Appendix A – Sewer Contingency Study

RBF CONSULTING

MEMORANDUM

To: Mike Hoolihan, PE

From: Corey Hess, PE and Robert Reid, PE

Date: September 8, 2011

Subject: Sewer Delivery Contingency Study for Development North of Irvine Boulevard

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The SAMP for Planning Areas 51 and 30 identifies construction of a regional sewer facility (Reach 'B') from Irvine Boulevard to the southern planning area boundary near the railroad (see Figure 4-1). The sewer would be designed to convey wastewater from portions of development north of Irvine Boulevard as well as development within Planning Area 51. The remainder of the sewer flows will be conveyed through an existing 18-inch sewer pipeline crossing beneath the SR-133 (SR-133 sewer crossing). The SR-133 sewer crossing does not have capacity to serve full build out of the development north of Irvine Boulevard (Planning Area 6, District 8 of Great Park Neighborhoods (District 8), and any future entitlement of the UC Regents parcel). This memorandum has been prepared to analyze potential contingency alternatives for wastewater conveyance in support of development north of Irvine Boulevard if the existing sewer main under SR-133 reaches capacity prior to the completion of Reach 'B' through Planning Area 51.

Existing Conditions and Flow Contributions

Under current conditions, flow contribution to the 18-inch SR-133 pipeline comes from sewer systems along Portola Parkway and Irvine Boulevard. Flows along Portola Parkway come exclusively from development north of Portola Parkway (the Lomas Valley, Lambert Ranch and Lambert Sisters sub-areas of Planning Area 6). Flows along Irvine Boulevard come from District 8, the remainder of Planning Area 6, and the UC Regents parcel. Although the area of Planning Area 6 bordered by Irvine Boulevard to the south, SR-133 to the west, and District 8 to the east is currently planned to be light industrial, the landowner has submitted an application to the City of Irvine to allow residential land use. This area will flow directly into the existing pipeline constructed from Portola Parkway to the SR-133 sewer crossing.

Analysis

The existing 18-inch pipeline (with a slope = 0.0017 ft/ft) crossing at the SR-133 has a capacity of 1,771 gpm per IRWD standards. A simulation run using the model prepared for the PA 51 & 30 SAMP shows that full development north of Irvine Boulevard has a peak flow of 2,478 gpm. The PA 51 and 30 SAMP indicates 1,770 gpm will flow through the existing sewer under the SR-133 and the remainder will flow through the Reach 'B' sewer through the Great Park development. If development in the area north of Irvine Boulevard proceeds before the Reach 'B' sewer can be constructed and the full capacity of the SR-133 sewer crossing is realized,

Table 1 - Flow Estimate

LU Code	Land Use	Area (acres)	DUs	Flow Factor (gpd/du)	Average Flow (gpd)	Avg Flow (gpd)	Max Day Flow (gpd)	Max Day Flow (gpm)	Peak Flow [2] (gpm)	Flows Diverted/ Reduced by Alternative (gpm)		
										Alt 1	Alt 2A	Alt 2B
North of Portola Parkway												
PA 6 [1]												
	Lomas Valley				240,795	167	312,552	217				
	Lambert Sisters				8,140	6	10,566	7				
	Lambert Ranch Properties				29,260	20	37,979	26				
Subtotal (North of Portola Parkway)					278,195	193	361,097	251	344		344 Diverted	344 Diverted
North of Irvine Boulevard												
PA 6 [1]												
	Park Village				181,815	126	235,996	164				
	Center Village				169,749	118	220,334	153				
	Tomato Springs				142,122	99	184,474	128				
	Agua Chinon Hills				217,160	151	281,874	196				209
PA 6 West of District 8 [3]												Diverted
1182	Residential-High Density	19.6	548	145	79,460	55	103,139	72				
1162	Residential-Medium Density	3.6	36	220	7,920	6	10,280	7				
1162	Residential-Medium Density	16	160	220	35,200	24	45,690	32				
1162	Residential-Medium Density	4.4	44	220	9,680	7	12,565	9				
Subtotal (PA 6)					843,106	586	1,094,352	761				
District 8 GPN												
1162	Residential-Medium Density	51.4	386	220	84,920	59	110,226	77				
1172	Res Med High Density	8.3	88	150	13,200	9	17,134	12				
1132	Residential-Low Density	15.1	69	225	15,525	11	20,151	14				
1132	Residential-Low Density	12.6	54	225	12,150	8	15,771	11				
1162	Residential-Medium Density	20.7	129	220	28,380	20	36,837	26				
1182	Residential-High Density	7.5	166	145	24,070	17	31,243	22				
Subtotal (District 8 GPN)					178,245	124	231,362	161				
UC Regents												
	Residential Medium Density	209	1500	220	330,000	229	428,340	297				
Subtotal (UC Regents)		209	1500	220	330,000	229	428,340	297			544 Reduced	
Subtotal (North of Irvine Blvd)					1,351,351	939	1,754,054	1,219	2,135	700 Diverted		
Total (All Areas)					1,629,546	1,132	2,115,151	1,469	2,479			

Notes

[1] Proposed future wastewater flows per Appendix B of the Regional Sewer Study for Planning Area 40 - Sub Area Master Plan

[2] Highest flow per IRWD's standard diurnal, in a downstream pipeline (in the model for the PA 51 & 30 SAMP) to the sewershed.

[3] Currently planned as light industrial but may be changed to residential. Estimated average daily flows for residential development are equivalent with light industrial use.

other means of conveyance across the SR-133 is necessary to manage the estimated 700 gpm peak flow.

Contingency Alternatives

The following are alternatives for consideration if the existing sewer main under SR-133 reaches capacity prior to the completion of Reach 'B' through Planning Area 51.

Alternative 1 - Lift Station at Irvine Boulevard and State Route 133

This alternative would require construction of a new lift station near the overcrossing of Irvine Boulevard at the SR-133 and a force main across the Irvine Boulevard bridge (See Figure A). Per review of as-built plans provided by CalTrans (September 2011) adequate space exists within the Irvine Boulevard bridge for the 8-inch force main. Downstream reaches of the 18-inch system in Sand Canyon Avenue were analyzed and show pressurize flow during two hours of the peak flow 24 hour simulation. As a result, Alternative 1 may require three reaches of parallel 12-inch sewer pipeline be constructed in Sand Canyon Avenue (see Figure A) to ensure service is provided according to IRWD sewer criteria. It is recommended that flow monitoring be implemented to verify if the parallel pipeline would ultimately be required.

Alternative 1 Concept Design Summary:

Lift Station

- Design Capacity = 1,000 to 1,200 gpm
- No. of Pumps = 2 duty + 1 standby

Force Main

- Diameter 8-inch
- Length (approximate) = 1,800 ft

Construction cost for Alternative 1 is estimated to be approximately $1,200,000.

Construction cost for Alternative 1 w/ Sand Canyon Ave. parallels is approximately $1,600,000.

Alternative 2A – Portola / Sand Canyon Sewer Extension and Phased Development

This alternative assumes no future entitlement has been constructed on the UC Regents parcel. Therefore, there would be a reduction in flow to the SR-133 sewer crossing of 544 gpm. This alternative would require construction of new 12-inch gravity sewer mains in both Portola Parkway and Sand Canyon Avenue (See Figure A). This alternative would divert the existing flow which is currently conveyed through Planning Area 6, west of District 8, into a new gravity pipeline in Portola Parkway. The new pipeline would then continue west in Portola Parkway and tie into the existing 18-inch sewer main in Sand Canyon Avenue.

