# 1 Introduction

## Exploring an Example Network

In this section, you explore a preloaded example network that is provided as part of the standard SP Guru Transport Planner installation.

**Procedure 1-1 Exploring the Example Network**

**1** Open the WDMGuru_Examples project.

**1.1** Select **File** > **Open...**. The Open dialog box displays.

**1.2** Select the **WDMGuru_Examples** project, then press **Open**.

➥ The example project, which contains several scenarios, is loaded.

The first scenario, called Australia, appears in the workspace.

**2** Explore the layers.

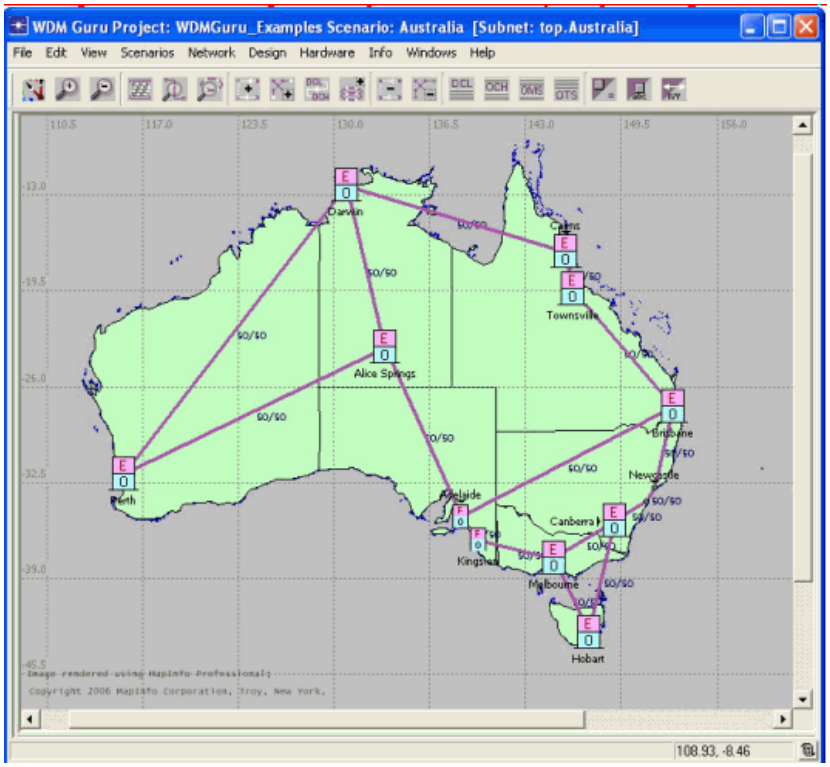
There are different layers in SP Guru Transport Planner: the LOP, DCL, OCH, OMS, and OTS layers. The following steps describe the different layers in more detail.

To switch between layers, use the **OTS**, **OMS**, **OCH**, and **DCL** buttons on the toolbar. Note that no LOP layer view is available.

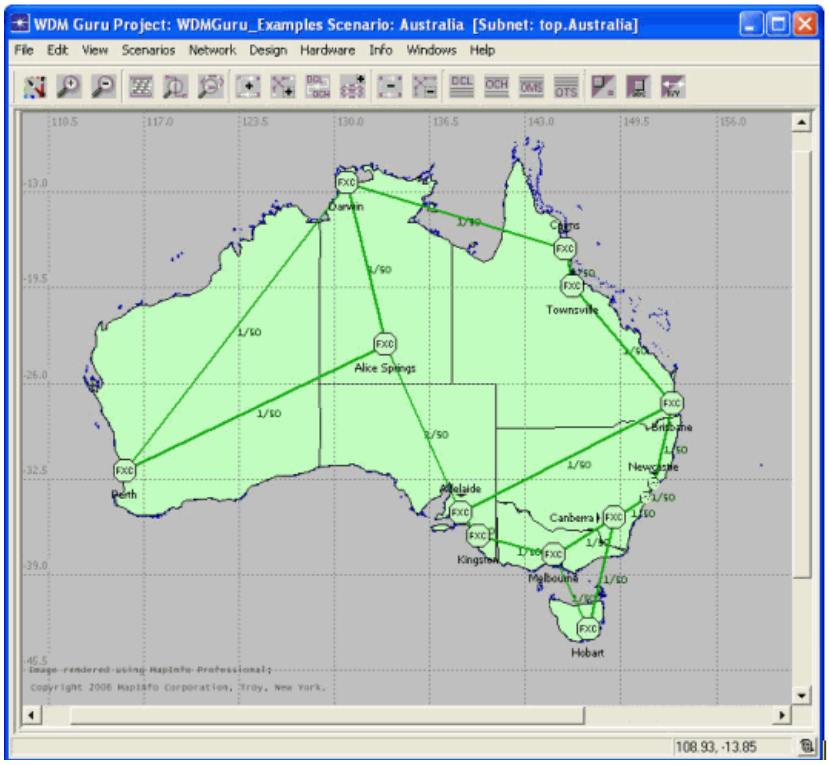
The **Optical Transmission Section** (OTS) layer represents the physical topology, comprising the cables and sites. In this layer, a different icon represents the type of each node, which can be one of four types:

- **EOCC**—an electrical and optical cross-connect
- **ECC**—an electrical cross-connect
- **OCC**—an optical cross-connect
- **Cable Splitter**—bifurcation point for optical fiber pairs

