RPMGLOBAL

haulsim

Training Workshops (Surface)

Product Version: 2.6

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Preface

The training workshops have been developed to supplement instructor led training. The guide has been constructed in a way that teaches students the key functionality of the application through practical hands on workshops. Each workshop details tasks that the student is required to complete. The workshops build on each other to help ensure a comprehensive understand of the application is achieved at the completion of the course. Space has been provided at the end of each workshop for learning checks and student notes.

Symbol Library

Note
A note for participants about the task being completed.

Important Reminder
An important reminder for the participant about the task being completed.

Learning Check
Check your understanding on the workshop and ask any related questions.

Course Outline

Pre-requisites	Experience in Mine Planning
Target Audience	Mine Planners, Project Engineers, Operational Managers, Business Improvement Specialists, Equipment Supplier Personnel
Nominal Duration	One Day
Course Objectives	This course aims to equip participants with the required knowledge and skills to use HAULSIM and tackle the complex challenges involved in mine simulation.
Learning Outcomes	At the end of the course, participants will have learned how to: • Successfully use HAULSIM • Navigate around HAULSIM • Build a HAULSIM model • Analyse a HAULSIM model
Assessment Strategy	The completion of workshop tasks
Resources	• Training workshops • Presentation • Training dataset & completed model

Background to Training Model

We will create a haulage simulation for the King Solomon Mine shown in the screen capture below.

The site has a pit, with a number of source locations where material will be excavated from. It also has a number of destinations which include dumps, crushers and stockpiles. Material will be moved from the source to the destinations by trucks via a road network. The road network will be configured to be similar to a normal mining operation (with some single lane roads, stop signs and one way roads).

The equipment to be used at the King Solomon Gold Mine will consist of three excavators (Terax (O&K) RH 120 C, Bucyrus RH 170 B, and Terax (O&K) RH 40 E), two Truck fleets (CAT 793D, and CAT 785D), as well as one wheel loader that moves material from the stockpile to the crusher (Volvo L350F).

Two different material types will be modelling (ore and waste). In some instances, material will require rehandling from the stockpile to the crusher.

The worked examples have been made as practicable as possible without becoming overcomplicated. There will be differences between your mine and the example, but the objective of the course is to learn about HAULSIM and not to create a model of your mine. Questions relating to situations or issues experienced at your mine are welcome.

Introductory Training Workshops

1 Application & Training Model Setup

Procedure – Application & Data Setup

1) Ensure **HAULSIM 2.6** is installed.

2) Open **Client License Manager** and **import** the **temporary license registration** file.

3) Create a new folder on your desktop called **Training**.

4) Copy the **Training Dataset** folder from your **USB** to the new **Training** folder.

For your reference, the Training Dataset also includes the completed training model.

Procedure – How to Access the Application

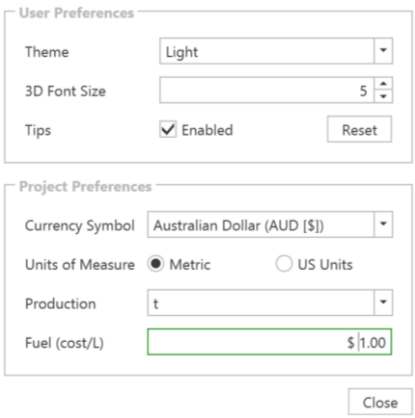
1) To access **HAULSIM**, click on the **HAULSIM** icon in your windows **Start** menu.

2) Click on **New Project**.

3) Set the **File Name** as **HAULSIM Training**.

4) Navigate to the **Training** folder created, and click **Save**.

5) In the **Preferences** window, configure the variables as follows.



6) Click **Close**.

Learning Check

Check your understanding of the workshop and ask any related questions.

Notes

2 Help & Application Navigation

Procedure – Access Help

1) To access the **Help** menu, click on the **Help** symbol in the top right hand corner of **HAULSIM**.

2) The Help menu opens in a separate window.

3) Browse through the different headings. Each heading covers a range of topics to assist with understanding the functionality in HAULSIM.

Procedure – Application Layout & Navigation

1) Discuss the key areas of the HAULSIM application. These include the **Build** and **Run** tabs, along with the **Navigator**, **3D View**, **Properties**, and **Event Log**.

Procedure – HAULSIM Simulation Settings

1) In the **File** menu, click **Simulation Settings** to show the simulation settings.

2) Review the input fields for the **General**, **Traffic**, **Fill Factors**, **Travel Time**, **Reports**, and **Time Usage** tabs.

3) Click **Close**.

Procedure – How to Move & Dock Windows

1) Left click on the **Navigator** title bar and start to drag it towards the **3D View**.

2) Discuss the layout panels appear in the centre and four sides of the screen.

3) Drop the **Navigator** window on different panels to see the effect.

4) Return the **Navigator** window to its original position.

Learning Check

Check your understanding of the workshop and ask any related questions.

Notes

3 Features

Procedure – Import Features

1) Under **Navigator**, right-click on **Features** then click **Import**.

2) Navigate to the **Training\Training Dataset\Triangulations** folder, select **Open Cut Stage Plan.dxf** then click **Open**.

3) Under **Navigator**, expand **Features** and note the newly imported feature.

4) Expand the **Open Cut Stage Plan** feature then right click on the layer **OPEN CUT STAGE PLAN**. Click **Feature Colour**. Set the colour to **light green** and discuss the application of Transparency.

5) Discuss the other right click menu options for **Features**.

6) Click **Save Project**.

Learning Check

Check your understanding of the workshop and ask any related questions.

Notes

4 Material

Procedure – Set Materials

1) Under **Navigator**, right-click on **Materials** and click **Configure**.

You can also double click on Materials to open the dialog

2) The **Materials** dialog screen is displayed.

3) Click **Add Material** to open the material list.

4) Select the **Copper Ore** row then click **Add**.

5) Review the different properties associated with the material.

Load and Haul Loading Times & Load and Carry Loading Times are covered in the advanced section of the training course.

6) Click **Close**.

Note the font has change from red to black in the Navigator window, thus verifying materials have been configured.

7) Click **Save Project**.

Learning Check

Check your understanding of the workshop and ask any related questions.

Notes

5 Road Network

Procedure – Import Road Network

1) Navigate to **Training\Training Dataset\CSV Files** then open the **Roads.csv** file. Discuss the layout of the file then close it.

2) In HAULSIM, under **Navigator**, right-click on **Road Network** then click **Import**.

3) Navigate to **Training\Training Dataset\CSV Files**, select the **Roads.csv** file and click **Open**.

4) Review the fields in the **Import Roads** dialog then click **Next**.

5) Review the **Field Names** attributed to each column then click **Import**.

6) In the **3D View** window, review the **Zoom** and **View** functionality.

To hide a Feature, right click on it and click Hide All.

7) Click **Save Project**.

Procedure – Configure Legends

1) In the **Legend** menu, click the **Grade** legend from the drop down list, then click **Show** to display the legend. Review the graphics in the **3D View**.