Hydraulic analysis indicates that the peak flow diversion to the Sand Canyon system via Portola Parkway would be 344 gpm, and the peak flow in the SR-133 pipeline to be 1,590 gpm, with a d/D of 0.69.

Preliminary utility research was completed in support construction of new sewer within Portola Parkway and Sand Canyon Avenue per Alternatives 2A and 2B. The record drawings included:

- Capital Facilities for Portola Parkway, Portola Springs and Modjeska (IRWD Project Nos. 10779, 20335, and 30779).
- SR-133 and PA-6 Sewer Improvements (IRWD Project No. 20795)
- Sand Canyon Relocation and Facilities (IRWD Project Nos. 10591, 20591, 20795, abd 30591).

Alternative 2A Concept Design Summary:

Gravity Main

- Diameter 12-inch
- Length (approximate) = 3,500 ft

Construction cost for Alternative 2A is estimated to be approximately $600,000.

Alternative 2B – Portola Pkwy / Sand Canyon Ave. Sewer Extensions

Alternative 2B would be an expansion of the design included in Alternative 2A if development of the UC Regents property occurs before the Reach 'B' sewer is in service. In addition to the improvements included in Alternative 2A, Alternative 2B would require the construction of an additional 8-inch gravity sewer main in Portola Parkway (See Figure A). Sewer pipeline depth may be approximately 20 feet between Lambert Road and Arrowhead due to existing topography. Preliminary hydraulic analysis indicates that the peak flow diversion to the Sand Canyon system via Portola Parkway would be 553 gpm, and the resulting peak flow in the SR-133 pipeline would 1,930 gpm, which flows at a depth-to-diameter (d/D) of 0.78. Alternative 2B was included although the results show a d/D just above the 0.75 criteria, as flows calculated from the model may vary from the actual future conditions. Downstream reaches of the 18-inch system in Sand Canyon Avenue were analyzed and show pressurized flow for two hours during peak flow conditions. As a result, Alternative 2B may require three reaches of parallel 12-inch pipeline be constructed in Sand Canyon Avenue (see Figure A) to maintain service within IRWD sewer criteria. It is recommended that flow monitoring be implemented to verify if the parallel pipelines would ultimately be required.

Alternative 2B Concept Design Summary:

Gravity Main

- Diameter 8-inch
- Length (approximate) = 2,500 ft
- Diameter 12-inch
- Length (approximate) = 3,500 ft

Construction cost for Alternative 2B is estimated to be approximately $900,000.

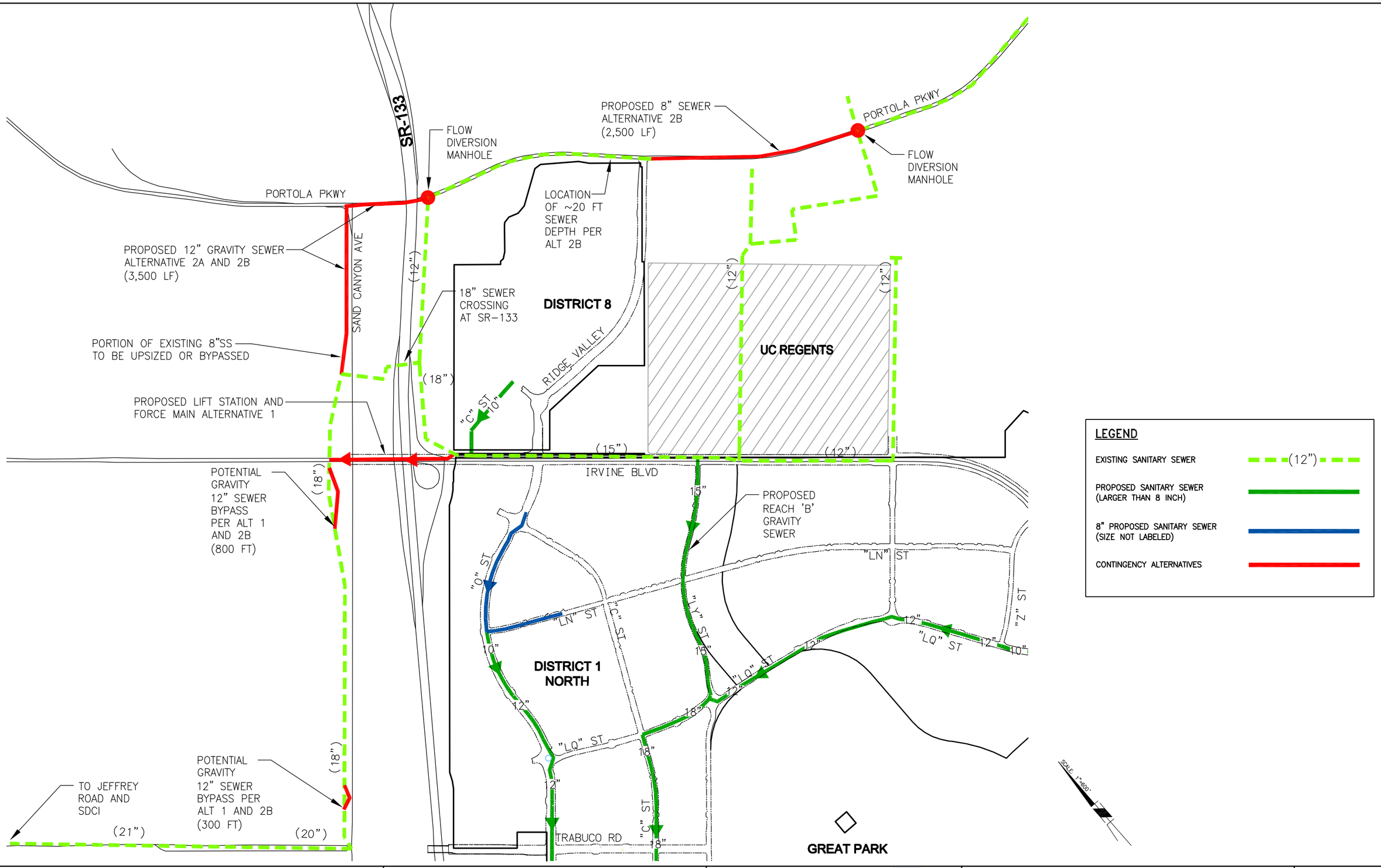
Construction cost for Alternative 1 w/ Sand Canyon Ave. parallels is approximately $1,300,000.

Regional Analysis

All three alternatives were analyzed in the regional sewer model for the PA 51 and 30 SAMP. The analysis for this Sewer Contingency Study includes simulating peak flows in the Sand Canyon Avenue, Trabuco Road, and Jeffrey Road systems en route to the San Diego Creek Interceptor. Through this analysis, it was determined that capacity constraints may exist in the Sand Canyon Avenue system for a short period of time under peak ultimate conditions.

Summary

For each of the three alternatives mentioned above, a magnitude of probable cost has been provided. If a contingency alternative is required, a complete design and cost analysis should be prepared.



