# Modeling Catchbasins and Hydrodynamic Devices with WinSLAMM 10.3

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## We will cover . . .

- Research Results
- Entering Catchbasin Data into the Model
- Model Output
- Variable Sensitivity

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# Catchbasins

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## Research Results

- A New Jersey study (Pitt, *et al.* 1994) found average removal rates of 32% for suspended solids using catchbasins with a suitable sump.
- Pitt & Shawley (1982) found cleaning catchbasin twice per year reduced total residue yields between 10% and 25%.
- Pitt & Field (2004) found sediment in catchbasins were the largest particles washed from streets.

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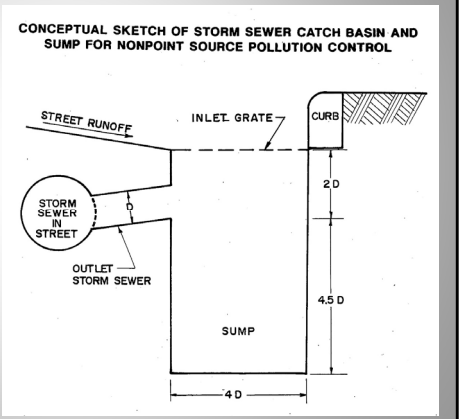
## Catchbasins . . .

- Are Inlets or Manholes
- Must Contain a Sump
- Are not very useful if streets are also swept (but capture large particles from all stormwater flows, not just from streets)
- Are applied as drainage controls

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## Four Components to Modeling Catchbasins

1. Device Density
2. Device Geometry
3. Flow and Particle Size Data
4. Device Cleaning Information

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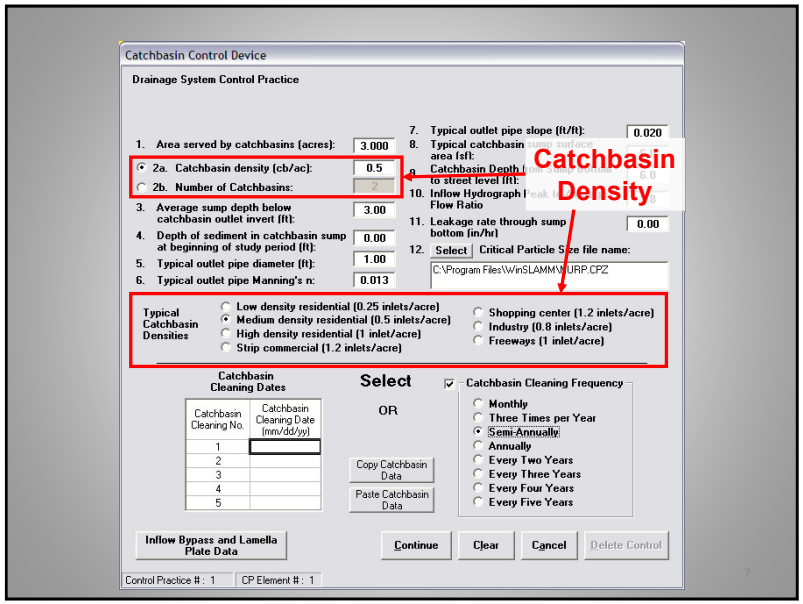


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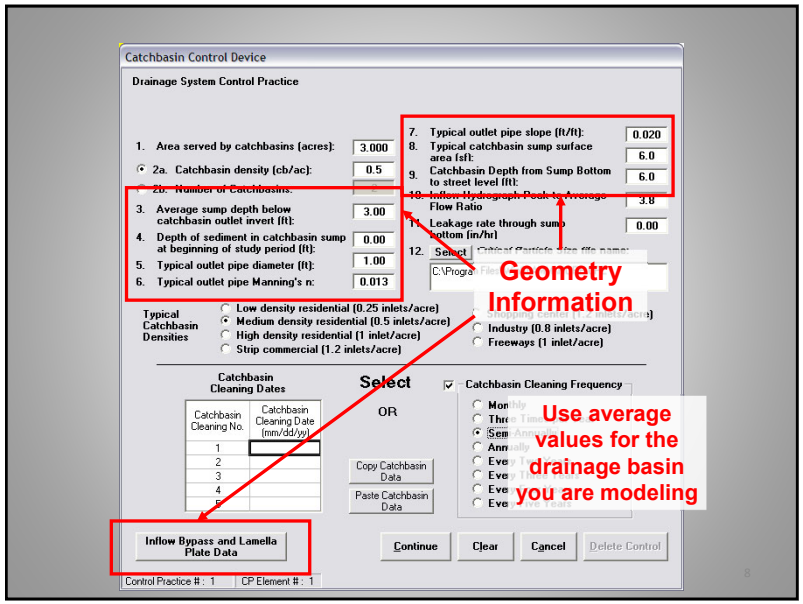


