TECHNICAL MEMORANDUM CH2MHILL

Shadow Rock Detention Basin Dry Season Runoff Capture and Collection System

PREPARED FOR: Trabuco Canyon Water District

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DATE: October 13, 2006

PROJECT NUMBER: 350271

1. Background

Shadow Rock Detention Basin receives runoff from the Trabuco Highlands community and conveys it to the existing storm drain system. Trabuco Canyon Water District (TCWD) is interested in working with the Trabuco Highlands Community Association (THCA) to operate and maintain Shadow Rock Detention Basin to treat and capture low-flow runoff for reuse. TCWD and THCA would like to modify the existing detention basin to create a less vector-prone site and provide increased nutrient consumption without negatively impacting the current design of the storm drain system and detention basin. Captured dry-season flows will be pumped to a separate existing storm drain located approximately 1,300 feet from Shadow Rock Basin. TCWD proposes to redirect dry-season flow to Dove Lake, which is a man-made reservoir that TCWD currently utilizes to supplement its reclaimed water demands.

2. Existing Conditions

Conveyance Structures and Water Flows

Currently, the site has multiple influent points including a primary stormwater channel, four stormwater v-ditches, and a subdrain. The primary channel and the subdrain each deliver low flows of approximately 20 gallons per minutes (gpm) (combined ~65 acre-feet/ year) and are the primary targets for treatment and capture by TCWD. The four v-shaped ditches and the primary channel are anticipated to deliver 77 acre-feet of stormwater annually (see Appendix 1, Shadow Rock Water Budget).

Vector issues

The current wet detention basin has a relatively flat bottom with no direct flow-path deep channels or open water pools. As a result, the basin creates undesirable vector habitat (mosquito breeding ground). Establishing a clear flow path and deep pools will eliminate

stagnant areas and create mosquito fish habitat, cost effectively controlling the current vector problem.

Vegetation Maintenance

The constantly saturated basin maintains a constant water depth between 1 inch and 18 inches, without deep pools, which is the ideal range to promote vegetative growth. As a result of this configuration, the Shadow Rock Basin is a thick, dense monotypic stand of cattails in shallow water. To create a hierarchy in the hydraulic regime, THCA clears out paths within the vegetation. The maintenance cost of vegetation removal is costly and not aesthetically pleasing to the community.

3. Environmental Documentation Requirements

This section identifies environmental documentation requirements, including permits/approvals, which may be required for the TCWD Shadow Rock Detention Basin Dry Season Runoff Capture and Collection System (Project).

Prerequisites

1) All Project activities would occur outside the open channel that is located directly downstream of the existing outfall structure.

2) The manmade detention basin is strictly a flood control/stormwater facility, and Project activities within the manmade detention basin would not require a California Department of Fish and Game (CDFG) Streambed Alteration Agreement, a Regional Water Quality Control Board (RWQCB) 401 Water Quality Certification, or a United States Army Corps of Engineers (USACE) 404 Permit.

Scenario 1 - Assumes Prerequisites are Fulfilled

Table 1 identifies the environmental documentation requirements, assuming that the above-stated prerequisites are fulfilled. TCWD should review requirements from past activities within the manmade detention basin, or through direct consultation with CDFG, RWQCB, and USACE, to confirm if agencies would regulate activities within the manmade basins.

TABLE 1
Scenario 1 - Environmental Document Requirements and Permits/Approvals

Agency/Entity and Contact	Documentation or Permit/Approval	Comments	Timeline
Trabuco Canyon Water District Contact: Hector Ruiz (949) 858-0277	Environmental review of the Project has been completed in accordance with the California Environmental Quality Act (CEQA). Specifically, the Project is included as Phase V in the TCWD Mitigated Negative Declaration for Dry Season Water Recovery Projects (Dated: August 16, 2006).	TCWD is the Lead Agency under CEQA, and is responsible for ensuring that mitigation and monitoring is adequately completed for the Project. Refer to Exhibit A, Mitigation Measures and Monitoring Program, of the TCWD Mitigated Negative Declaration for Dry Season Water Recovery Projects.	Complete

TABLE 1
Scenario 1 - Environmental Document Requirements and Permits/Approvals

Agency/Entity and Contact	Documentation or Permit/Approval	Comments	Timeline
California Department of Fish and Game (CDFG) Contact: South Coast Region Contact Line Phone: (858) 636-3160	CDFG Code, 1600 Streambed Alteration Agreement (SAA). For diversion of flow from the open channel that is located directly downstream of the existing outfall structure[1].	Fish and Game Code 1602 requires an SAA for activities that affect streams, including those that obstruct or divert flow.	3 – 4 months following submittal
City of Rancho Santa Margarita Contact: Tom Wheeler City Engineer (949) 635-1800	NPDES Permitting Process Grading Permit Encroachment Permit	City of Rancho Santa Margarita requires implementation of NPDES activities and reports to the San Diego RWQCB under its NPDES Order No. CAS0108740	Ongoing compliance with NPDES Order No. CAS0108740
Regional Water Quality Control Board, San Diego Region (RWQCB) Contact: General Permit Question Line Phone: (916) 341-5537	Clean Water Act Section 402 National Pollutant Discharge Elimination Permit (NPDES) General Construction Stormwater Activity Permit; required for land disturbance greater than 1 acre.	Typically the General Construction Stormwater (NPDES) Permit would be identified in the contract documents as the responsibility of the Contractor. This includes preparation of a Storm Water Pollution Prevention Plan (SWPPP).	Effective upon submittal of Notice of Intent (NOI) and draft SWPPP.
Trabuco Highlands Community Association (THCA) Contact: Cathy Acquazzino Phone: (949) 582-7770	Easements from THCA for Shadow Rock Detention Basin. MOU for operation and maintenance of Shadow Rock Detention Basin.	TCWD to coordinate with THCA.	Prior to design phase

[1] In permit applications, Shadow Rock Detention Basin should be called Shadow Rock Detention Basin Facility to emphasize that the basin is an existing manmade facility, that its primary function is as a flood control/stormwater detention facility, and that activities within it should not be regulated.

Scenario 2 – Assumes Prerequisites are not Fulfilled

Table 2 identifies the environmental documentation requirements, assuming that the above-stated prerequisites are not fulfilled.

TABLE 2
Scenario 2 - Environmental Document Requirements and Permits/Approvals

Agency/Entity and Contact	Documentation or Permit/Approval	Comments	Timeline
Trabuco Canyon Water District Contact: Hector Ruiz (949) 858-0277	Environmental review of the Project has been completed in accordance with the California Environmental Quality Act (CEQA). Specifically, the Project is included as Phase V in the TCWD Mitigated Negative Declaration for Dry Season Water Recovery Projects (Dated: August 16, 2006).	TCWD is the Lead Agency under CEQA, and is responsible for ensuring that mitigation and monitoring is adequately completed for the Project. Refer to Exhibit A, Mitigation Measures and Monitoring Program, of the TCWD Mitigated Negative Declaration for Dry Season Water Recovery Projects.	Complete

TABLE 2
Scenario 2 - Environmental Document Requirements and Permits/Approvals

Agency/Entity and Contact	Documentation or Permit/Approval	Comments	Timeline
California Department of Fish and Game (CDFG) Contact: South Coast Region Contact Line Phone: (858) 636-3160	CDFG Code, 1600 Streambed Alteration Agreement (SAA). For activities within Shadow Rock Detention Basin[1] and for diversion of flow from the open channel that is located directly downstream of the existing outfall structure.	Activities within the manmade basin would require an SAA. CDFG may include Shadow Rock Detention Basin as part of their SAA jurisdiction; SAA application should make the case that the manmade detention basin is strictly a flood control/stormwater facility and that Project activities within the detention basin should not be regulated by CDFG. Additionally, Fish and Game Code 1602 requires an SAA for activities that affect streams, including those that obstruct or divert flow.	3 – 4 months following submittal
City of Rancho Santa Margarita Contact: Tom Wheeler City Engineer (949) 635-1800	NPDES Permitting Process Grading Permit Encroachment Permit	City of Rancho Santa Margarita requires implementation of NPDES activities and reports to the San Diego RWQCB under its NPDES Order No. CAS0108740	Ongoing compliance with NPDES Order No. CAS0108740
Regional Water Quality Control Board, San Diego Region (RWQCB) Contact: Megan Quigley, 401 Coordinator Phone: (858) 268-5363	Clean Water Act Section 401 Water Quality Certification (401 Cert.). For excavation and fill activities within Shadow Rock Detention Basin.	Excavation and fill of manmade basin would require a 401 Cert. RWQCB may include Shadow Rock Detention Basin as part of their 401 Cert. jurisdiction; 401 Cert. application should make the case that the man-made detention basin is strictly a flood control/stormwater facility and that Project activities within the detention basin should not be regulated by RWQCB.	3 – 4 months following submittal
Regional Water Quality Control Board, San Diego Region (RWQCB) Contact: General Permit Question Line Phone: (916) 341-5537	Clean Water Act Section 402 National Pollutant Discharge Elimination Permit (NPDES) General Construction Stormwater Activity Permit; required for land disturbance greater than 1 acre.	Typically, the General Construction Stormwater (NPDES) Permit would be identified in the contract documents as the responsibility of the Contractor. This includes preparation of a Storm Water Pollution Prevention Plan (SWPPP).	Effective upon submittal of Notice of Intent (NOI) and draft SWPPP.
United States Army Corps of Engineers (USACE)	Clean Water Act Section 404 Permit. For excavation and fill activities within Shadow Rock Detention Basin.	It is not expected that USACE would assert 404 jurisdiction over the Shadow Rock Detention Basin; USACE generally excludes manmade facilities.	3 – 4 months following submittal
Trabuco Highlands Community Association (THCA) Contact: Cathy Acquazzino Phone: (949) 582-7770	Approval from THCA to improve Shadow Rock Detention Basin.	Coordinate with THCA to determine approval requirements.	1 – 2 months following submittal

[1] In permit applications, Shadow Rock Detention Basin should be called Shadow Rock Detention Basin Facility to emphasize that the basin is an existing manmade facility, that its primary function is as a flood control/stormwater detention facility, and that activities within it should not be regulated.

4. Site Modifications

Water Control Structures

Influent

The primary stormwater pipe will need to be modified with a diversion structure such that the low-flow water is diverted to the detention basin with adequate head to provide operational flexibility within the treatment system. To optimize treatment performance, the system should have a drop structure to aerate the low-flow water.

The modification cannot inhibit the required stormwater conveyance. It is recommended for the influent diversion structure to connect into the primary stormwater pipe upstream from the energy dissipation structure by placing a Y along the invert. Tying into the pipe itself will not require any modifications to the existing energy dissipation structure, which will expedite the permitting process.

Effluent

The sump and pump station to capture low-flow water will be located at the end of the configured flow path, Figure 1, to both maximize the length of the treatment cell and minimize the amount of conduit required.

The effluent control structure should be designed for maximum operational flexibility of the water surface. Controlling the water surface is important for three key reasons. First, lowering the water level to the top of the emergent bands allows for safe and easy maintenance access when clearing the emergent vegetation. Second, raising the water level before a storm event will allow a portion of the stormwater to be captured. Third, general flexibility will allow control of the water surface to respond to the vegetation requirements. For example, during planting, flooding the system prepares the soil and clearly delineates the area that will support emergent vegetation.