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SEWER CONTINGENCY STUDY

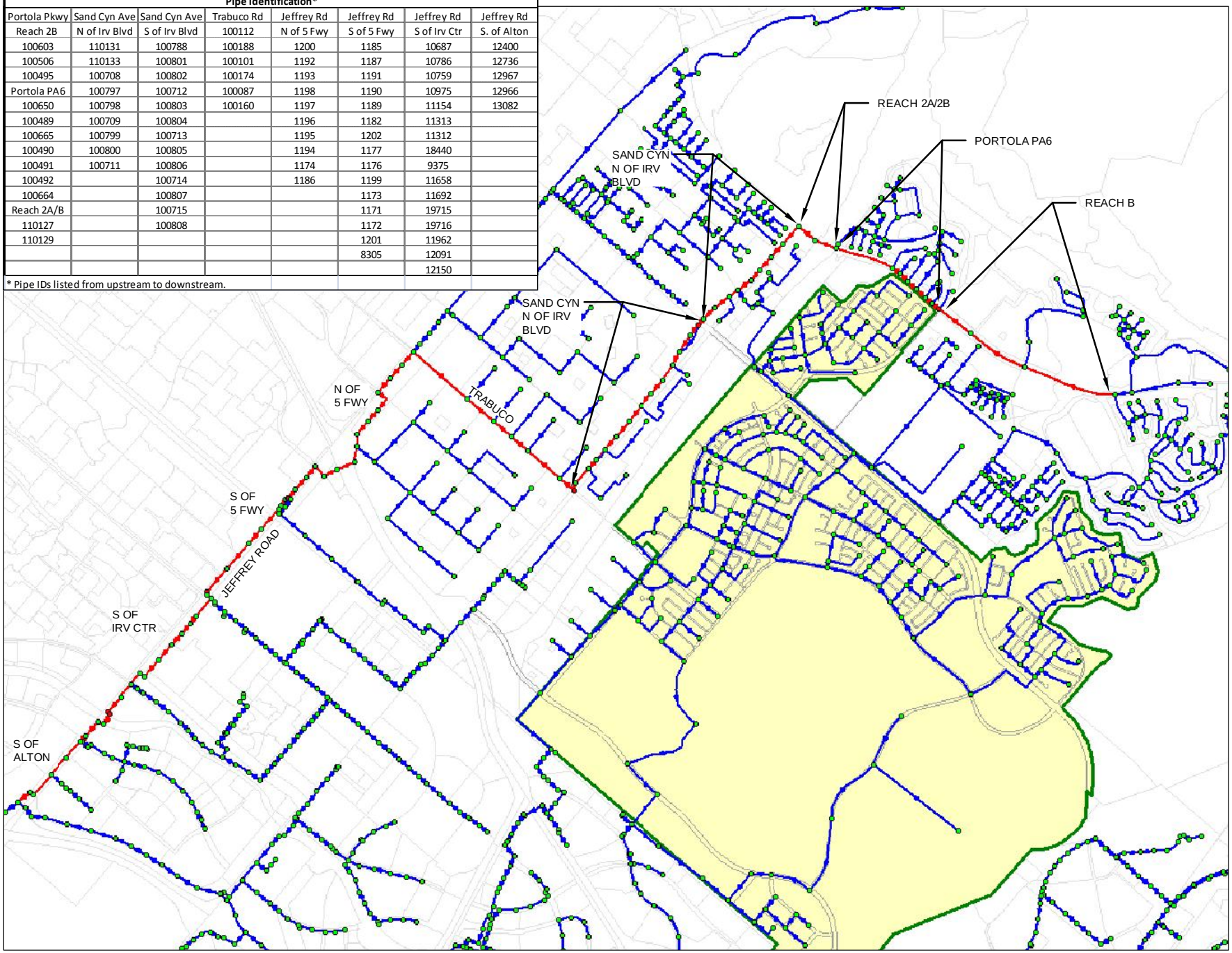
FIGURE A

ATTACHMENT 1

Model Output for Alternatives 1, 2A and 2B

Pipe Identification*							
Portola Pkwy	Sand Cyn Ave	Sand Cyn Ave	Trabuco Rd	Jeffrey Rd	Jeffrey Rd	Jeffrey Rd	Jeffrey Rd
Reach 2B	N of Irv Blvd	S of Irv Blvd	100112	N of 5 Fwy	S of 5 Fwy	S of Irv Ctr	S. of Alton
100603	110131	100788	100188	1200	1185	10687	12400
100506	110133	100801	100101	1192	1187	10786	12736
100495	100708	100802	100174	1193	1191	10759	12967
Portola PA6	100797	100712	100087	1198	1190	10975	12966
100650	100798	100803	100160	1197	1189	11154	13082
100489	100709	100804		1196	1182	11313	
100665	100799	100713		1195	1202	11312	
100490	100800	100805		1194	1177	18440	
100491	100711	100806		1174	1176	9375	
100492		100714		1186	1199	11658	
100664		100807			1173	11692	
Reach 2A/B		100715			1171	19715	
110127		100808			1172	19716	
110129					1201	11962	
					8305	12091	
						12150	

* Pipe IDs listed from upstream to downstream.



