Response Options Calculator (ROC)
Users Guide

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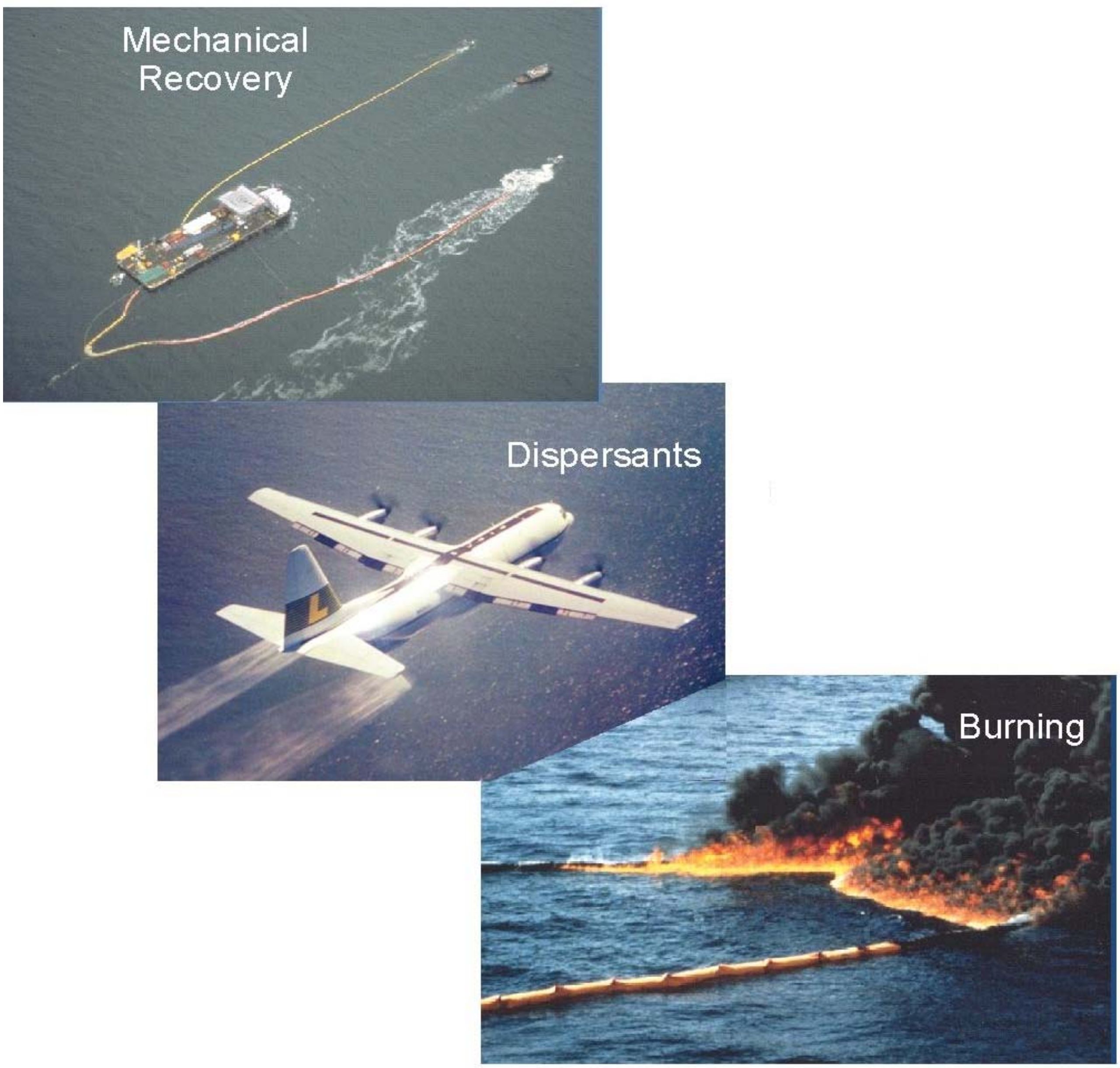

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Chapter 1

Welcome to ROC, the Response Options Calculator

ROC Disclaimer

The Response Options Calculator (ROC) indicates general performance for oil spill response systems. It cannot be used to determine exact values due to highly variable input parameters, process complexity, and inter-dependencies. Users accept responsibility for modeling results and their interpretation.

While the contributors made every effort to deliver a high quality product, we do not guarantee that the Response Options Calculator is free from defects. ROC is provided "as is," and you use it at your own risk.

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About ROC

ROC is a publicly available oil spill planning and response model that simulates oil weathering, spreading, and recovery by advancing skimming systems, treatment by dispersant application, and removal by in-situ burning. It combines and updates the algorithms from NOAA's ADIOS and Spill Tools programs, and includes new algorithms for oil slick spreading.

This manual includes three chapters to help you learn to use ROC. This chapter contains an overview of ROC, a description of how to download and install ROC, and an explanation of ROC's toolbar including the Conversion Calculator, Save File, Open File, Start New File, and Help. After reviewing this chapter, continue on to **Chapter 2** for the step-by-step ROC tutorial, Scenario 1. Refer to **Chapter 3** for descriptions of other features of ROC not covered in the tutorial. Sections of this chapter include explanations of how to add custom oils and new response platforms. At the end of the manual, you'll find a **Glossary** of terms used in ROC.

You can use ROC to …

- Predict spreading and weathering of oil spilled on the water surface.
- Estimate the volumes of oil that could be affected by skimmers, dispersant applications, and *in-situ* burning.

To use ROC, you describe a spill scenario by entering information into the program; ROC then creates and displays graphics showing the predicted weathering of the simulated oil spill in your scenario and the estimated treatment of oil by skimming, dispersing, and burning.

What ROC Can Do

In the marine environment, hydrocarbons can **"weather,"** or change physically and chemically while exposed to the environment. The weathering and spreading behavior of different hydrocarbons are critical to predicting their average thickness over time, which in turn determines the rate at which the oil potentially can be recovered, dispersed, and burned. ROC contains a database of crude oils and oil products to use in your simulations. It allows for adding of your own oils by entering information about the crude oil or refined product. It also allows for adding response systems that you define.

ROC is an oil spill response model that can:

- Estimate the theoretical performance of multiple oil spill response systems by processing information that you provide about environmental conditions, the oil release scenario(s) you wish to simulate, and information about the response systems.
- Show how response can be affected by the numbers, types, and configuration of response systems.
- Use weathering algorithms to make simple predictions about the changes the oil will undergo while it is exposed to the environment.
- Quickly be updated, re-run, and saved with new information.
- Display oil "mass balance" - simulate oil removal from the ocean surface by natural processes (e.g., evaporation) when the oil weathering mode is used, and by one or more response systems throughout a given simulation period. Oil remaining on the surface during a calculation interval (1 hour) is always assumed to be available to the selected response systems because oil is never allowed to "come ashore".
- ROC will give a warning if some of the data input appears to be inconsistent, for example, when attempting to model mechanical recovery in high seas, of if simulated oil appears to be below its pour point (warnings or "User Alerts" are found at the beginning of the Reports Tab). Nevertheless, an experienced user could continue with simulation. Special care should be taken when interpreting modeling results.

What ROC Can't Do, Assumptions, and Limitations

- ROC is not a trajectory model. It is not geo-specific. It is intended for modeling spills in open water outside of the influence of tides, land, ice, or debris.
- ROC assumes "best industry practices", i.e., that response occurs in the thickest oil.
- To simplify computations, ROC holds some factors constant that in reality could change. For example, during a real response, a skimming system's swath width might be altered over time as the nature and amount of oil on the surface change. However, the swath for a given response system remains constant in ROC for the duration of a simulation.
- Wind direction or ocean currents are not considered in ROC since ROC does not take into account changes in the location of a slick (relative to land) during a simulation period. The location of a slick (i.e., its proximity to shore) only comes into play as it might affect assigned "Transit Times" for response systems to travel between their staging, offloading, or burn sites and the area in which they are operating.
- Multiple (or separate, independently-spreading) oil slicks cannot be modeled in ROC. Separate ROC simulations should be run for these.
- ROC can't model response to very thin oil slicks or "sheens" (~ 1 micron, or ~ 10^{-4} inch). Such response may not be operationally feasible.
- Oil loss due to coming ashore is not included in ROC mass balance.
- ROC simulations may not have a duration greater than 5 days.

How to Get What You Want From ROC

As you begin working with ROC, you should experiment with the model to improve your intuition in factors affecting the response scenario you have created. To learn how oceanographic and atmospheric conditions influence oil spill weathering and spreading, we recommend that you try running the model with different wind speeds and temperatures. Strong winds can control the oil spill spreading, so try a variety of speeds. (ROC does include some limitations for some values, but you should try to check that your values are realistic for what you are modeling.)

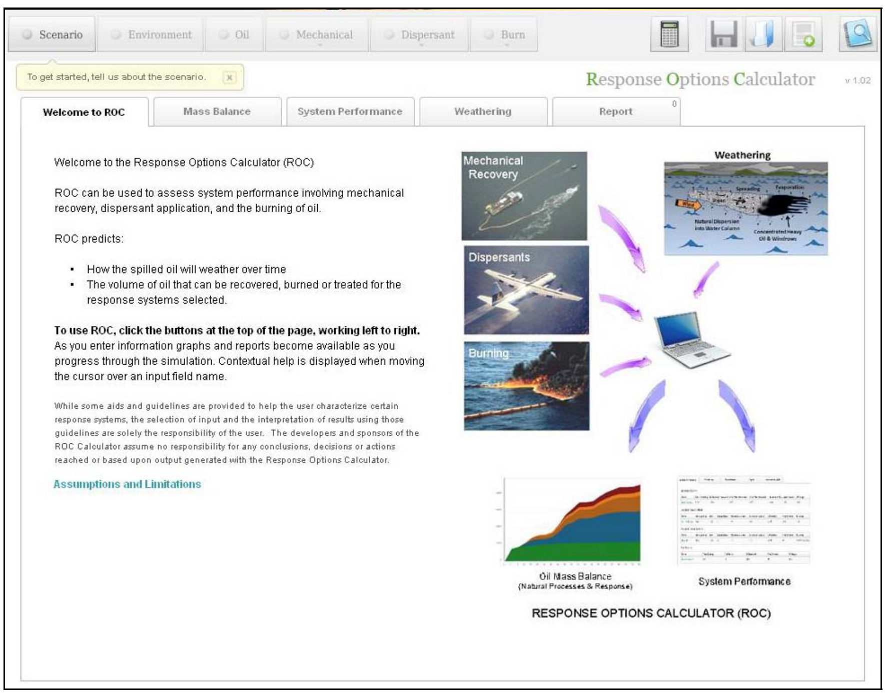
You should also experiment with how changing response system configurations can change potential recovery. For example, increasing the swath of a specific skimmer could increase potential recovery. Although some default values are provided for response options configurations, this model is best run with operational knowledge of response systems.

Getting and Installing ROC

ROC is publicly available via the Internet and operates in any Flash enabled browser. ROC may be freely used and distributed. To download or to use ROC online, use your browser to go to http://roc.genwest.com. There are two links here; one to the online version and the other to the downloadable ROC zip file. Extracting the zip file to a folder will include the files below. To launch ROC, open the file roc.html.

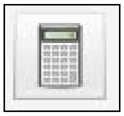
Name	Size	Type	Date Modified
help		File Folder	5/2/2010 2:10 PM
history		File Folder	5/2/2010 2:10 PM
images		File Folder	5/2/2010 2:10 PM
map_shapes		File Folder	5/2/2010 2:10 PM
xml		File Folder	5/2/2010 2:10 PM
AC_OETags.js	9 KB	JScript Script File	3/26/2010 2:30 PM
playerProductInstall.swf	1 KB	Shockwave Flash O...	3/26/2010 2:30 PM
roc.html	5 KB	Firefox Document	5/2/2010 12:19 PM
roc.swf	1,133 KB	Shockwave Flash O...	5/2/2010 12:19 PM

Welcome to ROC Tab



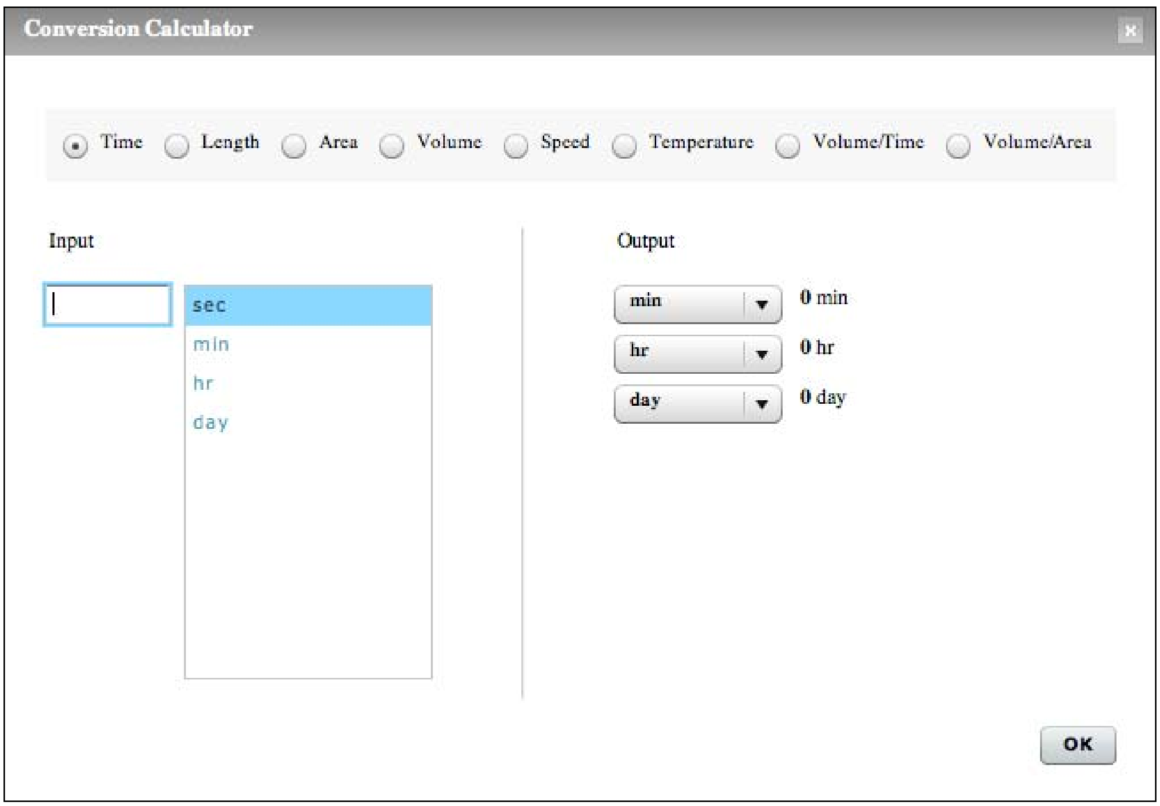
This is the ROC Welcome window. The tabs across the top allow you to create a scenario, specify environmental conditions, select a crude oil or oil product, and assign mechanical, dispersant, and/or burning countermeasures to your scenario. The next row of tabs displays ROC outputs for mass balance, system performance, weathering, and a simulation report.

The set of icons at the upper right activate a calculator for conversion of oil spill related units, a button to save your current simulation to a file for later use, a button to load a previously saved simulation, a clear button to reset ROC for a new simulation, and a button to navigate to the online help. The colored text Assumptions and Limitations also launches ROC Help.



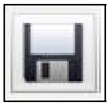
The ROC Conversion Calculator

The ROC Conversion Calculator is accessible from the Welcome window and other relevant windows throughout ROC where the Conversion Calculator icon appears.



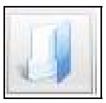
Conversions are available for the categories displayed across the top. Click the Radio Button for the category you wish. The left side of the window is for input. Enter the value to convert in the text box, then select the input units. The right side of the window displays up to three different output conversions. If the desired conversion unit is not displayed, click on one of the dropdown units and select the unit desired.

Click OK to exit the Unit Converter



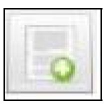
Saving ROC Files

Click on the ROC Save File icon to save all input to a small, formatted text file. These files can be reloaded into ROC to instantly recreate the saved scenario including response systems you have created. This is the <u>only</u> way to save custom oils or response systems you created electronically. Custom oils and response systems are lost when ROC is closed. Scenarios, custom oils and response systems could be recreated from a printed ROC Report, but a save file is much easier, faster, and more accurate. ROC save files can easily be emailed as attachments to ensure that a collaborator is using the same exact scenario.



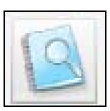
Opening ROC Files

Click on the ROC Open File Icon (a file folder) to open a text file previously saved in ROC.



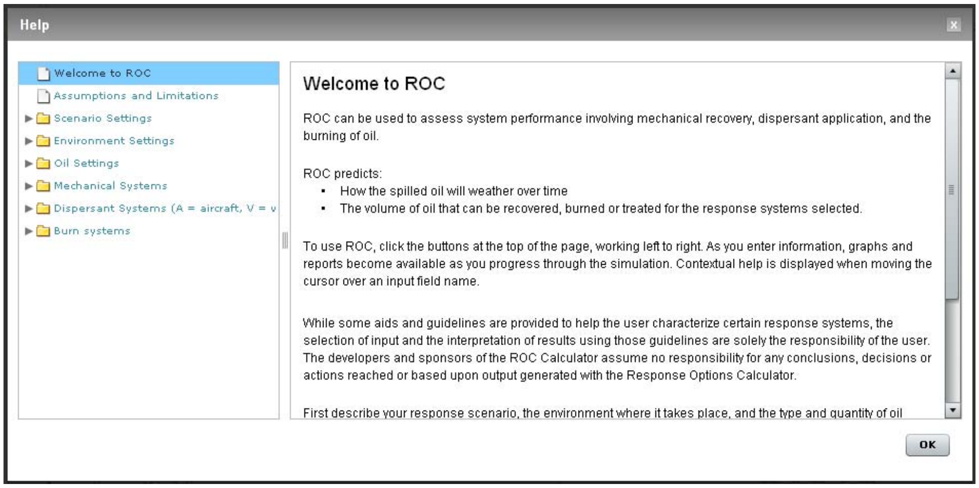
Starting a New ROC File

Clicking on the ROC Start New File icon will start a new ROC file. A dialog will prompt to save changes first.



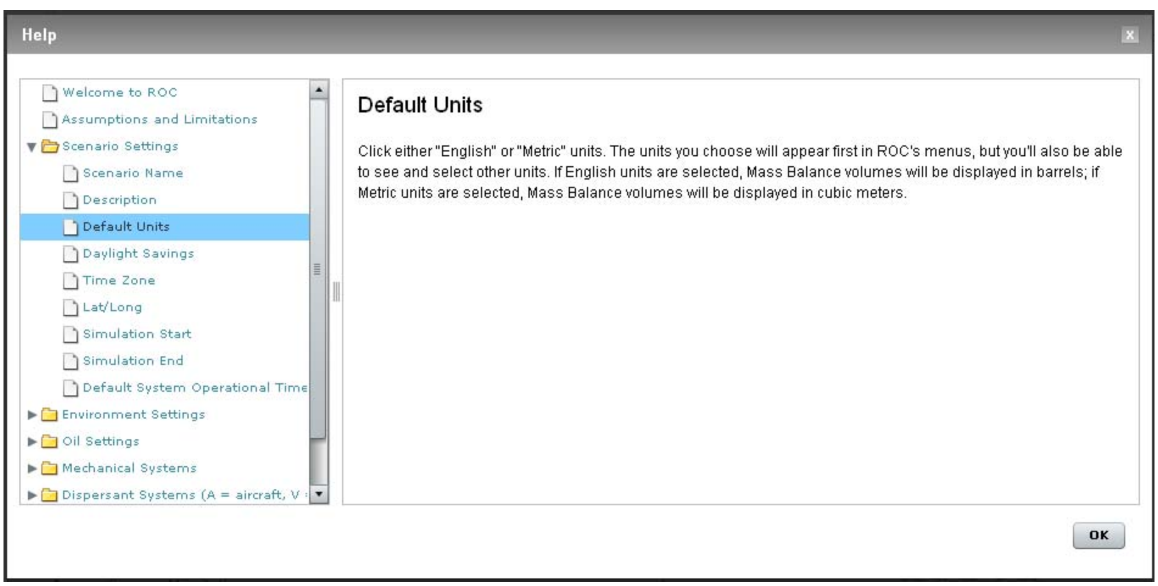
ROC Help

Click on the ROC Help icon to view explanations of ROC's main functions and features.



Click the dropdown arrow to the left of a Help category to display the topics for that category.

Select a topic name to view a discussion of that topic:



Sample **ROC Help** topic

Chapter 2

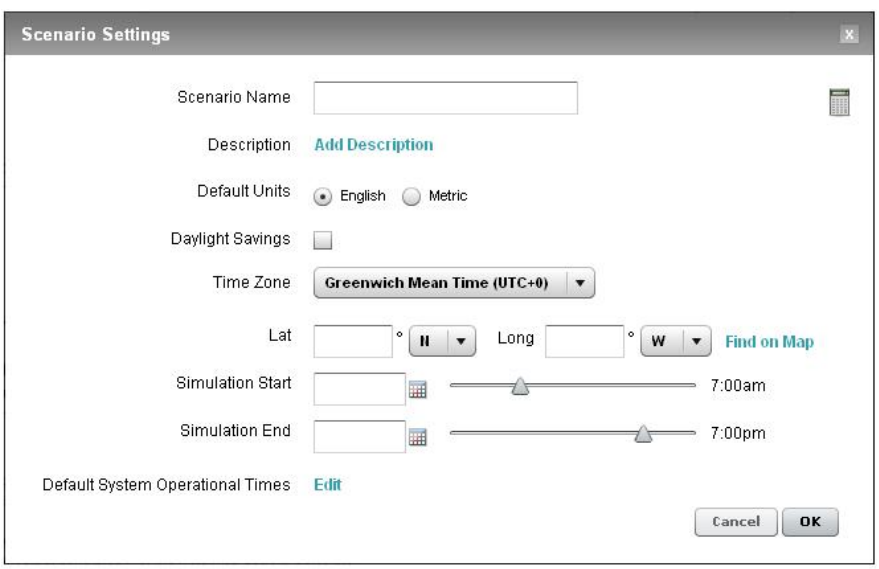
Creating a Simulation in ROC-Scenario 1

This chapter guides you, step-by-step, through a ROC scenario describing a hypothetical crude oil spill. Follow along, using your own copy of ROC, to familiarize yourself with ROC's features and capabilities. For more information about other aspects and features of ROC, refer to Chapter 3 of this manual.

This first scenario, which we will call Scenario 1, involves a "batch" spill. A batch spill is defined as a release of oil occurring over a short period of time as opposed to a continuous release which is assumed to continue at a constant rate for the duration of a simulation. In Scenario 1, we will first simulate the weathering and spreading of the oil without any response. We will then add response assets one-by-one to examine how each can contribute to the response.

Exercise:
Using ROC, we will first simulate an oil spill and then a response to the oil spill with the following information:
On January 1, 2011 at 0900 a vessel collision occurs off the coast of Washington (the release was far enough offshore that it will not come ashore during the simulation) resulting in a sudden release of approximately 5000 bbl of Alaska North Slope crude oil. The water temperature is 48 degrees F and the wind speed is 10 knots.

To begin the exercise, click on the Scenario Tab at the upper left hand corner of the ROC Welcome window, just above the visual prompt "To get started, tell us about the scenario."



On this screen you will name the scenario, add a description of the scenario if you wish, and select default units for input as well as the display of results.

> **Enter "Scenario 1" in the Scenario Name box**
> **Click on Add Description and enter any text you want to describe this scenario.**
> **For purposes of this exercise, leave the default English Units as is.**

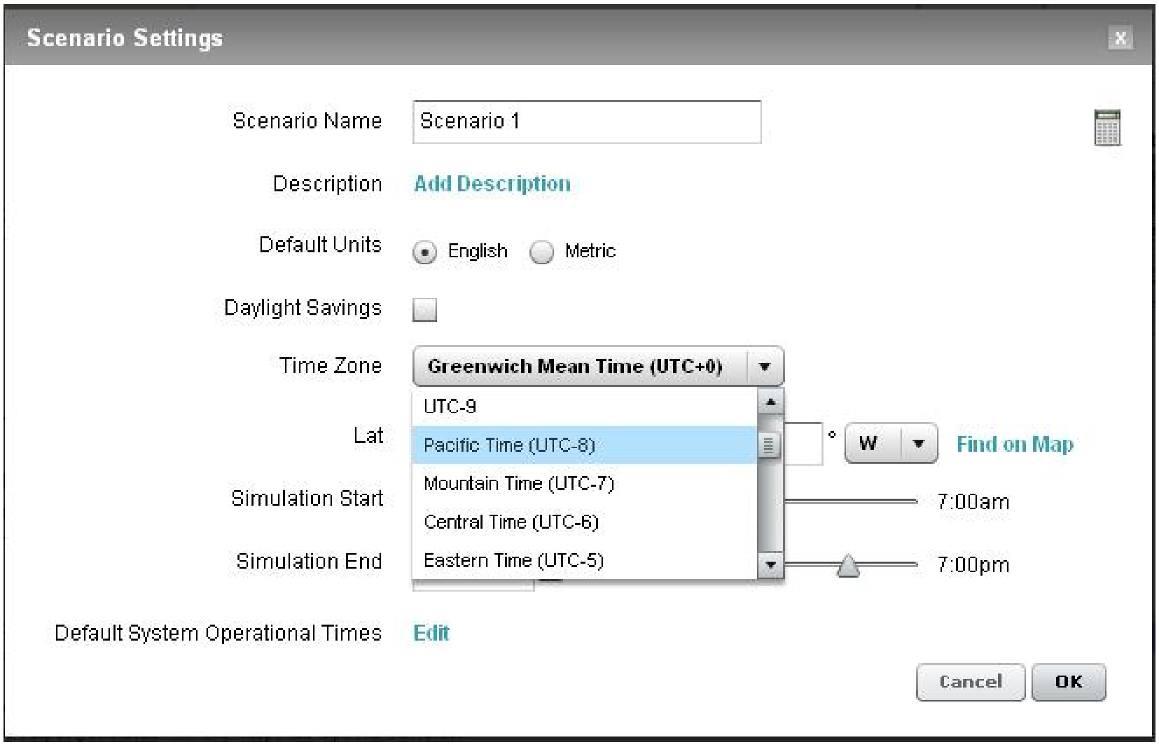
The units you choose will appear first in ROC's menus, but you'll also be able to see and select other units. If English units are selected, Mass Balance volumes will be displayed in barrels; if Metric units are selected, Mass Balance volumes will be displayed in cubic meters.

The next series of inputs determine the time of sunrise and sunset. ROC's initial assumption is that response happens only in daylight. You may override this assumption later on.

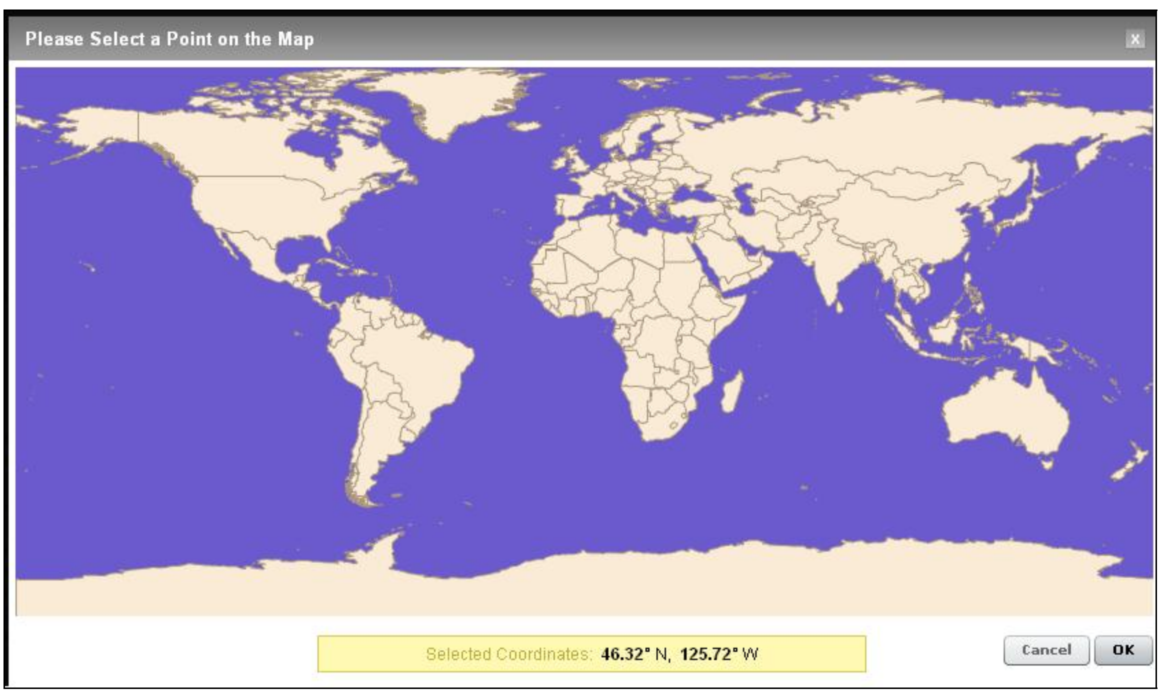
You may have noticed text popping up in moving around this screen. If you move the cursor over the label Default Units, text that describes this input will pop up on the screen. If you want to drill down further into the meaning of Default Units within ROC, click on the label to navigate to the ROC Help for this input.

Back at the settings for determination of sunrise and sunset, you may recall that ROC is not geographically specific so why are we asking for a location on the earth? We use time, location on the earth, and dates to calculate the time of sunrise and sunset for each day of your simulation. Location of the spill is necessary for calculations to tell ROC when resources arrive on scene.

> **We will be using a Start Date of January 1, 2011 so leave the Daylight Savings box unchecked. Select the Pacific Time Zone (UTC-8).**



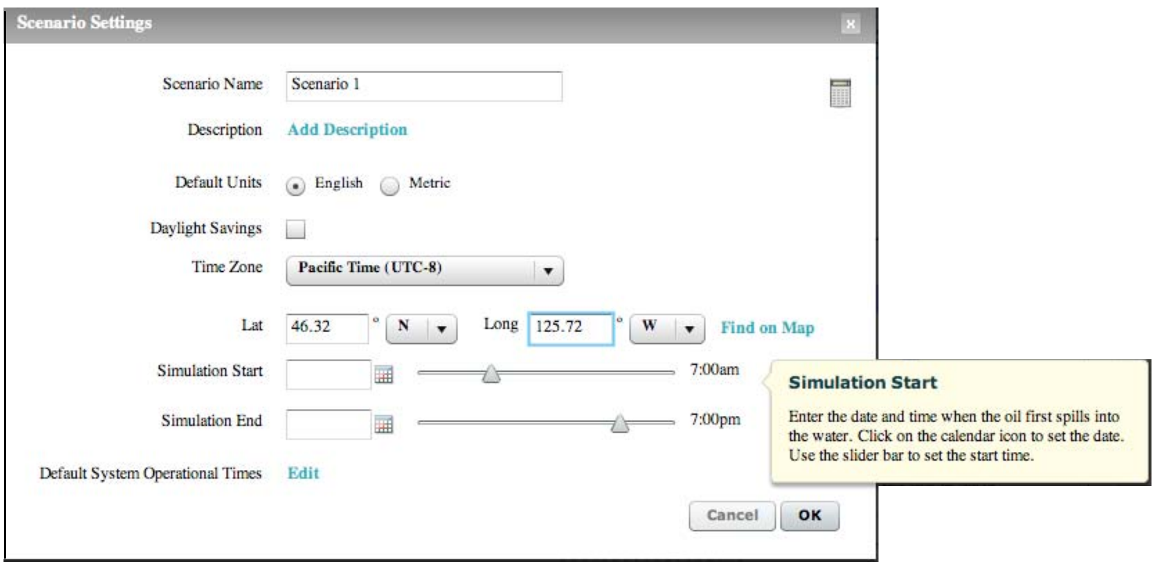
Next click Find on Map.



