

NETAFIM LANDSCAPE CONTROLLERS

NLC-100

USER MANUAL



NLC-100S



NLC-100D

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Chapter 1: Introducing NLC-100

The NLC is a microprocessor based irrigation control system. A central controller and up to 100 field stations comprise a complete system. In addition the controller will accept input from several external sensors in order to adjust its irrigation to the local weather conditions.

The Controller

The heart of a NLC based system is the controller. This is a microprocessor controlled device that stores your irrigation programs and NLC individual stations in the field when to activate their valve(s).

Irrigation Features

Here are the main features that the NLC utilizes to help you automate your irrigation:

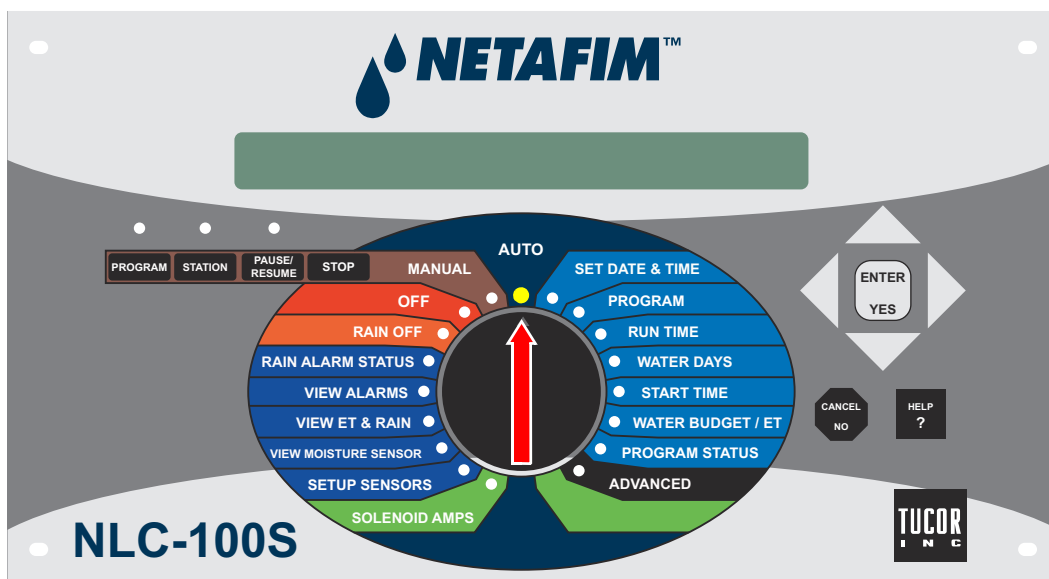
- Controls up to 100 solenoids (specifications vary depending on model) attached to valves or relays via the built-in connection board and three expansion boards.
- Provides ET corrected irrigation for optimal adjusted water consumption.
- Measures water flow and raises alarms or halts irrigation on unexpected flow.
- Allows for 10 independent irrigation programs. In addition there is a fixed test program that activates all 100 stations in turn.
- A program can activate up to 100 stations in named order.
- Each station can run for up to 17:59:50 (In fact, you can boost this even further by increasing the "water budget". For more information turn to **Adjusting the ET (Water budget)** on page 35.
- Each program can activate a one or more booster pumps in addition to the stations.

- Master valves and booster pumps will be activated in parallel in all connection and expansion boards (specifications vary depending on model).
- All programs have 12 start times per day.
- All programs can run simultaneously.
- You configure each program to run on any selection of days in a 14 day period, or on odd/even dates.
- You can activate one or more valves or programs manually while one or more programs are running, up to a total of 12 simultaneously running valves.
- A master valve can be selected that will open when any program or station is run. You typically assign master valve status to the valve controlling access to municipal water or pumping station.
- Up to 10 moisture sensors that can monitor soil moisture and adjust irrigation accordingly.

Chapter 2: Operating the controller

It is essential that you feel comfortable with the interface of the NLC before you start configuring stations, irrigation programs etc.

This section explains what all the controls are for in the different modes. For more information turn to **Chapter 3: Programming the NLC** on page 17 and **Running the NLC** on page 43.



The Display

The NLC has a back lit LCD display with two rows of 40 characters. Since the limit is 40 characters per row, sometimes words are abbreviated, but all messages should still be easy to understand - if in doubt about a message, consult this manual.

A typical message is the following that is displayed when the NLC is idle, waiting for the next program to run:

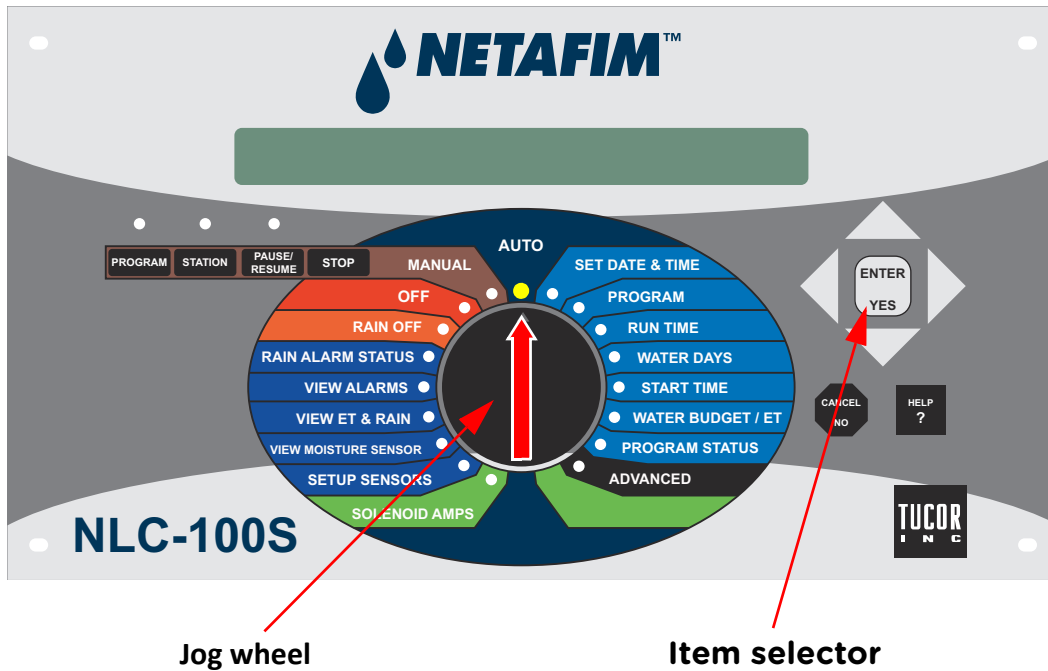
A standard display when idling in Auto mode



This simply states that the next program to run is program number one, the program's total run time is 40 minutes, and it will run on Tuesday at 09:44 PM, activating two stations in turn. In the top right you see the current time.

You will learn all about programs in For more information turn to **Chapter 3: Configuring Irrigation Programs** on page **18**.

Button and Controls



The NLC is handled by the dial and *item selectors* in conjunction. Select the mode using the dial, scroll through dialogs using the *item selectors* and confirm or cancel your selections using the YES and CANCEL buttons.

The Seven Main Modes

The NLC works in seven different modes, each allowing you to handle a subset of the controller functionality.

Each main mode has its own color on the front plate (provided in parenthesis after each mode name)

OFF (Red)

This is short for "Irrigation Off" - practically this means that the connection to the controller is shut down and no programs will be run. The display will still be lit and you'll see this message:

Idling in Irr. Off mode



This is also where you can manually turn irrigation off when it's raining.

MANUAL (Brown)

In manual mode you can start a program or a single station manually.

AUTO (Grey)

AUTO is the normal operating position and is probably where your system will spend the most of its time. When in auto mode the NLC makes sure that all programs are run according to schedule. Once everything is configured, you switch the system to auto mode and leave it to do its job.

You also have the option of starting additional valves or programs manually while a program is running in auto mode. This can be useful if you notice that an area needs a little extra watering but you don't want to create a new program to take care of it - just turn on the nearest valve for a few minutes.

PROGRAM (Light blue)

This is the mode you switch to when creating programs. For more information turn to **Chapter 3: Configuring Irrigation Programs** on page **18**.

SETUP (Dark blue)

This mode lets you configure the controller for various sensor inputs, view alarms and rain event status.

ADVANCED (Black)

In advanced mode you can configure a lot of settings that you don't have to change in the daily work with the controller:

- FloStack - plan and control system flow
- FloGuard - monitor the controller for potential problems
- Intellisets - manage ET devices, moisture sensors and related operations
- Define a custom irrigation period
- Assign booster pumps to programs
- Manage the run sequence and mapping of your stations
- Enable/disable whether or not to display the line
- Feature manager - enable/disable features only used by a subset of users, like misting and "cycle & soak" irrigation
- Erase the entire controller's data - in case you're setting up a new system from scratch

SOLENOID AMPS (Light green)

In this mode you can test each valve in the field individually.

(MORE: 2-wire short finding + decoder programming
install/trouble for D)

Chapter 3: Programming the NLC

Like conventional controllers, the NLC must be programmed to control your irrigation. The controller itself needs to be configured with basics like date and time, and in addition, the stations need to be configured and tested. Finally, you need to create your irrigation programs, and possibly configure the system for sensor inputs.

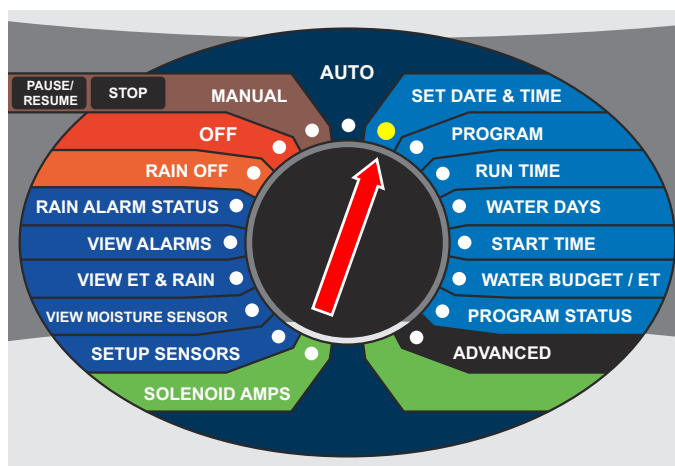
All of this happens at the controller, and this chapter walks you through all the tasks.

Basic Controller Configuration

The controller will remember date/time for up to two weeks when not connected to a power outlet. Most likely it will have lost this information when you first receive it, so the very first thing you have to do to get going is to set the date and time:

Setting the date and time

- 1 Turn the dial to the SET DATE & TIME position



Now the display looks something like this:



- 2 You change the settings with the up and down *item selectors* and move between the day, month and year slots with the left and right *item selectors*.

Push the **ENTER** button to save your setting - now the controller will save the date.

Note: The week day will be calculated automatically from the date you choose.

Important! Daylight savings are not handled automatically.

Configuring Irrigation Programs

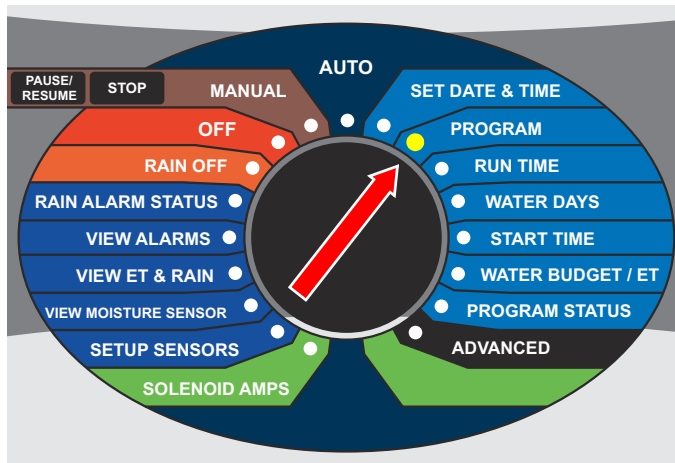
The NLC holds 10 programs that can each activate 100 stations in turn. Each program can run 12 times a day on odd, even or selected days in a two week period. Additionally, each program can activate a booster pump and a master valve throughout the duration of the program.

There is also a test program which can not be modified. This program is primarily used to troubleshoot the system.

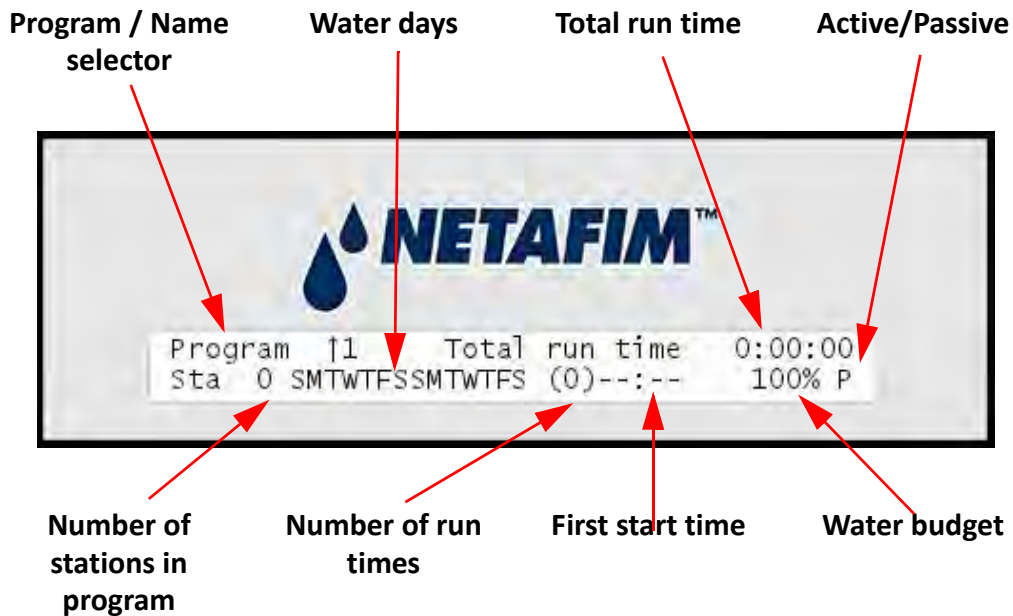
To start configuring a program, turn the dial to PROGRAM.

Important! Throughout this section we assume that you have turned the dial to the PROGRAM position - you then use the item selectors to choose the program you wish to edit, and then move the dial along to the aspect of the program you wish to edit (run time, water days, start times etc.). When working this way you will see both the PROGRAM and e.g. WATER DAYS

Turn to PROGRAM mode.



Now the NLC shows you the configuration for "Program 1". The first time you do this, most settings are blank, and the display will look like this:



The following sections walk you through everything you need to know in order to customize the 10 programs.

Configuring the stations

Each of the 10 programs can activate up to 100 stations in turn. The stations are run in turn according to their IDs, starting from ST01, ST02 etc¹. To configure a program, simply set the run times of each station to the number of minutes you wish it to run.

Here's an example of an irrigation program:

1. If you want the stations to run in a different order than this, you must assign sequence numbers to each station and the sequence number will determine the order instead.

Station	Run Time
ST01	10 min
ST02	5 min
ST04	50 min
ST16	10 min
...	...
...	...

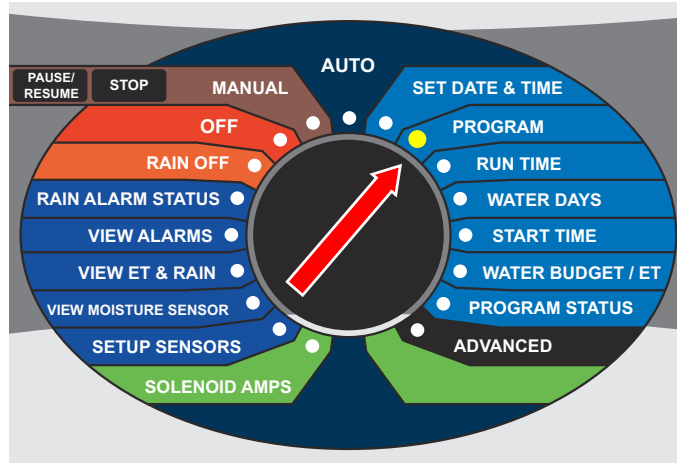
Note: A station can appear in as many programs as you wish, but obviously only one program can run a station at a time.

If two programs wish to run the same station at the same time, the station will simply keep running until the last program no longer needs it running.

Now let's look at how you configure the individual stations in a program.

Configuring a station in a program

- 1 Turn the dial to PROGRAM.



Now the display will look something like this:



- 2 Use the *item selectors* to scroll to the program you wish to configure a station for.
- 3 Now turn the dial to the **RUN TIME** position. Say you selected program 2 - then the display will look like this:



Note: The PROGRAM position will remain lit, and the RUN TIME position will be blinking, indicating that you are in PROGRAM mode, working on the RUN TIME aspect of the program.

- 4 Use the *item selectors* to select the station you wish to configure and push the ENTER button.

Now the cursor jumps to the right of the display, allowing you to select the station run time.

Tip: Instead of browsing through the list of available stations with the item selectors you can use the STATION button to browse only stations with a defined run time. This comes in handy when modifying run times of an existing program.

Note: The PROGRAM position will remain lit, and the RUN TIME position will be blinking, indicating that you are in PROGRAM mode, working on the RUN TIME aspect of the program.

A couple of notes on run times:

- Run times longer than four minutes are run in ten second blocks and will be rounded up to the nearest block. For instance, run times of 00:04:14 and 00:04:18 will both be rounded to 0:04:20.
 - Run time shorter than four minutes are not rounded.
 - The maximum run time is 17:59:50.
 - You can "delete" a station from a program by simply setting the run time to 0.
- 5 Use the *item selectors* to select the number of minutes you wish the station to run, and push the `ENTER` button to save your setting. Now the controller returns to the main screen for editing the run time. Say you just set station number five to run five minutes in program two, the display will look like this:



Pushing the `CANCEL` button when adjusting the run time will discard the new run time and keep the original one, even if this is zero.

Now you can select other stations and repeat steps four and five to determine how they should run in this program.

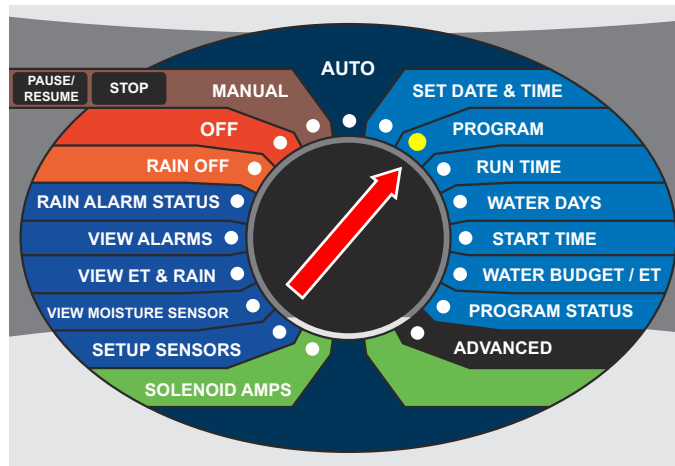
Setting Water Days

There are three ways to determine which days a program will run.

- On all odd dates (1, 3, 5 etc.)
- On all even dates (2, 4, 6 etc.)
- On selected days in a 14 day cycle. You select the days and the NLC will loop through the 14 day schedule.

To make the configuration as intuitive as possible, the 14 day period always starts with the current day.

- 1 Turn the dial to PROGRAM



Now the display will look something like this:



- 2 Use the *item selectors* to navigate to the program you wish to adjust the start times for and turn the dial to the WATER DAYS position.



- 3 Use the *item selectors* to choose between "Odd dates", "Even dates" or "14 day period" and push the ENTER button.

Note: The definition of an "Odd date" does not include the 31st day in a month because this would cause the program to run two days in a row (e.g. May 31 and June 1.) The same goes for February 29 on leap years.

If you select odd or even dates, you are done now, but if you select "14 day period" you need to walk through the next steps as well.

- 4 Assuming that today is a Sunday, the list of days will start with an "S" and a cursor will be blinking ontop of the first "S":

Selecting the water days



- 5 Now you can use the *item selectors* to navigate through the days. The up and down arrows will toggle the selected day to On/Off. Here's how selecting only Mondays, Wednesdays and Fridays would look like:



- 6 Once happy with the selection of days, push the CANCEL button or turn the dial away to go back to the main water days screen. If you choose to turn away the dial, you will see the controller return to the main water budget dialog.