PA 30 & 51 SAMP
Sewer Contingency Study
Hydraulic Model Results

Alternative 1						Baseline Run			Parallel 12-inch Run		
ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Flow (gpm)	Velocity (ft/s)	d/D	Flow (gpm)	Velocity (ft/s)	d/D
100087	100107	100151	20	829.879	0.017	2,760.66	7.513	0.401	2,760.66	7.513	0.401
100101	100192	100234	20	531.468	0.008	2,761.68	5.704	0.496	2,761.68	5.704	0.496
100112	100209	100154	20	451.712	0.014	2,366.09	6.717	0.389	2,366.09	6.717	0.389
100160	100151	23644	21	1,788.30	0.015	2,782.18	7.182	0.388	2,782.18	7.182	0.388
100174	100234	100107	20	597.474	0.017	2,761.25	7.503	0.402	2,761.25	7.503	0.402
100188	100154	100192	20	1,053.00	0.014	2,365.28	6.698	0.39	2,365.28	6.698	0.39
100712	100716	100807	18	437.098	0.008	2,186.06	5.353	0.512	2,186.06	5.353	0.512
100713	100717	100809	18	486.915	0.006	2,265.71	4.92	0.563	2,265.71	4.92	0.563
100714	100718	100811	18	317.162	0.002	2,323.08	3.351	0.816	2,323.08	3.351	0.816
100715	100719	100812	18	483.749	0.013	2,367.14	6.537	0.466	2,367.14	6.537	0.466
100788	100791	100805	18	328.53	0.002	2,342.81	3.021	1	1,838.10	2.978	0.567
100801	100805	100806	18	482.46	0.003	2,107.90	3.586	0.694	2,107.90	3.586	0.694
100802	100806	100716	18	379.49	0.013	2,107.79	6.336	0.437	2,107.79	6.336	0.437
100803	100807	100808	18	450.197	0.011	2,185.87	6.07	0.464	2,185.87	6.07	0.464
100804	100808	100717	18	413.75	0.019	2,185.56	7.379	0.4	2,185.56	7.379	0.4
100805	100809	100810	18	498.16	0.01	2,265.20	5.903	0.487	2,265.20	5.903	0.487
100806	100810	100718	18	437.045	0.008	2,264.58	5.545	0.512	2,264.58	5.545	0.512
100807	100811	100719	18	295.271	0.004	2,322.10	4.013	0.685	2,322.10	4.013	0.685
100808	100812	100209	18	171.627	0.016	2,366.26	7.166	0.434	2,366.26	7.166	0.434
10687	8733	11266	33	586.90	0.001	5,832.23	3.438	0.608	5,832.23	3.438	0.608
10759	11289	11290	33	332.872	0.001	5,800.08	3.215	0.641	5,800.08	3.215	0.641
10786	11266	11289	33	222.191	0.001	5,809.46	3.045	0.673	5,809.46	3.045	0.673
10976	11290	11627	33	355.088	0.001	5,785.93	3.265	0.631	5,785.93	3.265	0.631
11154	11627	11697	33	525.081	0.001	5,770.99	3.348	0.616	5,770.99	3.348	0.616
11312	11759	11525	33	130.647	0.002	5,724.84	3.671	0.567	5,724.84	3.671	0.567
11313	11697	11759	33	532.375	0.001	5,750.95	3.368	0.611	5,750.95	3.368	0.611
11658	9803	12184	33	482.66	0.001	6,423.09	3.164	0.712	6,423.09	3.164	0.712
11692	12184	12202	33	74.776	0.001	6,392.56	3.261	0.689	6,392.56	3.261	0.689
1171	1243	1244	36	799.999	0.001	5,588.85	2.528	0.657	5,588.85	2.528	0.657
1172	1244	1245	36	771.296	0.001	5,560.53	2.563	0.646	5,560.53	2.563	0.646
1173	1246	1243	36	475.268	0.001	5,602.09	2.605	0.642	5,602.09	2.605	0.642
1174	1247	1135	30	373.904	0.005	5,272.27	5.495	0.449	5,272.27	5.495	0.449
1176	1136	1137	36	91	0.108	5,616.07	16.855	0.162	5,616.07	16.855	0.162
1177	1138	1136	36	208	0.02	5,616.54	9.285	0.246	5,616.54	9.285	0.246
1182	1144	1143	30	22.79	0.014	5,616.68	8.312	0.346	5,616.68	8.312	0.346
1185	1253	1254	30	375.17	0.005	5,269.78	5.771	0.433	5,269.78	5.771	0.433
1186	1135	1253	30	474.35	0.005	5,271.34	5.566	0.445	5,271.34	5.566	0.445
1187	1254	1145	30	308.588	0.01	5,268.44	7.328	0.362	5,268.44	7.328	0.362
1189	1146	1144	30	257.839	0.044	5,264.25	12.289	0.249	5,264.25	12.289	0.249
1190	1255	1146	30	400.32	0.008	5,265.89	6.81	0.382	5,265.89	6.81	0.382
1191	1145	1255	30	351.821	0.005	5,267.52	5.436	0.453	5,267.52	5.436	0.453
1192	1256	1147	30	450.001	0.007	4,351.45	6.154	0.357	4,351.45	6.154	0.357
1193	1147	1257	30	452.308	0.008	4,350.89	6.293	0.352	4,350.89	6.293	0.352
1194	1258	1247	30	312.931	0.002	4,344.86	3.784	0.517	4,344.86	3.784	0.517
1195	1259	1258	30	429.108	0.004	4,346.82	4.891	0.424	4,346.82	4.891	0.424
1196	1260	1259	30	387.00	0.002	4,348.56	4.069	0.488	4,348.56	4.069	0.488
11962	12617	12367	33	155.75	0.001	6,379.17	3.204	0.699	6,379.17	3.204	0.699
1197	1148	1260	30	334.319	0.003	4,349.75	4.188	0.478	4,349.75	4.188	0.478
1198	1257	1148	30	276.596	0.009	4,350.15	6.488	0.344	4,350.15	6.488	0.344
1199	1137	1246	36	663.575	0.001	5,616.00	2.506	0.665	5,616.00	2.506	0.665
1200	23644	1256	30	427.469	0.007	4,351.80	6.131	0.358	4,351.80	6.131	0.358
1201	1245	1262	36	78.022	0.005	5,525.97	5.625	0.348	5,525.97	5.625	0.348
1202	1143	1138	36	57.329	0.013	5,616.62	7.984	0.273	5,616.62	7.984	0.273
12091	12367	12683	33	480.61	0.002	6,371.54	4.314	0.542	6,371.54	4.314	0.542
12150	12683	12705	33	180	0.001	6,350.20	3.239	0.689	6,350.20	3.239	0.689
12400	12705	13076	33	530.788	0.001	6,743.09	3.191	0.739	6,743.09	3.191	0.739
12736	13076	13266	33	562.077	0.001	6,705.91	3.26	0.721	6,705.91	3.26	0.721
12966	12258	12262	33	112.52	0.001	6,788.94	3.606	0.665	6,788.94	3.606	0.665
12967	13266	12258	33	643.82	0.001	6,832.49	3.453	0.695	6,832.49	3.453	0.695
13082	12262	12503	33	360.16	0.001	6,783.98	3.445	0.692	6,783.98	3.445	0.692
18440	11525	9634	33	350.195	0.001	5,721.04	3.141	0.646	5,721.04	3.141	0.646
19715	12202	12617	15	269.00	0.005	2,240.62	4.068	1	2,240.62	4.068	1
19716	12202	12617	21	298.254	0.003	4,149.25	3.843	1	4,149.25	3.843	1
8305	1262	8733	21	142.30	0.024	5,525.80	10.275	0.499	5,525.80	10.275	0.499
9375	9634	9803	33	420.448	0.001	6,446.38	3.379	0.673	6,446.38	3.379	0.673

