- **Existing Chloramination Facility** – Ammonia will be added at the existing chloramination facility located at the Los Caballos Pump Station site to produce chloramines. Based on the projected flow of 56 cfs, the existing ammonia storage will provide approximately 37 days of storage at a dosage rate of 0.5 mg/l. Therefore, the existing ammonia storage is adequate. It is assumed that new chemical metering pumps and piping will be required.

- **1305 Pump Station** – Disinfected water from the CCT is conveyed to the 1305 PZ with a proposed 1305 PZ Pump Station. The pump station will be located at the CCT. The pump station will be equipped with 4-200 hp motors (Q = 56 cfs, TDH = 53 feet). It is assumed that only the electrical equipment will be housed in the CMU building of the On-Site Sodium Hypochlorite Generation Facility.

- **1380 Pump Station** – Conveys potable water from the 1305 PZ to the 1380 PZ and will be located at the existing Los Caballos Pump Station site. The pump station will be phased as demands increase to require additional supplies. The pump station will be equipped with 5-250 hp motors (Q = 51 cfs, TDH = 110 feet). It is assumed that only the electrical equipment will be housed in a CMU building.

- **Transmission Pipeline** – Approximately 12,200 linear feet of a new 42-inch diameter transmission pipeline (1380 PZ) will be constructed within De Portola Road from the proposed 1380 Pump Station to Anza Road and be configured to be operated in the 1305 PZ until such time the pipeline is needed to increase conveyance in the 1380 PZ.

7.2 Project Costs

The total costs for the Upper VDC Project including untreated water purchases, amortized capital costs (interest rate assumed at 4.5%), and operating and maintenance costs over a 30-year planning period is approximately $1.51 billion as summarized in Table 7-1. The cost of purchasing MWD treated water over this same period is approximately $1.83 billion. The proposed Project results in a cost savings of approximately $319 million over a 30-year planning period. A detailed cost analysis is provided in Table 1 of **Appendix C**.

Table 7-1
Project Cost Summary

Costs	Upper VDC Project	Treated Water Alternative	Difference
Untreated Water Purchases	$1,221,000,000	$0	-$1,221,000,000
Treated Water Purchases	$0	$1,826,000,000	$1,826,000,000
Capital Costs (Amortized)	$97,880,000	$0	-$97,880,000
O&M Costs	$188,000,000	$0	-$188,000,000
Total Costs	**$1,507,000,000**	**$1,826,000,000**	**$319,000,000**

The capital costs include 20% for engineering, construction management, and administrative costs, and 20% for contingency. The following assumptions were used to determine the project costs:

7.2.1 Water Costs

RCWD has an 80 cfs turnout (EM-21) with MWD where raw water is purchased and conveyed to the Upper VDC basins for recharge. For the purpose of this analysis, it is assumed that RCWD will purchase Untreated Tier I water. RCWD provided MWD's estimated untreated and treated full service water rates through Year 2016 as provided in **Appendix C**. The average rate increase for Years 2012 through 2016 was 3.7% for untreated water and 5.1% for treated water. An average rate increase of 3.0% was applied to calculate the annual untreated and treated water costs for Year 2017 through Year 2043. Annual purchased water costs were based on projected recharge water rates and not pumping rates.

7.2.2 Capital and O&M Costs

<u>Production Wells</u>

- Total estimated capital cost of $20 million
- Capital cost of $2.0 million per well which includes engineering, drilling, and equipping
- Motor horsepower is 100 hp per well based on a total dynamic head of 90 feet
- 2 wells are constructed per year and phased over 5 years for a total of 10 new wells
- 6 wells operate at Year 1 (2014) which includes 4 existing and 2 proposed wells
- 14 wells operate at Year 5 (2018) which includes all 4 existing and 10 proposed wells
- Operating cost at start-up is $45,000 per well assuming continuous operation and energy rate of $0.127/Kw-hr
- Annual energy escalation rate of 5%

<u>Site Acquisition</u>

- Site acquisition cost of $2.53 million based on $50,000 per acre
- Site acquisition required for seven wells
- RCWD is considering purchasing approximately 50.7 acres comprised of APNs 927-150-038, 927-150-018, and 927-150-048 & 049 as shown in Figure 7-1

<u>Yard Piping</u>

- Total estimated capital cost of $5.1 million as summarized in Table 7-2 to convey water from the proposed wells to the CCT and convey potable water from the 1305 Pump Station (CCT) to the 1380 Pump Station
- Negligible O&M costs

Table 7-2
Yard Piping Costs

Pipe Dia.	Cost/ft	Linear Feet	Cost
16"	315	2,900	$913,500
20"	395	1,550	$612,250
24"	470	350	$164,500
30"	590	150	$88,500
36"	710	2,000	$1,420,000
48"	940	2,000	$1,880,000
Total		**8,950**	**$5,079,000**

Chlorine Contact Tank

- Total estimated capital cost of $1.8 million
- Negligible O&M costs

On-Site Sodium Hypochlorite Generation Disinfection

- Capital cost of $1.4 million which includes equipment and CMU building
- Annual operating cost of $160,000 for on-site generation at full production which includes salt, power, water softening, and electrode cell cleaning
- Annual consumption of 275,000 lbs of chlorine based on production of 56 cfs and dosage rate of 2.5 mg/l
- Annual escalation rate of 3.5%

Existing Chloramination Facility

- Capital cost of $100,000 which includes new metering pumps and piping
- Annual ammonia cost of $115,000 at full production
- Annual consumption of 55,000 lbs of ammonia based on production of 56 cfs and dosage rate of 0.5 mg/l
- Annual escalation rate of 3.5%

1305 Pump Station

- Total capital cost of $2.56 million
- Equipped with 4-200 hp VFD motors (Q = 56 cfs, TDH = 53 feet)
- Only the electrical equipment will be housed in a CMU building
- Annual operating cost at full capacity is $413,000 based on continuous operation and energy rate of $0.127/Kw-hr

- Annual energy escalation rate of 5%

1380 Pump Station

- Total capital cost of $4.0 million
- Equipped with 5-250 hp VFD motors (Q = 51 cfs, TDH = 110 feet)
- Only the electrical equipment will be housed in a CMU building
- Annual operating cost at full capacity is $780,000 based on continuous operation and energy rate of $0.127/Kw-hr
- Annual energy escalation rate of 5%

Transmission Pipeline

- 12,200 linear feet of a new 42-inch diameter transmission pipeline (1380 PZ) constructed from the proposed 1380 Pump Station to Anza Road within De Portola Road
- Capital cost of $10.1 million
- Negligible O&M costs

Equipment and Building

- Capital cost of $352,000 and includes $302,000 for the purchase of a D6 tractor for maintaining the recharge ponds and $50,000 for a storage garage consisting of a pre-engineered metal building
- Annual maintenance cost of $5,000 escalated at 3.5% per year

7.3 Sensitivity Analysis

The financial viability of the Project is dependent on the difference between MWD's untreated and treated water rates and the recharge/production rate of the Upper VDC Project. The total projects costs and resultant savings are based on MWD's rate projections through Year 2016, and an annual growth rate of 3.0% for untreated and treated water for Year 2017 through Year 2043. By the end of the 30-year planning study, the difference between untreated and treated water rates is $713/AF.

In order to evaluate the effect of MWD's (untreated and treated) rate escalation would have on the viability of the Project, other annual MWD escalation rates of 2%, 1%, and 0% were considered for Year 2017 through Year 2043. The total project costs based on varying MWD escalation rates are summarized in Table 7-3.

Table 7-3
Project Costs based on Varying MWD Rate Increases

Costs	Recharge = 60 cfs (43,135 AFY)			
	3% MWD Rate Increase	**2% MWD Rate Increase**	**1% MWD Rate Increase**	**0% MWD Rate Increase**
Untreated Water Costs	$1,221,000,000	$1,057,000,000	$919,000,000	$804,000,000
Capital Costs (Amortized)	$97,880,000	$97,880,000	$97,880,000	$97,880,000
O&M Costs	$188,000,000	$188,000,000	$188,000,000	$188,000,000
Total Costs (Rounded)	$1,507,000,000	$1,343,000,000	$1,205,000,000	$1,090,000,000
Treated Water Costs	$1,826,000,000	$1,581,000,000	$1,375,000,000	$1,203,000,000
Difference	**$319 Million**	**$238 Million**	**$170 Million**	**$113 Million**

The economic analysis is based on Todd Engineers Scenario 12 with ten new wells in combination with the existing Upper VDC wells will result in an annual recharge rate of 60 cfs and a pumping rate of 56 cfs. In the event that RCWD is only able to recharge the Upper VDC at 67-percent of the projected recharge rate, or 40 cfs, and with MWD rates escalating at only 1%, the project is still viable after constructing all improvements as shown in Table 7-4.

Table 7-4
Project Costs based on Varying MWD Rate Increases & Recharge Rate

Costs	3% MWD Rate Increase @ 60 cfs Recharge	1% MWD Rate Increase @ 40 cfs Recharge
Untreated Water Costs	$1,221,000,000	$637,860,000
Capital Costs (Amortized)	$97,880,000	$97,880,000
O&M Costs	$188,000,000	$188,000,000
Total Costs (Rounded)	$1,507,000,000	$924,000,000
Treated Water Costs	$1,826,000,000	$954,000,000
Difference	**$319 Million**	**$30 Million**

7.4 'No Project' Alternative

Should RCWD maintain current operations and production levels ("No Project" Alternative) and recharging approximately 26 cfs of untreated water with a production rate of 11 cfs throughout the same 30-year planning period rather than constructing additional recharge and conveyance facilities, the total costs is approximately $1.63 billion as summarized in Table 7-5. The costs include untreated and treated water purchases, well maintenance, and operational costs. The proposed Project therefore results in a cost savings of approximately $120 million over a 30-year planning period over the 'No Project' alternative. A detailed cost analysis is provided in Table 2 of **Appendix C**.

Table 7-5
Project Cost Summary

Costs	Upper VDC Project	'No Project' Alternative	Difference
Untreated Water Purchases	$1,221,000,000	$552,000,000	-$669,000,000
Treated Water Purchases	$0	$1,000,000,000	$1,000,000,000
Capital Costs (Amortized)	$97,880,000	$3,100,000	-$94,780,000
O&M Costs	$188,000,000	$72,000,000	-$116,000,000
Total Costs	**$1,507,000,000**	**$1,627,000,000**	**$120,000,000**

7.5 Feasibility

RCWD has already invested in the facilities necessary to convey 80 cfs of untreated MWD water from EM-21 to the Upper VDC recharge facilities which include an 80 cfs turnout and a 48-inch diameter raw water pipeline. With the recent amendment by CDPH to remove the 40-foot depth to groundwater requirement and subsequent reclassification as groundwater, RCWD can maximize the natural aquifer treatment system at the Upper VDC recharge facilities and its prior investments to realize substantial avoided costs. These total savings range from approximately $113 million to $319 million over 30 years based on MWD's long-term water rates. Based on an expected payback period of eight years, the Project is economically feasible as shown in Table 1 of Appendix C.

Section 8: Upper VDC Phasing Plan

The proposed improvements of the Upper VDC will be phased and considered incrementally in connection with operational experience from monitoring aquifer and pumping responses to additional recharge. In addition, improvements will be keyed to water demands increases within the region requiring the additional water supply. For the phasing proposed at this time, the plan is based on constructing two wells in one year, and then monitoring production for one year prior to drilling the next set of wells. The idea would be that either growth in the region occurs to require additional water supply or the additional water supply would be transmitted to areas beyond the study area region, but within RCWD, to offset other MWD treated water sources. The phasing plan shall consist of four phases, Phase I (Existing) through Phase IV (Ultimate), and include an operational strategy and recommended capital improvement for each phase. The Phasing Plan is based on anticipated recharge and production rates provided by RCWD staff.

8.1 Existing Operation

The current operation at the Upper VDC consists of average annual releases from Vail Lake of 5.5 cfs (4,000 AFY). Temporary piping is currently being used to convey untreated water to strategic areas of the recharge ponds resulting in a continuous recharge rate of 20 cfs. The maximum recharge capacity based on the current configuration is estimated at 26 cfs.

The current average production rate from the four Upper VDC wells is 10.6 cfs resulting in a recovery rate of 53%. This provides a downstream groundwater benefit of 14.9 cfs when coupled with the release of water from Vail Lake. The maximum pumping capacity from the existing Upper VDC wells is approximately 15.6 cfs (7,000 gpm).

8.2 Phase I

Phase I of the Upper VDC Project consists of modifying the existing operation at the Upper VDC to increase recharge from 20 cfs to 25 cfs, rehabilitating the existing wells, and converting disinfection from gaseous chlorine to on-site sodium hypochlorite generation. Phase I is expected to occur from 2012 through 2013.

8.2.1 Phase I - Existing Operational Modifications

The proposed Phase I operational strategy consists of the following:

- Maintain average annual releases from Vail Lake of 5.5 cfs
- Increase recharge to 25 cfs continuous
  - Continue temporary piping to convey pond discharge closer to existing wells
- Increase VDC well recovery:
  - Pumping rate of 15 cfs with a net increase over existing by 4.4 cfs
  - 60% recovery

- Downstream groundwater benefit:
  - 15.5 cfs with a net increase over existing by 0.65 cfs
- GW production:
  - Use VDC well pumping increase to offset treated water purchase
  - Keep downstream groundwater production at existing level and bank 0.65 cfs annually
- Suggested recharge strategy:

Pond No.	Existing Recharge Rate (cfs)	Recharge Rate w/ Modifications (cfs)
U-1	15	15
U-2E	0	0
U-2W	5	5
U-3	0	2.5
U-4	0	0
U-5	0	2.5
Pauba Canyon	0	0
Total	**20**	**25**

8.2.2 Phase I - Existing Operational Facility Improvements

The following are proposed facility improvements to the existing operations:

1. **Well Repair/Maintenance:**
   - Video log and rehabilitate Well Nos. 152 and 153
   - Video log and rehabilitate Well No. 157 is on-going
   - Video log and rehabilitate Well No. 158 has been completed
2. **Disinfection Facilities:**
   - Convert disinfection of the four existing Upper VDC wells from gaseous chlorine to on-site sodium hypochlorite generation (OSG) as proposed for FY2012-13 CIP.
3. **Upper VDC USGS Monitoring Well:**
   - Construct the mid-Pauba Valley USGS monitoring well near the intersection of Butterfield Stage Road and Temecula Parkway per contract work underway with the USGS (Bond Financed Project No. D1517)
   - Determine location of an additional USGS monitoring well

4. **Recovery Wells:**

   - Begin acquisition of adjacent property to the Upper VDC recharge basins for the construction of the off-site ("nearsite") wells and potential chlorine contact basin.

8.2.3 Phase I – Fiscal Analysis (2012 through 2013)

The cost of the Phase I facilities, total O&M costs, untreated water costs, and the avoided MWD treated water costs are summarized in Table 8-1. The costs are based on the proposed Phase I operating period from 2012 through 2013. A detailed cost analysis is provided in Table 1 of **Appendix D**.

Table 8-1
Project Cost Summary – Phase I

Description	Capital Cost ($)
Rehabilitate Well No's 152 and 153	$350,000
On-site NaOCL Generation Disinfection	$1,400,000
Monitoring Well	$500,000
Acquire downstream well property	$2,535,000
Total Capital Costs	**$4,785,000**
Total Amortized Capital Costs	**$471,000**
Water Recharge (cfs)	25
Total O&M Costs	$2,309,000
Untreated Water Costs	$21,135,000
Total Costs	**$23,915,000**
Avoided Treated Water Costs	**$30,074,000**
Cost Savings (Rounded)	**$6,160,000**

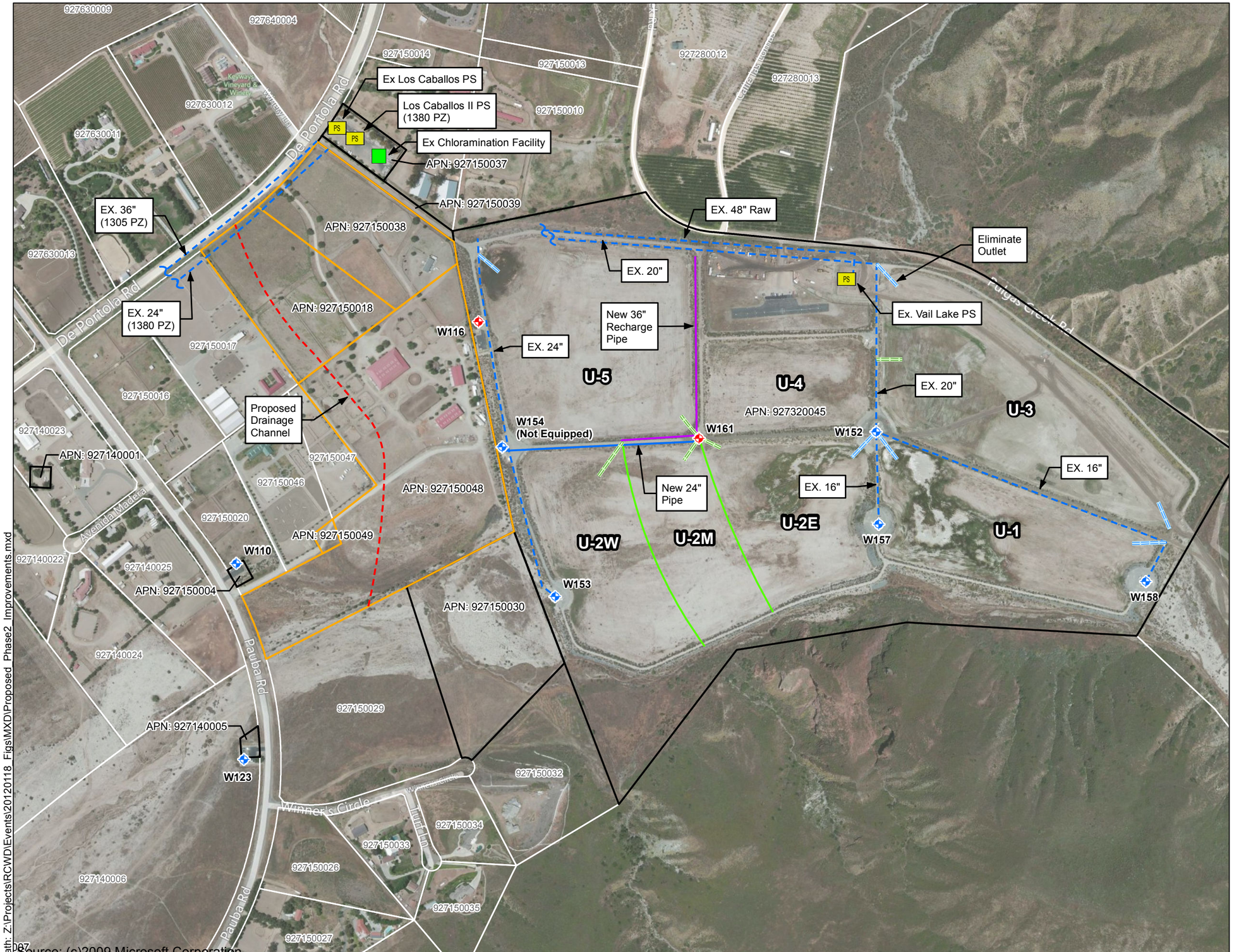
8.3 Phase II

Phase II of the proposed Upper VDC improvements, as shown in **Figure 8-1**, consists of modifying the berms and constructing a portion of the recharge piping, and constructing new production wells to increase the recharge rate to 30 cfs to 40 cfs, depending upon the number of wells constructed. Consideration will be made to equip previously constructed Well 154 and re-drill Well 116 at the existing well sites, and then construct at minimum one additional well for an increase of total production ranging from 18 cfs to 26 cfs from the Upper VDC. The proposed Los Caballos II Pump Station will be constructed at the existing Los Caballos Pump Station site to convey water from the Upper VDC (1305 Pressure Zone) to the 1380 Pressure Zone. Phase II construction is expected to occur from 2014 through 2015 with design of the berms, recharge piping and the Los Caballos II Pump Station completed by October 2013.

8.3.1 Phase II Operational Expansion

The proposed Phase II operational strategy consists of the following:

- Average annual releases from Vail Lake of 5.5 cfs



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Legend

- New Production Well
- Existing Production Well
- Facility
- Pump Station
- Proposed Drainage Channel
- New Low Berms
- Existing Outlet
- New Outlet
- New Recharge Pipe
- Existing Pipeline
- New Pipeline
- Potential Parcels For Acquisition (Phase I)
- RCWD Properties
- Non-RCWD Owned Parcels

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Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District

Proposed Upper VDC Phase II Improvements

K/J 1087103*01
May 2012

Figure 8-1

- Untreated water recharge: 30 to 40 cfs continuous
- VDC well recovery:
  - Recharge rate of 30 cfs:
    - Pumping rate of 18 cfs with a net increase over existing by 7.4 cfs
    - 60% recovery
  - Recharge rate of 40 cfs:
    - Pumping rate of 26 cfs with a net increase over existing by 15.4 cfs
    - 65% recovery
- Downstream groundwater benefit:
  - 17.5 cfs @ 30 cfs recharge rate with a net increase over existing by 2.7 cfs
  - 19.5 cfs @ 40 cfs recharge rate with a net increase over existing by 4.7 cfs
- Ground Water production:
  - Use VDC well pumping increase to offset treated water purchase
  - Downstream aquifer banking:
    - 2.1 cfs @ 30 cfs
    - 3.5 cfs @ 40 cfs
  - Average Pauba Unit GW production budget increase:
    - 0.6 cfs @ 40 cfs recharge
    - 1.2 cfs @ 50 cfs recharge
- Suggested recharge strategy:

	30 cfs Recharge	**40 cfs Recharge**
Pond No.	**Proposed Recharge Rate (cfs)**	**Proposed Recharge Rate (cfs)**
U-1	15	15
U-2E	0	0
U-2M	2.5	5
U-2W	10	10
U-3	0	0
U-4	0	0
U-5	2.5	10
Pauba Canyon	0	0
Total	**30**	**40**

8.3.2 Phase II Facility Improvements

In order to increase the recharge rate to 40 cfs, the following capital improvements are required as shown in **Figure 8-1**:

1. **Berm modifications & Well Pad Construction:**
   - Install new berms to sub-divide Pond U-2 into a total of three ponds
   - Re-grade pond bottoms to direct recharge closer to wells
   - Prepare well pads at Well Nos. 116 & 154 sites to achieve minimum 100' radius around well with confirmation to site replacements wells at these sites (or re-equip existing) from the re-development and pump testing effort
   - Construct well pad for proposed Well No. 161
2. **Pond Discharge Piping Modifications:**
   - Re-locate Pond No. U-3 discharge structure to mid-berm location
   - Install 36-inch diameter raw water pipeline along the berm between Pond Nos. U-4 and U-5 and between Pond Nos. U-2 and U-5
   - Install three (3) pond discharge structures: Pond No. U-5 southeast corner and Pond No. U-2M northeast corner & U-2W northwest corner
3. **Recovery Wells @ Upper VDC:**
   - Increase total VDC well capacity from 15.6 cfs to 26.7 cfs
   - Re-develop and pump test Well No. 154 to determine if it should be equipped or be re-drilled with a replacement well and then equip well.
   - Drill and equip Well No. 161
   - Drill & equip new (replacement) Well No. 116
4. **Partial Ultimate Well Discharge Piping Construction:**
   - 24" pipeline from Well No. 161 to Well No. 154
5. **Los Caballos II Pump Station: (2010 BF, Project No. D1577)**
   - Construct new pump station at existing Los Caballos I Pump Station site to pump from the 1305 PZ to 1380 PZ
   - Initial capacity = 6.7 cfs (2 duty + 1 standby pump, 3.3 cfs each)
   - Ultimate capacity = 22.3 cfs (5 duty + 1 standby pump, 4.5 cfs each)

6. **Downstream Well Repair/Maintenance/Replacement**

   - Continue video logging and rehabilitation of wells per maintenance plan and re-drill those wells determined to have either failed or at the end of their useful life per condition assessment. Budget four (4) downstream wells to be redrilled.

