DRAINAGE STUDY

DAY BREAK APARTMENT PLAT A1

South Jordan, Utah

Job # SLB00269
May 27, 2008

Prepared By:
Nolte Associates, Inc.
5217 South State Street, Suite 300
Murray, UT 84107
Phone: (801) 743-1300 • Fax: (801) 743-0300

Prepared For:
Kennecott Land, Co.
5295 South 300 West, Suite 475
Murray, UT 84107
Phone: (801) 743-4624 • Fax: (801) 743-4659

REGISTERED PROFESSIONAL ENGINEER
Tyler V. White
No. 5049576
10/13/08
STATE OF UTAH

1 INTRODUCTION

1.1 Project Overview and Study Purpose

The Kennecott Land Company and Western National Group are proposing to develop 21.75 acres of land located within the Daybreak Master Planned Community. The proposed project is identified as Kennecott Daybreak Apartment Venture #1 and will consist of street, parking lot, utility improvements preparatory to construction of residential, recreation, open space, and civic structures.

1.2 FEMA Flood Zone Designation

The project site is located in a FEMA designated Zone X per Flood Insurance Rate Map (FIRM) Panel 49035C0436F and 49035C0420E, dated May 15, 2002. Zone X is defined as an area not affected by the 0.2% annual chance flood event. No effective LOMRs have application to this project site.

2 METHODOLOGY

2.1 Compliance

The methodologies utilized in the preparation of this study are in compliance with established engineering practices. Rainfall data prepared and distributed by the City of South Jordan and NOAA was utilized in determining runoff from this project.

2.2 Hydrologic Modeling

Storm Drain System Modeling: The Rational Method is utilized to determine peak flow rates to each catch basin. The Rational Method utilizes the basin area in acres with the rainfall intensity (provided by South Jordan) and a Rational Method runoff coefficient. The equation utilized is defined as:

$$Q_p = CiA$$

The Rational Method routine within the StormCAD software (version 8.0) by Bentley was utilized to model and analyze the drainage sub basins in this study. For the purpose of sizing storm drain and determining the inlet capacity, a hydrologic subbasin was created for the area contributing to each catch basin. Inlet basins for the Apartment Venture plat are shown in Figure 1, Plat A1 Storm Drain Basin Map in Appendix A.

Retention Pond Modeling: All runoff up to the 100 year flood will be retained in underground storage galleries with the site and in the median of Daybreak View Parkway. For the purpose of sizing the retention ponds, the NRCS (SCS) Curve Number method has been utilized to determine the volume needed for each of the 3 underground retention galleries in the Apartment Venture plat. Separate hydrologic basins have been delineated for the sizing of the ponds and are determined based upon the contributing area to each gallery.

3 PROPOSED DEVELOPMENT

3.1 Hydrologic Modeling

As discussed in Section 2.2, the hydrologic modeling was performed utilizing the Rational Method as incorporated in the StormCAD program by Haestad Methods. Runoff data for each of the hydrologic subbasins can be found with the Inlet Report for the 10-year storm models, found in Appendix B.

3.2 Hydraulic Modeling

Catch basins and storm drain pipes are modeled in StormCAD to ensure adequate sizing for the 10-year storm event. The project is designed to capture the 10-year storm flow.

10-Year Storm Modeling: According to the Pipe Report for the 10-year storm event, no segments of the storm drain system will exceed capacity. The Inlet and Pipe Reports for the 10-year storm can be found in Appendix B of this report. A diagram of the storm drain model is found in Figure 2, Plat A1 Storm Drain Model in Appendix A.

3.3 Underground Storage Galleries

Apartment Plat Underground Retention: All galleries within the plat have been designed to retain the 100 year storm. Table 1 below summarizes the pond volume, design storm contained, tributary area, 100 year design storms for the area that drains to each pond. Figure 3, Plat A1 Pond Tributary Area Map in Appendix A, shows the contributing areas to each pond.

