DRAIN STUDY

LINCOLN MEADOWS

City of Lincoln, California
November 23, 2015

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I. Introduction

The proposed Lincoln Meadows subdivision will divide 40 acres into 148 low density single family homes. The purpose of this report is to determine the runoff generated by development of the subdivision and the pipe system to convey the runoff to the outfalls.

Location

The Lincoln Meadows project is located on the northwest corner of the intersection of Virginatown Road and Hungry Hollow Road, in the City of Lincoln (See Figure 1).

II. Narrative

The Lincoln Meadows project drains into two watersheds; the north portion of the project drains to Markham Ravine and the south portion drains to Auburn Ravine. Lincoln Meadows will be developed according to the City of Lincoln Design Criteria and Procedures Manual. Low Impact Development (LID) measures will be implemented to provide infiltration and evaporation opportunities for the runoff, which will reduce the flows into the drain system and help mitigate increased flows due to development. Two
detention basins will be built to maintain the post-project flows at 90% of the pre-project flows, one for each watershed, and will be sized to treat the remaining runoff from the impervious area that has not been treated by the LID measures.

III. Runoff and Flow Projections

The design flow was determined by using the City of Lincoln Design Criteria and Procedures Manual, Section 10-7. The spreadsheet for the drain pipe calculations was also developed from procedures outlined in Section 10-7. The Preliminary Drainage Study Exhibit depicts all of the sheds and pipe sizes comprising the proposed drain system, this exhibit is included in Appendix ‘A’ and the calculation spreadsheet is in Appendix ‘B’.

LID measures will be installed in Lincoln Meadows to reduce the runoff from impervious surfaces. These measures include: disconnected roof drains, interceptor trees, and detached sidewalk. The runoff reduction worksheet Form D-1e calculates the Water Quality Flow (WQF) created by the project. This worksheet was developed for Sacramento, Roseville and Folsom, but since the site has minimal clay soil and the rainfall intensity is similar to that in Roseville, this worksheet can be used to determine the runoff reduction for Lincoln Meadows. The WQF is generated by the 2 year or less “first flush” storm. The formula to calculate this flow is \( WQF = ciA \), where \( c \) is the runoff coefficient, \( i \) is the rainfall intensity and \( A \) is the adjusted area for treatment, which is reduced due to the LID measures being incorporated into the project. Volume based treatment provided by the detention basins is proposed for Lincoln Meadows, Roseville uses the CASQA volume calculation.

The north and south watersheds each have a Form D-1e worksheet and these have been included in Appendix ‘C’.

The two detention basins that will provide flow attenuation and water treatment are currently being designed by West Yost Associates and will be included in Appendix ‘D’ when available.

IV. Drain System

Lincoln Meadows will construct a storm drain system; the location of the storm drain system will be five feet north or west of the street centerline, as specified in the City of Lincoln Design Criteria and Procedures Manual, Section 10-5. The drain system will be sized to carry the 10 year storm, as specified in the City of Lincoln Design Criteria and Procedures Manual, Section 10-6, pipe sizes vary from 12” diameter to 30” diameter. The flow from larger storm events will travel overland in the streets to outfall points into Lot A; the allowable street encroachments specified in Table 10-1 will be maintained. All lot grading will be designed to have a minimum of one foot of freeboard above the 100 year water surface elevation.
V. Project Phasing

The Lincoln Meadows project is proposed to be broken up in two phases: Phase 1 building 76 lots and Phase 2 building the remaining 72 lots. While phasing is anticipated, this report analyzes the entire project being completely built out.

VI. Conclusions

The development of the Lincoln Meadows will be done utilizing practices and construction methods that will prevent impacting the existing flows and water quality of the Auburn Ravine and Markham Ravine watersheds that will receive drainage from this project.

The development of Lincoln Meadows will be done according to the City of Lincoln Design Criteria and Procedures Manual Chapter 10 which specifies how to design drainage systems.

LID measures such as disconnected roof drains, interceptor tree planting and detached sidewalks will be used to reduce the runoff that increases from the impervious surfaces constructed with development.

Peak flow increases will be mitigated by the construction of two detention basins, one for each of the watersheds existing on the property.