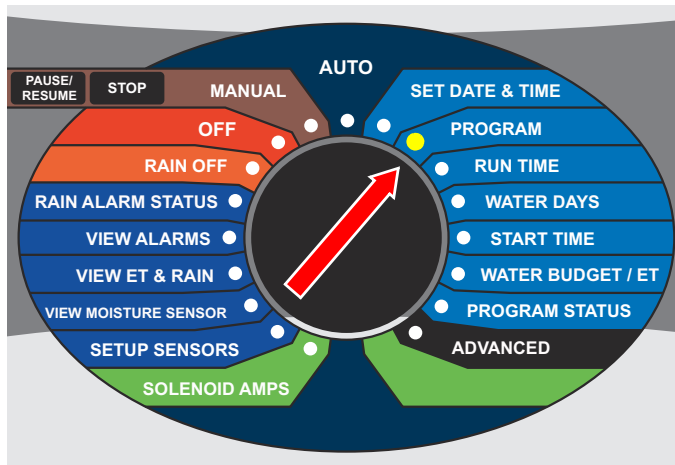
Now you can turn the dial to another position to edit the remaining aspects of the program.

Setting Start Times

Each program in the NLC can run up to 12 times per day.

Note: When you set the first start time for a program the controller automatically sets the program as active. For more information turn to **Chapter 3: Activating/deactivating a Program** on page 37.

- 1 Turn the dial to PROGRAM.



Now the display will look something like this:



- 2 Use the *item selectors* to navigate to the program you wish to adjust the start times for and turn the dial to the *START TIME* position. Now you'll see the following display:



Note: If you are using the misting feature of NLC you will also see *Cyc* and *End* fields:



Misting allows you to determine a more complex irrigation scheme where each start time is repeated a number of times within a specified time frame. For more information turn to **Appendix H: Advanced irrigation: Misting, Cycle and Soak** on page 167.

- 3 Use the *item selectors* to locate the one of the 12 runs you wish to set a start time for, and push the **ENTER** button. Now the cursor will jump to the right, letting you set the start time:



- 4 Use the *item selectors* to select the start time and push the **ENTER** button.

Tip: If you push the up and down arrow at the same time in this field, you will delete the current start time all together.

- 5 Now the controller will return to the default display for setting start times, and you can repeat steps two and three for all the start times you wish to set.

Note: Your start times will be sorted by start time - if the second start time you enter is before the first one, they will be swapped around next time you browse the list.

Also, if you select another number for your start than the next chronologically available one, the NLC will save your start with the next chronologically available number anyway.

This means that if you have two starts assigned and assign a third one but to the "6" run slot, this will be saved as start 3 and appear as such the next time you want to edit the program.

In short, you can say that your start times are sorted by time and their numbers "compressed" chronologically.

Adjusting Water Usage (Water Budget or ET)

There are two ways of determining how to adjust the amount of water used by an irrigation program:

- Setting the "Water Budget" to a value between 0 and 250 percent.

Just as you would expect, this determines how much water is used. However, since the controller simply tells a station to start or stop, the water budget doesn't control the water flow as such, but instead it determines the run time.

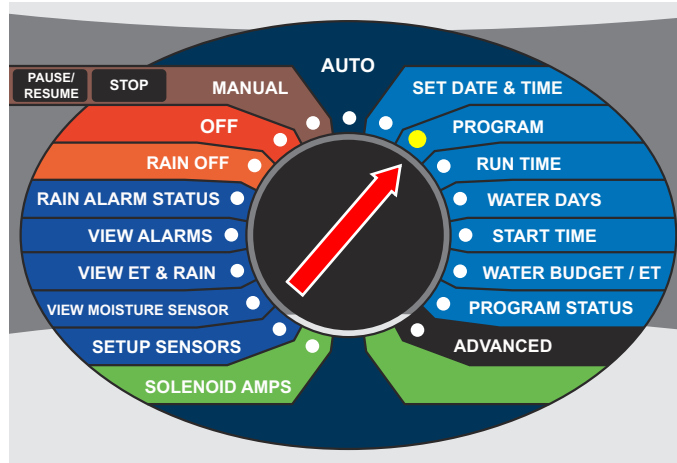
This means that if you have set up a program to run five stations for 10 minutes each, this is what will happen with the water budget set to 100 percent. But if you decrease the water budget to 80 percent, each station will only run eight minutes, and if you set the water budget to 120 percent, each station will run for 12 minutes.

Note: If the water budget is zero, the station will not run at all.

- Letting ET adjustment decide how the irrigation should be carried out. This way you tell the NLC how much water you want the program to provide per day, and then the controller will adjust for any ET and Rain input it receives. For more information turn to **Appendix B: Adding an ET Device** on page **87**.

The following two procedures walk you through configuring a program for each of the two options.

- 1 Turn the dial to PROGRAM



Now the display will look something like this:



- 2 Use the *item selectors* to navigate to the program you wish to adjust the water budget for and turn the dial to the **ET** position.

Now you'll see the following display:



Note: Please see the note below, "On switching between Water Budget and ET adjustment" on page 37.

- 3 Use the *item selectors* to choose "Water Budget" and push the Water Budget button. Now you'll see the following screen:

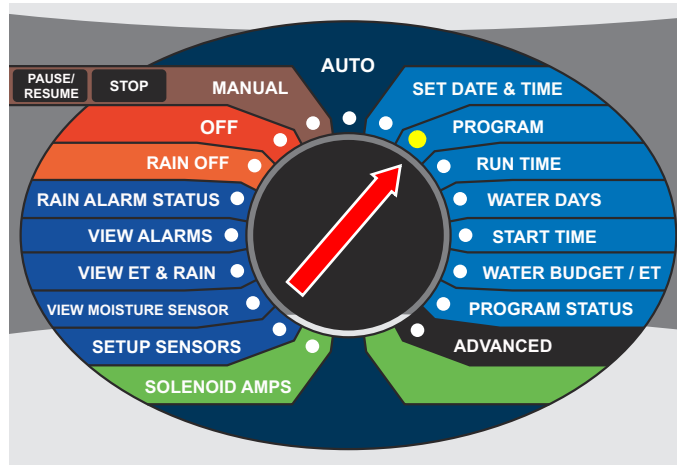


- 4 Use the *item selectors* to set the appropriate water budget and push the ENTER button to save the setting and exit.

Note: Adjusting the water budget is an easy way to accommodate shifting weather conditions without having to reconfigure all programs to apply more or less water. Just increase or decrease the water budget as needed, and the

Adjusting the ET (Water budget)

- 1 Turn the dial to PROGRAM



Now the display will look something like this:



- 2 Use the *item selectors* to navigate to the program you wish to adjust the water budget for and turn the dial to the WATER BUDGET / ET position.



- 3 Use the *item selectors* to choose "ET" and push the ENTER button. Now you'll see the following display:



Note: Please see the note below, [On switching between Water Budget and ET adjustment](#)

- 4 If you want the program to run before it has received an ET budget from the controller, you can provide one manually that will then be used as the starting point. After that, any ET figure that is received will be added to what you already entered - thus you can also use this feature to do a one-time adjustment of the ET. For more information turn to **Appendix B: How ET Works with the NLC** on page **87**.

Use the *item selectors* to set your desired ET budget for today.

- 5 Push the `ENTER` button to save your setting.
- 6 Programs that use ET adjustment instead of Water Budget adjustment will display the ET value instead of the Water Budget value in `PROGRAM` mode:

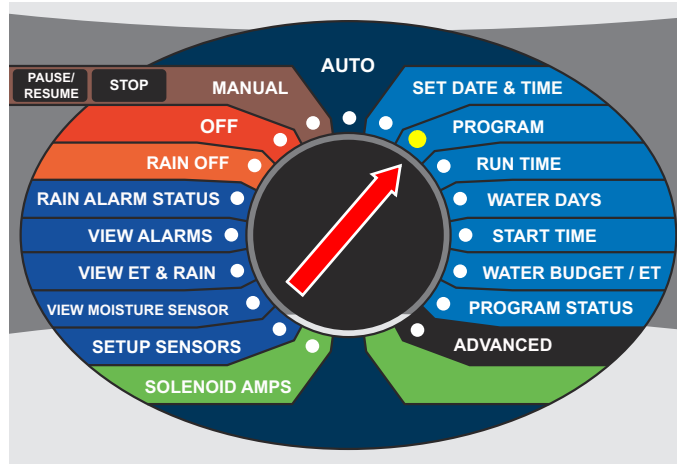
On switching between Water Budget and ET adjustment

If you have previously set a program to be adjusted by either Water Budget or ET, choosing the opposite setting will generate one of two warnings:



Activating/deactivating a Program

You can toggle the Active/Passive status of each of the 10 programs - only active programs are actually run. By default, newly created programs are set to Active as soon as you assign the first start time to them.



To toggle a program between Active and Passive:

- 1 Turn the dial to PROGRAM

Now the display will look something like this:



- 2 Use the *item selectors* to select the program you wish to toggle active or passive and turn the dial to the PROGRAM STATUS position:

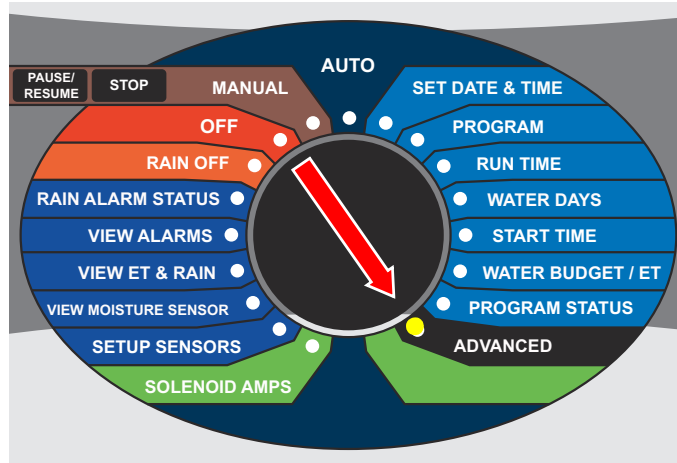


- 3 Use the *item selectors* to toggle between Active and Passive mode and push the ACTIVE/PASSIVE to save your selection and exit to the main display for Program mode.

Note: Making a program passive does not erase the program. In fact, a passive program can still be run manually. For more information turn to [Chapter 4: Running NLC in Manual Mode on page 51](#) and [Chapter 4: Running Extra Programs in Auto Mode on page 49](#).

The NLC lets you configure two stations to activate booster pumps, and each irrigation program can have one of these booster pumps associated. Here's how you assign a booster pump to a program:

- 1 Turn the dial to ADVANCED



Now the display looks like this:



- 2 Select 6. Booster to Program Assignment and push the ENTER button.
- 3 Use the *item selectors* to select one of the 10 programs and push the ENTER button.
- 4 Now use the *item selectors* to select between "Non", "BO1" or "BO2":



- 5 Once done, push the **ENTER** button to save the setting.
- 6 Now you can repeat steps three and four for to assign booster pumps to more programs, or push the **CANCEL** button to return to the main display for Advanced mode.

Adding a Master Valve (Supply Pump)

You might want to have the NLC control the opening of your supply pump when irrigation is active, and shut it down when irrigation is over.

Note: A station can not run a pump on its own - you must attach a relay connected to an external power source and the station will then activate the relay.

Testing a Program

After setting up your programs, you might want to test them without having to wait around for all of them to actually run.

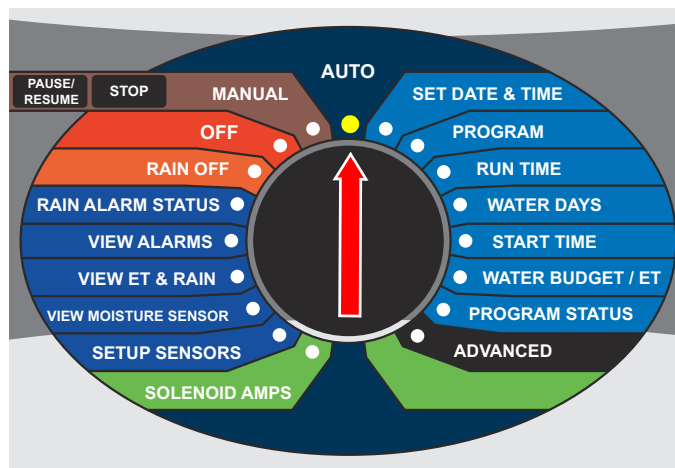
Since this is the same approach as you would take in a troubleshooting scenario, please refer to the separate Installation and troubleshooting manual.

Chapter 4: Running the NLC

Day to day usage of the NLC is pretty simple - the whole point of having a system like this is to automate the irrigation, so little or no intervention will be needed once your system is up and running.

Running NLC in Auto Mode

Once your system is configured, turn the dial to the **AUTO** position:

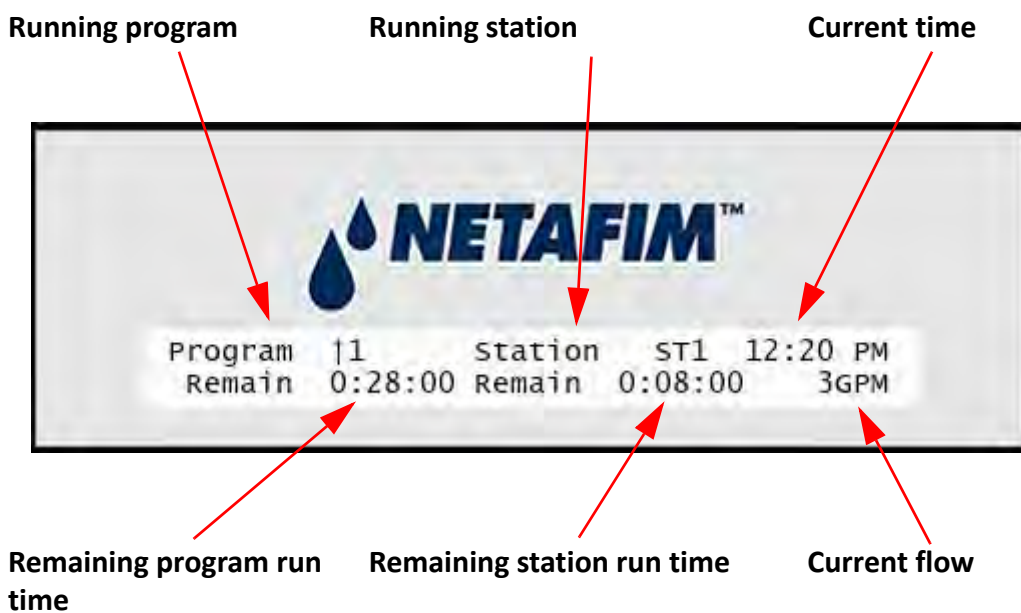


Now the display will tell you which program will run next:



In this case the next program that will run is number one. It has two stations and will run on Tuesday at 09:44 PM for 40 minutes.

You don't have to do anything more - just leave the controller in **AUTO** mode and the program will be run automatically. Once the program starts, the display will tell you what station is running, and the remaining run time for both the running station and the entire program:



Once this program has finished, the next one in line will appear in the display.

Up to 10 programs can run in parallel (only 4 programs per connect bord on NLC-H and NLC-S).

Tip: You can always get an overview of running programs and stations by using the item selectors: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

Pausing a Running Program

From time to time it may be necessary to pause the irrigation. Here's how you put a running program on hold:

- 1 Use the *item selectors* to locate the program you wish to pause, and push the PAUSE/RESUME button.

The response from the controller will vary depending on the status of the program and the number of programs running:

If the program you select is the only one running you'll see this display:



If the program you select is one of several running programs you'll see this display:



If the program you select is not running but other programs are, you'll see this display:



- 2 Push the button that suits your intentions (PAUSE/RESUME or PROGRAM) and the controller will pause the program(s) and return to the list of programs:



Once you're ready to resume the program, follow this procedure:

Resuming a paused program

- 1 Use the *item selectors* to locate the program you wish to resume, and push the PAUSE/RESUME button.

Depending on whether one or more programs are paused you'll see different displays, according to what you did when you paused the program(s).

- 2 Push the button you need according to the instructions in the display.
- 3 When the program(s) resume(s), the display will look as if the program(s) had just kept running.

Note: The last ten seconds of a program might be re-run, so each pause/resume will potentially add ten seconds to the total run time for that program.

Running Extra Stations in Auto Mode

When the NLC is running in auto mode you have the option of manually starting additional stations simultaneously. This can come in handy if a certain part of the terrain needs a little extra watering but you don't want to reconfigure a program for just one time's sake.

Note: The NLC supports up to 12 simultaneously running stations. This means that if for instance two programs are running, you can start ten more stations manually.

Running a station manually

- 1 Push the `STATION` button and the following display appears:



- 2 Use the *item selectors* to select the station you wish to activate. If you're happy with the suggested run time, push the **ENTER** button. Otherwise push the right arrow of the *item selectors* to move the cursor to the right to adjust the run time and then push the **ENTER** button. Now the station will start running immediately:



You can use the *item selectors* to browse through the list of running stations and programs from this display.

If you want to run more stations manually, just go through this procedure again for each station you want to activate.

To stop a manually started station before the end of its run time, use the *item selectors* to locate it and push the **STOP** button.

Note: You can always get an overview of running programs and stations by using the item selectors: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

Running Extra Programs in Auto Mode

When the NLC is running in auto mode you have the option of manually starting additional programs in parallel.

Note: If you select programs that try to start the same station in overlapping periods, the station will start when the first program asks for it and stop when the last program doesn't need it any more.

So, if program 1 wants to run station 12 from 08:00 to 08:10 and program 2 wants to run that same station from 08:05 to 08:15, the station will be run from 08:00 to 08:15.

Running a program manually has the advantage that you can select which station should be run first, allowing you to skip a part of the program.

- 1 Push the PROGRAM button.

Now there will be an arrow next to the program number, indicating that you should select the program you wish to run:



- 2 Use the *item selectors* to pick the desired program and push the right arrow in the *item selectors* to move on to select which station should be the first to run:



- 3 Use the *item selectors* to select the station you wish to start with, and push the ENTER button. Now the controller will run the selected program, keeping you informed of the status of the program:



You can browse through the status of running programs with the *item selectors*.

If you want to run more programs manually, just go through this procedure again for each program you want to activate.

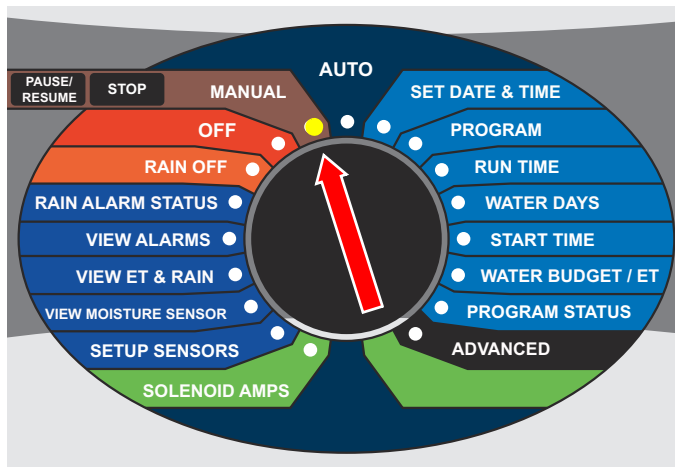
To stop a manually started program before the end of its run time, use the *item selectors* to locate it and push the `STOP` button.

Note: You can always get an overview of running programs and stations by using the item selectors: Use the left/right arrows to select between programs and stations and the up/down arrows to browse through the items (programs or stations).

Running NLC in Manual Mode

The NLC allows you to run all programs and stations manually only - not obeying the schedules for the 10 programs. To enable this feature, turn the dial to the `MANUAL` position:

Note: Please check the setting of the "Revert to auto" feature before working in manual mode. For more information turn to **Chapter 5: Feature Manager** on page 70.



Now the controller is ready to run programs or stations manually, and you're prompted to select one of the two:



From here on, the procedure for running stations is identical to Running a station manually. For more information turn to **Chapter 4: Running a station manually** on page 47.

Tip: You can manually run programs and stations simultaneously.

Alarms

When running in `AUTO` or `MANUAL` mode, the NLC will react on a number of conditions by raising one or more alarms.

Note: Though some alarms, like a rain alarm, can halt the execution of irrigation schedules, you can always start both stations and programs manually, even when there is an active alarm. Two exceptions: if a short alarm is active, you can not start anything, and if a station is failing you can not start this manually.

Becoming aware of alarms on-site

If the NLC has received an alarm, and is in `AUTO` or `MANUAL` mode (For more information turn to **Chapter 4: Running the NLC** on page **43**), the bottom row of the display will toggle between normal text and the alarm that has arrived.

For example, if you had a rain alarm at 01:10 PM, your display will toggle between normal mode and alarm notification:



The display will toggle between the two modes in short intervals.

If you had multiple alarms the controller will toggle to a different alarm each time it toggles to notification.