7. **Upper VDC USGS Monitoring Well: (2010 BF Project No. D1517)**

   - Construct one (1) USGS monitoring well near Well No. 233 or Johnson property)

8. **Hydrogeology:**

   - Complete hydraulic modeling of regional transmission/distribution network as part of the master plan study to confirm system improvement needs in Phase III below considering Phase II improvements.

8.3.3 Phase II Fiscal Analysis (2014 – 2015)

The cost of the Phase II facilities, total O&M costs, untreated water costs, and the avoided MWD treated water costs are summarized in Table 8-2. The costs are based on the proposed Phase II operating period from 2014 through 2015. A detailed cost analysis is provided in Table 1 of **Appendix D**.

Table 8-2
Project Cost Summary – Phase II

Description	Capital Cost
Berm Modifications & Grading	$100,000
36" Raw Water Recharge Pipeline	$1,065,000
Pond Discharge Structures (4)	$100,000
Redevelop & Pump Test Well 154	$175,000
Equip Well No. 154	$1,000,000
Drill and Equip Well Nos. 161 & 116	$4,000,000
24" Pipeline from Well No. 161 to 154	$470,000
Los Caballos II Pump Station	$4,000,000
Re-Drill 4 Downstream Wells	$4,000,000
Monitoring Well	$500,000
Total Capital Costs	**$15,410,000**
Total Amortized Capital Costs	**$2,359,000**
Water Recharge (cfs)	40
Total O&M Costs	$3,767,000
Untreated Water Costs	$35,843,000
Total Costs	$41,969,000
Avoided Treated Water Costs	**$53,590,000**
Cost Savings (Rounded)	**$11,621,000**

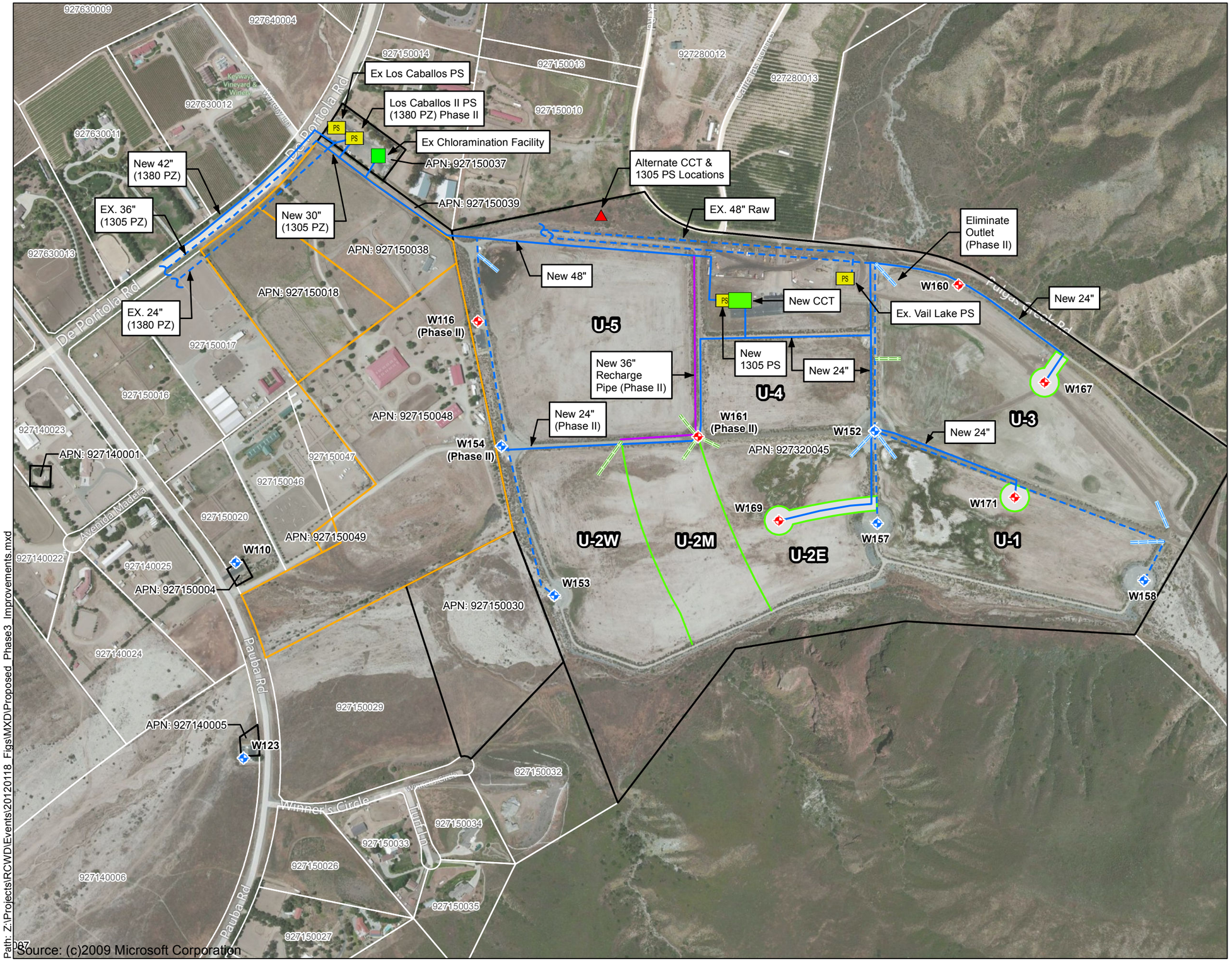
8.4 Phase III

Phase III of the Upper VDC improvements consists of constructing additional well pads for new wells within the Upper VDC and complete recharge piping, and constructing new production wells and associated discharge piping, as shown in **Figure 8-2**, to increase the recharge rate to 40 cfs to 50 cfs, depending upon the number of wells constructed. Additional wells will be constructed to result in total production of 26 cfs to 32.5 cfs from the Upper VDC wells. A new chlorine contact tank (CTT) and centralized treatment facility will be constructed at the Upper VDC to provide centralized disinfection of the Upper VDC wells. It is likely the proposed CCT will be eliminated from the plan as RCWD staff will work with CDPH to maintain the groundwater classification. The proposed 1305 Pump Station and associated transmission pipeline will be constructed to convey flow from the CCT or centralized treatment facility to De Portola Road. Phase III is expected to occur from 2016 through 2019.

8.4.1 Phase III Operation Expansion

The proposed Phase III operational strategy consists of the following:

- Average annual releases from Vail Lake of 5.5 cfs (4,000 AFY)
- Untreated water recharge: 40 to 50 cfs continuous
- VDC well recovery:
  - Recharge rate of 40 cfs:
    - Pumping rate of 26 cfs net increase over existing by 15.4 cfs
    - 65% recovery
  - Recharge rate of 50 cfs:
    - Pumping rate of 32.5 cfs net increase over existing by 21.9 cfs
    - 65% recovery
- Downstream ground water benefit:
  - 19.5 cfs @ 40 cfs recharge rate with a net increase over existing by 4.7 cfs
  - 23.0 cfs @ 50 cfs recharge rate with a net increase over existing by 8.2 cfs
- Ground Water production:
  - Use VDC well pumping increase to offset treated water purchase
  - Downstream aquifer banking:
    - 3.5 cfs @ 40 cfs
    - 5.5 cfs @ 50 cfs
  - Average Pauba Unit GW production budget increase:
    - 1.2 cfs @ 40 cfs recharge
    - 2.61 cfs @ 50 cfs recharge



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Legend

- Existing Production Well
- New Production Well
- Facility
- Pump Station
- Alternate CCT & 1305 PS Locations
- Existing Outlet
- New Outlet (Phase II)
- New Recharge Pipe
- New Pipeline
- Existing Pipeline
- New Low Berms (Phase II)
- New High Berms for Drive Access & Basin Divider
- RCWD Properties
- Non-RCWD Owned Parcels
- Potential Parcels for Acquisition (Phase I)

N

0 250 500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District

Proposed Upper VDC Phase III Improvements

K/J 1087103*01
May 2012

Figure 8-2

8.4.2 Phase III Facilities

In order to increase the recharge rate to 40 cfs to 50 cfs, the following capital improvements are required as shown in **Figure 8-2**:

1. **Hydrogeology:**
   - Confirm operations of recharge/recovery performance and confirm through additional groundwater modeling (if necessary) the location of additional production wells to be located within the Upper VDC basin for increased production.
2. **Recovery Wells @ Upper VDC:**
   - Increase total VDC well capacity between 26.7 cfs to 35.6 cfs
   - Drill & equip up to four (4) proposed wells: W160, W167, W169 & W171 considering locations most beneficial to manage basin recharge capacity and assure against liquefaction of key Upper VDC facilities.
   - Re-bowl existing wells in connection with pump maintenance work.
3. **Partial Ultimate Well Discharge Piping Construction:**
   - New 24” (diameter to be confirmed) pipeline from proposed wells to centralized disinfection facility
   - Re-plumb well discharge pipeline to centralized disinfection facility
4. **Disinfection Facilities:**
   - Construct chlorine contact tank (CCT) & central disinfection facility. Evaluate provisions to expand for Phase IV Operation Expansion as part of preliminary design.
   - Maintain OSG at existing well sites (constructed per Phase I) as back-up disinfection units of centralized disinfection facility.
5. **Pump Station & Transmission Pipelines:**
   - Construct 1305 PZ pump station to boost recovered well supply from centralized disinfection facility.
   - Construct 48” pipeline (diameter to be confirmed) from new 1305 PZ pump station to Los Caballos II (1380 PZ) pump station
   - Construct parallel 42” 1380 PZ pipeline from Los Caballos II Pump Station to Anza Road (plan to temporarily operate in 1305 PZ until east side demands require additional supply to 1380 PZ)

6. **Downstream well repair/maintenance/replacement**
   - Increase downstream pumping capacity
   - Continue video logging and rehabilitation of wells per maintenance plan and re-drill those wells determined to have either failed or at the end of their useful life per condition assessment. Budget four (4) downstream wells to be redrilled.

8.4.3 Phase III Fiscal Analysis (2016 – 2019)

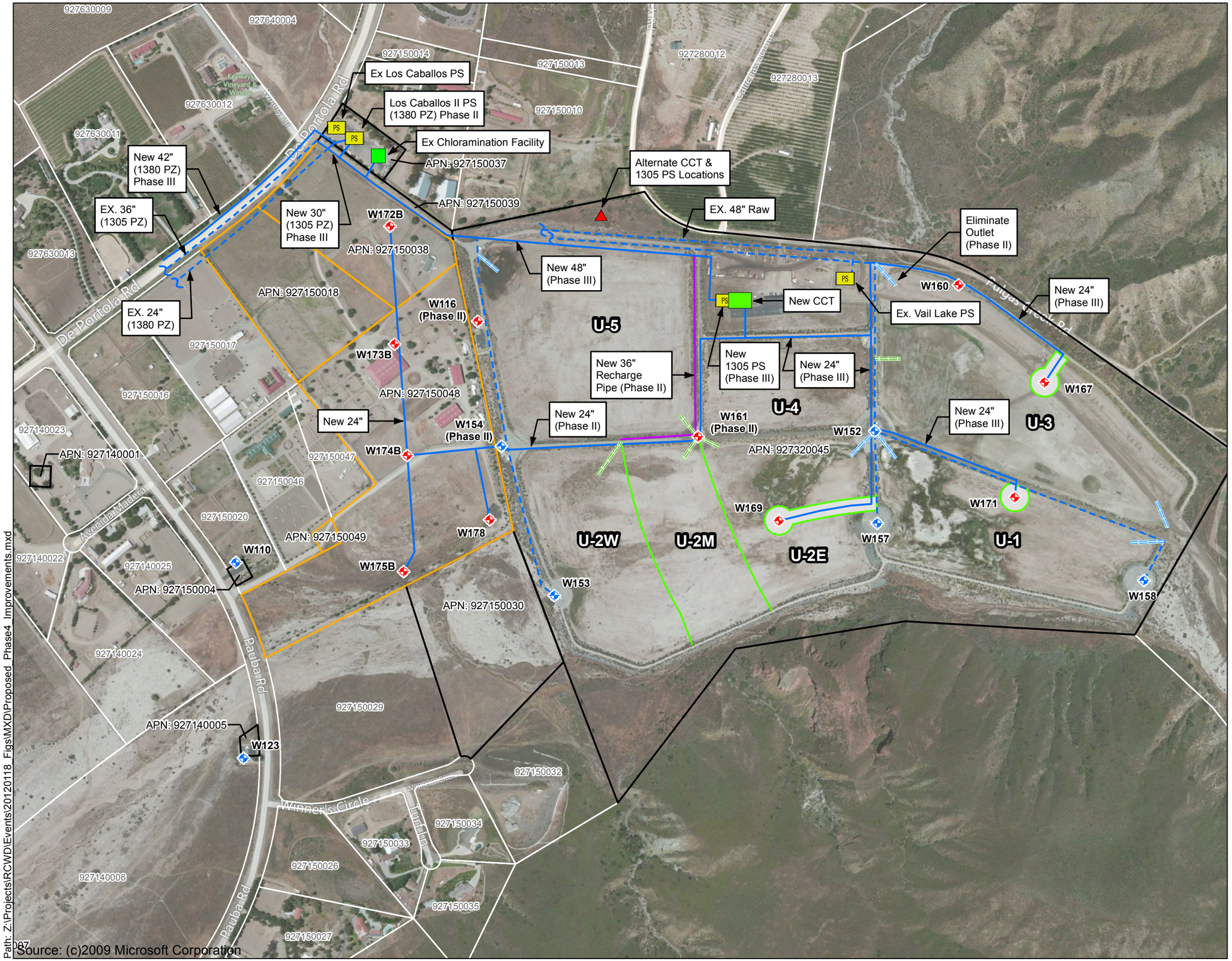
The cost of the Phase III facilities, total O&M costs, untreated water costs, and the avoided MWD treated water costs are summarized in Table 8-3. The costs are based on the proposed Phase III operating period from 2016 through 2019. A detailed cost analysis is provided in Table 1 of **Appendix D**.

Table 8-3
Project Cost Summary – Phase III

Description	Capital Cost
Wells 160, 167, 169, 171	$8,000,000
Re-bowl Existing Wells	$200,000
24" Yard Piping from wells to CCT	$430,000
Upper VDC Chlorine Contact Tank (CCT)	$3,337,000
1305 Pump Station	$2,560,000
48" Pipeline from CCT to Los Caballos II PS	$1,880,000
42" Pipeline (1380 PZ) from Los Caballos II PS to Anza Rd	$10,065,000
Re-Drill 4 Downstream Wells	$4,000,000
Total Capital Costs	**$30,472,000**
Total Amortized Capital Costs	**$11,951,000**
Water Recharge (cfs)	50
Total O&M Costs	$12,279,000
Untreated Water Costs	$97,959,000
Total Costs	$122,189,000
Avoided Treated Water Costs	**$146,560,000**
Cost Savings (Rounded)	**$24,370,000**

8.5 Phase IV "Ultimate"

Phase IV or the ultimate operation consists of constructing new production wells, as shown in **Figure 8-3**, to increase the recharge rate to 50 cfs to 60 cfs, depending upon the number of wells constructed. Additional wells will be constructed to result in total production of 32.5 cfs to 42 cfs from the Upper VDC wells. A new chlorine contact tank may be constructed off-site to provide centralized disinfection of the downgradient wells. Phase IV is expected to occur from 2020 through 2043.



Source: (c)2009 Microsoft Corporation

Path: Z:\Projects\RCWD\Events\20120118_Figs\MXD\Proposed_Phase4_Improvements.mxd

Legend

- Existing Production Well
- New Production Well
- Facility
- Pump Station
- Alternate CCT & 1305 PS Locations
- Existing Outlet
- New Outlet (Phase II)
- New Recharge Pipe
- New Pipeline
- Existing Pipeline
- New Low Berms (Phase II)
- New High Berms for Drive Access & Basin Divider (Phase III)
- RCWD Properties
- Non-RCWD Owned Parcels
- Potential Parcels for Acquisition (Phase I)

N

0 250 500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District

Proposed Upper VDC Phase IV Improvements

K/J 1087103*01
May 2012

Figure 8-3

8.5.1 Phase IV Operation Expansion

The ultimate operational strategy consists of the following:

- Average annual releases from Vail Lake: 5.5 cfs (4,000 AFY)
- Untreated water recharge: 50-60 cfs continuous
- VDC well recovery:
  - Recharge rate of 50 cfs:
    - Pumping rate of 32.5 cfs net increase over existing by 21.9 cfs
    - 65% recovery
  - Recharge rate of 60 cfs:
    - Pumping rate of 42.0 cfs net increase over existing by 31.4 cfs
    - 70% recovery
- Downstream ground water benefit:
  - 23.0 cfs @ 50 cfs recharge with a net increase over existing by 8.2 cfs
  - 23.5 cfs @ 60 cfs recharge with a net increase over existing by 8.6 cfs
- GW production:
  - Use VDC well pumping increase to offset treated water purchase
  - Downstream aquifer banking
    - 5.5 cfs @ 50 cfs
    - 5.5 cfs @ 60 cfs
  - Average Pauba Unit GW production budget increase:
    - 2.6 cfs @ 50 cfs
    - 3.1 cfs @ 60 cfs

8.5.2 Phase IV Facilities

In order to increase the recharge rate to 50 cfs to 60 cfs, the following capital improvements are required:

1. **Hydrogeology:**
   - Confirm operations of recharge/recovery performance and confirm through additional groundwater modeling (if necessary) the location of additional production wells to be located within (and immediately downsteam) of the Upper VDC basin for increased production.

2. **Recovery Wells @ Upper VDC:**
   - Complete acquisition of property adjacent to Upper VDC
   - Drill & equip up to five (5) new recovery wells downstream at property adjacent to Upper VDC.
   - Increase total Upper VDC well capacity between 27.6 cfs to 33.1 cfs
   - Drill & equip W172B, W173B, W174B, W175B & W178
3. **Ultimate Well Discharge Piping Construction:**
   - New 24" (diameter to be confirmed) pipeline for 5 additional wells located on property adjacent to the Upper VDC for directing well production to centralized disinfection facility. Construction of separate downstream well centralized CCT/disinfection facility shall be considered as part of Phase III study of recharge/recovery performance to confirm ultimate expansion as part of Phase III preliminary design. For planning purposes, consider separate downstream well centralized CCT/disinfection facility.
4. **Downstream well repair/maintenance/replacement**
   - Continue video logging and rehabilitation of wells per maintenance plan and re-drill those wells determined to have either failed or at the end of their useful life per condition assessment. Budget four (4) downstream wells to be redrilled.

8.5.3 Phase IV Fiscal Analysis (2020 – 2043)

The cost of the Phase IV facilities, total O&M costs, untreated water costs, and the avoided MWD treated water costs are summarized in Table 8-4. The costs are based on the proposed Phase IV operating period from 2020 through the study period of 2043. A detailed cost analysis is provided in Table 1 of **Appendix D**.

Table 8-4
Project Cost Summary – Phase IV

Description	Capital Cost
Wells (5)	$10,000,000
Downstream Chlorine Contact Tank	$3,337,000
Re-Drill 4 Downstream Wells	$4,000,000
Total Capital Costs	**$17,337,000**
Total Amortized Capital Costs	**$104,683,000**
Water Recharge (cfs)	60
Total O&M Costs	$201,142,000
Untreated Water Costs	$1,081,373,000
Total Costs	$1,387,198,000
Avoided Treated Water Costs	**$1,617,881,000**
Cost Savings (Rounded)	**$230,700,000**

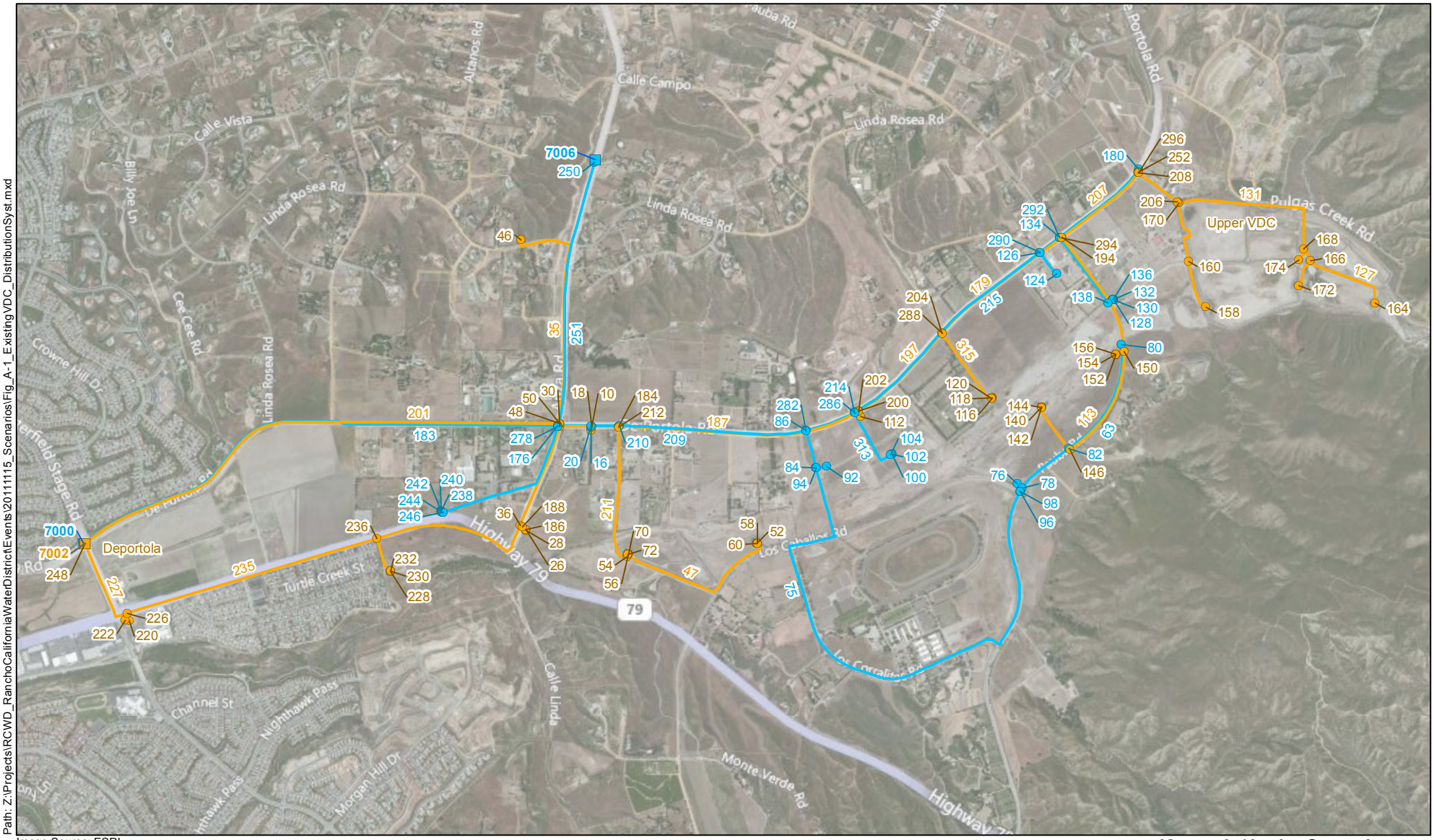
8.6 Summary

A summary of recharge and recovery along with the phased capital and operational costs are presented in Table 8-5.