2) In the **Legend** menu, click **Configure**.

3) Change the **upper value** of the **second increment**, and the **lower value** of the **third increment** to be **10%**.

4) Click **Close** and review the graphics in the **3D View**.

5) **Close** the Legend window.

Procedure – Configure Cutting Planes

1) In the **Cutting Planes** menu, select **Configure**.

2) Activate **Top** (tick) and set the elevation at **1200**. Click **OK** and review the 3D View.

3) Click **Configure**, then deactivate **Top**. Click **Close**.

Learning Check

Check your understanding of the workshop and ask any related questions.

Notes

6 Sources

Procedure – Import Sources

1) Under **Navigator**, expand **Locations,** right-click on **Sources**, then click **Import**.

2) Navigate to the **Training\Training Dataset\CSV Files** folder, select **Sources.csv,** then click **Open**. Review the fields then click **Next**. Check that the fields have been mapped appropriately then click **Import**.

3) Review the imported **Sources** in the **3D Graphic**.

4) Under **Navigator**, expand **Locations,** right click on **Sources** then click **Configure**.

5) Navigate to the **Loading** column for **Source 01** and select **Double Sided** from the drop down menu for methodology.

6) In the same manner change the **Loading** values for **Source 02** and **Source 03** to **Double Sided**.

7) Click **Close**.

Procedure – Navigate Around Grids

1) With the **Sources** window still open, hover the mouse over the **Name** column header and select the **Filter** icon. Click **Source 03** and note how this is the only source that now appears in the table. Click the **Filter** icon then click **(All)**.

2) Right click on the **Name** column to display menu then discuss the options available.

3) Click **Show Search Panel**.

4) Type **3** into the search window and note that now only sources which have 3 are now visible in the table.

5) Click **Close** on the search panel, then **Close** on the Sources dialog.

6) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

7 Destinations

Procedure – Import Destinations

1) Under **Navigator**, expand **Locations**, right-click on **Destinations**, then click **Import**.

2) Navigate to the **Training\Training Dataset\CSV Files** folder, select **Destinations.csv** then click **Open**. Review the fields and click **Next**. Check that the fields are mapped correctly then click **Import**.

3) Review the imported **Destinations** in the **3D View**.

4) Under **Navigator**, expand **Locations**, right-click on **Destinations**, then click **Configure**.

5) Discuss the different options and update the **values** as shown below.

Name	Layout	Bays	Crush Rate (tph)	Initial Qty (t)	Material	Capacity (t)	Ore Pass Out	Max Queue
Conveyor Discharge Point	Stockpile	1		0.00	Copper Ore	1,000.00		
Conveyor Feed Point	Dump	1						
Crusher	Crusher	1	2,000.00			500.00		2
Dump 01	Dump	1						
Dump 02	Dump	1						
Dump 03	Dump	1						
Leach	Dump	1						
Stockpile	Stockpile	1		2,000.00	Copper Ore	5,000.00		
Truck Load Area	Loading Point			0.00	Copper Ore	200.00		

6) Click **Close**.

7) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

8 Ancillary Locations

Procedure – Import Ancillary Locations

1) Under **Navigator**, expand **Locations,** right-click on **Ancillary Locations**, then click **Import**.

2) Navigate to the **Training\Training Dataset\CSV Files** folder, click **Ancillary.csv,** then click **Open**. Review the fields and click **Next**. Check that the fields are mapped correctly then click **Import**.

3) Double click **Ancillary Locations** under **Navigator** to display the **Configure** window.

4) Discuss the different fields options and update as shown below:

Name	Type
Workshop	Workshop
Fuel Bay South	Fuel Bay
Fuel Bay North	Fuel Bay
Temp Crib Hut	Lunch Room
Crib Hut	Lunch Room

5) Click **Close**.

6) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

9 Equipment

Procedure – Add New Loading Units

1) Under **Navigator**, expand **Equipment**, then double click on **Loading Units**.

2) Under **Loader Types**, click **Add Loader Type**.

3) Discuss the purpose and features of the **Equipment Library** and how the **Standard** and **User** libraries work.

4) Select the **Terex (O&K) RH 120 C Shovel** by using both the **Search** and **Filter** functionality.

5) Review the components of the equipment then click **Select Equipment**.

6) Repeat the required steps above to add a **Bucyrus Shovel RH 170 B (T2 Cat)** and **Terex (O&K) Backhoe RH 40 E (T3 Cat)**.

7) Ensure the **Animation Type** for the **Loading Type** is correctly configured.

Note that the Settings for each Loader Type will be configured in later workshops

8) Under **Loader Types**, click the **RH 120 C** row then click **Add Loading Unit** in the **Loading Units** section.

9) Repeat for the **RH 170 B** and **RH 40 E** then update the **Start Locations** as shown below.

Name	Loader Type	Start Location
Loader 01	Terex (O&K) RH 120 C	Source 01
Loader 02	Bucyrus RH 170 B	Source 03
Loader 03	Terex (O&K) RH 40 E	Source 05

You can also double click on the Load & Haul Unit Types to add a unit below.

10) Click **Close**.

11) Click **Save Project**.

Procedure – Add New Load & Haul Units

1) Under **Navigator**, expand **Equipment**, then double click on **Load & Haul Units**.
2) Under **Load & Haul Types**, click **Add Load & Haul Type**.
3) Search for the **Caterpillar 793 D (MA-1 Standard) Rear Dump** truck.
4) Review the components of the equipment then click **Select Equipment**.
5) Repeat the required steps above to add a **Caterpillar 785 D (Standard)** truck.
6) Ensure the **Animation Type** for the **CAT 793 D** is set to **Large Truck** and the **CAT 785 D** to **Small Truck**.
7) Under **Load & Haul Types**, select equipment **Caterpillar – 793 D**.
8) Under **Load & Haul Units**, click **Add Load & Haul Unit** ten times. Repeat step for the **Caterpillar – 785 D** fleet. There will be 20 trucks in total now for the model.
9) Click **Close**.
10) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

10 Tasks

Procedure – Add Load & Haul Tasks

1) Under **Navigator**, right click on **Tasks** then click **Configure**.

2) Click **Add Load and Haul Group** to create three **Task Groups**.

3) Configure the tasks as shown below.

Group				Task						
Group Type	Primary Equipment	Dispatcher Target Rate (tph)	Group Cycles	Source	Destination	Material	Quantity (t)	Secondary Equipment	Task Cycles	Id
Load & Haul	Loader 01	1,000.00		Source 01	Dump 01	Copper Ore	50,000.00		∞	1
Load & Haul	Loader 02	1,000.00		Source 03	Crusher	Copper Ore	70,000.00		∞	2
Load & Haul	Loader 03	1,000.00		Source 05	Dump 03	Copper Ore	100,000.00		∞	3

4) Click **Close**.

5) Click **Save Project**.