Table 1: Pond Required and Available Volumes

WATERSHED	DESCRIPTION	BASIN AREA (AC)	100 YR STORAGE REQUIRED (FT^3)	100 YEAR STORAGE PROVIDED (FT^3)	EXCESS (FT^3)
A1-E	Plat A1 East Side	10.36	75,359	75,676	317
A1-W	Plat A1 West Side	14.04	93,654	93,807	153
A1-DAYBREAK VIEW PARKWAY	Daybreak View Parkway South of Plat A1	13.75	80,151	80,323	172

The NRCS Curve Number method is utilized to approximate runoff volumes and appropriately size each pond. Ultimate condition pond sizing has been designed according to the master plan. Each pond will be equipped with a drywell that has a sedimentation chamber to settle any sediment that enters the system with the storm water. Drywells have been designed to drain the volume of each pond within 36 hours of peak volume. No gallery in the Apartment Venture plat should be full longer than 36 hours under normal operating conditions. An infiltration rate (K) of 4.0 cm/sec is taken from a geotechnical exploration with specific infiltration tests and equates to 1.65-cfs through a 4-ft diameter well. This rate

5 References

1. *Hydrologic Analysis and Design*, Richard H. McCuen, Prentice Hall, Upper Saddle River, New Jersey, 1998.

2. *Hydrologic Criteria and Drainage Design Manual*, Clark County Regional Flood Control District, Clark County, Nevada, 1990.

3. *Design and Construction of Sanitary and Storm Sewers*, American Society of Civil Engineers, New York, p.332, 1969.

4. *Geotechnical Study for Trilobyte and Hill Side Detention Ponds: Dry Wells Daybreak Utah Development,* AMEC Earth and Environmental, Inc., Salt Lake City, UT, September 6, 2005. Project number 3-817-004657.

Appendix A

Figures

Figure 1: Plat A1 Storm Drain Basin Map
Figure 2: Plat A1 Pond Tributary Area Map
Figure 3: Plat A1 StormCAD Model

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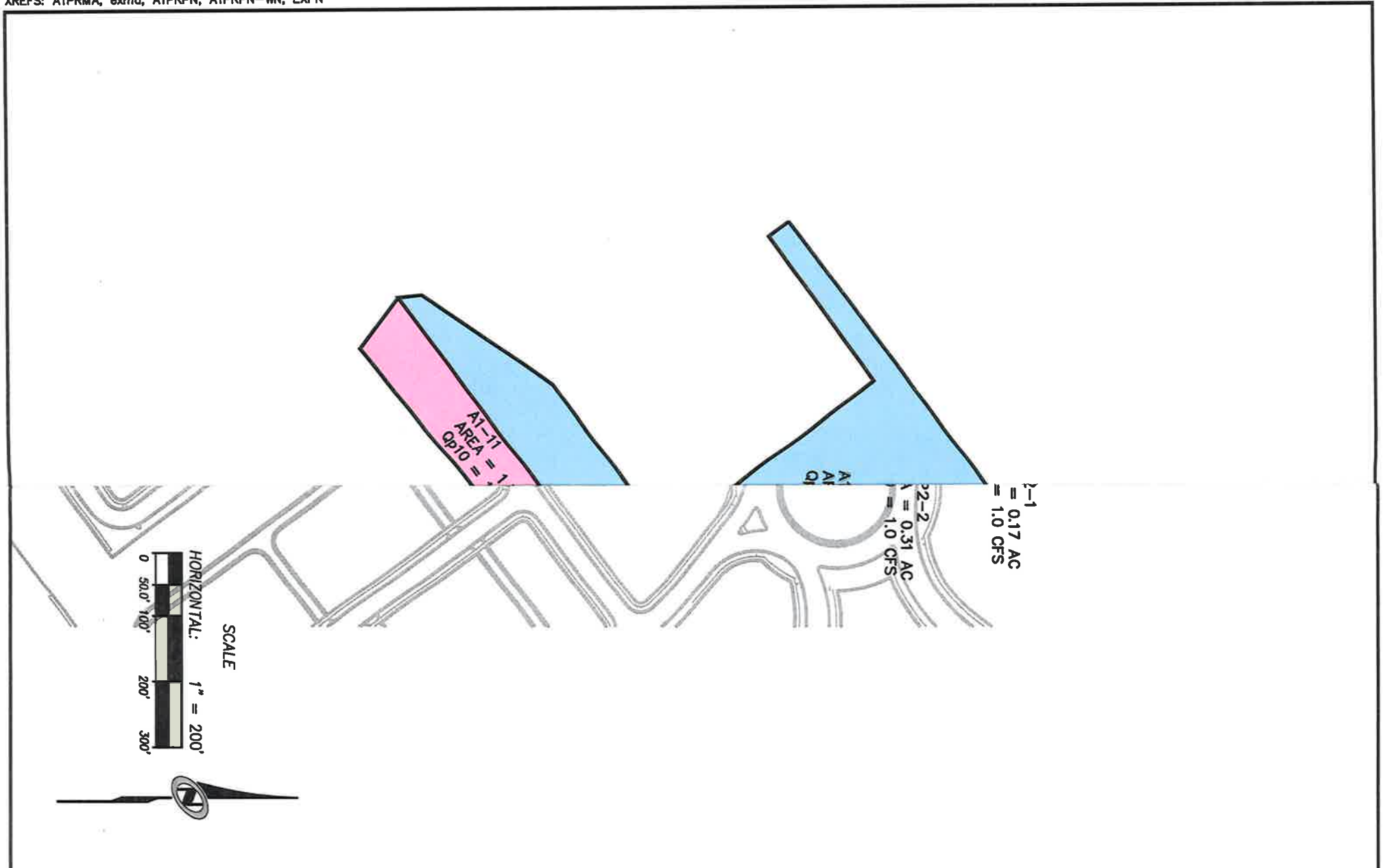
WEST
XREFS: A1PRMA, exma, A1PRPN, A1PRPN-WN, EXPN