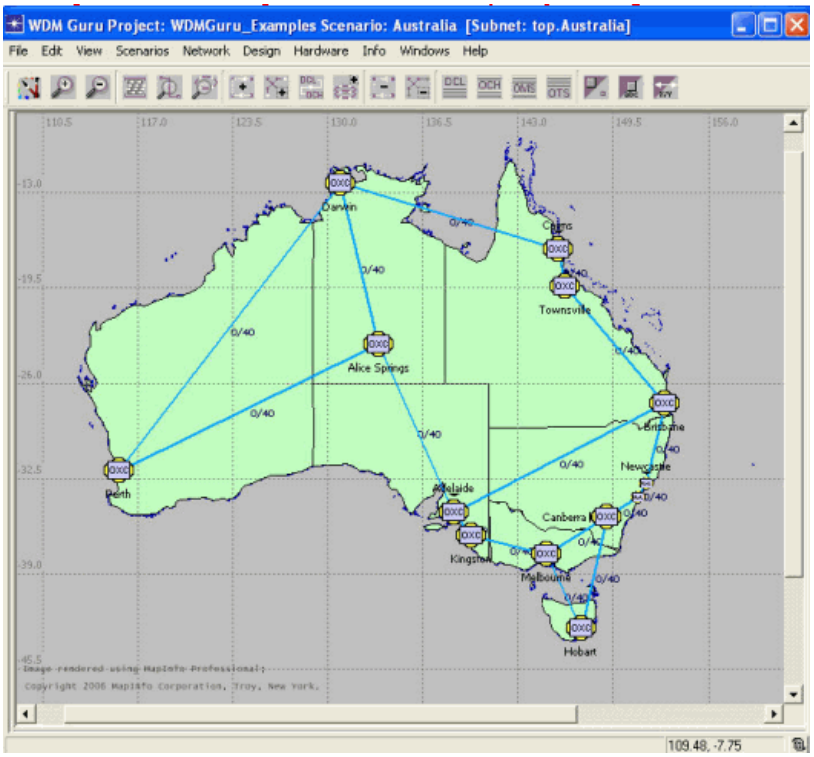
The OTS layer also represents the cable infrastructure between the nodes. The numerical annotation alongside each link indicates the number of fiber pairs physically contained within the cable. Note that in this example only nodes of the EOCC type are deployed and that each cable contains 50 fiber pairs.




The **Optical Multiplex Section** (OMS) layer represents the lit fibers (fibers in use) on each link. The link annotation shows the lit fibers versus total fibers.Note that in this example, one fiber pair (out of the 50 available) has been lit on each cable.



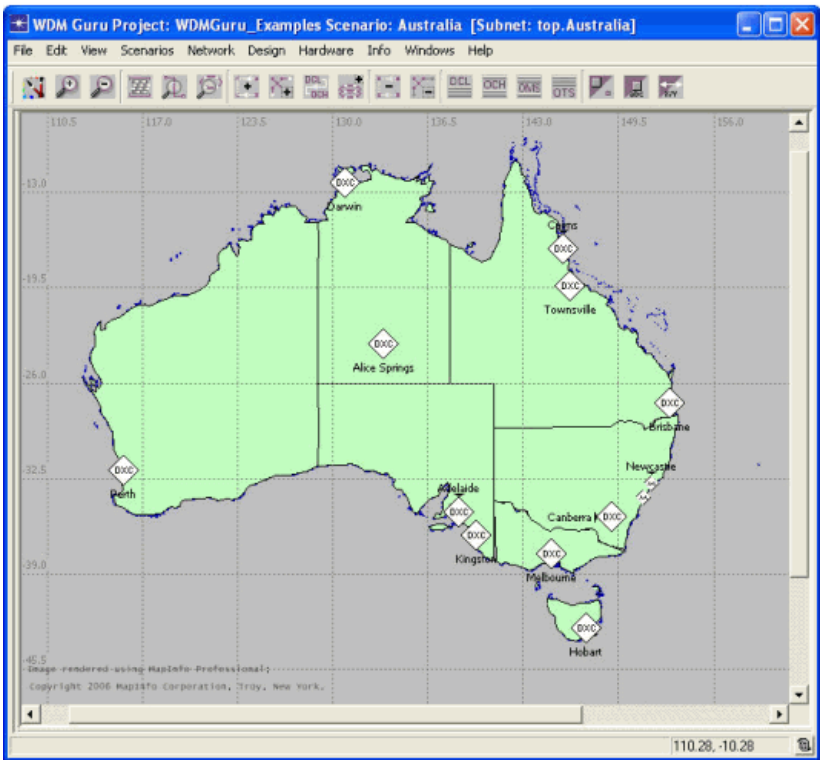
The **Optical Channel Layer** (OCH) represents optical channels or wavelengths. In this layer, optical traffic is routed. The links are annotated with used and total number of optical channels. In this example, no traffic is accommodated in the OCH layer (i.e., no wavelengths are in use).



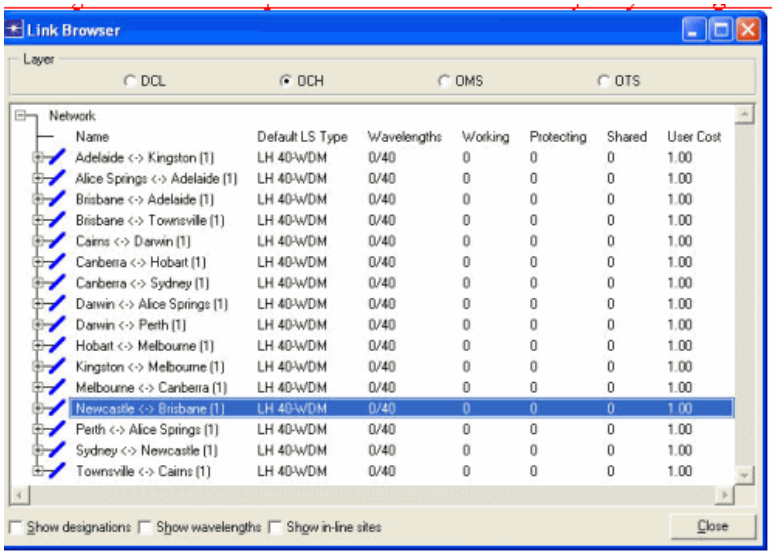

The layer below is the **Digital Client Layer** (DCL) and represents the SONET/ SDH network. In this layer, SONET/ SDH traffic is routed. Physical and logical DCL links are distinguished by the following characteristics:

- Physical DCL links connect an ECC node with an ECC or EOCC node. In this case, the SONET trunk capacity is implemented directly by the fiber (OMS) layer and each fiber supports only one SONET trunk.
- Logical DCL links are supported by non-native OCH layer connections between two EOCC nodes. A routed non-native OCH connection is "trailed" to the DCL layer and creates a logical link in the DCL layer. Such a connection is created to carry DCL traffic, while a native OCH connection supports wavelength services. The capacity of the logical DCL link corresponds to the capacity that can be hosted by the OCH connection. For example, an OC-48 optical channel, trailed to the DCL layer, creates a SONET trunk that can host OC-48 or its equivalent STS-48 traffic, in other words, 48 STS-1's.

Note that neither physical DCL links (no ECC nodes) nor logical DCL links (no OCH traffic is accommodated in the network) are present in this example.




