

Using Manning's Equation to calculate flow in a pipe of:

$$Q = \frac{1.49 A r_H^{2/3} S^{1/2}}{n}$$

State what Manning's Coefficient

To calculate flow in a partially full pipe, it is necessary to calculate the Area and Perimeter of a partially full pipe. These equations are

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$\theta = 2\cos^{-1}\left(\frac{r-h}{r}\right)$$

$$P = 2\pi r - r\theta$$

Where r = radius and h = depth of pipe not inundated. For Scottsdale, all pipes must flow at d/D = 65% for pipes 12" and less and 70% for greater than 12".

$$\frac{d}{D} = \frac{2r-h}{2r} \; or \; h = 2r - 2r\frac{d}{D}$$

$$r_H = \frac{A}{P}$$

an available

The existing 8" sewer at 0.45% slope has a capacity of 276 GPM at 65% d/D. This section does not need to be upgraded.

$$h = 2r - 2r\frac{d}{D} = 2(0.333) - 2(0.333)(0.65) = 0.233$$

$$\theta = 2\cos^{-1}\left(\frac{0.333 - .233}{0.333}\right) = 2.53 \text{ rad}$$

$$A = \pi 0.333^2 - \frac{0.333^2(2.53 - \sin 2.53)}{2} = 0.24 \text{ SF}$$

$$P = 2\pi(0.333) - (0.333)(2.53) = 1.25 \text{ LF}$$

$$r_H = 0.24/1.25 = 0.19$$

State in the narrative that Manning's Coefficient of 0.013 is being used

$$Q = \frac{1.49(0.24)(0.19)^{2/3}0.0045^{1/2}}{0.013} = 0.61\ cfs = 276 \text{ GPM}$$

2. Connection 2 - Existing 8" Stetson Sewer from midpoint manhole to 6th Avenue Manhole

?

AGREE, UPSIZE TO 10"

This sewer has very offsite flows, shown above as the Southern Stetson Buildings. The Residential Tower of the Triangle Site is tributary to this sewer. The calculation is shown in the table of Sewer Demand as Connection 2. In addition the flows from Connection 1 add to Connection 2, creating a net of 285 GPM peak flow.

The existing 8" sewer has a capacity of 276 GPM at 65% d/D. The calculations are identical to #1 above. This section will be upgraded to a 10" pipe with a capacity of 500 GPM.

$$h = 2r - 2r\frac{d}{D} = 2(0.417) - 2(0.417)(0.833) = 0.292$$

$$\theta = 2\cos^{-1}\left(\frac{0.417 - .292}{0.417}\right) = 2.53 \text{ rad}$$

$$A = \pi 0.417^2 - \frac{0.417^2(2.53 - \sin 2.53)}{2} = 0.38 \text{ SF}$$

$$P = 2\pi(0.417) - (0.417)(2.53) = 1.56 \text{ LF}$$

$$r_H = 0.38/1.56 = 0.24$$

$$Q = \frac{1.49(0.38)(0.24)^{2/3}0.0045^{1/2}}{0.013} = 1.11\ cfs = 500 \text{ GPM}$$

3. Connection 3 - Proposed 8” Sewer in 6th Avenue

UPSIZE TO 10"

This sewer will serve the Marketplace site, the Hotel Tower of the Triangle Site, and the 2 Buildings East of the Marketplace. The calculations are shown above in the Table of Sewer Demand as Connection 3, with a net flow of 409 GPM.

An 8” Sewer at 1/8 per foot has a capacity of 420 GPM at 65% d/D.

inch?

This is 1.04% slope and may not be attainable. Construct 10 inch sewer with minimum 0.52% slope.

AGREE.

$$A = \pi 0.333^2 - \frac{0.333^2(2.53 - \sin 2.53)}{2} = 0.24 \text{ SF}$$

$$h = 2r - 2r\frac{d}{D} = 2(0.333) - 2(0.333)(0.65) = 0.233$$

$$\theta = 2\cos^{-1}\left(\frac{0.333 - .233}{0.333}\right) = 2.53 \text{ rad}$$

$$P = 2\pi(0.333) - (0.333)(2.53) = 1.25 \text{ LF}$$

$$r_H = 0.24/1.25 = 0.19$$

$$Q = \frac{1.49(0.24)(0.19)^{2/3}0.104^{1/2}}{0.013} = 0.94\ cfs = 420 \text{ GPM}$$

4. Existing 8” Stetson Sewer to existing 12” 5th Avenue Sewer

CAN 12" @ PROPOSED SLOPE BE ACHIEVED ?

This sewer will serve the combined flows of Connections 1, 2, and 3 with a net flow of 694 GPM.

Use consistent slope units throughout

The existing 8” Sewer at 0.6% slope has a capacity of 318 GPM, and is insufficient. We propose replacing this sewer with a new 12” pipe at 0.6% slope, which has a capacity of 939 GPM at 65% d/D.

$$h = 2r - 2r\frac{d}{D} = 2(0.5) - 2(0.5)(0.65) = 0.35$$

$$\theta = 2\cos^{-1}\left(\frac{0.5 - .35}{0.5}\right) = 2.53 \text{ rad}$$

CAN THIS SLOPE BE ACHIEVED? YOU HAVE FIXED POINTS.

$$A = \pi 0.5^2 - \frac{0.5^2(2.53 - \sin 2.53)}{2} = 0.54 \text{ SF}$$

$$P = 2\pi(0.5) - (0.5)(2.53) = 1.88 \text{ LF}$$

$$r_H = 0.54/1.88 = 0.29$$

$$Q = \frac{1.49(0.54)(0.29)^{2/3}0.006^{1/2}}{0.013} = 2.09\ cfs = 939\ \text{GPM}$$

Place

5. Existing Connection 1 - Existing 12" 5th Avenue Sewer to 70th ~~Street~~ Manhole

UPSIZE TO 15" REQUIRED BUT NOT SHOWN ON EXHIBIT 11

This sewer will serve the combined flows of Connections 1, 2, and 3, Existing Connection 1 with a net flow of 734 GPM.