A Storm Water Pollution Prevention Program (SWPPP) will be developed for Lincoln Meadows and it will include an erosion control plan that indicates where Best Management Practices (BMP) measures will be implemented during construction to prevent soil and pollutants from entering the watersheds.
APPENDIX A

Preliminary Drainage Study Exhibit
APPENDIX B

Calculation Spreadsheet
<table>
<thead>
<tr>
<th>NODE</th>
<th>TO</th>
<th>FROM</th>
<th>AREA (acres)</th>
<th>Cum Area</th>
<th>Total Response</th>
<th>Qo</th>
<th>Qu</th>
<th>Qi</th>
<th>Fl</th>
<th>D/FLAP</th>
<th>FaP</th>
<th>Storm Drain Type</th>
<th>30 μ Ff Grade Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEN-01</td>
<td>N05</td>
<td>OVERLAND</td>
<td>0.46</td>
<td>0.46</td>
<td>0.32</td>
<td>0.23</td>
<td>0.05</td>
<td>0.54</td>
<td>0.72</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N06</td>
<td>OVERLAND</td>
<td>0.31</td>
<td>0.31</td>
<td>0.23</td>
<td>0.18</td>
<td>0.00</td>
<td>0.37</td>
<td>0.49</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N07</td>
<td>OVERLAND</td>
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<td>0.36</td>
<td>0.23</td>
<td>0.19</td>
<td>0.02</td>
<td>0.21</td>
<td>1.51</td>
<td>0.95</td>
<td>0.049</td>
<td>10.26</td>
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</tr>
<tr>
<td></td>
<td>N08</td>
<td>OVERLAND</td>
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<td>0.28</td>
<td>0.15</td>
<td>0.14</td>
<td>0.00</td>
<td>0.21</td>
<td>0.05</td>
<td>0.16</td>
<td>0.016</td>
<td>19.49</td>
<td>26.20</td>
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<tr>
<td></td>
<td>N09</td>
<td>OVERLAND</td>
<td>0.80</td>
<td>0.80</td>
<td>0.46</td>
<td>0.26</td>
<td>0.03</td>
<td>0.83</td>
<td>0.83</td>
<td>0.06</td>
<td>0.016</td>
<td>24.00</td>
<td>22.16</td>
</tr>
<tr>
<td></td>
<td>N10</td>
<td>OVERLAND</td>
<td>0.32</td>
<td>0.32</td>
<td>0.15</td>
<td>0.11</td>
<td>0.01</td>
<td>0.25</td>
<td>2.19</td>
<td>0.72</td>
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<td>0.70</td>
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<td>0.38</td>
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<td>14.97</td>
<td>27.86</td>
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<td>0.14</td>
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<td>0.21</td>
<td>0.15</td>
<td>0.01</td>
<td>0.0035</td>
<td>15.00</td>
<td>9.95</td>
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<tr>
<td></td>
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<td>OVERLAND</td>
<td>0.46</td>
<td>0.46</td>
<td>0.32</td>
<td>0.23</td>
<td>0.00</td>
<td>0.54</td>
<td>0.72</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*From Fig. 5-1 Placer County Drainage Manual**From Fig. 5-2 Placer County Drainage Manual
<table>
<thead>
<tr>
<th>NODE</th>
<th>TO</th>
<th>FROM</th>
<th>AREA (acres)</th>
<th><strong>V</strong></th>
<th><strong>L</strong></th>
<th><strong>T</strong></th>
<th><strong>T</strong></th>
<th>DIA</th>
<th>SLOPE</th>
<th>RIM</th>
<th>UPPER</th>
<th>LOWER</th>
<th>mysqli-A-FiAp</th>
<th><strong>Qmax</strong></th>
<th><strong>VEL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>M4A</td>
<td>M4</td>
<td>M4A</td>
<td>0.20</td>
<td>0.76</td>
<td>2.8</td>
<td>180</td>
<td>0.08</td>
<td>21.4</td>
<td>1.24</td>
<td>1.83</td>
<td>2.01</td>
<td>0.2</td>
<td>0.36</td>
<td>0.1</td>
<td>0.87</td>
</tr>
<tr>
<td>M4A</td>
<td>M4</td>
<td>M4A</td>
<td>1.61</td>
<td>1.61</td>
<td>2.8</td>
<td>180</td>
<td>0.96</td>
<td>22.4</td>
<td>1.19</td>
<td>1.59</td>
<td>1.96</td>
<td>0.2</td>
<td>0.31</td>
<td>0.2</td>
<td>1.98</td>
</tr>
<tr>
<td>SOUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