**3** The node and link properties can be explored per layer in the node and link browsers. Select **Network > Node Browser** or **Network > Link Browser**, or double-click on a node or link. Within a browser, use the radio buttons at the top to select the layer you want to inspect.



4 In the browser, right-click anywhere in the row of a node or link to get the list of actions that can be performed or attributes that can be set for this element. The possible actions depend on the element, the current layer, and the network status. For example, in the node browser at the OTS layer you can edit the node location, the node type (as no traffic is yet routed in the network), and so on. See the SP Guru Transport Planner *User Guide* for an overview of the attributes that can be edited.

5 Close the node and link browser.

6 Click on the buttons at the far right of the toolbar, called **Show/Hide Node Icons**, **Show/Hide Node Names**, and **Show/Hide Link Annotations**. These three operations allow you to hide or show various elements of the display, so you can view the information of interest, or reduce the complexity of the network diagram.

7 Close the project without saving it to disk.

**7.1** Select **File > Close**.

**7.2** Select **Don't Save** in the **Close Confirm** dialog box.

**End of Procedure 1-1**

## Designing a Network Manually

The process of network modeling consists of specifying the information that describes all aspects of the network, such as

- Network topology
- Traffic pattern
- SONET/ SDH rings
- Amplification and regeneration locations
- Fibers lit
- Traffic routes

You can do modeling tasks manually within the user interface or by importing files that specify the network information (see Importing Network Elements).

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**Procedure 1-2 Creating a SP Guru Transport Planner Project Manually**

**1** Create a new project.

**1.1** Select **File** > **New...**.

➥ The **New** dialog box appears.

**1.2** Choose **OK**.

**1.3** Enter **Example2** as the project name (do not change the scenario name), and then press **OK**.

➥ The **Create a New Network** dialog box appears.

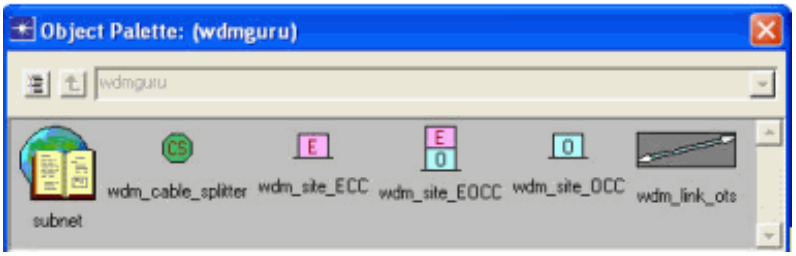
**1.4** Choose **SONET** as the TDM nomenclature of the bit rates. SONET and SDH are the US and European standards used in today's transport networks.

**1.5** Select **km** as the distance unit and **Logical** in the **View** category. (In logical view, no background map is displayed.)

**1.6** Click **OK**.

**2** Add nodes.

**2.1** Press the  button on the toolbar or choose **Edit > Open Object Palette** to open the Object Pallet. The Object Palette displays. From this window, you can add nodes (cable splitter, ECC, EOCC, or OCC) and links.



**2.2** Click on the **wdm_site_EOCC** icon. Drag it to the workspace and click on each of the places where you want to add sites. For this example, create four EOCC nodes (which will have as default names node_0 to node_3). Right-click or press **Esc** to stop adding sites.

**2.3** In the same way, create one node of the ECC type (node_4) and one of the OCC type (node_5).

**2.4** Inspect the different layers by using the **OTS**, **OMS**, **OCH**, and **DCL** buttons on the toolbar (do not close the Object Palette yet). All six nodes display in the OTS and OMS layer. All nodes also display in the OCH layer, but node_4 displays in gray. Because this node is an ECC (electrical cross-connect), it can only switch at the electrical level. In the DCL layer, node_5 is not shown, as it is an OCC (optical cross-connect). Such a node only supports switching at the optical level. The EOCC (electrical-optical cross-connect) nodes display in all layers. Switching at both the optical and electrical level is possible in these nodes.

**2.5** Press the **OTS** button on the toolbar. Remove node_4 and node_5 by left-clicking the nodes and and pressing the **Delete** button on the keyboard.

**Note—**The **wdm_cable_spitter** icon is used to add a cable splitter node. These nodes are only displayed in the OTS layer. The **Subnet** icon is used to add text fields to the canvas.

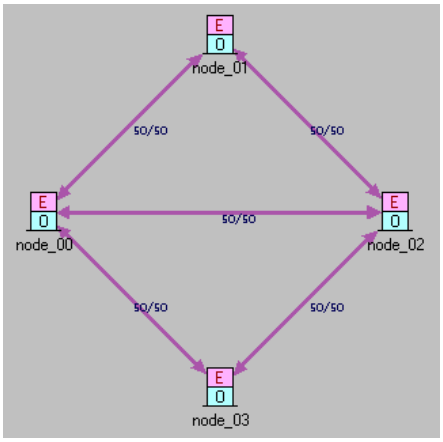
**3** Add OTS links.

**3.1** Click on the **wdm_link** icon in the object palette to add a link between two nodes.

**3.2** Click on the two nodes that you want to connect with a link. Create the following links:

- **node_0 <-> node_1**
- **node_1 <-> node_2**
- **node_2 <-> node_3**
- **node_3 <-> node_0**
- **node_0 <-> node_2**

**3.3** Right-click in the Project Editor workspace or press **Esc** to stop adding links. The nature of the link depends on the end nodes of the link. Links connecting OCC/OCC, OCC/EOCC and EOCC/EOCC node pairs are OCH links, on which WDM line systems are deployed. Links connecting ECC/ECC and ECC/EOCC node pairs are physical DCL links, on which SONET/ SDH line systems are deployed. Links between OCC/ECC node pairs are not allowed.




**3.4** Close the **Object Palette**.

**4** Create a traffic matrix.

**4.1** Select **Network** > **Traffic Matrix Editor** to open the dialog box for managing traffic matrices.

**4.2** Choose **OCH** and press **New**.

➥ An empty traffic matrix labeled OCH_0 is created. The bit rate of the traffic matrix is OC-48 (2.5 Gb/s).