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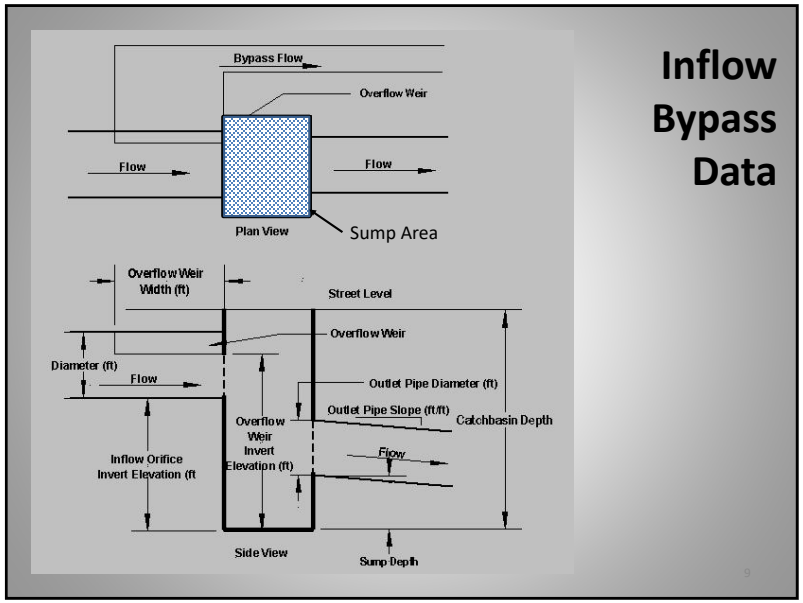
Inflow Bypass Data
Bypass Flow
Overflow Weir
Flow
Flow
Plan View
Sump Area
Overflow Weir Width (ft)
Street Level
Overflow Weir
Diameter (ft)
Flow
Outlet Pipe Diameter (ft)
Outlet Pipe Slope (ft/ft)
Catchbasin Depth
Overflow Weir Invert Elevation (ft)
Flow
Inflow Orifice Invert Elevation (ft
Side View
Sump Depth
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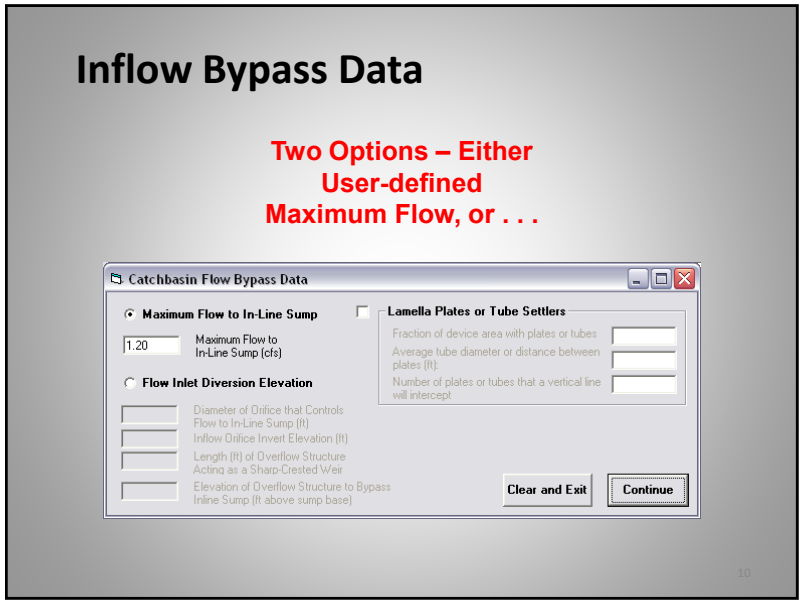
Inflow Bypass Data
Two Options – Either
User-defined
Maximum Flow, or . . .
Catchbasin Flow Bypass Data
Maximum Flow to In-Line Sump
1.20
Maximum Flow to In-Line Sump (cfs)
Flow Inlet Diversion Elevation
Lamella Plates or Tube Settlers
Fraction of device area with plates or tubes
Average tube diameter or distance between plates (ft):
Number of plates or tubes that a vertical line will intercept
Diameter of Orifice that Controls Flow to In-Line Sump (ft)
Inflow Orifice Invert Elevation (ft)
Length (ft) of Overflow Structure Acting as a Sharp-Crested Weir
Elevation of Overflow Structure to Bypass Inline Sump (ft above sump base)
Clear and Exit
Continue
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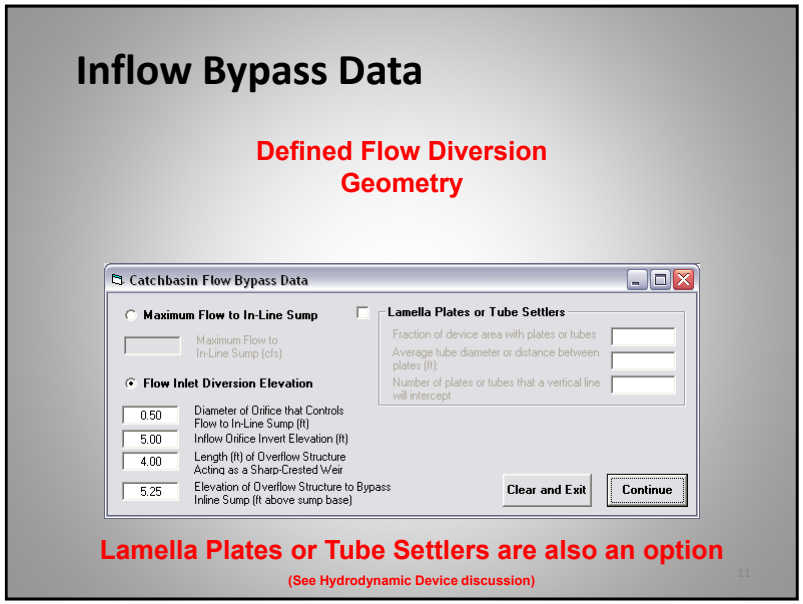
Inflow Bypass Data
Defined Flow Diversion
Geometry
Catchbasin Flow Bypass Data
Maximum Flow to In-Line Sump
Maximum Flow to In-Line Sump (cfs)
Flow Inlet Diversion Elevation
Lamella Plates or Tube Settlers
Fraction of device area with plates or tubes
Average tube diameter or distance between plates (ft):
Number of plates or tubes that a vertical line will intercept
0.50
Diameter of Orifice that Controls Flow to In-Line Sump (ft)
5.00
Inflow Orifice Invert Elevation (ft)