Note: If you had more than three alarms the fourth message in the bottom row of the display will say that you should visit the alarm list for details - the display will look something like this:



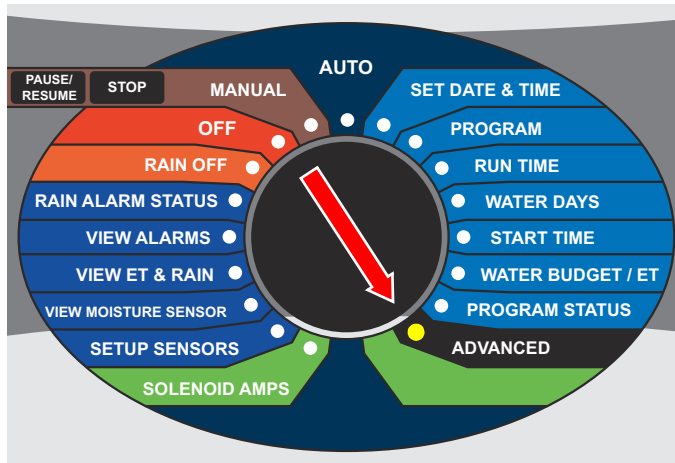
Receiving alarm notifications on email

If your communication subscription with your supplier allows it, the NLC will support sending out alarm notifications to one or more email addresses.

Note: This requires the WIN-100 or LAN-200 module.

To configure your controller to email alarms, follow this procedure:

- 1 Turn the dial to `ADVANCED`



Now the display looks like this:



- 2 Scroll down to Alarm Notification and press the ENTER button. Now you see the following display:



- 3 Select `Email addresses` and press the `ENTER` button. If no email addresses are entered, you can select `Add new`:



Now you can enter an email address using the up/down arrow keys to select the characters. Once you are done, press the `ENTER` button.

- 4 Next you configure which alarms should be emailed. Select `Alarm Notification settings` and press the `ENTER` button. Now you see the following display:



Here you can scroll between the different alarms emitted by the controller.

- 5 Select the alarm you wish to configure and press the `ENTER` button. Now you see the following display:



You can select each email address you have entered, and determine if you want an email when this type of alarm is raised and/or when it is recalled.

- 6 Select the email you wish to configure for the current alarm and press the **ENTER** button. Use the arrow keys to set On and Off to either Yes or No - see the explanation table below:

Setting	Selection	Meaning
On	Yes	Send email when the alarm is raised
	No	No email when the alarm is raised
Off	Yes	Send email when the alarm is recalled
	No	No email when the alarm is recalled

Viewing the alarm list

To view the list of alarms in the NLC, follow this procedure:

- 1 Turn the dial to the **VIEW ALARMS** position. Now you'll see a scrollable list of the different types of alarms known to the NLC:



In this case there is no **Off** time for the alarm, meaning that the alarm is still on. Had the alarm ceased you would see the end time too.

Use the *item selectors* to scroll through the list. The list contains information on the latest observed alarms of the 12 known alarm types:

Note: The alarm list will not survive a power failure - if the controller loses power, the list is wiped clean.

Alarms in the NLC

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
1. Rain	Rain alarm.	Will automatically disappear when it stops raining.
2. Alarm	Whatever alarm you have attached to the alarm terminal. If you're using the AUX terminal for a flow sensor, you won't ever see this alarm.	The alarm stays on as long as the attached alarm is active, but you can clear it by viewing the alarm list.
3. ET	Evapotranspiration alarm. This will only ever be raised if you're running in "ET-enabled" mode. For more information turn to Appendix B: How ET Works with the NLC on page 87 .	Will automatically disappear when the "ET enable" device is no longer controlling your irrigation.

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
4. Short	<p>Short alarm.</p> <p style="text-align: center;">Note</p> <p>A short alarm may really be a "Broken Fuse" alarm or a general "Overload" alarm - it need not be a true short in your system.</p> <p>Overload is defined as a current of more than 2A for more than five minutes.</p> <p>If you enable current readings, you will get a "FUSE" message in the display if a fuse is blown out.</p> <p>You may also run the electrical test for a specific station and get a definite answer to whether there is an overload situation of a blown fuse in that station.</p>	<p>The alarm stays on as long as there is a short in your system. You can clear the notification by viewing the alarm list.</p>
5. High F	High flow alarm	<p>The alarm stays on as long as the flow is too high. You can clear the notification by viewing the alarm list.</p>
6. MPF	Main pump failure	<p>The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.</p>

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
7. USch F	<p>Unscheduled flow alarm. This means that water is flowing in your pipes when you're not irrigating. Such an alarm indicates that you have a leak.</p>	<p>Stays on as long as the flow is too high. The normally open master valve (NOM) will be activated, so the alarm will clear itself, but you can clear the notification by viewing the alarm list.</p>
8. St. Err	<p>Station error alarm. This means that one or more stations in the field have failed, and will only be raised if you are using a flow sensor.</p> <p style="text-align: center;">Note</p> <p>This alarm only concerns flow related problems - not any electrical errors that may occur in a station.</p>	<p>Stays on until all stations are labeled OK (For more information turn to Appendix C: Inspecting and Toggling Station Status on page 126). You can clear the notification by viewing the alarm list.</p>
9. Max St.	<p>Maximum number of stations reached. This means that a program tried to start a station when the maximum number of stations was already running.</p>	<p>The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.</p>

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
10. Repeat.	The number of repeats has been reduced in a misting program. This typically happens if ET expands the run time for repeats and the program can't fit all the repeats into the configured time frame. For more information turn to Appendix H: Advanced irrigation: Misting, Cycle and Soak on page 167.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
11. NW Prg.	A program has not been run because it was set to start in the non-water time window. For more information turn to Appendix G: Defining a custom irrigation period on page 163.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
12. NW Stp.	A program was halted because it was running when entering the non-water time window. For more information turn to Appendix G: Defining a custom irrigation period on page 163.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.
13. Mst NR.	There is no response from your moisture sensors.	Stays on until the sensors are all responding.
14. Mst Lv.	One or more of your moisture sensors is reporting a moisture level below the alarm threshold.	Stays on until the moisture level is above the threshold.

Short name in display (Alarm type)	Full name / Description	How to clear alarm (see note below)
15. Rem ET	Your controller is not receiving ET data from the remote ET server.	The alarm will be cleared once you have viewed the alarm list and acknowledged the alarm.

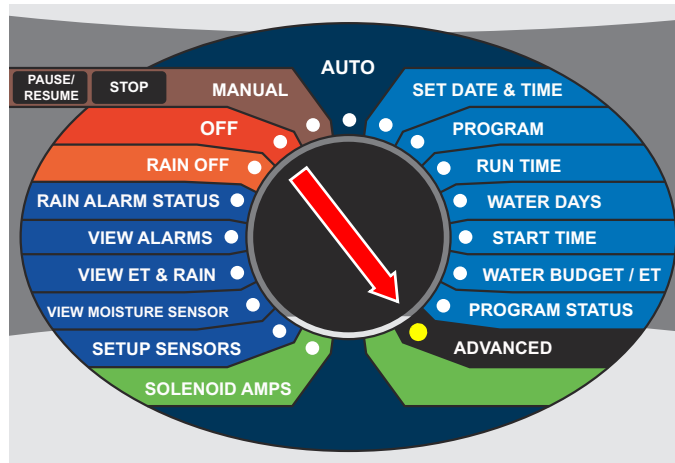
- 2 When you have viewed the list of alarms you will no longer be notified in the display about past alarms. Of course you can always revisit the list.

Monitor Data

If your communication subscription allows, you can enable the controller to send monitor data to your Web interface.

To enable relaying monitor data to your Web interface, follow this procedure:

- 1 Turn the dial to `ADVANCED`



Now the display looks like this:



- 2 Use the arrow keys to select Monitor Data and press the ENTER button. Now you see the following display:



3 Select enable/Disable mon events.

Now you get a list of all the events that can trigger monitor data. For each of these you can select them using the ENTER button and enable/disable them:

- Programs
- Stations
- Daily Water Usage
- Hourly Water Usage
- System Mode Change
- Alarms & Rain Shutdown
- Installation Data Change
- Program Data Change
- Moisture
- Clock Changed
- Water Window
- Daily ET and Rain
- Daily Assigned Program ET
- Hourly Rain

- 4 Finally you can configure how often the controller should poll the board for problems. From the main `Monitor Data` menu select `Board surv log interval` and you will see the following display:



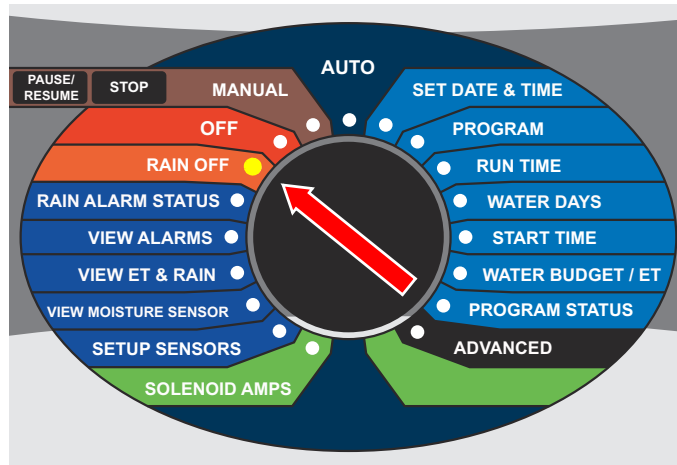
- 5 Select your desired interval and press the `ENTER` button.

Rain Shutdown

Despite all the features controlling irrigation in your NLC you still have a manual handle to pull if you want to halt irrigation immediately - typically if heavy rain sets in.

To halt all irrigation immediately, simply turn the dial to `RAIN OFF`:

Note: The rain shutdown can be enabled for 999 hours.



You will be prompted to enter the number of hours you wish to halt irrigation. Use the *item selectors* to enter the number of hours and press the `ENTER` button to start the shutdown.

To end the shutdown, push the `CANCEL` button.

Chapter 5: Advanced Features

Intellisets

With the Intellisets feature set you can allow external evapotranspiration (ET) devices to control your irrigation.

Intellisets comes in a couple of flavors:

- Simple ET which allows a WR7 Receiver to tell the NLC if it should irrigate today or not.
- Complex ET control based on historical ET data: you enter the historical ET correction figures for the entire year and use these to adjust your irrigation throughout the year. You can also use the historical data as a fall-back mechanism for a connected weather station.
- Complex ET control which allows the NLC to adjust the irrigation level based on ET data from a weather station - exact amount of rain and environmental conditions.
- Complex ET control based on remote ET data received from a central ET server.

All methods ensure more efficient water consumption than you would see from using a "flat" irrigation scheme throughout the year.

In addition the NLC provides two extra sources of information about irrigation needs:

- Moisture sensors that will tell you exactly how moist your soil is, giving you the best evidence of how much irrigation is needed.
- "Extended rain shutdown" - a feature that will halt all irrigation after a rain alarm has occurred, regardless of what your ET tells you about irrigation needs.
- For more information turn to **Appendix B: Adding an ET Device** on page **87**.

FloGuard

FloGuard is the NLC safety system that constantly monitors the controller for potential problems and raises alarms when needed.

FloGuard will detect things like pipe leaks, faulty stations, malfunctioning pumps and many other things that could otherwise go unnoticed and damage your system.

You will also get notifications of "normal" alarms like rain alarms, ET input, short circuits and any alarms stemming from your own auxiliary input devices.

Note: FloGuard requires a flow meter to be connected.

FloStack

The FloStack feature set helps you plan and control the flow in your system.

By entering an expected flow for each station and a maximum system flow capacity you can ensure that the NLC will not try to start more valves than the system can feed.

An extremely handy feature is the "Learn Flow" feature that automatically detects the flow of each station by running all stations in turn and comparing with measurements from a flow sensor.

You can read about FloStack in For more information turn to **Appendix C: Adding a flow sensor** on page **109**.

Feature Manager

The Feature Manager lets you enable a few extra features that not all users will need, most notably the Mist Manager.

With the Mist Manager you can add an extra perspective on running irrigation schedules. Instead of a program just running one station at a time for a fixed

duration, you can break each run into multiple cycles.

Instead of telling the NLC to run a number of stations for three minutes each, you can tell it to run each station in 18 second time slices 10 times with breaks in between. This adds up to the same water consumption, but allows the irrigation to soak in between the cycles.

Irrigation cycles that are measured in seconds are typically referred to as "misting", whereas cycles that are measured in minutes are referred to as "Cycle & Soak".

You can read all about the Feature Manager in For more information turn to **Appendix H: Advanced irrigation: Misting, Cycle and Soak** on page **167**.

Another feature is "Revert to auto", which will pull your controller back into auto mode, when it has been sitting in other modes for 10 minutes. This ensures that irrigation will always be resumed, even if someone leaves the controller hanging in a random menu item.

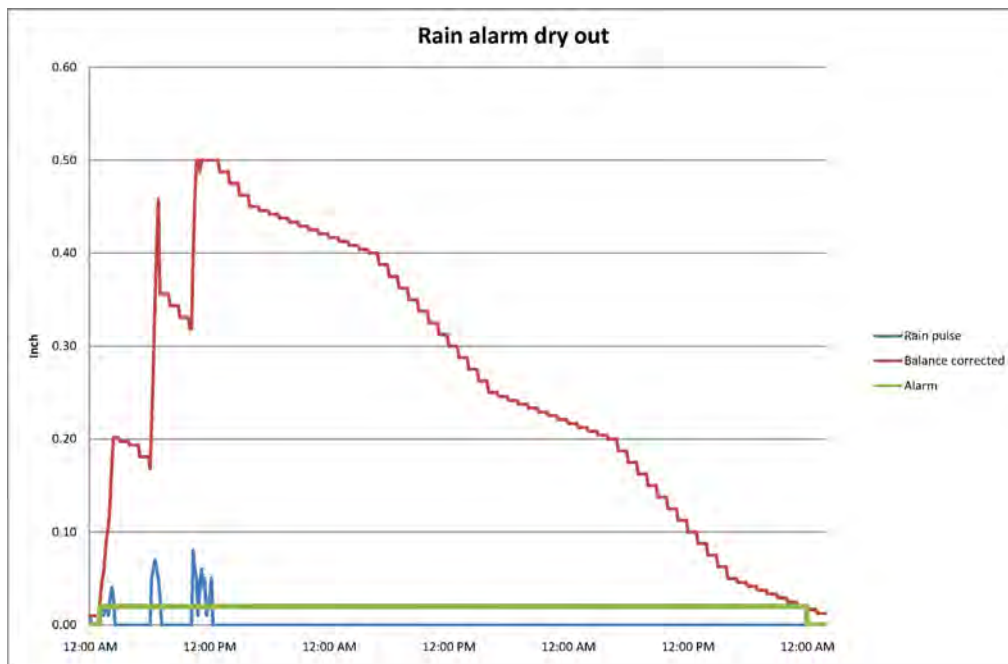
Note: The controller will not revert to auto if in "Irrigation off" or "Extended rain shutdown". Also, when performing a short finding, the time limit is not 10 minutes but three hours. This feature is enabled by default.

Appendix A: How Amount Based Rain Alarms Work

The following examples show how the amount based rain alarm works. In all the examples the usable rain is 0.86".

Example A.1

Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.20" (standard)	0.20"	0.50"	0.02"

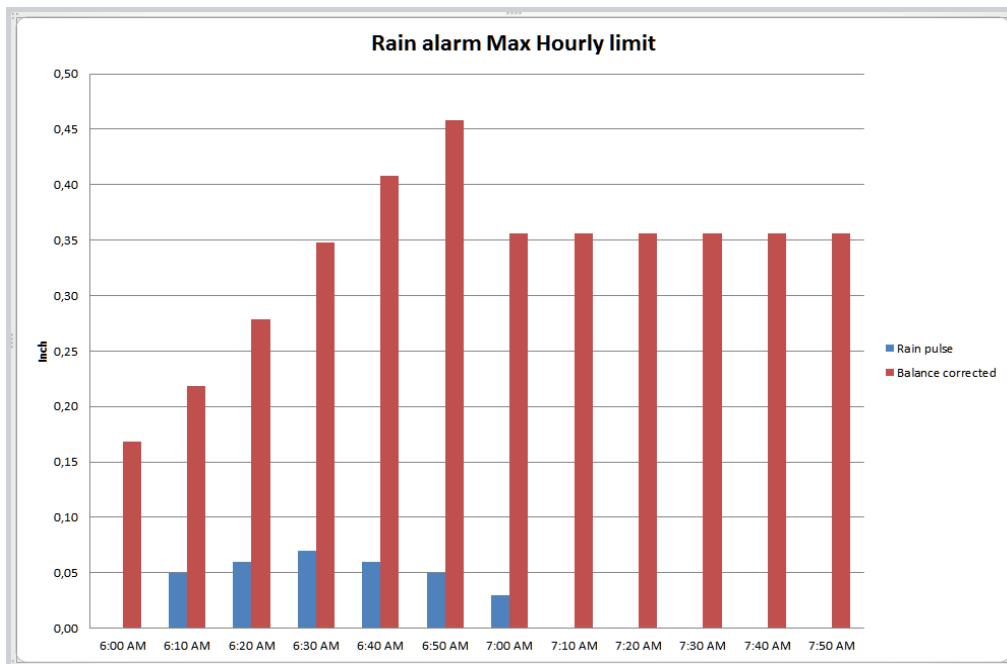


The graphs show the rain built up the balance whenever it rains. Every hour the balance is reduced by a fraction of the Daily ET ($\frac{1}{4}$ during the night and $\frac{3}{4}$ during the day). When the balance reaches the Rain alarm limit the rain alarm will go on/off.

The second rain burst shows a situation where the max hour rain limits makes limitations. More details below.

The third rain burst shows that we hit the soil holding and by that limit the balance.

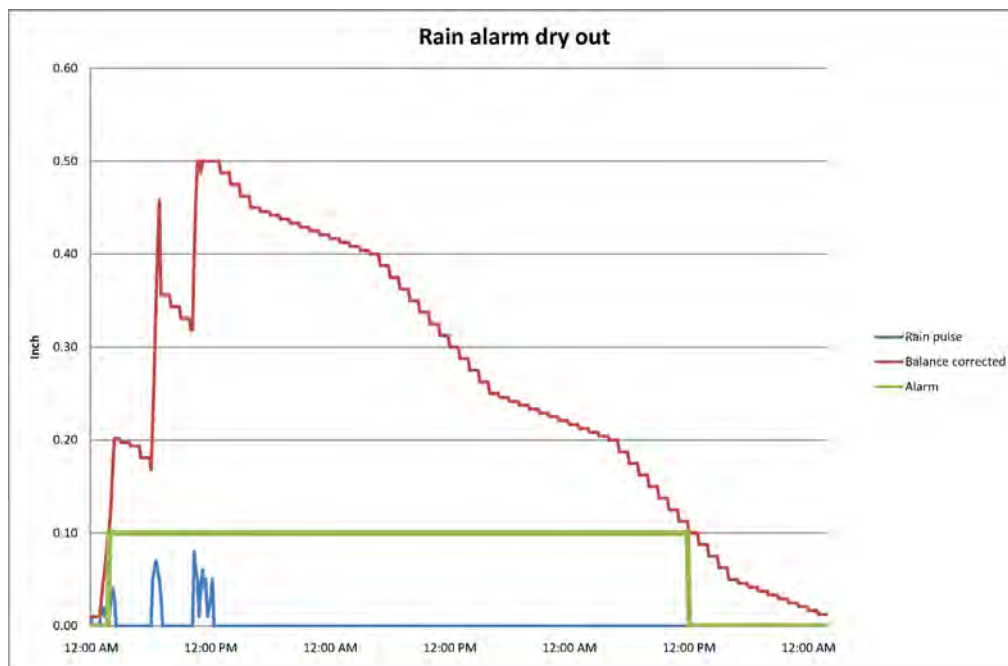
Note: The graph spans three full days.



This graph shows how the balance grows minute by minute. At each whole hour the balance is corrected for max hourly rain and for the hourly dry out. In this case the hour between 7 AM and 7 AM has too much rain compared to max hourly rain and the balance is reduced.

Example A.2.

Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.20" (standard)	0.20"	0.50"	0.10"

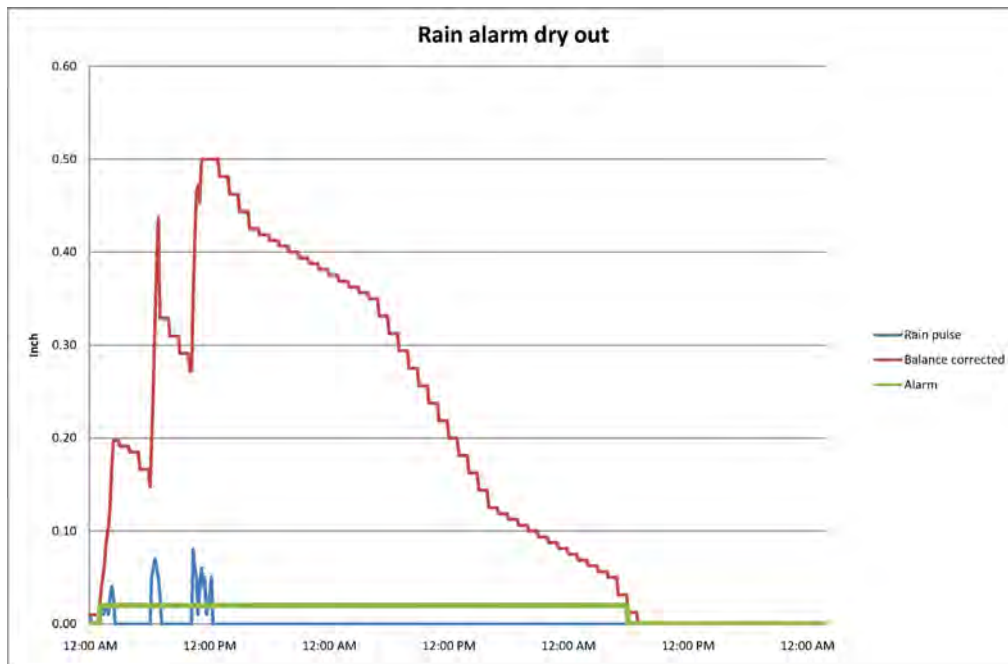


In this graph we see the same as in example 1 except that the rain alarm goes on later and off earlier.

