CONCEPTUAL MASTER WASTEWATER SYSTEM REPORT FOR McDOWELL MOUNTAIN BACK BOWL

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WP# 042054 06

Prepared for
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1 0 INTRODUCTION

1 1 General Background and Project History

The *McDowell Mountain Back Bowl* (herein referred to as the *Back Bowl*), is located at the eastern edge of the City of Scottsdale, Maricopa County, Arizona, within a portion of Section 11, Township 4 North, Range 5 East The site is currently an assemblage of undeveloped parcels bound to the west by the existing Sonoran Crest Development (122nd Street alignment), to the east by the 128th Street alignment, to the north by the Happy Valley Road alignment, and to the south by the McDowell Mountain Sonoran Preserve Access to the development is planned from the west via the ½ -mile section roadway, Alameda Road Plate 1 provides a vicinity map for the project and surrounding areas

The *Back Bowl* is a 330-acre residential custom lot sub-division, nestled at the northern base of the McDowell Mountains The development includes approximately 121 lots ranging in size from 2 to 3 acres and a clubhouse with amenities such as jacuzzis, pools, water falls, and restaurant facilities Interpretive trails and scattered pocket parks with water features will also be incorporated into the site plan

Crown Community Development has considered expanding the *Back Bowl* to approximately 400 acres which would include the acquisition of the 40-acre parcel located at the northeast ¼ of Section 11, four (4) 2 5-acre parcels located at the northeast boundary of Sonoran Crest, and the 30-acre parcel located in the middle of the southern ½ portion of Section 11

This *Conceptual Master Wastewater System Report for McDowell Mountain Back Bowl* is prepared as two options Option 1 which represents the proposed 330-acre development, and Option 2 which includes the potential expansion (400-acre development) Land use information is provided by LVA Urban Design Studio L L C (LVA), January 6, 2004

1.2 Scope of Master Wastewater System Report

The intent of the *Conceptual Master Wastewater System Report for McDowell Mountain Back Bowl* is to identify the locations and preliminary sizes of the proposed sewer infrastructure required to provide sanitary service to the development for Options 1 and 2 The components of the sewer infrastructure discussed in this report include on-site and off-site sanitary sewer lines, a sewage pumping station and force main This report also presents the estimated wastewater flow calculations and the estimated pipe capacities

1 3 *Topographic Conditions*

Topography on the site slopes from the south to the northeast and northwest Slopes vary, with the majority in the 3 to 5 percent range, and some minor portions being much steeper Steeper slopes (5% and greater) are associated with the southern portion of the subject site Gentler slopes (3% or less) are located within the northern portion of the subject site

The majority of the subject site drains towards the northeast The remainder of the site drains either westerly or northwesterly towards Alameda Road

2.0 DESIGN REQUIREMENTS

The design criteria for the *Back Bowl* development are consistent with the requirements set by the *City of Scottsdale Design Standards and Policy Manual* and with *Arizona Department of Environmental Quality, Bulletin No 11* Please refer to Appendix C – *References* for these agency standards

2.1 Population

The equivalent population is calculated based on the land use information for the development It is computed as the ratio of the total wastewater flow for all land uses within a sub area to the average daily wastewater flow per person The equivalent population inflow at each node of the proposed wastewater system is included with the peak flow calculations in Appendix A A summary of the land use for Options 1 and 2 are provided in Table 2-1 *McDowell Mountain Back Bowl Land Use*

Table 2-1· McDowell Mountain Back Bowl Land Use

Land Use	Option 1	Option 2
Residential Custom Lots	125	146
Commercial Area	10,000 Sq ft	10,000 Sq ft

2 2 Wastewater Flow Criteria

The following is a summary of the major wastewater flow criteria utilized

1 The average wastewater flow for a ***residential*** dwelling unit with a density less than or equal to 2 dwelling units per acre is ***250*** gallons per day (gpd), based on an average wastewater flow of ***100*** gpd/person, and a density of ***2.5*** persons/dwelling unit

2 The average wastewater flow for ***non-residential*** land use (club house) is ***0 9*** gpd/sq ft

3 The peak hour flow is 4 0 times the average-day flow

2 3 Wastewater System Criteria

1 Sewer lines are designed to provide mean velocities during full-flow conditions greater than 2 5 feet per second (fps) and less than 10 0 fps, based upon Manning's formula, with a roughness coefficient value of "n" equal to 0 013

2 Sewer lines are designed to convey the peak flow such that ratio of depth of flow to pipe diameter (d/D ratio) is less than or equal to 0 65 for pipe sizes less than 12 inches

3 Sewer lines 8 inches in diameter shall be designed at the minimum slope of 0 0052 ft/ft

3 0 WASTEWATER FLOW CALCULATIONS

The average-day and peak wastewater flows are calculated using the criteria discussed in Section 2 0 of this report Table 3 1 presents a summary of the average-day and peak-flow calculations for Options 1 and 2 Please refer to Appendix A – *Table 1 Estimated Peak Flow Calculations* for detailed flow calculations for Option 1, and Appendix B – *Table 1 Estimated Peak Flow Calculations* for detailed flow calculations for Option 2

Table 3-1· Average and Peak Flows for Options 1 and 2

System	Average-Day Flow (gpd)	Peak-Flow (gpd)
Option 1	34,750	139,000
Option 2	41,000	164,000

3 1 Pipe Sizing and Capacity Calculations

The pipe sizes are designed at the minimum slope using peak-flow pipe capacity and velocity calculations During peak-flow conditions, d/D ratios are less than the minimum requirement of 0 65 During full-flow conditions, pipe velocities are within the design range of 2 5 to10 0 fps The actual pipe slopes and locations may vary upon final determination of subdivision layout Deviations from the proposed system in this report shall ensure minimum design criteria are followed

4 0 GENERAL PLAN FOR THE ON-SITE WASTEWATER SYSTEM

The proposed on-site master wastewater system for Options 1 and 2 consist of 8-inch diameter gravity sewer lines Details of these systems are presented below

4 1 Proposed On-Site Collection System for Option 1

Based on the topographic conditions, the proposed wastewater system for Option 1 consists of three (3) sewer systems and outfall locations A description of these systems and the direction of the flow are as follows

Sewer System 1 Alameda Road outfall (Node A to Node I) in the northwest direction

Sewer System 2 128th Street outfall (Node J to Node Q) in the eastern direction

Sewer System 3 Happy Valley Road alignment outfall (Node R to Node AM) in the northern direction

Please refer to Plate 2 – *Option 1 Conceptual Master Wastewater System* for the pipe sizes and outfall locations Sewer System 1 collects wastewater flow from Node A to Node I northwesterly and outfalls to the existing 8-inch gravity sewer along Alameda Road in Sonoran Crest Sewer System 2 collects flows from Node J to Node Q easterly and outfalls to the proposed 8-inch gravity sewer along the 128th street alignment System 3 collects flows from Node R to Node AM northerly and outfalls to the proposed 8-inch gravity sewer along the Happy Valley Road alignment The proposed sewer systems consist of 8-inch diameter sewer lines to be constructed in the local collector roadways and sewer easements Table 4 1 presents the average day and peak wastewater flows for the three (3) systems for Option 1 Please refer to Appendix A for detailed results

Table 4-1 Average and Peak Wastewater Flows for Option 1

System	Average-Day Flow (gpd)	Peak-Flow (gpd)
1	7,000	28,000
2	6,500	26,000
3	21,250	85,000
Total	***34,750***	***139,000***

4 2 Proposed On-Site Collection System for Option 2

Based on the topographic conditions, the proposed wastewater system for Option 2 consists of three (3) different sewer systems and outfall locations A description of these systems and the direction of the flow are as follows

Sewer System 1 Alameda Road outfall (Node A to Node I) in the northwest direction

Sewer System 2 Southerly 128th Street outfall (Node J to Node Q in the eastern direction

Sewer System 3 Northerly 128th Street outfall (Node R to Node AM) in the northeast direction

Please refer to Plate 3 – *Option 2 Conceptual Master Wastewater System* for the pipe sizes and outfall locations Sewer System 1 collects wastewater flow from Node A to Node I northwesterly and outfalls to the existing 8-inch gravity sewer along Alameda Road in Sonoran Crest Sewer System 2 and System 3 collect wastewater flow from Node J to Node Q easterly and Node R to Node AM northeasterly, respectively, and outfall to the proposed 8-inch gravity sewer along the 128th street alignment The proposed sewer systems consist of 8-inch diameter sewer lines to be constructed in the local collector roadways and sewer easements Table 4 2 presents the average-day and peak wastewater flows for the three (3) systems for Option 2 Please refer to Appendix B for detailed results

Table 4-2 Average and Peak Wastewater Flows for Option 2

System	Average-Day Flow (gpd)	Peak-Flow (gpd)
1	8,000	32,000
2	7,750	31,000
3	25,250	101,000
Total	***41,000***	***164,000***

The 8-inch diameter on-site sewer lines proposed for Options 1 and 2 have adequate capacity to convey the estimated wastewater flow to the outfall locations Please refer to *Table 2 Estimated Pipe Capacities* in Appendices A & B for Options 1 and 2 respectively It is anticipated that some lots may require individual grinder pumps with private force mains that would discharge into the proposed gravity sewer system

5 0 GENERAL PLAN FOR THE OFF-SITE WASTEWATER SYSTEM

The off-site sewer infrastructure for development Options 1 and 2 consists of existing gravity sewer systems within the Sonoran Crest and Granite Ridge development, proposed 8-inch gravity sewer lines, a sewage pumping station and force-main The ultimate outfall for the wastewater flow generated by the *Back Bowl* will be conveyed southerly via the existing 10-inch sewer line along Happy Valley Road to the City of Scottsdale Water Reclamation Facility Plates 2 and 3 (*Option 1 and 2 Conceptual Master Wastewater System*) identify the locations of the off-site sewer infrastructure

For Option 1, flows directed in the north-west direction (sewer system 1) will outfall to the existing 8-inch gravity sewer system within Sonoran Crest Flows directed in the eastern direction (sewer system 2) will be conveyed northerly via a proposed 8-inch gravity sewer line along 128th Street, from Node Q to a proposed sewage pumping station located near the intersection of 128th Street and the Happy Valley Road alignment The proposed sewage pumping station will also collect flow from sewer system 3 via a proposed 8-inch gravity sewer line along the Happy Valley Road alignment

Flows collected at the sewage pumping station would be pumped westerly through a proposed force-main along the Happy Valley Road alignment to the point of discharge into the existing 8-inch gravity sewer system within the Granite Ridge development Please refer to Plate 2 for an illustration of the off-site sewer plan for Option 1

The off-site sewer system for Option 2 is similar to Option 1, except for the proposed 8-inch gravity sewer line along the Happy Valley Road alignment Option 2 allows flow from sewer system 3 to outfall to the proposed 8-inch gravity sewer along 128th Street Pleas refer to Plate 3 for an illustration of the off-site sewer plan for Option 2

The proposed sewage pumping station would be required to pump a design wastewater flow of 111,000 gpd or 132,000 gpd for Options 1 and 2 respectively, at an approximate total dynamic head of 42 feet The force-main size necessary to convey these design flows at a minimum velocity of 4 0 fps is approximately 3-inches The force main would be constructed of ductile iron pipe, and would be aligned along a graded and re-vegetated sewer easement to assure continual access to City maintenance crews The preliminary design and location of this force main is conceptual and is intended to be finalized with the actual design of the force main

According to the sewer improvement plan for the Sonoran Crest sewer system, the 8-inch outfall line is adequate to intercept the 28,000 gpd and 32,000 gpd peak wastewater flows generated by sewer system 1 for Options 1 and 2, respectively, with a surplus capacity of approximately 1 07 MG Please refer to Appendix C – *Reference*) for the Sonoran Crest sewer improvement plan

The outfall system within Granite Ridge has adequate capacity to intercept flows from the force-main, with a surplus capacity of roughly 0 42 MG Information regarding the existing sewer system in Granite Ridge is obtained from the *Engineering Report for Sewer Construction Facilities for the Granite Ridge Subdivision*, prepared by Arcadis, dated January 23, 2003 A copy of this report is provided in Appendix C – *References* Please refer to Table 2 under Appendices A and B for the capacity calculations for the Granite Ridge sewer system Provisions will be made to accommodate odor control of the receiving manhole in the Granite Ridge Sewer System with the actual design of the force main

6 0 CONCLUSIONS

Based on the analysis of the *Conceptual Master Wastewater System Report*, the following conclusions can be made

1 The wastewater demand and system criteria are consistent with the criteria established with the *City of Scottsdale Design Standards and Policies Manual and Arizona Department of Environmental Quality (ADEQ) Bulletin No 11*

2 Wastewater service will be supplied to the development through 8-inch diameter sewer lines

3 Average-day flow and peak-hour flow calculations are developed in order to provide preliminary sizing for the capacity of the sewer lines

4 Pipe capacities are such that the d/D ratio is not to exceed 0 60 during peak-hour conditions

5 The system is designed at the minimum slopes required to achieve a velocity under full-flow conditions between 2 5 fps and 10 0 fps

