Urban Drainage and Flood Control District

Douglas County E-19 Surveys

WEST PLUM CREEK @ PINE CLIFF ROAD
ALERT ID: 2813
LID: WPCC2

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Introduction

HDR Engineering Inc. was contracted by the Urban Drainage and Flood Control District to survey and provide information about various flood warning stream gage sites in a manner consistent with National Weather Service E-19 procedures. On June 25, 2004, HDR personnel surveyed two sites. This report is a summary of the work done and information gathered for the Pine Cliff Road gage on West Plum Creek. Included in this report are elevations of critical points in the vicinity of the site, estimates of stages causing flood damage in vicinity of the gage, and a revised rating curve.

Site

The stream gage is located on the south, upstream face, of Pine Cliff Road over West Plum Creek. The ALERT ID number for this Gage is 2813, while the National Weather Service LID is WPCC2 and is referred to as Pine Cliff Road. There is a 40-foot bridge over West Plum Creek at the gage site. West Plum Creek has a narrow flood plain in the vicinity of this gage. Potential flooding at the gage site itself would consist of flooding of the small valley and the possibility of overtopping the Pine Cliff Road. Once Pine Cliff Road is overtopped, the flow will continue along the road to the east. Figure 1 shows the location of the site on the Douglas County ALERT map.

