APPENDIX 8.14B

Stormwater Calculations

Storm Drain Calculations

AES HIGHGROVE ENERGY FACILITY
CITY OF GRAND TERRACE, CA

STORM DRAIN CALCULATIONS

Project Number 322752

CH2MHILL

Preliminary
(to be verified in final design)

AES Highgrove Energy Facility, City of Grand Terrace, CA

Storm Drainage, Rational Method

Design Criteria:

Rainfall Intensity:	100 yr Storm Event
Tc = 5 min	(Based from Nomograph for Kirpich Equation, Civil Engineering, Vol. 10, No. 6, June 1940, p.362)
i = 5.16 in/hr	(Based on the IDF curve for 100 year storm, from NOAA Atlas 14)
A1 = 1.875 Acres A2 = 3.953 Acres A3 = 0.721 Acres	(See Attached Drainage Study Plan)

$\sum Q = \sum CiA$

Units:

Q = CFS

C = 0.69 (Recommended Rational Runoff Coefficient, San Bernardino County Hydrology Manual)

i = in/hr

A = Acres

Capacity Calculation for Detention Basin

A1 = 1.875 Acres
A2 = 3.953 Acres
A3 = 0.721 Acres

(See Attached Drainage Study Plan)

R = 4.310 in

(Based on the IDF curve, from NOAA Atlas 14 for 10 year-48 hour storm event per Caltrans Standard Specifications, Section 77, July 1992)

$\sum V = \sum CAR/12$

Caltrans Standard Specifications, Section 77, July 1992

Units:

V = Acre-Feet

C = 0.69 (Recommended Rational Runoff Coefficient, San Bernardino County Hydrology Manual)

A = Acres

R = Rainfall Value in inches

CH2MHILL

Preliminary
(to be verified in final design)

AES HIGHGROVE ENERGY FACILITY
STORM DRAINAGE RUNOFF (POST DEVELOPMENT)

DRAINAGE AREA	Rainfall (inches)	TYPE OF SURFACE	AREA (FT^2)	AREA (ACRES)	COEFFICIENT ©	I(100yr) (in/hr)	Q (100yr) (cfs)	Q' (100yr) (cfs) LINE TOTAL	BRANCH TOTAL	Q CUM (cfs)	Volume (acre-feet)
A1	4.310	Asphalt Paving	81671.21	1.875	0.69	5.16	6.73				0.465
A2	4.310	Asphalt Paving	172187.21	3.953	0.69	5.16	14.19				0.980
A3	4.310	Asphalt Paving	31403.88	0.721	0.69	5.16	2.59	23.51	23.51	23.51	0.179
										SUM=	**1.623**

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

California 34.03 N 117.32 W 1062 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 3
G.M. Bonnin, D. Todd, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2003