6 The existing 8-inch sewer along Alameda Road in Sonoran Crest and has adequate capacity to accommodate peak flows generated by the *back Bowl* development in the northwest direction for both Options 1 and 2

7 The existing 8-inch Granite Ridge gravity sewer system has adequate capacity to accommodate peak flows generated by the *back Bowl* development conveyed by the proposed force main for both Options 1 and 2

8 Finally, the existing sewer collector system along Happy Valley Road is more than capable of accommodating the additional flows from the *Back Bowl* development for both Options 1 and 2

APPENDIX A

Option 1

Table 1: Estimated Wastewater Flow Calculations

TABLE 1 WASTEWATER FLOW CALCULATIONS

Project Master Wastewater Plan for McDowell Mountain Back Bowl
Location City of Scottsdale
Date January 13 2005
References City of Scottsdale Design Standards and Policies Manual
Site Plan for Sonoran Crest dated 2/22/1999
Engineering Report for Construction of Sewer Facilities Granite Ridge Subdivision, Arizona Dated Janurary 23, 2002
Sewer Quarter Section Map (46 55) City of Scottsdale, Arizona

				RESIDENTIAL		NON-RESIDENTIAL						
UPSTREAM NODE	DOWNSTREAM NODE	PIPE DIA (IN)	PIPE SLOPE (FT / FT)	DWELLING UNITS < 2 DU/ACRE	ADF/UNIT	AREA (SQ FT)	ADF/SQ FT	SUB AREA ADF (GPD)	EQUIVALENT POPULATION	TOTAL ADF (GPD)	PEAKING FACTOR	PEAK FLOW (GPD)
Gravity Outfall to Alameda Road												
A	B	8	0 0052	4	250			1 000	10 0	1 000	4 00	4 000
C	B	8	0 0052	3	250			750	7 5	750	4 00	3 000
B	E	8	0 0052	8	250			2 000	20 0	3 750	4 00	15 000
D	E	8	0 0052	4	250			1,000	10 0	1 000	4 00	4,000
E	F	8	0 0052	1	250			250	2 5	5 000	4 00	20 000
G	F	8	0 0052	4	250			1,000	10 0	1 000	4 00	4 000
F	H	8	0 0052	4	250			1,000	10 0	7 000	4 00	28 000
H	I	8	0 0052							7,000	4 00	28,000
Subtotal				***28***	***250***			***7,000***	***70 0***	***7,000***		***28,000***
Gravity Outfall to 128th Street Alignement												
J1	K	8	0 0052	5	250			1,250	12 5	1 250	4 00	5,000
L	K	8	0 0052	4	250			1,000	10 0	1 000	4 00	4,000
K	N	8	0 0052	3	250			750	7 5	3,000	4 00	12 000
M	N	8	0 0052	3	250			750	7 5	750	4 00	3 000
N	P	8	0 0052	6	250			1,500	15 0	5 250	4 00	21 000
O	P	8	0 0052	3	250			750	7 5	750	4 00	3,000
P	Q	8	0 0052	2	250			500	5 0	6,500	4 00	26 000
Subtotal				***26***				***6,500***	***65 0***	***6,500***		***26,000***
Gravity Outfall to the Happy Valley Road Alignment												
R	S	8	0 0052	4	250	5000	0 9	5,500	55 0	5,500	4 00	22 000
S	U	8	0 0052	4	250			1,000	10 0	6,500	4 00	26 000
T	U	8	0 0052	2	250			500	5 0	500	4 00	2,000
U	V	8	0 0052	2	250			500	5 0	7 500	4 00	30 000
W	X	8	0 0052	3	250			750	7 5	750	4 00	3 000
X	Z	8	0 0052	4	250			1,000	10 0	1,750	4 00	7 000
Y	Z	8	0 0052	3	250			750	7 5	750	4 00	3 000
Z	V	8	0 0052	1	250			250	2 5	2 750	4 00	11 000
V	AA	8	0 0052	6	250			1,500	15 0	11 750	4 00	47 000
AA	AJ	8	0 0052	5	250			1,250	12 5	13,000	4 00	52 000
AK	AJ	8	0 0052	3	250			750	7 5	750	4 00	3 000
AJ	AH	8	0 0052	2	250			500	5 0	14 250	4 00	57 000
AB	AC	8	0 0052	5	250			1,250	12 5	1 250	4 00	5 000
AD	AC	8	0 0052	3	250			750	7 5	750	4 00	3 000
AC	AE	8	0 0052	2	250			500	5 0	2 500	4 00	10 000
AE	AF	8	0 0052	8	250			2,000	20 0	4 500	4 00	18 000
AG	AF	8	0 0052	3	250			750	7 5	750	4 00	3 000
AF	AH	8	0 0052	3	250			750	7 5	6 000	4 00	24 000

TABLE 1 WASTEWATER FLOW CALCULATIONS

Project Master Wastewater Plan for McDowell Mountain Back Bowl
Location City of Scottsdale
Date January 13 2005
References City of Scottsdale Design Standards and Policies Manual
Site Plan for Sonoran Crest dated 2/22/1999
Engineering Report for Construction of Sewer Facilities Granite Ridge Subdivision, Arizona Dated Janurary 23, 2002
Sewer Quarter Section Map (46 55) City of Scottsdale Arizona

				RESIDENTIAL		NON RESIDENTIAL						
UPSTREAM NODE	DOWNSTREAM NODE	PIPE DIA (IN)	PIPE SLOPE (FT / FT)	DWELLING UNITS < 2 DU/ACRE	ADF/UNIT	AREA (SQ FT)	ADF/SQ FT	SUB-AREA ADF (GPD)	EQUIVALENT POPULATION	TOTAL ADF (GPD)	PEAKING FACTOR	PEAK FLOW (GPD)
AI	AH	8	0 0052	3	250			750	7 5	750	4 00	3 000
AH	AM	8	0 0052	1	250			250	2 5	21 250	4 00	85 000
AM	AN	8	0 0052							21,250	4 00	85,000
Subtotal				*67*		*5000*	*0 9*	*21,250*	*212 5*	*21,250*		*85,000*
Total				**121**				**34,750**	**347 5**	**34,750**		**139,000**
Outfall to Offsite Gravity Sewer System in Sonoran Crest												
I	NODE 1	8	0 0200					7,000 0	70 0	7 000	4	28 000
NODE 1	NODE 2	8	0 0239							7 000	4	28 000
NODE 2	NODE 3	8	0 0196							7,000	4	28 000
NODE 4	NODE 5	8	0 0052							*7 000*	4	*28 000*
NODE 5[1]	NODE 6	8	0 0052	58 0	250			14 500 0	145 0	21,500	4	86,000
NODE 6	NODE 7	8	0 0250							21,500	4	86 000
NODE 7	NODE 8	8	0 0281							21 500	4	86 000
Outfall to Offsite Gravity Sewer System in Granite Ridge												
Q	NODE 4	8	0 0052							6 500	4	26 000
NODE 4	AM	8	0 0052							6 500	4	26 000
AM	AN	8	0 0052							27 750	4	111 000
AN	A0			FM						27 750	4	111 000
A0 [2]	AP	8	0 0052	12 0	250			3,000 0	30 0	30 750	4	123 000
AP [3]	AQ	8	0 0052	114 0	250			28 500 0	285 0	59 250	4	237 000
AQ [4]	AR	10	0 0040	76 0	250			19 000 0	190 0	78 250	4	313 000
AR	AS	10	0 0040							78,250	4	313,000

Note
1) Contributing flows include flows generated from 58 dwelling units in Sonoran Crest
2) Contributing flows include flows generated from 12 lots in Granite Ridge
3) Contributing flows include flows generated from 114 lots in Desert Ridge
4) Contributing flows include flows generated from 18 lots in Boulder Mountain and 58 lots in Quarter Section 46-55

Table 2: Estimated Pipe Capacities

TABLE 2 ESTIMATED PIPE CAPACITIES

Project Master Wastewater Plan for McDowell Mountain Back Bowl
Location Scottsdale Arizona
Date January 12 2005

Project Number 042054 06
Project Engineer Gordon W Wark P E

FROM NODE	TO NODE	PIPE SIZE (IN)	PEAK FLOW (GPD)	PIPE SLOPE (FT/FT)	FULL FLOW VELOCITY, V_o (FPS)	PARTIAL FLOW VELOCITY, V_1 (FPS)	PIPE CAPACITY (GPD)	SURPLUS CAPACITY (GPD)	d/D
Gravity Outfall to the West									
A	B	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
C	B	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
B	E	8	15 000	0 0052	2 5	1 1	564 339	549 339	0 11
D	E	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
E	F	8	20 000	0 0052	2 5	1 2	564 339	544 339	0 13
G	F	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
F	H	8	28 000	0 0052	2 5	1 3	564 339	536 339	0 15
H	I	8	28,000	0 0052	2 5	1 3	564 339	536,339	0 15
Gravity Outfall to the East at Node S									
J1	K	8	5 000	0 0052	2 5	0 8	564 339	559 339	0 07
L	K	8	4 000	0 0052	2 5	0 7	564 339	560,339	0 06
K	N	8	12 000	0 0052	2 5	1 0	564 339	552 339	0 10
M	N	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
N	P	8	21 000	0 0052	2 5	1 2	564 339	543 339	0 13
O	P	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
P	Q	8	26 000	0 0052	2 5	1 3	564 339	538,339	0 15
Gravity Outfall to the East at Node AF									
R	S	8	22 000	0 0052	2 5	1 2	564 339	542 339	0 13
S	U	8	26 000	0 0052	2 5	1 3	564 339	538 339	0 15
T	U	8	2 000	0 0052	2 5	0 6	564 339	562 339	0 04
U	V	8	30 000	0 0052	2 5	1 3	564 339	534 339	0 16
W	X	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
X	Z	8	7 000	0 0052	2 5	0 9	564 339	557 339	0 08
Y	Z	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
Z	V	8	11 000	0 0052	2 5	1 0	564 339	553 339	0 10
V	AA	8	47 000	0 0052	2 5	1 5	564 339	517 339	0 20
AA	AJ	8	52 000	0 0052	2 5	1 6	564 339	512 339	0 21
AK	AJ	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
AJ	AH	8	57 000	0 0052	2 5	1 6	564 339	507 339	0 21
AB	AC	8	5 000	0 0052	2 5	0 8	564 339	559 339	0 07
AD	AC	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
AC	AE	8	10,000	0 0052	2 5	1 0	564 339	554 339	0 09
AE	AF	8	18 000	0 0052	2 5	1 1	564 339	546 339	0 12
AG	AF	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
AF	AH	8	24 000	0 0052	2 5	1 2	564 339	540 339	0 14
AI	AH	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
AH	AM	8	85 000	0 0052	2 5	1 8	564 339	479 339	0 26
AM	AN	8	85 000	0 0052	2 5	1 8	564 339	479 339	0 26
Gravity Outfall to the Almeda Sewer Line in Sonoran Crest									
I	NODE 1	8	28 000	0 0200	4 9	2 1	1 106 761	1 078 761	0 11
NODE 1	NODE 2	8	28 000	0 0239	5 4	2 2	1 209 867	1 181 867	0 11
NODE 2	NODE 3	8	28 000	0 0196	4 9	2 1	1 095 637	1 067 637	0 11
NODE 4	NODE 5	8	28 000	0 0052	2 5	1 3	564 339	536 339	0 15
NODE 5(1)	NODE 6	8	86 000	0 0052	2 5	1 8	564 339	478 339	0 26
NODE 6	NODE 7	8	86 000	0 0250	5 5	3 2	1 237 396	1 151 396	0 18
NODE 7	NODE 8	8	86 000	0 0281	5 8	3 3	1 311 873	1 225 873	0 17
Outfall to the Granite Ridge Gravity System									
Q	NODE 4	8	26 000	0 0052	2 5	1 3	564 339	538 339	0 15
NODE 4	AM	8	26 000	0 0052	2 5	1 3	564 339	538 339	0 15
AM	AN	8	111 000	0 0052	2 5	1 9	564 339	453 339	0 30
AN	A0	FM	111 000						
A0 (2)	AP	8	123 000	0 0052	2 5	2 0	564 339	441 339	0 32
AP (3)	AQ	8	237 000	0 0052	2 5	2 4	564 339	327 339	0 45
AQ (4)	AR	10	313 000	0 0040	2 5	2 3	897 486	584 486	0 41
AR	AS	10	313,000	0 0040	2 5	2 3	897,486	584,486	0 41

Force Main Calculations

Project	**Master Wastewater Plan for McDowell Mountain Back Bowl**		
Location	Scottsdale, Arizona		
Date	January 7, 2005		
References	City of Scottsdale Design Standards and Policies Manual		Project Number 042054 06
References	Hazen-Williams formula		Project Engineer Gordon W W.

