APPENDIX I

Drainage Study
JVR Energy Park
Part 4

Appendix B – Hydrologic Figures

LAG Time Calculations

Narrative:

The San Diego County Unit Hydrograph Program (SDUH) will be used to find Qmax from offsite watersheds. The equations below describe how to find the Corps Lag Time used in the Unit Hydrograph Program.

$$CorpsT_1(hours) = 24\overline{n}((L \times L_c)/s^{0.5})^m$$ SDCHM *Equation 4-17*

Legend:

L = length to longest watercourse (miles)

L_c = length along longest watercourse, measured upstream to a point opposite the watershed centroid (miles)

s = overall slope of drainage area between the headwaters and the collection point (feet per mile)

m = a constant determined by regional flood reconstitution studies (0.38 for San Diego County)

$\overline{n}$ = the average of the Manning's n values of the watercourse and its tributaries (see SDCHM section 4.3.5)

Lag Time Calculations: See Figure 9 for Basin Locations

Basin #1 (South)		
Elev1(high)	4580	ft
Elev2(low)	2800	ft
L	13.68	miles
L_c	3.22	miles
S	130.1169591	ft/miles
m	0.38	unitless
n	0.070	unitless
Corps Lag	**2.81**	**hours**

Basin #2 (West)		
Elev1(high)	4000	ft
Elev2(low)	2800	ft
L	9.55	miles
L_c	4.29	miles
S	125.6545	ft/miles
m	0.38	unitless
n	0.070	unitless
Corps Lag	**2.75**	**hours**

LAG Time Calculations

Basin #3 (East)		
Elev1(high)	4060	ft
Elev2(low)	2780	ft
L	5.37	miles
L_c	2.1	miles
S	238.3613	ft/miles
m	0.38	unitless
n	0.070	unitless
Corps Lag	**1.49**	**hours**

Basin (Mid)		
Elev1(high)	4580	ft
Elev2(low)	2700	ft
L	16	miles
L_c	3.5	miles
S	117.5	ft/miles
m	0.38	unitless
n	0.070	unitless
Corps Lag	**3.14**	**hours**

Basin (Overall)		
Elev1(high)	4580	ft
Elev2(low)	2700	ft
L	17.03	miles
L_c	3.8	miles
S	110.3934	ft/miles
m	0.38	unitless
n	0.070	unitless
Corps Lag	**3.35**	**hours**

SEE FIGURE 2 FOR WATERSHED LOCATIONS

BASIN OUTLET

```
*****************************************************************************
* The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the      *
* procedures described in Section 4 of the San Diego County Hydrology       *
* Manual for NRCS Hydrologic Method calculations.  The SDUH Peak Discharge  *
* Program may be used only for determination of peak flow rate, and may not *
* be used for detention basin design or other routing purposes for which a  *
* hydrograph is required.  To generate a hydrograph, the calculation method *
* described in Section 4 of the San Diego County Hydrology Manual may be    *
* used, or a computer program that includes good documentation of the       *
* calculations (see Section 1.7 of the San Diego County Hydrology manual).  *
* Note: the RATHYDRO computer program is not based on the calculation method*
* described in Section 4 of the San Diego County Hydrology Manual and may   *
* not be used to generate a hydrograph based on the SDUH Peak Discharge     *
* Program output.                                                           *
*****************************************************************************

 Project Identification: Jacumba_CorpLag_Overall
 Storm Frequency (years) =  100
 Drainage Area (square miles) =  111.000
 6-Hour Rainfall (inches) =     3.00
 6-Hour Depth-Area Factor =    0.885
 24-Hour Rainfall (inches) =     5.00
 24-Hour Depth-Area Factor =    0.933
 Adjusted Curve Number = 79
 Unit Interval (minutes) = 30
 Watershed Lag Time (hours) =    3.350
 Peak Flow Rate (cfs) =    26164.4
```

BASIN #1 (SOUTH)

```
*****************************************************************************
* The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the      *
* procedures described in Section 4 of the San Diego County Hydrology       *
* Manual for NRCS Hydrologic Method calculations.  The SDUH Peak Discharge  *
* Program may be used only for determination of peak flow rate, and may not *
* be used for detention basin design or other routing purposes for which a  *
* hydrograph is required.  To generate a hydrograph, the calculation method *
* described in Section 4 of the San Diego County Hydrology Manual may be    *
* used, or a computer program that includes good documentation of the       *
* calculations (see Section 1.7 of the San Diego County Hydrology manual).  *
* Note: the RATHYDRO computer program is not based on the calculation method*
* described in Section 4 of the San Diego County Hydrology Manual and may   *
* not be used to generate a hydrograph based on the SDUH Peak Discharge     *
* Program output.                                                           *
*****************************************************************************

 Project Identification: Jacumba_CorpLag_South
 Storm Frequency (years) =  100
 Drainage Area (square miles) =   82.000
 6-Hour Rainfall (inches) =     3.00
 6-Hour Depth-Area Factor =    0.902
 24-Hour Rainfall (inches) =     5.00
 24-Hour Depth-Area Factor =    0.941
 Adjusted Curve Number = 83
 Unit Interval (minutes) = 20
 Watershed Lag Time (hours) =    2.810
 Peak Flow Rate (cfs) =    24661.0
```