PA 30 & 51 SAMP
Sewer Contingency Study
Hydraulic Model Results

Alternative 2A

ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Flow (gpm)	Velocity (ft/s)	d/D
100087	100107	100151	20	829.879	0.017	2,778.76	7.526	0.403
100101	100192	100234	20	531.468	0.008	2,779.64	5.713	0.498
100112	100209	100154	20	451.712	0.014	2,383.85	6.728	0.391
100160	100151	23644	21	1,788.30	0.015	2,800.37	7.199	0.389
100174	100234	100107	20	597.474	0.017	2,779.29	7.515	0.403
100188	100154	100192	20	1,053.00	0.014	2,383.10	6.714	0.391
100489	100484	100672	8	238.674	0.041	27.93	3.003	0.109
100490	100474	100487	8	288.62	0.017	84.45	3.043	0.233
100491	100487	100490	8	292.703	0.017	98.47	3.167	0.253
100492	100490	100489	8	228.771	0.017	112.46	3.341	0.267
100650	100662	100484	8	199.25	0.004	13.91	1.076	0.137
100664	100489	100504	8	1,483.32	0.025	126.53	3.924	0.259
100665	100672	100474	8	282.92	0.035	41.79	3.191	0.138
100708	100711	100801	12	423.18	0.018	317.61	4.384	0.259
100709	100710	100803	18	280.63	0.021	2,044.57	7.526	0.375
100711	100714	100791	18	196.341	0.012	2,059.27	6.246	0.434
100712	100716	100807	18	437.098	0.008	2,203.03	5.368	0.514
100713	100717	100809	18	486.915	0.006	2,282.93	4.931	0.566
100714	100718	100811	18	317.162	0.002	2,240.60	2.951	0.887
100715	100719	100812	18	483.75	0.013	2,284.82	6.551	0.468
100788	100791	100805	18	328.527	0.002	2,059.35	3.025	0.801
100797	100801	100802	12	330.922	0.008	318.09	3.223	0.323
100798	100802	100710	12	418.987	0.026	318.61	4.976	0.237
100799	100803	100804	18	434.818	0.012	2,058.36	6.063	0.443
100800	100804	100714	18	390.355	0.023	2,058.99	7.854	0.365
100801	100805	100806	18	482.455	0.003	2,124.60	3.592	0.698
100802	100806	100716	18	379.485	0.013	2,124.70	6.35	0.438
100803	100807	100808	18	450.197	0.011	2,202.95	6.076	0.466
100804	100808	100717	18	413.751	0.019	2,202.72	7.389	0.402
100805	100809	100810	18	498.16	0.01	2,282.54	5.917	0.489
100806	100810	100718	18	437.045	0.008	2,282.01	5.554	0.514
100807	100811	100719	18	295.271	0.004	2,339.72	4.018	0.688
100808	100812	100209	18	171.627	0.016	2,384.02	7.188	0.436
10687	8733	11266	33	586.9	0.001	5,851.24	3.439	0.609
10759	11289	11290	33	332.872	0.001	5,819.07	3.215	0.643
10786	11266	11289	33	222.191	0.001	5,828.46	3.045	0.675
10976	11290	11627	33	355.088	0.001	5,804.90	3.27	0.632
110127	100504	110092	12	558.706	0.007	297.37	3.083	0.318
110129	110092	110094	12	520.403	0.009	298.69	3.407	0.297
110131	110094	110096	12	588.325	0.034	299.64	5.364	0.216

110133	110096	100711	12	424.752	0.045	300.14	5.935	0.201
11154	11627	11697	33	525.081	0.001	5,789.94	3.346	0.618
11312	11759	11525	33	130.647	0.002	5,743.74	3.672	0.568
11313	11697	11759	33	532.375	0.001	5,769.88	3.369	0.613
11658	9803	12184	33	482.66	0.001	6,441.91	3.164	0.714
11692	12184	12202	33	74.78	0.001	6,411.34	3.26	0.691
1171	1243	1244	36	799.999	0.001	5,607.78	2.53	0.659
1172	1244	1245	36	771.296	0.001	5,579.52	2.565	0.648
1173	1246	1243	36	475.268	0.001	5,620.99	2.605	0.644
1174	1247	1135	30	373.904	0.005	5,290.93	5.499	0.45
1176	1136	1137	36	91	0.108	5,634.87	16.875	0.162
1177	1138	1136	36	208	0.02	5,635.34	9.29	0.246
1182	1144	1143	30	22.79	0.014	5,635.48	8.324	0.346
1185	1253	1254	30	375.17	0.005	5,288.50	5.783	0.433
1186	1135	1253	30	474.35	0.005	5,290.03	5.569	0.446
1187	1254	1145	30	308.588	0.01	5,287.18	7.34	0.362
1189	1146	1144	30	257.839	0.044	5,283.05	12.316	0.249
1190	1255	1146	30	400.32	0.008	5,284.67	6.811	0.383
1191	1145	1255	30	351.821	0.005	5,286.28	5.448	0.453
1192	1256	1147	30	450.001	0.007	4,369.87	6.157	0.358
1193	1147	1257	30	452.308	0.008	4,369.35	6.308	0.352
1194	1258	1247	30	312.93	0.002	4,363.49	3.787	0.518
1195	1259	1258	30	429.108	0.004	4,365.41	4.897	0.425
1196	1260	1259	30	387.00	0.002	4,367.10	4.071	0.49
11962	12617	12367	33	155.75	0.001	6,397.90	3.204	0.701
1197	1148	1260	30	334.319	0.003	4,368.26	4.195	0.479
1198	1257	1148	30	276.596	0.009	4,368.64	6.496	0.344
1199	1137	1246	36	663.575	0.001	5,634.80	2.506	0.667
1200	23644	1256	30	427.469	0.007	4,370.19	6.135	0.359
1201	1245	1262	36	78.022	0.005	5,544.98	5.628	0.349
1202	1143	1138	36	57.329	0.013	5,635.42	7.991	0.274
12091	12367	12683	33	480.61	0.002	6,390.26	4.317	0.543
12150	12683	12705	33	180	0.001	6,368.88	3.239	0.691
12400	12705	13076	33	530.788	0.001	6,761.74	3.191	0.741
12736	13076	13266	33	562.077	0.001	6,724.50	3.26	0.723
12966	12258	12262	33	112.52	0.001	6,807.36	3.61	0.666
12967	13266	12258	33	643.82	0.001	6,851.01	3.452	0.697
13082	12262	12503	33	360.16	0.001	6,802.40	3.449	0.693
18440	11525	9634	33	350.195	0.001	5,739.92	3.143	0.647
19715	12202	12617	15	269	0.005	2,247.20	4.08	1
19716	12202	12617	21	298.254	0.003	4,161.43	3.855	1
8305	1262	8733	21	142.296	0.024	5,544.81	10.285	0.5
9375	9634	9803	33	420.448	0.001	6,465.24	3.383	0.674