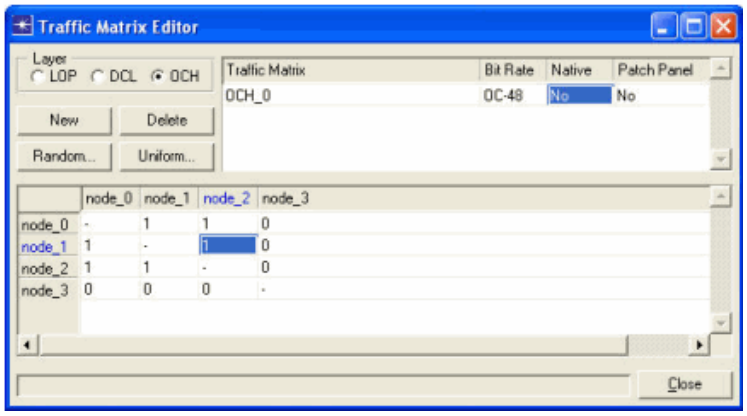
**4.3** Set the **Native** flag of the traffic matrix to **No**. If an OCH traffic demand is native, it supports optical traffic only, and no SONET/SDH traffic can ride on top of the wavelengths. In the opposite case, OCH demands are trailed to the client SONET/SDH layer, where they appear as links to support traffic in this layer.

**4.4** The **Patch Panel** flag of the traffic matrix is set to **No**. This implies that the traffic matrix is not hardwired (using the patch panel) in the nodes, but uses OXC (or IXC, OADM) ports instead.

**4.5** The matrix can be filled in manually by selecting an element of the matrix. Select the element **node_01/node_1** and fill in **1**. Do the same for the elements **node_0/node_2** and **node_1/node_2**.

**4.6** The **Random** button is used to fill the matrix with randomized values. You can specify the range for the random values. The **Uniform** button sets all values of the traffic matrix to the specified value.

**4.7** As shown below, a traffic matrix was created with a bi-directional demand of 1 wavelength between node_0 and node_1, between node_0 and node_2 and between node_1 and node_2.



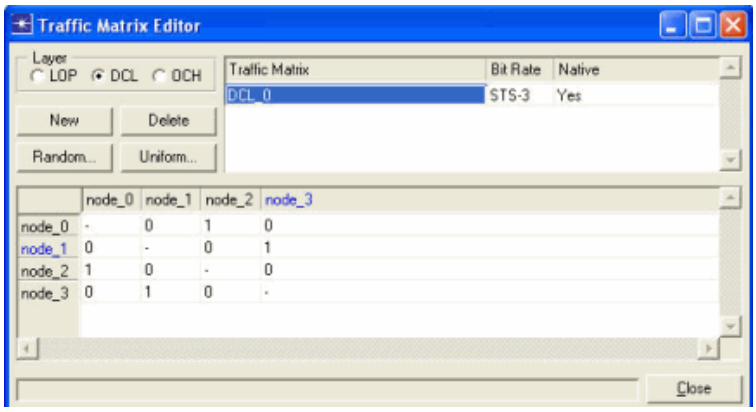

**4.8** Select **DCL** as the layer. Now you can create and manage traffic matrices with SONET demands.

**4.9** Press **New**.

➥ An empty traffic matrix, DCL_0, is created.

The bit rate of the traffic matrix is STS-3 (i.e., 150 Mb/s). The traffic matrix is native implying it only supports SONET traffic and no LOP traffic.

**4.10** Fill in **1** as traffic demand between **node_0** and **node_2** and between **node_1** and **node_3**.



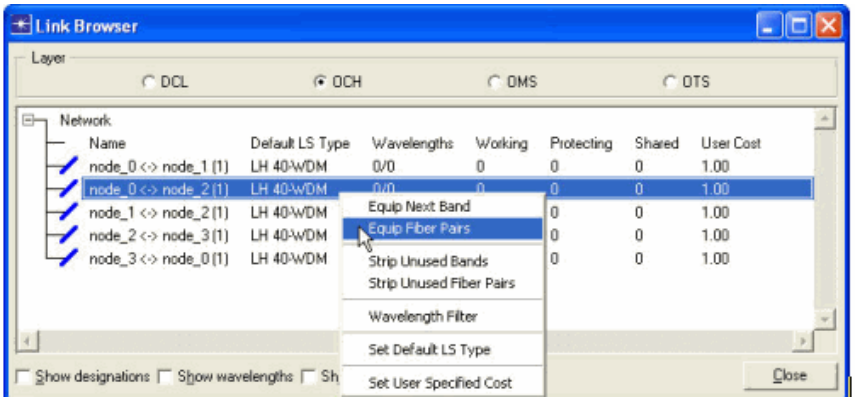

**4.11** Close the **Traffic Matrix Editor** dialog box.

**5** Equip fiber pairs on the links.

**5.1** Open the link browser by selecting **Network** > **Link Browser** (or by double clicking on a link).

**5.2** Choose the **OCH** layer in this dialog box.

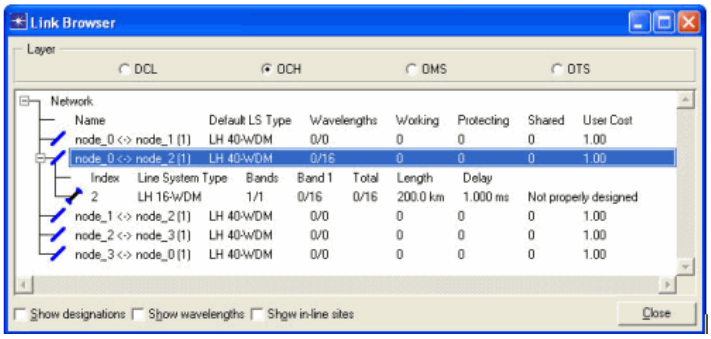
**5.3** Right-click on the link **node_0 <-> node_2** and select **Equip Fiber Pairs**.




➥ The **Equip Fiber Pairs** dialog box appears.

**5.4** Select the WDM line system type to use in lighting the fiber. For example, pick **LH 16-WDM**. Press **Equip**. This action lights a fiber pair of the LH 16-WDM type on the selected OCH link.

**5.5** Click on the **+** icon next on the link **node_0 <-> node_2**. The lit fiber pairs on the link appear.




**5.6** Close the link browser.

**6** Save the project.

**6.1** Select **File** > **Save** to save the Example2 project

**7** Select **File** > **Close** to close the project.

**End of Procedure 1-2**

## Importing Network Elements

This section describes how to create a network by importing network elements. Example network element files are in the following directory:

*<installation_directory>\12.0.A\models\std\wdmguru\examples*

You can view the example element files in a spreadsheet program to examine the file format.

See the **File** > **Export** > **Network Elements** dialog box for the corresponding export functions, creating .csv files listing the network elements.