From Fig. 5-1 Placer County Drainage Manual
From Fig. 5-2 Placer County Drainage Manual 10/19/2015 12:09 PM
APPENDIX C

Form D-1e
LID Worksheets
Appendix D-1: Residential Sites: Runoff Reduction Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Markham Ravine-North Shed
Project Located In: Roseville

Step 1 - Calculate Area Requiring Treatment

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage Shed Area</td>
<td>24.8 acres</td>
</tr>
<tr>
<td>Open Space and Parks Acreage*</td>
<td>4.2 A_{OS}</td>
</tr>
<tr>
<td>Treatment Area A - A_{OS} = A_{T}</td>
<td>20.6 A_{T}</td>
</tr>
<tr>
<td>Number of Units in A_{T}</td>
<td>100</td>
</tr>
<tr>
<td>Number of units per acre in A_{T}</td>
<td>5</td>
</tr>
<tr>
<td>Assumed Initial Impervious Fraction</td>
<td>0.35 I</td>
</tr>
</tbody>
</table>

* includes all areas maintained in a natural state and planned for landscaped park areas

Table D-1a

<table>
<thead>
<tr>
<th>Dwelling units per acre</th>
<th>Imperviousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.17</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
</tr>
<tr>
<td>3,4</td>
<td>0.35</td>
</tr>
<tr>
<td>5,6</td>
<td>0.40</td>
</tr>
<tr>
<td>7</td>
<td>0.50</td>
</tr>
<tr>
<td>8,9</td>
<td>0.55</td>
</tr>
<tr>
<td>10-14</td>
<td>0.60</td>
</tr>
<tr>
<td>15-20</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Step 2 - Calculate Impervious Area Treatments

<table>
<thead>
<tr>
<th>Runoff Reduction Measures</th>
<th>Effective Area Managed (A_C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnected Roof Drains (see Fact Sheet)</td>
<td></td>
</tr>
<tr>
<td>use Form D-1a for credits</td>
<td>3.52 acres</td>
</tr>
<tr>
<td>Disconnected Pavement (see Fact Sheet)</td>
<td></td>
</tr>
<tr>
<td>use Form D-1b for credits</td>
<td>0.77 acres</td>
</tr>
<tr>
<td>Interceptor Trees (see Fact Sheet)</td>
<td></td>
</tr>
<tr>
<td>use Form D-1c for credits</td>
<td>0.66 acres</td>
</tr>
<tr>
<td>Alternative Driveway Design (see Fact Sheet)</td>
<td></td>
</tr>
<tr>
<td>use Form D-1d for credits</td>
<td>0.00 acres</td>
</tr>
</tbody>
</table>

Total Effective Area Managed (Credit Area): A_C = 4.08 acres

Adjusted Area for Flow-Based Treatment: A_{T} - A_{C} = 15.57 acres

Adjusted Impervious Fraction for A: \( \frac{(A_{T} - A_{C})}{A} = 0.09 \)

Check the website for the electronic version at www.sacstormwater.org click on "how development"
Form D-1a: Disconnected Roof Drains Worksheet
See Fact Sheet for more information regarding Disconnected Roof Drain credit guidelines

1. Determine efficiency Multiplier
   - Runoff is directed to a dispersal trench or dry well
     (Type A and B soils only)
     Runoff is directed across landscaping, determine setback:
     - 25 ft + Use multiplier of 1.00
     - > 20 and < 25 ft Use multiplier of 0.90
     - > 15 and < 20 ft Use multiplier of 0.70
     - > 10 and < 15 ft Use multiplier of 0.45
     - > 5 and < 10 ft Use multiplier of 0.25
   - Efficiency Multiplier: 0.90
     Box J1
     Box J2

2. Determine percentage of roof drains disconnected
   - 100.0%
     Box J3

3. Select project density in dwelling units per acre:
   - 1 Use reduction factor of 0.08
   - 2 Use reduction factor of 0.13
   - 3,4 Use reduction factor of 0.19
   - 5,6 Use reduction factor of 0.23
   - 7 Use reduction factor of 0.26
   - 8,9 Use reduction factor of 0.33
   - 10-14 Use reduction factor of 0.37
   - 15-20 Use reduction factor of 0.44
   - Reduction Factor: 0.19
     Box J3

