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Field Collection of Site Development Characteristics

Contents

Introduction

Accurate knowledge of development characteristics in the drainage area being investigated helps improve the accuracy of stormwater quality and quantity modeling. Development characteristics of interest include impervious cover types and quantities, landscaping, roofing materials, areas of different surfaces, drainage system information, etc. Different surfaces in urban areas contribute flows and pollutants differently from other types of surfaces. As an example, pitched roofs are much more efficient in producing runoff than flat roofs. Treated wood, galvanized metals, and other coverings, all affect the concentrations of heavy metals from roofs. Similar differences exist for other types of urban surfaces. Obviously, the magnitude of “impervious” surfaces in each land use in an area has a large effect on runoff production. The ways these surfaces are connected to the drainage system also affects the amount of runoff produced. In addition, the types and extent of disturbed urban soils all affect runoff quality and quantity. It is therefore necessary to survey an area to determine these development characteristics in order to produce the most accurate runoff quality and quantity predictions, and to identify opportunities for retro-fitting stormwater management practices in existing areas. The data from these surveys can also be used to help identify public education programs and to identify changes in future development that can decrease runoff problems.

The first step in this process is to collect available land use information for the areas of study. Local planning agencies and facility managers have very distinct land use descriptions and these categories should be the basis for the stormwater quality modeling. In some cases, these land use descriptions may be further subdivided, depending on age of development, etc. Aerial photographs of the study area are also needed in order to identify how the land use categories are located throughout the area, and to enable major differences in the main land use categories to be identified. In most large urbanized areas, from 10 to 20 land use categories and subcategories are usually sufficient to represent the range of conditions encountered. About 10 to 15 example homogeneous neighborhoods are selected in each of these categories for the site surveys. Each homogeneous area is relatively small, such as a single block area, a single school or church, a mall, a cemetery, a park, or up to about 5 or 10 acres of other areas. The selected neighborhoods are then surveyed by visiting the areas and filling out a form containing basic site information, supplemented by photographs. Surfaces in each of the selected neighborhoods are also carefully measured using aerial photographs to determine the areas associated with the different surfaces. Relatively high resolution aerial photographs are of most use for this phase. Automatic image processing can be used for part of these analyses, but manual measurements are also usually needed. The following discussion describes these survey steps, after a description of typical land use categories. In industrial areas, the surface covers can vary greatly and additional effort may be needed. For specific drainage areas, such as regulated outfalls for compliance modeling, it may be necessary to survey each building and lot. This memo therefore is divided into two main sections: the first section is for conventional land uses in developed urban areas, while the second section is for detailed surveys that vary greatly in relatively small areas.

This site development and supporting information is needed when using either WinSLAMM or the Navy Summary Spreadsheet to calculate expected discharges and sources of stormwater contaminants. The information needed for both approaches is basically the same, so this memo describes the information and the recommended procedures for collecting the information. In the summary spreadsheet, there are 67 different source area types specifically listed, but as few as necessary can be used. Most of the paved and roof areas have three separate categories, corresponding to directly connected areas and disconnected areas draining to either sandy or silty/clayey soils. There are also ten special impervious source areas corresponding to specialized naval activities (airfields, piers, laydown areas, galvanized metal roofs, etc.). The basic 37 source area categories (similar for residential, institutional, commercial, and industrial land uses), are shown below, and the site surveys for these areas are discussed in the first section:

Basic Source Area Categories

Roofs - directly connected

Roofs - disconnected sandy soils
Roofs - disconnected silty or clayey soils
Paved parking/storage - directly connected
Paved parking/storage - disconnected sandy soils
Paved parking/storage - disconnected silty or clayey soils
unpaved parking/storage - directly connected
unpaved parking/storage - disconnected sandy soils
unpaved parking/storage - disconnected silty or clayey soils
driveways - directly connected
driveways - disconnected sandy soils
driveways - disconnected silty or clayey soils
sidewalks/walks - directly connected
sidewalks/walks - disconnected sandy soils
sidewalks/walks - disconnected silty or clayey soils
street/high traffic urban areas - smooth pavement
street/high traffic urban areas - intermediate pavement
street/high traffic urban areas - rough pavement
large landscaping areas - sandy soils
large landscaping areas - silty soils
large landscaping areas - clayey soils
undeveloped areas - sandy soils
undeveloped areas - silty soils
undeveloped areas - clayey soils
small landscaped areas - sandy soils
small landscaped areas - silty soils
small landscaped areas - clayey soils
other pervious areas - sandy soils
other pervious areas - silty soils
other pervious areas - clayey soils
other directly connected impervious areas
other partially connected impervious areas - sandy soils
other partially connected impervious areas - silty or clayey soils
highway paved lane and shoulder areas
highway large turf areas - sandy soils
highway large turf areas - silty soils
highway large turf areas - clayey soils

Besides the above listed basic source area categories, ten “other impervious areas” are available for each land use. For the Navy calibrated WinSLAMM model, they were identified in the industrial area and represent unique naval facility site activities. These are described in the following table:

OIA1 - airfield apron/runway paved areas - directly connected

OIA1 - airfield apron/runway paved areas- disconnected sandy
OIA1 - airfield apron/runway paved areas - disconnected silty or clayey
OIA2 - other airfield paved areas- directly connected
OIA2 - other airfield paved areas- disconnected sandy soils
OIA2 - other airfield paved areas- - disconnected silty or clayey soils
OIA3 - light pier/laydown/storage/loading dock concrete areas- directly connected
OIA3 - light pier/laydown/storage/loading dock concrete areas - disconnected sandy soils
OIA3 - light pier/laydown/storage/loading dock concrete areas - disconnected silty or clayey soils
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - directly connected
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - disconnected sandy soils
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - disconnected silty or clayey soils
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas- directly connected
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas - disconnected sandy soils
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas- disconnected silty or clayey soils
OIA6 - light pier/laydown/storage/loading dock asphalt areas - directly connected
OIA6 - light pier/laydown/storage/loading dock asphalt areas- disconnected sandy soils
OIA6 - light pier/laydown/storage/loading dock asphalt areas- disconnected silty or clayey soils
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- directly connected
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- disconnected sandy soils
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- disconnected silty or clayey soils
OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - directly connected
OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - disconnected sandy soils

OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - disconnected silty or clayey soils
OIA9 - galvanized metal roofs, directly connected- directly connected
OIA9 - galvanized metal roofs - disconnected sandy soils
OIA9 - galvanized metal roofs- disconnected silty or clayey soils
OIA10 - other impervious areas with galvanized materials- directly connected
OIA10 - other impervious areas with galvanized materials - disconnected sandy soils
OIA10 - other impervious areas with galvanized materials - disconnected silty or clayey soils

The second section of this memo describes the site survey methods for these additional areas, specifically for naval facilities.

Basic Land Use Categories and Field Inventories

During field inventories, all land covers are considered in each land use. These usually include streets, building roofs, parking lots, walkways, landscaped areas, undeveloped parcels, etc. Some planning agencies separate the streets from the land uses and consider these surfaces as part of a larger transportation land use. If that is the case, the areas need to be adjusted to include these surfaces as an integral part of each of the land uses. The following are typical definitions for basic land use categories:

Descriptions of Land Uses

Residential Land Uses

High Density Residential: Urban single family housing having a density greater than 6 units/acre. This land use includes the homes (roofs), driveways, yards, sidewalks, and streets, in addition to some minor surfaces. This category could be subdivided into age of development groups.

Medium Density Residential*:* Urban single family housing at a density of 2 to 6 units/acre. The same as above, the homes, driveways, yards, sidewalks and streets adjacent to the house are included as the main surfaces. It may be especially important to subdivide this category into age of development groups as these areas usually represent most of the area of a community and trends in construction over the years may result in significant differences in development characteristics with time (such as the ratios of roof areas to landscaped areas). In addition, maturity of vegetation will vary with time which may also affect runoff characteristics.

Low Density Residential: Similar to the previous residential areas, except having a density of 0.7 to 2 units/acre. Again, this category could be subdivided into age of development groups, especially as landscaped areas may affect the stormwater characteristics more than the impervious areas.

Duplexes: Connected housing of two family units being 1 to 3 stories in height. Units may be adjoined up-and-down, side-by-side or front-and-rear. This land use includes the streets, buildings, yards, parking lots, and driveways as the main surfaces.

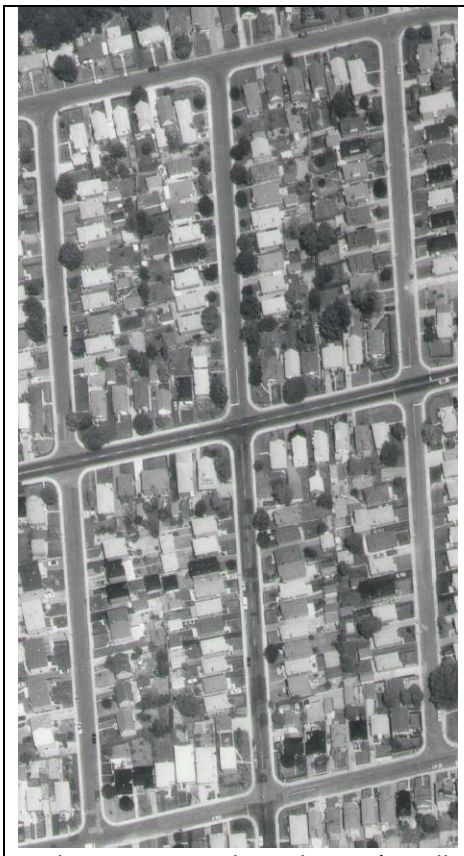
Multiple Families: Like duplexes, but housing containing three or more family units that are 1 to 3 stories in height.

Apartments: Multiple family units of 4 or more stories in height.

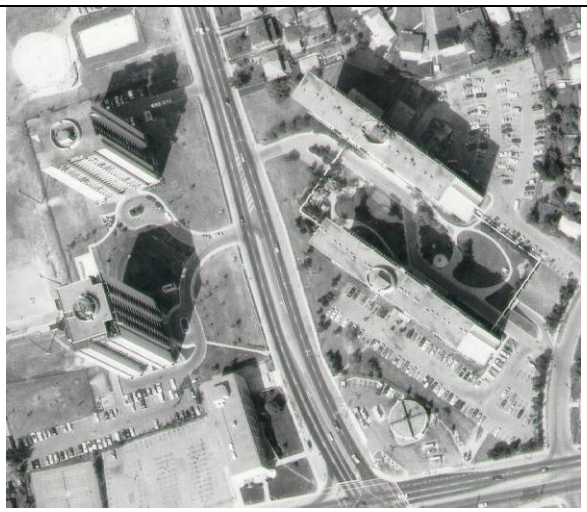
Trailer Parks: A mobile home or trailer park that includes all vehicle homes, yards, driveways, streets, walkways, and office area.

Medium Density Residential Area (no alleys)

Older Medium Density Residential Area (no alleys, but with more mature trees)



High Density Residential Area (no alleys)



High Rise Apartments

Example aerial photographs of different residential area categories (Pitt and McLean 1986).

Multi-family residential areas. Impervious areas (pitched roofs and parking areas) are all directly connected. Small amounts of landscaped areas are also present.


Older medium density residential area.


Newer medium density residential area.

Commercial Land Uses

Strip Commercial: Includes buildings for which the primary function is the sale of goods or services. Some institutional land use such as post offices, fire and police stations, and court houses are also included in this category. The strip commercial land use includes the buildings, parking lots, and streets. This category does not include buildings used for the manufacturing of goods or warehouses, nurseries, tree farms, or lumber yards.

Shopping Centers: These are commercial areas where the adjoining parking lot is at least 2.5 times the building roof area. The buildings in this category are usually surrounded by parking areas. This land use includes the buildings, parking areas, and the streets, plus any landscaping. This area also includes large regional shopping malls.

Office Parks: This is a land use containing non-retail businesses. The buildings are usually multi-story buildings surrounded by larger areas of lawn and other landscaping. This land use includes the buildings, the lawn, parking areas, and streets. The types of businesses found in this category may include: insurance offices, government buildings, company headquarters, etc.

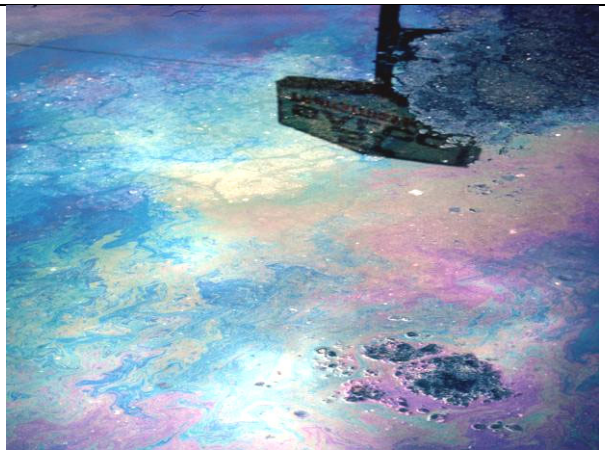
Downtown Central Business District: Highly impervious downtown areas of commercial and institutional land use. This land use also includes the buildings, parking areas, streets, but with minimal landscaping.

Example aerial photograph of strip commercial area surrounded by older high density residential area (Pitt and McLean 1986).

Paved parking area with frequent automobile movement

Contamination of paved parking areas due to commercial activities

Contamination of paved parking area due to inappropriate waste disposal



Parking area at automobile service area

Typical problem areas in commercial areas that should be documented during field surveys.

Typical strip commercial areas

Commercial shopping mall

Industrial Land Uses

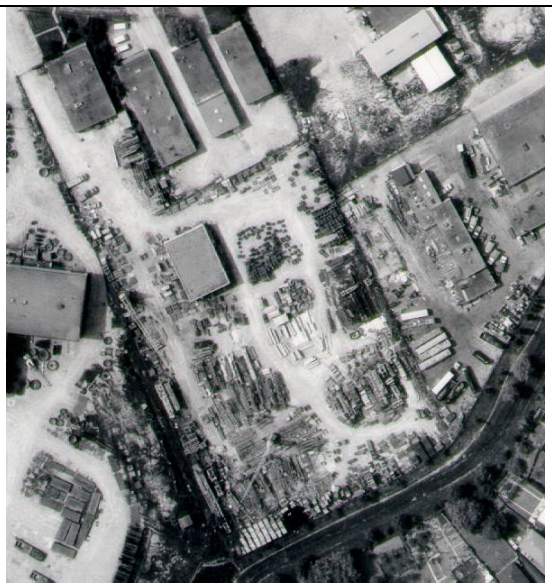
Manufacturing (Heavy) Industrial: Those buildings and premises which are devoted to the manufacture of products, with many of the operations conducted outside, such as power plants, steel mills, and cement plants.

Medium Industrial: This category includes businesses such as lumber yards, auto salvage yards, junk yards, grain elevators, agricultural coops, oil tank farms, coal and salt storage areas, slaughter houses, and areas for bulk storage of fertilizers. Municipal public works yards are also included in this category.

Non-Manufacturing (Light) Industrial: Those buildings which are used for the storage and/or distribution of goods awaiting further processing or sale to retailers. This category mostly includes warehouses and wholesalers where all operations are conducted indoors, but with truck loading and transfer operations conducted outside.

The “other impervious areas” categories in industrial areas may be especially useful when describing unique critical source areas, as described later in this memo for naval base operations.

Non-manufacturing, light industrial area - warehousing



Medium industry - scrap yard/storage area

Example aerial photographs of industrial areas (Pitt and McLean 1986).

Contaminated paved storage area at vehicle junk yard

Contaminated unpaved storage area

Large-scale metal recycling operation on unpaved surface

Heavy equipment storage area on concrete surface

Activities in industrial areas that contribute to stormwater pollutants that should be documented during field surveys.

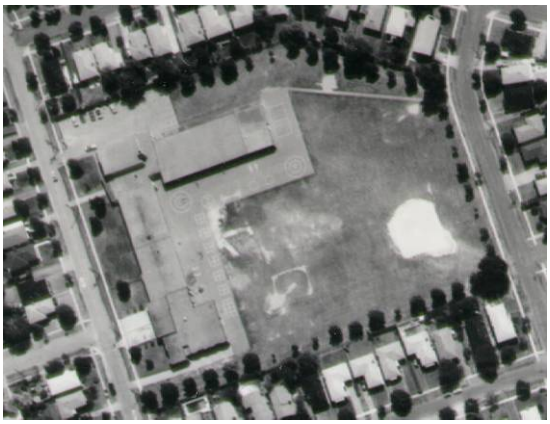
Light and medium industrial land use activities.

Institutional Land Uses

Hospitals: Medical facilities that provide patient overnight care. Includes nursing homes, state, county, or private facilities. This land use includes the buildings, grounds, parking lots, and driveways as the main surfaces.

Education (Schools): Includes any public or private primary, secondary, or college educational institutional grounds. The land use consists of the buildings, playgrounds, athletic fields, roads, parking lots, and lawn areas.

Miscellaneous Institutional: Churches and large areas of institutional property not part of strip commercial and downtown areas.



Example aerial photograph of educational land use area (Pitt and McLean 1986).

School

Church

Open Space Land Uses

Cemeteries: Includes cemetery grounds, roads, and buildings located on the grounds.

Parks: Outdoor recreational areas including municipal playgrounds, botanical gardens and arboretums, golf courses, and natural areas.

Undeveloped: Lands that are private or publicly owned with no structures and have an almost complete vegetative cover. This includes vacant lots, transformer stations, radio and TV transmission areas, water towers, and railroad rights-of-way.

Example aerial photograph of open space land use area, a cemetery (Pitt and McLean 1986).

Freeway Land Uses

Freeways: These are limited access highways and the interchange areas, including any vegetated rights-of-ways.

Example aerial photograph of freeway land use area (Pitt and McLean 1986).

Suburban freeway with large shoulders and grass swales at median

Urban freeway with minimal grass area, almost completely paved right-of-way

 Depressed downtown freeway with eroding embankment	

Basic Homogeneous Neighborhood Surveys in Single Land Use Areas

An “Area Description” field sheet is used to record important characteristics of the homogeneous land use areas during the field surveys. In addition, aerial photographs, such as from GoogleEarth https://maps.google.com/maps?hl=en&tab=nl or other high resolution satellite images are used to measure the actual coverage of each type of surface in each neighborhood studied. The following discussion describes the field sheet and the information requested.

Location: Site number:
Date: Time:
Photo numbers:
Land-use and industrial activity:
Residential: low medium high density single family
multiple family
trailer parks
high rise apartments
Income level: low medium high
Age of development: <1960 1960-1990 1990-2010 >2010
Institutional: school church hospital other (type):
Commercial: strip shopping center/mall downtown hotel offices
Industrial: light medium heavy (manufacturing) describe:
Open space: undeveloped park golf cemetery
Other: freeway utility ROW railroad ROW other:
Maintenance of building: excellent moderate poor
Heights of buildings: 1 2 3 4+ stories
Roof drains: % underground % gutter % impervious % pervious
Roof types: flat composition shingle wood shingle galvanized metal other metal other:
Sediment source nearby? No Yes (describe):
Treated wood near drainage system or directly connected pavement? No telephone poles fence other:
Landscaping near road or directly connected impervious surfaces:
Quantity: none some much
Type: deciduous evergreen lawn
Maintenance: excessive adequate poor
Leafs on street: none some much
Topography:
Street slope: flat (<2%) medium (2-5%) steep (>5%)
Land slope (next to street): flat (<2%) medium (2-5%) steep (>5%)
Traffic speed: <25mph 25-40mph >40mph
Traffic density: light moderate heavy
Parking density: none light (20 to 50%) moderate (50 to 80%) heavy (>80%)
Width of street: number of parking lanes:
number of driving lanes:
Condition of street: good fair poor
Texture of street: smooth intermediate rough very rough
Pavement material: asphalt concrete unpaved
Driveways: paved unpaved
Condition: good fair poor
Texture: smooth intermediate rough
Gutter material: grass swale lined ditch concrete asphalt
Condition: good fair poor
Street/gutter interface: smooth fair uneven
Litter loadings near street: clean fair dirty
Parking/storage areas (describe):
Condition of pavement: good fair poor
Texture of pavement: smooth intermediate rough unpaved
Directly connected to drainage: yes no
Other paved areas (such as alleys and playgrounds), describe:
Condition: good fair poor
Texture: smooth intermediate rough
Directly connected to drainage: yes no
Other notes/comments:

Basic area description field sheet.

Example of 1 m monochromatic aerial photograph (USGS photo).


Example of sub meter color satellite image (Google).

Detailed Instructions for Basic Field Inventory Sheet

Each homogeneous area to be investigated in each survey sheet usually covers a about 4 blocks (can be along a street or more commonly, an enclosed area a block on a side). The areas are identified before going into the field from aerial photographs based on similar visual characteristics. For shopping malls, hospitals, and other single land uses, each field sheet is for one location. Large industrial areas (especially) that contain a large number of a variety of critical source areas need more detailed site surveys that are discussed in the second section of this memo (and uses the "other impervious areas" of WinSLAMM or the Navy Summary Spreadsheet).

• *Location*:

The block address number range and the street name are noted. A sub-area name can also be used to describe the drainage area, or portion of town. A field sheet is filled out for each homogeneous land use sampling area being investigated in the study area. Specific blocks to be surveyed are selected based on maps and aerial photographs before the survey is conducted. Each site needs at least two photographs taken: one is a general scene and the other is a close-up showing about 25 by 40 centimeters of pavement. Additional photographs are usually taken to record unusual conditions. A photograph is also taken of the completed field sheet at the end of each neighborhood survey to separate and label the images. These photographs are very important to confirm the descriptions recorded on the data sheets and to verify the consistency of information for the different areas within each category. The photographs are also very important when additional site information is needed, but not specifically recorded on the data sheets. Google street view can also be used to supplement the site surveys, but they cannot replace going into the field (especially for off-street features such as roof drain disconnections).

• *Land-use*:

The land-use type that best describe the block is circled. The previous land use descriptions are one scheme that has been used with WinSLAMM. However, these definitions may need to be modified based on local practice and information. Also, some of the homogeneous areas may need to be re-categorized after the data is obtained. As an example, the housing density initial estimates may be incorrect for some areas and the surveyed areas may need to be moved to another category after the accurate measurements are available. If more than one land-use is present in an area being studied (would happen if conducting a survey in a monitored area), then a separate form should be used for each homogeneous land use subarea. The approximate income level for the residential areas is also circled. The specific types of industrial activities (warehouses, metal plating, bottling, electronics, gas station, etc.) for industrial and commercial areas are also noted on the form, but more detailed information, discussed later, should also be obtained. Also, the approximate age of development is circled.

• *Roof drainage*:

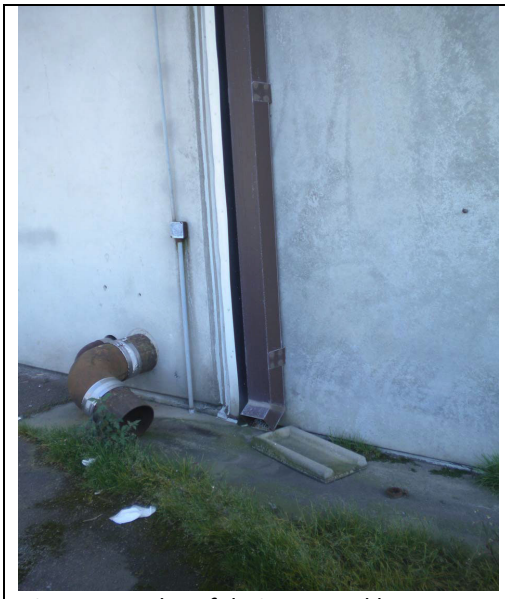
The discharge locations of the roof drains are also noted on the form. The approximate distribution of the discharge locations is noted if more than one location is evident. This is determined by driving around the complete area and tallying the roof drain locations (on the back of the field sheet, for example). It is assumed that all backyard drains are disconnected, unless alleys are present. In that case, drive the alleys and note the back drain connections. Obviously, do not trespass to view all the drains. The "underground" location may be to storm sewers, sanitary sewers, or dry wells. Some areas have the roof drains apparently directed underground but are actually discharged to the roadside gutter or drainage ditch. If they lead to the gutter (discharge locations are usually seen along the gutter), then the "to gutter" category is circled. Additionally, if the flow path length is less than about five feet (flat, shorter if steep) over pervious ground for a typical house, it is functionally directly connected to impervious areas, requiring circling the "to impervious" category. The roof types and building heights are also indicated (again, the approximate distributions are noted if more than one type is present in the "homogeneous" subarea). It is necessary to take an inventory of all visible roof drains in the substudy inventory area by keeping tallies of each type of drain connection. The distribution of the percentage per connection type is put on the inventory sheet. If other categories of characteristics vary in the study block (paved or unpaved driveway categories is another common variation), then these are also tallied for the area and the results shown on the sheet.