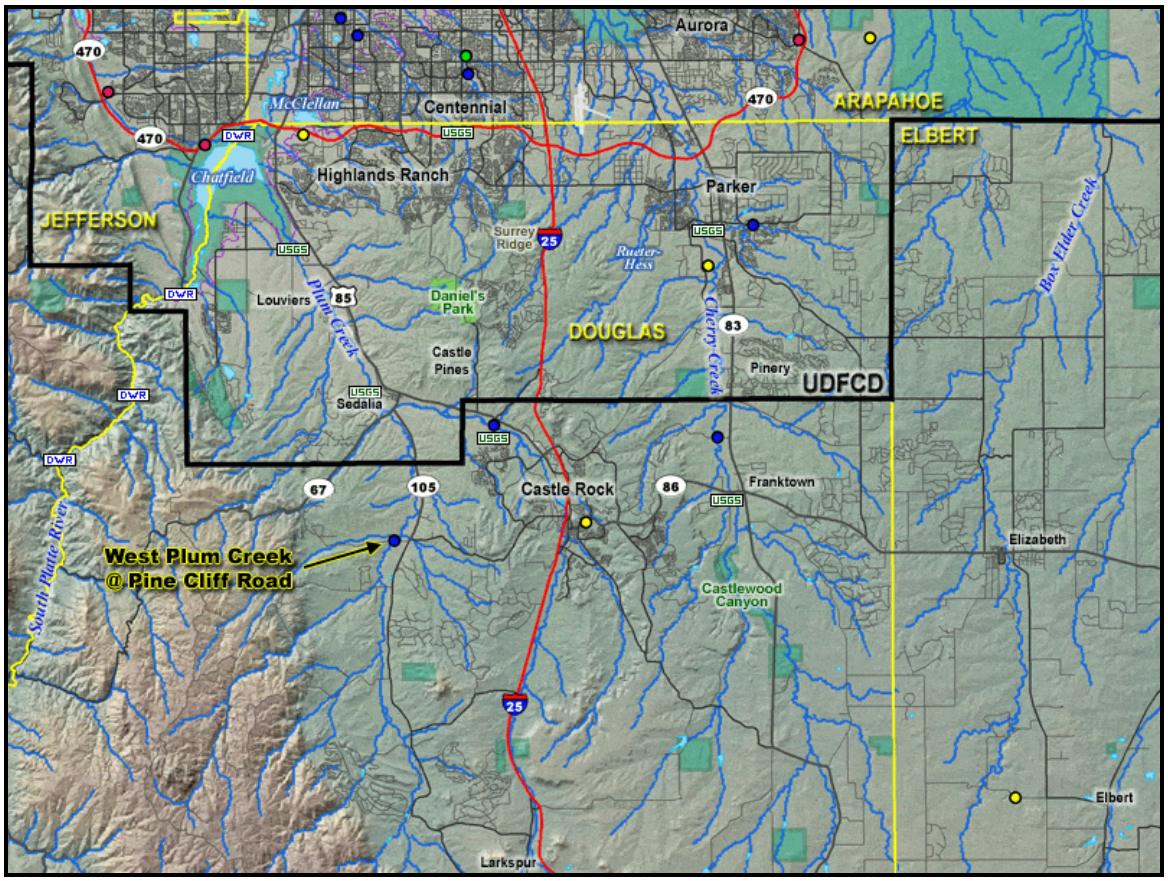

Figure 1 – Location Map

Surveyed locations

Ground elevations were surveyed along a cross section for a rating curve for the site. In addition, the elevations and locations of hazard locations, along with low flow channel water surface elevations up and downstream from the gage. Figure 2 shows locations of the surveyed points in the vicinity of the gage. The base of the ALERT transmitter was surveyed at an elevation of 100.00 for a temporary benchmark. The flow line elevation is 84.9 feet. The low flow channels banks will be overtopped at 2.0 feet above the invert elevation. Water will begin to overtop the road at 10.3 feet above the invert elevation. Based on the water surface elevations in the low flow channel, the estimated channel energy slope is 0.1 percent.