Grading

Grading criteria should balance the cut and fill to minimize construction cost and maintain the detention requirements of the basin.

The final grading elevations for the detention basin will require detention modeling because stormwater detention is a nonlinear calculation and cannot be examined using static volumes. It may result that merely building the berm out of the spoil generated by the deep pools does not affect the detention requirements of the basin. However, it may also result that the volumetric change by building the berm above the previously designed static water elevation of 1,318 feet negates the ability of the basin to detain the design storm.

The design drawings, by Hunsaker and Associates in 1981, list a static water surface of 1,318 feet. The current aerial topographic data show an average basin elevation of ~1,319 feet with a variance from 1,318.7 to 1,320.5 feet, indicating that either significant sedimentation has occurred or that the aerial survey picked up plant elevations. Under either circumstance, it is recommended that the newly cleared basin be resurveyed prior to the final design.

The hydraulic head loss through the system is anticipated to be insignificant, less than 2 inches (assuming an emergent marsh depth if 12 inches). The head loss should be remodeled during final design if the emergent marsh depth changes because the head loss

will grow significantly as the emergent areas become shallower. Supporting calculations are shown in Appendix 2.

Emergent Marsh"Bands"

Bands of emerging vegetation, spanning the full width of the flow path, should be designed with a normal operating depth between 6 to 18 inches; 12 inches is recommended.

Deep Pools

Pools should be created to a minimum depth of 5 feet and a preferred depth of 6 feet. These pools are critical components to natural treatment systems as they passively facilitate mixing to aerate the water as well as provide mosquito fish habitat. Creating pools deeper than the vegetation will grow ensures that the designed pools remain open without excess maintenance. Table 3 shows the observed depth range of various emergent species and should be used conservatively as a guideline when determining the pool depths and plant species.

Pools should span the full width of the flow path, and should be long enough (along the flow path) to prevent infill from old vegetation. This assumes a pool depth of 6 feet, a 5-foot vertical drop from the emergent bands, and a 2:1 slope. The minimum length of each pool should be 25 feet.

Central Berm

The central berm has two primary functions. First, this will define the flow path creating circulation within the system. Second, this will provide maintenance access, both for future vegetation removal and for vector management in broadcasting biorational pesticides. The Orange County Vector Control District, OCVCD, prefers to have access within 30 feet of all fringe vegetation. The berm should be an appropriate width to safely facilitate the TCWD back hoe as the primary tool for removing vegetation.

Planting

The planting tables below, Tables 3 and 4, outline target native plants that have proven successful in past natural treatment systems for both emergent and riparian vegetation. Riparian vegetation is the dry land vegetation that is hydraulically related to the basin. The basin planting plan should utilize riparian vegetation strategically to shade the open pools, while allowing lines of sight out into the system for monitoring. The planting plan should incorporate as much of the existing mature riparian vegetation as is feasible.

TABLE 3
Select Emergent Plant Species and Depth Tolerance

Species			Growth Range (Down)	
Common Name	Botanical Name	Container Size	cm	ft
Tule	*Scirpus acutus*	2 per 1 gal	150	4.9
Three Square Bulrush	*Scirpus americanus*	2 per 1 gal	60	2.0
California Bulrush	*Scirpus californicus*	2 per 1 gal	180	5.9
Big Bulrush	*Scirpus robustus*	2 per 1 gal	120	3.9
Common Cattail	*Typha latifolia*	3 per 1 gal	30	1.0
Narrow Leafed Cattail	*Typha angustifolia*	3 per 1 gal	100	3.3

Source: Payne (1992; Table A.8 [original Kadlec and Wentz, 1974], supplemented by Levine and Willard, 1990)

TABLE 4
Select Hearty Native Californian Riparian Vegetation

Species		Container Size	Planting Centers (Feet)
Common Name	**Botanical Name**		
Trees			
Fremont Cottonwood	*Populus fremontii*	1 gal	24
Western sycamore	*Platanus racemosa*	1 gal	24
Mexican elderberry	*Sambucus mexicana*	1 gal	16
Arroyo Willow	*Salix lasiolepis*	1 gal/cuttings	8
Red Willow	*S. laevigata*	1 gal/cuttings	12
Goodding's willow	*S. gooddingii*	1 gal/cuttings	16
Yellow Tree Willow	*S. lasiandra*	1 gal/cuttings	12
Shrubs/Vines			
Mulefat	*Baccharis salicifolia*	1 gal	8
Emoryi's baccharis	*Baccharis emoryi*	1 gal	8
Coyote bush	*Baccharis pilularis*	1 gal	8
California wild grape	*Vitis californica*	1 gal	18
California blackberry	*Rubus ursinus*	1 gal	10
Virgin's bower	*Clematis ligusticifolia*	1 gal	8

5. Construction Phasing

Assuming either of the two scenarios in Section 3, the construction phasing of the Project can be streamlined.

Scenario 1 assumes that no additional environmental permitting is required for the Project and the design and construction can follow a typical schedule. This work should include:

- Detailed survey of existing cleared conditions
- Inventory of existing onsite materials (i.e., riprap boulders and existing mature vegetation)
- Stormwater Hydraulic Analysis
- Final Design
- Site Survey/ Staking of Final Design
- Grading
- Influent and Effluent Structure Modifications
- Site Hydration
- Planting

Under Scenario 2, two phases have of work have been identified, which can proceed simultaneously.

Phase 1

- Detailed survey of existing cleared conditions
- Inventory of existing onsite materials (i.e., riprap boulders and existing mature vegetation)
- Stormwater Hydraulic Analysis
- Final Design
- Site Survey/ Staking of Final Design
- Grading
- Site Hydration
- Planting

Phase 2

- Submit Permit Applications
- Obtain Permits from Agencies
- Modify Influent and Effluent Structures when site is ready

Phase 1 consists of work within the basin and excludes connecting and modifying the existing influent and effluent structures (see Table 1).

Phase 2 includes obtaining permits for primarily connecting and modifying the influent and effluent structures (see Table 2).

6. Natural Treatment System Maintenance

Routine maintenance would include the following.

Water Levels and Inflow Rate

Water level and inflow rate control is important in natural treatment system operation. Excessive fluctuation has been shown to unduly stress emergent vegetation and decrease treatment performance. Pipes and structures should be maintained regularly to prevent flow blockage.

Water level control in the Shadow Rock Basin, should be managed at approximately 12 to 18 inches in emergent marsh zones and up to 6 feet in the deep pool zones.

Inflow rate and water depth controls are the only process-related adjustments for the treatment cells and are typically performed infrequently.

Vegetation Management

As the emergent vegetation grows, it may begin to obstruct water flow in areas of the cells and cause short-circuiting. If areas become overgrown, they should be thinned out to maintain a uniform flow pattern over the cells. Similarly, if unwanted vegetation begins to overwhelm the desired species, then the undesirable invasive plants should be removed.

Water Quality Sampling

Water quality sampling efforts should include influent and effluent sampling to evaluate the performance of the system and establish a trend. Routine chemical parameters in addition to constituents of concern for this system should be monitored on a regular or periodic basis similar to Dove Lake.

Mosquito Abatement

Creating natural water treatment systems can create habitats suitable for development of mosquito populations. While reported cases are rare in the United States, mosquito-borne diseases are a major public health problem internationally, and a mandated concern for vector control agencies. Available results from other studies of natural treatment systems in the southwestern United States indicate that an integrated vector management control plan can prevent the incidence of nuisance mosquito populations and serve to protect the public from exposure to mosquito-borne diseases.

The proposed basin modifications include deep pools for mosquito fish habitats, continuous water flow, and greater access for OCVCD to monitor and implement mosquito and vector control measures.

Sediment Removal

Drains feeding Shadow Rock Basin are primarily from the surrounding residential community and common areas where the ground cover is pavement, housing, or dense vegetation; and the amount of sediment and debris is anticipated to be low. Sediment captured in the basin, however, can be removed, as needed, to maintain the proposed inlet areas and basin clear. The proposed design with the central berm/access road permits the use of a backhoe for removing any accumulation sediment.

7. Treatment Performance Modeling Results

Currently, the existing basin stores water that becomes stagnant and has minimal movement of water throughout the basin. The proposed basin modifications will result in significantly improving the quality of water flowing through the basin and will increase pollutant removal.

The pollutant removal performance for the modified Shadow Rock Detention Basin was modeled using a first-order, empirical-area-based model described in Kadlec and Knight (1996). Model results showed significant expected removals of Nitrate and Total Phosphorus under the average conditions assumed for design (based on limited existing data). Appendix 3, Pollutant Removal for Recorded Values, summarizes water quality modeling results and modeled inflow/outflow rates.

Because of the limited flow and water quality data, the pollutant removal model was run for a hypothetical future condition. This model run assumed 10x the volume of water as well as 10x the concentration of each of the modeled parameters. Appendix 3, sheet 2, Pollutant Removal for Hypothetical Values, summarizes water quality modeling results and modeled inflow/outflow rates. The results of this hypothetical run indicate that significant pollutant removal of up to 50 percent or more can occur with a combined increase of pollutant loads and flows.

While there are no treatment goals or criteria required for the basin, it is clear that the proposed modifications will significantly improve water quality and increase the amount of pollutants removed compared to the existing basin design.