4. Determine Area Managed
   - Multiply Box J3 by A1, and enter the result in Box J4
     3.9 acres
     Box J4

5. Multiply Boxes J1, J2 and J4, and enter the Result in Box J
   - 3.5 acres
     Box J

This is the amount of area credit to enter into the "Disconnected Roof Drains" Box of Form D-1

Form D-1b: Disconnected Pavement Worksheet
See Fact Sheet for more information regarding NDC Pavement credit guidelines

Divided Sidewalks

1. Determine percentage of units with divided Sidewalks
   - 94.0%
     Box K1

Multiply Box K1, A1, and 0.04 and enter the result in Box K

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-1

Form D-1c: Interceptor Tree Worksheet
See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.
   - 100 trees
     Box L1

2. Multiply Box L1 by 200 and enter result in Box L2
   - 20000 sq. ft.
     Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.
   - 100 trees
     Box L3

4. Multiply Box L3 by 100 and enter result in Box L4
   - 10000 sq. ft.
     Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.
   - 0 sq. ft.
     Box L5

6. Multiply Box L5 by 0.5 and enter the result in Box L6
   - 0 sq. ft.
     Box L6

Total Interceptor Tree Credits

Add Boxes L2, L4, and L6 and enter it into Box L7
- 3000 sq. ft.
  Box L7

Divide Box L7 by 43560 to get the number of acres effectively managed and enter the result in Box L8
- 0.69 acres
  Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-1

Check the website for the electronic version at www.sactowater.org click on "new developments"
Form D-1d: Alternative Driveway Design
See Fact Sheet for more information regarding Alternative Driveway Design credit guidelines

1. Select type of driveway
   - Porous Driveway
   - Cobblestone Block Porous Pavement
   - Porous Concrete/Asphalt Pavement
   - Modular Block Porous Pavement
   - Porous Gravel Pavement & Hollywood Driveway
   - Not Directly-connected Driveway

   Multiplier:
   - Cobblestone Block Porous Pavement 0.40
   - Porous Concrete/Asphalt Pavement 0.60
   - Modular Block Porous Pavement 0.75
   - Hollywood Driveway
   - Not Directly-connected Driveway 1.00

   Box M1

2. Determine percentage of units with Alternative Driveways:
   - Box M2

3. Multiply Boxes M1, M2, A_T, and 0.04, and enter the result in Box M
   - This is the amount of area credit to enter into the "Alternative Driveway Design" Box of Form D-1

   Box M

   0.00

Step 3 - Calculate Flow or Volume Requiring Treatment

Form D-1e Treatment - Flow-Based (Rational Method)
Calculate treatment flow (cfs):
   Flow = Runoff Coefficient \times Rainfall Intensity \times Adjusted Treatment Area

Determine C Factor using Table D-1b:
   \[ C = 0.50 \]

Determine i using Table D-1c (Rainfall Intensity):
   \[ i = 0.20 \]

\[ A_T \text{ from Step 2} = 15.57 \]

\[ \text{Flow} = C \times i \times A_T \]

\[ \text{Flow} = 1.56 \text{ cfs} \]

Table D-1b

<table>
<thead>
<tr>
<th>Runoff Coefficient (Rational), C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family areas</td>
</tr>
<tr>
<td>Multi-units, detached</td>
</tr>
<tr>
<td>Apartment dwelling areas</td>
</tr>
<tr>
<td>Multi-units, attached</td>
</tr>
<tr>
<td>User Specified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Runoff Coefficient (Rational), C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roseville</td>
</tr>
<tr>
<td>Sacramento</td>
</tr>
<tr>
<td>Folsom</td>
</tr>
</tbody>
</table>

Table D-1c

<table>
<thead>
<tr>
<th>Rainfall Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roseville</td>
</tr>
<tr>
<td>Sacramento</td>
</tr>
<tr>
<td>Folsom</td>
</tr>
</tbody>
</table>

Form D-1f Treatment - Volume-Based (CASQA)
Calculate treatment volume (Acre-Feet):
   Treatment Volume = Area \times (Storage Volume \times Conversion Factor)

Determine Adjusted C_A using Table D-2d (for CASQA Method) and the Adjusted Impervious
   Fraction (i_A) from Step 2:
   \[ C_A = 0.10 \]

Determine Unit Basin Storage Volume (Fig. D-2A) using C_A:
   \[ S_V = 0.06 \]

\[ A \text{ from Step 1} = 24.75 \]

\[ \text{Treatment volume} = A \times (S_V / 12) \]

\[ \text{Treatment volume} = 0.12 \text{ Acre-Feet} \]