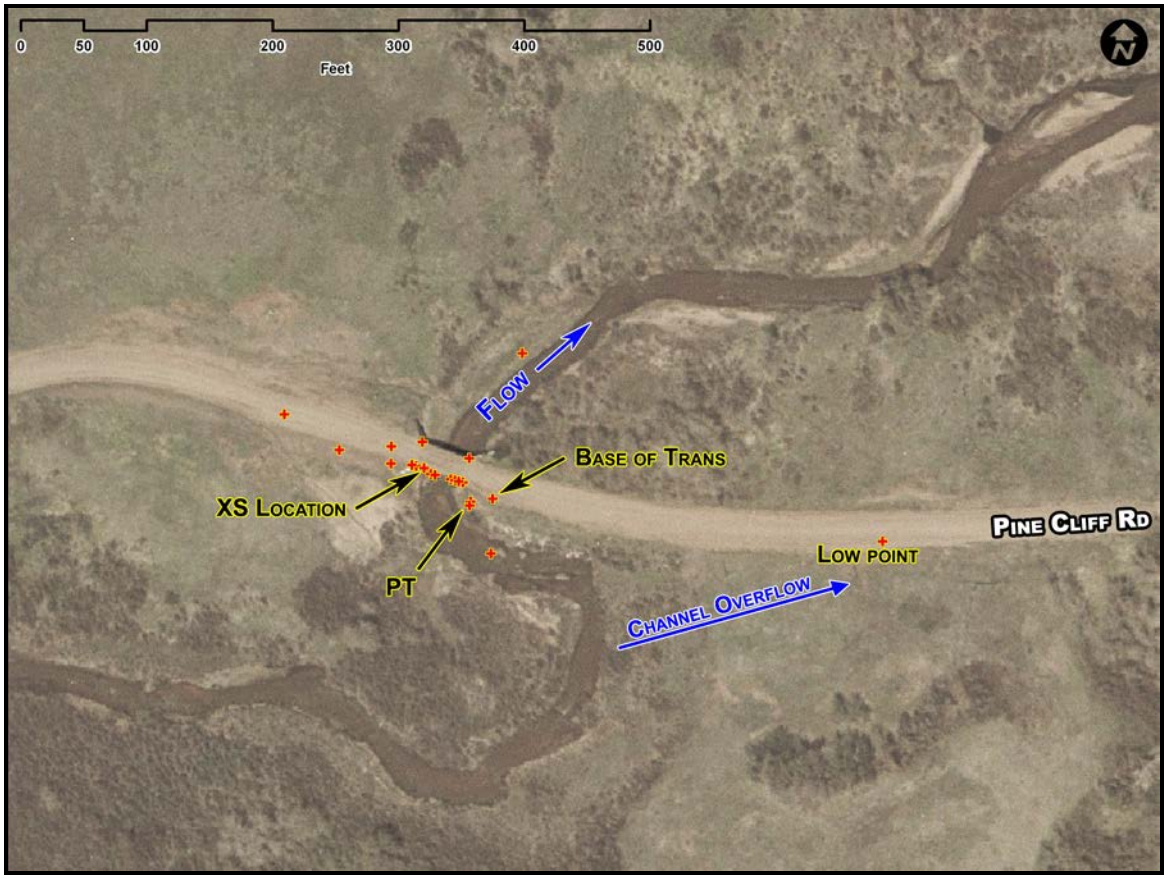

Figure 2 – Surveyed Points (Aerial - DRCOG 2004)

Rating Curve Development

Hydraulics for the existing bridge were evaluated using the HEC River Analysis System (HEC-RAS) program developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center[1]. HEC-RAS uses the standard step method to calculate water surface profiles. The following assumptions are used by HEC-RAS in computing water surface profiles:

- Steady flow;
- Gradually varied flow;
- One-dimensional flow;
- Channel slopes are small, less than 1:10

A rating curve was established for the gage using the surveyed cross-sections and the Army Corps of Engineers computer program HEC-RAS. The resulting rating curve from the analysis is in Table 1.

Q cfs	Depth ft	Comment
3800	10.30	Road Overtops above here
3500	9.78	
3000	9.12	
2000	7.45	
1300	6.00	10-yr discharge
900	5.27	
800	5.08	
700	4.88	
600	4.67	
500	4.44	
400	4.19	
300	3.90	
200	3.53	
100	2.80	
50	2.05	Top of Bank
25	1.52	
10	1.04	
5	0.80	
1	0.46	
0.1	0.19	

Table 1 – Rating Curve

[1] U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS Water Surface Profiles, Computer Program, Davis, California, March 2001.