A directly connected roof drain

A disconnected roof drain (drains to pervious area)

Pitched metal roof

Flat commercial roofs

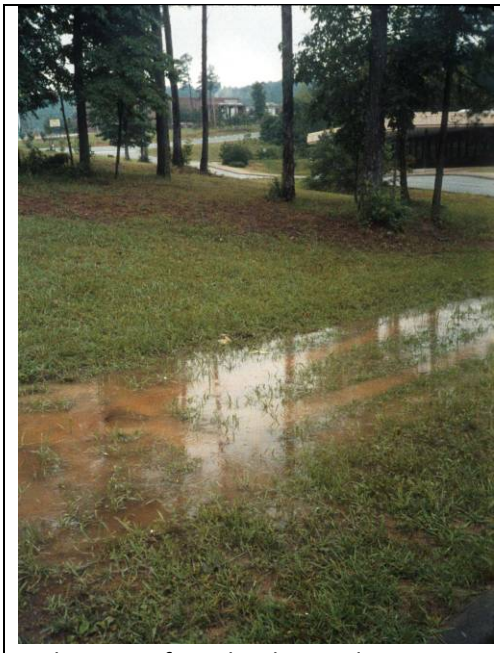


Disconnected roof drain at naval base

“Underground” roof drain at naval base (showing perforations to allow release if water backs up, possibly draining to underground dry well or french drain)

Underground roof drain at navel base (not clear where it is connected)

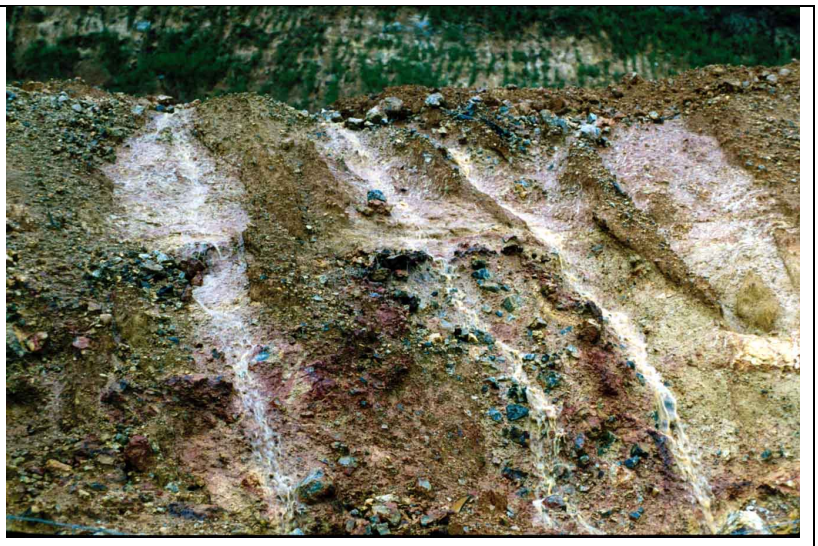
• *Sediment sources*:
Sediment sources near the drainage (street, drainage way, or gutter), such as construction sites, unpaved driveways, unpaved parking areas or storage lots, or eroding vacant land, are described and photographed.



Soil erosion from landscaped areas having fine-grained soils during periods of high rain intensities

Scoured drain pathway from paved area.

Utility work near street.

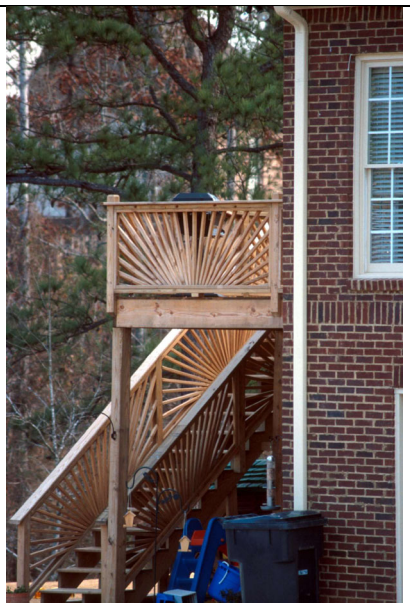


Unprotected slope.

Erosion source at navel base (bare soil near pavement)

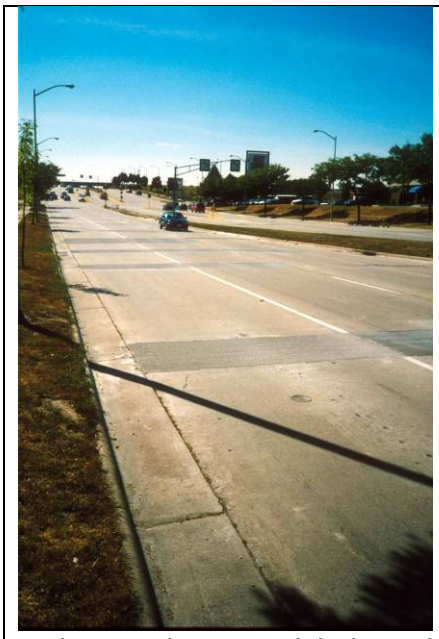
- *Treat wood near drainage system or directly connected impervious area:*

Circle or describe any treated wood that is located near any directly connected impervious area. Most wood treatment chemicals (heavy metals or organic compounds) are effectively captured if drained to landscaped areas. If these areas drain to pavement, much of the toxicants can directly enter the drainage system. Also describe the type of wood preservative, if possible (Copper-chromium-arsenic, CCA, creosote, etc.).



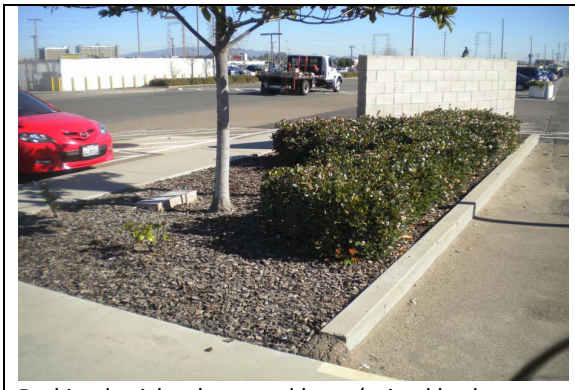
Treated wood near drainage system or directly connected impervious areas can contribute toxicants to the storm drainage system.

• *Landscaping near road or directly connected impervious surfaces:*
Describe the type of landscaping near the road and other directly connected impervious surfaces. Large amounts of trees near these areas can add nutrients to the stormwater. Deciduous vegetation can add large amounts of leaf litter in the fall that requires special cleanup operations to prevent clogging of the drainage system. Excessive maintenance (total absence of weeds, for example) implies an excess amount of chemical use (fertilizers, herbicides, and pesticides) that also contribute to stormwater degradation.



Wide arterial street with little roadside vegetation.

Narrow residential street with substantial adjacent vegetation.



Parking lot island at naval base (raised bed to not a biofilter area, but could be easilty converted)

• *Parking density:*

Vehicles parked along a street cleaning route reduce the length of curb that may be cleaned by municipal street cleaning operations. Since most of the street surface pollutants are found close to the curb on smooth streets with little parking, parked vehicles can significantly reduce the cleaning effectiveness of normal cleaning programs on these streets. Extensively parked cars block the migration of particulates towards the curb, resulting in higher “middle of the street" loading values than for streets with little or no parking. The percentage of curb length occupied by parked vehicles is close to the percentage of parking spaces occupied, but is usually smaller due to parking restrictions such as driveways and fire hydrants. As the number of parked cars increases, the percentage of' curb left uncleaned by street cleaning operations increases proportionally, especially as the street cleaning equipment must also maneuver around the parked cars.

If a smooth street has extensive on-street parking 24 hours a day (such as in a high density residential neighborhood), most of the street surface particulates would not be within the 8 ft. strip next to the curb that is usually cleaned by street cleaning equipment. If the percentage of curb length occupied by parked cars exceeds

about 80 percent for extensive 24 hour parking conditions, it would be best if the parked cars remained and the street cleaner swept around the cars (in the 8 to 16 ft. strip from the curb). Of course, all of the cars should be removed periodically to allow the street cleaner to operate next to the curb to remove litter caught under the cars. In an area with extensive daytime parking only (such as in downtown commercial areas), the parked cars should remain parked during cleaning (daytime cleaning) if the percentage of curb length occupied exceeds about 95 percent.

• *Street and Pavement*:
The numbers of traffic and parking lanes are also noted on the field sheet. Pavement condition and texture are different characteristics and are noted separately. Condition implies the state of repair, specifically relating to cracks and pot holes in the pavement. Texture implies roughness. A rough street may be in excellent condition: many new street overlays result in very rough streets. Some much worn streets may also be quite smooth, but with many cracks. Rough or streets in poor condition have much greater street dirt loadings and are much more difficult to clean with street cleaning equipment. They also produce less washoff of the street dirt during rains. Smooth streets are cleaned by both street cleaning equipment and rains more effectively.

A close-up photograph of the street surface is used to make final determinations of street texture by comparing with reference photographs. An overview photograph of the street is also taken to make the final determination of the street condition. The gutter/street interface condition is an indication of how well the street pavement and the gutter material join. Many new pavement overlay jobs result in uneven pavement near the gutter, resulting in a several centimeter ridge along the gutter/street interface. If the street interface is in poor condition or is uneven, an additional photograph is taken to show the interface close-up. The litter perception is also indicated on the field sheet and another photograph is taken of heavily littered areas.


Smooth textured street.


Intermediate textured street.

Rough textured street

Very rough textured street.

Paver blocks (appear to be grouted so don't allow infiltration, but substantial detention storage during smaller rains) at navel base.

Rough textured pavement at naval base

Concrete in poor condition (large numbers of large cracks) at naval base

Very rough pavement (worn) at naval base

Dirty asphalt parking lot on naval base

Basic Aerial Photographic Measurements of Source Areas

The measurements of the source areas from aerial photographs are also needed to quantify the areas associated with each area description (areas of roofs that are directly connected, areas of parking areas that are disconnected, areas of rough textured streets, etc.). After the field data description sheets are filled out during each neighborhood survey, the corresponding aerial photographs and/or GIS maps are examined, and the individual elements (roofs, parking areas, street areas, sidewalks, landscaping, etc) are measured. This can be done manually or by using automated tools, such as GIS Tools. The aerial photograph area measurements are usually tabulated and summarized in Excel spreadsheets. These data are then used to build the WinSLAMM files to describe each land use area. This information can be manually measured from aerial photographs and recorded on data sheets, using one sheet for each site surveyed. An example of this manual measurement data sheet is shown below, but most current measurements are done with GIS systems.

Little Shades Creek Stormwater Study - Site Characteristics

Site #: 66 Land use: Single-Family Zoning: R-1 Govt: VCSt.

Description: High density buildings

Location: Chestnut Road

Total area: 11.6 ha.

Total number of units in area: 31 Density: 2.67 /ha

Streets: Total street length: 992.2 m Street length density: 85.53 m/ha

Average street width: 6.05 m Street area: 6007.8 m^2

Street area density: 517.48 m^2/ha

Grass area between sidewalk and street: width: ____ m length: ____ m

area: ____ m^2 density: X m^2/ha

Sidewalk: width: ____ m length: ____ m area: ____ m^2 density: X m^2/ha

Front landscaping: average per unit 2350 m^2 x 31 # units = 72838 m^2

density: 6279 m^2/ha

Driveways: avg. per unit 78.65 m^2 x 31 # units = 2438.15 m^2 density: 210.19 m^2/ha

100 % paved; 210.19 m^2/ha

0 % unpaved; 0 m^2/ha

Parking areas: ____ m^2 density: X m^2/ha

____ % paved; X m^2/ha

____ % unpaved; X m^2/ha

Storage areas: ____ m^2 density: X m^2/ha

____ % paved; X m^2/ha

____ % unpaved; X m^2/ha

Playgrounds: ____ m^2 density: X m^2/ha

____ % paved; X m^2/ha

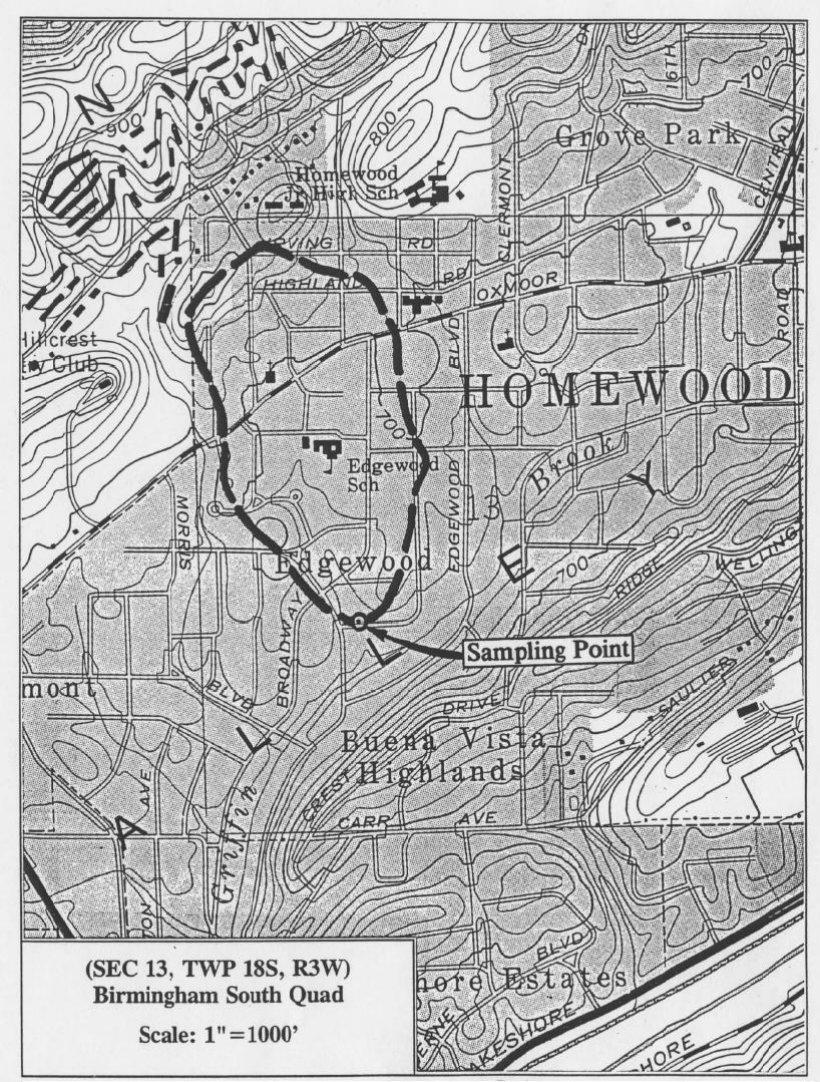
____ % unpaved; X m^2/ha

Example of first page of the area measurement sheets.

Bochis (2007) and Bochis, *et al*. (2008) recently examined several different approaches using automated methods to acquire the source area data as part of a stormwater study in Jefferson County, AL. The first

step was to obtain satellite imagery taken during 2001 and 2003, plus watersheds paper maps from the Storm Water Management Authority of Jefferson County (SWMA). All images were originally purchased from Space Imaging and acquired by IKONOS Satellite imagery which is a high-resolution satellite operated by Space Imaging LLC. IKONOS produces 1-meter black-and-white (panchromatic) and 4-meter multi-spectral (red, blue, green, near infrared) imagery that can be combined in a variety of ways to accommodate a wide range of high-resolution imagery applications. The satellite was launched on September 24, 1999 and has been delivering commercial data since early 2000.

The second step was the electronic delineation of the study watersheds using map digitizing and GIS tools. The multi-spectral image of Jefferson County and the paper maps of the watersheds were used to manually digitize and then cut each of the watersheds using ArcGIS 9 (ArcMap). Each watershed was saved separately as a shape file (.SHP). The following are examples of a high density residential shape file, showing the location on the USGSA quad map and the cut out shape aerial image. Since these were monitored watersheds, they usually included a mixture of land uses, although each was predominately a single land use. Therefore, several homogeneous land use neighborhoods were inventoried in each watershed to represent each of the land uses present. The areas of these land uses were also determined and the characteristics of the complete watershed were therefore known.



ALJC009: HIGH DENSITY RESIDENTIAL- SHADES CREEK BASIN

Mixed High Density Residential Area - Site Satellite Image (Bochis 2007).

The multi-spectral Jefferson.sid aerial images were obtained from the National Aerial Photography Program (NAPP) which were further processed by SWMA. Film negatives were purchased by SWMA from the USGS and were scanned and saved into digital format, orthorectified and sid'ed into USGS quad arrangements (one singular layer). They were not scanned by a metric scanner (which would have resulted in sharper and more precise output images).

The National Aerial Photography Program was initiated in 1980 and coordinated by the USGS. The purpose is to acquire aerial photography of each of the 48 lower states every five years. They are acquired at 20,000 feet elevation and centered on 1:24,000 scale USGS maps, with eight frames making up one USGS quadrangle map. Each frame represents 32.3 sq.mi. at 2-ft pixels. Final output are digital ortho quarter quads (DOQQ) and revised approximately every five years. For more information about NAPP, see: http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/NAPP. The next step used the two 1-meter panchromatic satellite images ("Leafoff.img" flown December 2000 and "Leaffon.img", flown summer 2001; raster format "ERDAS IMAGE", number of raster bands: 1) of Jefferson County.

These images were purchased by SWMA from Space Imaging and were assembled into mosaics using a PLSS-Township arrangements. It is complete for the entire county area, but with cloud obstructions in some areas. The overlapping/cutting process made use of GIS Tools: ArcInfo, ArcToolbox and ArcMap 8.9. Each image was saved separately (.IMG extension) having the equivalent name of the watershed.

The satellite image measurement process was initially used to describe the different land uses within the watersheds. For residential land uses, the most visible neighborhoods (having minimal cloud cover) were selected and their individual elements were electronically measured. However, for industrial, commercial, and institutional areas, it was necessary to take account of all the elements incorporated into the land use due to greater variabilities of the different surface cover areas. The areas of the individual elements were calculated using ArcGIS and stored in the shape file attribute table.

Data measurement storage and processing

The older Little Shades Creek area measurements were obtained manually from aerial photographs and then transferred to Excel worksheets. The individual elements of the six Jefferson County watersheds were measured in square feet units and recorded directly in an electronic format (.dBASE IV). For easier handling of these data, the files were later converted into Excel worksheet files. Data normalizing was also performed to account for rounding errors.

In order to construct WinSLAMM files, several types of information about the sites are needed: drainage system (grass swales, curb and gutter in good/fair/poor condition, undeveloped roadside) and the fraction of each type of drainage system serving the study area; the soil type (sandy, silty, clayey); some of the field information (roof type, street texture, etc.), and the area measurements normalized data. All of the information was obtained during the field surveys, or during the aerial photograph measurements. Appendix A summarizes the WinSLAMM, version 10, model screens showing how the input information is entered into the model. A number of communities have incorporated direct connections between their GIS systems and WinSLAMM, automating the development of the source description files. In other areas, regional agencies have created standard land use files based on extensive regional surveys for direct use by stormwater managers in their areas. However, for more variable areas, such as for the naval facilities examined during this project, site specific surveys for the drainage areas for the outfalls of interest are needed. The following section describes the supplemental survey information associated with these detailed investigations.

The following basic source area form is used to summarize the total source areas for the each land use, excluding the specialized critical source areas that are defined in the next section for the industrial categories at the naval facilities.

Basic Source Form for Summary Spreadsheet Model

Source Area Categories for Location: _____ **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**	**Total Area in Category (acres)**
Roofs - directly connected	
Roofs - disconnected sandy soils	
Roofs - disconnected silty or clayey soils	
Paved parking/storage - directly connected	
Paved parking/storage - disconnected sandy soils	
Paved parking/storage - disconnected silty or clayey soils	
unpaved parking/storage - directly connected	
unpaved parking/storage - disconnected sandy soils	
unpaved parking/storage - disconnected silty or clayey soils	
driveways - directly connected	
driveways - disconnected sandy soils	
driveways - disconnected silty or clayey soils	
sidewalks/walks - directly connected	
sidewalks/walks - disconnected sandy soils	
sidewalks/walks - disconnected silty or clayey soils	
street/high traffic urban areas - smooth pavement	
street/high traffic urban areas - intermediate pavement	
street/high traffic urban areas - rough pavement	
large landscaping areas - sandy soils	
large landscaping areas - silty soils	
large landscaping areas - clayey soils	
undeveloped areas - sandy soils	
undeveloped areas - silty soils	
undeveloped areas - clayey soils	
small landscaped areas - sandy soils	
small landscaped areas - silty soils	
small landscaped areas - clayey soils	
other pervious areas - sandy soils	
other pervious areas - silty soils	
other pervious areas - clayey soils	
other directly connected impervious areas	
other partially connected impervious areas - sandy soils	
other partially connected impervious areas - silty or clayey soils	
highway paved lane and shoulder areas	
highway large turf areas - sandy soils	
highway large turf areas - silty soils	
highway large turf areas - clayey soils	

Specialized Field Surveys for Unique Source Areas Present at Naval Facilities

Besides the above listed basic source area categories, ten "other impervious areas" are available for each land use. For the Navy calibrated WinSLAMM model, they were identified in the industrial area and represent unique naval facility site activities. These are listed in the following table which is used to summarize the field surveys and aerial photographic analyses:

Specialized Critical Source Areas ("other impervious areas")

Source Area Categories for Location: _____ **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**	**Total Area in Category (acres)**
OIA1 - airfield apron/runway paved areas - directly connected	
OIA1 - airfield apron/runway paved areas- disconnected sandy	
OIA1 - airfield apron/runway paved areas - disconnected silty or clayey	
OIA2 - other airfield paved areas- directly connected	
OIA2 - other airfield paved areas- disconnected sandy soils	
OIA2 - other airfield paved areas- - disconnected silty or clayey soils	
OIA3 - light pier/laydown/storage/loading dock concrete areas- directly connected	
OIA3 - light pier/laydown/storage/loading dock concrete areas - disconnected sandy soils	
OIA3 - light pier/laydown/storage/loading dock concrete areas - disconnected silty or clayey soils	
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - directly connected	
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - disconnected sandy soils	
OIA4 - moderate pier/laydown/storage/loading dock concrete areas - disconnected silty or clayey soils	
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas- directly connected	
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas - disconnected sandy soils	
OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas- disconnected silty or clayey soils	
OIA6 - light pier/laydown/storage/loading dock asphalt areas - directly connected	
OIA6 - light pier/laydown/storage/loading dock asphalt areas- disconnected sandy soils	
OIA6 - light pier/laydown/storage/loading dock asphalt areas- disconnected silty or clayey soils	
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- directly connected	
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- disconnected sandy soils	
OIA7 - moderate pier/laydown/storage/loading dock asphalt areas- disconnected silty or clayey soils	
OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - directly connected	
OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - disconnected sandy soils	
OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas - disconnected silty or clayey soils	
OIA9 - galvanized metal roofs, directly connected- directly connected	
OIA9 - galvanized metal roofs - disconnected sandy soils	
OIA9 - galvanized metal roofs- disconnected silty or clayey soils	
OIA10 - other impervious areas with galvanized materials- directly connected	
OIA10 - other impervious areas with galvanized materials - disconnected sandy soils	
OIA10 - other impervious areas with galvanized materials - disconnected silty or clayey soils	

The site surveys should be based on aerial photographs to allow identifying each source area in the study area. Facility managers usually have the buildings numbered that make this easier, while surrounding paved parking or landscaped areas can be identified by their proximity to the numbered

buildings. Storage and laydown areas will likely require unique labeling for identification. The following tables can be used for the site surveys in small watershed areas, having space about ten, or more, source areas in each category. If more are expected, it is easy to add rows to the form to accommodate additional areas. All of these areas should be clearly defined on aerial photographs and maps. The "other impervious area #10" for impervious areas with galvanized materials should be carefully identified as having a footprint only reflecting the area affected by the galvanized material. If contained on a larger paved area, the remaining area should be appropriately designated (most likely storage or laydown area). Descriptions of the basic sources listed below are included previously.