The existing 12" Sewer has a minimum slope of 0.30%, yielding a capacity of 664 GPM at 65% d/D.

$$h = 2r - 2r\frac{d}{D} = 2(0.5) - 2(0.5)(0.65) = 0.35$$

$$\theta = 2\cos^{-1}\left(\frac{0.5 - .35}{0.5}\right) = 2.53\ \text{rad}$$

$$A = \pi 0.5^2 - \frac{0.5^2(2.53 - \sin 2.53)}{2} = 0.54\ \text{SF}$$

$$P = 2\pi(0.5) - (0.5)(2.53) = 1.88\ \text{LF}$$

$$r_H = 0.54/1.88 = 0.29$$

$$Q = \frac{1.49(0.54)(0.29)^{2/3}0.003^{1/2}}{0.013} = 1.48\ cfs = 664\ \text{GPM}$$

This will be replaced with a 15" sewer that has a minimum slope of 0.30%, yielding a capacity of 1,333 GPM at 70% d/D.

All manholes that are 10-foot deep, or the sewer line is 15-inches in diameter or greater, shall be 5-foot diameter per DSPM Section 7-1.405

$$h = 2r - 2r\frac{d}{D} = 2(0.625) - 2(0.625)(0.70) = 0.375$$

$$\theta = 2\cos^{-1}\left(\frac{0.625 - .375}{0.625}\right) = 2.32\ \text{rad}$$

$$A = \pi 0.625^2 - \frac{0.625^2(2.32 - \sin 2.32)}{2} = 0.92\ \text{SF}$$

$$P = 2\pi(0.625) - (0.625)(2.32) = 2.48\ \text{LF}$$

$$r_H = 0.92/2.48 = 0.37$$

$$Q = \frac{1.49(0.92)(0.37)^{2/3}0.003^{1/2}}{0.013} = 2.97\ cfs = 1{,}333\ \text{GPM}$$

DID NOT TAKE IN TO ACCOUNT DEMANDS CORRECTLY

6. Connection 4 - Existing 12" 5th Avenue Sewer from 70th Street to Goldwater

This sewer will serve the combined flows of Connections 1, 2, 3 and the Southbridge West sites (shown as Connection 4 above) with a net flow of 915 GPM.

173+81+408+31+ 255= 948

The existing 12" Sewer in this section has a minimum slope of 0.77%, yielding a capacity of 1064 GPM at 65% d/D.

NOT BASED ON MY CHECK OF MANHOLE INVERTS GIVEN IN QUARTER SECTION MAPS

$$h = 2r - 2r\frac{d}{D} = 2(0.5) - 2(0.5)(0.65) = 0.35$$

$$\theta = 2\cos^{-1}\left(\frac{0.5 - .35}{0.5}\right) = 2.53 \text{ rad}$$

$$A = \pi 0.5^2 - \frac{0.5^2(2.53 - \sin 2.53)}{2} = 0.54 \text{ SF}$$

$$P = 2\pi(0.5) - (0.5)(2.53) = 1.88 \text{ LF}$$

$$r_H = 0.54/1.88 = 0.29$$

$$Q = \frac{1.49(0.54)(0.29)^{2/3}0.0077^{1/2}}{0.013} = 2.37\ cfs = 1064 \text{ GPM}$$

7. Connection 5 - Existing 16" Goldwater Sewer from 5th Avenue to Indian School

This sewer will serve the combined flows of Connections 1, 2, 3 4 and the Rose Garden site (shown as Connection 5 above) with a net flow of 877 GPM. There is also the proposed flow from the Caesar's Hotel Addition of 630 GPM (provided by City Staff), plus the existing flow of 342 GPM (measured at 3rd Avenue). The combined flow in the Goldwater Sewer will be 1,849 GPM. The calculated flows from existing buildings shown above are not included, because their flows were physically measured in this sewer.

The existing 16" Sewer in this section has a minimum slope of 0.27%, yielding a capacity of 1502 GPM at 70% full.

WHICH IS LESS THAN THE DEMAND

(126+81+409+214+186) - (84+22+33) + 342+60 = 1,849 (Okay)

$$h = 2r - 2r\frac{d}{D} = 2(.667) - 2(0.667)(0.70) = 0.4$$

$$\theta = 2\cos^{-1}\left(\frac{0.667 - .4}{0.667}\right) = 2.32 \text{ rad}$$

$$A = \pi 0.667^2 - \frac{0.667^2(2.32 - \sin 2.32)}{2} = 1.04 \text{ SF}$$

$$P = 2\pi(0.667) - (0.667)(2.32) = 2.64 \text{ LF}$$

$$r_H = 1.04/2.64 = 0.39$$

$$Q = \frac{1.49(1.04)(0.39)^{2/3}0.0027^{1/2}}{0.013} = 3.35\ cfs = 1502\ \text{GPM}$$

This section will need to be upgraded to an 18" pipe. This pipe, at the existing slopes, will have a capacity of 2,056 GPM at 70% full.

$$h = 2r - 2r\frac{d}{D} = 2(.75) - 2(0.75)(0.70) = 0.45$$

$$\theta = 2\cos^{-1}\left(\frac{0.75 - .45}{0.75}\right) = 2.32\ \text{rad}$$

$$A = \pi 0.75^2 - \frac{0.75^2(2.32 - \sin 2.32)}{2} = 1.32\ \text{SF}$$

$$P = 2\pi(0.75) - (0.75)(2.32) = 2.97\ \text{LF}$$

$$r_H = 1.32/2.97 = 0.44$$

$$Q = \frac{1.49(1.32)(0.44)^{2/3}0.0027^{1/2}}{0.013} = 4.58\ cfs = 2{,}056\ \text{GPM}$$

