

STORMWATER REPORT
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Appendix A:

Figure 1 25-Year 24-hour Pre Construction Flow

Figure 2 25-Year 24-hour Post Construction Flow

Figure 3 A-D 25-Year 24-hour Post Construction Flow pipe segment by pipe segment

Figure 4 Canyon Ridge Basin Pipe Routing Hydraulic Analysis

Figure 5 Canyon Ridge Basin Pipe Routing Hydraulic Grade Slope Calculations

Figure 6 2-yr, 24-hour post-developed hydrograph

Figure 7 Canyon Ridge Basin Existing Pipe System

KINSLIE HEIGHTS SUBDIVISION

PROJECT OVERVIEW

The Kinslie Heights subdivision site is located in Oregon City, at 14270 Canyon Ridge Dr. The subdivision contains 2.04 acres, while the basin entire basin consists of 13.4 acres. The 13.4 acre basin consists of the proposed Kinslie Estates, Gentry Estates, and Canyon Ridge subdivisions. The pre-developed basin contains 1 house with extensive impervious area, of 0.67 acres of improvements. In total with the rezone, the site will be designed to collect, treat, and provide detention for 10 potential future lots. The site is at the furthest point away from the outfall within the drainage basin. From an elevation of 422', the site's collected stormwater travels over 2,100 feet to its unrestricted outfall with a flow line of 379.14', a drop of 43 feet at an average pipe slope of 1.7%.

Kinslie Heights will flow into a 12" PVC pipe constructed with the Gentry Estates subdivision which was connected to the Canyon Ridge storm drainage system in 2006. The Canyon Ridge subdivision which was built in the late 80's was designed with private septic systems and a public storm drainage system. No records of the constructed improvements were found in the Clackamas County archives. The storm drainage system was surveyed to its outfall by the project survey team. The storm drain line size and grade was identified on Figure 1. The constructed pipe from the 80's was a concrete material. The pipes appeared to be in adequate condition, though we found ± 150 lb boulders in the last manhole before the outfall. Clackamas County was notified of the problem.

STORMWATER SYSTEM AND DOWNSTREAM ANALYSIS:

Using a design of 4 inches in 24 hours, a hydraulic analysis was performed by the project engineer using the Santa Barbara Unit Hydrograph method and Manning's Pipe Flow calculations, which show that the storm drainage system can adequately accommodate all of the runoff from the proposed Kinslie Heights subdivision in a 25-year storm event, without detention (see Figure 3A-3D). A detailed hydraulic analysis for each segment of the existing storm drainage piping system was performed. The analysis showed that the entire existing storm drainage function more than adequately, with just one manhole experiencing a slight back water of 0.34 feet in the manhole to facilitate the hydraulic grade required to increase the flow rate in the downstream 12" pipe (Figure 4 – Canyon Creek Drainage Basin/Figure 5 – Hydraulic Calculations). The Manhole retained 4.99' of freeboard meaning the Canyon Creek drainage system is not taxed at all and can easily accommodate the undetained flow from the Kinslie Heights subdivision.

The 25 year storm flow increase resulting from the development of Kinslie Heights is 0.13 cfs (Figure 2 - 7.89 cfs minus Figure 1 - 7.76 cfs), a 1.7% increase in runoff. This small an increase in a 25-year's storm runoff, does not warrant a detention system which the City would have to maintain. As mitigation, the applicant proposes to repair the outfall rip rap and erosion which is occurring immediately below the existing outfall pipe, and downhill for approximately 150 feet below the existing outfall and build a channel sufficient to accommodate the 25-year storm event until dispersed.

STORMWATER QUALITY:

The project applicant is requesting that the typical requirement for Stormwater Quality be waived in favor of repairs to the existing outfall. In order to mitigate for the requirement for water quality is to treat 2/3rds of the 2-yr, 24-hr post-development flow, the applicant will create a dispersal basin, to spread the flow from the existing outfall result in reduced erosion downstream for the existing storm outfall. The resulting flow rates would be reduced and as witnessed in the field, will result in the stormwater being filtered through the forest duff, before reaching Beaver Creek. According to the Oregon City requirements, the 2 year, 24 hour storm results in 2.0 inches of rainfall, therefore two-thirds of the water quality storm is 1.33 inches. Currently, the 6 month storm of 2 cfs (Figure 4) from the entire Canyon Ridge subdivision is untreated. Our proposed mitigation will provide a much higher level of treatment for the entire Canyon Ridge basin.

