DRAINAGE REPORT
FOR

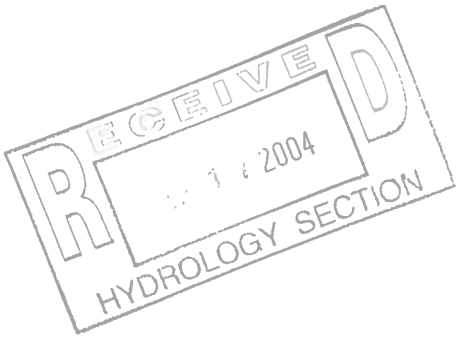
Ironstone Bank

Prepared by:

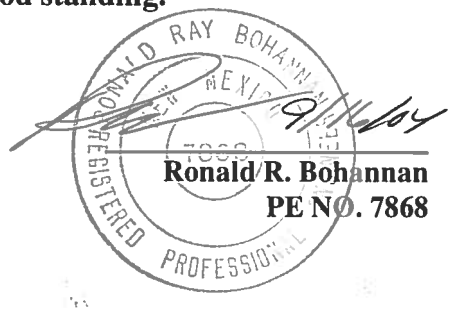
Tierra West, LLC
8509 Jefferson NE
Albuquerque, New Mexico 87113

Prepared for:
Kimley-Horn & Associates, Inc.
3001 Weston Parkway
Cary, NC 27513

September, 2004



I certify that this report was prepared under my supervision, and I am a registered professional engineer in the State of New Mexico in good standing.



Ronald R. Bohannan
PE NO. 7868

Job No 240001

TABLE OF CONTENTS

Prelude

This report is being prepared at the request of the current owner, Kimley-Horn, who proposes to develop a bank.

Location

The subject site is located on the northeast corner of Seven-Bar Loop Road and Cottonwood Drive and consists of a portion of Tract MM-1, Seven-Bar Ranch. The exact location of the site is shown highlighted on the enclosed Zone Atlas page number B-14. The site will be built in one phase and contains 2.48 acres more or less.

Existing Drainage Conditions

The site is currently undeveloped and naturally sheet flows from the west to the northeast. The undeveloped flow of 3.21 cfs drains to Tract MM, Seven-Bar Ranch located due east of the site. The flow then naturally sheet flows to a temporary detention pond as shown in the Lowe's Drainage Report prepared by Wilson & Co. and approved in October 2001.

No offsite flows enter the parcel. The site it bounded by Seven-Bar Loop Road on the south and Cottonwood Drive on the west. The remaining portion of Tract MM-1 is on the north and is currently vacant, as is Tract MM located on the east side of the project.

Flood Plain

The site is located on FIRM Map 35001C0109 F as shown on the attached excerpt. The map shows that the site does not fall within any 100-year flood plan.

Proposed Drainage Management Plan

The proposed site is divided into 3 basins with the site draining to the south. The flows from the site will sheet flow to a pond located on the southern portion of the site. From this pond the flows will be captured in a stand-pipe and routed to an exiting manhole in Seven-Bar Loop Road via a new 18" RCP.

It is anticipated that another small tract of land will be subdivided from the remaining portion of Tract MM-1. The additional parcel will be located due north of the site and contain approximately 1.38 acres. With this in mind, the Ironstone Bank will accept the historical discharge (1.78 cfs) from the future site into their pond. The developed flow rates from the future tract will pond on site and have a controlled discharge not to exceed the 1.78 cfs.

This report proposes that the drainage from these sites be allowed to enter the existing storm sewer system located in Seven-Bar Loop Road. The existing storm sewer system is at the high end of the drainage system used by the Cottonwood Mall. Based on the drainage report for Cottonwood Mall and SAD 223-Part 2 prepared by Bohannan-Huston, Inc. and approved August 1994 the Mall area was allowed to discharge 169 cfs into an existing storm sewer located at Corrales Road and Coors By-Pass Road. The site currently discharges 160 cfs, allowing for the potential of another 9 cfs to be added to the system.

After reviewing the report it was determined that the pipe sizes at the high end of the system would only allow an additional 2.0 cfs without negatively affecting the existing storm sewer system. Based on this new information the discharge from the pond on the Ironstone Bank tract was limited to 1.44 cfs. At this rate the pond will drain in eleven hours and, as shown on the enclosed Hydra-Flow analysis, it will have a minimal impact on the HGLs of the existing storm sewer system.

The site has an emergency overflow in the event of a storm greater than the 100-year storm or poor maintenance of the storm drain facilities. The water will pond until it reaches the low-point of the site at the entrance off Seven-Bar Loop Road. The water will then flow out the entrance of the site and into Seven-Bar Loop Road. At no time will the water surface elevation be greater than any commercial pad prior to flowing out the entrance.

