![Micromine Alastri logo]
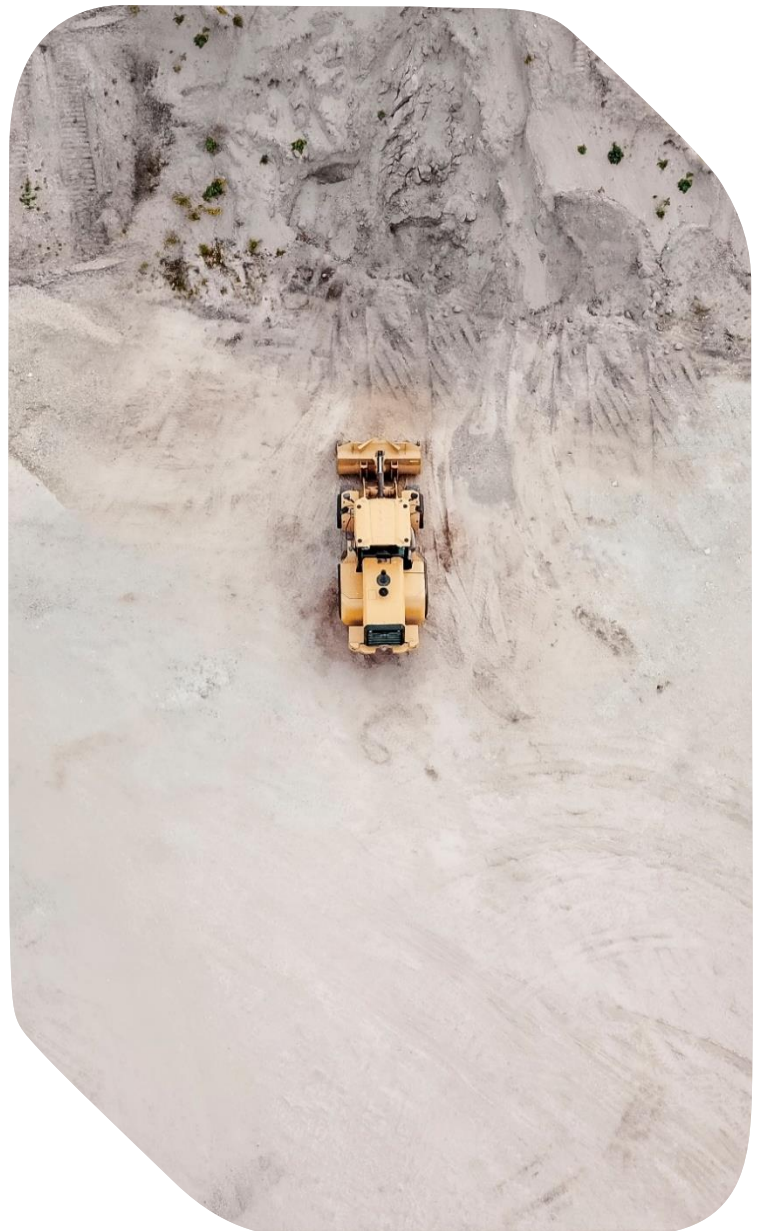
Introduction to **Micromine Alastri Tactical Scheduler**

Training Booklet

Version 01 December 2021

Contents

Introduction

The Alastri Tactical Scheduler (ATS) guides mining engineers through the process of building and fine-tuning an open-pit mine schedule.

It is used for automated scheduling based on targets, constraints, and objectives. This application provides comprehensive optimization of drilling, mixed-fleet haulage and product handling, as well as communicates the schedule through a fully customizable real-time integrated reporting and 3D animations.

General	
Project	Alastri Tactical Scheduler file type with a ".tsch" extension
Scenario	A set of time-based schedule inputs
Report	Schedule results summarized in tabular form
Period	Schedule time increments
Run	The software process of generating a schedule
Scheduling	The human process of generating a schedule
Setup	
Agents	Agents execute the scheduling logic into an ordered list of schedule transactions
Calendar	A table of schedule inputs (crushers, fleets, inventories, constraints, specifications) by time period
Constraints	Limits on movement by period, source, destination, material and agent
Dependencies	Dependencies prevent a block being mined before its nominated predecessors
Fleet Assignments	A list of permissible truck/loader combinations assigned to user-defined mining areas, such as Manned/Autonomous or Production/Rehandle
Preschedule	Blocks that are mined or partially mined before the starting point of the schedule
Product Specifications	Specified grade targets and limits for materials at source, in stockpiles, at crushers, railed or shipped
Steps	The components of fleet movement required to transport material from point A to point B; used to model rehandle and mixed fleets
Data	
Table	A database of 3D scheduling blocks and inventories. Contains a block tree and associated reserves
Level	The table's block hierarchy, ie. Mine\Pit\Stage\Bench
Phase	A collection of benches in the block tree. The parent level to the bench level (Also alternatively referred to as "Stage")
Bench	A collection of blocks at the same elevation, forming a level running surface for truck travel
Block	A single closed solid representing the spatial location of its enclosed materials. Block properties (such as location and surface area) are referred to as Miscellaneous Fields
Parcel	A single material type inside of a given block. Parcel properties (i.e. volume, tonnes, grades, moisture) are referred to as Mining Fields
Dry Tonnes	The weight of a given material, excluding moisture
Wet Tonnes	The weight of a given material, including moisture
Product Fields	Fields (such as grade) which have both an *in situ* value and a *product* value
Navigation	
Viewport	Any 3D visualisation area
Tab	Tabbed working area
Panel	Interactive frame within a tab
Dialog	A new window that opens to enter information
Dropdown	A dropdown box that lets you choose from a list
Icon/Button	A button that can be pressed
Checkbox/Flag	A box that can be ticked on or off

Prerequisites

To complete the workshops in this series you will require:

1. A valid 20-digit license key.
2. A personal login to https://www.alastri.com/.
3. Tactical Scheduler installed on your computer.
4. Completed projects in Haul Infinity and Rapid Reserver (or .invmodel file).

Download sample data set

1. Download the sample data set for ATS.
2. Extract the archive to a working folder.
3. You should see Fields, Designs, PitSolids and Surveys folders.

Rapid Reserver and Haul Infinity

1. You will need Inventory Model file, exported from Rapid Reserver (see Rapid Reserver Training Booklet).
2. Haul Infinity is always embedded to ATS. Make sure you are using valid HI project, with connected blocks and roads.

System Requirements

The following information outlines the recommended system requirements to run the Alastri suite of products. As the hardware required depends on the complexity of the mine and the amount of data, meaningful minimum requirements cannot always be listed. Ultimately the only way to know whether specific hardware will work for a specific mine site is to validate the software's performance during the free trial period.

- For large multi-pit mines with raw LIDAR surfaces and block models with 80M blocks the requirements will be at the extreme end.
- The minimum requirements will only support small mines with a small block model and surfaces with low triangle counts. Running Alastri Haul Infinity on minimum system requirements may slow the application response, depending on the size of the model. Use recommended requirements for optimal use.
- Please note that as our software develops over time, these requirements may change, and hardware upgrades may become necessary.

Component	Minimum	Standard	Extreme
Processor	Intel i5	Intel i7	Intel i9
Memory (RAM)	8 GB	64 GB	128 GB
Operating System	Windows 10 x64	Windows 10 x64	Windows 10 x64
Video Memory (GRAM)	2 GB	8 GB	12 GB
Monitor	1920 x 1080	Dual 1920 x 1080	Triple 1920 x 1080
Video Connection	HDMI, DisplayPort, DVI, VGA - USB not supported		
Video Driver	**Driver no more than 6 months old (OpenGL 4.6+)**		
Hard Drive	Solid State Drive with at least 50 GB Free		
Power Connection	AC Power - Battery power not supported (plug in the laptop)		
Network Connection	Consistent, reliable, high speed (>1 MB/s) connection to the Internet		
Software Prerequisites	.NET 4.7.2		

	Microsoft Visual Studio 2019 C++ Redistributables (https://aka.ms/vs/16/release/vc_redist.x64.exe) Microsoft Excel	
Input Devices	Keyboard and Mouse with a left mouse button, right mouse button, and middle mouse button/scroll wheel	

Many IT departments block downloads of Microsoft prerequisites, so you may need to download them manually. The installation error "Element Not Found" indicates that you must download and install these manually.

- Microsoft .NET Framework 4.5.1.
- Microsoft VSTO Runtime for Office 2010.

First Principles

ATS is a medium term mine scheduler encompassing Haulage. Details of the site, equipment and reserves are input in the setup.

The Schedule is a list of transactions concerning Sources, Destinations, and Equipment over time.

The required data is setup in the **Setup** Tab, the inputs for these requirements can be changed over time in the Calendar of the **Schedule** tab.
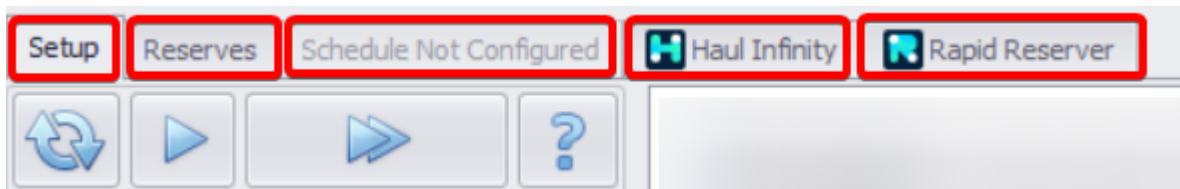
Setup tab	Contains a series of steps that must be completed to create a valid project. To proceed to the next steps and run your model you'll be prompted to complete every step of this tab.
Reserves tab	Main tab to view and analyse reserves and dumps solids and their contents.
Schedule tab	List of transactions concerning Sources, Destinations and Equipment over time.
Haul Infinity tab	Tactical Scheduler also includes the Haul Infinity application tab, which allows you to directly import haulage network data and updates into the scheduling.
Rapid Reserver tab	You can optionally embed Rapid Reserver tab, which makes it much easier to update reserves inventory data.

This document provides only a brief description of all the steps and tools for working with your mine schedule. For a full and detailed description, see Alastri Tactical Scheduler Documentation section of the main documentation portal.

The exercises in this chapter are for familiarisation purposes and are deliberately light on detail. More in-depth discussion follows in the next section.

Unless otherwise noted, each exercise follows from the preceding exercise.

Project Setup

Creating and opening a project

1. Download the latest version in the Alastri Hub portal and start Tactical Scheduler.
2. Create a new project and name it "ATS. Demo Project". The main Tactical Scheduler project file is saved in ".tsch" format.
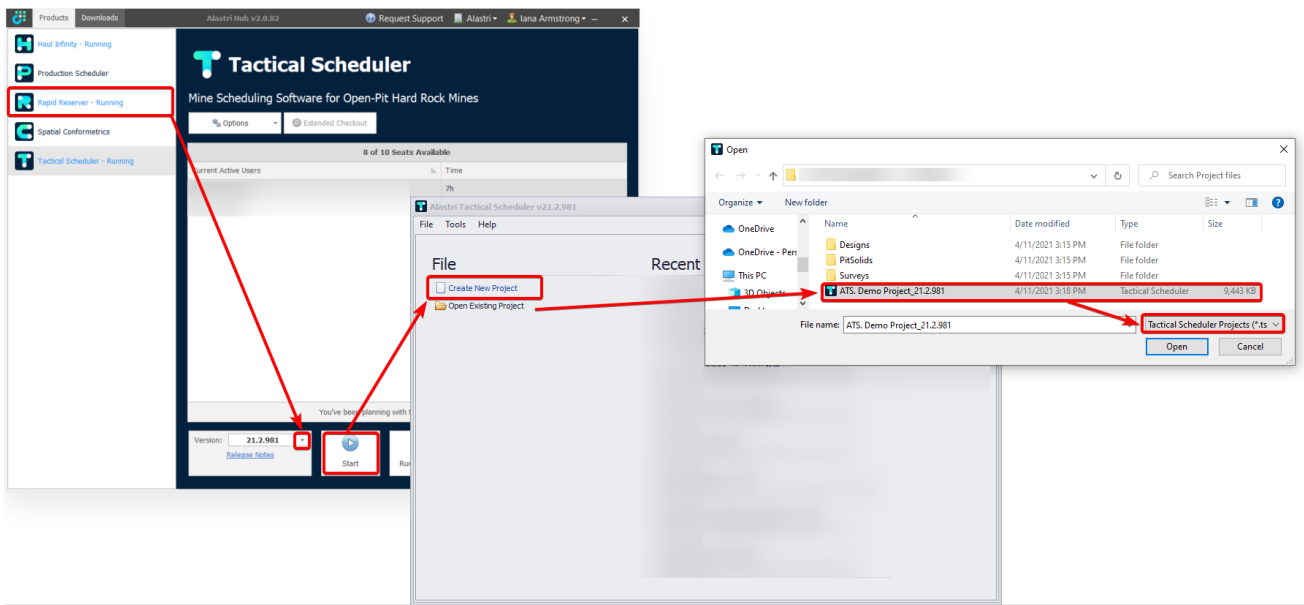
When Tactical Scheduler project is saved, multiple different files will appear in the save location.