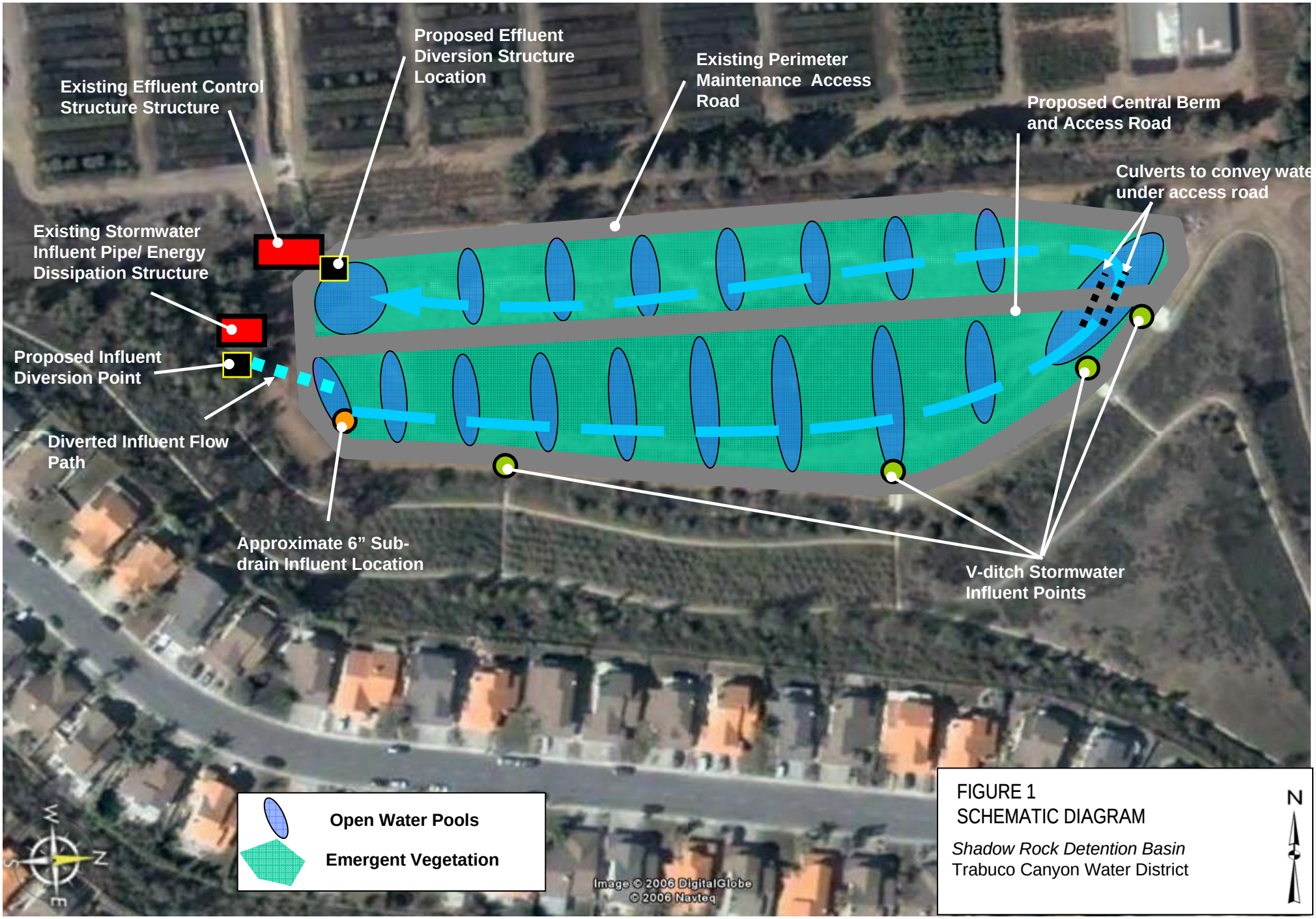

FIGURE 1
SCHEMATIC DIAGRAM

Shadow Rock Detention Basin
Trabuco Canyon Water District

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APPENDIX 1 WATER BUDGET

Sheet No. 1
Calculation No. 1
Project No.

PROJECT TITLE : TRABUCO CANYON WATER DISTRICT
DRY WEATHER LOW FLOW TREATMENT AND RECOVERY

Calc By CS Date 9/22/2006 Rev
Checked By Date

SUBJECT / FEATURE: WATER BUDGET = Q+P-ETo-Ex

Dimensions:	% of Total Sit	Units	Value
Total Site Area	100%	acres	3.58
		ft^2	155944.80
Emergent Marsh Area (Ae):	66%	acres	2.36
		ft^2	102923.57
Average Depth Emergent Marsh (De):		ft	1.00
		m	0.30
Open Water Area (Ao): (as part of Emergent)	34%	acres	0.80
		ft^2	34994.01
Average Depth Open Water (Do):		ft	5.00
Total Storage (S) = ((Ae*De)+(Ao*Do)):		ft^3	277,893.63
		acre-feet	6.380

Hydrology:	Units	Value	
Basin Area (Aw):	acres	3.58	
	ft3	155,948	
Catchment Surface Area (Ac):	acres	80.00	Estimate based on TCH as-built plans
Runoff Coefficient (R):	fraction	90%	Assumption based on typical residential rate
Total Storage (S):	ft^3	277,894	
	acre-feet	6.380	
Net Input (Qi):	af/year	142	
	cfs	0.20	Average
Annual Flow Output (Qo):	af/year	120	
	cfs	0.17	
Average Flow (Qavg) = ((Qi+Qo)/2):	af/year	131	
	cfs	0	
Hydraulic Retention Time = (S/Qavg):	d	17.8	
Hydraulic Loading Rate (Qo/Aw):	in/d	1.20	
	cm/d	3.06	
Infiltration Rate:	ft/d	0.006	Assumption: Double the infiltration rate of a clay liner.
Exfiltration (site)	ft3/day	935.7	

	Variable Input
	Climate or Constant
	Calculated Field

Parameter		Values												SUM
Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Days in Month	days in mo.	31	28	31	30	31	30	31	31	30	31	30	31	
Inflow - Storm drain - Low Flow Diversion - Qa	cfs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Inflow - Storm drain - Low Flow Diversion - Qa	ft3/day	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	
Inflow - Storm drain - Low Flow Diversion - Qa	Af/mth	5	5	5	5	5	5	5	5	5	5	5	5	**65**
Inflow - Storm flow - Adjacent Runoff - Qb	Af/mth	15	16	13	6	2	0	0	0	2	2	8	12	**77**
Inflow - Storm flow - Adjacent Runoff - Qb	ft3/day	22,151	23,902	19,349	8,843	2,276	613	88	700	2,364	3,152	11,557	17,423	
Inflow - Storm flow - Adjacent Runoff - Qb	cfs	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1
Inflow- Total (Qt) = (Qa+Qb)	cfs	**0.3**	**0.4**	**0.3**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**2**
Inflow- Total (Qt) = (Qa+Qb)	ft3/day	29,849	31,600	27,047	16,541	9,975	8,311	7,786	8,399	10,062	10,850	19,255	25,121	204,797
Inflow- Total (Qt) = (Qa+Qb)	Af/mth	**21**	**20**	**19**	**11**	**7**	**6**	**6**	**6**	**7**	**8**	**13**	**18**	**142**
Precipitation Average (P)	inches	2.53	2.73	2.21	1.01	0.26	0.07	0.01	0.08	0.27	0.36	1.32	1.99	13
Evapotranspiration (ETo)	inches/mth	2.18	2.49	3.67	4.71	5.18	5.87	6.29	6.17	4.57	3.66	2.59	2.25	50
Evapotranspiration (ETo)	ft3/mth	28,330.0	32,358.5	47,693.1	61,208.3	67,316.2	76,283.0	81,741.1	80,181.6	59,389.0	47,563.2	33,658.1	29,239.7	644,962
Evapotranspiration (ETo)	af/mth	0.7	0.7	1.1	1.4	1.5	1.8	1.9	1.8	1.4	1.1	0.8	0.7	**15**
Exfiltration	ft3/mth	29,005.7	26,198.7	29,005.7	28,070.1	29,005.7	28,070.1	29,005.7	29,005.7	28,070.1	29,005.7	28,070.1	29,005.7	
Exfiltration	af/mth	0.67	0.60	0.67	0.64	0.67	0.64	0.67	0.67	0.64	0.67	0.64	0.67	**8**
Net Output (Qo) = (Qi - Et - Ex)	ft3/mth	867,989	826,250	761,773	406,955	212,891	144,980	130,613	151,171	214,406	259,786	515,930	720,516	5,213,261
Net Output (Qo) = (Qi - Et - Ex)	af/mth	20	19	17	9	5	3	3	3	5	6	12	17	**120**

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APPENDIX 2: HYDRAULIC HEADLOSS

Sheet No. 1
Calculation No 1
PROJECT TITLE : TRABUCO CANYON WATER DISTRICT
Project No. 350271
DRY WEATHER LOW FLOW TREATMENT AND RECOVERY
Calc By CS Date 10/12/2006 Rev
SUBJECT / FEATURE: KADLEC AND KNIGHT, HEADLOSS APPROXIMATION
Checked B y Date

IEUA- Kadlec and Knight Overland Flow in Wetlands

$Q = aWh^bS^c$

Q= Flow rate [m^3/day]
a, b, c = Empirical Constants
W = Wetland width [m]
h = Wetland height [h]
S = Friction Slope

Variable Flows	cfs	[m^3/s]	[m^3/d]
Q =	0.089	0.003	218

Emergent Marsh Coef	Dense Veg	
n	0.009	s/$m^{1/3}$
a	1.00E+07	$m^{1/3}$/d
b	3.00	
c	1	
depth	2	ft

Open Water Coef		
n	0.03	s/$m^{1/3}$
a	2.88E+06	$m^{1/3}$/d
b	3	
c	1	
depth	6	ft

Stations			Depth		Width		Unit Head loss		Length	Total Head loss		HGL
Downstream	Upstream	Zone Description	(ft)	(m)	(ft)	(m)	(m/m)	(ft/ft)	(ft)	(ft)	(in)	(ft)
												0.00
100+00	100+25	Open Water	6.00	1.83	60	18.29	0.000001	0.000002	25	0.00	0.00	0.00
100+25	100+75	Emergent Marsh	1.00	0.30	60	18.29	0.000042	0.000138	50	0.01	0.08	0.01
100+75	101+00	Open Water	6.00	1.83	60	18.29	0.000001	0.000002	25	0.00	0.00	0.01
101+00	101+50	Emergent Marsh	1.00	0.30	60	18.29	0.000042	0.000138	50	0.01	0.08	0.01
101+50	101+75	Open Water	6.00	1.83	60	18.29	0.000001	0.000002	25	0.00	0.00	0.01
101+75	102+25	Emergent Marsh	1.00	0.30	660	201.17	0.000004	0.000013	50	0.00	0.01	0.01
102+25	102+50	Open Water	6.00	1.83	70	21.34	0.000001	0.000002	25	0.00	0.00	0.01
102+50	103+00	Emergent Marsh	1.00	0.30	70	21.34	0.000036	0.000118	50	0.01	0.07	0.02
103+00	103+25	Open Water	6.00	1.83	70	21.34	0.000001	0.000002	25	0.00	0.00	0.02
103+25	103+75	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.03
103+75	104+00	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.03
104+00	104+50	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.03
104+50	104+75	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.03
104+75	105+25	Emergent Marsh	1.00	0.30	90	27.43	0.000028	0.000092	50	0.00	0.06	0.04
105+25	105+50	Open Water	6.00	1.83	90	27.43	0.000000	0.000001	25	0.00	0.00	0.04
105+50	106+00	Emergent Marsh	1.00	0.30	90	27.43	0.000028	0.000092	50	0.00	0.06	0.04
106+00	106+25	Open Water	6.00	1.83	90	27.43	0.000000	0.000001	25	0.00	0.00	0.04
106+25	106+75	Emergent Marsh	1.00	0.30	100	30.48	0.000025	0.000083	50	0.00	0.05	0.04
106+75	107+00	Open Water	6.00	1.83	100	30.48	0.000000	0.000001	25	0.00	0.00	0.04
107+00	107+50	Emergent Marsh	1.00	0.30	100	30.48	0.000025	0.000083	50	0.00	0.05	0.05
107+50	107+75	Open Water	6.00	1.83	100	30.48	0.000000	0.000001	25	0.00	0.00	0.05
107+75	108+25	Emergent Marsh	1.00	0.30	100	30.48	0.000025	0.000083	50	0.00	0.05	0.05
108+25	108+50	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.05
108+50	109+00	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.06
109+00	109+25	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.06
109+25	109+75	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.06
109+75	110+00	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.06
110+00	110+50	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.07
110+50	110+75	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.07
110+75	111+25	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.07

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APPENDIX 2: HYDRAULIC HEADLOSS