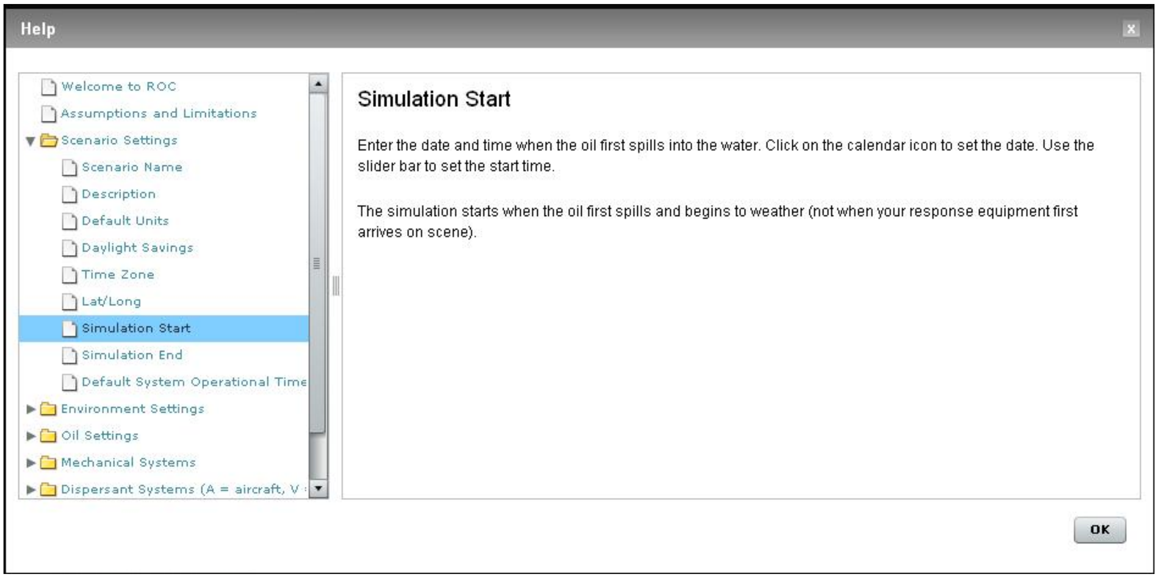
Each time you click at an approximate (remember this is only to calculate time of sunrise/sunset, ROC is not geo-specific) location on the world map, the coordinates of that location are displayed at the bottom of the map. For the purposes of this exercise click on OK to return to the Scenario Settings window and enter coordinates of 46.32 degrees North and 125.72 degrees West. This will ensure your results are consistent with the exercise results presented here.

You may have already noticed the appearance of pop-ups in navigating around Scenario Settings. In many ROC windows, you can get basic information about a data entry field by placing the cursor over a field label.

Move the cursor over the Simulation Start label.



Click on Simulation Start label to launch ROC Help for this topic.



Click OK to return to Scenario Settings.
Select a Start Date of January 1, 2011 by clicking on the calendar icon next to the Simulation Start Date field, then click on the previous button until January 2011 is displayed, then click on "1".

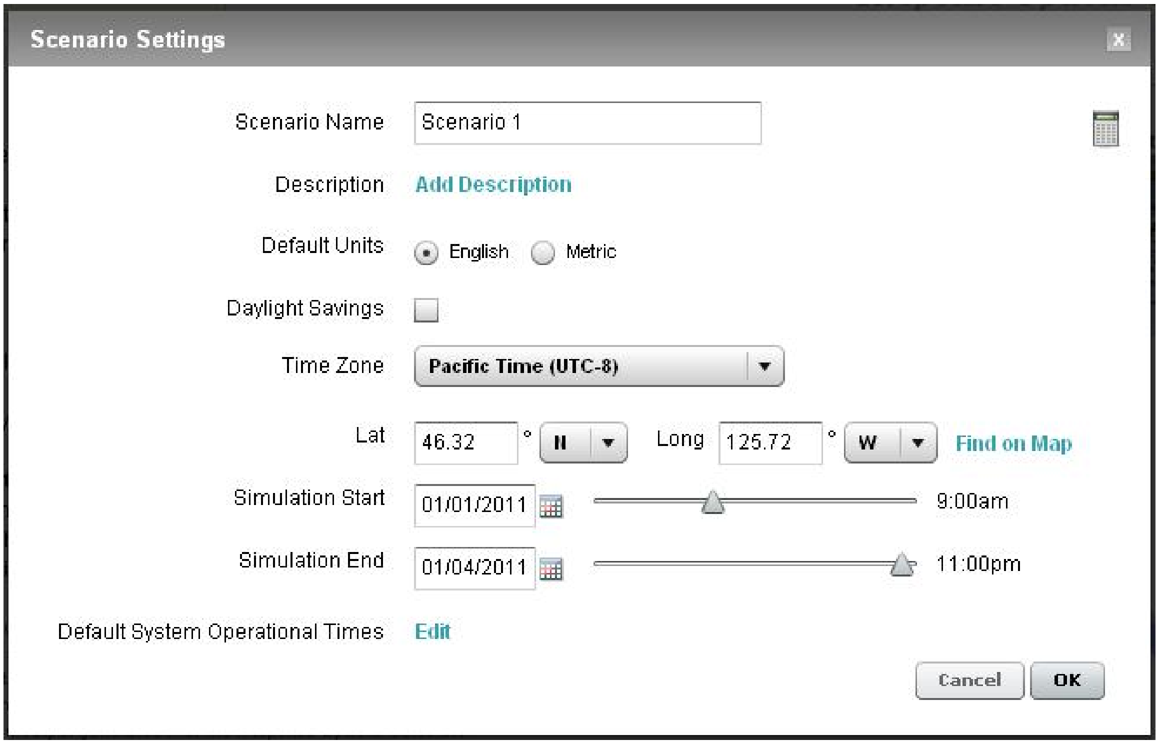
The Simulation Start Time is adjusted with the slider bar to the right of the Simulation Start Date field.

Click and drag the triangular slider until the time reads 9:00 am.

(Note that ROC limits the Simulation Start and End Times to the nearest hour.)

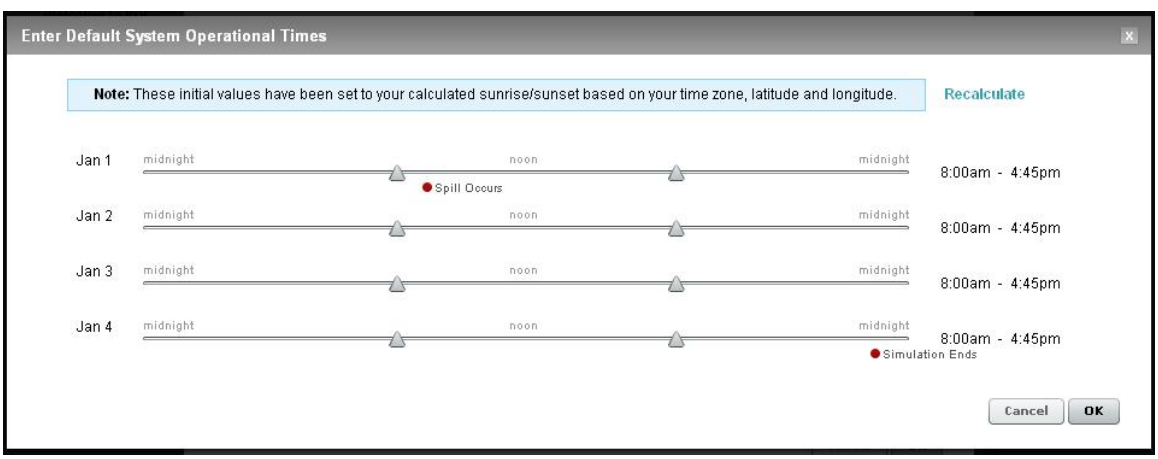
Now set the Simulation End Date to January 4, 2011 and the Simulation End Time to 11:00 pm.

Scenario Settings should look like this:



The information that has been entered here has enabled ROC to estimate the time of sunrise and sunset for each day of your simulation to the nearest 15 minutes. These will also become the default start and end times of each system you assign to response in this simulation. When you begin to use ROC for your own simulations and have more exact times of sunrise/sunset for the dates of your simulation or wish to change the Default System Operational Times, click on Edit. For the purposes of this exercise leave the present settings unchanged.

Click on Edit to view these settings:



In this example ROC has estimated that sunrise occurred at 8:00 am and sunset occurred at 4:45 pm for every day of Simulation 1. This means that the default for each assigned response system will be the same; start at 8:00 am and stop at 4:45 pm. Day 1 of any response is a special start time case for every system assigned to the spill. Each system will have its own notification, recall, cascade time (if needed) and transit time. To correctly calculate each system's start time for a drill or a real incident, it will be necessary to have a spill location. For this exercise we will be using simulated cascade and transit times to set the start day/time for each system.

Special Note: Start time for assigned skimming systems (and the oil collection phase of in-situ burning) is defined in ROC as that time that the system is on scene at the oil slick, fully configured, and ready to collect oil. Start time for dispersant application systems is the time they are at their assigned staging area ready to start the first sortie.

The start time on the initial day of response for every system assigned must be set manually in ROC, based on the above considerations.

Click OK to dismiss the Default Systems Operational Times window and return to the Scenario Settings window.

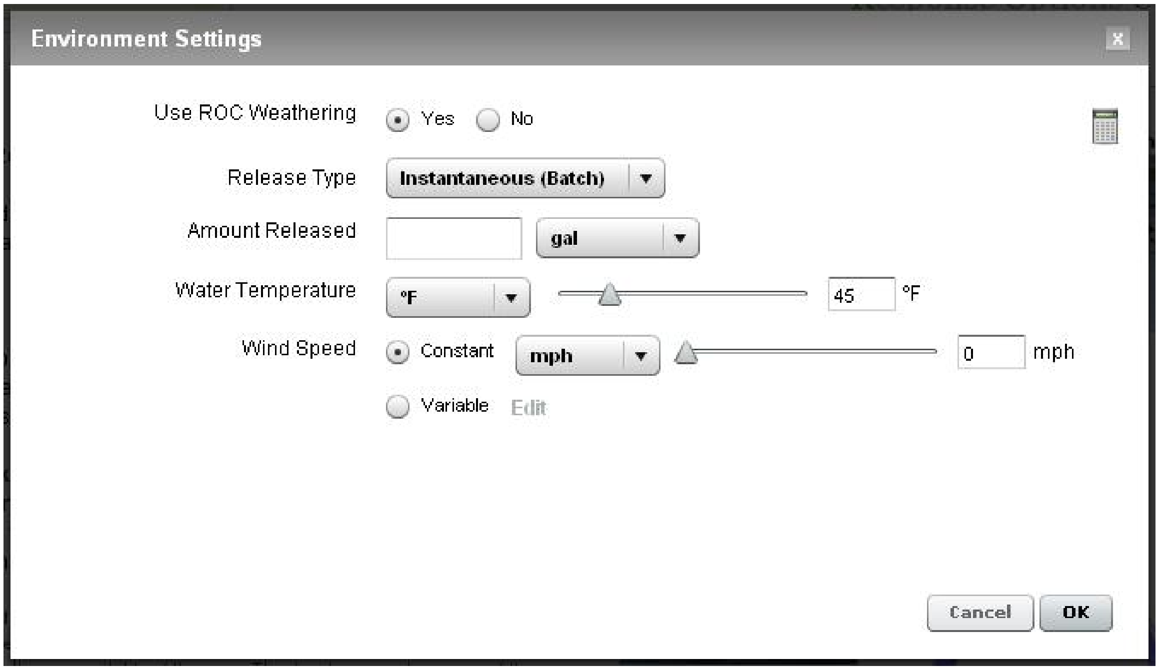
We are now finished with the Scenario Settings window.

Click OK to return to the ROC Welcome Screen.

Note that the Scenario Tab has a "green light" which gives a visual indication that the Scenario Tab contains the necessary information to continue and an onscreen prompt directs you to the Environment tab to continue data entry.

Click on the Environment Tab to open the Environment Settings window.

(this is located just above the visual prompt "Now tell us about your environment.")



The first decision is to choose Yes (default setting) or No for Use ROC Weathering. With Use ROC Weathering set to Yes, the weathering/spreading module of ROC will perform calculations for every hour of the simulation for:

Oil slick thickness
Oil viscosity
Water content in oil emulsification
Oil evaporation
Oil volume remaining
Area covered by oil slick
Oil natural dispersion

Select No to enter an oil slick thickness manually. This thickness will remain constant for the duration of the simulation.

For Scenario 1, leave Use ROC Weathering set to Yes.

The Release Type can be Continuous or Instantaneous (Batch).

For Scenario 1, leave Release Type set to Instantaneous (Batch). Choose bbl from the units drop down list and enter 5000 for the Amount Released.

The Scenario 1 water temperature is 48 degrees F and the wind speed is a constant 10 knots.

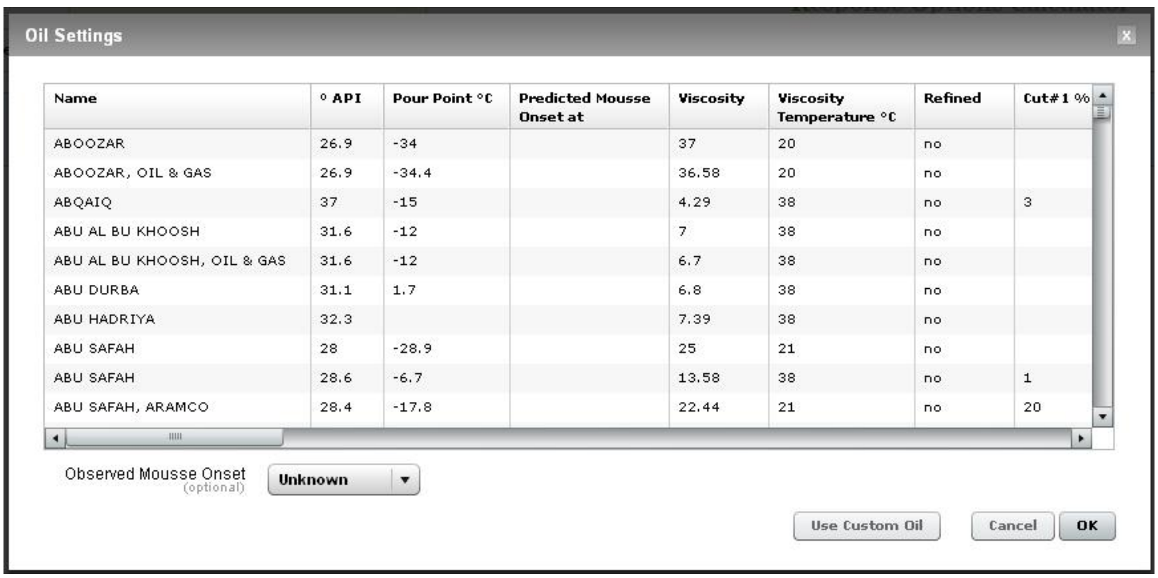
Use the Water Temperature slider bar to set the temperature to 48 degrees or enter 48 manually.

Select "kt" from the Wind Speed units drop-down and use the slider bar to set the wind speed units to "10" or enter the units directly.

Click OK to accept the data entered and return to the ROC Welcome Screen.

We now have "green lights" for the Scenario and Environment Tabs. Next is the Oil Tab.

Click on the Oil Tab.


Oil Settings

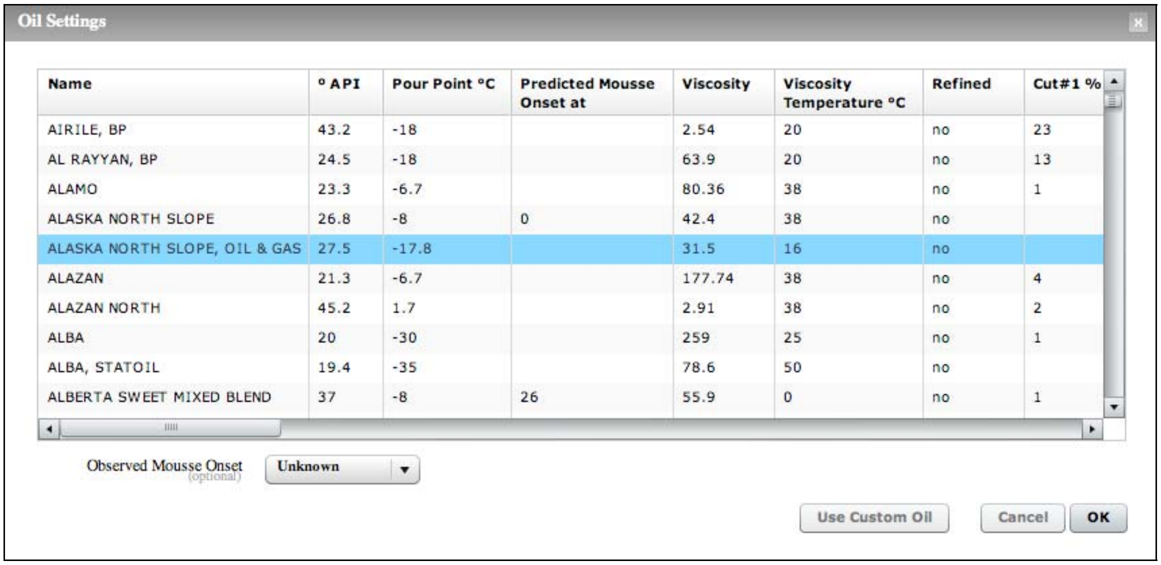
Name	° API	Pour Point °C	Predicted Mousse Onset at	Viscosity	Viscosity Temperature °C	Refined	Cut#1 %
ABOOZAR	26.9	-34		37	20	no	
ABOOZAR, OIL & GAS	26.9	-34.4		36.58	20	no	
ABQAIQ	37	-15		4.29	38	no	3
ABU AL BU KHOOSH	31.6	-12		7	38	no	
ABU AL BU KHOOSH, OIL & GAS	31.6	-12		6.7	38	no	
ABU DURBA	31.1	1.7		6.8	38	no	
ABU HADRIYA	32.3			7.39	38	no	
ABU SAFAH	28	-28.9		25	21	no	
ABU SAFAH	28.6	-6.7		13.58	38	no	1
ABU SAFAH, ARAMCO	28.4	-17.8		22.44	21	no	20

Observed Mousse Onset (optional) Unknown

Use Custom Oil | Cancel | OK

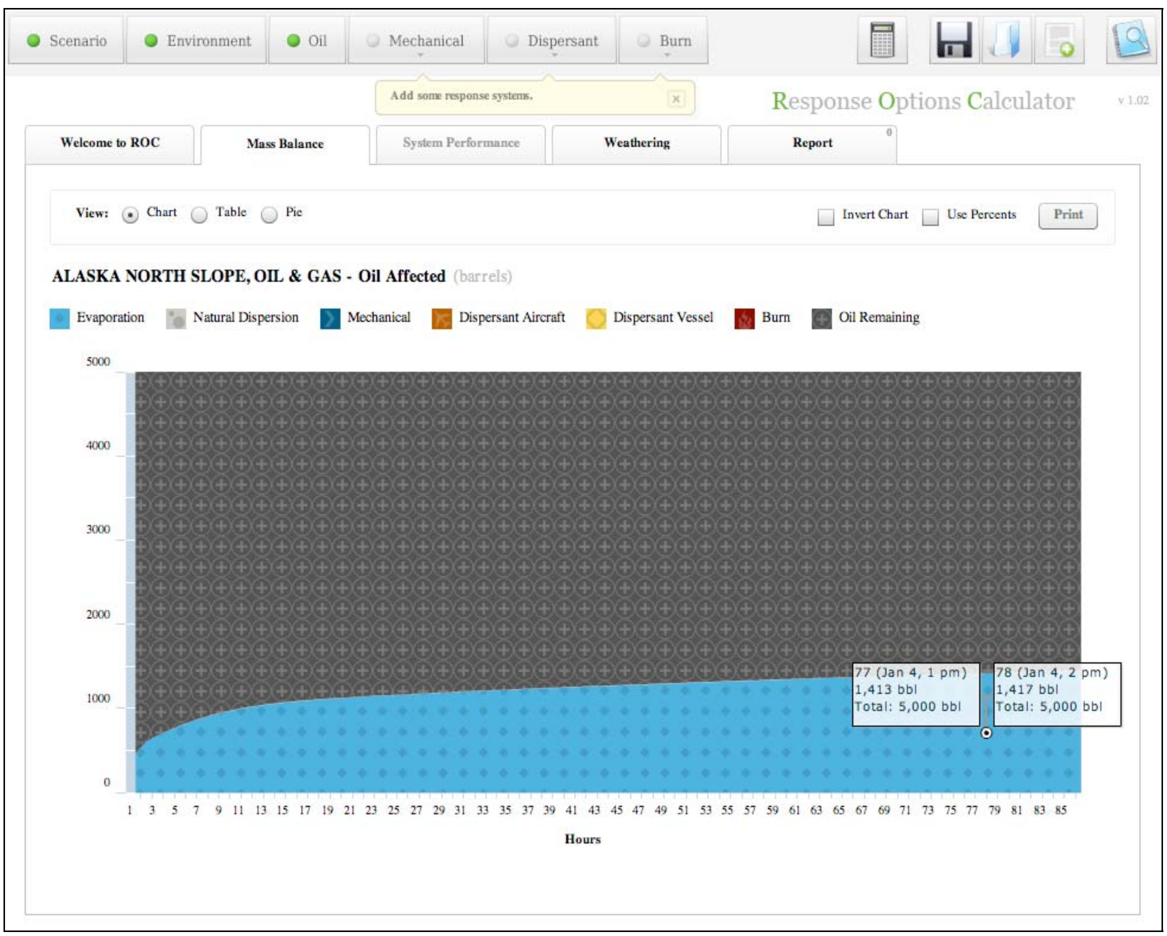
There are over 1000 crude oils and refined products in the ROC oil database, a subset of the oil database used in the NOAA, Office of Response and Restoration, oil weathering model ADIOS. The ROC oil database is sorted alphabetically ascending by product Name. It can be ordered alphabetically descending by clicking on the Name field. The list can also be ordered ascending or descending by API gravity. For purposes of Scenario 1 leave the list order unchanged.

Scroll down to and click on ALASKA NORTH SLOPE, OIL & GAS.



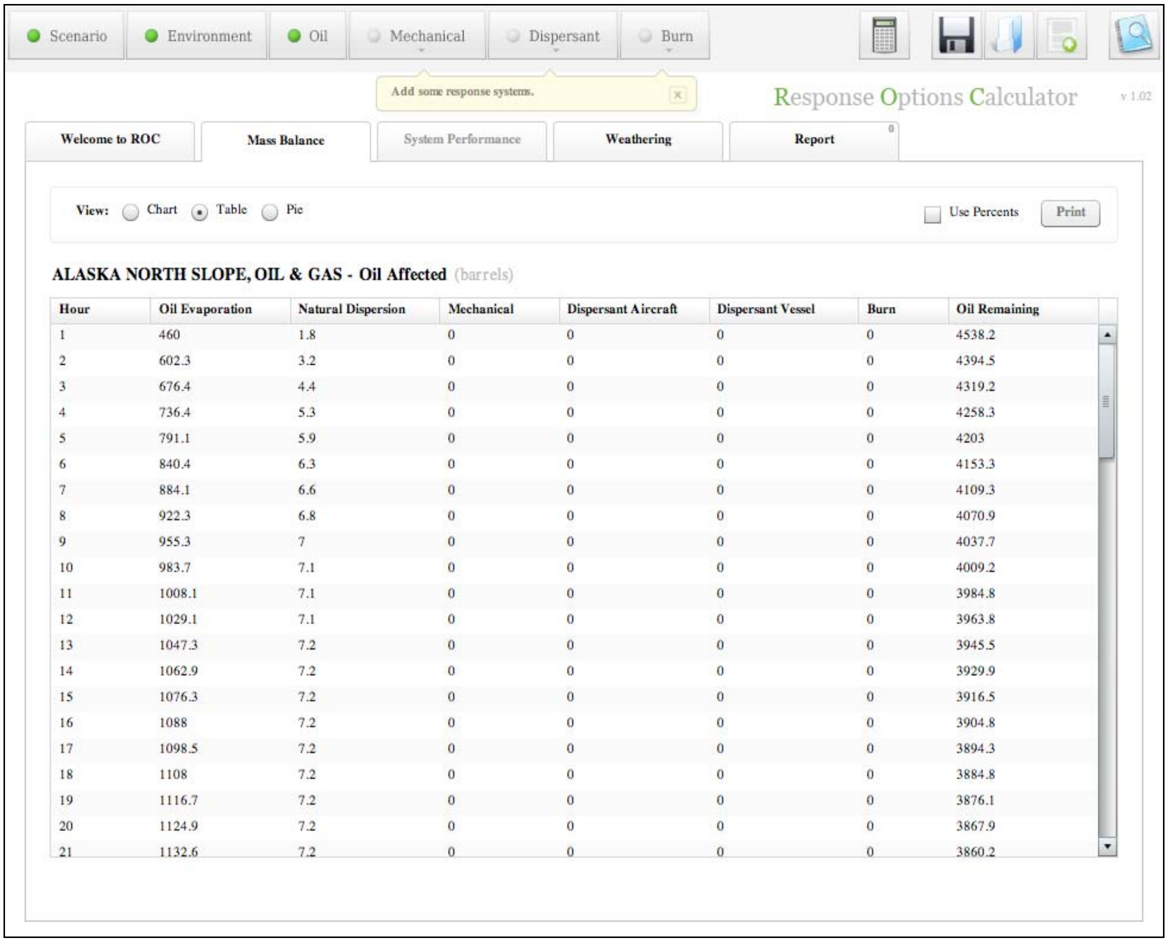
Name	° API	Pour Point °C	Predicted Mousse Onset at	Viscosity	Viscosity Temperature °C	Refined	Cut#1 %
AIRILE, BP	43.2	-18		2.54	20	no	23
AL RAYYAN, BP	24.5	-18		63.9	20	no	13
ALAMO	23.3	-6.7		80.36	38	no	1
ALASKA NORTH SLOPE	26.8	-8	0	42.4	38	no	
ALASKA NORTH SLOPE, OIL & GAS	27.5	-17.8		31.5	16	no	
ALAZAN	21.3	-6.7		177.74	38	no	4
ALAZAN NORTH	45.2	1.7		2.91	38	no	2
ALBA	20	-30		259	25	no	1
ALBA, STATOIL	19.4	-35		78.6	50	no	
ALBERTA SWEET MIXED BLEND	37	-8	26	55.9	0	no	1

Clicking OK accepts this oil and, as there is sufficient information to Calculate ROC weathering, returns to the Mass Balance Tab.



This mass balance chart view displays the time-dependent evaporation of the 5000 bbl spill of Alaska North Slope (Oil & Gas) crude oil as modeled by ROC. In this example the cursor was moved to hours 77-78 of the simulation showing evaporation (in blue) of 1,413 – 1,417 bbl (This can also be displayed as a percentage). The black area of the graph represents the volume of oil remaining. Also present, but not visible at this scale, is the amount of natural dispersion of the oil into the water column. Checking the Invert Chart box displays the mass balance with response at the top, natural processes at the bottom, and remaining oil in the middle. The mass balance can also be displayed as a pie diagram or table.

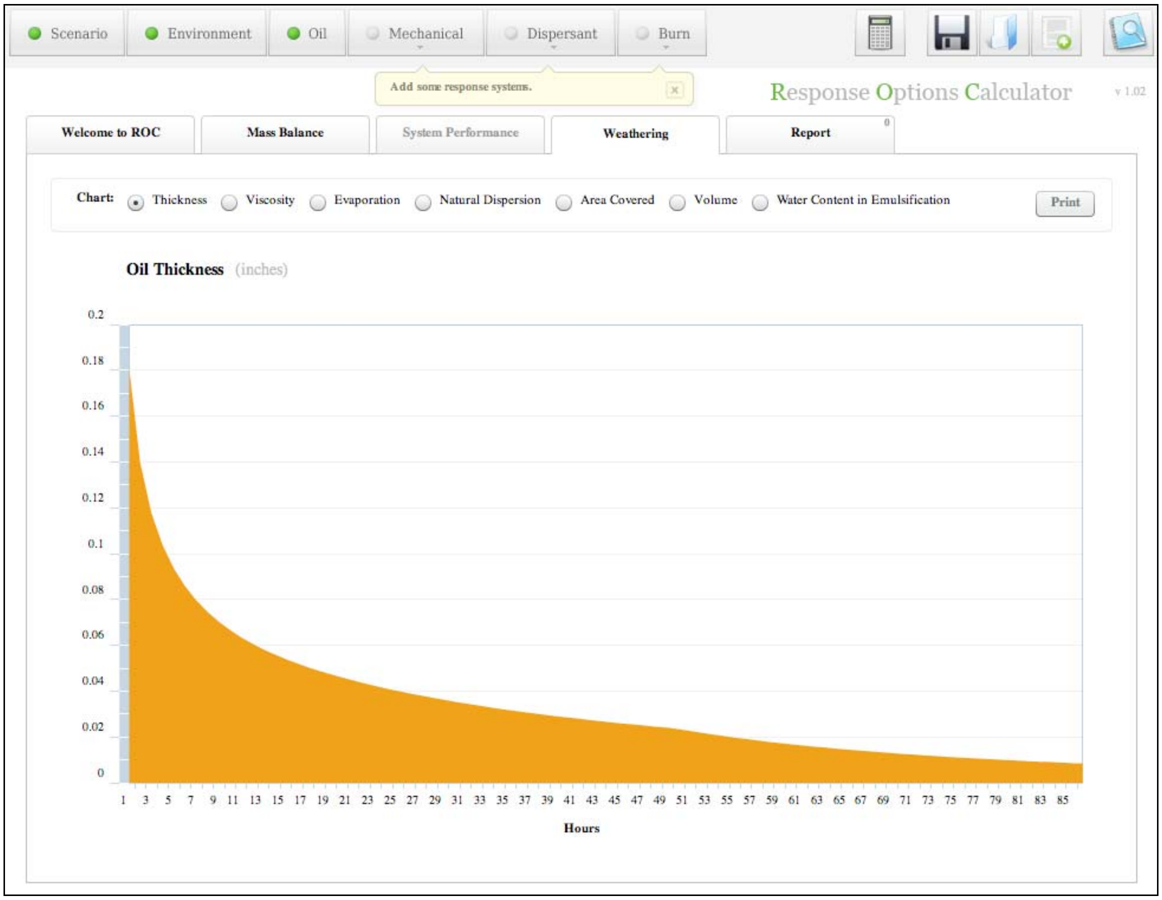
Select View: Table



Hour	Oil Evaporation	Natural Dispersion	Mechanical	Dispersant Aircraft	Dispersant Vessel	Burn	Oil Remaining
1	460	1.8	0	0	0	0	4538.2
2	602.3	3.2	0	0	0	0	4394.5
3	676.4	4.4	0	0	0	0	4319.2
4	736.4	5.3	0	0	0	0	4258.3
5	791.1	5.9	0	0	0	0	4203
6	840.4	6.3	0	0	0	0	4153.3
7	884.1	6.6	0	0	0	0	4109.3
8	922.3	6.8	0	0	0	0	4070.9
9	955.3	7	0	0	0	0	4037.7
10	983.7	7.1	0	0	0	0	4009.2
11	1008.1	7.1	0	0	0	0	3984.8
12	1029.1	7.1	0	0	0	0	3963.8
13	1047.3	7.2	0	0	0	0	3945.5
14	1062.9	7.2	0	0	0	0	3929.9
15	1076.3	7.2	0	0	0	0	3916.5
16	1088	7.2	0	0	0	0	3904.8
17	1098.5	7.2	0	0	0	0	3894.3
18	1108	7.2	0	0	0	0	3884.8
19	1116.7	7.2	0	0	0	0	3876.1
20	1124.9	7.2	0	0	0	0	3867.9
21	1132.6	7.2	0	0	0	0	3860.2

The Mass Balance Table lists the natural and response related items for removal of oil slick/emulsion volume and the oil remaining. In this example, the Natural Dispersion is very low. To view the Table values as percents, click on the box Use Percents. Note the condition of the tabs in this view. The Mechanical, Dispersant, and Burn Tabs are not "green-lighted" as no response has been specified. On the next level of tabs, all are bold, indicating content is present in the tab, except for the System Performance tab. Again, this is because no response has been defined.

