# APPENDIX I

# SUPPORTING DETAILS RELATED TO HYDROLOGIC CONDITIONS OF CONCERN

## Supporting Details Related to Hydrologic Conditions of Concern

Hydrologic conditions of concern do not occur in this project because peak flows and runoff volume have been reduced in the proposed re-development when compared with the current conditions. The following sections demonstrate that the previous statement can be verified though basic hydrologic principles.

### I-1 Runoff Volume from the Water Quality Storm Event

The Runoff volume will be obtained according to the equations explained in Appendix A. Basically the volume of runoff $V_R$ as a function of the C coefficient, the 24 hr precipitation P and the area A is equal to: $V_R = CPA$

Assuming a precipitation depth of 0.75", a rainfall distribution similar to that described in Table B-1 of the Draft LAC Stormwater BMP Manual, a $C_u$ = 0.1 for impervious areas during the complete storm event because the intensity does not exceed 1.04 in/hr, and a C=0.9 for pervious areas is used. Table I-1 is a summary of the expected runoff volume for each sub-area of the project in Pre-Development and Post-Development conditions for the 0.75" storm analyzed here.

**TABLE I-1: Pre and Post Comparison of Runoff for a 0.75"-24hr storm event**

| AREA NAME (1) | AREA-Pre (acres) | AREA-Post (acres) | fp Pre-Dev | fp Post-Dev | Cd Pre-Dev. | Cd Post-Dev. | $V_R$-Pre P=0.75" ($ft^3$) | $V_R$-Post P=0.75" ($ft^3$) | Infiltration volume ($ft^3$) | Discharged Runoff ($ft^3$)(1) | Runoff Post/Pre |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 8.01 | 8.01 | 0 | 0.064 | 0.900 | 0.849 | 19,040 | 18,507 | 18,507 | 0 | |
| A2 | 0.29 | 0.46 | 0.033 | 0.190 | 0.874 | 0.751 | 724 | 949 | 0 | 949 | |
| Total A | 8.30 | 8.47 | 0.032 | 0.071 | 0.874 | 0.843 | 19,764 | 19,456 | 18,507 | 949 | 4.8% |
| B1 | 4.78 | 4.99 | 0.024 | 0.144 | 0.881 | 0.785 | 11,451 | 10,657 | 10,657 | 0 | |
| B2 | 0.62 | 0.52 | 0.024 | 0.070 | 0.881 | 0.846 | 1,495 | 1,207 | 0 | 1,207 | |
| Total B | 5.40 | 5.51 | 0.024 | 0.136 | 0.881 | 0.791 | 12,946 | 11,865 | 10,657 | 1,207 | 9.3% |
| C2 | 0.84 | 0.56 | 0 | 0.220 | 0.900 | 0.720 | 2,064 | 1,094 | 0 | 1,094 | 53.0% |
| **TOTAL** | **14.54** | **14.54** | **0.027** | **0.102** | **0.878** | **0.818** | **34,774** | **32,415** | **29,164** | **3,250** | **9.3%** |

(1): discharged runoff corresponds to runoff leaving the site after the Biocells and the UIB for the given 24hr storm event

It is clear from the inspection of Table I-1 that runoff volume has reduced from every sub-area, including those that have increased slightly in size, even before subtracting the infiltration volume that will occur in the biocells and underground infiltration system. The reason is that the increase in pervious areas reduces the runoff more than the increase in runoff caused by the area change in sub-areas A and B. As the total area has to be the same, obviously not all areas can increase, and therefore area C reduces in total area and also increases in percentage of pervious area.

### I-2 Runoff Volume from the 10 yr-24hr Storm Event

The Runoff volume for this storm will be calculated as before. There are two basic differences: first, the total 24hr precipitation for a 10yr storm event is 7.25" (almost an order of magnitude larger); second the C coefficient for pervious areas increases from $C_u$=0.1 to $C_u$=0.123 because during the most intense portions of the storm the intensity exceeds the value 1.04 in/hr and then $C_u$ has to be calculated with the equation explained in Appendix A and the weighted average $C_u$ coefficient for the 24 hr duration of rainfall increases. Table I-2 shows the results for a 10yr-24hr storm event. The reason this event was analyzed is to demonstrate that not only runoff volume has not been exceeded in a moderate event (as the 0.75"-24hr storm event is) but also is not exceeded even for an extreme event as the 10yr-24hr storm event.