Note that Tasks is red under Navigator. This indicates that there are errors in the configuration of the Tasks or in the Haul Network. Select Load & Haul Tasks then select the Event Log Viewer.

Procedure – Find Missing Segments

1) Review the haulage route from **Source 05** to the **Dump 03**.

2) Note the section missing from the data that was imported.

3) This can either be fixed in the original haul network dataset or in HAULSIM by drawing a road to connect the route. For the purposes of the training course this will be completed in HAULSIM and the steps are shown in the section below.

Procedure – Draw a Road

1) On the main toolbar, click on **Roads**.

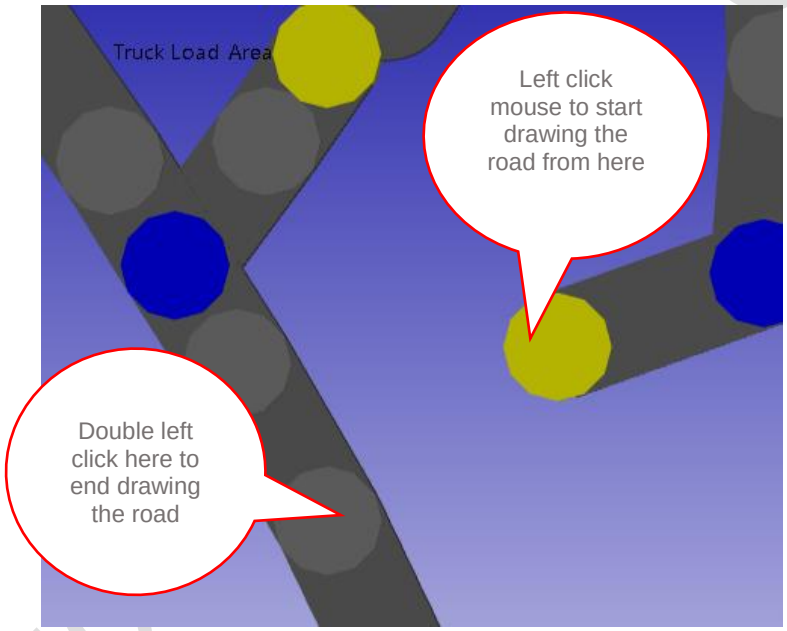
2) Click the **Draw Road** option from the drop down menu.

3) Choose the start location on the workspace as shown in the picture below and move the cursor there.

4) Left click the mouse to start drawing the road.

5) Move the mouse cursor to the end position (see picture below).

6) Double click or press enter to end drawing of the road.



7) Click the **Individual** cursor from the drop down menu and click anywhere in the workspace. The new road is now added to the network.

8) Note the red error in the **Tasks** is resolved.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

11 Run Simulation & View Dashboards

Procedure – Run Simulation & View Dashboard

1) Click the **Run** tab.

2) Navigate to the **Duration** field at the bottom of the screen and change number from **0** to **12**.

This will stop the simulation at 12 hours duration (simulation time).

3) **Navigate** to the **Simulation** menu and click **Run**.

4) Adjust the **Run Speed** slider to slow down the speed of the simulation.

5) Zoom in and out to view the animation of the equipment completing the tasks. Discuss the different shading of the equipment.

6) Review the following simulation **Dashboards**: Material Movement, Tasks, States, Performance, Costs, Productivity, and Fuel Consumption.

7) Adjust the **Run Speed** slider to speed up the simulation.

8) Ensure the simulation runs for the entire duration to allow reports to be fully populated. Once completely run, the **Simulation Time** will change to **20:00:00**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

12 Reports

Procedure – Review Report Layout

1) Navigate to the **Analysis & Report** menu and click **Reports**.

2) Review the different report sections: Haul Unit Summary, Loading Unit Summary, Haul Unit State, Loading Unit State, and Material Movement Summary.

Procedure – Change How Report Data is Displayed

1) Click the **Haul Unit Summary** report tab.

2) Right click **next** to **Data Headers** and click **Show Field List**.

3) Click next to **Data Headers** then hover the mouse cursor over the menu option. Note that these fields now displayed are the report columns.

4) Right click on **Operating Cost** and click **Hide** to remove this as a reporting column.

5) Do the same for the **Ownership Cost** and **Fuel Cost** fields.

6) Hover the mouse over **Data Headers** and drag **Fuel Consumed (L)** to be after **Volume (m3)**.

7) From the **PivotGrid Field List**, drag **Distance Travelled (km)** to the **Data Headers** list after **Fuel Consumed (L)**.

8) Drag **Material** from the **PivotGrid Field List** to the right of **Equipment** and review how the data is now displayed (note that currently the model is only set with one material type). Advanced workshops will introduce new materials and the report will update accordingly.

Fields for each report (loading unit summary, haul unit state etc). are customised for each type of report.

Procedure – Using Report Graphs

1) Click on each report column header and review its corresponding graph.

2) Click on the **Truck 01 Total** and review the corresponding graph.

3) Click on the **Chart Type** dropdown and select **Bar Series 3D**.

Procedure – Export Raw Data to Excel

1) Click **Export** and review the options available.

2) Click **Export Raw Data to Excel**, when prompted save the report to the **Training** folder then open it when prompted.

3) Review the information reported.

4) **Close** the excel report and return to HAULSIM.

5) **Close** the Pivot Grid Report window.

Procedure – Cycle Time Analysis

1) Click the **Build** tab.

2) Under the **Tools** menu, click **Cycle Time**.

3) Ensure the following fields are set:

Field	Setting
Path	Quickest
Loader	Terax (O&K) RH 120 C
Hauler	Caterpillar - 785 D
Material	Copper Ore
Start	Source 01
End	Dump 01

4) Click **Find Route**.

5) Review the reporting field values for this route.

6) Double click on the cycle time reporting row to view the **Travel Times Details** window.

7) Review the reporting fields for each segment and discuss the **Performance Limit** (Maximum Speed Limit) and the **Equivalent Cornering Radius (m)**.

8) **Close** the **Travel Time Details** window and the **Cycle Time** window.

Procedure – Cornering Speed and Radius

1) In the **File** menu, click **Simulation Settings** and open the **Cornering Speed** tab.

2) Tick **Enable Cornering Speed**, discuss the different fields and leave as the default.

3) Click **Close**.

4) In the **Cycle Time** menu click **Find Route** assuming the route is the same as the previous procedure.

5) Double click on the cycle time reporting row to view the **Travel Times Details** window.

6) Review the reporting fields for each segment and discuss the updated **Equivalent Cornering Radius (m)**.

7) **Close** the **Travel Time Details** window and the **Cycle Time** window.

8) In **Simulation Settings** proceed to the **cornering speed** tab and untick **Enable Cornering Speed**.

9) Click **Save**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

13 Create New Materials

Procedure – Create New Materials

1) Return to the **Build** tab.

2) Under **Navigator**, right-click on **Materials** then click **Configure**.