Extracted: Thu May 4 2006

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

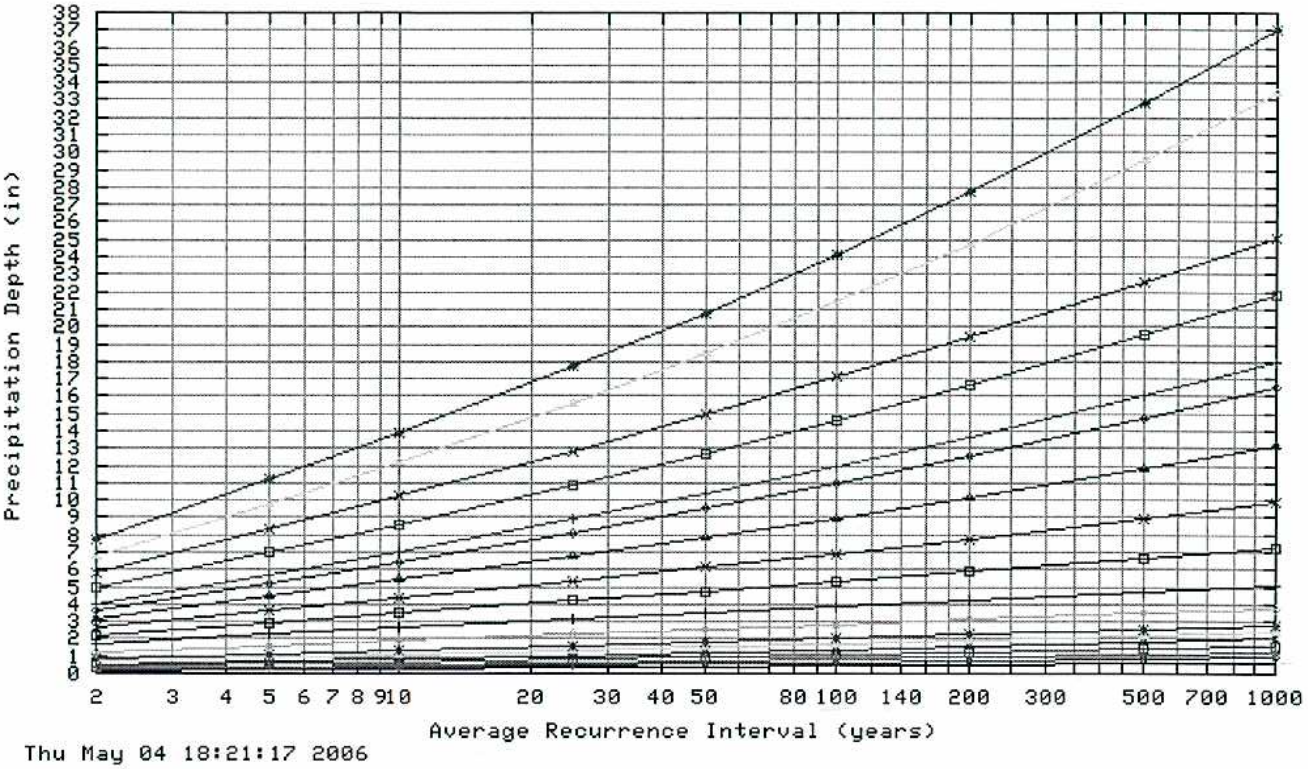
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.16	0.25	0.31	0.42	0.52	0.72	0.88	1.26	1.73	2.21	2.61	3.15	3.64	4.03	4.91	5.82	6.73	7.74
5	0.22	0.33	0.41	0.55	0.68	0.93	1.12	1.61	2.24	2.94	3.58	4.43	5.19	5.72	6.99	8.31	9.77	11.17
10	0.26	0.39	0.49	0.66	0.81	1.09	1.32	1.89	2.62	3.48	4.31	5.41	6.40	7.04	8.60	10.21	12.18	13.87
25	0.32	0.48	0.60	0.81	1.00	1.32	1.59	2.25	3.13	4.21	5.32	6.75	8.10	8.89	10.86	12.83	15.62	17.70
50	0.37	0.56	0.70	0.94	1.16	1.51	1.81	2.52	3.50	4.76	6.11	7.83	9.47	10.38	12.68	14.91	18.44	20.81
100	0.43	0.65	0.80	1.08	1.34	1.71	2.03	2.81	3.88	5.33	6.93	8.95	10.94	11.96	14.60	17.09	21.49	24.16
200	0.48	0.74	0.91	1.23	1.52	1.92	2.26	3.09	4.26	5.89	7.78	10.13	12.50	13.64	16.63	19.37	24.78	27.74
500	0.57	0.86	1.07	1.44	1.79	2.21	2.58	3.48	4.75	6.65	8.94	11.78	14.71	16.02	19.50	22.54	29.51	32.85
1000	0.64	0.97	1.20	1.62	2.00	2.44	2.83	3.77	5.13	7.22	9.86	13.09	16.50	17.94	21.80	25.07	33.42	37.04