Table 8-5
Project Phase Summary

Description	Phase I	Phase II	Phase III	Phase IV
Vail Lake Releases (cfs)	5.5	5.5	5.5	5.5
Untreated Water Recharge (cfs)	25	30 - 40	40 - 50	50 - 60
Upper VDC Production (cfs)	15	18 - 26	26 - 32.5	32.5 - 42
Recovery %	60	60 - 65	65	65 - 70
Downstream GW Benefit (cfs)	15.5	17.5 - 19.5	19.5 - 23	23 - 23.5
Downstream Banking (cfs)	0.65	0.58 - 1.2	3.5 - 5.5	5.5
Year(s)	2012 - 2013	2014 - 2015	2016 - 2019	2020 - 2043
Capital Costs	$4,785,000	$15,410,000	$30,472,000	$17,337,000
Total Amortized Costs	$471,000	$2,359,000	$11,951,000	$104,683,000
Total O&M Costs	$2,309,000	$3,767,000	$12,279,000	$201,142,000
Untreated Water Costs	$21,135,000	$35,843,000	$97,959,000	$1,081,373,000
Total Costs	$23,915,000	$41,969,000	$122,189,000	$1,387,198,000
Treated Water Costs if RCWD did not implement this program	$30,074,000	$53,590,000	$146,560,000	$1,617,881,000
Cost Savings	$6,160,000	$11,621,000	$24,370,000	$230,700,000

Appendix A: Modeling Results



Path: Z:\Projects\RCWD_RanchoCaliforniaWaterDistrict\Events\20111115_Scenarios\Fig_A-1_ExistingVDC_DistributionSyst.mxd

Image Source: ESRI

Legend

- Hydraulic Boundary Reservoir (1305 PZ)
- Hydraulic Boundary Reservoir (1380 PZ)
- Junction (1305 PZ)
- Junction (1380 PZ)
- Pipe (1305PZ)
- Pipe (1380 PZ)

N

0 1,250 2,500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District
Upper VDC Optimized Conjunctive Use Study

Existing VDC Distribution System

K/J 1087103*01
November 2011

Figure A-1

Model Output - Existing MDD

JUNCTION: ID (Char)	JUNCTION: DESCRIPT (Char)	JUNCTION: PHASE (Num)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)	OUTPUT: HEAD (ft)	OUTPUT: PRESSURE (psi)
10	W 232	1305	-770	1,184	1,306	53
16		1380	0	1,184	1,306	53
18		1305	0	1,184	1,306	53
20		1380	0	1,184	1,362	77
26	W 124	1305	-300	1,175	1,305	57
28		1305	0	1,175	1,305	57
30		1305	0	1,183	1,306	53
36		1305	0	1,175	1,305	56
46	W 151	1305	-727	1,286	1,356	30
48		1305	0	1,183	1,306	53
50		1305	0	1,183	1,306	53
52	W 131	1305	-1,100	1,198	1,325	55
54		1305	0	1,178	1,314	59
56	W 130	1305	-1,125	1,178	1,315	59
58		1305	0	1,198	1,325	55
60		1305	0	1,198	1,325	55
70		1305	0	1,178	1,315	59
72		1305	0	1,178	1,315	59
76	W 149	1380	-300	1,224	1,371	64
78		1380	0	1,224	1,371	64
80		1380	0	1,246	1,371	54
82		1380	0	1,231	1,371	61
84		1380	0	1,211	1,369	69
86		1380	0	1,208	1,367	69
92	W 233	1380	-1,400	1,211	1,371	69
94		1380	0	1,211	1,370	69
96		1380	0	1,224	1,371	64
98		1380	0	1,224	1,371	64
100	W 210	1380	-566	1,214	1,368	67
102		1380	0	1,214	1,368	67
104		1380	0	1,214	1,368	67
112	W 125	1305	-900	1,217	1,308	39
116	W 132	1305	-800	1,234	1,311	33
118		1305	0	1,234	1,311	33
120		1305	0	1,234	1,311	33
124	W 203	1380	-540	1,243	1,369	55
126		1380	0	1,242	1,368	54
128	W 110	1380	-801	1,250	1,371	52
130		1380	0	1,250	1,371	52
132		1380	0	1,250	1,371	52
134		1380	0	1,247	1,368	52
136		1380	0	1,250	1,371	52
138		1380	0	1,250	1,371	52
140	W 133	1305	-625	1,234	1,312	34
142		1305	0	1,234	1,312	34
144		1305	0	1,234	1,312	34
146		1305	0	1,231	1,311	34
150		1305	0	1,246	1,310	28

Model Output - Existing MDD

152	W 123	1305	-200	1,246	1,310	28
154		1305	0	1,246	1,310	28
156		1305	0	1,246	1,310	28
158	W 153	1305	-833	1,266	1,311	19
160		1305	0	1,266	1,311	19
164	W 158	1305	-1,131	1,280	1,323	19
166		1305	0	1,280	1,322	18
168		1305	0	1,280	1,321	18
170		1305	0	1,260	1,311	22
172	W 157	1305	-1,715	1,280	1,323	19
174	W 152	1305	-1,401	1,280	1,321	18
176	Pauba	1380	4,114	1,183	1,362	77
180		1380	0	1,253	1,368	50
184		1305	0	1,190	1,306	50
186		1305	0	1,175	1,305	57
188		1305	0	1,175	1,305	56
194		1305	0	1,247	1,309	27
200		1305	0	1,217	1,308	39
202		1305	0	1,217	1,308	39
204		1305	0	1,234	1,308	32
206		1305	0	1,260	1,311	22
208	Los Caballos	1305	2,215	1,253	1,309	24
210		1380	0	1,190	1,363	75
212		1305	0	1,190	1,306	50
214		1380	0	1,216	1,367	65
220	W 126	1305	-1,100	1,115	1,304	82
222		1305	0	1,115	1,304	82
226	Butterfield	1305	14,760	1,115	1,304	82
228	W 141	1305	-450	1,152	1,308	68
230		1305	0	1,152	1,308	68
232		1305	0	1,152	1,308	68
236		1305	0	1,152	1,305	66
238	W 234	1380	-240	1,165	994	-74
240		1380	0	1,165	994	-74
242		1380	0	1,165	994	-74
244	Aluarez	1380	11,609	1,165	994	-74
246		1380	0	1,165	1,003	-70
248	Deportola	1305	5,982	1,123	1,305	79
250	Anza	1380	11,000	1,187	1,379	83
278		1380	0	1,183.00	1,360.25	76.8
282		1380	0	1,208.00	1,366.65	68.74
286		1380	0	1,216.00	1,366.92	65.4
288		1305	0	1,234.00	1,308.26	32.18
290		1380	0	1,242.00	1,367.71	54.47
292		1380	0	1,247.00	1,367.74	52.32
294		1305	0	1,247.00	1,308.68	26.73
296		1305	0	1,253.00	1,308.88	24.21

Model Output - Existing MDD

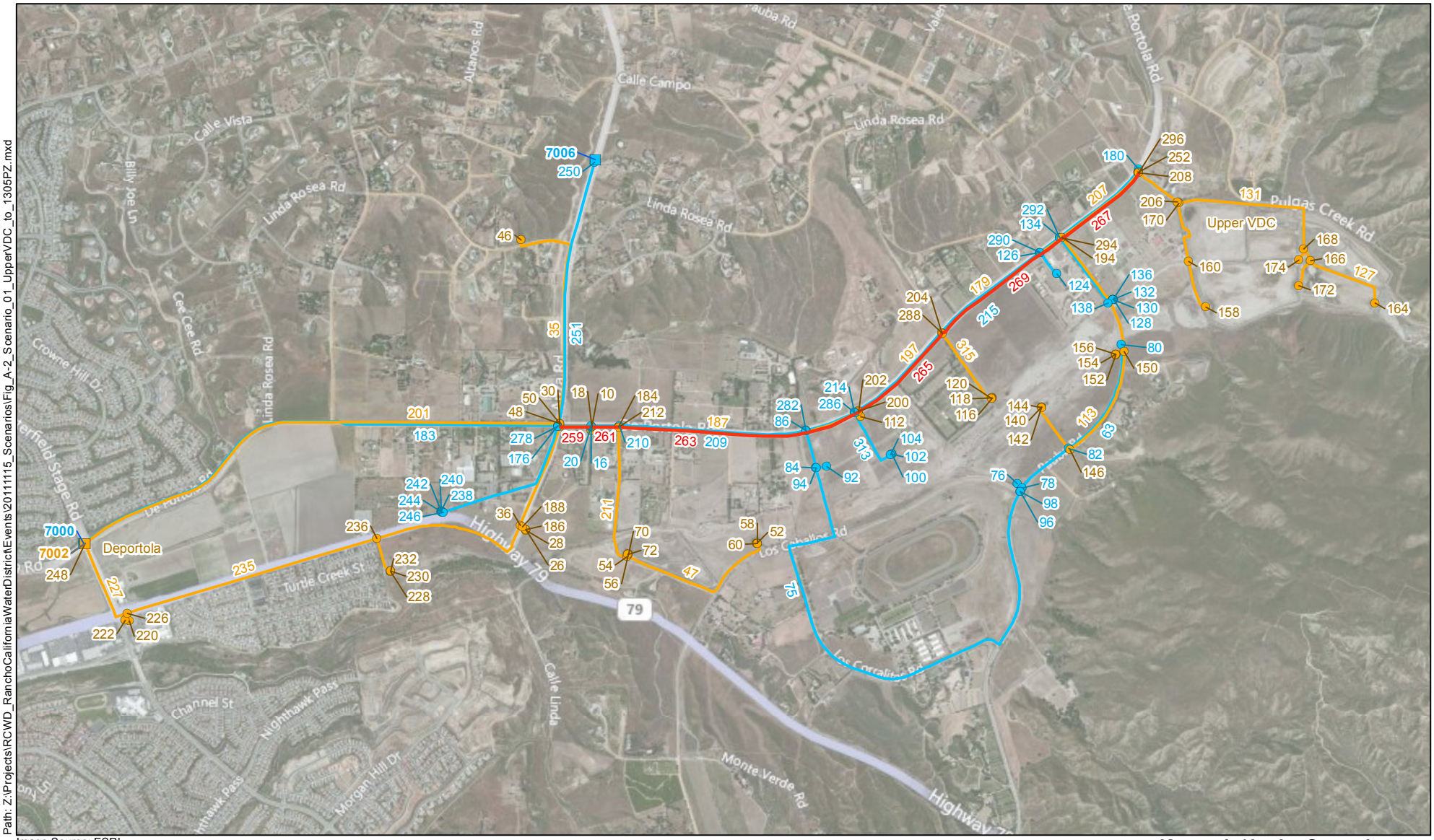
PIPE: ID (Char)	PIPE: PHASE (Num)	OUTPUT: LENGTH (ft)	OUTPUT: DIAMETER (in)	OUTPUT: FLOW (gpm)	OUTPUT: VELOCITY (ft/s)	OUTPUT: HEADLOSS (ft)	OUTPUT: HL_1000 (ft/kft)
15	1380	67	12	770	2.2	0.1	1.8
17	1305	20	12	770	2.2	0.0	1.8
19	1380	22	12	0	0.0	0.0	0.0
25	1305	5	12	300	0.9	0.0	0.3
29	1305	104	12	300	0.9	0.0	0.3
33	1305	1,931	36	3,881	1.2	0.3	0.2
35	1305	4,253	8	727	4.6	49.9	11.7
39	1305	3	12	727	2.1	0.0	1.6
41	1305	10	12	1,100	3.1	0.0	3.5
43	1305	8	12	1,125	3.2	0.0	3.7
45	1305	4	6	1,100	12.5	0.4	102.7
47	1305	2,986	12	1,100	3.1	10.5	3.5
55	1305	3	8	1,125	7.2	0.1	26.4
57	1305	36	12	1,125	3.2	0.1	3.7
61	1380	122	12	300	0.9	0.0	0.3
63	1380	2,225	12	0	0.0	0.0	0.0
65	1380	1,099	14	0	0.0	0.0	0.0
67	1380	75	14	300	0.6	0.0	0.2
69	1380	683	14	1,700	3.5	2.5	3.7
71	1380	193	12	1,400	4.0	1.1	5.5
73	1380	9	8	1,400	8.9	0.3	39.5
75	1380	10,465	14	300	0.6	1.6	0.2
77	1380	10	12	300	0.9	0.0	0.3
79	1380	11	12	566	1.6	0.0	1.0
81	1380	24	8	566	3.6	0.2	7.4
89	1305	9	12	800	2.3	0.0	1.9
91	1305	3	8	800	5.1	0.0	14.0
95	1380	494	10	540	2.2	1.1	2.3
97	1380	7	12	801	2.3	0.0	2.0
99	1380	3	6	801	9.1	0.2	57.0
101	1380	109	12	801	2.3	0.2	2.0
103	1380	2	16	801	1.3	0.0	0.5
105	1380	1,457	12	801	2.3	2.8	2.0
107	1305	10	12	625	1.8	0.0	1.2
109	1305	3	6	625	7.1	0.1	36.0
111	1305	966	12	625	1.8	1.2	1.2
113	1305	2,126	16	625	1.0	0.6	0.3
117	1305	9	12	200	0.6	0.0	0.1
119	1305	2	6	200	2.3	0.0	4.4
121	1305	210	12	200	0.6	0.0	0.2
123	1305	941	20	833	0.9	0.2	0.2
127	1305	1,545	16	1,131	1.8	1.4	0.9
129	1305	273	20	2,846	2.9	0.5	1.7
131	1305	2,991	20	4,247	4.3	10.6	3.6
133	1305	521	16	1,715	2.7	1.0	2.0
135	1305	223	20	1,401	1.4	0.1	0.5
137	1305	31	24	4,247	3.0	0.1	1.5
145	1380	605	24	-3,607	2.6	0.7	1.1

Model Output - Existing MDD

151	1380	939	24	-1,907	1.4	0.3	0.3
153	1380	443	24	-801	0.6	0.0	0.1
159	1305	490	36	7,615	2.4	0.3	0.6
161	1305	10	16	-2,225	3.6	0.0	3.2
163	1305	2	8	300	1.9	0.0	2.3
165	1305	43	16	300	0.5	0.0	0.1
169	1305	55	48	-4,504	0.8	0.0	0.1
171	1305	573	36	8,385	2.6	0.4	0.7
173	1380	510	24	-3,607	2.6	0.6	1.1
177	1380	1,902	24	0	0.0	0.0	0.0
179	1305	2,770	36	3,690	1.2	0.4	0.2
181	1305	8	16	-825	1.3	0.0	0.5
183	1380	9,265	24	-4,987	3.5	18.3	2.0
187	1305	4,406	36	5,390	1.7	1.4	0.3
193	1305	10	16	-900	1.4	0.0	0.6
195	1305	96	12	-900	2.6	0.2	2.4
197	1305	2,074	36	4,490	1.4	0.5	0.2
199	1305	9	12	-800	2.3	0.0	2.0
201	1305	9,259	48	5,231	0.9	0.7	0.1
203	1305	878	24	5,080	3.6	1.8	2.0
205	1305	1,236	24	-833	0.6	0.1	0.1
207	1305	1,815	36	2,865	0.9	0.2	0.1
209	1380	3,374	24	-3,607	2.6	3.7	1.1
211	1305	2,501	16	-2,225	3.6	8.0	3.2
213	1380	32	4	0	0.0	0.0	0.0
215	1380	4,435	24	-1,341	1.0	0.8	0.2
217	1380	6	12	-566	1.6	0.0	1.0
221	1305	3,020	36	4,181	1.3	0.6	0.2
223	1305	97	12	1,100	3.1	0.3	3.5
225	1305	187	42	1,100	0.3	0.0	0.0
227	1305	1,661	36	-9,029	2.9	1.4	0.8
229	1305	11	8	450	2.9	0.1	4.8
233	1305	675	8	450	2.9	3.3	4.8
235	1305	4,700	36	4,631	1.5	1.1	0.2
237	1380	7	8	240	1.5	0.0	1.5
239	1380	3	4	240	6.1	0.1	44.1
241	1380	23	8	240	1.5	0.0	1.5
243	1380	34	12	-11,369	32.3	9.0	265.2
245	1380	2,856	14	-11,369	23.7	357.4	125.1
247	1305	13	48	-751	0.1	0.0	0.0
249	1380	45	24	17,889	12.7	0.9	21.0
251	1380	4,829	24	6,889	4.9	17.3	3.6
253	1305	4	6	-450	5.1	0.1	19.6
305	1380	12	14	-11,369	23.7	1.5	125.2
309	1380	13	14	1,700	3.5	0.1	3.7
313	1380	1,180	12	-566	1.6	1.2	1.0
315	1305	1,506	12	-800	2.3	2.9	1.9
317	1380	10	10	540	2.2	0.0	2.3
319	1380	13	12	801	2.3	0.0	2.0
321	1305	2,377	16	-825	1.3	1.2	0.5
323	1305	12	24	5,080	3.6	0.0	2.0

Model Output - Existing MDD

TANK: ID (Char)	TANK: DESCRIPT (Char)	OUTPUT: DEMAND (gpm)
7000	PZ 1380	-4,987
7002	PZ 1305	-9,780
7006	PZ 1380	-17,889



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Legend

- Proposed Pipe (1305 PZ)
- Hydraulic Boundary Reservoir (1305 PZ)
- Hydraulic Boundary Reservoir (1380 PZ)
- Junction (1305 PZ)
- Junction (1380 PZ)
- Pipe (1305PZ)
- Pipe (1380 PZ)

N

0 1,250 2,500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District
Upper VDC Optimized Conjunctive Use Study

Upper VDC Flows to 1305 PZ
Scenario 1

K/J 1087103*01
November 2011

Figure A-2

Model Output - Scenario 1

JUNCTION: ID (Char)	JUNCTION: DESCRIPT (Char)	JUNCTION: PHASE (Num)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)	OUTPUT: HEAD (ft)	OUTPUT: PRESSURE (psi)
10	W 232	1305	-770	1,184	1317	57
16		1380	0	1,184	1317	57
18		1305	0	1,184	1317	57
20		1380	0	1,184	1362	77
26	W 124	1305	-300	1,175	1314	60
28		1305	0	1,175	1314	60
30		1305	0	1,183	1316	57
36		1305	0	1,175	1314	60
46	W 151	1305	-727	1,286	1365	34
48		1305	0	1,183	1316	57
50		1305	0	1,183	1316	57
52	W 131	1305	-1100	1,198	1336	60
54		1305	0	1,178	1325	64
56	W 130	1305	-1125	1,178	1326	64
58		1305	0	1,198	1336	60
60		1305	0	1,198	1336	60
70		1305	0	1,178	1325	64
72		1305	0	1,178	1325	64
76	W 149	1380	-300	1,224	1371	64
78		1380	0	1,224	1371	64
80		1380	0	1,246	1371	54
82		1380	0	1,231	1371	61
84		1380	0	1,211	1369	69
86		1380	0	1,208	1367	69
92	W 233	1380	-1400	1,211	1371	69
94		1380	0	1,211	1370	69
96		1380	0	1,224	1371	64
98		1380	0	1,224	1371	64
100	W 210	1380	-566	1,214	1368	67
102		1380	0	1,214	1368	67
104		1380	0	1,214	1368	67
112	W 125	1305	-900	1,217	1323	46
116	W 132	1305	-800	1,234	1330	42
118		1305	0	1,234	1330	42
120		1305	0	1,234	1330	42
124	W 203	1380	-540	1,243	1369	55
126		1380	0	1,242	1368	54
128	W 110	1380	-801	1,250	1371	52
130		1380	0	1,250	1371	52
132		1380	0	1,250	1371	52
134		1380	0	1,247	1368	52
136		1380	0	1,250	1371	52
138		1380	0	1,250	1371	52
140	W 133	1305	-625	1,234	1335	44
142		1305	0	1,234	1335	44
144		1305	0	1,234	1335	44
146		1305	0	1,231	1334	45
150		1305	0	1,246	1333	38
152	W 123	1305	-200	1,246	1333	38
154		1305	0	1,246	1333	38
156		1305	0	1,246	1333	38
158	W 153	1305	-833	1,266	1337	31

Model Output - Scenario 1

160		1305	0	1,266	1337	31
164	W 158	1305	-1131	1,280	1350	30
166		1305	0	1,280	1348	30
168		1305	0	1,280	1348	29
170		1305	0	1,260	1337	33
172	W 157	1305	-1715	1,280	1349	30
174	W 152	1305	-1401	1,280	1348	29
176	Pauba	1380	4114	1,183	1362	77
180		1380	0	1,253	1368	50
184		1305	0	1,190	1317	55
186		1305	0	1,175	1314	60
188		1305	0	1,175	1314	60
194		1305	0	1,247	1332	37
200		1305	0	1,217	1323	46
202		1305	0	1,217	1323	46
204		1305	0	1,234	1327	40
206		1305	0	1,260	1337	33
208	Los Caballos	1305	2215	1,253	1335	36
210		1380	0	1,190	1363	75
212		1305	0	1,190	1317	55
214		1380	0	1,216	1367	65
220	W 126	1305	-1100	1,115	1305	82
222		1305	0	1,115	1305	82
226	Butterfield	1305	14760	1,115	1305	82
228	W 141	1305	-450	1,152	1314	70
230		1305	0	1,152	1314	70
232		1305	0	1,152	1314	70
236		1305	0	1,152	1310	69
238	W 234	1380	-240	1,165	994	-74
240		1380	0	1,165	994	-74
242		1380	0	1,165	994	-74
244	Aluarez	1380	11609	1,165	994	-74
246		1380	0	1,165	1003	-70
248	Deportola	1305	5982	1,123	1305	79
250	Anza	1380	11000	1,187	1379	83
252	New Supply	1305	-24043	1,260	1336	33
278		1380	0	1,183	1360	77
282		1380	0	1,208	1367	69
286		1380	0	1,216	1367	65
288		1305	0	1,234	1327	40
290		1380	0	1,242	1368	54
292		1380	0	1,247	1368	52
294		1305	0	1,247	1332	37
296		1305	0	1,253	1335	36