4.00
Length (ft) of Overflow Structure Acting as a Sharp-Crested Weir
5.25
Elevation of Overflow Structure to Bypass Inline Sump (ft above sump base)
Clear and Exit
Continue
Lamella Plates or Tube Settlers are also an option
(See Hydrodynamic Device discussion)
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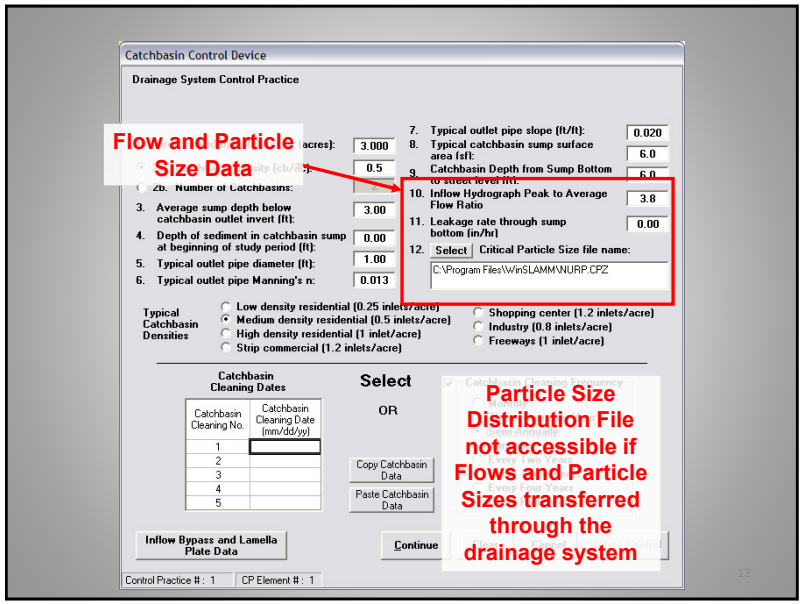
Catchbasin Control Device
Drainage System Control Practice
Flow and Particle Size Data
3. Average sump depth below catchbasin outlet invert (ft): 3.00
4. Depth of sediment in catchbasin sump at beginning of study period (ft): 0.00
5. Typical outlet pipe diameter (ft): 1.00
6. Typical outlet pipe Manning's n: 0.013
7. Typical outlet pipe slope (ft/ft): 0.020
8. Typical catchbasin sump surface area (sf): 6.0
9. Catchbasin Depth from Sump Bottom to Weir Level (ft): 6.0
10. Inflow Hydrograph Peak to Average Flow Ratio 3.8
11. Leakage rate through sump bottom (in/hr) 0.00
12. Select Critical Particle Size file name:
C:\Program Files\WinSLAMM\NURP.CPZ
Typical Catchbasin Densities
Low density residential (0.25 inlets/acre)
Medium density residential (0.5 inlets/acre)
High density residential (1 inlet/acre)
Strip commercial (1.2 inlets/acre)
Shopping center (1.2 inlets/acre)
Industry (0.8 inlets/acre)
Freeways (1 inlet/acre)
Catchbasin Cleaning Dates
Catchbasin Cleaning No.
Catchbasin Cleaning Date (mm/dd/yy)
Select
OR
Copy Catchbasin Data
Paste Catchbasin Data
Inflow Bypass and Lamella Plate Data
Continue
Particle Size Distribution File not accessible if Flows and Particle Sizes transferred through the drainage system
Control Practice #: 1
CP Element #: 1
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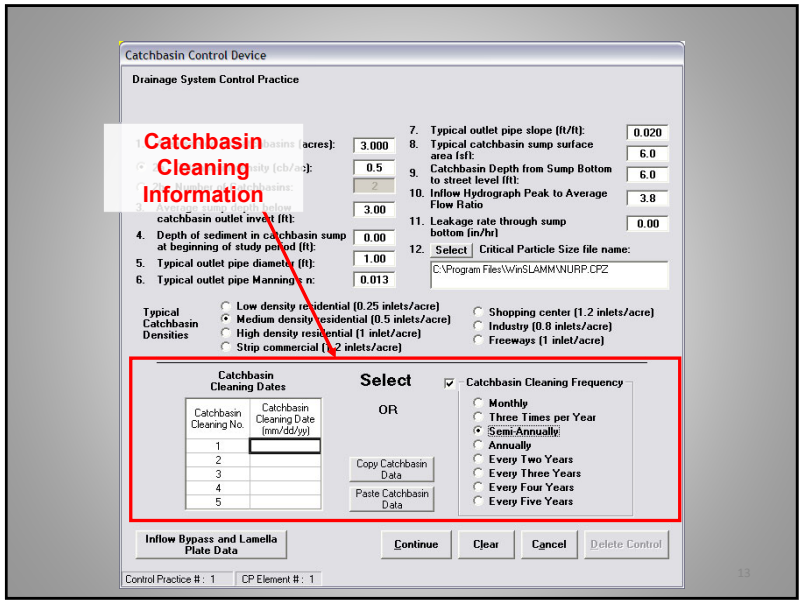