PA 30 & 51 SAMP
Sewer Contingency Study
Hydraulic Model Results

Alternative 2B						Baseline Run			Parallel 12-inch Run		
ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Flow (gpm)	Velocity (ft/s)	d/D	Flow (gpm)	Velocity (ft/s)	d/D
100087	100107	100151	20	829.879	0.017	2,974.01	7.669	0.418	2,973.14	7.667	0.418
100101	100192	100234	20	531.468	0.008	2,974.54	5.808	0.518	2,973.87	5.807	0.518
100112	100209	100154	20	451.712	0.014	2,578.19	6.871	0.408	2,577.78	6.87	0.408
100160	100151	23644	21	1,788.30	0.015	2,995.81	7.336	0.404	2,994.80	7.333	0.404
100174	100234	100107	20	597.474	0.017	2,974.40	7.646	0.419	2,973.61	7.644	0.419
100188	100154	100192	20	1,053.00	0.014	2,577.59	6.859	0.408	2,577.11	6.858	0.408
100489	100484	100672	8	238.674	0.041	296.49	5.985	0.354	296.49	5.985	0.354
100490	100474	100487	8	288.62	0.017	353.16	4.519	0.499	353.16	4.519	0.499
100491	100487	100490	8	292.703	0.017	367.29	4.542	0.513	367.29	4.542	0.513
100492	100490	100489	8	228.771	0.017	381.39	4.66	0.518	381.39	4.66	0.518
100495	100505	100662	8	1,003.67	0.004	265.71	2.42	0.661	265.71	2.42	0.661
100506	100517	100505	8	1,574.86	0.004	224.38	2.338	0.589	224.38	2.338	0.589
100603	100619	100517	8	2,372.35	0.036	99.74	4.161	0.21	99.74	4.161	0.21
100650	100662	100484	8	199.253	0.004	282.36	2.455	0.688	282.36	2.455	0.688
100664	100489	100504	8	1,483.32	0.025	395.53	5.369	0.477	395.53	5.369	0.477
100665	100672	100474	8	282.922	0.035	310.42	5.704	0.379	310.42	5.704	0.379
100708	100711	100801	12	423.18	0.018	587.23	5.219	0.356	587.23	5.219	0.356
100709	100710	100803	18	280.625	0.021	2,233.32	7.704	0.394	2,233.32	7.704	0.394
100711	100714	100791	18	196.341	0.012	2,248.86	6.393	0.456	2,248.86	6.393	0.456
100712	100716	100807	18	437.10	0.008	2,394.54	5.474	0.541	2,394.92	5.475	0.541
100713	100717	100809	18	486.915	0.006	2,475.42	5.025	0.596	2,475.57	5.025	0.596
100714	100718	100811	18	317.162	0.002	2,534.14	3.195	1	1,684.30	3.201	0.63
100715	100719	100812	18	483.749	0.013	2,578.92	6.686	0.489	2,578.61	6.685	0.489
100788	100791	100805	18	328.527	0.002	2,249.03	2.836	1	1,359.42	2.821	0.585
100797	100801	100802	12	330.922	0.008	587.67	3.807	0.451	587.67	3.807	0.451
100798	100802	100710	12	418.987	0.026	588.11	5.927	0.325	588.11	5.927	0.325
100799	100803	100804	18	434.818	0.012	2,247.27	6.206	0.466	2,247.27	6.206	0.466
100800	100804	100714	18	390.355	0.023	2,248.34	8.049	0.383	2,248.34	8.049	0.383
100801	100805	100806	18	482.455	0.003	2,314.96	3.638	0.748	1,425.14	3.299	0.535
100802	100806	100716	18	379.485	0.013	2,315.94	6.493	0.46	2,316.38	6.494	0.46
100803	100807	100808	18	450.197	0.011	2,394.87	6.209	0.489	2,395.15	6.209	0.489
100804	100808	100717	18	413.751	0.019	2,394.98	7.554	0.421	2,395.19	7.555	0.421
100805	100809	100810	18	498.16	0.01	2,475.47	6.039	0.513	2,475.51	6.039	0.513
100806	100810	100718	18	437.045	0.008	2,475.27	5.665	0.54	2,475.22	5.665	0.54
100807	100811	100719	18	295.271	0.004	2,533.61	4.07	0.732	2,533.39	4.069	0.732
100808	100812	100209	18	171.627	0.016	2,578.33	7.33	0.456	2,577.93	7.329	0.456
10687	8733	11266	33	586.9	0.001	6,043.36	3.464	0.623	6,040.21	3.465	0.622
10759	11289	11290	33	332.872	0.001	6,010.12	3.235	0.657	6,006.81	3.239	0.656
10786	11266	11289	33	222.191	0.001	6,019.84	3.066	0.69	6,016.58	3.064	0.69
10976	11290	11627	33	355.088	0.001	5,995.47	3.289	0.646	5,992.11	3.287	0.646
110127	100504	110092	12	558.706	0.007	566.95	3.678	0.451	566.95	3.678	0.451
110129	110092	110094	12	520.403	0.009	568.357	4.071	0.418	568.357	4.071	0.418
110131	110094	110096	12	588.325	0.034	569.31	6.45	0.298	569.31	6.45	0.298
110133	110096	100711	12	424.752	0.045	569.78	7.146	0.277	569.78	7.146	0.277
11154	11627	11697	33	525.081	0.001	5,980.02	3.369	0.632	5,976.59	3.373	0.631
11312	11759	11525	33	130.65	0.002	5,932.16	3.699	0.58	5,928.55	3.701	0.58
11313	11697	11759	33	532.375	0.001	5,959.15	3.394	0.626	5,955.63	3.392	0.626
11658	9803	12184	33	482.66	0.001	6,628.89	3.177	0.73	6,625.16	3.18	0.729
11692	12184	12202	33	74.776	0.001	6,597.39	3.274	0.707	6,593.58	3.277	0.706
1171	1243	1244	36	799.999	0.001	5,802.20	2.547	0.675	5,799.61	2.546	0.675
1172	1244	1245	36	771.296	0.001	5,772.91	2.581	0.664	5,770.02	2.584	0.663
1173	1246	1243	36	475.268	0.001	5,815.92	2.622	0.659	5,813.49	2.621	0.659
1174	1247	1135	30	373.904	0.005	5,486.75	5.553	0.459	5,484.91	5.551	0.459

1176	1136	1137	36	91	0.108	5,830.33	17.05	0.165	5,828.17	17.044	0.165
1177	1138	1136	36	208	0.02	5,830.81	9.388	0.25	5,828.66	9.384	0.25
1182	1144	1143	30	22.79	0.014	5,830.96	8.402	0.353	5,828.82	8.399	0.353
1185	1253	1254	30	375.17	0.005	5,484.21	5.832	0.442	5,482.25	5.83	0.442
1186	1135	1253	30	474.35	0.005	5,485.80	5.622	0.455	5,483.91	5.62	0.455
1187	1254	1145	30	308.588	0.01	5,482.84	7.408	0.37	5,480.83	7.406	0.37
1189	1146	1144	30	257.839	0.044	5,478.54	12.444	0.254	5,476.40	12.439	0.254
1190	1255	1146	30	400.32	0.008	5,480.23	6.885	0.39	5,478.13	6.883	0.39
1191	1145	1255	30	351.82	0.005	5,481.90	5.495	0.463	5,479.86	5.493	0.463
1192	1256	1147	30	450.001	0.007	4,565.70	6.236	0.367	4,564.33	6.234	0.367
1193	1147	1257	30	452.31	0.008	4,565.21	6.385	0.36	4,563.77	6.383	0.36
1194	1258	1247	30	312.931	0.002	4,559.34	3.825	0.532	4,557.58	3.824	0.532
1195	1259	1258	30	429.108	0.004	4,561.28	4.958	0.435	4,559.60	4.956	0.435
1196	1260	1259	30	387	0.002	4,562.99	4.117	0.502	4,561.39	4.115	0.502
11962	12617	12367	33	155.75	0.001	6,583.46	3.219	0.717	6,579.64	3.217	0.717
1197	1148	1260	30	334.319	0.003	4,564.14	4.238	0.491	4,562.61	4.242	0.491
1198	1257	1148	30	276.596	0.009	4,564.52	6.577	0.353	4,563.02	6.575	0.353
1199	1137	1246	36	663.575	0.001	5,830.25	2.523	0.684	5,828.10	2.522	0.684
1200	23644	1256	30	427.469	0.007	4,565.98	6.214	0.368	4,564.67	6.212	0.368
1201	1245	1262	36	78.022	0.005	5,737.14	5.682	0.355	5,733.99	5.684	0.355
1202	1143	1138	36	57.329	0.013	5,830.90	8.066	0.279	5,828.75	8.063	0.279
12091	12367	12683	33	480.61	0.002	6,575.55	4.345	0.553	6,571.72	4.348	0.553
12150	12683	12705	33	180	0.001	6,553.54	3.252	0.707	6,549.66	3.255	0.706
12400	12705	13076	33	530.788	0.001	6,946.10	3.205	0.758	6,942.21	3.203	0.758
12736	13076	13266	33	562.077	0.001	6,907.74	3.274	0.738	6,903.78	3.272	0.738
12966	12258	12262	33	112.52	0.001	6,988.08	3.628	0.679	6,983.97	3.625	0.679
12967	13266	12258	33	643.82	0.001	7,033.05	3.47	0.711	7,029.01	3.468	0.711
13082	12262	12503	33	360.16	0.001	6,982.94	3.46	0.708	6,978.83	3.463	0.707
18440	11525	9634	33	350.195	0.001	5,928.20	3.164	0.662	5,924.58	3.162	0.662
19715	12202	12617	15	269	0.005	2,312.39	4.198	1	2,311.06	4.196	1
19716	12202	12617	21	298.25	0.003	4,282.16	3.967	1	4,279.69	3.964	1
8305	1262	8733	21	142.296	0.024	5,736.95	10.37	0.51	5,733.80	10.365	0.51
9375	9634	9803	33	420.448	0.001	6,652.92	3.399	0.688	6,649.25	3.397	0.688