Sheet No. 2
Calculation No 1
PROJECT TITLE : TRABUCO CANYON WATER DISTRICT
Project No. 350271
DRY WEATHER LOW FLOW TREATMENT AND RECOVERY
Calc By CS Date 10/12/2006 Rev
SUBJECT / FEATURE: KADLEC AND KNIGHT, HEADLOSS APPROXIMATION
Checked By Date

111+25	111+50	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.07
111+50	112+00	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.08
112+00	112+25	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.08
112+25	112+75	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.08
112+75	113+00	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.08
113+00	113+50	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.09
113+50	113+75	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.09
113+75	114+25	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.09
114+25	114+50	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.09
114+50	115+00	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.10
115+00	115+25	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.10
115+25	115+75	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.10
115+75	116+00	Open Water	6.00	1.83	80	24.38	0.000001	0.000002	25	0.00	0.00	0.10
116+00	116+50	Emergent Marsh	1.00	0.30	80	24.38	0.000032	0.000103	50	0.01	0.06	0.11
Total									**1,650**	**0.11**	**1.3**	

Length is equal to Upstream Station minus Downstream Station.
Unit Head loss = Slope, S

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APPENDIX 3 POLLUTANT REMOVAL FOR RECORDED VALUES

Sheet No. 1
Calculation No. 1

PROJECT TITLE : **TRABUCO CANYON WATER DISTRICT**
SHADOW ROCK BASIN DRY WEATHER
LOW FLOW TREATMENT AND RECOVERY

Project No. 350271
Calc By CS/PF Date 10/13/2006 Rev
Checked By SL Date 10/20/2006

SUBJECT / FEATURE: **KADLEC AND KNIGHT, Tanks In Series Model**

Wetland Tanks-in-Series Pollutant Removal Equation:

$$C_{OUT} = C^* + \left(\left[1 + \frac{k_{TIS}}{Nq} \right]^{-N} * \left(C_{IN} - C^* \right) \right)$$

Shadow Rock Basin Value
Kadlec and Knight Defined Rate Constant
Calculated Field

Shadow Rock Basin

3.6	Area	acres
0.089	Influent	cfs
1	HLR (q)	cm/d
0.086	Effluent	cfs
0.05	ET	cm/d

Trabuco Canyon Average Seasonal Temperatures

Summer Temp	20.3	Cº
Winter Temp	13.7	Cº

Source: www.worldclimate.com
Data for: Tustin- Irvine Ranch, Orange County

Nitrate		Total P		BOD		
Winter	Summer	Winter	Summer	Winter	Summer	
2	2	0.62	0.62	2.14	2.14	Cin mg/L
0.00	0.00	0.03	0.03	3.6	3.6	Cout mg/L
0	***0***	***0.02***	***0.02***	***3.6***	***3.6***	C* mg/L
36	***20***	***12***	***12***	***34***	***34***	kTIS m/yr
3	***3***	***3***	***3***	***3***	***3***	N Number
100%	100%	95%	95%	-69%	-69%	Concentration Removal
100%	100%	95%	95%	-63%	-63%	Mass Removal

Where:

Term	Unit	Definition
Cin	mg/L	Pollutant Concentration in influent stream
Cout	mg/L	Pollutant Concentration in effluent stream
C*	mg/L	Background pollutant concentration (varies among pollutants)
kTIS	m/yr	Tanks-in-Series first order rate constant
N	dimension	Number of Tanks-in-Series (most wetlands act as 3)
q	cm/d	Hydraulic Loading Rate

Notes:
Influent concentrations are based on limited water quality testing. Actual concentrations will have seasonal variance
Removal rate of Nitrate relates to water temperature while Total P and BOD does not
Increases in BOD are a result of very low inffluent concentrations

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APPENDIX 3 POLLUTANT REMOVAL FOR HYPOTHETICAL VALUES

Sheet No. 2
Calculation No. 1

PROJECT TITLE : TRABUCO CANYON WATER DISTRICT
SHADOW ROCK BASIN DRY WEATHER
LOW FLOW TREATMENT AND RECOVERY

Project No. 350271

Calc By CS/PF Date 10/13/2006 Rev
Checked By SL Date 10/20/2006

SUBJECT / FEATURE: KADLEC AND KNIGHT, Tanks In Series Model

Wetland Tanks-in-Series Pollutant Removal Equation:

$$C_{OUT} = C^* + \left(\left[1 + \frac{k_{TIS}}{Nq} \right]^{-N} * \left(C_{IN} - C^* \right) \right)$$

Hypothetical Shadow Rock Basin Value
Shadow Rock Basin Value
Kadlec and Knight Defined Rate Constant
Calculated Field

Shadow Rock Basin

3.6	Area	acres
1	Influent	cfs
17	HLR (q)	cm/d
0.997	Effluent	cfs
0.05	ET	cm/d

Trabuco Canyon Average Seasonal Temperatures

Summer Temp	20.3	Cº
Winter Temp	13.7	Cº

Source: www.worldclimate.com
Data for: Tustin- Irvine Ranch, Orange County

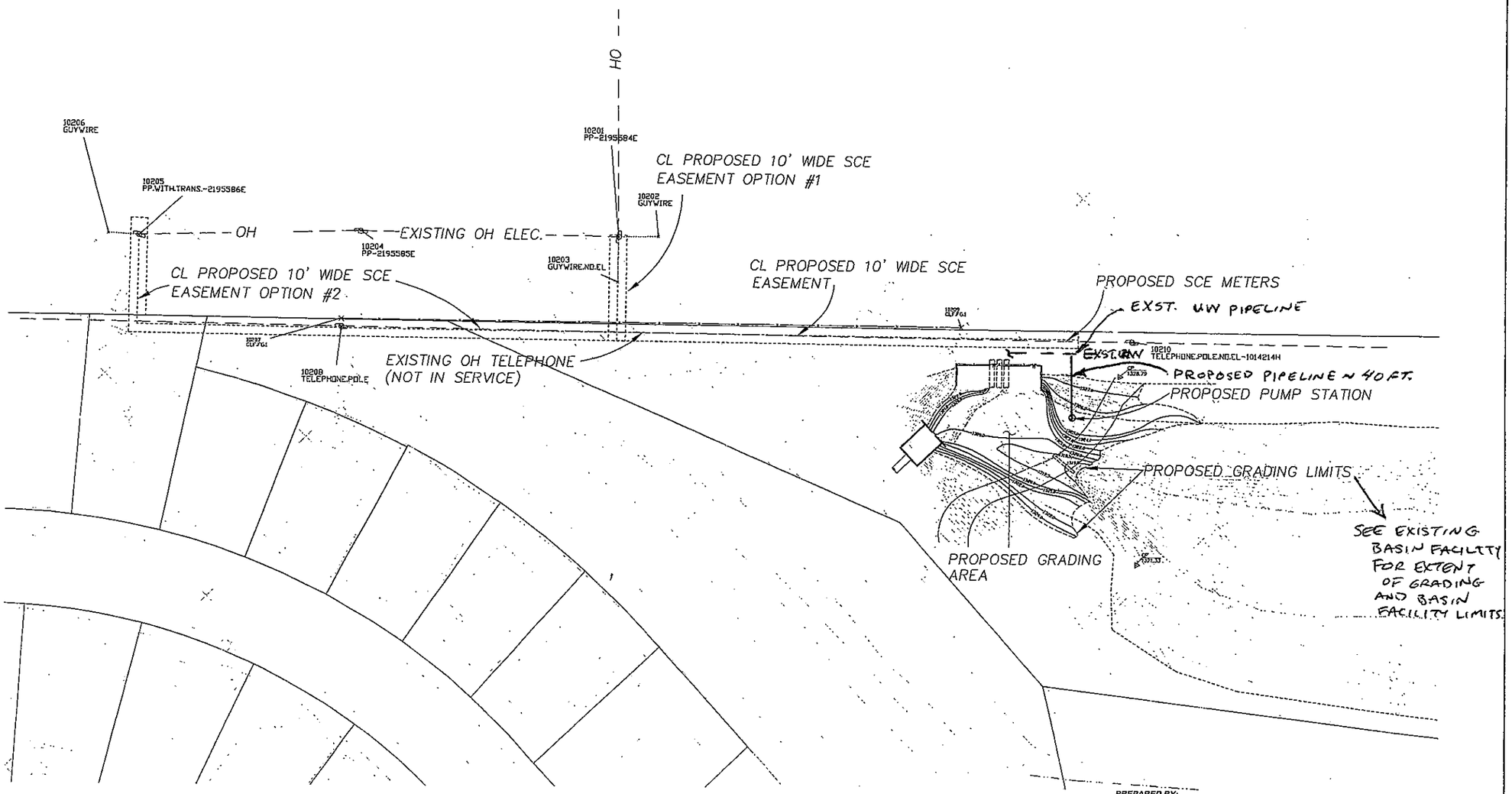
Nitrate		Total P		BOD		
Winter	Summer	Winter	Summer	Winter	Summer	
20	20	6.2	6.2	20.4	20.4	Cin mg/L
3.97	0.00	3.28	3.28	7.9	7.9	Cout mg/L
0	***0***	***0.02***	***0.02***	***4.6***	***4.6***	C* mg/L
36	***20***	***12***	***12***	***34***	***34***	kTIS m/yr
3	***3***	***3***	***3***	***3***	***3***	N Number
80%	100%	47%	47%	61%	61%	Concentration Removal
80%	100%	47%	47%	61%	61%	Mass Removal

Where:

Term	Unit	Definition
Cin	mg/L	Pollutant Concentration in influent stream
Cout	mg/L	Pollutant Concentration in effluent stream
C*	mg/L	Background pollutant concentration (varies among pollutants)
kTIS	m/yr	Tanks-in-Series first order rate constant
N	dimension	Number of Tanks-in-Series (most wetlands act as 3)
q	cm/d	Hydraulic Loading Rate

Notes:
Influent concentrations are based on limited water quality testing. Actual concentrations will have seasonal variance
Removal rate of Nitrate relates to water temperature while Total P and BOD does not
Increases in BOD are a result of very low inffluent concentrations

SHADOW ROCK DETENTION BASIN FACILITY – PROPOSED SITE IMPROVEMENTS (PRELIMINARY)



SCALE: 1" = 20'