Ed Christensen

ekc 14:23 05-Feb-13

Project 12-107.06
Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH
25-year Pre Construction at the Outfall

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	706.0	20.3'	2.88%	1.3'
4	pipe	concrete.pipe	n=0.013	891.0	9.0'	1.00%	2.7'
5	pipe	concrete.pipe	n=0.013	125.0	3.4'	2.71%	0.2'

total Time of Concentration = 30.1'

storm hyetograph: SCS TypeIA
return period = 25 years
storm duration = 24 hr.
total rainfall = 4.00 in.

pervious area = 8.44 A CN = 88 GpD:Res,1/4-A.lots
impervious area = 4.96 A CN = 98
total site area = 13.40 A

hydrograph file: c:\quick3\25-year pre kinslie heights outfall.hyd

peak flow = 7.76cfs @ 8.00 hr.
runoff volume = 151,388 cu.ft.

Ed Christensen

ekc 14:24 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

25-year Post Construction at the Outfall

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	706.0	20.3'	2.88%	1.3'
4	pipe	concrete.pipe	n=0.013	891.0	9.0'	1.00%	2.7'
5	pipe	concrete.pipe	n=0.013	125.0	3.4'	2.71%	0.2'

total Time of Concentration = 30.1'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 4.00 in.

pervious area = 7.77 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 5.63 A CN = 98

total site area = 13.40 A

hydrograph file: c:\quick3\25-year post kinslie heights outfall.hy

peak flow = 7.89cfs @ 8.00 hr.

runoff volume = 153,909 cu.ft.

Ed Christensen

ekc 14:37 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

25-year Post Construction at MH 1-3

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	706.0	20.3'	2.88%	1.3'
4	pipe	concrete.pipe	n=0.013	507.0	3.9'	0.77%	1.8'

total Time of Concentration = 28.9'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 4.00 in.

pervious area = 6.79 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 4.92 A CN = 98

total site area = 11.71 A

hydrograph file: c:\quick3\25-year post kinslie heights at mh 1-3.hyd

peak flow = 7.00cfs @ 8.00 hr.

runoff volume = 134,498 cu.ft.

Ed Christensen

ekc 14:40 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

25-year Post Construction at MH 1-4

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	706.0	20.3'	2.88%	1.3'
4	pipe	concrete.pipe	n=0.013	285.0	2.7'	0.95%	0.9'

total Time of Concentration = 28.0'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 4.00 in.

pervious area = 4.38 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 3.17 A CN = 98

total site area = 7.55 A

hydrograph file: c:\quick3\25-year post kinslie heights at mh 1-4.hyd

peak flow = 4.57cfs @ 8.00 hr.

runoff volume = 86,708 cu.ft.

Ed Christensen

ekc 14:45 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

25-year Post Construction at MH 1-5

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	706.0	20.3'	2.88%	1.3'

total Time of Concentration = 27.1'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 4.00 in.

pervious area = 3.84 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 2.78 A CN = 98

total site area = 6.62 A

hydrograph file: c:\quick3\25-year post kinslie heights at mh 1-5.hyd

peak flow = 4.06cfs @ 8.00 hr.

runoff volume = 76,028 cu.ft.