Model Output - Scenario 1

PIPE: ID (Char)	PIPE: PHASE (Num)	OUTPUT: LENGTH (ft)	OUTPUT: DIAMETER (in)	OUTPUT: FLOW (gpm)	OUTPUT: VELOCITY (ft/s)	OUTPUT: HEADLOSS (ft)	OUTPUT: HL_1000 (ft/kft)
15	1380	67	12	770	2.2	0.1	1.8
17	1305	20	12	239	0.7	0.0	0.2
19	1380	22	12	0	0.0	0.0	0.0
25	1305	5	12	300	0.9	0.0	0.3
29	1305	104	12	300	0.9	0.0	0.3
33	1305	1,931	36	10,190	3.2	2.0	1.0
35	1305	4,253	8	727	4.6	49.9	11.7
39	1305	3	12	727	2.1	0.0	1.6
41	1305	10	12	1,100	3.1	0.0	3.5
43	1305	8	12	1,125	3.2	0.0	3.7
45	1305	4	6	1,100	12.5	0.4	102.6
47	1305	2,986	12	1,100	3.1	10.5	3.5
55	1305	3	8	1,125	7.2	0.1	26.3
57	1305	36	12	1,125	3.2	0.1	3.7
61	1380	122	12	300	0.9	0.0	0.3
63	1380	2,225	12	0	0.0	0.0	0.0
65	1380	1,099	14	0	0.0	0.0	0.0
67	1380	75	14	300	0.6	0.0	0.2
69	1380	683	14	1,700	3.5	2.5	3.7
71	1380	193	12	1,400	4.0	1.1	5.5
73	1380	9	8	1,400	8.9	0.3	39.5
75	1380	10,465	14	300	0.6	1.6	0.2
77	1380	10	12	300	0.9	0.0	0.3
79	1380	11	12	566	1.6	0.0	1.0
81	1380	24	8	566	3.6	0.2	7.4
89	1305	9	12	800	2.3	0.0	2.0
91	1305	3	8	800	5.1	0.0	14.0
95	1380	494	10	540	2.2	1.1	2.3
97	1380	7	12	801	2.3	0.0	2.0
99	1380	3	6	801	9.1	0.2	57.0
101	1380	109	12	801	2.3	0.2	2.0
103	1380	2	16	801	1.3	0.0	0.5
105	1380	1,457	12	801	2.3	2.8	2.0
107	1305	10	12	625	1.8	0.0	1.2
109	1305	3	6	625	7.1	0.1	36.0
111	1305	966	12	625	1.8	1.2	1.2
113	1305	2,126	16	625	1.0	0.6	0.3
117	1305	9	12	200	0.6	0.0	0.2
119	1305	2	6	200	2.3	0.0	4.4
121	1305	210	12	200	0.6	0.0	0.2
123	1305	941	20	833	0.9	0.2	0.2
127	1305	1,545	16	1,131	1.8	1.4	0.9
129	1305	273	20	2,846	2.9	0.5	1.7
131	1305	2,991	20	4,247	4.3	10.6	3.6
133	1305	521	16	1,715	2.7	1.0	2.0
135	1305	223	20	1,401	1.4	0.1	0.5
137	1305	31	24	4,247	3.0	0.1	1.5
145	1380	605	24	-3,607	2.6	0.7	1.1
151	1380	939	24	-1,907	1.4	0.3	0.3
153	1380	443	24	-801	0.6	0.0	0.1
159	1305	490	36	12,741	4.0	0.8	1.6
161	1305	10	16	-929	1.5	0.0	0.6

Model Output - Scenario 1

163	1305	2	8	300	1.9	0.0	2.3
165	1305	43	16	300	0.5	0.0	0.1
169	1305	55	48	-22,237	3.9	0.1	1.1
171	1305	573	36	12,980	4.1	0.9	1.6
173	1380	510	24	-3,607	2.6	0.6	1.1
177	1380	1,902	24	0	0.0	0.0	0.0
179	1305	2,770	36	13,879	4.4	5.0	1.8
181	1305	8	16	-825	1.3	0.0	0.5
183	1380	9,265	24	-4,987	3.5	18.3	2.0
187	1305	4,406	36	11,812	3.7	6.0	1.4
193	1305	10	16	2,431	3.9	0.0	3.7
195	1305	96	12	-900	2.6	0.2	2.4
197	1305	2,074	36	14,243	4.5	4.0	1.9
199	1305	9	12	-800	2.3	0.0	2.0
201	1305	9,259	48	22,964	4.1	10.5	1.1
203	1305	878	24	5,080	3.6	1.8	2.0
205	1305	1,236	24	-833	0.6	0.1	0.1
207	1305	1,815	36	13,497	4.3	3.1	1.7
209	1380	3,374	24	-3,607	2.6	3.7	1.1
211	1305	2,501	16	-2,225	3.6	8.0	3.2
213	1380	32	4	0	0.0	0.0	0.0
215	1380	4,435	24	-1,341	1.0	0.8	0.2
217	1380	6	12	-566	1.6	0.0	1.0
221	1305	3,020	36	10,490	3.3	3.3	1.1
223	1305	97	12	1,100	3.1	0.3	3.5
225	1305	187	42	1,100	0.3	0.0	0.0
227	1305	1,661	36	-2,720	0.9	0.2	0.1
229	1305	11	8	450	2.9	0.1	4.8
233	1305	675	8	450	2.9	3.3	4.8
235	1305	4,700	36	10,940	3.5	5.5	1.2
237	1380	7	8	240	1.5	0.0	1.5
239	1380	3	4	240	6.1	0.1	44.1
241	1380	23	8	240	1.5	0.0	1.5
243	1380	34	12	-11,369	32.3	9.0	265.2
245	1380	2,856	14	-11,369	23.7	357.4	125.1
247	1305	13	48	16,983	3.0	0.0	0.7
249	1380	45	24	17,889	12.7	0.9	21.0
251	1380	4,829	24	6,889	4.9	17.3	3.6
253	1305	4	6	-450	5.1	0.1	19.6
255	1305	14	24	24,043	17.1	0.5	36.3
259	1305	577	42	-19,448	4.5	0.9	1.6
261	1305	500	42	-18,917	4.4	0.8	1.5
263	1305	4,418	42	-17,621	4.1	5.9	1.3
265	1305	2,081	36	-14,289	4.5	4.0	1.9
267	1305	1,836	36	-13,411	4.2	3.1	1.7
269	1305	2,779	36	-13,854	4.4	5.0	1.8
305	1380	12	14	-11,369	23.7	1.5	125.2
309	1380	13	14	1,700	3.5	0.1	3.7
313	1380	1180	12	-566	1.6	1.2	1.0
315	1305	1506	12	-800	2.3	2.9	1.9
317	1380	10	10	540	2.2	0.0	2.3
319	1380	13	12	801	2.3	0.0	2.0
321	1305	2377	16	-825	1.3	1.2	0.5
323	1305	12	24	5,080	3.6	0.0	2.0

Model Output - Scenario 1

TANK: ID (Char)	TANK: DESCRIPT (Char)	OUTPUT: DEMAND (gpm)
7000	PZ 1380	-4,987
7002	PZ 1305	14,263
7006	PZ 1380	-17,889

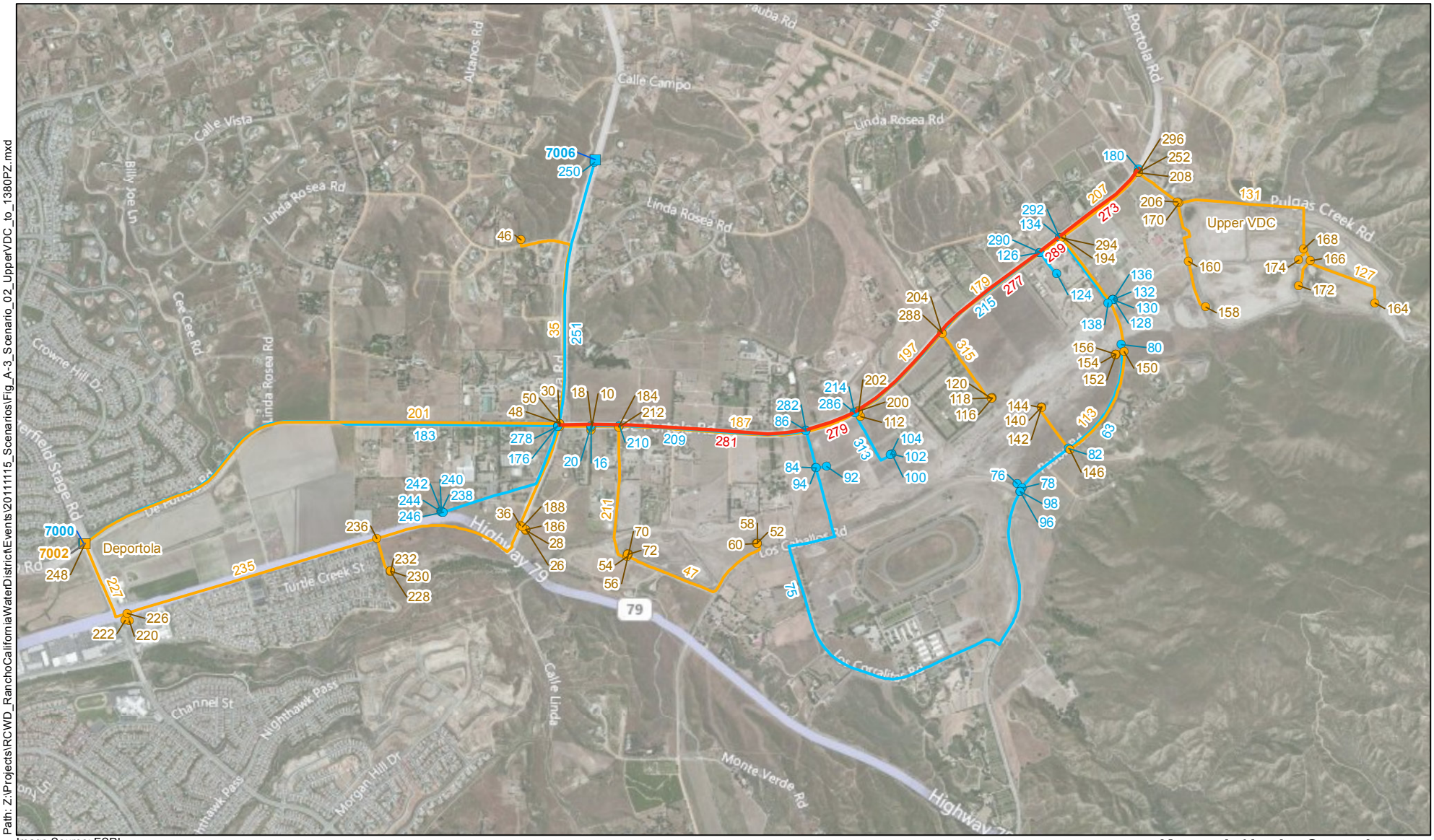


Image Source: ESRI

Path: Z:\Projects\RCWD_RanchoCaliforniaWaterDistrict\Events\20111115_Scenarios\Fig_A-3_Scenario_02_UpperVDC_to_1380PZ.mxd

Legend

- Proposed Pipe (1380 PZ)
- Hydraulic Boundary Reservoir (1305 PZ)
- Hydraulic Boundary Reservoir (1380 PZ)
- Junction (1305 PZ)
- Junction (1380 PZ)
- Pipe (1305PZ)
- Pipe (1380 PZ)

N

0 1,250 2,500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District
Upper VDC Optimized Conjunctive Use Study

Upper VDC Flows to 1380 PZ
Scenario 2

K/J 1087103*01
November 2011

Figure A-3

Model Output - Scenario 2

JUNCTION: ID (Char)	JUNCTION: DESCRIPT (Char)	JUNCTION: PHASE (Num)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)	OUTPUT: HEAD (ft)	OUTPUT: PRESSURE (psi)
10	W 232	1305	-770	1,184	1305	53
16		1380	0	1,184	1305	52
18		1305	0	1,184	1305	52
20		1380	0	1,184	1390	89
26	W 124	1305	-300	1,175	1305	56
28		1305	0	1,175	1305	56
30		1305	0	1,183	1305	53
36		1305	0	1,175	1305	56
46	W 151	1305	-727	1,286	1355	30
48		1305	0	1,183	1305	53
50		1305	0	1,183	1305	53
52	W 131	1305	-1,100	1,198	1324	55
54		1305	0	1,178	1313	59
56	W 130	1305	-1,125	1,178	1313	59
58		1305	0	1,198	1324	55
60		1305	0	1,198	1324	54
70		1305	0	1,178	1313	59
72		1305	0	1,178	1313	59
76	W 149	1380	-300	1,224	1398	75
78		1380	0	1,224	1398	75
80		1380	0	1,246	1398	66
82		1380	0	1,231	1398	72
84		1380	0	1,211	1396	80
86		1380	0	1,208	1394	81
92	W 233	1380	-1,400	1,211	1398	81
94		1380	0	1,211	1397	80
96		1380	0	1,224	1398	75
98		1380	0	1,224	1398	75
100	W 210	1380	-566	1,214	1396	79
102		1380	0	1,214	1396	79
104		1380	0	1,214	1396	79
112	W 125	1305	-900	1,217	1305	38
116	W 132	1305	-800	1,234	1308	32
118		1305	0	1,234	1308	32
120		1305	0	1,234	1308	32
124	W 203	1380	-540	1,243	1400	68
126		1380	0	1,242	1399	68
128	W 110	1380	-801	1,250	1402	66
130		1380	0	1,250	1402	66
132		1380	0	1,250	1402	66
134		1380	0	1,247	1399	66
136		1380	0	1,250	1402	66
138		1380	0	1,250	1402	66
140	W 133	1305	-625	1,234	1308	32
142		1305	0	1,234	1308	32
144		1305	0	1,234	1308	32
146		1305	0	1,231	1307	33
150		1305	0	1,246	1306	26
152	W 123	1305	-200	1,246	1306	26
154		1305	0	1,246	1306	26
156		1305	0	1,246	1306	26
158	W 153	1305	0	1,266	1305	17

Model Output - Scenario 2

160		1305	0	1,266	1305	17
164	W 158	1305	0	1,280	1305	11
166		1305	0	1,280	1305	11
168		1305	0	1,280	1305	11
170		1305	0	1,260	1305	19
172	W 157	1305	0	1,280	1305	11
174	W 152	1305	0	1,280	1305	11
176	Pauba	1380	4,114	1,183	1389	89
180		1380	0	1,253	1401	64
184		1305	0	1,190	1305	50
186		1305	0	1,175	1305	56
188		1305	0	1,175	1305	56
194		1305	0	1,247	1305	25
200		1305	0	1,217	1305	38
202		1305	0	1,217	1305	38
204		1305	0	1,234	1305	31
206		1305	0	1,260	1305	19
208	Los Caballos	1305	2,215	1,253	1305	23
210		1380	0	1,190	1390	87
212		1305	0	1,190	1305	50
214		1380	0	1,216	1395	77
220	W 126	1305	-1,100	1,115	1304	82
222		1305	0	1,115	1303	82
226	Butterfield	1305	14,760	1,115	1303	82
228	W 141	1305	-450	1,152	1308	67
230		1305	0	1,152	1308	67
232		1305	0	1,152	1308	67
236		1305	0	1,152	1304	66
238	W 234	1380	-240	1,165	1022	-62
240		1380	0	1,165	1022	-62
242		1380	0	1,165	1021	-62
244	Aluarez	1380	11,609	1,165	1021	-62
246		1380	0	1,165	1030	-58
248	Deportola	1305	5,982	1,123	1305	79
250	Anza	1380	11,000	1,187	1380	84
270	New Supply	1380	-29,123	1,253	1403	65
278		1380	0	1,183	1388	89
282		1380	0	1,208	1394	81
286		1380	0	1,216	1395	77
288		1305	0	1,234	1305	31
290		1380	0	1,242	1399	68
292		1380	0	1,247	1399	66
294		1305	0	1,247	1305	25
296		1305	0	1,253	1305	23

Model Output - Scenario 2

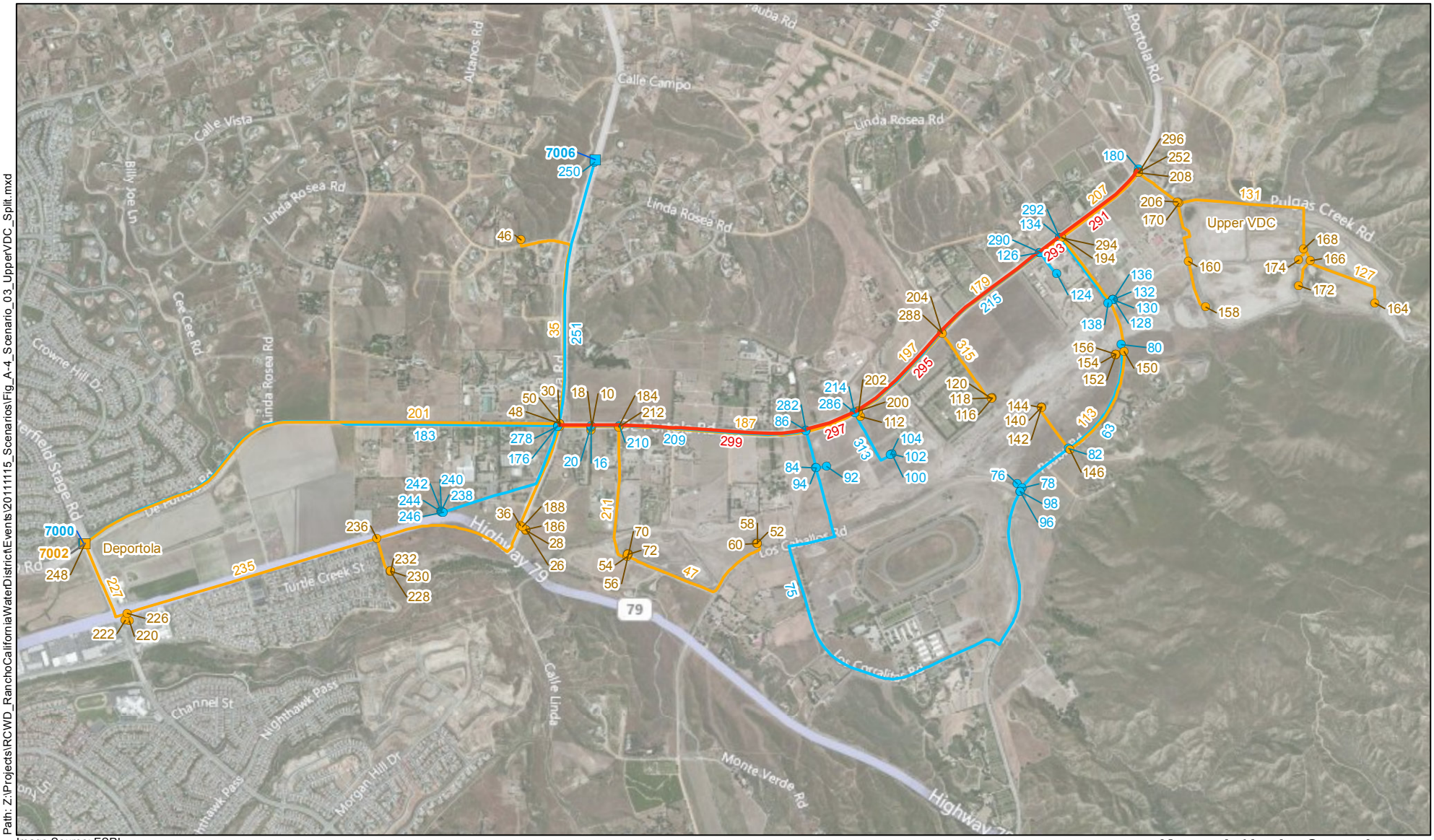
PIPE: ID (Char)	PIPE: PHASE (Num)	OUTPUT: LENGTH (ft)	OUTPUT: DIAMETER (in)	OUTPUT: FLOW (gpm)	OUTPUT: VELOCITY (ft/s)	OUTPUT: HEADLOSS (ft)	OUTPUT: HL_1000 (ft/kft)
15	1380	67	12	770	2.2	0.1	1.8
17	1305	20	12	770	2.2	0.0	1.8
19	1380	22	12	0	0.0	0.0	0.0
25	1305	5	12	300	0.9	0.0	0.3
29	1305	104	12	300	0.9	0.0	0.3
33	1305	1,931	36	3,279	1.0	0.2	0.1
35	1305	4,253	8	727	4.6	49.9	11.7
39	1305	3	12	727	2.1	0.0	1.6
41	1305	10	12	1,100	3.1	0.0	3.5
43	1305	8	12	1,125	3.2	0.0	3.7
45	1305	4	6	1,100	12.5	0.4	102.6
47	1305	2,986	12	1,100	3.1	10.5	3.5
55	1305	3	8	1,125	7.2	0.1	26.3
57	1305	36	12	1,125	3.2	0.1	3.7
61	1380	122	12	300	0.9	0.0	0.3
63	1380	2,225	12	0	0.0	0.0	0.0
65	1380	1,099	14	0	0.0	0.0	0.0
67	1380	75	14	300	0.6	0.0	0.2
69	1380	683	14	1,700	3.5	2.5	3.7
71	1380	193	12	1,400	4.0	1.1	5.5
73	1380	9	8	1,400	8.9	0.3	39.5
75	1380	10,465	14	300	0.6	1.6	0.2
77	1380	10	12	300	0.9	0.0	0.3
79	1380	11	12	566	1.6	0.0	1.0
81	1380	24	8	566	3.6	0.2	7.4
89	1305	9	12	800	2.3	0.0	2.0
91	1305	3	8	800	5.1	0.0	14.0
95	1380	494	10	540	2.2	1.1	2.3
97	1380	7	12	801	2.3	0.0	2.0
99	1380	3	6	801	9.1	0.2	57.0
101	1380	109	12	801	2.3	0.2	2.0
103	1380	2	16	801	1.3	0.0	0.5
105	1380	1,457	12	801	2.3	2.8	2.0
107	1305	10	12	625	1.8	0.0	1.2
109	1305	3	6	625	7.1	0.1	36.0
111	1305	966	12	625	1.8	1.2	1.2
113	1305	2,126	16	625	1.0	0.6	0.3
117	1305	9	12	200	0.6	0.0	0.2
119	1305	2	6	200	2.3	0.0	4.4
121	1305	210	12	200	0.6	0.0	0.2
123	1305	941	20	0	0.0	0.0	0.0
127	1305	1,545	16	0	0.0	0.0	0.0
129	1305	273	20	0	0.0	0.0	0.0
131	1305	2,991	20	0	0.0	0.0	0.0
133	1305	521	16	0	0.0	0.0	0.0
135	1305	223	20	0	0.0	0.0	0.0
137	1305	31	24	0	0.0	0.0	0.0
145	1380	605	24	-3,471	2.5	0.6	1.0
151	1380	939	24	-3,305	2.3	0.9	0.9
153	1380	443	24	-3,211	2.3	0.4	0.9
159	1305	490	36	2,535	0.8	0.0	0.1
161	1305	10	16	-2,225	3.6	0.0	3.2