Click on the Weathering Tab.

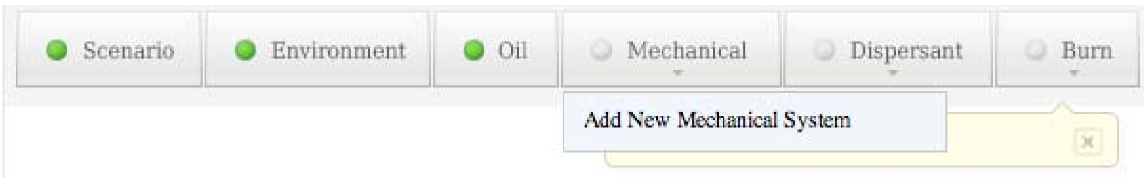


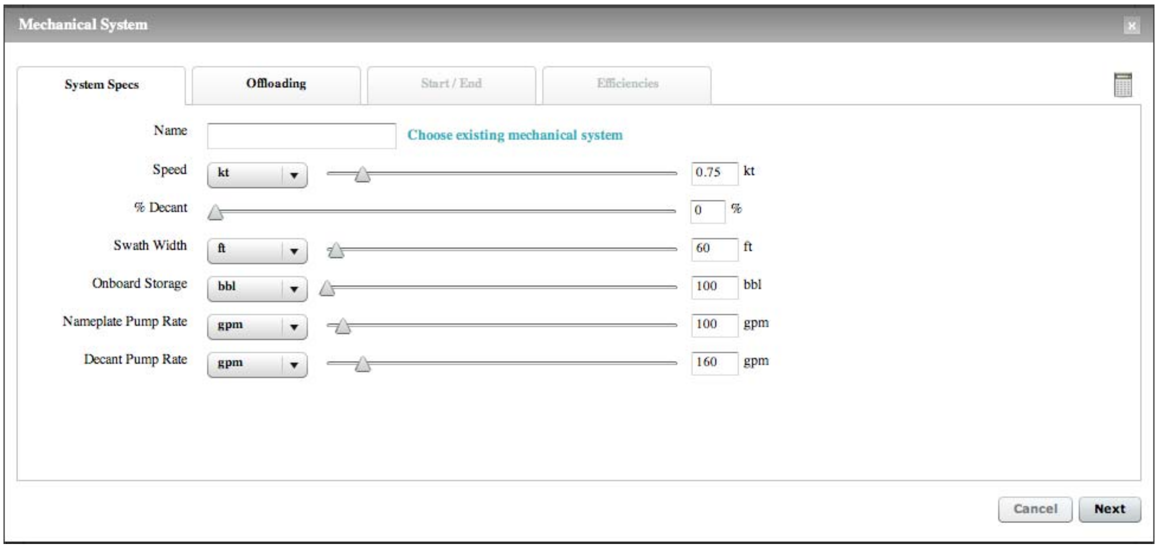
ROC predicts that average thickness within the slick generally will decline over time, with thickness greatest at the downwind (leading edge) end. This chart shows the average thickness of the heaviest oil in the slick at the downwind end (including added thickness from any emulsification of the oil). For more information on ROC spreading (and resultant oil slick thickness) refer to the Genwest Technical Document “Development of Spreading Algorithms for the MARO (Model for Assessment of Response Options) Calculator” by J. A. Galt and Roy Overstreet.

Other Chart options on the Weathering Tab will be discussed below. Next will be adding response systems to Scenario 1.

Mechanical Tab

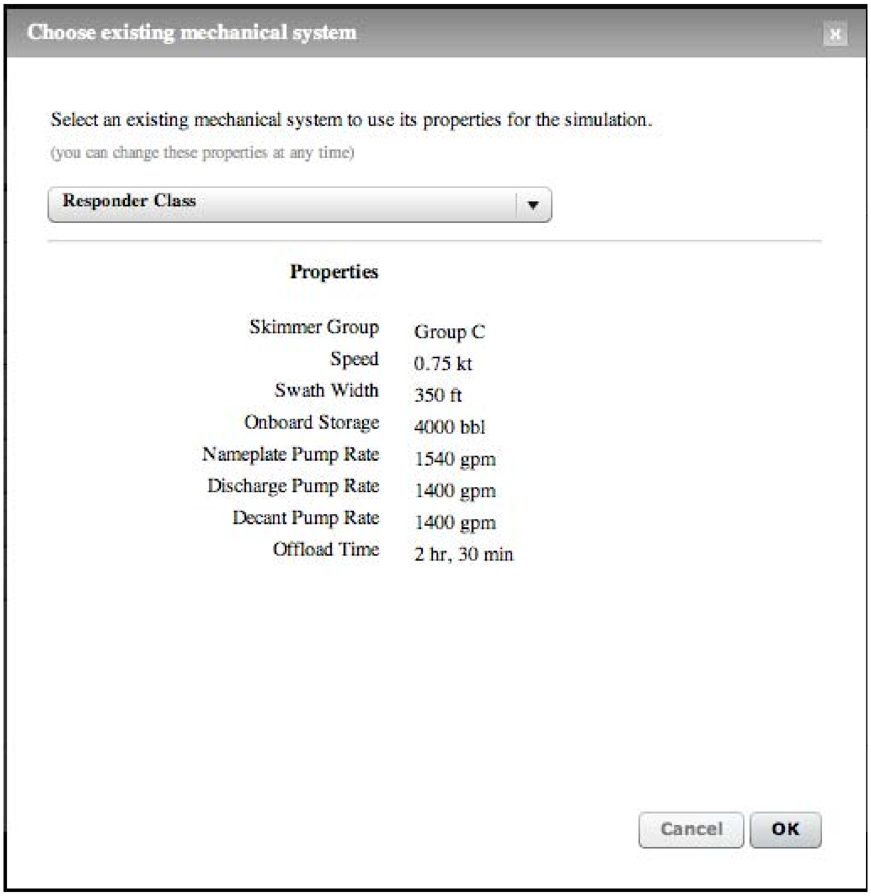
Move the cursor over the Mechanical Tab and then click on Add New Mechanical System.



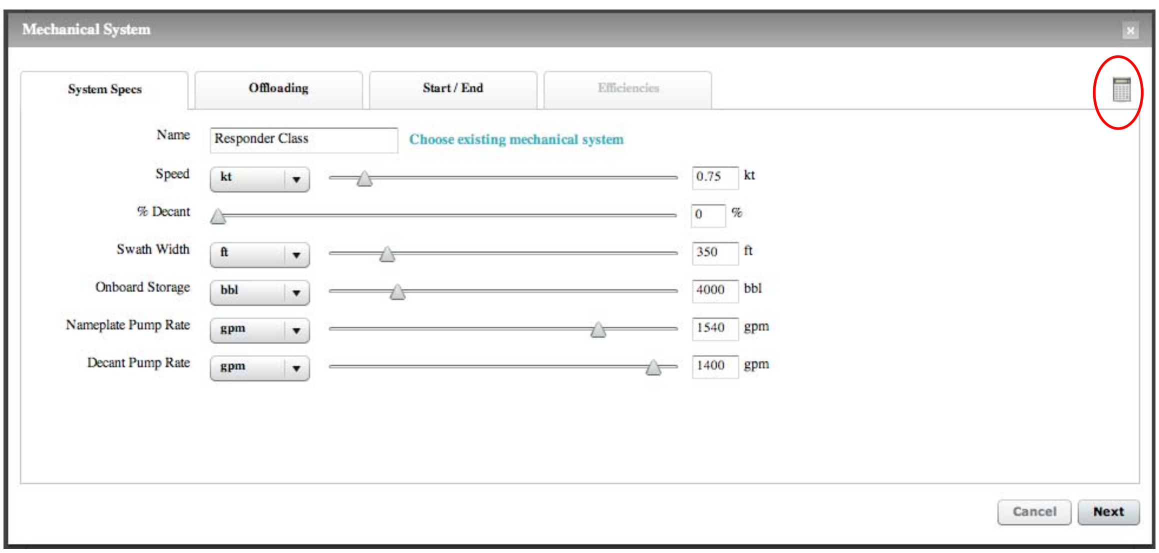


This window opens with default System Specs for a new skimming system. For Scenario 1 we will be using a pre-defined skimming system already loaded in ROC.

> **Click on Choose existing mechanical system to view the available list of skimming systems and to choose a system for Scenario 1.**

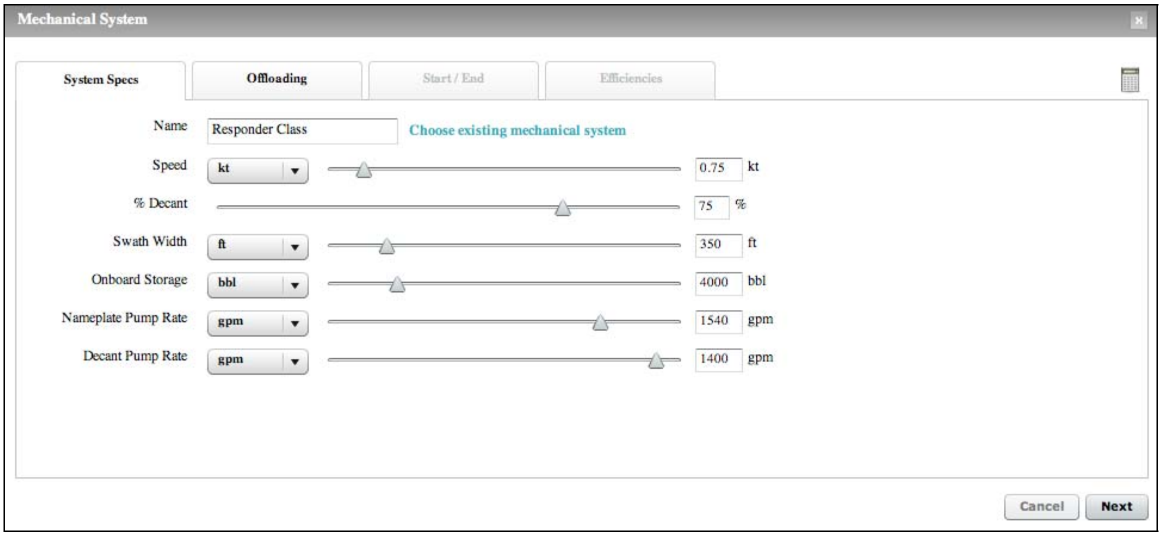


Click on OK to load the default values for a Responder Class skimming system.

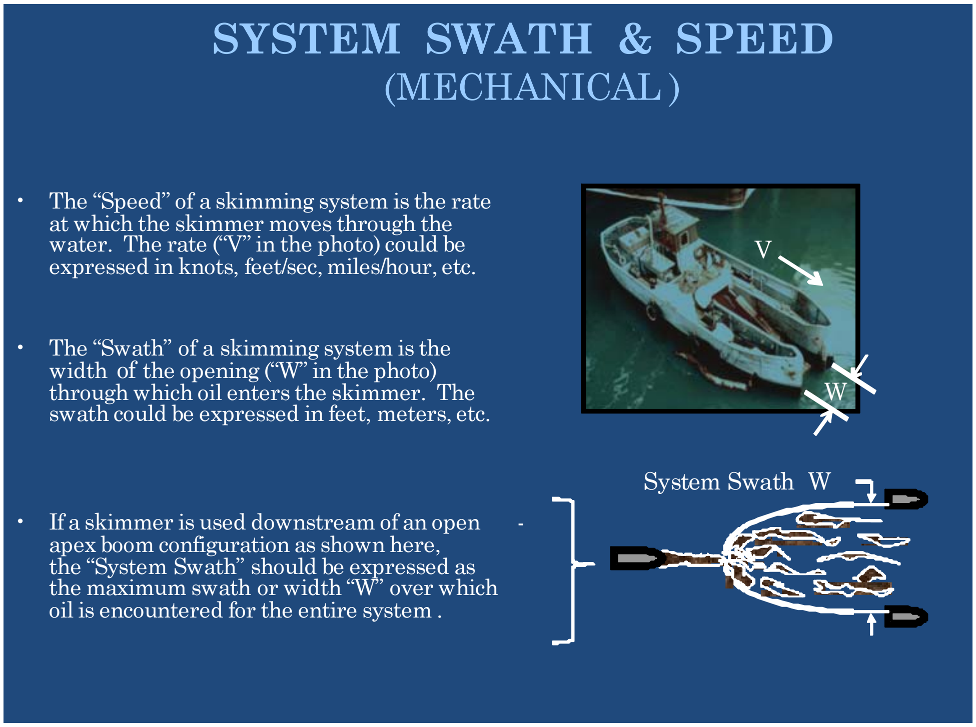


This window displays the basic specifications of the Responder Class skimming system. All these specifications are necessary for ROC to estimate performance. Note that these system specifications are representative and may require modification for different configurations of the skimmer. For Scenario 1 we will change the % Decant to 75%. This means that 75% of the free water brought on-board will be decanted off, leaving more room in the on-board storage for recovered oil/emulsion. Note the calculator icon that is available on all response system windows for unit conversions if desired.

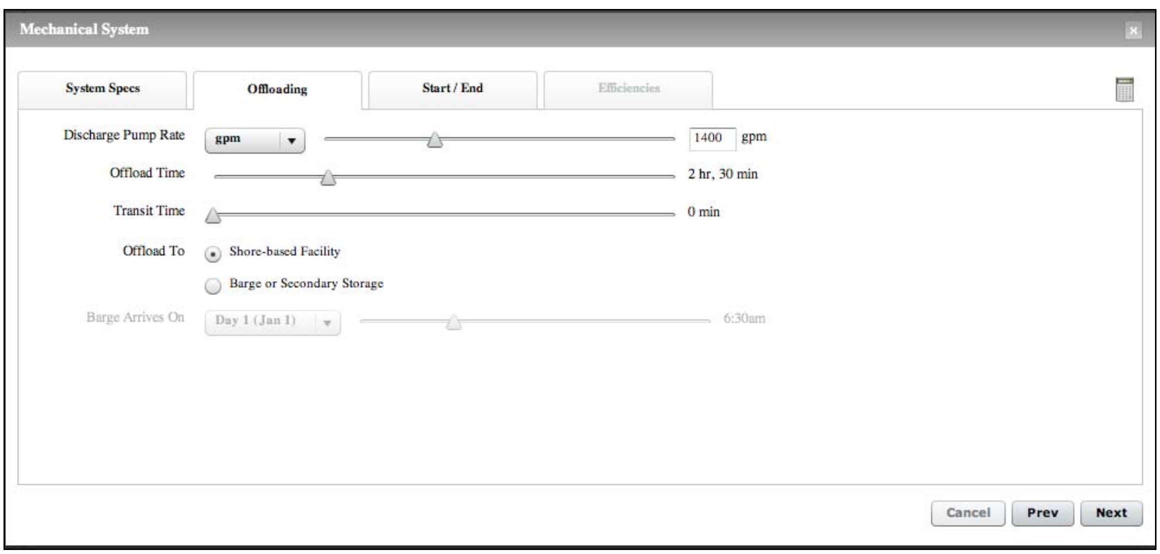
Move the % Decant slider bar to 75%.



It is impossible for a skimmer to recover more oil than the oil that is encountered. Encounter Rate is a function of the system swath, the speed at which the system moves through the water and the average thickness of the oil slick. This Responder Class skimmer has the speed set to 0.75 knot and the swath is set to 350 feet. The following graphic by Al Allen (Spiltec) illustrates skimmer system swath and speed.



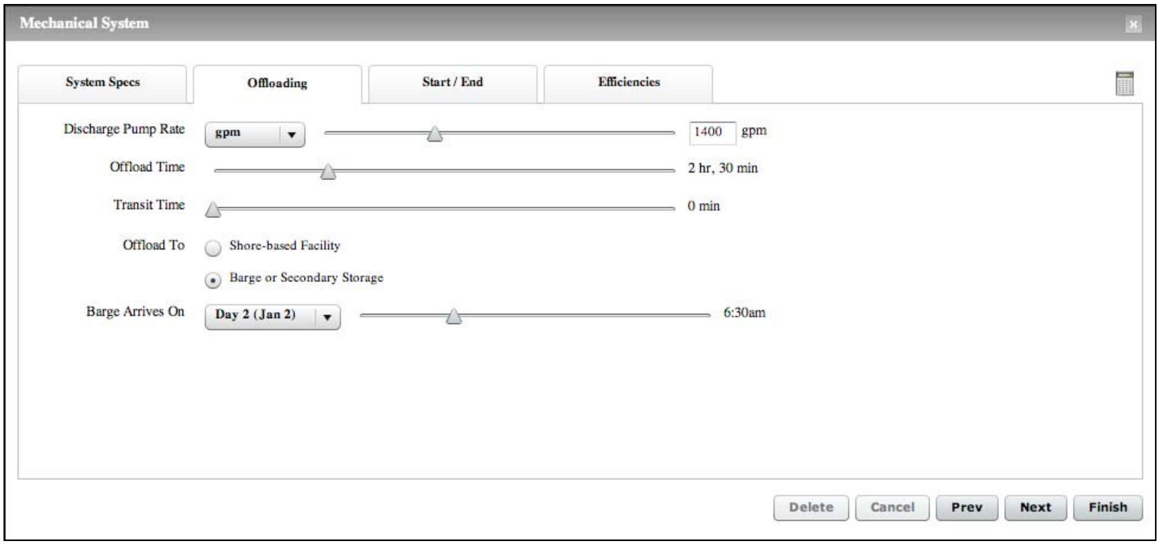
Click on the Offloading Tab or Next.



After a skimming system fills its onboard storage, the oil/emulsion/free water in the storage needs to be unloaded to allow the skimmer to return to the oil slick to recover more. This window displays the offloading parameters for the Responder Class skimming system we are defining for Scenario 1.

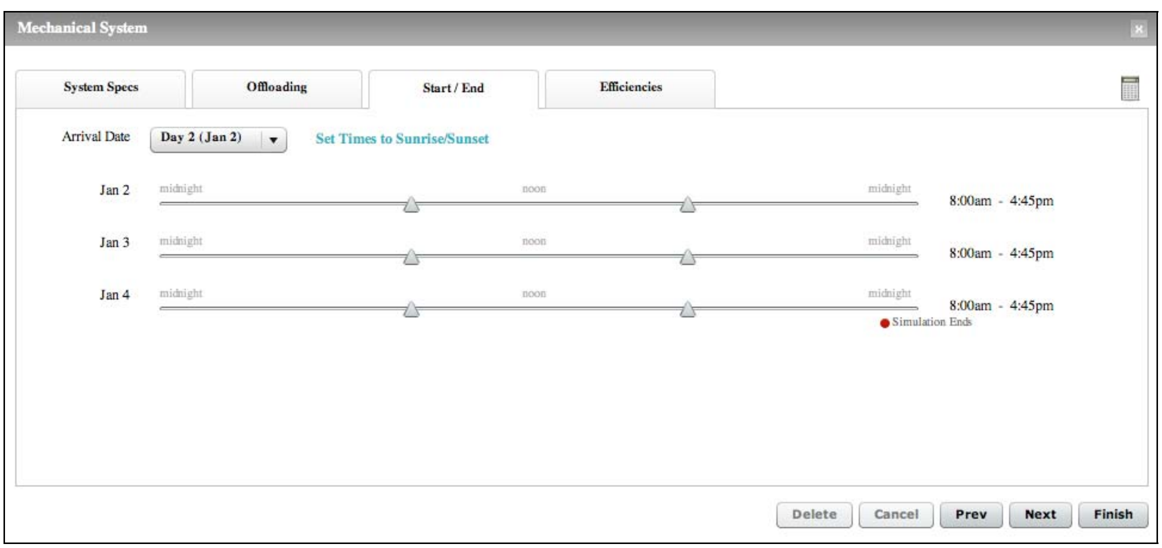
The Transit Time is the number of minutes the skimmer must travel to the location where it will offload or transfer the onboard storage. After offloading the skimmer travels back to the spill site for the same amount of time to resume collection. The default is 0 minutes which implies that a barge or other secondary storage is immediately available to the skimmer. This default will be used for Scenario 1. A barge arrives at 0630 on day 2 and is stationed near the skimmer.

Select Offload To Barge or Secondary Storage, Barge Arrives on Day 2 (drop-down) at 6:30am (slider bar).



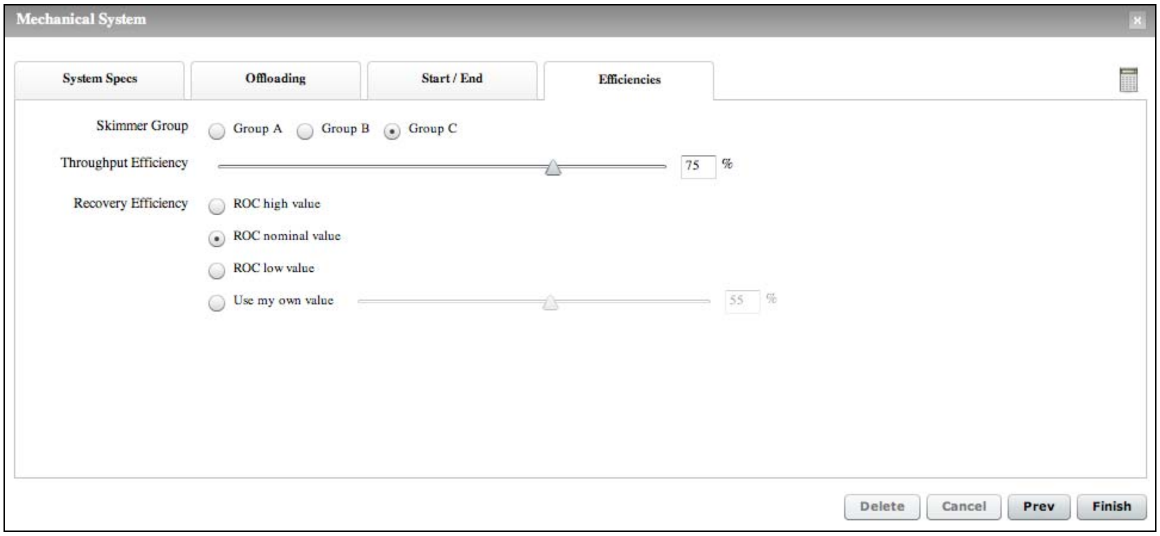
Click on the Start/End Tab or Next.

Although ROC is not geographically specific, it is necessary in ROC to know the spill location relative to where each response resource located to determine when the resource begins response. For Scenario 1 we will presume that after notification, mobilization, and transit to the spill, our skimmer, Responder Class, arrives in time to configure and begin skimming on Day 2 at 0800 (time of sunrise).



The final Tab for the skimming system specification is Efficiencies.

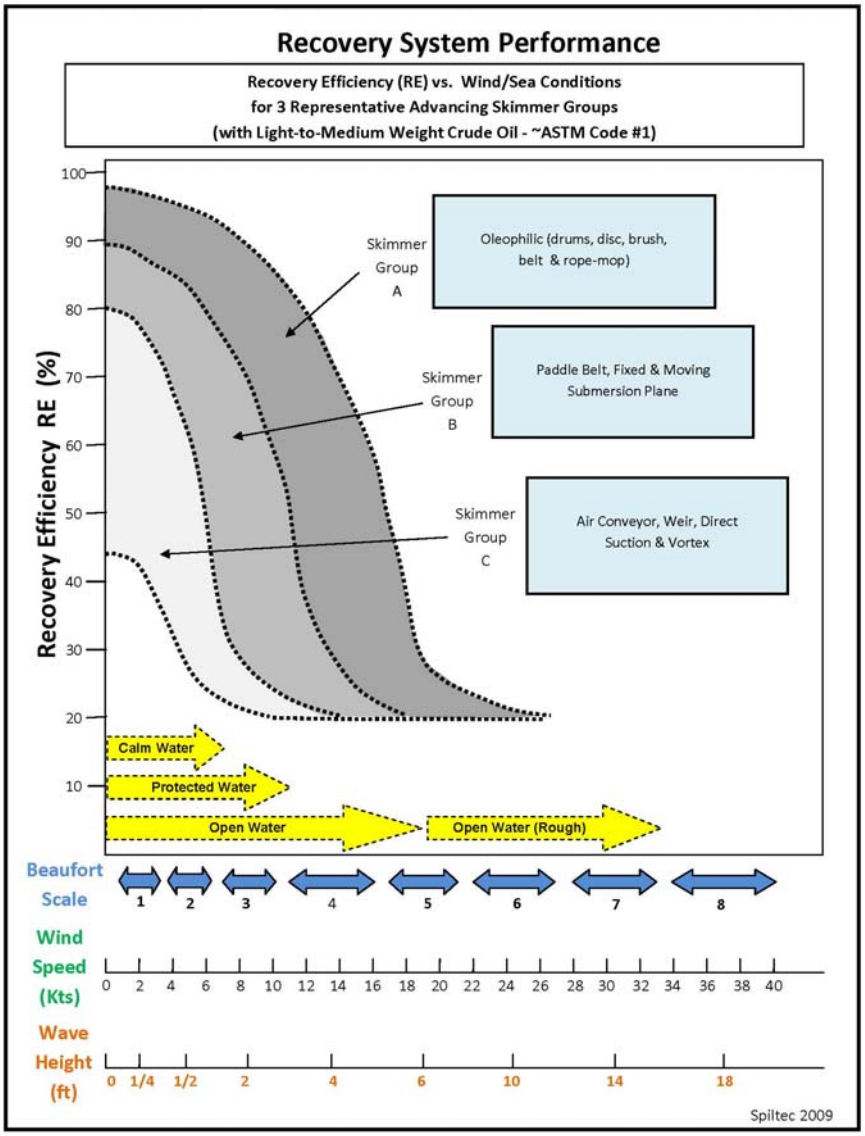
Click on the Efficiencies Tab or the Next Button.

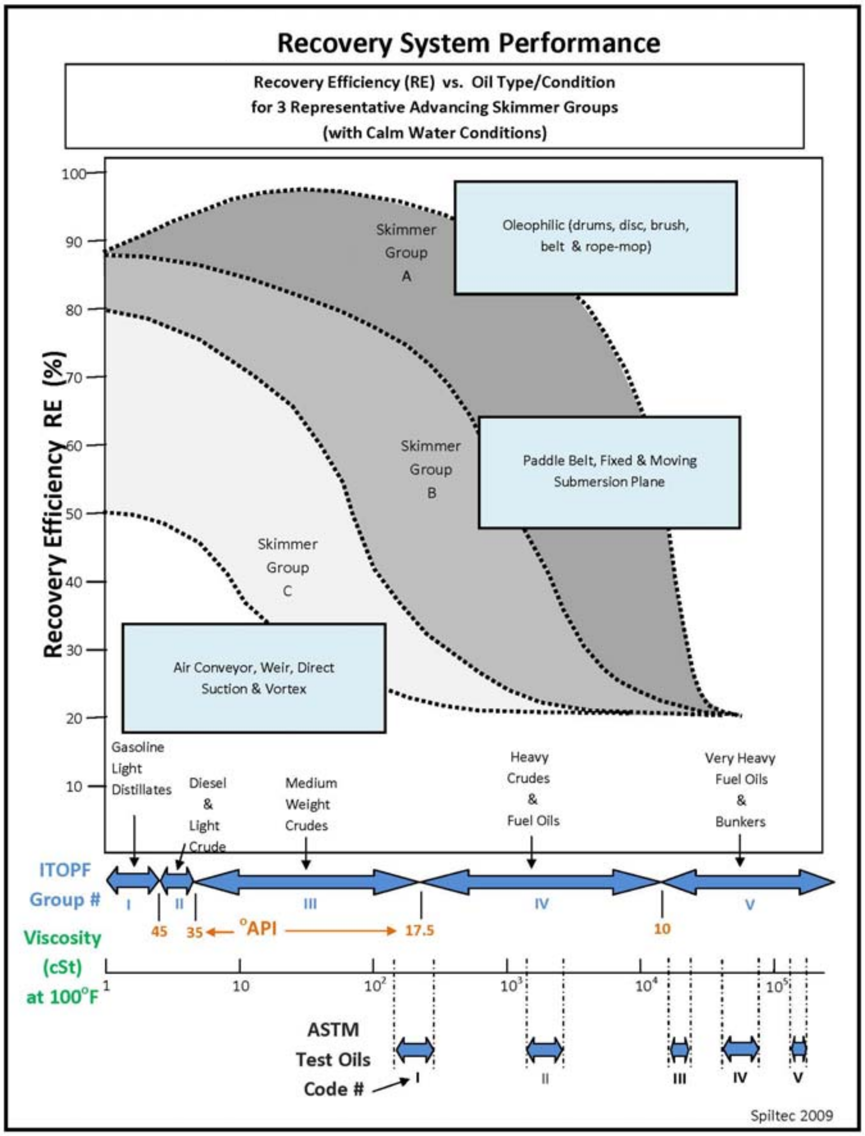


ROC groups skimmers into 3 groups. Group A, associated with the highest recovery efficiencies, includes the oleophilic skimmers – drum, disc, brush, belt, and rope-mop. Group B includes paddle belt, fixed and moving submersion plane skimmers. Group C, the least efficient, includes air conveyor, wier, direct suction, and vortex skimmers. For this skimmer in Scenario 1 we will use Group C.

Throughput Efficiency (TE) is the amount of oil/emulsion recovered expressed as a percentage of the amount of oil/emulsion encountered. The ROC default value that is used in Scenario 1 is 75%, which means 75% of the oil/emulsion encountered is recovered. The remaining 25% is lost to entrainment.

Recovery Efficiency (RE) is the ratio expressed as a percentage of oil/emulsion recovered to the total volume of fluids recovered. A RE of 50% means that 50% of the total fluids brought onboard is oil/emulsion and 50% is free water. (Recall that in the System Specs Tab, the Percent Decant was set to 75% - 75% of the free water brought onboard is decanted and 25% is retained for Scenario 1). ROC Recovery Efficiencies are based on the Skimmer Group, the wind speed, and the viscosity of the oil. Al Allen has prepared the following Recovery Efficiency diagrams based on tank tests and his many years of experience. The first is the Recovery Efficiency relative to the wind speed and the second is the RE relative to the oil viscosity.


