

CR2.2 – Avoid traps and vulnerabilities.

Level of Achievement:

RESTORATIVE

Summary:

The project team identified and assessed possible changes in key engineering design variables such as water balance. The project team conducted a comprehensive water balance study during pre-design efforts considering different evapotranspiration rates and wetland sizes. Actual flow monitoring was conducted to understand how much dry-weather runoff (source water supply) would be available from the 63" storm drain.

The project team understood the potential of droughts and decreased dry-weather runoff in the future due to water conservation measures. Also, assuming that similar stormwater treatment projects are constructed in the future, the source water supply should diminish over time. Therefore, flexible operation features were built into the project such that the wetland may be operated differently. The three cells that make up the wetland are designed to operate independently. Valves are installed so that stormwater may be pumped to any of the three cells. Sluice gates and end caps for the orifices are designed to isolate any of the three cells. This flexibility provides opportunity to reconfigure the wetland in the event that source water is reduced (i.e., consider converting one of the cells to park space).

Supporting documentation:

- Section 6.3.2 – Water Balance from Pre-Design Report
- Site plan exhibit showing flexible operation features

Section 6.3.2 – Water Balance from Pre-Design Report

6.3.2 Water Balance

In order to determine the general water balance at the site, particularly during dry periods (droughts), the following assumptions were made:

- The entire wetland area will have a lined bottom which will not allow for infiltration. A lined wetland will maintain water levels and prevent infiltration of polluted runoff water to groundwater.
- The potential evapotranspiration rate is assumed to equal 85% of the pan evaporation rate. The pan evaporation rate data was estimated for a Los Angeles airport location using a form of the Penman equation: (*Source: http://www.ocs.oregonstate.edu/page_links/comparative_climate/california/california.html*). The ratio of 0.85 was used to estimate the evapotranspiration from this data. Generally, based on regional location, surrounding soils/plant conditions, wind speed, relative humidity and upwind fetch this ratio may vary from 0.35 to 0.85 (*Wanielista, Kersten, Ealgin: Hydrology: Water quantity and quality control - 2nd Edition*).
- Average monthly precipitation is maintained (data for downtown Los Angeles obtained from NOAA: <http://www.wrh.noaa.gov/lox/climate/cvc.php>).
- Constant baseflow of 0.02 cfs (14,000 gpd) is available.

Initially, water balance calculations were conducted based on the baseflow value of 80,000 gpd provided by the Draft Concept Report. Subsequently, a revised baseflow estimate of approximately 23,000 gpd was provided and water balance calculations were conducted. Previous versions of this report present water balance calculations based on 80,000 and 20,000 gpd baseflows. In September 2007, flow monitoring was conducted adjacent to the Wetland Park Project in the San Pedro Street storm drain for a period of one week and resulted in an average measured baseflow of approximately 14,000 gpd. The Storm Water Flow Monitoring Report is included in this document as Appendix I. This Final Preliminary Design Report presents water balance calculations based on the measured value of 14,000 gpd. The tables below present water balance calculations for wetland footprints of 4.5 and 4.0 acres having effective evapotranspiration areas of 3.7 and 3.3 acres, respectively.

Table 6-1 shows that for a wetland footprint of 4.5 acres and a baseflow of 14,000 gpd and with average precipitation rates, there is a positive outflow from the wetland during the months of October – April (Column H).

**Table 6-1 Average Monthly Water Balance Summary
(4.5 Acre Wetland Footprint & Baseflow Estimate of 14,000 gpd)**

	A	B	C	D	E	F	G	H
Month	Dry-weather Baseflow (ac-ft) (14,000 gpd)	Average Monthly Precipitation (inches)	Average Monthly Pan Evaporation (inches)	Average Monthly Evapotranspiration (ET) (inches) (85% of C)	Precip - ET (inches) (B - D)	Effective ET Area for 4.5 acre Wetland (Acres)	Precip - ET (ac-ft) [E (ft) x F]	Monthly Outflow (ac-ft) (A + G)
Jan	1.33	3.06	3.50	2.98	0.09	3.7	0.03	1.36
Feb	1.20	3.42	3.60	3.06	0.36	3.7	0.11	1.31
Mar	1.33	2.48	5.10	4.34	-1.86	3.7	-0.57	0.76
Apr	1.29	1.10	5.80	4.93	-3.83	3.7	-1.18	0.11
May	1.33	0.25	6.70	5.70	-5.45	3.7	-1.68	(0.35)
Jun	1.29	0.08	6.40	5.44	-5.36	3.7	-1.65	(0.36)
Jul	1.33	0.01	7.80	6.63	-6.62	3.7	-2.04	(0.71)
Aug	1.33	0.06	7.30	6.21	-6.15	3.7	-1.89	(0.56)
Sep	1.29	0.27	6.10	5.19	-4.92	3.7	-1.52	(0.23)
Oct	1.33	0.43	5.30	4.51	-4.08	3.7	-1.26	0.08
Nov	1.29	1.35	4.00	3.40	-2.05	3.7	-0.63	0.66
Dec	1.33	2.40	3.60	3.06	-0.66	3.7	-0.20	1.13
Annual Totals	15.68	14.91	65.20	55.42	-40.51	3.7	-12.49	3.19
Average Daily Flows	14,000	gallons per day						

Table 6-2 presents the surface applied irrigation requirements to sustain treatment wetland habitat and maintain water balance for the 4.5 acre wetland scenario. Table 6-2 indicates that irrigation requirements for the wetland (in inches per week) are less than the irrigation requirements for an equivalent area of turf (using City of Los Angeles, Department of Recreation and Parks design irrigation rate of 1.5 inches per week).