Ed Christensen

ekc 14:50 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

25-year Post Construction at MH 1-6

2-year, 24-hour rainfall = 2.00"

	<i>flow type</i>	<i>description</i>	<i>coeff.</i>	<i>distance</i>	<i>fall</i>	<i>slope</i>	<i>T/C</i>
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
2	shallow concentrated	paved,gravel	K=27	219.0	2.0'	0.91%	1.4'
3	pipe	concrete.pipe	n=0.013	480.0	18.7'	3.90%	0.7'

total Time of Concentration = 26.6'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 4.00 in.

pervious area = 3.09 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 2.44 A CN = 98

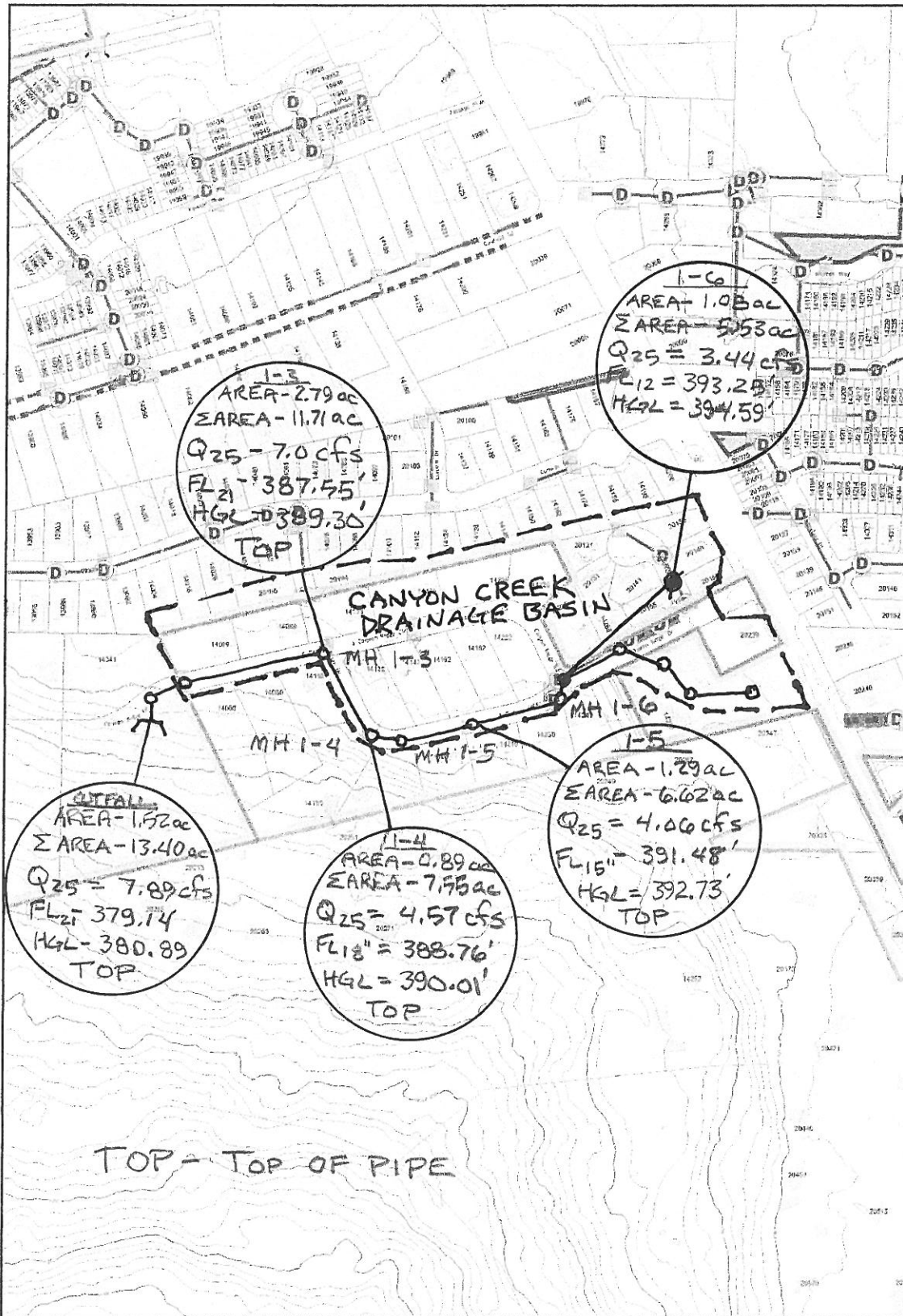
total site area = 5.53 A

hydrograph file: c:\quick3\25-year post kinslie heights at mh 1-6.hyd

peak flow = 3.44cfs @ 8.00 hr.