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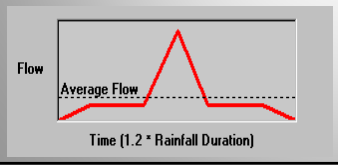
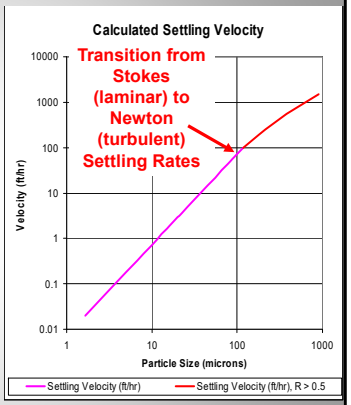
# Catchbasin Performance

- Particulate removal based upon particle size
- Settling modeled as a detention basin assuming:
  - Vertical sides
  - No storage
- Flow rate calculated using Complex Triangular Hydrograph

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# Additional Output

Catchbasin Performance by Event

| Rain No. | Rain Depth (in) | Runoff Volume per CB (cf) | Maximum Inflow from Basin (cfs) | Time Increment (min) | Maximum Inflow through CB (cfs) | Volume In (cf) | Hydraulic Volume Out (cf) | Seepage Volume Out (cf) | Total Volume Out of CB (cf) | Bypass Volume (cf) | Cumulative Volume Out of CB (cf) | CB Efficiency Reduction | Maximum Inflow Stage | Maximum CB Stage | Weighted Total Solids Reduction (fraction) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.01 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 2 | 0.06 | 307.3593 | 5.41E-02 | 10 | 5.41E-02 | 312.848 | 312.848 | 0 | 312.848 | 0 | 312.848 | 0 | 0 | 3.07 | 0.1834095 |
| 3 | 0.01 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 312.848 | 0 | 0 | 3 | 1 |
| 4 | 0.02 | 25.168 | 7.38E-03 | 6 | 7.38E-03 | 25.61744 | 25.61744 | 0 | 25.61744 | 0 | 338.4654 | 0 | 0 | 3.02 | 0.353254 |
| 5 | 0.2 | 1430.123 | 0.179711 | 14 | 0.179711 | 1455.661 | 1455.661 | 0 | 1455.661 | 0 | 1794.126 | 0 | 0 | 3.12 | 0.1200792 |
| 6 | 0.01 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1794.126 | 0 | 0 | 3 | 1 |
| 7 | 0.04 | 170.4842 | 2.50E-02 | 12 | 2.50E-02 | 173.5285 | 173.5285 | 0 | 173.5285 | 0 | 1967.655 | 0 | 0 | 3.05 | 0.2404892 |
| 8 | 0.23 | 1670.089 | 0.163229 | 15 | 0.163229 | 1694.667 | 1694.667 | 0 | 1694.667 | 0 | 3662.322 | 0 | 0 | 3.12 | 0.1247973 |
| 9 | 0.19 | 1346.409 | 0.169192 | 14 | 0.169192 | 1370.453 | 1370.453 | 0 | 1370.453 | 0 | 5032.774 | 0 | 0 | 3.12 | 0.1233367 |