Note: The graph spans three full days.

Example A.3.

Daily ET	Max. hourly rain	Soil holding	Rain alarm limit
0.30" (standard)	0.20"	0.50"	0.02"



This shows a more dry condition with higher ET than standard. The alarm period is then shorter.

Note: The graph spans three full days.

Configuring the Extended Rain Shutdown Feature

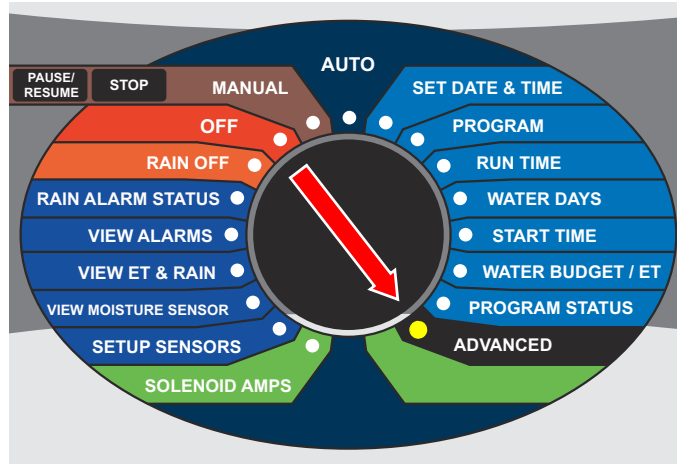
Given enough rain, at some point the NLC will halt irrigation (based on the values you have set in Section A.1. However, there is a way to further refine this feature by defining:

- How many hours the rain alarm must be active before an extended rain shutdown will actually occur.
- If the extended rain shutdown should be longer than the duration of the rain alarm.
- For how long the extended rain shutdown can last.

Note: The Extended Rain Alarm behaves exactly as if you turned the dial to `RAIN OFF` (For more information turn to **Chapter 4: Rain Shutdown on page 67**).

First you must enable the extended rain shutdown feature set:

- 1 Turn the dial to `ADVANCED`



Now the display looks like this:



2 Select 8. Feature Manager. Now you will see the following:



- 3 Select 2. Ena/Dis Extended Rain Alarm. Now you will see the following:



- 4 Select `Enable` and push the `ENTER` button to save.

Now you are ready to actually configure the extended rain shutdown parameters:

- 1 Use the *item selectors* to select 3. `Intellisat` and push the `ENTER` button. Now you'll see the following screen:



- 2 Select 3. Extended Rain Alarm. Now you see the following screen:



Important

Note:

Note: You will only see this menu item if you enabled the feature as described in the previous procedure.

The three values you must set here are:

Setting	Description
Minimum Rain Duration	For how long must the rain alarm have been active before an extended rain shutdown takes place.
Adjustment	You can use this value to prolong the duration of the rain shutdown. If the rain alarm has been active for an hour and you set the adjustment to 3.0, the shutdown will last three hours.
Max. Shutdown	How many hours can the rain shutdown be kept up. Value is between 0 and 999 hours.

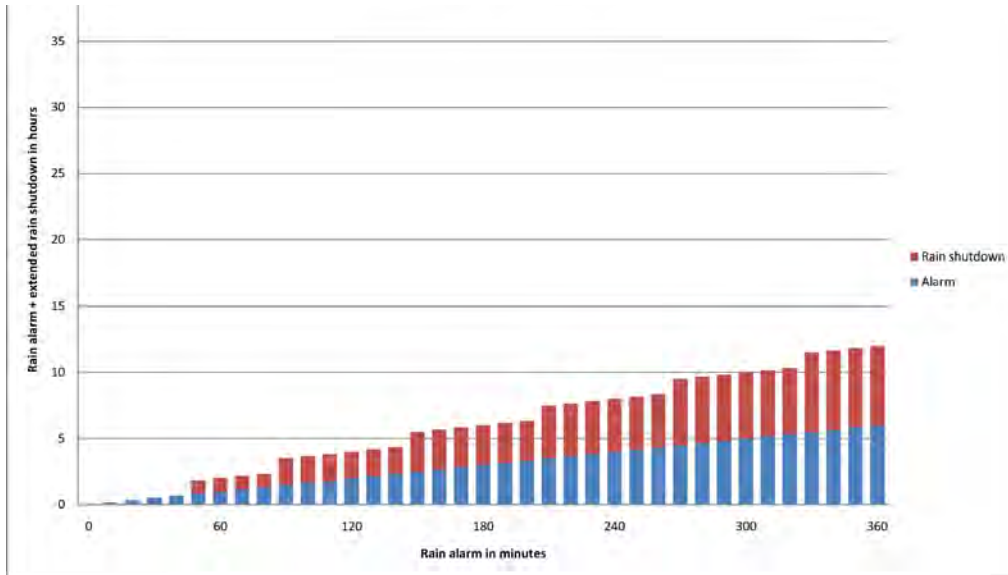
Examples using Different Parameters

The following examples show how the extended rain shutdown feature works on different parameters. It is important to notice that using the amount based rain alarm feature in the NLC (For more information turn to **Appendix A: How Amount Based Rain Alarms Work** on page 73) utilize the normal ET to simulate a dry out, which means the rain alarm will stay on as long time as the applied rain will last in respect to ET. Normally it will not be necessary to extend the rain alarm in these cases. If a rain contact is used without any dry out mechanism the extended rain shutdown is an excellent feature to avoid irrigation for a period after rainfall.

Example A.4.

Rain min. duration	Adjust factor	Max shutdown
45 minutes	1 (1:1)	999 hours

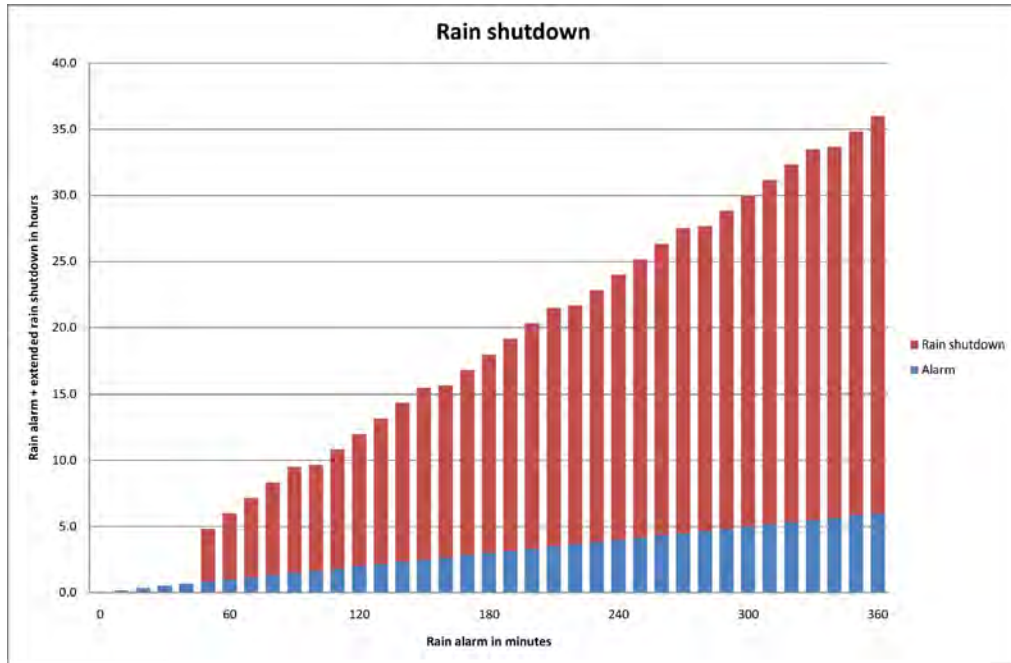
Note: Setting a value to zero is the same as disabling the feature.



The graph shows how the extended rain shutdown extends the rain alarm. The rain itself is of course 1 hour for 60 minutes, but the extended rain shutdown on top of that varies depending on the parameters. In this case the factor is one so 60 minutes rain alarm gives an extension with one hour rain shutdown. Note that the first 45 minutes don't have extensions due to the Rain Min Duration.

Example A.5

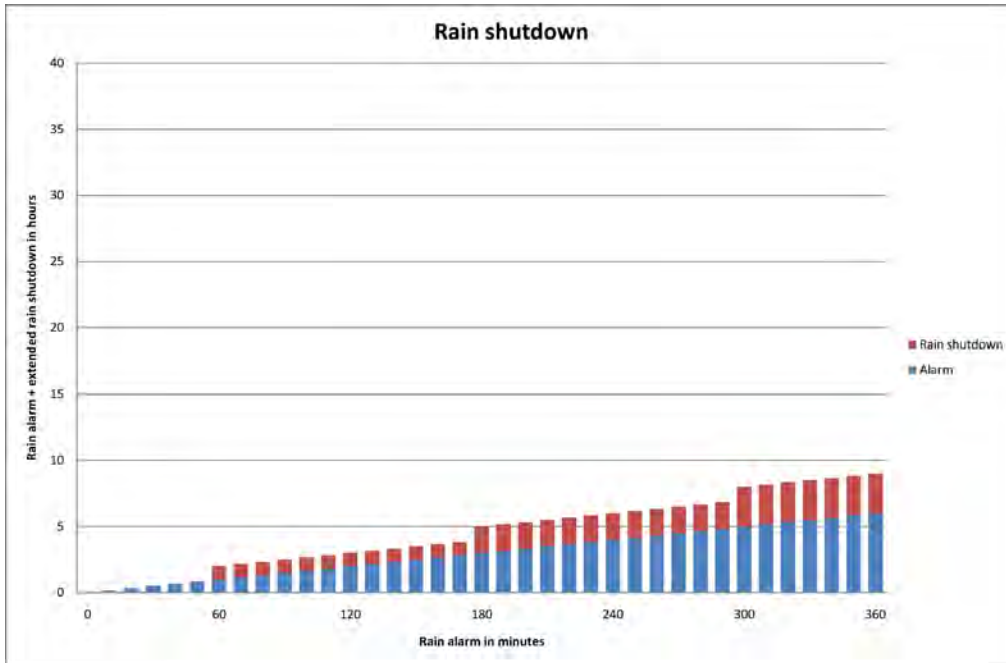
Rain min. duration	Adjust factor	Max shutdown
45 minutes	5	999 hours



In this example the adjust factor extend each rain alarm hour with 5 hours rain shut down. So 6 hours rain alarm with prevent irrigation for 6+30=36 hours.

Example A.6

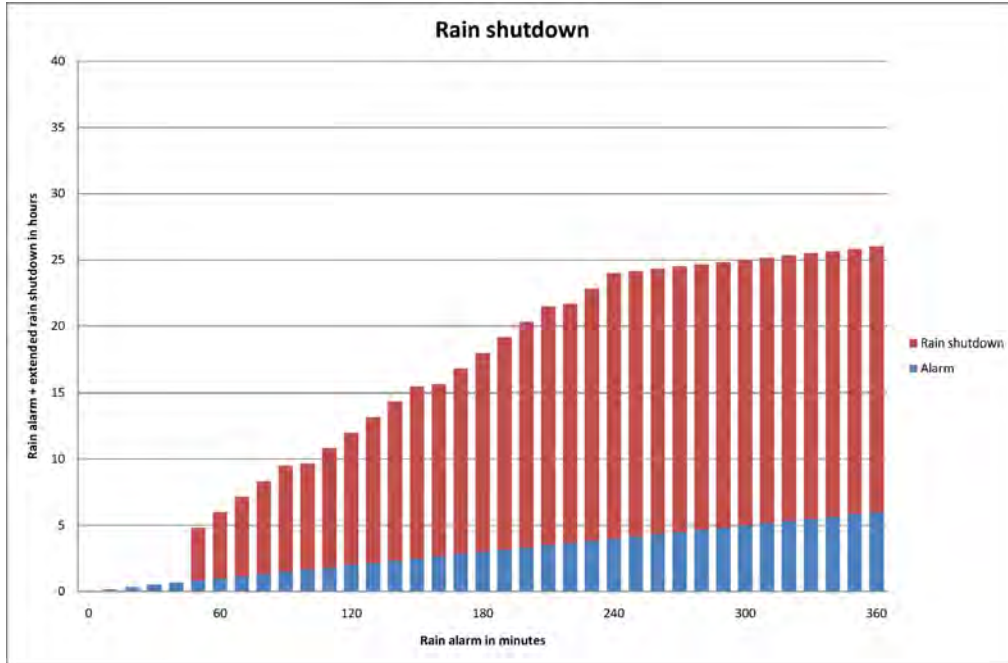
Rain min. duration	Adjust factor	Max shutdown
45 minutes	0.5	999 hours



In this example the factor is 0.5 and thus the rain shutdown extension is only half of the rain alarm.

Example A.7

Rain min. duration	Adjust factor	Max shutdown
45 minutes	5	20 hours



This example has the same factor as example 2, but the max shutdown limits the rain shutdown extension in the case of long rain alarm periods.

Appendix B: Adding an ET Device

Evapotranspiration (ET) devices can help the NLC adjust irrigation based on weather conditions. You can either let an ET device provide daily input on how the irrigation should be adjusted, or you can enter historic ET data on how the weather usually behaves throughout the year and the controller will adjust its irrigation accordingly.

Note: Historical ET data acts as "fall back" data for the controller if the communication with a connected weather station should fail. Thus, you should enter historical ET data even if you are using a weather stations.

How ET Works with the NLC

The NLC will receive ET data from an external weather station or from a historical ET report describing the evaporation throughout the year. Combining this data with the input from a rain sensor or a tipping rain bucket, and the expected level of irrigation the controller can calculate exactly how much water to use for irrigation.

Here's a rough breakdown of how ET works with the NLC - the items are in no particular order but should all be considered when planning for ET adjusted irrigation:

- The controller needs a number of inputs in order to calculate the ET correction:
- Amount of water that has evaporated and transpired (The ET figure)
- Amount of rain fall (The rain figure)
- How much water the soil can retain (Soil holding)
- How much water is used for irrigation under normal circumstances
- The ET and rain figures are provided by a weather station and a rain

sensor - the rest is entered by you at the controller (if you use historical ET data, this is entered at the controller as well).

- Every day at midnight the controller adds up the ET and rain input it has received and calculates how to adjust tomorrow's "ET Budget" - the amount of water that the irrigation should provide.

Note: If you use a custom irrigation period, this happens at the start of your irrigation period, which might not be midnight. For more information turn to **Appendix G: Defining a custom irrigation period on page 163.**

Let's look at two examples - one where ET has exceeded the rain fall, and one that works the other way around:

Example B.1. ET calculation with rain shortage

In this example the rain fall has not been able to make up for the ET.

- 0.30" of water was lost due to ET in the last 24 hours.
- 0.20" of rain has fallen in the last 24 hours.
- Your soil holding is set to 0.50".

Now we're short of 0.10" of water since this is the difference between ET and fallen rain. Thus the ET Budget for tomorrow will be adjusted with 0.4".

Since we don't have any excess water, the soil holding value is irrelevant.

Example B.2. ET calculation with excess rain

In this example the relationship is reversed and we have more rain than ET - soil holding is the same.

- 0.30" of water was lost due to ET in the last 24 hours.
- 0.90" of rain has fallen in the last 24 hours.
- Your soil holding is set to 0.50".

You would think that the ET budget for tomorrow should simply be adjusted with -0.6" because the excess rain lets us irrigate 0.6" less. However, since the soil is only capable of holding 0.5" we can not benefit from all of the rain, but only 0.5" of the 0.6". Conclusion: tomorrow's ET budget will be adjusted with -0.5", meaning that we will not need to irrigate at all. Unless, of course, the ET budget is still positive after adjusting with -0.5.

In other words: we can never benefit more from fallen rain than the soil is capable of holding back. So this example will end up with a -0.5" adjustment no matter how much more rain we have had.

- If you don't connect a weather station but let your programs run from historical ET data the controller simply reads the historical data each midnight, subtracts the rain figure and adds the result to the ET budget.

Note: You can still use a tipping rain bucket to measure fallen rain and have this affect the ET correction. Soil holding is still a limiting factor on how much we can benefit from rain fall.

Note: When the NLC looks at the ET budget and has to figure out how long it has to irrigate, it looks at the "ET Base" setting (see Step 4 Page 105 for instructions on how to set this value).

A bit of background is needed to understand how this works:

When the controller is irrigating normally, it is considered to be irrigating at a water budget of 100% (For more information turn to **Chapter 3: Adjusting Water Usage (Water Budget or ET)** on page **31**). In order for the ET figure to make sense to the controller, you need to tell it what the ET figure would be when running at a 100% water budget. So, if the "ET Base" setting¹ is 0.20", and today's ET budget says 0.10", the controller will run at a water budget of 50 percent, meaning that programs will only run 50 percent of their configured run time.

The tricky part is to make your irrigation programs fit into this model. If the "ET Base" setting is 0.20", you have to make sure that all your programs are configured to apply exactly 0.20" every day. So you have to look at the application rate in each zone and adjust run time and number of start times accordingly.

Let's look at an example:

Example B.3. Calculating ET run time

The following formula is used to calculate the run time (values explained in the table below): $(60 \times ET_0 \times K_c) / (Pr \times I_e)$

	Description	Example value
60	A constant value	60
ET ₀	Evapotranspiration base	0.20
K _c	Crop coefficient	0.50
Pr	Precipitation rate from manufacturer's data	0.45
I _e	Irrigation coefficient	0.80

1. We recommend using the highest monthly ET for your area as the base.

Based on the example values above, the run time would be:

$$(60 \times 0.20 \times 0.50) / (0.45 \times 0.80) = 16.7 \text{ minutes.}$$

- It is possible to set a minimum ET value that determines whether irrigation will take place at all (see Step 4 Page 105). There can be several reasons to set a minimum ET value:
- If you only provide an insignificant amount of water, the effect is useless.
- If you have rotating valves, maybe they won't make a complete rotation before their short run time is over, and you'll get uneven irrigation.

But isn't a bit of water better than no water at all? Yes, but take a look at this example to see why setting a minimum ET can be a good idea:

Example B.4. How minimum ET value works

In this example we assume the following circumstances for the program in question:

- Today's ET budget has been adjusted to 0.4".
- The program has four start times.
- The minimum ET value has been set to 0.2" because irrigating less than this gives you an uneven irrigation and has little effect on the turf.

Each of the four start times can irrigate one fourth of the total ET budget, meaning 0.1". Here's how each of the four start times will take place:

Start time #	Action	Explanation
1	No irrigation	The budget is 0.4" and there are four starts left, meaning that each must provide $0.4/4 = 0.1$ " which is below the 0.2" minimum.
2	No irrigation	The budget is 0.4" and there are three starts left, meaning that each must provide $0.4/3 = 0.13$ " which is below the 0.2" minimum.
3	Irrigation	The budget is 0.4" and there are two starts left, meaning that each must provide $0.4/2 = 0.2$ " which equals the 0.2" minimum. Now the 0.2" that the program provided is subtracted from the budget, so the budget is now 0.2".
4	Irrigation	The budget is 0.2" and there is one start left that must provide $0.2/1 = 0.2$ " which equals the 0.2" minimum.

Now the ET minimum value has ensured that we got two useful irrigations instead of four uneven irrigations.