Roofs, pitched

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description, including roofing material (galvanized metal roofs are "other impervious areas #9") (and photo numbers)	Directly connected (acres)	Disconnected to sandy soils (acres)	Disconnected to silty or clayey soils (acres)
Total areas in subcategory:			

Roofs, flat

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description, including roofing material (galvanized metal roofs are "other impervious areas #9") (and photo numbers)	Directly connected (acres)	Disconnected to sandy soils (acres)	Disconnected to silty or clayey soils (acres)
Total areas in subcategory:			

Paved parking areas

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description (and photo numbers)	Directly connected (acres)	Disconnected to sandy soils (acres)	Disconnected to silty or clayey soils (acres)
Total areas in subcategory:			

Unpaved parking areas

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description (and photo numbers)	Directly connected (acres)	Disconnected to sandy soils (acres)	Disconnected to silty or clayey soils (acres)
Total areas in subcategory:			

Driveways

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description (and photo numbers)	Directly connected (acres)	Disconnected to sandy soils (acres)	Disconnected to silty or clayey soils (acres)
Total areas in subcategory:			

Streets with curbs and gutters

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description, including street widths (and photo numbers)	Smooth pavement (acres)	Intermediate pavement (acres)	Rough pavement (acres)
Total areas in subcategory:			

Streets with roadside grass swales

Land Use: _____ Date Surveyed: _____ Surveyed by: _____

Location and description, including street widths (and photo numbers)	Smooth pavement (acres)	Intermediate pavement (acres)	Rough pavement (acres)
Total areas in subcategory:			

Landscaped areas and undeveloped areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**		
Location and description (and photo numbers)	**Sandy soils (acres)**	**Silty or clayey soils (acres)**
Total areas in subcategory:		

OIA1 - airfield apron/runway paved areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA2 - other airfield paved areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA3 - light pier/laydown/storage/loading dock concrete areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA4 - moderate pier/laydown/storage/loading dock concrete areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA5 - heavy pier/laydown/storage/loading dock and scrapyard concrete areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA6 - light pier/laydown/storage/loading dock asphalt areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA7 - moderate pier/laydown/storage/loading dock asphalt areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA8 - heavy pier/laydown/storage/loading dock and scrapyard asphalt areas **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA9 - galvanized metal roofs **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

OIA10 - other impervious areas with galvanized materials **Land Use: _____ Date Surveyed: _____ Surveyed by: _____**			
Location and description, including galvanized material areas exposed, such as fence length and height (and photo numbers)	**Directly connected (acres)**	**Disconnected to sandy soils (acres)**	**Disconnected to silty or clayey soils (acres)**
Total areas in subcategory:			

Description of Specialized Source Areas

The above list of specialized source areas identified for naval facilities include four major categories (airfield aprons, runways and other paved areas; pier, laydown, or storage areas; galvanized roofs; and paved areas with galvanized materials). Each of these categories is described below. Each category is separated in to directed connected impervious areas or impervious areas that drain to sandy soils or drain to silty or clayey soils. The largest category (the piers, laydown areas, storage areas, plus loading docks) are also separated in light, moderate, or heavy industrial activity, and if paved with asphalt or concrete. The following are example photographs for each of these major source areas.

Airfield Apron, Runway, and Other Paved Areas

These areas are located at naval air stations and other aircraft operations areas. The active runway and associated aprons are noted separately from other adjacent paved areas.

Asphalt area adjacent to runway at naval base

Pier, Laydown, Storage, or Loading Dock Areas (concrete or asphalt) (light, moderate, or heavy use)

Most of the active areas on the naval bases likely are included in these laydown, pier, and storage areas. These are separated into three categories corresponding to the amount of activity and materials stored, and further noted if asphalt or concrete. The light laydown, pier, or storage areas have little industrial activity and few materials stored. Examples include little used areas such as ceremonial piers, or inactive storage areas. No obvious contaminating materials are stored in these areas, but some aluminum, untreated wood, hoses, and painted steel may be stored in these areas. Medium industrial activity laydown, piers, and storage areas include long-term material and equipment storage and small areas of frequently moved materials. Heavy industrial activity occurs on piers when ships are being actively prepared for deployment, large amounts of materials being stored (including treated wood, rusty metals, open debris containers, paint yards, etc.).

Light Laydown, Pier, or Storage Areas

 Light laydown area, electrical cables, (on concrete) at naval base	 Light laydown area, aluminum ramp, (on concrete) at naval base

Medium Laydown, Pier, or Storage Areas

Medium storage area, with containers (on concrete) at naval base

Medium storage area, vehicles (on asphalt and semi pervious steet mats) at naval base

Medium storage and laydown area (on asphalt) at naval base

Medium storage and laydown area (on asphalt) at naval base

Medium storage area, mic steel parts, pallets, and shipping crates (on asphalt) at naval base

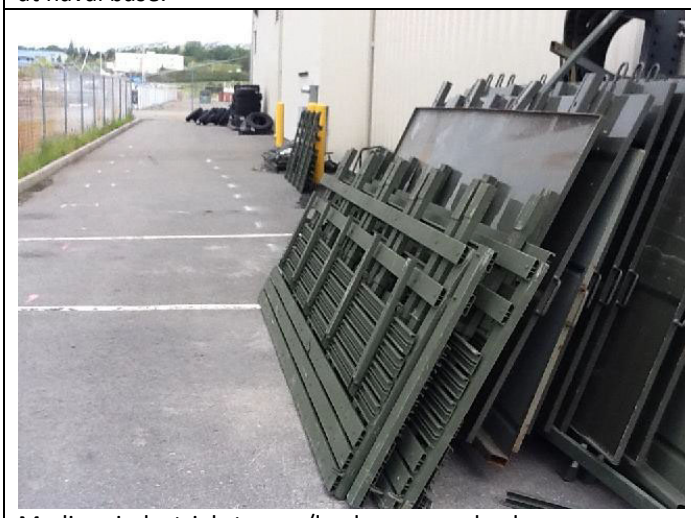
Medium industrial storage/laydown area (on asphalt) at naval base.

Medium industrial storage/laydown area, crane tracks, industrial equip. and trailer (on asphalt) at naval base

Medium storage area, rubber (on concrete) at naval base

Medium industrial storage/laydown area, mobile offices, electical cable on gangplank, note crane tracks (on asphalt) at naval base.

Medium industrial storage/laydown area, scrap metal and garbage bins (on asphalt) at naval base.



Medium industrial storage/laydown area, laydown area adjacent to truck yard (on asphalt), at naval base.

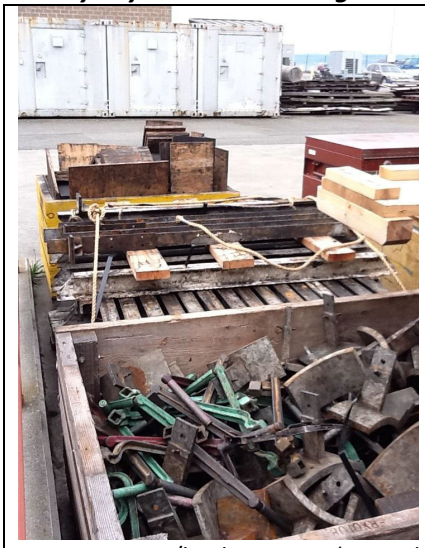
Medium industrial storage/laydown area, loading area and laydown of pervious grassy area. (on asphalt, grass in foreground), at naval base.

 Medium laydown area, metal cube supports (on concrete) at naval base	 Medium laydown area, painted metal barge support stands, treated wood, and barge (on concrete) at naval base

Medium laydown area, painted metal platform supports with rubber (on concrete) at naval base

Medium storage/laydown area (on asphalt) at navy base

Heavy Laydown and Storage Areas



Heavy storage/laydown area (on asphalt) at navy base

Heavy storage/laydown area (on asphalt) at navy base

Heavy storage/laydown area, rubber bumpers, aluminum stairs/walkways, some galvanized materials, conex and hoses (on asphalt) at navy base

Heavy industrial storage/laydown area, treated (copper?) wood (on asphalt) at naval base

Heavy industrial storage/laydown area, electrical cables on gangplank with large crane on track in background, misc. laydown (on asphalt) at naval base.

Heavy industrial storage/laydown area, deck plating (on asphalt) at naval base.

Heavy storage area, gas cylinders (on asphalt) at naval base

Heavy storage area, tires and pipes (on concrete) at naval base

Heavy industrial storage/laydown area, cable laydown area (on asphalt) at naval base.

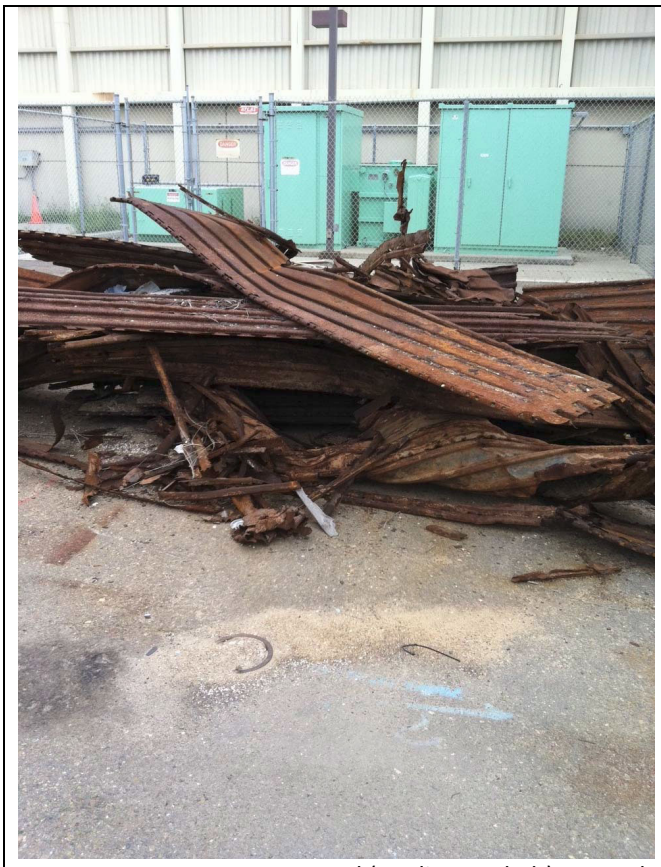
Heavy industrial storage/laydown area, wooden boxes with steel reinforced edges (on asphlt), at naval base.

Heavy storage area, mixed metals (on concrete) at navel base

Heavy storage area/laydown area, mixed metals at naval base

Heavy laydown area, pipes (on concrete) at naval base

Heavy laydown area, cables and steel matting, at naval base

 Heavy storage area, rusty metal (on dirty asphalt) at naval base	

Galvanized Metal Roofs

Galvanized metal roofs are in a separate category from other building roofs due to the excess zinc content of the roof runoff.

Galvanized metal roofs, painted galvanized w/significant paint peeling of wall. Note broken drainage, connected.

Galvanized metal roofs, galvanized storage sheds, drains to ground.

Other Impervious Areas with Galvanized Materials (or Zinc Sacrificial Anodes)

Other impervious areas with galvanized materials are usually small areas where galvanized steel pipes are stored, galvanized utility boxes are located, galvanized stairways, and sacrificial zinc anodes are stored. If the galvanized metal is painted, the conditions of the coating should be noted on the survey form. Also, these are usually small concentrated areas within larger paved storage or laydown areas. The areas affected by the galvanized materials should be estimated on the survey forms, and the surrounding paved area also included in the appropriate category. Building siding and chain anchor fencing of galvanized steel also needs to be indicated; the areas of the buildings noted and the length and height of the fencing.

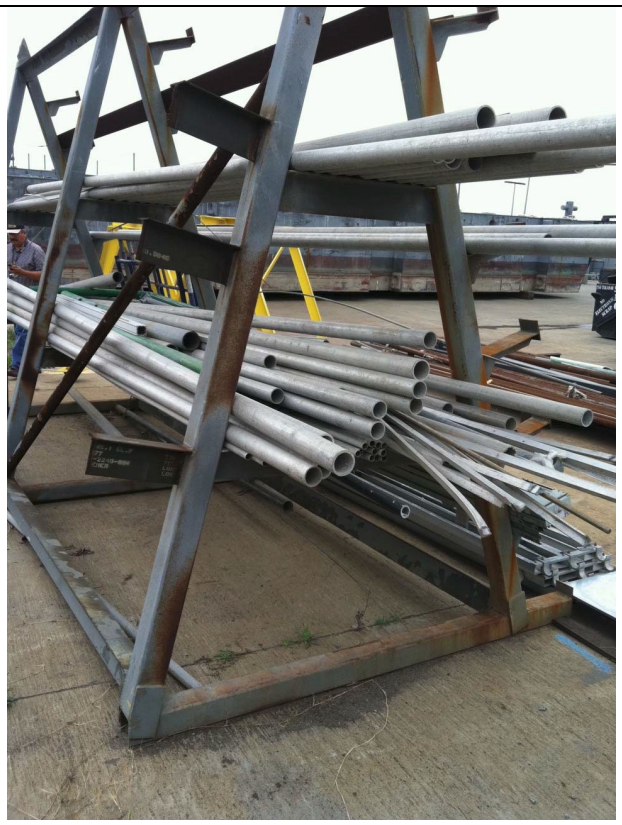
Galvanized metal circuit breaker boxes at naval base


Galvanized and copper piping at naval base


Galvanized steel fencing at naval base


Galvanized metal drying rack at paint shop at navel base

Galvanized metal pipe parking barrier at naval base



Painted galvanized frame with galvanized and copper pipes at navel base

Galvanized metal stairway (painted) at naval base

Galvanized metal stairway (painted) at naval base

Other galvanized material areas, galvanized utility box, 40 boxes on site at naval base.

Other galvanized material areas, galvanized stairway structure at naval base.

Other galvanized material areas, galvanized stairway structure at naval base.

Other galvanized material areas small dumpster with zinc waste. Note zinc particles on asphalt surface, at naval base.

Other galvanized material areas zinc anodes in dumpster, at naval base.

Other galvanized material areas galvanized shed, lead waste, Hazardous Waste Accumulation Area, at naval base.

Other galvanized material areas laydown area with miscellaneous items (note zinc debris on table), at naval base.

Other galvanized material areas cable reel, note zinc particles from corroded anodes, at naval base.

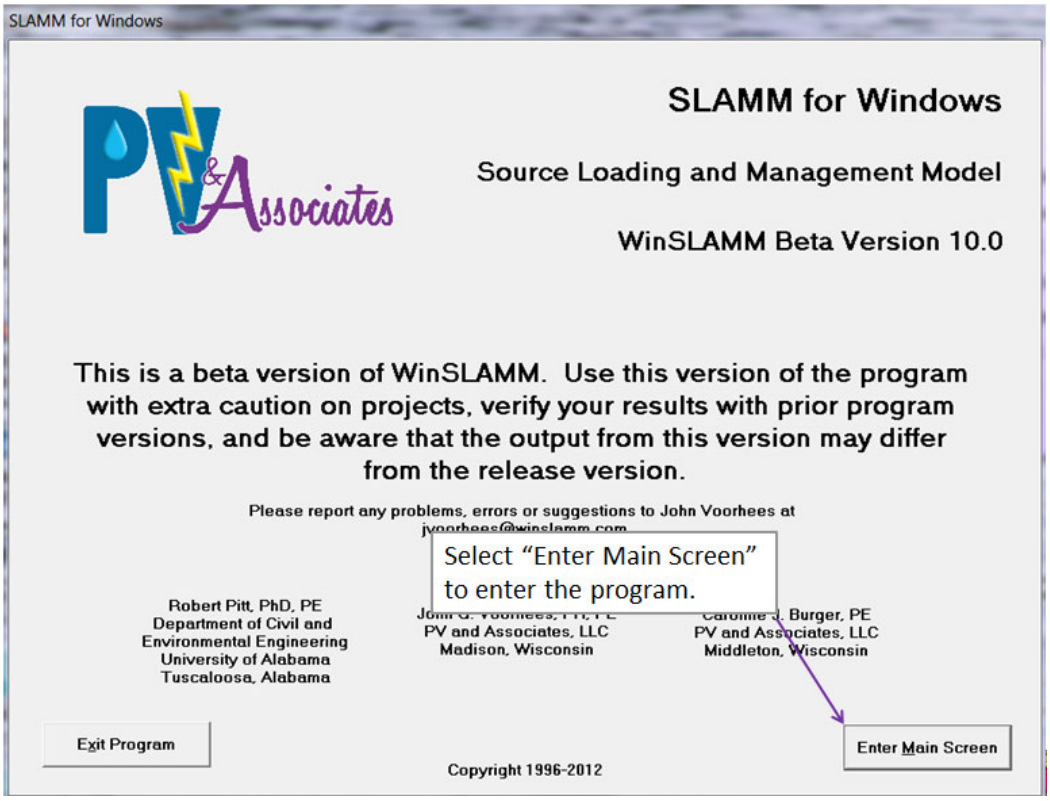
Other galvanized material areas storage and laydown including zinc anodes (note corroded anode material on ground), at naval base.

Other galvanized material areas, residue on asphalt is zinc, at naval base.

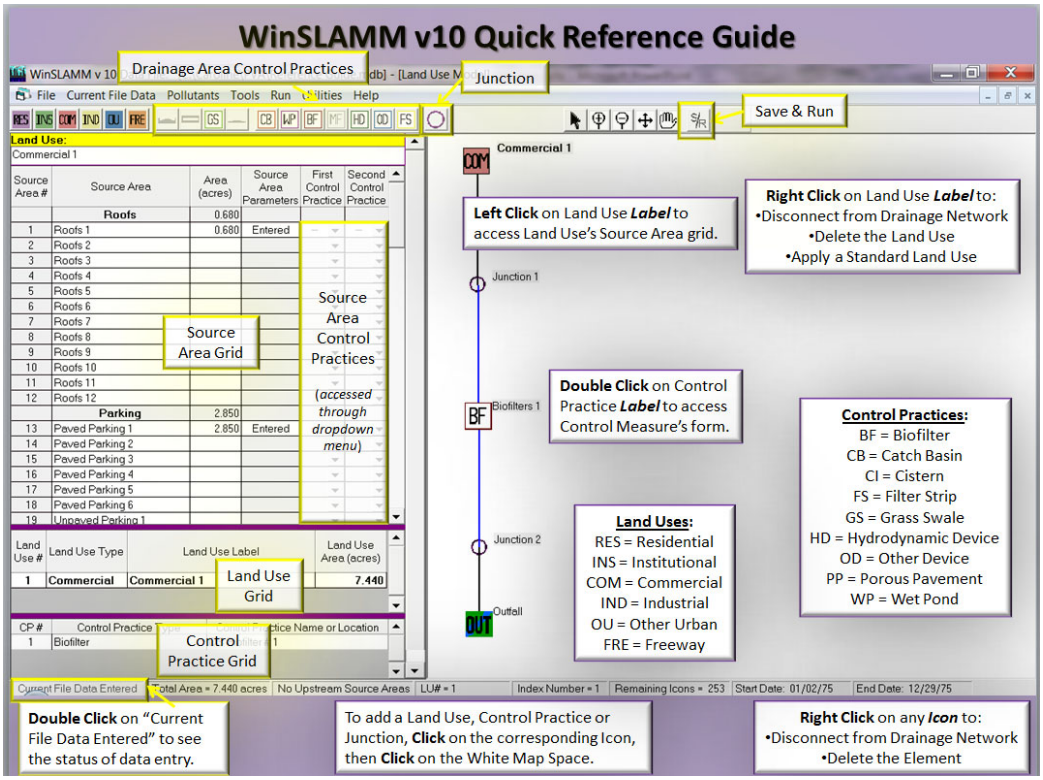
Other galvanized material areas, laydown and storage area, baskets are uncoated galvanized steel construction, at naval base.