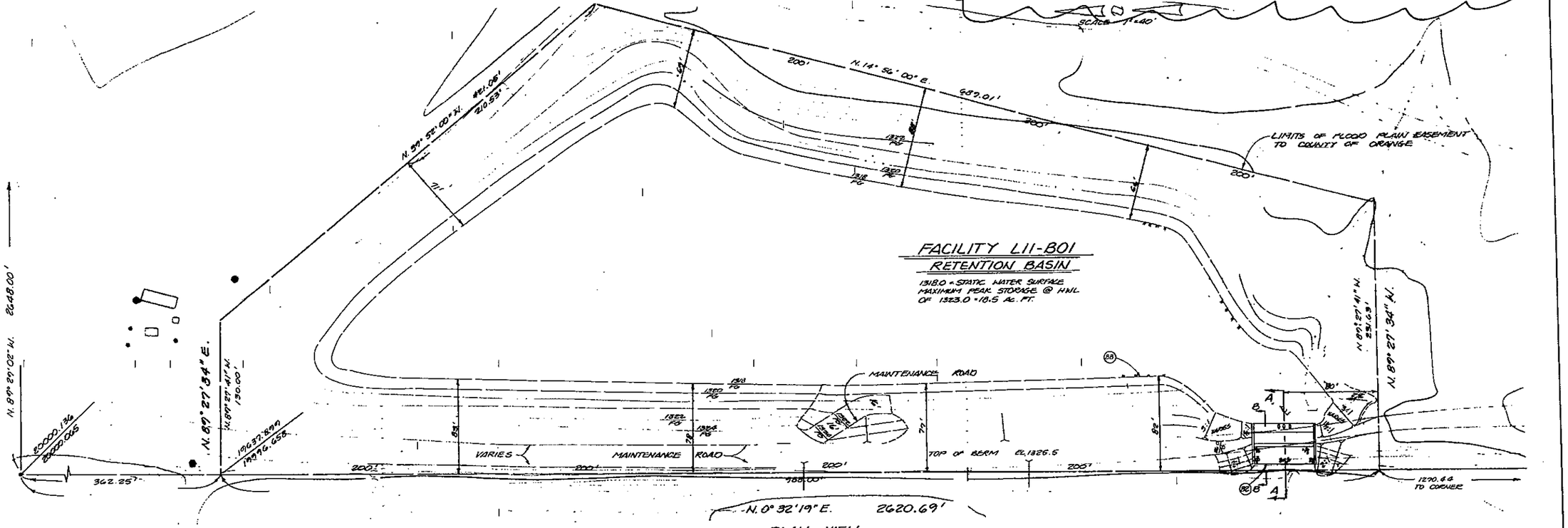
PREPARED BY:

DMc ENGINEERING
Civil • Surveying • Planning • Construction
Tel: (949) 753-9393 • Fax: (949) 753-9322
18 Technology Drive, Suite 160, Irvine, California 92618
E-Mail: dmc@dmceng.com • www.dmceng.com

JN: 728-26 08-19-2009

EXISTING SHADOW ROCK DETENTION BASIN FACILITY

SCALE 1"=40'



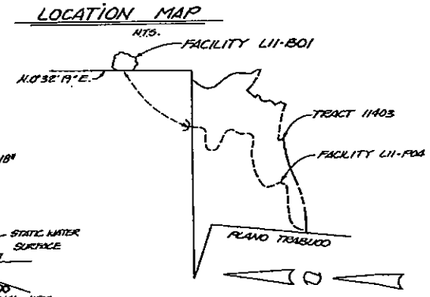
PLAN VIEW

CONSTRUCTION NOTES

(32) CONST. OUTLET PER DETAIL HEREON AND ON SHT. 7.

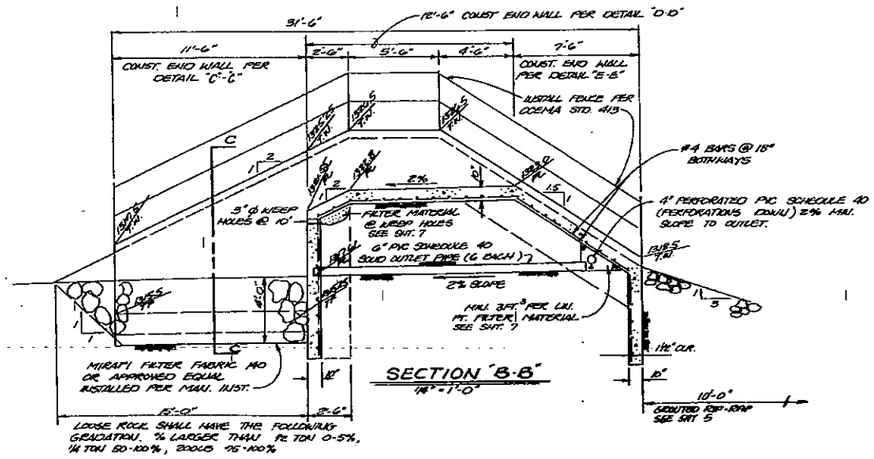
(38) GRADE RETENTION BASIN AS SHOWN

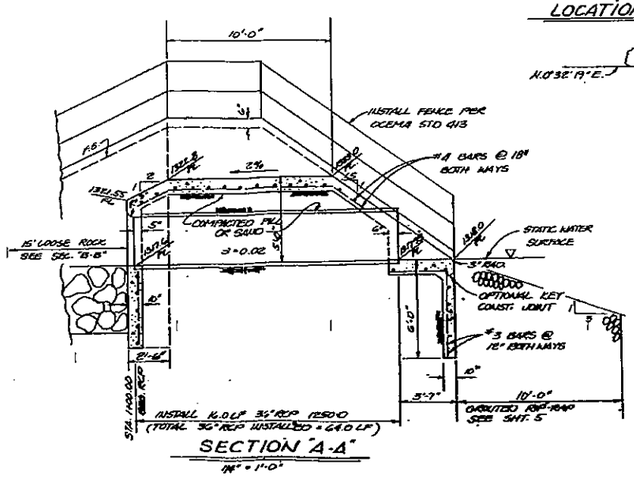
LOCATION MAP



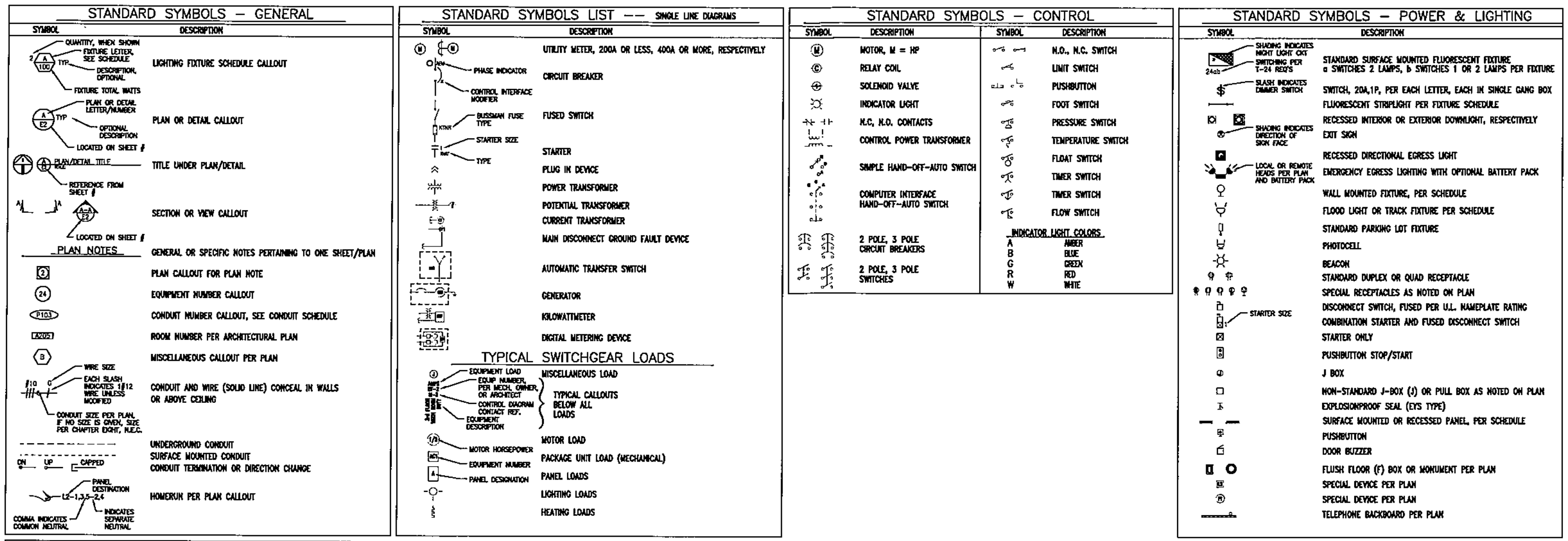
OPERATIONAL NOTES

1. MAINTAINED BY FEE OWNER
2. A PERMIT IS REQUIRED FROM OCEMA BEFORE EXCAVATION OF FILL IN BASIN
3. BASIN OUTLET IS SIZED TO REGULATE FLOWS FOR A 10 HOUR CYCLE FOR A 100 YEAR STORM - 6 HOUR DURATION.





		ORANGE COUNTY ENVIRONMENTAL MANAGEMENT AGENCY	
		STORM DRAIN IMPROVEMENTS FOR	
		FACILITY L11-B01	
		STORAGE BASIN	
		DWG. No. L11P04-713-1	
NO. DATE DESCRIPTION		PREPARED UNDER SUPERVISION OF	SHEET 6/7
REVISIONS		DATE	
DESIGN BY - DLS		SCALE AS SHOWN / DATE / DWG. NO. L11-B01	
DRAWN - RTC CHECKED			