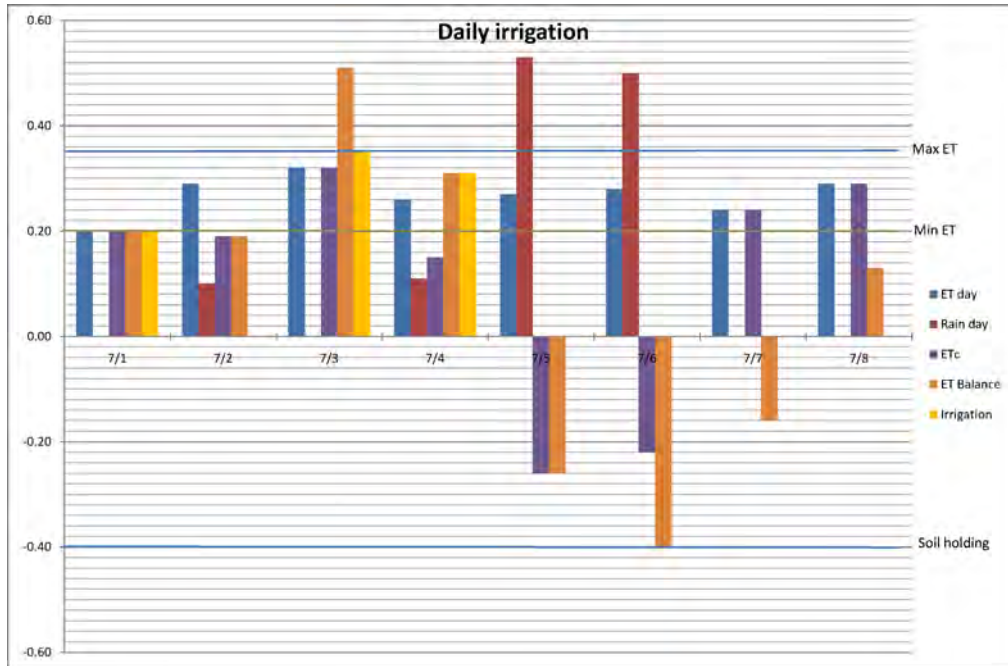
Examples

The following examples show a week with ET, Rain, ET balance and irrigation with various combinations of ET parameters.

Example B.5. All parameters in use

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.20"	0.35"	0.40"	0.10"

The program is set to run one time every day; i.e. it will if ET balance is greater than Min ET. The example starts with 0.20" ET, no rain and an empty ET balance.



Numbers

	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
Past			0.20	0.00	0.20	0.20	This is what we have when day 1 starts
1	0.20	0.20	0.29	0.10	0.19	0.19	Irrigate ETC from last day

2	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < Min. ET (0.20)
3	0.51	0.35	0.26	0.11	0.15	0.31	Irrigate for the last two days, but only Max ET (0.35)
4	0.31	0.31	0.27	0.53	-0.26	-0.26	Irrigation during night. Rain comes during the day.
5	-0.26	0.00	0.28	0.50	-0.22	-0.40	No irrigation as ET balance < 0
6	-0.40	0.00	0.24	0.00	0.24	-0.16	No irrigation as ET balance < 0
7	-0.19	0.00	0.29	0.00	0.29	0.13	

Table Explanation

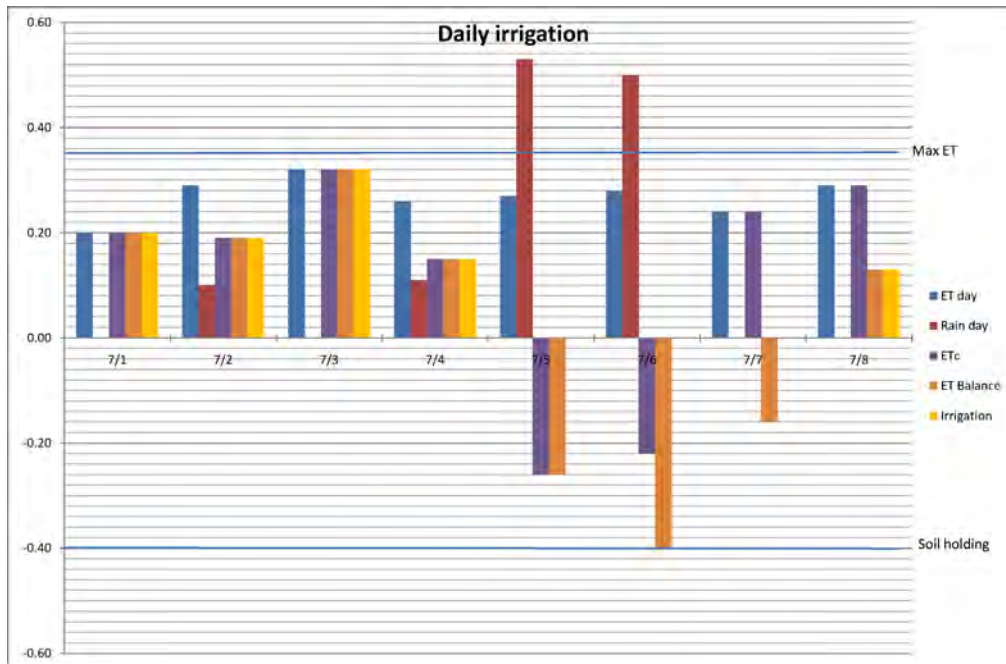
Date	Explanation
7/1	The ET balance is set to $ET_c = ET - \text{Rain}$. As the ET balance \geq Min ET the program will run and use the entire ET balance.
7/2	The $ET_c = 0.19$, which is added to the ET balance. As the ET balance is less than Min ET the program will not run.
7/3	The ET balance will now be the sum of ET_c for 7/2 and 7/3; i.e. 0.51". As this is above the Max ET the program will only apply 0.35" and the remaining 0.16" will be left in the ET balance.
7/4	Just a normal day. $ET - \text{Rain}$ from the past day is added to the ET balance and it irrigates.
7/5	A lot of rain. ET_c becomes negative and so do the ET balance. No irrigation.

Date	Explanation
7/6	Another day with a lot of rain. The ET balance would have been - 0.48" if it wasn't limited by the soil holding of 0.40"
7/7+8	Positive ETc and the ET balance increases, but still no irrigation.

Example B.6. No Min ET

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.00"	0.35"	0.40"	0.10"

The program is set to run one time every day; i.e. it will if the ET balance is greater than Min ET. The example starts with 0.20" ET, no rain and an empty ET balance.



Numbers

	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
Past			0.20	0.00	0.20	0.20	
1	0.20	0.20	0.29	0.10	0.19	0.19	
2	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as no min. ET.
3	0.32	0.32	0.26	0.11	0.15	0.15	
4	0.15	0.15	0.27	0.53	-0.26	-0.26	
5	-0.26	0.00	0.28	0.50	-0.22	-0.40	No irrigation as ET balance < 0. Limited by soil holding.
6	-0.40	0.00	0.24	0.00	0.24	-0.16	No irrigation as ET balance < 0
7	-0.16	0.00	0.29	0.00	0.29	0.13	No irrigation as ET balance < 0

Table Explanation

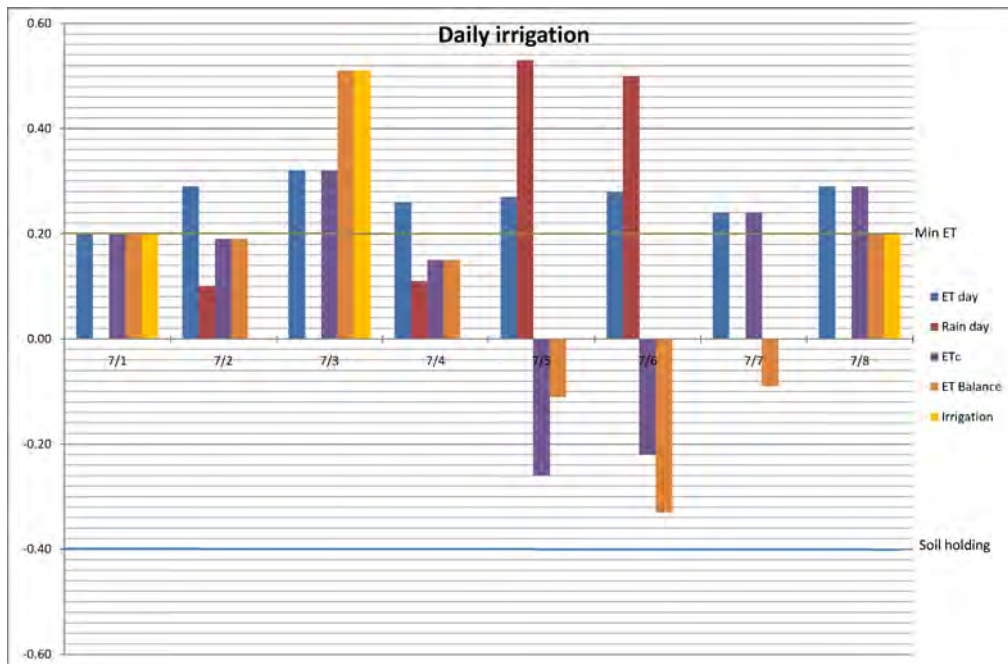
Date	Explanation
7/1-4	The ET balance is set to $ET_c = ET - Rain$. As the ET balance is \geq Min ET the program will run and use the entire ET balance.
7/5	A lot of rain. Etc becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain. The ET balance would have been -0.48" if it wasn't limited by the soil holding of 0.40"

Date	Explanation
7/7	Positive ETc and the ET balance increases, but still no irrigation.
7/8	Now we begin to irrigate again.

Example B.7. No Max ET

Min. ET	Max. ET	Soil holding	Max. hourly rain
0.20"	0.00" (Infinite)	0.40"	0.10"

The program is set to run one time every day; i.e. it will if the ET balance is greater than Min ET. The example starts with 0.20" ET, no rain and an empty ET balance.



Numbers

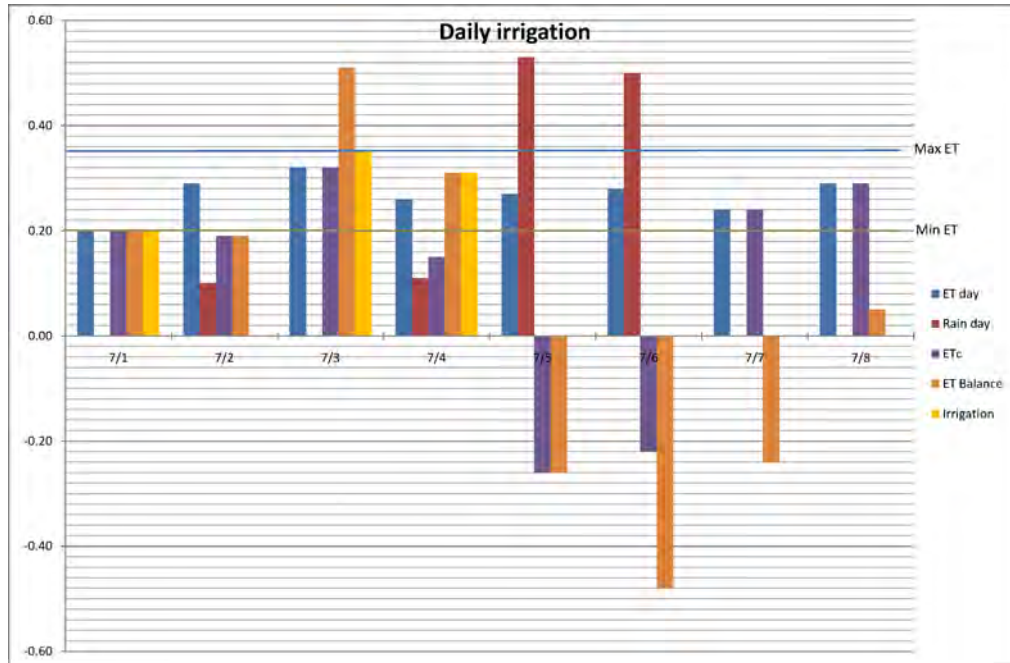
	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
1			0.20	0.00	0.20	0.20	
2	0.20	0.20	0.29	0.10	0.19	0.19	
3	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < min. ET (0.20)
4	0.51	0.51	0.26	0.11	0.15	0.15	Irrigate for the last two days and no max. ET.
5	0.15	0.15	0.27	0.53	-0.26	-0.26	No irrigation as ET balance < min. ET (0.20)
6	-0.11	0.00	0.28	0.50	-0.22	-0.33	No irrigation as ET balance < 0
7	-0.33	0.00	0.24	0.00	0.24	-0.09	No irrigation as ET balance < 0
8	-0.09	0.00	0.29	0.00	0.29	0.20	No irrigation as ET balance < 0

Explanation

Date	Explanation
7/1	The ET balance is set to $ET_c = ET - \text{Rain}$. As the ET balance is $\geq \text{Min ET}$ the program will run and use the entire ET balance.
7/2	The $ET_c = 0.19$, which is added to the ET balance. As the ET balance is less than Min ET the program will not run.
7/3	A lot of irrigation because there is no limit in Max ET.
7/4	As 7/2
7/5	A lot of rain. ET_c becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain.
7/7	Positive ET_c and the ET balance increase, but still no irrigation.
7/8	Now we begin to irrigate again.

Example B.8. No soil holding

The program is set to run one time every day; i.e. it will if the ET balance is greater than the Min ET. The example starts with 0.20" ET, no rain and an empty ET balance.



Numbers

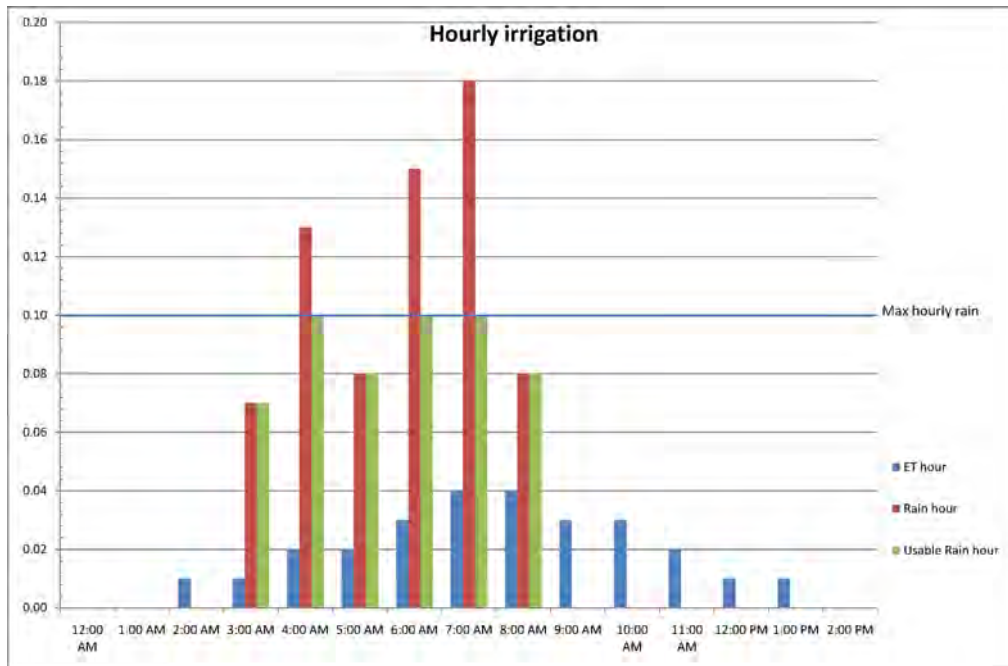
	12:01 AM	24 Hour Cycle				11:59 PM	
Day	Starting balance	Irrigation	E.T.	Rain	Etc.	End balance	
1			0.20	0.00	0.20	0.20	
2	0.20	0.20	0.29	0.10	0.19	0.19	
3	0.19	0.00	0.32	0.00	0.32	0.51	No irrigation as ET balance < min. ET (0.20)

4	0.51	0.35	0.26	0.11	0.15	0.31	Irrigate for the last two days, but only max. ET.
5	0.31	0.31	0.27	0.53	-0.26	-0.26	No irrigation as ET balance < min. ET (0.20)
6	-0.26	0.00	0.28	0.50	-0.22	-0.48	No irrigation as ET balance < 0. Not limited by soil holding.
7	-0.48	0.00	0.24	0.00	0.24	-0.24	No irrigation as ET balance < 0
8	-0.24	0.00	0.29	0.00	0.29	0.20	No irrigation as ET balance < 0

Date	Explanation
7/1	The ET balance is set to $ET_c = ET - \text{Rain}$. As the ET balance is \geq Min ET the program will run and use the entire ET balance.
7/2	The $ET_c = 0.19$, which is added to the ET balance. As the ET balance is less than the Min ET the program will not run.
7/3	The ET balance will now be the sum of ET_c for 7/2 and 7/3; i.e. 0.51". As this is above the Max ET the program will only apply 0.35" and the remaining 0.16" will be left in the ET balance.
7/4	Just a normal day. $ET - \text{Rain}$ from the past day is added to the ET balance and it irrigates.
7/5	A lot of rain. ET_c becomes negative and so does the ET balance. No irrigation.
7/6	Another day with a lot of rain. No limit in the ET balance as there is no soil holding
7/7+8	Positive ET_c and the ET balance increases, but still no irrigation.

Example B.9. Max. hourly rain

The program is set to run one time every day; i.e. it will if ET balance is greater than Min ET. The example starts with 0.20" ET, no rain and an empty ET balance.



The example shows the effect of max hourly rain. If it rains more than Max hourly rain within an hour only the Max hourly rain is used.

Options for Getting ET Data

Your controller will accept ET data from a number of sources, and the mechanisms using the ET data to calculate irrigation aspects are identical, regardless of input method.

The NLC accepts ET data from the following sources:

Name in controller menu	Description
Local Weather Station	Input is pulses from a weather station and tipping bucket (For more information turn to on page 107)
Historic ET	Manually entered historical ET data (For more information turn to Using Historical ET Data on page 103)
Remote ET & Rain	ET and rain data is received from the RealNet server.
Remote ET	ET data is received from the RealNet server. No rain data received.
Local WS with Alarm send	Same as Local Weather Station, but rain alarm activation/de-activation will be passed on to the RealNet server.

For more information turn to on page **107** (swap in your preferred source for the local weather station.)

Using Historical ET Data

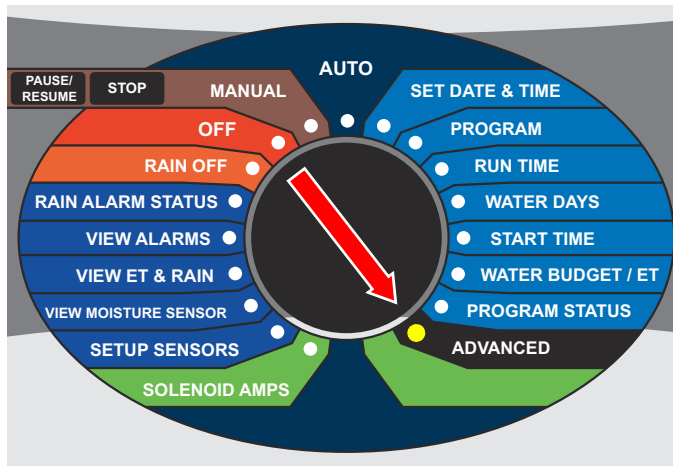
If you don't have a local weather station you can use historical ET data to correct your irrigation instead.

Before you start this procedure you need to know how much water evaporates every month of the year - on a daily basis. Meaning that for each month you'll get to enter a figure that will be used each day that month.

Your start times will be sorted by start time - if the second start time you enter is before the first one, they will be swapped around next time you browse the list.

Configuring for Historical ET Data

1. Turn the dial to ADVANCED



Now the display looks like this:



- 2 Use the *item selectors* to select 3. `IntellisSet` and push the `ENTER` button. Now you'll see the following screen:



- 3 Select 1. `ET`. Now the display will look like this:



- 4 Select 6. `Device Setup`. Now the display will look like this:



- 5 Select 1. ET Input Method. Now the display will look like this:



- 6 Select `Historic` and push the `ENTER` button.
- 7 Push the `CANCEL` button once to go back to the main `Intellisets™` menu.
- 8 Select 5. `Historic Data Settings` in the menu and push the `ENTER` button. Now you'll see the following screen:



- 9 Use the item selectors to browse the months and set the daily ET adjustment for each.
- 10 Push the CANCEL button to return to the main Intellisett™ menu.

Appendix C: Adding a flow sensor

The NLC can measure the flow of water in your system and react on any unusual situation by quarantining faulty stations, stacking programs that exceed the expected flow or even cutting off the water supply completely if it seems that you have a leak.

This works by letting a flow sensor measure the flow on the main pipe that feeds your system, and connecting the flow sensor to the NLC.

There are four types of flow alarms - three of which can go off when irrigating and one that is only relevant when no stations are running:

Alarm Types

Alarm Name	Description	What happens?
High Flow	Occurs when your system is using more gallons per minute than your defined threshold.	All running programs are halted.
Flow Deviation	Occurs when your flow is above or below a certain percentage from the expected flow.	All running stations are halted and blacklisted.
Unscheduled Flow	Occurs when there is a flow even when there shouldn't be (when no stations are running). This indicates a leak somewhere on the pipe.	Normally open master valve (NOM) is activated for 17:59:50.

Alarm Name	Description	What happens?
Master Pump Failure (MFP)	Occurs when your flow is below a certain threshold.	The master pump or all running programs are stopped, depending on your configuration (For more information turn to Appendix C: Setting Alarm Actions on page 120).

Before you can take advantage of the features associated with flow sensor input you have to connect a flow sensor and configure a few things in the controller. The following sections walk you through the process.

Setting Alarm Thresholds

For each of the alarms described in **Appendix C: Alarm Types** on page 109, you must set a threshold value, and you also need to tell the controller for how long the alarm must be on before the controller should take action.