Known Values

Hazen-Williams coefficient, C =	**140**	PVC Force Main, "C" = 140
Initial Elevation =	**2,640**	located at proposed sewage pun
Final Elevation =	**2,660**	Existing Stub of Granite Ridge D
Forcemain Length (ft) =	**5,660**	
Minor Loss Equivalent Length (10% of Length) =	**566**	
Average Flow	**27,750**	gpd
Peak Hour Flow	**111,000**	gpd

Calculated Values

Referenced Equations

$v = Q / A$ (1 cfs = 449 gpm)

$A = pi * [(D / 12) ^2] / 4$

$H_f = 3022 * [(v / C) ^1.85] / [(D / 12) ^1.165]$

where v = velocity, feet per second (fps)
Q = flow rate, gallons per minute (gpm)
A = conveyance area, square feet
D = inside pipe diameter, inches
H_f = head loss, feet per thousand feet of pipe

Peak Flow (gpd)	Peak Flow (gpm)	Pipe Dia (in.)	Velocity (fps)	Head Loss per 1,000 ft (ft)	Total Friction Head Loss (ft)	Total Dynamic Head Loss (ft)	Pressure Loss (psi)
111,000	77 08	2	7 87	118 65	49 0	69 0	30
		2 5	5 04	40 07	31 4	51 4	22
		3	3 50	16 50	21 8	41 8	18
		3 25	2 98	11 18	18 6	38 6	17
		3 5	2 57	7 80	16 0	36 0	16

Design Pipe Size = 3"

Notes

1) The velocity and head loss calculations are based on the peak flow rate The pump capacity should be used for the actual flow rate during the final lift station design

2) Wet well sizing, pump cycling and pump discharge rates would be designed such that the minimum flow velocity in the forcemain is not less than 4 fps

4) For higher-velocity force mains, it may be required to increase the size of the forcemain prior to discharging to a manhole, etc in order to reduce the discharge velocity

5) Surge calculations should be performed to ensure that the proper pipe class is being used

6) When wastewater is pumped over a considerable distance, increasing the forcemain size may reduce horsepower requirements (and operation & maintenance costs) of the lift station pumps, due to reduced friction

APPENDIX B

Option 2

Table 1: Estimated Wastewater Flow Calculations

TABLE 1 WASTEWATER FLOW CALCULATIONS

Project Master Wastewater Plan for McDowell Mountain Back Bowl

Location City of Scottsdale

Date January 25 2005

References City of Scottsdale Design Standards and Policies Manual
Site Plan for Sonoran Crest dated 2/22/1999
Engineering Report for Construction of Sewer Facilities Granite Ridge Subdivision Arizona Dated Janurary 23 2002
Sewer Quarter Section Map (46-55) City of Scottsdale Arizona

Project Number 042054 06

Project Engineer Gordon W Wark P E

				RESIDENTIAL		NON-RESIDENTIAL							
UPSTREAM NODE	DOWNSTREAM NODE	PIPE DIA (IN)	PIPE SLOPE (FT / FT)	DWELLING UNITS < 2 DU/ACRE	ADF/UNIT	AREA (SQ FT)	ADF/SQ FT	SUB AREA ADF (GPD)	EQUIVALENT POPULATION	TOTAL ADF (GPD)	TOTAL EQUIVALENT POPULATION	PEAKING FACTOR	PEAK FLOW (GPD)
Gravity Outfall to the West													
A1	A	8	0 0052	4	250			1 000	10	1 000	10	4 00	4 000
A	B	8	0 0052	4	250			1 000	10	2 000	20	4 00	8 000
C	B	8	0 0052	3	250			750	8	750	8	4 00	3 000
B	E	8	0 0052	8	250			2,000	20	4 750	48	4 00	19 000
D	E	8	0 0052	4	250			1,000	10	1,000	10	4 00	4 000
E	F	8	0 0052	1	250			250	3	6,000	60	4 00	24 000
G	F	8	0 0052	4	250			1,000	10	1 000	10	4 00	4 000
F	H	8	0 0052	4	250			1,000	10	8,000	80	4 00	32 000
H	I	8	0 0052		0			0	0	8,000	80	4 00	32,000
Subtotal				*32*	*250*			*8,000*		*8,000*	*80*		*32,000*
Gravity Outfall to the East at Node S													
J	J1	8	0 0052	3	250			750	8	750	8	4 00	3,000
A1	K	8	0 0052	3	250			750	8	750	8	4 00	3 000
J1	K	8	0 0052	3	250			750	8	2 250	23	4 00	9,000
L	K	8	0 0052	5	250			1,250	13	1 250	13	4 00	5 000
K	N	8	0 0052	3	250			750	8	4 250	43	4 00	17 000
M	N	8	0 0052	3	250			750	8	750	50	4 00	3 000
N	P	8	0 0052	6	250			1 500	15	6 500	65	4 00	26,000
O	P	8	0 0052	3	250			750	8	750	8	4 00	3 000
P	Q	8	0 0052	2	250			500	5	7,750	78	4 00	31,000
Subtotal				*31*				*7,750*		*7,750*	*78*		*31,000*
Gravity Outfall to the East at Node AF													
R	S	8	0 0052	4	250	5000	0 9	5 500	55	5 500	55	4 00	22 000
S	U	8	0 0052	3	250			750	8	6 250	63	4 00	25,000
T	U	8	0 0052	2	250			500	5	500	5	4 00	2 000
U	V	8	0 0052	2	250			500	5	7 250	73	4 00	29,000
W	X	8	0 0052	3	250			750	8	750	8	4 00	3 000
X	Z	8	0 0052	4	250			1,000	10	1,750	18	4 00	7 000
Y	Z	8	0 0052	3	250			750	8	750	8	4 00	3 000
Z	V	8	0 0052	2	250			500	5	3 000	30	4 00	12,000
V	AA	8	0 0052	4	250			1,000	10	11,250	113	4 00	45,000
AA	AJ	8	0 0052	4	250			1 000	10	12,250	68	5 00	61,250
AB	AC	8	0 0052	5	250			1 250	13	1 250	13	4 00	5 000
AD	AC	8	0 0052	4	250			1,000	10	1 000	10	4 00	4 000
AC	AE	8	0 0052	2	250			500	5	2 750	28	4 00	11,000
AE	AE1	8	0 0052	6	250			1,500	15	4,250	43	4 00	17,000
AE2	AE1	8	0 0052	7	250			1,750	18	1 750	18	4 00	7 000
AE1	AH	8	0 0052	6	250			1,500	15	7,500	75	4 00	30 000
AI	AH	8	0 0052	3	250			750	8	750	8	4 00	3 000
AH	AJ	8	0 0052	2	250			500	5	8 000	88	4 00	32 000

TABLE 1: WASTEWATER FLOW CALCULATIONS

Project Master Wastewater Plan for McDowell Mountain Back Bowl
Location City of Scottsdale
Date January 25 2005
References *City of Scottsdale Design Standards and Policies Manual*
Site Plan for Sonoran Crest dated 2/22/1999
Engineering Report for Construction of Sewer Facilities Granite Ridge Subdivision, Arizona Dated Janurary 23, 2002
Sewer Quarter Section Map (46 55) City of Scottsdale Arizona

Project Number 042054 06
Project Engineer Gordon W Wark, P E

				RESIDENTIAL		NON-RESIDENTIAL							
UPSTREAM NODE	DOWNSTREAM NODE	PIPE DIA (IN)	PIPE SLOPE (FT / FT)	DWELLING UNITS < 2 DU/ACRE	ADF/UNIT	AREA (SQ FT)	ADF/SQ FT	SUB-AREA ADF (GPD)	EQUIVALENT POPULATION	TOTAL ADF (GPD)	TOTAL EQUIVALENT POPULATION	PEAKING FACTOR	PEAK FLOW (GPD)
AJ	AK	8	0 0052	4	250			1,000	10	22,000	98	4 00	88 000
AK	AA2	8	0 0052	5	250			1,250	13	23,250	110	4 00	93 000
AA1	AA2	8	0 0052	8	250			2 000	20	2 000	133	4 00	8 000
AA2	AM	8	0 0052							25,250	233	4 00	101,000
Subtotal				*83*		*5,000*	*0 9*	*25,250*		*25,250*	*233*		*101,000*
Total				**146**				**41,000**		**41,000**	**390**		**164,000**
Gravity Outfall to the Almeda Sewer Line in Sonoran Crest													
I	NODE 1	8	0 0200						-	8,000	80	4	32 000
NODE 1	NODE 2	8	0 0239							8,000	80	4	32 000
NODE 2	NODE 3	8	0 0196							8,000	80	4	32 000
NODE 4	NODE 5	8	0 0052							8,000	80	4	32,000
NODE 5[1]	NODE 6	8	0 0052	58	250			14,500	145	22 500	225	4	90,000
NODE 6	NODE 7	8	0 0250							22 500	225	4	90 000
NODE 7	NODE 8	8	0 0281							22,500	225	4	90,000
Outfall to the Granite Ridge Gravity System													
Q	NODE 4	8	0 0052							7 750	78	4	31,000
NODE 4	AM	8	0 0052							7,750	78	4	31,000
AM	AN	8	0 0052							33 000	310	4	132 000
AN	A0			FM	250					33 000	310		132 000
A0 [2]	AP	8	0 0052	12	250			3 000	30	36 000	340	4	144,000
AP [3]	AQ	8	0 0052	114	250			28 500	285	64 500	625	4	258 000
AQ [4]	AR	10	0 0040	76	250			19,000	190	83 500	815	4	334 000
AR	AS	10	0 0040							83,500	815	4	334,000

Note
1) Contributing flows include flows generated from 58 dwelling units in Sonoran Crest
2) Contributing flows include flows generated from 12 lots in Granite Ridge
3) Contibuting flows include flows generated from 114 lots in Desert Ridge
4) Contibuting flows include flows generated from 18 lots in Boulder Mountain and 58 lots in Quarter Section 46-55

Table 2: Estimated Pipe Capacities

TABLE 2 ESTIMATED PIPE CAPACITIES

Project Master Wastewater Plan for McDowell Mountain Back Bowl
Location Scottsdale Arizona
Date January 25 2005

Project Number 042054 06
Project Engineer Gordon W Wark P E

FROM NODE	TO NODE	PIPE SIZE (IN)	PEAK FLOW (GPD)	PIPE SLOPE (FT/FT)	FULL FLOW VELOCITY, V_q (FPS)	PARTIAL FLOW VELOCITY, V_f (FPS)	PIPE CAPACITY (GPD)	SURPLUS CAPACITY (GPD)	d/D
Gravity Outfall to the West									
A1	A	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
A	B	8	8 000	0 0052	2 5	0 9	564 339	556 339	0 08
C	B	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
B	E	8	19 000	0 0052	2 5	1 2	564 339	545 339	0 13
D	E	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
E	F	8	24 000	0 0052	2 5	1 2	564 339	540 339	0 14
G	F	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
F	H	8	32 000	0 0052	2 5	1 4	564 339	532 339	0 16
H	I	8	32 000	0 0052	2 5	1 4	564 339	532 339	0 16
Gravity Outfall to the East at Node S									
J	J1	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
A1	K	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
J1	K	8	9,000	0 0052	2 5	0 9	564 339	555 339	0 09
L	K	8	5 000	0 0052	2 5	0 8	564 339	559 339	0 07
K	N	8	17 000	0 0052	2 5	1 1	564 339	547,339	0 12
M	N	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
N	P	8	26 000	0 0052	2 5	1 3	564 339	538 339	0 15
O	P	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
P	Q	8	31,000	0 0052	2 5	1 3	564,339	533 339	0 16
Gravity Outfall to the East at Node AF									
R	S	8	22 000	0 0052	2 5	1 2	564 339	542 339	0 13
S	U	8	25 000	0 0052	2 5	1 3	564 339	539 339	0 14
T	U	8	2 000	0 0052	2 5	0 6	564 339	562 339	0 04
U	V	8	29 000	0 0052	2 5	1 3	564 339	535 339	0 15
W	X	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
X	Z	8	7 000	0 0052	2 5	0 9	564 339	557 339	0 08
Y	Z	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
Z	V	8	12 000	0 0052	2 5	1 0	564 339	552 339	0 10
V	AA	8	45 000	0 0052	2 5	1 5	564 339	519 339	0 19
AA	AJ	8	61 250	0 0052	2 5	1 6	564 339	503 089	0 22
AB	AC	8	5 000	0 0052	2 5	0 8	564 339	559 339	0 07
AD	AC	8	4 000	0 0052	2 5	0 7	564 339	560 339	0 06
AC	AE	8	11 000	0 0052	2 5	1 0	564 339	553 339	0 10
AE	AE1	8	17 000	0 0052	2 5	1 1	564 339	547 339	0 12
AE2	AE1	8	7 000	0 0052	2 5	0 9	564 339	557 339	0 08
AE1	AH	8	30 000	0 0052	2 5	1 3	564 339	534 339	0 16
AI	AH	8	3 000	0 0052	2 5	0 7	564 339	561 339	0 05
AH	AJ	8	32 000	0 0052	2 5	1 4	564 339	532 339	0 16
AJ	AK	8	88 000	0 0052	2 5	1 8	564 339	476 339	0 27
AK	AA2	8	93 000	0 0052	2 5	1 8	564 339	471 339	0 27
AA1	AA2	8	8 000	0 0052	2 5	0 9	564 339	556 339	0 08
AA2	AM	8	101 000	0 0052	2 5	2	564 339	463 339	0 29
Gravity Outfall to the Almeda Sewer Line in Sonoran Crest									
I	NODE 1	8	32 000	0 0200	4 9	2 2	1 106 761	1 074 761	0 12
NODE 1	NODE 2	8	32 000	0 0239	5 4	2 3	1 209 867	1 177 867	0 11
NODE 2	NODE 3	8	32 000	0 0196	4 9	2 2	1 095 637	1 063 637	0 12
NODE 4	NODE 5	8	32 000	0 0052	2 5	1 4	564 339	532 339	0 16
NODE 5(1)	NODE 6	8	90 000	0 0052	2 5	1 8	564 339	474 339	0 27
NODE 6	NODE 7	8	90 000	0 0250	5 5	3 2	1 237 396	1 147 396	0 18
NODE 7	NODE 8	8	90 000	0 0281	5 8	3 3	1 311 873	1 221 873	0 18
Outfall to the Granite Ridge Gravity System									
Q	NODE 4	8	31 000	0 0052	2 5	1 3	564 339	533 339	0 16
NODE 4	AM	8	31 000	0 0052	2 5	1 3	564 339	533 339	0 16
AM	AN	8	132 000	0 0052	2 5	2 0	564 339	432 339	0 33
AN	A0	0	132 000						
A0 (2)	AP	8	144 000	0 0052	2 5	2 1	564 339	420 339	0 34
AP (3)	AQ	8	258 000	0 0052	2 5	2 4	564 339	306 339	0 47
AQ (4)	AR	10	334 000	0 0040	2 5	2 4	897 486	563 486	0 42
AR	AS	10	334,000	0 0040	2 5	2 4	897,486	563,486	0 42

Force Main Calculations

Project	**Master Wastewater Plan for McDowell Mountain Back Bowl**		
Location	Scottsdale, Arizona		
Date	January 7, 2005		
References	City of Scottsdale Design Standards and Policies Manual		Project Number 042054 06
References	Hazen-Williams formula		Project Engineer Gordon W W.