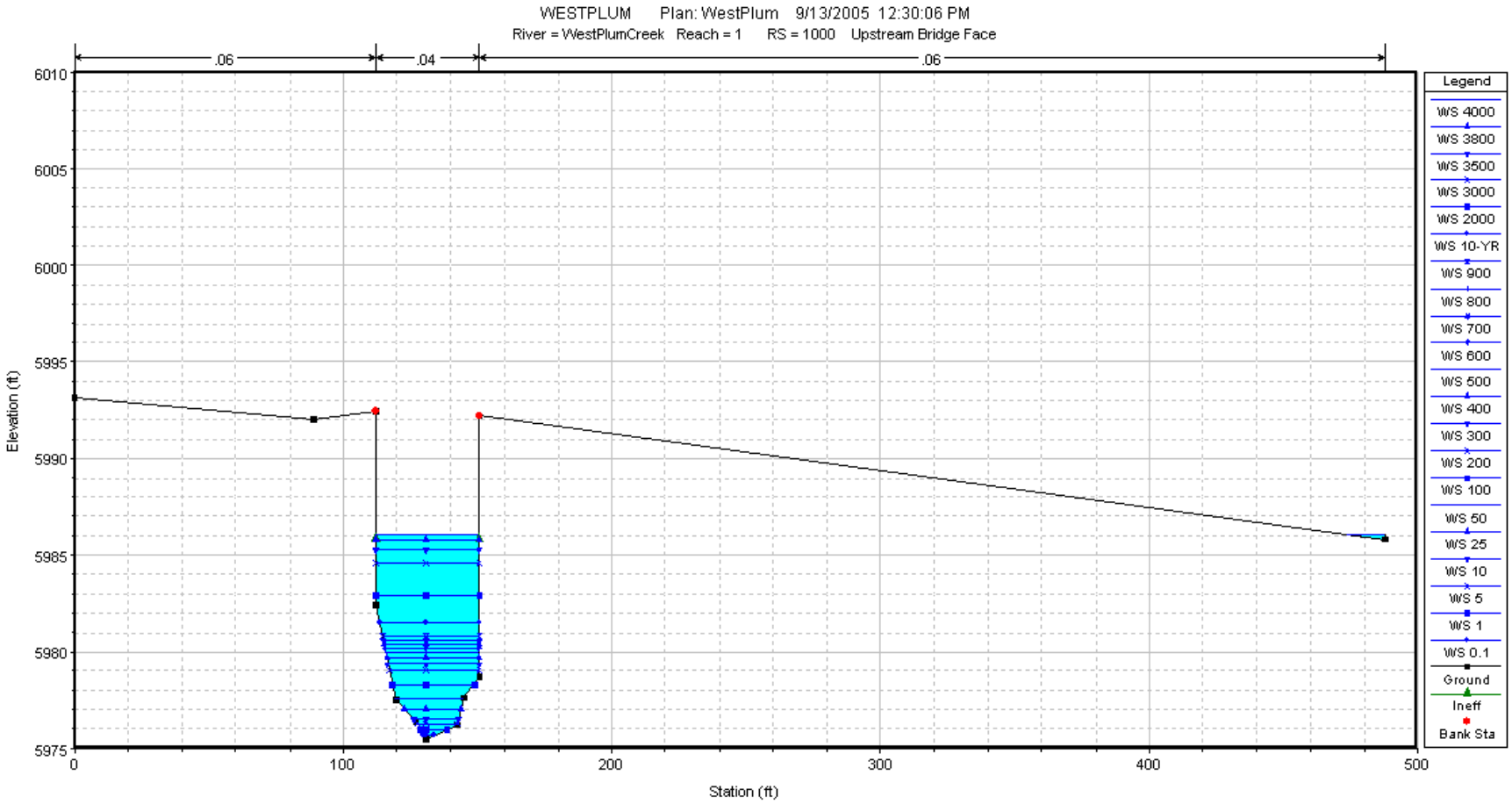

Figure 3 – HEC-RAS Cross Section with all Profiles

River	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
WestPlumCreek	4000	4000	5975.5	5986.11	5984.2	5988.21	0.008001	11.65	345.01	53.08	0.69
WestPlumCreek	3800	3800	5975.5	5985.8	5983.99	5987.84	0.008012	11.48	331.07	38.98	0.69
WestPlumCreek	3500	3500	5975.5	5985.28	5983.64	5987.25	0.008153	11.26	310.97	38.98	0.7
WestPlumCreek	3000	3000	5975.5	5984.62	5983.03	5986.34	0.007719	10.52	285.14	38.98	0.69
WestPlumCreek	2000	2000	5975.5	5982.95	5981.61	5984.23	0.007413	9.09	220.03	38.98	0.67
WestPlumCreek	10-YR	1300	5975.5	5981.5	5980.41	5982.47	0.007444	7.92	164.11	37.54	0.67
WestPlumCreek	900	900	5975.5	5980.77	5979.62	5981.44	0.006051	6.56	137.25	36.39	0.6
WestPlumCreek	800	800	5975.5	5980.58	5979.4	5981.17	0.005569	6.14	130.4	36.1	0.57
WestPlumCreek	700	700	5975.5	5980.38	5979.15	5980.88	0.005033	5.67	123.36	35.79	0.54