.tsch	Tactical Scheduler also includes the Haul Infinity application tab, which allows you to directly import haulage network data and updates into the scheduling.
.lock	Locks out a file to one user at a time
.old	If the main project files are corrupted for any reason, the ".old" files can be restored as functional project files by removing ".old" from the file name
.cache	Reduces scheduling time by saving results of previous runs
.layers	Saves triangulations external to the main project. Deleting the ".layers" file is the same as deleting all layers from the project
.drapeImages	Saves draped images external to the main project. Deleting the ".drapeImages" file is the same as deleting all draped images from the project

Example:

~ATS. Demo Project_21.2.981.lock	4/11/2021 3:47 PM	LOCK File	1 KB
ATS. Demo Project_21.2.981	4/11/2021 3:47 PM	Haul Infinity	47 KB
ATS. Demo Project_21.2.981.hinf.old	4/11/2021 3:18 PM	OLD File	47 KB
ATS. Demo Project_21.2.981.layers	4/11/2021 3:47 PM	LAYERS File	36,749 KB
ATS. Demo Project_21.2.981	4/11/2021 3:47 PM	Rapid Reserver	25,720 KB
ATS. Demo Project_21.2.981.rara.old	4/11/2021 3:18 PM	OLD File	25,715 KB
ATS. Demo Project_21.2.981	4/11/2021 3:47 PM	Tactical Scheduler	9,443 KB
ATS. Demo Project_21.2.981.tsch.old	4/11/2021 3:18 PM	OLD File	9,443 KB

Setup

The **Setup** tab contains a series of steps that must be completed to create a valid working project. To proceed to the next tabs and run your model you'll be prompted to complete every step of this tab.

The required information (such as details of the site, equipment, and reserves) is to be populated in the **Setup** tab, the inputs for these requirements can be changed over time in the Calendar of the Schedule tab.

ATS was created as a medium mining scheduler only. To customise a project for site-specific requirements and drilling, extension scripts can be added.

In this training booklet we will start with basic setup and scheduling on a mining only project that is not customised.

The schedule always requires the valid Haul Infinity project to be embedded for the cycle time calculations.

Configuration Options step

In the Configuration Options step, you may choose how the schedule is going to run, as well as specify the setup steps and schedule mode to use in the project.
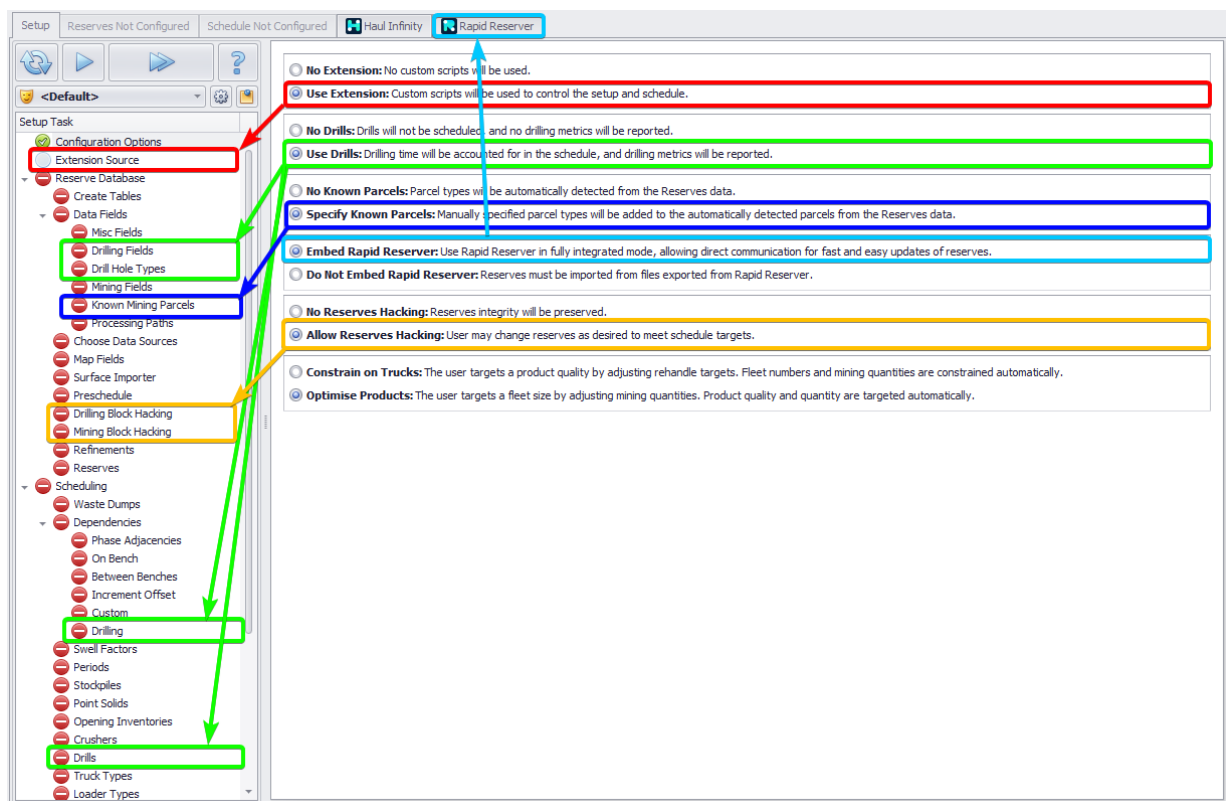
- Check the **Use Extension** option to allow scripted changes to the reserves database, stockpile inventories, equipment performance, processing plant performance, and reporting fields.

- o To run drilling, extension scripts are required. In this training project, we are not going to use drilling. Check the **No Drills** option.
- o Contact your Alastri support representative for assistance with Site Specific Extensions.
- **Known Parcels** can be setup to model parcels that do not exist in the imported inventory. An example is having a single weighted average grade and material for a stockpile content.
- **Rapid Reserver** (RR) can be embedded in ATS (as a separate tab, like HI is).
    - o This can be useful if running ATS in the short-term space producing weekly plans in a rolling monthly/quarterly schedule. This allows user to quickly update reserves with the latest site information, without having to re-import the reserves.
    - o However, it slows down a schedule and it's not always recommended to run with RR embedded. By default, scheduling inventories are exported from Rapid Reserver and imported into Tactical Scheduler.
- **Reserves Hacking** allow a user to change the reserve values for particular blocks, overwriting the data supplied by the geologists.
- Scheduling Modes, there are two possible scheduling modes in ATS.
    - o **Constrain on Trucks**. Schedule continues mining until equipment hours are used up. Cannot put product specification on a stockpile or crusher. It means that all material will follow the destination logic on parcel movement. If you are trying to reach a particular target at a crusher, you will need to set up series of constraints and manually edit inputs in the calendar until the final product is achieved.
    - o **Optimise Products**. Product Specifications can be placed on stockpiles and crushers, allowing users to target a specific product. This is done by the internal algorithm calculating the best possible outcome for each period. However, in doing so equipment hours may overflow. To control this the user will have to set up a series of constraints to manage how the equipment is used.

For this demo project, flag **No Extensions**, **No Drills**, **No Known Parcels**, **Embed Rapid Reserver**, **No Reserves Hacking** and **Optimise Product** options.
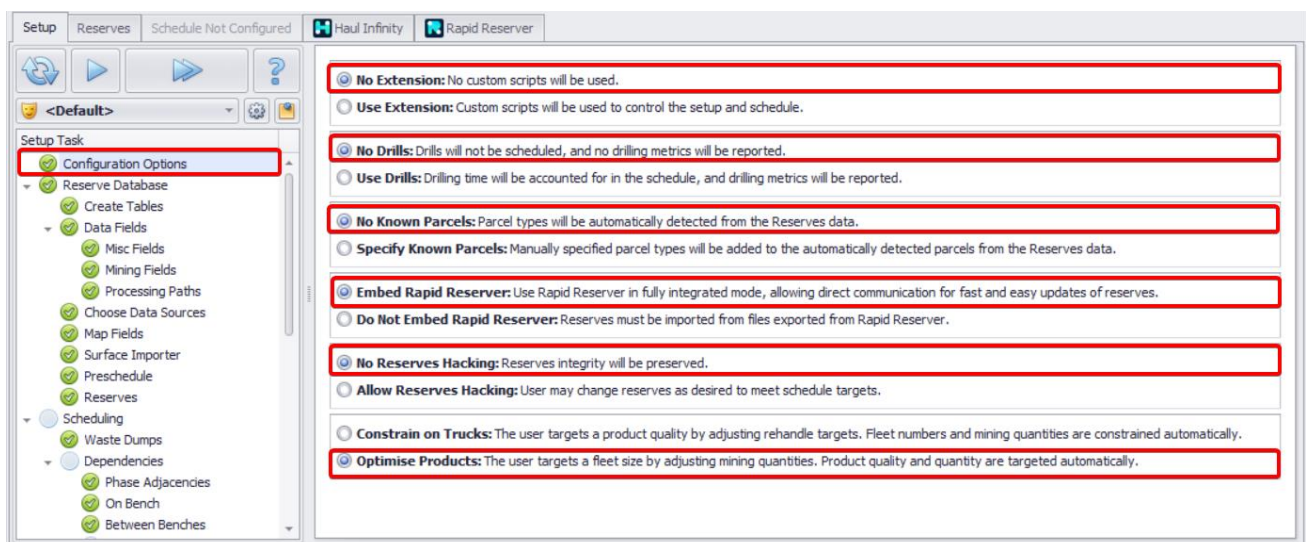

Reserves Database step

Tables are a database holding a tree of 3D scheduling blocks. In this step we define the levels of the pit and dump trees, and specify which level is the bench/lift level.

Tables should be created for each class of blocks: pits, dumps, and (if required) backfills. The number of levels in each table should match the level hierarchy of the inventory files, so they can be mapped one to one in the **Map Fields** step.

> ➤ Create tables: Reserves and Dumps.

A table marked as "Dump" or "LongTermStockpile" has no reserves information and cannot be mined. If an area must be dumped and reclaimed (such as a land bridge), then the blocks must be imported twice (once as dumps, once as reserves).
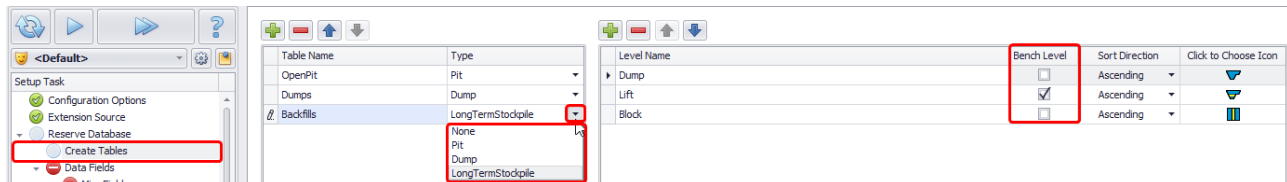
Every table must specify the Bench Level, which is the running level of the trucks. This is used in the generation of On Bench Dependencies to determine bench access and progression.