| 10 | 0.44 | 3510.688 | 0.237547 | 15 | 0.237547 | 3642.1 | 3642.1 | 0 | 3642.1 | 0 | 8674.874 | 0 | 0 | 3.14 | 0.103546 |
| | | | | | | | | | 1008.875 | 0 | 9683.749 | 0 | 0 | 3.08 | 0.1605299 |
| | | | | | | | | | 385.6555 | 0 | 10069.4 | 0 | 0 | 3.05 | 0.2257967 |
| | | | | | | | | | 85.35033 | 0 | 10154.75 | 0 | 0 | 3.04 | 0.2659832 |
| | | | | | | | | | 173.5285 | 0 | 10328.28 | 0 | 0 | 3.06 | 0.2102898 |
| | | | | | | | | | 85.35033 | 0 | 10413.63 | 0 | 0 | 3.03 | 0.2855439 |
| | | | | | | | | | 0 | 0 | 10413.63 | 0 | 0 | 3 | 1 |
| | | | | | | | | | 238.8086 | 0 | 10652.44 | 0 | 0 | 3.08 | 0.168602 |
| | | | | | | | | | 85.35033 | 0 | 10737.79 | 0 | 0 | 3.03 | 0.2855439 |
| | | | | | | | | | 25.61744 | 0 | 10763.41 | 0 | 0 | 3.04 | 0.2504332 |
| | | | | | | | | | 395.6464 | 0 | 11159.06 | 0 | 0 | 3.1 | 0.1407803 |
| | | | | | | | | | 25.61744 | 0 | 11184.67 | 0 | 0 | 3.03 | 0.3116934 |
| | | | | | | | | | 25.61744 | 0 | 11210.29 | 0 | 0 | 3.03 | 0.3116934 |
| | | | | | | | | | 25.61744 | 0 | 11235.91 | 0 | 0 | 3.03 | 0.3116934 |
| | | | | | | | | | 25.61744 | 0 | 11261.53 | 0 | 0 | 3.02 | 0.353254 |
| | | | | | | | | | 0 | 0 | 11261.53 | 0 | 0 | 3 | 1 |
| | | | | | | | | | 238.8086 | 0 | 11500.33 | 0 | 0 | 3.09 | 0.1460115 |
| | | | | | | | | | 4716.113 | 0 | 16216.45 | 0 | 0 | 3.22 | 7.04E-02 |
| | | | | | | | | | 0 | 0 | 16216.45 | 0 | 0 | 3 | 1 |

Other Output Options

- Stage-outflow data
- Performance by time step
- Stage-inflow data

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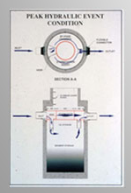
# Hydrodynamic Devices



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# Research Results

- **Clark (2006) evaluated the performance of inclined plate settlers for treating stormwater solids**
- **Greb, *et al*. (1998) evaluated the performance of a hydrodynamic device in a City of Madison maintenance yard.**

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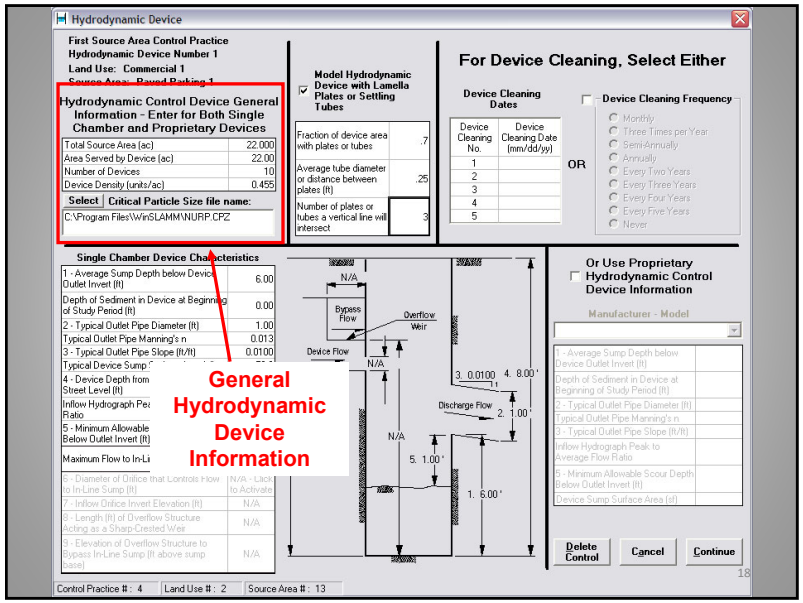