Calculations

The weighted E method from the "City of Albuquerque Development Process Manual Volume 11 – Design Criteria, 1997 Revision" was used to calculate the runoff and volume for the site.

Summary

This site will discharge 1.44 cfs into the existing storm sewer system in Seven-Bar Loop Road, while ponding the flows on site. The additional 1.44 cfs in the existing storm sewer will have minimal impact to the system, which does have the capacity to allow up to an additional 2.0 cfs. If the pond fails the water will continue to pond until it overflows out the entrance on Seven-Bar Loop Road.

Weighted E Method

Undeveloped On-Site Basins

											100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Treatment A %	Treatment A (acres)	Treatment B %	Treatment B (acres)	Treatment C %	Treatment C (acres)	Treatment D %	Treatment D (acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
1	108,235	2.48	100%	2.48	0%	0.00	0%	0	0%	0.00	0.440	0.091	3.21	0.080	0.017	0.60
Total	108,235	2.48										0.091	3.21		0.017	0.60

Undeveloped Off-Site Basins

											100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Treatment A %	Treatment A (acres)	Treatment B %	Treatment B (acres)	Treatment C %	Treatment C (acres)	Treatment D %	Treatment D (acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
OS-1	60,116	1.38	100%	1.38	0%	0.00	0%	0	0%	0.00	0.440	0.051	1.78	0.080	0.009	0.33

Equations:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

Excess Precipitation, E (inches)		
Zone 1	100-Year	10 - Year
E_a	0.44	0.08
E_b	0.67	0.22
E_c	0.99	0.44
E_d	1.97	1.24

Peak Discharge (cfs/acre)		
Zone 1	100-Year	10 - Year
Q_a	1.29	0.24
Q_b	2.03	0.76
Q_c	2.87	1.49
Q_d	4.37	2.89

Weighted E Method

Developed Basins

												100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Area (sq. mi.)	Treatment A %	Treatment A (acres)	Treatment B %	Treatment B (acres)	Treatment C %	Treatment C (acres)	Treatment D %	Treatment D (acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
A	37,557	0.86	0.00135	0%	0	43%	0.37	0%	0.00	57%	0.49	1.411	0.101	2.90	0.801	0.058	1.70
B	54,117	1.24	0.00194	0%	0	48%	0.60	0%	0.00	52%	0.65	1.346	0.139	4.03	0.750	0.078	2.32
C	16,561	0.38	0.00059	0%	0	100%	0.38	0%	0.00	0%	0.00	0.670	0.021	0.77	0.220	0.007	0.29
OS-1	60,116	1.38	0.00216	0%	0	20%	0.28	0%	0.00	80%	1.10	1.710	0.197	5.39	1.036	0.119	3.40
Totals	168,351	3.86											0.459	13.09		0.261	7.71

Equations:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

Excess Precipitation, E (inches)		
Zone 1	100-Year	10 - Year
E_a	0.44	0.08
E_b	0.67	0.22
E_c	0.99	0.44
E_d	1.97	1.24

Peak Discharge (cfs/acre)		
Zone 1	100-Year	10 - Year
Q_a	1.29	0.24
Q_b	2.03	0.76
Q_c	2.87	1.49
Q_d	4.37	2.89

VOLUME CALCULATIONS
POND 1

Ab - Bottom Of The Pond Surface Area
At - Top Of The Pond Surface Area
D - Water Depth
Dt - Total Pond Depth
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$
C = (At - Ab) / Dt

Ab =	5,141.00
At =	8,644.00
Dt =	2.50
C =	1401.20

ACTUAL ELEV.	DEPTH (FT)	VOLUME (AC-FT)	Q (CFS)
5041.00	0	0	0.0000
5041.50	0.50	0.0630	0.6009
5042.00	1.00	0.1341	1.1179
5042.50	1.50	0.2132	1.4623
5043.00	2.00	0.3004	1.7399
5043.50	2.50	0.3956	1.9788

<u>Orifice Equation</u>
Q = CA SQRT(2gH)

C =	0.6
Diameter (in)	7.125
Area (ft^2)=	0.277
g =	32.2
H (Ft) =	Depth of water above center of orifice
Q (CFS)=	Flow