Data Fields steps

Different data fields are used to hold data mapped across from the Inventory files and create new fields for scripting purposes (such as drilling).
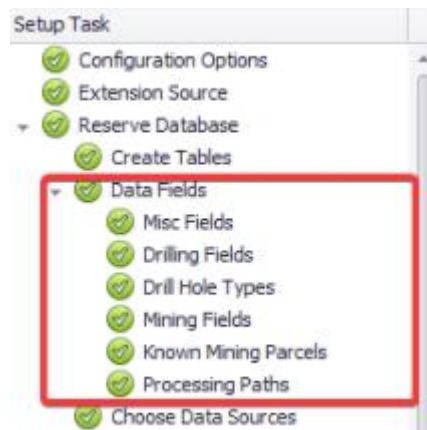
Data Fields	Description
Misc Fields	Block properties such as location, volume, depletion, etc. ➤ For this training project, we may accept the default fields.
Drilling Fields	Hole properties such as length, explosives, etc. ➤ For this training project, not applicable.
Drill Hole Types	Hole types by pattern size, drill rig, rock type, etc. ➤ For this training project, not applicable.

Mining Fields	Content properties such as density, moisture, tonnes, and grades.
	➢ See below.
Known Mining Parcels	Material types which may not be present in the inventory files but must be accounted for in stockpile opening inventories.
	➢ For this training project, not applicable.
Processing Paths	Allows product fields to have different values at different points, such as wetPlant/dryPlant, rail/ship, lump/fine subproducts.
	➢ See below.

In addition to the defaults, we should add any block model fields that are present in the inventory files and which are relevant to scheduling. For example: product grades, contaminants, resource class, geological class, and water table class.

➢ Create Mining Grade fields:

1. Press the **Add** button to create new mining fields = grades.
2. Set a filed type to "Title".
3. Add three grade indents, Fe, Al, and Si.
   a. Set their indents to "1" to include Fe, Al and Si under "grade" parent.
   b. Type "%" as unit of measurement
4. Grade fields are created with **Product Field** ticked. As these will be tracked across the process system. Any field which affects the commercial value of the material should be marked as a product field.
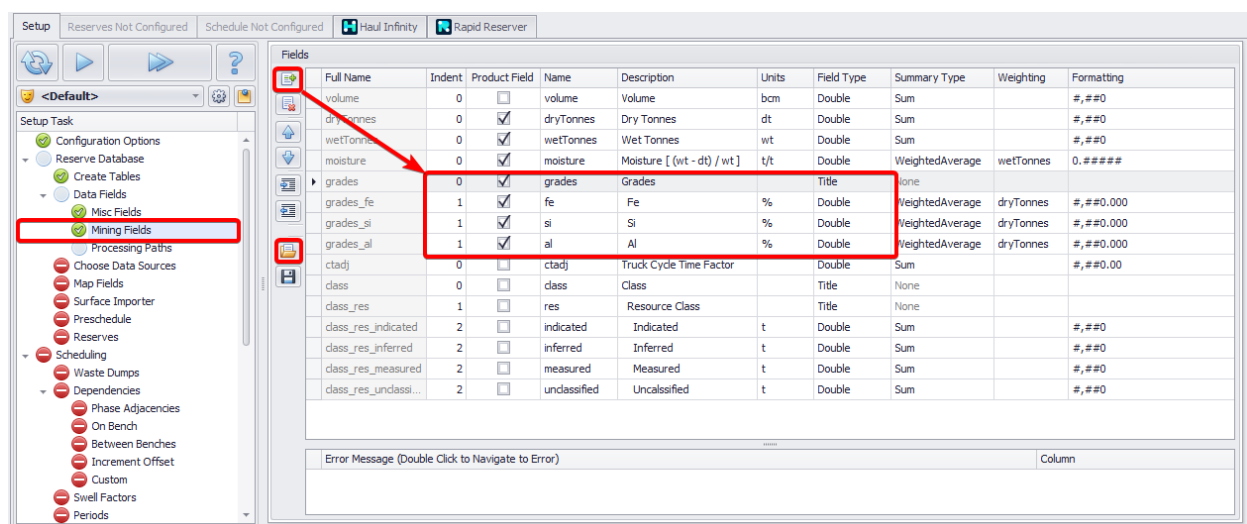
Click the folder icon on the side and import the miningFields.openfields file to auto-populate the **Fields** table (or configure manually from the side button menu).

Processing Paths

The **Processing Paths** step is used to allow product fields to have different values depending on how they are processed, transported, and screened.

- Processing streams are the mutually exclusive paths from pit to product.
- Product points are the changes to the product that occur along the transport path.
- Sub products are the split of product types at each point in each stream.

For example, the ratio of "Lump" to "Fines" sub products may change when handled from rail to ship, and the product grades are different through the wet plant vs the dry plant.

➢ Use the plus and minus buttons to configure the Processing Paths as shown, then press play button to continue.
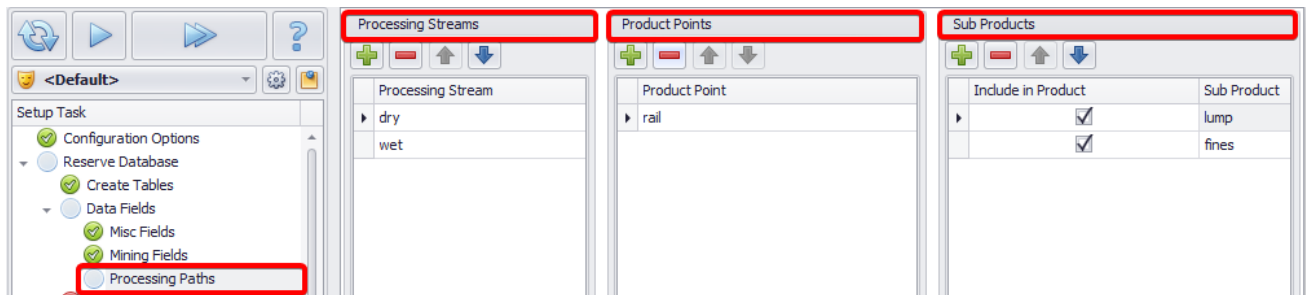
Choose Data Source step

Reserves can be embedded in the project, imported from external data sources, or both.

In this demo project we are embedding Rapid Reserver to demonstrate how easy it is to update reserves with the latest site information, however it slows down a schedule and for bigger medium term projects it's recommended not to embed RR, but to import block solids in the ".invModel" format.

To use embedded reserves:

1. In Tactical Scheduler > Setup tab > Configuration Options step > enable Embed Rapid Reserver flag.
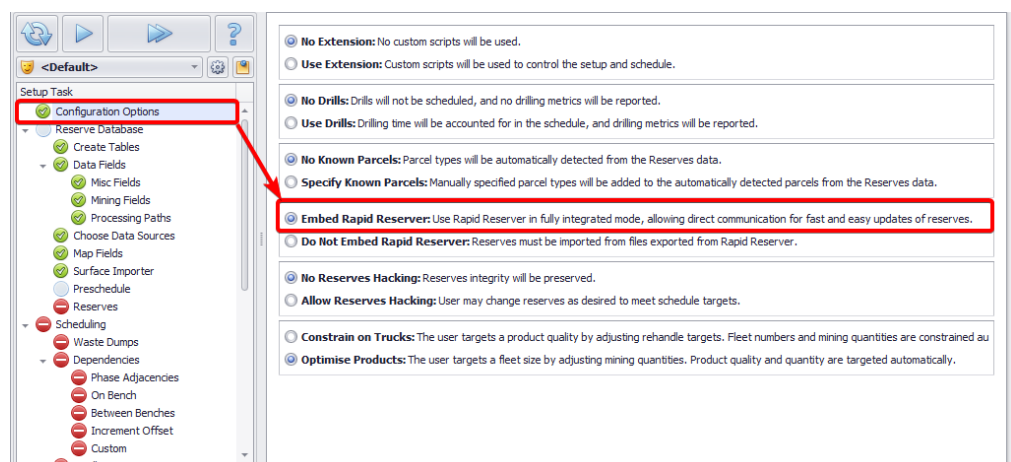
2. Rapid Reserver tab > *File > Open* > ".rara" file.
3. Wait for reserves to finish calculating.
4. Embedded reserves are shown as bold blue text.
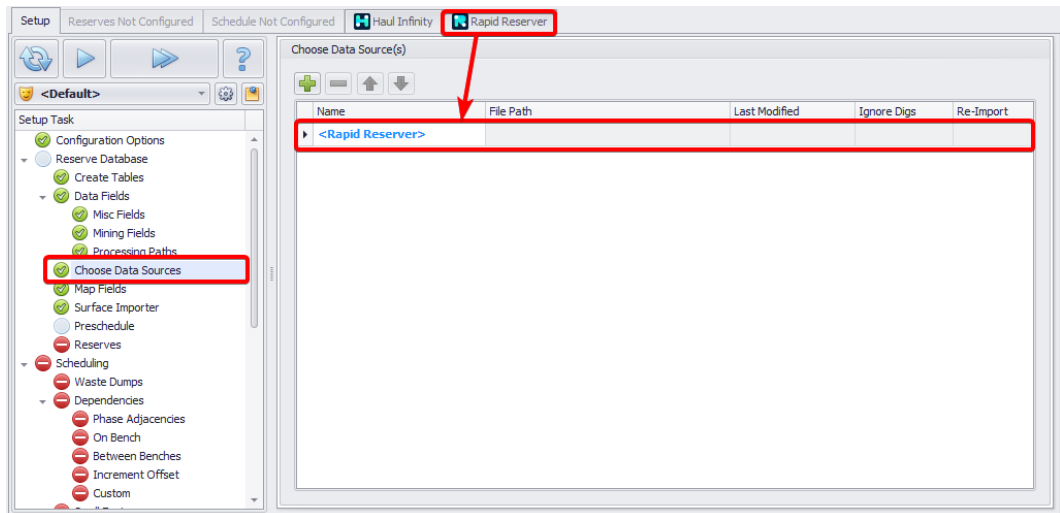
To import reserves:

1. Go to Rapid Reserver > Designer tab > Export button > "From Project" > Alastri Inventory Model > save "blocks.invModel" file.
2. Go to Tactical Scheduler > Setup tab > Choose Data Sources step > green plus icon > import "blocks.invModel" file.
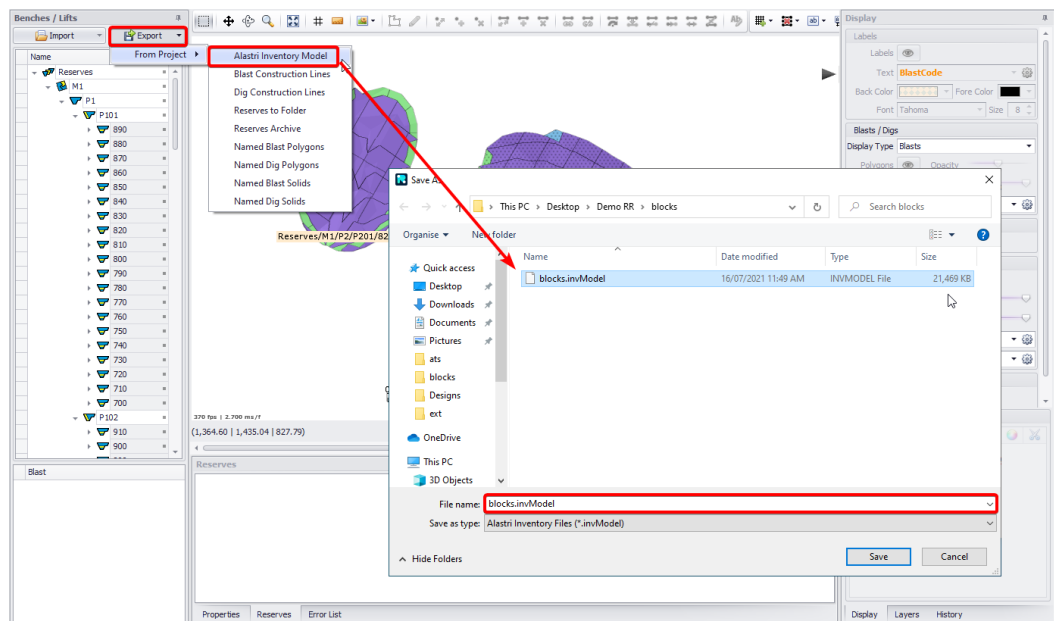
✓ Projects with Rapid Reserver embedded can also have ".invModel" files imported.