Model Output - Scenario 2

163	1305	2	8	300	1.9	0.0	2.3
165	1305	43	16	300	0.5	0.0	0.1
169	1305	55	48	-26	0.0	0.0	0.0
171	1305	573	36	3,305	1.0	0.1	0.1
173	1380	510	24	-3,471	2.5	0.5	1.0
177	1380	1,902	24	-3,091	2.2	1.5	0.8
179	1305	2,770	36	-1,390	0.4	0.1	0.0
181	1305	8	16	-825	1.3	0.0	0.5
183	1380	9,265	24	3,471	2.5	9.3	1.0
187	1305	4,406	36	310	0.1	0.0	0.0
193	1305	10	16	-900	1.4	0.0	0.6
195	1305	96	12	-900	2.6	0.2	2.4
197	1305	2,074	36	-590	0.2	0.0	0.0
199	1305	9	12	-800	2.3	0.0	2.0
201	1305	9,259	48	753	0.1	0.0	0.0
203	1305	878	24	0	0.0	0.0	0.0
205	1305	1,236	24	0	0.0	0.0	0.0
207	1305	1,815	36	-2,215	0.7	0.1	0.1
209	1380	3,374	24	-3,471	2.5	3.4	1.0
211	1305	2,501	16	-2,225	3.6	8.0	3.2
213	1380	32	4	0	0.0	0.0	0.0
215	1380	4,435	24	-3,231	2.3	3.9	0.9
217	1380	6	12	-566	1.6	0.0	1.0
221	1305	3,020	36	3,579	1.1	0.5	0.2
223	1305	97	12	1,100	3.1	0.3	3.5
225	1305	187	42	1,100	0.3	0.0	0.0
227	1305	1,661	36	-9,631	3.0	1.5	0.9
229	1305	11	8	450	2.9	0.1	4.8
233	1305	675	8	450	2.9	3.3	4.8
235	1305	4,700	36	4,029	1.3	0.9	0.2
237	1380	7	8	240	1.5	0.0	1.5
239	1380	3	4	240	6.1	0.1	44.1
241	1380	23	8	240	1.5	0.0	1.5
243	1380	34	12	-11,369	32.3	9.0	265.2
245	1380	2,856	14	-11,369	23.7	357.4	125.1
247	1305	13	48	-5,229	0.9	0.0	0.1
249	1380	45	24	-2,775	2.0	0.0	0.7
251	1380	4,829	24	-4,926	3.5	9.3	1.9
253	1305	4	6	-450	5.1	0.1	19.6
271	1380	39	24	29,123	20.7	2.0	51.7
273	1380	1,909	54	26,032	3.7	1.5	0.8
277	1380	4,445	54	27,233	3.8	3.9	0.9
279	1380	950	54	27,725	3.9	0.9	0.9
281	1380	4,497	54	29,259	4.1	4.5	1.0
283	1380	4,839	30	8,849	4.0	9.3	1.9
289	1380	455	54	26,713	3.7	0.4	0.9
305	1380	12.02	14	-11,369	23.7	1.5	125.2
309	1380	12.67	14	1,700	3.5	0.1	3.7
313	1380	1,179.63	12	-566	1.6	1.2	1.0
315	1305	1,506.21	12	-800	2.3	2.9	1.9
317	1380	10.04	10	540	2.2	0.0	2.3
319	1380	12.6	12	801	2.3	0.0	2.0
321	1305	2,376.85	16	-825	1.3	1.2	0.5
323	1305	11.52	24	0	0	0	0

Model Output - Scenario 2

TANK: ID (Char)	TANK: DESCRIPT (Char)	OUTPUT: DEMAND (gpm)
7000	PZ 1380	3,471
7002	PZ 1305	-14,860
7006	PZ 1380	2,775



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Legend

- Proposed Pipe (1380 PZ)
- Hydraulic Boundary Reservoir (1305 PZ)
- Hydraulic Boundary Reservoir (1380 PZ)
- Junction (1305 PZ)
- Junction (1380 PZ)
- Pipe (1305PZ)
- Pipe (1380 PZ)

N

0 1,250 2,500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District
Upper VDC Optimized Conjunctive Use Study

Upper VDC Flows Split
Scenario 3

K/J 1087103*01
November 2011

Figure A-4

Model Output - Scenario 3

JUNCTION: ID (Char)	JUNCTION: DESCRIPT (Char)	JUNCTION: PHASE (Num)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)	OUTPUT: HEAD (ft)	OUTPUT: PRESSURE (psi)
10	W 232	1305	-770	1,184	1307	53
16		1380	0	1,184	1306	53
18		1305	0	1,184	1306	53
20		1380	0	1,184	1396	92
26	W 124	1305	-300	1,175	1306	57
28		1305	0	1,175	1306	57
30		1305	0	1,183	1306	53
36		1305	0	1,175	1306	57
46	W 151	1305	-727	1,286	1356	30
48		1305	0	1,183	1306	53
50		1305	0	1,183	1306	53
52	W 131	1305	-1,100	1,198	1326	55
54		1305	0	1,178	1315	59
56	W 130	1305	-1,125	1,178	1315	59
58		1305	0	1,198	1326	55
60		1305	0	1,198	1325	55
70		1305	0	1,178	1315	59
72		1305	0	1,178	1315	59
76	W 149	1380	-300	1,224	1407	79
78		1380	0	1,224	1407	79
80		1380	0	1,246	1407	70
82		1380	0	1,231	1407	76
84		1380	0	1,211	1406	84
86		1380	0	1,208	1403	85
92	W 233	1380	-1,400	1,211	1407	85
94		1380	0	1,211	1406	85
96		1380	0	1,224	1407	79
98		1380	0	1,224	1407	79
100	W 210	1380	-566	1,214	1406	83
102		1380	0	1,214	1406	83
104		1380	0	1,214	1406	83
112	W 125	1305	-900	1,217	1309	40
116	W 132	1305	-800	1,234	1313	34
118		1305	0	1,234	1313	34
120		1305	0	1,234	1313	34
124	W 203	1380	-540	1,243	1413	74
126		1380	0	1,242	1412	74
128	W 110	1380	-801	1,250	1416	72
130		1380	0	1,250	1416	72
132		1380	0	1,250	1416	72
134		1380	0	1,247	1413	72
136		1380	0	1,250	1416	72
138		1380	0	1,250	1416	72
140	W 133	1305	-625	1,234	1313	34
142		1305	0	1,234	1313	34
144		1305	0	1,234	1313	34
146		1305	0	1,231	1312	35
150		1305	0	1,246	1311	28
152	W 123	1305	-200	1,246	1312	28
154		1305	0	1,246	1312	28
156		1305	0	1,246	1312	28
158	W 153	1305	-833	1,266	1313	20

Model Output - Scenario 3

160		1305	0	1,266	1313	20
164	W 158	1305	-1,131	1,280	1325	19
166		1305	0	1,280	1324	19
168		1305	0	1,280	1323	19
170		1305	0	1,260	1312	23
172	W 157	1305	-1,715	1,280	1325	19
174	W 152	1305	-1,401	1,280	1323	19
176	Pauba	1380	4,114	1,183	1394	92
180		1380	0	1,253	1416	70
184		1305	0	1,190	1307	51
186		1305	0	1,175	1306	57
188		1305	0	1,175	1306	57
194		1305	0	1,247	1310	27
200		1305	0	1,217	1309	40
202		1305	0	1,217	1309	40
204		1305	0	1,234	1310	33
206		1305	0	1,260	1312	23
208	Los Caballos	1305	2,215	1,253	1311	25
210		1380	0	1,190	1397	90
212		1305	0	1,190	1307	51
214		1380	0	1,216	1405	82
220	W 126	1305	-1,100	1,115	1304	82
222		1305	0	1,115	1304	82
226	Butterfield	1305	14,760	1,115	1304	82
228	W 141	1305	-450	1,152	1308	68
230		1305	0	1,152	1308	68
232		1305	0	1,152	1308	68
236		1305	0	1,152	1305	66
238	W 234	1380	-240	1,165	1027	-60
240		1380	0	1,165	1027	-60
242		1380	0	1,165	1027	-60
244	Aluarez	1380	11,609	1,165	1027	-60
246		1380	0	1,165	1036	-56
248	Deportola	1305	5,982	1,123	1305	79
250	Anza	1380	11,000	1,187	1380	84
272	New Supply (1380)	1380	-22,876	1,253	1417	71
274	New Supply (1305)	1305	-1,167	1,253	1311	25
278		1380	0	1,183	1393	91
282		1380	0	1,208	1403	85
286		1380	0	1,216	1405	82
288		1305	0	1,234	1310	33
290		1380	0	1,242	1412	74
292		1380	0	1,247	1413	72
294		1305	0	1,247	1310	27
296		1305	0	1,253	1311	25

Model Output - Scenario 3

PIPE: ID (Char)	PIPE: PHASE (Num)	OUTPUT: LENGTH (ft)	OUTPUT: DIAMETER (in)	OUTPUT: FLOW (gpm)	OUTPUT: VELOCITY (ft/s)	OUTPUT: HEADLOSS (ft)	OUTPUT: HL_1000 (ft/kft)
15	1380	67	12	770	2.2	0.1	1.8
17	1305	20	12	770	2.2	0.0	1.8
19	1380	22	12	0	0.0	0.0	0.0
25	1305	5	12	300	0.9	0.0	0.3
29	1305	104	12	300	0.9	0.0	0.3
33	1305	1,931	36	4,095	1.3	0.4	0.2
35	1305	4,253	8	727	4.6	49.9	11.7
39	1305	3	12	727	2.1	0.0	1.6
41	1305	10	12	1,100	3.1	0.0	3.5
43	1305	8	12	1,125	3.2	0.0	3.7
45	1305	4	6	1,100	12.5	0.4	102.7
47	1305	2,986	12	1,100	3.1	10.5	3.5
55	1305	3	8	1,125	7.2	0.1	26.4
57	1305	36	12	1,125	3.2	0.1	3.7
61	1380	122	12	300	0.9	0.0	0.3
63	1380	2,225	12	0	0.0	0.0	0.0
65	1380	1,099	14	0	0.0	0.0	0.0
67	1380	75	14	300	0.6	0.0	0.2
69	1380	683	14	1,700	3.5	2.5	3.7
71	1380	193	12	1,400	4.0	1.1	5.5
73	1380	9	8	1,400	8.9	0.3	39.5
75	1380	10,465	14	300	0.6	1.6	0.2
77	1380	10	12	300	0.9	0.0	0.3
79	1380	11	12	566	1.6	0.0	1.0
81	1380	24	8	566	3.6	0.2	7.4
89	1305	9	12	800	2.3	0.0	2.0
91	1305	3	8	800	5.1	0.0	14.0
95	1380	494	10	540	2.2	1.1	2.3
97	1380	7	12	801	2.3	0.0	2.0
99	1380	3	6	801	9.1	0.2	57.0
101	1380	109	12	801	2.3	0.2	2.0
103	1380	2	16	801	1.3	0.0	0.5
105	1380	1,457	12	801	2.3	2.8	2.0
107	1305	10	12	625	1.8	0.0	1.2
109	1305	3	6	625	7.1	0.1	36.0
111	1305	966	12	625	1.8	1.2	1.2
113	1305	2,126	16	625	1.0	0.6	0.3
117	1305	9	12	200	0.6	0.0	0.1
119	1305	2	6	200	2.3	0.0	4.4
121	1305	210	12	200	0.6	0.0	0.2
123	1305	941	20	833	0.9	0.2	0.2
127	1305	1,545	16	1,131	1.8	1.4	0.9
129	1305	273	20	2,846	2.9	0.5	1.7
131	1305	2,991	20	4,247	4.3	10.6	3.6
133	1305	521	16	1,715	2.7	1.0	2.0
135	1305	223	20	1,401	1.4	0.1	0.5
137	1305	31	24	4,247	3.0	0.1	1.5
145	1380	605	24	-4,947	3.5	1.2	1.9
151	1380	939	24	-4,662	3.3	1.6	1.7
153	1380	443	24	-4,475	3.2	0.7	1.6
159	1305	490	36	8,782	2.8	0.4	0.8
161	1305	10	16	-2,225	3.6	0.0	3.2

Model Output - Scenario 3

163	1305	2	8	300	1.9	0.0	2.3
165	1305	43	16	300	0.5	0.0	0.1
169	1305	55	48	-5,457	1.0	0.0	0.1
171	1305	573	36	9,552	3.0	0.5	0.9
173	1380	510	24	-4,947	3.5	1.0	1.9
177	1380	1,902	24	-4,278	3.0	2.8	1.5
179	1305	2,770	36	4,857	1.5	0.7	0.3
181	1305	8	16	-825	1.3	0.0	0.5
183	1380	9,265	24	4,392	3.1	14.4	1.6
187	1305	4,406	36	6,557	2.1	2.0	0.5
193	1305	10	16	-900	1.4	0.0	0.6
195	1305	96	12	-900	2.6	0.2	2.4
197	1305	2,074	36	5,657	1.8	0.7	0.4
199	1305	9	12	-800	2.3	0.0	2.0
201	1305	9,259	48	6,184	1.1	0.9	0.1
203	1305	878	24	5,080	3.6	1.8	2.0
205	1305	1,236	24	-833	0.6	0.1	0.1
207	1305	1,815	36	4,032	1.3	0.3	0.2
209	1380	3,374	24	-4,947	3.5	6.6	1.9
211	1305	2,501	16	-2,225	3.6	8.0	3.2
213	1380	32	4	0	0.0	0.0	0.0
215	1380	4,435	24	-4,528	3.2	7.3	1.7
217	1380	6	12	-566	1.6	0.0	1.0
221	1305	3,020	36	4,395	1.4	0.7	0.2
223	1305	97	12	1,100	3.1	0.3	3.5
225	1305	187	42	1,100	0.3	0.0	0.0
227	1305	1,661	36	-8,815	2.8	1.3	0.8
229	1305	11	8	450	2.9	0.1	4.8
233	1305	675	8	450	2.9	3.3	4.8
235	1305	4,700	36	4,845	1.5	1.2	0.3
237	1380	7	8	240	1.5	0.0	1.5
239	1380	3	4	240	6.1	0.1	44.1
241	1380	23	8	240	1.5	0.0	1.5
243	1380	34	12	-11,369	32.3	9.0	265.2
245	1380	2,856	14	-11,369	23.7	357.4	125.1
247	1305	13	48	202	0.0	0.0	0.0
249	1380	45	24	4,392	3.1	0.1	1.6
251	1380	4,829	24	-6,260	4.4	14.5	3.0
253	1305	4	6	-450	5.1	0.1	19.6
285	1380	29	24	22,876	16.2	1.0	33.1
287	1305	22	24	1,167	0.8	0.0	0.1
291	1380	1,910	42	18,598	4.3	2.8	1.5
293	1380	456	42	19,202	4.5	0.7	1.6
295	1380	4,452	42	19,689	4.6	7.3	1.6
297	1380	956	42	20,121	4.7	1.6	1.7
299	1380	4,496	42	21,536	5.0	8.7	1.9
303	1380	4,844	8	348	2.2	14.5	3.0
305	1380	12	14	-11,369	23.7	1.5	125.15
309	1380	13	14	1,700	3.54	0.05	3.71
313	1380	1,180	12	-566	1.61	1.21	1.02
315	1305	1,506	12	-800	2.27	2.93	1.94
317	1380	10	10	540	2.21	0.02	2.29
319	1380	13	12	801	2.27	0.02	1.95
321	1305	2,377	16	-825	1.32	1.2	0.51
323	1305	12	24	5,080	3.6	0.02	2.03

Model Output - Scenario 3

TANK: ID (Char)	TANK: DESCRIPT (Char)	OUTPUT: DEMAND (gpm)
7000	PZ 1380	4,392
7002	PZ 1305	-8,613
7006	PZ 1380	-4,392

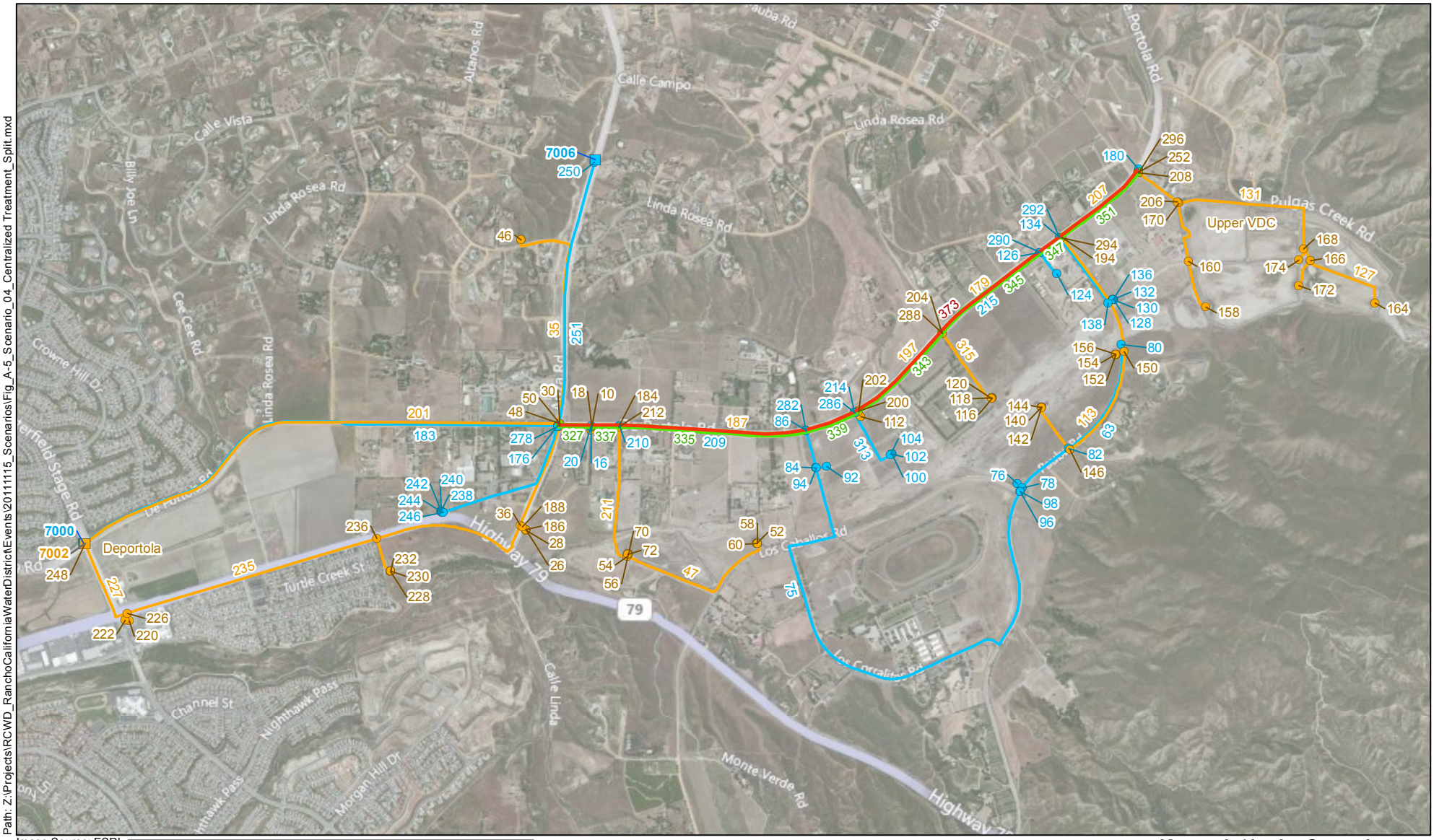


Image Source: ESRI

Legend

- Proposed Pipe (1380 PZ)
- Proposed Pipe (Raw Pipeline to VDC Disinfection)
- Hydraulic Boundary Reservoir (1305 PZ)
- Hydraulic Boundary Reservoir (1380 PZ)
- Junction (1305 PZ)
- Junction (1380 PZ)
- Pipe (1305PZ)
- Pipe (1380 PZ)

N

0 1,250 2,500

Scale: Feet

Kennedy/Jenks Consultants

Rancho California Water District
Upper VDC Optimized Conjunctive Use Study

Centralized Disinfection, Flows Split
Scenario 4

K/J 1087103*01
November 2011

Figure A-5

Model Output - Scenario 4

JUNCTION: ID (Char)	JUNCTION: DESCRIPT (Char)	JUNCTION: PHASE (Num)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)	OUTPUT: HEAD (ft)	OUTPUT: PRESSURE (psi)
10	W 232	1305	-770	1,184	1,300	50
16		1380	0	1,184	1,300	50
18		1305	0	1,184	1,307	53
20		1380	0	1,184	1,394	91
26	W 124	1305	-300	1,175	1,306	57
28		1305	0	1,175	1,306	57
30		1305	0	1,183	1,306	53
36		1305	0	1,175	1,306	57
46	W 151	1305	-727	1,286	1,351	28
48		1305	0	1,183	1,306	53
50		1305	0	1,183	1,301	51
52	W 131	1305	-1,100	1,198	1,318	52
54		1305	0	1,178	1,307	56
56	W 130	1305	-1,125	1,178	1,307	56
58		1305	0	1,198	1,318	52
60		1305	0	1,198	1,317	52
70		1305	0	1,178	1,307	56
72		1305	0	1,178	1,307	56
76	W 149	1380	-300	1,224	1,299	32
78		1380	0	1,224	1,299	32
80		1380	0	1,246	1,299	23
82		1380	0	1,231	1,299	29
84		1380	0	1,211	1,297	37
86		1380	0	1,208	1,399	83
92	W 233	1380	-1,400	1,211	1,298	38
94		1380	0	1,211	1,297	37
96		1380	0	1,224	1,299	32
98		1380	0	1,224	1,299	32
100	W 210	1380	-566	1,214	1,294	34
102		1380	0	1,214	1,294	34
104		1380	0	1,214	1,293	34
112	W 125	1305	-900	1,217	1,292	33
116	W 132	1305	-800	1,234	1,292	25
118		1305	0	1,234	1,292	25
120		1305	0	1,234	1,292	25
124	W 203	1380	-540	1,243	1,287	19
126		1380	0	1,242	1,405	71
128	W 110	1380	-801	1,250	1,288	17
130		1380	0	1,250	1,288	17
132		1380	0	1,250	1,288	16
134		1380	0	1,247	1,406	69
136		1380	0	1,250	1,288	17
138		1380	0	1,250	1,288	16
140	W 133	1305	-625	1,234	1,288	23
142		1305	0	1,234	1,288	23
144		1305	0	1,234	1,288	23
146		1305	0	1,231	1,287	24
150		1305	0	1,246	1,286	17