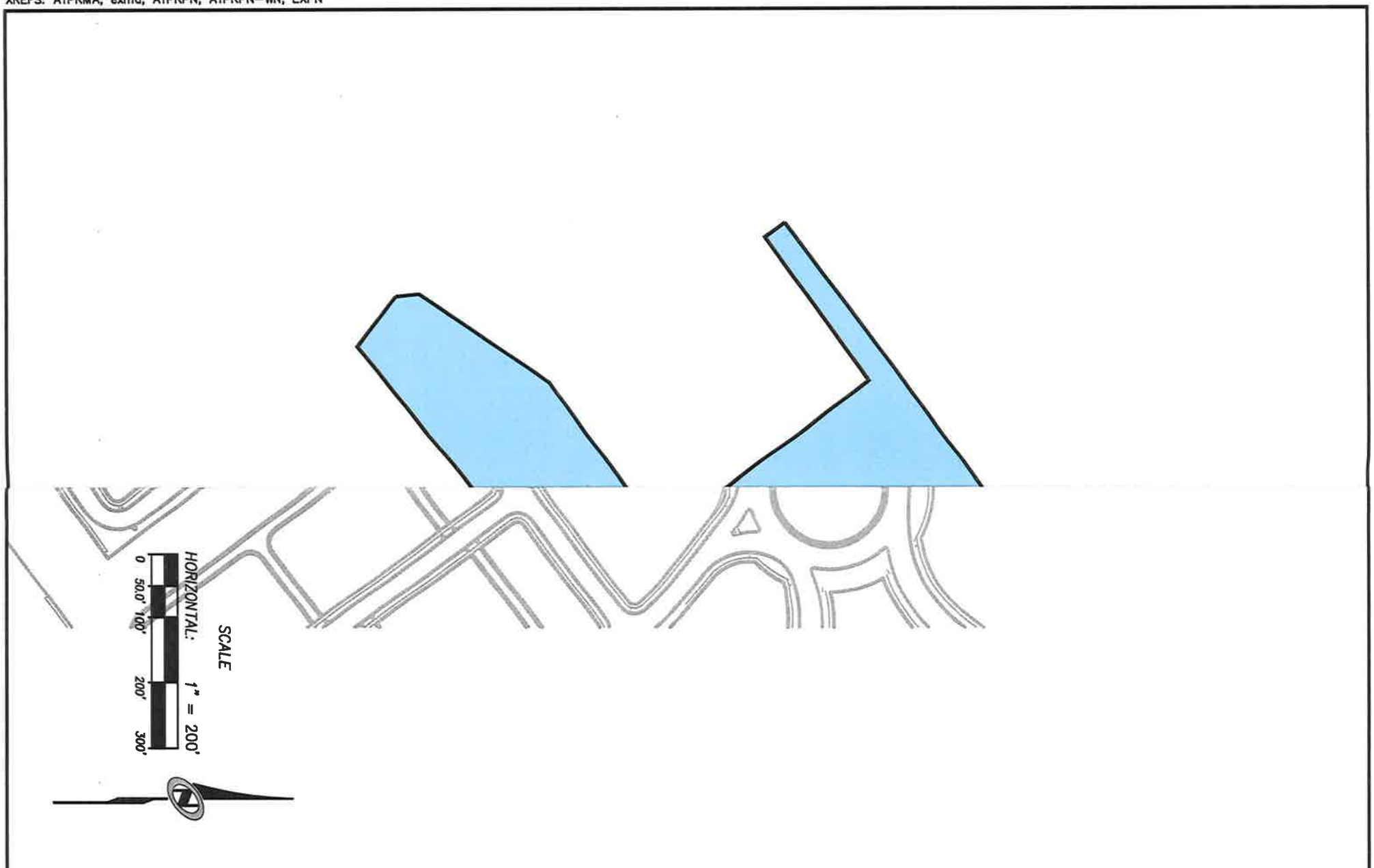


JOB NUMBER SLB0153	SHEET NUMBER 1 OF 3 SHEETS	DATE: 5/29/08 TIME: 8:00:39 AM NETWORK: SLS1 PLOT: N:\SLB0153MP\PLATE\STAD\STORMWATER\A1PRSD\A1 STORM DRAIN RE DWG NAME: ET01.DWG LAYOUT: Layout1 DESIGNER: CRW MGR: TVW	NOLTE BEYOND ENGINEERING 6871 SOUTH REDWOOD ROAD, SUITE 101 WEST JORDAN, UT 84084 801.748.1800 TEL 801.748.0800 FAX WWW.NOLTE.COM