Map Fields

All fields for all Phases must be manually mapped across.

1. Go through the list of phases and assign each of them to a Destination table ("Reserves" for pits and "Dumps" for dumps and backfills. If you don't wish to import the blocks, then set the destination table to "<Skip>" (it will ignore the phase).
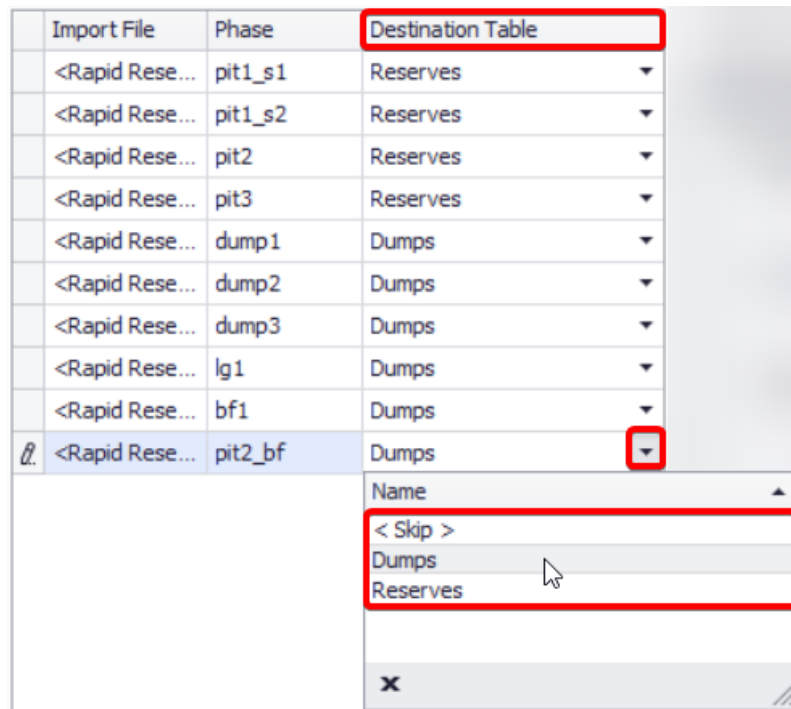
2. Block Mappings: fields in Red must be mapped.
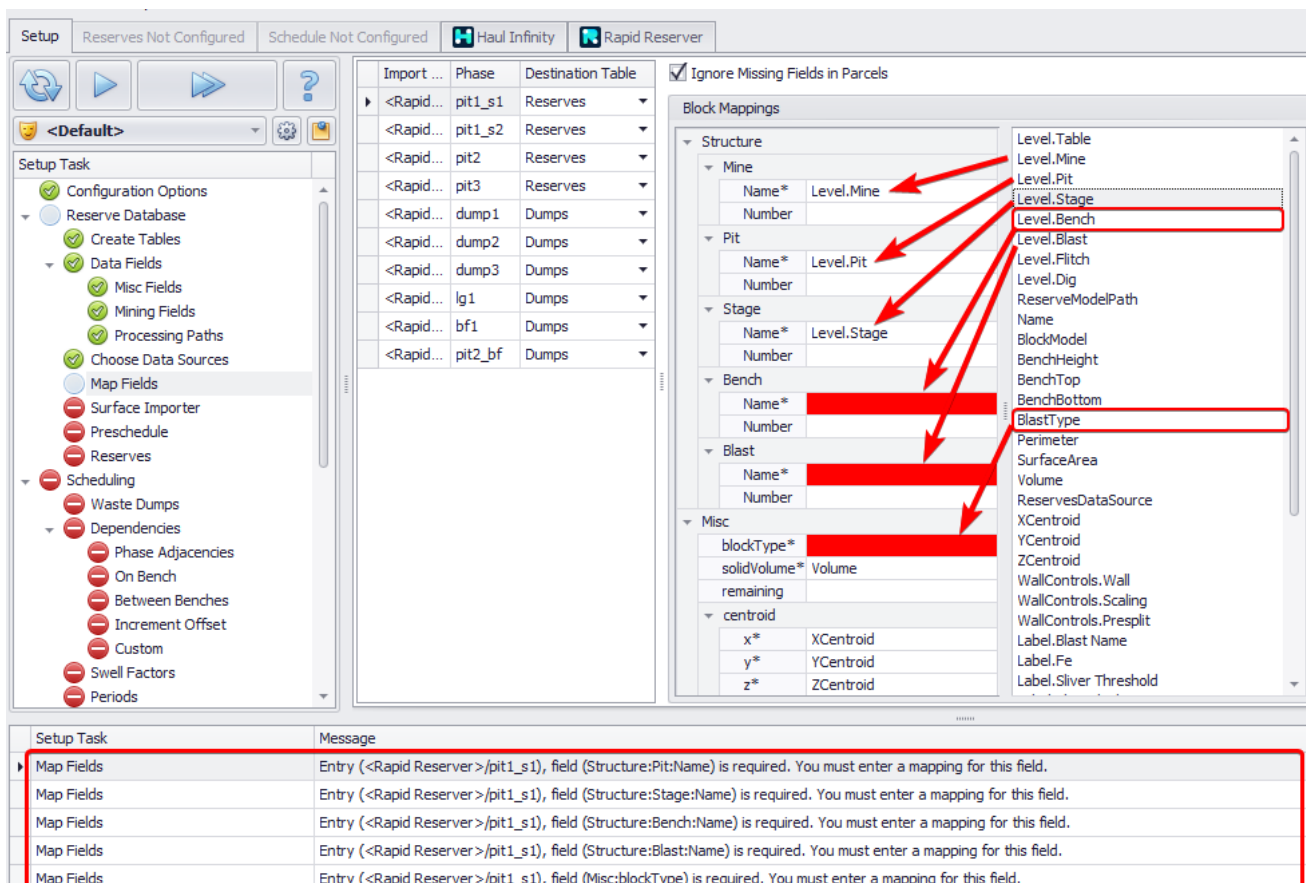
3. Populate parcel fields by dragging and dropping items from the inventory reserves fields. To leave a mapping blank, toggle Ignore Missing Fields in Parcels to true.

4. You can copy 🗐 and paste 📋 mappings for each Pit phase.
5. Parcel mapping for dumps is not required, map dumps blocks only.

✓ When completed, check for errors at the bottom of a screen. Incorrect block or parcel mapping won't let you to proceed to the next step. Follow the instructions in the message to fix all the errors.

Surface Importer

This step is used to flag dig and blast solids based on their position relative to the surface (above or below).

More information available in the main documentation portal (to access, navigate to Alastri Product Documentation > Tactical Scheduler Documentation > TS Setup tab > TS Reserves

Database > TS Surface Importer, or simply press the Help button ❓).

Preschedule

The Preschedule step is used to completely remove or modify blocks to their anticipated state at the start of the schedule.

Blocks can be completely removed, or a percentage of the tonnes removed.

➢ Manually preschedule blocks:

1. Extend Records tree structure to the Reserves/M1/P2/P201/760.
2. Use the Visibility Mode button to toggle between viewing all blocks, or only the currently selected records in the tree.
3. Click on block(s) in the viewport.
4. Press the flag icon from the toolbar.
5. Type in the remaining ratio (50% = 0.5, 0% = 0 (block is fully mined out)).
6. Tick Remove Full Prescheduled Blocks.
7. Press OK.
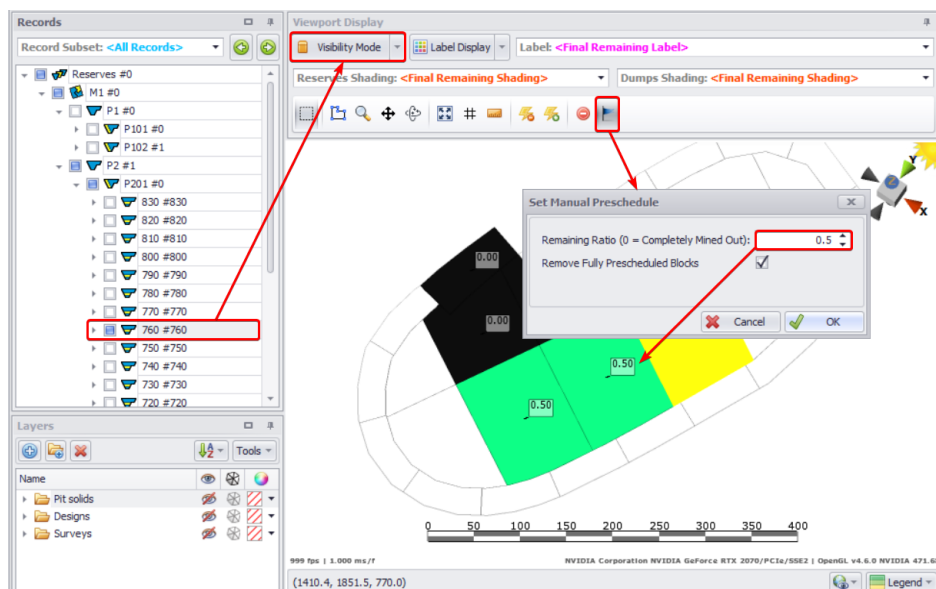
Blocks can be prescheduled from a starting surface via the Flag Auto Preschedule icon. The starting surface must already be loaded into the Layers panel (bottom left).