BASIN #2 (WEST)

```
*****************************************************************************
* The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the      *
* procedures described in Section 4 of the San Diego County Hydrology       *
* Manual for NRCS Hydrologic Method calculations.  The SDUH Peak Discharge  *
* Program may be used only for determination of peak flow rate, and may not *
* be used for detention basin design or other routing purposes for which a  *
* hydrograph is required.  To generate a hydrograph, the calculation method *
* described in Section 4 of the San Diego County Hydrology Manual may be    *
* used, or a computer program that includes good documentation of the       *
* calculations (see Section 1.7 of the San Diego County Hydrology manual).  *
* Note: the RATHYDRO computer program is not based on the calculation method*
* described in Section 4 of the San Diego County Hydrology Manual and may   *
* not be used to generate a hydrograph based on the SDUH Peak Discharge     *
* Program output.                                                           *
*****************************************************************************

 Project Identification: Jacumba_CorpLag_West
 Storm Frequency (years) =  100
 Drainage Area (square miles) =   19.500
 6-Hour Rainfall (inches) =     3.00
 6-Hour Depth-Area Factor =    0.964
 24-Hour Rainfall (inches) =     5.00
 24-Hour Depth-Area Factor =    0.975
 Adjusted Curve Number = 68
 Unit Interval (minutes) = 20
 Watershed Lag Time (hours) =    2.750
 Peak Flow Rate (cfs) =     4181.3
```

BASIN #3 (EAST)

```
*****************************************************************************
* The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the      *
* procedures described in Section 4 of the San Diego County Hydrology       *
* Manual for NRCS Hydrologic Method calculations.  The SDUH Peak Discharge  *
* Program may be used only for determination of peak flow rate, and may not *
* be used for detention basin design or other routing purposes for which a  *
* hydrograph is required.  To generate a hydrograph, the calculation method *
* described in Section 4 of the San Diego County Hydrology Manual may be    *
* used, or a computer program that includes good documentation of the       *
* calculations (see Section 1.7 of the San Diego County Hydrology manual).  *
* Note: the RATHYDRO computer program is not based on the calculation method*
* described in Section 4 of the San Diego County Hydrology Manual and may   *
* not be used to generate a hydrograph based on the SDUH Peak Discharge     *
* Program output.                                                           *
*****************************************************************************

 Project Identification: Jacumba_CorpLag_East
 Storm Frequency (years) =  100
 Drainage Area (square miles) =    6.900
 6-Hour Rainfall (inches) =     3.00
 6-Hour Depth-Area Factor =    0.983
 24-Hour Rainfall (inches) =     5.00
 24-Hour Depth-Area Factor =    0.988
 Adjusted Curve Number = 70
 Unit Interval (minutes) = 10
 Watershed Lag Time (hours) =    1.490
 Peak Flow Rate (cfs) =     2521.7
```

BASIN #4 (MID)

```
*****************************************************************************
* The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the      *
* procedures described in Section 4 of the San Diego County Hydrology       *
* Manual for NRCS Hydrologic Method calculations.  The SDUH Peak Discharge  *
* Program may be used only for determination of peak flow rate, and may not *
* be used for detention basin design or other routing purposes for which a  *
* hydrograph is required.  To generate a hydrograph, the calculation method *
* described in Section 4 of the San Diego County Hydrology Manual may be    *
* used, or a computer program that includes good documentation of the       *
* calculations (see Section 1.7 of the San Diego County Hydrology manual).  *
* Note: the RATHYDRO computer program is not based on the calculation method*
* described in Section 4 of the San Diego County Hydrology Manual and may   *
* not be used to generate a hydrograph based on the SDUH Peak Discharge     *
* Program output.                                                           *
*****************************************************************************

 Project Identification: Jacumba_CorpLag_Mid
 Storm Frequency (years) =  100
 Drainage Area (square miles) =  104.200
 6-Hour Rainfall (inches) =     3.00
 6-Hour Depth-Area Factor =    0.888
 24-Hour Rainfall (inches) =     5.00
 24-Hour Depth-Area Factor =    0.934
 Adjusted Curve Number = 79
 Unit Interval (minutes) = 30
 Watershed Lag Time (hours) =    3.140
 Peak Flow Rate (cfs) =    25740.6
```