3) Click **Copper Ore** and click **Copy Material**.

4) Set the values of the new material as follows.

Name	Insitu Bank Density	Excavatability	Swell Factors	Loader Bucket Fill Factor
Waste	2.40	Hard	1.5	Average

5) Click **Close**.

6) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

14 Add New Tasks to Task Groups

Procedure – Create New Tasks

1) Select the **Task Group** row for **Loader 01** (Task ID 1).

2) Click **Add Task** and review the configuration for the second task in that group.

3) Repeat these steps for **Loader 02** and **Loader 03**.

4) Configure the **Tasks** as shown below.

Group				Task					
Group Type	Primary Equipment	Dispatcher Target Rate (tph)	Group Cycles	Source	Destination	Material	Quantity (t)	Secondary Equipment	Task Cycles	Id
Load & Haul	Loader 01	1,200.00	∞	Source 01	Dump 01	Waste	10,000.00		∞	1
					Leach	Copper Ore	5,000.00		∞	4
Load & Haul	Loader 02	1,800.00	∞	Source 03	Crusher	Copper Ore	20,000.00		∞	2
					Stockpile	Copper Ore	10,000.00		∞	5
Load & Haul	Loader 03	700.00	∞	Source 05	Dump 03	Waste	5,000.00		∞	3
					Dump 01	Waste	2,000.00		∞	6

5) Review the functionality to delete task group, move group up/down, delete task, and move task up/down).

6) Click **Save Project**.

7) Click the **Run** tab. **Run** the simulation at **Run Speed Max**. Review the **Tasks** and **Material Movement** dashboards.

8) Click **Reports** and note the **Total Production** from **Source 01** (Material Movement Summary Tab). This will be used in the next workshop. Close the **Report** window.

If Task Cycles is set to 0 (infinity) then both tasks in the group are started at the same time and HAULSIM mines them proportionately so they finish at the same time. If it is required that one tasks is completed before the next then set each task up as a separate group.

9) Open **HAULSIM Help** and search for Tasks. Review the documentation for Tasks paying particular attention to **Dispatcher Target Rate** and **Rules Used When Completing Tasks**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

15 Ancillary Equipment

Procedure – Create Ancillary Unit (Grader)

1) Click the **Build** tab. Under **Navigator**, expand **Equipment**, then double click on **Ancillary Units**.

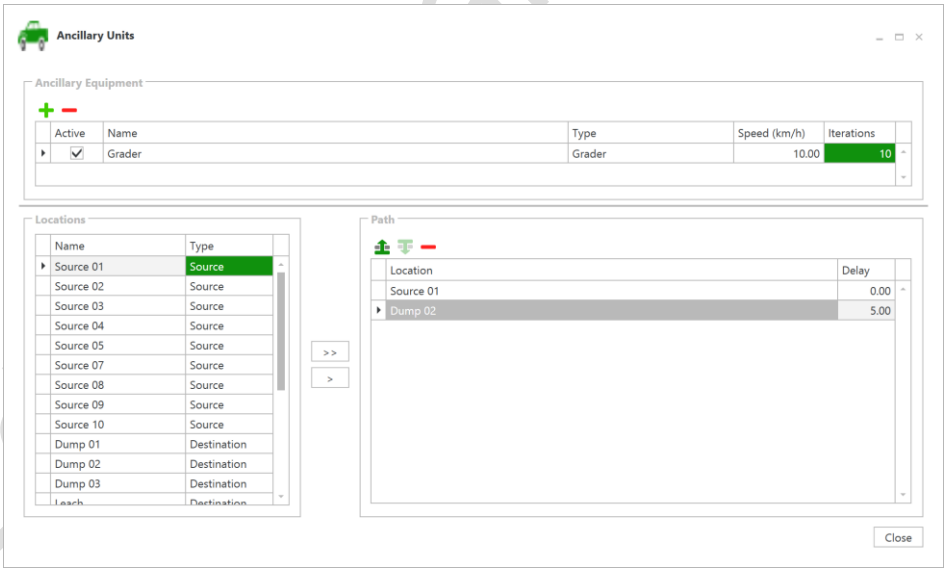
2) Click **Add Ancillary Equipment**.

3) Under **Ancillary Equipment**, rename **Vehicle 01** to **Grader**, change **Type** to **Grader**, leave **Speed** at **10km/hr**, and set **Iterations** to **10**.

4) Under **Locations**, select **Source 01** and **Dump 02**. Click the **Move** icon (single arrow) to add these locations to the path.

Note you can multi-select locations by using shift and ctrl keys.

5) Set the **Delay** of **Dump 02** to be **5.00**. The final configuration is as shown below.



6) Click **Close**.

7) **Run** the simulation at **Run Speed 1.0** to observe the interaction of the grader on the circuit. Increase the **Run Speed** to **Max** and complete the simulation for the shift. Review the total material movement from **Source 01** to understand the impact of the grader on production.

8) **Deactivate** (untick) the **Grader** in **Ancillary Units**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

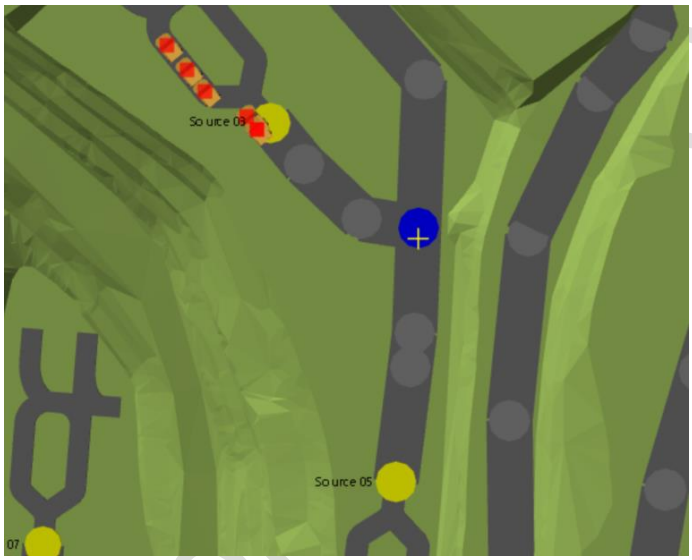
16 Road Rules

Procedure – Add Stop Sign

1) In the **3D View**, navigate to the intersection of **Source 03** and **Source 05**.

2) Click **Traffic Rules** from the main menu and click **Stop** from the drop down list.

3) Double click on the node from the Source 05 road to release the **STOP** sign and add it to the road network (see picture below).



4) Click **Individual** from the drop down menu and click anywhere in the workspace. The Stop sign is added to the road network.

Different road rules cannot be set adjacent to each other as road rules are attached to nodes between arcs. At least two arcs with no rules are required between arcs containing rules.

5) **Run** the simulation at **Run Speed 0.2** to observe the impact of the stop sign. Increase the **Run Speed** to **Max** and complete the simulation for the shift. Review the total material movement from **Source 05** to understand the impact of the stop sign on production (if any).