8. Existing 18" Goldwater Sewer from Indian School to Osborn

This sewer will serve the flow from Section 7 above, plus 517 GPM (from measurements provided by City Staff on the Indian School Sewer). The combined flow in the Goldwater Sewer will be 2,366 GPM

The existing 18" Sewer in this section has a minimum slope of 0.34% (based on the 70th Street Interceptor As Built plans), yielding a capacity of 2308 GPM at 70% full. The calculation for the minimum slope is

$$h = 2r - 2r\frac{d}{D} = 2(.75) - 2(0.75)(0.70) = 0.45$$

$$\theta = 2\cos^{-1}\left(\frac{0.75 - .45}{0.75}\right) = 2.32\ \text{rad}$$

$$A = \pi 0.75^2 - \frac{0.75^2(2.32 - \sin 2.32)}{2} = 1.32\ \text{SF}$$

$$P = 2\pi(0.75) - (0.75)(2.32) = 2.97\ \text{LF}$$

According to the City's GIS data and QS map, segment 5 is a shorter length pipe with flatter slope. Please verify and include a map in the final BOD identifying all sewer segments. The City agreed that the shorter segment (~50 feet) of pipe will not be required to be replaced by the developer

$$r_H = 1.32/2.97 = 0.44$$

$$Q = \frac{1.49(1.32)(0.44)^{2/3}0.0034^{1/2}}{0.013} = 5.14\ cfs = 2{,}308\ \text{GPM}$$

Segment	Slope	Capacity (GPM) @70%
1	0.0046	2,684
2	0.0050	2,798
3	0.0040	2,503
4	0.0098	3,918
5	0.0076	3,450
6	0.0034	2,308*
7	0.0046	2,684
8	0.0043	2,595
9	0.0059	3,040

Provide written permission from Water Resources staff as an Appendix to the BOD

1 segment has a slope flat enough to create a situation where the d/D for the flow is greater than the 70% number dictated by the DS&PM. The pipe will run with a d/D of 71.4%. The pipes will carry the flow without running full, or surcharging. Based on discussions with City Staff, if small sections of these sewers are marginally over capacity, but the majority remains sufficient, no upgrade will be required. This is the case here. This section will not need to be upgraded.

9. Existing 21" Goldwater Sewer from Osborn to Earll, then along Earll to Miller

This sewer will serve the combined flows of Connections 1, 2, 3 4 and the Rose Garden site (shown as Connection 5 above) with a net flow of 877 GPM. There is also the proposed flow from the Caesar's Hotel Addition of 630 GPM (provided by City Staff), plus the existing flow of 1,449 GPM (measured at near Miller). The combined flow in Section 9 will be 2,956 GPM

The existing 21" Sewer in this section has an minimum slope of 0.14% (based on City Quarter Section Data), yielding a capacity of 2,234 GPM at 70% full.

2,366+1,449 - (342+517) = 2,956 gpm (Okay)

$$h = 2r - 2r\frac{d}{D} = 2(0.875) - 2(0.875)(0.70) = 0.525$$

$$\theta = 2\cos^{-1}\left(\frac{0.875 - .525}{0.875}\right) = 2.32\ \text{rad}$$

$$A = \pi 0.875^2 - \frac{0.875^2(2.32 - \sin 2.32)}{2} = 1.80\ \text{SF}$$

$$P = 2\pi(0.875) - (0.875)(2.32) = 3.47\ \text{LF}$$

$$r_H = 1.80/3.47 = 0.52$$

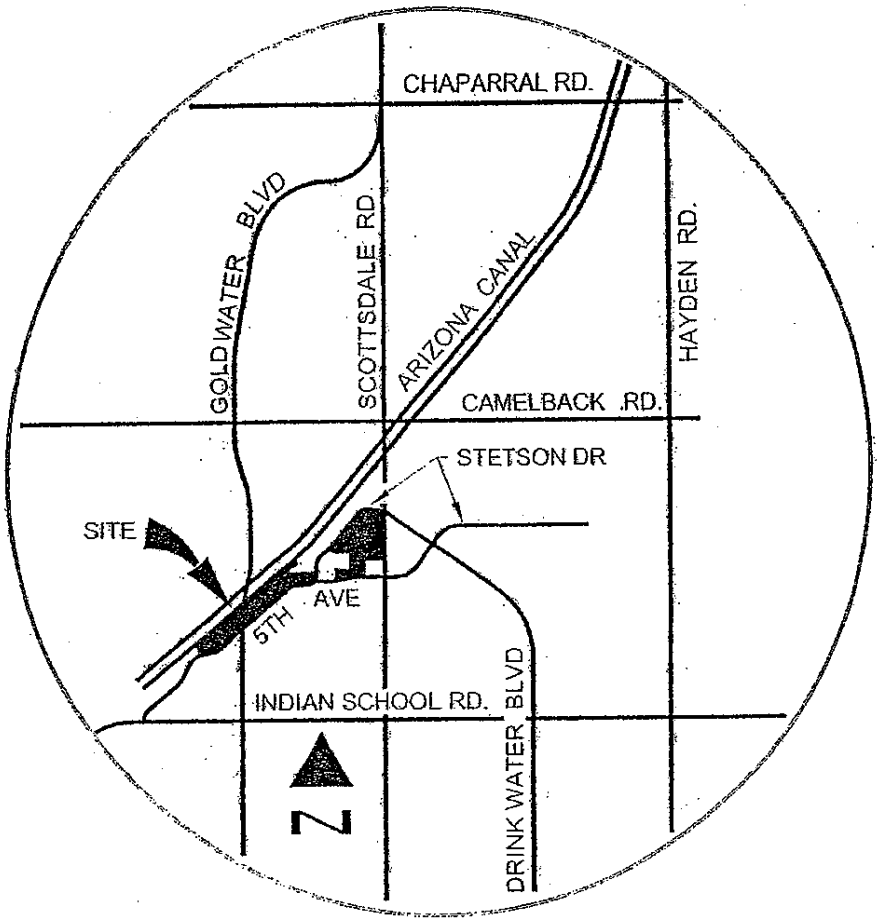
$$Q = \frac{1.49(1.80)(0.52)^{2/3}0.0016^{1/2}}{0.013} = 4.98\ cfs = 2{,}388\ \text{GPM}$$