WestPlumCreek	600	600	5975.5	5980.17	5978.92	5980.59	0.004462	5.18	115.88	35.46	0.5
WestPlumCreek	500	500	5975.5	5979.94	5978.67	5980.28	0.00386	4.64	107.73	35.09	0.47
WestPlumCreek	400	400	5975.5	5979.69	5978.34	5979.94	0.003205	4.05	98.87	34.69	0.42
WestPlumCreek	300	300	5975.5	5979.4	5977.89	5979.57	0.002508	3.38	88.73	34.23	0.37
WestPlumCreek	200	200	5975.5	5979.03	5977.54	5979.13	0.001778	2.62	76.22	33.65	0.31
WestPlumCreek	100	100	5975.5	5978.3	5976.99	5978.35	0.001313	1.9	52.54	30.34	0.25
WestPlumCreek	50	50	5975.5	5977.55	5976.57	5977.59	0.00134	1.57	31.93	25.23	0.25
WestPlumCreek	25	25	5975.5	5977.02	5976.29	5977.05	0.001355	1.28	19.5	21.08	0.23
WestPlumCreek	10	10	5975.5	5976.54	5976.07	5976.55	0.001338	0.97	10.3	16.83	0.22
WestPlumCreek	5	5	5975.5	5976.3	5975.94	5976.31	0.001313	0.77	6.53	15.1	0.2
WestPlumCreek	1	1	5975.5	5975.96	5975.72	5975.96	0.001138	0.46	2.15	9.46	0.17
WestPlumCreek	0.1	0.1	5975.5	5975.69	5975.59	5975.69	0.001306	0.28	0.36	3.89	0.16