**TABLE I-2: Pre and Post Comparison of Runoff for a 10yr (7.25")-24hr storm event**

| AREA NAME (1) | AREA-Pre (acres) | AREA-Post (acres) | fp Pre-Dev | fp Post-Dev | Cd Pre-Dev. | Cd Post-Dev. | $V_R$-Pre P=7.25" ($ft^3$) | $V_R$-Post P=7.25" ($ft^3$) | Infiltration volume ($ft^3$) | Discharged Runoff ($ft^3$)(1) | Runoff Post/Pre |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 8.01 | 8.01 | 0 | 0.064 | 0.900 | 0.850 | 184,215 | 179,214 | 20,329 | 158,885 | |
| A2 | 0.29 | 0.46 | 0.033 | 0.190 | 0.875 | 0.756 | 6,999 | 9,227 | 0 | 9,227 | |
| Total A | 8.30 | 8.47 | 0.032 | 0.071 | 0.875 | 0.842 | 191,213 | 188,441 | 20,329 | 168,112 | 87.9% |
| B1 | 4.78 | 4.99 | 0.024 | 0.144 | 0.881 | 0.788 | 110,842 | 103,453 | 14,581 | 88,873 | |
| B2 | 0.62 | 0.52 | 0.024 | 0.070 | 0.882 | 0.848 | 14,461 | 11,692 | 0 | 11,692 | |
| Total B | 5.40 | 5.51 | 0.024 | 0.136 | 0.882 | 0.794 | 125,302 | 115,145 | 14,581 | 100,565 | 80.3% |
| C2 | 0.84 | 0.56 | 0 | 0.220 | 0.900 | 0.726 | 19,952 | 10,651 | 0 | 10,651 | 53.4% |
| **)TAL** | **14.54** | **14.54** | **0.027** | **0.102** | **0.879** | **0.820** | **336,468** | **314,237** | **34,910** | **279,328** | **83.0%** |

(1): discharged runoff corresponds to runoff leaving the site after the Biocells and the UIB for the given 24hr storm event

It is clear from the inspection of Table I-2 that runoff volume has reduced from every sub-area, including those that have increased slightly in size, even before subtracting the infiltration volume that will occur in the biocells and underground infiltration system. The reason is again that the increase in pervious areas reduces the runoff more than the increase in runoff caused by the area change in sub-areas A and B.

The infiltration volume only takes into account the maximum volume that has been retained in the system in the bio-cells and in the underground infiltration systems and infiltrated while precipitation is occurring and does not take into account the additional infiltration that occurs from the time the rain stops until the time the elevation of the underground systems reach the invert elevation of the outlet structure. Therefore a more accurate calculation of the runoff will yield a slightly smaller value. The infiltration value is higher than in the previous case because all possible retention volume is full during an extreme event and may not be full during a 0.75" for some of the underground infiltration systems and bio-cells. The discharge runoff issimply the total runoff volume less the volume infiltrated.

## I-3 Peak Flows from the Water Quality Storm Event

Peak flows from Water Quality Storm events are usually associated with an intensity of 0.2 in/hr or with the maximum intensity resulting from twice the intensity obtained from in Table B-1 of the Draft LAC Stormwater BMP Manual for a given time of concentration. As the time of concentration of each sub-area is different, and as the UIS may additionally reduce the peak flow by means of the detention volume provided above the invert of the outlet of each UIS, a comparison will be made based solely on the 0.2 in/hr intensity criteria.

It can be seen in Table I-3 that assuming an intensity of 0.2 in/hr and neglecting the retention and detention capabilities of the bio-cells and UIS for simplicity of calculations (and not because the reduction of peak flow is not significant) all peak flows for all sub-areas are smaller after re-development.