Segment	Slope	Capacity (GPM) @70%	d/D (if > 70%)
1	0.0070	4,995	
2	0.0034	3,481	
3	0.0167	7,715	
4	0.0031	3,324	
5	0.0131	6,833	
6	0.0030	3,270	
7	0.0037	3,631	
8	0.0042	3,869	
9	0.0027	3,102	
10	0.0016	2,388	0.857
11	0.0087	5,568	
12	0.0019	2,602	0.751
13	0.0041	3,823	
14	0.0048	4,136	
15	0.0067	4,049	
16	0.0043	3,915	
17	0.0327	10,795	

2 reaches have slopes flat enough to create a situation where the d/D for the flow is greater than the 70% number dictated by the DS&PM. Neither of these reaches are adjacent to each other, and are adjacent to at least 1 reach with substantially higher capacity. The pipes will carry the flow without running full, or surcharging. Based on discussions with City Staff, if small sections of these sewers are marginally over capacity, but the majority remains sufficient, no upgrade will be required. This is the case here. This section will not need to be upgraded.

Provide written permission from Water Resources staff as an Appendix to the BOD

According to City GIS data and QS maps, segments 10 and 12 are approximately 191-feet and 442-feet long, respectively. Under capacity of these segments were not discussed with WR. These segments are required to be upsized by the developer at their own expense. Please include a map in the final BOD identifying all above sewer segments.



VICINITY MAP

SW 1/4 SEC 22 T2N R4E
NOT TO SCALE

SOUTHBRIDGE EXPANSION

EXHIBIT 1 LOCATION OF THE PROJECT

VICINITY MAP
EXHIBIT 1

TRIANGLE SITE

STETSON NORTHERN BUILDINGS

STETSON SOUTHERN BUILDINGS

SOUTHBRIDGE WEST SITE

ROSE GARDEN SITE

BUILDINGS WEST OF MARKETPLACE

MARKETPLACE SITE

EXISTING FLOWS

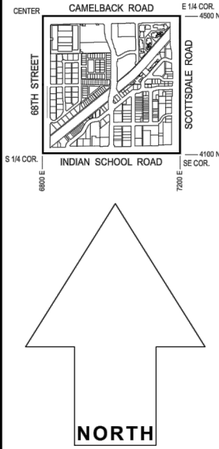
Treatment Plant

Sewer Main - Gravity

Sewer Main - Force

Sewer Main - Private

VICINITY MAP



SCALE: 1" = 100'

0 50 100 200

The map scale of 1" = 100' is based on a full size print of 30" x 36"

SEWER

QUARTER SECTION MAP

17-44

SE 1/4 SEC. 22 T2N R4E

EXHIBIT 2

GENERAL NOTES:

- THIS IS A COMPUTER GENERATED DRAWING. FOR ANY REVISIONS PLEASE CONTACT THE CITY OF SCOTTSDALE GIS DEPARTMENT AT (480) 312-7792.

ALL BEARING AND DISTANCES ARE BASED ARE AND IN FEET AND DECIMALS. IRON PINS ARE GIVEN TO CALCULATED SECTION

SCOTTSDALE GEOGRAPHIC INFORMATION SYSTEMS

CITY OF SCOTTSDALE

Scottsdale, Arizona 85251

LEGEND:

Cleanout

Lift Station

Manhole

N O T I C E

THIS DOCUMENT IS PROVIDED FOR GENERAL INFORMATION PURPOSES ONLY. THE CITY OF SCOTTSDALE DOES NOT WARRANT ITS ACCURACY, COMPLETENESS OR SUITABILITY FOR ANY PARTICULAR PURPOSE. IT SHOULD NOT BE RELIED UPON WITHOUT FIELD VERIFICATION.