Known Values

Hazen-Williams coefficient, C =	**140**	PVC Force Main, "C" = 140
Initial Elevation =	**2,640**	located at proposed sewage pun
Final Elevation =	**2,660**	Existing Stub of Granite Ridge G
Forcemain Length (ft) =	**5,660**	
Minor Loss Equivalent Length (10% of Length) =	**566**	
Average Flow	**33,000**	gpd
Peak Hour Flow	**132,000**	gpd

Calculated Values

Referenced Equations

$v = Q / A$ (1 cfs = 449 gpm)

$A = pi * [(D / 12) ^2] / 4$

$H_f = 3022 * [(v / C) ^1.85] / [(D / 12) ^1.165]$

where v = velocity, feet per second (fps)
Q = flow rate, gallons per minute (gpm)
A = conveyance area, square feet
D = inside pipe diameter, inches
H_f = head loss, feet per thousand feet of pipe

Peak Flow (gpd)	Peak Flow (gpm)	Pipe Dia (in)	Velocity (fps)	Head Loss per 1,000 ft (ft)	Total Friction Head Loss (ft)	Total Dynamic Head Loss (ft)	Pressure Loss (psi)
132,000	91 67	2	9 36	163 49	58 3	78 3	34
		2 5	5 99	55 21	37 3	57 3	25
		3	4 16	22 74	25 9	45 9	20
		3 25	3 55	15 41	22 1	42 1	18
		3 5	3 06	10 74	19 0	39 0	17

Design Pipe Size = 3

Notes

1) The velocity and head loss calculations are based on the peak flow rate The pump capacity should be used for the actual flow rate during the final lift station design

2) Wet well sizing, pump cycling and pump discharge rates would be designed such that the minimum flow velocity in the forcemain is not less than 4 fps

4) For higher-velocity force mains, it may be required to increase the size of the forcemain prior to discharging to a manhole, etc in order to reduce the discharge velocity

5) Surge calculations should be performed to ensure that the proper pipe class is being used

6) When wastewater is pumped over a considerable distance, increasing the forcemain size may reduce horsepower requirements (and operation & maintenance costs) of the lift station pumps, due to reduced friction

References

Project	Master Wastewater Plan for McDowell Mountain Back Bowl	Project Number	042054 06
Location	Scottsdale, Arizona	Project Engineer	Gordon W Wark, P E
Date	January 13, 2005		
References	City of Scottsdale Design Standards and Policies Manual		

Land Use	Average Day Flow
Residential	250 gpd/DU
Commercial	0 90 gpd/sf
General Office	0 50 gpd/sf
Hotel	402 gpd/room

Type	Pipe Size (IN)	Min Slope (FT/FT)	Design Flow (GPCD)	Peaking Factor	Manhole Spacing
Residential	8	0 00520	100	4	500
Commercial	10	0 00400	100	4	500
Retail	12	0 00300	100	4	500
Resort	15	0 00220	105	Harmons	500
Cultural/Institutional			105	Harmons	600
			105	Harmons	600
			105	Harmons	600

Minimum Pipe Velocity	2 5 FPS
Maximum Pipe Velocity	10 FPS

Source ADEQ Bulletin

APPENDIX C

References

ductile iron pipe (DIP) with an approved interior and exterior liners Those systems designed with velocities of 2 5 feet per second shall be constructed of either Vitrified Clay or Ductile Iron pipe Alternate material will be considered by the City upon submittal of written request by the engineer

In general, pipe materials should not change between manholes

Where standard strength pipe is not structurally sufficient or when proper cover cannot be maintained, additional strength must be obtained by using extra-strength pipe, special bedding specifications or special construction methods

All types of pipe material used in design shall have established ASTM, ANSI, or NSF standards of manufacture or seals of approval and shall be designated for use as sewer pipe

No public sewers shall be less than eight (8) inches in diameter unless permission is received in writing from the Water Resources Department

B SYSTEM LAYOUT

If the horizontal direction or slope of the sewer line changes, a manhole shall be constructed The horizontal angle formed between the two lines shall not be less than ninety (90) degrees In sewers that are twelve (12) inches or larger, angles formed shall be between one hundred-twenty (120) and one hundred-fifty (150) degrees to the downstream pipe, for odor control *purposes*

Horizontal curvilinear sewers will not be allowed

Sewer flows shall not pass through collection systems that have not been accepted by the City of Scottsdale

Public sewer flows shall not flow through a private sewer system

All public sewer lines shall be located within a dedicated street right-of-way or private street access easement All sewers shall be aligned parallel to and south or west of the street centerline In general, sewer lines should not cross the street centerline except in cases where curvilinear roadway alignments are encountered

C DESIGN FLOWS

In the absence of flow data provided by the designer, new domestic sewage systems shall be designed in accordance with the following

1 Sewers eight (8) to twelve (12) inches in diameter shall be designed with peak capacities, when flowing full, of not less than four hundred (400) gallons per capita per day (gpcd)

2 Sewer lines larger than twelve (12) inches in diameter shall be designed using one hundred five (105) gpcd and a peaking factor developed from "Harmon's Formula"

$Qmax=Qavg[1+14/(4+P^{1/2})]$
WHERE P = Population / 1,000

Commercial flows should be based upon known regional data or accepted engineering reference sources, approved by the City

Density data to be used in sewer design*

Single-family units	2 5 persons/unit
Multi-family units	
Townhouse/Patio homes	2 5 persons/unit
Apartments	2 5 persons/unit

*Subject to regional variations as approved by the City's Planning Department

D HYDRAULIC DESIGN

Sewer lines should be designed and constructed to give mean velocities of not less than 2 5 fps, based upon Manning's Formula, using an "*n*" value of 0 013 Hydrogen sulfide problems continue to be a concern, therefore must be analyzed in the Design Report and be provided for the design of the system where required Conversely, to prevent abrasion and erosion of the pipe material, the maximum velocity shall be limited to 10 fps at estimated peak flow Where velocities exceed this maximum figure, the line shall be constructed of DIP or its equivalent In no case shall the velocities greater than 15 fps be allowed All velocities should be analyzed under peak flow conditions

The d/D ratio for gravity sewer pipes 12 inches in diameter and less shall be no greater than 0 65 in the ultimate peak flow condition The d/D ratio for gravity sewers greater than 12 inches in diameter shall be no greater than 0 70 in the ultimate peak flow condition

E MANHOLES AND CLEAN OUTS

Manholes in City streets must be located near the center of the traffic lane of the interior lane, rather than on or near the line separating traffic lanes Manholes should not be located in bike trails, equestrian trails, sidewalks, or crosswalks Manholes shall be installed at the end of each line, at all changes of grade, pipe sizes, alignments and at distances not to exceed those shown below

SPACING Pipe Size - Inches	Maximum Manhole Spacing - Feet
8 - 15	500
18 - 30	600
36 - 60	800
Over 60	1,300

Cleanouts may be used in place of manholes at the end of laterals which cannot be extended and are less than one hundred fifty (150) feet in length Cleanouts must be placed on the end of all line extensions to allow for cleaning and televising of lines To assure line, grade and material compatibility, a manhole shall be installed at the point of connection when a cleanout is removed for a sewerline extension

All manholes should be the pre-cast concrete type as detailed in the Maricopa Association of Governments (MAG) standard details for Public Works Construction, detail No 420, excluding the steps and/or cast in anchors for steps If a manhole is more than ten (10) feet deep or the line is over twelve (12) inches in diameter, the manhole shall be five (5) feet in diameter

3) In addition to the acceptance test, the sewer line shall be cleaned to remove foreign material.

4) Manholes shall be placed at each end of the curve not to exceed 400 feet spacing

4 Manholes and Cleanouts

a Location - Except as itemized below, manholes shall be installed at the end of each line at all changes of grade, pipe size, or alignment, at all sewer pipe intersections, and at distances not exceeding those shown below

MANHOLE SPACING

Pipe Size (in)	Max Manhole Spacing (ft)
8 - 15	500
18 - 30	600
36 - 60	800
Over 60	1300

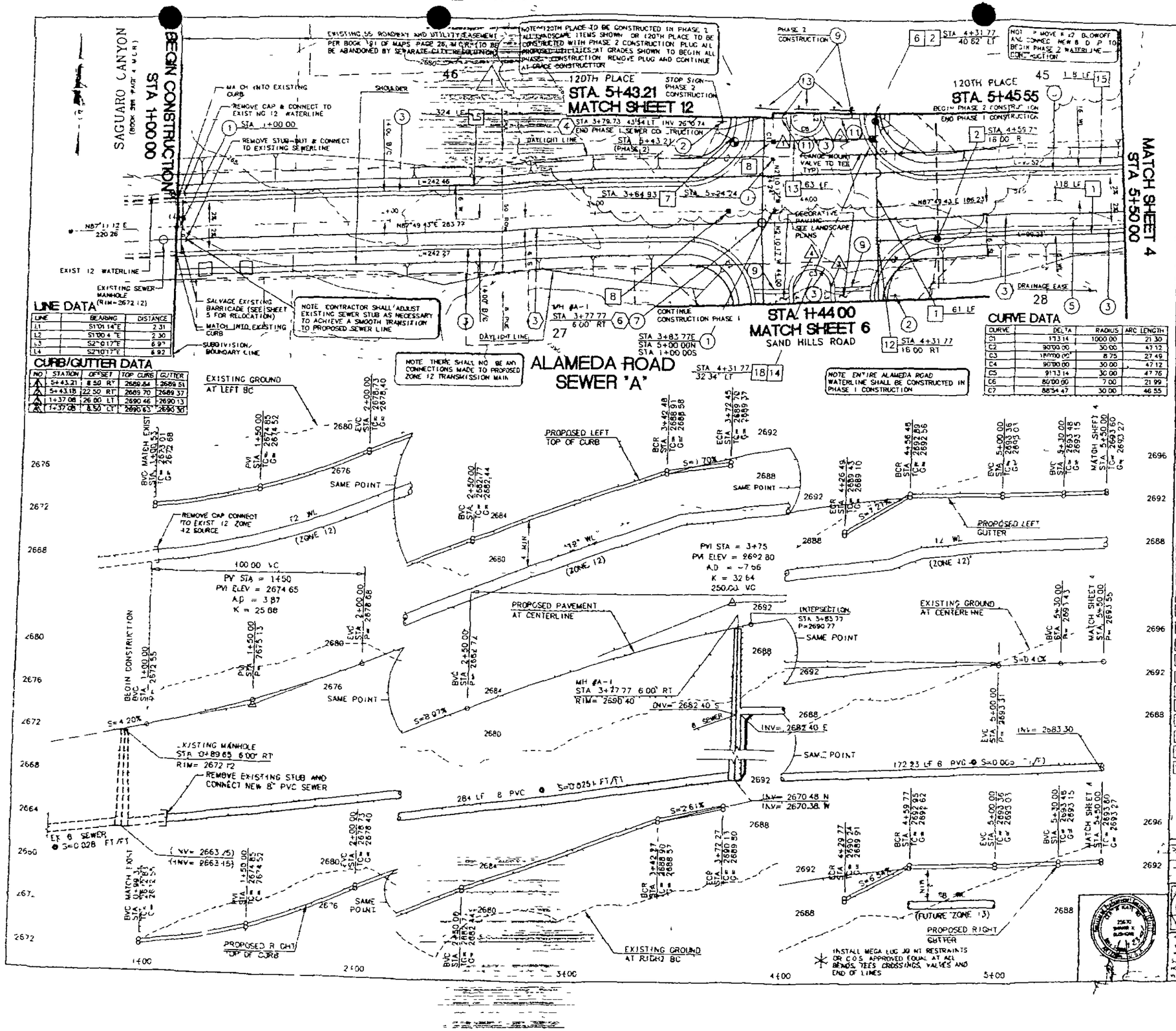
Cleanouts may be used in place of manholes at the end of laterals less than 200 feet in length

Where manholes are located in areas of flooding, consideration shall be given in design to eliminate storm water entrance.