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**Procedure 1-3 Importing Network Elements**

**1** Create a new project.

**1.1** Select **File** > **New...**. When the **New** dialog box appears, choose **OK**.

**1.2** Enter **Example3** as the project name (do not change the scenario name), and then press **OK**.

➥ The **Create a New Network** dialog box appears.

**1.3** Choose **SONET** as the TDM nomenclature of the bit rates. SONET and SDH are the US and European standards used in today's transport networks. Select **km** as distance unit and **Logical** in the **View** category. In logical view, no background map is displayed.

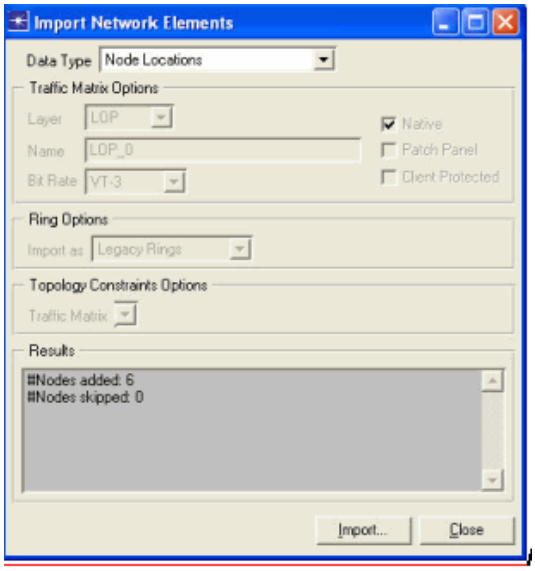
**1.4** Click **OK**.

**2** Import the network topology.

**2.1** Select **File** > **Import** > **Network Elements...** to open the dialog box that enables you to import network elements from a .csv file.

**2.2** Select **Node Locations** as **Data Type**. Click **Import**, move to the directory specified at the beginning of this section, and select the file **WDMGuru_import_node_locations.csv**.

**2.3** Press **Open** (Windows) or **OK** (UNIX). This imports six nodes and displays them in the workspace.



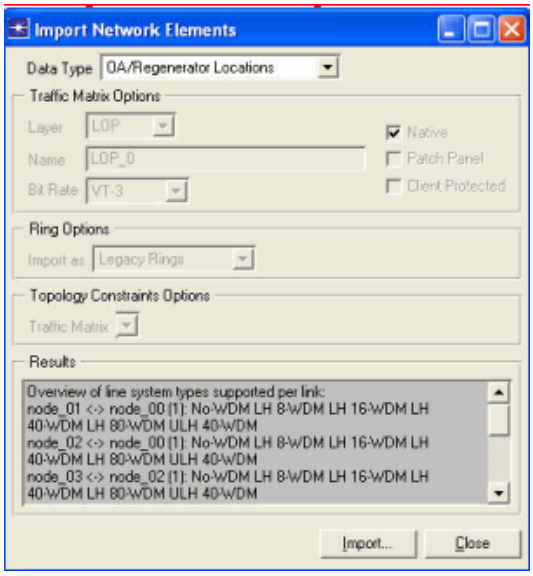

**2.4** Select **OTS links** as the **Data Type**.

**2.5** Click **Import**, select the file **WDMGuru_import_OTS_links.csv** in the file browser, then click **Open** (Windows) or **OK** (UNIX).

➥ Eight OTS links have been added to the network.

**2.6** Select **OA/Regenerator Locations** as the **Data Type**. Browse for the input file **WDMGuru_import_OA_regen_locations.csv**, then press **Open** (Windows) or **OK** (UNIX).

➥ Seven optical amplifier and regenerator sites have been added to the network.




**3** Import the equipped fibers and the traffic matrices.

**3.1** Select **Equipped Fibers** as the **Data Type**, click **Import**, and select the file **WDMGuru_import_equipped_fibers.csv**.

➥ Eight fibers have been equipped in the network.

**3.2** Select **Traffic Matrix** as the **Data Type**. Select **OCH** as the **Layer**. Set the traffic matrix name as **OCH_1**. Select **OC-48** as the bit rate. Put a checkmark next to **Native** and uncheck **Patch Panel**.

**3.3** Click **Import** and select the file **WDMGuru_import_OCH_trafficmatrix.csv**.

➥ A new OCH traffic matrix (OCH_1) has been created with 26 OC-48 wavelength demands.

**3.4** Select **Traffic Matrix** as the **Data Type** and **LOP** as the **Layer**. The LOP layer is the Lower Order Path layer of SONET.

**3.5** Fill in **LOP_0** as the **Name** and choose **VT-6 (6** Mb/s**)** as the **Bit Rate**.

**3.6** Click **Import** and select the file **WDMGuru_import_LOP_trafficmatrix.csv**. A new LOP traffic matrix has been created with 882 VT-6 demands.

**3.7** Select **Connection List** as the **Data Type** and **OCH** as the **Layer**.

Importing connection lists is similar to importing traffic matrices, but the first allows you to optionally specify the routes along with which connections are accommodated in the network.

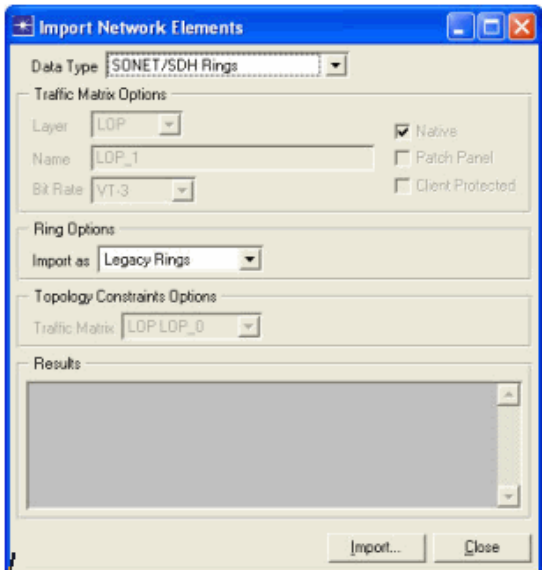
**3.8** Name the traffic matrix **OCH_2** and select **OC-192** as the bit rate. Put a checkmark next to **Native** and uncheck **Patch Panel** and **Client Protected**.

**3.9** Click **Import** and select the file **WDMGuru_import_OCH_connectionlist.csv**.

➥ A new OCH traffic matrix, OCH_2, has been created with eight connections. All these connections are routed in the network.