Recovery System Performance
Recovery Efficiency (RE) vs. Wind/Sea Conditions
for 3 Representative Advancing Skimmer Groups
(with Light-to-Medium Weight Crude Oil - ~ASTM Code #1)
Recovery Efficiency RE (%)
100
90
80
70
60
50
40
30
20
10
Skimmer Group A
Oleophilic (drums, disc, brush, belt & rope-mop)
Skimmer Group B
Paddle Belt, Fixed & Moving Submersion Plane
Skimmer Group C
Air Conveyor, Weir, Direct Suction & Vortex
Calm Water
Protected Water
Open Water
Open Water (Rough)
Beaufort Scale
1 2 3 4 5 6 7 8
Wind Speed (Kts)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Wave Height (ft)
0 1/4 1/2 2 4 6 10 14 18
Spiltec 2009

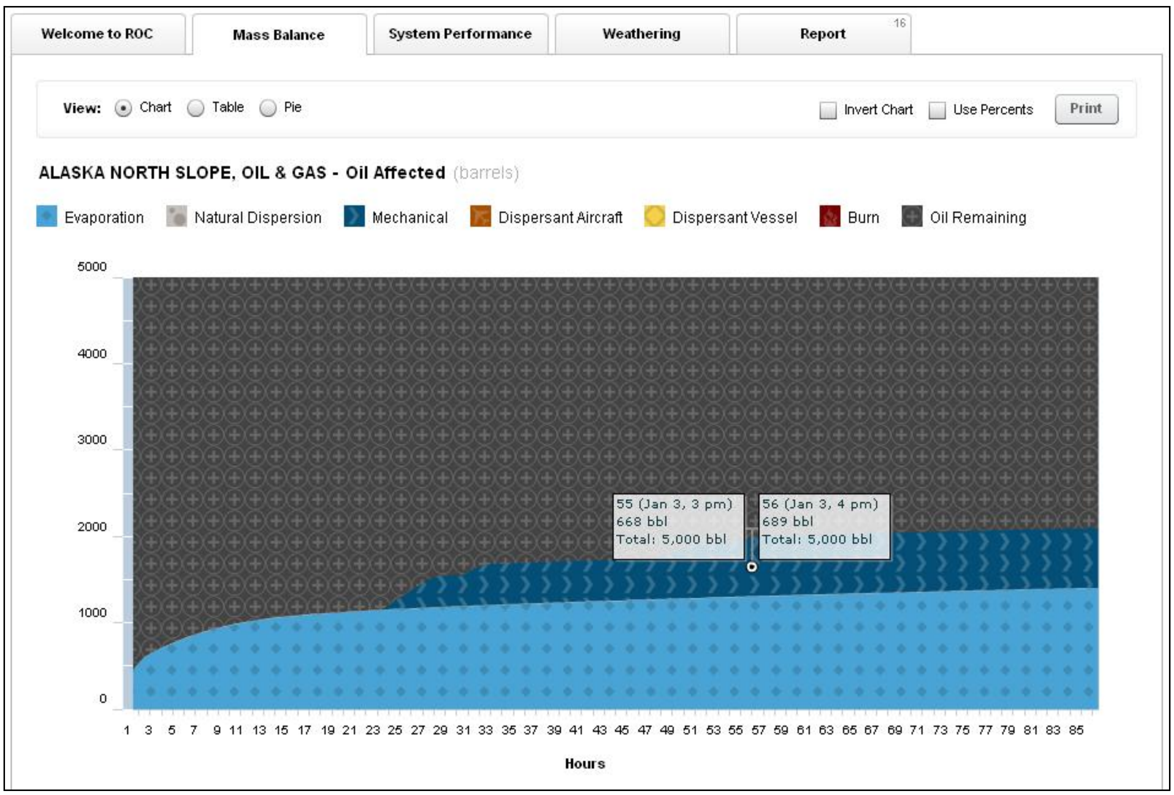


There are no hard and fast values for Recovery Efficiency for any system. The graphs above and the following discussion are meant to provide general guidance. Actual performance in the field will depend on many factors and could be different.

Selection of the Skimmer Group is the first step in determination of RE in ROC. Within each Group the options are ROC High Value, ROC Nominal Value, and ROC Low Value. ROC High Value corresponds to ideal recovery conditions and ROC Low Value corresponds to marginal recovery conditions. ROC compares the Wind RE and the Vicosity RE for every one-hour Calculation Interval (CI) and uses the lesser value for that CI. Specification of a user defined RE (Use my own value) overrides all other specifications of RE and remains constant for the duration of the simulation.

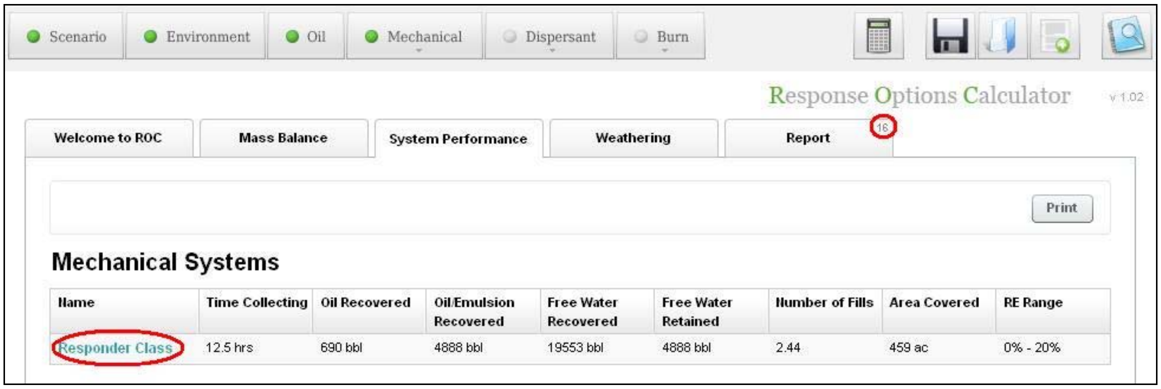
For Scenario 1, use the ROC Nominal Value for Recovery Efficiency. Click Finish.

Clicking Cancel during entry of a response system will result in the loss of all data entered for that system. Clicking Finish saves the data and assigns the system to the scenario described. To unassign the system (but not delete it), uncheck the box next to the system Name. To edit the data for a system, click on the Name of the system.



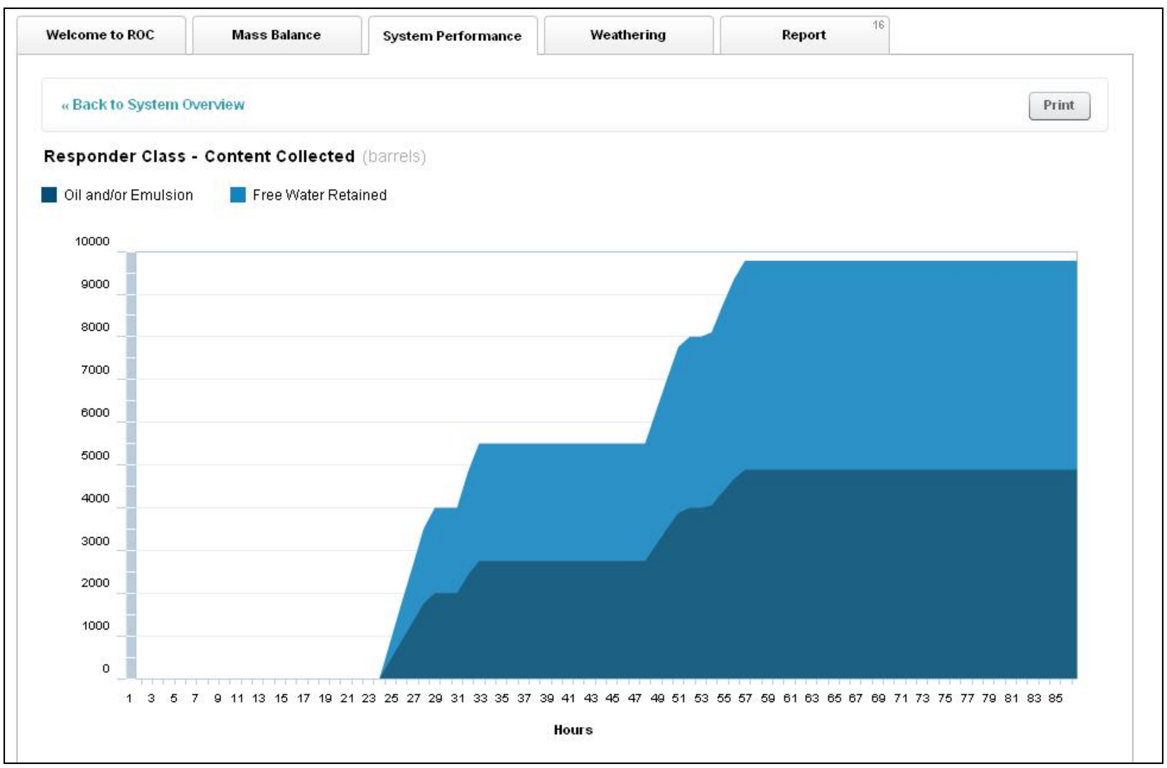
The dark blue in the Mass Balance diagram represents the contribution of the Skimmer Responder Class. The cursor has been placed between hour 55 and 56 of the simulation. At hour 56, the skimmer Responder Class has collected a total of 689 bbl of oil. Moving the cursor further to the left shows that no more oil is collected in the simulation. The System Performance Tab is now bold indicating that something is there.

Click on the System Performance Tab.



This is a summary of the skimmer Responder Class for Scenario 1. Out of the 4888 barrels of oil/emulsion recovered, 690 barrels is oil. Out of the 19553 barrels of free water recovered, 4888 barrels were retained on-board. Note the red circle in the Report Tab. These are User Alerts which will be discussed below. For a graphical display of the Responder Class information,

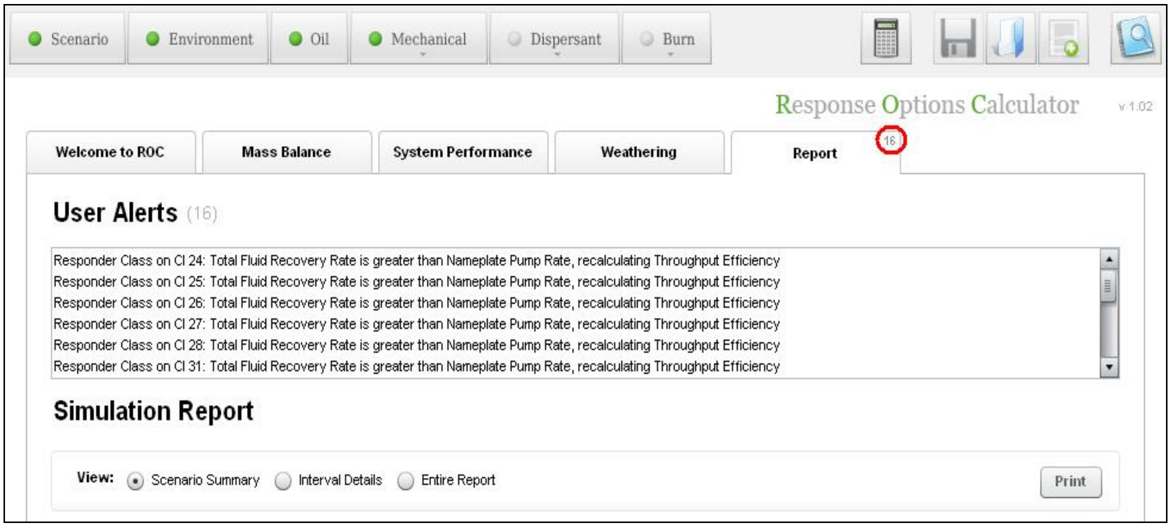
Click on Responder Class.



The dark blue portion of the graph represents oil and/or emulsion recovered and the light blue portion represents free water retained. The steep areas of the two graphs indicate where the skimmer is recovering oil/emulsion and free water. Note that the second area of recovery is less steep than the first. This is due to the lower average thickness during the second recovery period. The short horizontal areas indicate times of offloading and the longer horizontal areas are times of darkness when no skimming is taking place.

Finally note that the graphs "flatline" at about hour 56 indicating no more recovery. What is going on here?

Click on the Report Tab.

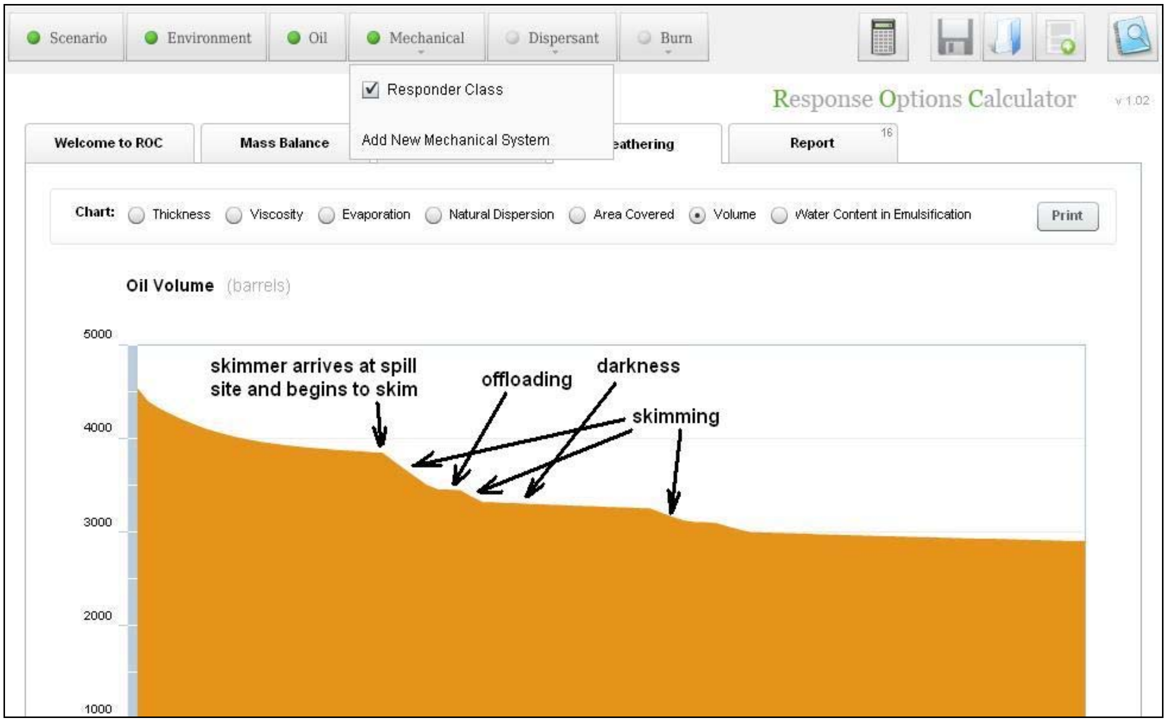


ROC collects detailed information about each simulation and presents this information in the Reports Tab. Included in this information are User Alerts, the number of which appears in the upper right hand corner of the Reports Tab. In this example there are 16 User Alerts at this point in the simulation. User Alerts appear as a separate section at the top of the report There are three options for viewing the remainder of the report; Scenario Summary which is just a recap of data entered by the user, Interval Details which provides information for each 1 hour Calculation Interval of the simulation, and Entire Report which is a combination of the Scenario Summary and the Interval Details.

We came to this tab to explore the reason(s) why the Responder Class skimmer "flat lined" near hour 56. An examination of the User Alerts shows that Responder Class on CI 72: Unable to operate at current wind speed or oil viscosity. Since the wind speed for Scenario 1 is set at 10 knots it is because the oil viscosity became too high for the skimmer to operate. The time period between hour 56 and the time of this User Alert was a period of darkness so no skimming was taking place (recall that the user can override this default). For more detail on how ROC handles these situations, refer to Technical Documentation for the Response Options Calculator (ROC).

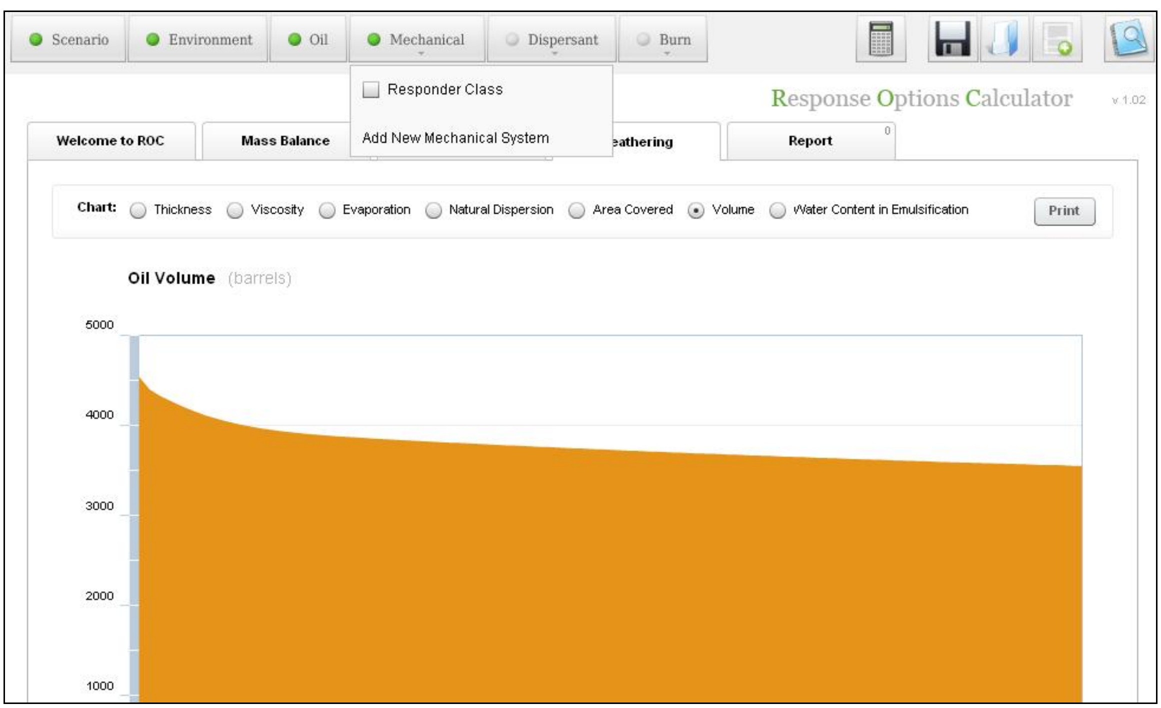
This completes the skimmer entry for Scenario 1. Before leaving the Mechanical Tab we can examine another aspect of how the Responder Class skimmer contributes to the response.

Click on the Weathering Tab and select Chart: Volume. Now move the cursor over the Mechanical Tab.



Note the checkbox next to the Responder Class. This indicates that this skimming system is active. The Oil Volume chart is displaying the contribution to volume reduction from the Responder Class system as well as from natural weathering.

Uncheck the box next to the Responder Class.



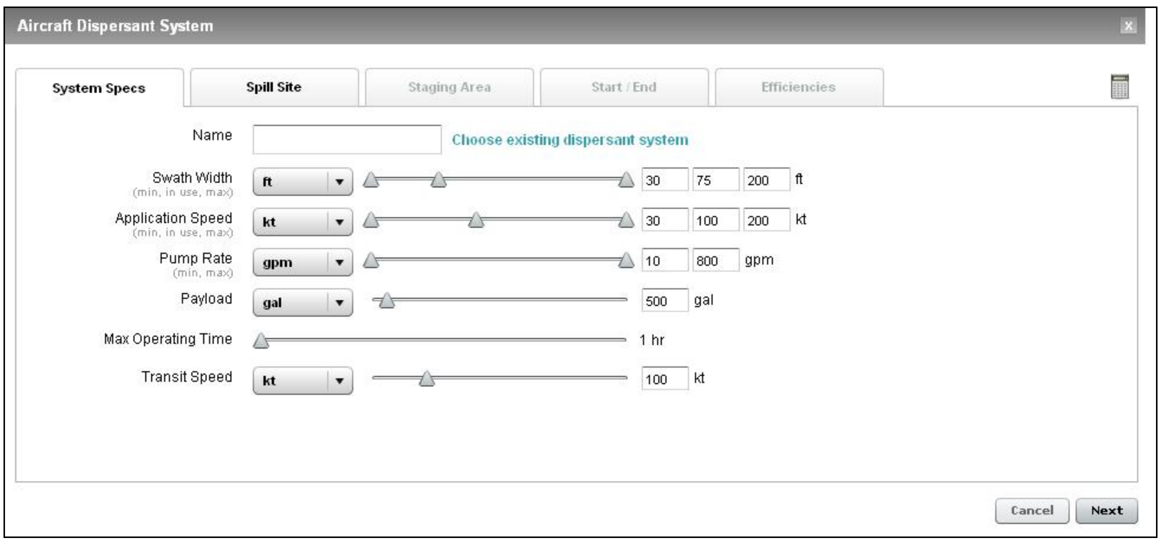
Whenever any change is made in ROC the entire simulation is immediately recalculated. In this case, with the Responder Class "unchecked", the reduction in volume is due to weathering only.

Dispersant Tab

Note: The following are just operational calculations. Special considerations and appropriate approvals are required before dispersants are used in the field.

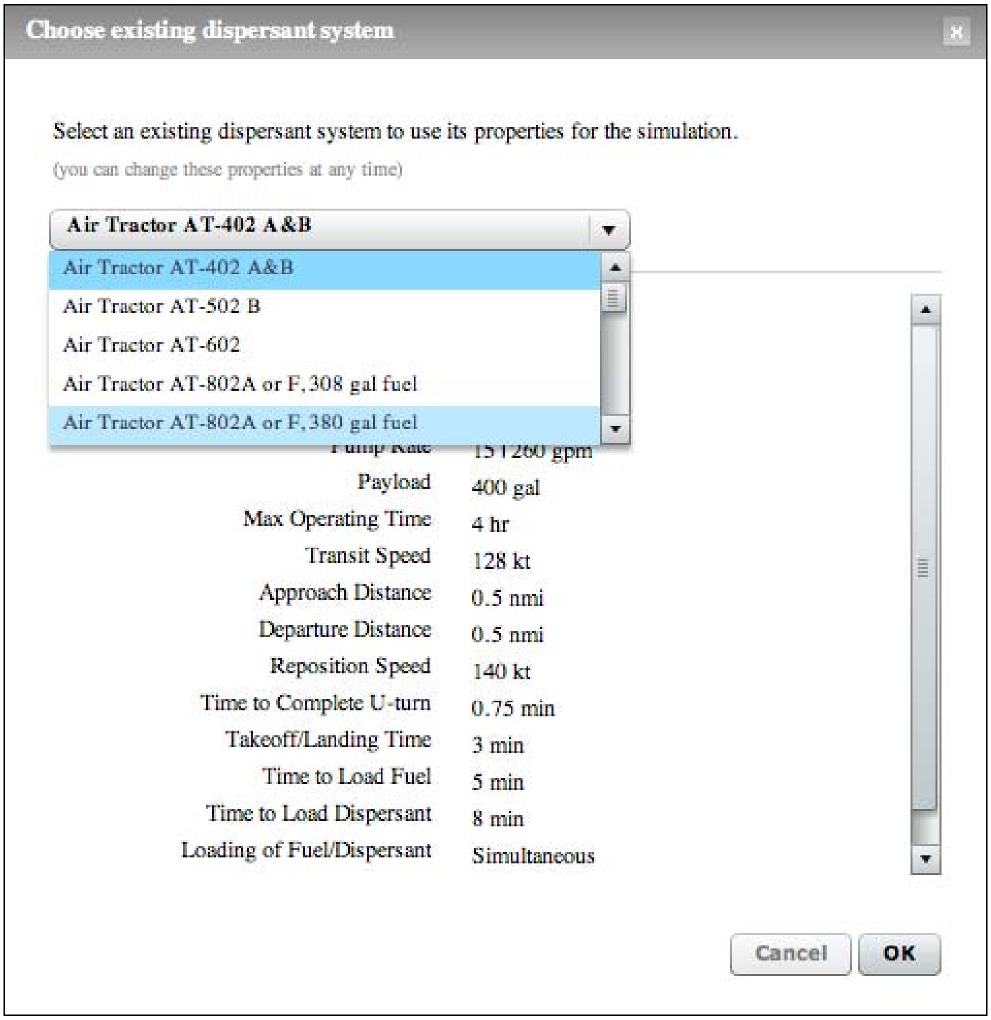
Now a dispersant application system will be added to Scenario 1. Note the "green light" on the Mechanical Tab indicating that skimming system(s) have been added to Scenario 1. Indicators for Dispersant and Burn are empty indicating no dispersant application or *in-situ* burning systems have been activated for Scenario 1.

Move the cursor over the Dispersant Tab and click on Add New Aircraft.

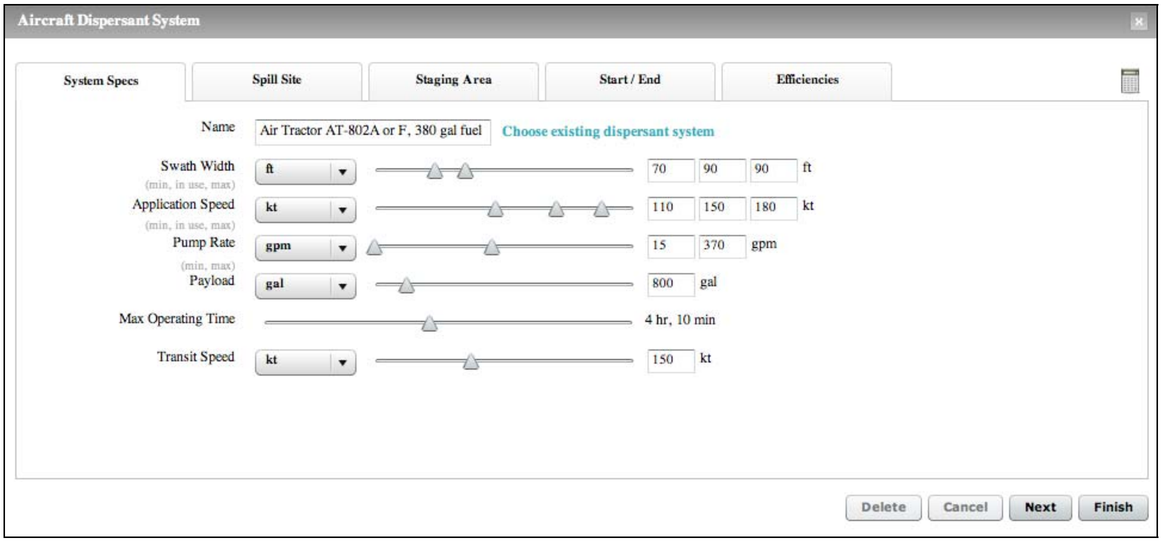


The System Specs Aircraft Dispersant System window contains default values. For Scenario 1 a defined aircraft dispersant application system will be selected from the ROC library.

Click on Choose existing dispersant system.



Click on the Air Tractor AT-402 A&B button to display the available systems. Scroll down and select Air Tractor AT-802A or F, 380 gal fuel, then click OK.



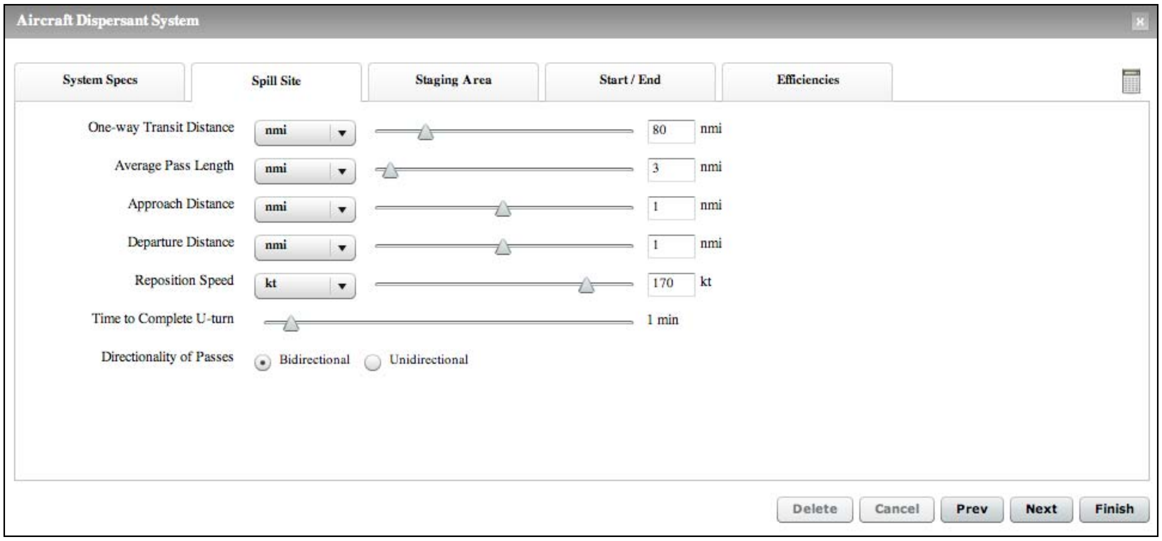
These system specs for this aircraft and the other dispersant application aircraft in the ROC library are from NOAA's Dispersant Mission Planner 2 (DMP2). The DMP2 is cited in CFR33 Appendix B to Part 155 as one method to calculate Effective Daily Application Capacity (EDAC) in vessel response plans that are approved by the US Coast Guard. Users should use care in changing single values where they appear as well as minimum and maximum values for some parameters. User-created systems can be added to ROC with any appropriate specifications.

Swath Width and Application Speed are each associated with three values; minimum, in use, and maximum. The in use value needs to fall between the minimum value and the maximum value.

ROC will adjust the Pump Rate (within the minimum and maximum values) for a given system Swath and Application Speed to attempt to achieve the desired dosage. The desired dosage can be set to a constant for the duration of a simulation (5 gallons of dispersant per acre is a typical dosage) or ROC will attempt to achieve the dosage appropriate to the system Swath, Application Speed, and the thickness of the oil slick during the sortie.

For Scenario 1 leave the default System Specs values unchanged.

Click on Next or on the Spill Site Tab. For Scenario 1, set the One-way Transit Distance to 80 nautical miles (nmi) and the Average Pass Length over the oil slick to 3 nautical miles.

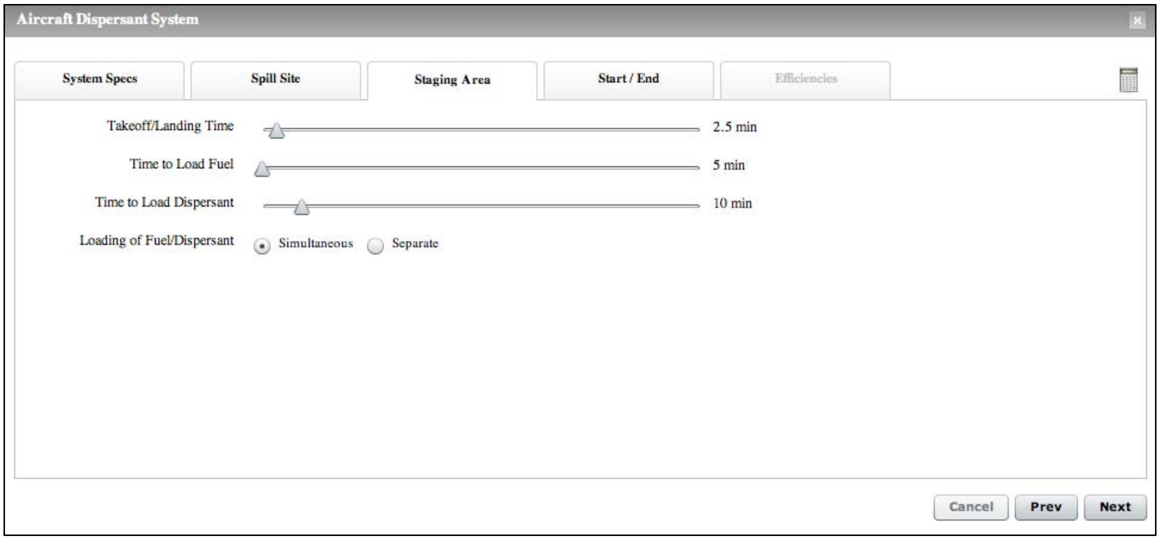


Dispersant aircraft fly to the spill site from a staging airport, a distance equal to the One-way Transit Distance. Upon arrival at the spill site they check in with the aerial observer aircraft. Ten minutes is allotted for check in. Spray passes over the oil slick (in this case 3 nautical miles) can be Bidirectional – spraying in two directions, or, Unidirectional – spraying only in one direction. Unidirectional spraying is typically upwind for better control of the spray pattern.