STANDARD SYMBOLS LIST –– ABBREVIATIONS

A	AMPS	F	FLUSH	MSC	MISCELLANEOUS	RM	ROOM		
AC1	AIR CONDITIONER #	FA	FIRE ALARM	MSB	MAIN SWITCHBOARD	RSG	RIGID STEEL GALVANIZED		
AFF	ABOVE FINISHED FLOOR	FBO	FURNISHED BY OTHERS			RVAT	REDUCED VOLTAGE AUTOTRANSFORMER		
AIC	AVAILABLE INTERRUPTING CURRENT	FDN	FOUNDATION	N	NEUTRAL	R/W	RIGHT OF WAY		
AL	ALARM	FL	FLOOR	N.C.	NORMALLY CLOSED				
ARCH	ARCHITECTURAL	FLUOR	FLUORESCENT	NEC	NATIONAL ELECTRICAL CODE	SCE	SOUTHERN CALIFORNIA EDISON		
ASC	AMPS SHORT CIRCUIT	FUT	FUTURE	NEMA	NATIONAL ELECTRICAL MFGR'S ASSOC.	SD	SMOKE DETECTOR		
ATS	AUTOMATIC TRANSFER SWITCH	FVNR	FULL VOLTAGE NON REVERSING	NIC	NOT IN CONTRACT	SDG&E	SAN DIEGO GAS & ELECTRIC	1L,2L...	1 LAMP, 2 LAMP, ETC
		FVR	FULL VOLTAGE REVERSING	NL	NIGHT LIGHT	SEC	SECONDARY	1P,2P...	1 POLE, 2 POLE, ETC
BKBD	BACKBOARD			N.O.	NORMALLY OPEN	SIM	SIMILAR		
BKR	BREAKER	G	GROUND	NTS	NOT TO SCALE	SM	SURFACE MOUNTED		
BLDG	BUILDING	GFI	GROUND FAULT INTERRUPTER			SP	SPECIAL, SEE SCHEDULE		
		GND	GROUND	OH	OVERHEAD	SQ	SQUARE		
CAB	CABINET	GRD	GRADE	OL	OVERLOAD	SQ FT	SQUARE FEET		
CB	CIRCUIT BREAKER					SS	SOLID STATE		
CCTV	CABLE TELEVISION	HOA	HAND-OFF-AUTO	P	POLE	SS	STAINLESS STEEL		
CKT	CIRCUIT	HP	HORSEPOWER	PB	PULL BOX	SWGR	SWITCHGEAR		
CL	CLOCK	HP1	HEATPUMP #	PC	PHOTOCELL				
CLF	CURRENT LIMITING FUSE	HVAC	HEATING VENTILATION AIR CONDITIONING	PKG	PARKING	TC	TIMECLOCK		
CLG	CEILING	I	INTERCOM	PLC	PROGRAMMABLE LOGIC CONTROLLER	TELE	TELEPHONE	INSTRUMENT RELAY NUMBERS	
CONN	CONNECTION	IBC	INSTALLED BY CONTRACTOR	PLUMB	PLUMBING	TV	TELEVISION	27	UNDERVOLTAGE RELAY
CP1	CONTROL PANEL #	INCAND	INCANDESCENT	PNL	PANEL	TYP	TYPICAL	47	PHASE SEQUENCE RELAY
		IRR CONT	IRRIGATION CONTROLLER	PP	PAY PHONE			50	INSTANTANEOUS OVERCURRENT RELAY
D	DATA OUTLET	IS	INTRUSION SWITCH	PP#	POWER POLE #	UG	UNDERGROUND	51	OVERCURRENT RELAY
DIA	DIAMETER	J	J BOX	PRI	PRIMARY	UGPS	UNDERGROUND PULL SECTION		
DN	DOWN			PS	PRESSURE SWITCH	UL	UNDERWRITERS LABORATORY		
DWG	DRAWING	LS	LIMIT SWITCH	PT	PRESSURE TRANSMITTER	UNO	UNLESS NOTED OTHERWISE		
		LT	LIGHT			UPS	UNINTERRUPTIBLE POWER SUPPLY		
EDF	ELECTRIC DRINKING FOUNTAIN	MAX	MAXIMUM	QTY	QUANTITY			INDICATOR LIGHT COLORS	
EF1	EXHAUST FAN #	MCC	MOTOR CONTROL CENTER	R	ROOF MOUNTED	WP	WEATHERPROOF	A	AMBER
ELECT	ELECTRICAL	MCP	MASTER CONTROL PANEL	R	RELAY	WR	WRAPPED	B	BLUE
EM	EMERGENCY	MECH	MECHANICAL	REC	RECEPTACLE			G	GREEN
ENGR	ENGINEER	MFGR	MANUFACTURER	REFR	REFRIGERATOR	XFMR	TRANSFORMER	R	RED
EQUIP	EQUIPMENT	MH	MOUNTING HEIGHT	REL	RELAY			W	WHITE
EWC	ELECTRIC WATER COOLER	MIN	MINIMUM	RGS	RIGID GALVANIZED STEEL				

GENERAL ELECTRICAL NOTES

1. THE INTENT OF THESE DRAWINGS IS TO DESCRIBE A COMPLETE AND OPERABLE SYSTEM. BRING ANY QUESTIONS TO THE ENGINEERS ATTENTION PRIOR TO BIDDING.
2. PROVIDE GROUNDING WHERE INDICATED OR REQUIRED BY CODE.
3. ALL INSTALLATIONS SHALL MEET FULLY WITH ALL THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE (N.E.C.) MATERIAL SHALL BE U.L. LABELED OR LISTED.
4. PROVIDE GROUND WIRE IN ALL CONDUIT.
5. ALL EQUIPMENT SHALL BE INSTALLED PER MANUFACTURERS REQUIREMENTS. PREMISIS SHALL BE CLEANED OF DIRT AND DEBRIS.
6. SUBCONTRACTOR SHALL FURNISH FOR APPROVAL SHOP DRAWINGS OF ELECTRICAL EQUIPMENT, MOTOR STARTERS, LIGHTING FIXTURES, AND DEVICES PRIOR TO PURCHASE. ALL DIMENSIONS SHOWN ON ELECTRICAL DRAWINGS ARE PRELIMINARY BASED ON AVAILABLE INFORMATION AT BID TIME. FINAL DIMENSIONS MUST BE VERIFIED WITH ACTUAL EQUIPMENT SIZE AND FIELD VERIFIED DIMENSIONS OF EXISTING SITE/BUILDING CONDITIONS AND EQUIPMENT SIZES.
7. ALL CONDUCTORS SHALL BE COPPER TYPE 'THWN' BELOW GRADE AND TYPE 'THHN/THWN' FOR EXPOSED AND ABOVE GRADE WORK.
8. FURNISH AND PAY FOR ALL PERMITS, INCLUDING ELECTRICAL UTILITY CHARGES AND BUILDING DEPARTMENT PERMIT CHARGES.
9. COORDINATE ELECTRICAL WORK WITH REQUIREMENTS OF OTHER TRADES.
10. IN ADDITION TO WIRING HERE INDICATED, CONTRACTOR SHALL REVIEW CIVIL AND OTHER DRAWINGS PRIOR TO BID AND INCLUDE ALL WIRING MATERIALS (INCLUDING RELAYS AND CONTROL DEVICES) INDICATED THERON AS PART OF ELECTRICAL WORK.
11. EACH SWITCH TO BE SEPARATE 2"x3" BOX OR 2"x3" SPACE IN GANG BOX.
12. THE ELECTRICAL SUBCONTRACTOR MUST BE LICENSED BY THE STATE (C-10) AND MUST VISIT THE JOB SITE PRIOR TO BIDDING, EXAMINE EXISTING CONDITIONS, AND INCLUDE IN HIS BID ALL LABOR AND MATERIAL TO INTERFACE WITH OTHER SYSTEMS.
13. THE CONTRACTOR SHALL CONTACT THE ELECTRIC, UTILITY COMPANIES AND OBTAIN FROM THEM THEIR REQUIREMENTS FOR CONDUITS, SUBSTRUCTURES, PADS, METERS, BACKBOARDS, PULL BOXES, ETC., AND INCLUDE COST OF FURNISHING AND INSTALLING THIS REQUIRED EQUIPMENT IN BID.
14. OBTAIN MAXIMUM AVAILABLE FAULT CURRENT FROM THE POWER COMPANY PRIOR TO BID. EQUIPMENT, BUSES, AND CIRCUIT PROTECTIVE DEVICES SHALL HAVE INTERRUPTING RATING TO PROTECT THE ELECTRICAL SYSTEM AGAINST THE MAXIMUM AVAILABLE FAULT CURRENT.
15. ALL UNDERGROUND RISERS AND SWEEPS TO BE PVC COATED RIGID STEEL GALVANIZED CONDUIT.
16. TEMPORARY POWER FOR CONSTRUCTION, DEMOLITION, OR SYSTEM CHECKOUT IS TO BE PROVIDED BY THE CONTRACTOR AND SHALL BE PER N.E.C. AND CAL OSHA REQUIREMENTS.
17. PULL BOXES NOT SPECIFICALLY SIZED ON THE DRAWINGS SHALL BE SIZED PER N.E.C. ARTICLE 370 AND FURNISHED WITH BOLT DOWN TRAFFIC RATED COVER. SET ON 12" PEA GRAVEL BASE.
18. PRIOR TO DIGGING OR EXCAVATION, LOCATE U.G. UTILITIES BY CALLING 1-800-422-4133.
19. CIRCUIT BREAKERS USED AS SWITCHES SHALL BE LISTED FOR SWITCHING AND MARKED "SWD".
20. NOTE: DANGER
    ALL CUSTOM CONTROL PANELS OR PLC'S MUST BE DESIGNED, CONSTRUCTED, PROGRAMMED AND TESTED BY A U.L. 580 APPROVED PANEL SHOP. SUBMIT ALL FABRICATION DRAWINGS INCLUDING SCHEMATICS, WIRING DIAGRAMS WITH WIRE NUMBERS, BILL OF MATERIALS AND OPERATION MANUAL TO THE ENGINEER FOR APROVAL PRIOR TO FABRICATION. ELECTRICAL CONTRACTORS (C-10's) ARE NOT ACCEPTABLE FOR THIS WORK. A LIST OF TYPICAL U.L. PANEL SHOPS FOLLOWS:
    1.) FREEDOM AUTOMATION (760) 231-6192
    2.) NDC (714) 575-8911
    3.) CALIBRATED CONTROLS, INC. (760) 739-5665
    4.) INNOVATIVE, INC. (909) 465-6333
    5.) OR APPROVED EQUAL
21. PROVIDE CONDUIT SEALS WITH DRAIN PLUG (EYSD) IN ALL CONDUITS ENTERING VAULTS TO PREVENT GROUND WATER OR WATER PONDS OR ANY WATER CONTAINMENT AREA FROM DRAINING WATER INTO ELECTRICAL EQUIPMENT IN BELOW GRADE VAULTS (NEC 230-8).

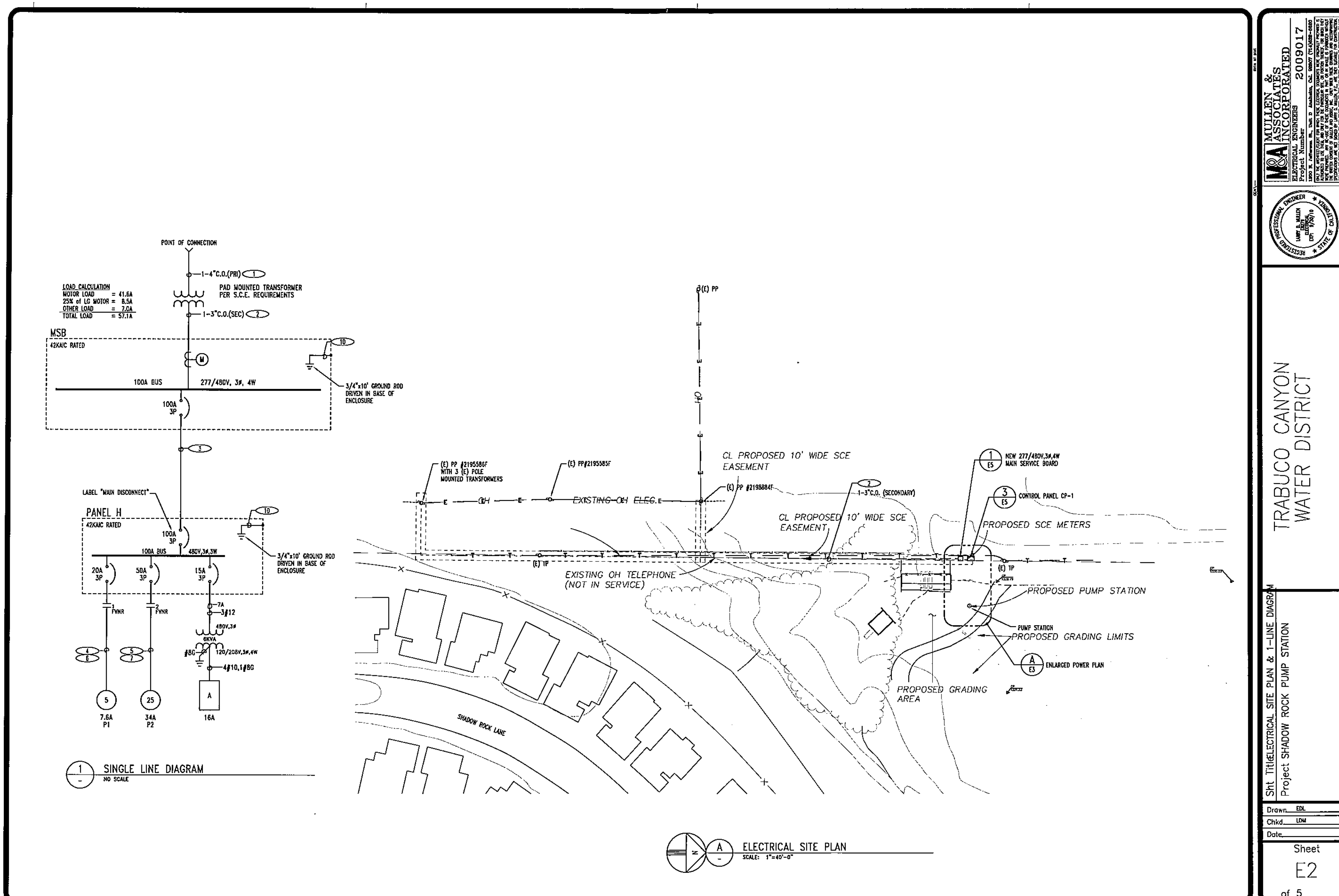
MULLEN & ASSOCIATES INCORPORATED
ELECTRICAL ENGINEERS
Project Number 2009017