6) Click **Save Project**.

Procedure – Add One Way Road

1) In the 3D View, navigate to the **Crusher** area.

2) Run the simulation at **Run Speed 1.0**. Observe the behaviour of the vehicles travelling in both directions to the crusher.

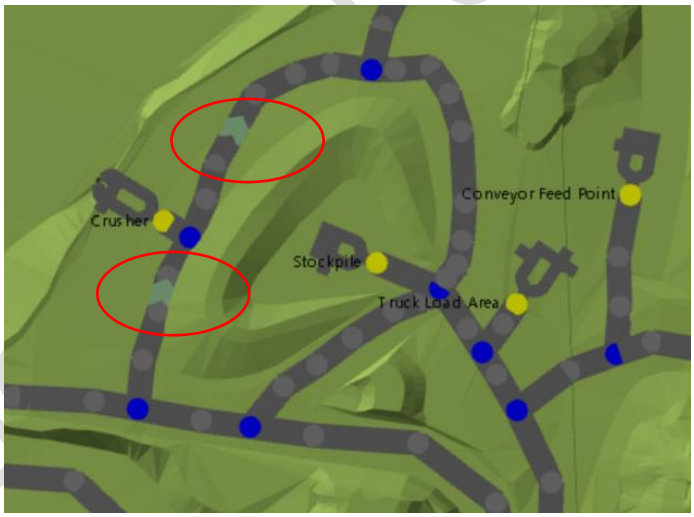
3) Click the **Build** tab.

4) Click **Traffic Rules** from the main menu then click **One-Way** from the drop down list.

5) Double click to release the **ONE-WAY** controls as shown below.

Double click on the ONE-WAY sign to change the direction of travel on the road.

6) Click **Individual** and click on the screen.



7) **Run** the simulation at **Run Speed 1.0**. Observe the behaviour of the vehicles where road rules are applied.

8) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

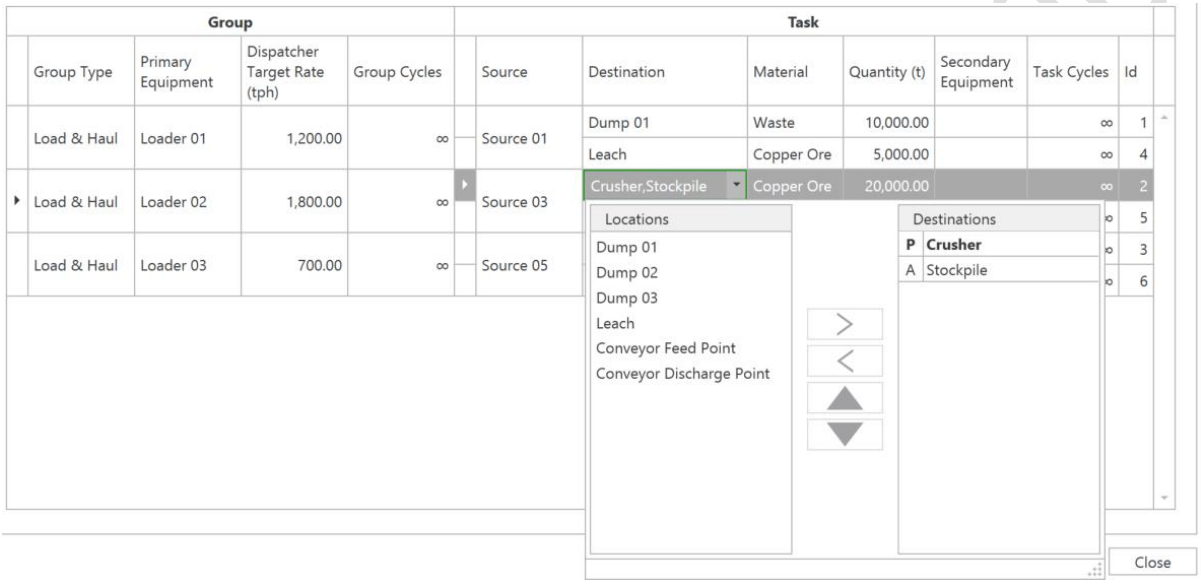
17 Configure Stockpile & Loader

Procedure – Add an Alternative Destination & Max Queue at Crusher

1) Click the **Build** tab.

2) Under **Navigator**, double click **Tasks**.

3) To add an alternate destination, click the **Crusher** destination for **Task Id 2**. Under **Locations**, click **Stockpile** then click the **single right arrow**.



4) Click **Close**.

5) Under **Navigator**, expand **Locations** then double click on **Destinations**. Review the **Max Queue** currently set for the **Crusher**.

6) Click **Close**.

7) **Run** the simulation at **Run Speed Max**. Observe the behaviour of the trucks around the **Crusher** and also note the quantity of material dumped at the Stockpile.

8) Click **Save Project**.

Procedure – Add a New Load & Carry Type of Equipment

1) Under **Navigator**, expand **Equipment**, then double click on **Load & Carry Units**.

2) Click the **Add Load & Carry Type** icon to open the **Equipment Library**.

3) Find and select the **Volvo CE - L 350 F** front end loader. Click **Copy**.

4) Discuss the use of the **User Database** then click **OK**.

5) Click the **L 350 F** that has been created in the **User Library** and update with the following configuration.

Field	Setting
Model	L 350 F - A
Engine	Volvo D16 LAE3
Bucket	Rock STE Teeth 6.6m^3 / 8.6yd^3)

6) Click **Save**.

7) With the **L 350 F - A FEL** still selected, click **Select Equipment**.

8) Click **Close**.

Procedure – Add a New Load & Carry Unit

1) Ensure the **Load & Carry Units** configuration window is still open.

2) Under **Load & Carry Type**, Click the **Volvo CE – L 350 F – A** type.

3) Click the **Add Load & Carry Unit** icon.

4) Set the **Name** of the **L 350 F** unit to be **FEL 01** and leave the **Start Location** set as **Workshop**.

5) Click **Close**.

Procedure – Add New Load & Carry Task Group

1) Under **Navigator**, double click **Tasks**.

2) Click **Add Load and Carry Group**.

3) Set the **Source** as **Stockpile, Destination** as **Crusher** and ensure the **Material** is set as **Copper Ore**. Leave the default **Quantity** as **100,000**.

4) Click **Close**.

5) **Run** the simulation at **Run Speed 1.0**. Observe the stockpile loader reclaiming material from the stockpile to crusher.

6) Click **Save Project**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

18 Edit Road Network

Procedure – Import a New Road

1) Under **Navigator**, right-click on **Road Network** then click **Import**.

2) Navigate to **Training\Training Dataset\Complex Road\Complex Road.csv** and click Open.

3) Review the configuration of the fields then click **Next** followed by **Import**.

4) The new complex road network is displayed as shown below.

5) Zoom in and view the large number of nodes on the newly imported road.