Appendix B – NTS Correspondence

Project No.
8506.000.005

June 22, 2011
Latest Revision October 13, 2011

Ms. Fiona Sanchez
Irvine Ranch Water District
15600 Sand Canyon Avenue
Irvine, CA 92618

Subject: Heritage Fields
Irvine, California

POST-CONSTRUCTION WATER QUALITY TREATMENT FEATURES AND CONDITION OF APPROVAL

Dear Ms. Sanchez:

We appreciated the opportunity to meet with you and your team on June 20, 2011, and September 22, 2011, regarding the conceptual design, location and maintenance of the proposed bioretention facilities at the Heritage Fields project in Irvine, California.

This letter summarizes comments from the June 2011 and September 2011 meetings, incorporates subsequent project team discussions, provides an updated Water Quality Basin Exhibit, and confirms our teaming commitment with Irvine Ranch Water District (IRWD) for discussions with the Santa Ana RWQCB. This letter also presents condition-of-approval (COA) for IRWD acceptance of the bioretention cells into IRWD's Natural Treatment System (NTS).

BACKGROUND

As discussed, because of the favorable geologic conditions and because the site is relatively flat, this project offers opportunities for retention and infiltration of stormwater and can, therefore, meet the objectives of the Santa Ana RWQCB.

In an effort to meet the Low Impact Development (LID) and integrated management goals for BMPs in the Orange County MS4 at the project site and based on the favorable geologic and post-development site conditions, we propose to modify the originally planned detention basins (including NTS facilities) with bioretention cells that are designed to treat urban run-off before discharging into the municipal storm system(s).

BIORETENTION CELLS

Design. The bioretention cells will be designed according to currently accepted design methods from the Orange County MS4, and will incorporate design approaches and construction details that have been approved by and constructed under the regulatory oversight of other RWQCBs. As discussed, there are several Northern California project sites that have had functioning bioretention facilities for at least 5 years. In addition, we will confirm that the planned

infiltration will incorporate hydrogeologic considerations and ensure that water quality is not adversely impacted.

Conceptual Plan and Function. In general, the bioretention cells receive low-flow and dry-weather urban run-off, typically from sheet flow or a storm drain outfall, then filter the run-off through a permeable (5 inches per hour or greater) sandy loam medium, then through an open-graded gravel medium, and ultimately into a collection system (subdrain) installed at the bottom of the facility that reintroduces the treated water into the downgradient storm system. The surfaces of the bioretention cells are depressed relative to the surrounding areas to allow the low-flow storm drain diversion to gravity drain into the bioretention cell. For the project site, we estimate the surface of the bioretention cells will be roughly 4 to 8 feet below adjacent grade(s), with 3:1 (horizontal:vertical) or flatter side slopes.

Vegetation. Vegetation on the slopes and in the cell area can be seasonal native grasses, manicured grass, ornamental grasses, trees, and shrubs, or a combination thereof. Prior to transferring maintenance responsibility, the planned vegetation will have been installed and irrigated (at least for the first year) to establish coverage and maturity. It should be noted that the performance of the bioretention cell relies on the drainage medium and microbiological processes, not surficial vegetation. As a result, where landscaping is desired within the bioretention cells, the homeowners association (HOA) or other entity can be responsible for maintaining such vegetation. This landscaping responsibility will be incorporated into the Operations and Maintenance (O&M) Manual for post-construction stormwater facilities, and within the HOA Covenants, Conditions, and Restrictions (CC&Rs) or similar appropriate documents for a maintaining entity acceptable to IRWD.

Monitoring. Influent and effluent monitoring for the bioretention cells may be carried out as appropriate. The monitoring parameters and frequency will be mutually established and agreed upon by Heritage Fields El Toro LLC, IRWD, Santa Ana RWQCB, as applicable. This can further be vetted during the first 2 to 3 years the bioretention facilities are in-use to establish long-term reasonable monitoring parameters and frequency.

PLANNED LAYOUT

Over the course of land-plan refinements, the number of water quality/basin features has been modified. This includes eliminating one previously planned basin in Development District 4 that treated a tributary area of roughly 170 acres and routing the run-off to a planned basin in Development District 1S. As of February 2011, nine (9) facilities, plus Marshburn Retarding Basin (Basin 1), were planned to treat urban run-off from Development Districts (DD) 1N, 1S, 4, 7 and 8 – identified as Basins 1 through 10 (RBF, February 2011).

As presented in the September 22, 2011, basin optimization meeting with you and the project Civil Engineers, the project team made further refinements and basin merging. From an engineering standpoint and unless other circumstances dictate changes during future grading plan refinements, we have determined the following opportunities and constraints for combining water quality basins.

- **Basin 1 (DD-8)**: Existing Marshburn Retarding Basin - cannot be adjusted or relocated.

- **Basin 2 (DD-8)**: Relocating or merging is constrained by an offsite improvement (existing box culvert running parallel to/under Irvine Boulevard) that would hinder gravity drainage.

- **Basins 3 and 4 (DD 1N/1S)**: It appears Basins 3 and 4 can be merged.

- **Basin 5 (DD-1S)**: Relocating or merging is constrained by topography, downstream and offsite improvements and Marshburn Channel constraints, the land plan area use for commercial and civic facilities, and the nature of the tributary watershed area.

- **Basins 6 and 7 (DD-1S)**: Relocating or merging is constrained by topography and existing watersheds (Marshburn Channel and Bee Canyon).

- **Basin 8 (DD-7)**: Relocating or merging is constrained by topography and watershed (unable to cross under/over Agua Chinon).

- **Basin 9 (DD-7)**: Basin 9 was merged into Basin 10.

Attached is the revised exhibit, which provides the optimized basin layout and the approximate tributary acreage, presented in our September 22, 2011, meeting. We will continue to seek basin consolidation opportunities from an engineering standpoint (civil, geotechnical, and water resources) with IRWD, and understand IRWD's requirements that we demonstrate that such opportunities have been maximized to the extent practicable.