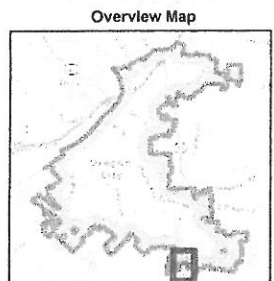
runoff volume = 63,952 cu.ft.

Oregon City GIS Map



- Legend**
- City Limits
 - UGB
 - Streams
 - Above Ground
 - - Below Ground
 - Unknown Flow
 - Taxlots
 - Unimproved ROW
 - Structures (City Owned)
 - Manhole
 - Inlet
 - ⊗ Outlet
 - Conduits (City Owned)
 - Pipe
 - Culvert
 - - - Ditch
 - Detention Tank
 - Ponds

Notes
 Canyon Ridge Drainage Basin



The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.



0 388 Feet
 1:4,660

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KINSLIE HEIGHTS
HYDRAULIC GRADE ANALYSIS
MANNING'S EQUATION FOR SLOPE

$$\Delta h = 4.66 n^2 \frac{1Q^2}{d^{14/3}} \quad \text{where } n = 0.013$$

$$\Delta h = 4.66 (0.013)^2 \frac{509' (7 \text{ cfs})^2}{(21/12)^{14/3}} = 0.99' \text{ OR}$$

OUTFALL TO MH 1-3

$S_h = 0.00195$; $S_{ACTUAL} = 0.126$ ∴ HYDRAULIC GRADE IS AT TOP OF PIPE

$$\Delta h = 4.66 (0.013)^2 \frac{222' (4.57 \text{ cfs})^2}{(18/12)^{14/3}} = 0.42' \text{ OR}$$

MH 1-3 TO MH 1-4

$S_h = 0.0019$; $S_{ACTUAL} = 0.0045$ ∴ HYDRAULIC GRADE IS AT TOP OF PIPE

$$\Delta h = 4.66 (0.013)^2 \frac{194' (4.06)^2}{(15/12)^{14/3}} = 0.766' \text{ OR}$$

MH 1-4 TO 1-5

$S_h = 0.00395$; $S_{ACTUAL} = 0.0072$ ∴ HYDRAULIC GRADE IS AT TOP OF PIPE

$$\Delta h = 4.66 (0.013)^2 \frac{226' (3.44 \text{ cfs})^2}{(12/12)^{14/3}} = 2.11'$$

MH 1-5 TO 1-6

$S_h = 0.0093$; $S_{ACTUAL} = 0.0078$ ∴ HGL = +0.34' ABOVE TOP OF PIPE

IN MH 1-6 : $FL_{12} = 393.25'$; $HGL = 394.59'$; $RIM = 399.58'$

∴ MH 1-6 HAS 4.99' OF FREEBOARD ✓ OK

NOTE: ALL PIPE SLOPES FROM MH 1-6 THROUGH THE PROJECT EXCEED THE HYDRAULIC GRADE SLOPE.

Ed Christensen

ekc 14:31 05-Feb-13

Project 12-107.06

Kinslie Heights Pipe Analysis

RUNOFF by the SANTA BARBARA URBAN HYDROGRAPH

2-year Post Construction at Outfall

2-year, 24-hour rainfall = 2.00"

	flow type	description	coeff.	distance	fall	slope	T/C
1	overland sheet	short.grass,lawns	n=0.15	176.0	2.0'	1.14%	24.4'
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4	pipe	concrete.pipe	n=0.013	891.0	9.0'	1.01%	2.7'
5	pipe	concrete.pipe	n=0.013	125.0	3.4'	2.72%	0.2'

total Time of Concentration = 30.1'

storm hyetograph: SCS TypeIA

return period = 25 years

storm duration = 24 hr.

total rainfall = 2.00 in.

pervious area = 7.77 A CN = 88 GpD:Res,1/4-A.lots

impervious area = 5.63 A CN = 98

total site area = 13.40 A

hydrograph file: c:\quick3\2-year post kinslie heights outfall.hyd

peak flow = 3.11cfs @ 8.00 hr.

runoff volume = 63,480 cu.ft.