Note: Setting a threshold to zero will disable the alarm. This section describes how to enter these settings.

Setting the alarm reaction delay

- 1 Turn the dial to **ADVANCED**, use the *item selectors* to scroll to item number 3. FloGuard, and push the **ENTER** button.

Now you'll see this display:



- 2 Choose 2. Alarm Thresholds and push the ENTER button.

Now you'll see the following display:



- 3 Use the *item selectors* to select 1. Alarm Reaction Delay. Now you'll see the following display:



- 4 Use the *item selectors* to set the reaction time in minutes. The controller won't raise any sensor alarms until they have been on for this period.

Note: A Master Pump Failure (MPF) will ignore this setting - MPF alarms have a fixed delay of 30 seconds.

- 5 Push the `ENTER` button to save your selection.

Setting the high flow threshold

- 1 Turn the dial to `ADVANCED`, use the *item selectors* to scroll to item number 3. FloGuard, and push the `ENTER` button.

Now you'll see this display:



- 2 Choose 2. Alarm Thresholds and push the ENTER button.

Now you'll see the following display:



- 3 Use the *item selectors* to select 2. High Flow. Now you'll see the following display:



- 4 Use the *item selectors* to set the maximum flow in gallons per minute. If this flow is exceeded the controller will raise a high flow alarm.

If this alarm is activated all running programs will be halted, but the next program will be started normally when it is scheduled. Of course, if the next program also generates a high flow alarm it is halted too.

- 5 Push the `ENTER` button to save your selection.

Setting the Flow Deviation

- 1 Turn the dial to `ADVANCED`, use the *item selectors* to scroll to item number 3. `FloGuard`, and push the `ENTER` button.

Now you'll see this display:



- 2 Choose 2. Alarm Thresholds and push the ENTER button.

Now you'll see the following display:



- 3 Use the *item selectors* to select 3. Flow Deviation. Now you'll see the following display:



- 4 Use the *item selectors* to set the deviation percentage from expected flow. The controller will raise an alarm if the flow exceeds or falls short of the expected flow with this many percent.

If this alarm is activated all running stations will be halted and blacklisted (marked as failed). Any programs that include failed stations will simply skip those stations and run the next one in the program. To clear a station you need to mark it OK on the controller (see **Appendix C:** on page **127** for instructions.)

You can read more about the expected flow in **Appendix C: Setting Expected Station Flow** on page **121**.

- 5 Push the `ENTER` button to save your selection.

Setting the unscheduled flow threshold

- 1 Turn the dial to `ADVANCED`, use the *item selectors* to scroll to item number 3. FloGuard, and push the `ENTER` button.

Now you'll see this display:



- 2 Choose 2. Alarm Thresholds and push the `ENTER` button.

Now you'll see the following display:



- 3 Use the *item selectors* to select 4. *Unscheduled Flow*. Now you'll see the following display:



- 4 Use the *item selectors* to set the unscheduled flow limit in gallons per minute. This is an alarm that will be raised only when no stations are running. You may have a minor natural leak of water in your pipes but here you can set the maximum flow allowed when no stations are running.

If this alarm is activated the normally open master valve (NOM) will be activated, and remain on for 999 minutes. It can be turned off just like any other station (For more information turn to **Chapter 4: Running Extra Stations in Auto Mode** on page 47).

Important! If you turn the mode selector away from `AUTO` or `MANUAL` mode the normally open master valve (NOM) will be reset and the water will no longer be cut off from your system.

- 5 Push the `ENTER` button to save your selection.

Setting the master pump failure threshold

- 1 Turn the dial to `ADVANCED`, use the *item selectors* to scroll to item number 3. `FloGuard`, and push the `ENTER` button.

Now you'll see this display:



- 2 Choose 2. `Alarm Thresholds` and push the `ENTER` button.

Now you'll see the following display:



- 3 Use the *item selectors* to select 5. Master Pump Failure. Now you'll see the following display:



- 4 Use the *item selectors* to set the minimum flow that must be in your pipe if the master pump is working correctly. You can decide whether this alarm should result in all programs to be halted, or all pumps and master valves should be turned off (For more information turn to **Appendix C: Setting Alarm Actions** on page 120). The action you choose will be in effect until the next station gets activated (manually or by a program.)
- 5 Push the `ENTER` button to save your selection.

Setting Alarm Actions

The only flow alarm for which you can decide the action is the master pump failure alarm - you get to decide whether this should cause all programs to be halted or all pumps and master valves to be shut down.

Configuring alarm action for MPF

- 1 Turn the dial to **ADVANCED**, use the *item selectors* to scroll to item number 3. FloGuard, and push the **ENTER** button.

Now you'll see this display:



- 2 Choose 3. Action Configuration. Now you'll see the following display:



- 3 Use the *item selectors* to choose between:

- **Pumps/MVs:** All pumps and master valves will be shut down when an alarm goes off. The programs will still be finished even if the pumps are turned off in order not to interrupt the irrigation schedule since an MPF alarm will be cleared next time a program has to start.
 - **Programs:** All running programs will be shut down when an alarm goes off.
- 4 Push the **ENTER** button to save your selection.

Setting Expected Station Flow

In order to be able to calculate when the current flow is deviating from the expected flow, the NLC needs to know how much flow you expect each station to pull.

To teach the controller about the expected flow you can either enter a value for each station or run the automated "learn flow" feature that will assess the flow for each station in turn.

Note: Please be advised that the system will not be able to handle a flow higher than 9999 gallons per minute.

Entering expected flow for a station

- 1 Turn the *dial* to **ADVANCED** and select 2. **FloStack**.

Now you'll see the following display:



Scroll down and select 2. Expected Flow by pushing the ENTER button. Now you'll see a scrollable list of stations and their expected flow in gallons per minute:



- 2 Use the *item selectors* to locate the station you wish to configure and push the ENTER button.

- 3 Now you can set the expected flow using the *item selectors* and save your setting by pushing ENTER again.

If the above procedure seems to tedious there's an easier way - you can let the NLC asses the expected flow for each station. If you choose this approach the controller will run all stations in turn for a fixed duration, measure the flow for each of them and save the flow as the expected one.

Running the "learn flow" feature

- 1 Turn the *dial* to ADVANCED and select 2. FloStack.

Now you'll see the following display:



- 2 Scroll down and select 3. Learn Flow by pushing the ENTER button. Now you'll see the following display:



- 3 Use the *item selectors* (both up, down, right and left) to choose a station to start from and set the run time for each station. All stations will be run for the same period of time.

The NLC measures the flow continuously while the station is running the "Learn Flow" feature but only the last measurement is used. The last measurement is likely to be the most accurate one as the flow will have stabilized after running for a few minutes.

- 4 Push **ENTER** to start the test. Now you'll see the starting the test at the station you selected (ST1) and running it for the selected duration (3 minutes):



- 5 When a station is done running its measured flow will be stored as the expected flow for that station. Pushing **CANCEL** at any time will abort the "learn flow" feature but the stations measured so far are still saved. This means that you don't have to measure all stations in one sitting - simply re-run the "learn flow" feature with a new "Start from" setting to finish what you may have cancelled earlier.

Viewing the Current Flow

Given that you have configured your flow sensor correctly, the NLC lets you see the real time flow directly in the controller display:

- 1 Turn the dial to **ADVANCED**, use the *item selectors* to scroll to item number 3. **FloGuard**, and push the **ENTER** button.

Now you'll see this display:



- 2 Select 4. Flow Sensor Setup, and push the ENTER button.

Now you'll see this display:



- 3 Select 3. Current Flow Pulses and GPM and you'll see the current system flow in both pulses per second and gallons per minute:



Note: The NLC can measure correctly up to a flow of 250 pulses per second. If your flow exceeds this you should use a sensor that has a higher "water amount per pulse" ratio. However, a higher frequency is preferred over a lower one, as it provides the most accurate measuring, so in an ideal world your frequency closes in on 250 pulses per second without ever exceeding it.

Inspecting and Toggling Station Status

Stations can be blacklisted if the controller suspects that they are faulty and cause deviations in the expected flow (For more information turn to **Appendix C: Setting the Flow Deviation** on page **114**). However, the controller might blacklist an innocent station since all stations that are running when the deviation takes place are blacklisted. So, to enable these stations again you need to toggle their status from `Failed` to `OK`.

Tip: Since blacklisted stations are simply skipped when running programs that require them, marking a station as failed is an excellent way of taking a single station out of use without having to redo the program all together. This can be useful if you just need to check or replace the station in the field.

This procedure explains how you toggle station status:

Managing station status

- 1 Turn the dial to **ADVANCED**, use the item selectors to scroll to item number 3. FloGuard, and push the **ENTER** button.

Now you'll see this display:



- 2 Select 1. Station Status by pushing the **ENTER** button. Now you'll see a scrollable list of stations and their status - Failed or OK:



- 3 If you wish to toggle the status of a station, locate it with the *item selectors* and push the **ENTER** button.

Tip: Instead of browsing through the entire list of stations you can use the `STATION` button to browse only failed stations.

Using the *item selectors* again, you can toggle the station between `OK` and Failed status.

- 4 Push the `CANCEL` button to exit the menu.

Appendix D: Moisture sensors

With moisture sensors your controller can learn the exact moisture levels in the soil and adjust irrigation based on this knowledge.

The Role of Moisture Sensors

Adding moisture sensors to your NLC takes the guesswork out of irrigation and adds a new level of intelligence to the picture - you now enjoy "Total Cycle Management":

- 1 Calculate your irrigation run times based on local ET and Rain
- 2 Communicate - get runtimes and system status via the Internet
- 3 Validate runtime scheduling based on feedback from the soil



Let's examine the three components of Total Cycle Management in turn.

Calculate

When planning irrigation you look at the best evapotranspirational (ET) data you have available. In descending order of accuracy you may have access to one or more of the following:

- Data from a local weather station.
- Real-time ET data from an off-site weather station.
- Daily weather reports from an off-site weather station.
- Historical weather data for your area.

In addition you know about the soil type, vegetation and other factors that should affect your irrigation planning, but even the best planning is still, in essence, guesswork, as you don't know for sure how the soil is responding.

Communicate

With an intelligent irrigation controller like the NLC you get a lot of help in correcting your calculations along the way. A variety of alarms (For more information turn to **Chapter 4: Alarms** on page **53**) can be raised and many will lead to your irrigation schedules being adjusted to the new conditions.

For example, if it rains heavily, the NLC won't blindly keep irrigating as you may have told it to.

The NLC logs everything elaborately and even lets you view real-time data in the web based interface. With this knowledge you can re-adjust your calculation, but still, an important piece is missing from the puzzle.

Validate

To validate your calculations and the feedback the system has given you there is no way around measuring the exact levels of moisture in the ground.

By adding moisture sensors to the NLC you are now full circle. Irrigation can now be adjusted automatically based on the data flowing from your moisture sensors, and long term you can adjust your schedules according to what you learn from the full circle irrigation scheme, gradually refining your irrigation schedules to perfection.

When setting up moisture sensors with the NLC, you tell the controller which soil type you are measuring, and then the NLC will pull in data every 10 minutes, and you are allowed to configure precisely how the controller should react to this data - this happens as fine grained as on a per-program basis:

- Set limits for how dry the soil should be before irrigating and how moist it must be before irrigation is prevented.
- Determine whether or not the collected data should affect current irrigation directly, or if the data should just be collected for schedule refinement later on.

The moisture sensors also work in conjunction with the regular ET mechanism and affects the amount of water assigned to irrigation moving forward. The range of ET adjustment can be from zero to two times the daily ET, meaning that a very dry soil can result in ET being doubled and a very moist soil can bring the ET for the following day to zero.

You determine per program how much the controller can adjust the ET by setting a value between 0 and 100%, a 100% being double from normal ET (For more information turn to **Appendix D: How irrigation is adjusted by moisture sensors** on page **132.**)

How irrigation is adjusted by moisture sensors

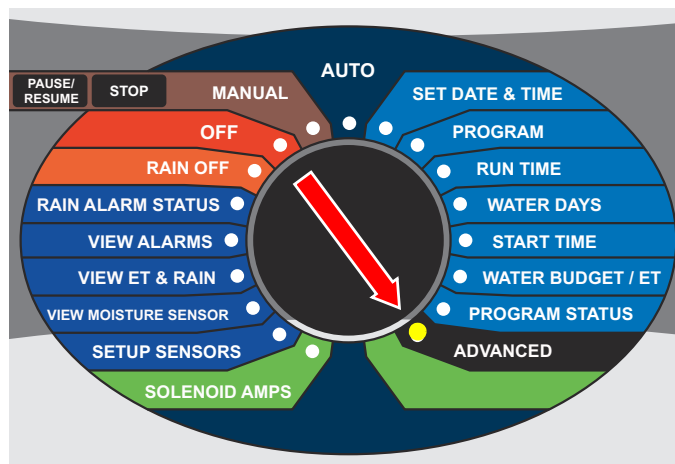
Each program can accept input from a moisture sensor and its input can be used for the following:

- Allow irrigation if the moisture level is low enough
- Raise an alarm if the moisture level is too low
- Prevent irrigation if the moisture level is too high
- Optionally adjust the ET balance

Note: Each moisture sensor can control multiple programs and its input can be interpreted differently by different programs.

Here is how you configure your programs to use a moisture sensor:

- 1 Turn the dial to ADVANCED



Now the display looks like this:



- 2 Use the *item selectors* to select 3. *Intellisat* and push the ENTER button. Now you'll see the following screen:



- 3 Select 2. *Moisture* and push the ENTER button. Now the display looks like this:



- 4 Select the first option: 1. Moisture program settings and push the **ENTER** button. Now the display looks like this:



- 5 Now, using the *item selectors*, set the values for all seven columns:

Column	Description
Pgm	The program to assign a moisture sensor to.
Sens	Which sensor to assign.
Allow	The lower threshold for when irrigation will be allowed - e.g. 5% means that irrigation will be allowed as long as the moisture readings are below 5%.
Prevent	The higher threshold for when irrigation will be prevented - e.g. 30% means that irrigation will be prevented if the moisture readings are 30% or higher.
Alarm	The lower threshold for when an alarm will be raised.
Ctrl	Set to Yes or No depending on whether you want the moisture sensors to control your Irrigation. If irrigation is prevented due to high moisture readings, ET for the following day will be increased.
Reg	A percentage with which the ET will be adjusted. 0% means no adjustment and 100% means that the ET will be as much as doubled for the following day.

- 6 Push the **ENTER** button to save your configuration.
-

- 7 Repeat steps four and five for each program you wish to assign a moisture sensor to.

Once you have completed all the procedures in this section, your system should be up and running, utilizing moisture sensor readings and adjusting irrigation accordingly.

How moisture sensor input affects ET

The NLC can handle single moisture sensor via the external RS232 port and an additional external RS232/RS485 (SMI-100) converter. The controller can handle up to 10 moisture sensors on a multi drop line.

The moisture sensor is able to allow or prevent irrigation and/or adjust ET on specific programs dependent on the actual moisture and the setup. All the setup can be done at the controller and on the WEB. It is also possible to view the actual moisture level both on the controller and on the WEB.

The moisture sensors may be set up to simply allow or prevent irrigation. The irrigation is still controlled by water days, WB or ET, start times, etc. The sensor just acts as a switch for one or more programs.

More powerfully, the moisture sensor is also able to adjust the daily ET, which is added to the ET balance corrected for rain for each program. The principle is that high moisture shall reduce the ET applied to the ET balance and low moisture shall increase the ET applied to the ET balance. With full regulation the adjusted ET shall vary between 0 and double the amount of daily ET. The regulation is individual per program.

Abbreviations

Term	Description
Factor %	A user definable regulation factor between 0 and 100%. Set to 0 means no regulation. Set to 100% means full regulation.
100% regulation when wet	No ET is added to the balance.

Term	Description
100% regulation when dry	2x the ET is added to the balance.
Wet	At or near field capacity.
Dry	At or near permanent wilt point.
Optimal	The target balance between soil and climate ET.
VSM	The actual volumetric soil moisture.
ETm	Moisture adjusted ET and corrected for rain and added to ET balance.
ET	ET for the prior 24 hour period.
Rain	Rain for the prior 24 hour period.

VSM ranges for the different soil types

Soil type	VSM(dry)	VSM(wet)	VSM(Optimal)
Standard	0	49	25.5
Sand	2	22	12
Loam	6	36	21
Clay	15	50	32.5

The following examples show 7 days with various daily ET and rain in combination with start off of dry, wet or optimal soil condition with 0%, 50% or 100% regulation. The examples have the following common conditions:

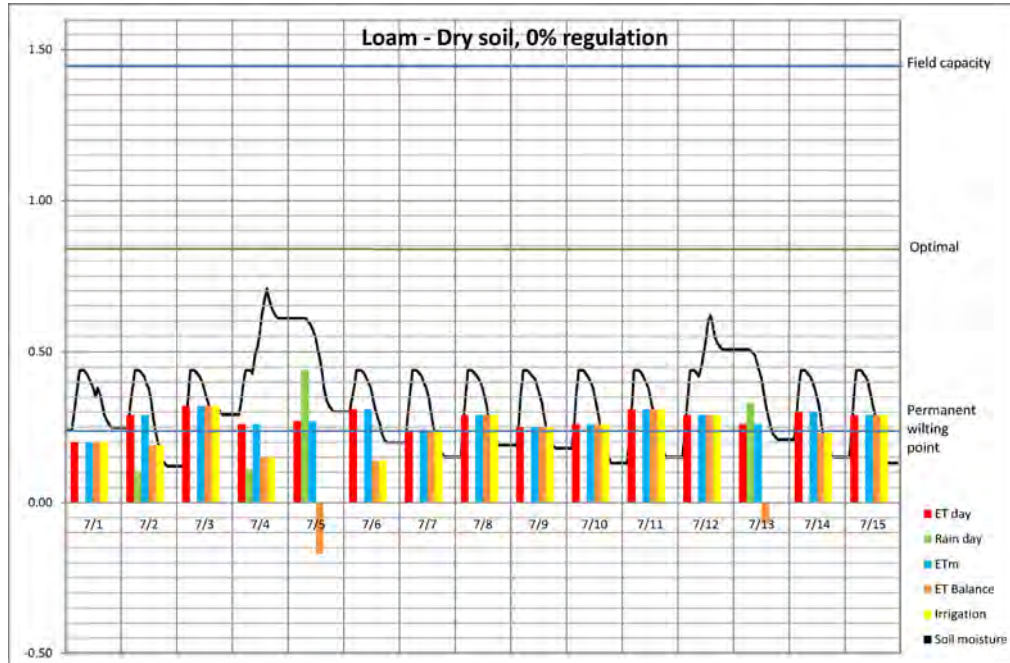
- Soil type loam. Root zone 4". This means the VSM for dry, optimal and wet corresponds to 0.24", 0.84" and 1.44" of water.
- The first irrigation period begins with ET=0.20, Rain=0.00", ET balance = 0.00".
- The irrigation program runs every day if ET balance is above 0.00" (no minimum/maximum ET defined.)

- Allow and prevent irrigation based on the moisture is not used.
- The water applied by irrigation and rain reach the root zone the same day.