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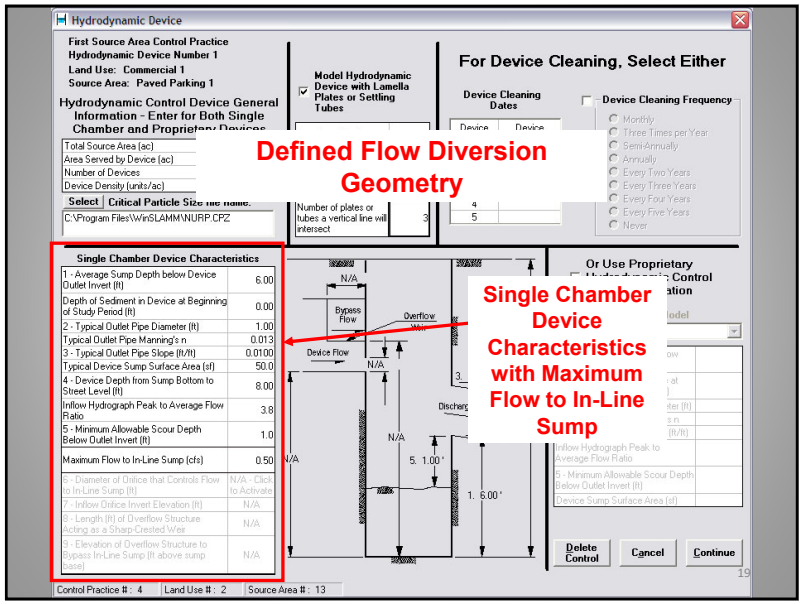


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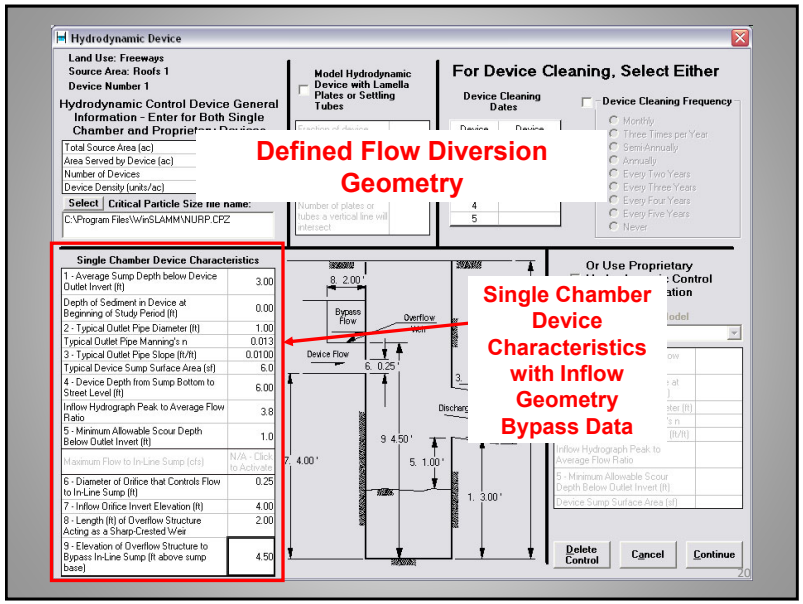


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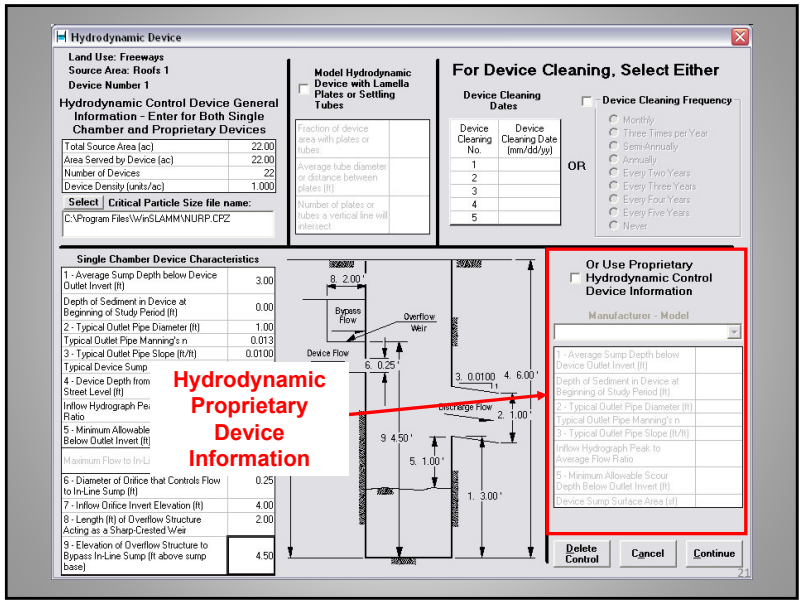
Hydrodynamic Device
Land Use: Freeways
Source Area: Roofs 1
Device Number 1
Hydrodynamic Control Device General Information - Enter for Both Single Chamber and Proprietary Devices
Model Hydrodynamic Device with Lamella Plates or Settling Tubes
For Device Cleaning, Select Either
Device Cleaning Dates
Device Cleaning Frequency
Single Chamber Device Characteristics
Or Use Proprietary Hydrodynamic Control Device Information
Hydrodynamic Proprietary Device Information
Delete Control
Cancel
Continue
21