Text version of table

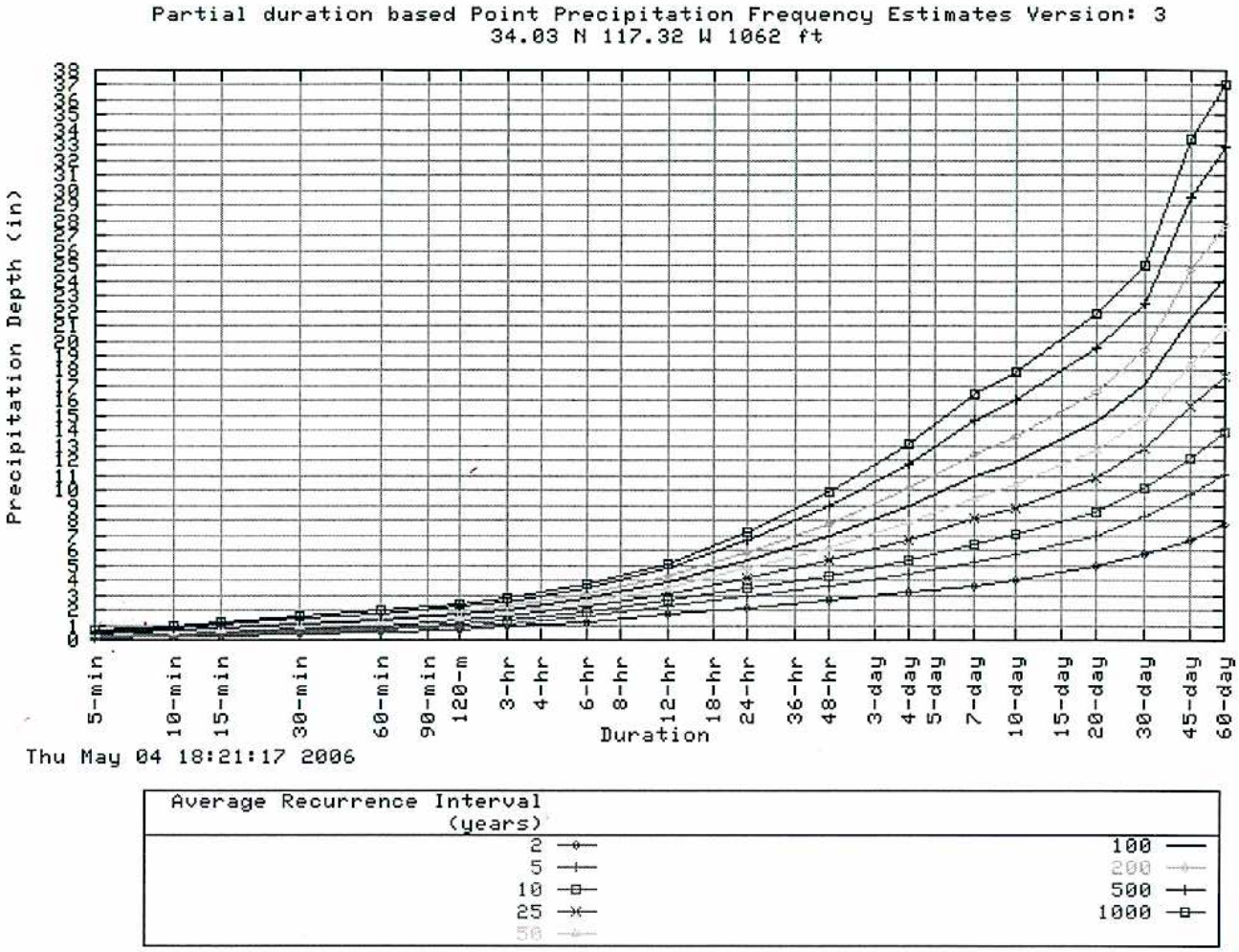
* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Partial duration based Point Precipitation Frequency Estimates Version: 3
34.03 N 117.32 W 1062 ft



Thu May 04 18:21:17 2006

Duration			
5-min	120-min	48-hr	30-day
10-min	3-hr	4-day	45-day
15-min	6-hr	7-day	60-day
30-min	12-hr	10-day	
60-min	24-hr	20-day	