THE CITY OF SCOTTSDALE

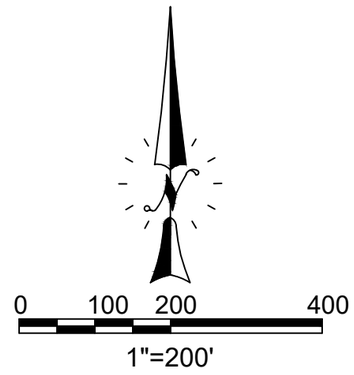
19-MAY-19

17-43

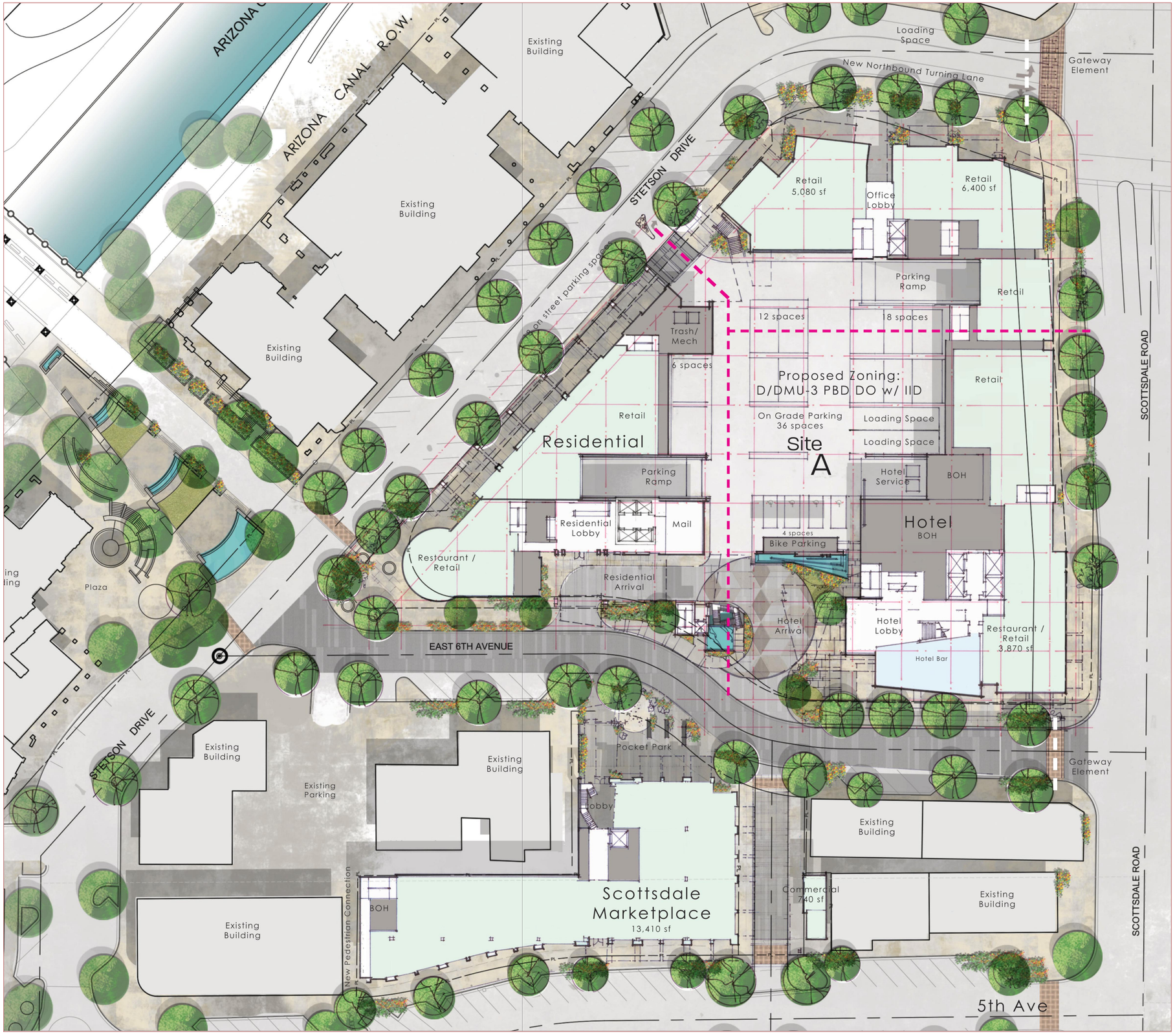
17-45

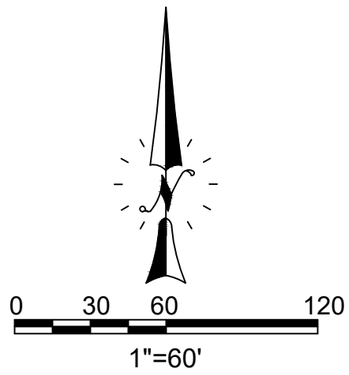
17-44

16-44

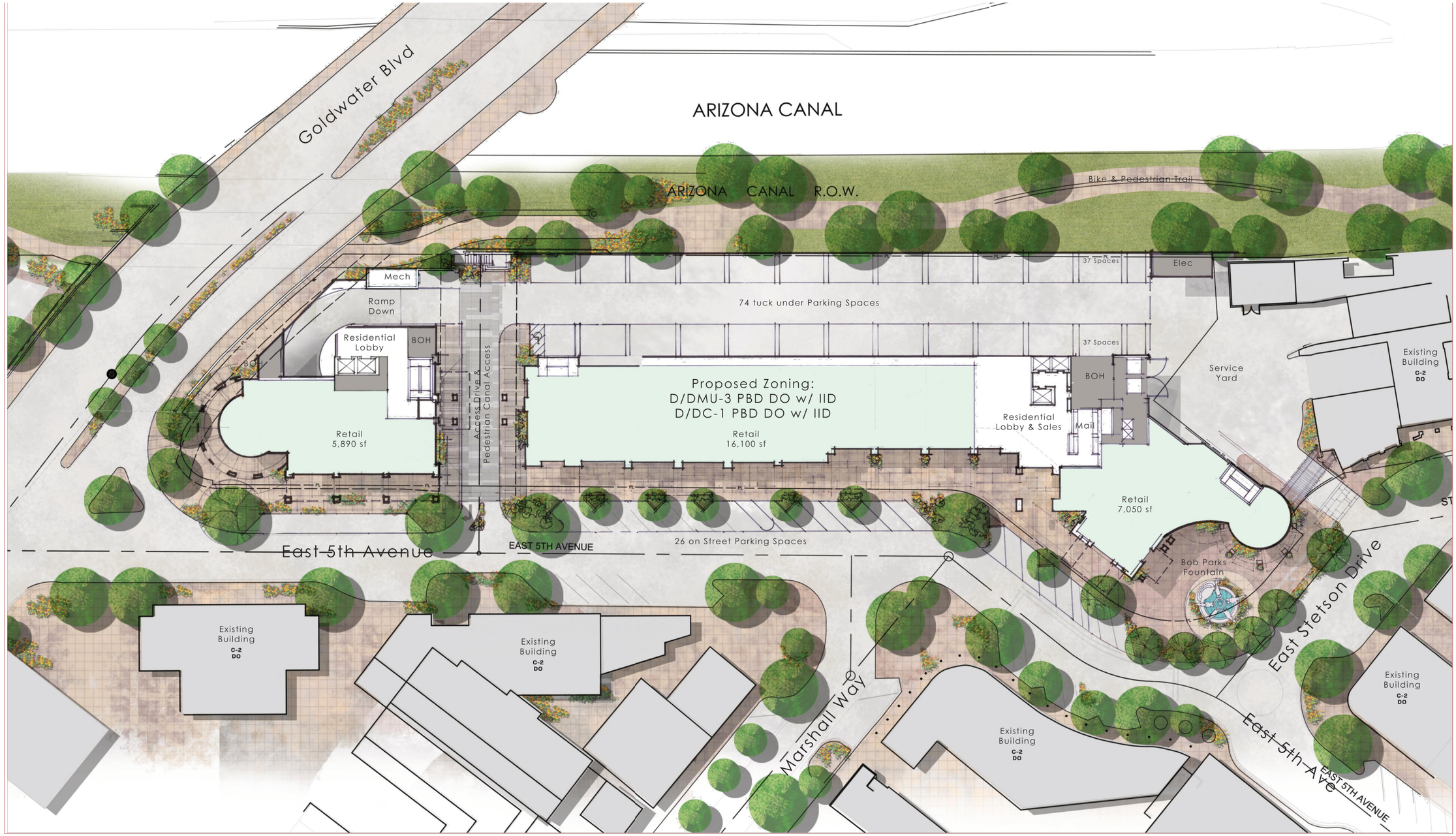


OVERALL SITE PLAN
AERIAL PHOTOGRAPH
PROPOSED CONDITION
EXHIBIT 3





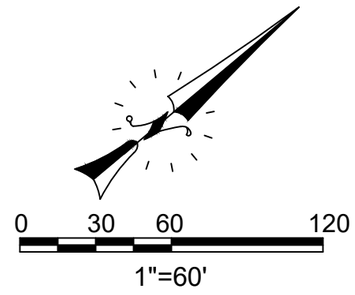
TRIANGLE AND MARKETPLACE SITES AERIAL PHOTOGRAPH PROPOSED CONDITION EXHIBIT 4



0 30 60 120

1"=60'

SOUTHBRIDGE WEST
AERIAL PHOTOGRAPH
PROPOSED CONDITION
EXHIBIT 5



ROSE GARDEN
AERIAL PHOTOGRAPH
PROPOSED CONDITION
EXHIBIT 6

CAPACITY @ MIN SLOPE

8" 296 GPM
10" 458 GPM
12" 662 GPM
14" 1010 GPM
18" 1674 GPM
21" 2306 GPM

131

131+42=173 GPM

126GPM - 84 GPM =42 GPM

OFFICE/RETAIL
HFF= 1394 +/- (GROUND +122')

EX SEWER TO BE
ABANDONED/REMOVED

NEW 8" DIA
SEWER TAP

ART GALLERY
6420 S.F.
HFF=1286.5 +/-
(GROUND +15)

81 GPM

RESIDENTIAL
TOWER
HFF=1392.5 +/-
(GROUND +121')
184 UNITS

EAST STETSON DRIVE

SCOTTSDALE ROAD

NEW 8" DIA
SEWER TAP

31

285 GPM

EX SEWER TO BE
ABANDONED/REMOVED

386 GPM

NEW SEWER MH

HOTEL 1
HFF=1348.0 +/-
(GROUND +76')
200 KEYS

NEW 10" DIA PVC
SEWER REPLACEMENT

NEW 10"

NEW 10"

NEW 8" DIA
SEWER TAP

NEW TAP TO
EXIST M.H.

NEW 8" DIA PVC