Automatically preschedule blocks above the surface:

1. Press the Flag Auto Preschedule icon ⚡ above the viewport.
2. In the Preschedule with Surface window:
   a. choose the preschedule surface (imported from the samples data folder;
   b. set the minimum and maximum thresholds (values outside of threshold will be rounded up or down).
3. Tick the records to be prescheduled.
4. Review result in the viewport and use the Legend button to see the shading applied by remaining ratio.
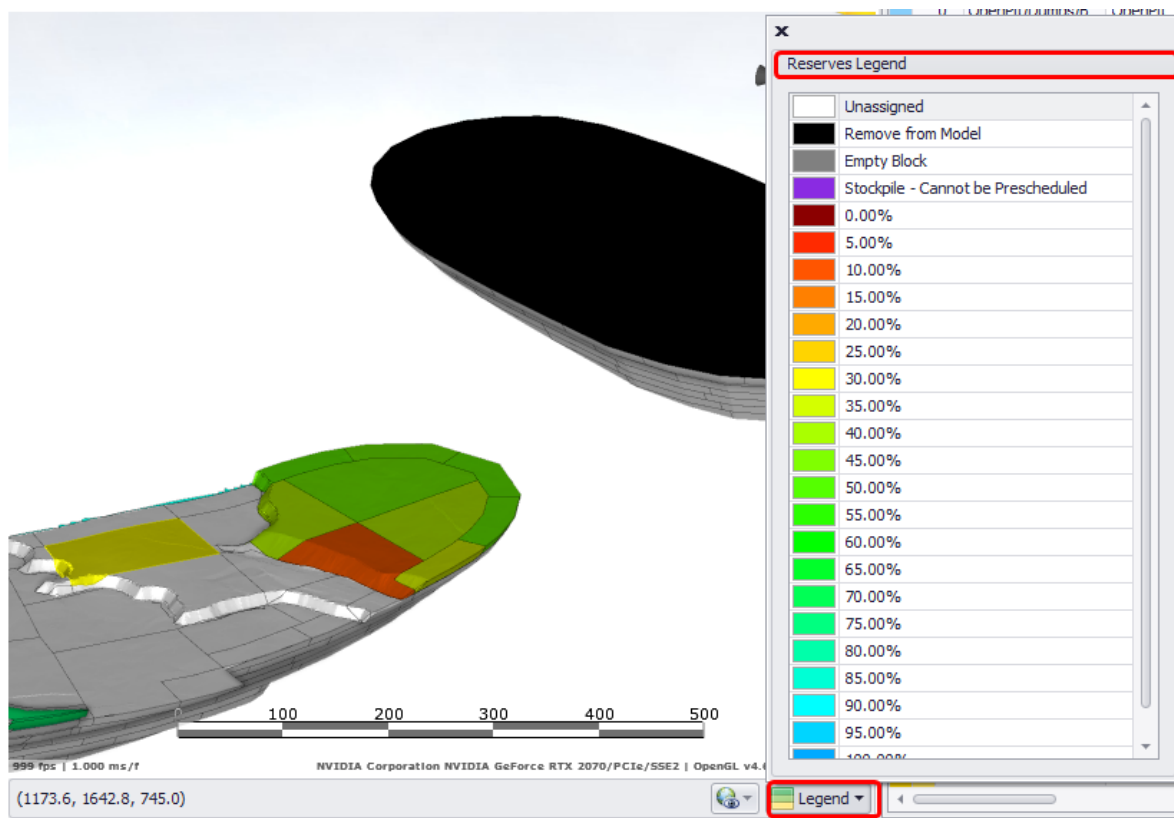
Reserves step

Review records and solids in the Reserves tab and press the blue play button to proceed.

Once all the Reserve Database steps are complete, the results will be visible in the Reserves tab.
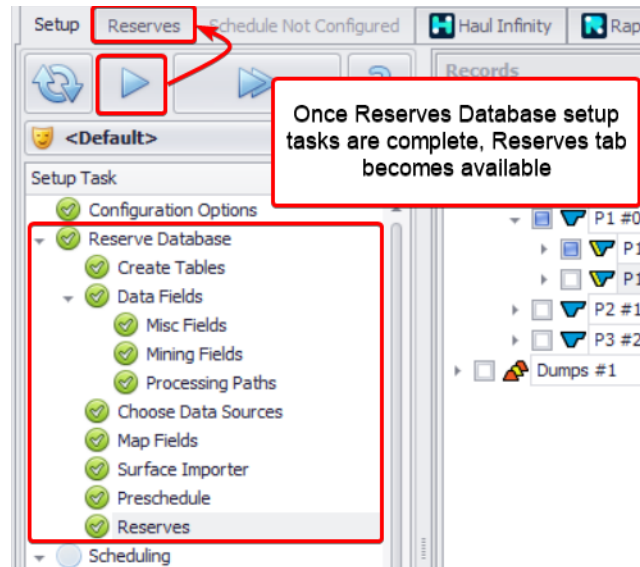
Review the Reserves tab for common errors, such as:

- overlapping solids,
- missing solids,
- zero values in product fields,
- negative values in product fields.

If any such errors are noted, make the necessary changes in Rapid Reserver and re-import the reserves.

Always compare the Reserves data panel to the Preschedule data panel to confirm that call factors and drill calculations are being correctly applied.

Scheduling

The schedule setup in the next steps specifies the scheduling periods, targets, locations, equipment, and material flow.

	Setup steps
Time	Periods
Locations	Waste Dumps, Stockpiles, Crushers
Location Status	Dependencies, Destination Logic
Equipment	Trucks, Loaders, Fleets
Equipment Usage	Steps Logic, Dynamic Haulage
Targets	Agents, Product Specifications, Constraints

The fields specified in the scheduling setup are used to generate a calendar of inputs.

The calendar of inputs is used to control the schedule period by period.

Scheduling mode

The scheduling engine in ATS can be run in two modes:

- Constrain by Trucks uses the fleet numbers to calculate material movement.
- Optimised Products uses material movement to calculate fleet numbers.

Optimised Products is the preferred option, because rehandle and blending can be auto generated as a function of ex-pit movement. When constraining by trucks, the rehandle and blending must be manually specified as calendar inputs.

Optimised Products

Optimised Products mode requires attention to the following Setup tasks

Destination Logic	Waste and Crusher Feed rules tell the engine where to apply product handling optimisation.
Constraints	Constraints tell the agents how much to mine, and how much equipment to use.
Product Specifications	Product rules determine the flow of material to meet blending and grade targets.

Truck Constrained

Constrain by Trucks mode requires attention to the following Calendar values

Equipment Numbers	Loader, truck and fleet allocations must be updated in the Calendar.
Reclaim Targets	Stockpile reclaim targets must be updated in the Calendar.

Waste Dumps

Waste dump names and capacities are automatically detected from the Reserve Database steps (in blue). Tables marked as "Dumps" in the Create Tables step will automatically list their contents (you cannot edit it).

- ➢ Add an Overflow Dump = WD_01 with a capacity 10 ml m3.
  - o This is a point dump. It must exist in Haul Infinity. The node name must follow the convention Dumps/<Name>.

Dependencies

The Dependencies setup tasks allow users to set different dependencies for a project. Dependencies control the physical dependencies and availability of a block to be extracted from the pit and filled in the dump.

If a Dependency rule prevents a block being mined, no incentive can force that block to be mined.

The user can setup rules that allow logical controls to be put in place regarding the order when blocks/stages can be mined.

Phase Adjacencies

Using with dependency type you can indicate if a benches from adjacent phases are inter-dependent.

Example 1.

To excavate Stage 1 and Stage 2 simultaneously, without undercutting Stage 2 beneath Stage 1:

- Locate "Reserves/M1/P1/P102" in the Name column.
- Select "Reserves/M1/P1/P101" in the Above Stages dropdown list. In this example if Stage 2 was mined first, Stage 1 would be undercut.
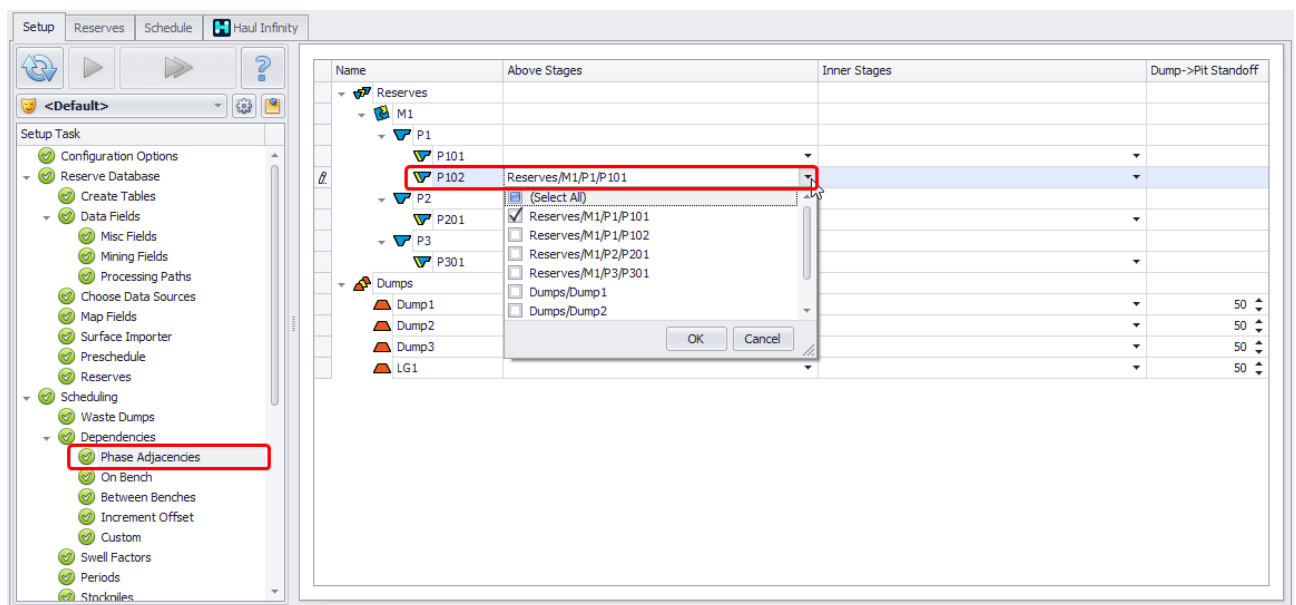
Blocks in Stage 2 will check for vertical dependencies to Stage 1

In the example below if Stage 2 was mined first, Stage 1 would be undercut.

So, for Bench 110 RL the Stage 1 block must be mined before the Stage 2 block.
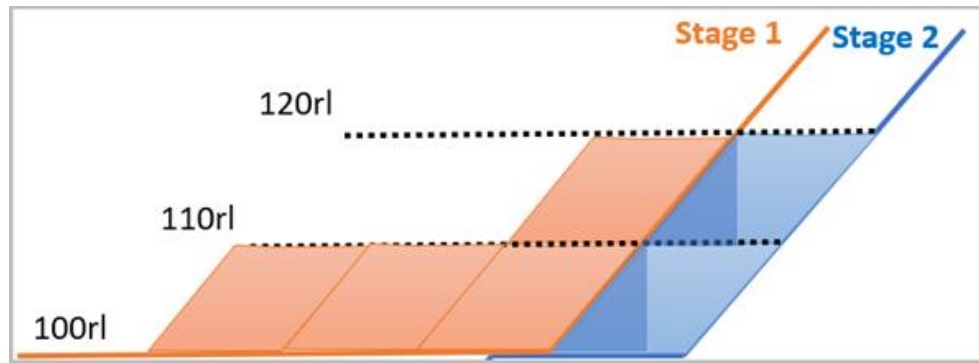
Example 2.

To backfill Stage 1 while it is being mined, with an offset of 50 meters between mining and dumping.

- Locate the backfill dump in the list.
- Set the Above Stages to the pit blocks in that area.
- Set the standoff distance between cut and fill operations.

This tutorial has no backfill designs, so we may continue with the default settings.

Note that Phase Adjacencies only set vertical dependencies between blocks. To finish an entire stage before another, see Custom Dependencies step below.