Pipe Capacity

Pipe	D	Slope	Area	R	Q Provided	Q Required	Velocity
	(in)	(%)	(ft^2)		(cfs)	(cfs)	(ft/s)
1	10	0.66	0.55	0.208	1.78	1.78	3.26
2	18	0.98	1.77	0.375	10.43	1.44	0.81
A	24	1	3.14	0.500	22.68	1.18	0.38
B	24	0.1	3.14	0.500	7.17	7.00	2.23
C	27	0.21	3.98	0.563	14.23	12.00	3.02
D	36	0.45	7.07	0.750	44.86	38.60	5.46
E	42	0.132	9.62	0.875	36.65	45.90	4.77
F	42	0.2	9.62	0.875	45.12	48.20	5.01
G	54	0.573	15.90	1.125	149.26	60.50	3.80
H	54	0.6	15.90	1.125	152.73	69.10	4.34
I	54	0.6	15.90	1.125	152.73	71.90	4.52
J	54	0.2	15.90	1.125	88.18	79.10	4.97
K	60	0.2	19.63	1.250	116.79	104.20	5.31
L	66	0.3	23.76	1.375	184.43	110.40	4.65
M	72	0.3	28.27	1.500	232.59	120.70	4.27
N	84	0.1	38.48	1.750	202.56	159.60	4.15
O	84	0.1	38.48	1.750	202.56	163.10	4.24

Manning's Equation:

$Q = 1.49/n * A * R^{(2/3)} * S^{(1/2)}$

A = Area
R = D/4
S = Slope
n = 0.013

SIDEWALK CULVERTS

Orifice Equation:

$$Q = CA\sqrt{2gH}$$

Where:
C = 0.6
A = 0.5833*2 = 1.167 ft^2
g = 32.2
H = Height of water measured from center of orifice

$$Q = 0.6 * 1.1678\sqrt{2 * 32.2 * 0.2917}$$

Q=3.035 cfs

Basin A
3.035 cfs > 2.90 cfs
Use one 24" sidewalk culvert

Basin B
6.07 cfs > 4.03 cfs
Use a 48" wide opening

Storm Sewer Tabulation

EXISTING CONDITIONS

Line #	Line ID	Incr. Area (ac)	Rnoff coeff (C)	Incr. CA	Sum CA	Tc (min)	Rnfal Inten (in/hr)	Total runoff (cfs)	Add. flow (cfs)	Total flow (cfs)	Capac. @ full (cfs)	Line size (in x in)	Line length (ft)	Line slope (%)	Veloc. up (ft/s)	Veloc. down (ft/s)	HGL up (ft)	HGL down (ft)	Invert up (ft)	Invert down (ft)	Dns line #
1	N	0.00	0.00	0.00	0.00	16.6	0.00	0.0	38.9	159.6	225.6	84 c	176	0.12	7.1	9.2	5032.28	5031.33	5028.32	5028.10	0
2	M	0.00	0.00	0.00	0.00	15.1	0.00	0.0	10.3	120.7	242.4	72 c	263	0.33	6.0	5.0	5033.19	5033.07	5029.18	5028.32	1
3	L	0.00	0.00	0.00	0.00	13.4	0.00	0.0	6.2	110.4	185.9	66 c	313	0.31	6.2	5.2	5033.99	5033.75	5030.14	5029.18	2
4	K	0.00	0.00	0.00	0.00	10.9	0.00	0.0	25.1	104.2	116.5	60 c	450	0.20	6.0	5.6	5035.21	5034.59	5031.04	5030.14	3
5	J	0.00	0.00	0.00	0.00	8.5	0.00	0.0	7.2	79.1	88.1	54 c	419	0.20	5.0	5.0	5036.44	5035.76	5031.88	5031.04	4
6	I	0.00	0.00	0.00	0.00	7.9	0.00	0.0	2.8	71.9	152.8	54 c	116	0.60	4.6	4.5	5036.97	5036.82	5032.58	5031.88	5
7	H	0.00	0.00	0.00	0.00	7.0	0.00	0.0	8.6	69.1	152.3	54 c	165	0.60	4.8	4.3	5037.42	5037.29	5033.57	5032.58	6
8	G	0.00	0.00	0.00	0.00	6.4	0.00	0.0	12.3	60.5	148.9	54 c	110	0.57	4.4	3.9	5037.80	5037.77	5034.20	5033.57	7
9	F	0.00	0.00	0.00	0.00	5.0	0.00	0.0	2.3	48.2	44.8	42 c	246	0.20	5.5	5.7	5038.68	5038.10	5035.69	5035.20	8
10	E	0.00	0.00	0.00	0.00	3.3	0.00	0.0	7.3	45.9	36.6	42 c	310	0.13	4.8	4.8	5039.77	5039.15	5036.10	5035.69	9
11	D	0.00	0.00	0.00	0.00	1.7	0.00	0.0	26.6	38.6	44.7	36 c	285	0.45	5.5	5.5	5041.08	5040.12	5037.38	5036.10	10
12	C	0.00	0.00	0.00	0.00	1.3	0.00	0.0	5.0	12.0	14.0	27 c	69	0.20	3.0	3.0	5041.64	5041.54	5037.52	5037.38	11
13	B	0.00	0.00	0.00	0.00	0.8	0.00	0.0	5.8	7.0	7.3	24 c	87	0.10	2.2	2.2	5041.87	5041.78	5037.61	5037.52	12
14	A	0.00	0.00	0.00	0.00	0.0	0.00	0.0	1.2	1.2	22.6	24 c	150	1.00	0.4	0.4	5041.95	5041.94	5039.11	5037.61	13