Model Output - Scenario 4

152	W 123	1305	-200	1,246	1,286	17
154		1305	0	1,246	1,286	17
156		1305	0	1,246	1,286	17
158	W 153	1305	-833	1,266	1,285	8
160		1305	0	1,266	1,285	8
164	W 158	1305	-1,131	1,280	1,297	8
166		1305	0	1,280	1,296	7
168		1305	0	1,280	1,296	7
170		1305	0	1,260	1,285	11
172	W 157	1305	-1,715	1,280	1,297	7
174	W 152	1305	-1,401	1,280	1,296	7
176	Pauba	1380	4,114	1,183	1,394	91
180		1380	0	1,253	1,408	67
184		1305	0	1,190	1,307	51
186		1305	0	1,175	1,306	57
188		1305	0	1,175	1,306	57
194		1305	0	1,247	1,317	30
200		1305	0	1,217	1,312	41
202		1305	0	1,217	1,292	32
204		1305	0	1,234	1,314	35
206		1305	0	1,260	1,285	11
208	Los Caballos	1305	2,215	1,253	1,319	28
210		1380	0	1,190	1,395	89
212		1305	0	1,190	1,299	47
214		1380	0	1,216	1,400	80
220	W 126	1305	-1,100	1,115	1,304	82
222		1305	0	1,115	1,304	82
226	Butterfield	1305	14,760	1,115	1,304	82
228	W 141	1305	-450	1,152	1,308	68
230		1305	0	1,152	1,308	68
232		1305	0	1,152	1,308	68
236		1305	0	1,152	1,305	66
238	W 234	1380	-240	1,165	1,302	59
240		1380	0	1,165	1,302	59
242		1380	0	1,165	1,302	59
244	Aluarez	1380	0	1,165	1,302	59
246		1380	0	1,165	1,302	59
248	Deportola	1305	5,982	1,123	1,305	79
250	Anza	1380	11,000	1,187	1,380	84
278		1380	0	1,183	1,301	51
282		1380	0	1,208	1,295	37
286		1380	0	1,216	1,292	33
288		1305	0	1,234	1,289	24
290		1380	0	1,242	1,286	19
292		1380	0	1,247	1,285	16
294		1305	0	1,247	1,285	16
296		1305	0	1,253	1,283	13
298		1305	0	1,183	1,301	51
300		1380	0	1,184	1,300	50
302		1305	0	1,190	1,299	47
308		1305	0	1,217	1,292	32

Model Output - Scenario 4

310		1305	0	1,234	1,289	24
312		1305	0	1,247	1,285	16
314		1305	0	1,253	1,283	13
316	1380 Supply	1380	-26,723	1,253	1,409	68
318	1305 Supply	1305	-12,494	1,253	1,319	28
322	New VDC	1305	-24,043	1,253	1,283	13
324	Aluarez (2)	1380	11,609	1,183	1,394	91

Model Output - Scenario 4

PIPE: ID (Char)	PIPE: PHASE (Num)	OUTPUT: LENGTH (ft)	OUTPUT: DIAMETER (in)	OUTPUT: FLOW (gpm)	OUTPUT: VELOCITY (ft/s)	OUTPUT: HEADLOSS (ft)	OUTPUT: HL_1000 (ft/kft)
15	1380	67	12	770	2.2	0.1	1.8
17	1305	20	12	0	0.0	0.0	0.0
19	1380	22	12	0	0.0	0.0	0.0
25	1305	5	12	300	0.9	0.0	0.3
29	1305	104	12	300	0.9	0.0	0.3
33	1305	1,931	36	4,095	1.3	0.4	0.2
35	1305	4,253	8	727	4.6	49.9	11.7
39	1305	3	12	0	0.0	0.0	0.0
41	1305	10	12	1,100	3.1	0.0	3.5
43	1305	8	12	1,125	3.2	0.0	3.7
45	1305	4	6	1,100	12.5	0.4	102.7
47	1305	2,986	12	1,100	3.1	10.5	3.5
55	1305	3	8	1,125	7.2	0.1	26.3
57	1305	36	12	1,125	3.2	0.1	3.7
61	1380	122	12	300	0.9	0.0	0.3
63	1380	2,225	12	0	0.0	0.0	0.0
65	1380	1,099	14	0	0.0	0.0	0.0
67	1380	75	14	300	0.6	0.0	0.2
69	1380	683	14	1,700	3.5	2.5	3.7
71	1380	193	12	1,400	4.0	1.1	5.5
73	1380	9	8	1,400	8.9	0.3	39.5
75	1380	10,465	14	300	0.6	1.6	0.2
77	1380	10	12	300	0.9	0.0	0.3
79	1380	11	12	566	1.6	0.0	1.0
81	1380	24	8	566	3.6	0.2	7.4
89	1305	9	12	800	2.3	0.0	2.0
91	1305	3	8	800	5.1	0.0	14.0
95	1380	494	10	540	2.2	1.1	2.3
97	1380	7	12	801	2.3	0.0	2.0
99	1380	3	6	801	9.1	0.2	57.0
101	1380	109	12	801	2.3	0.2	2.0
103	1380	2	16	801	1.3	0.0	0.5
105	1380	1,457	12	801	2.3	2.8	2.0
107	1305	10	12	625	1.8	0.0	1.2
109	1305	3	6	625	7.1	0.1	36.0
111	1305	966	12	625	1.8	1.2	1.2
113	1305	2,126	16	625	1.0	0.6	0.3
117	1305	9	12	200	0.6	0.0	0.2
119	1305	2	6	200	2.3	0.0	4.4
121	1305	210	12	200	0.6	0.0	0.2
123	1305	941	20	833	0.9	0.2	0.2
127	1305	1,545	16	1,131	1.8	1.4	0.9
129	1305	273	20	2,846	2.9	0.5	1.7
131	1305	2,991	20	4,247	4.3	10.6	3.6
133	1305	521	16	1,715	2.7	1.0	2.0
135	1305	223	20	1,401	1.4	0.1	0.5
137	1305	31	24	4,247	3.0	0.1	1.5
145	1380	605	24	-3,716	2.6	0.7	1.1

Model Output - Scenario 4

151	1380	939	24	-3,716	2.6	1.1	1.1
153	1380	443	24	-3,716	2.6	0.5	1.1
159	1305	490	36	10,279	3.2	0.5	1.0
161	1305	10	16	0	0.0	0.0	0.0
163	1305	2	8	300	1.9	0.0	2.3
165	1305	43	16	300	0.5	0.0	0.1
169	1305	55	48	-6,183	1.1	0.0	0.1
171	1305	573	36	10,279	3.2	0.6	1.0
173	1380	510	24	-3,716	2.6	0.6	1.1
177	1380	1,902	24	-3,716	2.6	2.2	1.1
179	1305	2,770	36	10,279	3.2	2.9	1.0
181	1305	8	16	0	0.0	0.0	0.0
183	1380	9,265	24	4,284	3.0	13.8	1.5
187	1305	4,406	36	10,279	3.2	4.6	1.0
193	1305	10	16	0	0.0	0.0	0.0
195	1305	96	12	-900	2.6	0.2	2.4
197	1305	2,074	36	10,279	3.2	2.2	1.0
199	1305	9	12	0	0.0	0.0	0.0
201	1305	9,259	48	6,183	1.1	0.9	0.1
203	1305	878	24	5,080	3.6	1.8	2.0
205	1305	1,236	24	-833	0.6	0.1	0.1
207	1305	1,815	36	10,279	3.2	1.9	1.0
209	1380	3,374	24	-3,716	2.6	3.9	1.1
211	1305	2,501	16	-2,225	3.6	8.0	3.2
213	1380	32	4	0	0.0	0.0	0.0
215	1380	4,435	24	-3,716	2.6	5.1	1.1
217	1380	6	12	0	0.0	0.0	0.0
221	1305	3,020	36	4,395	1.4	0.7	0.2
223	1305	97	12	1,100	3.1	0.3	3.5
225	1305	187	42	1,100	0.3	0.0	0.0
227	1305	1,661	36	-8,814	2.8	1.3	0.8
229	1305	11	8	450	2.9	0.1	4.8
233	1305	675	8	450	2.9	3.3	4.8
235	1305	4,700	36	4,845	1.5	1.2	0.3
237	1380	7	8	240	1.5	0.0	1.5
239	1380	3	4	240	6.1	0.1	44.1
241	1380	23	8	240	1.5	0.0	1.5
243	1380	34	12	240	0.7	0.0	0.2
245	1380	2,856.05	14	240.00	0.5	0.28	0.1
247	1305	13	48	201	0.0	0.0	0.0
249	1380	45	24	4,284	3.0	0.1	1.5
251	1380	4,829	24	-6,106	4.3	13.8	2.9
253	1305	4	6	-450	5.1	0.1	19.6
305	1380	12	14	0	0.0	0.0	0.0
309	1380	13	14	0	0.0	0.0	0.0
313	1380	1,180	12	-566	1.6	1.2	1.0
315	1305	1,506	12	-800	2.3	2.9	1.9
317	1380	10	10	0	0.0	0.0	0.0
319	1380	13	12	0	0.0	0.0	0.0
321	1305	2,377	16	-825	1.3	1.2	0.5
323	1305	12	24	0	0.0	0.0	0.0

Model Output - Scenario 4

325	1380	54	8	240	1.5	0.1	1.5
327	0	548.76	12	967	2.74	1.52	2.76
329	1305	59	12	727	2.1	0.1	1.6
331	1380	21	12	770	2.2	0.0	1.8
333	1305	24	16	2,225	3.6	0.1	3.2
335	0	3,393	24	3,962	2.8	4.4	1.3
337	0	498	16	1,737	2.8	1.0	2.0
339	0	943	24	5,662	4.0	2.4	2.5
341	0	66	24	6,228	4.4	0.2	3.0
343	0	2,067	30	7,128	3.2	2.7	1.3
345	0	2,303	30	7,928	3.6	3.6	1.6
347	0	443	30	8,468	3.8	0.8	1.8
349	0	20	36	9,269	2.9	0.0	0.9
351	0	1,815	36	10,094	3.2	1.8	1.0
353	0	49	60	39,217	4.5	0.1	1.0
355	1305	39	24	5,080	3.6	0.1	2.0
357	1305	36	16	825	1.3	0.0	0.5
359	0	29	12	800	2.3	0.1	1.9
361	1305	22	16	900	1.4	0.0	0.6
363	1380	28	24	26,723	19.0	1.2	44.1
365	1305	31	36	12,494	3.9	0.1	1.5
369	1305	6	54	24,043	3.4	0.0	0.7
371	1380	33	36	-11,609	3.7	0.0	1.3
373	1380	12,206	48	23,007	4.1	13.9	1.1
375	0	4,842	10	610	2.5	13.8	2.9

Model Output - Scenario 4

TANK: ID (Char)	TANK: DESCRIPT (Char)	OUTPUT: DEMAND (gpm)	OUTPUT: ELEVATION (ft)
7000	PZ 1380	4,284	1,380
7002	PZ 1305	-8,613	1,305
7006	PZ 1380	-4,284	1,380
7008	Treatment Tank	39,217	1,253

Appendix B: Review of Preliminary Clearwell Designs by Flow Science

Flow Science Incorporated

723 East Green St., Pasadena, CA 91101 **(626) 304-1134 FAX (626) 304-9427**
Two Penn Ctr., Ste. 200, Philadelphia PA 19102 **(215) 854-6445 FAX (215) 564-4552**
420 Neff Ave., Ste. 230, Harrisonburg, VA 22801 **(540) 442-8433 FAX (540) 442-8863**

MEMORANDUM

To: Mr. David Ferguson, Principal Engineer
Kennedy/Jenks Consultants

From: Imad Hannoun, Ph.D., P.E. (VA)
E. John List, Ph.D., P.E. (CA)
Flow Science Incorporated

Date: November 23, 2011

Re: Valle de Los Caballos Upper Recharge/Recovery Facility Clearwells
Rancho California Water District

Project No: FSI V114105

INTRODUCTION

This memorandum presents the results of a review of preliminary clearwell designs for the Valle de Los Caballos Upper Recharge/Recovery Facility Clearwells, Rancho California Water District (RCWD). The evaluation is limited to:

- Checking the disinfection time calculations performed by Kennedy/Jenks Consultants (**Appendix A**)
- Reviewing of several proposed baffling options for the proposed clearwells prepared by Kennedy Jenks Consultants (**Appendix B**). In particular, four (4) clearwell baffling configurations labeled 1A, 1B, 2A, and 2B are considered.

This memorandum has been prepared by Flow Science Incorporated of Pasadena, California, working under contract with Kennedy/Jenks Consultants of Los Angeles, California.

EVALUATION

CT Calculations

The methodology used to calculate the CT requirements for a clearwell is based on several variables including the water pH and temperature, minimum proposed free chlorine disinfectant residual, flow rate, clearwell volume, as well as a baffling factor. The calculations performed by Kennedy/Jenks consider that the pH $\leq$ 7.7, water temperature $\geq$ 12.5 degrees C, free chlorine residual

≥ 2.0 mg/L, and 0.5-log reduction for *Giardia*. Furthermore, two flow rates are considered, 65.0 and 87.5 cubic feet per second (cfs). The calculations also consider various baffling factors associated with each clearwell baffling layout. Based on these values, it is deemed that the calculated required minimum total retention times (in minutes) shown in **Appendix A** Column K are done in accordance with USEPA Guidance Manual Disinfection Profiling and Benchmarking – Appendix E (1999) for computing CT requirements.

Baffling Factors

Appendix B of this memorandum presents four (4) baffling alternatives for the proposed clearwell. As shown in **Table 1**, Alternatives 1A and 1B correspond to a flow rate of 65.0 cfs, whereas Alternatives 2A and 2B correspond to a flowrate of 87.5 cfs. Alternative 1A features a total length/width ratio of 17:1, whereas Alternative 1B utilizes a larger length/width ratio of 20:1. Based on Flow Science's experience with other clearwells of similar, but not identical dimensions, we consider that baffling factors of 0.60 and 0.65, respectively, are reasonable values to consider for this analysis. A baffling factor is defined as the ratio of T_{10}/T_{ave}, where:

T_{10} is defined as the time it takes 10% of the flow entering the clearwell to reach the outlet, and

T_{ave} is average residence time in the clearwell, obtained by dividing total volume by average flowrate.

It is also noted that the porous screens located at the end of each 180-degree turn contribute positively towards a higher baffling factor. The baffling factors of 0.60 and 0.65 for Alternatives 2A and 2B, respectively are also considered reasonable. It is strongly recommended, however, that a Computational Fluid Dynamics (CFD) investigation be conducted before final design to confirm these values.

Table 1: Summary of the Various Clearwell Alternatives and Associated Baffling Factors

Alternative #	Flowrate (cfs)	Total Length/Width Ratio*	Baffling Factor
1A	65.0	17:1	0.60
1B	65.0	20:1	0.65
2A	87.5	17:1	0.60
2B	87.5	21:1	0.65

* Ratio is calculated by dividing the total length of the path in the flow direction by the width of a single pass.

It is also recommended that the CFD study address the uniformity of the flow approaching the weir. A non-uniform, or highly turbulent flow approaching the weir may lead to elevated levels of turbulence in the pump manifold, potentially resulting in ill-conditioned flow entering the pumps. In

particular, it may be possible to reduce the width of the influent channel just upstream of the weir through the use of flow straightening devices. Such a design element can be investigated using CFD.

Appendix A

CT Calculations (performed by Kennedy/Jenks Consultants)

RCWD - UPPER VDC: Disinfection Optimization (Contactor Conceptual Design) - Upper VDC Wells Max Q = 29,123 gpm

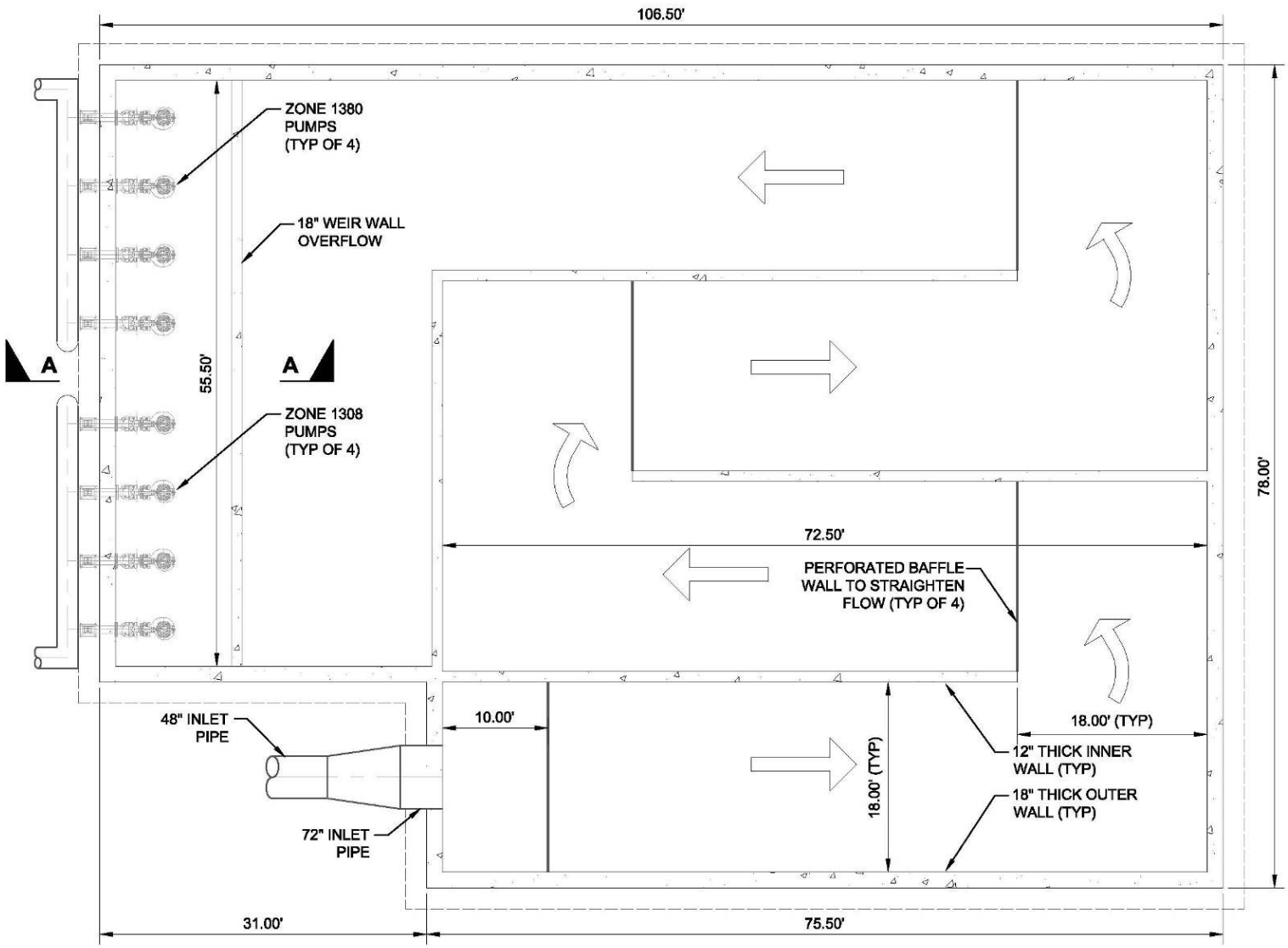
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Flow Rate																	
gpm	mgd	cfs	Chlorine Residual mg/L	pH	Temp °C	CT required 0.5 log *Giardia*	CT calculated for 1.1 ratio	Contact Time (min)	Baffling Factor	Total Detention Time (min)	Contactor Volume (gal)	Contactor Volume (cu ft)	Length with Depth=15' Row W=18'	Length with Depth=15' Row W=16'	Contactor CT Volume (gal)	Contactor Non-CT Vol (gal)	
29,123	41.94	65.01	2.0	7.7	12.5	23.3	25.63	12.82	1.00	12.82	373,200	49,890					
29,123	41.94	65.01	2.0	7.7	12.5	23.3	25.63	12.82	0.60	21.36	622,100	83,163	308		622,100	75,740	1A
29,123	41.94	65.01	2.0	7.7	12.5	23.3	25.63	12.82	0.65	19.72	574,200	76,760		320	574,200	66,427	1B

RCWD - UPPER VDC: Disinfection Optimization (Contactor Conceptual Design) - All Wells Max Q = 39,217 gpm

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Flow Rate																	
gpm	mgd	cfs	Chlorine Residual mg/L	pH	Temp °C	CT required 0.5 log *Giardia*	CT calculated for 1.1 ratio	Contact Time (min)	Baffling Factor	Total Detention Time (min)	Contactor Volume (gal)	Contactor Volume (gal)	Length with Depth=18' Row W=19'	Length with Depth=16' Row W=17.5'	Contactor CT Volume (gal)	Contactor Non-CT Vol (gal)	
39,217	56.48	87.54	2.0	7.7	12.5	23.3	25.63	12.82	1.00	12.82	502,600	67,188					
39,217	56.48	87.54	2.0	7.7	12.5	23.3	25.63	12.82	0.60	21.36	837,700	111,984	327		837,700	101,054	2A
39,217	56.48	87.54	2.0	7.7	12.5	23.3	25.63	12.82	0.65	19.72	773,200	103,362		369	773,200	85,876	2B

Appendix B

Clearwell Layout Alternatives (Prepared by Kennedy/Jenks Consultants)

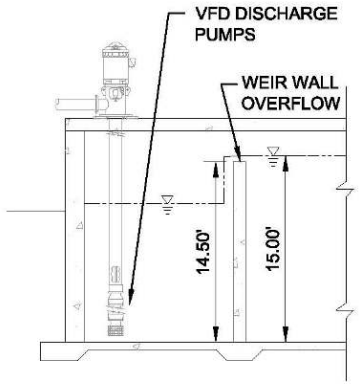


PLAN

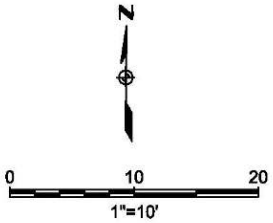
*LAYOUT HAS 17:1 LENGTH TO WIDTH RATIO

ASSUMPTIONS:
1. DESIGN FLOW IS 29,123 GPM.
2. CHLORINE RESIDUAL IS 2.0 MG/L.
3. pH IS 7.7.
4. TEMPERATURE IS 12.5° C.

DESIGN NOTES:
1. DEPTH OF WATER IN THE TANK IS APPROXIMATELY 15'.
2. HEIGHT OF WEIR AT OUTLET IS 14.5'.
3. CHLORINE CONTACT TANK HAS 2' MIN FREEBOARD AND IS COVERED WITH A CONCRETE SLAB.