DAYBREAK
FIGURE 1
PLAT A1 STORM DRAIN BASIN MAP

PREPARED FOR: KLC DATE SUBMITTED: MAY 08

WEST
XREFS: A1PRMA, exma, A1PRPN, A1PRPN-WN, EXPN

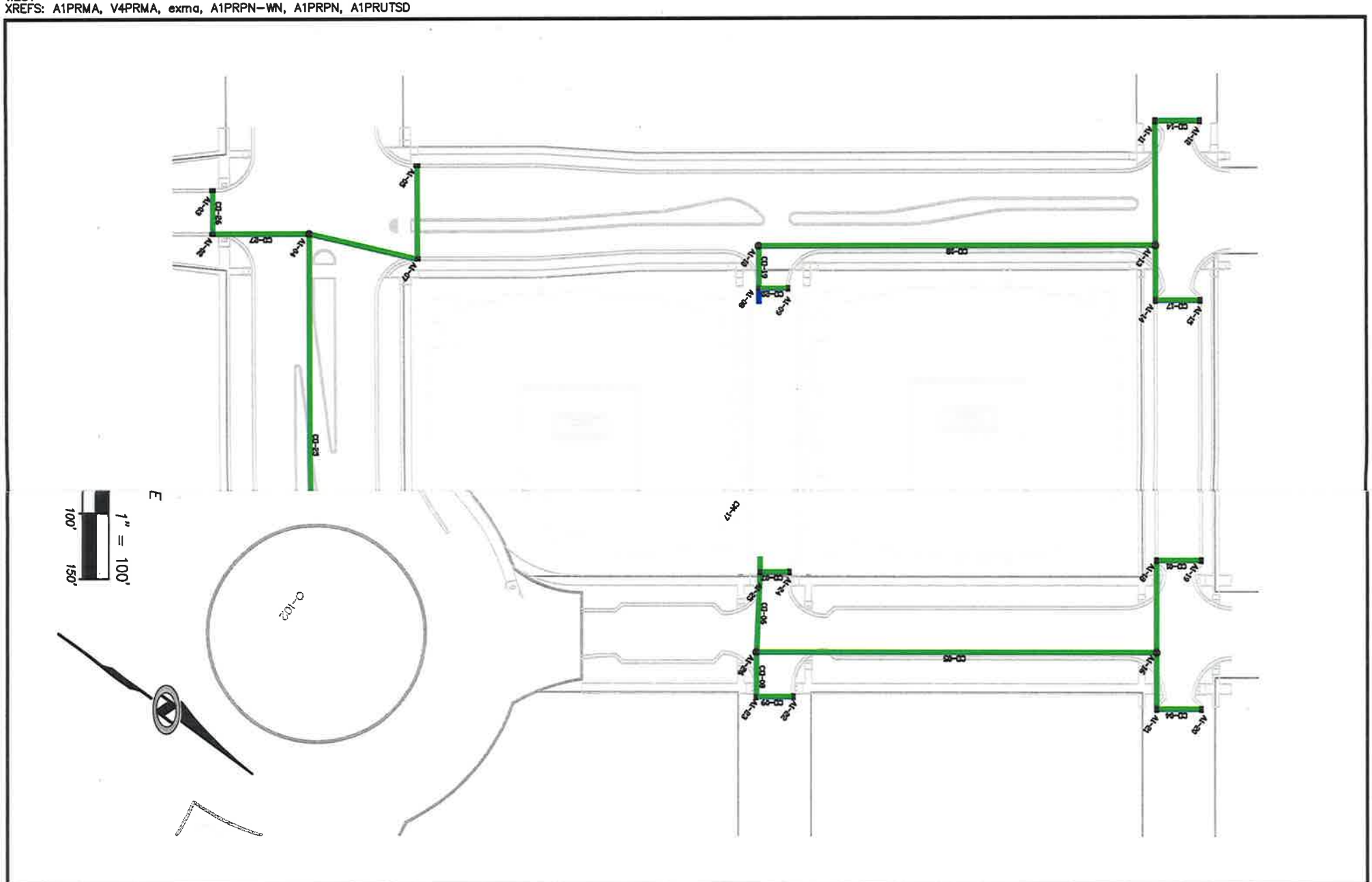


JOB NUMBER SLB0153	SHEET NUMBER 2 OF 3 SHEETS	DATE: 5/29/08 TIME: 8:01:19 AM NETWORK: SLS1 PATH: \SLB0153MP\PLATSTAD\STORMWATER\A1PRSD\A1 STORM DRAIN RE DWG NAME: ET02.DWG LAYOUT: Layout1 DESIGNER: CRW MGR: TVW	NOLTE BEYOND ENGINEERING 6871 SOUTH REDWOOD ROAD, SUITE 101 801.748.1930 TEL 801.748.6900 FAX WEST JORDAN, UT 84084 WWW.NOLTE.COM

DAYBREAK
FIGURE 2
PLAT A1 POND TRIBUTARY AREA

PREPARED FOR: KLC DATE SUBMITTED: MAY 08

WEST
XREFS: A1PRMA, V4PRMA, exma, A1PRPN-WN, A1PRPN, A1PRUTSD



JOB NUMBER SLB0153	OF 3 SHEETS	SHEET NUMBER 3	DATE: 5/29/08 TIME: 8:02:00 AM NETWORK: SLS1 DWG NAME: ET03.DWG LAYOUT: Layout1 DESIGNER: CRW MGR: TVW

NOLTE
BEYOND ENGINEERING
6371 SOUTH REDWOOD ROAD, SUITE 101 WEST JORDAN, UT 84084
801.743.1800 TEL 801.743.0800 FAX WWW.NOLTE.COM

DAYBREAK
FIGURE 3
PLAT A1 STORM CAD MODEL

PREPARED FOR: KLC DATE SUBMITTED: MAY 08

Appendix B

10 YEAR MODEL RESULTS
Inlet Report (Including Hydrologic Data)
Pipe Report

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SCENARIO: BASE
CATCH BASIN REPORT