**4** Import SONET/SDH rings.

**4.1** Select **SONET/SDH Rings** as the **Data Type** to configure SONET/SDH rings in the DCL layer of your network.



**4.2** Click **Import** and select the file **WDMGuru_import_SONET_rings.csv**.

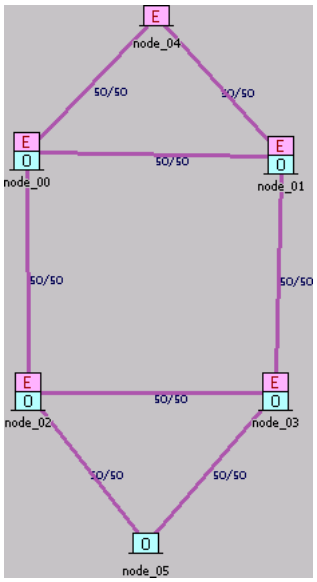
➥ Four rings have been added to the network.

**4.3** Close the **Import Network Elements** dialog box.

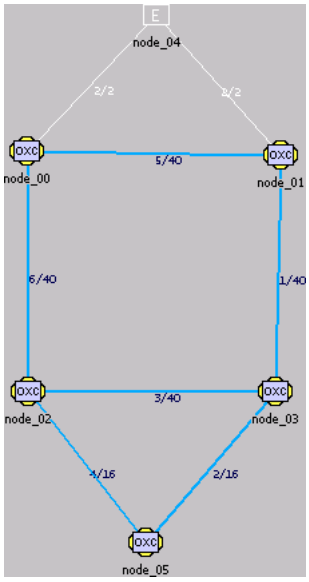
**5** This sequence of file imports produces a six-node network that contains the following:

- Four EOCC nodes, one ECC and one OCC node (OTS layer)
- Seven OA locations (OTS layer)
- Eight lit fiber pairs (OMS layer)
- Two OCH traffic matrices (OCH layer): OCH_1, unrouted, containing 26 connection units and OCH_2, 100% routed, containing 12 connection units
- Four SONET rings (DCL layer)
- One LOP traffic matrix (LOP layer): LOP_0, unrouted, containing 882 connection units

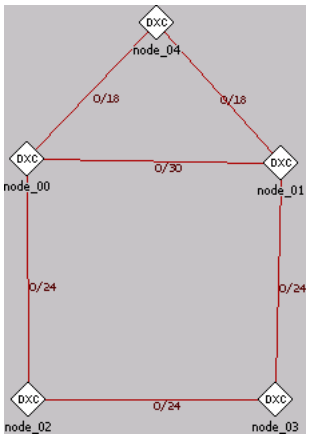
OTS Layer




OCH Layer




DCL Layer




**6** Save and close the project.

**6.1** Select **File** > **Save** to save the Example3 project.

**6.2** Select **File** > **Close** to close the project.

**End of Procedure 1-3**

# Network Properties

The **Network Properties** dialog box shows a set of specifications that are applicable to the network as a whole. Most of these settings cannot be changed after traffic is routed in the network.

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**Procedure 1-4 Exploring Network Properties**

**1** Open the WDMGuru_Examples project.

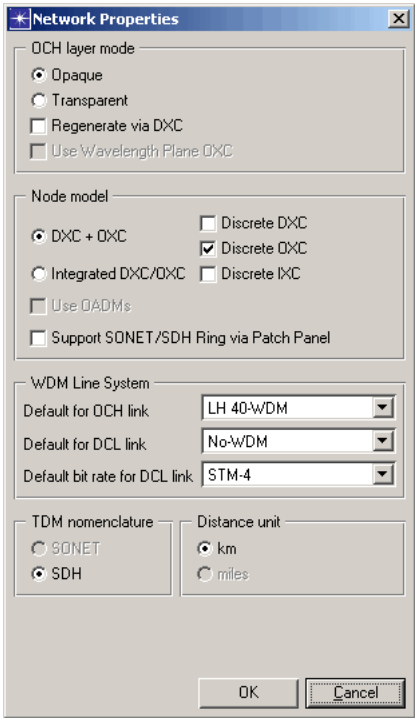
**1.1** Select **File** > **Open...**.

**1.2** Select the **WDMGuru_Examples** project and press **Open**.

➥ The example project is loaded, containing various scenarios. The Australia scenario is loaded in the workspace.

**2** Open the **Network Properties** dialog box.

**2.1** Select **Network** > **Network Properties...** (or right-click on the workspace and select **Network Properties** or double click on the workspace).




**3** Explore the network properties:

- **OCH Layer Mode** refers to the optical layer architecture. You can select **Opaque** or **Transparent**. This tutorial focuses on the opaque mode.
- **Node model** refers to the model used for DXC (digital cross-connect) and OXC (optical cross-connect) equipment in the EOCC nodes (switching at both DCL and OCH layers). Selecting **Integrated DXC/OXC** directs SP Guru Transport Planner to use a single integrated electrical switch that implements both DXC and OXC functions. This integrated switch interfaces with SONET/ SDH line cards and with DWDM line systems. These node models can

be either discrete or continuous. Using discrete node models, you can specify different types of nodes (e.g., DXCs), each with a different capacity and cost (see Equipment Properties). Using continuous node models, you use one node type that automatically scales with the required capacity. If the option **Use OADMs** is selected, all OXCs with a degree lower than 3 (i.e. less than three incident links) are replaced by an OADM. Note that this option is disabled in the example, because there are lit fiber pairs in the network. The option called **Support SONET/ SDH Ring via Patch Panel** specifies whether SONET/ SDH rings are implemented in the OCH layer using patch panels, or contribute to the OXC size.

- **WDM Line System** allows you to specify the default type of line system to be deployed for DCL links (links attached to at least one ECC node), and for OCH links (links between EOCCs and OCCs). You can also specify the default bit rate for DCL links.
- The **TDM nomenclature** option allows you to model the network in terms of SONET or SDH technologies. This can only be specified if traffic has not yet been routed in the network.
- **Distance Unit** designates the unit of measure for distances in the network; this can only be specified during the creation of a new scenario or project.