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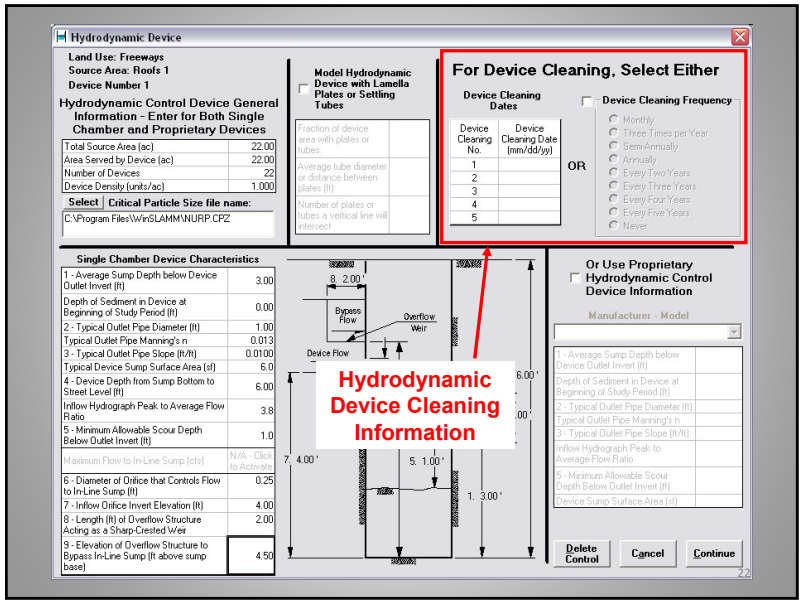
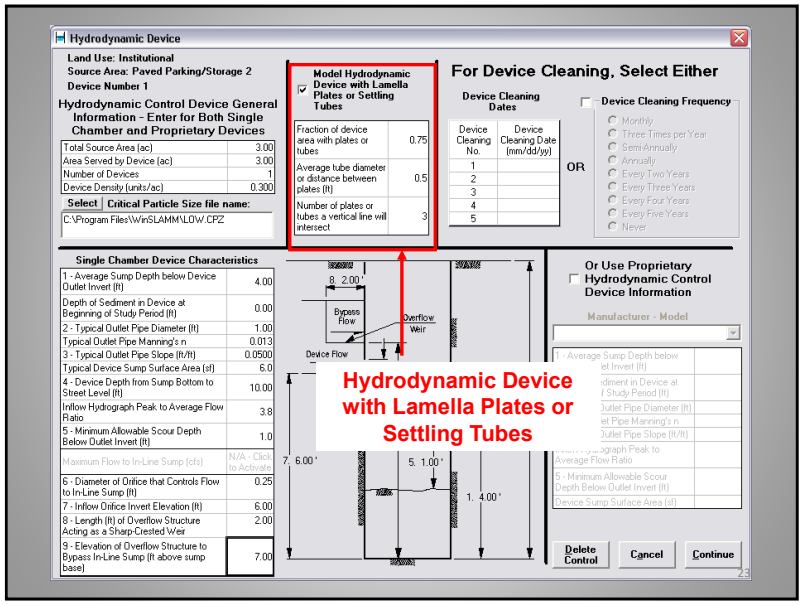

Hydrodynamic Device
Land Use: Freeways
Source Area: Roofs 1
Device Number 1
Hydrodynamic Control Device General Information - Enter for Both Single Chamber and Proprietary Devices
Model Hydrodynamic Device with Lamella Plates or Settling Tubes
For Device Cleaning, Select Either
Device Cleaning Dates
Device Cleaning Frequency
Single Chamber Device Characteristics
Or Use Proprietary Hydrodynamic Control Device Information
Hydrodynamic Device Cleaning Information
Delete Control
Cancel
Continue
22

22


Hydrodynamic Device
Land Use: Institutional
Source Area: Paved Parking/Storage 2
Device Number 1
Hydrodynamic Control Device General Information - Enter for Both Single Chamber and Proprietary Devices
Model Hydrodynamic Device with Lamella Plates or Settling Tubes
For Device Cleaning, Select Either
Device Cleaning Dates
Device Cleaning Frequency
Single Chamber Device Characteristics
Or Use Proprietary Hydrodynamic Control Device Information
Hydrodynamic Device with Lamella Plates or Settling Tubes
Delete Control
Cancel
Continue
23