Label	Inlet Type	Inlet	Clogging Factor (%)	Gutter Depth (in)	Gutter Spread (ft)	Flow (Total Surface) (ft^3/s)	Capture Efficiency (Calculated) (%)	Capture Efficiency (%)	Maximum Spread in Sag (ft)	Maximum Depth in Sag (in)
A1-18	Catalog Inlet	KLC	50	-0.2	3.6	0.77	100	100	8	6
A1-19	Catalog Inlet	KLC	50	1	8.5	2.21	100	100	8	6
A1-20	Catalog Inlet	KLC	50	-0.6	2.8	0.29	100	100	8	6
A1-21	Catalog Inlet	KLC	50	-1.4	1.2	0.02	100	100	8	6
A1-25	Catalog Inlet	KLC	50	-0.9	2.3	0.12	100	100	8	6
A1-24	Catalog Inlet	KLC	50	-0.4	3.3	0.57	100	100	8	6
A1-23	Catalog Inlet	KLC	50	-1	2.1	0.07	100	100	8	6
A1-22	Catalog Inlet	KLC	50	0.4	6	1.45	100	100	8	6
A1-01	Catalog Inlet	KLC	50	0.4	5.6	1.35	100	100	8	6
A1-27	Catalog Inlet	KLC	50	0.2	4.9	1.17	100	100	8	6
A1-28	Catalog Inlet	KLC	50	0.6	6.7	1.65	100	100	8	6
A1-11	Catalog Inlet	KLC	50	0.2	4.9	1.16	100	100	8	6
A1-12	Catalog Inlet	KLC	50	2.3	13.8	4.55	100	100	8	6
A1-15	Catalog Inlet	KLC	50	0.4	5.7	1.37	100	100	8	6
A1-14	Catalog Inlet	KLC	50	-0.7	2.7	0.27	100	100	8	6
A1-08	Catalog Inlet	KLC	50	-0.9	2.3	0.11	100	100	8	6
A1-09	Catalog Inlet	KLC	50	-0.4	3.3	0.57	100	100	8	6
A1-05	Catalog Inlet	KLC	50	2.5	14.5	4.98	100	100	8	6
A1-07	Catalog Inlet	KLC	50	-0.2	3.6	0.75	100	100	8	6
A1-03	Catalog Inlet	KLC	50	0.3	5.6	1.33	100	100	8	6
A1-02	Catalog Inlet	KLC	50	-0.6	2.9	0.36	100	100	8	6