PROJECT FILE: IRON.STM | I-D-F FILE: SAMPLE.IDF | TOTAL NUMBER OF LINES: 14 | RUN DATE: 09-07-2004

NOTES: c = circular; e = elliptical; b = box; Intensity = 56.76727 / (Tc + 11) ^ .7948174; Return period = 5 Yrs.

Storm Sewer Tabulation

WITH ADDITIONAL 1.44 cfs

Line #	Line ID	Incr. Area (ac)	Rnoff coeff (C)	Incr. CA	Sum CA	Tc (min)	Rnfal Inten (in/hr)	Total runoff (cfs)	Add. flow (cfs)	Total flow (cfs)	Capac. @ full (cfs)	Line size (in x in)	Line length (ft)	Line slope (%)	Veloc. up (ft/s)	Veloc. down (ft/s)	HGL up (ft)	HGL down (ft)	Invert up (ft)	Invert down (ft)	Dns line #
1	1	0.00	0.00	0.00	0.00	16.6	0.00	0.0	38.9	161.0	225.6	84 c	176	0.12	7.1	9.2	5032.30	5031.34	5028.32	5028.10	0
2	2	0.00	0.00	0.00	0.00	15.1	0.00	0.0	10.3	122.1	242.4	72 c	263	0.33	6.0	5.1	5033.21	5033.09	5029.18	5028.32	1
3	3	0.00	0.00	0.00	0.00	13.4	0.00	0.0	6.2	111.8	185.9	66 c	313	0.31	6.3	5.3	5034.00	5033.78	5030.14	5029.18	2
4	4	0.00	0.00	0.00	0.00	10.9	0.00	0.0	25.1	105.6	116.5	60 c	450	0.20	6.0	5.7	5035.26	5034.61	5031.04	5030.14	3
5	5	0.00	0.00	0.00	0.00	8.5	0.00	0.0	7.2	80.5	88.1	54 c	419	0.20	5.1	5.1	5036.51	5035.81	5031.88	5031.04	4
6	6	0.00	0.00	0.00	0.00	7.9	0.00	0.0	2.8	73.3	152.8	54 c	116	0.60	4.6	4.6	5037.07	5036.91	5032.58	5031.88	5
7	7	0.00	0.00	0.00	0.00	7.0	0.00	0.0	8.6	70.5	152.3	54 c	165	0.60	4.7	4.4	5037.55	5037.40	5033.57	5032.58	6
8	8	0.00	0.00	0.00	0.00	6.4	0.00	0.0	12.3	61.9	148.9	54 c	110	0.57	4.4	3.9	5037.96	5037.90	5034.20	5033.57	7
9	9	0.00	0.00	0.00	0.00	5.0	0.00	0.0	2.3	49.6	44.8	42 c	246	0.20	5.5	5.6	5038.82	5038.25	5035.69	5035.20	8
10	10	0.00	0.00	0.00	0.00	3.3	0.00	0.0	7.3	47.3	36.6	42 c	310	0.13	4.9	4.9	5039.97	5039.28	5036.10	5035.69	9
11	11	0.00	0.00	0.00	0.00	1.7	0.00	0.0	26.6	40.0	44.7	36 c	285	0.45	5.7	5.7	5041.37	5040.34	5037.38	5036.10	10
12	12	0.00	0.00	0.00	0.00	1.3	0.00	0.0	5.0	13.4	14.0	27 c	69	0.20	3.4	3.4	5041.99	5041.87	5037.52	5037.38	11
13	13	0.00	0.00	0.00	0.00	0.8	0.00	0.0	5.8	8.4	7.3	24 c	87	0.10	2.7	2.7	5042.29	5042.17	5037.61	5037.52	12
14	14	0.00	0.00	0.00	0.00	0.0	0.00	0.0	2.6	2.6	22.6	24 c	150	1.00	0.8	0.8	5042.42	5042.40	5039.11	5037.61	13

PROJECT FILE: IRONA.STM | I-D-F FILE: SAMPLE.IDF | TOTAL NUMBER OF LINES: 14 | RUN DATE: 09-08-2004

NOTES: c = circular; e = elliptical; b = box; Intensity = 56.76727 / (Tc + 11) ^ .7948174; Return period = 5 Yrs.