The aircraft makes an approach to the slick, descending close to the water and adjusting to Application Speed. The aerial observer gives a signal to turn spray on which continues for one pass length of the oil slick. At the end of each pass the aircraft adjusts to Reposition Speed and may increase altitude in the Departure.

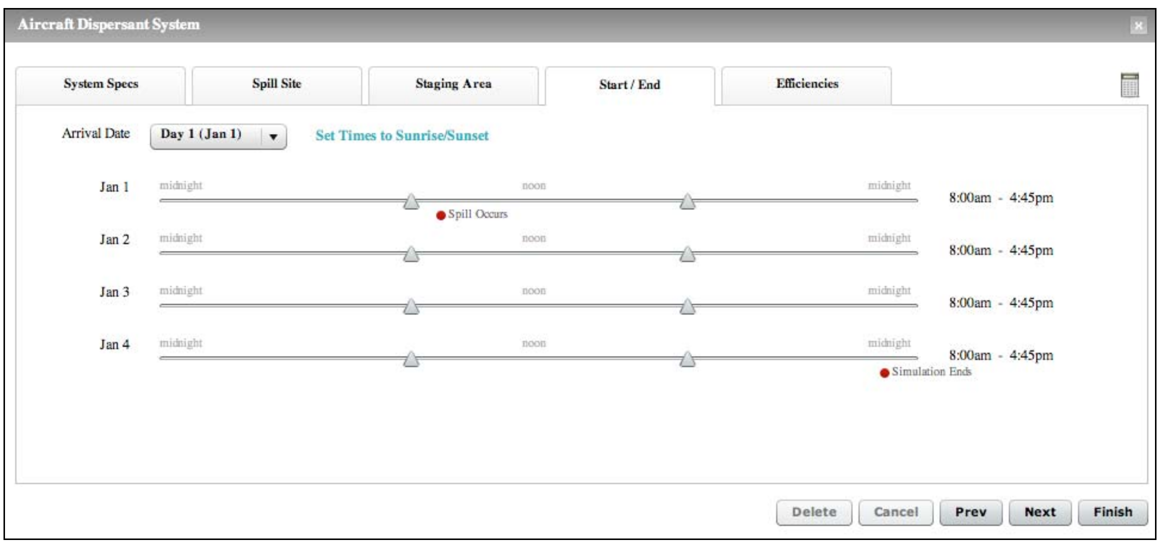
A U-Turn places the aircraft in position for another Approach and spray pass (Bidirectional) or the aircraft proceeds over the slick at altitude, makes a U-Turn, an Approach, and makes another pass in the same direction as the previous pass (Unidirectional).

Click on Next or the Staging Area Tab.

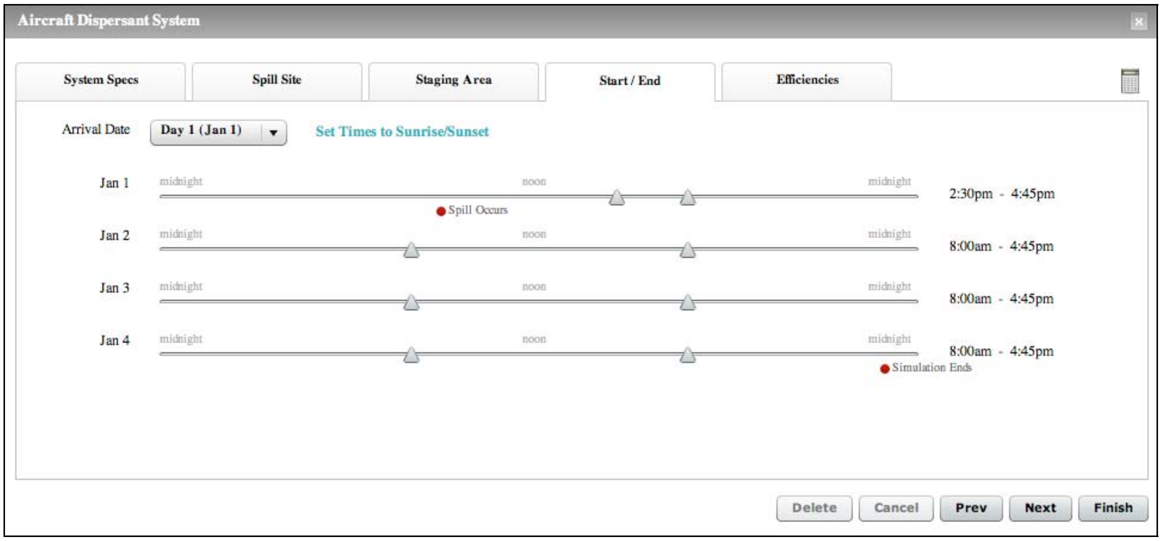


All these values remain unchanged for Scenario 1.

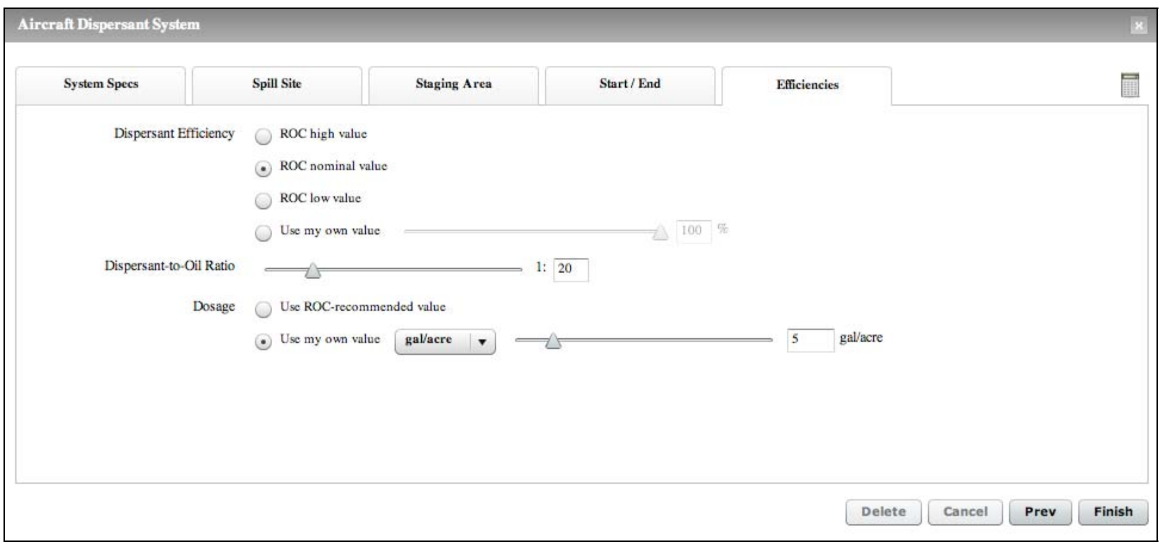
Click on Next or on the Start/End Tab.



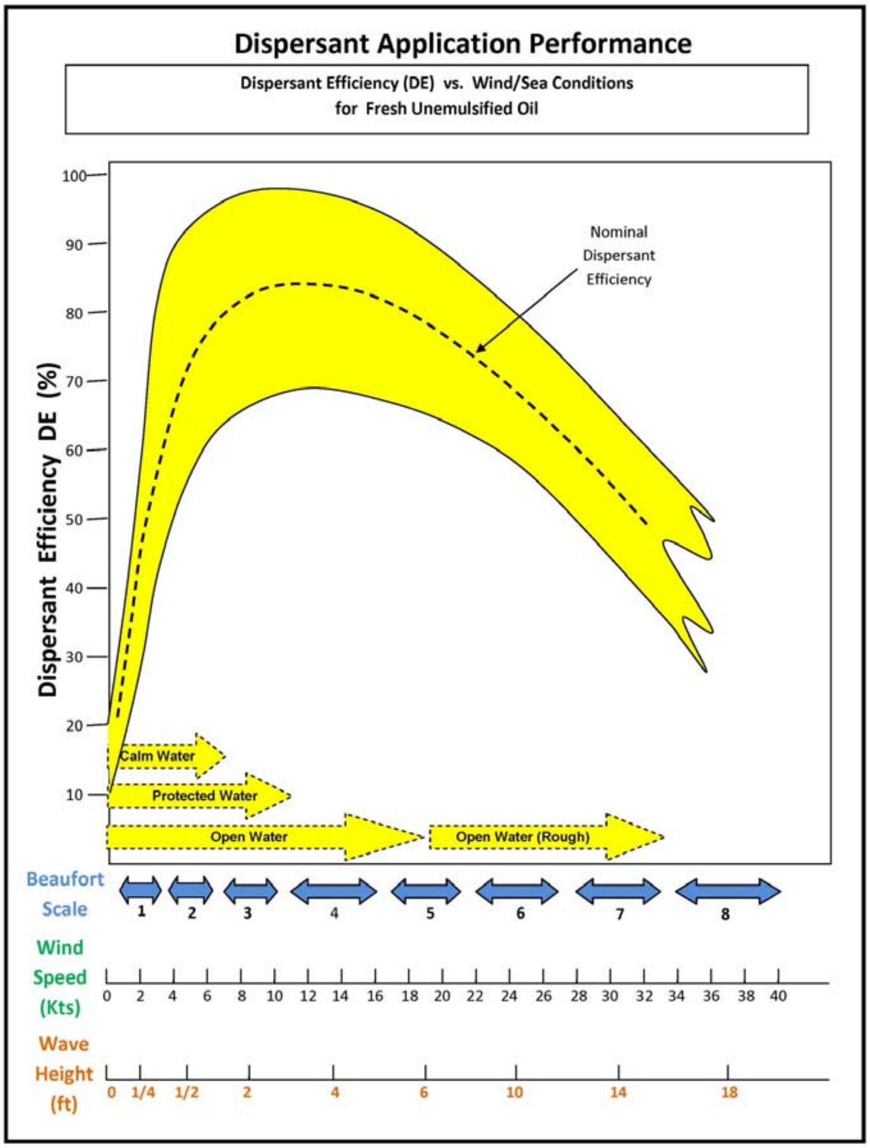
For Scenario 1 set the Arrival Date/Time to Day 1(Jan 1) at 2:30 pm.

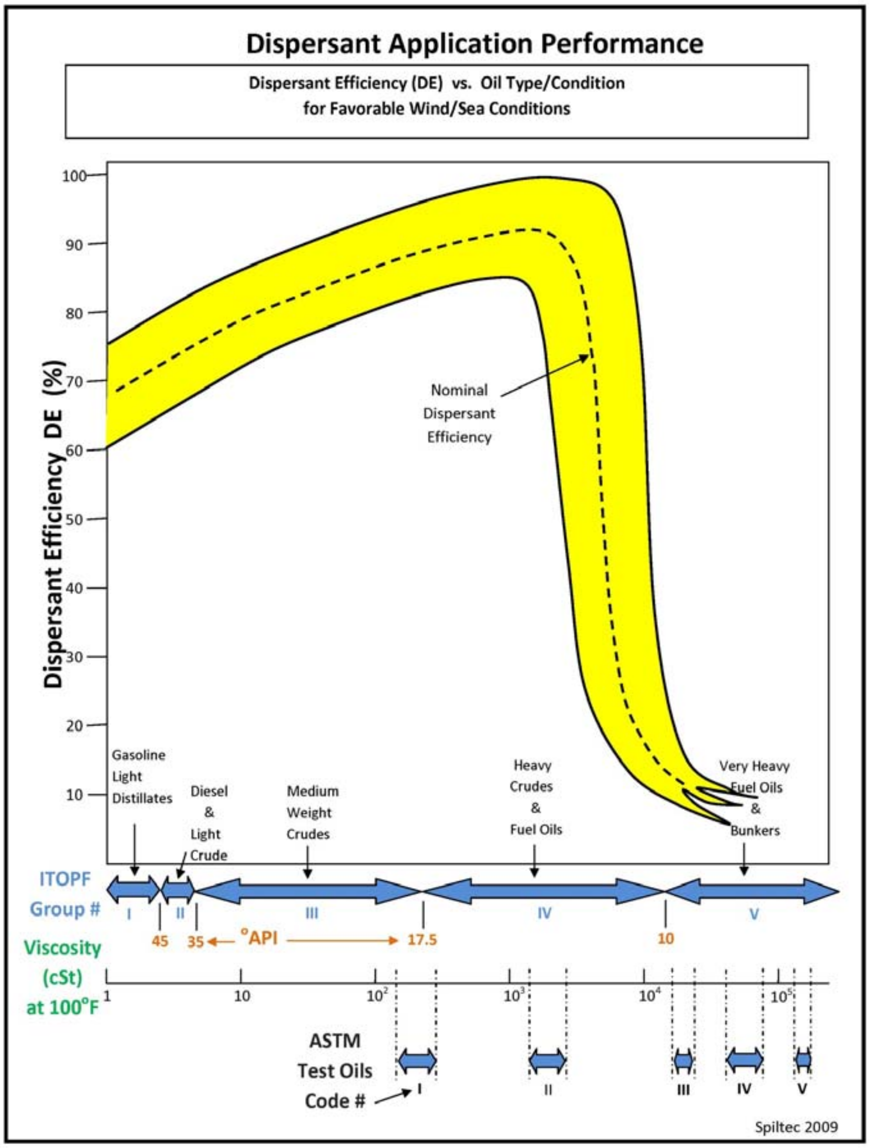


Click on the Efficiencies Tab or Next.



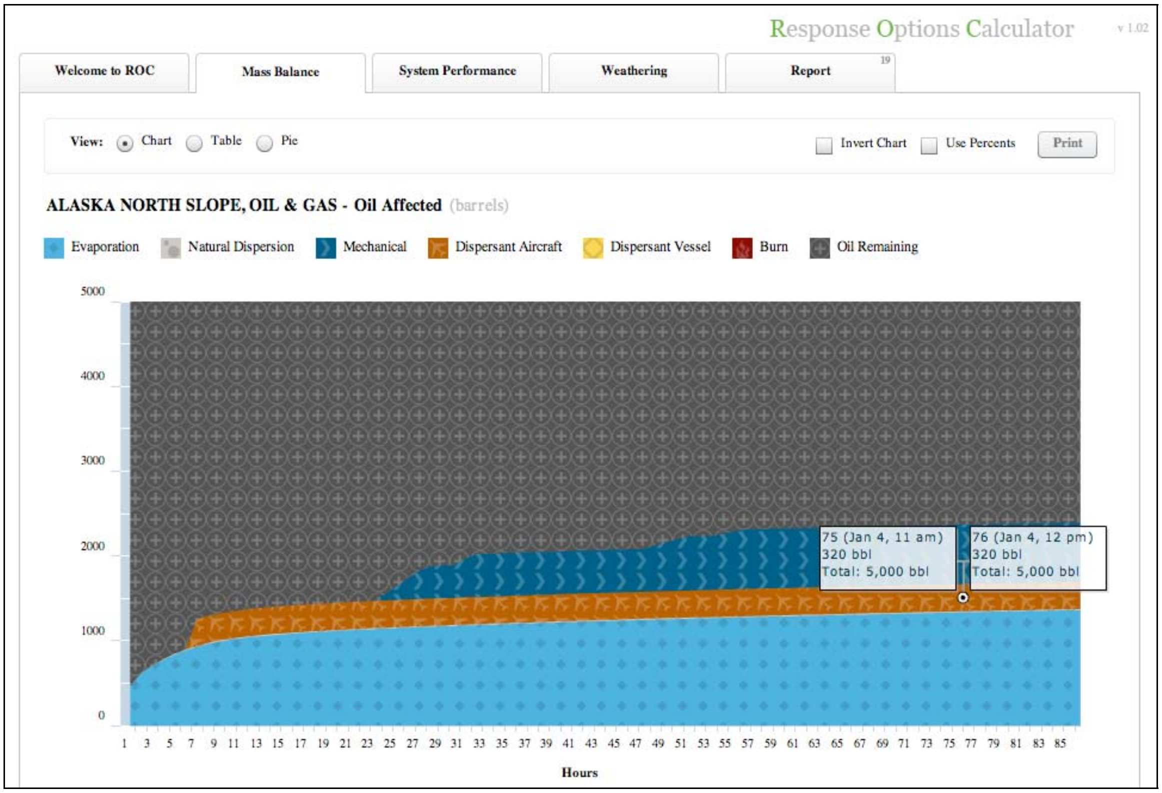
In addition to the Recovery Efficiency (RE) diagrams presented earlier for skimming systems, Al Allen has prepared Dispersant Efficiency (DE) diagrams. ROC uses these in the same way for dispersants. For each Calculation Interval (CI) in a simulation, A DE for the CI wind speed is compared to the DE for the oil viscosity. ROC then uses the lesser of the two as the DE for that Calculation Interval. Select ROC high value when conditions are ideal for dispersant use and ROC low value when conditions are marginal. Select Use my own value to manually enter any desired Dispersant Efficiency. Manually entered values will be used for the duration of the simulation.


Dispersant Application Performance
Dispersant Efficiency (DE) vs. Wind/Sea Conditions
for Fresh Unemulsified Oil
Dispersant Efficiency DE (%)
100
90
80
70
60
50
40
30
20
10
Nominal
Dispersant
Efficiency
Calm Water
Protected Water
Open Water
Open Water (Rough)
Beaufort
Scale
1
2
3
4
5
6
7
8
Wind
Speed
(Kts)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Wave
Height
(ft)
0 1/4 1/2 2 4 6 10 14 18



The Dispersant-to-Oil Ratio is the manufacturers recommended ratio of dispersant applied to volume of oil to be treated. A ratio of 1:20 is typical. At this ratio each volume of dispersant will treat 20 volumes of oil. The Dosage refers to the volume of dispersant that is to be applied to each unit area. A Dosage of 5 gallons of dispersant applied to each acre of oil slick area is commonly used.

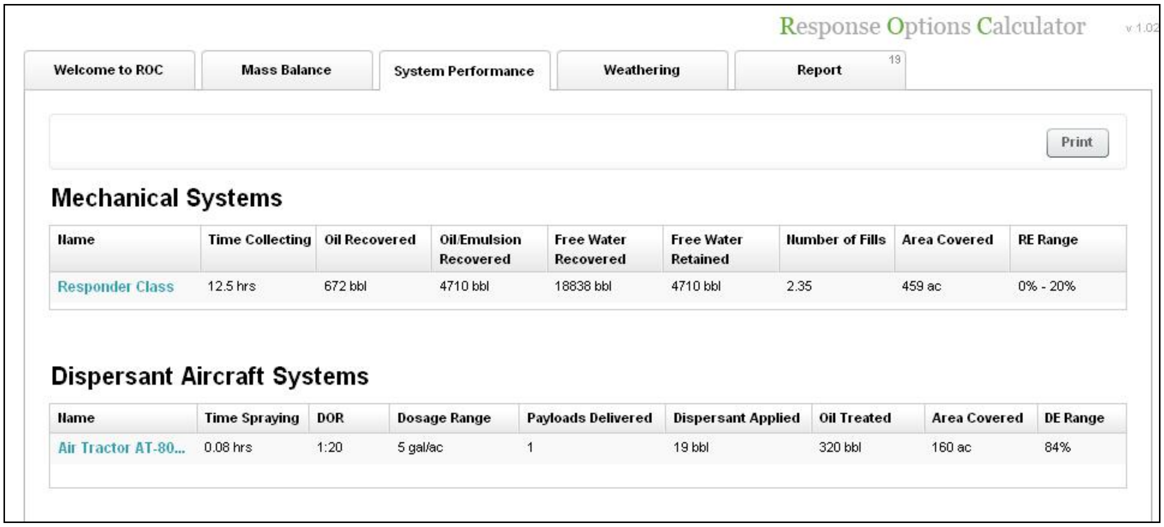
For Simulation 1 select the ROC Nominal Value for Dispersant Efficiency, 1:20 for the Dispersant-to-Oil Ratio, and enter 5 gal/acre for the Dosage. Click Finish.



The Mass Balance Chart now shows the addition of the dispersant application from the Air Tractor in orange. Note that the contribution of the orange portion of the graph does not increase with time (constant thickness) after the first day indicating no additional dispersant application after the first day. The dispersant has treated an estimated 320 bbl of oil.

The System Performance Tab now contains the summary of the Responder Class skimming system data and the Air Tractor data.

Click on the System Performance Tab.



Mechanical Systems

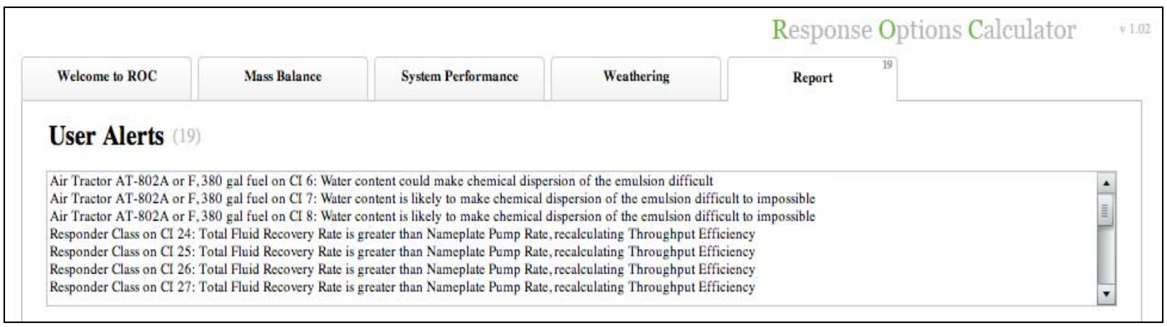
Name	Time Collecting	Oil Recovered	Oil/Emulsion Recovered	Free Water Recovered	Free Water Retained	Number of Fills	Area Covered	RE Range
Responder Class	12.5 hrs	672 bbl	4710 bbl	18838 bbl	4710 bbl	2.35	459 ac	0% - 20%

Dispersant Aircraft Systems

Name	Time Spraying	DOR	Dosage Range	Payloads Delivered	Dispersant Applied	Oil Treated	Area Covered	DE Range
Air Tractor AT-80...	0.08 hrs	1:20	5 gal/ac	1	19 bbl	320 bbl	160 ac	84%

There are additional User Alerts on the Report Tab related to the Air Tractor.

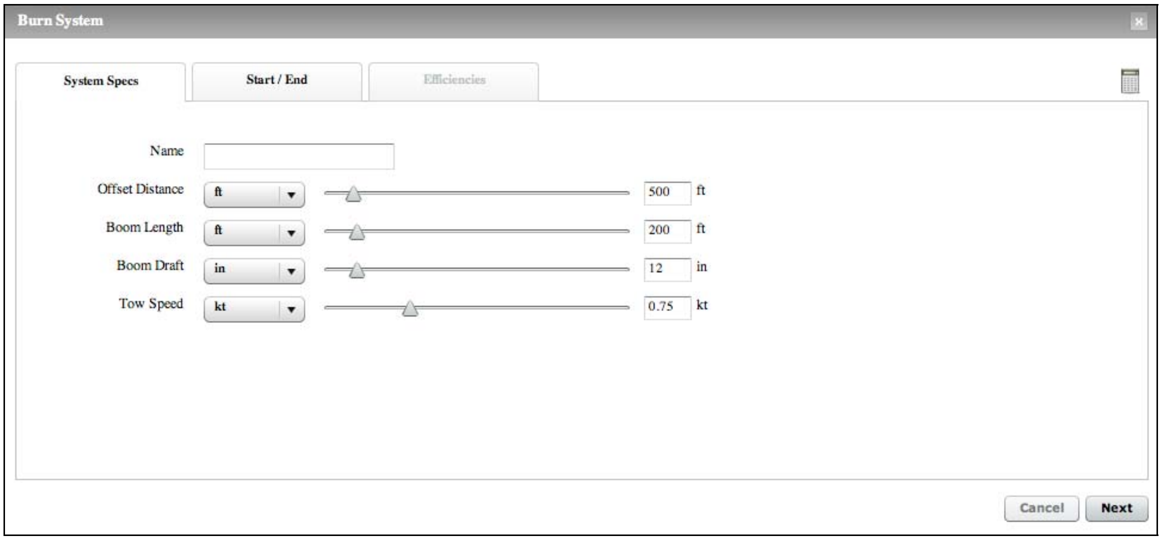
Click on the Report Tab.



Dispersants become more ineffective as the water content of the oil emulsion increases. The first User Alert at CI 6 is activated when the water content of the emulsion exceeds 25%. The next two dispersant alerts are activated when the water content exceeds 35%. The water content in the emulsion continues to increase overnight. At 8:00 am the next day (January 2nd) the Air Tractor is scheduled to fly again, but the water content of the emulsion exceeds 70% (see Weathering Tab, Chart Water Content in Emulsion). This is considered to be past the point when dispersants would work at all and the Air Tractor becomes inactive (see ROC Help, Dispersant Efficiency).

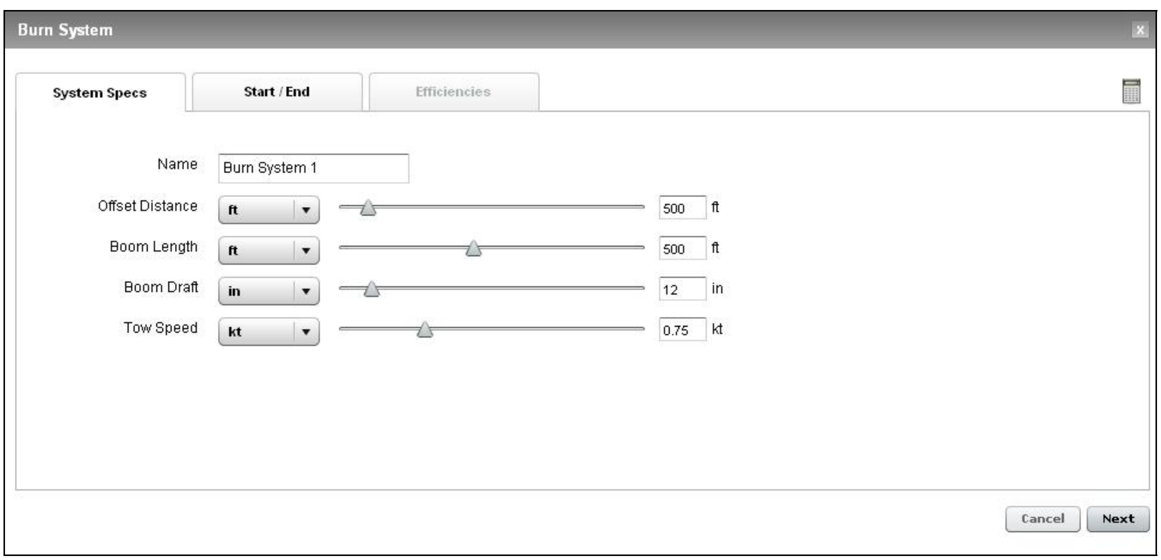
<u>Burn Tab</u>

Put the cursor over the Burn Tab and click on Add New Burn System

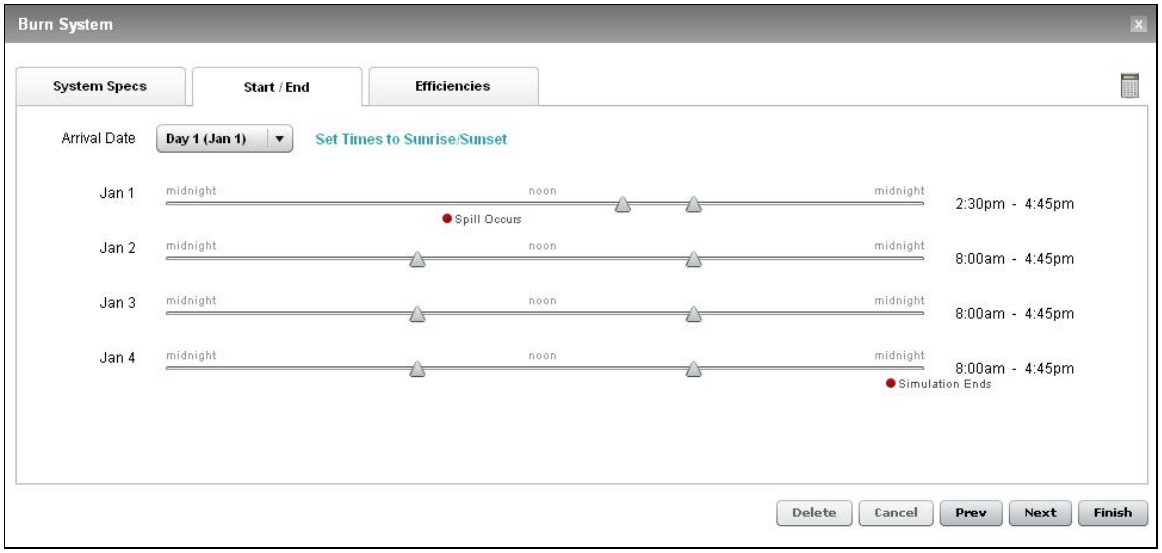


ROC does not contain any pre-defined *in-situ* burn systems so all burn systems are created within ROC. The System Specs window contains the basic information needed to define a burn system. Offset Distance is the distance from the oil slick collection site to an area where the oil can safely be ignited. Boom Length refers to the length of fire boom that is being used. Refer to ROC help for an explanation of burn system configurations, boom holding capacity, etc.

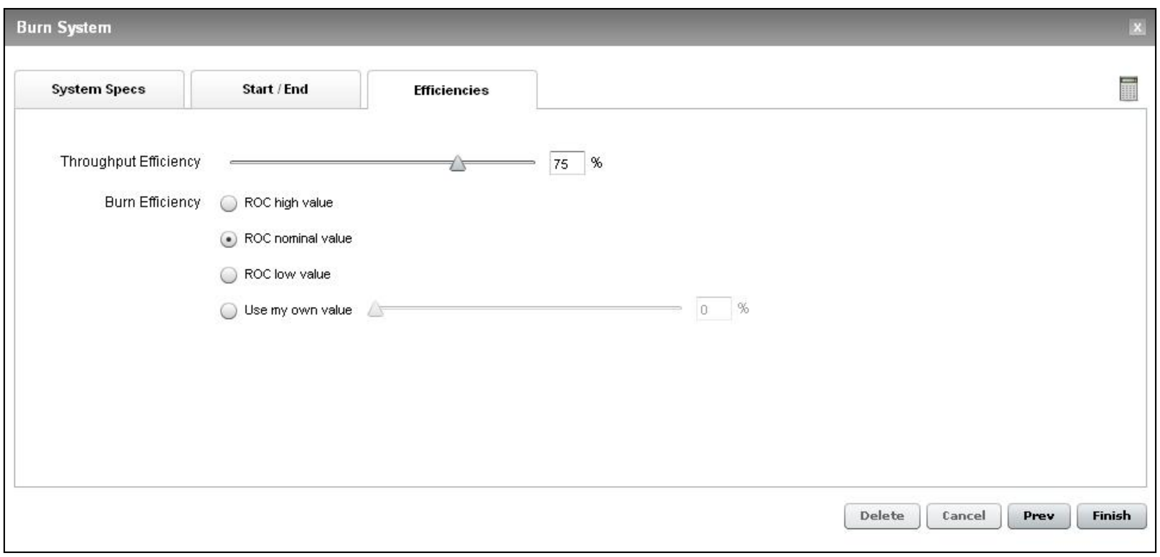
Enter Burn System 1 in the Name Field. Set the Boom Length to 500 feet.