On bench

You can manually or automatically setup dependencies between blocks on a bench/lift. There are options to use automatic dependencies, manually created dependencies, or a combination of the two.
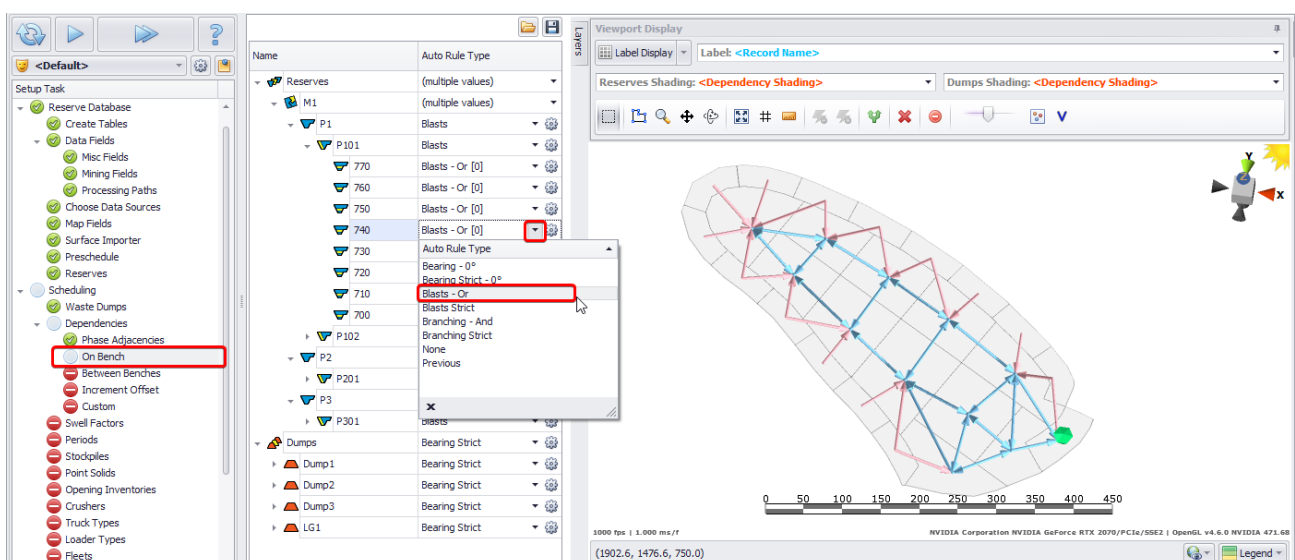
Every bench in the project has an Auto Rule Type which determines automatic dependency creation. The following options are available to choose from every tree level dropdown.

None	No automatic dependencies will be created; the blocks may be mined in any order
Bearing	Dependencies will be created pointing the opposite of direction specified, with more than one block is available at once
Bearing Strict	Dependencies will be assigned such that the blocks will be released to honour the direction specified, while only one block will be available at once
Branching	Dependencies will be created branching out from the start point(s) created by the user, while more than one block will be available at once.
Branching Strict	Dependencies will be assigned such that only one block is available at once and will be extracted in order of shortest distance from the starting point
Blasts	Same as "Branching", but the start points include any blocks marked as ramp shots, and dependencies for trim shots are automatically created. Both "AND" and "OR" dependency types are supported (see below).
Blasts Strict	Same as "Blasts", but only one block is available at any one time
Previous	Uses the dependencies assigned on the lift below or flitch above

✓ Auto Rule Types can be specified at any level in the block tree and are automatically inherited by all children.

Note that having block dependencies reduces the number of decision points for the algorithm, thus speeding up the software. Try to avoid selecting Auto Rule Type "None".

- Or = Blue arrows = If this block OR that block is mined, the current block is available.
- And = Red Arrows = This block AND that block must be mined before this is available.
  o Trim blast, the production shots in front must be mined first.

Use the command below to set up each bench with direction or ramp entry.

Mining Direction		Set Compass bearing
Branching Out/ Blasting Out		Set Ramp starting point. All branching/blasting out rules must have at least one ramp starting point.
		Toggle AND/OR rule type
		Auto-detect ramp entry points from Haul Infinity
Manual		Remove Auto Dependencies
		Restore Auto Dependencies
		Draw Manual Dependencies
		Delete manual Dependencies
		Reset Manual Dependencies

"AND" and "OR" Dependency types

AND type	OR type
Returns TRUE if all of the conditions evaluate to TRUE	Returns TRUE if any condition evaluates to TRUE
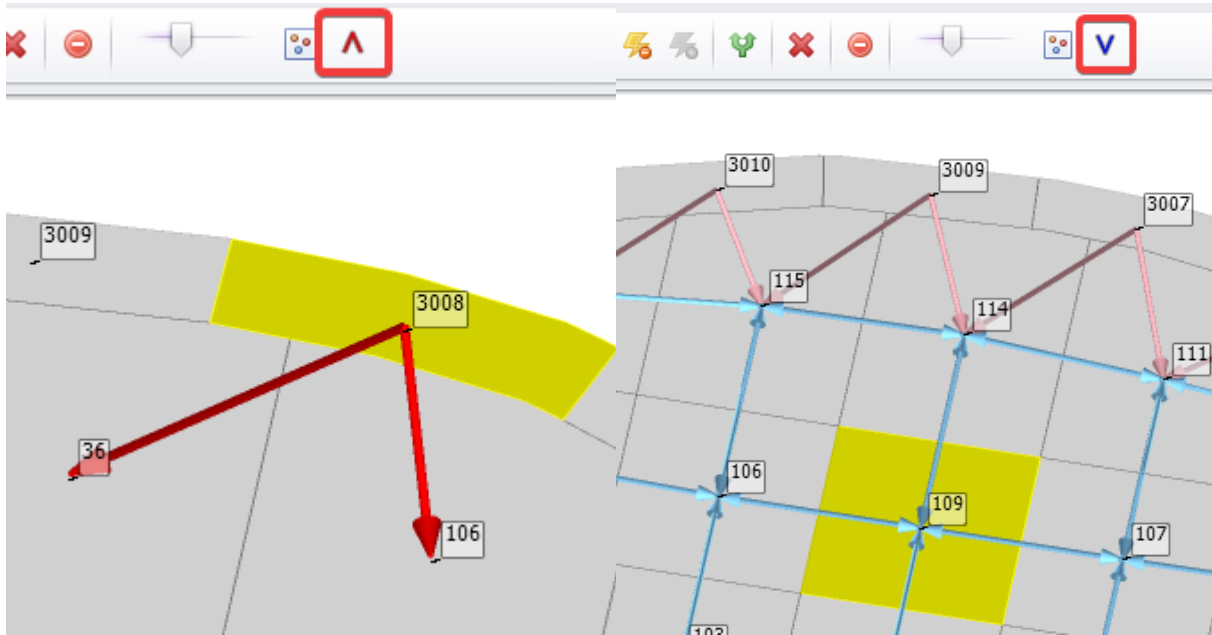
Selected and highlighted in yellow Blast 3008 will only be mined after blocks 36 AND 106 have been mined.

Mining on the selected and highlighted in yellow Blast 109 can begin after mining any of the blocks pointing to it with blue arrows (114 OR 107 OR 105 OR 106).

✓ All circular dependencies must be resolved before progressing to the next step. Double click on the message in the Error panel to fix any errors.

	Type	Setup Task	Message
▶	❗	Bench	On-Bench dependency problem found on (Reserves/Mine1/Pit1/Stage1/550). Dependency cycle found:

Between Benches

Step Between Benches allows user to plan multiple bench mining in a single phase.

✓ Bench rules can be specified at any level of the block tree and are automatically inherited by all children.

Expand Distance forces all blocks to be mined within a radius before the next block below can be mined. It works by taking the polygonal boundary of a blast, expanding it by the nominated distance, and checking for any unmined blocks on the bench above that are within that area.

The green block cannot be mined until after the red block is mined.
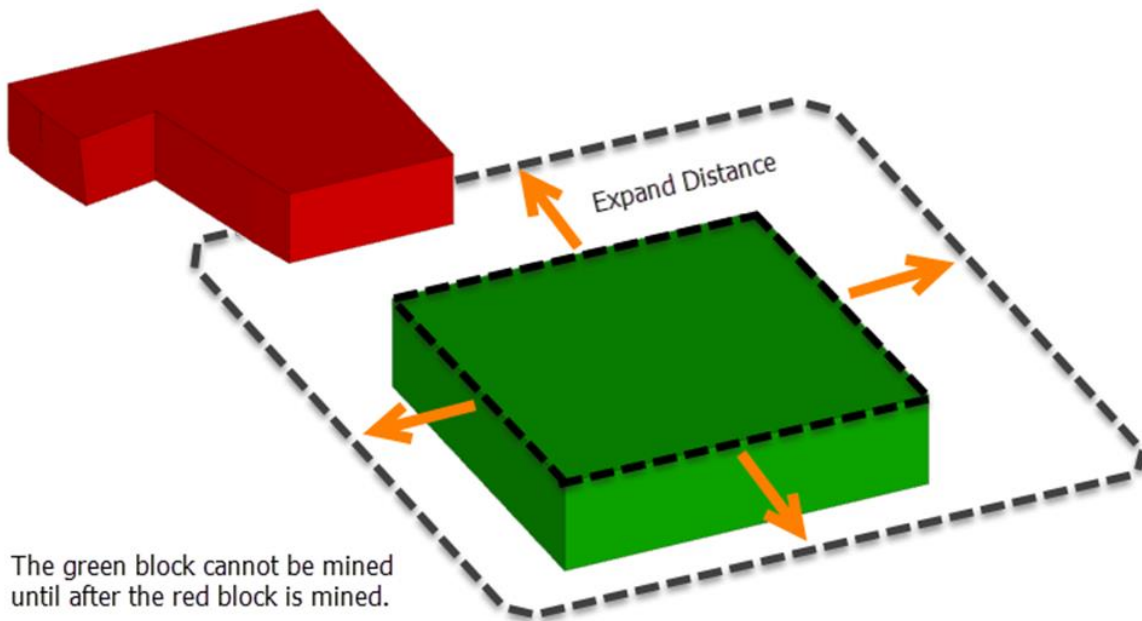
- ✓ Mined blasts are dependent on blasts within the Expand Distance on the bench above.

Positive Expand Distance

Block X **can't** be mined as a block on the bench above falls within the Expand Distance.

Block X **can** be mined as a no blocks on the bench above fall within the Expand Distance.

0m Expand Distance
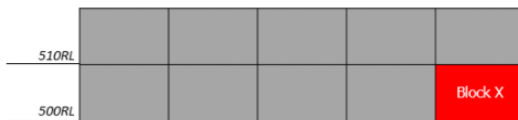
Block X **can't** be mined as a block on the bench above falls within the Expand Distance.
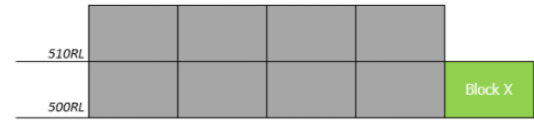
Block X **can** be mined as no blocks on the bench above fall within the Expand Distance.

Negative Expand Distance

Block X **can't** be mined with a Expand Distance of 0m as a block on the bench above falls within that Expand Distance.

With a negative Expand Distance, Block X **can** now be mined as a no blocks from the bench above fall within the Expand Distance.

- Max Active Benches forces one bench to finish before another can be started.

✓ A bench cannot be mined until the Nth bench above is completely mined out.

Increment Offset

Increment offset rules dictate the vertical lag between one phase and the next. This can be used to ensure that stages progress in a timely and concurrent manner.

See Documentation.

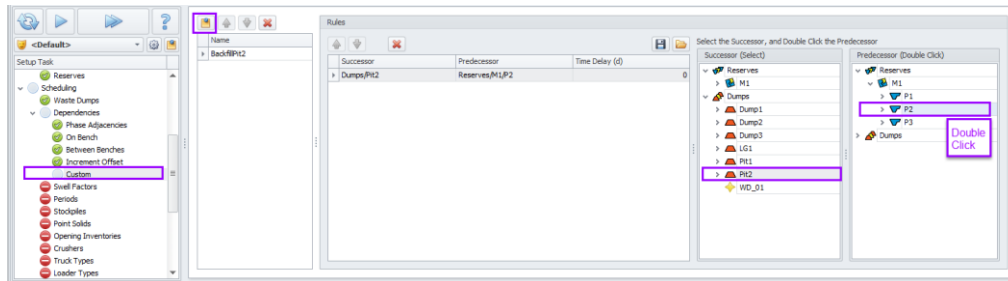To set a 20m vertical lag between stage 1 and stage 2 of pit1.
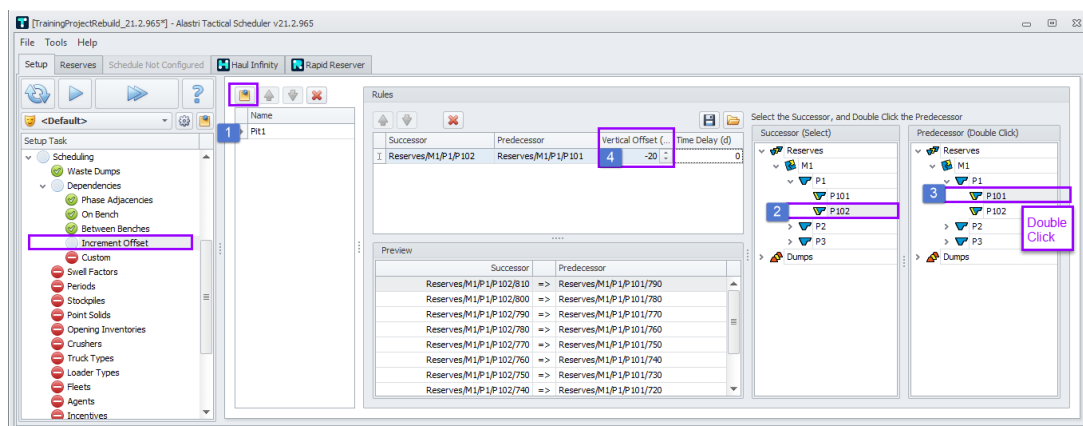
1. Create New Dependency.
2. Select Successor.
3. Select Predecessor – Double click.
4. Add a negative vertical offset between stages = -20.