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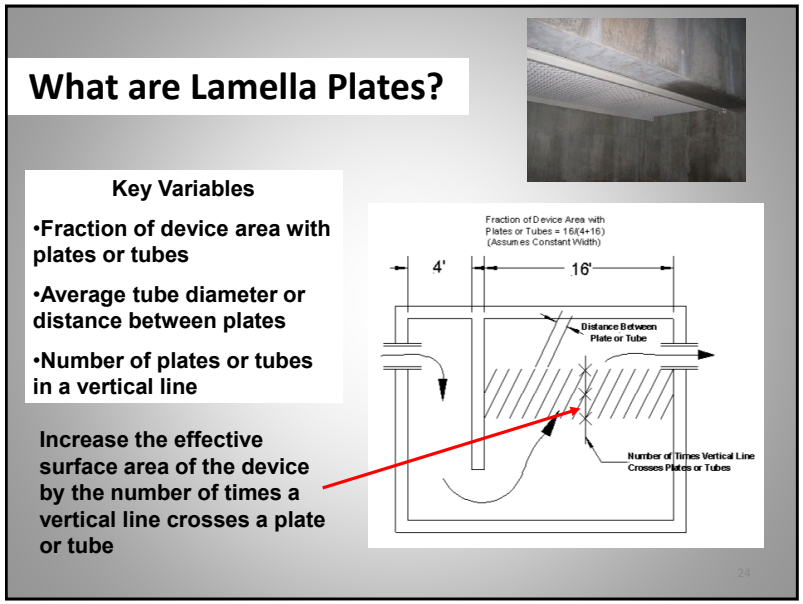
What are Lamella Plates?
Key Variables
•Fraction of device area with plates or tubes
•Average tube diameter or distance between plates
•Number of plates or tubes in a vertical line
Increase the effective surface area of the device by the number of times a vertical line crosses a plate or tube
Fraction of Device Area with Plates or Tubes = 16/(4+16)
(Assumes Constant Width)
4'
16'
Distance Between Plate or Tube
Number of Times Vertical Line Crosses Plates or Tubes
24

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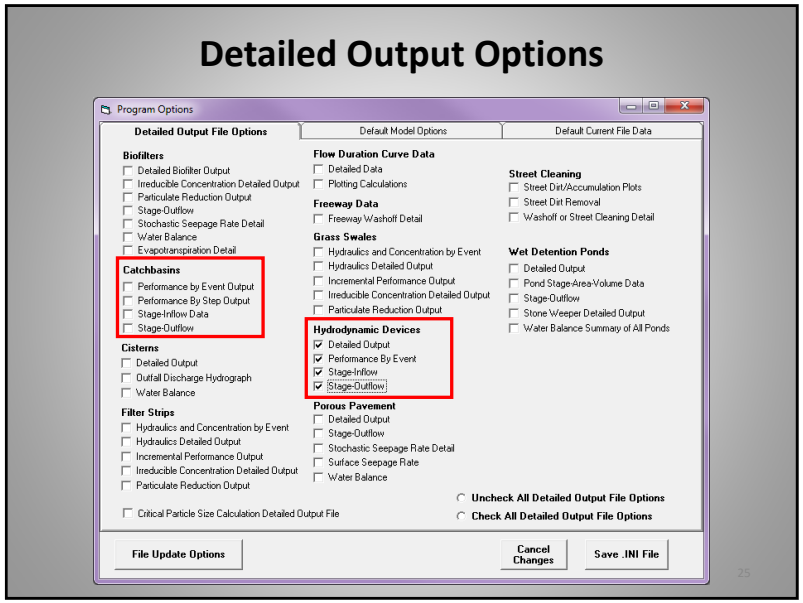
Detailed Output Options
Program Options
Detailed Output File Options
Default Model Options
Default Current File Data
Biofilters
Detailed Biofilter Output
Irreducible Concentration Detailed Output
Particulate Reduction Output
Stage-Outflow
Stochastic Seepage Rate Detail
Water Balance
Evapotranspiration Detail
Catchbasins
Performance by Event Output
Performance By Step Output
Stage-Inflow Data
Stage-Outflow
Cisterns
Detailed Output
Outfall Discharge Hydrograph
Water Balance
Filter Strips
Hydraulics and Concentration by Event
Hydraulics Detailed Output
Incremental Performance Output
Irreducible Concentration Detailed Output
Particulate Reduction Output
Critical Particle Size Calculation Detailed Output File
Flow Duration Curve Data
Detailed Data
Plotting Calculations
Freeway Data
Freeway Washoff Detail
Grass Swales
Hydraulics and Concentration by Event
Hydraulics Detailed Output
Incremental Performance Output
Irreducible Concentration Detailed Output
Particulate Reduction Output
Hydrodynamic Devices
Detailed Output
Performance By Event
Stage-Inflow
Stage-Outflow
Porous Pavement
Detailed Output
Stage-Outflow
Stochastic Seepage Rate Detail
Surface Seepage Rate
Water Balance
Street Cleaning
Street Dirt/Accumulation Plots
Street Dirt Removal
Washoff or Street Cleaning Detail
Wet Detention Ponds
Detailed Output
Pond Stage-Area-Volume Data
Stage-Outflow
Stone Weeper Detailed Output
Water Balance Summary of All Ponds
Uncheck All Detailed Output File Options
Check All Detailed Output File Options
File Update Options
Cancel Changes
Save .INI File
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