Sewer Size		Minimum Slope to Maintain Velocity of·					
(in)	(mm)	2 0 fps (0 6 m/s)			2 5 fps (0 75 m/s)		
n		010	013	015	010	013	015
8	200	0020	0033	0045	0031	0052	0070
10	250	0015	0024	0033	0023	0037	0052
12	300	0011	0019	0026	0018	0030	0040
15	380	00085	0014	0019	0013	0022	0030
18	450	00067	0011	0015	0010	0017	0023
24	600	00045	00077	0010	00071	0012	0016

Table IV-1

Minimum Slope To Maintain Indicated Velocities Flowing Full
(From Manning's Formula)



LINE DATA

LINE	BEARING	DISTANCE
L1	S10°01'14"E	2.31
L2	S1°00'4 "E	2.30
L3	S2°0'17"E	6.9"
L4	S2°10'17"E	6.92

CURB/GUTTER DATA

NO	STATION	OFFSET	TOP CURB	GUTTER
1	5+43.21	8.50 RT	2689.84	2689.51
2	5+43.18	22.50 RT	2689.70	2689.37
3	1+37.08	26.00 LT	2690.46	2690.13
4	1+37.08	8.50 LT	2690.63	2690.30

CURVE DATA

CURVE	DELTA	RADIUS	ARC LENGTH
C1	1°13'14	1000.00	21.30
C2	90°00'00	30.00	47.12
C3	16°42'00"	8.75	27.49
C4	90°00'00	30.00	47.12
C5	91°13'14	30.00	47.76
C6	80°00'00	7.00	21.99
C7	88°34'47	30.00	46.55

CONSTRUCTION NOTES

PAVING

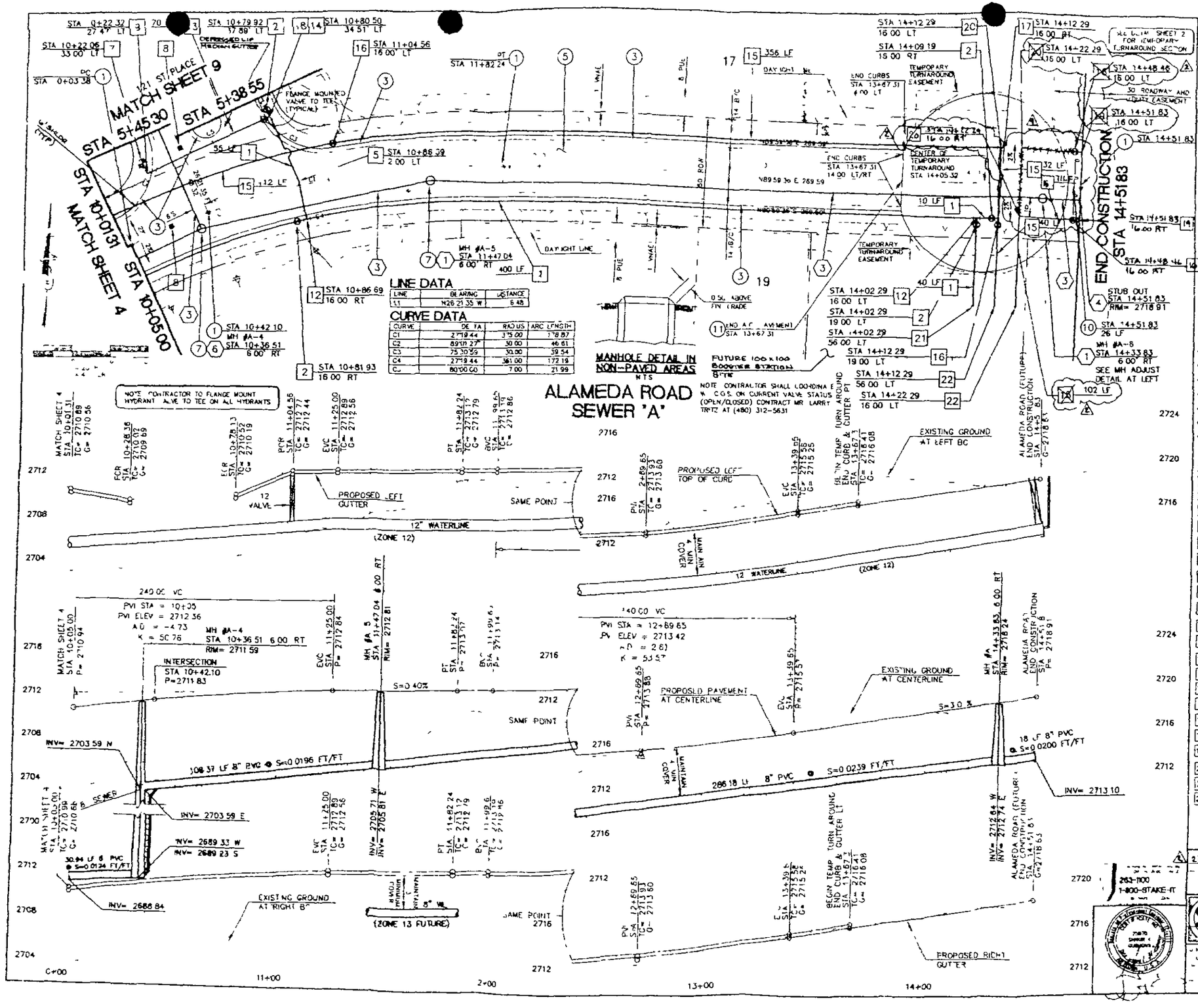
1. INSTALL SURVEY MONUMENT PER M A G STD DTL 120 1-B
2. INSTALL STOP S GN R1-1 PER COS STD D L 2 1 & MUTCD
3. INSTALL ROLL CURB AND GUTTER (H=4) PER MAG STD DTL 220-C
4. INSTALL 5 CURB TRANSITION PER MAG STD DTL 221
5. INSTALL A C PAVEMENT-SEE STRUCTURAL SECTION ON SHEET 2
6. INSTALL RIP RAP D=6 12 (STONE TO BE NATIVE TO SITE AND TREATED WITH EON TE OR EQUIVALENT)
7. ADJUST MANHOLE RING TO GRADE PER COS STD DTL 22 0
8. NSTALL 2-4 PVC CONDUITS (32 5 L F)
9. INSTALL 18 RIBBON CURB PER C O S STD DTL 2220-B
10. INSTALL SALVAGED BARRICADE PER MAG STD DTL 130 TYPE "B
11. INSTALL THICKENED EDGE PAVEMENT PER MAG STD DTL TYPE "B
12. ADJUST VALVE BOX TO GRADE PER MAG STD DTL 391-1
13. INSTALL TYPE A BARRICADE PER MAG STD D L 30)

SEWER

1. INSTALL 4 DIA SEWER MANHOLE PER MAG STD DTL 420 & 424
2. INSTALL 4 SEWER SERVICE PER MAG STD DTL 440
3. INSTALL 8 PVC SEWER
4. NSTALL SEWER STUB AT END OF LINE PER M A G STD DTL 427
5. INSTALL 5 DIA SEWER MANHOLE PER MAG STD DTL 420 & 424
6. INSTALL 5 DIA SEWER MANHOLE PER MAG STD DTL 420 424 & 426 TYPE B
7. INSTALL FORCEMAIN MANHOLE DISCHARGE (SEE SHEET 2)
8. INSTALL 1 1/2 SCH 80 PVC SEWER LINE (SEE DETAIL ON SHT 2)
9. IN-LINE LOW-PRESSURE CLEAN-OUT (SEE DETAIL ON SHEET 2)
10. INSTALL JUNCTION CLEAN-OUT PER DETAIL (SEE SHEET 2)
11. INSTALL TERMINAL CLEAN-OUT PER DETAIL (SEE SHEET 2)
12. INSTALL 1 1/2 SCH 80 PVC SEWER SERVICE (SEE DETAIL SHT 2)
13. INSTALL SEWAGE AIR RELEASE MANHOLE (SEE DETAIL SHEET 2)
14. CONCRETE ENCASEMENT OF SEWER PIPE PER MAG STD DTL 404

WATER

1. INSTALL 8 D P WATERLINE CLASS 350(TYP) (3 MIN COVER)
2. INSTALL 8 V B & C PER MAG STD DT- 391-1-C
3. INSTALL ELECTRONIC BALL MARKER PER COS SS 6 04
4. INSTALL 1 WATER SERV CE PER COS STD DT 2330
5. INSTALL 8 X 8 D I P 11 1/4 BEND W/ MEGA LUG JOIN RESTRAINTS OR C O S APPROVED EQUAL
6. INSTALL 8 X 2 BLOWOFF PER MAG STD DTL 380-8 W/ MEGA LUG JOINT RESTRAINTS OR C O S APPROVED EQUAL
7. INSTALL 6 FIRE HYDRANT (COMPLETE) PER MAG STD DT- 360 W/ MEGA LUG JOINT RESTRAINTS OR C O S APPROVED EQUAL
8. INSTALL FIRE HYDRANT MARKER PER COS STD DTL 2363
9. INSTALL 8 X 8 D I P 90° BEND W/ MEGA LUG JOINT RESTRAINTS OR C O S APPROVED EQUAL
10. INSTALL VERTICAL REALIGNMENT (COMPLETE) PER COS STD DTL 2370 (AIR RELEASE VALVES INCLUDED)
11. NSTALL 8 X 8 45 BEND W/ MEGA LUG JOINT RESTRAINTS
12. INSTALL 8 X 8 TEE W/ MEGA LUG JO NT RESTRAINTS OR C O S APPROVED EQUAL
13. INSTALL 6 D I P WATERL NE CLASS 350(TYP) (3 MIN COVER)
14. INSTALL 6 V B & C PER MAG STD DTL 391-1-C
15. INSTALL 12 D I P WATERLINE CLASS 350(TYP) (4 M N COVER)
16. INSTALL 12 V B & C PER MAG STD DTL 391-1-C
17. INSTALL 12 X 8 D I P TEE W/ MEGA LUG JOINT RESTRAINTS
18. NSTALL 8 X 6 TEE W/ MEGA LUG JOINT RESTRAINTS OR C O S APPROVED EQUAL
19. INSTALL 12 CAP WITH 2 CURB STOP AND FLUSHING PIPE PER MAG STD DTL 390, TYPE "B"



CONSTRUCTION NOTES

PAVING

1. INSTALL ALL SURVEY MONUMENT PER M.A.G. STD. DTL. 120-1 TYPE B
2. INSTALL STOP SIGN R1-1 PER C.O.S. STD. DTL. 21.1 & MU CO
3. INSTALL TYPE "C" CURB AND GUTTER (MOD.) PER M.A.G. STD. DTL. 220-C
4. INSTALL S.C.U.P.B. TRANSITION PER M.A.G. STD. DTL. 222
5. INSTALL A.C. PAVEMENT-SEE STRUCTURAL SECTION ON SHEET 2
6. INSTALL ALL R.P. RIP RAP D50=12" (STONE TO BE NATIVE TO SITE AND TREATED WITH SONITE OR EQUIVALENT)
7. ADJUST MANHOLE RING TO GRADE PER C.O.S. STD. DTL. 422-C
8. INSTALL 2-4" PVC CONDUITS (325 L.F.)
9. INSTALL 18" RIBBON CURB PER C.O.S. STD. D.T.L. 2220-B
10. INSTALL SALVAGED BARRICADE PER M.A.G. STD. D.T.L. 130 TYPE III
11. INSTALL THICKENED EDGE PAVEMENT PER M.A.G. STD. DTL. TYPE "B"
12. ADJUST VALVE BOX TO GRADE PER M.A.G. STD. DTL. 391-1-C