Factor %	VSM %	ET	ETm
0	6 (dry)	0.20	0.20
0	21 (optimal)	0.20	0.20
0	36 (wet)	0.20	0.20
50	6 (dry)	0.20	0.30
50	21 (optimal)	0.20	0.20
50	36 (wet)	0.20	0.10
100	6 (dry)	0.20	0.40
100	21 (optimal)	0.20	0.20
100	36 (wet)	0.20	0.00

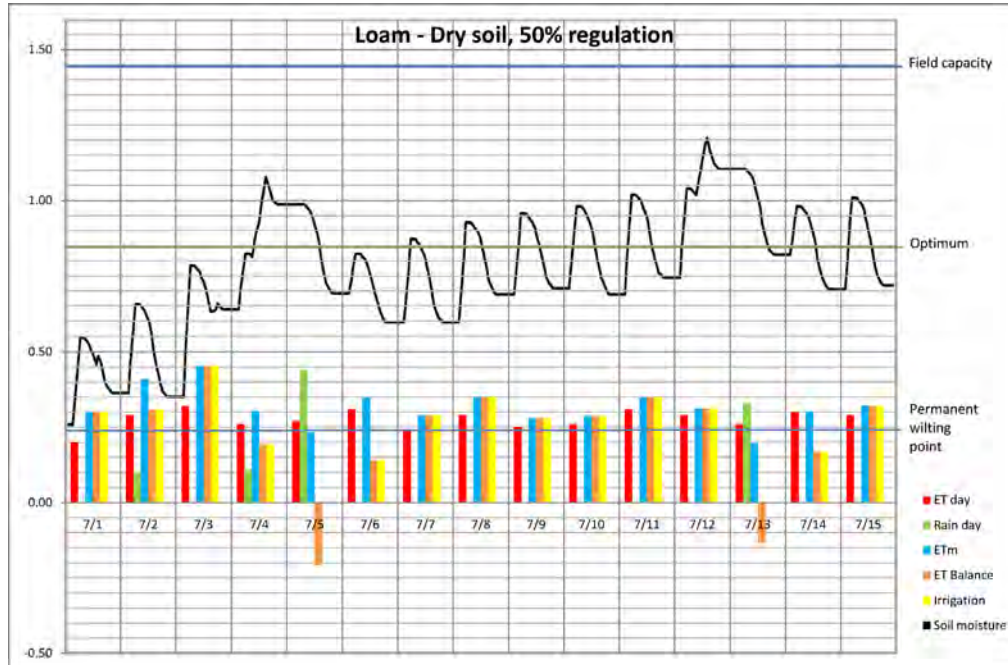
Example D.1. Dry start condition (stress point)

Soil moisture starts at 0.24"

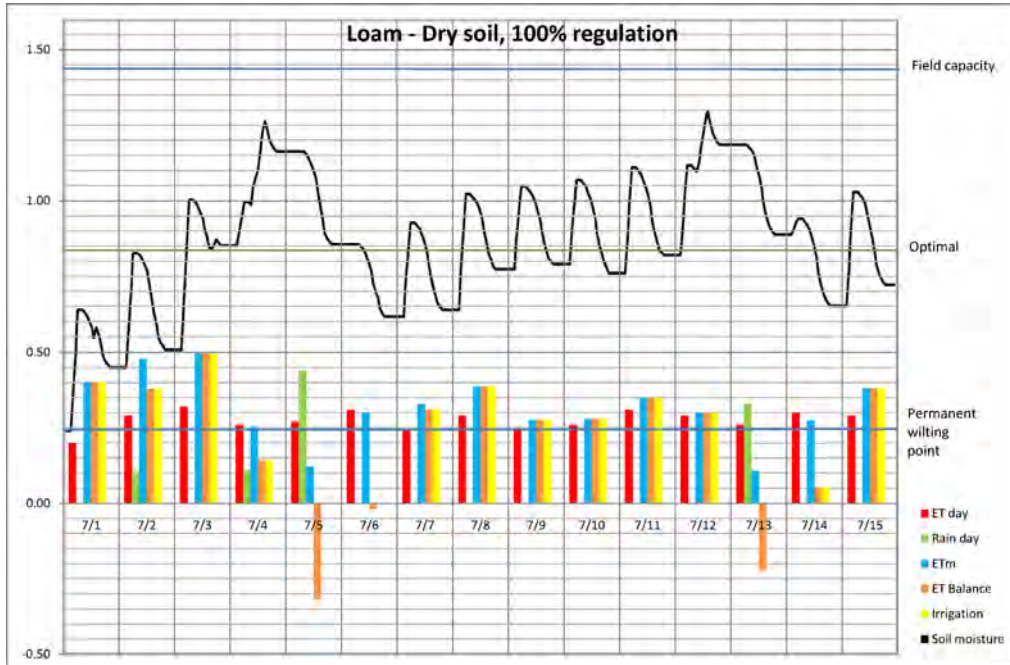


We start with 0.20" ET and no rain the first day. The soil is dry, but we have no regulation. Thus the $ET_m = ET$. Every day the $ET\ balance = ET_m (ET) - Rain$. There is no irrigation on 7/5 as the ET balance is negative.

The result is that we start out with a dry soil and we will keep a dry soil. The moisture content in the soil varies over the day as the irrigation falls in the night (increase soil moisture) and during the day the ET dries out the soil. The example shows that most of the days the soil moisture is below the permanent wilting point at the end of the day.



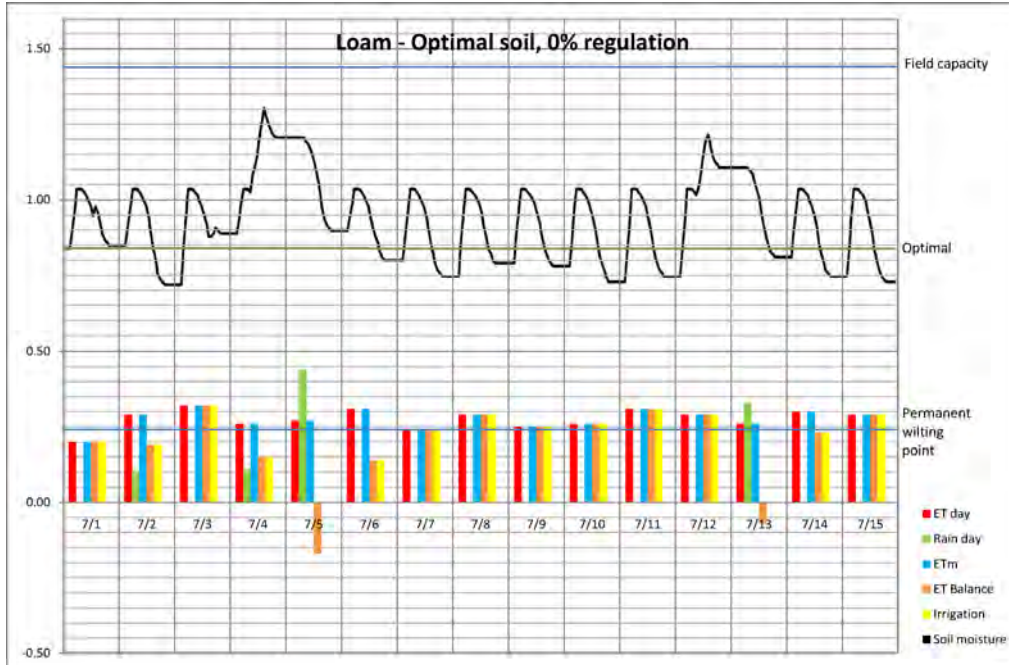
We start with 0.20" ET and no rain the first day. The soil is dry, and we have 50% regulation. Thus the ETm will be regulated up by 50% from the collected ET in the beginning and as the soil moisture reaches the nominal level the ETm is regulated less. The trend shows the soil moisture is growing until it reaches the optimum level.



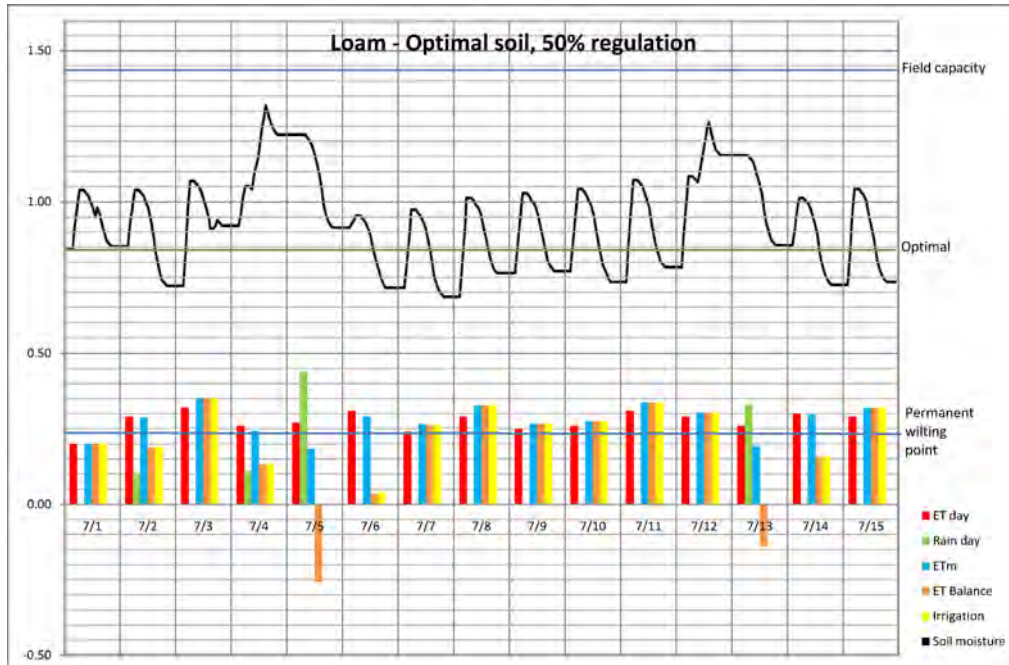
This shows the same tendency as the 50% regulation, just that the regulation of the soil moisture is far more aggressive.

Example D.2. Optimal start condition

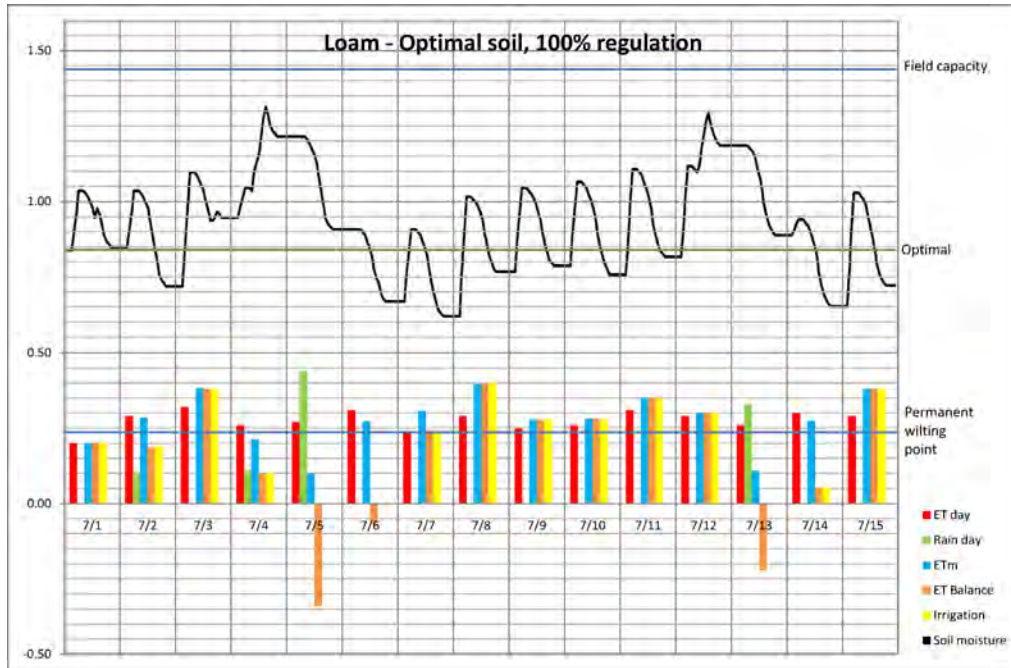
Soil moisture starts at 0.84"



In this case the soil moisture was in balance when we started and it is kept in balance.



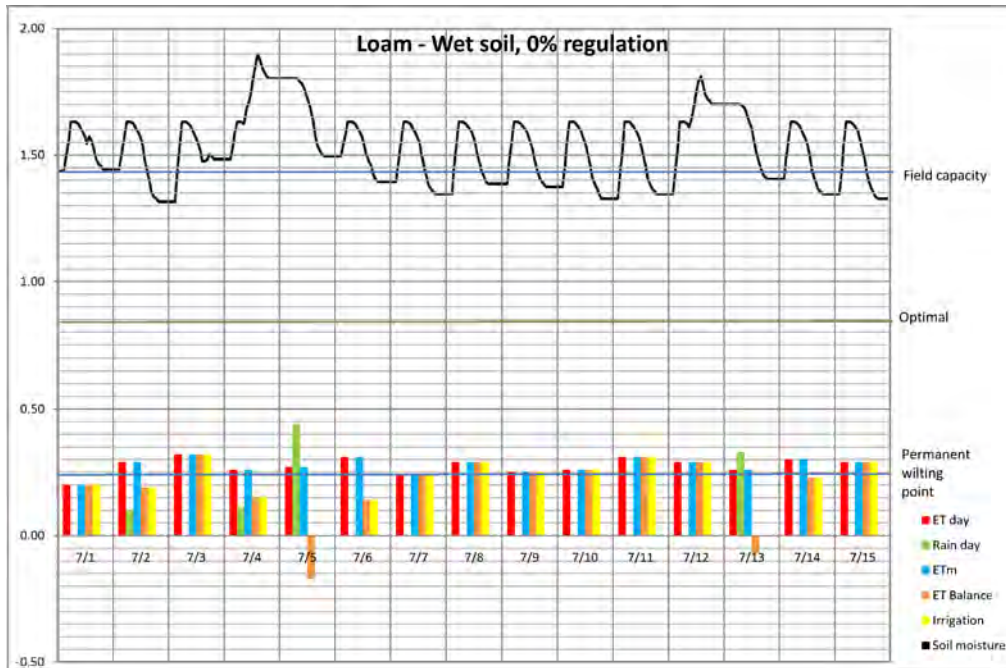
The regulation has very little influence as the soil moisture is in balance and we just deviate slightly from the nominal value.



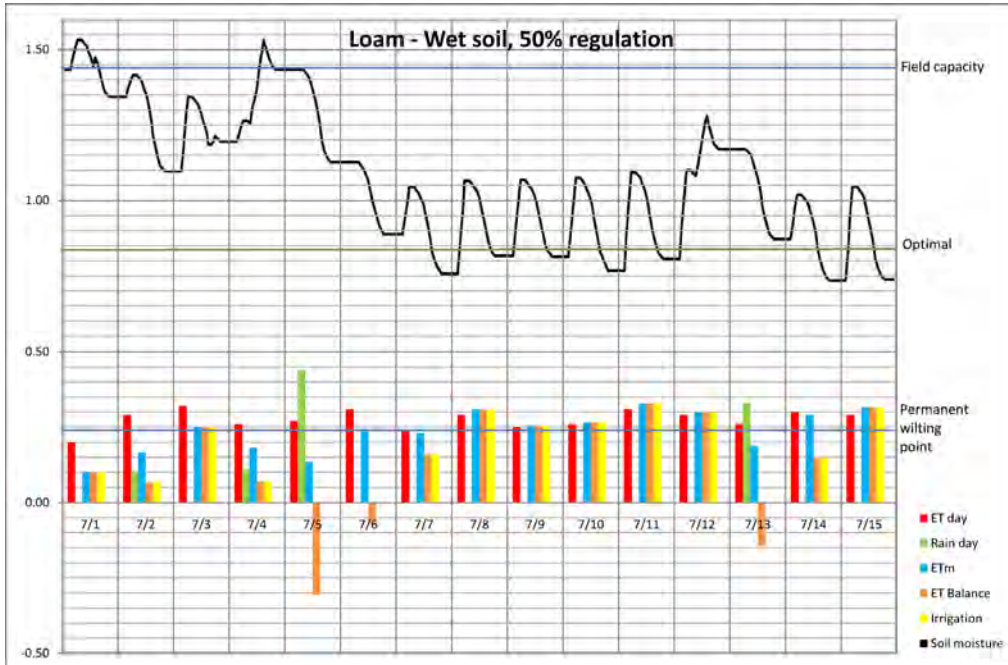
Same as with 50%

Example D.3. Wet start condition (field capacity)

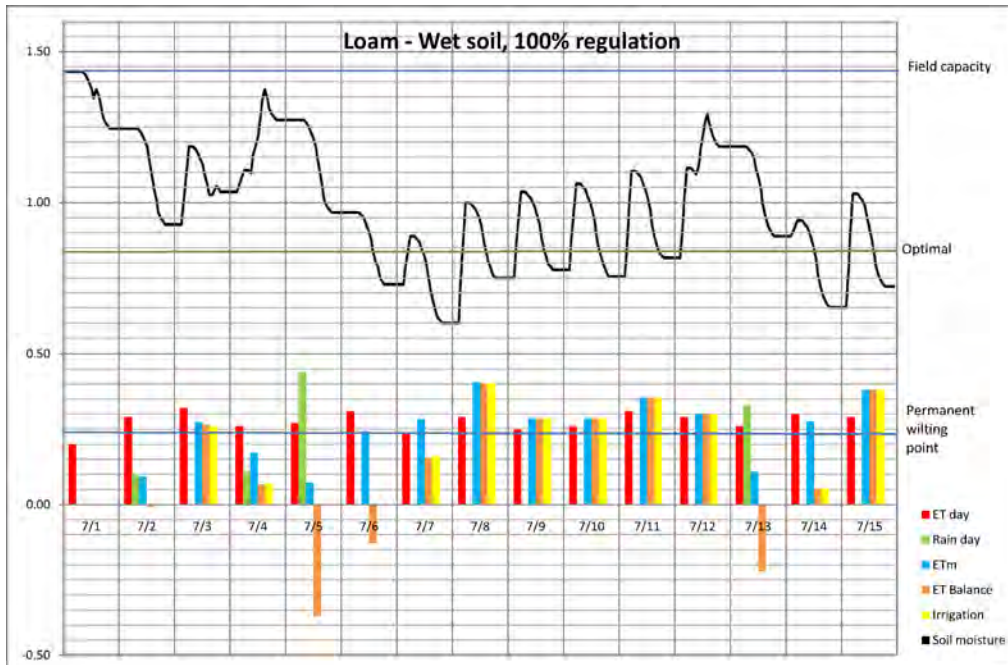
Soil moisture starts at 1.44"



We start with 0.20" ET and no rain the first day. The soil is wet, but we have no regulation. Thus the $ET_m = ET$. Every day the $ET\ balance = ET_m (ET) - Rain$. There is no irrigation on 7/5 and 7/13 as the ET balance is negative. The result is that we start out with a wet soil and we will keep a wet soil. We even keep the moisture above the field capacity, which means most of the irrigation is wasted.



The soil will dry towards the nominal value over time. It will still irrigate, but with less ETm than the collected ET. Using prevent irrigation above a certain level would avoid irrigation when it is very wet.

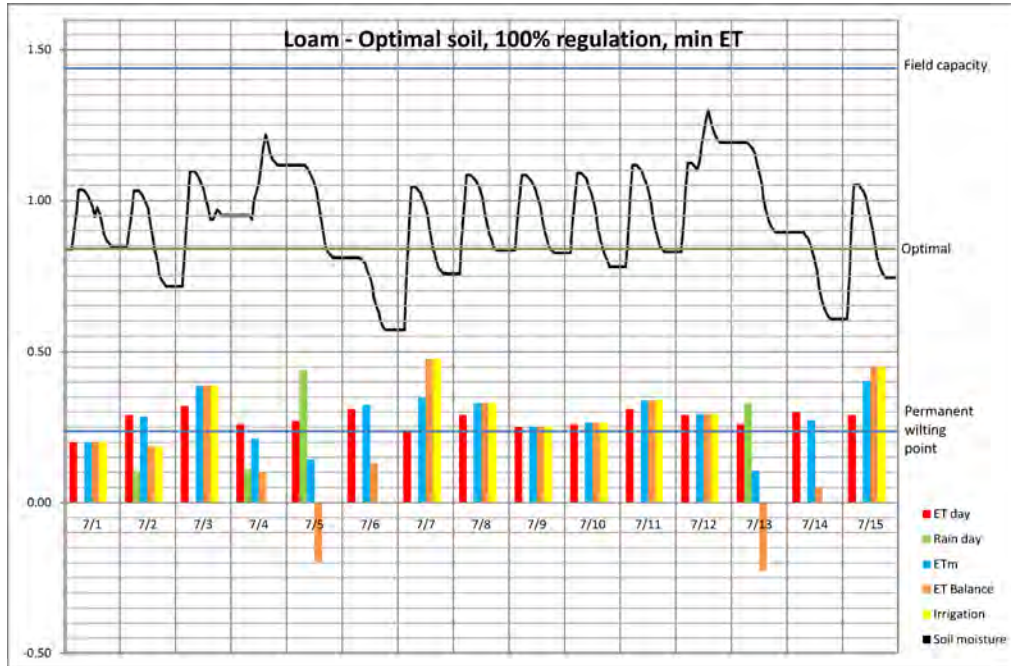


The same picture as the 50% regulation just that the progression towards the nominal value is much faster.

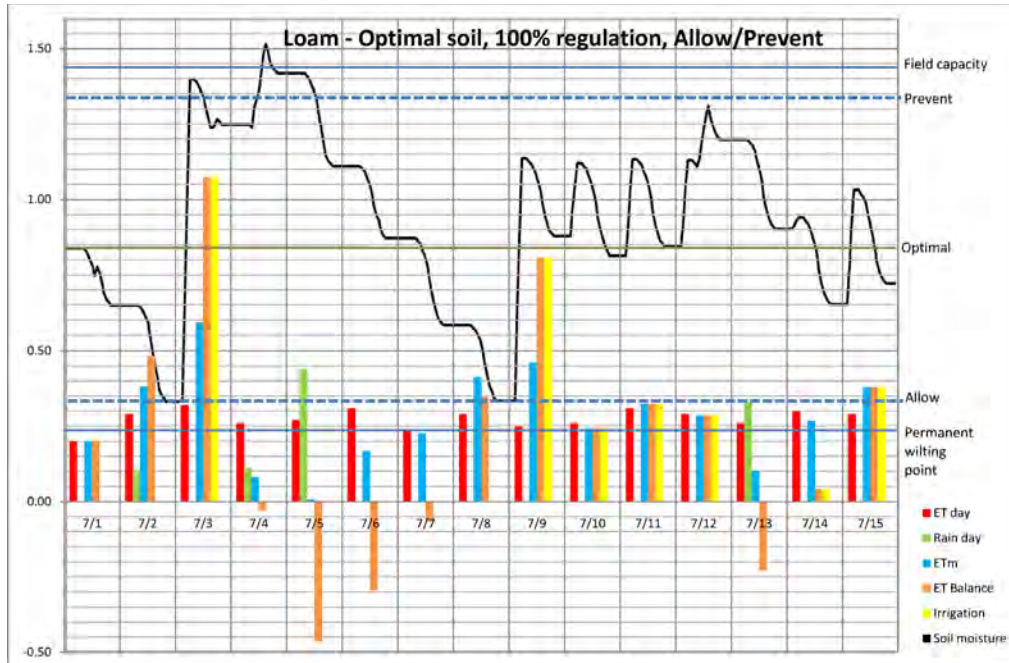
How irrigation is adjusted by moisture sensors The same results can be drawn for the other soil types. The only difference is the VSM range.