TRABUCO CANYON WATER DISTRICT

Sht Title ELECTRICAL SYMBOLS & NOTES
Project SHADOW PARK PUMP STATION

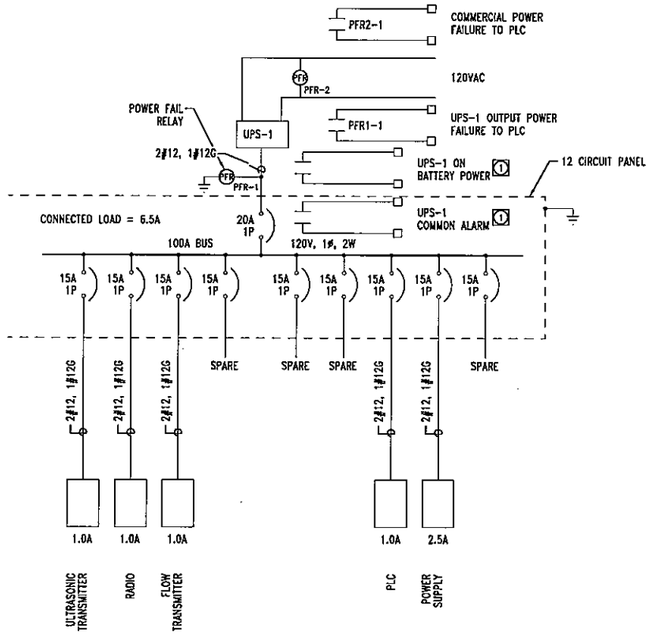
Drawn EDL
Chkd LDM
Date

Sheet E1 of 5


POINT OF CONNECTION
PAD MOUNTED TRANSFORMER PER S.C.E. REQUIREMENTS
LOAD CALCULATION
MOTOR LOAD = 41.6A
25% of LG MOTOR = 8.5A
OTHER LOAD = 7.0A
TOTAL LOAD = 57.1A
MSB
42KAIC RATED
100A BUS
277/480V, 3Ø, 4W
3/4"x10' GROUND ROD DRIVEN IN BASE OF ENCLOSURE
LABEL "MAIN DISCONNECT"
PANEL H
SINGLE LINE DIAGRAM
NO SCALE
CL PROPOSED 10' WIDE SCE EASEMENT
EXISTING OH ELEC.
EXISTING OH TELEPHONE (NOT IN SERVICE)
NEW 277/480V,3Ø,4W MAIN SERVICE BOARD
CONTROL PANEL CP-1
PROPOSED SCE METERS
PROPOSED PUMP STATION
PUMP STATION
PROPOSED GRADING LIMITS
ENLARGED POWER PLAN
PROPOSED GRADING AREA
SHADOW ROCK LANE
ELECTRICAL SITE PLAN
SCALE: 1"=40'-0"
MULLEN & ASSOCIATES INCORPORATED
ELECTRICAL ENGINEERS
Project Number 2009017
TRABUCO CANYON WATER DISTRICT
Sht Title ELECTRICAL SITE PLAN & 1-LINE DIAGRAM
Project SHADOW ROCK PUMP STATION
Drawn EDL
Chkd LDM
Date
Sheet
E2
of 5

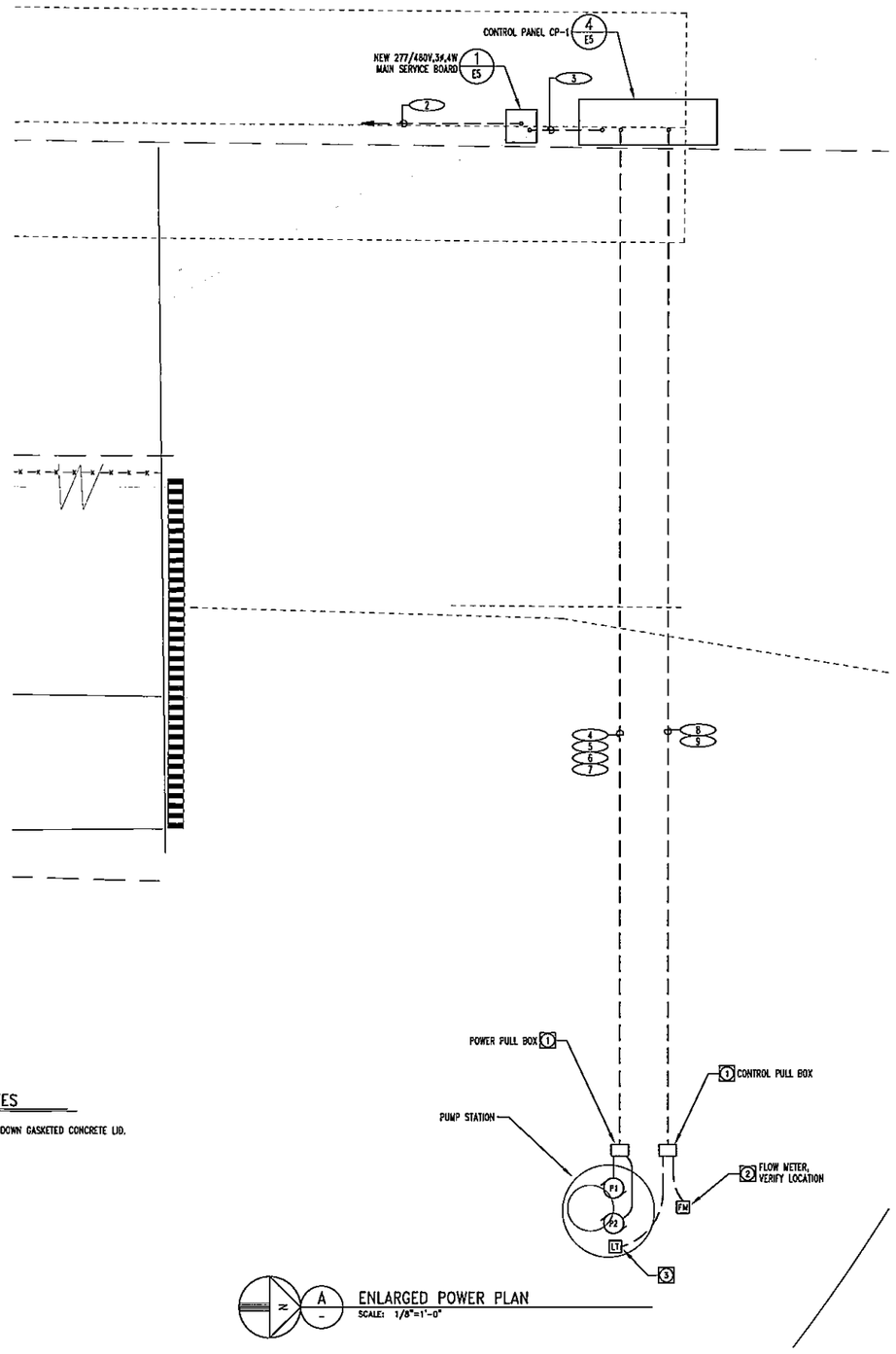
CONDUIT SCHEDULE

PLAN SYMBOL	CONDUIT		WIRE	DESCRIPTION	LOCATION		REMARKS
#	Qty	Size	Qty Size	Use	From	To	
1	1	4"	CONDUIT ONLY	PRIMARY	S.C.E. P.O.C.	S.C.E. TRANSFORMER	
2	1	3"	CONDUIT ONLY	SECONDARY	S.C.E. TRANSFORMER	MSB	
3	1	2"	3#1,1#8G	POWER	MSB	PANEL H	
4	1	3"	PUMP CABLES	POWER	PANEL H, P1 STARTER	P1	
5	1	2"	PUMP CABLES	POWER	PANEL H, P2 STARTER	P2	
6	1	2"	PUMP CABLES	CONTROL	P1 STARTER	P1	MOISTURE & TEMP.
7	1	1"	PUMP CABLES	CONTROL	P2 STARTER	P2	MOISTURE & TEMP.
8	1	1"	TRANSDUCER CABLES	CONTROL	LEVEL TRANSDUCER	CP-1	
9	1	1"	FLOWMETER CABLE	CONTROL	FLOWMETER	CP-1	
10	1	1"	#2G	GROUND	GROUND ROD	LOCAL PANEL	



1 — UPS POWER DISTRIBUTION
NO SCALE

1 PROVIDE INTERPOSING RELAY AS REQUIRED TO PROVIDE COMPATIBLE INPUT TO PLC. THESE INPUTS ARE AN INTEGRAL PART OF THE UPS.