SCENARIO: BASE
PIPES REPORT

Label	Start Node	Invert (Upstream) (ft)	Stop Node	Invert (Downstream) (ft)	Conduit Type	Conduit Shape	Material	Manning's n	Section Size	Diameter (in)	Rise (in)	Span (in)	Upstream CA (acres)	System CA (acres)
CO-19	A1-10	4,805.13	A1-08	4,803.75	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	3.398	3.398
CO-04	A1-20	4,803.77	A1-21	4,803.61	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.136	0.136
CO-05	A1-16	4,803.29	A1-26	4,800.35	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	1.523	1.523
CO-06	A1-26	4,800.35	A1-25	4,800.00	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.226	2.226
CO-07	A1-24	4,800.95	A1-25	4,800.00	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.263	0.263
CO-08	A1-23	4,800.50	A1-26	4,800.35	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.703	0.703
CO-09	A1-22	4,800.63	A1-23	4,800.50	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.672	0.672
CO-11	A1-01	4,798.81	OF-2	4,797.95	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.626	0.626
CO-12	A1-27	4,797.87	A1-28	4,797.77	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.54	0.54
CO-13	A1-28	4,797.77	OF-3	4,796.95	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	1.302	1.302
CO-14	A1-12	4,809.72	A1-11	4,809.56	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.104	2.104
CO-01	A1-19	4,803.79	A1-18	4,803.63	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	1.023	1.023
CO-18	A1-13	4,809.10	A1-10	4,805.13	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	3.398	3.398
CO-35	A1-25	4,800.00	OF-6	4,799.95	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.543	2.543
CO-20	A1-09	4,804.23	A1-08	4,803.75	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.265	0.265
CO-25	A1-04	4,798.93	OF-4	4,797.32	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	3.435	3.435
CO-26	A1-03	4,800.09	A1-02	4,799.93	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.615	0.615
CO-27	A1-02	4,799.93	A1-04	4,798.93	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.784	0.784
CO-28	A1-11	4,809.56	A1-13	4,809.10	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.641	2.641
CO-29	A1-14	4,809.71	A1-13	4,809.10	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.757	0.757
CO-30	A1-08	4,803.75	OF-5	4,803.70	User Defined Conduit	Circular Pipe	Concrete	0.013		24	0	0	3.716	3.716
CO-31	A1-05	4,799.71	A1-07	4,799.36	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.304	2.304
CO-32	A1-07	4,799.36	A1-04	4,798.93	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	2.651	2.651
CO-33	A1-21	4,803.61	A1-16	4,803.29	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.146	0.146
CO-34	A1-18	4,803.63	A1-16	4,803.29	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	1.377	1.377
CO-17	A1-15	4,809.87	A1-14	4,809.71	User Defined Conduit	Circular Pipe	Concrete	0.013		18	0	0	0.634	0.634