SEWER EXTENSION

408 GPM

386 GPM

22 GPM

See review comments on
Page 11

EAST 6TH AVENUE

NEW SEWER MH

' 12" DIA PVC
'ER REPLACEMENT

0 25 50
1"=50'

EXPIRES 12-31-21

EXHIBIT 7

CASE NO: 22-ZN-2018

SOUTHBRIDGE EXPANSION
TRIANGLE SITE
PRELIMINARY SEWER PLAN
SCOTTSDALE, ARIZONA

Scale	1"=50'
Date	1-18-19
Rev	7-8-19
Designed	WSG
Drawn	MJF
File:	STETSON EXHIBITS 7-17-19.dwg

GOOKIN ENGINEERS
ENGINEERS • HYDROLOGISTS • PLANNERS • SURVEYORS
4203 N0RTH BROWN AVENUE
SCOTTSDALE, ARIZONA 85251
480-947-3741

1

JOB NO.
2591B

All manholes that are 10-foot deep or the sewer line is 15-inch in diameter or greater, shall be 5-feet in diameter per DSPM Section 7-1.405 (Typ)

285 GPM

694 GPM

409 GPM

31 GPM

255 GPM

980 GPM

NEW 10" DIA PVC SEWER REPLACEMENT

NEW TAP TO EXIST M.H.

NEW 8" DIA PVC SEWER EXTENSION

10" SEWER REQUIRED

NEW 12" DIA PVC SEWER REPLACEMENT

IF SLOPES CAN BE ACHIEVED

NEW 15" DIA PVC SEWER REPLACEMENT

8" STUB SHOWN IN LIS

THIS CANNOT BE PRIVATE SEWER, IT SERVICES MULTIPLE PARCELS. IT IS EXISTING IN A PUE

NEW SEWER MH

EX SEWER TO BE ABANDONED/REMOVED

HOTEL 1
HFF=1348.0 +/-
(GROUND +76')
200 KEYS

NEW 8" DIA SEWER TAP

EAST 6TH AVENUE

NEW SEWER MH

NEW TAP TO EXIST M.H. & PLUG W. SIDE OF M.H.