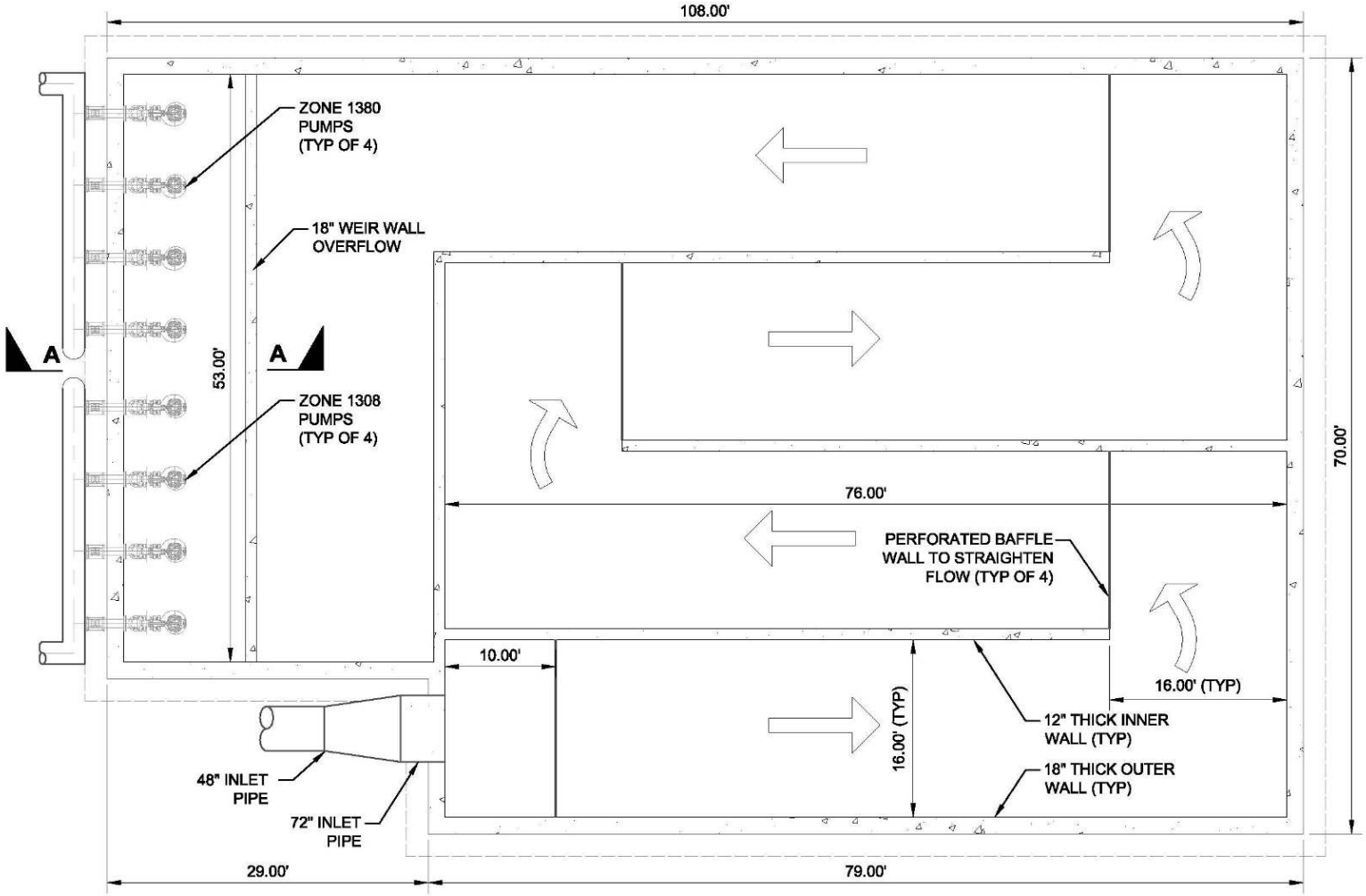


SECTION A-A



Kennedy/Jenks Consultants
Rancho California Water District
Upper VCD
Temecula, California

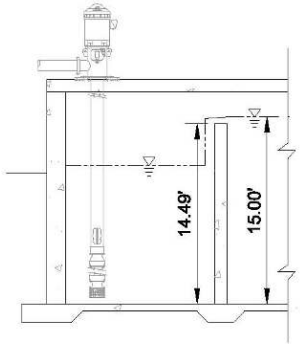
ALTERNATE #1A
Disinfection Optimization
November 2011
K/J #1087103*01
Figure 1A



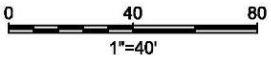
PLAN

ASSUMPTIONS:
1. DESIGN FLOW IS 29,123 GPM.
2. CHLORINE RESIDUAL IS 2.0 MG/L.
3. pH IS 7.7.
4. TEMPERATURE IS 12.5° C.

DESIGN NOTES:
1. DEPTH OF WATER IN THE TANK IS APPROXIMATELY 15'.
2. HEIGHT OF WEIR AT OUTLET IS 14.49'.
3. CHLORINE CONTACT TANK HAS 2' MIN FREEBOARD AND IS COVERED WITH A CONCRETE SLAB.



SECTION A-A

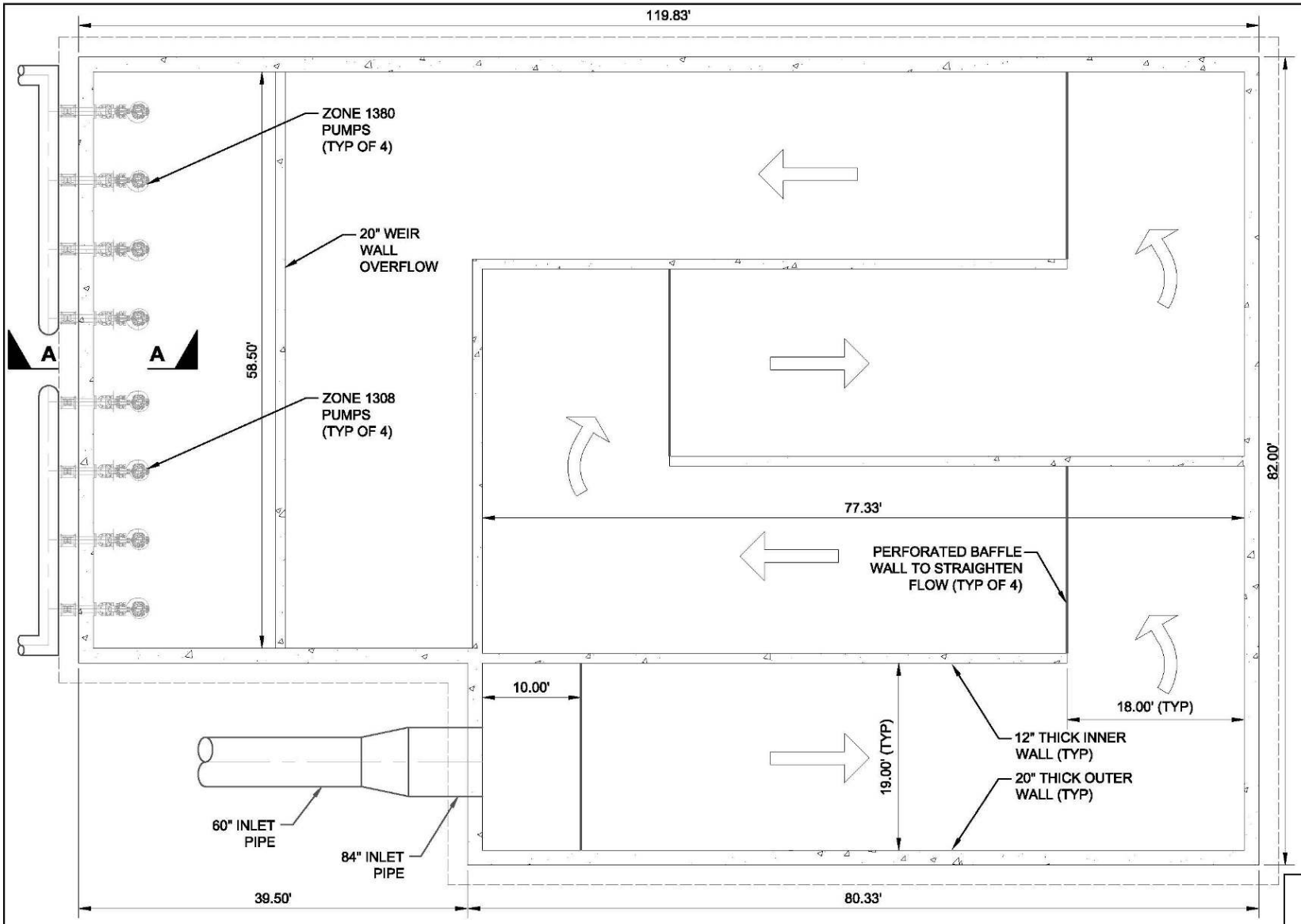


Kennedy/Jenks Consultants

Rancho California Water District
Upper VCD
Temecula, California

ALTERNATE #1B
Disinfection Optimization
November 2011
K/J #1087103*01
Figure 1B

*LAYOUT HAS 20:1 LENGTH TO WIDTH RATIO

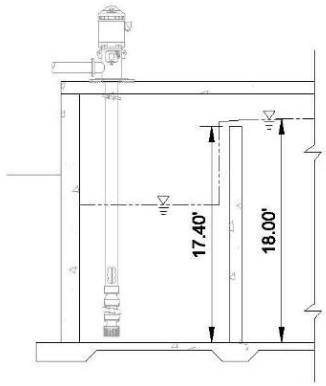


PLAN

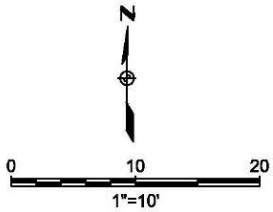
*LAYOUT HAS 17:1 LENGTH TO WIDTH RATIO

ASSUMPTIONS:
1. DESIGN FLOW IS 39,217 GPM.
2. CHLORINE RESIDUAL IS 2.0 MG/L.
3. pH IS 7.7.
4. TEMPERATURE IS 12.5° C.

DESIGN NOTES:
1. DEPTH OF WATER IN THE TANK IS APPROXIMATELY 18'.
2. HEIGHT OF WEIR AT OUTLET IS 17.4'.
3. CHLORINE CONTACT TANK HAS 2' MIN FREEBOARD AND IS COVERED WITH A CONCRETE SLAB.



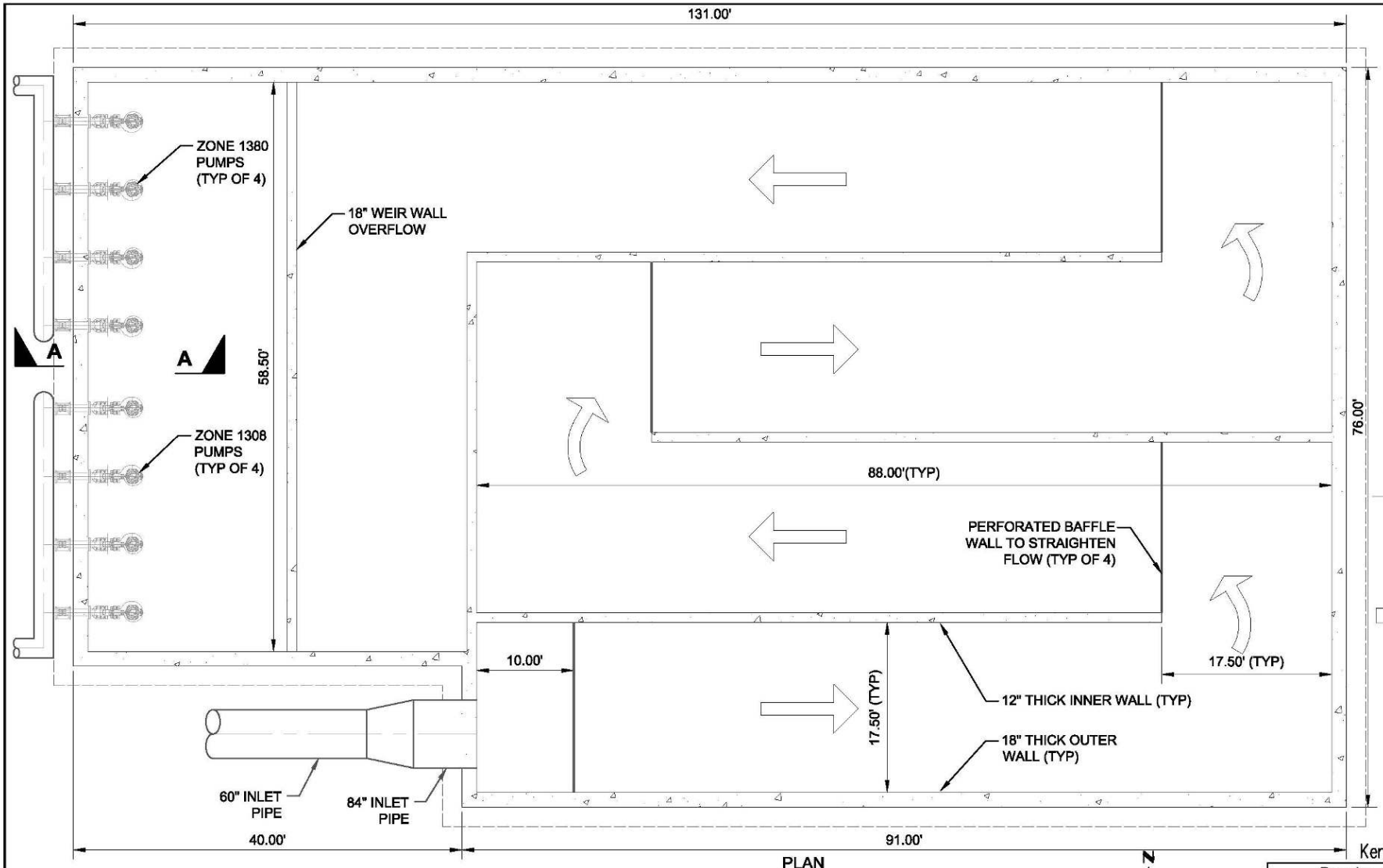
SECTION A-A



Kennedy/Jenks Consultants

Rancho California Water District
Upper VCD
Temecula, California

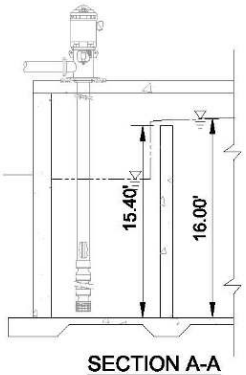
ALTERNATE #2A
Disinfection Optimization
November 2011
K/J #1087103*01
Figure 2A



PLAN

ASSUMPTIONS:
1. DESIGN FLOW IS 39,217 GPM.
2. CHLORINE RESIDUAL IS 2.0 MG/L.
3. pH IS 7.7.
4. TEMPERATURE IS 12.5° C.

DESIGN NOTES:
1. DEPTH OF WATER IN THE TANK IS APPROXIMATELY 16'.
2. HEIGHT OF WEIR AT OUTLET IS 15.4'.
3. CHLORINE CONTACT TANK HAS 2' MIN FREEBOARD AND IS COVERED WITH A CONCRETE SLAB.



SECTION A-A

N

0 10 20
1"=10'

*LAYOUT HAS 21:1 LENGTH TO WIDTH RATIO

Kennedy/Jenks Consultants
Rancho California Water District
Upper VCD
Temecula, California

ALTERNATE #2B
Disinfection Optimization
November 2011
K/J #1087103*01
Figure 2B

Appendix C: MWD Long-Term Estimated Rates and Project Cost Tables

Metropolitan Water District
Long-Term Estimated Rate Increases

Year	Untreated Tier I ($/AF)	% Increase	Treated Tier I ($/AF)	% Increase	Difference (Treated - Untreated) ($/AF
2012	$560	--	$794	--	$234
2013	$608	8.6%	$868	9.3%	$260
2014	$610	0.3%	$912	5.1%	$302
2015	$628	3.0%	$939	3.0%	$311
2016	$647	3.0%	$968	3.1%	$321
2017	*$666*	3.0%	*$997*	3.0%	$331
2018	*$686*	3.0%	*$1,027*	3.0%	$341
2019	*$707*	3.0%	*$1,058*	3.0%	$351
2020	*$728*	3.0%	*$1,089*	3.0%	$361
2021	*$750*	3.0%	*$1,122*	3.0%	$372
2022	*$773*	3.0%	*$1,156*	3.0%	$383
2023	*$796*	3.0%	*$1,191*	3.0%	$395
2024	*$820*	3.0%	*$1,226*	3.0%	$407
2025	*$844*	3.0%	*$1,263*	3.0%	$419
2026	*$870*	3.0%	*$1,301*	3.0%	$431
2027	*$896*	3.0%	*$1,340*	3.0%	$444
2028	*$922*	3.0%	*$1,380*	3.0%	$458
2029	*$950*	3.0%	*$1,422*	3.0%	$471
2030	*$979*	3.0%	*$1,464*	3.0%	$486
2031	*$1,008*	3.0%	*$1,508*	3.0%	$500
2032	*$1,038*	3.0%	*$1,553*	3.0%	$515
2033	*$1,069*	3.0%	*$1,600*	3.0%	$531
2034	*$1,101*	3.0%	*$1,648*	3.0%	$546
2035	*$1,135*	3.0%	*$1,697*	3.0%	$563
2036	*$1,169*	3.0%	*$1,748*	3.0%	$580
2037	*$1,204*	3.0%	*$1,801*	3.0%	$597
2038	*$1,240*	3.0%	*$1,855*	3.0%	$615
2039	*$1,277*	3.0%	*$1,910*	3.0%	$634
2040	*$1,315*	3.0%	*$1,968*	3.0%	$653
2041	*$1,355*	3.0%	*$2,027*	3.0%	$672
2042	*$1,395*	3.0%	*$2,088*	3.0%	$692
2043	*$1,437*	3.0%	*$2,150*	3.0%	$713

Note: Rates for Years 2012 through 2016 are based on MWD's Forecasted Rates from FY 2012-2013.
Rates for Years 2017 through 2043 are based on an assumed 3% annual average increase

FY 2012-2013 Forecasted MWD Rates

01-Feb-12

	1/1/2011	1/1/2012	1/1/2013	1/1/2014	1/1/2015	1/1/2016
Untreated	527	560	608	610	628	647
Tier II	125	126	141	133	133	133
Total	652	686	749	743	761	780
Untreated %		6.3%	8.6%	0.3%	3.0%	3.0%
Tier II %		5.2%	9.2%	-0.8%	2.5%	2.5%
Treated	744	794	868	912	939	968
Tier II	125	126	141	133	133	133
Total	869	920	1,009	1,045	1,072	1,101
Treated %		6.7%	9.3%	5.1%	3.0%	3.0%
Tier II %		5.9%	9.7%	3.6%	2.6%	2.6%