Procedure – Simplify a Road

1) Choose the **Rectangle** function from the **Select** drop down menu.

2) Use the **Rectangle** select function to select all nodes in the newly imported road and note how the selected segment is now highlighted blue.

Draw rectangle from top left to bottom right to include all segments that the rectangle crosses. Draw from bottom right to top left to include only those segments which are 100% included in the rectangle.

3) Click the **Simplify Roads** tool from the **Ribbon**.

4) Tick the **Simplify** check box and enter the **Horizontal Tolerance** to be **10m**, and the **Vertical Tolerance** to be **1m**.

5) Click **Simplify** then **Cancel**.

6) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace.

7) Zoom in to see the simplified road with reduced number of nodes.

Procedure – Simplify a Road (Auto Connect)

1) Use the **Rectangle** select function to select all nodes in the newly imported road.

2) Click **Simplify Roads**.

3) Tick **Auto Connect** check box and enter the **Horizontal Tolerance** to be **20m**, and the **Vertical Tolerance** to be **5m**.

4) Click **Simplify** then **Cancel**.

5) Click **Individual** from the Select drop down menu and click anywhere in the workspace.

6) Zoom in to see the simplified road with connected nodes.

7) Use **Rectangular** select to select the segments still not connected and repeat the Auto Connect process using **30m Horizontal Tolerance**.

8) Select the **Grade Legend** to review the grade of the newly imported and simplified road.

Procedure – Draw Road

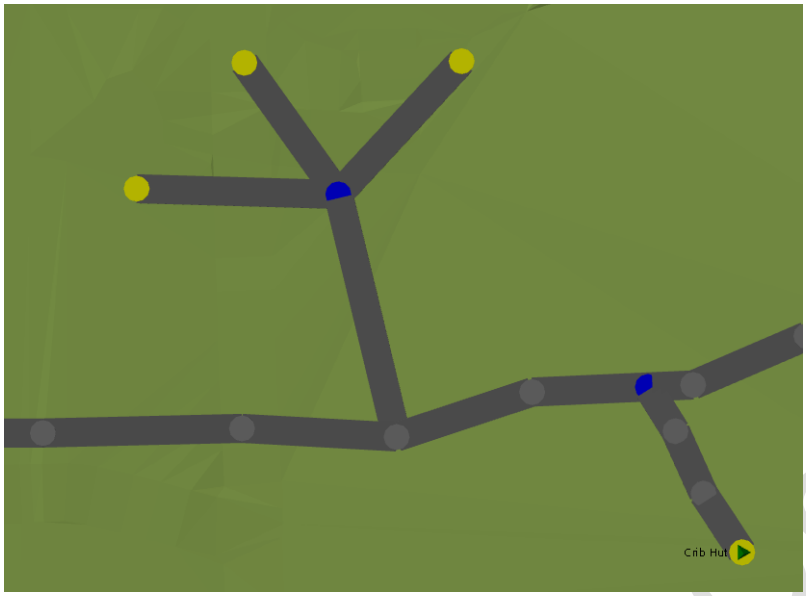
1) In the 3D View, navigate to the **Crib Hut** area.

2) Click on **Roads** menu option and choose the **Draw Road** option from the drop down menu.

3) Navigate to an empty space on the surface topography and click the mouse. Click to create the following nodes.

4) Double click or click Enter to end drawing of road. The four road segments will look similar to the picture below.

5) Click **Individual** and click on the screen.



Procedure – Add a Node

1) Click **Add Node** from the **Roads** drop down menu.

2) Choose a segment from the newly created road where you would like the node placed. **Double click** at the location where you would like to add the node.

3) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace and view the newly created node.

Procedure – Move a Node

1) Select **Move Node** from the **Roads** menu option.

2) Click the node which was created in the procedure above and ensure it highlights in blue.

3) **Click + Drag**, then release the mouse when the node is in its desired location.

4) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace.

Multiple nodes can be moved at one time. To move more than one node at a time, select a node and hold down Ctrl key to select more.

Procedure – Remove a Node

1) Click on **Remove Node** from the **Roads** menu option.

2) Click the node moved in the procedure above and **double click** on it.

3) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace. Note that the node has now been removed from the workspace.

Procedure – Delete a Segment

1) Navigate to the road segments previously drawn near the **Crib Hut**.

2) Left click mouse on one of the road segments and note how it highlights blue.

3) Press **Delete** on the keyboard.

4) Redraw the deleted road segment.

Procedure – Draw a Road Using Drawing Restrictions

1) Click on **Draw Roads**.

2) Click the **Draw Road** option from the **Road** drop down menu.

3) Navigate to **Road Drawing Restrictions** in the status bar at the bottom of the screen.

4) Tick the **Length** field and change its value to **250m** and tick the **Grade field** and set to **7%**:

5) Click an empty space on the workspace and move the cursor there. Left click the mouse. Note how a circle appears measuring 250m from the original cursor.

6) Click the mouse once in the end of the circle to end the road segment. Note how the circle now adjusts to be a **250m** radius from the previous mouse click, allowing the next segment to be drawn in a different direction.

7) In the similar way, draw one more road segments. Double click or press Enter to end drawing of road.

8) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace. Rotate and review the new road which was added to the network.

9) **Delete** the segments of the new road just created.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

19 Add New Locations

Procedure – Create New Source

1) In the 3D View, navigate to the **Crib Hut** area.
2) In the **Build Simulation** menu, click **Sources** then click **Load & Carry**.
3) Double click on one of the yellow **Termination Points** created in the previous workshop.
4) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace. Note how **Source 11** has now been added to the road network.

Procedure – Rename a Source

1) Click on the new Source previously created. It will be highlighted blue.
2) In the **Properties** box, click inside the field beside **Name**. Change the name to **New Source**.
3) Click anywhere in the **3D View**.

Procedure – Create a New Destination

1) In the **Build Simulation** menu, click **Destinations** then click **Stockpile**.
2) Double click a different yellow **Termination Point** at the end of the new road previous created
3) **Destination 1** has been added to the road network.
4) Rename **Destination 1** to **New Stockpile** in the **Properties** window.
5) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace.

Procedure – Create Ancillary Location

1) In the **Build Simulation** menu, click **Ancillary** then click **Fuel Bay**.

2) Click **Fuel Bay** from the **Ancillary** drop down menu.

3) Double click on a different yellow **Termination Point** just created, and view the new Ancillary location.

4) Change the **name** of the new Ancillary location to **New Fuel Bay**.

5) Click **Individual** from the **Select** drop down menu and click anywhere in the workspace.

6) The Locations created should be similar to the screenshot below.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

20 Match Loaders to Trucks

Procedure – Create an Equipment Group

1) **Run** the simulation at **Run Speed 1.0**. Observe how all trucks go to all loaders.

2) Under **Navigator**, double click on **Groups**.

3) Click the **Load & Haul** tab.

4) Click the **Add Group** icon and rename it to **TG 793 D**.