**4** Close the project.

**4.1** Select **File** > **Close**.

**4.2** Select **Don’t Save** in the **Close Confirm** dialog box.

**End of Procedure 1-4**

## Equipment Properties

SP Guru Transport Planner lets you specify the cost for the link and node equipment. You can do this using the dialog boxes, under **Network** > **Equipment Properties**, or by importing an equipment properties file. The equipment properties are divided into the following sections:

- SONET/ SDH Mesh Equipment
- SONET/ SDH Ring Equipment
- WDM Link Equipment
- WDM Node Equipment
- Generic Link Costs

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**Procedure 1-5 Exploring Equipment Properties**

**1** Open the WDMGuru_Examples project.

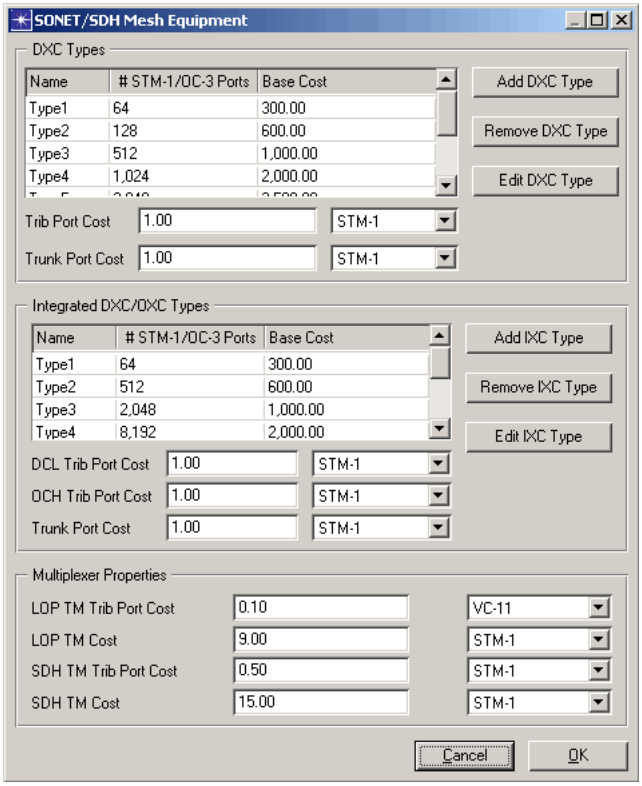
**1.1** Select **File** > **Open...**.

**1.2** Select the **WDMGuru_Examples** project, then press **Open**.

➥ The example project that contains several scenarios loads. The Australia scenario appears in the workspace.

**2** Examine the **SONET/ SDH Mesh Equipment** dialog box.

**2.1** Select **Network > Equipment Properties > SONET/ SDH Mesh Equipment...**.




You can use this dialog box to specify which DXC and integrated DXC/OXC types are supported in your network and to specify the tributary and trunk port cost for each bit rate supported by this equipment.

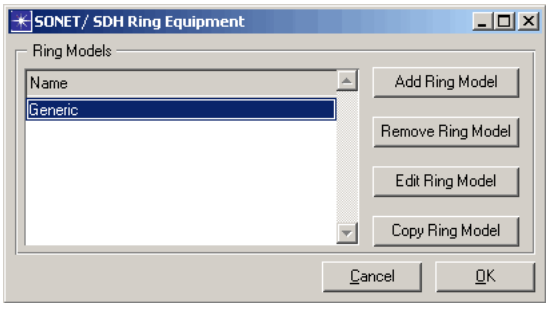
This dialog box also specifies the SONET/SDH terminal multiplexer cost for each supported bit rate. To add a new DXC or integrated DXC/OXC type, use the corresponding **Add** buttons. Similarly, you can remove or edit each type by using the corresponding **Remove** or **Edit** buttons, respectively.

**2.2** Press **Cancel** to close the dialog box.

**3** Inspect the **SONET/ SDH Ring Equipment** dialog box.

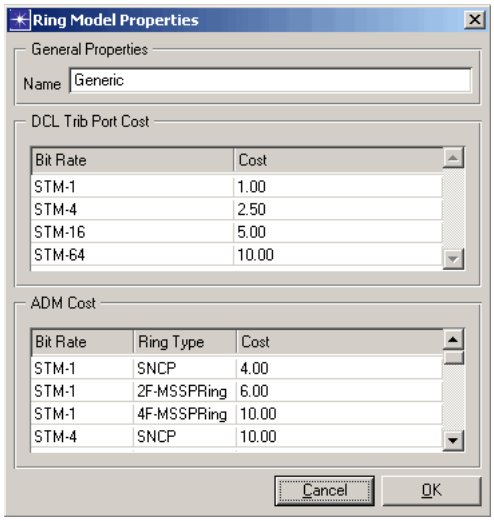
**3.1** Select **Network > Equipment Properties > SONET/ SDH Ring Equipment...**.

➥ The **SONET/SDH Ring Equipment** dialog box appears. This dialog box enables you to create, edit, and delete different ring models.



**3.2** Verify that the **Generic** ring model is selected, then click **Edit Ring Model**.

**3.3** The **Ring Model Properties** dialog box appears.

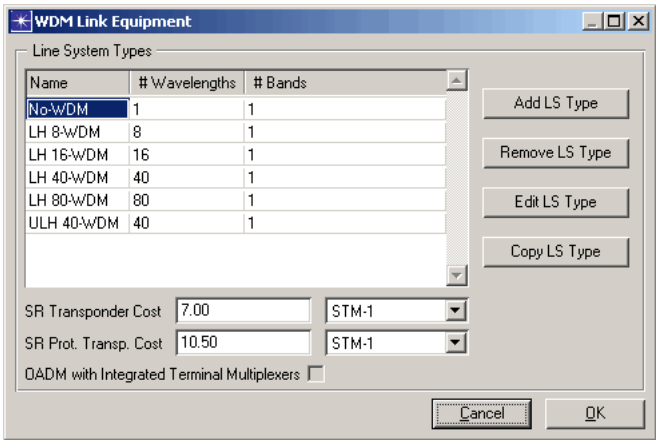



This dialog box manages the properties of an individual ring model—specifically, the cost of SONET/SDH ADM equipment and SONET/SDH ADM tributary cards for each distinct bit rate supported by your rings. Select any field under the **Cost** column to edit and enter new values.