SHEET NOTES

1. 11"x17" PULL BOX WITH BOLT DOWN GASKETED CONCRETE LID.
2. FLOW METER FLOW TUBE
3. LEVEL TRANSDUCER

N — A — ENLARGED POWER PLAN
SCALE: 1/8"=1'-0"

M&A MULLEN & ASSOCIATES INCORPORATED
ELECTRICAL ENGINEERS
Project Number 2009017

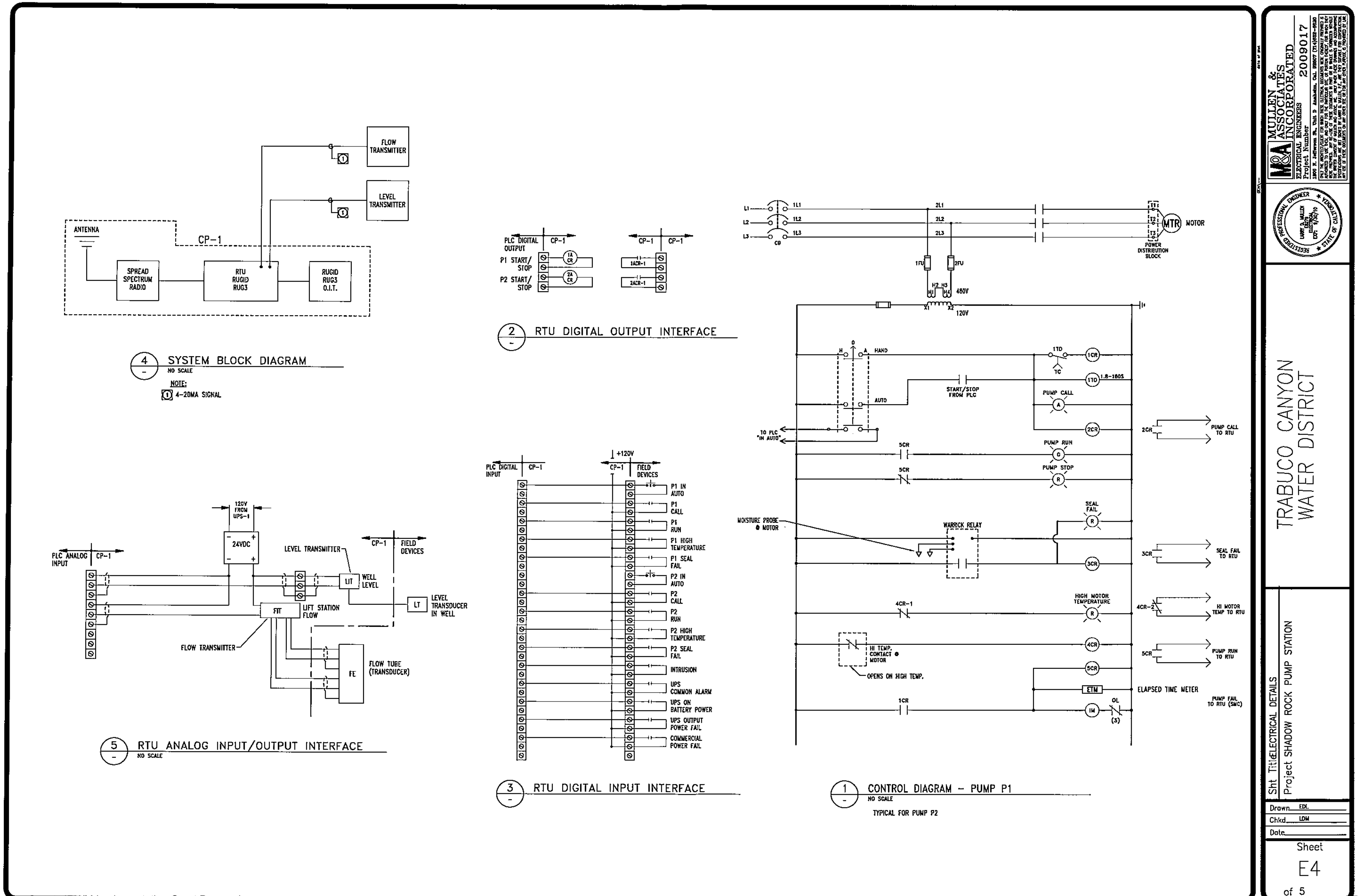
REGISTERED PROFESSIONAL ENGINEER — LARRY B. MULLEN — ELECTRICAL — EXP. 6/30/11 — STATE OF CALIFORNIA

TRABUCO CANYON WATER DISTRICT

Sht Title ELECTRICAL ENLARGED PLAN & DETAILS
Project SHADOW ROCK PUMP STATION

Drawn EDL
Chkd. LDM
Date

Sheet E3 of


FLOW TRANSMITTER
LEVEL TRANSMITTER
ANTENNA
CP-1
SPREAD SPECTRUM RADIO
RTU RUGID RUG3
RUGID RUG3 O.I.T.
4 SYSTEM BLOCK DIAGRAM
NO SCALE
NOTE:
1 4-20MA SIGNAL
PLC DIGITAL OUTPUT
P1 START/ STOP
P2 START/ STOP
2 RTU DIGITAL OUTPUT INTERFACE
120V FROM UPS-1
24VDC
LEVEL TRANSMITTER
PLC ANALOG INPUT
FIELD DEVICES
WELL LEVEL
LEVEL TRANSDUCER IN WELL
LIFT STATION FLOW
FLOW TRANSMITTER
FLOW TUBE (TRANSDUCER)
5 RTU ANALOG INPUT/OUTPUT INTERFACE
NO SCALE
PLC DIGITAL INPUT
+120V
P1 IN AUTO
P1 CALL
P1 RUN
P1 HIGH TEMPERATURE
P1 SEAL FAIL
P2 IN AUTO
P2 CALL
P2 RUN
P2 HIGH TEMPERATURE
P2 SEAL FAIL
INTRUSION
UPS COMMON ALARM
UPS ON BATTERY POWER
UPS OUTPUT POWER FAIL
COMMERCIAL POWER FAIL
3 RTU DIGITAL INPUT INTERFACE
MOTOR
POWER DISTRIBUTION BLOCK
480V
120V
HAND
AUTO
TO PLC "IN AUTO"
START/STOP FROM PLC
PUMP CALL
PUMP RUN
PUMP STOP
PUMP CALL TO RTU
MOISTURE PROBE @ MOTOR
WARRICK RELAY
SEAL FAIL
SEAL FAIL TO RTU
HIGH MOTOR TEMPERATURE
HI MOTOR TEMP TO RTU
HI TEMP. CONTACT @ MOTOR
OPENS ON HIGH TEMP.
PUMP RUN TO RTU
ELAPSED TIME METER
PUMP FAIL TO RTU (SMC)
1 CONTROL DIAGRAM - PUMP P1
NO SCALE
TYPICAL FOR PUMP P2
MULLEN & ASSOCIATES INCORPORATED
ELECTRICAL ENGINEERS
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Sht Title ELECTRICAL DETAILS
Project SHADOW ROCK PUMP STATION
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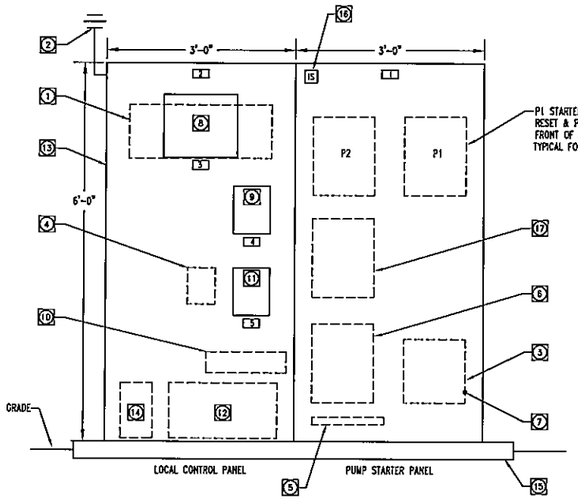


3 — CONTROL PANEL ELEVATION
SCALE: 1"=1'-0"

CONTROL PANEL NOTES

1. RTU-RUG3 MANUFACTURED BY RUGD COMPUTER CO. WITH 12VDC POWER SUPPLY.
2. SPREAD SPECTRUM ANTENNA.
3. TRANSFORMER
4. RADIO.
5. GROUND BUS
6. PANEL 'A'
7. DASHED ITEMS ARE LOCATED BEHIND DOORS.
8. OPERATOR INTERFACE TERMINAL (O.I.T.) RUG3
9. LEVEL TRANSMITTER
10. 120VAC TO 24VDC C/B POWER SUPPLY. POWER ONE #PS24-12-A OR EQUAL. RATED 12A AT 24VDC.
11. FLOW TRANSMITTER
12. UPS
13. NEMA 1 ENCLOSURE - 72"x72"x24"DEEP WITH 2 DOORS. (SHOWN WITH DOORS CLOSED). PROVIDE BARRIER BETWEEN POWER SECTION AND CONTROL SECTION. NEMA 1 ENCLOSURE MOUNTED INSIDE NEMA 3R, 10 GAUGE W.P. ENCLOSURE WITH VANDAL RESISTANT LOCKABLE HANDLES. 30" DEEP. PROVIDE FULL HEIGHT EQUIPMENT MOUNTING PANELS. PROVIDE 4' - 2 LAMP SURFACE MOUNTED FLUORESCENT FIXTURE.
14. UPS PANEL
15. 6" THICK REINFORCED CONCRETE PAD, 3" ABOVE GRADE WITH 2" APRON ON ALL SIDES, WITH GRAVEL BASE.
16. PROVIDE INTRUSION SWITCH ON OUTER DOOR.
17. PANEL 'H'

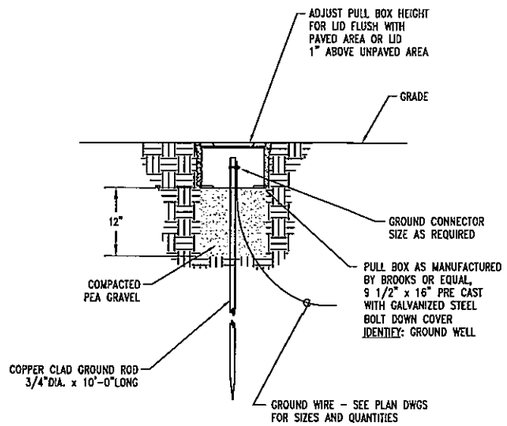
NAMEPLATE SCHEDULE
1. PUMP STARTER PANEL
2. LOCAL CONTROL PANEL
3. GRAPHICAL OPERATOR INTERFACE
4. WET WELL LEVEL #1
5. FLOW

PANEL mtd — 10KAIC RATED WITH 30A MAIN C.B. — 100A bus

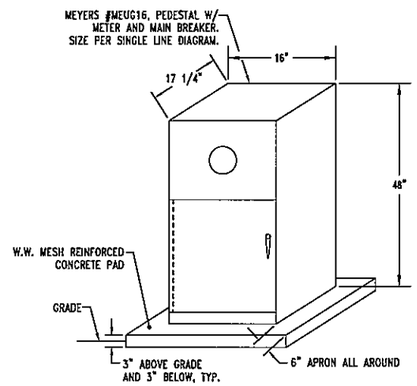
voltage 120/208V, 3ϕ, 4W — **PANEL A SCHEDULE**

ckt. no.	ckt. amps	ckt. pole	no. of outlets 1 2 3	4	5	6	location	watts A	B	C
1	20	1				1	LIGHTING	80		
2	20	1					SPARE	600		
3	20	1					RECEPTACLE		1000	
4	20	1					SPARE		600	
5	20	1					UPS			1200
6	20	1					SPARE			600
7	20	1					SPARE	600		
8	20	1					SPARE	600		
9							SPACE		-	
10							SPACE		-	
11							SPACE			-
12							SPACE			-
total watts	5280							1880	1600	1800

lol — X 1.25 = — watts
other load — watts
total load — 5280 watts = 15A amps



2 — GROUND WELL DETAIL
SCALE: 1"=1'-0"



1 — MAIN SERVICE BOARD
N.T.S.

M&A MULLEN & ASSOCIATES INCORPORATED
ELECTRICAL ENGINEERS
1600 N. Lakeview St., Unit D Anaheim, Cal. 92807 (714)998-9990
Project Number 2009017

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