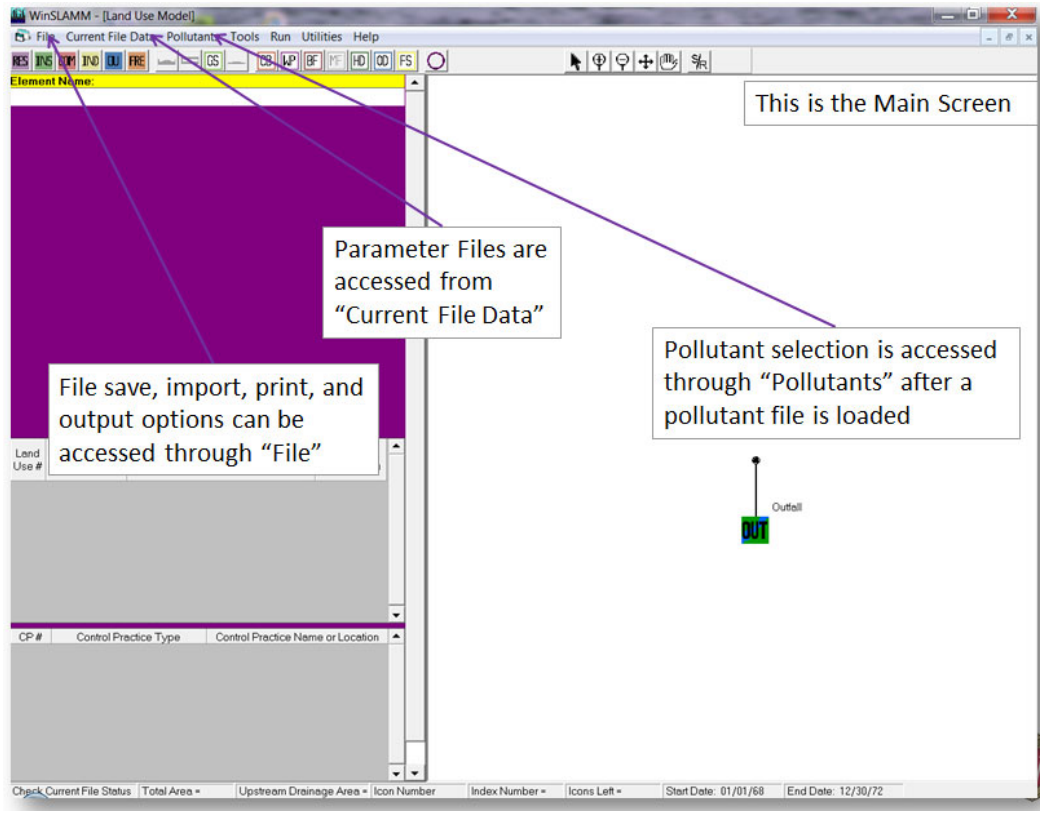
Appendix A: WinSLAMM Version 10 Data Entry

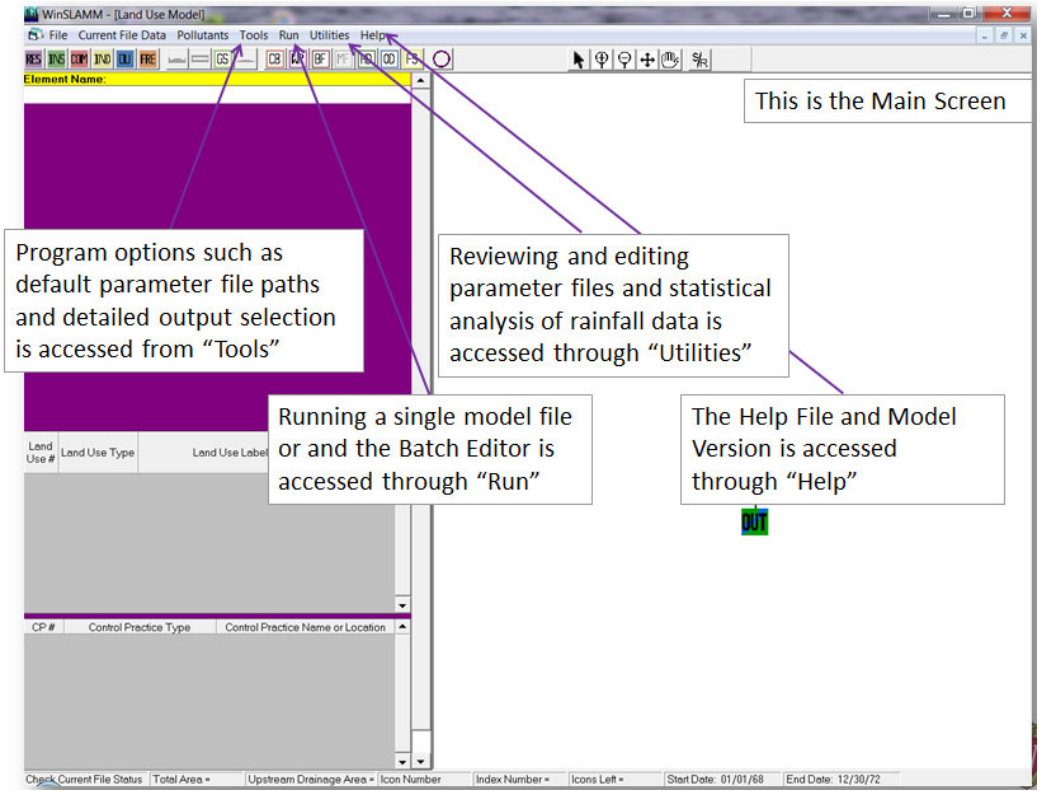
The following figures show the screens for WinSLAMM, version 10, used to enter information pertaining to an area being modeled for stormwater quality. The notations on the screen summarize the features of the various screen elements. When the model is opened, the following screen appears:

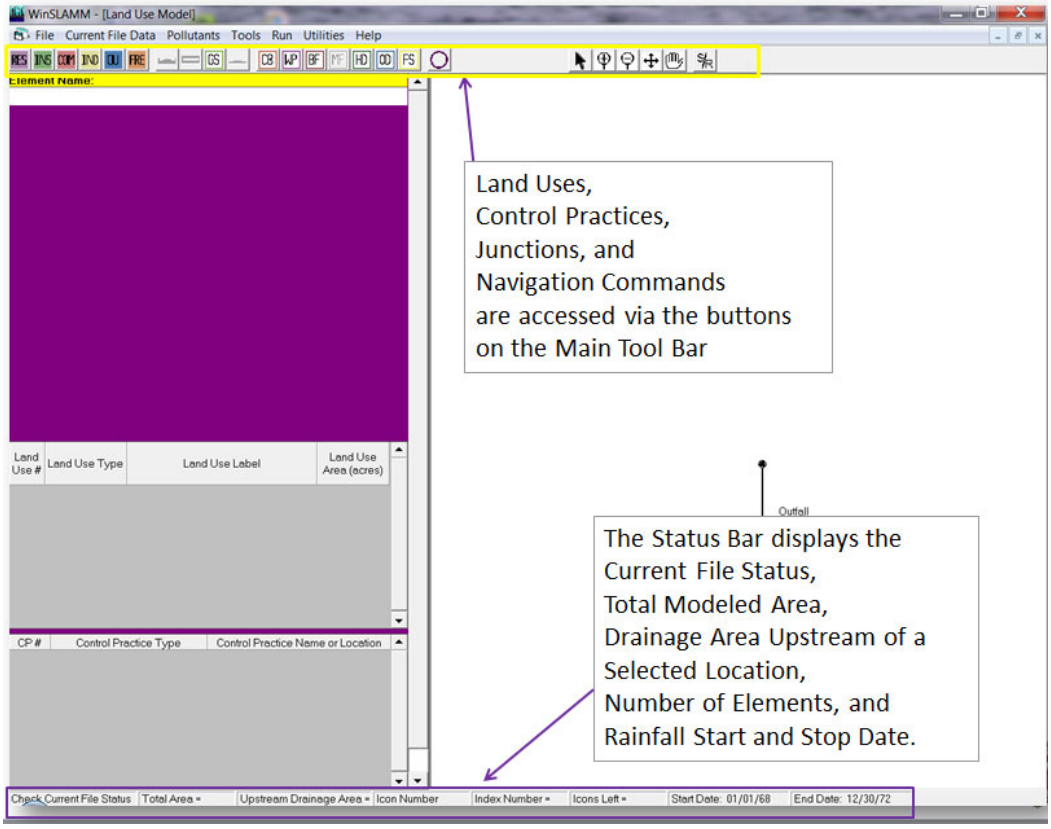


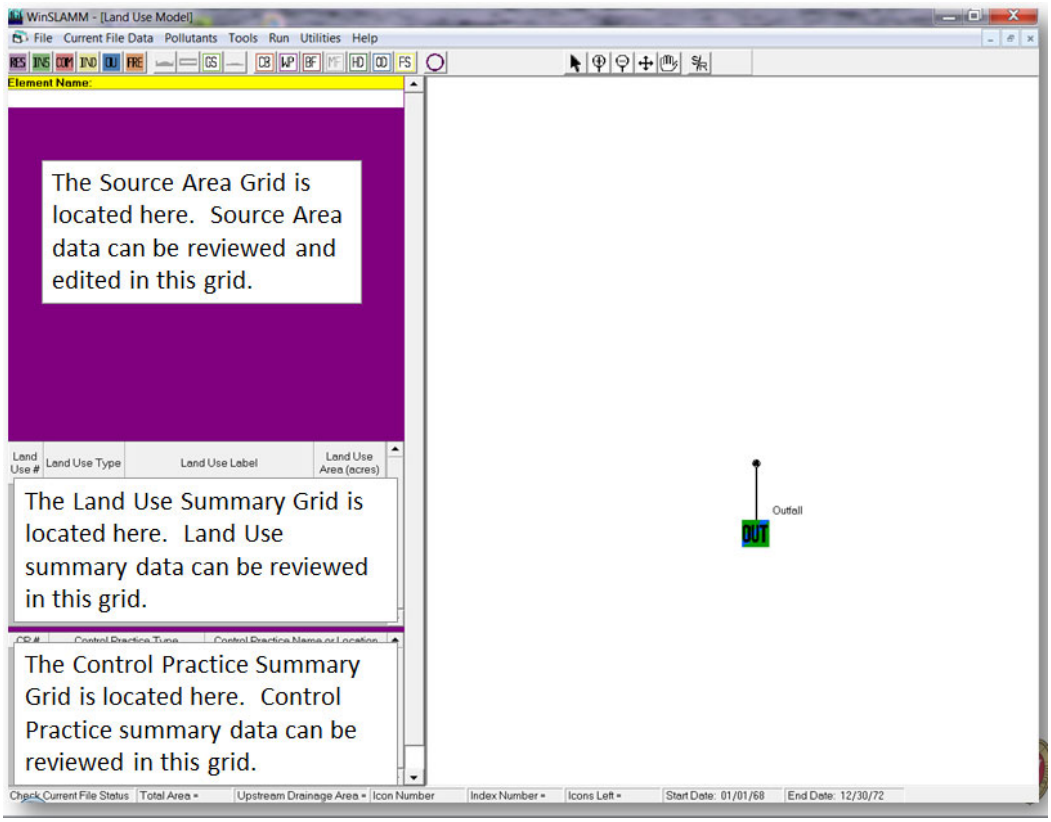
When the "enter main screen" is selected, the following main screen appears. The notations explain the drop down menus and areas on the screen.


WinSLAMM v10 Quick Reference Guide
Drainage Area Control Practices
Junction
Save & Run
Source Area Grid
Source Area Control Practices (accessed through dropdown menu)
Land Use Grid
Control Practice Grid
Left Click on Land Use Label to access Land Use's Source Area grid.
Right Click on Land Use Label to:
•Disconnect from Drainage Network
•Delete the Land Use
•Apply a Standard Land Use
Double Click on Control Practice Label to access Control Measure's form.
Control Practices:
BF = Biofilter
CB = Catch Basin
CI = Cistern
FS = Filter Strip
GS = Grass Swale
HD = Hydrodynamic Device
OD = Other Device
PP = Porous Pavement
WP = Wet Pond
Land Uses:
RES = Residential
INS = Institutional
COM = Commercial
IND = Industrial
OU = Other Urban
FRE = Freeway
Double Click on "Current File Data Entered" to see the status of data entry.
To add a Land Use, Control Practice or Junction, Click on the corresponding Icon, then Click on the White Map Space.
Right Click on any Icon to:
•Disconnect from Drainage Network
•Delete the Element

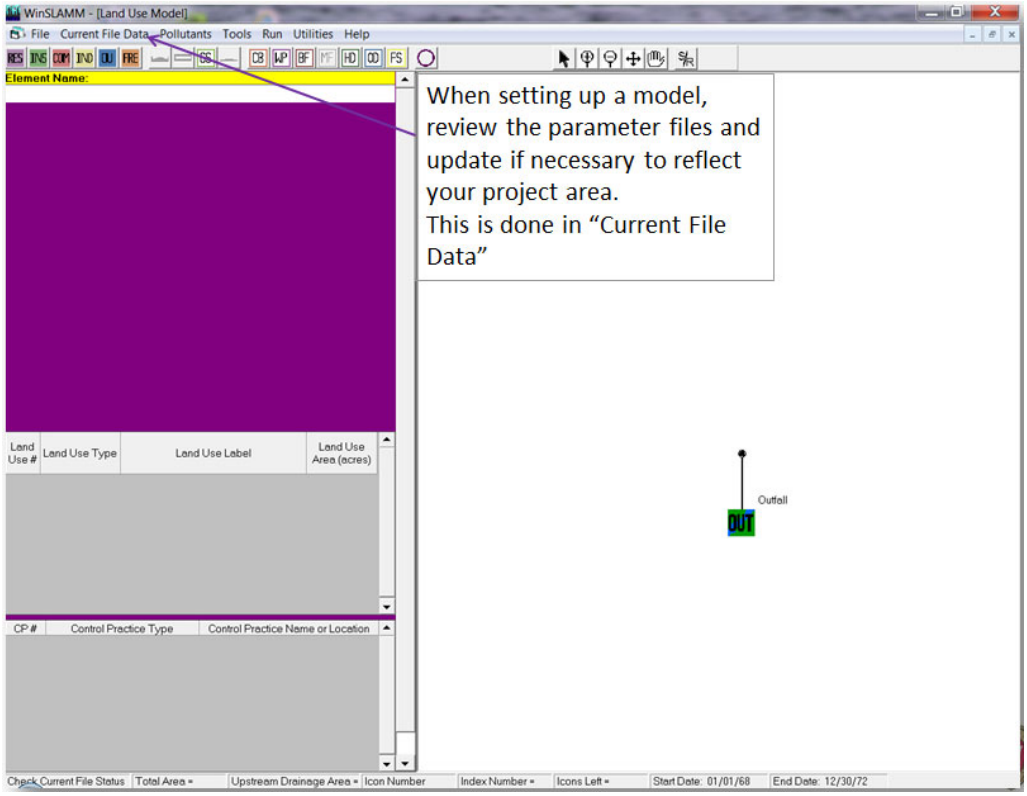

This is the Main Screen
Parameter Files are accessed from "Current File Data"
File save, import, print, and output options can be accessed through "File"
Pollutant selection is accessed through "Pollutants" after a pollutant file is loaded


WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Element Name:
This is the Main Screen
Program options such as default parameter file paths and detailed output selection is accessed from "Tools"
Reviewing and editing parameter files and statistical analysis of rainfall data is accessed through "Utilities"
Running a single model file or and the Batch Editor is accessed through "Run"
The Help File and Model Version is accessed through "Help"
Land Use #
Land Use Type
Land Use Label
CP #
Control Practice Type
Control Practice Name or Location
Check Current File Status
Total Area =
Upstream Drainage Area =
Icon Number
Index Number =
Icons Left =
Start Date: 01/01/68
End Date: 12/30/72


WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Element Name:
Land Uses,
Control Practices,
Junctions, and
Navigation Commands
are accessed via the buttons
on the Main Tool Bar
Land Use #
Land Use Type
Land Use Label
Land Use Area (acres)
CP #
Control Practice Type
Control Practice Name or Location
Outfall
The Status Bar displays the
Current File Status,
Total Modeled Area,
Drainage Area Upstream of a
Selected Location,
Number of Elements, and
Rainfall Start and Stop Date.
Check Current File Status
Total Area =
Upstream Drainage Area =
Icon Number
Index Number =
Icons Left =
Start Date: 01/01/68
End Date: 12/30/72

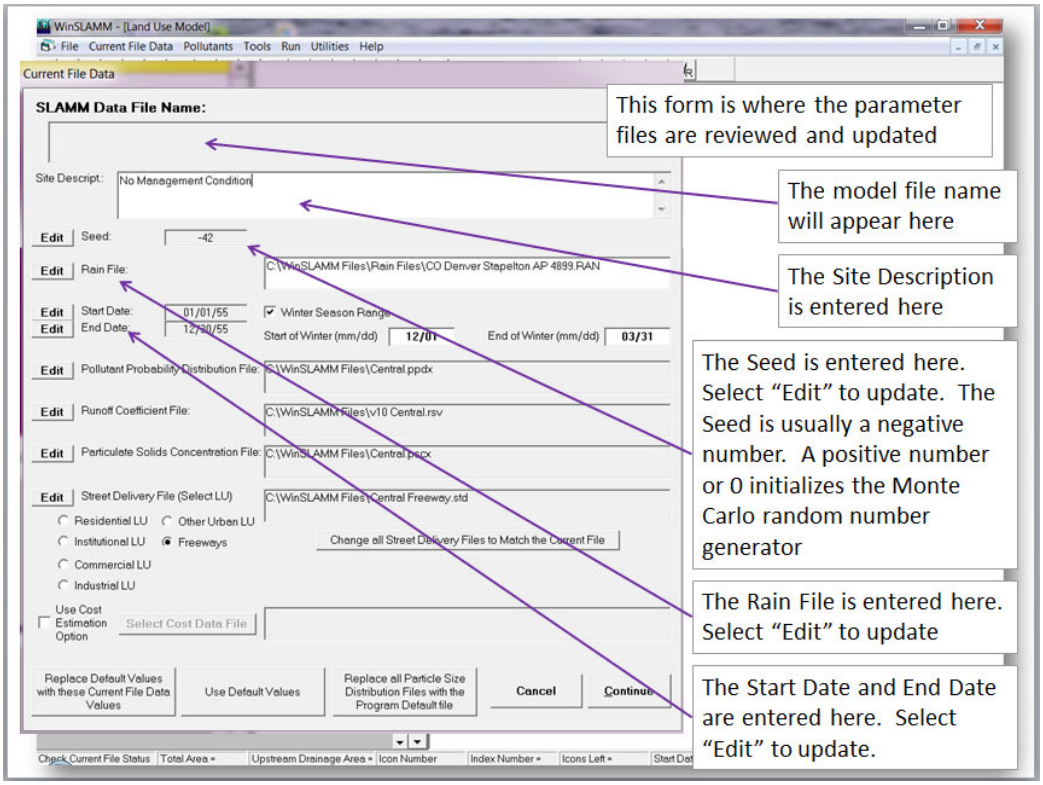


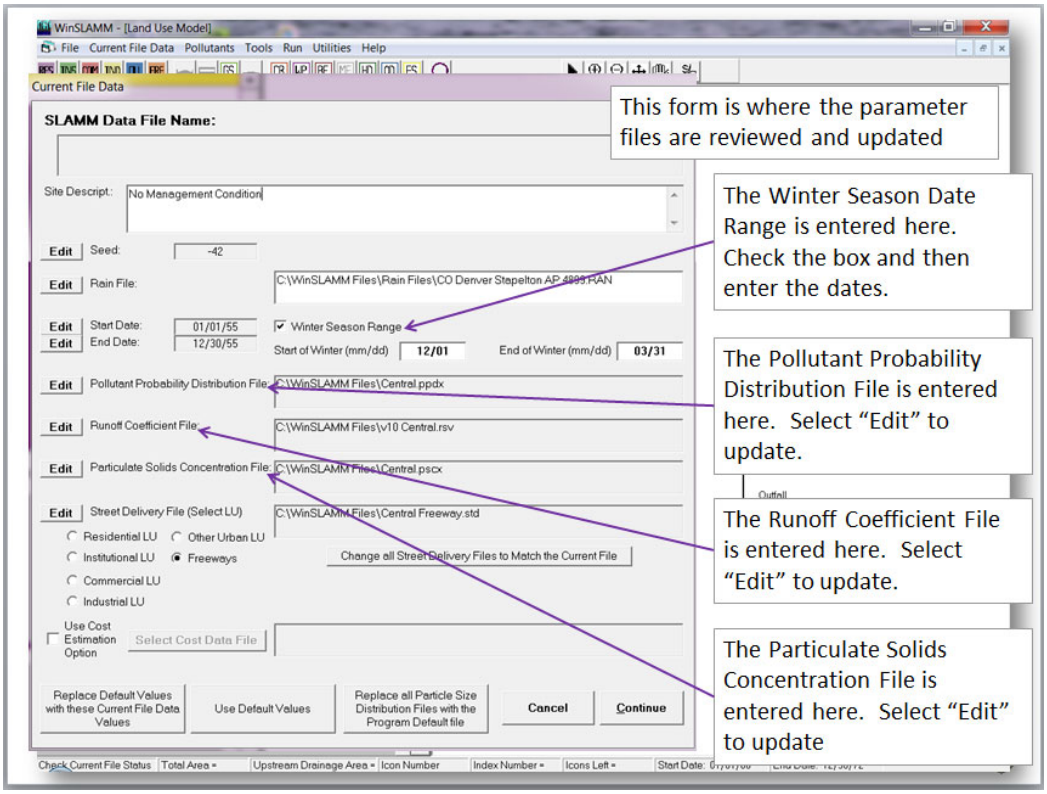
The parameter files are sets of files that have been created as calibration files for an area. For the Navy project, currently file sets are available for the San Diego facilities and the Puget Sound facilities.

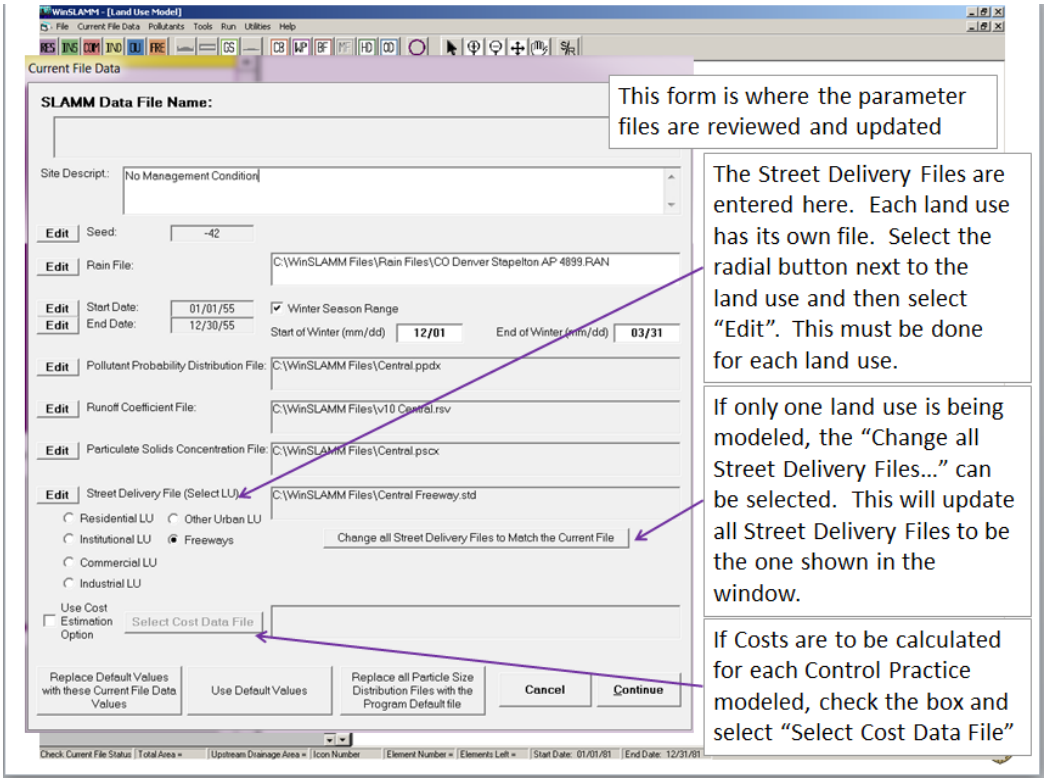


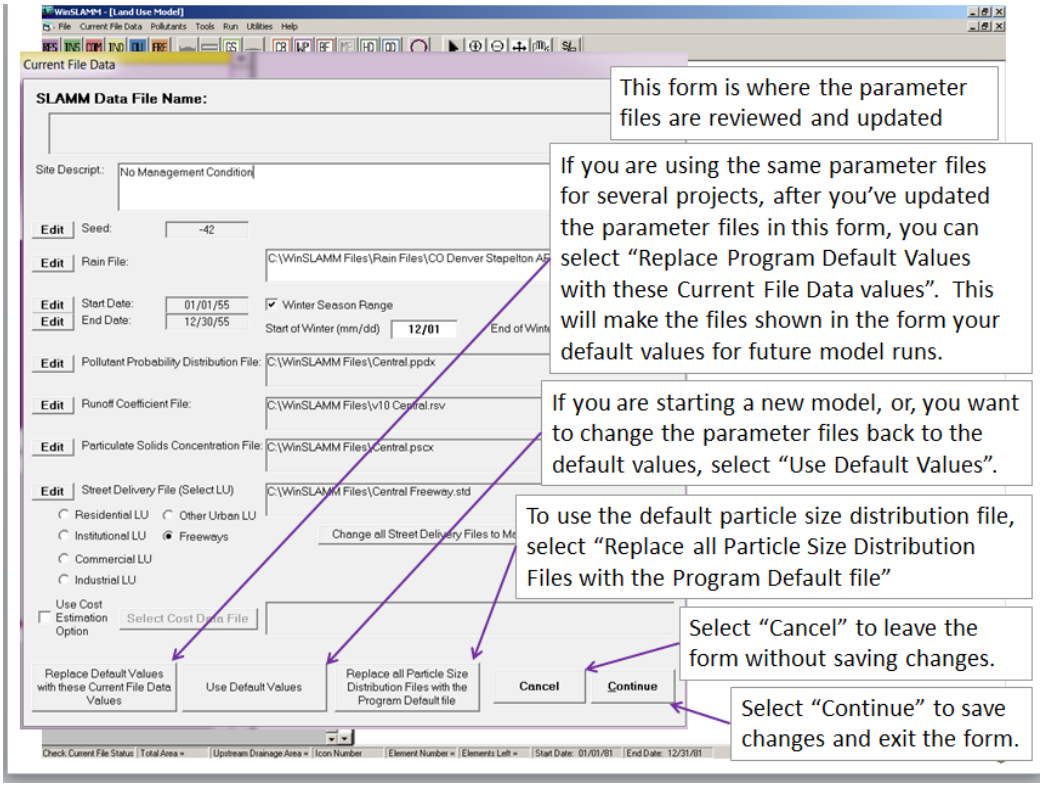
These Navy calibrated parameter files are as follows:

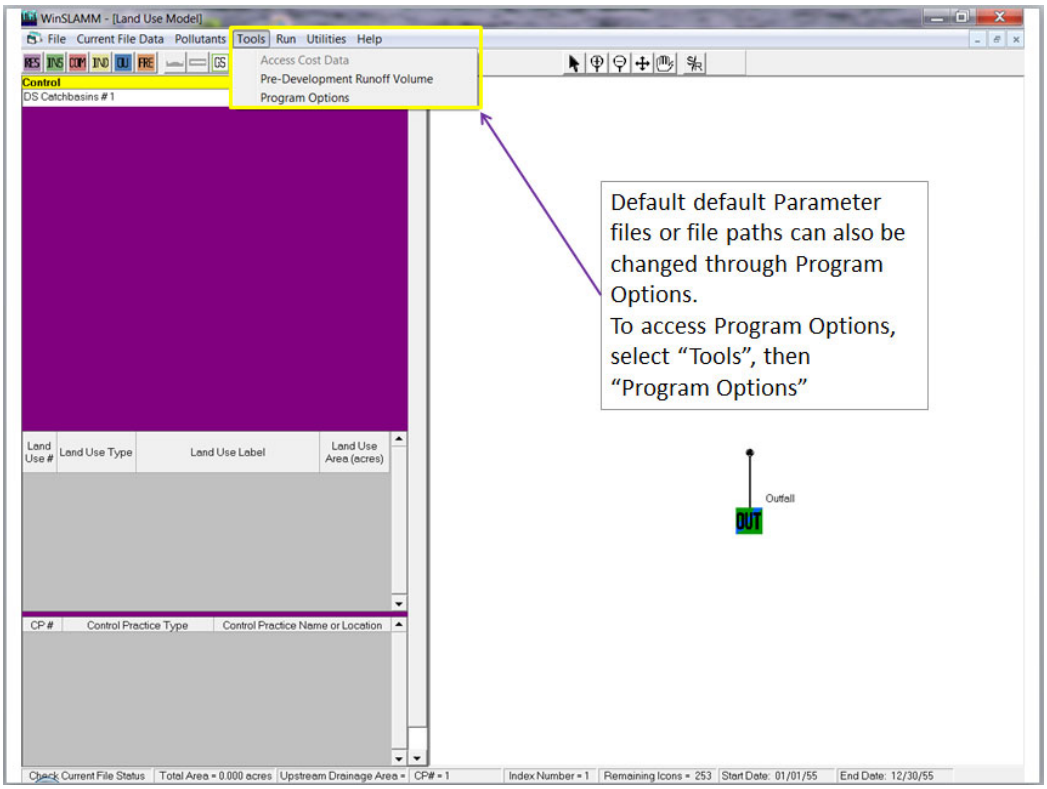
	San Diego Navy Facility Files	Puget Sound Navy Facility Files
Rain File (*.ran)	CA SanDiego AP 4805.ran	Wa Auburn 5477.ran; Wa_BURLINGTON_4810.ran; Wa_EVERETT_4810.ran; Wa_QUILCENE_4810.ran
Pollutant Probability Distribution File (*.ppdx)	NavySouthwest Feb 11 2012A.ppdx	Navy Northwest Mar 28 2012.ppdx
Runoff Coefficient File (*.rsv)	v10 Southwest.rsv	v10 Northwest.rsv
Particulate Solids Concentration File (*.pscx)	NavySouthwest Feb 11 2012B.pscx	Navy Northwest Mar 25 2012.pscx
Street Delivery Files (*.std)		
Residential areas	Southwest street Res and Other Urban.std	Northwest street Res and Other Urban.std
Other areas	Southwest street Res and Other Urban.std	Northwest street Res and Other Urban.std
Institutional areas	Southwest street Com Inst Indust Dec 4 2011A.std	Northwest street Com Inst Indust.std
Freeways	Southwest Freeway.std	Northwest Freeway.std
Commercial areas	Southwest street Com Inst Indust Dec 4 2011A.std	Northwest street Com Inst Indust.std
Industrial areas	Southwest street Com Inst Indust Dec 4 2011A.std	Northwest street Com Inst Indust.std

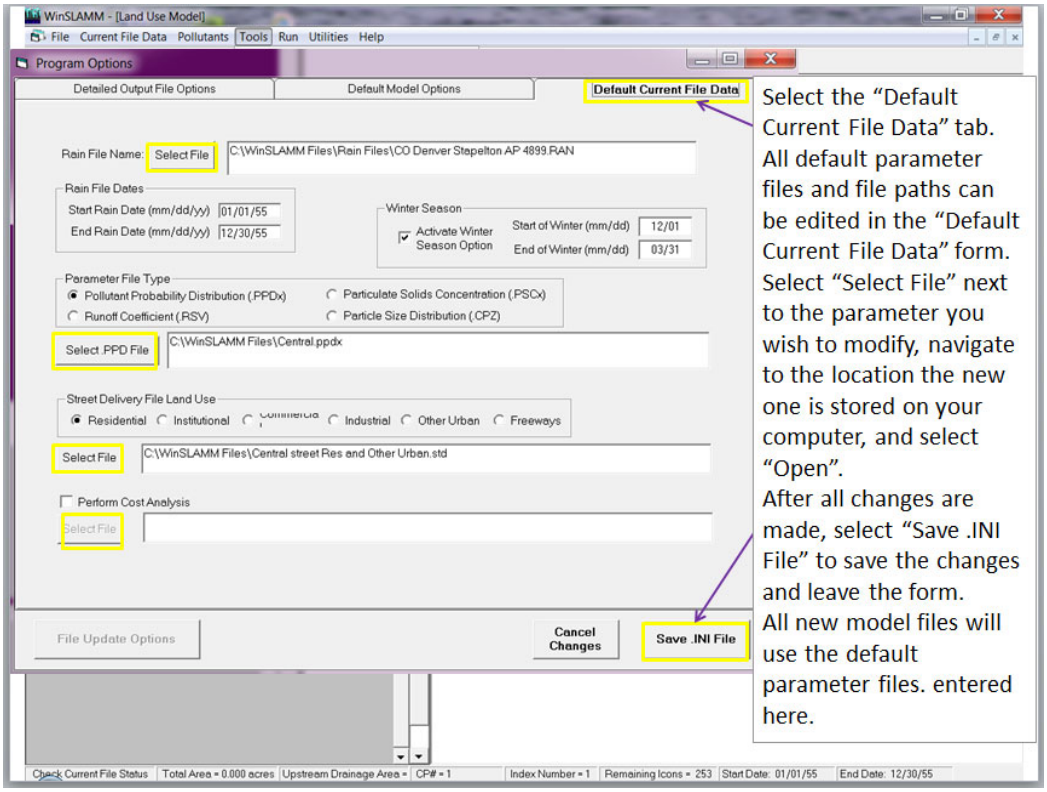

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Current File Data
SLAMM Data File Name:
Site Descript.: No Management Condition
Edit Seed: -42
Edit Rain File: C:\WinSLAMM Files\Rain Files\CO Denver Stapelton AP 4899.RAN
Edit Start Date: 01/01/55
Edit End Date: 12/30/55
Winter Season Range
Start of Winter (mm/dd) 12/01
End of Winter (mm/dd) 03/31
Edit Pollutant Probability Distribution File: C:\WinSLAMM Files\Central.ppdx
Edit Runoff Coefficient File: C:\WinSLAMM Files\v10 Central.rsv
Edit Particulate Solids Concentration File: C:\WinSLAMM Files\Central.pscx
Edit Street Delivery File (Select LU) C:\WinSLAMM Files\Central Freeway.std
Residential LU Other Urban LU
Institutional LU Freeways
Commercial LU
Industrial LU
Change all Street Delivery Files to Match the Current File
Use Cost Estimation Option
Select Cost Data File
Replace Default Values with these Current File Data Values
Use Default Values
Replace all Particle Size Distribution Files with the Program Default file
Cancel
Continue
Check Current File Status Total Area = Upstream Drainage Area = Icon Number Index Number = Icons Left =
This form is where the parameter files are reviewed and updated
The model file name will appear here
The Site Description is entered here
The Seed is entered here. Select "Edit" to update. The Seed is usually a negative number. A positive number or 0 initializes the Monte Carlo random number generator
The Rain File is entered here. Select "Edit" to update
The Start Date and End Date are entered here. Select "Edit" to update.


WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Current File Data
SLAMM Data File Name:
Site Descript.: No Management Condition
Edit Seed: -42
Edit Rain File: C:\WinSLAMM Files\Rain Files\CO Denver Stapelton AP 4899.RAN
Edit Start Date: 01/01/55
Edit End Date: 12/30/55
Winter Season Range
Start of Winter (mm/dd) 12/01
End of Winter (mm/dd) 03/31
Edit Pollutant Probability Distribution File: C:\WinSLAMM Files\Central.ppdx
Edit Runoff Coefficient File: C:\WinSLAMM Files\v10 Central.rsv
Edit Particulate Solids Concentration File: C:\WinSLAMM Files\Central.pscx
Edit Street Delivery File (Select LU) C:\WinSLAMM Files\Central Freeway.std
Residential LU Other Urban LU
Institutional LU Freeways
Commercial LU
Industrial LU
Change all Street Delivery Files to Match the Current File
Use Cost Estimation Option
Select Cost Data File
Replace Default Values with these Current File Data Values
Use Default Values
Replace all Particle Size Distribution Files with the Program Default file
Cancel
Continue
Check Current File Status Total Area = Upstream Drainage Area = Icon Number Index Number = Icons Left =
This form is where the parameter files are reviewed and updated
The Winter Season Date Range is entered here. Check the box and then enter the dates.
The Pollutant Probability Distribution File is entered here. Select "Edit" to update.
The Runoff Coefficient File is entered here. Select "Edit" to update.
The Particulate Solids Concentration File is entered here. Select "Edit" to update

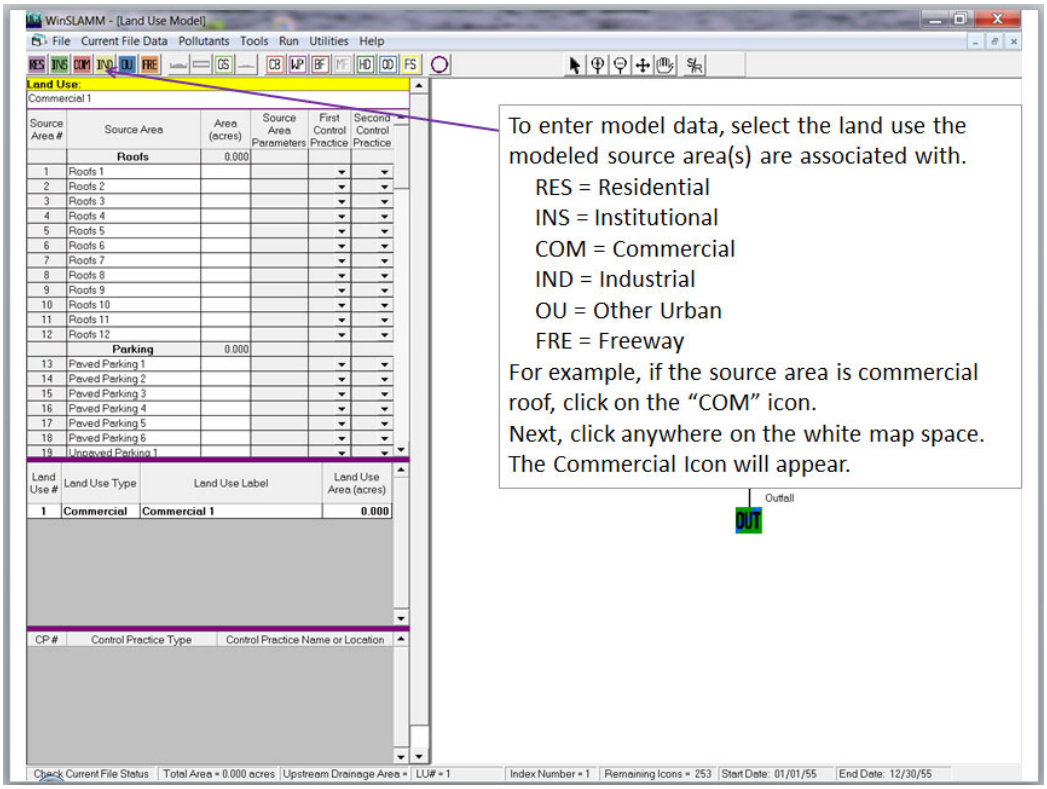

This form is where the parameter files are reviewed and updated
The Street Delivery Files are entered here. Each land use has its own file. Select the radial button next to the land use and then select "Edit". This must be done for each land use.
If only one land use is being modeled, the "Change all Street Delivery Files…" can be selected. This will update all Street Delivery Files to be the one shown in the window.
If Costs are to be calculated for each Control Practice modeled, check the box and select "Select Cost Data File"

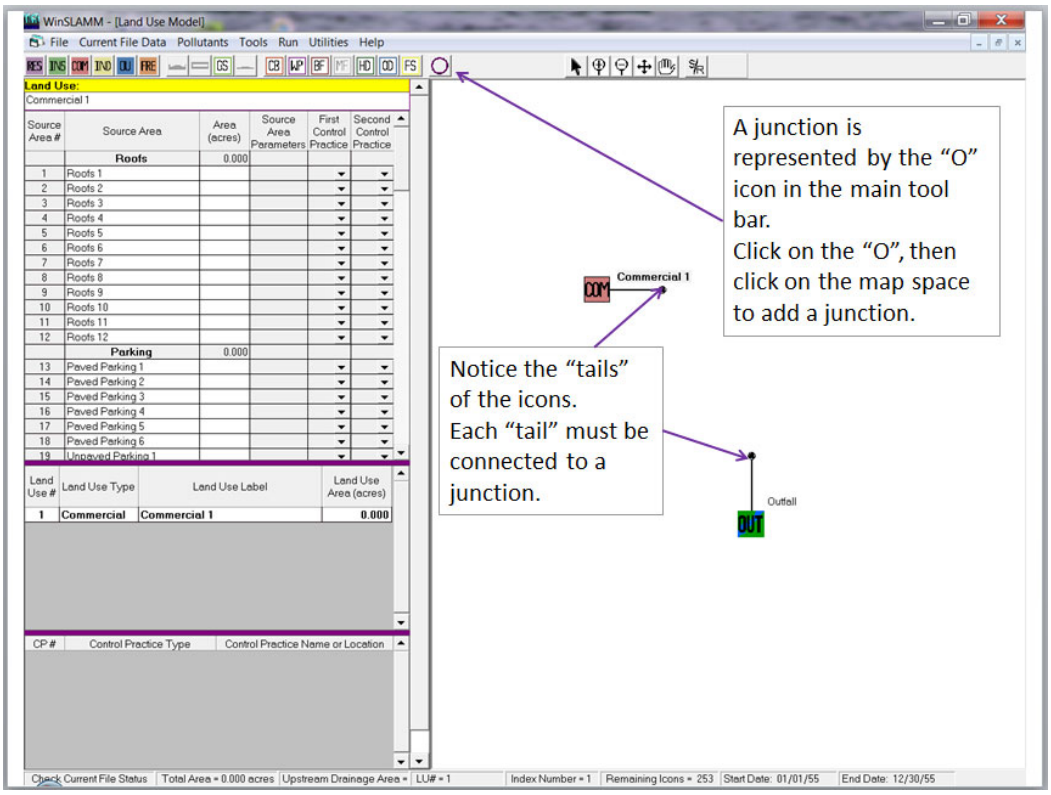

This form is where the parameter files are reviewed and updated
If you are using the same parameter files for several projects, after you've updated the parameter files in this form, you can select "Replace Program Default Values with these Current File Data values". This will make the files shown in the form your default values for future model runs.
If you are starting a new model, or, you want to change the parameter files back to the default values, select "Use Default Values".
To use the default particle size distribution file, select "Replace all Particle Size Distribution Files with the Program Default file"
Select "Cancel" to leave the form without saving changes.
Select "Continue" to save changes and exit the form.

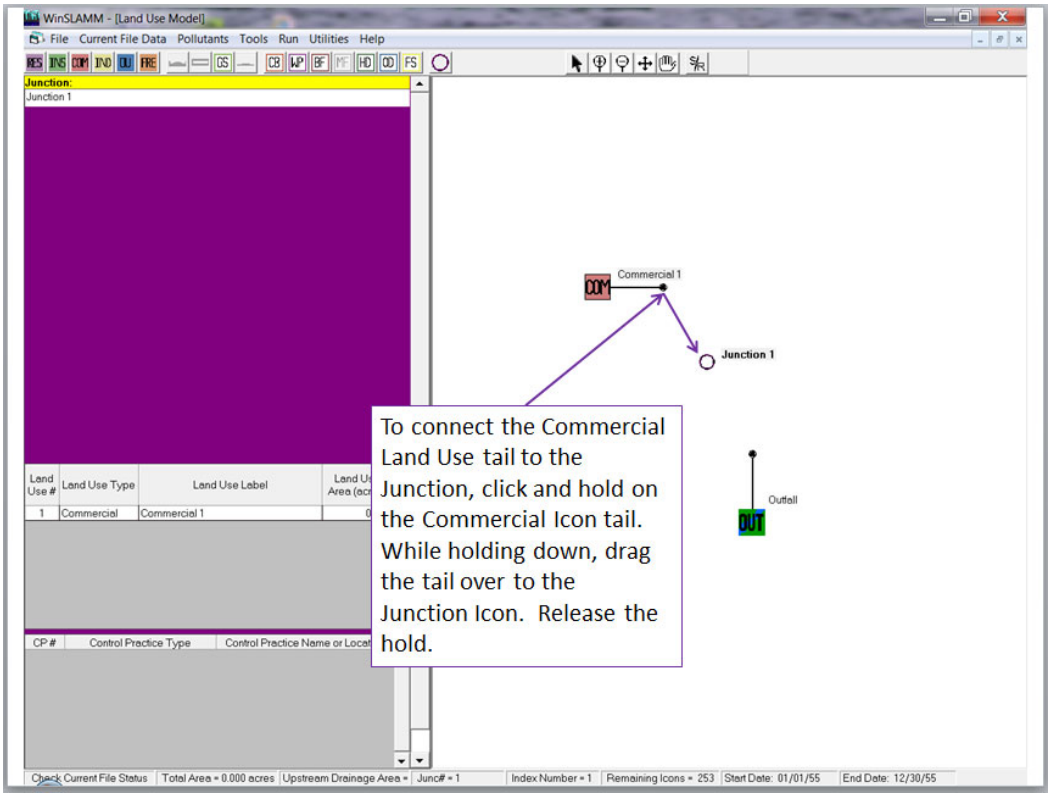

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Access Cost Data
Pre-Development Runoff Volume
Program Options
Control
DS Catchbasins # 1
Land Use # Land Use Type Land Use Label Land Use Area (acres)
CP # Control Practice Type Control Practice Name or Location
Outfall
Check Current File Status Total Area = 0.000 acres Upstream Drainage Area = CP# = 1 Index Number = 1 Remaining Icons = 253 Start Date: 01/01/55 End Date: 12/30/55
Default default Parameter files or file paths can also be changed through Program Options.
To access Program Options, select “Tools”, then “Program Options”

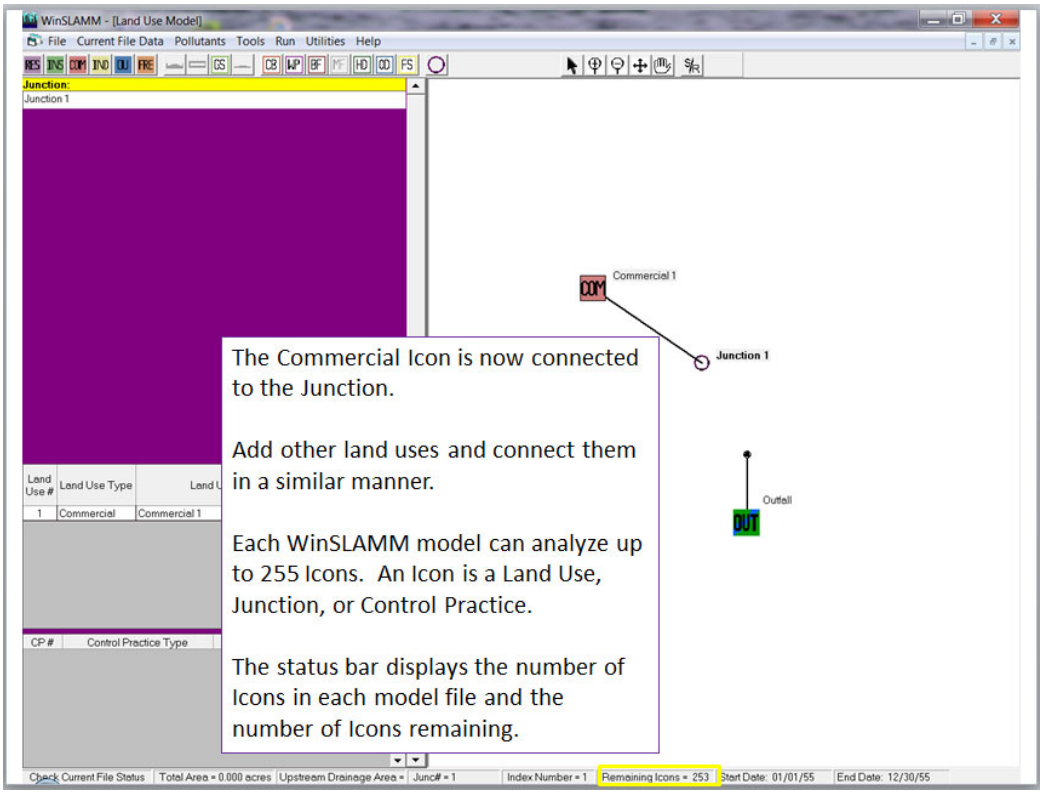

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Program Options
Detailed Output File Options
Default Model Options
Default Current File Data
Rain File Name: Select File C:\WinSLAMM Files\Rain Files\CO Denver Stapelton AP 4899.RAN
Rain File Dates
Start Rain Date (mm/dd/yy) 01/01/55
End Rain Date (mm/dd/yy) 12/30/55
Winter Season
Activate Winter Season Option
Start of Winter (mm/dd) 12/01
End of Winter (mm/dd) 03/31
Parameter File Type
Pollutant Probability Distribution (.PPDx)
Particulate Solids Concentration (.PSCx)
Runoff Coefficient (.RSV)
Particle Size Distribution (.CPZ)
Select .PPD File C:\WinSLAMM Files\Central.ppdx
Street Delivery File Land Use
Residential Institutional Industrial Other Urban Freeways
Select File C:\WinSLAMM Files\Central street Res and Other Urban.std
Perform Cost Analysis
Select File
File Update Options
Cancel Changes
Save .INI File
Check Current File Status Total Area = 0.000 acres Upstream Drainage Area = CP# = 1 Index Number = 1 Remaining Icons = 253 Start Date: 01/01/55 End Date: 12/30/55
Select the “Default Current File Data” tab. All default parameter files and file paths can be edited in the “Default Current File Data” form. Select “Select File” next to the parameter you wish to modify, navigate to the location the new one is stored on your computer, and select “Open”.
After all changes are made, select “Save .INI File” to save the changes and leave the form.
All new model files will use the default parameter files. entered here.