CONDITION OF APPROVAL

Based on the above information regarding merging the previously planned nine water quality basins (excluding Marshburn Retarding Basin) into seven water quality basins and the commitment of Heritage Fields El Toro LLC to continue engaging you in communications with Santa Ana RWQCB for design and maintenance/testing of water quality facilities, the following is the condition of approval (COA) for acceptance of the bioretention facilities into IRWD's Natural Treatment System:

> *IRWD agrees to accept post-construction Operations and Maintenance (O&M) responsibilities (excluding landscaping) for the water quality treatment facilities, subject to receipt and approval by IRWD of an application for service and agreement on IRWD's forms, and satisfaction of all applicable requirements, as then shall be in effect, of IRWD's Rules and Regulations For Water, Sewer, Recycled Water, and Natural Treatment System Service and IRWD's Procedural Guidelines and General Design Requirements. The foregoing requirements shall incorporate monitoring protocols acceptable to IRWD and to the Santa Ana Regional Water Quality Control Board. Such protocols shall be established prior to issuance of residential building permits within residential areas tributary to a new bioretention facility, and the City of Irvine shall be notified of the monitoring requirements. The Procedural Guidelines and Design*

Requirements do not currently address the requirements for acceptance of bioretention facilities as a type of facility that IRWD will operate as part of its Natural Treatment System, and will be updated by IRWD to include such requirements prior to IRWD's acceptance of any such facilities.

Final acceptance of each bioretention facility shall occur as follows: Upon completion of development within each area tributary to a particular bioretention facility (including certificates of occupancy and builder-provided landscaping), and subject to the requirements set forth in the preceding paragraph, the facility shall be eligible for transfer and may be offered to IRWD for acceptance no sooner than 1 year following placement of the facility in service or such longer probationary period as may be applicable pursuant to IRWD's Procedural Guidelines and Design Requirements for any bioretention facilities that are deemed to serve as pilot facilities for the acceptance of bioretention facilities into IRWD's Natural Treatment System. The application for service and agreement and the Procedural Guidelines and Design Requirements shall also govern the facility acceptance process, including without limitation fee title and easement conveyance, execution of any new or amended jurisdictional interface agreement(s) with the agency operating any downgradient or other affected storm water conveyance and bypass facilities, and homeowners' association CC&Rs and other transfer documents as applicable to the bioretention facility and assumption by the homeowners' association or other non-IRWD party acceptable to IRWD of maintenance of landscaping and other appurtenant maintenance obligations.

CLOSING

We appreciate the opportunity to team with you in the design of the water quality treatment facilities.

Sincerely,

ENGEO Incorporated

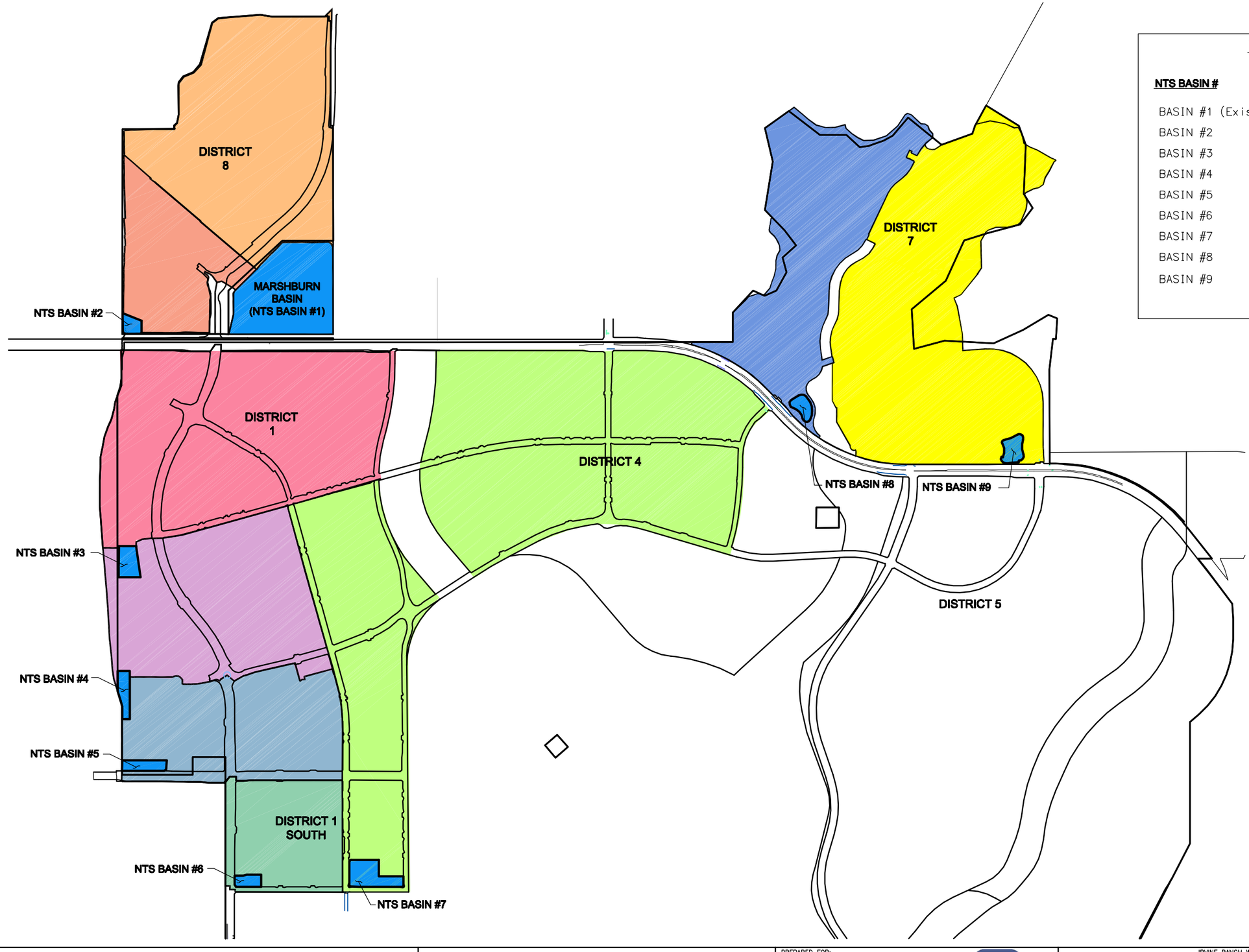
Julia A. Moriarty, GE
Principal

Uri Eliahu, GE
President

jam/ue/jf:coa

Attachment: Exhibit - Water Quality Basin Exhibit (RBF, September 2011)

cc: 1 - Ms. Jennifer Bohen, Heritage Fields El Toro LLC (e-mail only)



LEGEND

NTS BASIN #	TRIBUTARY AREA	TRIBUTARY ACREAGES
BASIN #1 (Existing)		121.4 AC
BASIN #2		46.0 AC
BASIN #3		190.2 AC
BASIN #4		99.4 AC
BASIN #5		78.2 AC
BASIN #6		42.6 AC
BASIN #7		338.4 AC
BASIN #8		94.7 AC
BASIN #9		173.7 AC

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PREPARED FOR:
IRVINE RANCH WATER DISTRICT

IRVINE RANCH WATER DISTRICT
GREAT PARK / GREAT PARK NEIGHBORHOODS
SUB-AREA MASTER PLAN
(2011 UPDATE)

NTS / WATER QUALITY BASIN EXHIBIT

FIG. 6-1

PATH/FILENAME: H:\PDATA\10105001\CADD\LAND\EXHIBITS\2011 MASTER PLAN UPDATE\UTILITY\NTS_WATER QUALITY BASIN EXH_FIG_6-1.DWG
LAST UPDATE: Friday, October 14, 2011 9:02:44 AM
PLOT DATE: Friday, October 14, 2011 9:03:23 AM
ANSI D — 34-0"x22-0"