Min and max for ET come into play when the system starts to use the ET balance; i.e. after the moisture correction, which is on what we add to the ET balance. Max hourly rain is during the day when we collect rain. Soil holding is the maximum that the ET balance can go negative.

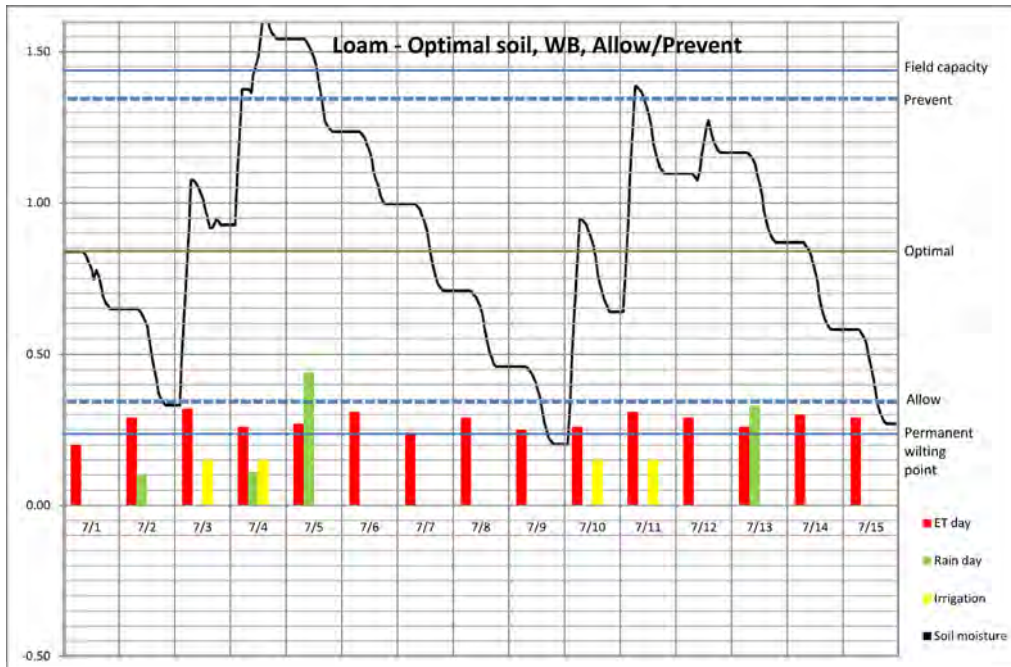
Soil moisture starts at 0.24”.



Compared to the similar example in the beginning the minimum ET of 0.15” avoids the small amount of irrigation on 7/4 and 7/14.



In the example the Allow irrigation is set to 0.34” and Prevent irrigation is set to 1.34”. Thus the irrigation is prevented until the soil moisture drops below 0.34”. At that point the ET balance is large and the first coming days irrigation will increase the soil moisture to above prevent level. The next five days the soil moisture will drop due to ET until it again allows irrigation. In the next period it will not increase above the prevent and start settle at the optimum.



This example has the same allow and prevent settings as the previous, but instead of ET controlled irrigation as water budget program is used. The water budget program is set with start times at 1 AM, 2 AM, 3 AM, 4 AM, 5 AM and 6 AM. Each start apply 0.15" water and it is assumed this is in the soil the following hour.

The result is again that the soil moisture drops until it is below 0.34" and then on 7/3 the controller irrigates 6 times 0.15". The next day it irrigates 3 times 0.15" until it reach the 1.34". The following days the soil dries out and it all repeats from 7/10.

Appendix E: Changing Station Run Sequence and Mapping

Normally stations in a program will be run in the order indicated by their station ID numbers (For more information turn to **Chapter 3: Configuring Irrigation Programs** on page **18**), but you can circumvent this by assigning sequence numbers to stations instead.

The typical scenario is when you want to add a station to an existing installation - instead of this station always being run as the last one due to its high ID number, you can "merge" it into the middle of the pack by using sequence numbers.

Example E.1. Putting a new station in the middle of the run chain

Consider a scenario where you have 40 stations with ID numbers from 1 to 40 placed in the terrain. You want to add number 41 but you would like it to be run after station 20 instead of in the end of a program cycle. To achieve this you would alter the sequence number for ST41 to 21:

Normal run sequence	Run sequence after changing the sequence number for ST41 to 21
ST1	ST1
ST2	ST2
St3	St3
...	...
ST20	ST20
ST21	SY41
ST22	ST21
...	...
ST39	ST38
ST40	ST39
ST41	ST40

If station run sequences are changed, this will show when you are assigning stations to a program - if you changed the sequence like in the example above, scrolling through the station list you would see ST41 appear right after ST20 in the list.

Note: In all other places (station test, expected flow lists, etc.) stations are listed according to station ID and not to run sequence.

The following two procedures show you how to alter and reset station run sequences.

Changing the station run sequence

- 1 Turn the dial to *ADVANCED*, use the *item selectors* to scroll to item number 6. *Station Run Sequence & Mapping*, and push the *ENTER* button.

Now you will see this display:

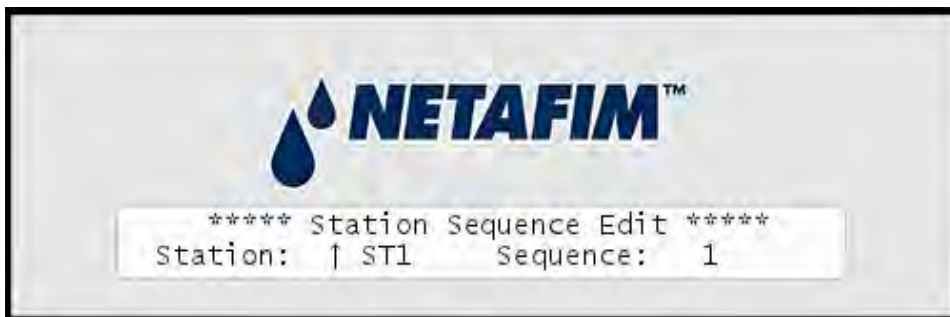


- 2 Select *1. Program Station Run Sequence*. Now you will see the following display:



- 3 Select 1. `edit` and push the `ENTER` button.

Now you will see this display:



- 4 Use the *item selectors* to select the station you wish to re-arrange and change its sequence number.
- 5 Push the `ENTER` button to save your sequences.

Resetting station run sequences

- 1 Turn the dial to `ADVANCED`, use the *item selectors* to scroll to item number 6. Station Run Sequence & Mapping, and push the `ENTER` button.

Now you will see this display:



- 2 Select 1. Program Station Run Sequence. Now you will see the following display:



- 3 Select 2. Reset to factory default and push the ENTER button. Now you will see this display:



- 4 Push the **ENTER** button to acknowledge that you're resetting the sequence numbers, or **CANCEL** to exit.

Changing Station Output Mapping

In addition to changing the station run sequence, you may alter the mapping between station names and physical stations, meaning that station 1 can be re-mapped to not activate the valve connected to terminal 1, but an arbitrary valve.

This is how it is done:

Changing Station Output Mapping

- 1 Turn the dial to **ADVANCED**, use the *item selectors* to scroll to item number 6. **Station Run Sequence & Mapping**, and push the **ENTER** button.

Now you will see this display:



- 2 Select **2. Station Output Mapping** and press the **ENTER** button. Now the display will look like this:



- 3 Select 1. Edit and press the ENTER button. Now you will see the following display:



- 4 Use the *item selectors* to map station names to physical output terminals and press the ENTER button to save your mapping.+

In case you want to reset to the factory defaults of stations names mapped directly to corresponding terminal IDs, follow this procedure:

Resetting Station Output Mapping

- 1 Turn the dial to ADVANCED, use the *item selectors* to scroll to item number 6. Station Run Sequence & Mapping, and push the ENTER button.

Now you will see this display:



- 2 Select 2. Station Output Mapping and press the ENTER button. Now the display will look like this:



- 3 Select 2. Reset to factory default. Now you will see the following display:



- 4 Push the ENTER button to acknowledge that you are resetting all mappings, or CANCEL to exit.

Appendix F: Using Simple Flow Management

The NLC allows for simple flow management by comparing the current flow to system capacity and preventing too many stations from running at once.

Configuring for Flow Management

Setting up your system for flow management only involves two things:

- 1 Defining the expected flow for your stations. For more information turn to **Appendix C: Setting Expected Station Flow** on page **121**.
- 2 Set the maximum system capacity. For more information turn to **Appendix F: Setting the System Flow Capacity** on page **160**.

How the Flow Management Works

Whenever a station is about to start, the NLC will try to determine whether the system has sufficient capacity to start the station by doing a little calculation. A station can be started if:

$$(\text{Required Capacity} + \text{Capacity in Use}) \leq \text{Total Capacity}$$

In plain words: the capacity required by the station plus the capacity already used must not exceed the total system capacity.

The required capacity and the capacity in use is determined from the station flow, whether entered or learned (For more information turn to **Appendix C: Setting Expected Station Flow** on page **121**).

If a station can not be started it will be queued in "pending" state. On the controller this will appear as "Waiting", just as paused stations. However, pending stations have a higher priority than others next time the NLC frees some capacity. (This is known as the *stacking mechanism*.)

There are a couple of things to keep in mind when using flow management:

- *When running in AUTO mode, manually started stations will overrule the flow management and ignore the higher priority of pending stations. Manually started programs will obey the flow management though.*
- The entire concept of flow management is ignored when running in MANUAL mode.
- When pausing a program the NLC will release the capacity to flow management and thus the program might go into "pending" state when resumed if the capacity is used up by other stations.

Setting the System Flow Capacity

If you tell the NLC about the flow capacity of your pipes, the controller can automatically queue up stations that would exhaust the capacity by starting. Here's how you enter the flow capacity at the controller:

- 1 Turn the *dial* to ADVANCED and select 2. FloStack.

Now you'll see the following display:



- 2 Select 1. System Flow Capacity and you'll see this display:



- 3 Use the *item selectors* to set the system flow capacity and push the ENTER button to save your setting.

Important

Leaving the System Flow Capacity at zero GPM means that the setting won't be used to correct which stations are started.

Appendix G: Defining a custom irrigation period

You can change the standard irrigation window in the NLC that runs from 12:00 AM to 12:00 AM. This has two effects:

- 1 The entire water cycle will start when your irrigation period starts. If this is different from 12:00 AM, please be aware that:
 - Programs will start running on the first start time after your irrigation period starts. This can potentially lead to a bit of confusion where programs leap into days you wouldn't think they should be running, or start running before they normally would.

Important! The irrigation period normally starts at midnight, but if you move the start into the PM window, your period starts earlier. Moving the start into the AM window will start the period later.

Example G.1. Skewed days with custom irrigation periods

Consider a program with four start times: 02:00 AM, 05:00 AM, 06:00 PM and 11:00 PM that runs on odd days.

If your irrigation period starts at 08:00 PM and runs to 08:00 PM, here's how the program could run:

Date	Start time	Action
September 2.	11:00 PM	Runs despite the even date - your irrigation period has started earlier than midnight.
September 3.	02:00 AM	Runs as expected.
September 3.	05:00 AM	Runs as expected.
September 3.	06:00 PM	Runs as expected.
September 3.	11:00 PM	Will not run despite the odd date - your irrigation window has closed.
...

- All ET calculations are based on the irrigation period, be it the standard one or your custom period.
- 2 You can define a "non-water" window by not letting the period span 24 hours. If you define the start to 06:00 PM and the end to 08:00 AM no programs or stations will be started between 08:00 AM and 06:00 PM.

Note: You can still run both stations and programs manually in the non-water window.

Programs that try to start in the non-water window will generate an alarm. And if a program is running when the non-water window starts the program is halted and an alarm is raised. For more information turn to **Chapter 4: Alarms** on page **53**.

Here is how you actually define the irrigation period at the controller:

Configuring the Irrigation Period

- 1 Turn the dial to **ADVANCED**, use the *item selectors* to scroll to item number 4. Irrigation Period, and push the **ENTER** button.

Now you'll see this display:



- 2 Use the *item selectors* to set the start and end time and push the **ENTER** button to save your settings.

Appendix H: Advanced irrigation: Misting, Cycle and Soak

The NLC lets you go beyond regular irrigation and build misting and "Cycle & Soak" programs.

Important! *The basics are the same as when building a regular irrigation program, so make sure to read **Chapter 3: Configuring Irrigation Programs** on page 18. and pay particular attention to **Chapter 3: Setting Start Times** on page 28.*

How is This Different from Regular Programs?

Misting and "Cycle & Soak" programs are configured the same way as regular programs (see **Chapter 3: Configuring Irrigation Programs** on page 18 for a walk-through), except for one point: The program start times have a more elaborate configuration.

In addition to start time, you configure an end time and a cycle count for how often you want the program repeated within this time frame. The controller will then "even out" the repeats within your time frame, leaving identical breaks between them.

So, if the total run time for your program is ten minutes and you configure the program to run three times between 10:00 AM and 11:00 AM, your program will run at 10:00, 10:25 and 10:50, leaving 15 minute breaks at 10:10 and 10:35.

The terms "Misting" and "Cycle & Soak" refer to two variants of this concept:

- **Misting:** typically describes a program that runs its stations for a very short time - run times are in seconds.
- **Cycle & Soak:** typically describes a program that uses longer run times - measured in minutes.

Both will run a number of cycles per start, whereas a normal program will only run once per start.

When the NLC Alters Your Program

There are a number of scenarios where the NLC will reduce the number of repeats in a program start:

Program was paused

If a program has been paused the NLC will not aggregate the cycles that should have been run in the pause - these cycles are just ignored and the program continues at the point it would be at had it not been paused.

Maximum system capacity met

If a program tries to run a cycle when the maximum system capacity is reached, this cycle is just dropped.

ET adjustments

If ET adjustments have dictated that you can irrigate less than normally today, reducing the number of cycles can be the outcome.

If the number of cycles is reduced, a *Repeat* alarm is raised. (See **Chapter 4: Alarms** on page **53** for details.)

How to Configure for Misting or Cycle & Soak

A misting program will typically run a number of stations for just a few seconds at a time, and then add longer breaks between the program start times.

Here's an example of a simple misting program:

Station	Run time
ST1	0:00:05
ST2	0:00:08
ST3	0:00:15
ST4	0:00:06
ST5	0:00:08
...	...

Note: Since the NLC will start stations every ten seconds you might experience short breaks between starts in a misting program. For example you'll see short breaks of between five and two seconds in the program above. For run time over four minutes, the end time is aligned to ten second slots too, so for example a run time of 0:05:13 will run for 0:05:20.

And here's a program that start at various frequencies in different time intervals:

Full misting program example

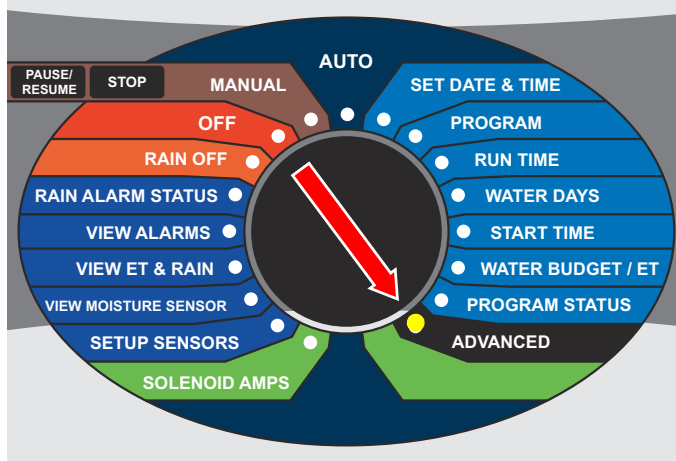
#	Start #	Details	Irrigation will start @
	1	Start time: 08:00 AM End time: 09:00 AM Count: 3 Repeat duration: 10 minutes	<ul style="list-style-type: none"> • 08:00:00 AM • 08:25:00 AM • 08:50:00 AM
	2	Start time: 09:00 AM End time: 10:00 AM Count: 4 Repeat duration: 10 minutes	<ul style="list-style-type: none"> • 09:00:00 AM • 09:16:40 AM • 09:33:20 AM • 09:50:00 AM
	3	Start time: 10:00 AM End time: 11:00 AM Count: 5 Repeat duration: 10 minutes	<ul style="list-style-type: none"> • 10:00:00 AM • 10:12:30 AM • 10:25:00 AM • 10:37:30 AM • 10:50:00 AM

Finally, let's see how you go about creating a misting program on the controller - let's say you want to configure the first start time in the example program above - here's how you would do it:

The first thing you need to do in order to use the misting features is to enable them:

Enabling Misting

- 1 Turn the dial to `ADVANCED`



Now the display looks like this:



- 2 Use the *item selectors* to scroll to item number 8. *Feature Manager*, and push the **ENTER** button.

Now you'll see this display:



- 3 Select 1. Ena/Dis Cycle and End Time.

Now you'll see this display:



- 4 Use the *item selectors* to select `Enable` and push the `ENTER` button to save your setting.

And then you're ready to configure the program:

Setting the Start Times With Count and End Time

- 1 Create your program as explained in **Chapter 3: Configuring Irrigation Programs** on page 18, but when you get to **Chapter 3: Setting Start Times** on page 28, swap that part out for the instructions in this procedure instead.

- 2 Use the *item selectors* to navigate to the program you wish to adjust the start times for and push the `START TIMES` button.

Now you'll see the following display:



- 3 Use the *item selectors* to locate the one of the four runs you wish to set a start time for, and push the `ENTER` button.

Now the cursor will jump to the right, letting you set the start time:



- 4 Use the *item selectors* to set the start time to 08:00 AM and push the right arrow to jump to the cycle field (`Cyc`).
- 5 Use the *item selectors* to set the count to four and push the right arrow to jump to the end time field (`End`).

Note: *As soon as you enter the End field, the controller will set the default end time to (total run time * count) + start time = 08:04. You must extend the end time in order get the breaks in between the four cycles:*



If you cut the end time shorter, one of two things will happen, depending on which type of program you are dealing with:

- **If you are handling a water budget based program:** The `Cyc` field will automatically decrease in order to fit in the cycles possible before the end time - you'll see it when you have saved the start time.
 - **If you are handling an ET controlled program:** No adjustments are made to the number of cycles. The fact that ET may decrease the run time of your cycles, you may still be able to fit in your number of cycles even though you lower the end time.
- 6 Set the end time to 09:00 and push the `ENTER` button to save your settings - now the cycles will be evenly spread out in the hour between 08:00 and 09:00.

Note: *When running this program, the controller still considers the program to be running, even though it is waiting between two cycles - here's what the display will look like right after the first cycle in the first run:*



Things to Keep in Mind

When using misting or cycle & soak programs, there are a number of things to consider that don't apply to regular programs:

- If you're using ET: Each cycle still obeys the water budget dictated by ET. This means that each cycle might have to run for so long that the time frame for the start time doesn't have enough room to fit in all the cycles. In this case the number of cycles is cut down adequately. The "cut out" irrigation is added to tomorrow's ET figure.
- If you're using a maximum system capacity (For more information turn to **Appendix F: Using Simple Flow Management** on page 159) a cycle might be unable to run if the maximum capacity is reached. If the program is ET controlled, the "cut out" irrigation is added to tomorrow's ET figure.
- If you pause a misting program the cycles that should have taken place during the pause are dropped in order to fit the total number of cycles in the program run time window. If the program is ET controlled, the irrigation that is lost on this account is added to tomorrow's ET figure.
- You should ensure that flow limits or reaction delay is set to consider the "on/off" nature of misting programs in order to avoid false alarms. Ideally you should use a separate pipe system without

flow sensors for misting programs. For more information turn to **Appendix C: Setting Alarm Thresholds** on page **110**.

- The NLC can handle up to five station starts within ten seconds, so you should avoid starting more than five stations at once, or you will start seeing alarms.

Glossary

Term	Description
Cable	Two wires surrounded by insulation.
Two-wire	Synonym for a cable.
Wire	An individual copper wire.



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