NEW 6" DIA SEWER TAP

22 GPM

NEW CLEANOUT

MARKETPLACE
HFF= 1305.0 +/- (GROUND +36')
56,862 S.F.

EX SEWER TO BE ABANDONED/REMOVED

E. 5TH AVENUE

E STETSON DR

SCOTTSDALE ROAD

0 25 50
1"=50'

EXPIRES 12-31-21

EXHIBIT 8

CASE NO: 22-ZN-2018

SOUTHBRIDGE EXPANSION
MARKETPLACE SITE
PRELIMINARY SEWER PLAN
SCOTTSDALE, ARIZONA

Scale	1"=50'
Date	1-18-19
Rev	7-8-19
Designed	WSG
Drawn	MJF
File:	STETSON EXHIBITS 7-17-19.dwg

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SCOTTSDALE, ARIZONA 85251
480-947-3741

2

JOB NO. 2591B

ARIZONA CANAL

EX SEWER TO BE ABANDONED/REMOVED

GOLDWATER BLVD

70TH PL.

255 GPM

RESIDENTIAL/RETAIL
HFF=1339.5 +/- (GROUND +68')

RESIDENTIAL/RETAIL
HFF=1406.5 +/- (GROUND +135')
75,605 S.F. + 177 UNITS

EX SEWER TO BE ABANDONED/REMOVED

NEW 8" DIA SEWER TAP

NEW 8" DIA SEWER TAP

16DIP

EXIST 16" DIP SEWER

12W

8S

6-W

20-W-DIP

E. 5TH AVENUE

12PVC

S

MARSHALL WAY

EXISTING 12" SEWER TO REMAIN

NEW 15" DIA PVC SEWER REPLACEMENT

8"VCP

0 25 50
1"=50'

EXPIRES 12-31-21

EXHIBIT 9

CASE NO: 22-ZN-2018

SOUTHBRIDGE EXPANSION
SOUTHBRIDGE WEST SITE
PRELIMINARY SEWER PLAN
SCOTTSDALE, ARIZONA

Scale	1"=50'
Date	1-18-19
Rev	7-8-19
Designed	WSG
Drawn	MJF
File:	STETSON EXHIBITS 7-17-19.dwg

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SCOTTSDALE, ARIZONA 85251
480-947-3741

3

JOB NO. 2591B

ARIZONA CANAL

GOLDWATER BLVD

561 GPM EX.

RESIDENTIAL
HFF=1334. +/- (GROUND +61')
118 UNITS

152

EX SEWER TO BE
ABANDONED/REMOVED

NEW 8" DIA
SEWER TAP

152 GPM

16DIP

EXIST 16" DIP
SEWER

713 GPM

980 GPM

E. 5TH AVENUE

W 12DIP W 12DIP

1693 GPM

SHOULD BE A 21"

20W 16DIP 20W 6-W

0 25 50
1"=50'

CAPACITY @ MIN SLOPE

8" 296 GPM
10" 458 GPM
12" 662 GPM
14" 1010 GPM
18" 1674 GPM
21" 2306 GPM

EXHIBIT 10

CASE NO: 22-ZN-2018

EXPIRES 12-31-21

SOUTHBRIDGE EXPANSION
ROSE GARDEN SITE
PRELIMINARY SEWER PLAN
SCOTTSDALE, ARIZONA

Scale	1"=50'
Date	1-18-19
Rev	7-8-19
Designed	WSG
Drawn	MJF
File:	STETSON EXHIBITS 7-17-19.dwg