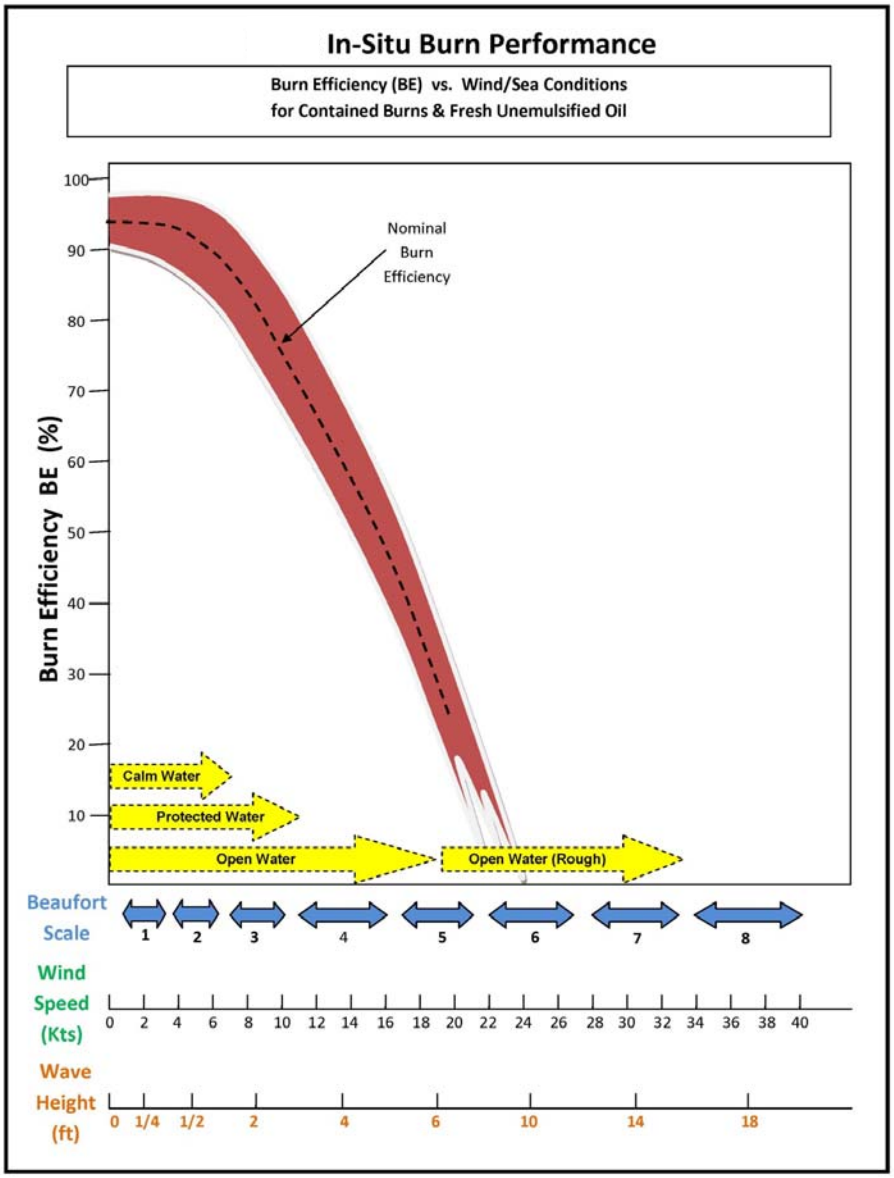
Click on the Start/End Tab or Next.
Set the Start Time to 2:30 pm on Day 1.

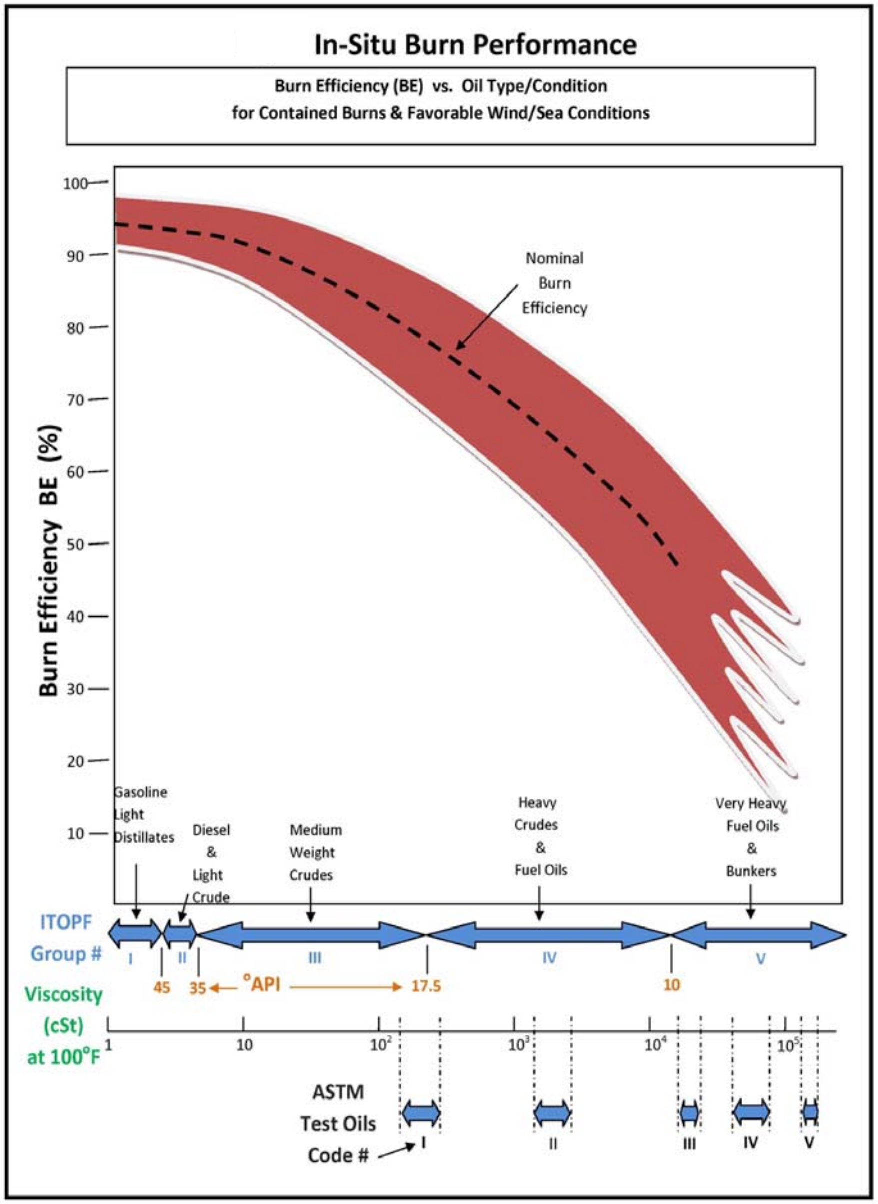


Click on Efficiencies Tab or the Next button.



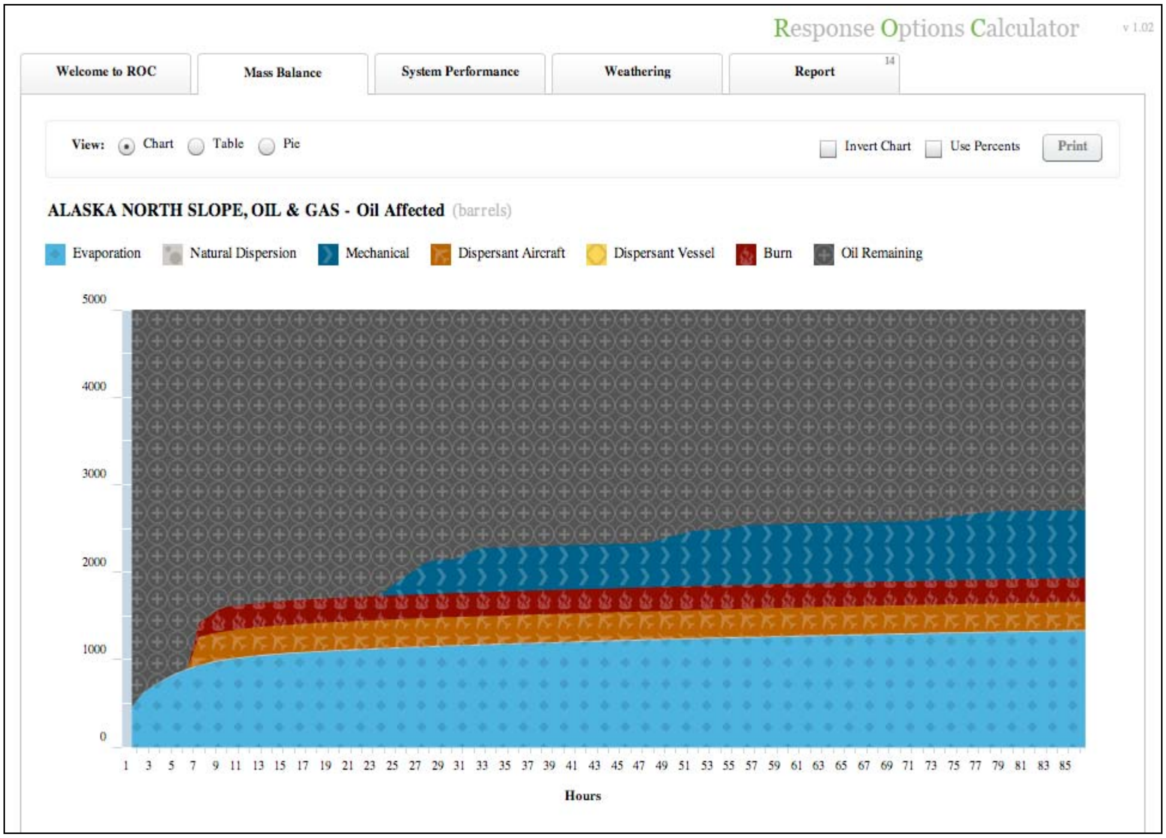
As was the case for skimming and dispersants, Al Allen (Spiltec) has developed Burn Efficiency diagrams vs. Wind Speed and Burn Efficiency vs. Oil Viscosity.


In-Situ Burn Performance
Burn Efficiency (BE) vs. Wind/Sea Conditions
for Contained Burns & Fresh Unemulsified Oil
Burn Efficiency BE (%)
100
90
80
70
60
50
40
30
20
10
Nominal
Burn
Efficiency
Calm Water
Protected Water
Open Water
Open Water (Rough)
Beaufort Scale
1
2
3
4
5
6
7
8
Wind Speed (Kts)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Wave Height (ft)
0 1/4 1/2 2 4 6 10 14 18



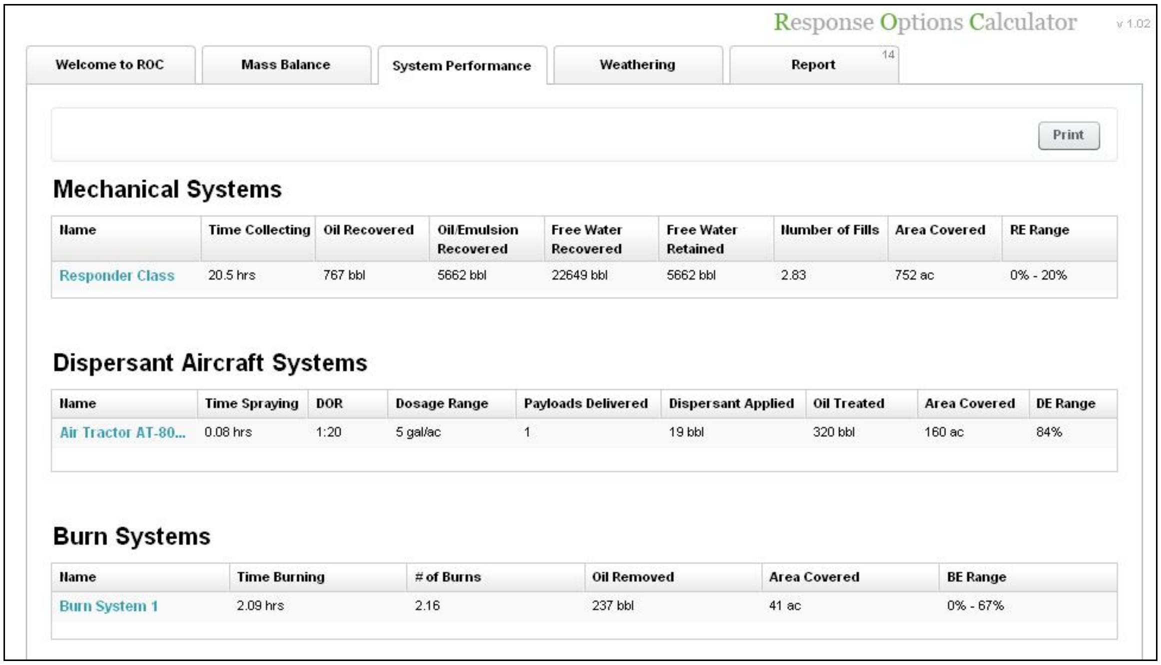
Leave the default Throughput Efficiency at 75% and the Burn Efficiency at the ROC Nominal.

Click on Finish.



The In-situ burning is displayed in red. As was the case for dispersants, the ROC emulsification on day 2 is greater than 70% so that burning for this oil/environment for the remainder of the simulation is not possible.

Click on the System Performance Tab.



Mechanical Systems

Name	Time Collecting	Oil Recovered	Oil/Emulsion Recovered	Free Water Recovered	Free Water Retained	Number of Fills	Area Covered	RE Range
Responder Class	20.5 hrs	767 bbl	5662 bbl	22649 bbl	5662 bbl	2.83	752 ac	0% - 20%

Dispersant Aircraft Systems

Name	Time Spraying	DOR	Dosage Range	Payloads Delivered	Dispersant Applied	Oil Treated	Area Covered	DE Range
Air Tractor AT-80...	0.08 hrs	1:20	5 gal/ac	1	19 bbl	320 bbl	160 ac	84%

Burn Systems

Name	Time Burning	# of Burns	Oil Removed	Area Covered	BE Range
Burn System 1	2.09 hrs	2.16	237 bbl	41 ac	0% - 67%

Congratulations, you have completed Scenario 1.

Save this simulation as it will be used as a starting point for a Continuous Release scenario in Chapter 3.

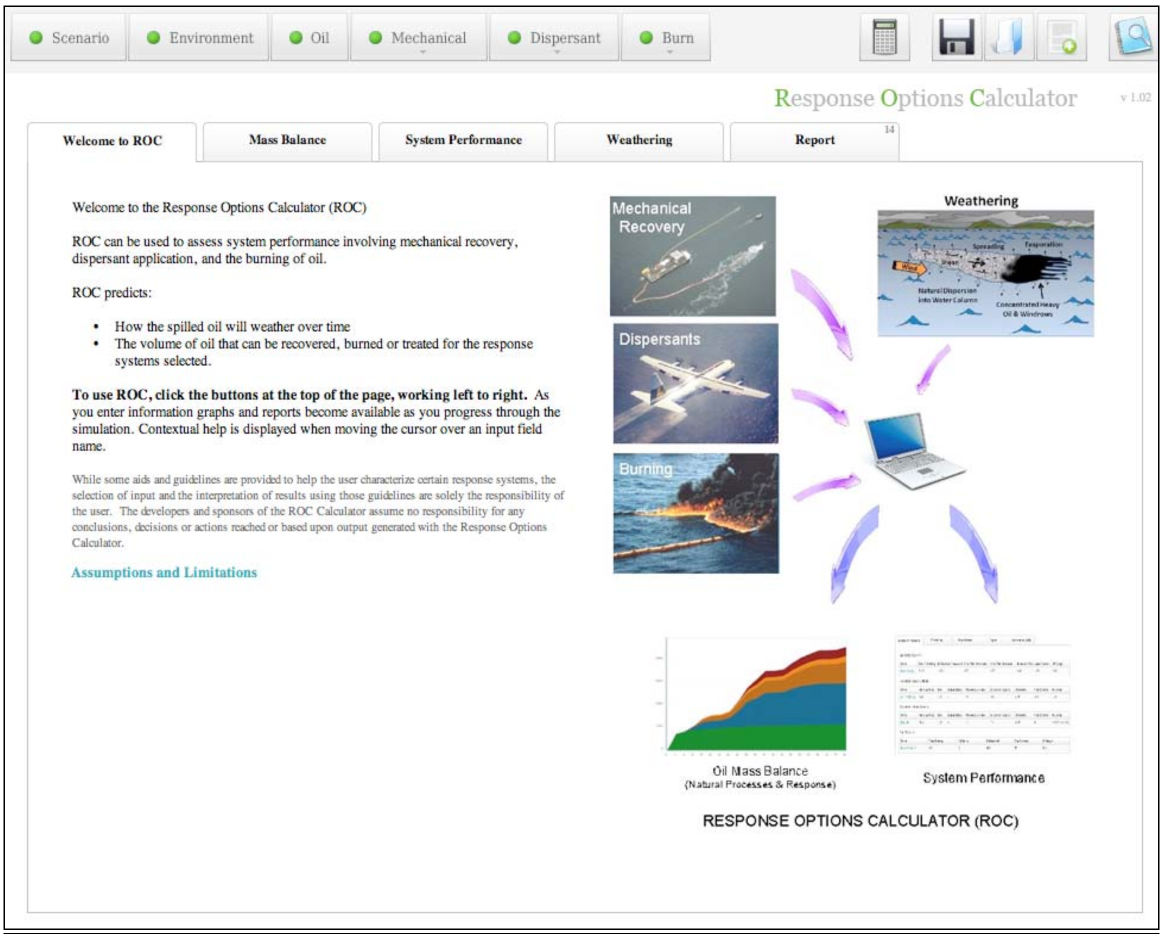
Move the cursor over the Save icon (a floppy disk image –remember these?)
Name the Save File as Scenario 1 or other filename as appropriate.

Chapter 3

Other Features of ROC

This chapter describes features and options available in ROC not previously covered in the development of Scenario 1 in Chapter 2.

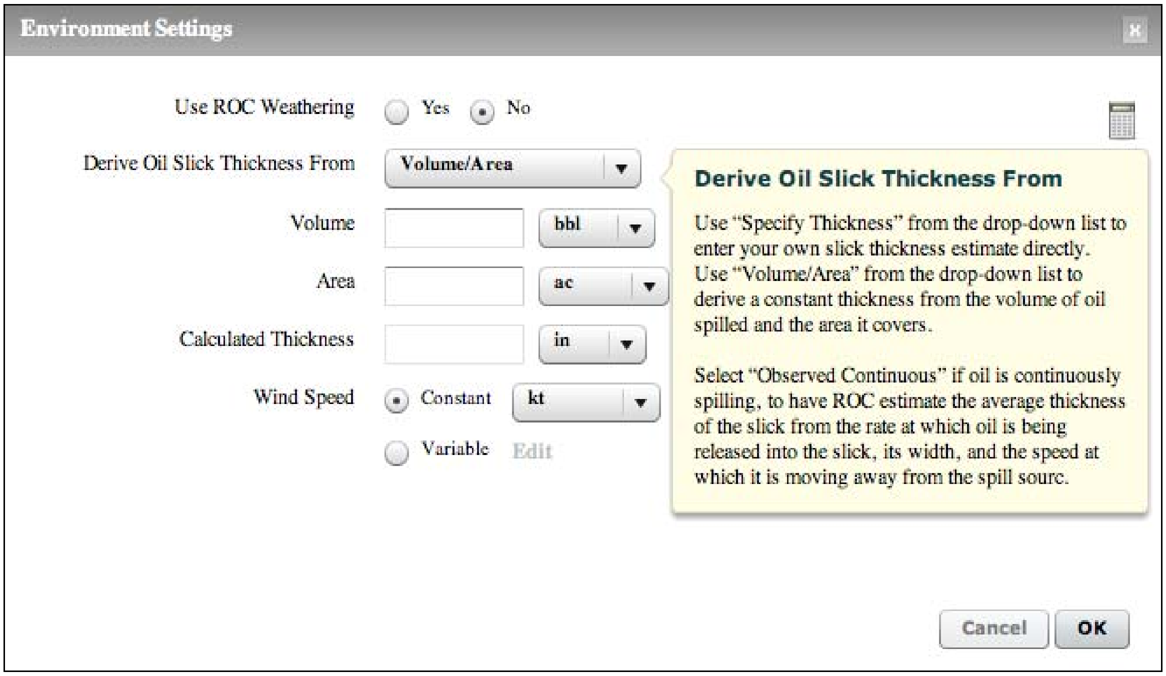
Open the Welcome to ROC window



Environment Tab

Scenario 1 used the ROC weathering module to calculate the oil slick thickness available for response for every hour of the simulation. ROC has the option to set the oil slick thickness to a constant value.

Click on the Environment Tab. Set Use ROC Weathering to No

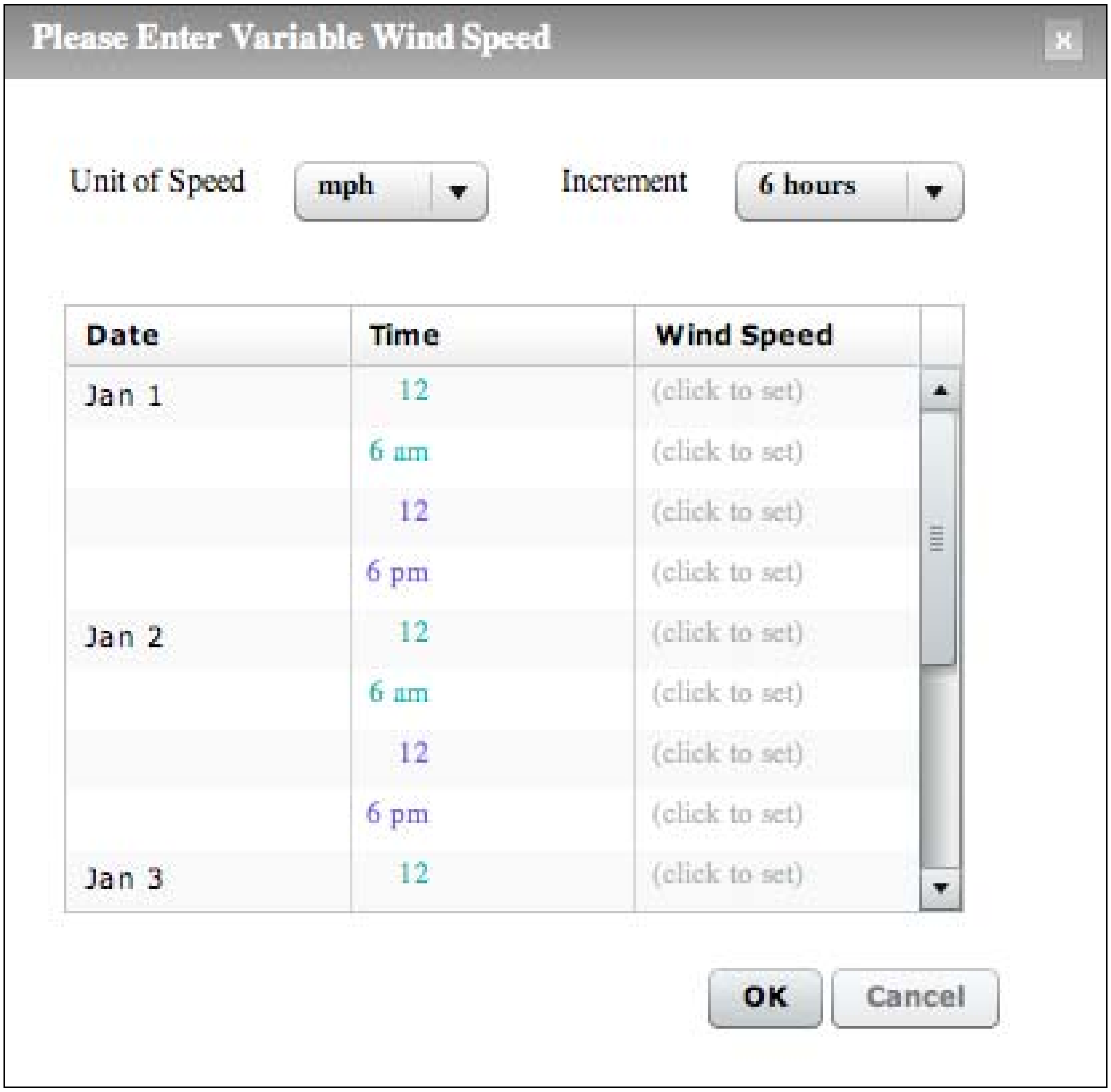


With ROC weathering off (set to No), an oil slick thickness must be specified. This is done by selecting one of three different methods from the drop-down menu for Derive Oil Slick Thickness From:

1. Enter Thickness directly
2. Derive Oil Slick Thickness From a specification of the Volume and Area of the oil slick (shown)
3. Observed Continuous release.

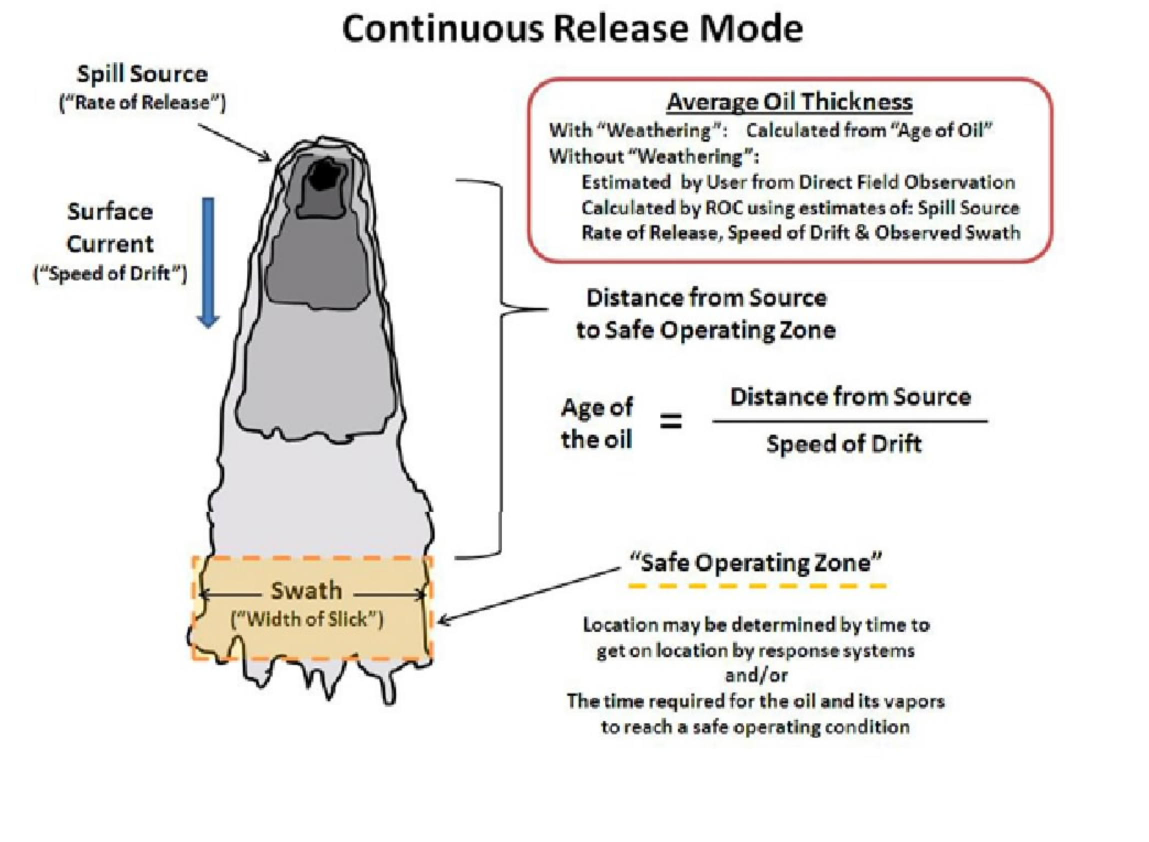
The tutorial, Scenario 1, developed in Chapter 2 specified a constant wind speed of 10 knots. An option in the Environment Settings window is to specify a variable wind speed.

Select Wind Speed Variable and then click on Edit.



Choose Wind Speed Units from the drop-down menu, then choose the Increment or time interval between Wind Speeds. The default Interval is 6 hours. Click on (click to set) for each time interval to enter Wind Speed values. Each wind speed value will prevail until the next different value. The last value entered will prevail to the end of the simulation.

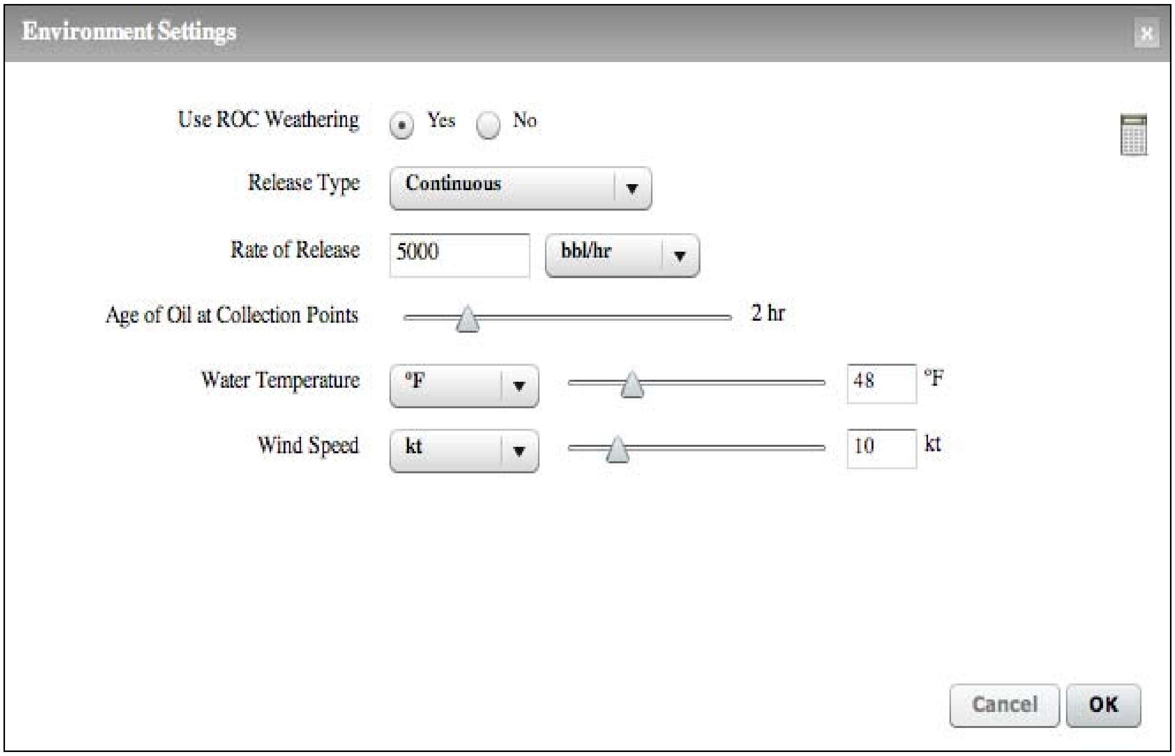
ROC also incorporates a Continuous Release Mode with a selection of Yes for Use ROC Weathering. In this mode, a "Safe Operating Zone" is specified by the user. This could be a location relative to the Spill Source that is determined by the time to get response systems on-scene, or the time require for the oil and its vapors to reach a safe operating condition.