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.19	0.29	0.36	0.48	0.59	0.81	1.00	1.40	1.92	2.48	2.93	3.51	4.06	4.50	5.49	6.51	7.63	8.75
5	0.25	0.38	0.47	0.63	0.78	1.05	1.27	1.79	2.49	3.30	4.01	4.92	5.78	6.38	7.82	9.28	11.05	12.62
10	0.29	0.45	0.56	0.75	0.93	1.23	1.50	2.08	2.91	3.90	4.83	6.00	7.12	7.84	9.61	11.39	13.75	15.63
25	0.36	0.55	0.69	0.92	1.14	1.49	1.80	2.49	3.46	4.71	5.95	7.49	8.98	9.87	12.10	14.27	17.55	19.87
50	0.42	0.64	0.79	1.07	1.32	1.70	2.04	2.79	3.88	5.32	6.82	8.67	10.51	11.51	14.10	16.58	20.69	23.34
100	0.48	0.73	0.91	1.23	1.52	1.92	2.29	3.10	4.29	5.94	7.74	9.92	12.13	13.27	16.22	18.99	24.09	27.06
200	0.55	0.83	1.03	1.39	1.72	2.15	2.55	3.42	4.71	6.56	8.69	11.24	13.87	15.12	18.46	21.52	27.73	31.06
500	0.64	0.98	1.21	1.63	2.02	2.48	2.90	3.84	5.26	7.40	9.99	13.07	16.33	17.76	21.65	25.03	33.07	36.80
1000	0.72	1.10	1.36	1.83	2.26	2.74	3.19	4.17	5.67	8.04	11.03	14.54	18.35	19.93	24.25	27.89	37.48	41.50

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

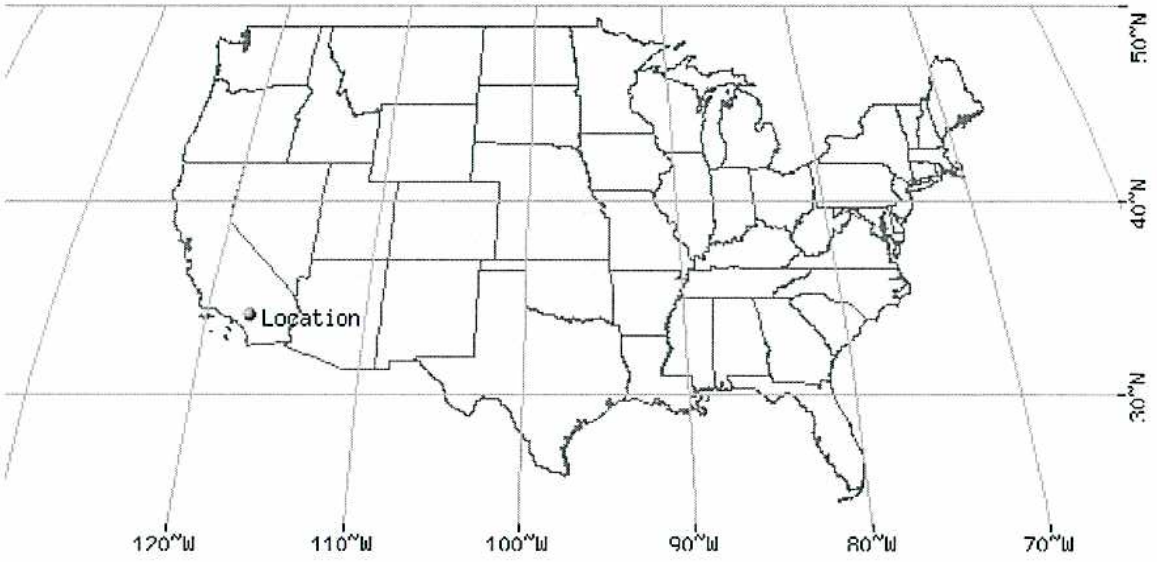
* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		