**Table 6-2 Average Monthly Irrigation Requirements
(4.5 Acre Wetland Footprint & Baseflow Estimate of 14,000 gpd)**

Month	Monthly Water Balance (from Table 6-1)	Surface Applied Irrigation Requirements (gal per day)	Surface Applied Irrigation Requirements (inches per week)
	(ac-ft)	(gal per day)	(inches per week)
Jan	1.36	0	0
Feb	1.31	0	0
Mar	0.76	0	0
Apr	0.11	0	0
May	(0.35)	3,647	0.25
Jun	(0.36)	3,951	0.28
Jul	(0.71)	7,455	0.52
Aug	(0.56)	5,916	0.41
Sep	(0.23)	2,460	0.17
Oct	0.08	0	0
Nov	0.66	0	0
Dec	1.13	0	0

Table 6-3 below indicates that for a wetland footprint of 4.0 acres and a baseflow of 14,000 gpd and with average precipitation rates, there is a positive outflow from the wetland during the months of October – April (Column H). Surface applied irrigation would be used to sustain treatment wetland habitat and maintain water balance under this scenario as in the previous scenario.

**Table 6-3 Average Monthly Water Balance Summary
(4.0 Acre Wetland Footprint & Baseflow Estimate of 14,000 gpd)**

	A	B	C	D	E	F	G	H
Month	Dry-weather Baseflow (ac-ft) (14,000 gpd)	Average Monthly Precipitation (inches)	Average Monthly Pan Evaporation (inches)	Average Monthly Evapotranspiration (ET) (inches) (85% of C)	Precip - ET (inches) (B - D)	Effective ET Area for 4.0 acre Wetland (Acres)	Precip - ET (ac-ft) [E (ft) x F]	Monthly Outflow (ac-ft) (A + G)
Jan	1.33	3.06	3.50	2.98	0.09	3.3	0.02	1.36
Feb	1.20	3.42	3.60	3.06	0.36	3.3	0.10	1.30
Mar	1.33	2.48	5.10	4.34	-1.86	3.3	-0.51	0.82
Apr	1.29	1.10	5.80	4.93	-3.83	3.3	-1.05	0.24
May	1.33	0.25	6.70	5.70	-5.45	3.3	-1.50	(0.17)
Jun	1.29	0.08	6.40	5.44	-5.36	3.3	-1.47	(0.19)
Jul	1.33	0.01	7.80	6.63	-6.62	3.3	-1.82	(0.49)
Aug	1.33	0.06	7.30	6.21	-6.15	3.3	-1.69	(0.36)
Sep	1.29	0.27	6.10	5.19	-4.92	3.3	-1.35	(0.06)
Oct	1.33	0.43	5.30	4.51	-4.08	3.3	-1.12	0.21
Nov	1.29	1.35	4.00	3.40	-2.05	3.3	-0.56	0.73
Dec	1.33	2.40	3.60	3.06	-0.66	3.3	-0.18	1.15
Annual Totals	15.68	14.91	65.20	55.42	-40.51	3.3	-11.14	4.54
Average Daily Flows	14,000	gallons per day						

Table 6-4 presents the surface applied irrigation requirements to sustain treatment wetland habitat and maintain water balance for the 4.0 acre wetland scenario. Table 6-4 indicates that irrigation requirements for the wetland (in inches per week) are less than the irrigation requirements for an equivalent area of turf (using City of Los Angeles, Department of Recreation and Parks design irrigation rate of 1.5 inches per week).

**Table 6-4 Average Monthly Irrigation Requirements
(4.0 Acre Wetland Footprint & Baseflow Estimate of 14,000 gpd)**

Month	Monthly Water Balance (from Table 6-3)	Surface Supply Irrigation Requirements	Surface Applied Irrigation Requirements
	(ac-ft)	(gal per day)	(inches per week)
Jan	1.36	0	0
Feb	1.30	0	0
Mar	0.82	0	0
Apr	0.24	0	0
May	(0.17)	1,739	0.12
Jun	(0.19)	2,010	0.14
Jul	(0.49)	5,136	0.36
Aug	(0.36)	3,763	0.26
Sep	(0.06)	681	0.05
Oct	0.21	0	0
Nov	0.73	0	0
Dec	1.15	0	0

Site plan exhibit showing
flexible operation features