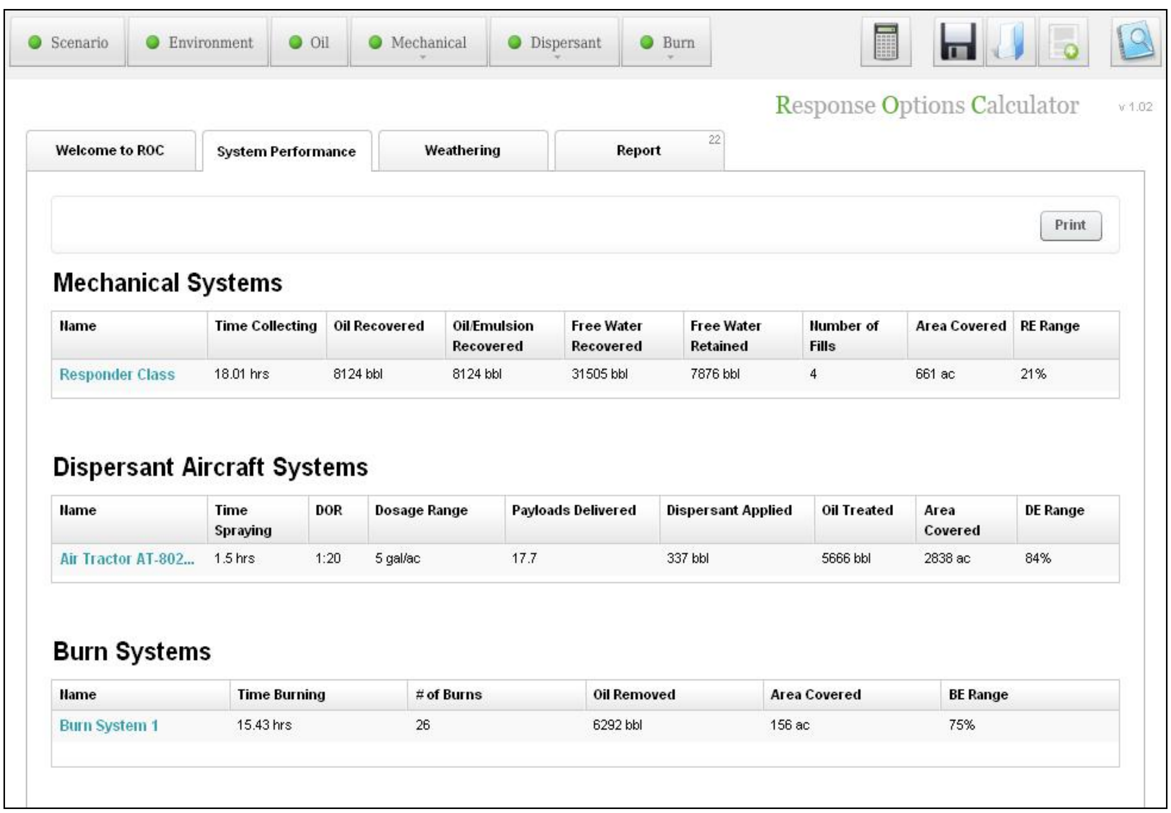
ROC weathers the oil to the location of the Safe Operating Zone, at which point all weathering stops. Response resources are then presented with a constant thickness of oil for the duration of the simulation.

Continuous Release Scenario

Go to the Environment Settings window
Set Use ROC Weathering to Yes
Set Release Type to Continuous
Enter 5000 bbl/hr for Rate of Release
Set the slider for Age of Oil at Collection Points to 2 hr
Set the slider for Water Temperature to 48 degrees F
Set the slider for Wind Speed to 10 kt (note: There is no option for variable wind speed here)

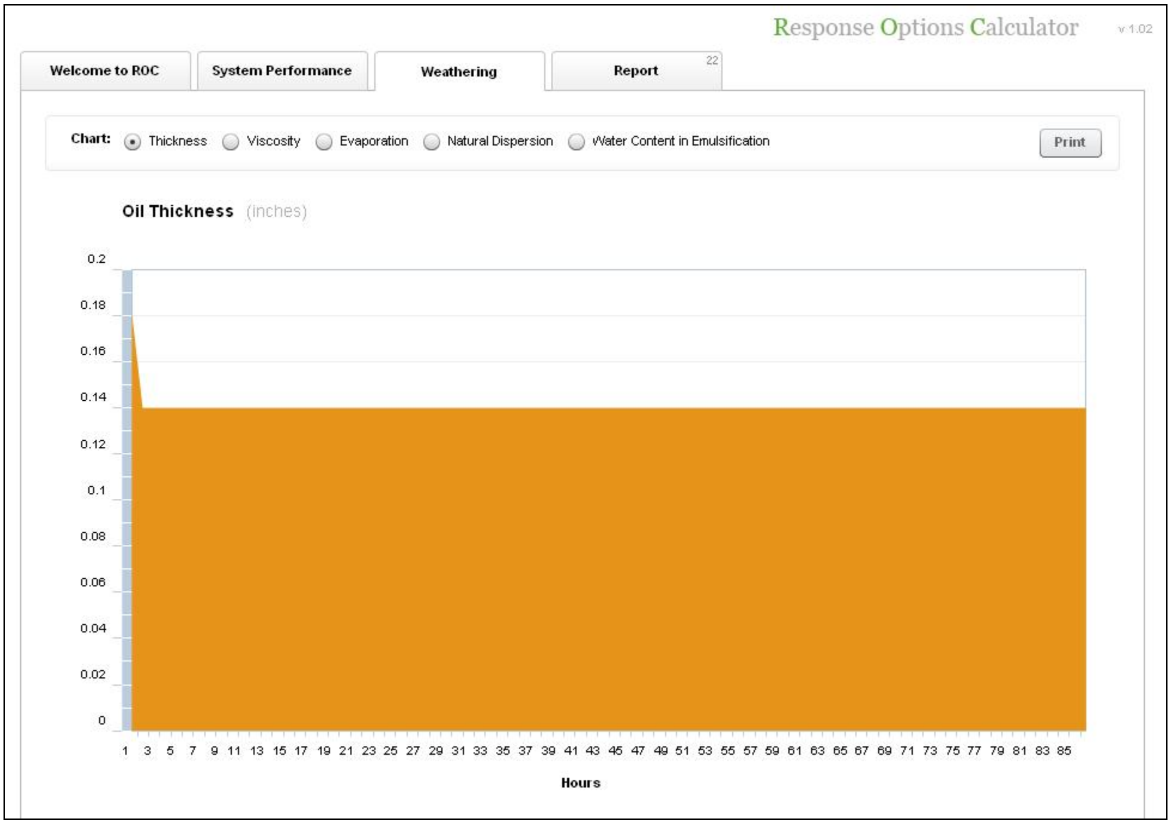

Environment Settings
Use ROC Weathering
Yes
No
Release Type
Continuous
Rate of Release
5000
bbl/hr
Age of Oil at Collection Points
2 hr
Water Temperature
°F
48
°F
Wind Speed
kt
10
kt
Cancel
OK

Click OK.


Scenario
Environment
Oil
Mechanical
Dispersant
Burn
Response Options Calculator
v 1.02
Welcome to ROC
System Performance
Weathering
Report
22
Print
Mechanical Systems
Name | Time Collecting | Oil Recovered | Oil/Emulsion Recovered | Free Water Recovered | Free Water Retained | Number of Fills | Area Covered | RE Range
Responder Class | 18.01 hrs | 8124 bbl | 8124 bbl | 31505 bbl | 7876 bbl | 4 | 661 ac | 21%
Dispersant Aircraft Systems
Name | Time Spraying | DOR | Dosage Range | Payloads Delivered | Dispersant Applied | Oil Treated | Area Covered | DE Range
Air Tractor AT-802... | 1.5 hrs | 1:20 | 5 gal/ac | 17.7 | 337 bbl | 5666 bbl | 2838 ac | 84%
Burn Systems
Name | Time Burning | # of Burns | Oil Removed | Area Covered | BE Range
Burn System 1 | 15.43 hrs | 26 | 6292 bbl | 156 ac | 75%

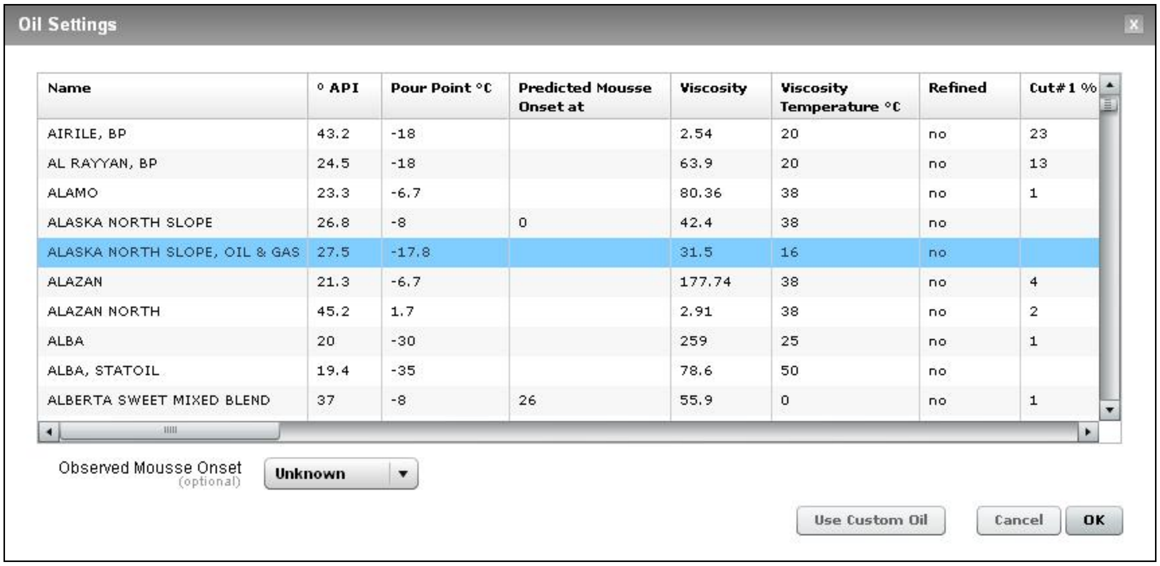
This is the same suite of response systems used for Simulation 1. The results are different for two main reasons; the response systems are responding to oil that has weathered for only two hours, and the oil thickness is very heavy and constant over time.

Click on the Weathering Tab, Chart: Thickness.



<u>Oil Tab</u>

Click on the Oil Tab



Name	° API	Pour Point °C	Predicted Mousse Onset at	Viscosity	Viscosity Temperature °C	Refined	Cut#1 %
AIRILE, BP	43.2	-18		2.54	20	no	23
AL RAYYAN, BP	24.5	-18		63.9	20	no	13
ALAMO	23.3	-6.7		80.36	38	no	1
ALASKA NORTH SLOPE	26.8	-8	0	42.4	38	no	
ALASKA NORTH SLOPE, OIL & GAS	27.5	-17.8		31.5	16	no	
ALAZAN	21.3	-6.7		177.74	38	no	4
ALAZAN NORTH	45.2	1.7		2.91	38	no	2
ALBA	20	-30		259	25	no	1
ALBA, STATOIL	19.4	-35		78.6	50	no	
ALBERTA SWEET MIXED BLEND	37	-8	26	55.9	0	no	1

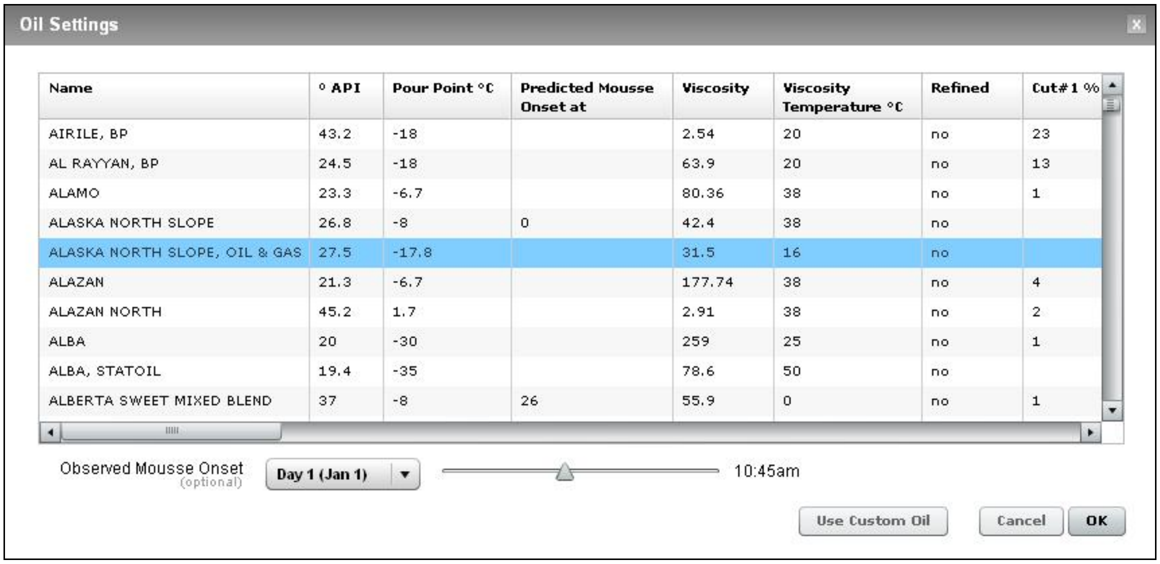
Observed Mousse Onset

Mousse is a common term for water-in-oil emulsions. Most crude oils and some refined petroleum products eventually emulsify (form mousse) in the turbulent conditions at the sea surface. Mousse is more viscous and takes up more volume than the oil before emulsification. Highly emulsified oil is difficult to burn, chemically disperse, or recover by skimming. Crude oils differ in their tendency to form mousse. Some emulsify readily and quickly, some more slowly, and some do not emulsify. Typically, an oil begins to emulsify once a given percentage of its lighter components have evaporated.

User Alerts for emulsification:
When an emulsion exceeds 25% water-in-oil: "Water content could make ignition and/or chemical dispersion difficult."
When an emulsion exceeds 35% water-in-oil: "Water content is likely to make ignition and/or chemical dispersion difficult to impossible."
When an emulsion exceeds 50% water-in-oil: "Water content is highly likely to preclude successful ignition and/or dispersion of the emulsion."
When an emulsion exceeds 70% water-in-oil: "Burn Efficiency and Dispersant Efficiency are set to zero."

The ROC Weathering module has algorithms to determine the onset of emulsification. If there is visual or other information of mousse onset then this information will override the ROC prediction.

Click on the drop-down Observed Mousse Onset Unknown and select the day of observed mousse onset. Then use the slider to set the time for that day.

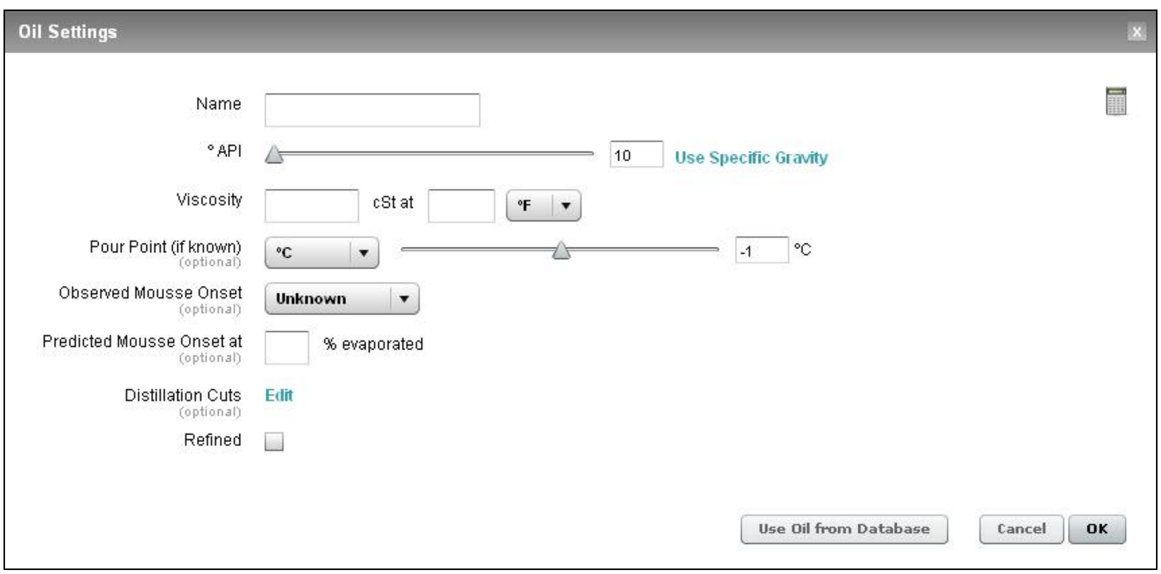


In this example the onset of emulsification is set to Day 1 (Jan 1) at 10:45 am.

<u>Custom Oil</u>

Custom oils can be added for a ROC simulation.

Click on the Use Custom Oil button.



The required information to be entered for a custom oil includes:

<u>Oil Name</u>

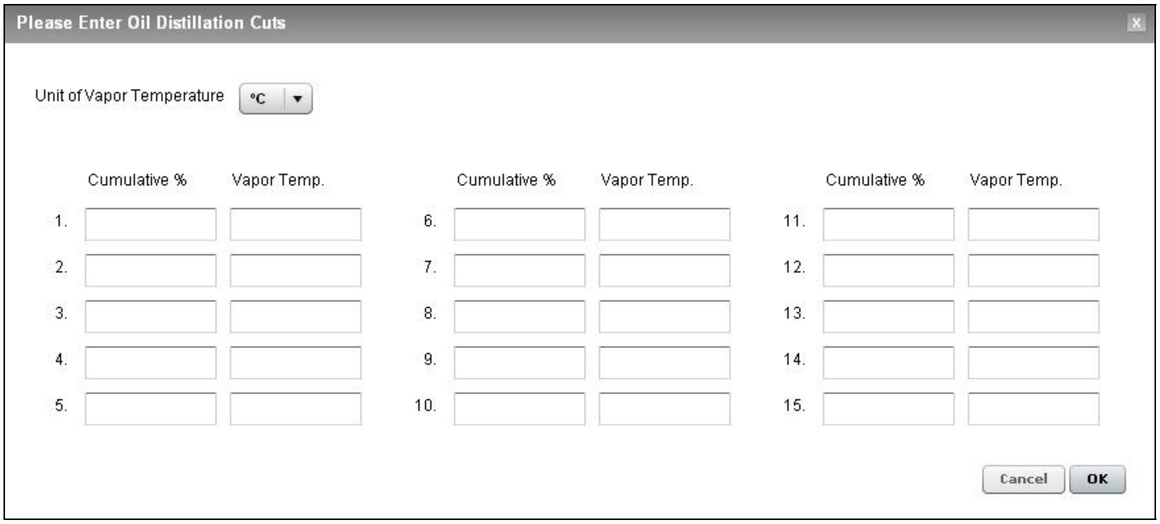
<u>API Gravity (or Specific Gravity)</u> - An oil or other product with an API of 10 or more degrees floats on fresh water; a product with an API of less than 10 degrees (e.g., bitumen) sinks in fresh water. The Specific Gravity of fresh water is 1; an oil or other product with a Specific Gravity of greater than 1 sinks in fresh water.

An oil or other product with a Specific Gravity of less than 1 floats on fresh water.
Viscosity - Viscosity is a measure of a fluid's resistance to flow. Viscosity influences the efficiency of mechanical recovery (skimming) as well as dispersant and burning operations.
Viscosity Reference Temperature
Refined – Check this box if the oil is a refined product. Leave unchecked for crude oils.

Optional information for entering a custom oil includes:

Pour Point - "Pour Point" is not used in ROC's weathering calculations, but is compared to the "Water Temperature" in the "Environment Settings" tab. A User Alert is issued when the Pour Point is within 2 degrees C of the Water Temperature.
Observed Mousse Onset – This can be entered in one of two ways; the date and time of observed mousse onset, or the predicted percent evaporation of the oil at mousse onset.
Distillation Cuts - Crude oils are typically characterized by distillation (increasing the temperature of the oil while measuring the percentage of oil remaining). A crude oil is a complex mixture of many hydrocarbon compounds, which differ in their boiling points. In the process of fractional distillation, the temperature of a crude oil is increased (with pressure controlled). As the temperature increases, the hydrocarbon compounds that make up the oil are progressively vaporized. The compounds with lower boiling points vaporize first, followed by those with higher boiling points. Those vaporized compounds, called "fractions" or "cuts"" are condensed within the distillation column and then can be further analyzed. Distillation produces a series of paired measurements of temperature and percent of oil remaining ("distillation cuts").

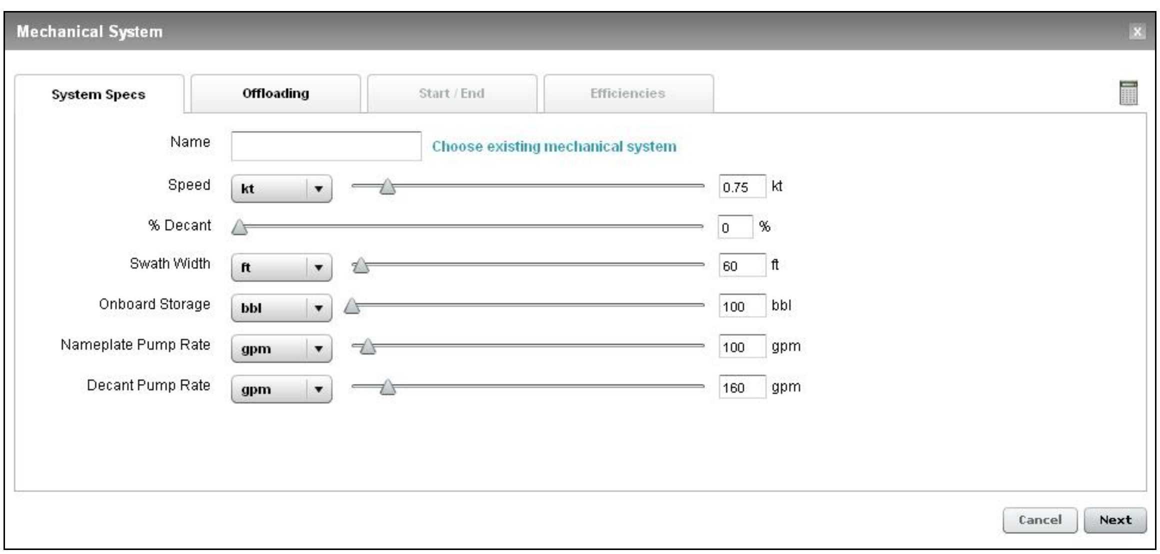
Click on Distillations Cuts Edit



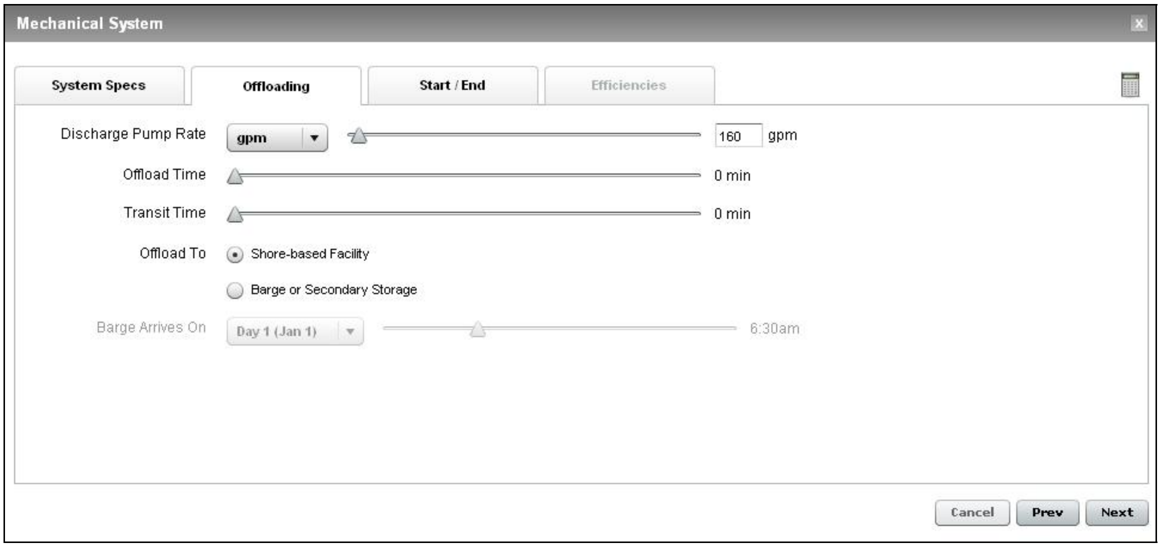
Up to 15 pairs of distillation cuts can be entered; a cumulative percent and the vapor temperature for that cumulative percent. It is necessary that both values of each pair be greater that the values of the previous pair entered.

<u>Custom Mechanical System</u>

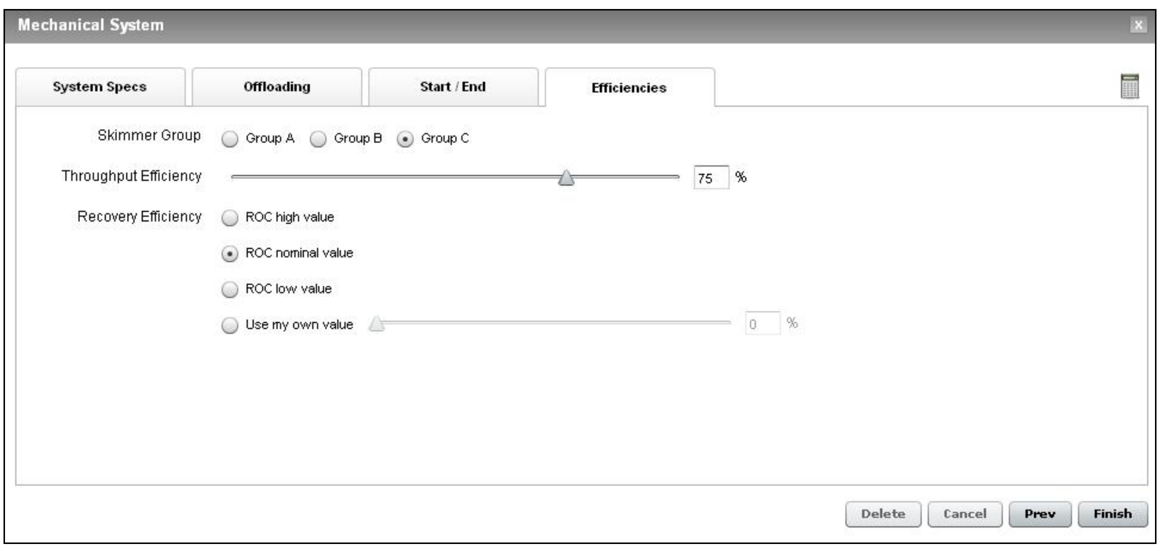
Custom response systems for skimming can be created by modifying the default values displayed when selecting Add New Mechanical System under the Mechanical Tab. Although some default values are provided for custom response system configurations, this model is best run with operational knowledge of response systems.



This is the default Mechanical System Specs window.



This is the default Mechanical System Offload window. Start/End times for the simulation are defined in the Scenario Tab. Default Start Time for each day of the simulation is time of sunrise. Default End Time for each day of the simulation is time of sunset. Users will need to specify the arrival time of each system on its first day of response based on spill location, notification time, mobilization time, and travel time to the spill site.



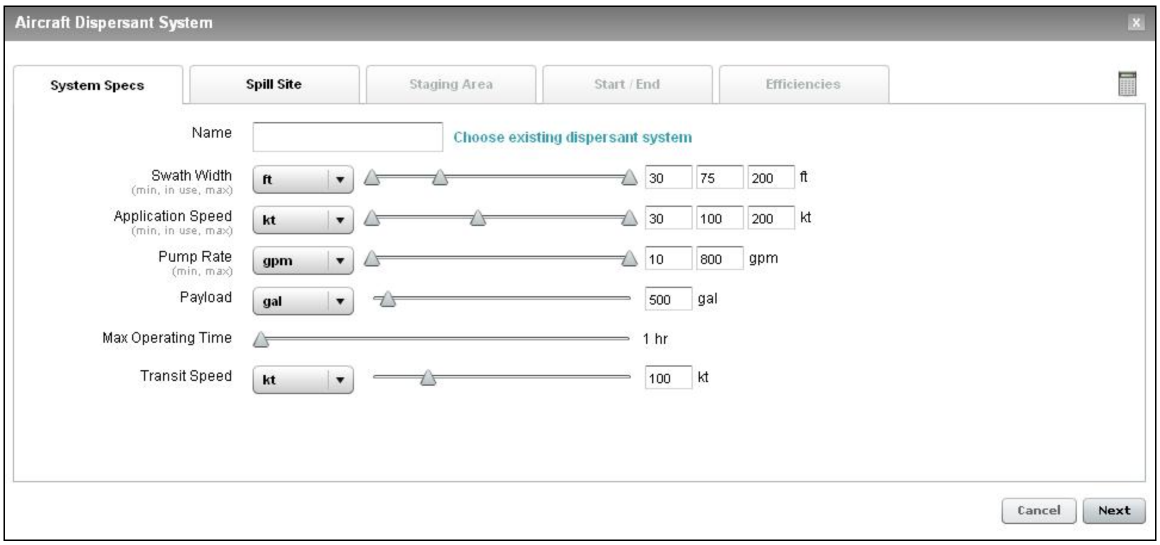
There are three choices for Skimmer Group. The Skimmer Group with the highest Recovery Efficiencies, Group A, includes the oleophillic skimmers – drums, disk, brush, belt, and rope-mop. The intermediate group, Group B includes paddle belt, fixed submersion plane, and moving submersion plane. The Skimmer Group with the lowest Recovery Efficiencies, Group C, includes air conveyer, wier, direct suction, and vortex skimmers (see the Skimmer Recovery Efficiency diagrams earlier in this document or in ROC Help).

The ROC Default Throughput Efficiency for skimmers is 75%.

Recovery Efficiency can be estimated by ROC for each one-hour Calculation Interval based on Skimmer Group, wind speed, and viscosity. For ideal recovery conditions select Recovery Efficiency, ROC high value. For intermediate recovery conditions select Recovery Efficiency, ROC nominal value. For marginal recovery conditions select Recovery Efficiency, ROC low value.

<u>Custom Aircraft Dispersant System</u>

There are two choices for adding custom dispersant application systems; Add New Aircraft or Add New Vessel under the Dispersant Tab.



This is the Aircraft Dispersant System Specifications window. The first step in adding a custom system is to enter a Name for the system.

For Swath Width, enter the minimum value, the maximum value, and some intermediate value to use in the simulation. Do the same for Application Speed (this is the speed of the system while spraying).