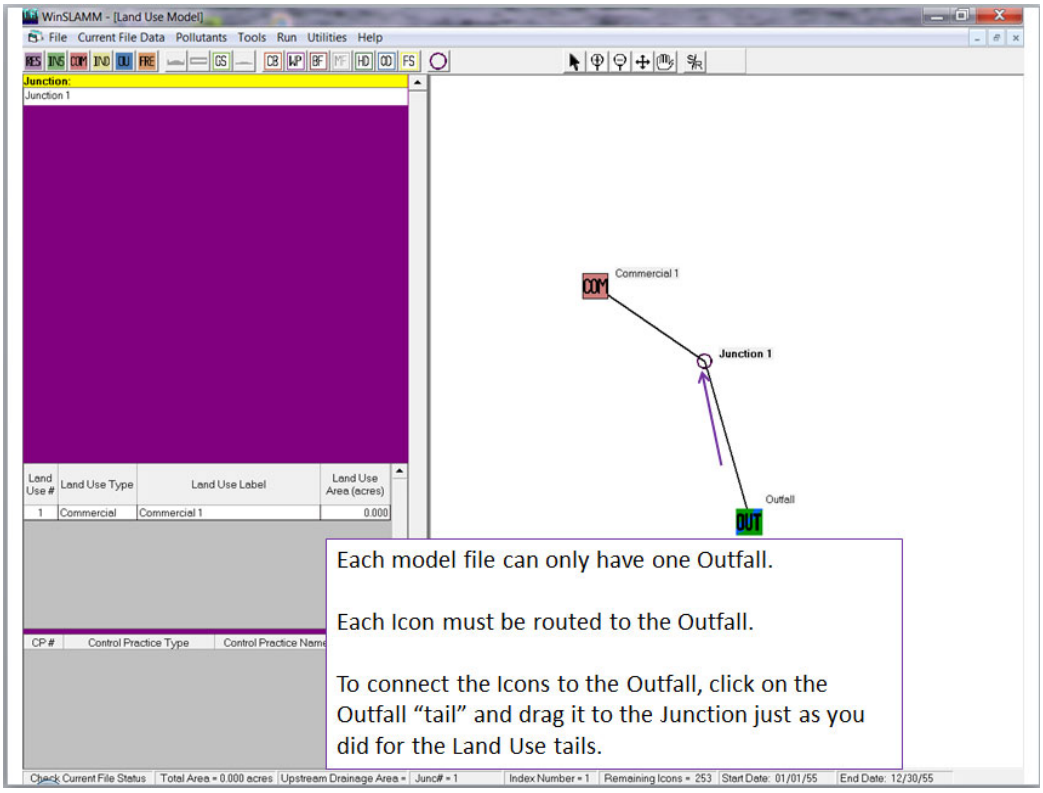
The following screens show how the land use and development characteristics are entered for a study area

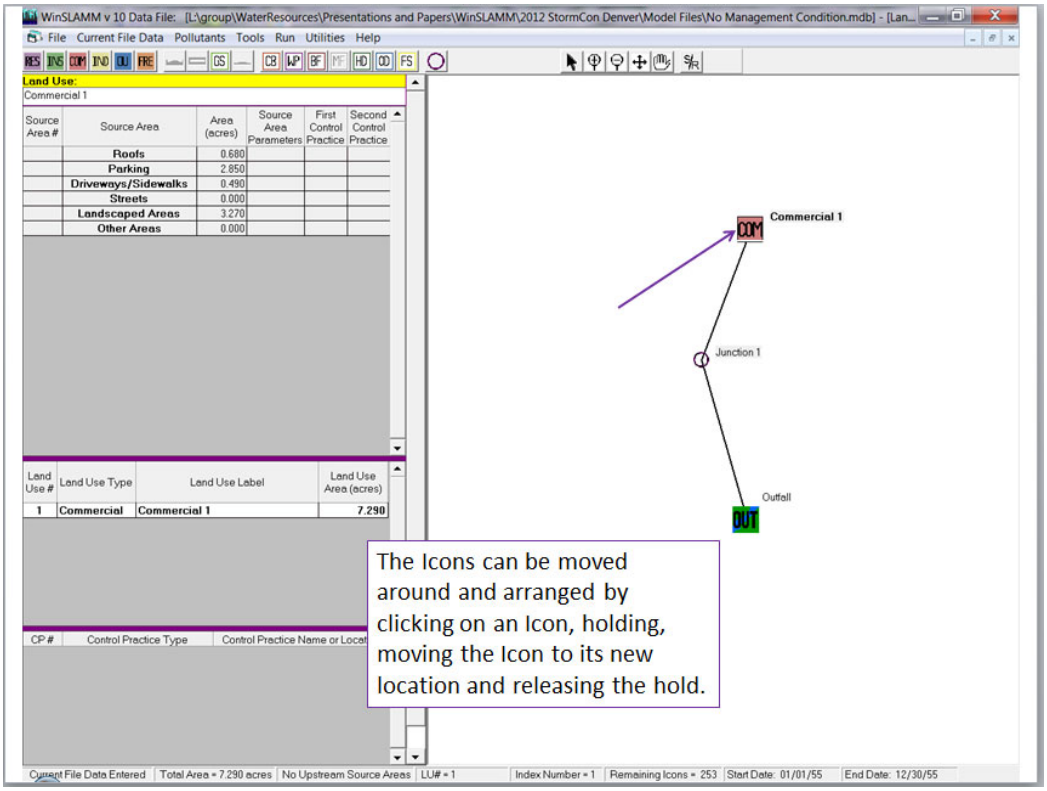


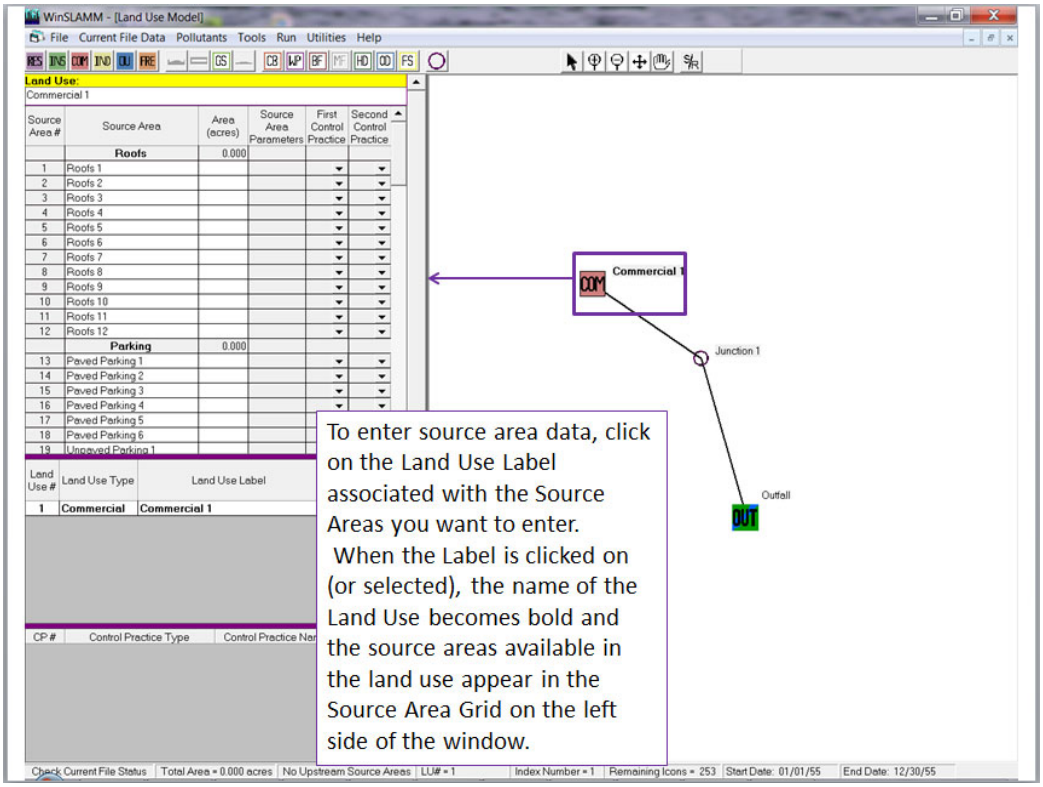


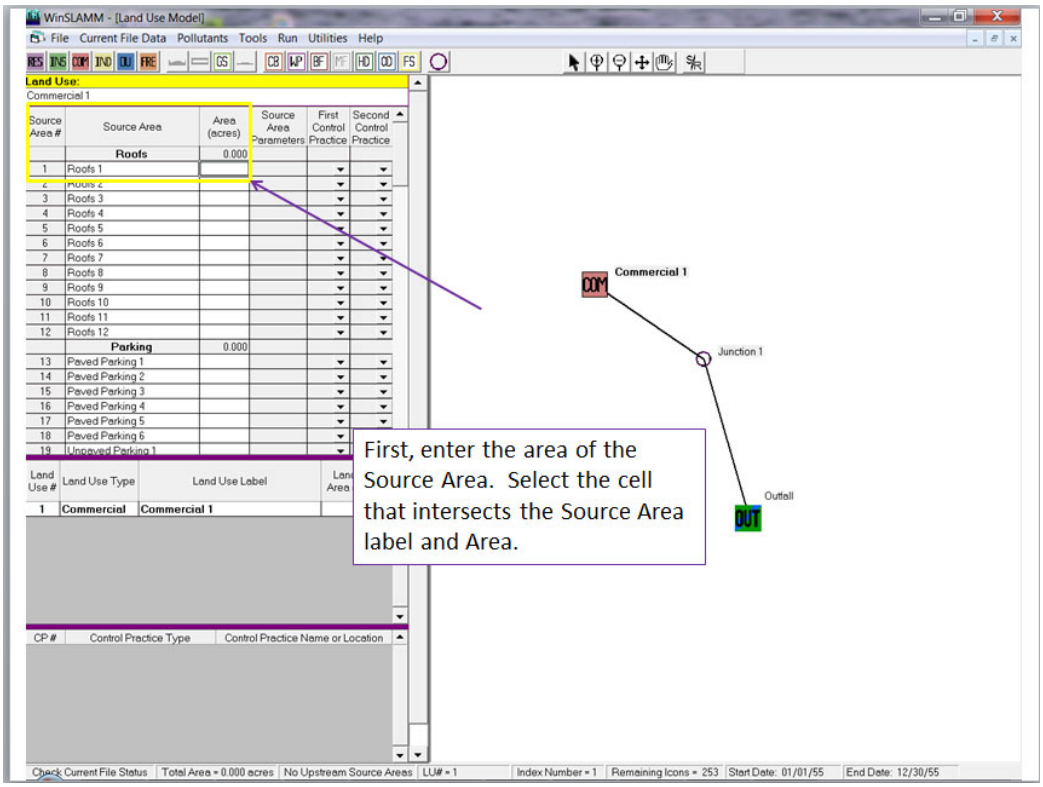

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Junction:
Junction 1
Commercial 1
Junction 1
Outfall
Land Use #
Land Use Type
Land Use Label
1
Commercial
Commercial 1
CP #
Control Practice Type
Control Practice Name or Locat
To connect the Commercial Land Use tail to the Junction, click and hold on the Commercial Icon tail. While holding down, drag the tail over to the Junction Icon. Release the hold.
Check Current File Status
Total Area = 0.000 acres
Upstream Drainage Area =
Junc# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/01/55
End Date: 12/30/55

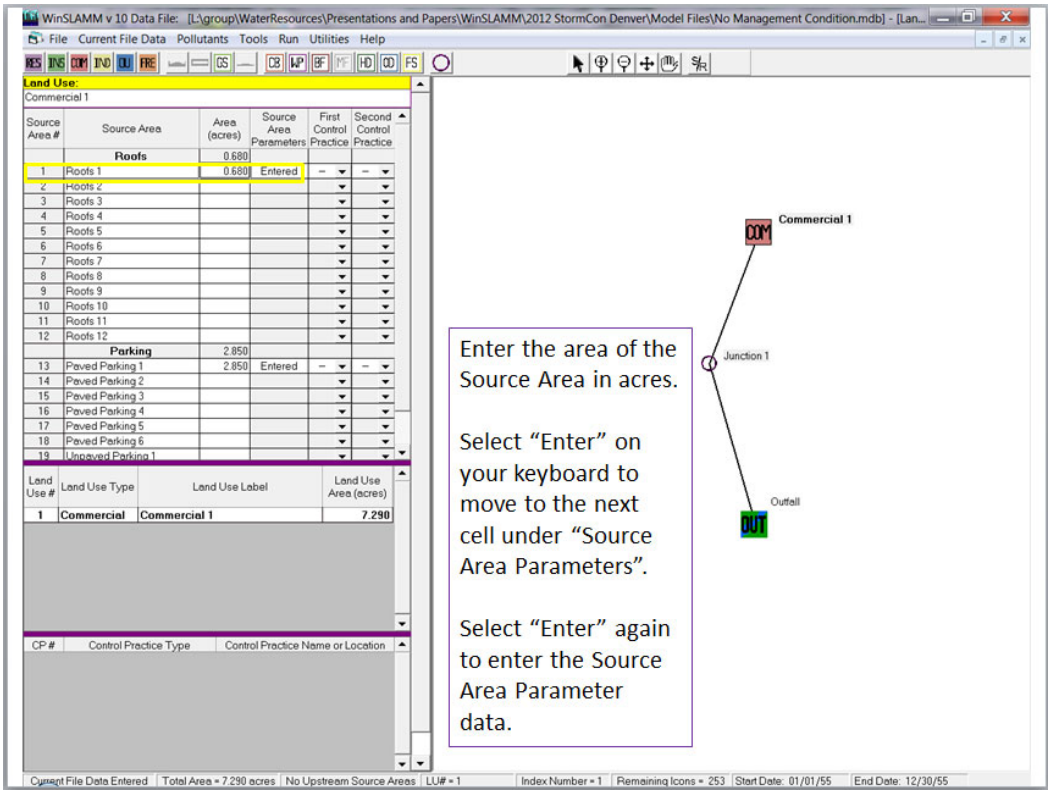

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Junction:
Junction 1
Commercial 1
Junction 1
Outfall
Land Use #
Land Use Type
1
Commercial
Commercial 1
CP #
Control Practice Type
The Commercial Icon is now connected to the Junction.
Add other land uses and connect them in a similar manner.
Each WinSLAMM model can analyze up to 255 Icons. An Icon is a Land Use, Junction, or Control Practice.
The status bar displays the number of Icons in each model file and the number of Icons remaining.
Check Current File Status
Total Area = 0.000 acres
Upstream Drainage Area =
Junc# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/01/55
End Date: 12/30/55

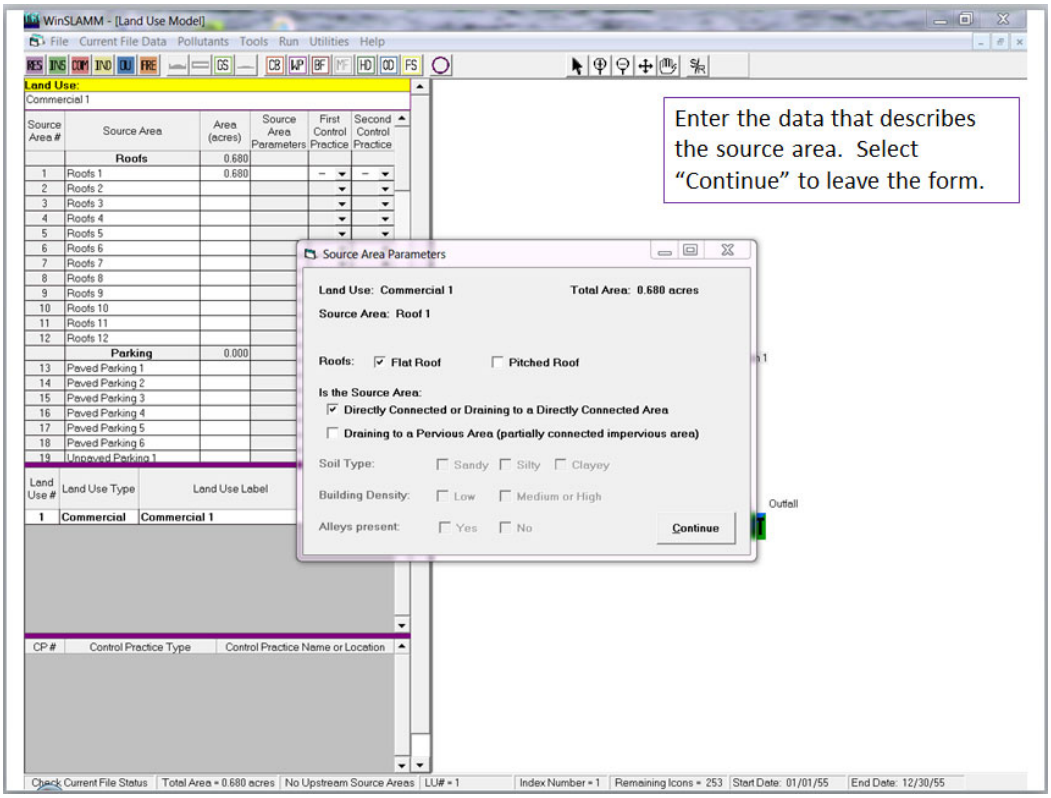

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Junction:
Junction 1
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 | Commercial | Commercial 1 | 0.000
CP # | Control Practice Type | Control Practice Name
Commercial 1
Junction 1
Outfall
Each model file can only have one Outfall.
Each Icon must be routed to the Outfall.
To connect the Icons to the Outfall, click on the Outfall "tail" and drag it to the Junction just as you did for the Land Use tails.
Check Current File Status | Total Area = 0.000 acres | Upstream Drainage Area = | Junc# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55

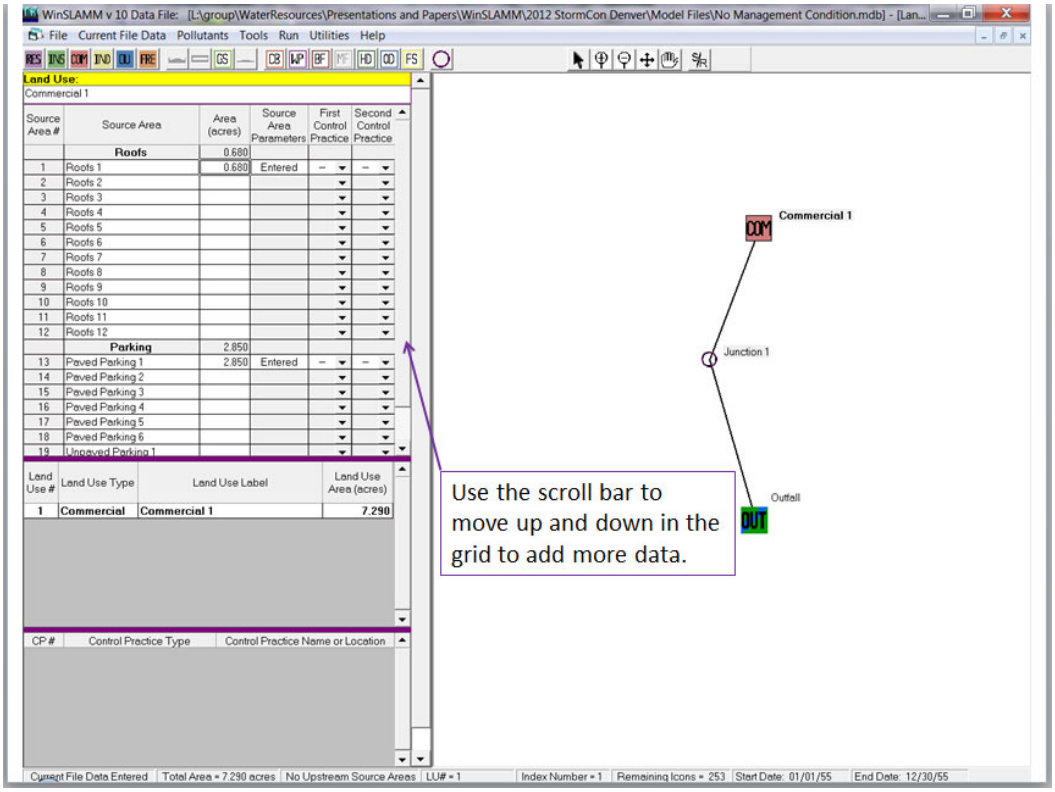

WinSLAMM v 10 Data File: [L:\group\WaterResources\Presentations and Papers\WinSLAMM\2012 StormCon Denver\Model Files\No Management Condition.mdb] - [Lan...
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs | 0.680
Parking | 2.850
Driveways/Sidewalks | 0.490
Streets | 0.000
Landscaped Areas | 3.270
Other Areas | 0.000
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 | Commercial | Commercial 1 | 7.290
CP # | Control Practice Type | Control Practice Name or Locat
Commercial 1
Junction 1
Outfall
The Icons can be moved around and arranged by clicking on an Icon, holding, moving the Icon to its new location and releasing the hold.
Current File Data Entered | Total Area = 7.290 acres | No Upstream Source Areas | LU# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55

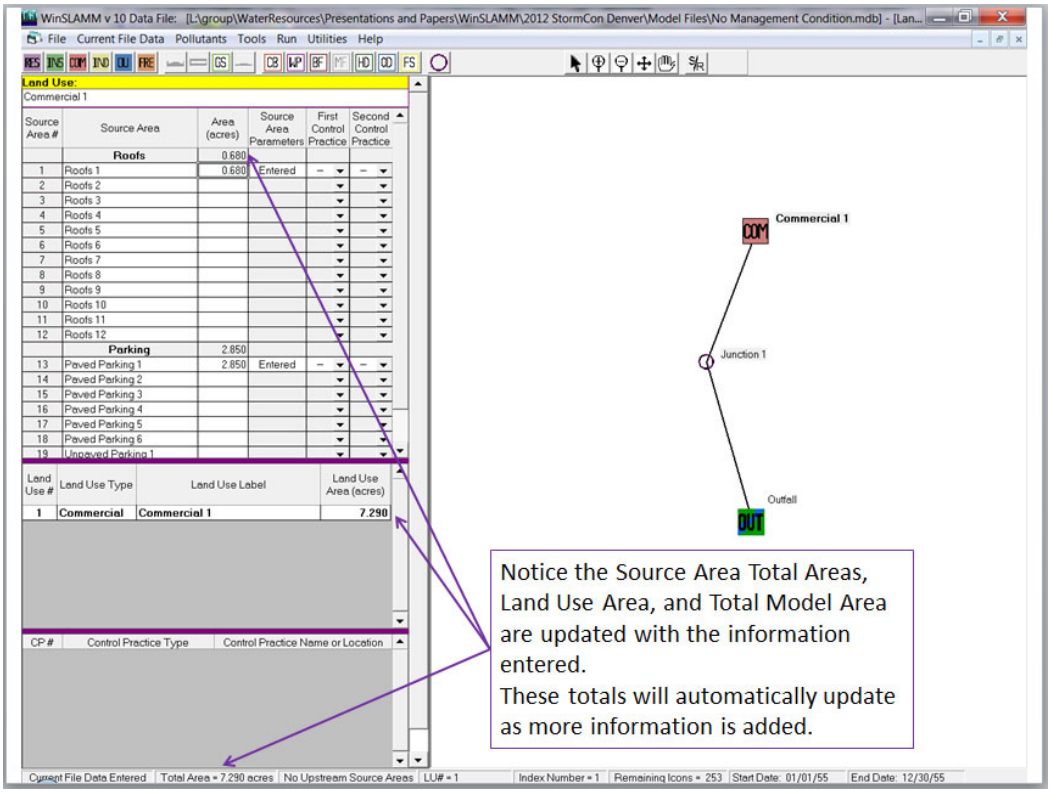

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.000
1 Roofs 1
2 Roofs 2
3 Roofs 3
4 Roofs 4
5 Roofs 5
6 Roofs 6
7 Roofs 7
8 Roofs 8
9 Roofs 9
10 Roofs 10
11 Roofs 11
12 Roofs 12
Parking 0.000
13 Paved Parking 1
14 Paved Parking 2
15 Paved Parking 3
16 Paved Parking 4
17 Paved Parking 5
18 Paved Parking 6
19 Unpaved Parking 1
Land Use # | Land Use Type | Land Use Label
1 Commercial Commercial 1
CP # | Control Practice Type | Control Practice Nar
Commercial 1
COM
Junction 1
Outfall
OUT
To enter source area data, click on the Land Use Label associated with the Source Areas you want to enter. When the Label is clicked on (or selected), the name of the Land Use becomes bold and the source areas available in the land use appear in the Source Area Grid on the left side of the window.
Check Current File Status | Total Area = 0.000 acres | No Upstream Source Areas | LU# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55


WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.000
1 Roofs 1
3 Roofs 3
4 Roofs 4
5 Roofs 5
6 Roofs 6
7 Roofs 7
8 Roofs 8
9 Roofs 9
10 Roofs 10
11 Roofs 11
12 Roofs 12
Parking 0.000
13 Paved Parking 1
14 Paved Parking 2
15 Paved Parking 3
16 Paved Parking 4
17 Paved Parking 5
18 Paved Parking 6
19 Unpaved Parking 1
Land Use # | Land Use Type | Land Use Label
1 Commercial Commercial 1
CP # | Control Practice Type | Control Practice Name or Location
Commercial 1
COM
Junction 1
Outfall
OUT
First, enter the area of the Source Area. Select the cell that intersects the Source Area label and Area.
Check Current File Status | Total Area = 0.000 acres | No Upstream Source Areas | LU# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55

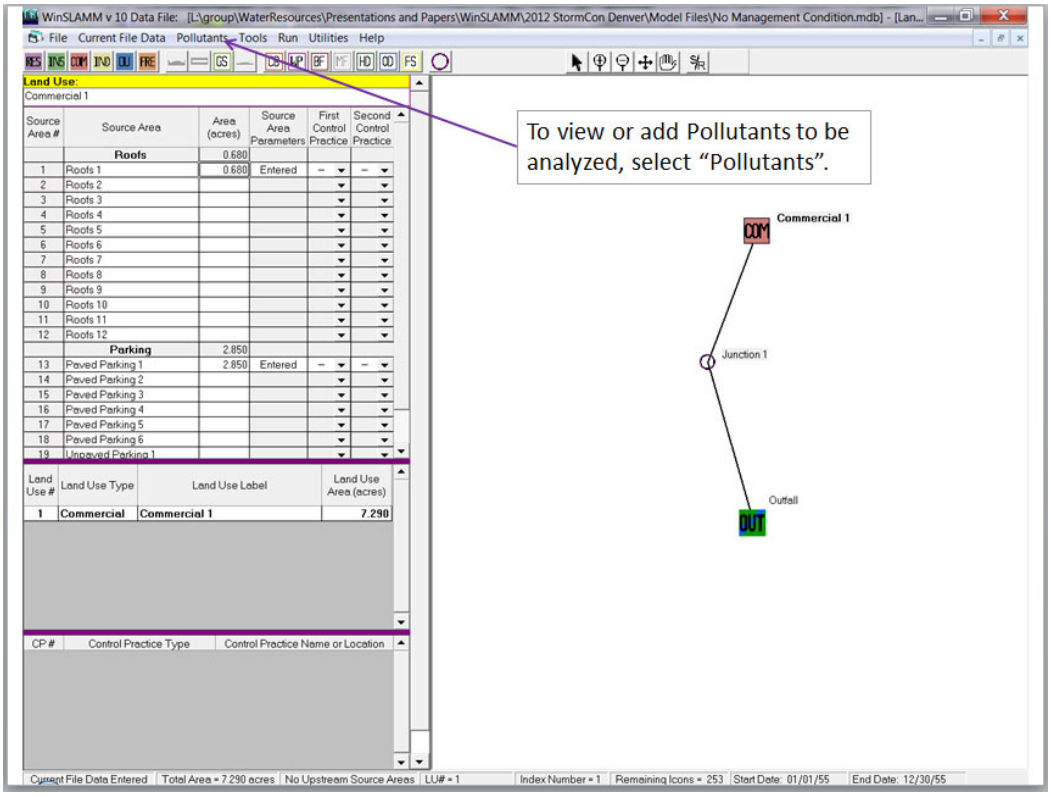

WinSLAMM v 10 Data File: [L:\group\WaterResources\Presentations and Papers\WinSLAMM\2012 StormCon Denver\Model Files\No Management Condition.mdb] - [Lan...
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.680
1 Roofs 1 0.680 Entered
2 Roofs 2
3 Roofs 3
4 Roofs 4
5 Roofs 5
6 Roofs 6
7 Roofs 7
8 Roofs 8
9 Roofs 9
10 Roofs 10
11 Roofs 11
12 Roofs 12
Parking 2.850
13 Paved Parking 1 2.850 Entered
14 Paved Parking 2
15 Paved Parking 3
16 Paved Parking 4
17 Paved Parking 5
18 Paved Parking 6
19 Unpaved Parking 1
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 Commercial Commercial 1 7.290
CP # | Control Practice Type | Control Practice Name or Location
Enter the area of the Source Area in acres.
Select “Enter” on your keyboard to move to the next cell under “Source Area Parameters”.
Select “Enter” again to enter the Source Area Parameter data.
Commercial 1
Junction 1
Outfall
Current File Data Entered
Total Area = 7.290 acres
No Upstream Source Areas
LU# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/01/55
End Date: 12/30/55

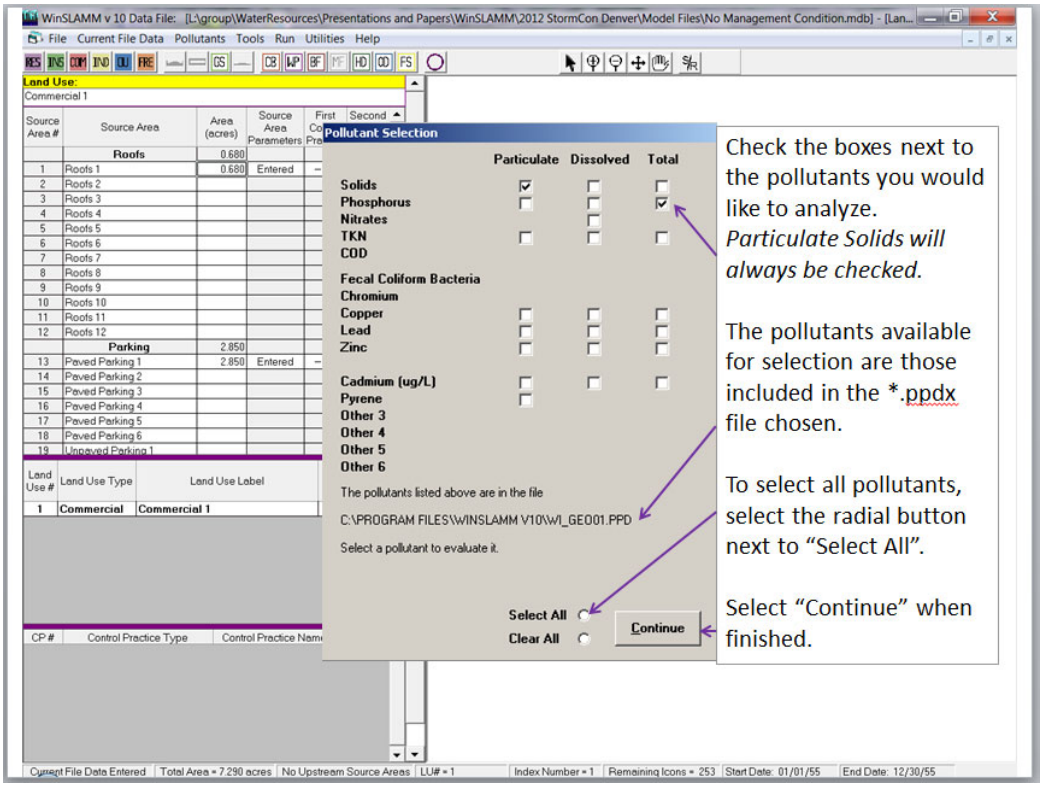

WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Enter the data that describes the source area. Select “Continue” to leave the form.
Source Area Parameters
Land Use: Commercial 1
Total Area: 0.680 acres
Source Area: Roof 1
Roofs: Flat Roof Pitched Roof
Is the Source Area:
Directly Connected or Draining to a Directly Connected Area
Draining to a Pervious Area (partially connected impervious area)
Soil Type: Sandy Silty Clayey
Building Density: Low Medium or High
Alleys present: Yes No
Continue
Outfall
Check Current File Status
Total Area = 0.680 acres
No Upstream Source Areas
LU# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/01/55
End Date: 12/30/55


WinSLAMM v 10 Data File: [L:\group\WaterResources\Presentations and Papers\WinSLAMM\2012 StormCon Denver\Model Files\No Management Condition.mdb] - [Lan...
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.680
1 Roofs 1 0.680 Entered
2 Roofs 2
3 Roofs 3
4 Roofs 4
5 Roofs 5
6 Roofs 6
7 Roofs 7
8 Roofs 8
9 Roofs 9
10 Roofs 10
11 Roofs 11
12 Roofs 12
Parking 2.850
13 Paved Parking 1 2.850 Entered
14 Paved Parking 2
15 Paved Parking 3
16 Paved Parking 4
17 Paved Parking 5
18 Paved Parking 6
19 Unpaved Parking 1
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 Commercial Commercial 1 7.290
CP # | Control Practice Type | Control Practice Name or Location
Commercial 1
COM
Junction 1
Outfall
OUT
Use the scroll bar to move up and down in the grid to add more data.
Current File Data Entered | Total Area = 7.290 acres | No Upstream Source Areas | LU# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55

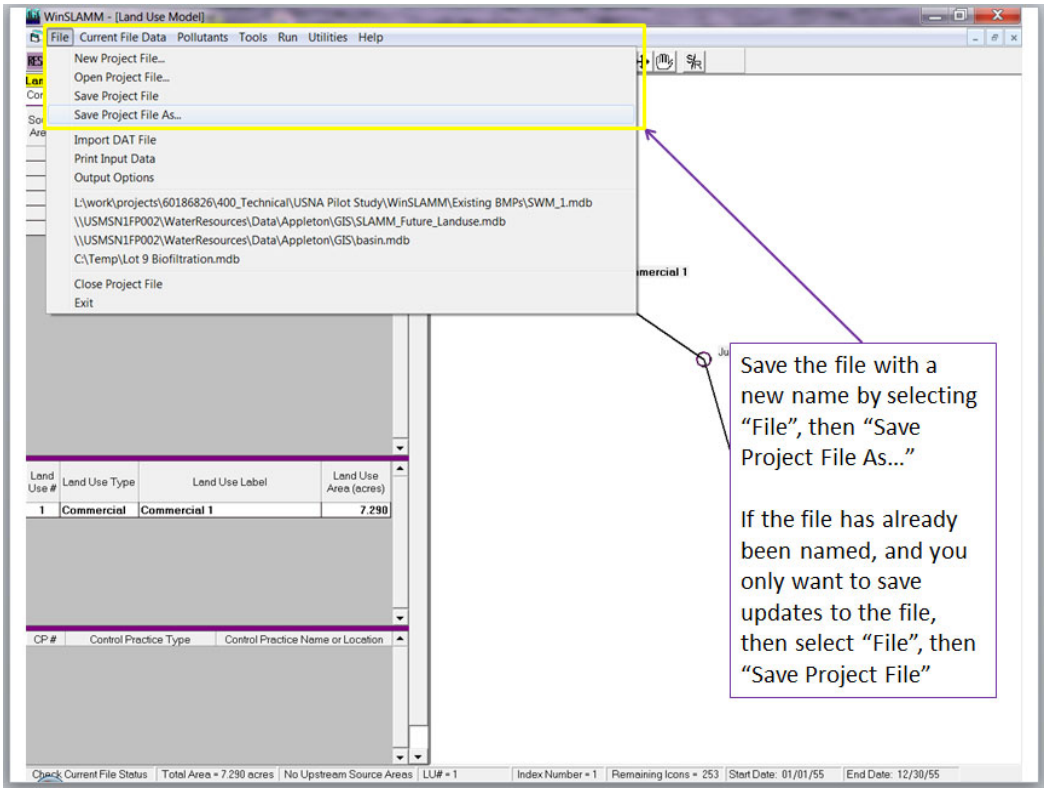

WinSLAMM v 10 Data File: [L:\group\WaterResources\Presentations and Papers\WinSLAMM\2012 StormCon Denver\Model Files\No Management Condition.mdb] - [Lan...
File Current File Data Pollutants Tools Run Utilities Help
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.680
1 Roofs 1 0.680 Entered
2 Roofs 2
3 Roofs 3
4 Roofs 4
5 Roofs 5
6 Roofs 6
7 Roofs 7
8 Roofs 8
9 Roofs 9
10 Roofs 10
11 Roofs 11
12 Roofs 12
Parking 2.850
13 Paved Parking 1 2.850 Entered
14 Paved Parking 2
15 Paved Parking 3
16 Paved Parking 4
17 Paved Parking 5
18 Paved Parking 6
19 Unpaved Parking 1
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 Commercial Commercial 1 7.290
CP # | Control Practice Type | Control Practice Name or Location
Commercial 1
COM
Junction 1
Outfall
OUT
Notice the Source Area Total Areas, Land Use Area, and Total Model Area are updated with the information entered.
These totals will automatically update as more information is added.
Current File Data Entered | Total Area = 7.290 acres | No Upstream Source Areas | LU# = 1 | Index Number = 1 | Remaining Icons = 253 | Start Date: 01/01/55 | End Date: 12/30/55

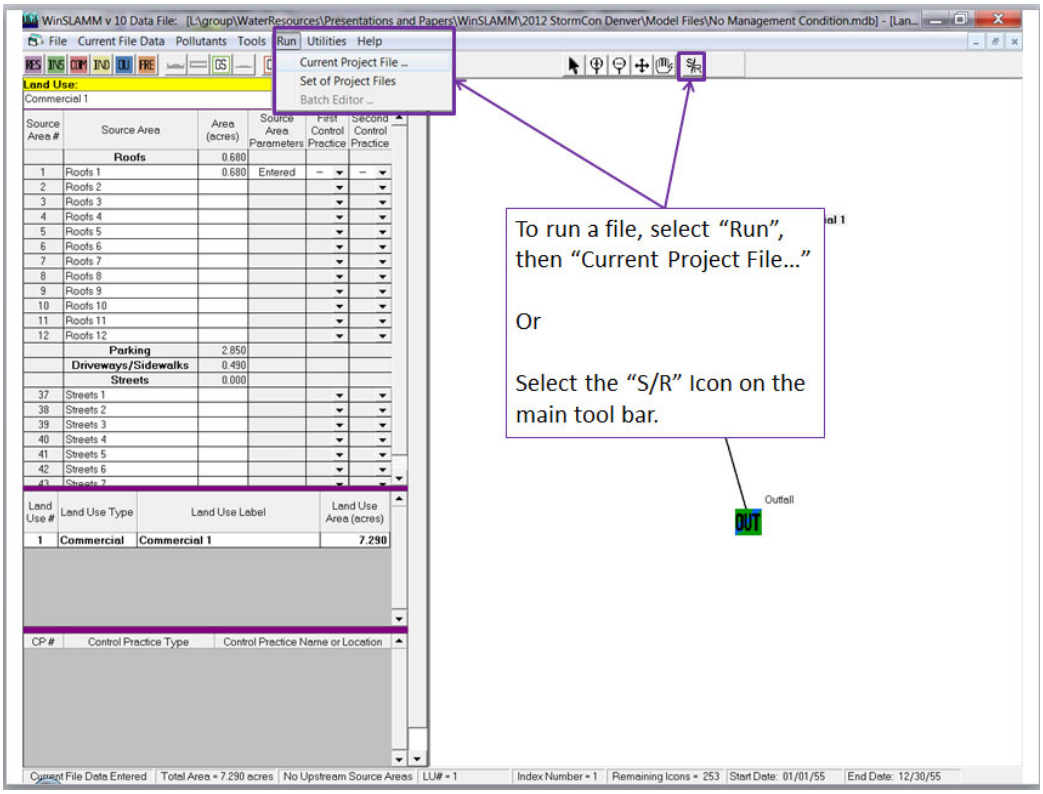
The following screens show how the pollutant selections are made for the model run:

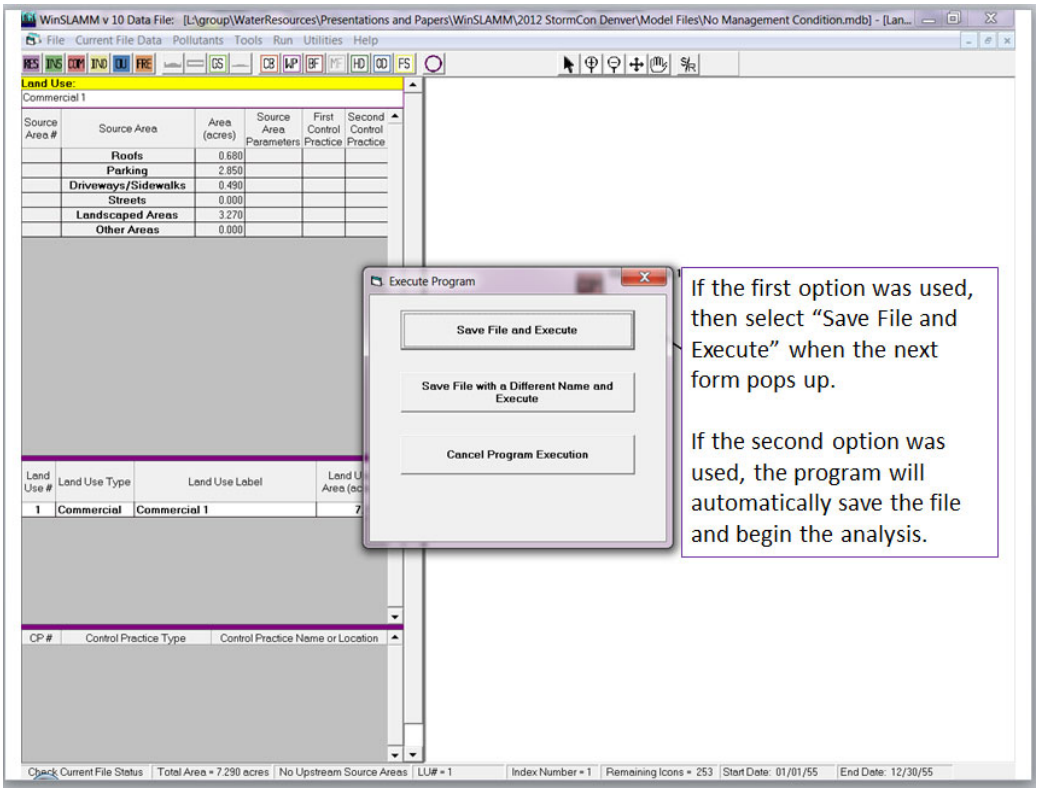




The completed file is then saved and then run:

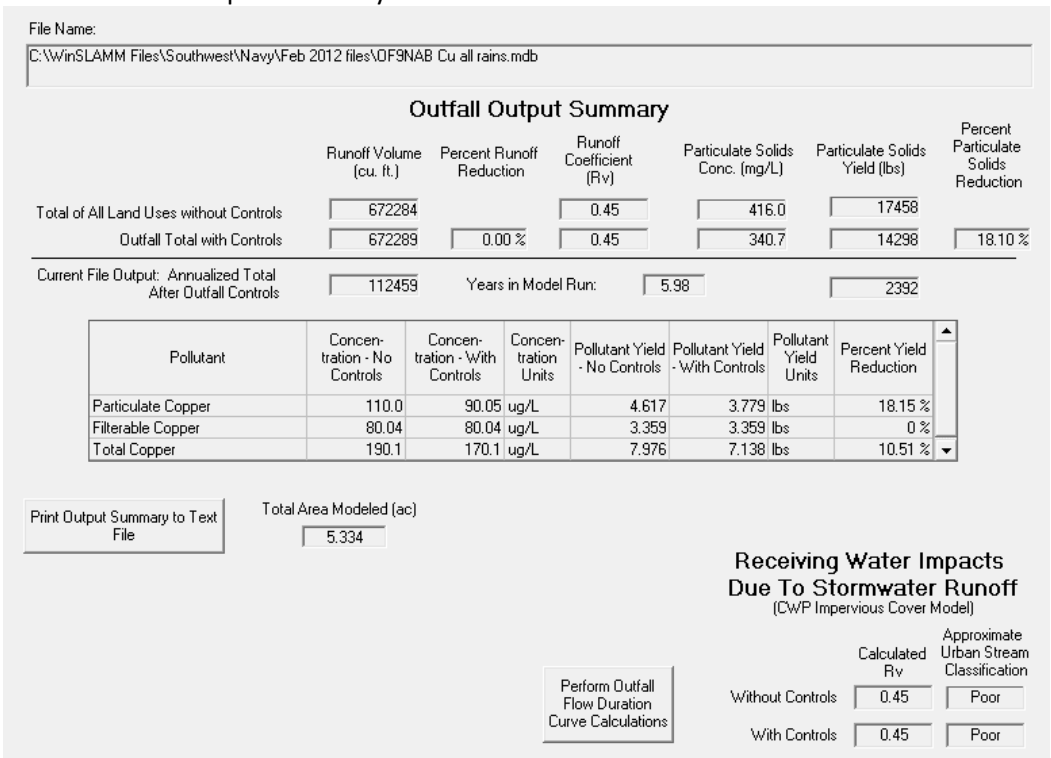


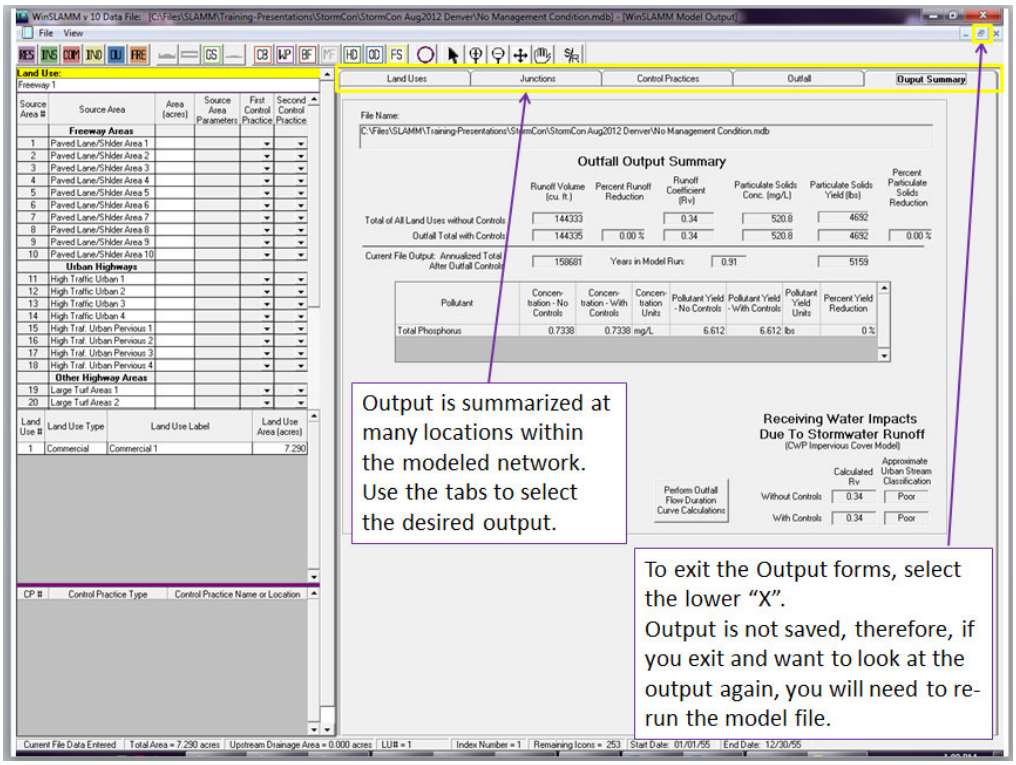




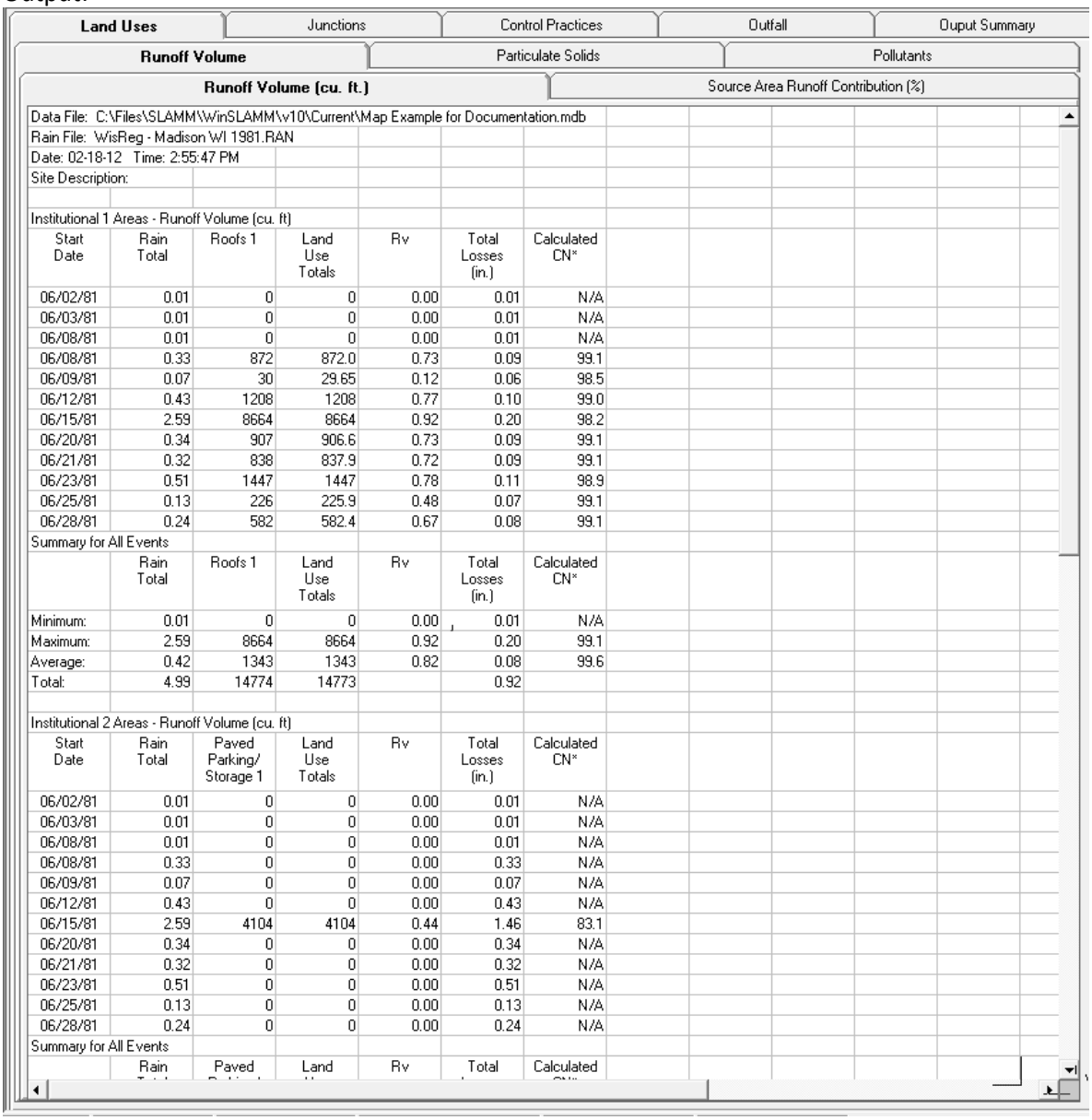
The following screens show some of the output options:

Overall Outfall Output Summary Form:




Land Uses
Junctions
Control Practices
Outfall
Ouput Summary
Outfall Output Summary
Output is summarized at many locations within the modeled network. Use the tabs to select the desired output.
To exit the Output forms, select the lower "X".
Output is not saved, therefore, if you exit and want to look at the output again, you will need to re-run the model file.

Runoff Volume Tab Complete
Output:



Land Uses | Junctions | Control Practices | Outfall | Ouput Summary

Runoff Volume | Particulate Solids | Pollutants

Runoff Volume (cu. ft.) | Source Area Runoff Contribution (%)

Data File: C:\Files\SLAMM\WinSLAMM\v10\Current\Map Example for Documentation.mdb
Rain File: WisReg - Madison WI 1981.RAN
Date: 02-18-12 Time: 2:55:47 PM
Site Description:

Institutional 1 Areas - Runoff Volume (cu. ft)

Start Date	Rain Total	Roofs 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
06/02/81	0.01	0	0	0.00	0.01	N/A
06/03/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.33	872	872.0	0.73	0.09	99.1
06/09/81	0.07	30	29.65	0.12	0.06	98.5
06/12/81	0.43	1208	1208	0.77	0.10	99.0
06/15/81	2.59	8664	8664	0.92	0.20	98.2
06/20/81	0.34	907	906.6	0.73	0.09	99.1
06/21/81	0.32	838	837.9	0.72	0.09	99.1
06/23/81	0.51	1447	1447	0.78	0.11	98.9
06/25/81	0.13	226	225.9	0.48	0.07	99.1
06/28/81	0.24	582	582.4	0.67	0.08	99.1

Summary for All Events

	Rain Total	Roofs 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
Minimum:	0.01	0	0	0.00	0.01	N/A
Maximum:	2.59	8664	8664	0.92	0.20	99.1
Average:	0.42	1343	1343	0.82	0.08	99.6
Total:	4.99	14774	14773		0.92	

Institutional 2 Areas - Runoff Volume (cu. ft)

Start Date	Rain Total	Paved Parking/ Storage 1	Land Use Totals	Rv	Total Losses (in.)	Calculated CN*
06/02/81	0.01	0	0	0.00	0.01	N/A
06/03/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.01	0	0	0.00	0.01	N/A
06/08/81	0.33	0	0	0.00	0.33	N/A
06/09/81	0.07	0	0	0.00	0.07	N/A
06/12/81	0.43	0	0	0.00	0.43	N/A
06/15/81	2.59	4104	4104	0.44	1.46	83.1
06/20/81	0.34	0	0	0.00	0.34	N/A
06/21/81	0.32	0	0	0.00	0.32	N/A
06/23/81	0.51	0	0	0.00	0.51	N/A
06/25/81	0.13	0	0	0.00	0.13	N/A
06/28/81	0.24	0	0	0.00	0.24	N/A

Summary for All Events

Rain	Paved	Land	Rv	Total	Calculated

Control Practices Summary

Outputs:

Land Uses | Junctions | **Control Practices** | Outfall | Ouput Summary

Runoff Volume | Part. Solids Yield (lbs) | Part. Solids Conc. (mg/L) | **Summary Table**

Data File: C:\Files\SLAMM\WinSLAMM\v10\Current\MyProject.mdb
Rain File: WisReg - Madison WI 1981.RAN
Date: 03-10-12 Time: 9:01:59 PM
Site Description:

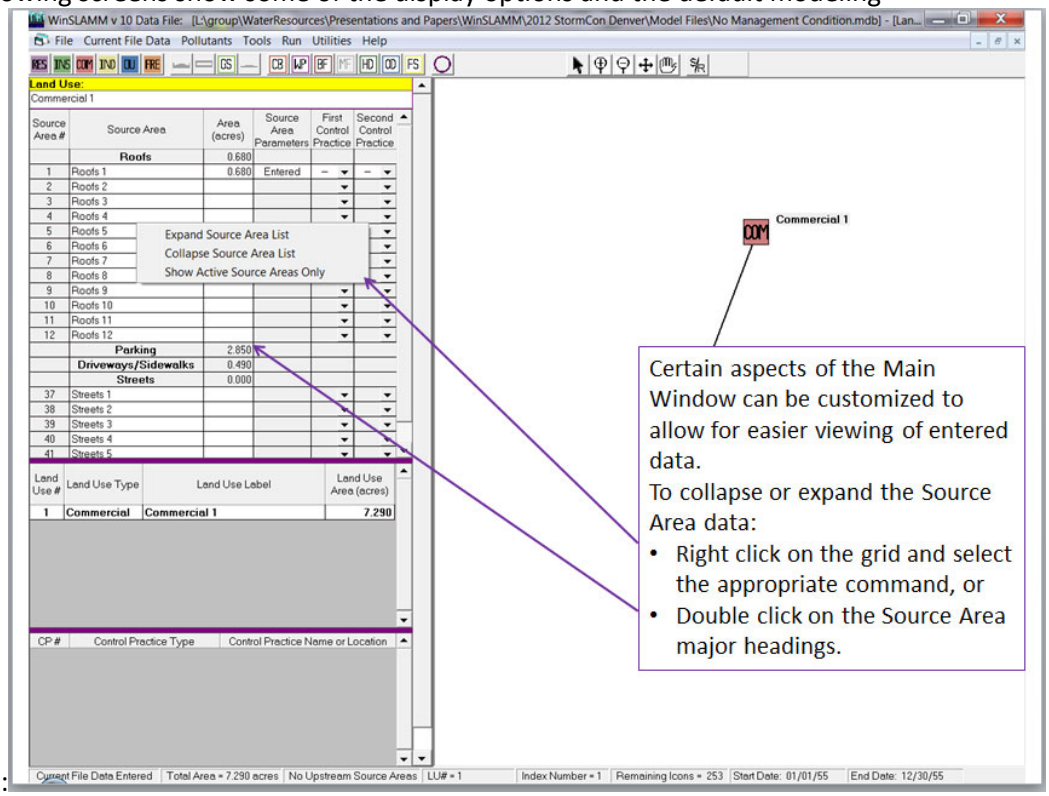
Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (cf)	Total Outflow Volume (cf)	Percent Volume Reduction	Total Influent Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction	Flow Weighted Influent Conc (mg/L)	Co
1	Biofilter	SA Device, LU# 1 ,SA# 45	14046	9.388E-04	100.00	199.0	1.330E-05	100.00	227.0	
2	Grass Swales	Grass Swales 1	75484	22574	70.09	174.4	43.71	74.93	37.00	
3	Biofilter	Biofilters 1	90114	79138	12.18	208.1	182.8	12.18	37.00	
4	Street Cleaning	SA Device, LU# 1 ,SA# 37	10902	10902	0	80.53	52.99	34.20	118.3	

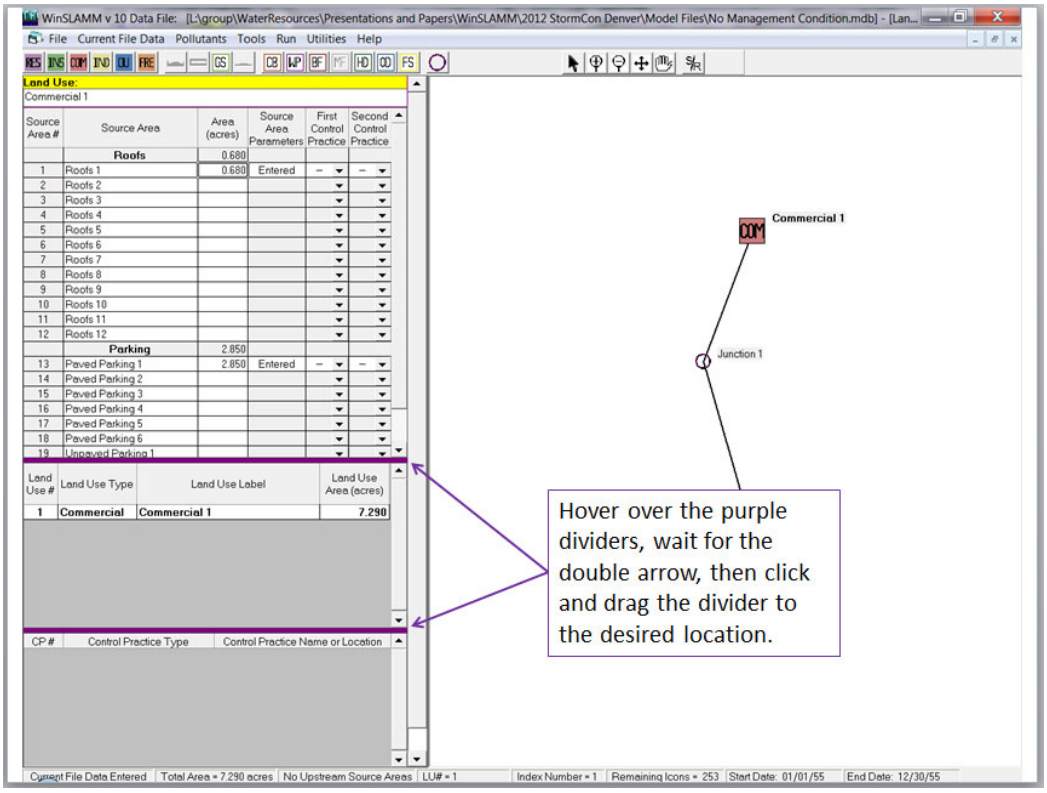
Control Practice No.	Control Practice Type	Flow Weighted Effluent Conc (mg/L)	Percent Conc. Reduction	Influent Median Part. Size (microns)	Effluent Median Part. Size (microns)	Notes	Maximum Stage (ft)	Bypass Volume (cf)	Treated Volume (cf)	% of Clogging Factor	Ma Su Po Tim
1	Biofilter	227.0	-2.017E-05	0.50	7.80		1.51	0			
2	Grass Swales	31.02	16.17	0.50	5.85		0.42		22574		
3	Biofilter	37.00	-2.062E-05	0.50	7.80		2.98	77747			
4	Street Cleaning	77.86	34.20	0.50	5.00	SA Performance Only					

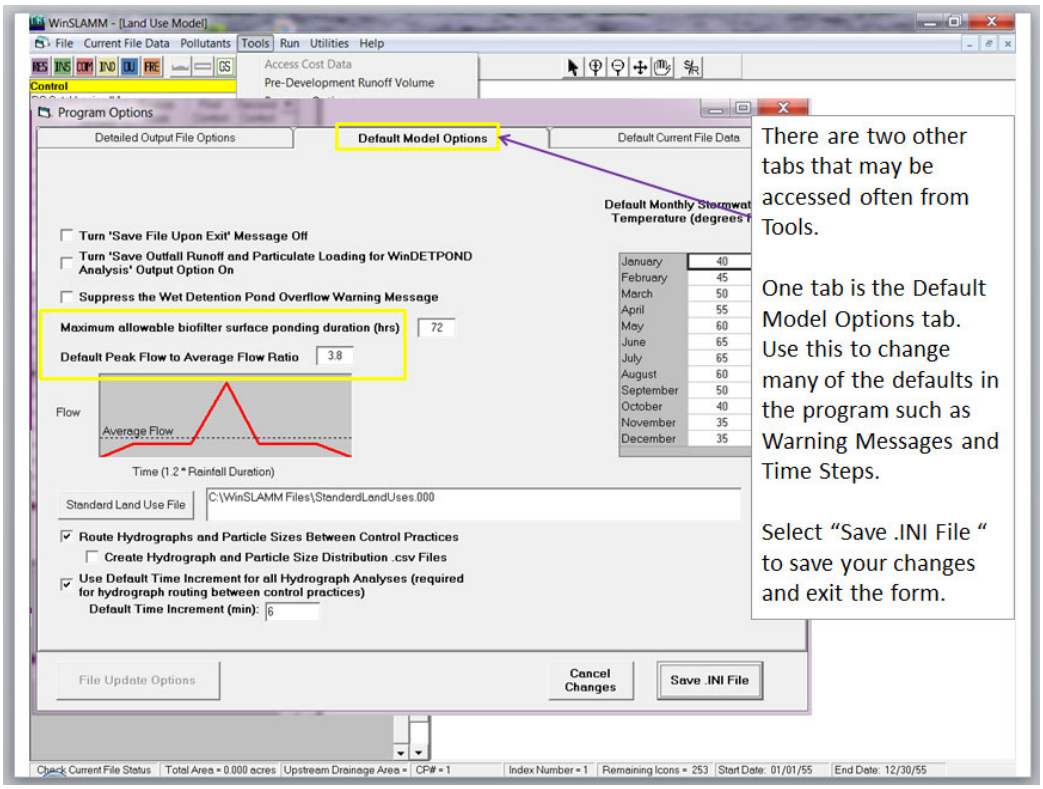
Control Practice No.	Control Practice Type	Maximum Surface Ponding Time (hrs)	Maximum Subsurface Ponding Time (hrs)	Volume Infiltrated (cf)	Underdrain Discharge Vol. (cf)	Evapo-Transpir. Vol. (cf)	Minimum Soil Moist. (frac)	Surface Discharge Bypass Vol. (cf)	Evap. Vol. (cf)	Volume Supplemtl. Irrig.(cf)	Maximum Velocity (ft/s)
1	Biofilter	9.2	4122.09	14000.85	0			0.00	7.4		
2	Grass Swales			52910							0.17
3	Biofilter	82.9	8114.26	12784.68	0			77746.72			
4	Street Cleaning										

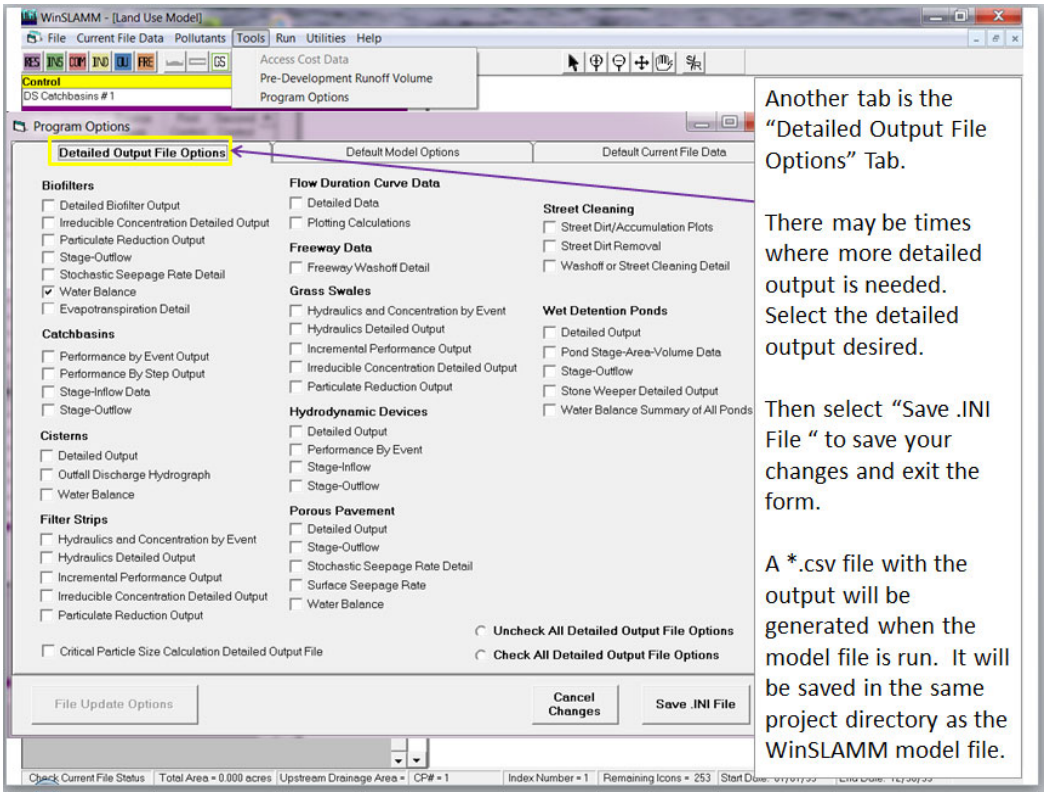
Control Practice No.	Control Practice Type	Volume Infiltrated (cf)	Underdrain Discharge Vol. (cf)	Evapo-Transpir. Vol. (cf)	Minimum Soil Moist. (frac)	Surface Discharge Bypass Vol. (cf)	Evap. Vol. (cf)	Volume Supplemtl. Irrig.(cf)	Maximum Velocity (ft/s)	Surface Ponding Events >72 hrs (Count)	Ttl. Rains /Runoff Producing Events
1	Biofilter	14000.85	0			0.00	7.4			0	170/0
2	Grass Swales	52910							0.17		170/32
3	Biofilter	12784.68	0			77746.72				4	170/46
4	Street Cleaning										170/74

The following screens show some of the display options and the default modeling options:






WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Access Cost Data
Pre-Development Runoff Volume
Program Options
Detailed Output File Options
Default Model Options
Default Current File Data
Turn 'Save File Upon Exit' Message Off
Turn 'Save Outfall Runoff and Particulate Loading for WinDETPOND Analysis' Output Option On
Suppress the Wet Detention Pond Overflow Warning Message
Maximum allowable biofilter surface ponding duration (hrs) 72
Default Peak Flow to Average Flow Ratio 3.8
Flow
Average Flow
Time (1.2 * Rainfall Duration)
January 40
February 45
March 50
April 55
May 60
June 65
July 65
August 60
September 50
October 40
November 35
December 35
Standard Land Use File
C:\WinSLAMM Files\StandardLandUses.000
Route Hydrographs and Particle Sizes Between Control Practices
Create Hydrograph and Particle Size Distribution .csv Files
Use Default Time Increment for all Hydrograph Analyses (required for hydrograph routing between control practices)
Default Time Increment (min): 6
File Update Options
Cancel Changes
Save .INI File
There are two other tabs that may be accessed often from Tools.
One tab is the Default Model Options tab. Use this to change many of the defaults in the program such as Warning Messages and Time Steps.
Select "Save .INI File " to save your changes and exit the form.


WinSLAMM - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
Access Cost Data
Pre-Development Runoff Volume
Program 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
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
Critical Particle Size Calculation Detailed Output File
File Update Options
Cancel Changes
Save .INI File
Another tab is the "Detailed Output File Options" Tab.
There may be times where more detailed output is needed. Select the detailed output desired.
Then select "Save .INI File " to save your changes and exit the form.
A *.csv file with the output will be generated when the model file is run. It will be saved in the same project directory as the WinSLAMM model file.