Custom

Custom dependencies can be used to force precedence at any level of the block tree. Between pits down to block level.

See Documentation.

Periods

The Periods step creates the time intervals to be used in the scheduling calendar.

Select the Period Wizard icon
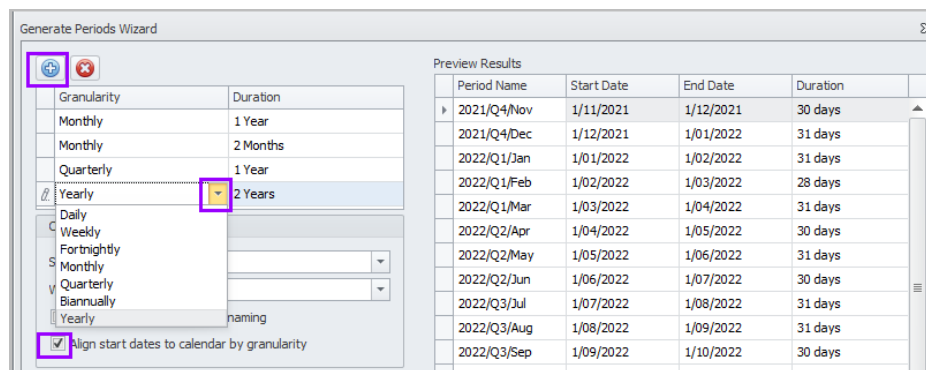
Stockpiles

Create Stockpiles here, these stockpiles must exist in Haul Infinity of they are to be used in the schedule.

Point Solids

If Solid designs exist for a Stockpile or point dump it can be imported here, set a colour and will be seen to build/reclaim in the Animation.

Opening Inventories

Stockpile Opening Inventories can be typed in, or imported directly from a csv file in a format detailing Parcels tonnes and grades

	A	B	C	D	E	F	G	H
1	StockpileName	Parcel	Mining_grades_fe	Mining_grades_al	Mining_grades_si	Mining_volume	Mining_dryTonnes	Mining_wetTonnes

Crushers

Every project must have at least one crusher, which represents the commercial output of material from site.

1. Add crushers
2. Select Processing Stream from the drop-down list.
3. Tick Availability Types required.
   a. These will appear as extra rows in the Schedule Calendar. Only select the availability and utilisation values that need to be input in the calendar.
4. Capacity field to input the processing rate in the Calendar (volume / tonnes)


Truck Types

Every project must have at least one truck type, which is used to calculate fleet numbers, engine hours and fuel burn.

- Add Trucks, same as in Haul Infinity.
- Toggle availability types required. They will appear as extra rows in the Schedule Calendar. Only select the availability and utilisation values that need to be input in the calendar.
- "Cycle Time Factor Field" reads a value from the block model, so travel times can be factored faster or slower for different areas.

"Adjust Travel Time Factor by Time" introduces a new row in the calendar, so travel times can be factored faster or slower in different periods (ie. wet weather period).

Loader Types

Every project must have at least one loader type, which is used to calculate cycle times and production rates.
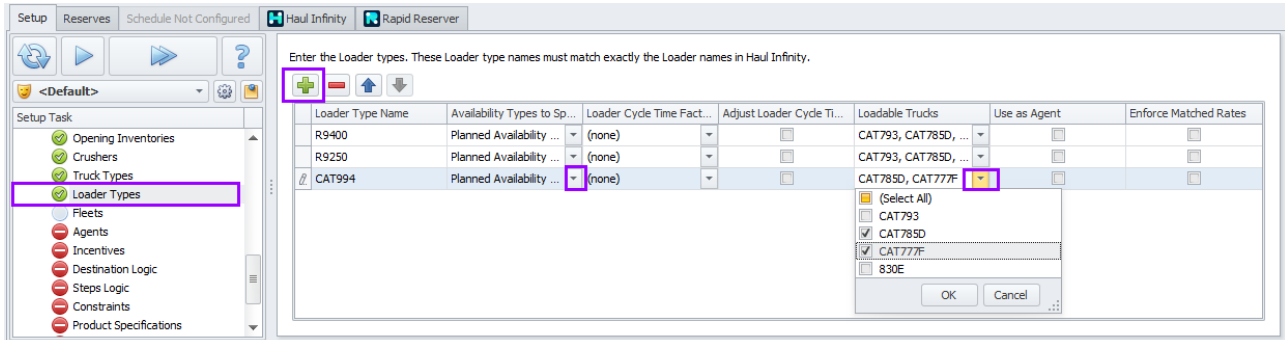
- Add Loaders, same as in Haul Infinity.
- Toggle availability types required. They will appear as extra rows in the Schedule Calendar. Only select the availability and utilisation values that need to be input in the calendar.
- Loader Cycle Time Factor by Time and Adjust Loader Cycle Time Factor by Time – same as for trucks in the previous step.
- Specify trucks than can be loaded by the selected loader type. Pay attention to the equipment sizes – small diggers cannot load large trucks, such as Komatsu 830E. Dependant on which Truck and Loader combinations are used at site.
- Flag in the Use as Agent column creates a 1:1 mapping between an Agent and a Loader. This is useful in short term scheduling (QP), but not required in longer term plans (5YP/LOM).

Fleets

Setup Fleet configurations.

Different Loader:Truck combinations may be setup to work in different parts of the operation.

> Stockpile rehandle fleet, ExPit fleet, small truck fleet etc..

Define order of Loader and fleet usage.

- If Trucks are selected in the same rule, neither has priority. The loader may use either truck in any order.
- If Trucks are selected in the separate rules, 1: has priority, then 2:...etc.
  - The loader will use up all the trucks in rule 1: and only when these are exhausted will it look at the availability of the trucks in rule 2:.
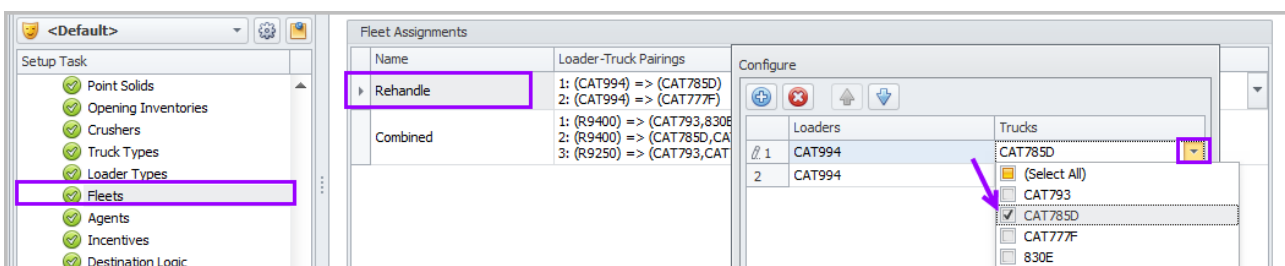
Scheduling Logic

Agents

Agents execute the scheduling logic selecting what blocks will be mined next. All available blocks are ranked for selection.
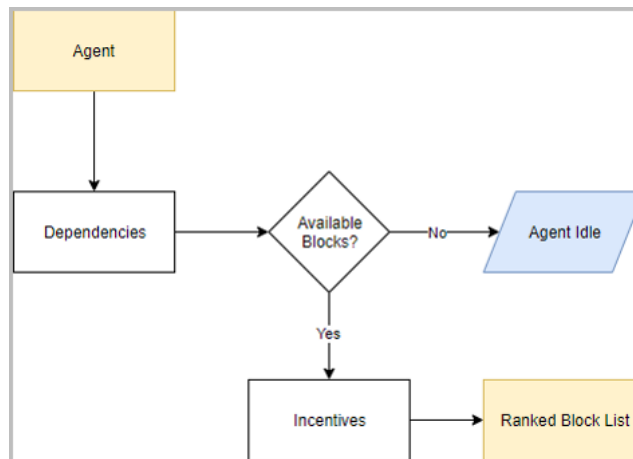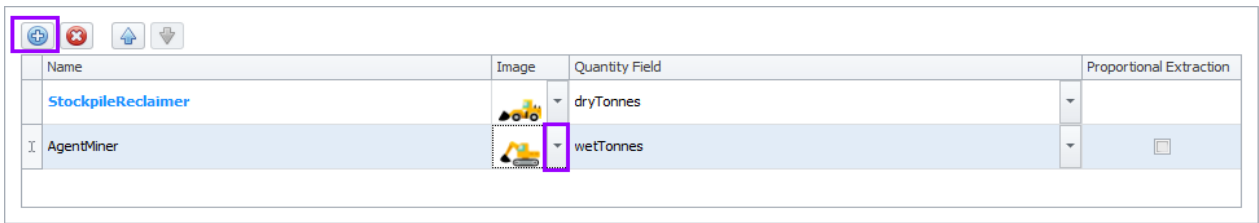

Agents, Dependencies and Incentives

During each scheduling period, agents choose blocks to be mined from the pit:

1. What blocks are available based on the Dependencies
2. Agent ranks all available blocks based on incentives
   o These include internal incentives such as shortest cycle time
3. Checks destination logic for available destinations
4. Checks constraints for available movement
5. Checks steps logic for available fleet hours
6. Checks dynamic haulage for available route
7. If the block fails any checks, then remove it from the available block list
8. Else schedules the top ranked block in the list
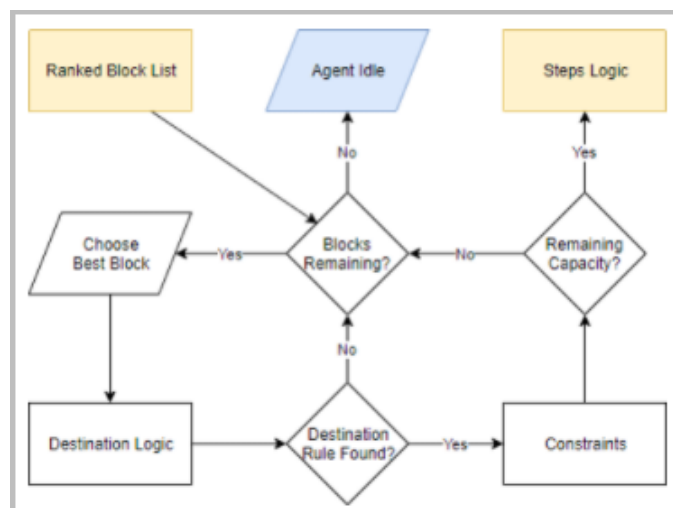
- StockpileReclaimer is a default Agent created by the software to reclaim from stockpiles to feed the Crusher.
- If not using Loader agents (defined in the Loader step) add "AgentMiner " here.
- Select image to appear in the animation.