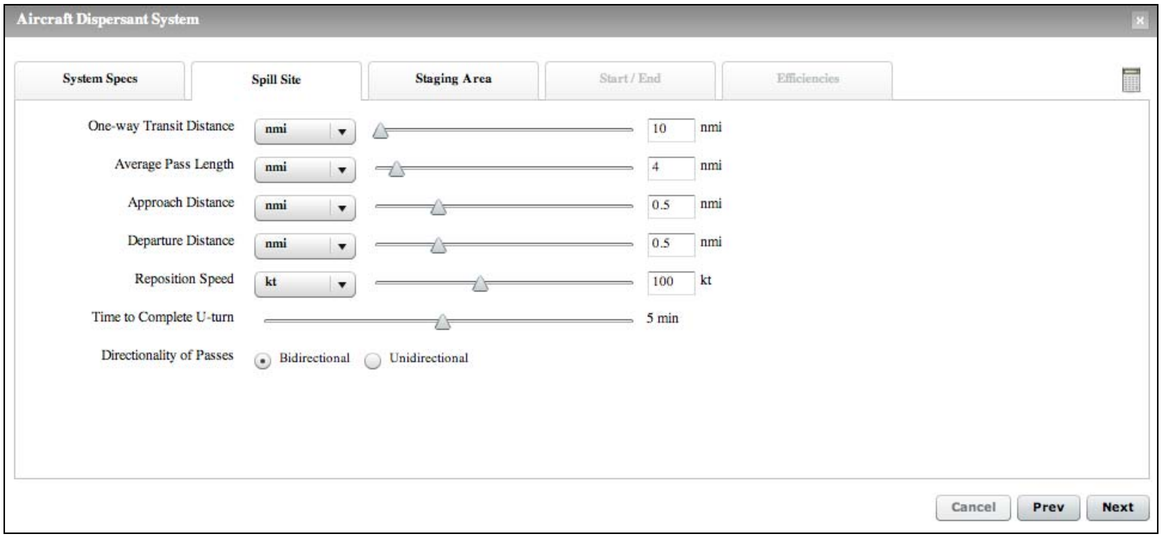
Enter a minimum and maximum Pump Rate. ROC will adjust the Pump Rate to attempt to achieve the Dosage.

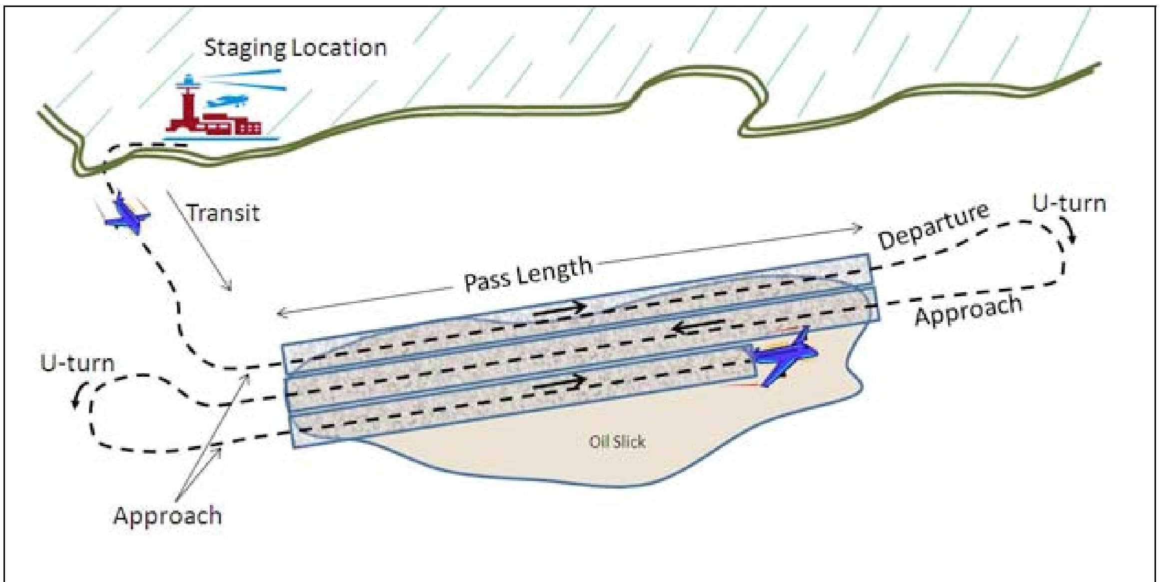
The Payload is the volume of dispersant carried on-board the application system.

The Max Operating Time is the time in hours that the system can operate before it returns to the staging area including some reserve time.

Enter the Transit Speed, the speed from the staging site to spill site and on the return.

Click on the Spill Site Tab





Representative Bi-Directional Dispersant Spray Pattern

Enter the One-way Transit Distance from the staging area to the spill site.

Enter the Average Pass Length. This is the length of each spray pass over the oil slick.

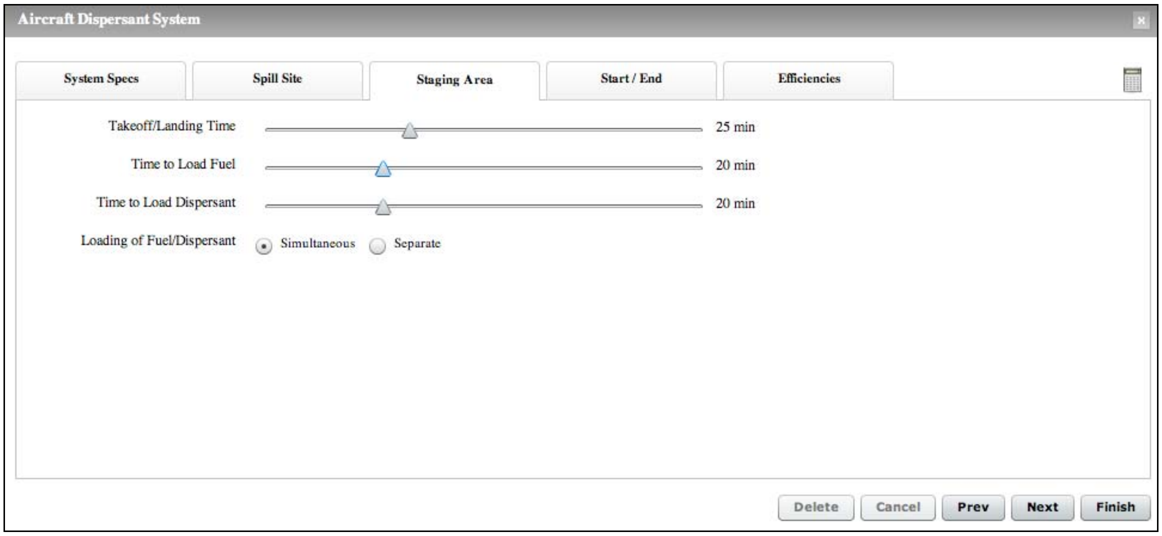
Enter the Approach Distance. This is the distance used by the system to descend to spray altitude and line up for the next spray pass at Reposition Speed.

Enter the Departure Distance. This is the distance used by the system to ascend from spray altitude at Reposition Speed and prepare for a U-turn.

Time to Complete U-turn. This is the time in minutes for the system to make a U-turn in preparation for another Approach or Departure.

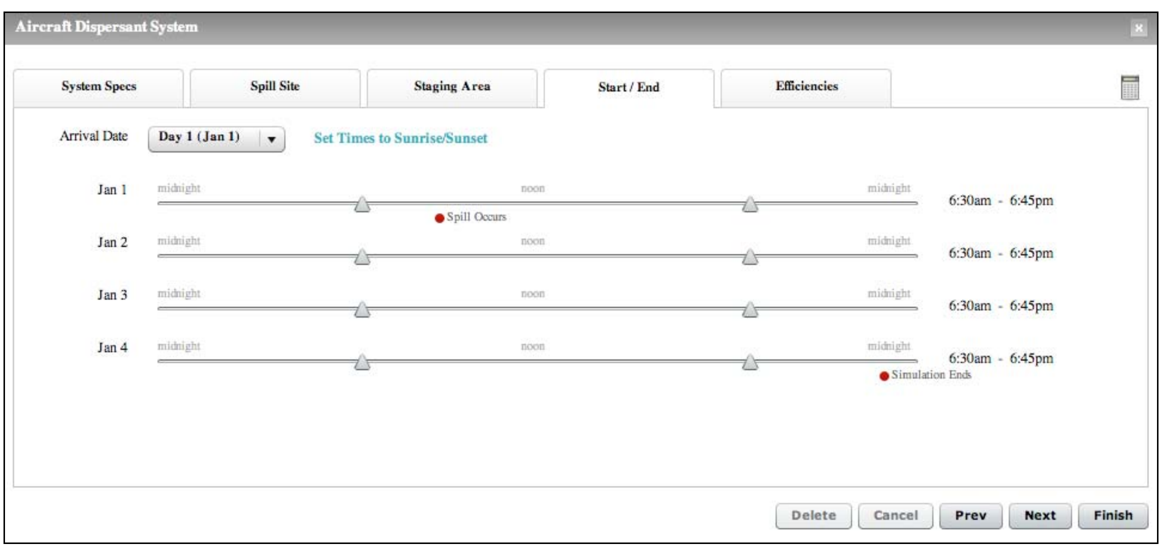
Select Bidirectional or Unidirectional for Directionality of Passes. Unidirectional means that the spray passes are always in the same direction. Bidirectional means that dispersant is sprayed in both directions (see graphic above).

Click on the Staging Area Tab or Next.



This is the window that contains information about activities at the Staging Area – Takeoff/Landing Time, Time to Load Fuel, Time to Load Dispersant, and an indicator if Loading of Fuel/Dispersant is to be Simultaneous or Separate. If the selection is Simultaneous, ROC uses the greater of the Time to Load Fuel and the Time to Load Dispersant as the time to reload. If the selection is Separate, the two times are added together as the time to reload.

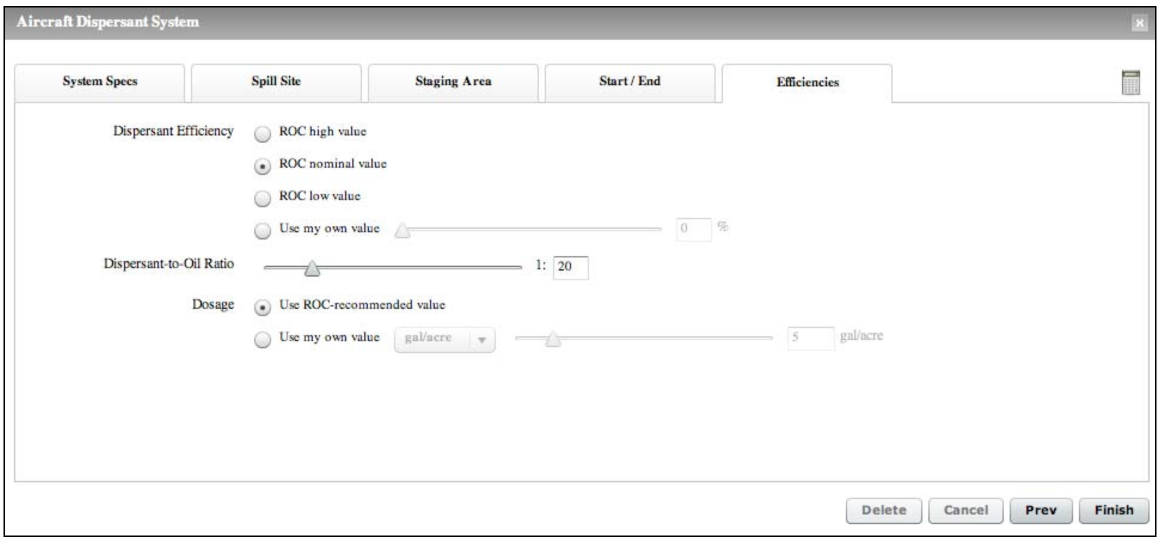
Click on the Start/End Tab or Next to Continue



Upon entry to this window, the entire simulation is displayed with each day on a line. Red dots indicate the time the Spill Occurred and the Simulation End Time.

The user will need to specify the date and time that the aircraft dispersant application system is loaded with fuel and dispersant, and is ready to take off from the Staging Area for the first dispersant application. For subsequent days, the Start Time is set to sunrise and the End Time to sunset (these are default values that can be changed). Note that the End Time refers to the end time for spraying. Spray aircraft may travel back to the staging area in darkness.

Click on the Efficiencies Tab or Next

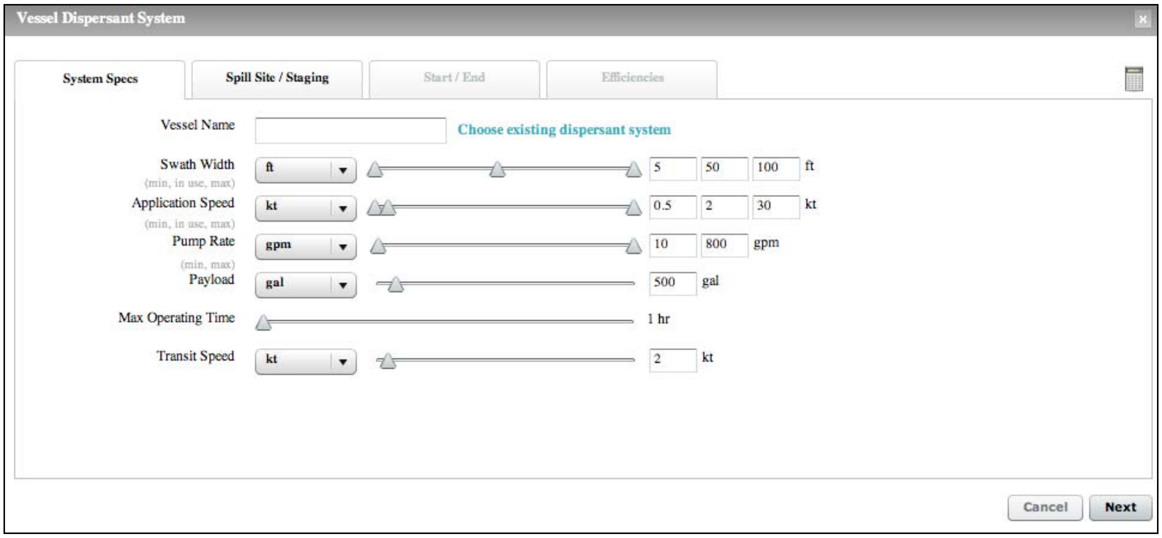


The default for the Dispersant Efficiency is the ROC nominal value. The default for the Dispersant-to-oil Ratio (DOR) is 1:20. Check with the specific dispersant manufacturer for the recommended DOR. The default Dosage is 5 gallons of dispersant per acre of oil slick. ROC will attempt to match the specified Dosage by changing the system Pump Rate within the minimum and maximum specified on the Aircraft Systems Specs window. Refer to Chapter 2 or ROC help for further guidance on Dispersant Efficiency, DOR, and Dosage.

Click Finish to complete your custom Aircraft Dispersant application system.

<u>Custom Vessel Dispersant System</u>

Move the cursor over the Dispersant Tab and click on Add New Vessel.



This is the Vessel Dispersant System Specifications window. The first step in adding a custom system is to enter a Name for the system.

For Swath Width, enter the minimum value, the maximum value, and some intermediate value to use in the simulation. Do the same for Application Speed (this is the speed of the system while spraying).

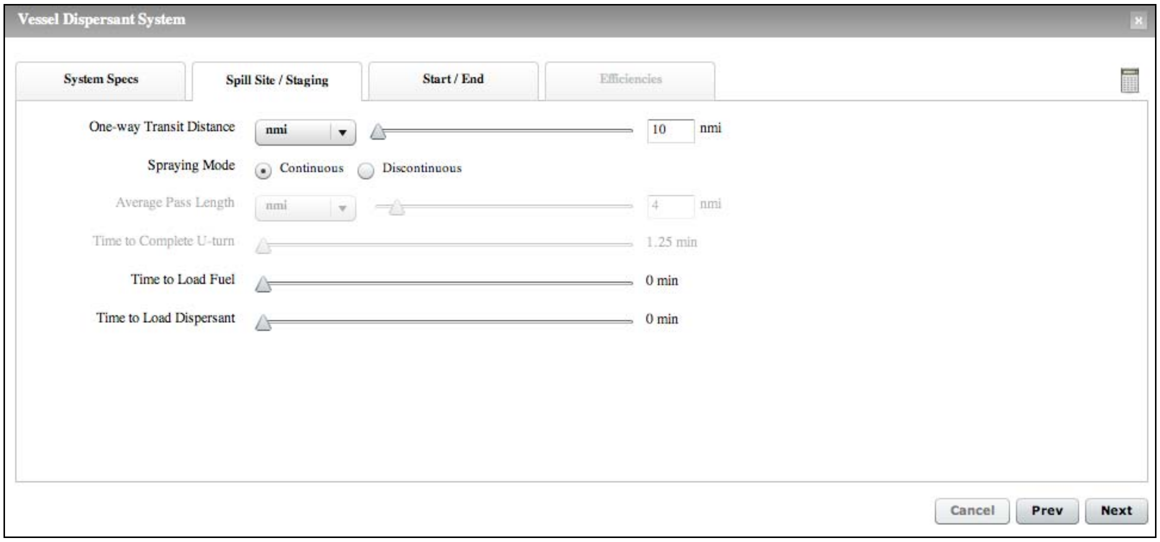
Enter a minimum and maximum Pump Rate. ROC will adjust the Pump Rate to attempt to achieve the Dosage.

The Payload is the volume of dispersant carried on-board the application system.

The Max Operating Time is the time in hours that the system can operate before it returns to the staging area.

Enter the Transit Speed, the speed from the staging site to spill site and on the return.

Click on the Spill Site/Staging Tab

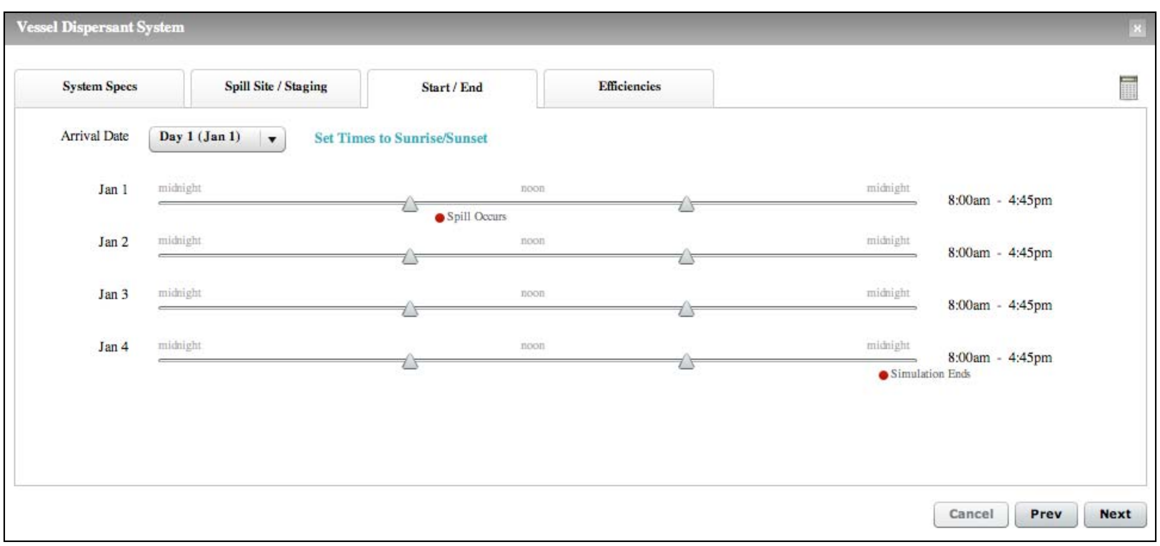


Enter the One-way Transit Distance from the staging area to the spill site.

ROC has 2 Spraying Modes for vessel dispersant application systems, Continuous and Discontinuous. In certain oil slick configurations it is possible to spray continuously without stopping the spray to reposition in the slick. For other slick configurations it is sometimes more efficient to make a spray pass across the oil slick, turn off the spray, and make a U-turn to reposition before making another spray pass. When Spraying Mode Discontinuous is selected, Average Pass Length and Time to Complete U-turn become active for data entry.

At the staging area ROC will use the greater of the Time to Load Fuel and the Time to Load Dispersant as the time to reload.

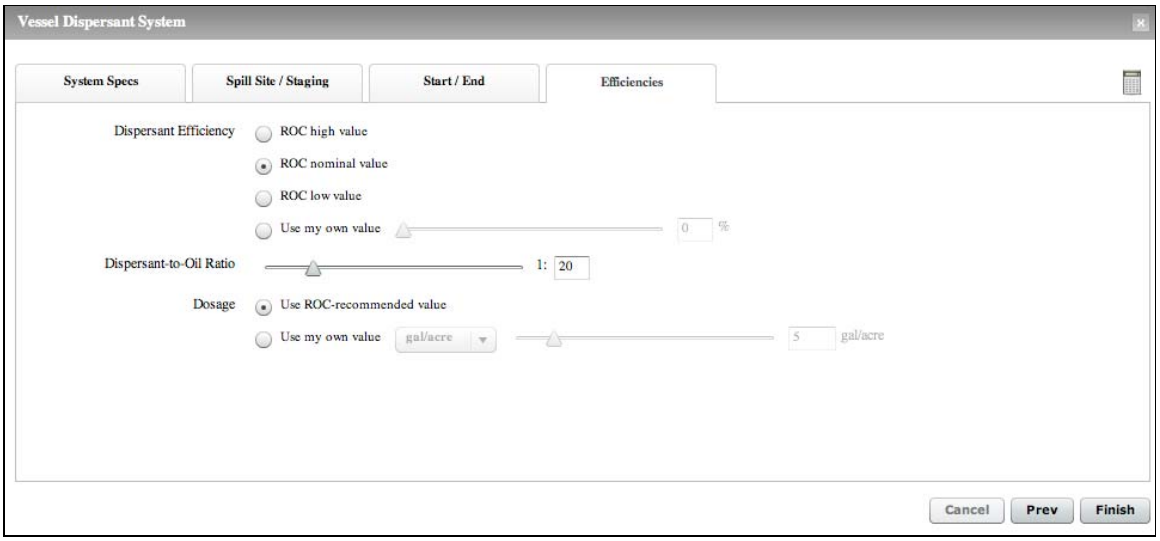
Click on the Start/End Tab or Next to Continue



Upon entry to this window, the entire simulation is displayed with each day on a line. Red dots indicate the time the Spill Occurred and the Simulation End Time.

The user will need to specify the date and time that the vessel dispersant application system is loaded with fuel and dispersant, and is ready to depart from the Staging Area for the first dispersant application. For subsequent days, the Start Time is set to sunrise and the End Time to sunset (these are default values that can be changed). Note that the End Time refers to the end time for spraying. Spray vessels may travel back to the staging area in darkness.

Click on the Efficiencies Tab or Next



The default for the Dispersant Efficiency is the ROC nominal value. The default for the Dispersant-to-oil Ratio (DOR) is 1:20. Check with the specific dispersant manufacturer for the recommended DOR. The default Dosage is 5 gallons of dispersant per acre of oil slick. ROC will attempt to match the specified Dosage by changing the system Pump Rate within the minimum and maximum specified on the Vessel Systems Specs window. Refer to Chapter 2 or ROC help for further guidance on Dispersant Efficiency, DOR, and Dosage.

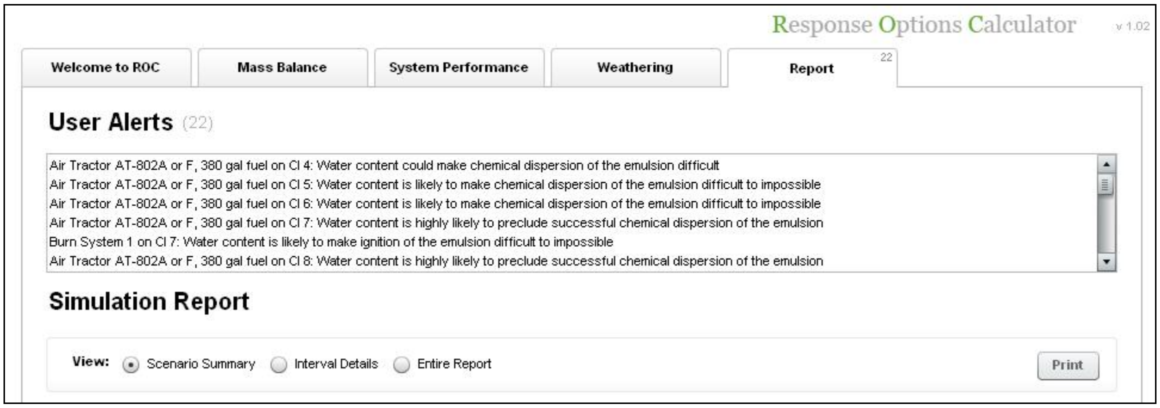
Click Finish to complete your custom Vessel Dispersant application system.

All *in-situ* burn systems created in ROC are custom and were described in Chapter 2.

<u>The ROC Report Tab</u>

ROC captures detailed input and output information for each simulation and displays this information in the Report Tab.

Click on the Report Tab

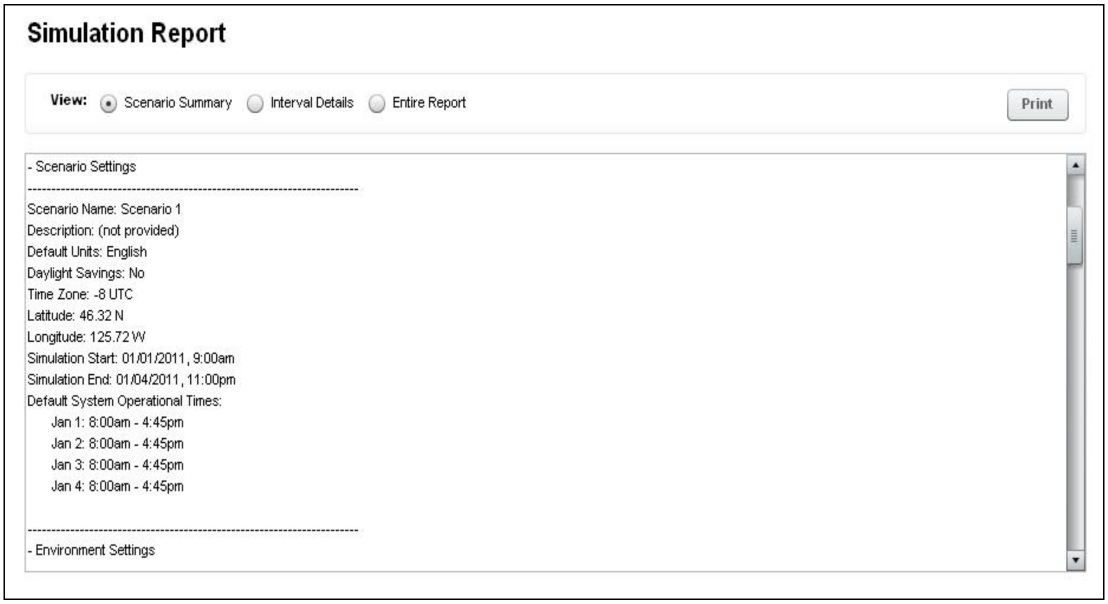


User Alerts will be displayed at the top of the report accessed by the Report Tab. The number of user alerts for the simulation is displayed at the upper right corner of the Report tab. User Alerts are generated for several conditions, including when the Total Fluid Recovery Rate (TFRR) exceeds the Nameplate Recovery Rate of a skimmer, when water content reaches values which in general might significantly impact the efficient recovery/transfer, burning and chemical dispersal of oil, and when the Pour Point of the oil is within 2 degrees C of the water temperature.

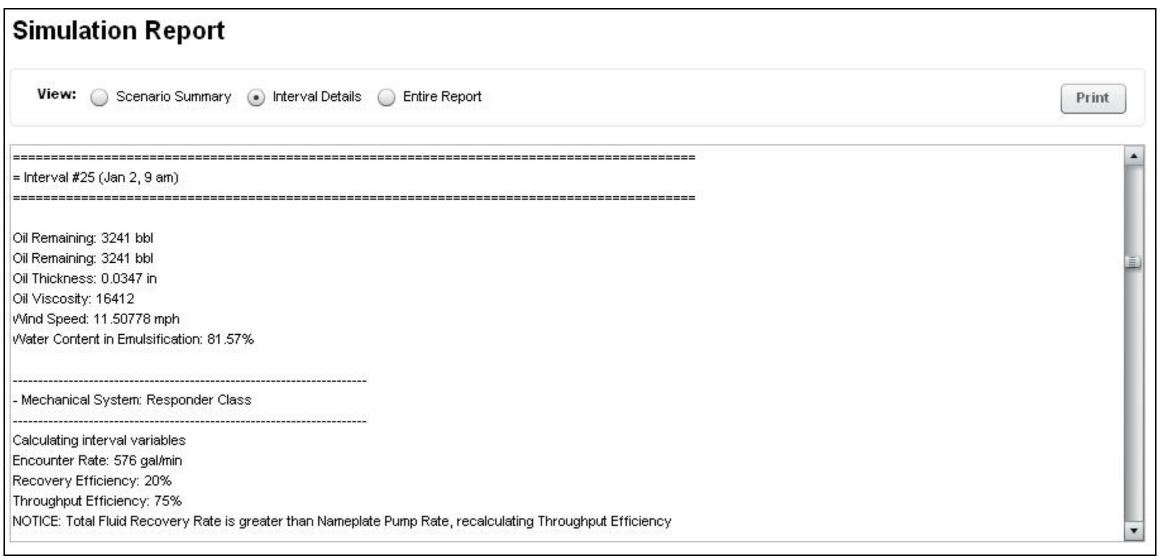
When the TFFR exceeds Nameplate for a skimmer, ROC will create a User Alert and will also re-compute the Throughput Efficiency (TE) for the current Calculation Interval for the specific skimmer so that the TFRR equals the Nameplate.

In the case of excessive water content, recognize that a specific system being simulated may work well beyond that value.

The Simulation Report is available in three different content categories; Scenario Summary, Interval Details, and Entire Report. The Scenario Summary Report contains all the user input data for the simulation.



The Interval Details Report contains everything that that occurs in each Calculation Interval.



The Entire Report combines the Scenario Summary Report and the Interval Details Report.

Glossary

ADIOS	Automated Data Inquiry for Oil Spills, a NOAA oil weathering model.
Cascade Time	Response systems are frequently located outside the immediate area of an oil spill. They are said to be “cascaded” from their home base to the location of the spill.
Constant wind	Wind that is blowing steadily at a particular speed from a particular direction, in the case of ROC, over the duration of the simulation.
Decant	The process of removing recovered free water and discharging back into the sea.
Dialog box	A window that ROC presents to you, in which you enter information or choose options.
Entrainment	Loss of oil under a boom
Mass balance	At any point in time, the sum of all the losses of oil due to weathering (evaporation, natural dispersion) and response plus the amount of oil remaining is equal to the amount of oil initially spilled. This can be displayed in volume units or as a percentage in a time-dependant chart, a table or a pie diagram.
Non-weathering pollutant	A pollutant type that does not change chemically or physically over time in the marine environment.
Over flight	An airplane or helicopter flight over a spill area to determine the location and extent of the spill.
Age of Oil at Collection Points	The number of hours the pollutant has been in the water before response.
Start New File	To reset or restart ROC with different initial conditions.

Run duration	The length of the ROC simulation. The maximum ROC run duration is 5 days.
Scenario	A description of how much, and what type of oil has spilled, the current environmental conditions and the response assets assigned to combat the spill.
Sortie	A sortie, as used in ROC, consists of all the actions necessary for a dispersant application system to apply one payload of dispersant.
SSC	NOAA Scientific Support Coordinator.
Weathering	Physical and chemical changes that a pollutant undergoes while it is exposed to the environment. In the marine environment, a pollutant can change its density, viscosity (resistance to flow), rate of evaporation and dispersion into the water column, and the rate at which an oil-in-water mixture may form.
Variable wind	Wind that is changing speed over time. ROC does not make use of wind direction.