SEWER

1. INSTALL 4' DIA. SEWER MANHOLE PER M.A.G. S.D. DTL. 420 & 424
2. INSTALL 4" SEWER SERVICE PER M.A.G. STD. DTL. 440
3. INSTALL 8" PVC SEWER
4. INSTALL SEWER STUB AT END OF LINE PER M.A.G. STD. DTL. 427
5. INSTALL 5' DIA. SEWER MANHOLE PER M.A.G. STD. DTL. 420 & 424
6. INSTALL 5' DIA. SEWER MANHOLE PER M.A.G. STD. DTL. 420 424 & 426 TYPE B
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1. INSTALL 8" D.I.P. WATERLINE CLASS 350(TYP.) (3' MIN. COVER)
2. INSTALL 8" V.B. & C. PER M.A.G. STD. DTL. 391-1-C
3. INSTALL ELECTRONIC BALL MARKER PER C.O.S. STD. 5.10.4
4. INSTALL 1" WATER SERVICE PER C.O.S. STD. DTL. 2330
5. INSTALL 8" X 8" D.I.P. 1/4 BEND W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
6. INSTALL 8" X 2" BLOWOFF PER M.A.G. STD. DTL. 380-8 W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
7. INSTALL 6" FIRE HYDRANT (COMPLETE) PER M.A.G. STD. DTL. 36.. W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
8. INSTALL FIRE HYDRANT MARKER PER C.O.S. STD. DTL. 2383
9. INSTALL 8" X 8" D.I.P. 90° BEND W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
10. INSTALL VERTICAL REALIGNMENT (COMPLETE) PER C.O.S. STD. DTL. 2370 (AIR RELEASE VALVES INCLUDED)
11. INSTALL 8" X 8" 45° BEND W/ MEGA LUG JOINT RESTRAINTS
12. INSTALL 8" X 8" TEE W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
13. INSTALL 6" D.I.P. WATERLINE CLASS 350(TYP.) (3' MIN. COVER)
14. INSTALL 6" V.B. & C. PER M.A.G. STD. DTL. 391-1-C
15. INSTALL 2" D.I.P. WATERLINE CLASS 350(TYP.) (4' MIN. COVER)
16. INSTALL 2" V.B. & C. PER M.A.G. STD. DTL. 391-1-C
17. INSTALL 12" X 8" D.I.P. TEE W/ MEGA LUG JOINT RESTRAINTS
18. INSTALL 8" X 6" TEE W/ MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL
19. INSTALL 12" CAP WITH 2" CURB STOP AND FLUSHING PIPE PER M.A.G. STD. DTL. 380 TYPE "B"
20. INSTALL 12" 90° BEND W/ MEGA LUG JOINT RESTRAINTS
21. INSTALL 8" PLUG W/ MEGA LUG JOINT RESTRAINTS
22. INSTALL 12" PLUG W/ MEGA LUG JOINT RESTRAINTS

* INSTALL MEGA LUG JOINT RESTRAINTS OR C.O.S. APPROVED EQUAL AT ALL BENDS, TEES, CROSSINGS, VALVES AND END OF LINES

2	2/27/01	REVISE WATERLINE LOCATION

263-1100
1-800-STAKE-IT

SKG ENTERPRISES INC

SONORAN CREST
PAVING-WATER AND
SEWER PLANS

227-PA-97 OS #57-4657-45 5-ZN-99 14-PP-99 3253-99A

Presented to

MARICOPA COUNTY ENVIRONMENTAL SERVICES DEPARTMENT

WATER & WASTE MANAGEMENT DIVISION

1001 North Central Avenue, Suite 150
Phoenix, Arizona 85004

and

CITY OF SCOTTSDALE WATER RESOURCES DIVISION

4388 East San Salvador Drive
Scottsdale, Arizona 85258

Triple Five Group of Companies
Granite Ridge Subdivision
Scottsdale, Arizona

Engineering Report for Construction
of Sewer
Facilities

PREPARED FOR

Triple Five Group of Companies

ARCADIS

Triple Five Group of Companies
Granite Ridge Subdivision
Scottsdale, Arizona

Engineering Report for
Construction of Sewer
Facilities

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Tel 602 438 0883
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Our Ref
AZ000809 0004

Date
January 23 2002

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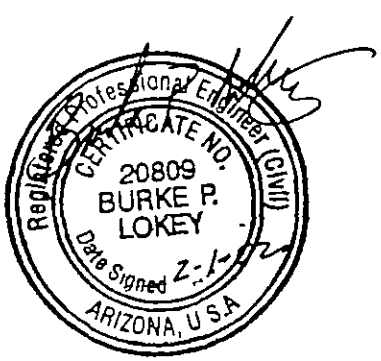
Appendices

Appendix Hydraulic Analysis of Sewer System



1 0 Introduction

1 1 Purpose

ARCADIS G&M, Inc (ARCADIS) was contracted by Triple Five Group of Companies to prepare construction drawings, specifications and County and City permit applications to construct a new sewer system for Granite Ridge subdivision in Scottsdale, Arizona The new sanitary sewer system construction will include installation of 8-inch PVC gravity sewer mains and building service connections in accordance with City of Scottsdale, State, and County regulations

This engineering report is part of the City of Scottsdale and Maricopa County Environmental Services Department (MCESD) subdivisions plan review package, and was prepared in accordance with the following standards

- City of Scottsdale Design Standards and Policies, Revised 1999, Chapter 5, Wastewater
- ADEQ Aquifer Protection Permit, Arizona Administrative Code R18-9-E301 and
- City of Scottsdale Supplement to MAG Uniform Standard Specifications and Details for Public Works Construction and
- City of Scottsdale Design Guidelines and Policies for Environmentally Sensitive Lands
- Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction

1 2 Project Contacts

The construction project owner is Triple Five Group of Companies Barry Markham is the owner's representative ARCADIS has prepared engineering analysis, reports, and construction drawings and specifications for this project The owner and engineer contact information is as follows

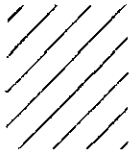
'Owner
Barry Markham
Triple Five Group of Companies
1201 S Alma School Road, Suite 10550
Mesa, AZ 85210
(480) 890-0555
Fax (480) 898-0832

Engineers
Burke Lokey, PE, Project Manager
Jeff Bower, PE, Project Engineer
ARCADIS G&M, Inc
8222 S 48th Street, Suite 140
Phoenix, AZ 85044
(602) 438-0883
Fax (602) 438-0102

1 3 Site Location

The project location is Scottsdale, Arizona just east of Troon Mountain from the intersection of Happy Valley and Alma School Roads The project is bounded on the south by 118th Place and La Junta Road intersection, on the east by state owned lands, on the north by undeveloped private property, and on the west by the future 118th Street alignment A vicinity map is provided as Figure 1

The construction site is located in Section 3 of Township 4 North, Range 5 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona The latitude and longitude near the center of the construction site are approximately 33°43'00" North and 111°50'00" West. respectively



NTS

ARCADIS

VICINITY MAP

FIGURE

1

| DATE 1/22/02 | PRJ# AZ000809 0004 | DWG G:\TLR\LANDRESOURCES\809GRANITERIDGE\80904\ENGINEERING_REPORTS\FIGURE1.DWG | CHK BPL | MAN BPL | ART JAS

1 4 Existing Site Conditions

At this time, the project site consists of undeveloped desert, classified as Environmentally Sensitive Land (ESL) by the City of Scottsdale No existing roads or utilities are presently known to exist on the property Soil conditions were provided in a report by Construction Inspection & Testing Company titled *Soil Investigation, Residential Development 118th Street and Happy Valley Road, Scottsdale, Arizona* dated June 23, 1994 According to the report, the site predominantly consists of clayey sands (SC) with interbedded gravel deposits

According to City of Scottsdale maps and verified by engineering reconnaissance, a sanitary sewer manhole exists at the intersection of North 118th Place and East La Junta Road The manhole was measured and it was determined that the existing invert is approximately 7 4 feet below the rim elevation The new sewer system intended for Granite Ridge will tie to this manhole and the manhole grouting will be modified as necessary to provide smooth flow lines

2.0 Sewer System Design

This section presents an analysis of the proposed sewer system design as required to show compliance with the aforementioned regulations (see Figure 2 for system layout) This section is as follows

1 Materials

2 Hydraulic Design

3 System Layout

4 Pump Station Design

5 Force Mains

2 1 Materials

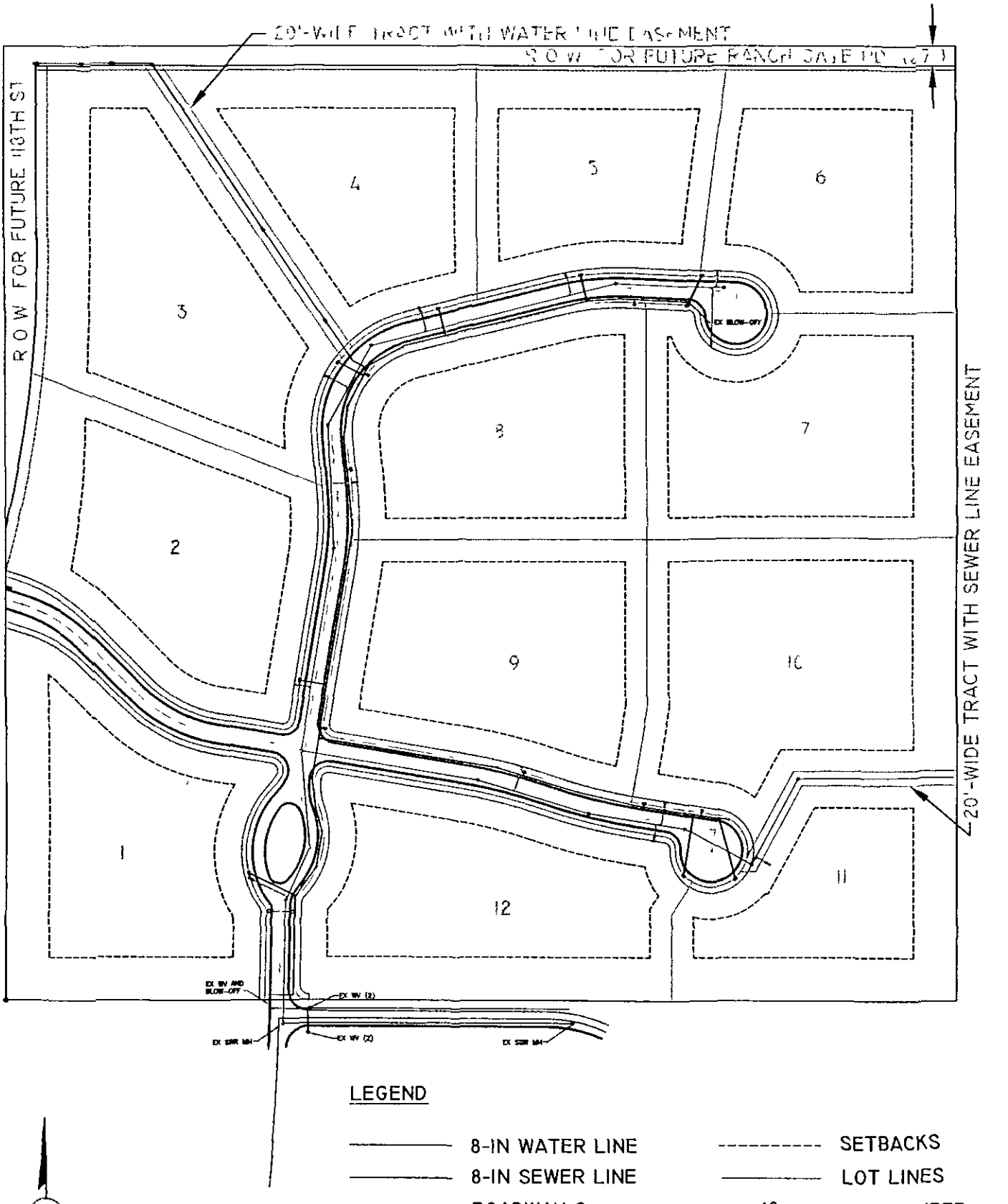
The material selected for the new sewer mains is Polyvinyl Chloride (PVC), SDR 35, which is permitted by the City of Scottsdale and MAG In general, sewer pipe burial depths will be from 4-ft to 10-ft, which are within the recommended design range for trench cover soil load and H-20 truck live loads (Unibell, 1997)

All sewer mains for this project will be minimum diameter of 8-in Building connection laterals will be 4-in pipes Building connections will be installed to the Right of way and marked for future building tie-in

2 2 Hydraulic Design

The hydraulic design of the sewerage system consists of determining the peak flow required, peak capacity available, and computing applicable sewer pipe slopes to meet requirements

FIGURE 2 PROPOSED WATER & SEWER SYSTEM LAYOUT



G \TLR\LAND RESOURCES\809 GRANITE RIDGE\80904\ENGINEERING_REPORTS\FIGURE2_10 21 02 DWG

Peak Capacity Required

The City of Scottsdale design policies require that the peak capacity of the new sewer system be designed to handle 400-gallons per capita per day (gpcd) when flowing full Using the City's planning data for typical density data of 2 5 persons per dwelling unit, the twelve (12) home lots planned for Granite Ridge will require a peak capacity of 12,000 gallons per day (gpd)

Granite Ridge will tie to the sewer system already in place for the Desert Crest subdivision An analysis of the new total peak capacity for these two systems as they discharge to the City's 10-in main at Happy Valley Road is provided in the Appendix Using Quarter Section map 46-56 showing the existing sewerage and home lots, the number of Desert Crest home lots was estimated to be 114 Peak capacity required for Desert Crest was computed to be 114,000 gpd for a total peak capacity required for the two subdivisions of 126,000 gpd

The Contractor will be required to test the sewer system upon installation in accordance with MAG standards According to MAG requirements the maximum allowable leakage rate is 0 5-gallon per hour per 100 ft of pipe per inch diameter of pipe Since the Contractor must meet this requirement for all pipe segments it was assumed that the average infiltration rate for the system will be ½ of the required rate, which is 0 25 gallon per hour per 100 ft of pipe per inch diameter For a total pipe length of 10,400 ft (1,500 ft for Granite Ridge and 8,900 ft for Desert Crest), a total infiltration rate of 4,992 gpd was estimated for the 8-in sewer mains Desert Crest sewer pipe lengths were measured from Quarter Section map 46-56 /

Total peak capacity required for Granite Ridge, Desert Crest, and estimated groundwater infiltration was computed to be 130,992 gpd (0 20 cfs)

Peak Capacity Available

An analysis for the Peak capacity available is included in the Appendix The analysis is based upon the Manning's formula for a full circular pipe with roughness coefficient, n, of 0 013 With a minimum velocity criterion of 2 5 feet per second (fps), the required sewer pipe slope is 0 0052 and available capacity of 563 157 gpd Available capacity at the required minimum slope exceeds the required capacity, indicating that the proposed 8-in pipe will adequately convey the wastewater Calculations are included showing the

depth-to-diameter (d/D) ratios, flowrates, and velocities for several reaches within the subdivision Results indicate that d/D will not exceed the 0 65 requirement for 8" pipe as per the City of Scottsdale DS&PM

Hydrogen Sulfide Generation Potential

Hydrogen sulfide is known to be produced from within the slime layer that develops along the interior wall of sewer pipes Key factors in the production of excessive amounts of hydrogen sulfide include the following (ASCE, 1982)

- Insufficient dissolved oxygen present in the wastewater
- High temperatures
- Inadequate pipe slope causing low wastewater velocities

Pipe slope and estimated wastewater velocities were computed and results indicate that the proposed slopes will not cause low velocities Therefore, the high wastewater temperatures and insufficient oxygen are the operative parameters An estimation of the hydrogen sulfide potential is provided in the Appendix Results of the analysis show that the effective biological oxygen demand (EBOD) of the wastewater greatly affects hydrogen sulfide generation potential If EBOD of the wastewater is kept less than 316-mg/l, then marginal conditions will exist for sulfide generation Higher EBOD conditions may make sulfide generation more common

2 3 System Layout

This project consists of installation of a wastewater collection system that will tie to the city's collection system at East Happy Valley Road (through the Desert Crest system) In accordance with ESL guidelines, the sewerage system will only be located within the road right of way

To maintain velocity requirements, the proposed sewer pipes will be sloped at a minimum of 0 0052 ft / ft (0 52%) All proposed pipe runs will be straight, with manholes between runs where horizontal and vertical grade breaks, alignment changes, end of runs, or maximum spacing of 500-ft are required Curvilinear pipe will not be used

All manholes will be pre-cast concrete type as specified by MAG detail no 420 Additional manhole requirements by the City of Scottsdale are noted on the drawings

Separation between Water and Other Utilities

New sewer mains will be installed such that they are at least horizontally 6 ft (outside diameter to outside diameter) from water mains and other utilities At locations where the water mains must cross sewer mains, both mains will be encased in concrete as required by MAG Standard Specifications

New sewer service connections (lateral) will be required to cross the water main The sewer laterals will be installed below the water main and provide at least 12-inches of clearance If it is not possible to place the new laterals at least 12-inches below the water mains, then the sewer laterals will be encased in 6-inches of concrete as required per City of Scottsdale requirements

Installation of Sewer Mains

Gravity sewer mains will be installed and tested according to Section 615, Sewer Line Construction, MAG Uniform Standard Specifications for Public Works Construction and City of Scottsdale Supplement to MAG Construction drawings show the plan and profile views and include the required pipe slope, diameter, and estimated length for each pipe run Sewer pipes will be placed at least four (4) feet below grade, and the pipes will be aligned to follow the paved streets

2 4 Pump Station Design

Pump stations are not proposed for this development

2 5 Force Mains

Force mains are not proposed for this development

3 0 References

American Society of Civil Engineers (ASCE) Gravity Sanitary Sewer Design and Construction Manuals and Reports of Engineering Practice, No 60 New York 1982

Uni-bell PVC Pipe Association Deflection The Pipe / Soil Mechanism UNI-TR-1-97 1997

Appendix

Hydraulic Analysis of Sewer System

ARCADIS G&M 8222 South 48 Street, Phoenix, Arizona 85044	Project Number AZ000809 0004 TASK 00002 Project Name Granite Ridge subdivision Subject Sewer Design Calculations By JWB Date Dec 2001 Checked by BPL Date Dec 2001

PURPOSE

This analysis was conducted to show compliance with City of Scottsdale and ADEQ regulations for sanitary sewer engineering design This analysis is part of the Engineering Report to be submitted to both aforementioned agencies for review and approval of the Granite Ridge Subdivision sanitary sewer system The analysis includes the following

1 Estimate of design sewer flows
2 Hydraulic analysis of sewer
3 Analysis of hydrogen sulfide generation potential

SUMMARY OF CONCLUSIONS

The results of the sanitary sewer system analysis indicate that the new sewer system for Granite Ridge will not adversely effect the existing system in Desert Crest To maintain required flow velocities, the new system will be constructed with a minimum design slope of 0 0052 ft per ft of main

Revisions

Rev No	Revision Descriptions
0	Original Issue

Sign off

Rev No	Originator (Print) Sign/Date	Verification/Checking Method	Verifier/Checker (Print) Sign Date
0	J W Bower, PE J W Bower 21 Jan 2002	Individual Critical Review	B P Lokey, PE B P Lokey 1/22/02

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II REFERENCES	3
III ANALYTICAL METHODS AND INPUTS	4
IV CALCULATIONS	7
V CONCLUSIONS	14

I. ASSUMPTIONS

1 The new sewer system will be flow by gravity and flow partially full

2 The flow conditions for the new system will approximate uniform flow conditions, thus the Manning formula will provide a reasonable approximation of the design flow conditions Solids were not considered within analysis

3 Existing Desert Crest sewer system consists of approximately 114 potential home sites Analysis will include addition of new sewer main to the Desert Crest system to Happy Valley Road

II REFERENCES

1 City of Scottsdale Design Standards and Policies, Revised December 1999

2 City of Scottsdale Water and Sewer Quarter Section Map No 46-56 NE 1/4 Section 10, T4N, R5E undated

3 <removed>

4 Arcadis, G&M, Inc Preliminary Plat for Granite Ridge Subdivision March 2001

5 American Society of Civil Engineers (ASCE) Gravity Sanitary Sewer Design and Construction Manuals and Reports on Engineering Practice No 60 New York 1982

6 Maricopa Association of Governments (MAG) Uniform Standard Specifications for Public Works Construction (Rev 1999)

III. ANALYTICAL METHODS AND INPUTS

A ESTIMATION OF DESIGN SANITARY SEWER FLOWS

In accordance with the City of Scottsdale Design Standards and Policies [1], the domestic sewage system planned for Granite Ridge will be designed for peak capacities, when flowing full, of at least 400 gallons per capita per day (*gpcd*) The proposed sewer line will be 8-in in diameter

Existing system for Desert Crest subdivision consists of 8-in PVC sewer mains [2] From Happy Valley Road, the existing sewer follows North 117th Street to Whispering Wind Drive and North 118th Place An additional 8-in branch ties to the 117th Street main from East Juan Tabo Road An estimation of the existing and addition of twelve new lots for Granite Ridge peak capacity when flowing full is computed below

PEAK DESIGN CAPACITY:

Existing Lots (Desert Ridge)=	114	
Peak Capacity per capita per day =	400	gpcd
Density =	2 5	persons/unit
Exist Peak Cap Total =	114,000	gpd
New lots (Granite Ridge) =	12	
Peak Capacity per capita per day =	400	gpcd
Density =	2 5	persons/unit
New Lots Peak Cap Total =	12,000	gpd
Total New Peak Capacity =	**126,000**	**gpd**

B HYDRAULIC ANALYSIS

MANNINGS FULL PIPE CALCULATION

The gravity sanitary sewer peak capacity, when flowing full, can be approximated using the Manning formula The formula computes the estimated flowrate based on pipe diameter and pipe bed slope

$$Q = \frac{1.486}{n} R^{2/3} S^{1/2} A$$

where,

Q	flowrate [cfs]
n	Mannings roughness factor
R	Hydraulic radius (area / wetted perimeter) [ft]
S	Pipe bed slope [ft/ft]
A	Pipe cross-sectional area [ft^2}

The Manning's roughness factor is the approximate resistance to flow within the pipe PVC pipe is very smooth, but will be approximately 0 013 when a slime layer develops – which is normal [1] The hydraulic radius is one-forth of the diameter (0 25 x D) for a full, circular pipe The bed slope will vary for this project as shown in the design plans Since the flowrate is directly proportional to the slope, the most shallow slope will be analyzed to estimate the least available flowrate for the subdivision The pipe cross-sectional area is one-forth of the diamteter squared multiplied by pi (pi x D^2 / 4)

C ESTIMATED SULFIDE GENERATION POTENTIAL

Sanitary sewers are at risk of internal corrosion damage due to hydrogen sulfide generation The hydrogen sulfide is generally known to be produced from within the slime layer that develops along the interior wall of the sewer pipes Key factors in the production of excessive amounts of hydrogen sulfide include insufficient dissolved oxygen present in the wastewater, high temperature wastewater, and inadequate sewer pipe slope causing low velocities [5] Analysis of the anticipated wastewater DO and temperature are beyond the scope of this analysis and are difficult to control However, the sewer pipe slope can be kept steep enough to reduce the potential for low velocities and hydrogen sulfide buildup.

One method proposed by ASCE, called the Z formula was applied to estimate the potential for hydrogen sulfide buildup in this new system [5]

$$Z = \frac{EBOD}{S^{0.5} Q^{0.33}} x \frac{P}{b}$$

where,

P	wetted perimeter (= θ x D)
b	surface width (=IDxsin(180-θ))

For a partially flowing pipe,

$$\theta = \arccos\left(1 - 2\frac{d}{D}\right)$$

IV CALCULATIONS AND RESULTS

INPUT PARAMETERS

Pipe ID =	8	in (inside diameter)
n =	0 013	Mannings roughness coefficient

A REQUIRED FLOWRATE

The total required peak flowrate is the calculated population density flow and infiltration by groundwater [3] MAG testing requirements allow a maximum groundwater infiltration rate of 0 5 gph per 100-ft of pipe per inch diameter of pipe [6] Since the Contractor must meet this requirement for all pipe segments, it was assumed that on average, the infiltration will be 1/2 of the MAG requirement or 0 25 per 100-ft of pipe per inch diameter Pipe length is approximate based on subdivision layout

New Pipe (Granite Ridge)·

Pipe Dia =	8	in
Pipe Ln =	1500	feet
Infiltration =	30	gph
	720	gpd

Existing Pipe (Desert Crest).

Pipe Dia =	8	in
Pipe Ln =	8900	feet
Infiltration =	178	gph
	4272	gpd

Total Infiltration = 4992 gpd

Peak Capacity for Full Flowing Pipe

	Discharge		
	(gpd)	(gpm)	(cfs)
Usage	126,000	87 50	0 1950
+ infiltration	130,992	90 97	0 2027

B AVAILABLE DISCHARGE – FULL CIRCULAR PIPE

Pipe ID=	8	in
A =	0 349	sf
R =	0 167	ft

Available Discharge for varying slopes and FULL pipe

Required Full pipe discharge = 130,992 gpd

Slope	Discharge (cfs)	(gpm)	(gpd)	Velocity (ft/s)	
0 00029	**0 21**	**92**	**132,992**	**0 59**	← Slope to meet required discharge
0 003	0 66	297	427,749	1 90	
0 005	0 85	383	552,221	2 45	
0 0052	**0 87**	**391**	**563,157**	**2.50**	← Slope to meet required velocity
0 01	1 21	542	780,959	3 46	
0 013	1 38	618	890,430	3 95	
0 015	1 48	664	956,475	4 24	

Required Slope = 0.0052 ft/ft

AVAILABLE DISCHARGE – PARTIALLY FULL CIRCULAR PIPE

Flowrate estimates for three reaches within the subdivision are calculated below Calculations are based on the the city's Design Standard and Policies Manual data which advises 400 gpcd Calculations assumed 2 5 persons per unit for this subdivision for a total of 1,000 gallons per unit per day (400 gpcd x 2 5 ppu)

Reach No 1
Areas north of intersection Lots 2, 3, 4, 5, 6, 7, 8
No of Lots = 7
Peak Capacity = 7000 gpd

Reach No 2
Areas east of intersection Lots 9, 10, 11, 12
No of Lots = 4
Peak Capacity = 4000 gpd

Reach No 3
Subdivision entrance All Lots
No of Lots = 12
Peak Capacity = 12000 gpd

Analysis of the pipe flow depths, flowrates, and velocities were computed with FlowMaster, Version 6 1 by Haestad Methods Minimum pipe slopes for the three reaches were selected from the design drawings to complete the analysis Reaches 1 and 3 were sloped at 0 0052 ft/ft minimum and Reach 2 was sloped at 0 04 ft/ft

Results from the FlowMaster analysis follow (3 pages) A summary table is provided below

Reach No	Slope [ft/ft]	Q [gpd]	Velocity [ft/s]	d/D
1	0 0052	7000	0 86	0 075
2	0 04	4000	1 47	0 03
3	0 0052	12000	1 01	0 105

OUTPUT - REACH No. 1

Worksheet

Worksheet for Circular Channel

Project Description	
Worksheet	*Granite Ridge Sanitary*
Flow Element	Circular Channel
Method	Manning s Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0 013	
Slope	0 005200	ft/ft ← slope from drawings
Diameter	8	in
Discharge	4 860	gpm ← 7,000 gpd

Results		
Depth	0 05	ft
Flow Area	1 3e 2	ft²
Wetted Perimeter	0 38	ft
Top Width	0 36	ft
Cntical Depth	0 05	ft
Percent Full	7 8	%
Cntical Slope	0 008250	ft/ft
Velocity	0 86	ft/s
Velocity Head	0 01	ft
Specific Energy	0 06	ft
Froude Number	0 80	
Maximum Discharg	420 698	gpm
Discharge Full	391 090	gpm
Slope Full	0 000001	ft/ft
Flow Type	Subcritical	

OUTPUT - REACH NO. 2

Worksheet

Worksheet for Circular Channel

Project Description	
Worksheet	Granite Ridge Sanitary
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0 013	
Slope	0 040000	ft/ft
Diameter	8	in
Discharge	2 780	gpm

slope from drawings

4,000 gpd

Results		
Depth	0 02	ft
Flow Area	4 2e-3	ft²
Wetted Perimeter	0 26	ft
Top Width	0 25	ft
Critical Depth	0 04	ft
Percent Full	3 7	%
Critical Slope	0 009078	ft/ft
Velocity	1 47	ft/s
Velocity Head	0 03	ft
Specific Energy	0 06	ft
Froude Number	2 00	
Maximum Discharg	1,166 805	gpm
Discharge Full	1 084 688	gpm
Slope Full	2 627485e-7	ft/ft
Flow Type	Supercritical	

OUTPUT - REACH No. 3

Worksheet

Worksheet for Circular Channel

Project Description	
Worksheet	Granite Ridge Sanitary
Flow Element	Circular Channel
Method	Manning s Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0 013	
Slope	0 005200	ft/ft ← slope from drawings
Diameter	8	in
Discharge	8 330	gpm ← 12,000 gpd

Results		
Depth	0 07	ft
Flow Area	1 8e-2	ft²
Wetted Perimeter	0 43	ft
Top Width	0 40	ft
Critical Depth	0 06	ft
Percent Full	10 1	%
Critical Slope	0 007676	ft/ft
Velocity	1 01	ft/s
Velocity Head	0 02	ft
Specific Energy	0 08	ft
Froude Number	0 83	
Maximum Discharg	420 698	gpm
Discharge Full	391 090	gpm
Slope Full	0 000002	ft/ft
Flow Type	Subcritical	

C CHECK FOR HYDROGEN SULFIDE GENERATION POTENTIAL

INPUT DATA

Pipe ID =	8 0	inches
Slope =	0 0052	ft/ft
Discharge =	130992	gpd
	0 203	cfs
d =	3 0	in (assumed depth of partial flow in the pipe)

CALCULATIONS

θ =	1 3181	
P =	0 8787	ft
b =	0 645	ft

Check Z formula for several potential EBOD conditions

EBOD (mg/l)	Z	condition
156	4987	sulfide rarely generated
157	5019	marginal conditions
312	9974	marginal conditions
313	10006	sulfide generation common
500	15984	sulfide generation common

Sewer system EBOD conditions are a function of several factors, like climate, temperature, loading rate, and others Typical residential EBOD may be 200 mg/l to 500 mg/l [5]

V CONCLUSIONS

Once tied into the Scottsdale wastewater system, The Granite Ridge subdivision will add 12 homes sites to the existing Desert Crest subdivision sewer main Based on an estimate of available home sites from a city utility map [2], the proposed Granite Ridge layout [4], and estimated infiltration, a required sewer peak capacity flowrate of 135,984-gpd was computed

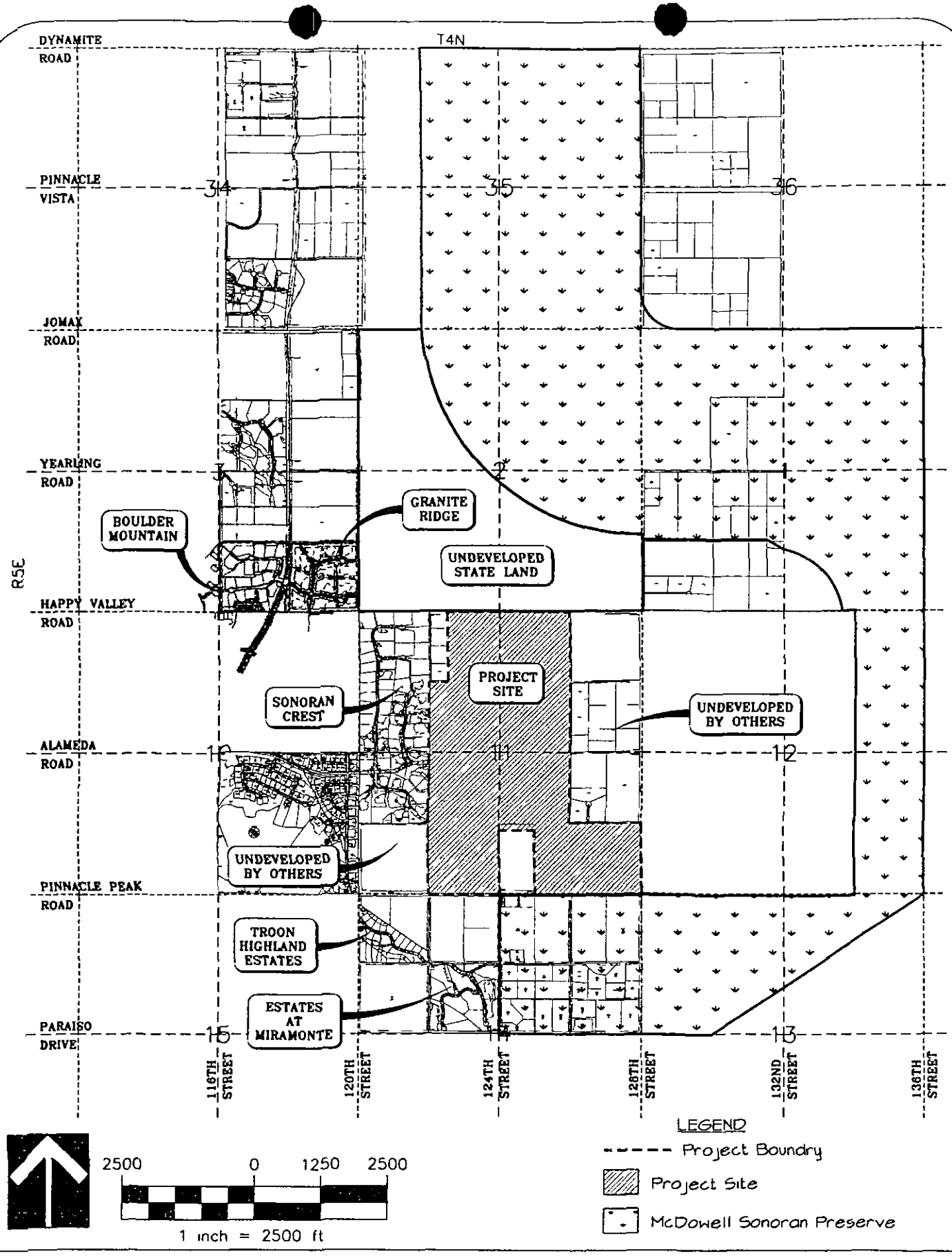
Using Manning's equation for a gravity flowing pipe, the peak capacity will be maintained with a minimum slope of 0 0003 ft/ft and a pipe velocity requirement of 2 5-ft/sec can be met with a **minimum design slope of 0 0052 ft/ft**

The potential for hydrogen sulfide generation within the new sewer system is greatly dependent upon the Biological Oxygen Demand (BOD) of the incoming wastewater If the BOD is less than approximately 158-mg/l, then hydrogen sulfide generation is likely to be rare If BOD is less than approximately 316-mg/l, then hydrogen sulfide generation is likely to be marginal Greater BOD values will make hydrogen sulfide generation more common

Hydrogen sulfide generation is due to several factors like amount of oxygen in the wastewater, ability of oxygen to get into the sewerage, flowrate, and temperature [5]

PLATE 1

Vicinity Map



CROWN COMMUNITY DEVELOPMENT
A Kenny Crown Company

McDOWELL MOUNTAIN BACK BOWL

Plate 1
Vicinity Map

WOOD/PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors
(602) 335-8500

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PLATE 2

Option 1 Master Wastewater System

GRANITE RIDGE

OUTFALL TO EXISTING 8" GRAVITY SEWER IN GRANITE RIDGE

PROPOSED FORCE MAIN

UNDEVELOPED STATE LAND

HAPPY VALLEY ROAD (ALIGNMENT)

OUTFALL TO PROPOSED 8" GRAVITY SEWER IN HAPPY VALLEY ROAD

8" GRAVITY SEWER

PROPOSED SEWAGE PUMPING STATION

PROPOSED 8" GRAVITY SEWER

120TH STREET (ALIGNMENT)

SONORAN CREST

128TH STREET

OUTFALL TO EXISTING 8" GRAVITY SEWER IN SONORAN CREST

ALAMEDA ROAD

OUTFALL TO PROPOSED GRAVITY SEWER IN 128th ST.

PINNACLE PEAK ROAD (ALIGNMENT)

AM AH AK AG AJ AF AI AD AA T AE V AC Z U S Y AB X R I H G W F E J D N K P O Q L M C B A

800 0 400 800

1 inch = 800 ft.

LEGEND

- DIRECTION OF FLOW
- 8-INCH SEWER LINE
- FORCE MAIN
- GRAVITY SEWER
- PROJECT BOUNDARY
- SEWER NODE
- LIFT STATION
- EXISTING 1 FOOT CONTOURS
- EXISTING 5 FOOT CONTOURS

NOTE

LOTTING AND ROADWAY LAYOUTS ARE CONCEPTUAL AND SUBJECT TO CHANGE. THE SEWER SYSTEM LAYOUT IS A CONCEPTUAL DESIGN ILLUSTRATING THE PIPE SIZES NECESSARY TO SERVE THE DEVELOPMENT AND IS NOT SPECIFIC TO ITS LOCATION.

CROWN COMMUNITY DEVELOPMENT
A Henry Crown Company

McDOWELL MOUNTAIN BACK BOWL

Plate 2

"Option 1 - Conceptual Master Wastewater System"

WOOD/PATEL ASSOCIATES
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Land Surveyors
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PLATE 3

Option 2 Master Wastewater System

GRANITE RIDGE

OUTFALL TO EXISTING 8" GRAVITY SEWER IN GRANITE RIDGE

UNDEVELOPED STATE LAND

PROPOSED FORCE MAIN

PROPOSED SEWAGE PUMPING STATION

HAPPY VALLEY ROAD (ALIGNMENT)

OUTFALL TO PROPOSED GRAVITY SEWER IN 128th ST.

120TH STREET (ALIGNMENT)

SONORAN CREST

AH AK AE2 AJ AA2 AM AE1 AI AA1 AD AA T AE V AC Z U Y S AB X

PROPOSED 8" GRAVITY SEWER

128TH STREET (ALIGNMENT)

OUTFALL TO EXISTING 8" GRAVITY SEWER IN SONORAN CREST

I H R ALAMEDA ROAD W F G E J J1 D N K P Q B C O M A L

OUTFALL TO PROPOSED GRAVITY SEWER IN 128th ST.

PINNACLE PEAK ROAD (ALIGNMENT)

LEGEND

- DIRECTION OF FLOW
- 8-INCH SEWER LINE
- FORCE MAIN
- GRAVITY SEWER
- PROJECT BOUNDARY
- SEWER NODE
- LIFT STATION
- EXISTING 1 FOOT CONTOURS
- EXISTING 5 FOOT CONTOURS

800 0 400 800

1 inch = 800 ft.

NOTE

LOTTING AND ROADWAY LAYOUTS ARE CONCEPTUAL AND SUBJECT TO CHANGE. THE SEWER SYSTEM LAYOUT IS A CONCEPTUAL DESIGN ILLUSTRATING THE PIPES SIZE NECESSARY TO SERVE THE DEVELOPMENT AND IS NOT SPECIFIC TO ITS LOCATION.

CROWN COMMUNITY DEVELOPMENT
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McDOWELL MOUNTAIN BACK BOWL

Plate 3

"Option 2 - Conceptual Master Wastewater System"

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