5) In the **Available Trucks** table, use the **Ctrl** key and click the ten **Caterpillar 793 D** trucks.

6) Use the single right **Arrow** icon to move selected equipment from the **Available Trucks** table to the **Assigned Trucks** table.

A group name must be selected for the arrowed buttons to be enabled.

7) Repeat the above steps to create a truck group for the **Caterpillar 785 D** trucks called **TG 785 D**.

8) In the **Groups** dialog box, click the **Loaders** tab.

9) Click the **Add Group** icon and add three groups.

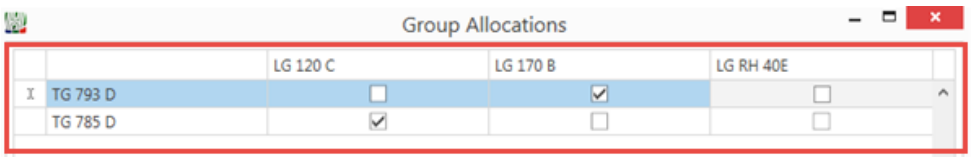
10) Rename **Group 1** to **LG RH 120 C**, **Group 2** to **LG RH 170 B** and **Group 3** to **LG RH 40 E**.

11) Allocate the appropriate **Available Loader** to each **Loader Group**.

Procedure – Allocate Trucks to a Loader

1) In the **Groups** dialog box, click the **Group Allocations…** icon.

2) Untick boxes to change group allocations as shown below.



3) Click **Close** on the **Group Allocations** and **Group** dialog boxes.

Procedure – Truck & Loader Loading Times

1) Under **Navigator** right-click on **Material** then click **Configure**.

2) Click the **Load and Haul Loading Times** tab.

3) Click on the loading time for the **RH 170 B** and **785 D** to see additional information.

4) Review the data and discuss where this information has been derived from. Leave default values as is.

5) Click **Close**.

6) **Run** the simulation at **Run Speed 1.0**. View the animation and observe the CAT 793 trucks (large trucks) going to RH 170 B (Source 3) and the CAT 785 trucks going to RH 120 C (small trucks). Note how Loader 3 has no trucks during the simulation.

Procedure – Load & Carry Loading Times

1) Under **Navigator** right-click on **Material** and click **Configure**.

2) Click the **Load & Carry Loading Times** tab.

3) Click on the **CAT 785 D** Loading Time value to display the distribution data.

4) Review and discuss then click **Close**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

21 Conveyors & Feeders

Procedure – Draw Conveyor

1) On the **Build** tab, under **Navigator** expand **Locations** then double click on **Destinations**.

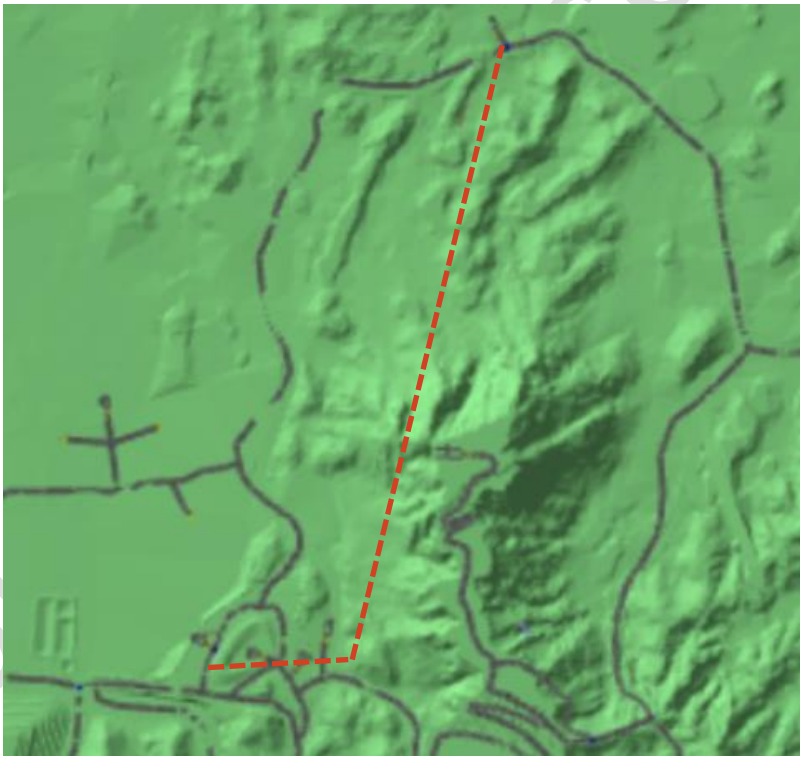
2) Navigate to the **Conveyor Feed Point** row and click on the **Layout** dropdown and choose **Crusher**.

3) Set the **Crush Rate** to **2,000** and the Capacity to **500t**.

4) Click **Close** on the Destinations dialog.

5) Under **Build Simulation**, click **Infrastructure** then **Draw Conveyor**.

6) Click on the **Crusher**, then the **Conveyor Feed Point**, then double click on the **Conveyor Discharge Point** as shown below.



Procedure – Add Conveyor

1) Under **Navigator**, expand **Equipment** then double click on **Conveyors**.

2) Under **Conveyors**, set the **Name** to **Conveyor**, **Capacity** to **500t**, and **Throughput** to **3,000t**.

3) Under **Feed Points**, set **Capacity** of both to **500t**.

4) Click **Close**.

Procedure – Feeders

Feeders instantaneously move material from one location to another. They are more applicable for underground simulations moving ore from an ore pass to a crusher but can be applied to open pit models if required.

Procedure – Run Simulation & Reset

1) **Run** the simulation at **Max Run Speed**. View the dashboards for **Material Movement** and **Equipment States** to see the impact of the conveyor on the simulation. Note that the Conveyor Discharge Point reaches it's capacity part way through the simulation.

2) Click the **Build** tab, expand **Locations**, then double click on **Destinations**.

3) For the **Conveyor Discharge Point**, increase the **Capacity** to **100,000t**. Click **Close**.

4) **Run** the simulation at **Max Run Speed**. View the dashboards for **Material Movement** and **Equipment States** to see the impact of increased capacity at the Conveyor Discharge Point. Note that the Stockpile reaches it's capacity part way through the simulation with the Loader blocked by trucks waiting to dump.

5) Click the **Build** tab, expand **Locations**, then double click on **Destinations**.

6) For the **Stockpile**, increase **Capacity** to **15,000t**. Click **Close**.