Incentives

Agents use Incentives to apply weighting to blocks to rank them for mining.
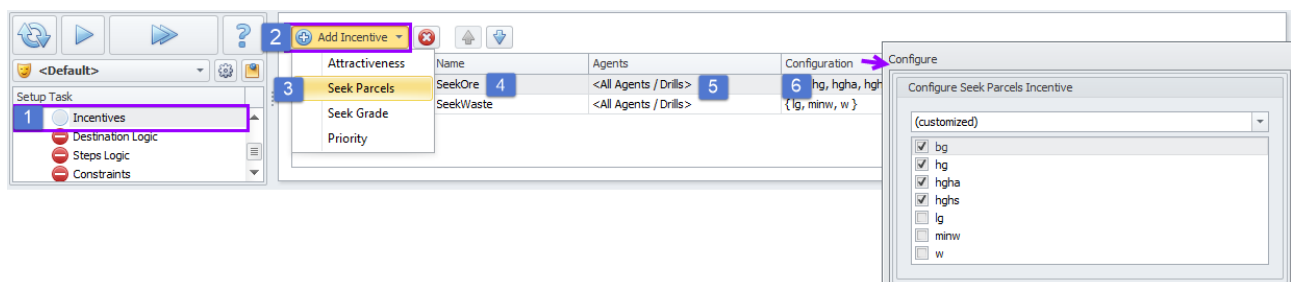
Shortest Cycle time is an internal weighting that will rank the blocks for mining, the user can specify extra incentives to fulfill their mining requirements.

There are 4 types of Incentives:

- Attractiveness – Rank different locations for mining.
  - Prefer the agent to select areas (pits/stages/) to mine in a particular order.
- Seek Parcels – Rank certain material types to be ranked higher by the Agent.
  - Have an incentive to mine ore to fill the Crusher/stockpiles.
  - Or to mine Waste in certain periods if enough ore stockpiled and wish to encourage the optimiser to mine more waste for development.
- Seek Grade - Target block which have a specific grade.
  - Be careful, if a Minimum/Maximum are set here, the block cannot be mined if outside these boundaries.
- Priority – User can select a sequence of blocks to mine in order.
- Good for short term (up to ~3 months) schedules not longer term.

Once an incentive is created, it's weighting is input in the calendar and can vary by period.

Create a Seek Parcels incentive to prioritise ore parcels.

1. Incentive step.
2. Add a new Incentive.
3. Seek Parcel incentive.
4. Give it a useful name – explains what the incentive does.

5. Select the agents it can apply to (all).
6. Configure Incentive (tick ore parcels).
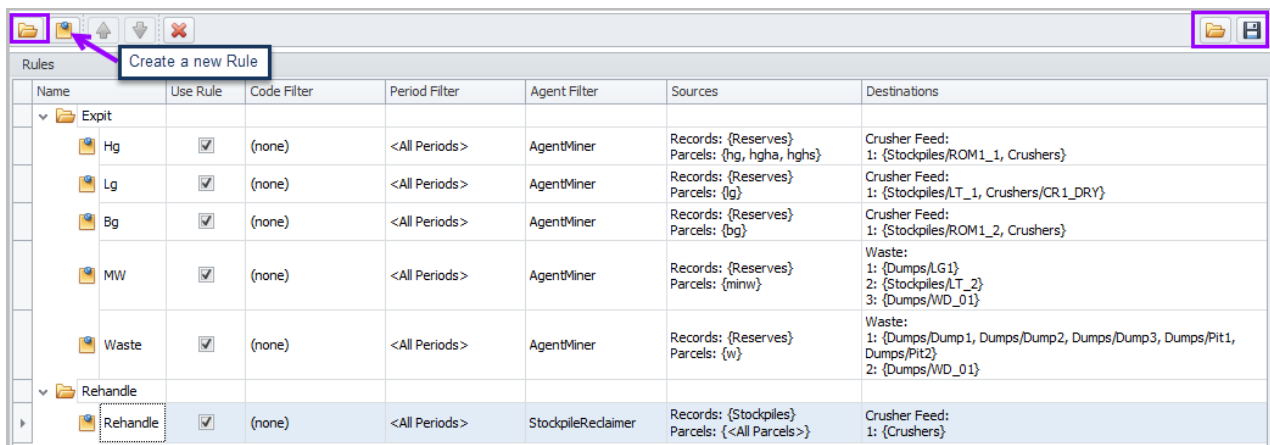
Destination Logic

Rules are created for the optimiser to know where material can go.

For each Agent, every parcel from every location what destinations is it allowed to go to.

- Waste Rules are listed in priority

  o All destinations input on the same row will have the same priority and material will be sent to the destination with the shortest cycle time that is available
  o For destinations on multiple rows, the higher rows have priority. When all the available destinations on a row are exhausted, the optimiser will cascade to the next row to find a destination.
  o Availability will be judged by Capacity, open haul route (Dynamic Haulage rules) and constraints operating on that destination.

Optimised Product: All Crusher Feed destinations can only be listed on one row, the products Spec rules will determine, which of the destinations the material will be sent to.

Create rules. Ensure every material from every source has a destination.

Name	Use Rule	Code Filter	Period Filter	Agent Filter	Sources	Destinations
Expit						
Hg	✓	(none)	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {hg, hgha, hghs}	Crusher Feed: 1: {Stockpiles/ROM1_1, Crushers}
Lg	✓	(none)	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {lg}	Crusher Feed: 1: {Stockpiles/LT_1, Crushers/CR1_DRY}
Bg	✓	(none)	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {bg}	Crusher Feed: 1: {Stockpiles/ROM1_2, Crushers}
MW	✓	(none)	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {minw}	Waste: 1: {Dumps/LG1} 2: {Stockpiles/LT_2} 3: {Dumps/WD_01}
Waste	✓	(none)	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {w}	Waste: 1: {Dumps/Dump1, Dumps/Dump2, Dumps/Dump3, Dumps/Pit1, Dumps/Pit2} 2: {Dumps/WD_01}
Rehandle						
Rehandle	✓	(none)	<All Periods>	StockpileReclaimer	Records: {Stockpiles} Parcels: {<All Parcels>}	Crusher Feed: 1: {Crushers}

Use folder and sensible names to follow the destination logic rules.

Rules can be exported and imported into another similar project.
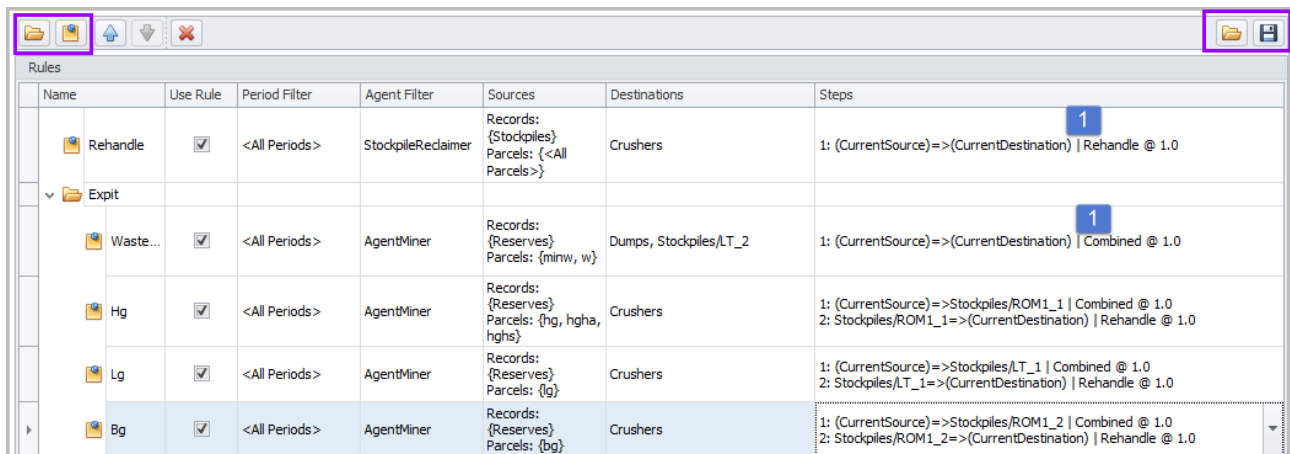
Steps

If Destination logic tells you where material can go, Steps Logic tells you how it will get there.

What intermediate steps it will go through before reaching the ultimate destination, and what equipment will be used. It is here that the fleet used is specified.

- Waste parcels will have one Source and one final destination uses the pit fleet (combined)
- Stockpile material will have one Source and one final destination uses the rehandle fleet
- Ore will have two steps

- From the pit to the stockpile using the pit fleet @1.0 means 100% of material follows this step
- From the stockpile to the crusher using the rehandle fleet
- The available destinations for these steps are the same as those input in the Destination rules.

Name	Use Rule	Period Filter	Agent Filter	Sources	Destinations	Steps
Rehandle	☑	<All Periods>	StockpileReclaimer	Records: {Stockpiles} Parcels: {<All Parcels>}	Crushers	1: (CurrentSource)=>(CurrentDestination) | Rehandle @ 1.0
∨ 📁 Expit						
Waste...	☑	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {minw, w}	Dumps, Stockpiles/LT_2	1: (CurrentSource)=>(CurrentDestination) | Combined @ 1.0
Hg	☑	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {hg, hgha, hghs}	Crushers	1: (CurrentSource)=>Stockpiles/ROM1_1 | Combined @ 1.0 2: Stockpiles/ROM1_1=>(CurrentDestination) | Rehandle @ 1.0
Lg	☑	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {lg}	Crushers	1: (CurrentSource)=>Stockpiles/LT_1 | Combined @ 1.0 2: Stockpiles/LT_1=>(CurrentDestination) | Rehandle @ 1.0
Bg	☑	<All Periods>	AgentMiner	Records: {Reserves} Parcels: {bg}	Crushers	1: (CurrentSource)=>Stockpiles/ROM1_2 | Combined @ 1.0 2: Stockpiles/ROM1_2=>(CurrentDestination) | Rehandle @ 1.0

Constraints

Constraints are used to control the schedule. They create rows in the calendar and input values over time.

There are four types:

- Standard (or Destination) constraints - Constrain the amount of material sent to a destination.
- Source constraints - Constrain how much material can come from a location.
- Bench Advance - Control how many benches are available.
- Agent Assignment – place equipment in the required location

Create the following constraints:

1. Source: Total Movement.
   a. For the Pit Agent set up a constraint to control all parcels (TMM) mined from each Stage in the pit.
2. Standard: CrusherMax.
   a. Constrain the amount f material sent to the Crusher.
3. AgentAssignment: Assign Loaders.
   a. Assign Loaders by Pit.

Product Specifications

In an Optimise Product Schedule, the inputs in Product Specifications control where the crusher feed will be sent.

Using cash flows and targets on the stockpiles and crushers, the optimiser can determine where (of the available destinations set) to ultimately send a parcel.

- Cash Flows are used to prioritise destinations
  - ALWAYS have a Cash Flow on a crusher, if rehandled material is required to fill it
  - If there are 2 crushers, one can be given a higher cash flow

Haulage Configurations

Dynamic Haulage

Access roads can be turned on/off over time depending on activities on site.

Errors

When all the steps are run, check the base for the error list.

The ATS schedule is checked against Haul Infinity

- Records not matched to blocks in Haul Infinity
- Missing Waste dumps or Stockpiles
- Equipment

Go to Haul Infinity to fix these errors

1. HI. Scheduler > Import Blocks from Scheduler
   a. Threr is a mismatch with the blocks currently in HI and those in ATS – update Haul Infinity
   b. Check the Blocks node at the lower left of the screen, are all the blocks connected to the network. If not, use your Haul Infinity Skills to connect them.
   c. When complete all blocks should be ticked green.