**TABLE I-3: Pre and Post Comparison of Peak Flow with an intensity of 0.2 in/hr**

| AREA NAME (1) | AREA-Pre (acres) | AREA-Post (acres) | Cd Pre-Dev. | Cd Post-Dev. | Pre-Peak I=0.2 in/hr | Post-Peak I=0.2 in/hr |
|---|---|---|---|---|---|---|
| A1 | 8.01 | 8.01 | 0.9 | 0.849 | 1.44 | 1.36 |
| A2 | 0.29 | 0.46 | 0.874 | 0.748 | 0.05 | 0.07 |
| Total A | 8.30 | 8.47 | 0.874 | 0.843 | 1.45 | 1.43 |
| B1 | 4.78 | 4.99 | 0.881 | 0.785 | 0.84 | 0.78 |
| B2 | 0.62 | 0.52 | 0.881 | 0.844 | 0.11 | 0.09 |
| Total B | 5.40 | 5.51 | 0.881 | 0.791 | 0.95 | 0.87 |
| C2 | 0.84 | 0.56 | 0.9 | 0.724 | 0.15 | 0.08 |
| **TOTAL** | **14.54** | **14.54** | **0.878** | **0.82** | **2.55** | **2.38** |

## I-4 Peak Flows from the 10yr-24hr Storm Event

Peak flows from a 10yr-24hr storm event involve the routing of a 10 yr-24hr hydrograph through the UIS to determine the attenuation on the peak the detention portion of the underground systems produce. To simplify these calculations, and to easily compare peak flows based on the same time of concentration for pre-development and post-development conditions, a simple Rational Method approach will be used and the time of concentration of 10 min will be assumed for areas A and B, and of 5 min for area C (C sheet-flows directly to the Rio Hondo channel). The reader is advised that the post-development peak flow after the Underground Infiltration Systems is smaller than the value presented here, because there is attenuation on the peak flow as a consequence of the detention volume of those systems, and such attenuation can only be accurately calculated simulating a 10yr-24hr synthetic hydrograph routed through the UIS using a Modified Puls Method approach (the modeling effort is beyond the scope of this document and therefore was not done here).

**TABLE I-4: Pre and Post Comparison of Peak Flow for a 10yr Storm Event**

| AREA NAME (1) | AREA-Pre (acres) | AREA-Post (acres) | I-10yrs (in/hr) | Cd Pre-Dev. | Cd Post-Dev. | Pre-Peak 10 yr event | Post-Peak 10 yr event |
|---|---|---|---|---|---|---|---|
| A1 | 8.01 | 8.01 | 2.86 | 0.9 | 0.868 | 20.61 | 19.89 |
| A2 | 0.29 | 0.46 | 2.86 | 0.884 | 0.806 | 0.75 | 1.07 |
| Total A | 8.30 | 8.47 | 2.86 | 0.884 | 0.865 | 20.99 | 20.96 |
| B1 | 4.78 | 4.99 | 2.86 | 0.888 | 0.829 | 12.13 | 11.82 |
| B2 | 0.62 | 0.52 | 2.86 | 0.888 | 0.866 | 1.58 | 1.30 |
| Total B | 5.40 | 5.51 | 2.86 | 0.888 | 0.833 | 13.72 | 13.13 |
| C2 | 0.84 | 0.56 | 4.31 | 0.9 | 0.819 | 3.27 | 1.97 |
| **TOTAL** | **14.54** | **14.54** | **2.86** | **0.887** | **0.85** | **36.88** | **35.34** |

From inspection of table I-4 it is evident that peak flows from the 10 yr storm event have been reduced below pre-development values, even without taking into account the mitigation effect of the UIS.

As a conclusion of this Appendix I, the volume of runoff and runoff peak flow will be reduced after re-development and that no Hydrologic Conditions of Concern are expected in this project due to the almost identical preservation of drainage patterns, the increment on landscape areas, and the incorporation of biocells and UIS as infiltration features from the hydrologic point of view.