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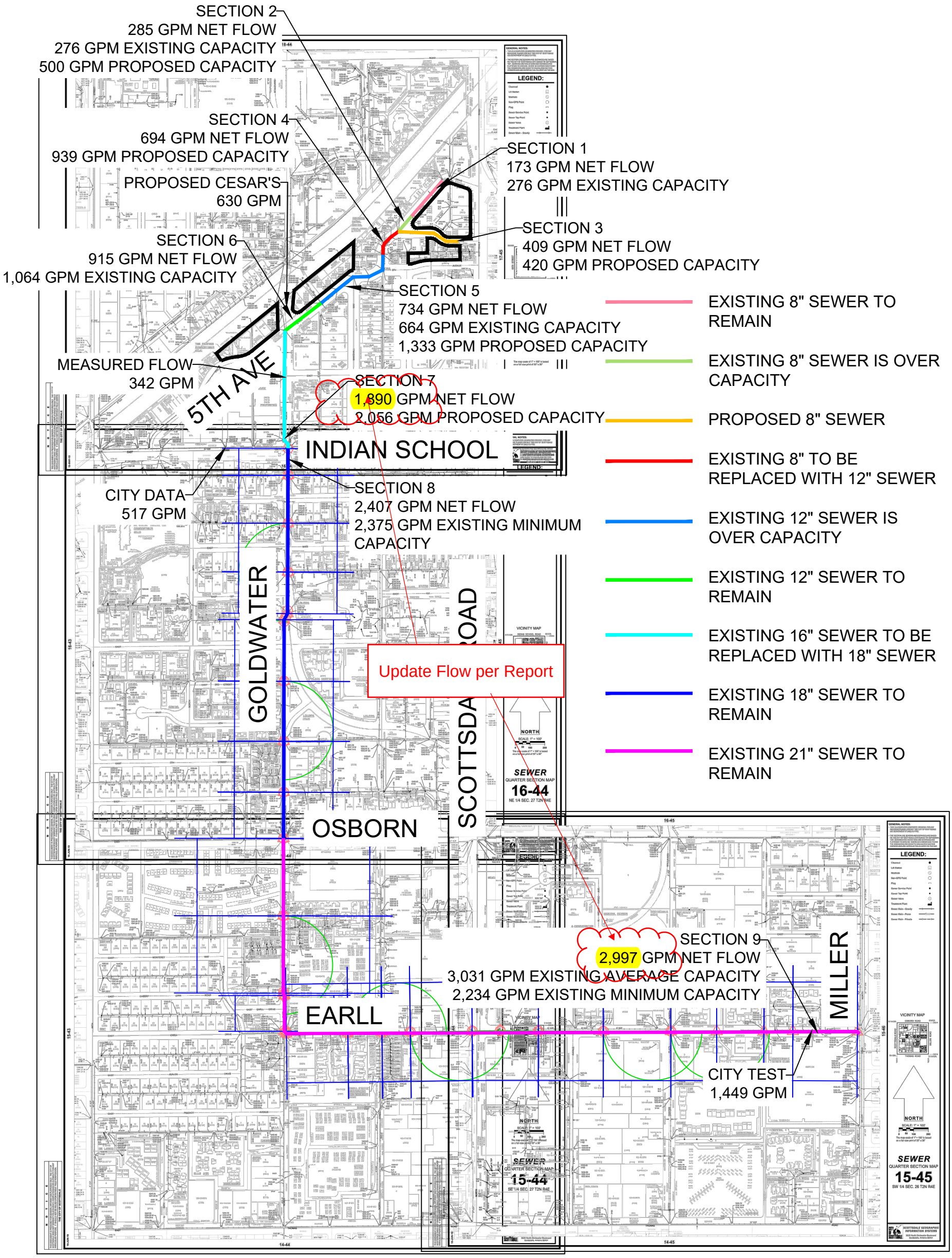
SCOTTSDALE, ARIZONA 85251
480-947-3741

4

JOB NO.
2591B



OVERALL SEWER SEGMENT MAP EXHIBIT 11

Flow Study for Gookin Engineering Southbridge Expansion Project

Ed Gookin
Gookin Engineering
4203 North Brown Ave. Scottsdale, Arizona • 85251

SL415 RDH Flow Study, 1 site in Scottsdale, AZ 5-3-19 to 5-14-19.

Equipment: Hach 901 Logger with AV sensor mounted on a pipe band.

The equipment was installed on 5-3--19 with confined space entry, pipe size confirmed, sensor calibrated and level depth confirmed to the flow level at that time.
Duration of monitoring: 11 days over 2 weekends.
Monitor, Flow gpm, velocity fps and Level inches
Data logging: 5 minutes intervals (No averaged intervals)

Site: Manhole on Goldwater and 3rd Ave.
Quarter section MH41605
16" DI (rusty pipe)
AV sensor installed upstream on the 16" line
There was no buildup in the pipe.
All data is good with minimal sensor interference from debris.

Attached is the excel sheet showing all Level, Velocity and Flow using the Manning equation within the loggers. Below are the data summaries for the site.

MH-41605 LEVEL (inches)			
Date	Maximum	Minimum	Average
5/3/2019	4.6100	2.3000	3.1784
5/4/2019	4.5100	1.2800	2.7333
5/5/2019	4.3500	1.2700	2.6026
5/6/2019	4.1400	1.3100	2.5876
5/7/2019	4.1800	1.3900	2.6464
5/8/2019	4.3200	1.4700	2.6796
5/9/2019	4.2400	1.4500	2.6401
5/10/2019	4.6400	1.2100	2.8589
5/11/2019	4.6600	1.5400	3.0157
5/12/2019	4.6300	1.5300	2.7652
5/13/2019	4.1400	1.2400	2.5410
5/14/2019	2.0200	1.3400	1.6365

MH-41605 VELOCITY (fps)			
Date	Maximum	Minimum	Average
5/3/2019	2.3900	1.5100	1.8896
5/4/2019	2.4400	1.0700	1.7847
5/5/2019	2.3100	0.9700	1.7394
5/6/2019	2.2600	1.0000	1.7303
5/7/2019	2.1600	0.9700	1.6840
5/8/2019	2.3200	1.0400	1.7049
5/9/2019	2.5000	0.9800	1.7378
5/10/2019	2.3000	0.6700	1.6997
5/11/2019	2.3400	0.9700	1.7233
5/12/2019	2.3200	1.0000	1.7042
5/13/2019	2.2300	1.0000	1.6751
5/14/2019	1.6300	0.8700	1.1931

EXHIBIT 12

Flow Study for Gookin Engineering Southbridge Expansion Project

MH-41605 FLOW (gpm)			
Date	Maximum	Minimum	Average
5/3/2019	341.6300	87.4800	168.5980
5/4/2019	299.5300	27.4200	138.0966
5/5/2019	277.6300	24.0200	125.2624
5/6/2019	256.2900	24.3900	122.6479
5/7/2019	264.3400	26.6200	122.8450
5/8/2019	309.1500	30.3100	127.1736
5/9/2019	278.8900	29.8200	126.2012
5/10/2019	313.6100	14.6300	142.7509
5/11/2019	323.7500	31.0100	153.8494
5/12/2019	317.5100	32.8400	133.2168
5/13/2019	263.3200	24.1300	116.6803
5/14/2019	74.5600	21.8800	40.9198

Monthly Summary		
Measures	Value	Unit
Max Total Flow	242781.120	GPD
Avg Total Flow	70524.785	GPD
Min Total Flow	0.000	GPD
Total Flow	2186268.336	gal

RDH Environmental Services
Randy Helfrich
Senior Manager
gm@rdh-env.com