SCENARIO: BASE
PIPES REPORT

System Intensity (in/hr)	Flow (ft^3/s)	Length (Unified) (ft)	Slope (Calculated) (%)	Capacity (Full Flow) (ft^3/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Cover (Start) (ft)	Cover (Stop) (ft)	Velocity (Average) (ft/s)	Design Conduit?	Length (User Defined) (ft)	Has User Defined Length?
2.089	7.16	28	4.929	23.32	4,809.13	4,808.23	4,806.17	4,804.38	2.5	2.98	11.61	TRUE	28	TRUE
2.144	0.29	32	0.5	7.43	4,807.77	4,807.77	4,803.98	4,803.97	2.5	2.66	2.04	TRUE	32	TRUE
2.119	3.25	332.8	0.884	9.87	4,808.49	4,805.62	4,803.98	4,801.18	3.7	3.77	5.01	TRUE	332.8	TRUE
2.066	4.64	59.1	0.593	8.09	4,805.62	4,804.95	4,801.18	4,800.92	3.77	3.45	4.73	TRUE	59.1	TRUE
2.144	0.57	20	4.75	22.89	4,804.95	4,804.95	4,801.23	4,800.92	2.5	3.45	5.47	TRUE	20	TRUE
2.138	1.51	29	0.517	7.55	4,804.63	4,805.62	4,801.18	4,801.18	2.63	3.77	3.34	TRUE	29	TRUE
2.144	1.45	26	0.5	7.43	4,804.63	4,804.63	4,801.18	4,801.18	2.5	2.63	3.26	TRUE	26	TRUE
2.144	1.35	36.5	2.356	16.12	4,802.81	4,803.00	4,799.25	4,798.24	2.5	3.55	5.54	TRUE	36.5	TRUE
2.144	1.17	20	0.5	7.43	4,801.87	4,801.87	4,798.41	4,798.41	2.5	2.6	3.06	TRUE	20	TRUE
2.139	2.81	69.5	1.179	11.41	4,801.87	4,803.00	4,798.41	4,797.46	2.6	4.55	5.34	TRUE	69.5	TRUE
2.144	4.55	32	0.5	7.43	4,813.72	4,813.72	4,810.81	4,810.77	2.5	2.66	4.41	TRUE	32	TRUE
2.144	2.21	32	0.5	7.43	4,807.79	4,807.79	4,804.35	4,804.29	2.5	2.66	3.67	TRUE	32	TRUE
2.122	7.27	299.8	1.324	12.09	4,814.46	4,809.13	4,810.14	4,806.48	3.86	2.5	7.15	TRUE	299.8	TRUE
2.056	5.27	10	0.5	7.43	4,804.95	4,805.00	4,800.92	4,800.83	3.45	3.55	4.56	TRUE	10	TRUE
2.144	0.57	20	2.4	16.27	4,808.23	4,808.23	4,804.74	4,804.76	2.5	2.98	4.33	TRUE	20	TRUE
2.118	7.33	322	0.5	7.43	4,805.93	4,805.06	4,800.14	4,798.37	5.5	6.24	4.79	TRUE	322	TRUE
2.144	1.33	31	0.516	7.55	4,804.09	4,804.09	4,800.52	4,800.49	2.5	2.66	3.22	TRUE	31	TRUE
2.136	1.69	69.5	1.439	12.6	4,804.09	4,805.93	4,800.42	4,800.19	2.66	5.5	4.96	TRUE	69.5	TRUE
2.138	5.69	91	0.505	7.47	4,813.72	4,814.46	4,810.58	4,810.36	2.66	3.86	4.65	TRUE	91	TRUE
2.136	1.63	38	1.604	13.3	4,813.87	4,814.46	4,810.19	4,810.20	2.66	3.86	5.11	TRUE	38	TRUE
2.087	7.82	10	0.5	16	4,808.23	4,808.23	4,804.74	4,804.69	2.48	2.53	5.06	TRUE	10	TRUE
2.144	4.98	69	0.507	7.48	4,803.71	4,803.94	4,800.74	4,800.64	2.5	3.08	4.53	TRUE	69	TRUE
2.132	5.7	80.7	0.533	7.67	4,803.94	4,805.93	4,800.48	4,800.32	3.08	5.5	4.75	TRUE	80.7	TRUE
2.131	0.31	38	0.841	9.63	4,807.77	4,808.49	4,803.97	4,803.98	2.66	3.7	2.5	TRUE	38	TRUE
2.137	2.97	68	0.5	7.43	4,807.79	4,808.49	4,804.29	4,803.98	2.66	3.7	3.97	TRUE	68	TRUE
2.144	1.37	32	0.5	7.43	4,813.87	4,813.87	4,810.31	4,810.26	2.5	2.66	3.21	TRUE	32	TRUE