234 260

Table 1
Upper VDC Conjunctive Use Optimization Study
Project Cost Comparison

		Upper VDC		Water Cost		Capital Cost									O&M Costs						Total Costs		Avoided Cost			
No.	Year	Recharge AF	Production (gpm)	Untreated Tier I ($/AF)	MWD Water Cost	Wells	Site Acquisition	Yard Piping	CCT & NaOCL	Pump Stations	Transmission Pipeline	Tractor & Building	Total Capital Cost	Total Amortized Cost	Well Energy	Chemical	PS Energy	RCWD Labor	Tractor	Total O&M Cost	Total Project Cost	Total ($/AF) (Production)	Treated Water Tier I ($/AF)	Treated Water Cost	Difference	Running Total
1	2014	23,744	9,123	$610	$14,483,840	$4,000,000	$2,535,000	$5,079,000	$3,337,000	$6,560,000	$10,065,000	$352,000	$31,928,000	$1,960,109	$1,035,000	$117,857	$511,286	$312,000	$5,000	$1,981,143	$18,425,092	$1,252	$912	$21,654,528	$3,229,436	$3,229,436
2	2015	28,464	13,123	$628	$17,875,392	$4,000,000							$4,000,000	$2,209,768	$1,181,250	$162,643	$715,800	$322,920	$5,175	$2,387,788	$22,472,947	$1,062	$939	$26,727,696	$4,254,749	$7,484,184
3	2016	33,184	17,123	$647	$21,470,048	$4,000,000							$4,000,000	$2,463,851	$1,339,538	$203,304	$894,750	$334,222	$5,356	$2,777,169	$26,711,068	$967	$968	$32,122,112	$5,411,044	$12,895,228
4	2017	37,904	21,123	$666	$25,259,605	$4,000,000							$4,000,000	$2,722,729	$1,510,701	$243,964	$1,073,700	$345,920	$5,544	$3,179,828	$31,162,162	$915	$997	$37,791,804	$6,629,642	$19,524,871
5	2018	43,135	25,123	$686	$29,607,963	$4,000,000							$4,000,000	$2,986,814	$1,695,631	$284,625	$1,252,650	$358,027	$5,738	$3,596,671	$36,191,448	$893	$1,027	$44,297,540	$8,106,092	$27,630,962
6	2019	43,135	25,123	$707	$30,496,202								$0	$2,986,814	$1,780,413	$294,587	$1,315,283	$370,558	$5,938	$3,766,779	$37,249,795	$919	$1,058	$45,626,466	$8,376,671	$36,007,633
7	2020	43,135	25,123	$728	$31,411,088								$0	$2,986,814	$1,869,433	$304,897	$1,381,047	$383,528	$6,146	$3,945,051	$38,342,954	$946	$1,089	$46,995,260	$8,652,306	$44,659,940
8	2021	43,135	25,123	$750	$32,353,421								$0	$2,986,814	$1,962,905	$315,569	$1,450,099	$396,951	$6,361	$4,131,885	$39,472,120	$974	$1,122	$48,405,118	$8,932,998	$53,592,937
9	2022	43,135	25,123	$773	$33,324,023								$0	$2,986,814	$2,061,050	$326,614	$1,522,604	$410,844	$6,584	$4,327,696	$40,638,534	$1,003	$1,156	$49,857,272	$9,218,737	$62,811,675
10	2023	43,135	25,123	$796	$34,323,744	$3,293,000							$3,293,000	$3,232,474	$2,164,103	$338,045	$1,598,734	$425,224	$6,814	$4,532,921	$42,089,139	$1,039	$1,191	$51,352,990	$9,263,851	$72,075,526
11	2024	43,135	25,123	$820	$35,353,456								$0	$3,232,474	$2,272,308	$349,877	$1,678,671	$440,107	$7,053	$4,748,015	$43,333,946	$1,069	$1,226	$52,893,579	$9,559,634	$81,635,160
12	2025	43,135	25,123	$844	$36,414,060								$0	$3,232,474	$2,385,923	$362,122	$1,762,604	$455,511	$7,300	$4,973,461	$44,619,995	$1,101	$1,263	$54,480,387	$9,860,392	$91,495,552
13	2026	43,135	25,123	$870	$37,506,482								$0	$3,232,474	$2,505,220	$374,797	$1,850,735	$471,453	$7,555	$5,209,760	$45,948,715	$1,134	$1,301	$56,114,798	$10,166,083	$101,661,635
14	2027	43,135	25,123	$896	$38,631,676								$0	$3,232,474	$2,630,481	$387,915	$1,943,271	$487,954	$7,820	$5,457,441	$47,321,591	$1,168	$1,340	$57,798,242	$10,476,651	$112,138,286
15	2028	43,135	25,123	$922	$39,790,627								$0	$3,232,474	$2,762,005	$401,492	$2,040,435	$505,033	$8,093	$5,717,057	$48,740,158	$1,203	$1,380	$59,532,190	$10,792,032	$122,930,318
16	2029	43,135	25,123	$950	$40,984,346								$0	$3,232,474	$2,900,105	$415,544	$2,142,457	$522,709	$8,377	$5,989,191	$50,206,010	$1,239	$1,422	$61,318,155	$11,112,145	$134,042,463
17	2030	43,135	25,123	$979	$42,213,876								$0	$3,232,474	$3,045,110	$430,088	$2,249,579	$541,004	$8,670	$6,274,451	$51,720,801	$1,276	$1,464	$63,157,700	$11,436,899	$145,479,362
18	2031	43,135	25,123	$1,008	$43,480,292								$0	$3,232,474	$3,197,366	$445,141	$2,362,058	$559,939	$8,973	$6,573,477	$53,286,243	$1,315	$1,508	$65,052,431	$11,766,188	$157,245,550
19	2032	43,135	25,123	$1,038	$44,784,701								$0	$3,232,474	$3,357,234	$460,721	$2,480,161	$579,537	$9,287	$6,886,940	$54,904,115	$1,355	$1,553	$67,004,004	$12,099,889	$169,345,439
20	2033	43,135	25,123	$1,069	$46,128,242	$4,425,000							$4,425,000	$3,751,297	$3,525,096	$476,846	$2,604,169	$599,820	$9,613	$7,215,544	$57,095,083	$1,409	$1,600	$69,014,124	$11,919,041	$181,264,480
21	2034	43,135	25,123	$1,101	$47,512,089								$0	$3,751,297	$3,701,350	$493,536	$2,734,378	$620,814	$9,949	$7,560,027	$58,823,413	$1,452	$1,648	$71,084,548	$12,261,134	$193,525,614
22	2035	43,135	25,123	$1,135	$48,937,452								$0	$3,751,297	$3,886,418	$510,810	$2,871,097	$642,543	$10,297	$7,921,164	$60,609,913	$1,496	$1,697	$73,217,084	$12,607,171	$206,132,786
23	2036	43,135	25,123	$1,169	$50,405,575								$0	$3,751,297	$4,080,739	$528,688	$3,014,652	$665,032	$10,658	$8,299,767	$62,456,640	$1,541	$1,748	$75,413,597	$12,956,957	$219,089,742
24	2037	43,135	25,123	$1,204	$51,917,743								$0	$3,751,297	$4,284,776	$547,192	$3,165,384	$688,308	$11,031	$8,696,690	$64,365,730	$1,588	$1,801	$77,676,005	$13,310,275	$232,400,017
25	2038	43,135	25,123	$1,240	$53,475,275								$0	$3,751,297	$4,499,014	$566,344	$3,323,653	$712,398	$11,417	$9,112,827	$66,339,399	$1,637	$1,855	$80,006,285	$13,666,886	$246,066,903
26	2039	43,135	25,123	$1,277	$55,079,533								$0	$3,751,297	$4,723,965	$586,166	$3,489,836	$737,332	$11,816	$9,549,116	$68,379,946	$1,688	$1,910	$82,406,473	$14,026,527	$260,093,431
27	2040	43,135	25,123	$1,315	$56,731,919								$0	$3,751,297	$4,960,163	$606,681	$3,664,328	$763,139	$12,230	$10,006,542	$70,489,758	$1,740	$1,968	$84,878,667	$14,388,910	$274,482,340
28	2041	43,135	25,123	$1,355	$58,433,877								$0	$3,751,297	$5,208,172	$627,915	$3,847,544	$789,849	$12,658	$10,486,138	$72,671,312	$1,793	$2,027	$87,425,027	$14,753,716	$289,236,056
29	2042	43,135	25,123	$1,395	$60,186,893								$0	$3,751,297	$5,468,580	$649,892	$4,039,921	$817,494	$13,101	$10,988,988	$74,927,179	$1,849	$2,088	$90,047,778	$15,120,600	$304,356,656
30	2043	43,135	25,123	$1,437	$61,992,500								$0	$3,751,297	$5,742,009	$672,639	$4,241,918	$846,106	$13,559	$11,516,231	$77,260,028	$1,907	$2,150	$92,749,212	$15,489,184	$319,845,840
TOTAL (Rounded)					**$1,221,000,000**	**$27,718,000**	**$2,535,000**	**$5,079,000**	**$3,337,000**	**$6,560,000**	**$10,065,000**	**$352,000**	**$55,646,000**	**$97,880,000**	**$91,740,000**	**$12,490,000**	**$67,220,000**	**$16,110,000**	**$260,000**	**$188,000,000**	**$1,507,000,000**			**$1,826,000,000**	**$319,000,000**	

Table 2
Upper VDC Conjunctive Use Optimization Study
No Project Alternative

		Upper VDC		Untreated Water Cost		Treated Water Cost			Capital Cost									O&M Costs						Total Costs	
No.	Year	Recharge AF	Production (gpm)	Untreated Tier I ($/AF)	Untreated Water Cost	Treated Water Purchased (AF)	Treated Water Tier I ($/AF)	Treated Water Cost	Wells	Site Acquisition	Yard Piping	CCT & NaOCL	Pump Stations	Transmission Pipeline	Tractor & Building	Total Capital Cost	Total Amortized Cost	Well Energy	Chemical	PS Energy	RCWD Labor	Tractor	Total O&M Cost	Total Project Cost	Total ($/AF) (Production)
1	2014	19,023	5,123	$610	$11,604,030	4,721	$912	$4,305,552								$0	$0	$945,000	$78,571		$104,000		$1,127,571	$17,037,153	$2,062
2	2015	19,023	5,123	$628	$11,946,444	9,441	$939	$8,865,099								$0	$0	$992,250	$81,321		$107,640		$1,181,211	$21,992,754	$2,662
3	2016	19,023	5,123	$647	$12,307,881	14,161	$968	$13,707,848								$0	$0	$1,041,863	$84,168		$111,407		$1,237,438	$27,253,167	$3,298
4	2017	19,023	5,123	$666	$12,677,117	18,881	$997	$18,825,112								$0	$0	$1,093,956	$87,114		$115,307		$1,296,376	$32,798,606	$3,969
5	2018	19,023	5,123	$686	$13,057,431	24,112	$1,027	$24,761,847								$0	$0	$1,148,653	$90,163		$119,342		$1,358,158	$39,177,437	$4,741
6	2019	19,023	5,123	$707	$13,449,154	24,112	$1,058	$25,504,703								$0	$0	$1,206,086	$93,318		$123,519		$1,422,924	$40,376,780	$4,887
7	2020	19,023	5,123	$728	$13,852,628	24,112	$1,089	$26,269,844								$0	$0	$1,266,390	$96,584		$127,843		$1,490,817	$41,613,290	$5,036
8	2021	19,023	5,123	$750	$14,268,207	24,112	$1,122	$27,057,939								$0	$0	$1,329,710	$99,965		$132,317		$1,561,992	$42,888,138	$5,190
9	2022	19,023	5,123	$773	$14,696,254	24,112	$1,156	$27,869,677								$0	$0	$1,396,195	$103,464		$136,948		$1,636,607	$44,202,538	$5,350
10	2023	19,023	5,123	$796	$15,137,141	24,112	$1,191	$28,705,768	$941,000							$941,000	$70,199	$1,466,005	$107,085		$141,741		$1,714,831	$45,627,939	$5,522
11	2024	19,023	5,123	$820	$15,591,255	24,112	$1,226	$29,566,941								$0	$70,199	$1,539,305	$110,833		$146,702		$1,796,840	$47,025,236	$5,691
12	2025	19,023	5,123	$844	$16,058,993	24,112	$1,263	$30,453,949								$0	$70,199	$1,616,271	$114,712		$151,837		$1,882,819	$48,465,961	$5,865
13	2026	19,023	5,123	$870	$16,540,763	24,112	$1,301	$31,367,567								$0	$70,199	$1,697,084	$118,727		$157,151		$1,972,962	$49,951,492	$6,045
14	2027	19,023	5,123	$896	$17,036,986	24,112	$1,340	$32,308,594								$0	$70,199	$1,781,938	$122,882		$162,651		$2,067,472	$51,483,251	$6,231
15	2028	19,023	5,123	$922	$17,548,095	24,112	$1,380	$33,277,852								$0	$70,199	$1,871,035	$127,183		$168,344		$2,166,563	$53,062,709	$6,422
16	2029	19,023	5,123	$950	$18,074,538	24,112	$1,422	$34,276,188								$0	$70,199	$1,964,587	$131,635		$174,236		$2,270,458	$54,691,383	$6,619
17	2030	19,023	5,123	$979	$18,616,774	24,112	$1,464	$35,304,473								$0	$70,199	$2,062,816	$136,242		$180,335		$2,379,393	$56,370,840	$6,822
18	2031	19,023	5,123	$1,008	$19,175,278	24,112	$1,508	$36,363,608								$0	$70,199	$2,165,957	$141,010		$186,646		$2,493,614	$58,102,698	$7,032
19	2032	19,023	5,123	$1,038	$19,750,536	24,112	$1,553	$37,454,516								$0	$70,199	$2,274,255	$145,946		$193,179		$2,613,380	$59,888,631	$7,248
20	2033	19,023	5,123	$1,069	$20,343,052	24,112	$1,600	$38,578,151	$1,264,000							$1,264,000	$218,401	$2,387,968	$151,054		$199,940		$2,738,962	$61,878,566	$7,489
21	2034	19,023	5,123	$1,101	$20,953,344	24,112	$1,648	$39,735,496								$0	$218,401	$2,507,366	$156,341		$206,938		$2,870,645	$63,777,885	$7,719
22	2035	19,023	5,123	$1,135	$21,581,944	24,112	$1,697	$40,927,561								$0	$218,401	$2,632,735	$161,812		$214,181		$3,008,728	$65,736,633	$7,956
23	2036	19,023	5,123	$1,169	$22,229,402	24,112	$1,748	$42,155,388								$0	$218,401	$2,764,371	$167,476		$221,677		$3,153,524	$67,756,715	$8,200
24	2037	19,023	5,123	$1,204	$22,896,284	24,112	$1,801	$43,420,049								$0	$218,401	$2,902,590	$173,338		$229,436		$3,305,363	$69,840,098	$8,452
25	2038	19,023	5,123	$1,240	$23,583,173	24,112	$1,855	$44,722,651								$0	$218,401	$3,047,719	$179,404		$237,466		$3,464,590	$71,988,814	$8,712
26	2039	19,023	5,123	$1,277	$24,290,668	24,112	$1,910	$46,064,330								$0	$218,401	$3,200,105	$185,684		$245,777		$3,631,566	$74,204,965	$8,980
27	2040	19,023	5,123	$1,315	$25,019,388	24,112	$1,968	$47,446,260								$0	$218,401	$3,360,111	$192,182		$254,380		$3,806,673	$76,490,722	$9,257
28	2041	19,023	5,123	$1,355	$25,769,970	24,112	$2,027	$48,869,648								$0	$218,401	$3,528,116	$198,909		$263,283		$3,990,308	$78,848,326	$9,542
29	2042	19,023	5,123	$1,395	$26,543,069	24,112	$2,088	$50,335,737								$0	$218,401	$3,704,522	$205,871		$272,498		$4,182,891	$81,280,097	$9,837
30	2043	19,023	5,123	$1,437	$27,339,361	24,112	$2,150	$51,845,809								$0	$218,401	$3,889,748	$213,076		$282,035		$4,384,860	$83,788,431	$10,140
		TOTAL (Rounded)			**$552,000,000**			**$1,000,000,000**	**$2,205,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$2,205,000**	**$3,100,000**	**$62,780,000**	**$4,060,000**	**$0**	**$5,370,000**	**$0**	**$72,000,000**	**$1,627,000,000**	

Appendix D: Phasing Cost Table

Table 1
Upper VDC Conjunctive Use Optimization Study
Project Cost Comparison by Phases

			Upper VDC		Water Cost		Capital Cost												O&M Costs					Total Costs		Avoided Cost			
Phase No.	No.	Year	Recharge AF	Production (gpm)	Untreated Tier I ($/AF)	MWD Water Cost	Wells	Grading/ Discharge	Site Acquisition	Yard Piping	CCT & NaOCL	Pump Stations	Transmission Pipeline	Downstream Wells	Monitoring Well	Total Capital Cost	Amortized Cost	Total Amortized Cost	Well Energy	Chemical	PS Energy	RCWD Labor	Total O&M Cost	Total Project Cost	Total ($/AF) (Production)	Treated Water Tier I ($/AF)	Treated Water Cost	Difference	Running Total
1		2012	18,095	6,728	$560	$10,133,200	$350,000		$2,535,000							$2,885,000	$177,115	$177,115	$945,000	$78,571		$104,000	$1,127,571	$11,437,886	$632	$794	$14,367,430	$2,929,544	$2,929,544
		2013	18,095	6,728	$608	$11,001,760					$1,400,000				$500,000	$1,900,000	$116,644	$293,759	$992,250	$81,321		$107,640	$1,181,211	$12,476,730	$690	$868	$15,706,460	$3,229,730	$6,159,274
		Total - Phase I				**$21,134,960**	**$350,000**	**$0**	**$2,535,000**	**$0**	**$1,400,000**	**$0**	**$0**	**$0**	**$500,000**	**$4,785,000**		**$470,873**	**$1,937,250**	**$159,893**	**$0**	**$211,640**	**$2,308,783**	**$23,914,616**			**$30,073,890**	**$6,159,274**	
2	1	2014	28,952	11,663	$610	$17,660,720	$5,175,000	$200,000		$1,535,000		$4,000,000		$2,000,000	$500,000	$13,410,000	$823,261	$1,117,019	$1,190,700	$147,293	$390,000	$111,407	$1,839,401	$20,617,140	$712	$912	$26,404,224	$5,787,084	$5,787,084
	2	2015	28,952	11,663	$628	$18,181,856								$2,000,000		$2,000,000	$124,829	$1,241,848	$1,250,235	$152,449	$409,500	$115,307	$1,927,490	$21,351,195	$737	$939	$27,185,928	$5,834,733	$11,621,817
		Total - Phase II				**$35,842,576**	**$5,175,000**	**$200,000**	**$0**	**$1,535,000**	**$0**	**$4,000,000**	**$0**	**$4,000,000**	**$500,000**	**$15,410,000**		**$2,358,867**	**$2,440,935**	**$299,742**	**$799,500**	**$226,714**	**$3,766,891**	**$41,968,335**			**$53,590,152**	**$11,621,817**	
3	3	2016	36,190	14,578	$647	$23,414,930	$4,200,000			**$215,000**	$3,337,000	$2,560,000	$11,945,000	$2,000,000		$24,257,000	$1,540,824	$2,782,673	$1,422,142	$202,866	$845,539	$208,000	$2,678,547	$28,876,149	$798	$968	$35,031,920	$6,155,771	$6,155,771
	4	2017	36,190	14,578	$666	$24,117,378										$0		$2,782,673	$1,493,249	$213,009	$887,816	$215,280	$2,809,354	$29,709,404	$821	$997	$36,082,878	$6,373,473	$12,529,244
	5	2018	36,190	14,578	$686	$24,840,899	$4,000,000			**$215,000**				$2,000,000		$6,215,000	$410,323	$3,192,995	$1,688,521	$265,607	$1,139,363	$222,815	$3,316,306	$31,350,200	$866	$1,027	$37,165,364	$5,815,164	$18,344,407
	6	2019	36,190	14,578	$707	$25,586,126										$0		$3,192,995	$1,772,947	$274,903	$1,196,332	$230,613	$3,474,795	$32,253,916	$891	$1,058	$38,280,325	$6,026,409	$24,370,816
		Total - Phase III				**$97,959,333**	**$8,200,000**			**$430,000**	**$3,337,000**	**$2,560,000**	**$11,945,000**	**$4,000,000**	**$0**	**$30,472,000**		**$11,951,336**	**$6,376,859**	**$956,385**	**$4,069,050**	**$876,708**	**$12,279,001**	**$122,189,670**			**$146,560,486**	**$24,370,816**	
4	7	2020	43,135	18,840	$728	$31,411,088	$4,000,000				$3,337,000			$1,000,000		$8,337,000	$575,145	$3,768,140	$1,994,565	$336,257	$1,484,539	$238,685	$4,054,045	$39,233,273	$910	$1,089	$46,995,260	$7,761,987	$7,761,987
	8	2021	43,135	18,840	$750	$32,353,421								$1,000,000		$1,000,000	$70,682	$3,838,823	$2,094,293	$348,026	$1,558,766	$247,039	$4,248,123	$40,440,367	$938	$1,122	$48,405,118	$7,964,751	$15,726,738
	9	2022	43,135	18,840	$773	$33,324,023	$4,000,000							$1,000,000		$5,000,000	$362,728	$4,201,551	$2,345,608	$415,623	$1,888,505	$255,685	$4,905,421	$42,430,995	$984	$1,156	$49,857,272	$7,426,276	$23,153,014
	10	2023	43,135	18,840	$796	$34,323,744								$1,000,000		$1,000,000	$74,601	$4,276,151	$2,462,889	$430,170	$1,982,930	$264,634	$5,140,622	$43,740,518	$1,014	$1,191	$51,352,990	$7,612,472	$30,765,486
	11	2024	43,135	18,840	$820	$35,353,456	$2,000,000									$2,000,000	$153,752	$4,429,904	$2,666,847	$474,907	$2,220,881	$273,896	$5,636,532	$45,419,892	$1,053	$1,226	$52,893,579	$7,473,687	$38,239,174
	12	2025	43,135	18,840	$844	$36,414,060										$0	$0	$4,429,904	$2,800,189	$491,529	$2,331,926	$283,483	$5,907,126	$46,751,090	$1,084	$1,263	$54,480,387	$7,729,297	$45,968,470
	13	2026	43,135	18,840	$870	$37,506,482										$0	$0	$4,429,904	$2,940,198	$508,733	$2,448,522	$293,405	$6,190,857	$48,127,243	$1,116	$1,301	$56,114,798	$7,987,555	$53,956,026
	14	2027	43,135	18,840	$896	$38,631,676										$0	$0	$4,429,904	$3,087,208	$526,538	$2,570,948	$303,674	$6,488,368	$49,549,948	$1,149	$1,340	$57,798,242	$8,248,294	$62,204,320
	15	2028	43,135	18,840	$922	$39,790,627										$0	$0	$4,429,904	$3,241,569	$544,967	$2,699,495	$314,302	$6,800,333	$51,020,864	$1,183	$1,380	$59,532,190	$8,511,326	$70,715,645
	16	2029	43,135	18,840	$950	$40,984,346										$0	$0	$4,429,904	$3,403,647	$564,041	$2,834,470	$325,303	$7,127,461	$52,541,710	$1,218	$1,422	$61,318,155	$8,776,445	$79,492,090
	17	2030	43,135	18,840	$979	$42,213,876										$0	$0	$4,429,904	$3,573,830	$583,782	$2,976,194	$336,688	$7,470,494	$54,114,274	$1,255	$1,464	$63,157,700	$9,043,426	$88,535,517
	18	2031	43,135	18,840	$1,008	$43,480,292										$0	$0	$4,429,904	$3,752,521	$604,215	$3,125,003	$348,473	$7,830,212	$55,740,407	$1,292	$1,508	$65,052,431	$9,312,023	$97,847,540
	19	2032	43,135	18,840	$1,038	$44,784,701										$0	$0	$4,429,904	$3,940,147	$625,362	$3,281,253	$360,669	$8,207,432	$57,422,037	$1,331	$1,553	$67,004,004	$9,581,967	$107,429,507
	20	2033	43,135	18,840	$1,069	$46,128,242										$0	$0	$4,429,904	$4,137,154	$647,250	$3,445,316	$373,293	$8,603,013	$59,161,159	$1,372	$1,600	$69,014,124	$9,852,965	$117,282,473
	21	2034	43,135	18,840	$1,101	$47,512,089										$0	$0	$4,429,904	$4,344,012	$669,904	$3,617,582	$386,358	$9,017,855	$60,959,848	$1,413	$1,648	$71,084,548	$10,124,699	$127,407,172
	22	2035	43,135	18,840	$1,135	$48,937,452										$0	$0	$4,429,904	$4,561,213	$693,350	$3,798,461	$399,880	$9,452,904	$62,820,260	$1,456	$1,697	$73,217,084	$10,396,824	$137,803,996
	23	2036	43,135	18,840	$1,169	$50,405,575										$0	$0	$4,429,904	$4,789,273	$717,618	$3,988,384	$413,876	$9,909,151	$64,744,630	$1,501	$1,748	$75,413,597	$10,668,966	$148,472,962
	24	2037	43,135	18,840	$1,204	$51,917,743										$0	$0	$4,429,904	$5,028,737	$742,734	$4,187,803	$428,362	$10,387,636	$66,735,283	$1,547	$1,801	$77,676,005	$10,940,722	$159,413,684
	25	2038	43,135	18,840	$1,240	$53,475,275										$0	$0	$4,429,904	$5,280,174	$768,730	$4,397,193	$443,354	$10,889,452	$68,794,630	$1,595	$1,855	$80,006,285	$11,211,654	$170,625,339
	26	2039	43,135	18,840	$1,277	$55,079,533										$0	$0	$4,429,904	$5,544,183	$795,635	$4,617,053	$458,872	$11,415,743	$70,925,180	$1,644	$1,910	$82,406,473	$11,481,293	$182,106,632
	27	2040	43,135	18,840	$1,315	$56,731,919										$0	$0	$4,429,904	$5,821,392	$823,483	$4,847,906	$474,932	$11,967,712	$73,129,535	$1,695	$1,968	$84,878,667	$11,749,132	$193,855,764
	28	2041	43,135	18,840	$1,355	$58,433,877										$0	$0	$4,429,904	$6,112,461	$852,305	$5,090,301	$491,555	$12,546,622	$75,410,402	$1,748	$2,027	$87,425,027	$12,014,625	$205,870,389
	29	2042	43,135	18,840	$1,395	$60,186,893										$0	$0	$4,429,904	$6,418,084	$882,135	$5,344,816	$508,759	$13,153,795	$77,770,592	$1,803	$2,088	$90,047,778	$12,277,186	$218,147,575
	30	2043	43,135	18,840	$1,437	$61,992,500										$0	$0	$4,429,904	$6,738,989	$913,010	$5,612,057	$526,566	$13,790,621	$80,213,025	$1,860	$2,150	$92,749,212	$12,536,187	$230,683,762
		Total - Phase IV				**$1,081,372,891**	**$10,000,000**	**$0**	**$0**	**$0**	**$3,337,000**	**$0**	**$0**	**$4,000,000**	**$0**	**$17,337,000**		**$104,682,741**	**$97,079,184**	**$14,960,302**	**$80,350,304**	**$8,751,742**	**$201,141,532**	**$1,387,197,164**			**$1,617,880,925**	**$230,683,762**	

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