Form D-1g Treatment - Volume-Based (ASCE-WEF)
Calculate water quality volume (Acre-Feet):
   WQV = Area \times Maximized Detention Volume (P_0)

\[ A \text{ from Step 1} = 24.75 \]

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using i_A from Step 2:
   \[ P_0 = 0.11 \]

\[ \text{Treatment volume} = A \times (P_0 / 12) \]

\[ \text{Treatment volume} = 0.22 \text{ Acre-Feet} \]

Check the website for the electronic version at www.sacostomwater.org click on "new development"
Appendix D-1: Residential Sites: Runoff Reduction Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Auburn Ravine-South Shed
Project Located in Roseville

Step 1 - Calculate Area Requiring Treatment

Drainage Shed Area

\[ A = 15.3 \text{ acres} \]

Open Space and Parks Acreage\(^\ast\)

\[ A_{OS} = 3.5 \]

Treatment Area

\[ A - A_{OS} = A_T = 11.8 \]

Number of Units in \( A_T \)

\[ 40 \]

Number of units per acre in \( A_T \)

\[ \frac{DU/A_T}{A_T} = 4 \]

Assumed Initial Impervious Fraction

\[ I = 0.35 \]

\(^\ast\) Includes all areas maintained in a natural state and planned for landscaped park areas

<table>
<thead>
<tr>
<th>Table D-1a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling units per acre</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3.4</td>
</tr>
<tr>
<td>5.6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8.9</td>
</tr>
<tr>
<td>10.14</td>
</tr>
<tr>
<td>15-20</td>
</tr>
</tbody>
</table>

\[ A - \text{Drainage Shed Area} \]

\[ A_{OS} - \text{Parks and Open Space} \]

\[ A_T - \text{Area with Runoff Reduction Potential} \]

Step 2 - Calculate Impervious Area Treatments

<table>
<thead>
<tr>
<th>Runoff Reduction Measures</th>
<th>Effective Area Managed ((A_C))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnected Roof Drains (see Fact Sheet)</td>
<td>[2.01] acres</td>
</tr>
<tr>
<td>Disconnected Pavement (see Fact Sheet)</td>
<td>[0.42] acres</td>
</tr>
<tr>
<td>Interceptor Trees (see Fact Sheet)</td>
<td>[0.33] acres</td>
</tr>
<tr>
<td>Alternative Driveway Design (see Fact Sheet)</td>
<td>[0.00] acres</td>
</tr>
<tr>
<td>Total Effective Area Managed (Credit Area)</td>
<td>[2.77] acres</td>
</tr>
</tbody>
</table>

\[ A_T \times A_C = \frac{8.98}{A} \]

\[ I_A = \frac{8.98}{15.3} = 0.59 \]

Check the website for the electronic version at www.sactostormwater.org click on "new development"
Form D-1a: Disconnected Roof Drains Worksheet
See Fact Sheet for more information regarding Disconnected Roof Drain credit guidelines

1. Determine efficiency Multiplier
   Runoff is directed to a dispersal trench or dry well 1.00
   (Type A and B soils only)
   Runoff is directed across landscaping, determine setback
   25 ft + Use multiplier of 1.00
   > 20 and < 25 ft Use multiplier of 0.90
   > 15 and < 20 ft Use multiplier of 0.70
   > 10 and < 15 ft Use multiplier of 0.45
   > 5 and < 10 ft Use multiplier of 0.25
   Efficiency Multiplier → 0.90 Bx J1

2. Determine percentage of roof drains disconnected → 100.0% Bx J2

3. Select project density in dwelling units per acre:
   1 Use reduction factor of 0.08
   2 Use reduction factor of 0.13
   3.4 Use reduction factor of 0.19
   5.6 Use reduction factor of 0.23
   7 Use reduction factor of 0.29
   8.9 Use reduction factor of 0.33
   10-14 Use reduction factor of 0.37
   15-20 Use reduction factor of 0.44
   Reduction Factor → 0.19 Bx J3

4. Determine Area Managed
   Multiply Box J3 by A_T and enter the result in Box J4
   2.2 acres Bx J4

5. Multiply Boxes J1, J2 and J4, and enter the Result in Box J
   This is the amount of area credit to enter into the "Disconnected Roof Drains" Box of Form D-1
   2.0 acres Box J