Table 2 – HEC-RAS Profile Output Table

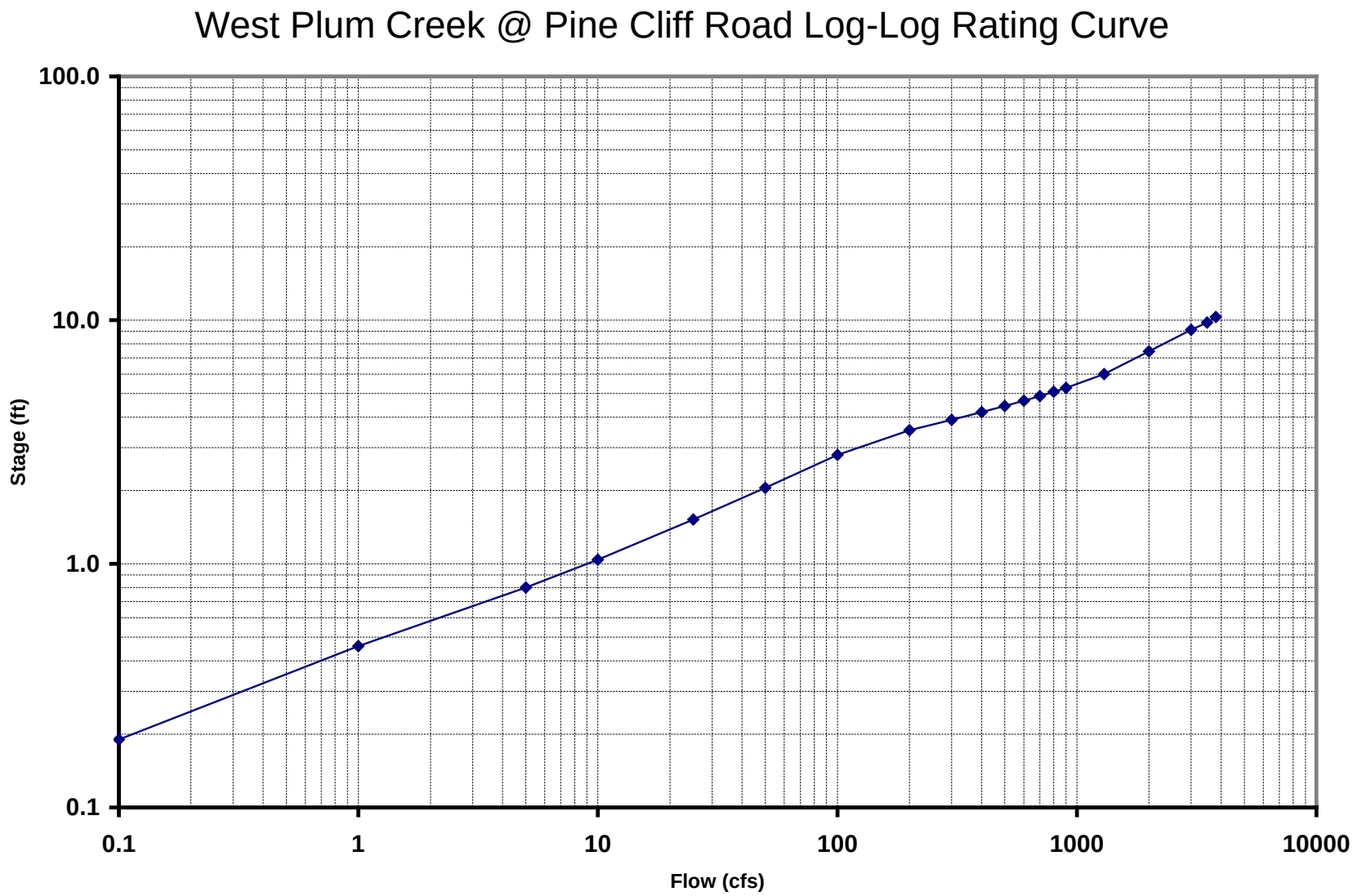

Figure 4 – HEC-RAS Log-Log Plot of Rating Table

Site photographs

Figure 5 – Looking Downstream

Figure 6 – Looking Upstream

Figure 7 – Upstream Face

Figure 8 – Downstream Face

Study Data

According to the Flood Hazard Area Delineation (FHAD) for the Plum Creek Watershed (WRC Engineering, Inc., 2001), the Pine Cliff gage has a drainage area of approximately 100 square miles. The following table includes estimates of the frequency-discharge data from the FHAD model SWMM output:

Frequency	Peak Discharge (cfs)
10-year	1,300
50-year	8,250
100-year	14,000

Table 3 – Frequency/Discharge Table

Historic records

There is limited information available for this gage. Since the gauge installation date in August 27, 1998, a peak stage of 2.9 feet above the invert was recorded on March 30, 1999.

Appendix

Pine Cliff Road

Point ID	Northing	Easting	Elev	Desc
1000	4357732	502963	101.432	INST
1001	4357774.583	502963	100.698	BS
1002	4357715.143	502965.558	92.571	UPBDGXS
1004	4357714.131	502965.343	91.843	UPBDGXSEDGSTL
1005	4357706.367	502964.753	86.888	UPBDGXSBNK
1006	4357698.933	502964.491	85.844	UPBGDXSEDGWAT
1007	4357695.302	502964.178	84.929	THALWEG
1008	4357683.576	502963.376	85.632	UPXSBDGEDGWAT
1009	4357681.173	502963.638	87.08	UPXSBNK
1010	4357675.243	502963.762	88.102	UPXSBNK
1011	4357675.344	502963.761	88.104	UPXSBDGEDGSTL
1012	4357661.986	502949.334	93.566	ENDWING
1013	4357664.06	502945.374	91.565	TOPPTTUBE
1014	4357637.78	502913.002	85.76	THALWEG
1015	4357647.961	502954.977	100	BASETRANSTOWER
1016	4357337.562	503001.7	95.272	LOWPOINTRD
1017	4357674.934	502964.427	101.625	TOPBDG
1018	4357673.851	502983.297	101.591	TOPBDG
1019	4357714.324	502984.835	101.886	TOPBDG
1020	4357714.706	502966.442	101.399	TOPBDG
1021	4357677.748	502963.931	100.138	LC
1022	4357737.235	502977.241	101.45	CLRD
1023	4357825.871	502980.205	102.575	CLRD
1024	4357653.345	503075.848	84.758	THALWEG

Table 4 – Survey Data