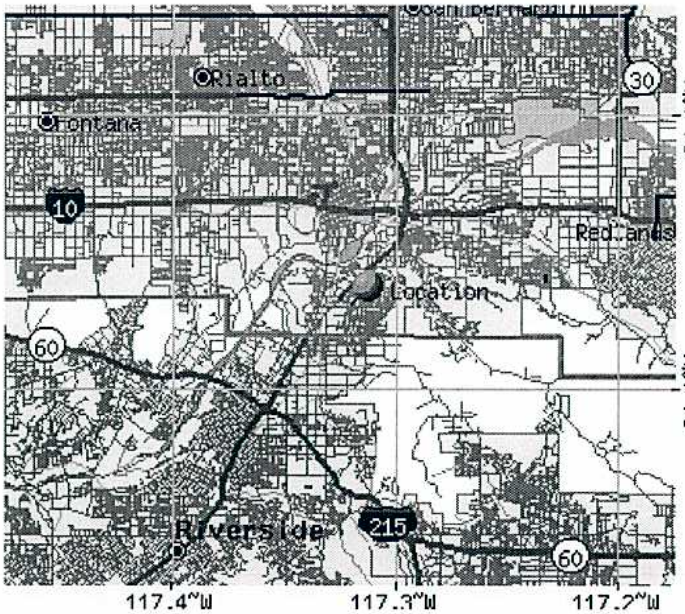
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.15	0.22	0.28	0.37	0.46	0.64	0.79	1.14	1.56	1.97	2.32	2.85	3.27	3.62	4.41	5.21	6.00	6.93
5	0.19	0.29	0.36	0.49	0.60	0.83	1.00	1.46	2.01	2.62	3.19	4.00	4.66	5.14	6.27	7.44	8.68	9.98
10	0.23	0.35	0.43	0.58	0.72	0.97	1.18	1.69	2.35	3.10	3.82	4.86	5.72	6.31	7.69	9.11	10.77	12.34
25	0.28	0.43	0.53	0.71	0.88	1.17	1.41	2.01	2.80	3.73	4.70	6.05	7.19	7.92	9.66	11.40	13.73	15.63
50	0.32	0.49	0.61	0.82	1.01	1.33	1.59	2.25	3.12	4.20	5.37	6.98	8.36	9.21	11.21	13.17	16.11	18.27
100	0.37	0.56	0.69	0.93	1.15	1.50	1.78	2.50	3.45	4.68	6.05	7.94	9.60	10.55	12.84	15.02	18.64	21.08
200	0.41	0.63	0.78	1.05	1.30	1.67	1.97	2.74	3.77	5.16	6.75	8.93	10.88	11.94	14.52	16.91	21.32	24.02
500	0.48	0.73	0.90	1.21	1.50	1.91	2.23	3.06	4.19	5.78	7.70	10.27	12.67	13.88	16.84	19.50	25.11	28.08
1000	0.53	0.81	1.00	1.35	1.67	2.09	2.42	3.30	4.49	6.25	8.43	11.32	14.10	15.41	18.66	21.53	28.14	31.39