Form D-1b: Disconnected Pavement Worksheet
See Fact Sheet for more information regarding NDC Pavement credit guidelines

Divided Sidewalks

1. Determine percentage of units with divided Sidewalks 90.0% Box K1
   Multiply Box K1, A_T, and 0.04 and enter the result in Box K
   0.42 acre Box K

Form D-1c: Interceptor Tree Worksheet
See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.
   48 trees Box L1

2. Multiply Box L1 by 200 and enter result in Box L2
   9600 sq. ft. Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.
   48 trees Box L3

4. Multiply Box L3 by 100 and enter result in Box L4
   4830 sq. ft. Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.
   0 sq. ft. Box L5

6. Multiply Box L5 by 0.5 and enter the result in Box L6
   0 sq. ft. Box L6

Total Interceptor Tree Credits

Add Boxes L2, L4, and L6 and enter it into Box L7
   14400 sq. ft. Box L7

Divide Box L7 by 43,660 to get the number of acres effectively managed and enter the result in Box L8
   0.33 acres Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-1

Check the website for the electronic version at www.sedastormwater.org click on "new development"
Form D-1d: Alternative Driveway Design
See Fact Sheet for more information regarding Alternative Driveway Design credit guidelines

1. Select type of driveway
   - Pervious Driveway
   - Cobblestone Block Porous Pavement: 0.40
   - Pervious Concrete/Asphalt Pavement: 0.60
   - Modular Block Porous Pavement
   - Porous Gravel Pavement &
   - Hollywood Driveway
   - Not Directly-connected Driveway: 1.00

   Box M1

2. Determine percentage of units with Alternative Driveways:
   Box M2

3. Multiply boxes M1, M2, A_T and 0.04, and enter the result in Box M
   This is the amount of area credit to enter into the "Alternative Driveway Design" Box of Form D-1
   Box M: 0.00

Step 3 - Calculate Flow or Volume Requiring Treatment

Form D-1e Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs):
Flow = Runoff Coefficient x Rainfall Intensity x Adjusted Treatment Area

Determine C Factor using Table D-1b

Determine i using Table D-1c (Rainfall Intensity)

\[ A_{ST} \text{ from Step 2} \]

\[ C = 0.50 \]

\[ i = 0.20 \]

\[ A_{ST} = 8.98 \]

\[ Flow = C \times i \times A_{ST} \]

\[ Flow = 0.50 \times 0.20 \times 8.98 \]

\[ Flow = 0.90 \text{ cfs} \]

<table>
<thead>
<tr>
<th>Runoff Coefficient (Rational), C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family areas: 0.50</td>
</tr>
<tr>
<td>Multi-units, detached: 0.60</td>
</tr>
<tr>
<td>Apartment dwelling areas: 0.70</td>
</tr>
<tr>
<td>Multi-units, attached: 0.75</td>
</tr>
<tr>
<td>User Specified: 0.00</td>
</tr>
</tbody>
</table>

Table D-1c

<table>
<thead>
<tr>
<th>Rainfall Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roseville: i = 0.20 in/hr</td>
</tr>
<tr>
<td>Sacramento: i = 0.18 in/hr</td>
</tr>
<tr>
<td>Folsom: i = 0.20 in/hr</td>
</tr>
</tbody>
</table>

Form D-1f Treatment - Volume-Based (CASQA)

Calculate treatment volume (Acre-Feet):
Treatment Volume = Area x (Storage Volume = Conversion Factor)

Determine Adjusted C_A using Table D-2d (for CASQA Method) and the Adjusted Impervious Fraction (i_M) from Step 2

Determine Unit Basin Storage Volume (Fig. D-2A) using C_A

\[ A_{ST} = 0.06 \]

\[ SV = 0.06 \]

\[ A = 15.25 \]

Treatment volume = \[ A_{ST} \times (SV / 12) \]

\[ Treatment volume = 0.07 \text{ Acre-Feet} \]

Form D-1g Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet):
WQV = Area x Maximized Detention Volume (P_d)

\[ A = 15.25 \]

\[ P_d = 0.11 \]

\[ Treatment volume = A \times (P_d / 12) \]

\[ Treatment volume = 0.13 \text{ Acre-Feet} \]

Check the website for the electronic version at www.sactostormwater.org click on "new development!"
APPENDIX D

Detention Basins