WATER QUALITY DESIGN = $\frac{2}{3}$ (3.11 cfs) OR 2.07 cfs

STORM DRAINAGE MASTER PLAN
 IN THE N.W. 1/4 OF SECTION 16, T.3S., R.2E., W.M.
 CITY OF OREGON CITY, CLACKAMAS COUNTY, OREGON
 NOVEMBER 16, 2012

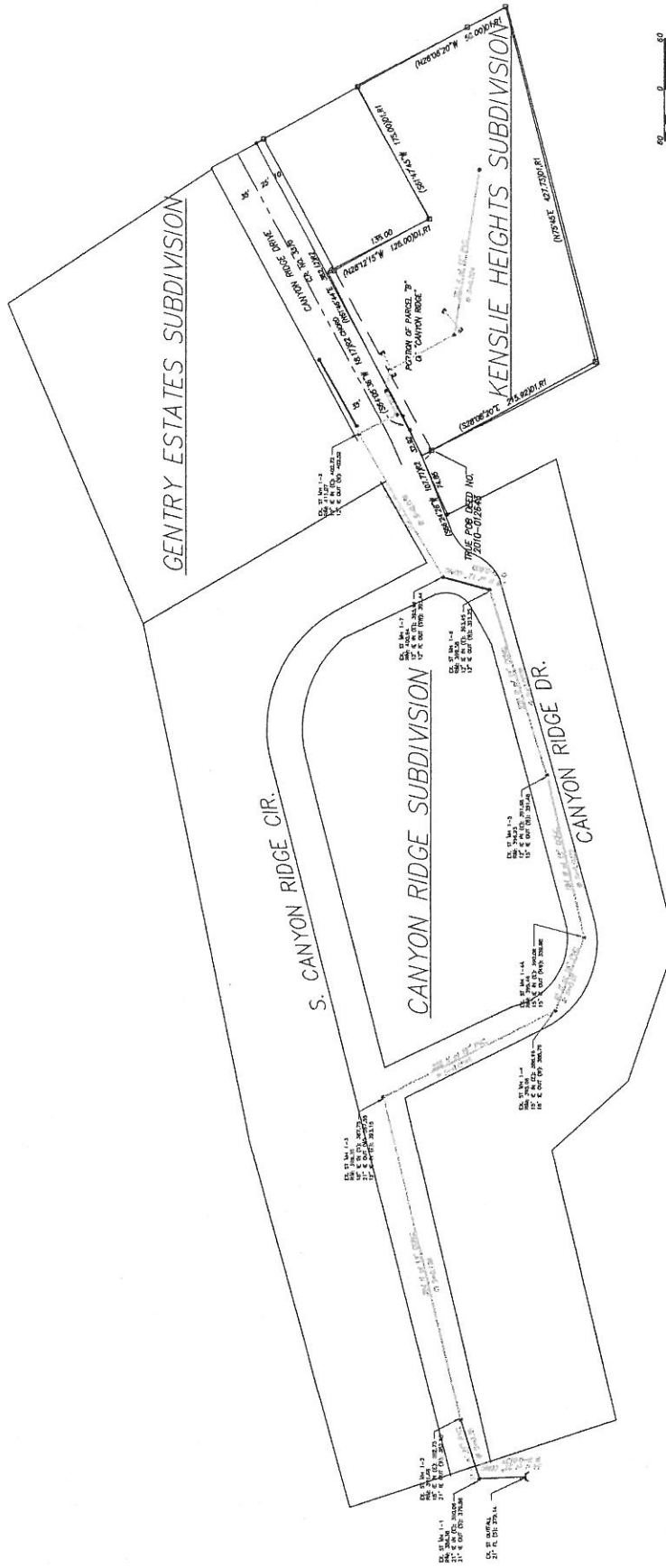


FIGURE 7



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