**3.4** Close both dialog boxes by clicking **Cancel**.

**4** Examine the **WDM Link Equipment** dialog box.

**4.1** Select **Network > Equipment Properties > WDM Link Equipment...**.

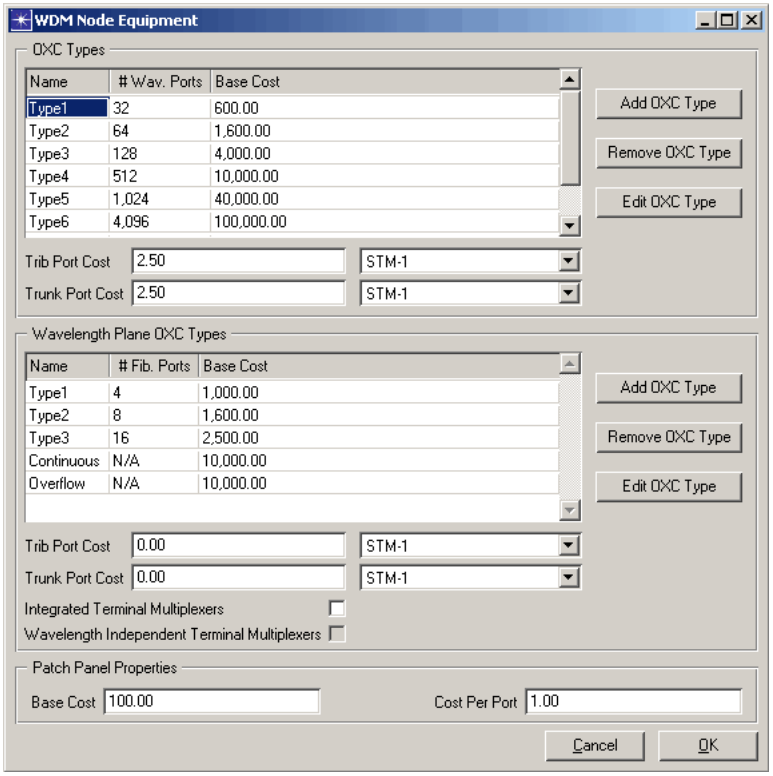



This dialog box manages the cost and properties for the WDM line systems supported in your network. Per line system type, the number of wavelengths and the number of bands is displayed. Use the **Add LS Type**, **Remove LS Type** and **Edit LS Type** buttons to manage the WDM line systems. You can also specify the short reach transponder cost (per OCH bit rate) and specify whether the OADMs in the network have integrated terminal multiplexers (only valid in transparent mode).

**4.2** Press **Cancel** to close the dialog box.

**5** Inspect the **WDM Node Equipment** dialog box.

**5.1** Select **Network > Equipment Properties > WDM Node Equipment...**.

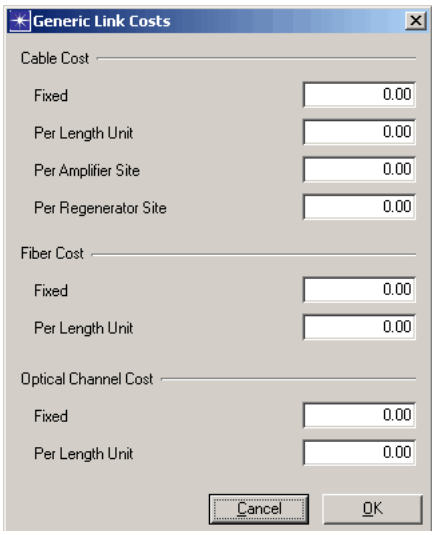



This dialog box manages the cost and properties for the (non-blocking or wavelength plane) OXC types supported in your network. Use the **Add OXC Type**, **Remove OXC Type** and **Edit OXC Type** buttons to manage the OXC types. Options concerning the wavelength plane OXCs can be specified here: whether they have integrated terminal multiplexers and whether their installed transponders are wavelength independent. In conclusion, the patch panel costs can be specified.

**5.2** Press **Cancel** to close the dialog box.

**6** Examine the **Generic Link Costs** dialog box.

**6.1** Select **Network > Equipment Properties > Generic Link Costs...**.

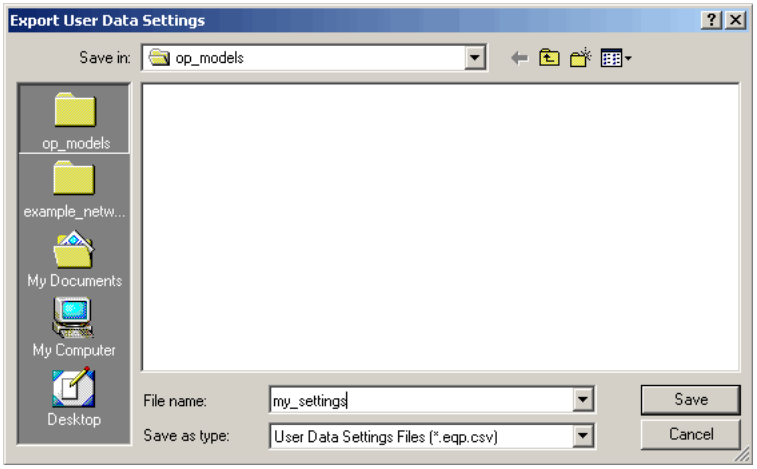



This dialog box is divided according to the layers of the network. For each layer, you can specify fixed costs as well as cost as a function of link distance. For the cables in the OTS layer, you can specify additional costs per amplification or regeneration site. These costs are added to the equipment costs. Fiber and channel costs are only counted for lit fibers and channels, respectively.

**6.2** Press **Cancel** to close the dialog box.

**7** Save and load the data settings to and from a file:

**7.1** Select **File > Export > User Data Settings** to save a set of data settings to a file. These settings consist of the equipment properties, the availability settings, and the delay settings.




After you save a User Data Settings file, you can import this data into another scenario by choosing File > Import > User Data Settings . These export/import operations allow you to easily transfer cost models among scenarios.

**NOTE—**You cannot import a User Data Settings file if the network already has equipment installed.

**NOTE—**Cost settings are maintained on a per-scenario basis, not on a per-project basis.

**8** Save and load the default data settings to and from a file:

When you create a new scenario, a default set of data settings is installed. To specify what these default settings should be, edit the current settings in all of the appropriate dialog boxes, then use File > Export > Save Default User Settings.

To load these properties into any scenario use File > Import > Load Default User Settings.

**9** Close the project.

**9.1** Select **File** > **Close**.

**9.2** Select **Don't Save** in the **Close Confirm** dialog box.

**End of Procedure 1-5**

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**Note—**See the SP Guru Transport Planner *User Guide* section on Concepts and Models for a detailed description of the cost model and equipment types supported in SP Guru Transport Planner.

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