7) Run the simulation at **Max Run Speed**. Click **Reports** and note the **Total Material Movement** from **Source 01** and **Source 03** for the next workshop.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

22 Stoppages

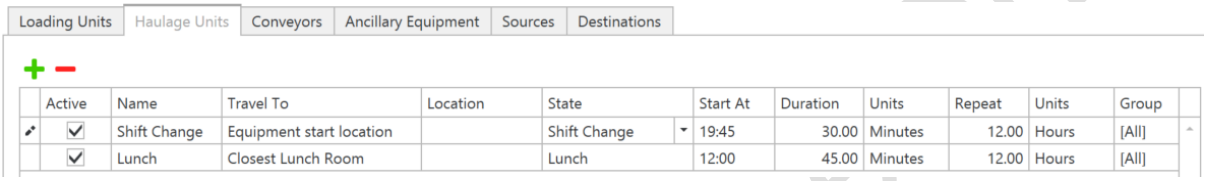
Procedure – Add Regular Stoppages

1) Under **Navigator**, double click on **Regular Stoppages**.

2) Click the **Haulage Units** tab.

3) Click **Add Regular Stoppage**.

4) Create the **Regular Stoppages** as shown in the diagram below.



Active	Name	Travel To	Location	State	Start At	Duration	Units	Repeat	Units	Group
☑	Shift Change	Equipment start location		Shift Change	19:45	30.00	Minutes	12.00	Hours	[All]
☑	Lunch	Closest Lunch Room		Lunch	12:00	45.00	Minutes	12.00	Hours	[All]

5) Click **Close**.

Procedure – Add Random Stoppages

1) Under **Navigator**, double click on **Random Stoppages**.

2) Click the **Haulage Units** tab.

3) Click **Add Random Stoppage**.

4) Rename the **Name** field to **Refuelling**.

5) Navigate to **Travel To** column and choose **Closest Fuel Bay** from the drop down menu.

6) Navigate to **State** column and choose **Refuelling** from the drop down menu.

7) Navigate to **First Stop At** column and click on the **Ellipsis**.

8) Discuss the various functions distribution curves and how they apply to the simulation model. Leave the default Normal curve as is for First Stop At (min), Stop Interval (min), and Stop Time (min).

9) Click **OK** on the **Expression Builder** dialog box, then **Close** on the **Random Stoppages** dialog box.

10) **Run** the simulation at **Maximum Run Speed**. Click Reports and note the **Total Material Movement** from **Source 01** and **Source 03**.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

23 Equipment Costing

Procedure – Add Loader Costs

1) Under **Navigator**, expand **Equipment**, double click **Loading Units**.

2) Under **Loading Unit Types** click the **Settings** icon for the **RH 120 C**.

3) Review the **Operational Data**, **Costing Data**, and **Distribution Data** tabs.

4) On the **Costing Data** tab, enter a **Purchase Price** of **$1,800,000**.

5) Under **Operating Costs** place a check mark in **Edit Total Operating Cost (Per Hour),** and enter an operating costs of **$216**.

6) Click **Close**.

7) Click the **Settings** icon for the **RH 170 B**, set the **Purchase Price** as **$2,100,000** and the **Total Operating (cost/hr)** as **$305**. Click **Close**.

8) Click the **Settings** icon for the **RH 40 E**, set the **Purchase Price** as **$1,100,000** and the **Total Operating (cost/hr)** as $**146**. Click **Close**.

Procedure – Add Load & Haul Costs

1) Under **Navigator**, expand **Equipment** then double click on **Load & Haul Units**.

2) Under **Load & Haul Unit Types** click the **Settings** icon for the **Caterpillar – 793 D**.

3) Review the **Operational Data**, **Costing Data**, and **Distribution Data** tabs.

4) In the **Costing Data** tab, set the **Purchase Price** to be **$1,100,000** and **Total Operating (cost/hr)** to be **$145**. Click **Close**.

5) Click the **Settings** icon for the **Caterpillar – 785 D**, set the **Purchase Price** as **$1,000,000** and the **Total Operating (cost/hr)** as **$130**. Click **Close**.

6) **Run** the simulation at **Maximum Run Speed**. Click **Reports (Haul Unit Summary)**, update the **Data Headers** to include **Operating Cost** and **Ownership Cost** from the **Field List** and observe the cost data generated.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

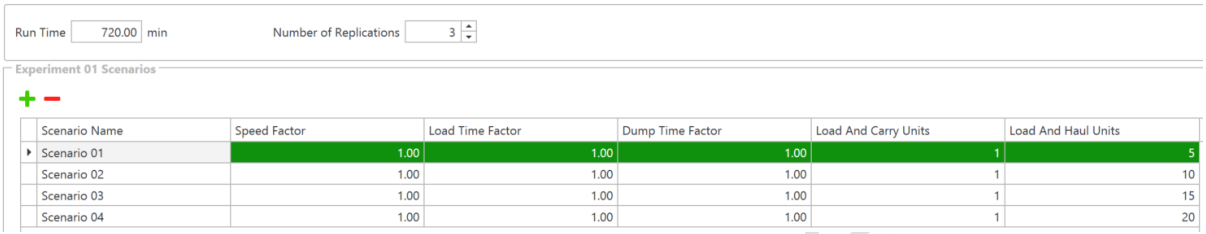
24 Experimenter

Procedure – Configure Experimenter

1) On the **Run** tab, click on **Experimenter** in the **Advanced** menu item.

2) Add <u>three</u> more **Scenarios** by clicking the **Add Scenario** button in the right hand panel.

3) Update data fields for each scenario and fields to the ones shown in the red rectangles below:



Scenario Name	Speed Factor	Load Time Factor	Dump Time Factor	Load And Carry Units	Load And Haul Units
Scenario 01	1.00	1.00	1.00	1	5
Scenario 02	1.00	1.00	1.00	1	10
Scenario 03	1.00	1.00	1.00	1	15
Scenario 04	1.00	1.00	1.00	1	20

Where we specify numbers of equipment units (e.g. 5 Load and Haul units), the Experimenter will use the first 5 listed in the equipment setup.

4) Click **Run** in the **Experimenter** and wait for the experiment to run with all scenarios fields shaded solid green.

5) Click on the **Experiment Results** tab to view the results.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes

25 Fleet Planner

Procedure – Configure Fleet Planner

1) In **Tools**, click **Fleet Planner**.

2) Under **Fleet Planner Inputs**, click **Add Fleet Planner Input**.

3) Configure the inputs as shown below.

Fleet Planner Inputs

	Effective Working Time Input				Haul System Input							
	Shift Duration	Non Operating Shift Delays	Operating Shift Delays	In Shift Working Time	Source	Destination	Material	Configuration	Loader	Hauler	Load & Carry	Number of haulers
▸	12:00	00:00	00:00	12:00	Source 03	Crusher	Copper Ore	Load & Haul	Bucyrus RH 170 B	Caterpillar - 793 D		Auto

4) Discuss the values and scenarios located in the **Production Per Shift** (t) column.

5) Under **Fleet Planner Results** adjust the **Number of Haulers** slider bar and note how the values in the table change.

6) Click the **Cycle Time** button to view the route and **Time Travel Details**.

7) Close the **Cycle Time**.

8) Close the **Fleet Planner** window.

Learning Check

Check your understanding on the workshop and ask any related questions.

Notes