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Maps -





These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

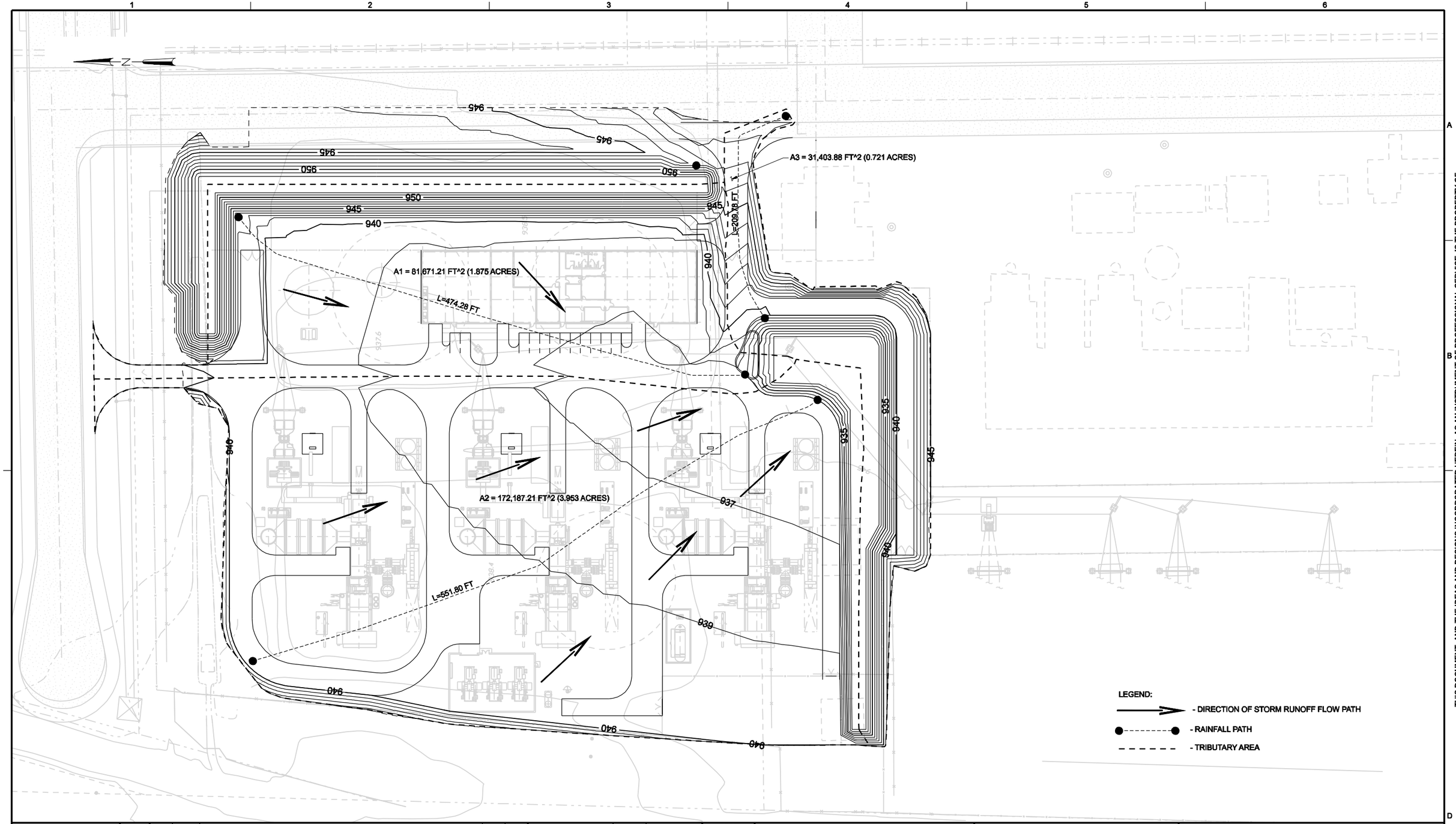
Please read disclaimer for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

Scale 1:228583 (0 2 4 6 8 mi; 0 2 4 6 8 10 km)

*average--true scale depends on monitor resolution



NO.	DATE	REVISION	BY	CHK
P1	mm/dd/yy	Preliminary For Internal Review	XXX	YYY

REVISION APPROVAL		REV DATE	
DISCIPLINE	REVIEWED	DISCIPLINE	REVIEWED
CIVIL		ELECTRICAL	
STRUCTURAL		INST & CONTROL	
MECHANICAL		ARCHITECTURAL	
PROCESS		ENVIRONMENTAL	
PIPING		GEN. ARRANG.	

PRINT DISTRIBUTION	
DATE	
STATUS	
REV.	
CLIENT	
FIELD	
INTRA CO.	

STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY				
FOR REVIEW AND APPROVAL				
APPROVED FOR CONSTRUCTION				
REVISED & APPROVED FOR CONSTRUCTION				

RESPONSIBLE ENGINEER

PE#

SCALE 1"=40'

AES
HIGHGROVE ENERGY FACILITY

PROJ NO. 322752

CH2MHILL

CIVIL

DRAINAGE STUDY
FIGURE 8.14-5

DWG. NO.

REV. P1

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

FILENAME: PLOT DATE: PLOT TIME: