



Technical Report

# **SANtricity Snapshot feature**

## **Overview and deployment guide**

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### **Abstract**

The NetApp® SANtricity® Snapshot™ feature enables administrators to capture a full point-in-time copy of one or more active volumes on a NetApp E-Series or EF-Series array. The feature includes the option to take incremental snapshots of changed blocks on those volumes based on a schedule set by the administrator. This technical report provides a full description of the feature, including GUI navigation instructions using SANtricity System Manager.

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# Introduction

This document describes the NetApp® SANtricity® Snapshot™ feature available in NetApp E-Series and EF-Series storage systems and provides guidance on deployment options. The Snapshot feature enables the administrator to create a point-in-time image of a volume, schedule periodic Snapshot images, create Snapshot images of a group of volumes at once, and roll back to an earlier point in time if a problem occurs. Snapshot images can be used for a wide range of purposes; the following are a few examples.

- Data protection – protect against accidental or malicious loss or corruption of data, such as inadvertent deletion, hardware failures, viruses, or sabotage.
- Testing a new version of a database before going live.
- Zero downtime backups.

The Snapshot feature uses a copy-on-write algorithm, which enables a point-in-time image to be available nearly immediately. When new writes occur to a volume that has a point-in-time image, the old data is copied from the volume to reserved capacity, and then the new data is written to the volume. The point-in-time Snapshot image is then a combination of data on the volume and data in reserved capacity. The copy-on-write is really a copy on first write; in other words, the old data is written to reserved capacity only the first-time new data is written to a given range of blocks on the volume. Subsequent writes to the range of blocks do not require a copy-on-write operation, thus minimizing performance impact of the Snapshot feature.

## Intended use

This information is for NetApp customers, partners, and OEMs. You should have a basic knowledge of storage fundamentals, including NetApp E-Series and EF-Series arrays, and a general knowledge of data protection in data storage.

## Overview of SANtricity Snapshot concepts

This section provides a brief description of several terms and concepts that you should be familiar with to effectively use the SANtricity Snapshot feature.

### Base volume

The base volume is the starting point for Snapshot images. Point-in-time images are created from a base volume either manually or on a schedule. A rollback to a specific point-in-time image returns a base volume to its state at the time the image was created. A base volume can be a standard volume residing on either a volume group or a disk pool, or a thin volume residing on a disk pool.

### Snapshot image

A Snapshot image is a logical point-in-time image of the content of a base volume. The image is maintained while the base volume continues to change as a result of write commands from the host. Immediately after creation of a Snapshot image, its logical content is identical to the physical content of the base volume. Using the copy-on-write mechanism, the first time a range of blocks on the base volume is changed, the original data in the range is written to reserved capacity so that the point-in-time image is preserved. Snapshot images are not accessible for read or write operations by the host. Snapshot volumes are required for host access.

### Snapshot group

A Snapshot group is a sequence of Snapshot images of a single base volume. There is a strict ordering of Snapshot images based on their creation times. Snapshot images in a Snapshot group can be created manually, by schedule, or both. When a Snapshot group contains multiple Snapshot images, there is at

most one copy-on-write operation for any write to the base volume. This approach allows many Snapshot images to be created for a base volume with minimal performance impact due to the copy-on-write algorithm. There can be more than one Snapshot group for a given base volume, but a Snapshot group is associated with only one base volume. Deleting Snapshot images in a Snapshot group must go in order, starting with the oldest.

## Snapshot group reserved capacity (repository)

Each Snapshot group has a reserved capacity, or repository, to hold metadata and data blocks from copy-on-write operations. This capability is known as Reserved Capacity in SANtricity System Manager (the management interface for current products), and Repository in SANtricity Storage Manager, CLI, and the REST API. At the time of the Snapshot group creation, the administrator must also create the reserved capacity for the Snapshot group. At the creation, reserved capacity is a single volume with the capacity specified. An administrator can reserve capacity internally by adding another volume that is concatenated to the existing reserved capacity.

## Snapshot scheduling

The Snapshot feature can be set to take scheduled Snapshot images on a single base volume or a consistency group. Schedules can be daily, weekly, monthly, or yearly; and the administrator can specify times of day, time between Snapshot images, and start and end dates. After a schedule is set, Snapshot images are created within the appropriate Snapshot groups. The administrator can also modify or delete Snapshot schedules.

## Snapshot volumes

The administrator can create a volume from a Snapshot image or set of volumes from consistency group Snapshot images. A Snapshot volume can be read-only or read/write and can be assigned to a host for I/O access. Writable Snapshot volumes have an associated expandable reserved capacity (repository) to store updated blocks from host write operations. A Snapshot volume cannot be a base volume for a Snapshot group.

## Consistency groups

A consistency group is a collection of base volumes, known as member volumes, that have a mutual consistency requirement for their Snapshot images. Consistency groups enable creation of simultaneous Snapshot images of all member volumes so that the content of multiple images represents a single point in time. This feature is useful for applications that span multiple volumes, such as a database with logs and database on different volumes. Each member volume has a Snapshot group and associated reserved capacity that is dedicated to the consistency group.

## Rollback

A base volume can be “rolled back” to a point-in-time image. A rollback operation causes the content of the base volume to revert to the selected Snapshot image. When a rollback is started, the base volume as it was at the time of the Snapshot image is immediately available for host I/O. The process of physically copying from the reserved capacity blocks that changed between the Snapshot image and the rollback request proceed in the background. The administrator can choose any Snapshot image in the Snapshot group for the rollback point. The rollback operation preserves all Snapshot images within the Snapshot group.

## Legacy Snapshot

There was an earlier implementation of Snapshot functionality in the E-Series systems, but it has been deprecated and is not covered in this document.

# Limits and restrictions

This section serves as a reference for Snapshot limits, requirements, and restrictions for the NetApp SANtricity Snapshot feature.

## Storage system limits

Table 1 lists maximum numbers of Snapshot objects allowed in each NetApp E-Series model.

**Table 1) Maximum number of Snapshot objects by E-Series model.**

Parameter	E2800/EF280 E2700*	EF300/EF600 E5700/EF570 E5600/EF560*
Snapshot images per storage system (includes images purged by auto-delete and pending due to asynchronous mirroring)	512	2,048 1,024 (EF300)
Snapshot groups per storage system	256	1,024 512 (EF300)
Snapshot groups per base volume	4	4
Snapshot images per Snapshot group	32	32
Member volumes per consistency group	32	64
Consistency groups per storage system	16	32
Snapshot volumes per storage system	256	1,024
Snapshot volumes per Snapshot image	4	4
Rollbacks per storage system in progress at once	8	8
Concatenated volumes in any given reserved capacity (repository)	16	16

\*End of availability.

## Snapshot functional requirements and restrictions

Table 2 lists requirements for use of the Snapshot feature, as well as the restrictions on interactions with other features.

**Table 2) Requirements and restrictions.**

Attribute	Requirements and restrictions
Reserved capacity (repository) location	<ul style="list-style-type: none"><li>• If the base volume is on a volume group, the reserved capacity can be on a volume group or disk pool.</li><li>• If the base volume is on a disk pool, the reserved capacity must be on the same disk pool.</li></ul>
Reserved capacity security	<p>The following list shows base volume security attributes on the left, and allowable reserved capacity attributes on the right:</p> <ul style="list-style-type: none"><li>• <b>Base volume:</b> not secure-capable – <b>Reserved capacity:</b> not secure-capable, FDE secure-capable or secure-enabled, FIPS secure-capable or secure-enabled.</li><li>• <b>Base volume:</b> FDE secure-capable but not enabled – <b>Reserved capacity:</b> FDE secure-capable or secure-enabled, FIPS secure-capable or secure-enabled.</li><li>• <b>Base volume:</b> FDE secure-enabled – <b>Reserved capacity:</b> FDE or FIPS secure-enabled.</li></ul>

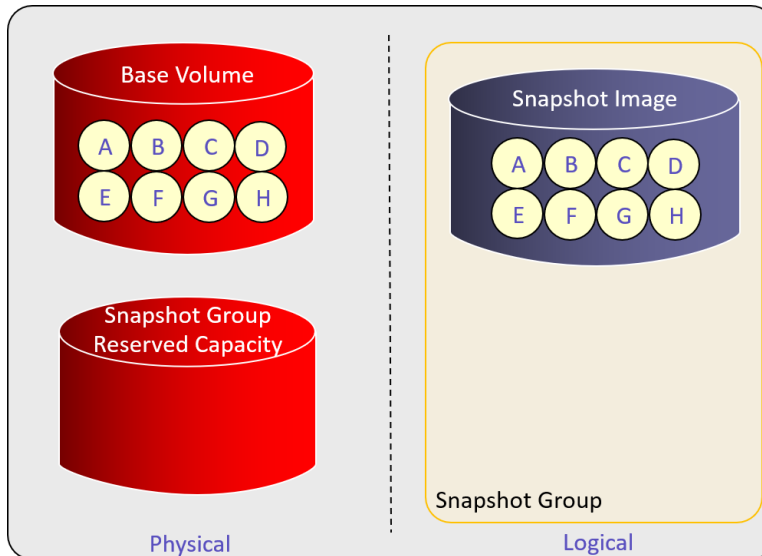
Attribute	Requirements and restrictions
	<ul style="list-style-type: none"> <li>• <b>Base volume:</b> FIPS secure-capable but not enabled – <b>Reserved capacity:</b> FIPS secure-capable or secure-enabled.</li> <li>• <b>Base volume:</b> FIPS secure-enabled – <b>Reserved capacity:</b> FIPS secure-enabled.</li> </ul>
Reserved capacity data assurance	The reserved capacity data assurance attribute must match the base volume.
Allowable base volume candidates	<ul style="list-style-type: none"> <li>• A standard volume or thin volume can become a base volume for Snapshot images.</li> <li>• A Snapshot group cannot be created with a Snapshot volume as its base volume.</li> </ul>
Snapshot volumes with other features	<ul style="list-style-type: none"> <li>• Synchronous mirroring – a Snapshot volume cannot be used as either a primary or secondary volume.</li> <li>• Asynchronous mirroring – a Snapshot volume cannot be used as either a primary or secondary volume.</li> <li>• Volume copy (offline) – a Snapshot volume can be a source but not a target.</li> <li>• Volume copy (online) – a Snapshot volume cannot be either a source or a target.</li> <li>• Thin provisioning – a Snapshot volume can be created from a Snapshot image of a thin volume.</li> <li>• Dynamic Volume Expansion (DVE) – This feature is not supported for Snapshot volumes.</li> </ul>
Rollback operations	<ul style="list-style-type: none"> <li>• Rollback on Snapshot volumes is not supported.</li> <li>• Only one rollback is allowed at a time per base volume.</li> <li>• A Snapshot image being used for a rollback cannot be deleted.</li> <li>• New Snapshot images cannot be created for a base volume during a rollback on that volume.</li> <li>• A rollback cannot be started if the base volume is undergoing Dynamic Capacity Expansion, Dynamic Volume Expansion, Dynamic RAID Migration, or Dynamic Segment Sizing. None of these operations can be started if a rollback is in progress on that base volume.</li> <li>• Volume copy (offline) – a rollback cannot be started if the base volume has an offline Volume copy relationship. An offline volume copy cannot be created involving a base volume undergoing a rollback.</li> <li>• Volume copy (online) – a rollback can be started on a base volume involved in an online volume copy. However, an online volume copy cannot be started on a base volume with a rollback in progress.</li> <li>• Asynchronous or synchronous mirroring – a rollback cannot be started on a base volume acting as a secondary volume; however, a rollback can be started on a base volume acting as primary.</li> </ul>
Controller ownership	<ul style="list-style-type: none"> <li>• The controller that owns a base volume will also own all Snapshot groups, Snapshot images, reserved capacity, and Snapshot volumes associated with that base volume. Ownership change of any one of these elements will cause ownership change of all the others.</li> </ul>
Deletion	<ul style="list-style-type: none"> <li>• Deletion of a base volume causes all Snapshot elements associated to also be deleted. The reserved capacity (repository) for any Snapshot group or Snapshot volume associated with the base volume is deleted as an entity. But the volumes that were used as part of the reserved capacity are retained as unused, unmapped volumes. They can be re-used later as reserved capacity.</li> <li>• A volume group or disk pool containing reserved capacity volumes cannot be deleted until after the associated Snapshot images or Snapshot volumes have been deleted.</li> </ul>

# Snapshot image operational model

## Snapshot groups and images

Immediately after a NetApp SANtricity Snapshot image is created, its content is identical to the base volume. In Figure 1, the left side of the image shows the physical layout while the right side of the image shows the logical view of the Snapshot group. When the Snapshot group is created, reserved capacity is allocated, but it contains only metadata and no user data until writes occur to the base volume. The Snapshot image is not viewable or writable from the host.

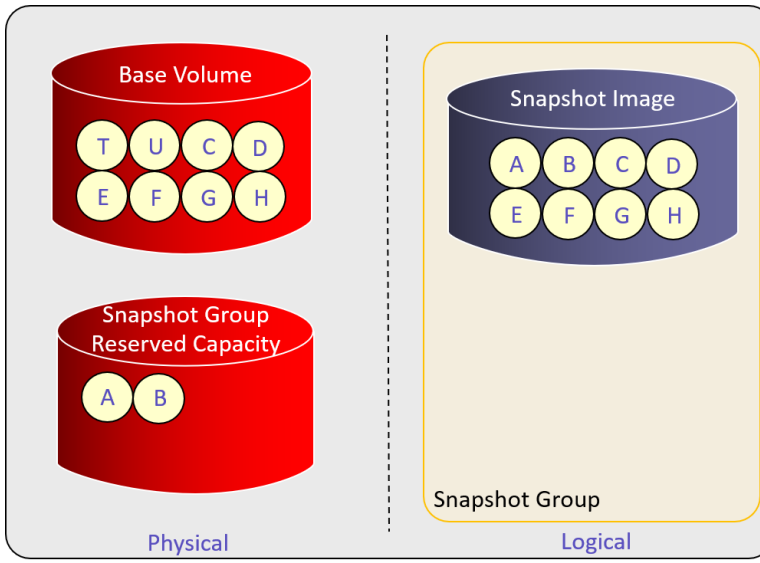
Figure 1) Snapshot image immediately after creation.



In the example shown in Figure 2, the first two blocks (with content A and B) of the base volume are overwritten by T and U. Because this is the first write to the base volume after creation of the Snapshot image, the controller will perform a copy-on-write operation to preserve the Snapshot image. Blocks with content A and B have been copied from the base volume to the Snapshot group reserved capacity, and blocks with content T and U have been written to the base volume. The logical Snapshot image has not changed.

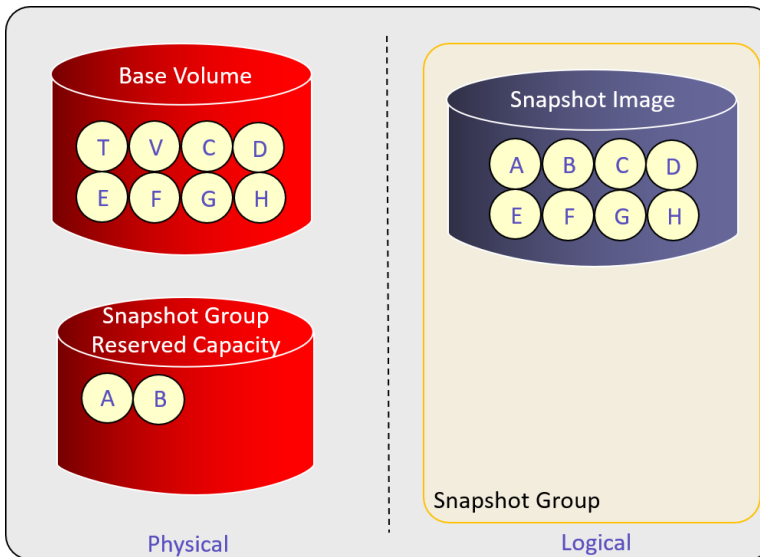


**Figure 2) Write to base volume causing copy-on-write operation.**



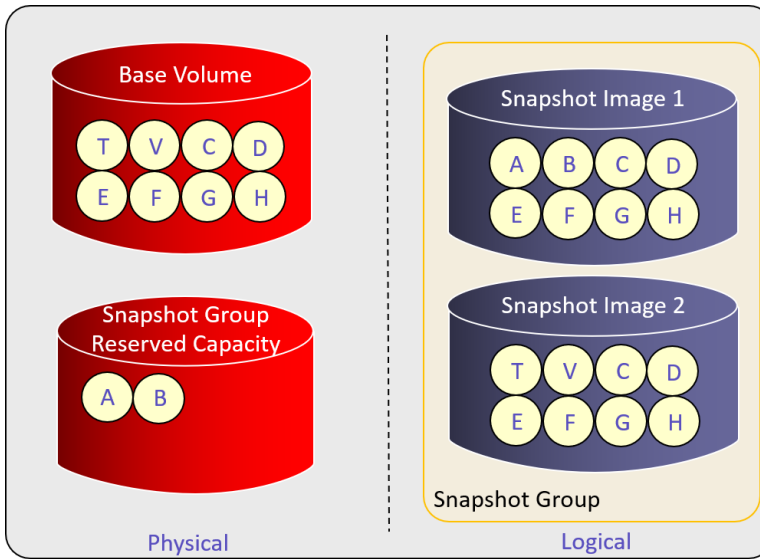
In the example shown in Figure 3, the host overwrites the content U with content V. In this case, there is no copy-on-write to preserve the Snapshot image because the original content B is already in the reserved capacity. Content V simply overwrites content U in the base volume.

**Figure 3) Write to base volume with no copy-on-write.**



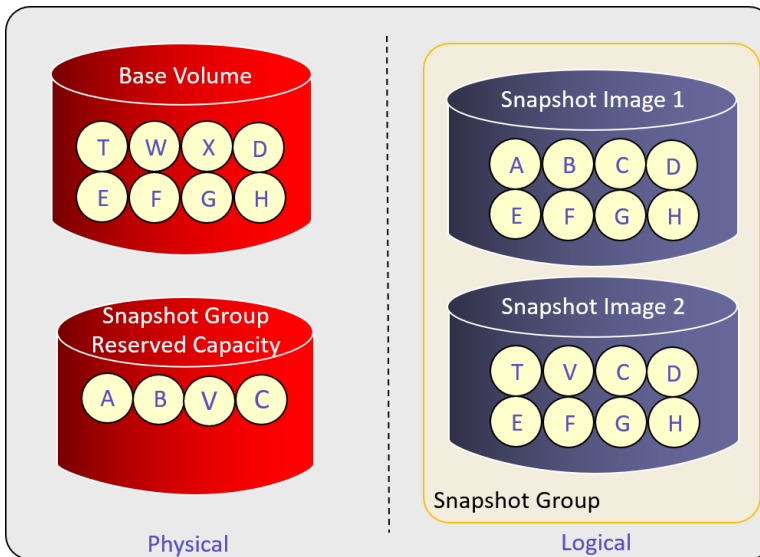
At this point, if the administrator manually or by schedule creates another Snapshot image, the base volume does not change, but there is a second Snapshot image in the Snapshot group that matches the current content of the base volume as shown in Figure 4. The reserved capacity doesn't receive any user data at this point but does maintain metadata for the time-sequencing of the two images. Snapshot image 2 in this group will always be after Snapshot image 1, even if the controller clock has changed so that the time of Snapshot 2 appears earlier than Snapshot 1.

**Figure 4) Subsequent Snapshot image immediately after creation.**



If the host now writes content W and X to the blocks on the base volume currently containing V and C, this write will trigger a copy of V and C to the reserved capacity and a write of W and X to the base volume, as shown in Figure 5.

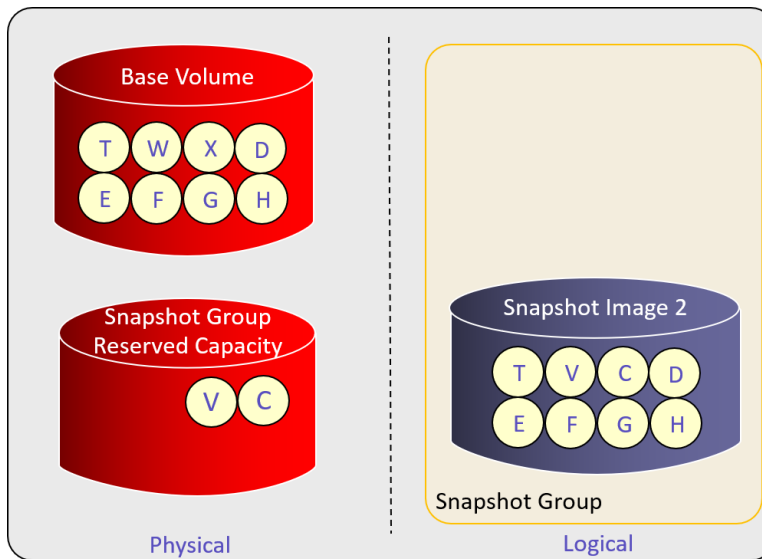
**Figure 5) Subsequent write causing copy-on-write.**



## Deleting a Snapshot image

It is possible to delete Snapshot images, but it must be done in strict order, starting with the oldest in the Snapshot group. In the example in Figure 6, that would be Snapshot Image 1. Space is freed within the reserved capacity by deleting the oldest Snapshot image. Any Snapshot volume associated with a Snapshot image being deleted will be disabled.

**Figure 6) Snapshot image deletion.**



## Deleting a Snapshot group

When a Snapshot group is deleted, all Snapshot images in the group are also deleted. The reserved capacity is deleted, and the administrator can delete the members that comprise it or retain them as unused volumes. If they are retained, they can be used for future reserved capacity requirements. Any Snapshot volume associated with a Snapshot image being deleted will be disabled.

## Snapshot image auto-deletion

The maximum number of Snapshot images in a Snapshot group is 32. However, the administrator can designate a maximum number of Snapshot images, after which the oldest image is deleted before creating a new Snapshot image. Setting the maximum number to 0 disables the auto-deletion.

## Snapshot group reserved capacity (repository)

The reserved capacity stores metadata related to copy-on-write operations and user data copied during these operations. The metadata requires at most 0.02% of the base volume capacity for each Snapshot image in the group. The Snapshot feature also reserves a small amount of space for rollback processing, 0.02% of base volume capacity. When choosing a size for the reserved capacity, the administrator needs to take these metadata needs into account. The administrator must also estimate how much of the base volume will change while there are Snapshot images in the Snapshot group. The default is 40% of base volume capacity, and the minimum allowed capacity is 32MiB plus 0.02% of the base volume for rollback processing.

## Alert on percentage of reserved capacity full

When creating a Snapshot group, the administrator can set up an alert to be notified when the reserved capacity reaches a certain percentage of being full. The default is 75%.

## Policy for behavior when reserved capacity is full

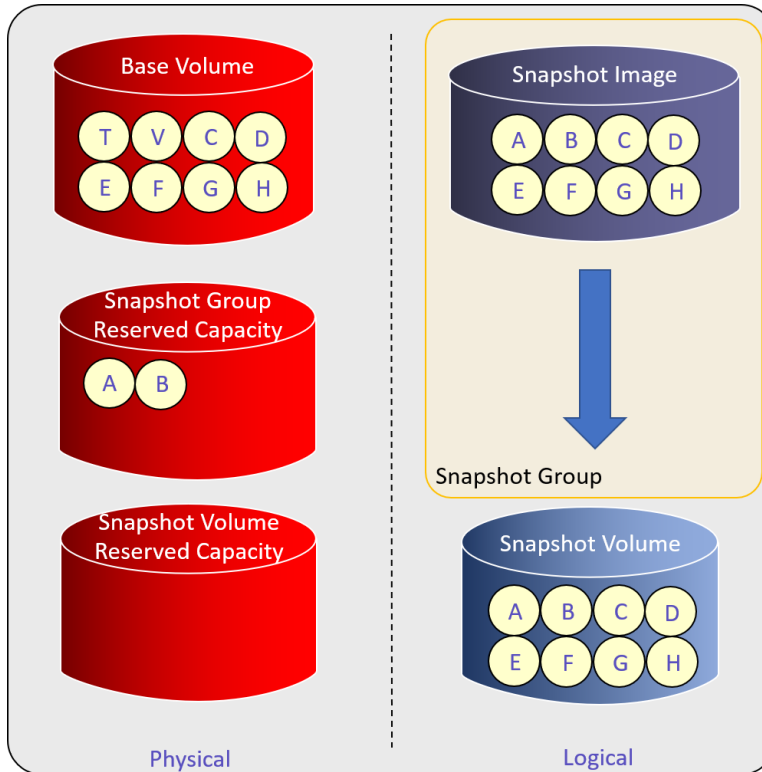
The administrator can also direct the controller on what to do when the reserved capacity is full and a write request to the base volume arrives. The administrator can select to either purge Snapshot images starting with the oldest or reject incoming write requests. When images are purged, the storage system

will raise a Needs Attention condition, and the administrator must delete the purged images to clear the condition.

## Snapshot volumes

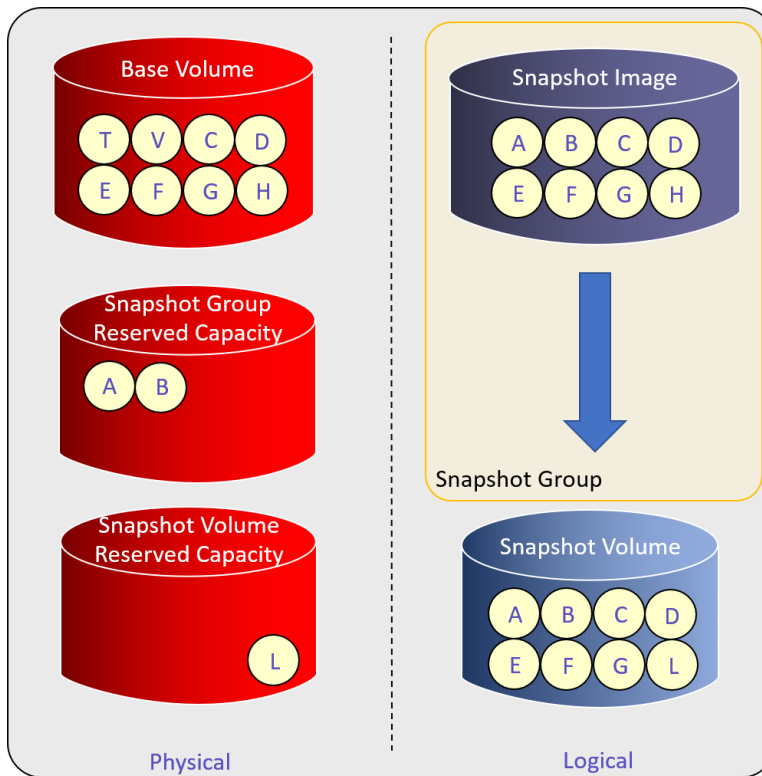
As noted earlier, a read-only or read/write volume can be created from a Snapshot image and assigned to a host. Figure 7 illustrates a Snapshot volume with its reserved capacity. The Snapshot volume reserved capacity is distinct from the reserved capacity for the Snapshot group. The reserved capacity is required only if the Snapshot volume is writable. A read-only Snapshot volume can be converted to read/write; reserved capacity is created as part of the conversion.

**Figure 7) Snapshot volume created from a Snapshot image.**



Using the example in Figure 7, if the host writes content L to the Snapshot volume that currently has content H, the new content will be physically written to the Snapshot volume reserved capacity. The new physical and logical states are shown in Figure 8. The base volume, Snapshot group reserved capacity, and the Snapshot image are unchanged. A read of the eight blocks shown in the Snapshot volume would return data from three physical sources: A and B from the Snapshot group reserved capacity, C, D, E, F, and G from the base volume, and L from the Snapshot volume reserved capacity.

**Figure 8) Snapshot volume after write from host.**



## Deleting a Snapshot volume

Deleting a Snapshot volume causes the reserved capacity and any host assignments to be also deleted. The administrator has the option of deleting the underlying reserved capacity volumes or keeping them for later use as reserved capacity.

## Disabling and recreating a Snapshot volume

The administrator might want to disable a Snapshot volume and re-create it on another Snapshot image. The Snapshot feature provides a convenient way to accomplish this task. Disabling a Snapshot results in the following:

- Any further reads or writes from the host will be rejected.
- It will be no longer associated with its Snapshot image but will still be associated with the base volume.
- Any host assignments will remain.
- The reserved capacity will be retained.

The Snapshot volume can be recreated on any Snapshot image in any Snapshot group associated with the same base volume, resulting in the following:

- The logical content of the Snapshot volume will be identical to the Snapshot image chosen.
- The reserved capacity is reused.
- The Snapshot volume will resume performing I/O operations from the host.

## Snapshot volume reserved capacity

This reserved capacity requires space for indexing metadata and all data written to the Snapshot volume. The minimum is 32MiB; the administrator should plan on this minimum, plus anticipated space needed for writes to the Snapshot volume. All writes to the Snapshot volume go to the reserved capacity. The default is 40% of the base volume capacity.

If the reserved capacity becomes full, the storage system raises a Needs Attention condition and further host writes are rejected. The administrator can set an alert for when the reserved capacity reaches a certain threshold; the default is 75%. SANtricity management software also provides a means to monitor the reserved capacity by showing how much is available for use by host writes.

## Consistency groups

A consistency group has two or more member volumes each with a dedicated Snapshot group and corresponding reserved capacity to hold the Snapshot images associated with the consistency group. Snapshot images are created all at once, either manually or via a schedule. Every time a point-in-time set of Snapshot images is taken on a consistency group, each Snapshot image contains the same timestamp and sequence number to distinguish one set of Snapshot images from all others.

At the time of consistency group creation, the administrator selects member volumes and creates the reserved capacity. More member volumes can be added later. The following attributes are managed at the consistency group level rather than at the individual Snapshot group level:

- Action taken when any reserved capacity is full (purge Snapshot images or reject writes)
- Snapshot image auto-deletion
- Percentage full for alert on reserved capacity
- Schedule
- Rollback priority

## Consistency group Snapshot volumes

Snapshot volumes for each consistency group member volume can be created for a given set of Snapshot images. SANtricity Storage Manager lets the administrator select the member volumes for which to create the Snapshot volumes, but SANtricity System Manager creates Snapshot volumes for every consistency group volume all at once. As with other Snapshot volumes, consistency group Snapshot volumes each have reserved capacity to hold index metadata and write data from the host. Member Snapshot volumes can be deleted, which results in the associated reserved capacity also being deleted with the option to retain or delete the underlying volumes that make up the reserved capacity.

Member Snapshot volumes can be disabled and re-created much as described above for regular Snapshot volumes, but this action happens for all member Snapshot volumes at once.

## Deleting a consistency group

When a consistency group is deleted, all its associated Snapshot groups, Snapshot images, and Snapshot volumes are also deleted. Reserved capacity for the Snapshot groups and Snapshot volumes is deleted, and the user can retain the underlying volumes or delete them.

## Removing a member volume from a consistency group

When a member volume is removed, its Snapshot group and reserved capacity are deleted. The administrator has the option of retaining or deleting the underlying volumes in the reserved capacity.

## Deleting a consistency group Snapshot image

When a Snapshot image in a consistency group is deleted, all Snapshot images within the consistency group with the same timestamp and sequence number are deleted at once. Any Snapshot volumes that exist on that set of Snapshot images are disabled.

## Rollback operations

One of the most important aspects of the Snapshot feature is that it lets the administrator roll back a volume or set of volumes to a previous state if an error condition occurs, whether because of a system failure or user error. The administrator can select a Snapshot image with the desired timestamp for the rollback and can set the priority of the rollback. If the Snapshot image is part of a consistency group, the administrator can select all or some of the associated base volumes to participate in the rollback.

A rollback causes the base volume or selected consistency group member volumes to revert to the point in time selected. The base volume (or member volumes) will be immediately accessible for read/write operations at the rolled back state, even though the internally generated data transfers from reserved capacity back to the base volume will occur in the background.

It is good practice to create a Snapshot image just before starting a rollback to provide a recovery point in the event the rollback fails or is canceled by the administrator. In effect, performing a rollback to this Snapshot image amounts to an undo of the rollback operation. After the undo rollback is started, any writes to the base volume that occurred between the Snapshot image and the start of the undo rollback will be lost. As an example, see the following:

1. At 4:00, the administrator discovers a problem and wants to revert to the 3:00 Snapshot image.
2. The administrator creates a Snapshot image.
3. The administrator starts a rollback to 3:00.
4. After the rollback completes, the administrator decides to undo it, and initiates a rollback to 4:00.
5. After the undo rollback completes, the base volume is at the state it was when the Snapshot image in step 2 was created. All writes to the base volume between step 2 and the start of the rollback in step 4 are lost.

## Preservation of Snapshot images during rollback

The Snapshot feature attempts to preserve all Snapshot images in all Snapshot groups associated with the base volume throughout the rollback process. Success in saving all these images depends on adequate reserved capacity during the rollback. The management GUIs (SANtricity Storage Manager and SANtricity System Manager) estimate the required reserved capacity for the rollback and will not start the rollback unless there is enough space. Of course, this estimate cannot consider any events (during the rollback) that might cause the reserved capacity space to be inadequate, such as host writes to the base volume. If such an event occurs, either Snapshot images will be purged or write requests to the base will be rejected, depending on the policy set by the administrator when the Snapshot group was created.

One exception is with other Snapshot groups in the same base volume. A rollback causes internally generated copy-on-write operations. If these operations cause a reserved capacity full condition on a Snapshot group other than the one being used for the rollback, the Snapshot feature will purge Snapshot images on that group regardless of the policy set for that group. Host-initiated writes will honor the policy.

## Canceling a rollback

A rollback in progress can be canceled by the administrator after it has been started; however, this cancellation will leave the base volume in an unknown state. One way to recover from this condition is to do a rollback to a valid Snapshot image. The management GUIs provide warnings so that the administrator is aware of the implications of canceling a rollback.

## Interactions between the Snapshot and mirroring features

Under certain circumstances, the Snapshot feature has slightly different operational characteristics when being used with asynchronous or synchronous mirroring. A discussion of these differences follows.

### Snapshot images and asynchronous mirroring

It is important to keep several aspects of asynchronous mirroring in mind when considering using the Snapshot feature with mirror consistency groups. (Mirror consistency groups are not the same as Snapshot consistency groups, also known as asynchronous mirroring groups.) First, because of potential role reversals for disaster recovery, any volume in a mirror consistency group can be either in a primary or secondary role at a given time. Second, the operation of asynchronous mirroring is such that changes on the primary member volumes of the group are written to the secondary member volumes periodically according to the synchronization interval set by the administrator. While the secondary is being updated, it does not contain a valid image of the primary at any synchronization point.

The following is a summary of how the Snapshot feature behaves differently when a base volume is a member of an asynchronous mirroring mirror consistency group:

- The policy for Snapshot group reserved capacity full will be auto-delete of Snapshot images. If a Snapshot base volume is added to a mirror consistency group, this policy is changed if the Snapshot group is set to fail base volume writes.
- The auto-deletion on maximum number of Snapshot images in a Snapshot group must be greater than zero. If a base volume is added to a mirror consistency group and has a value of 0, it will be set to the maximum of 32.
- If the base volume is acting in a primary role in asynchronous mirroring, both manual and scheduled Snapshot images are processed normally.
- If the base volume is acting in a secondary role, any requested Snapshot images will be created only between resynchronizations, such as all members of the mirror consistency group contain a valid image. If a Snapshot image is requested either manually or by schedule during a resynchronization, the Snapshot image will be in a pending state until the resynchronization is complete.

### Snapshot consistency group interaction with asynchronous mirroring

Snapshot consistency groups operate similarly to single base volume Snapshot groups with a few slight differences:

- When a member of a Snapshot consistency group is a member of a mirror consistency group, any other member of the Snapshot consistency group can be a member of the same mirror consistency group but cannot be members of any other mirror consistency group.
- Policies for reserved capacity full and auto-deletion are the same as above but apply to all members of the Snapshot consistency group.
- If any member of the Snapshot consistency group is a member of a mirror consistency group and acting in a secondary role, the same behavior as above regarding pending status during resynchronizations applies. However, it applies to the entire Snapshot consistency group. The point-in-time set of images for the Snapshot consistency group must wait until the resynchronization is complete.

### Rollback interaction with asynchronous mirroring

There are a few important interactions between Snapshot rollbacks and asynchronous mirroring.

- A rollback cannot be started on a base volume acting in a secondary asynchronous mirroring role.
- When a rollback is started on a base volume acting as a primary volume in asynchronous mirroring, the asynchronous mirror consistency group (also known as the asynchronous mirroring group) will be placed in a suspended state. If a resynchronization is in progress, it is canceled. Any writes to the



base volume during the rollback will be preserved for the asynchronous mirror group, so that after the rollback completes, resynchronizations to the secondary can resume without loss of the updates.

- During a rollback of a primary volume, an asynchronous mirroring role reversal is not allowed.
- During a rollback of a Snapshot base volume, it cannot be added to or removed from an asynchronous mirroring consistency group.

## Rollback interaction with synchronous mirroring

Interactions between rollback and synchronous mirroring are similar to, but not exactly the same as, interactions with asynchronous mirroring.

- A rollback cannot be started on a base volume acting in a secondary role with synchronous mirroring.
- If a rollback is started on a base volume acting in a primary role, the synchronous mirroring operation will be suspended. As a result, the primary and secondary will no longer be synchronized. Writes can continue to the primary, with the synchronous mirroring feature tracking all updates.
- After the rollback on a base volume in a primary role is complete, the administrator must resume the mirroring operation.
- If the rollback does not complete due to an error condition, the administrator might be able to restore the secondary to the primary to get the primary into the state it was before starting the rollback.

## Usage of the Snapshot feature with role-based access control

If the NetApp E-Series system being used is security-protected by the role-based access control (RBAC) feature, the administrator must have storage administrator privileges in order to create and modify Snapshot operations.

## Performance considerations

Copy-on-write operations related to the NetApp SANtricity Snapshot feature cause a performance impact to read/write operations on the base volume. After a Snapshot image is created, the first time a write is performed to any given area of the base volume, the controller will copy the original data from the base volume to the reserved capacity of the Snapshot group containing the image. Then the requested write operation can proceed. Because of this two-step process, the response time for the write operation will be longer than usual. It is important to keep in mind that this performance penalty does not occur on any subsequent writes to the same area of the base volume.

As described earlier, a subsequent Snapshot image for the same Snapshot group will trigger copy-on-write operations for every first write once again so that this second image can be preserved. The result is a longer response time for the write. For example, consider the following sequence:

1. Snapshot image 1 is created.
2. The host writes to area A of the base volume. A copy-on-write operation is performed.
3. The host writes to area A again. No copy-on-write is needed.
4. Snapshot image 2 is created.
5. The host writes to area A for a third time. A copy-on-write is required to preserve Snapshot image 2.
6. The host writes to area A for the fourth time. No copy-on-write is needed.

Thus, repeated Snapshot images, either done manually or through a schedule will cause more frequent copy-on-write performance impact.

Because of the internal implementation, writable Snapshot volumes also require copy-on-write operations the first time the host writes to a given area of the Snapshot volume. However, the repeated performance

penalty due to Snapshot schedules is not an issue, because a Snapshot volume is generally created once.

Finally, during a rollback, write performance on the base volume is affected both by new host writes and internally generated copy-on-write operations to support the rollback itself.

## Configure the SANtricity Snapshot feature through the management GUI

The NetApp SANtricity Snapshot feature can be configured on E-Series storage systems by means of a management GUI, CLI, or Web Services REST API. This section covers using the graphical management interfaces, SANtricity Storage Manager and SANtricity System Manager. SANtricity System Manager is the on-box GUI for currently shipping E-Series products, while SANtricity Storage Manager is the older host-installed management application for previous generations. The workflows differ slightly depending on which GUI is being used.

### Units convention

There are differences in units that are used in the management products for E-Series; for clarity, this section details those units. In this document, IEC binary units are used when referring to base 2 values, and decimal units will be used for base 10 values. Following are examples of binary units:

- KiB – kibibyte, or  $1024$  bytes
- MiB – mebibyte, or  $1024^2$  bytes
- GiB – gibibyte, or  $1024^3$  bytes
- TiB – tebibyte, or  $1024^4$  bytes
- PiB – pebibyte, or  $1024^5$  bytes

The following are examples of decimal units:

- KB – kilobyte, or  $1000$  bytes
- MB – megabyte, or  $1000^2$  bytes
- GB – gigabyte, or  $1000^3$  bytes
- TB – terabyte, or  $1000^4$  bytes
- PB – petabyte, or  $1000^5$  bytes

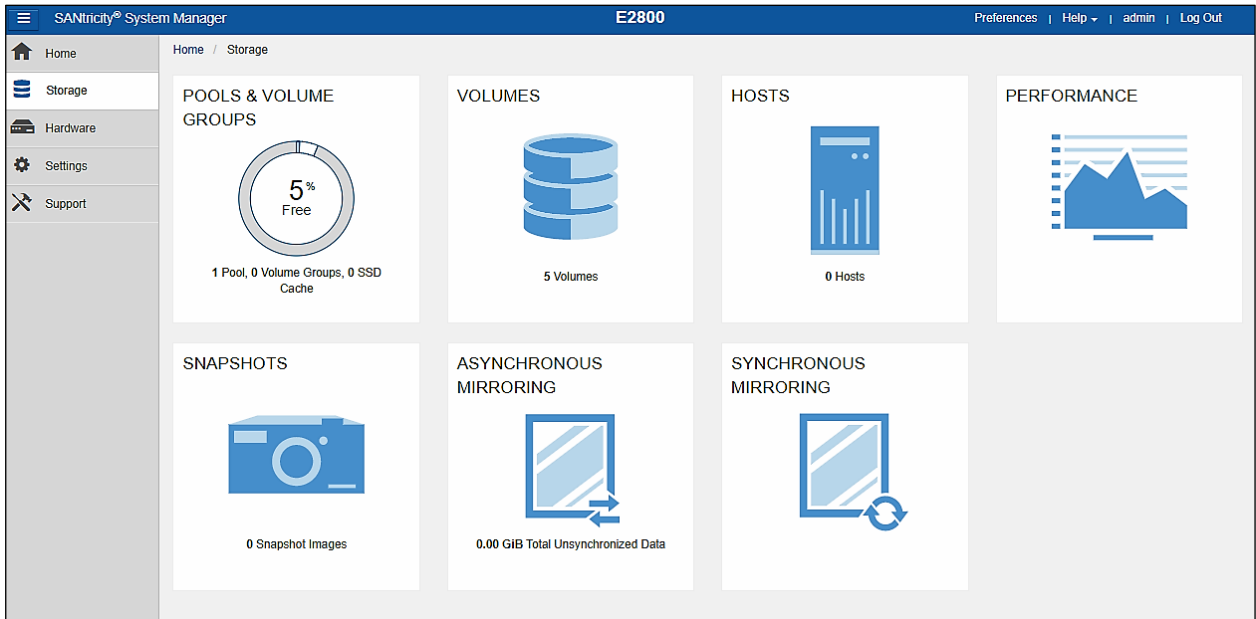
**Note:** SANtricity Storage Manager and the CLI use decimal unit labels for capacity, but the values are binary. SANtricity System Manager uses binary labels for binary values.

## Manage Snapshot groups, images, and schedules

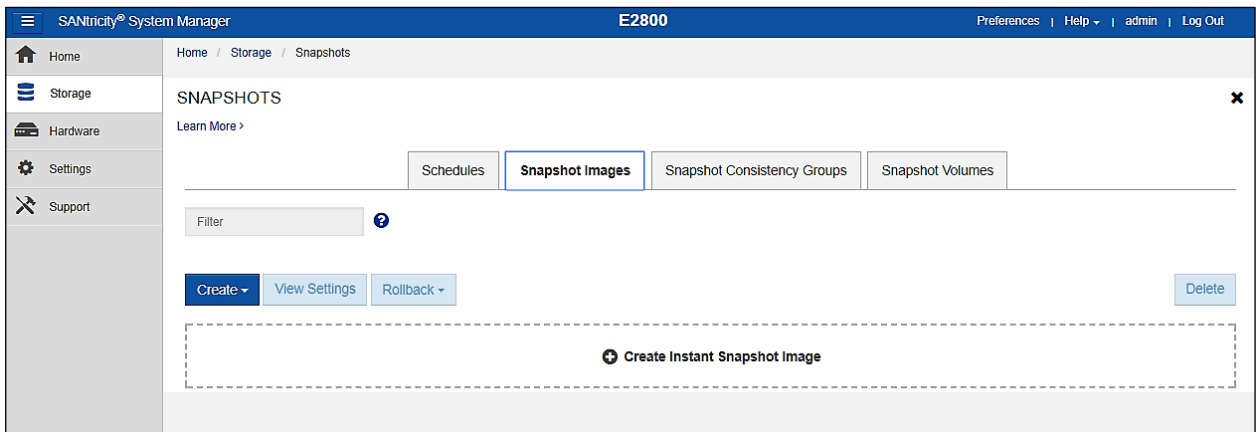
### Create Snapshot image in SANtricity System Manager

To create a Snapshot image in SANtricity System Manager, complete the following steps:

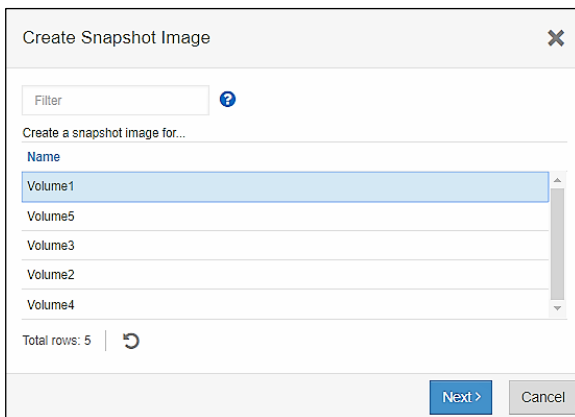
7. From the storage tiles view, select the Snapshots tile.



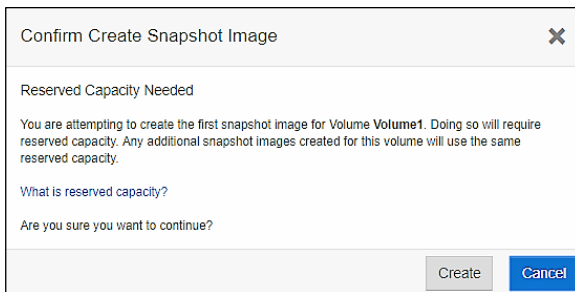
8. Select the Snapshot Images tab and click Create Instant Snapshot Image.



9. Select the volume to serve as the base volume for the Snapshot image. Click Next.



10. Read about Reserved Capacity and click Create to proceed.



Confirm Create Snapshot Image

Reserved Capacity Needed

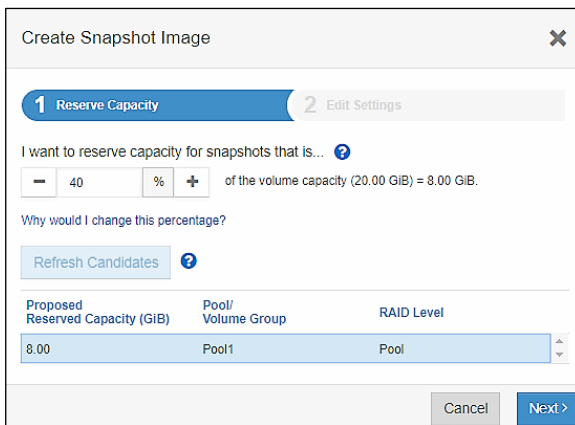
You are attempting to create the first snapshot image for Volume Volume1. Doing so will require reserved capacity. Any additional snapshot images created for this volume will use the same reserved capacity.

[What is reserved capacity?](#)

Are you sure you want to continue?

Create Cancel

11. Select Reserved Capacity size and location. The default size is 40% but can be changed up or down depending on the expected amount of change expected to the base volume while the Snapshot image is needed. Regarding the location, if the base volume is on a volume group, the reserved capacity can be on a volume group or disk pool. If the base volume is on a disk pool, the reserved capacity must be on that same pool. Click Next after making these selections.



Create Snapshot Image

1 Reserve Capacity 2 Edit Settings

I want to reserve capacity for snapshots that is... ?

- 40 % + of the volume capacity (20.00 GiB) = 8.00 GiB.

Why would I change this percentage?

[Refresh Candidates](#) ?

Proposed Reserved Capacity (GiB)	Pool/ Volume Group	RAID Level
8.00	Pool1	Pool

Cancel Next >

12. Set the policy for number of Snapshot images to allow in the Snapshot group before being auto-deleted. Maximum is 32. Set the alert threshold for reserved capacity and what to do when the reserved capacity gets full. NetApp recommends purging the oldest Snapshot image rather than rejecting writes to the base volume. Click Finish to create the Snapshot image.

Create Snapshot Image

1 Reserve Capacity

2 Edit Settings

I want the following settings to be applied...

**Snapshot image limit**

☒ Enable automatic deletion of snapshot images when...
 

-

32

+

 snapshots images have been created.

**Reserved capacity settings**

Alert me when...

-

75

%

+

 of reserved capacity is full.

Policy for full reserved capacity

☒ Purge oldest snapshot image (recommended)
 ☐ Reject writes to base volume (keep snapshot images valid)

< Back

Cancel

Finish

13. System Manager now shows a success message. Creating the Snapshot group is done behind the scenes and does not require an extra step for the administrator. If automatic deletion is disabled and the maximum number of Snapshot images (32) is reached, System Manager will prompt to give the administrator the option of creating a new Snapshot group.

SANtricity® System Manager

E2800

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Snapshot image with the timestamp Dec 20, 2017 2:01:29 PM created.

×

Learn More >

Schedules

**Snapshot Images**

Snapshot Consistency Groups

Snapshot Volumes

Filter

?

Create

View Settings

Rollback

Delete

Timestamp	Status	Associated Base Volume
Dec 20, 2017 2:01:29 PM	Optimal	Volume1

Total rows: 1

## Delete a Snapshot image in System Manager

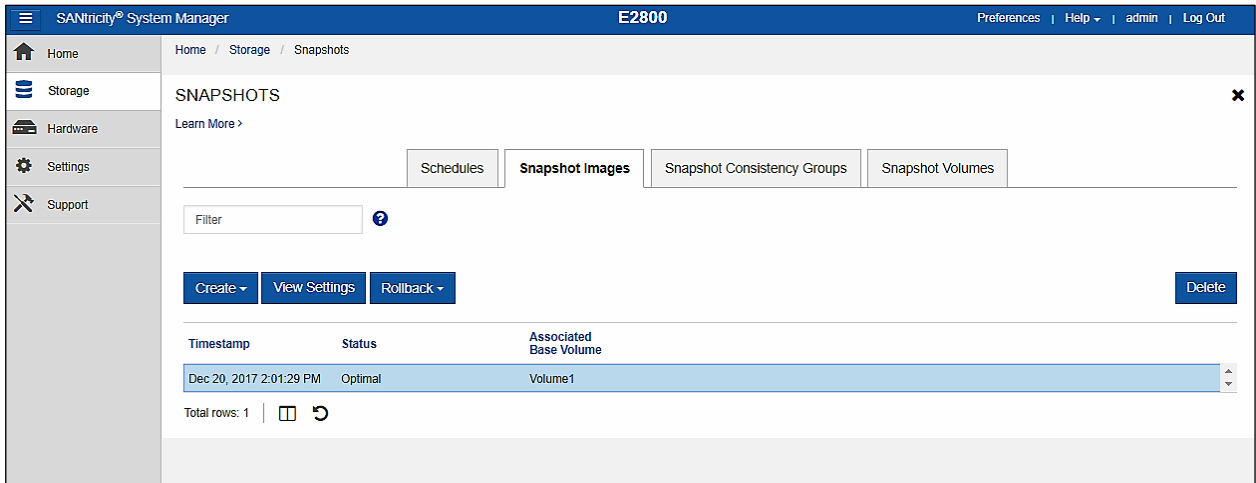
To delete a Snapshot image in System Manager, complete the following steps:

14. From the Snapshot Images tab, select the image to be deleted and click Delete.

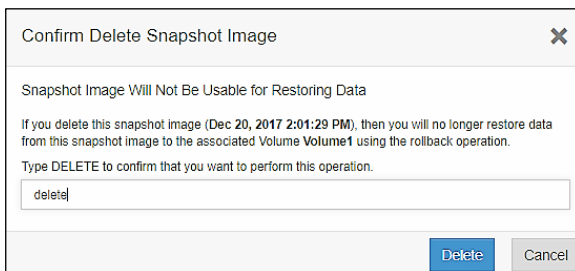
21

SANtricity Snapshot feature: Overview and deployment guide

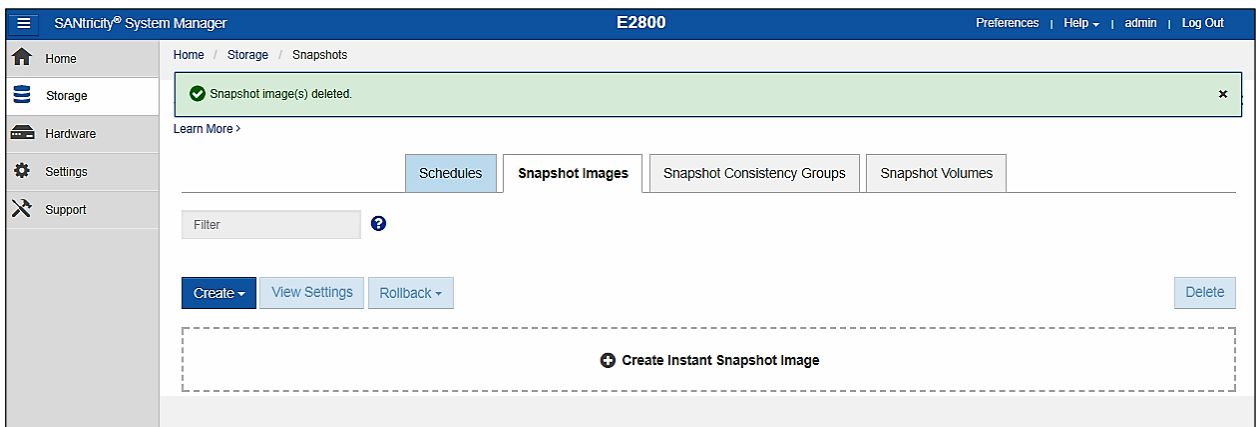
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15. Enter delete, and then click Delete to confirm.



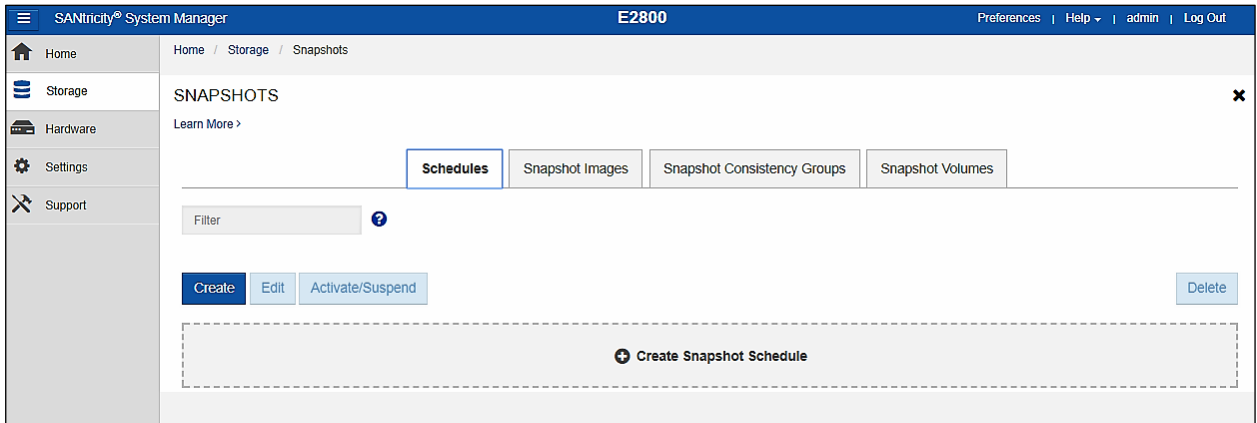
16. System Manager now shows that the deletion was successful.



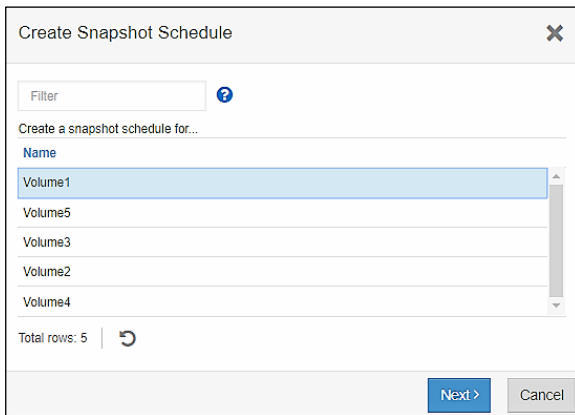
## Create a Snapshot schedule in System Manager

To create a Snapshot schedule in System Manager, complete the following steps:

1. Select the Schedules tab inside the Snapshots tile. Click Create Snapshot Schedule.



2. Select the volume to serve as the base volume for the sequence of scheduled Snapshot images. Click Next.



3. Click Show More Options and set the times for the desired Snapshot images. Click Next.

Create Snapshot Schedule

1 Create Schedule 2 Reserve Capacity 3 Edit Settings

I want snapshots for this volume to occur every...

Day/month Show fewer options

☒ Daily/Weekly  
☐ Monthly/Yearly

Select days ☒ Select all

Sun	Mon	Tue	Wed	Thu	Fri	Sat
✓	✓	✓	✓	✓	✓	✓

Start time and interval

Start time: 12:00 AM Time zone: (GMT-06:00) Central Time (US & Canada)

Snapshots per day: 1 Time between snapshots: 1 hour

☐ Create snapshot image right now?

Start and end dates

Start date: Dec 20, 2017 End date: ☐ Dec 27, 2017 ☒ No end date

Cancel Next >

- If there is not already a Snapshot group for this base volume, System Manager will now prompt to create the reserved capacity for a new Snapshot group. Set the size and location as in creating a Snapshot image. Click Next.

Create Snapshot Schedule

1 Create Schedule 2 Reserve Capacity 3 Edit Settings

I want to reserve capacity for snapshots that is... ?

- 40 % + of the volume capacity (20.00 GiB) = 8.00 GiB.

Why would I change this percentage?

Refresh Candidates ?

Proposed Reserved Capacity (GiB)	Pool/Volume Group	RAID Level
8.00	Pool1	Pool

< Back Cancel Next >

- Enter the desired Snapshot group settings, as in creating a Snapshot image. Click Finish.



Create Snapshot Schedule

1 Create Schedule

2 Reserve Capacity

3 Edit Settings

I want the following settings to be applied...

Snapshot image limit

☒ Enable automatic deletion of snapshot images when...

-

32

+

snapshot images have been created.

Reserved capacity settings

Alert me when...

-

75

%

+

of reserved capacity is full.

Policy for full reserved capacity

☒ Purge oldest snapshot image (recommended)
☐ Reject writes to base volume (keep snapshot images valid)

< Back

Cancel

Finish

- The Schedules tab now shows a success message along with the details of the schedule just created.

SANtricity® System Manager

E2800

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Snapshot schedule created.

Learn More >

Schedules

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Snapshot Consistency Groups

Snapshot Volumes

Filter

Create

Edit

Activate/Suspend

Delete

Schedule Created For	State	Frequency	Start Date	End Date	Attributes
Volume Volume1	Active	Daily/Weekly	Dec 20, 2017	None	Starts 12:00 AM, 8 snapshot image(s) per day - Every Day

Total rows: 1

## Create a Snapshot image in SANtricity Storage Manager AMW

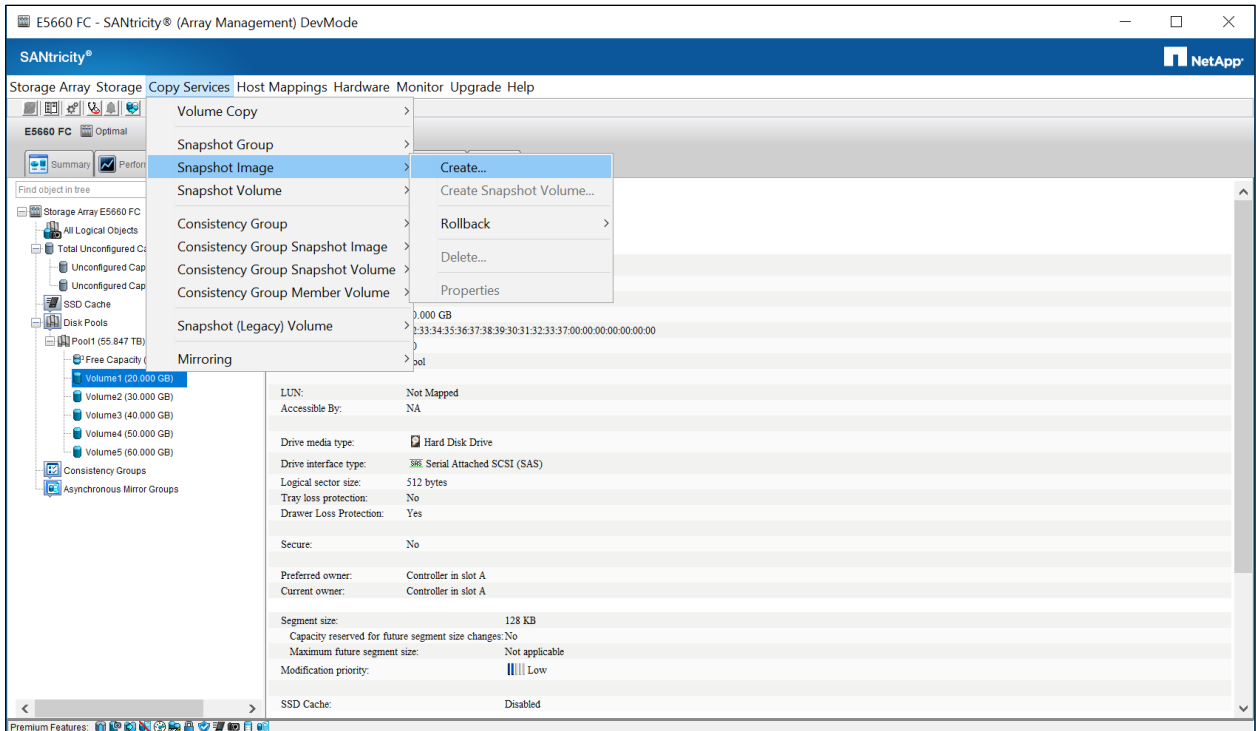
To create a Snapshot image in SANtricity Storage Manager AMW, complete the following steps:

- In AMW, select the volume to serve as the base volume, and then select Copy Services > Snapshot Image > Create.

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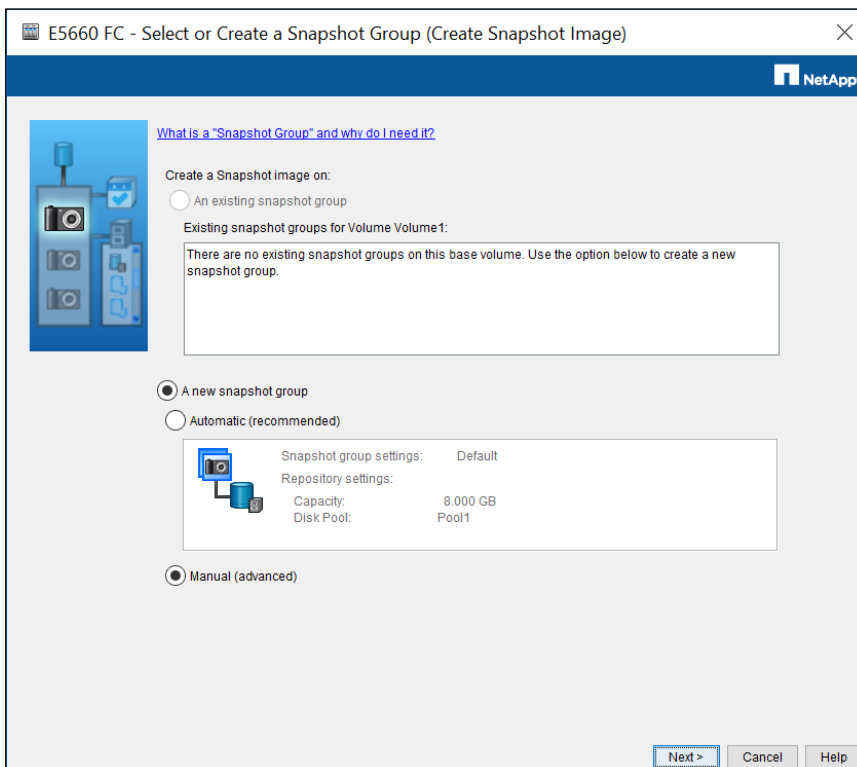
SANtricity Snapshot feature: Overview and deployment guide

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2. AMW then prompts to create a Snapshot group. Select Automatic or Manual:

- Select Automatic to choose defaults for location and repository (reserved capacity) settings, along with Snapshot group settings.
- Select Manual to allow the administrator to select other values for the settings.



Choosing Manual settings and selecting View Advanced brings up all the choices.

E5660 FC - Snapshot Group and Repository Settings (Create Snapshot Image)

Snapshot group name:

Snapshot Group Repository  
Specify repository candidate capacity by:

☒ Percentage of base volume capacity:  
Percent:  % (= 8,000 GB)

☐ Preferred capacity:  
Capacity:  Units:  (= 40% of base volume capacity)

[How are repository candidates ranked?](#)

Repository candidates:

Ranking	Repository Candidate	Capacity	Difference	Associated Element	RAID	QoS Match
1	(New)	8,000 GB	0.000 MB	Disk Pool ...	Pool	Yes

☒ Hide advanced options

☒ Enable automatic deletion of snapshot images when limit is reached  
Snapshot image limit:

Send alert when repository reaches:  % full

Policy for full repositories:  
☒ Purge oldest snapshot images (recommended)  
☐ Reject writes to base volume (keep snapshot images valid)

< Back Finish Cancel Help

The Snapshot group and Snapshot image are now viewable in AMW.

E5660 FC - SANtricity® (Array Management) DevMode

Storage Array Storage Copy Services Host Mappings Hardware Monitor Upgrade Help

E5660 FC Optimal

Summary Performance Storage & Copy Services Host Mappings Hardware Setup

Find object in tree

- Storage Array E5660 FC
  - All Logical Objects
    - Total Unconfigured Capacity (229,598 TB)
      - Unconfigured Capacity (HDD, SAS, 512 bytes) (2)
      - Unconfigured Capacity (SSD, SAS, 512 bytes) (5)
    - SSD Cache
    - Disk Pools
      - Pool1 (55,847 TB)
        - Free Capacity (55,640 TB)
        - Volume 1 (20,000 GB)
          - Snapshot Groups
            - Snapshot Images
              - Volume2 (30,000 GB)
              - Volume3 (40,000 GB)
              - Volume5 (60,000 GB)
            - Consistency Groups
            - Asynchronous Mirror Groups

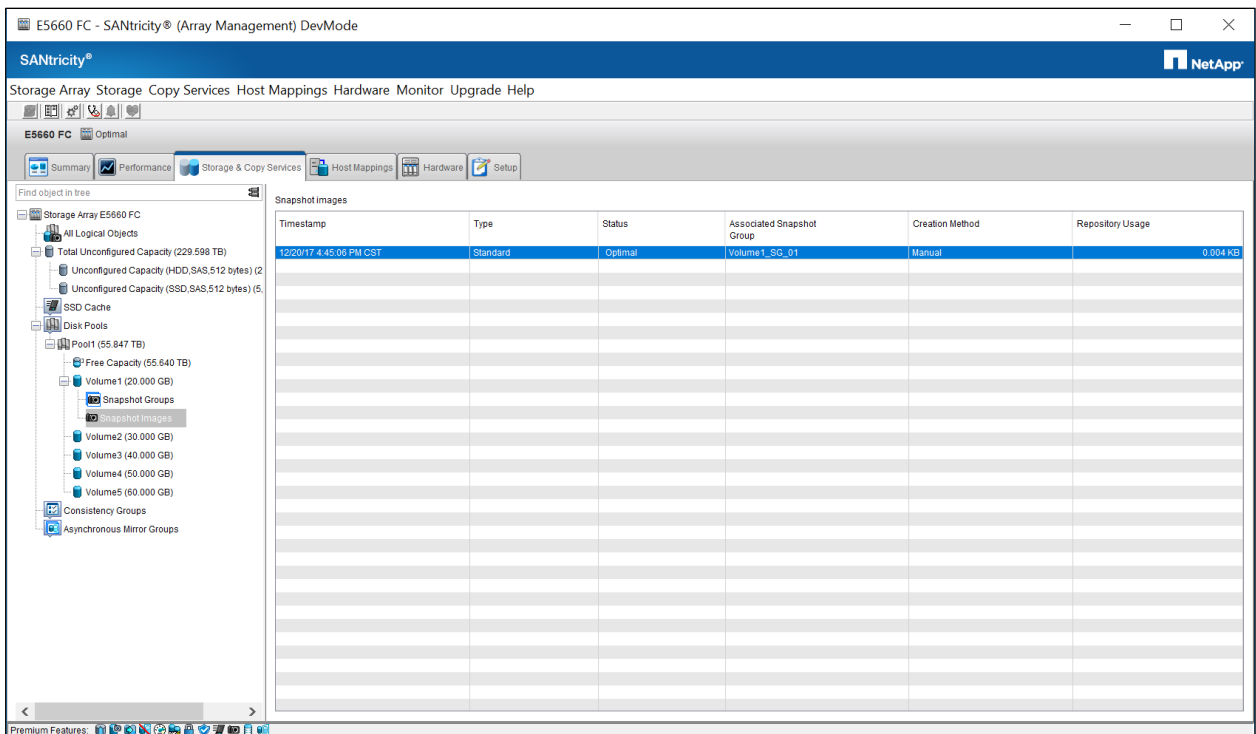
Snapshot groups

Name	Type	Status	Total Repository Capacity	Available Repository Capacity	Snapshot Image Limit	Snapshot Images	Scheduled
Volume1_SG_01	Standard	Optimal	8,000 GB	7,804 GB (98%)	32	1	No

Snapshot groups: Associated repositories

Associated Snapshot Group	Name	Status	Capacity
Volume1_SG_01	repos_0004	Optimal	8,000 GB

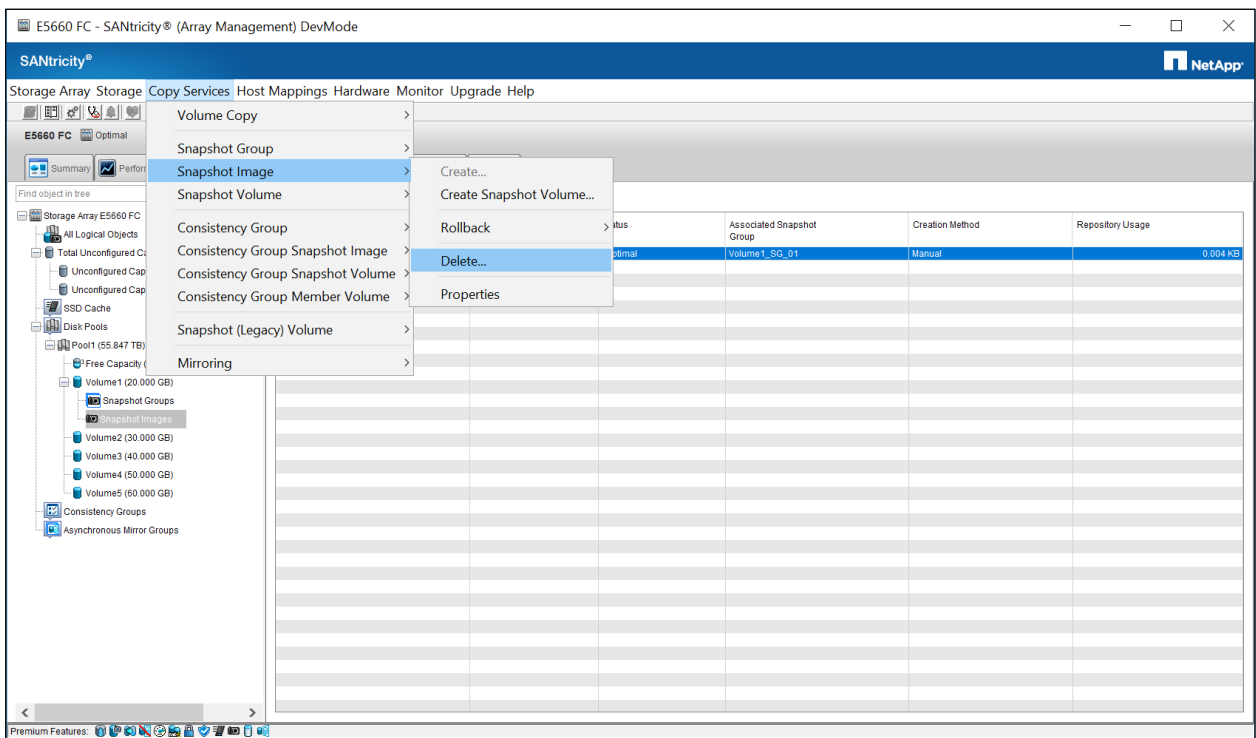
Premium Features:



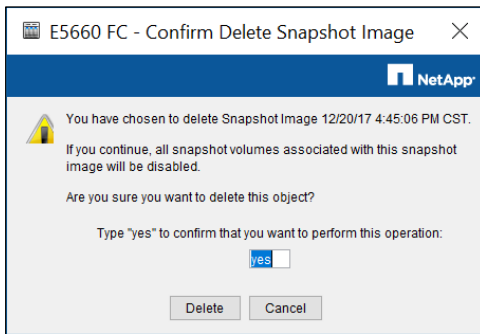
## Delete a Snapshot image in Storage Manager AMW

To delete a Snapshot image in Storage Manager AMW, complete the following steps:

1. Select the image to be deleted, and then on the Copy Services tab, select Snapshot Image > Delete.



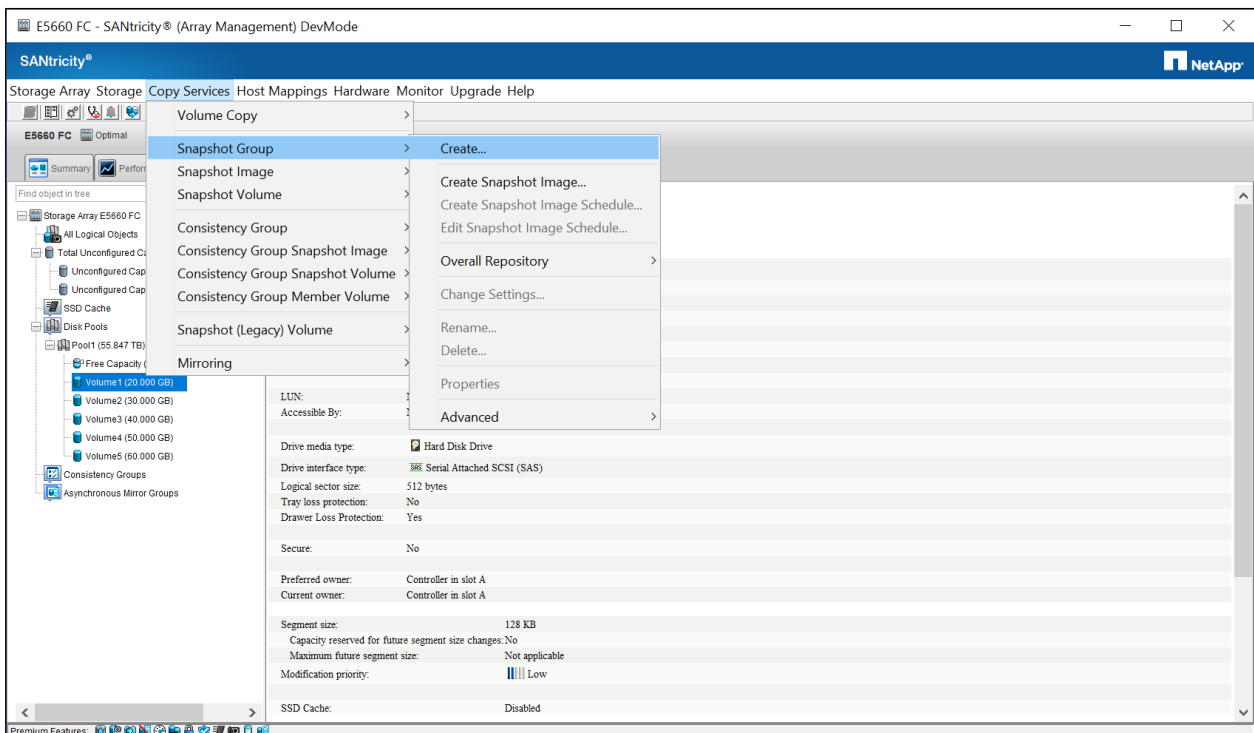
2. Enter **yes**, then click **Delete** to confirm.



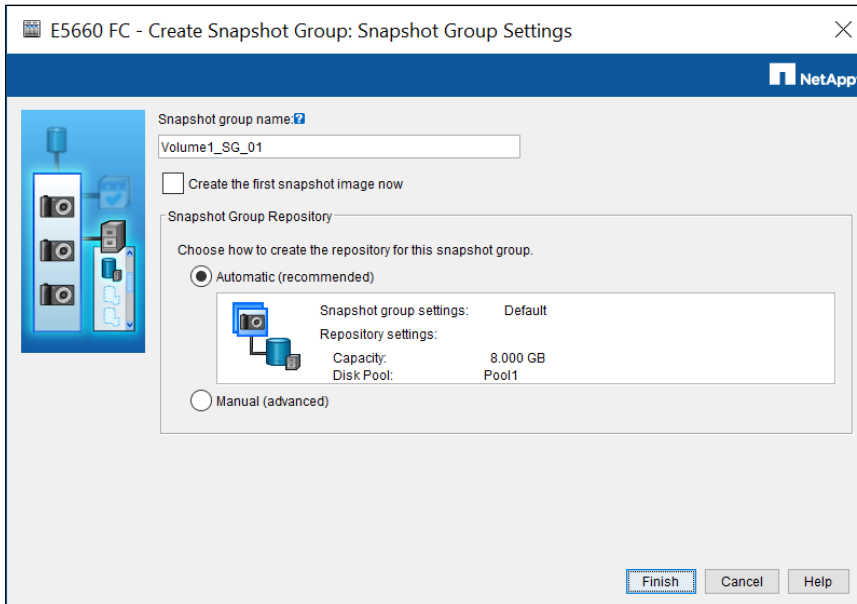
## Create a Snapshot schedule in Storage Manager AMW

To complete a Snapshot schedule in Storage Manager AMW, complete the following steps:

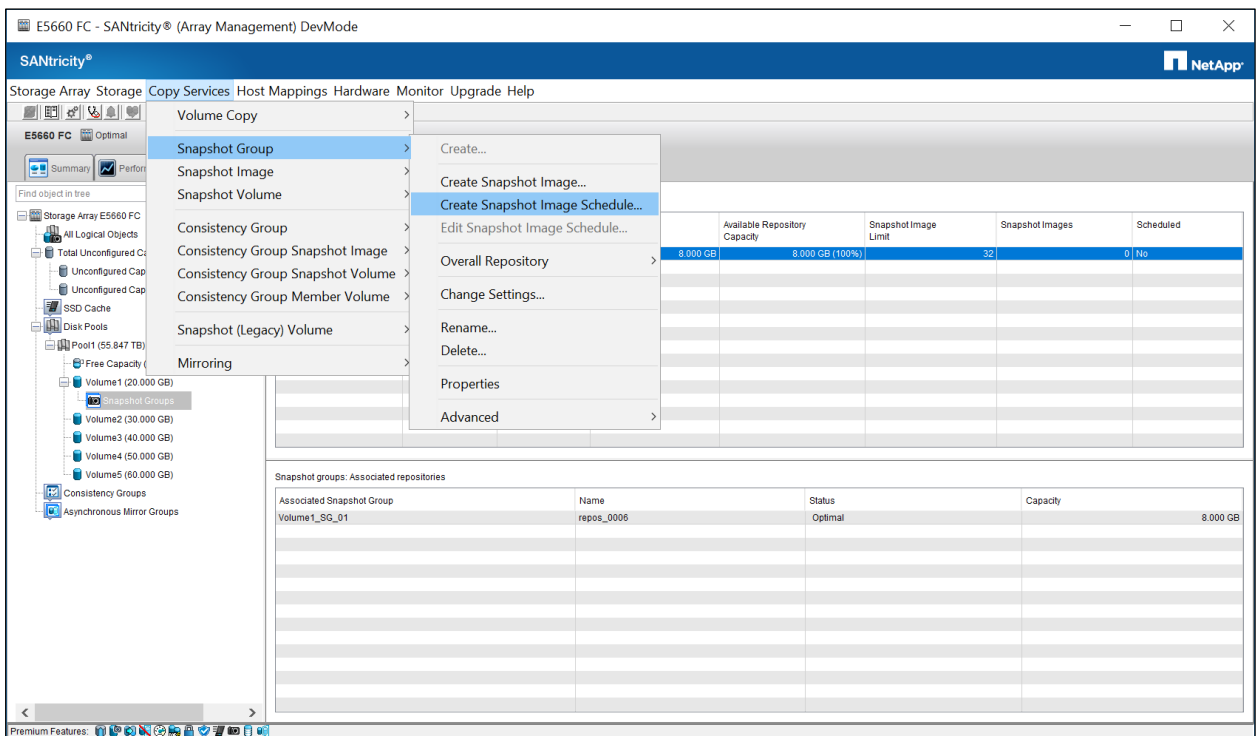
1. First, a Snapshot group must be created. Select the volume to serve as the base volume, and then on the Copy Services tab, select **Snapshot Group > Create**.



2. Select **Automatic** or **Manual** as before.



3. Select the Snapshot group, and then on the Copy Services tab, select Snapshot Group > Create Snapshot Image Schedule.



4. Select the desired schedule parameters and select Finish.

E5660 FC - Schedule Settings (Create Snapshot Image Schedule)

NetApp

Import settings from existing schedule ☒ Select all days

☒ Daily / Weekly ☐ Monthly / Yearly

☒ Sunday ☒ Monday ☒ Tuesday ☒ Wednesday  
☒ Thursday ☒ Friday ☒ Saturday

Snapshot images per day: 8 Time between Snapshot images: 3 hours

Start date: Dec 20, 2017 End date: ☐ End by: (minimum Dec 27, 2017) Dec 27, 2017  
☒ No end date

Start time: 12:00 AM Time zone: (GMT-06:00) Central Time (US & Canada)

☐ Create the first snapshot image now

Finish Cancel Help

## Manage Snapshot volumes

### Create a Snapshot volume in System Manager

The administrator can create a read-only or a read/write Snapshot volume from a Snapshot image.

1. Select the Snapshot Volumes tab in the Snapshots view. Click Create Snapshot Volume.

SANtricity® System Manager E2800 Preferences | Help | admin | Log Out

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SNAPSHOTS

Learn More >

Schedules Snapshot Images Snapshot Consistency Groups **Snapshot Volumes**

Filter ?

Create Convert to Read/Write Copy Volume View/Edit Settings Uncommon Tasks

+ Create Snapshot Volume

2. Select the Snapshot image on which to create the Snapshot volume. Click Next.

Create Snapshot Volume

Create snapshot volume(s) for...

Snapshot Image At	Associated Object
Dec 21, 2017 6:32:29 AM	Volume2

Total rows: 1

Next >

Cancel

3. Select a host to have access to the Snapshot volume or make this selection later. Choose whether it will be read/write or read-only and click Next.

Create Snapshot Volumes

1 Assign to Host

2 Reserve Capacity

3 Edit Settings

Make my snapshot volume(s) visible to...

Assign later

Access mode

☒ Read/write
 ☐ Read only

Note: Reserved capacity is not required for read only snapshot volumes.

Cancel

Next >

4. If the access mode will be read/write, enter the desired reserved capacity settings and click Next.

Create Snapshot Volumes

1 Assign to Host

2 Reserve Capacity

3 Edit Settings

I want to reserve capacity for snapshot volume that is...

40

%

of the volume capacity (30.00 GiB) = 12.00 GiB.

Why would I change this percentage?

Refresh Candidates

Proposed Reserved Capacity (GiB)	Pool/ Volume Group	RAID Level
12.00	Pool1	Pool

< Back

Cancel

Next >

5. Name the Snapshot volume and select the reserved capacity alert threshold. Click Finish.



Create Snapshot Volumes

1 Assign to Host

2 Reserve Capacity

3 Edit Settings

I want the following settings to be applied...

Snapshot volume settings

Name

Snapshot\_Vol\_2

☐ Enable SSD Cache

Reserved capacity settings

Alert me when...

-

75

%

+

of reserved capacity is full.

< Back

Cancel

Finish

System Manager now displays a success message, and the new Snapshot volume appears in the list.

SANtricity® System Manager

E2800

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✓ Snapshot volume created.

Learn More >

Schedules

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Snapshot Consistency Groups

Snapshot Volumes

Filter

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Convert to Read/Write

Copy Volume

View/Edit Settings

Uncommon Tasks

Name	Status	Reported Capacity (GiB)	Associated Base Volume	Created from Snapshot Image	Mode
Snapshot_Vol_2	Optimal	0.19	Volume2	Dec 21, 2017 6:32:29 AM	Read/write

Total rows: 1

## Delete a Snapshot volume in System Manager

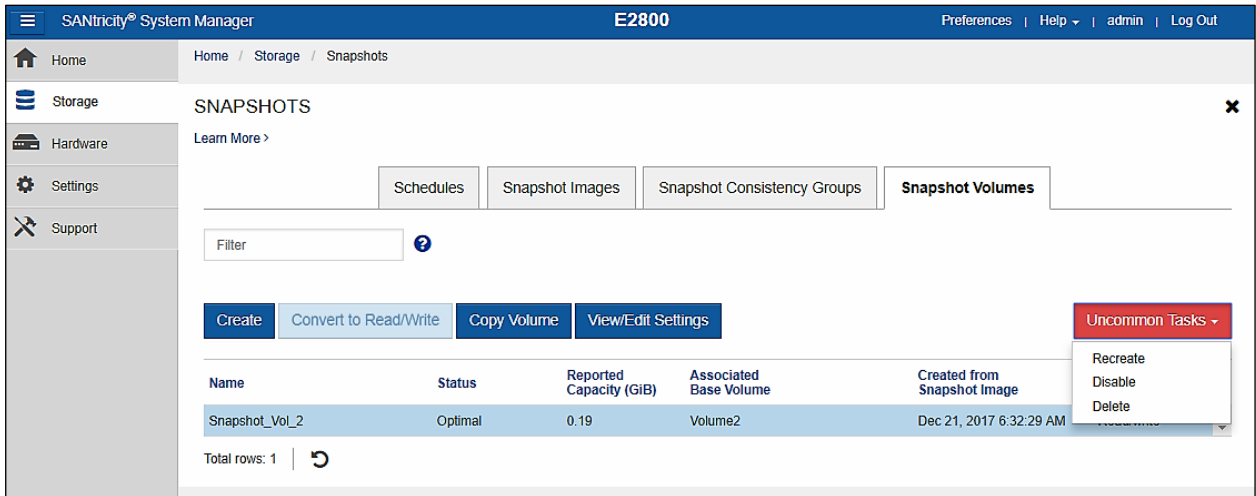
To delete a Snapshot volume in System Manager, complete the following steps:

- On the Snapshot Volumes tab, select the volume to be deleted and select the Uncommon Tasks button. Click Delete.

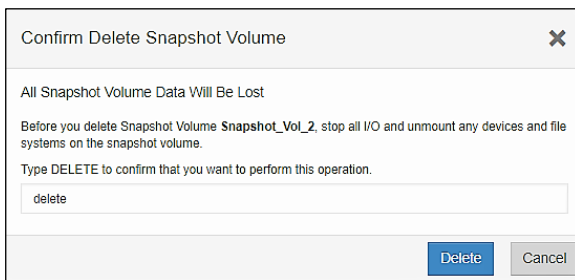
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SANtricity Snapshot feature: Overview and deployment guide

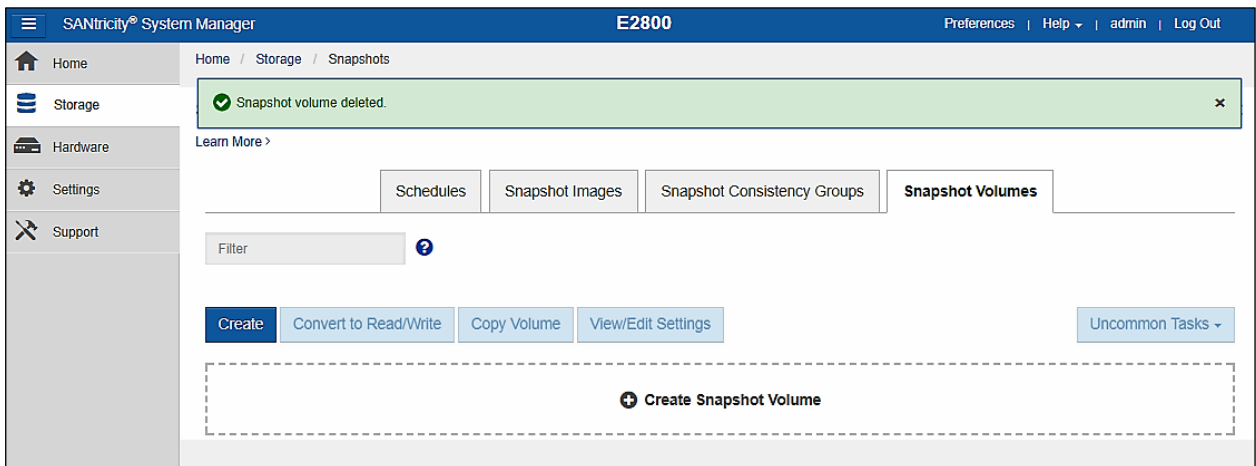
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2. Enter `delete` to confirm and then click Delete to carry out the deletion.



System Manager confirms the deletion and the Snapshot volume disappears from the list.



## Disable a Snapshot volume in System Manager

When a Snapshot volume is disabled, it is disconnected from its Snapshot image and host I/Os are rejected, but the volume retains its reserved capacity and connection to the base volume.

1. From the Snapshot Volumes tab, select the volume to be disabled and select the Uncommon Tasks button. Click Disable.



## Recreate a Snapshot volume in System Manager

It is possible to recreate a disabled Snapshot volume on any Snapshot image in the Snapshot group. Recreation will result in the Snapshot volume content being initially identical to the Snapshot image selected during the re-creation.

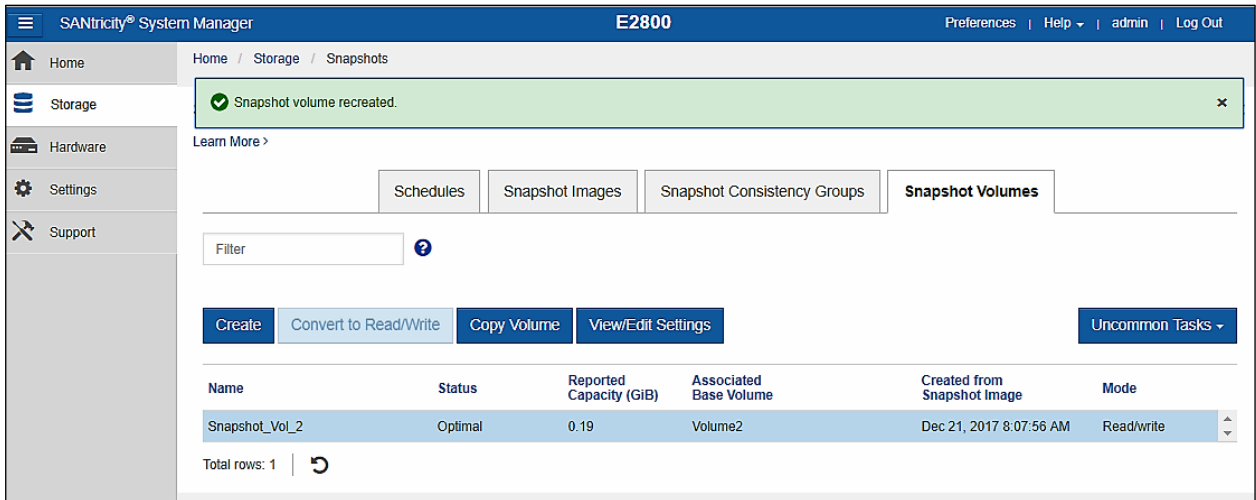
1. From the Snapshot Volumes tab, select the disabled Snapshot volume and Uncommon Tasks and click Recreate.

The screenshot shows the SANtricity System Manager interface. The top navigation bar includes 'SANtricity® System Manager', 'E2800', and links for 'Preferences', 'Help', 'admin', and 'Log Out'. The left sidebar contains navigation icons for 'Home', 'Storage', 'Hardware', 'Settings', and 'Support'. The main content area is titled 'SNAPSHOTS' and includes a 'Learn More >' link. Below this are tabs for 'Schedules', 'Snapshot Images', 'Snapshot Consistency Groups', and 'Snapshot Volumes'. The 'Snapshot Volumes' tab is selected. A 'Filter' input field is located above a table. The table has columns: 'Name', 'Status', 'Reported Capacity (GiB)', 'Associated Base Volume', and 'Created from Snapshot Image'. A single row is displayed for 'Snapshot\_Vol\_2' with a status of 'Disabled'. To the right of the table is a red 'Uncommon Tasks' button with a dropdown menu showing 'Recreate', 'Disable', and 'Delete' options. Below the table, it says 'Total rows: 1' with a refresh icon.

2. Select the Snapshot image to associate with the Snapshot volume and click Recreate.

The screenshot shows a 'Recreate Snapshot Volume' dialog box. It has a title bar with a close button. The main content area is titled 'Recreate Snapshot Volume Snapshot\_Vol\_2 using...'. There are two radio button options: 'An existing snapshot image created from Volume Volume2' (selected) and 'A new (instant) snapshot image of Volume Volume2'. Below the first option is a table with columns 'Timestamp' and 'Status'. The table contains three rows of snapshot images, all with a status of 'Optimal'. The third row, 'Dec 21, 2017 8:07:56 AM', is selected. At the bottom of the dialog are 'Recreate' and 'Cancel' buttons.

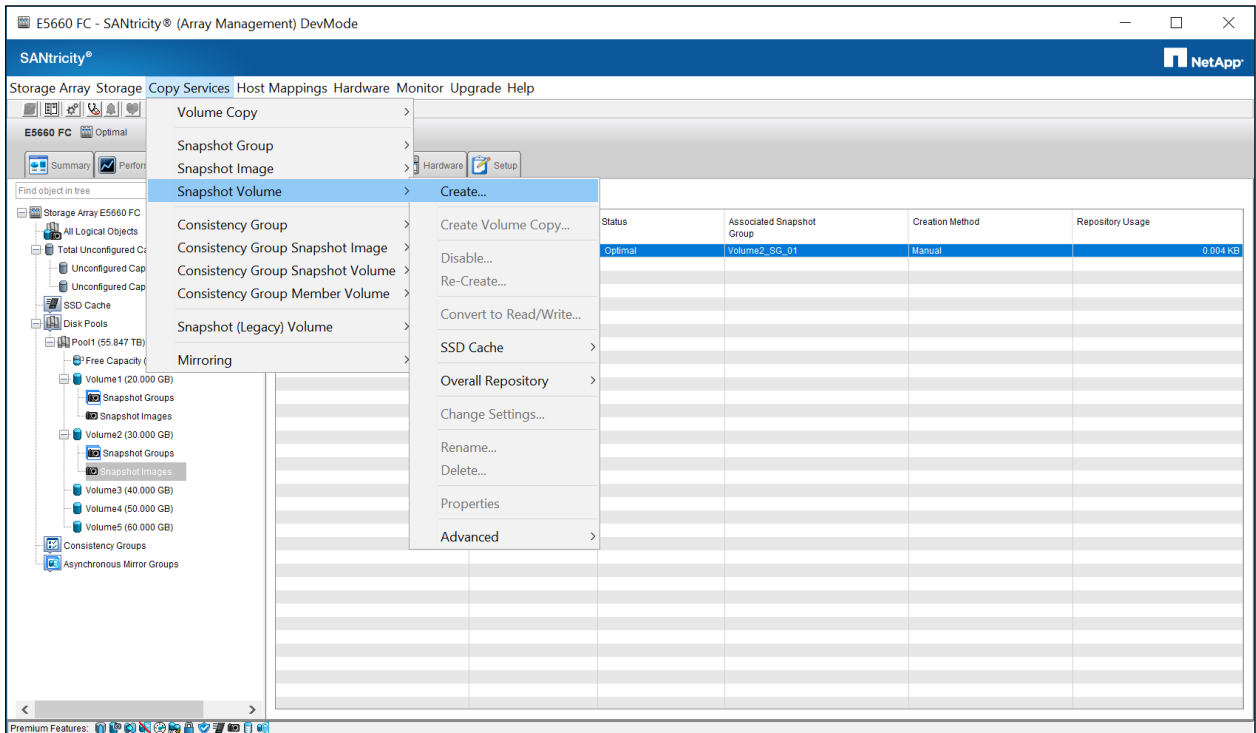
3. The Snapshot volume is now recreated and is shown as Optimal in the list.



## Create a Snapshot volume using SANtricity Storage Manager AMW

The administrator can create a read-only or a read/write Snapshot volume from a Snapshot image.

1. Select the Snapshot image on which to create the Snapshot volume, and then on the Copy Services tab, select Snapshot Volume > Create.



2. Enter a name for the new volume, select Read/Write or Read Only, and a repository creation method.

**E5660 FC - Snapshot Volume Settings (Create Snapshot Volume)**

Snapshot volume name:

Map to host:

Note: If storage partitioning is not enabled, the only option that will be displayed will be "Map Now to Default Group".

☐ Use SSD Cache

Access mode:

☒ Read/Write

☐ Read Only

Snapshot Volume Repository

Choose how to create the repository for this Snapshot Volume.

Note: Repositories are not required for Read Only Snapshot Volumes.

☒ Automatic (recommended)

Repository settings:

Capacity: 12,000 GB

Disk Pool: Pool1

☐ Manual (advanced)

**Finish** **Cancel** **Help**

The new Snapshot volume is now shown in the list.

**E5660 FC - SANtricity® (Array Management) DevMode**

Storage Array Storage Copy Services Host Mappings Hardware Monitor Upgrade Help

**E5660 FC** Optimal

Summary Performance Storage & Copy Services Host Mappings Hardware Setup

Find object in tree

- Storage Array E5660 FC
  - All Logical Objects
    - Total Unconfigured Capacity (229,598 TB)
      - Unconfigured Capacity (HDD, SAS, 512 bytes) (2)
      - Unconfigured Capacity (SSD, SAS, 512 bytes) (5)
    - SSD Cache
    - Disk Pools
      - Pool1 (55,847 TB)
        - Free Capacity (55,617 TB)
        - Volume 1 (20,000 GB)
          - Snapshot Groups
          - Snapshot Images
        - Volume 2 (30,000 GB)
          - Snapshot Groups
          - Snapshot Images
        - Volume 3 (40,000 GB)
          - Snapshot Groups
          - Snapshot Images
        - Volume 4 (50,000 GB)
          - Snapshot Groups
          - Snapshot Images
        - Volume 5 (60,000 GB)
          - Snapshot Groups
          - Snapshot Images
      - Consistency Groups
      - Asynchronous Mirror Groups

Name	Type	Status	Capacity	Snapshot Volume Timestamp	Snapshot Image Timestamp	Mode	Total Repository Capacity	Available Repository Capacity
Snapshot_Vol_2	Standard	Optimal	200,000 MB	12/21/17 8:36:16 AM CST	12/21/17 8:26:43 AM CST	Read Write	12,000 GB	8,520 GB (71%)

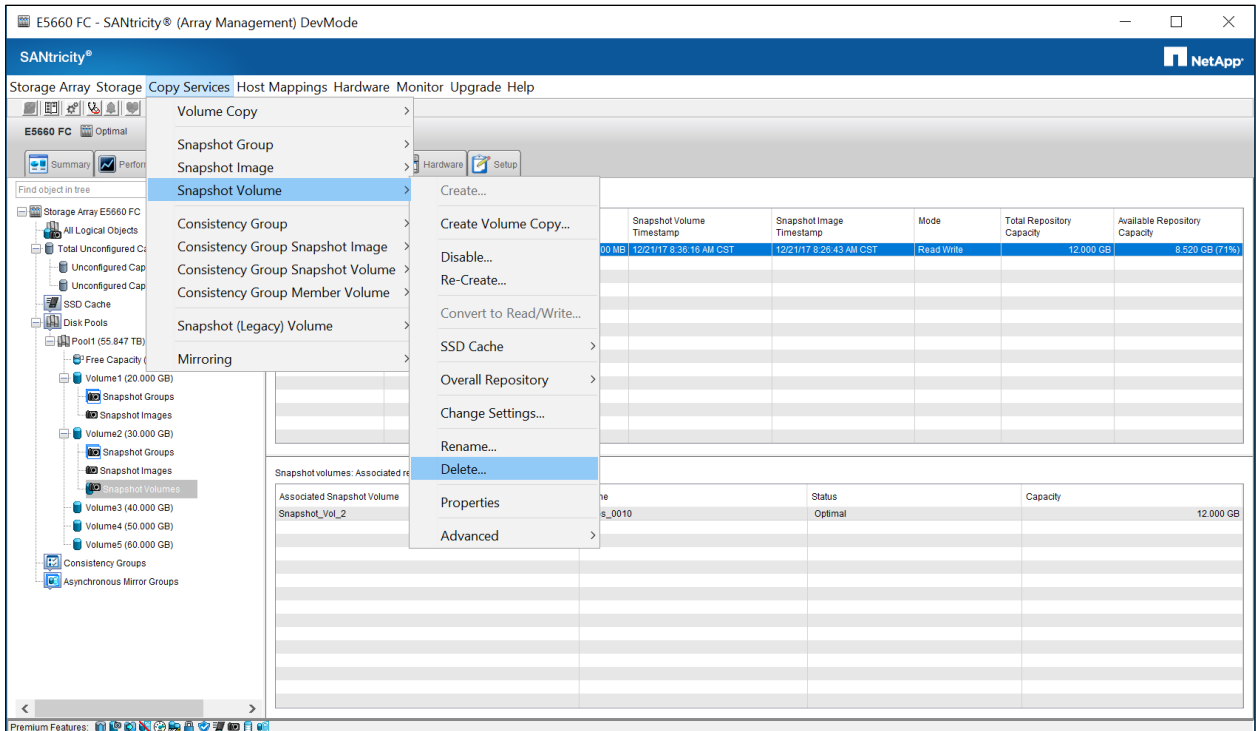
Snapshot volumes: Associated repositories

Associated Snapshot Volume	Name	Status	Capacity
Snapshot_Vol_2	repos_0010	Optimal	12,000 GB

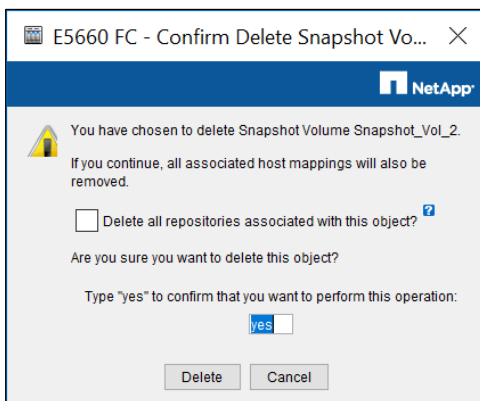
## Delete a Snapshot volume in Storage Manager AMW

To delete Snapshot volumes in Storage Manager AMW, complete the following steps:

1. Select the Snapshot volume to be deleted, and then from the Copy Services tab, select Snapshot Volume > Delete.



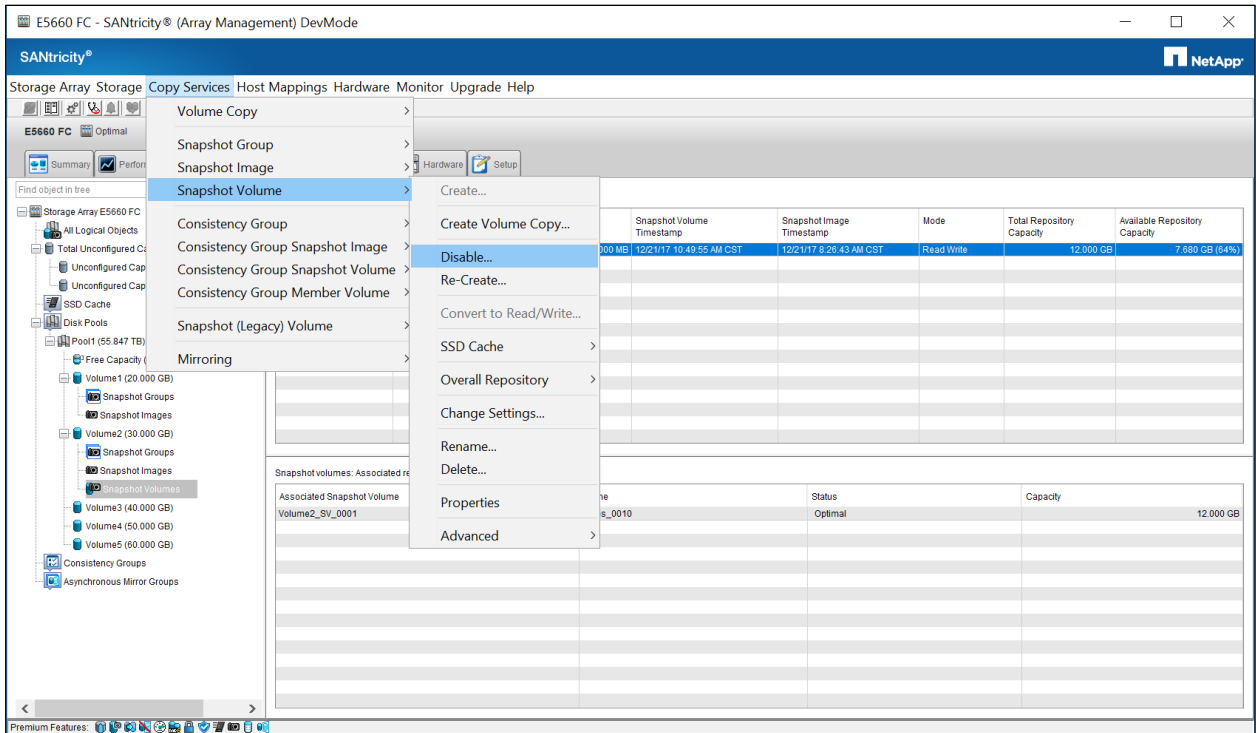
2. Select the option to delete repository volumes or leave blank to preserve the volumes for future use. Enter **yes** to confirm the deletion.



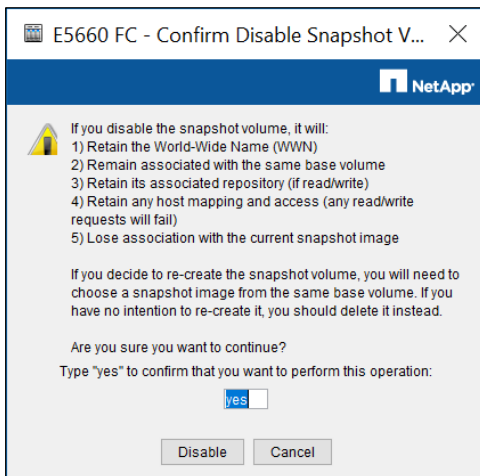
## Disable a Snapshot volume in Storage Manager AMW

When a Snapshot volume is disabled, it is disconnected from its Snapshot image and host I/Os are rejected, but the volume retains its reserved capacity and connection to the base volume.

1. Select the Snapshot Volume to be disabled, and then on the Copy Services tab, select Snapshot Volume > Disable.



2. In the warning dialog box, read the warnings and enter `yes` to confirm. Click Disable.



3. The Snapshot volume is now listed with a status of Disabled.



**Storage Array E5660 FC**

**Storage & Copy Services**

**Find object in tree**

- Storage Array E5660 FC
  - All Logical Objects
    - Total Unconfigured Capacity (229.598 TB)
      - Unconfigured Capacity (HDD, SAS, 512 bytes) (2)
      - Unconfigured Capacity (SSD, SAS, 512 bytes) (5)
    - SSD Cache
    - Disk Pools
      - Pool1 (55.847 TB)
        - Free Capacity (55.617 TB)
        - Volume1 (20,000 GB)
          - Snapshot Groups
          - Snapshot Images
          - Volume2 (30,000 GB)
            - Snapshot Groups
            - Snapshot Images
            - Snapshot Volumes
              - Volume3 (40,000 GB)
              - Volume4 (50,000 GB)
              - Volume5 (60,000 GB)
      - Consistency Groups
      - Asynchronous Mirror Groups

**Snapshot volumes**

Name	Type	Status	Capacity	Snapshot Volume Timestamp	Snapshot Image Timestamp	Mode	Total Repository Capacity	Available Repository Capacity
Volume2_SV_0001	Standard	Disabled	0.000 MB	12/21/17 10:49:55 AM CST	Not applicable	Read Write	12,000 GB	2,640 GB (22%)

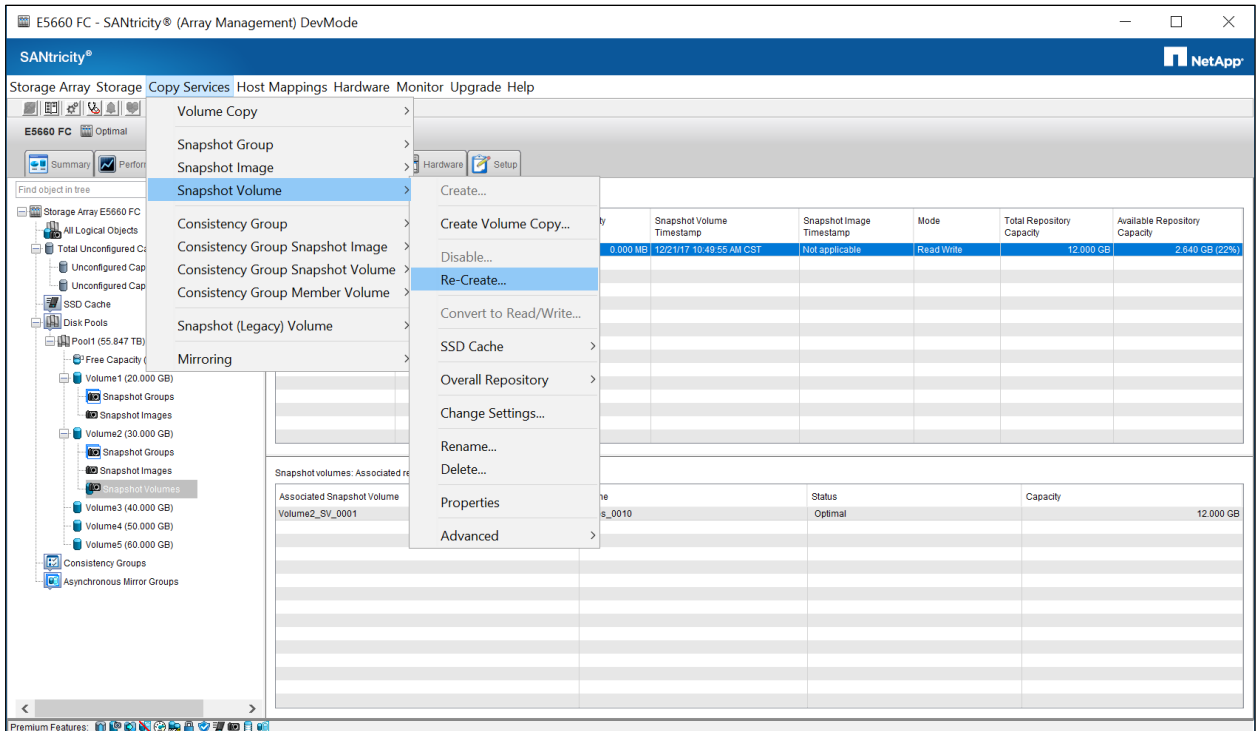
**Snapshot volumes: Associated repositories**

Associated Snapshot Volume	Name	Status	Capacity
Volume2_SV_0001	repos_0010	Optimal	12,000 GB

## Recreate a Snapshot volume in Storage Manager AMW

It is possible to recreate a disabled Snapshot volume on any Snapshot image in the Snapshot group. Recreation results in the Snapshot volume content being initially identical to the Snapshot image selected during the re-create.

1. Highlight the disabled Snapshot volume, and then from the Copy Services tab, select Snapshot Volume > Recreate.



2. In the Recreate Snapshot Volume dialog box, select a Snapshot image on which to recreate the Snapshot volume, or choose to recreate a new Snapshot image.

**E5660 FC - Re-Create Snapshot Volume**

You must refer to the specific instructions in online help for your host operating system before re-creating a snapshot volume. Failure to complete the steps listed for your host operating system may result in a loss of snapshot volume data consistency.

Re-create Snapshot Volume Volume2\_SV\_0001 using:

☒ An existing Snapshot Image

Existing snapshot images for base volume Volume2:

Snapshot Image Timestamp	Status	Snapshot Group
12/21/17 11:09:38 AM CST	Optimal	Volume2_SG_01
12/21/17 11:09:23 AM CST	Optimal	Volume2_SG_01
12/21/17 8:26:43 AM CST	Optimal	Volume2_SG_01

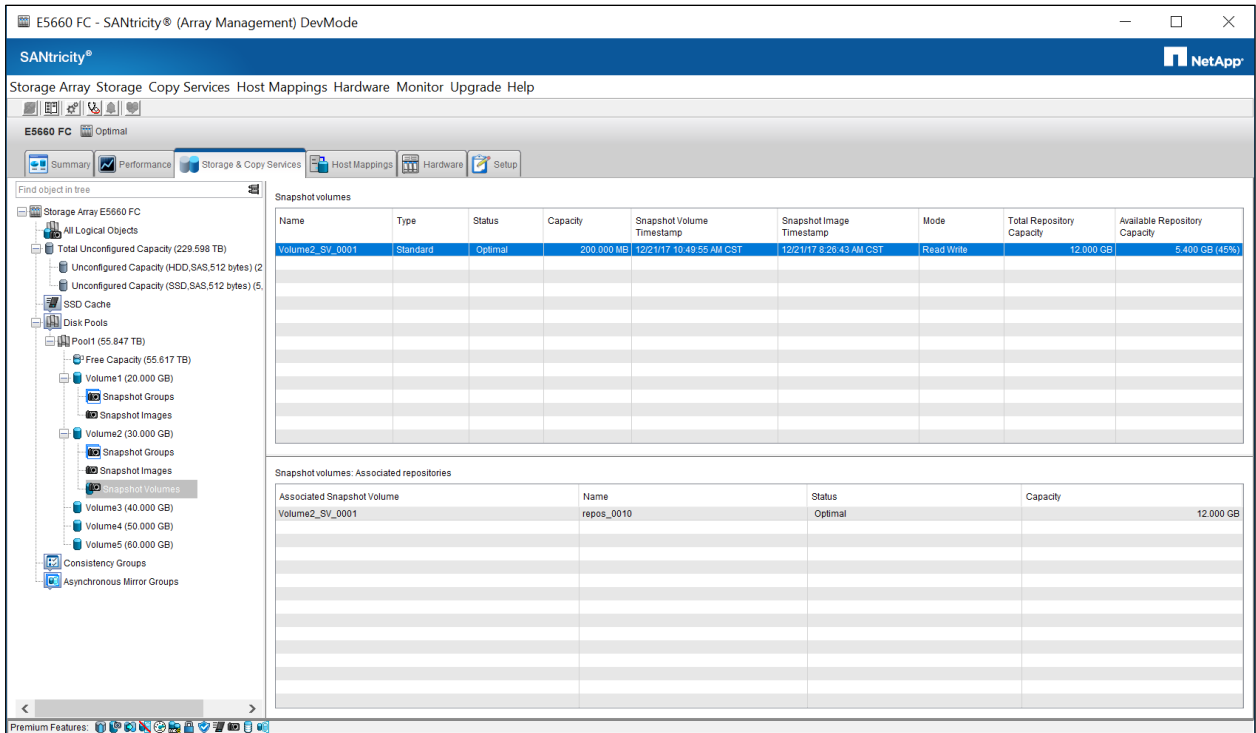
☐ A new snapshot image (on an existing snapshot group)

Existing snapshot groups for base volume Volume2:

Snapshot Group Name	Snapshot Images	Snapshot Image Limit	Total Repository Capacity	Available Repository Capacity
Volume2_SG_01	3	32	12,000 GB	11,414 GB (95%)

Re-Create Cancel Help

The Snapshot volume now shows an Optimal status with the new image timestamp.

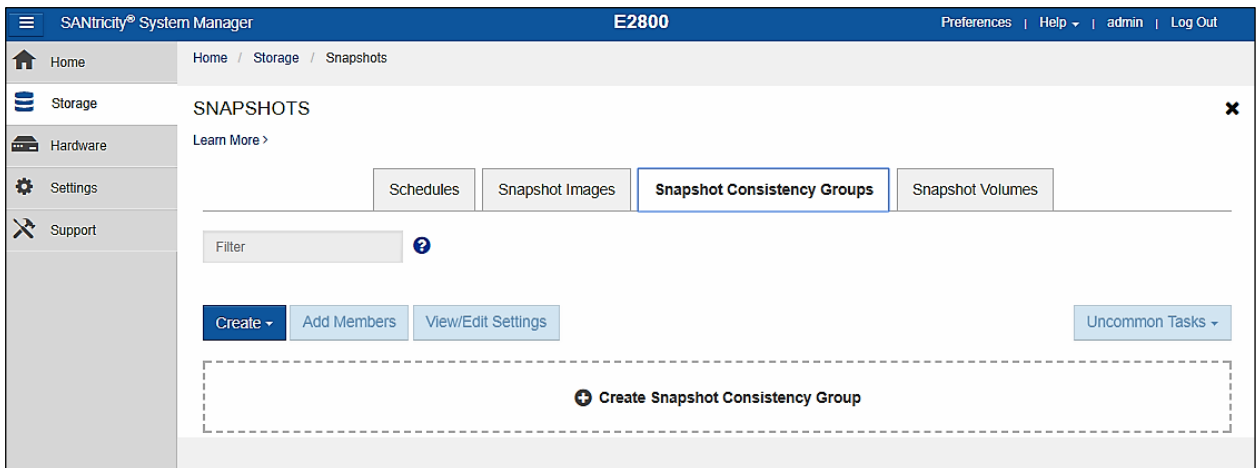


## Manage Snapshot consistency groups

### Create a consistency group in System Manager

To create a consistency group in System Manager, complete the following steps:

1. On the Snapshots page, select the Snapshot Consistency Groups tab, and click Create Snapshot Consistency Group.



2. Select the volumes to be members of the Consistency Group and click Next.

Create Snapshot Consistency Group

1 Add Members

2 Reserve Capacity

3 Edit Settings

I want the snapshot consistency group to contain the following volumes as members...

Why would I create a snapshot consistency group?

?

Eligible volumes ?

<input type="checkbox"/> Name	Reported Capacity (GiB)	Pool/ Volume Group
<input type="checkbox"/> Volume1	20.00	Pool1
<input checked="" type="checkbox"/> Volume5	60.00	Pool1
<input checked="" type="checkbox"/> Volume3	40.00	Pool1
<input type="checkbox"/> Volume2	30.00	Pool1
<input checked="" type="checkbox"/> Volume4	50.00	Pool1

Selected rows: 3 of 5

Cancel

Next >

- Select the reserved capacity percentage for the consistency group. This value will be used for all member volumes. Each individual percentage can be changed by clicking on Change Candidate. Click Next when the value has been set.

Create Snapshot Consistency Group

1 Add Members

2 Reserve Capacity

3 Edit Settings

I want to reserve capacity for snapshot consistency group snapshot images that is... ?

-

40

%

+

of each member volume's capacity.

Why would I change this percentage?

Refresh Candidates

?

Reserved Capacity (GiB)	Associated Member Volume	Pool/ Volume Group	RAID Level	Edit
16.00	Volume3	Pool1	Pool	Change candidate
20.00	Volume4	Pool1	Pool	Change candidate
24.00	Volume5	Pool1	Pool	Change candidate

Why do I need reserved capacity for every member volume?

< Back

Cancel

Next >

- Enter the name for the consistency group, select the automatic deletion policy, set the reserved capacity alert threshold, and select the reserved capacity full policy. Note that these settings are on the whole consistency group basis, not on individual members. Click Finish.

Create Snapshot Consistency Group

1 Add Members

2 Reserve Capacity

3 Edit Settings

I want the following settings to be applied...

Snapshot consistency group settings

Name

CG\_001

☒ Enable automatic deletion of snapshot images when...
 

-

32

+

snapshot images have been created.

Reserved capacity settings

Alert me when...

-

75

%

+

of reserved capacity is full.

Policy for full reserved capacity

☒ Purge oldest snapshot image (recommended)
   
☐ Reject writes to base volume (keep snapshot images valid)

< Back

Cancel

Finish

System Manager now confirms that the consistency group has been created.

SANtricity® System Manager

E2800

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✓ Snapshot consistency group has been created. [Create a snapshot schedule for this group >](#)

Learn More >

Schedules

Snapshot Images

Snapshot Consistency Groups

Snapshot Volumes

Filter

Create

Add Members

View/Edit Settings

Uncommon Tasks

+

Create Snapshot Consistency Group

Creating a Snapshot image on the consistency group is accomplished in the same way as a single Snapshot image. But afterward, System Manager shows Snapshot images for all member volumes with exactly the same timestamp.

**SNAPSHOTS**

Learn More >

Schedules **Snapshot Images** Snapshot Consistency Groups Snapshot Volumes

Filter ?

Create View Settings Rollback Delete

Timestamp	Status	Associated Base Volume	Associated Snapshot Consistency Group	Associated Snapshot Volumes
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None	None
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	None	Snapshot_Vol_2
Dec 21, 2017 12:56:03 PM	Optimal	Volume3	CG_001	None
Dec 21, 2017 12:56:03 PM	Optimal	Volume4	CG_001	None
Dec 21, 2017 12:56:03 PM	Optimal	Volume5	CG_001	None

Total rows: 6

## Delete a consistency group Snapshot image in System Manager

To delete a consistency group Snapshot image in System Manager, complete the following steps:

1. Select one of the Snapshot images in the consistency group and click Delete.

**SNAPSHOTS**

Learn More >

Schedules **Snapshot Images** Snapshot Consistency Groups Snapshot Volumes

Filter ?

Create View Settings Rollback Delete

Timestamp	Status	Associated Base Volume	Associated Snapshot Consistency Group	Associated Snapshot Volumes
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None	None
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	None	Snapshot_Vol_2
Dec 21, 2017 12:56:03 PM	Optimal	Volume3	CG_001	None
Dec 21, 2017 12:56:03 PM	Optimal	Volume4	CG_001	None
Dec 21, 2017 12:56:03 PM	Optimal	Volume5	CG_001	None

Total rows: 6

2. Select the member volume Snapshot images to delete. NetApp recommends deleting all at once. Enter `delete` and click Delete.

Confirm Delete Snapshot Image

Snapshot Image Will Not Be Usable for Restoring Data and Snapshot Volume(s) Affected

If you delete this snapshot image (Dec 21, 2017 12:56:03 PM), then all associated snapshot volumes will be disabled. Also, you will not be able to restore data from this snapshot image to the associated Volume **Volume3** using the rollback operation.

What is the disabled state?

**Note:** Because this snapshot image was created from a snapshot consistency group, there are additional snapshot images at Dec 21, 2017 12:56:03 PM for each snapshot consistency group member volume. It is recommended that you delete these snapshot images, as well.

Select the member volume snapshot images you want to delete...

Snapshot Image For	Associated Snapshot Volume
<input checked="" type="checkbox"/> Volume3	None
<input checked="" type="checkbox"/> Volume4	None
<input checked="" type="checkbox"/> Volume5	None

Selected rows: 3 of 3

Type DELETE to confirm that you want to perform this operation.

delete

Delete

Cancel

System Manager confirms the deletion, and all the images are removed from the list.

SANtricity® System Manager

E2800

[Preferences](#) | [Help](#) | [admin](#) | [Log Out](#)

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Snapshot image(s) deleted.

Learn More >

Schedules

Snapshot Images

Snapshot Consistency Groups

Snapshot Volumes

Filter

?

Create

View Settings

Rollback

Delete

Timestamp	Status	Associated Base Volume	Associated Snapshot Volumes
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	Snapshot_Vol_2

Total rows: 3

## Remove a member volume from the consistency group in System Manager

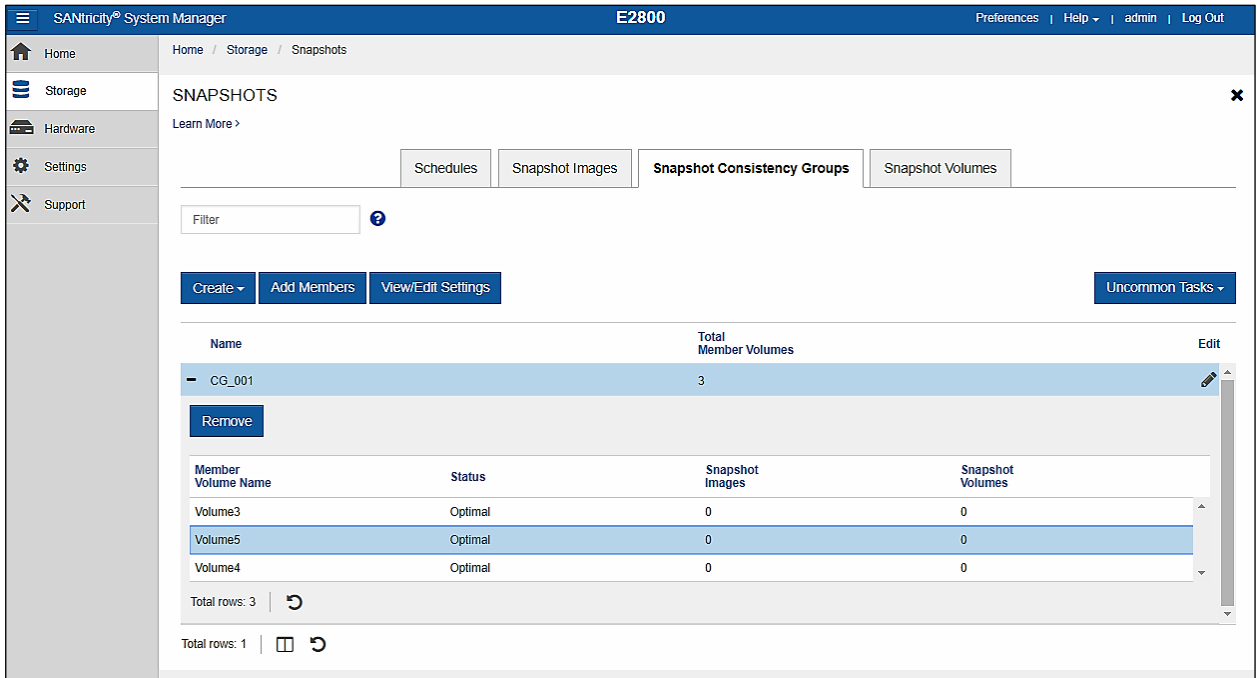
To remove a member volume from the consistency group in System Manager, complete the following steps:

1. From the Snapshot Consistency Groups tab, select the members to be removed. Click Remove.

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SANtricity Snapshot feature: Overview and deployment guide

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2. Read the warnings, then enter `remove` to confirm, then click Remove.

Confirm Remove Member Volume

All Associated Snapshot Images and Snapshot Volumes Will Be Deleted

If you remove Member Volume **Volume5**, then all snapshot volumes and snapshot images associated with the member volume will be deleted. The member volume will NOT be deleted.

Associated snapshot image(s): 0

Associated snapshot volume(s): 0

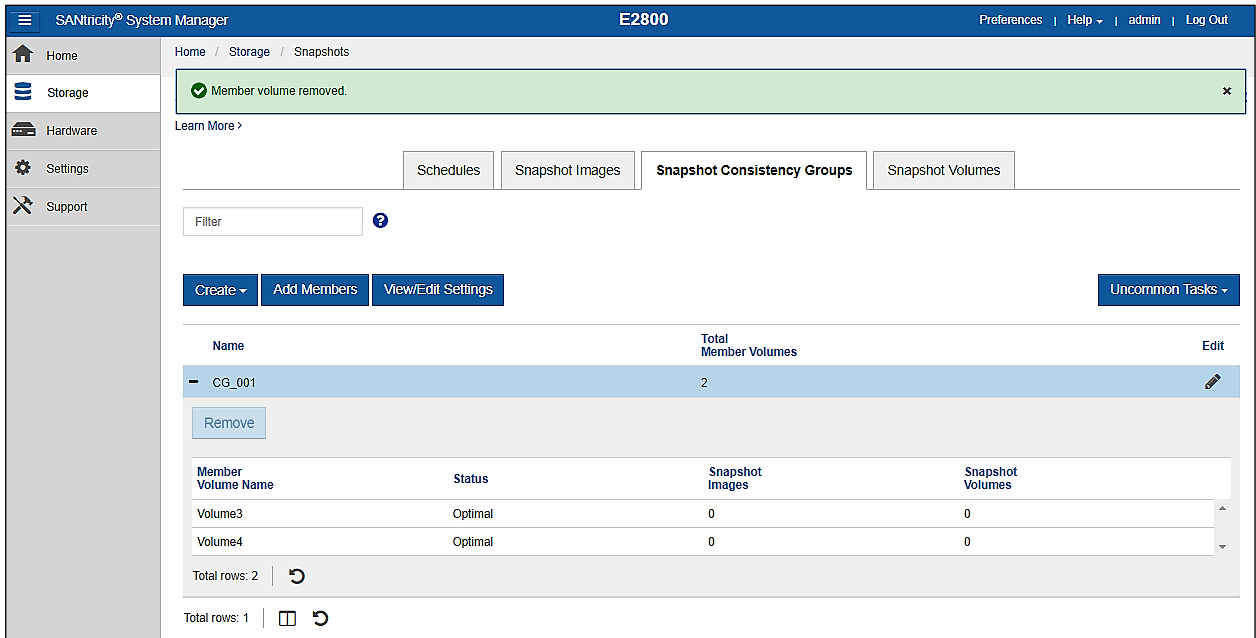
Type REMOVE to confirm that you want to perform this operation.

Remove

Cancel

System Manager confirms the removal and shows the remaining members in the list.

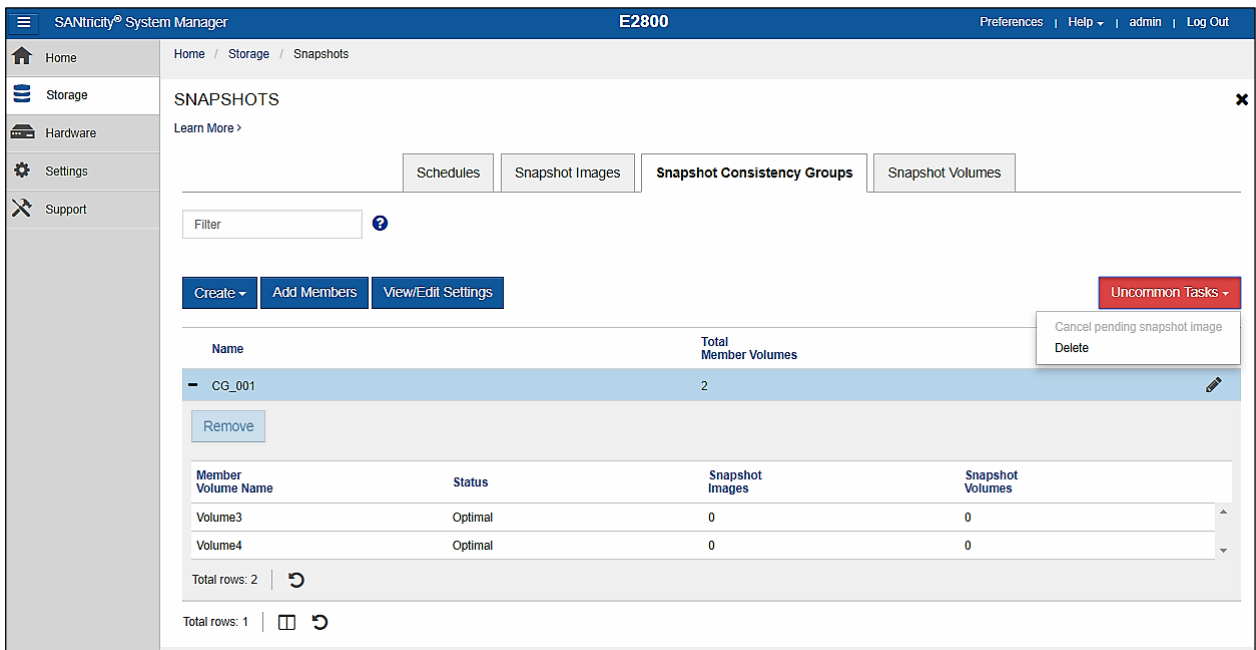




## Delete a consistency group in System Manager

To delete a consistency group in System Manager, complete the following steps:

1. From the Snapshot Consistency Groups tab, select the consistency group, click Uncommon Tasks, and select Delete.



2. Read the warnings, enter `delete`, and click Delete to carry out the operation.

System Manager confirms the deletion.



1. From the Copy Services tab, select Consistency Group > Create..



2. Select member volumes. Select the repository method for the consistency group. NetApp recommends Automatic, in which case defaults will be applied for all member volume repositories. Manual selection allows the administrator to customize the settings for each member.

Consistency group name:

☐ Add members later  
☒ Add members now

Eligible volumes:

Name	Status	Capacity	Associated Element
Volume4	Optimal	50,000 GB	Disk Pool Pool1
Volume5	Optimal	60,000 GB	Disk Pool Pool1
Volume2	Optimal	30,000 GB	Disk Pool Pool1
Volume1	Optimal	20,000 GB	Disk Pool Pool1

Member Repositories

[Why do I need a repository for every member of the consistency group?](#)

Choose how to create the snapshot volume repositories for each member in the consistency group.

☒ Automatic (recommended)

Default repository candidate settings:

Preferred capacity: 40% of base volume  
Allow undersized repositories: Yes  
Allow mismatch in QoS attributes: Yes

Repository candidates:

Member Name	Repository Candidate	Capacity (%)	Associated Element
Volume4	(New)	20,000 GB (40%)	Disk Pool Pool1
Volume5	(New)	24,000 GB (40%)	Disk Pool Pool1
Volume3	(New)	16,000 GB (40%)	Disk Pool Pool1

☐ Manual (customize repository candidate settings)

The consistency group and its member volumes are now listed under Member Volumes.

Storage Array E5660 FC - SANtricity® (Array Management) DevMode

Storage Array Storage Copy Services Host Mappings Hardware Monitor Upgrade Help

E5660 FC Optimal

Summary Performance Storage & Copy Services Host Mappings Hardware Setup

Find object in tree

- Storage Array E5660 FC
  - All Logical Objects
    - Total Unconfigured Capacity (228,598 TB)
      - Unconfigured Capacity (HDD,SAS,512 bytes) (2)
      - Unconfigured Capacity (SSD,SAS,512 bytes) (5)
    - SSD Cache
    - Disk Pools
      - Pool1 (55,847 TB)
        - Free Capacity (55,558 TB)
        - Volume1 (20,000 GB)
        - Snapshot Groups
          - Snapshot Images
        - Volume2 (30,000 GB)
        - Snapshot Groups
          - Snapshot Images
        - Volume3 (40,000 GB)
        - Volume4 (50,000 GB)
        - Volume5 (60,000 GB)
      - Consistency Groups
        - CG\_001
          - Member Volumes
      - Asynchronous Mirror Groups

Consistency group member volumes

Name	Total Repository Capacity	Available Repository Capacity	Repository Status
Volume3	16,000 GB	16,000 GB (100%)	Optimal
Volume4	20,000 GB	20,000 GB (100%)	Optimal
Volume5	24,000 GB	24,000 GB (100%)	Optimal

Consistency group member volumes: Associated repositories

Associated Member	Name	Status	Capacity
CG_001:Volume3	repos_0025	Optimal	16,000 GB

Premium Features:

Creating a Snapshot image is similar for a consistency group, but the individual member images are listed with the same timestamp.

The screenshot shows the SANtricity (Array Management) DevMode interface. The 'Storage & Copy Services' tab is selected. The left pane shows a tree view of the storage array hierarchy, including 'Consistency Groups' and 'Snapshot Images'. The main pane displays two tables:

Timestamp	Status	Creation Method
12/21/17 2:27:03 PM CST	Optimal	Manual

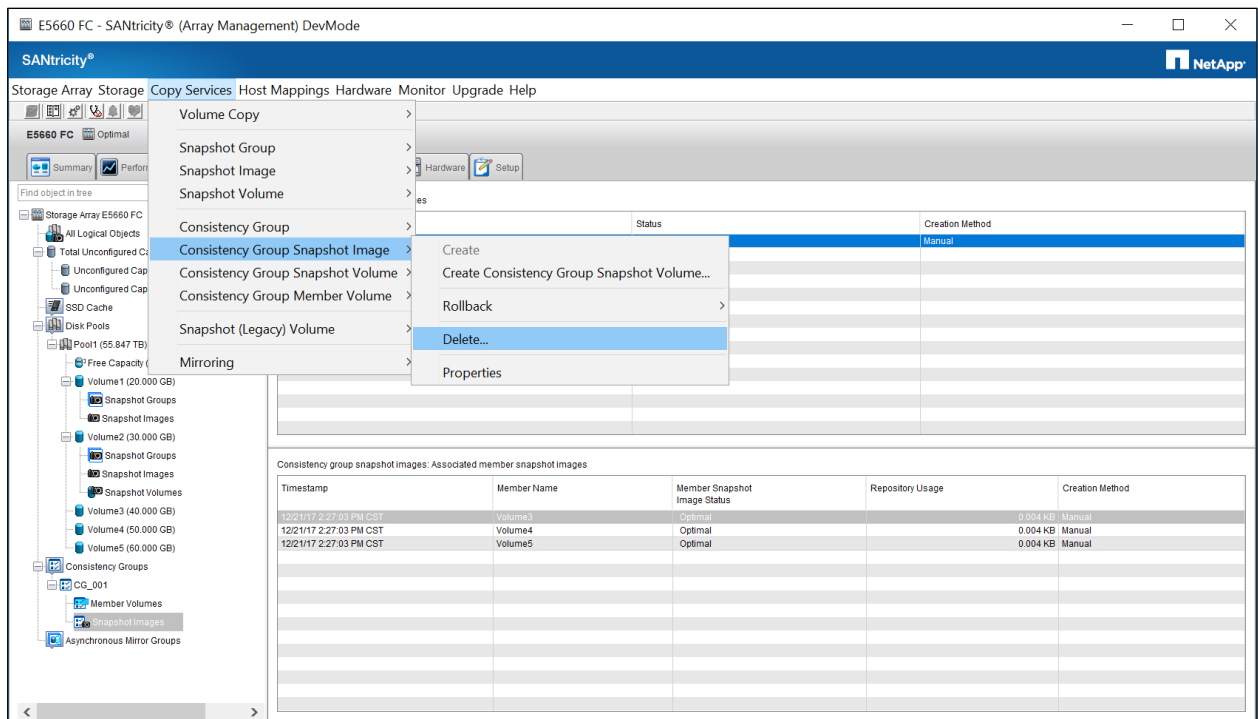
  

Timestamp	Member Name	Member Snapshot Image Status	Repository Usage	Creation Method
12/21/17 2:27:03 PM CST	Volume3	Optimal	0.004 KB	Manual
12/21/17 2:27:03 PM CST	Volume4	Optimal	0.004 KB	Manual
12/21/17 2:27:03 PM CST	Volume5	Optimal	0.004 KB	Manual

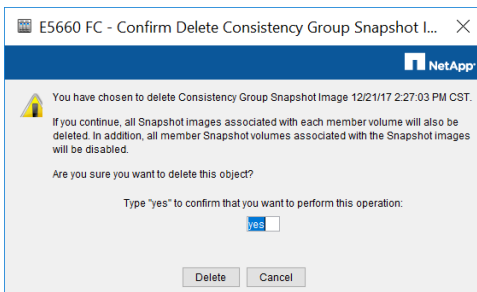
## Delete a consistency group Snapshot image in Storage Manager AMW

To complete a consistency group Snapshot image in Storage Manager AMW, complete the following steps:

1. Select the Consistency Group Snapshot image to be deleted. From the Copy Services tab, select Consistency Group Snapshot Image > Delete.



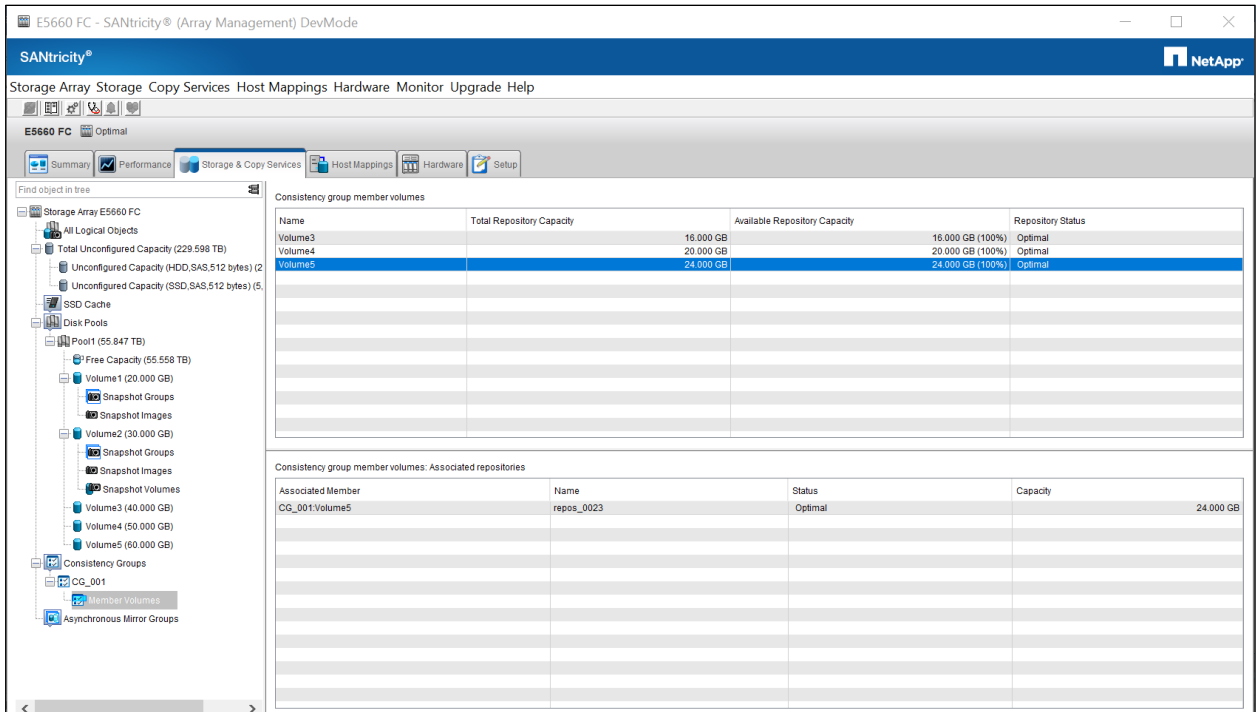
2. Read the warnings and enter yes to confirm. Click Delete.



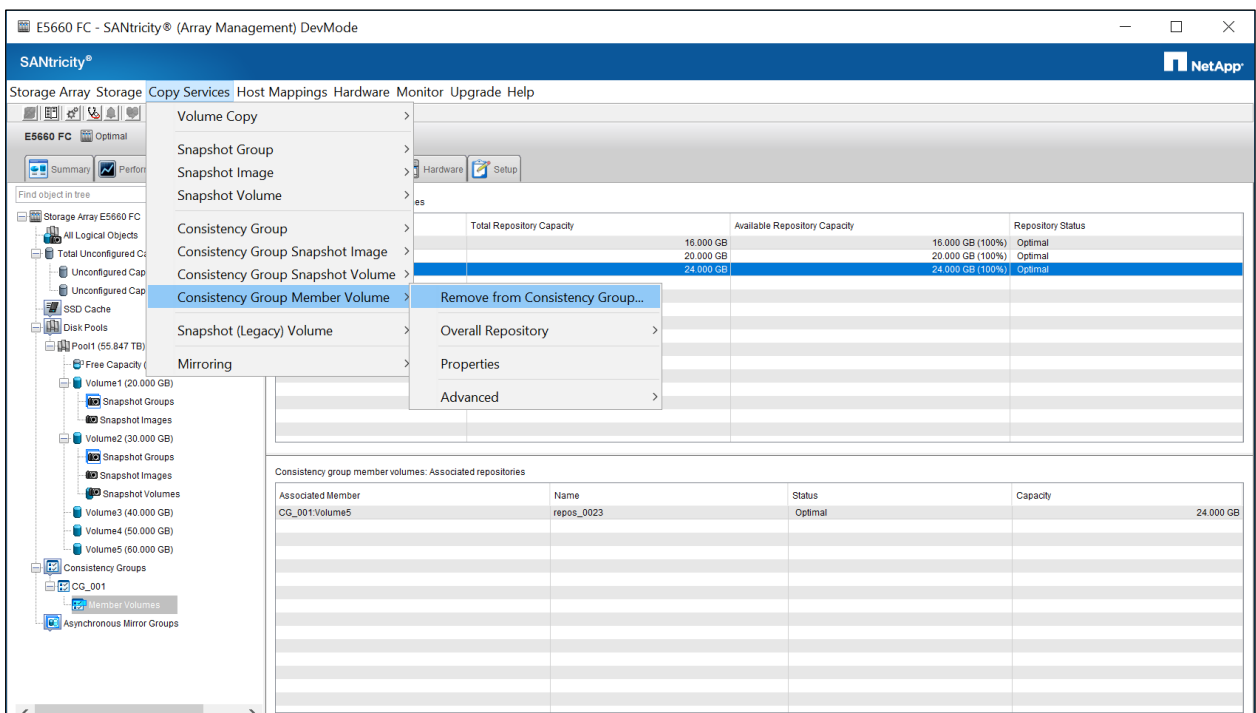
## Remove a member volume from the consistency group in Storage Manager AMW

To remove a member volume from the consistency group in Storage Manager AMW, complete the following steps:

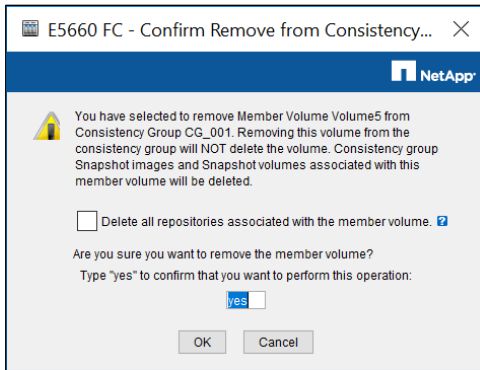
1. From the Member Volumes view, select the volume to be removed.



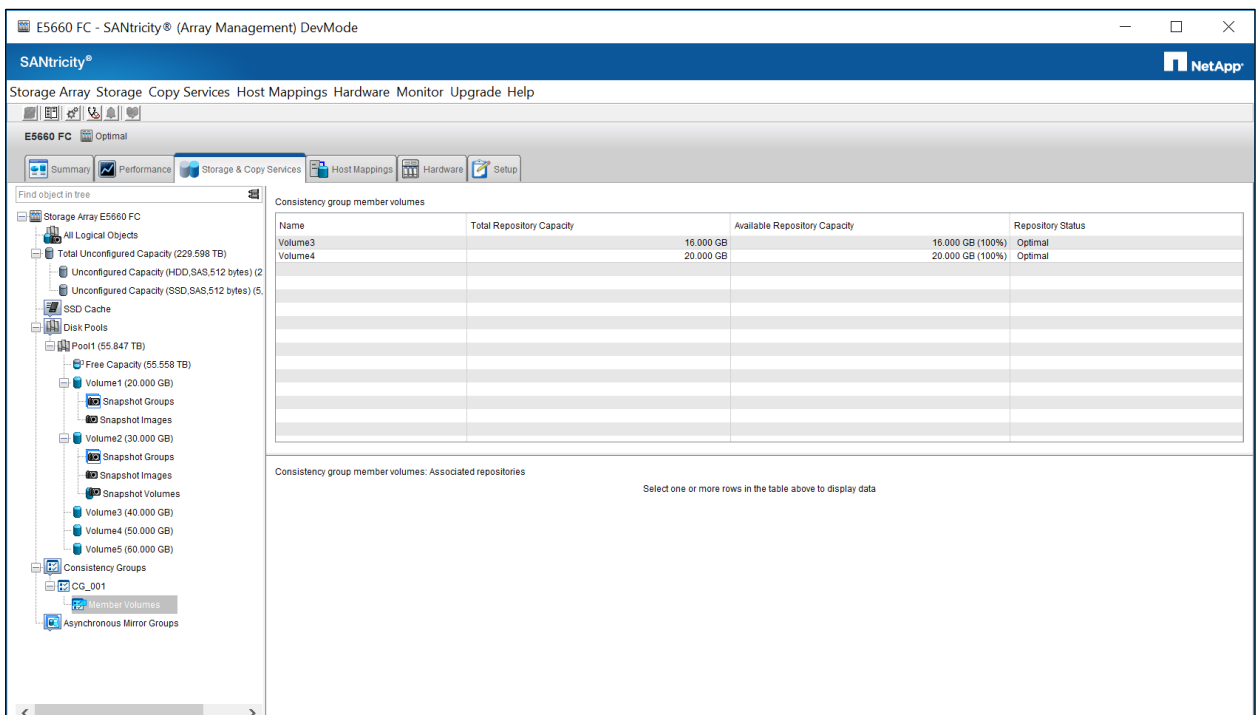
- From the Copy Services tab, select Consistency Group Member Volume > Remove from Consistency Group.



- Read the warnings and enter yes to confirm. Select the option to delete the repository volumes, leave unchecked if they might be used again. Click OK.



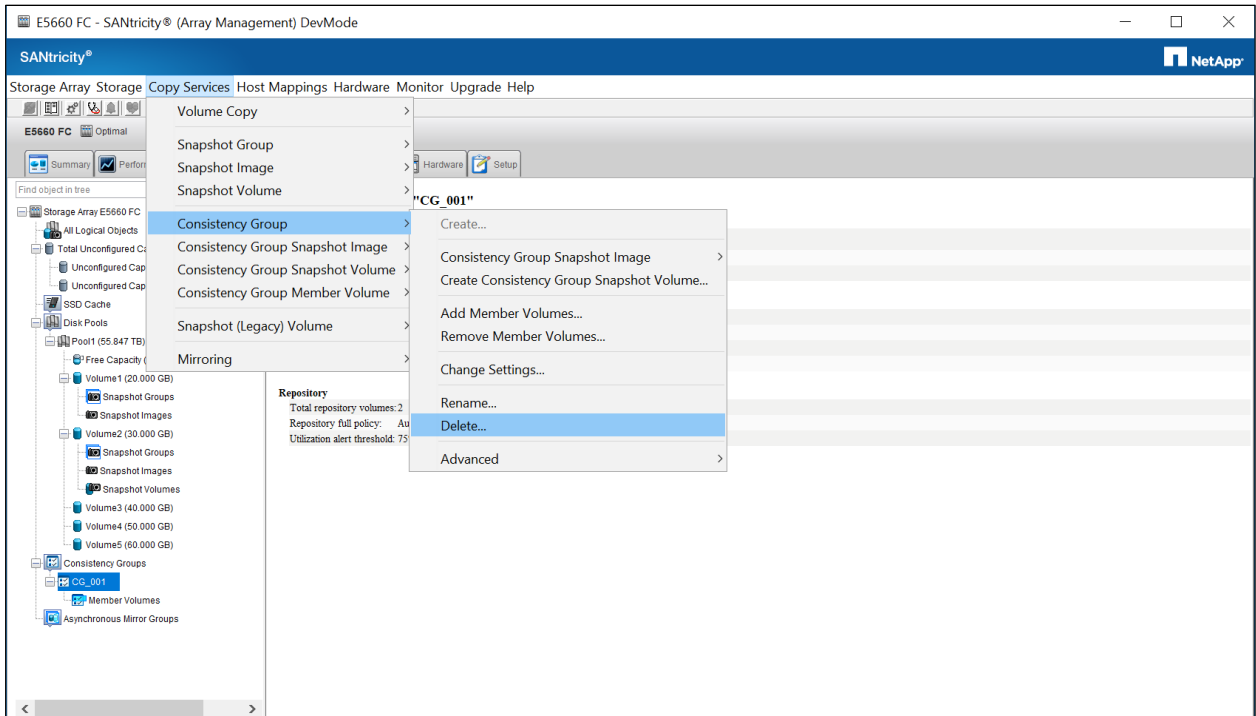
The Member Volume list now shows the member volumes with the selected member removed.



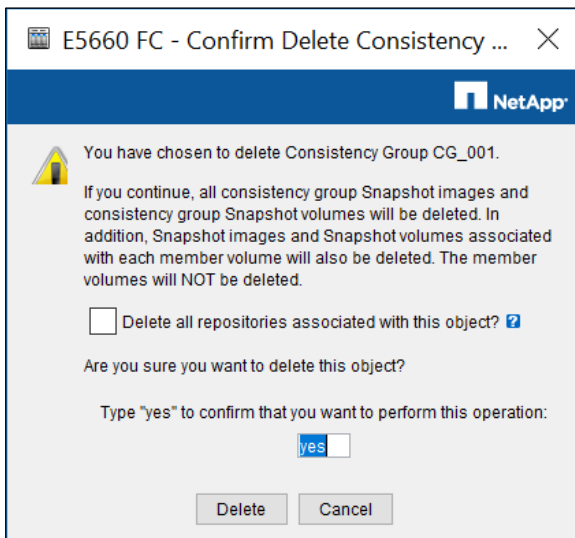
## Delete a consistency group in Storage Manager AMW

To delete a consistency group in Storage Manager AMW, complete the following steps:

1. Select the consistency group to be deleted. From the Copy Services tab, select Consistency Group > Delete.



2. Read the warnings and enter yes to confirm. If they will not be used again, select the option for deleting all repository volumes. Click Delete to continue.



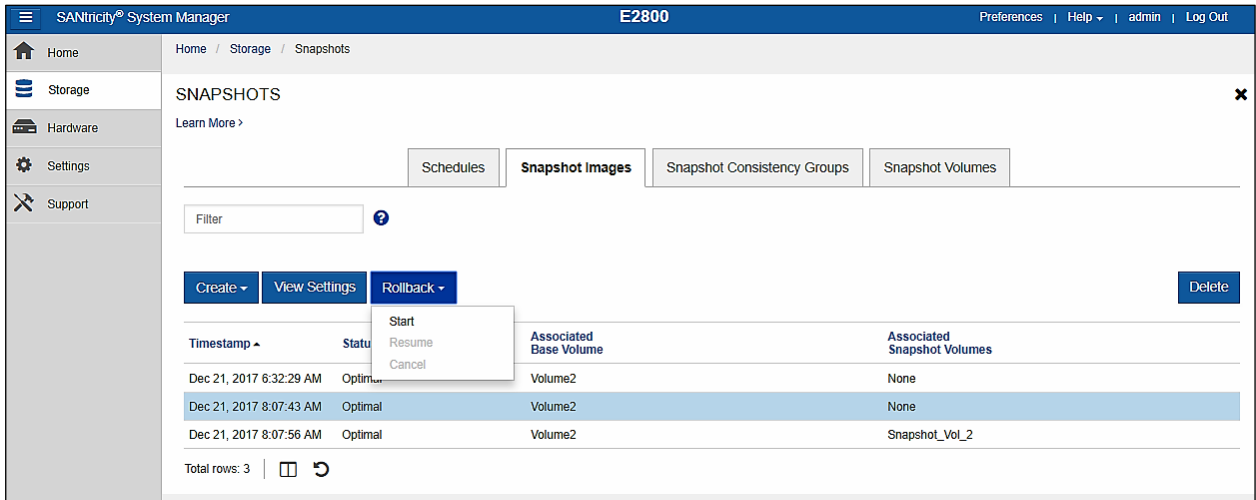
## Manage rollbacks

### Start a rollback in System Manager

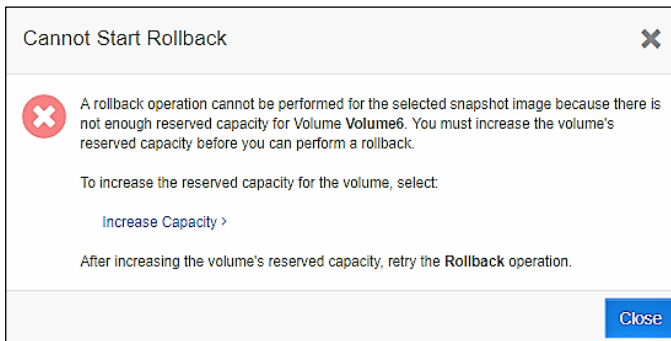
To start a rollback in System Manager, complete the following steps:

1. Select the Snapshot image to which the base volume will be rolled back. Click Rollback and select Start.

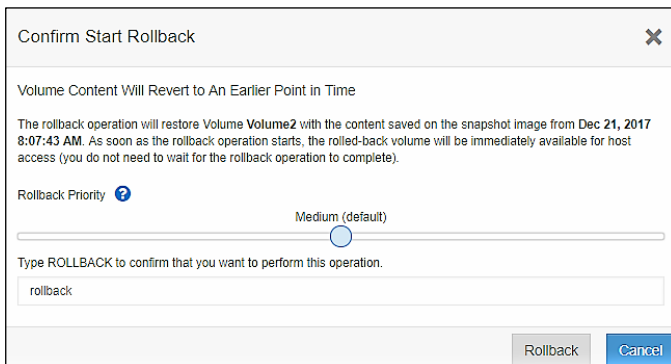




System Manager estimates the reserved capacity required for the rollback. If the assigned reserve capacity is not large enough, it will prompt the user to increase the reserved capacity.



- When the rollback is started with enough reserved capacity, System Manager prompts the user to confirm. Set the priority of the rollback, type rollback to confirm, and click Rollback.



System Manager confirms that the rollback has started.

The screenshot shows the SANtricity System Manager interface for E2800. A green banner at the top indicates "Rollback started. View in Operations in Progress >". The left sidebar shows the navigation menu with "Storage" selected. The main content area is titled "Snapshots" and contains a "Filter" input field, a "Learn More >" link, and a "Schedules" tab. Below these are buttons for "Create", "View Settings", "Rollback", and "Delete". A table lists snapshot images with columns for Timestamp, Status, Associated Base Volume, and Associated Snapshot Volumes.

Timestamp	Status	Associated Base Volume	Associated Snapshot Volumes
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:43 AM	Optimal - Rollback in progress	Volume2	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	Snapshot_Vol_2

Total rows: 3 | [Grid Icon] [Refresh Icon]

3. After the rollback is complete, all the Snapshot images are still listed and available.

The screenshot shows the SANtricity System Manager interface for E2800. The "Snapshots" section is active, and the "Snapshot Images" tab is selected. The table now shows three snapshot images, all with a status of "Optimal".

Timestamp	Status	Associated Base Volume	Associated Snapshot Volumes
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	Snapshot_Vol_2

Total rows: 3 | [Grid Icon] [Refresh Icon]

## Cancel a rollback in System Manager

While a rollback is in progress, it can be canceled. Cancellation should be an extremely rare event, because the base volume will be left in an undetermined state. One reason for canceling a rollback might be if the administrator inadvertently chose the wrong Snapshot image for the rollback and wants to roll back to an image with a different timestamp.

1. From the Snapshot images tab, select the image with a rollback in progress, click Rollback, and select Cancel.

**SANtricity® System Manager** E2800 Preferences | Help | admin | Log Out

Home / Storage / Snapshots

## SNAPSHOTS

Learn More >

Schedules **Snapshot Images** Snapshot Consistency Groups Snapshot Volumes

Filter ?

Create View Settings **Rollback** Delete

Timestamp	Status	Associated Base Volume	Associated Snapshot Volumes
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	Snapshot_Vol_2
Dec 22, 2017 5:17:08 AM	Optimal - Rollback in progress	Volume5	None

Total rows: 4 | [Grid Icon] [Refresh Icon]

- Note the warning about the base volume being left in an unknown state and click Yes.

**Confirm Cancel Rollback** [Close Icon]

Volume Will Be in an Indeterminate State

Canceling the rollback for Volume **Volume5** will leave the volume in an indeterminate state with potentially invalid or inconsistent data.

Are you sure you want to continue?

Yes No

- System Manager now displays a message that the rollback has been canceled.

**SANtricity® System Manager** E2800 Preferences | Help | admin | Log Out

Home / Storage / Snapshots

Rollback canceled.

## SNAPSHOTS

Learn More >

Schedules **Snapshot Images** Snapshot Consistency Groups Snapshot Volumes

Filter ?

Create View Settings **Rollback** Delete

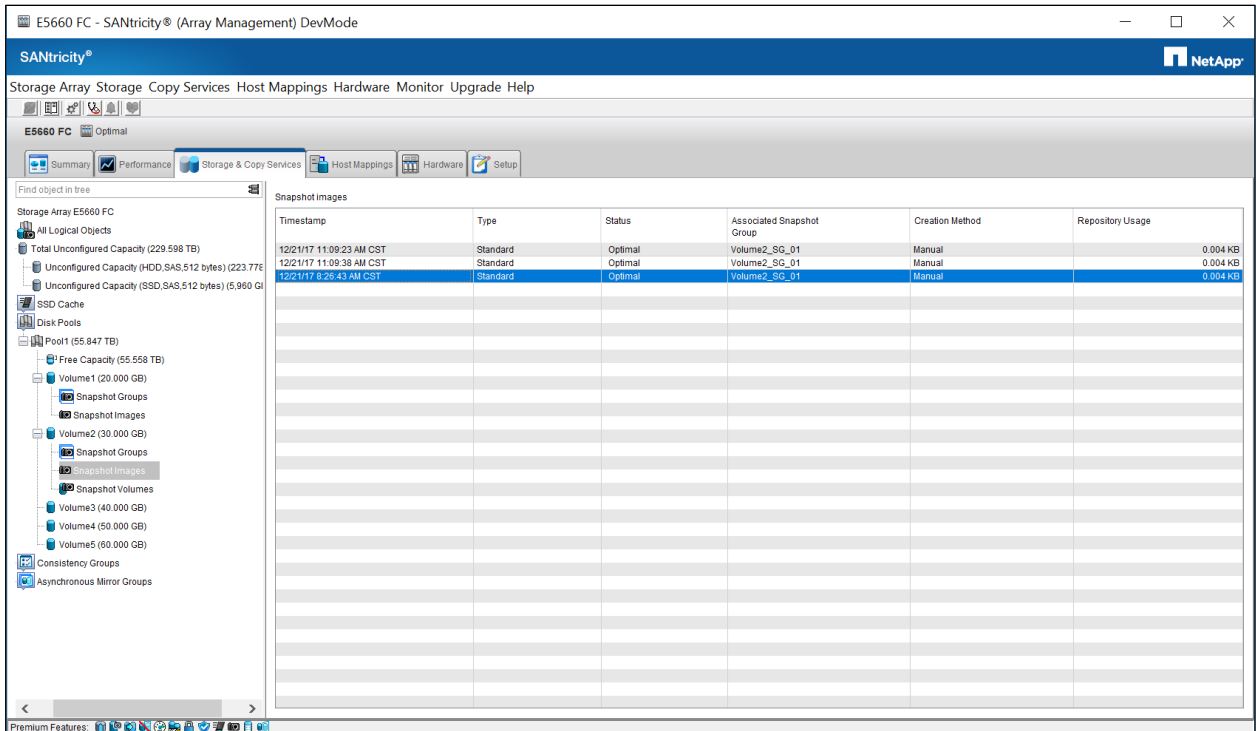
Timestamp	Status	Associated Base Volume	Associated Snapshot Volumes
Dec 21, 2017 8:07:43 AM	Optimal	Volume2	None
Dec 21, 2017 6:32:29 AM	Optimal	Volume2	None
Dec 21, 2017 8:07:56 AM	Optimal	Volume2	Snapshot_Vol_2
Dec 22, 2017 5:17:08 AM	Optimal	Volume5	None

Total rows: 4 | [Grid Icon] [Refresh Icon]

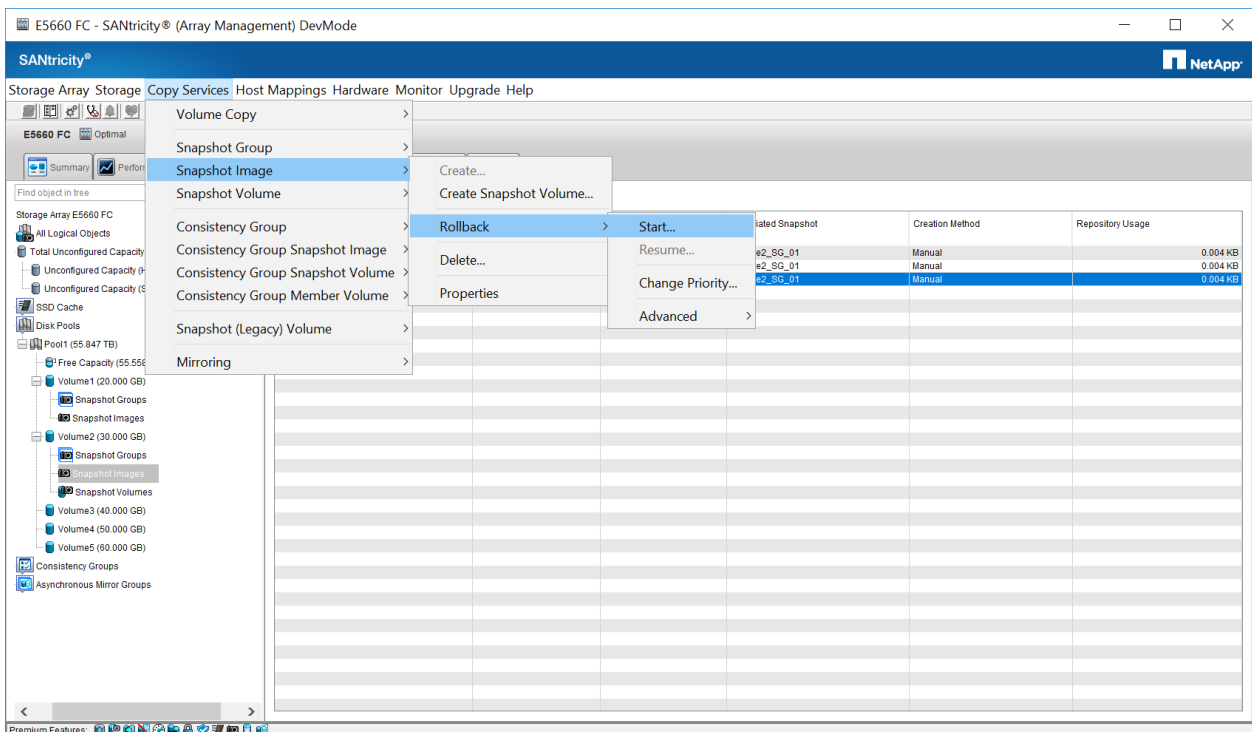
## Start a rollback in Storage Manager AMW

To start a rollback in Storage Manager AMW, complete the following steps:

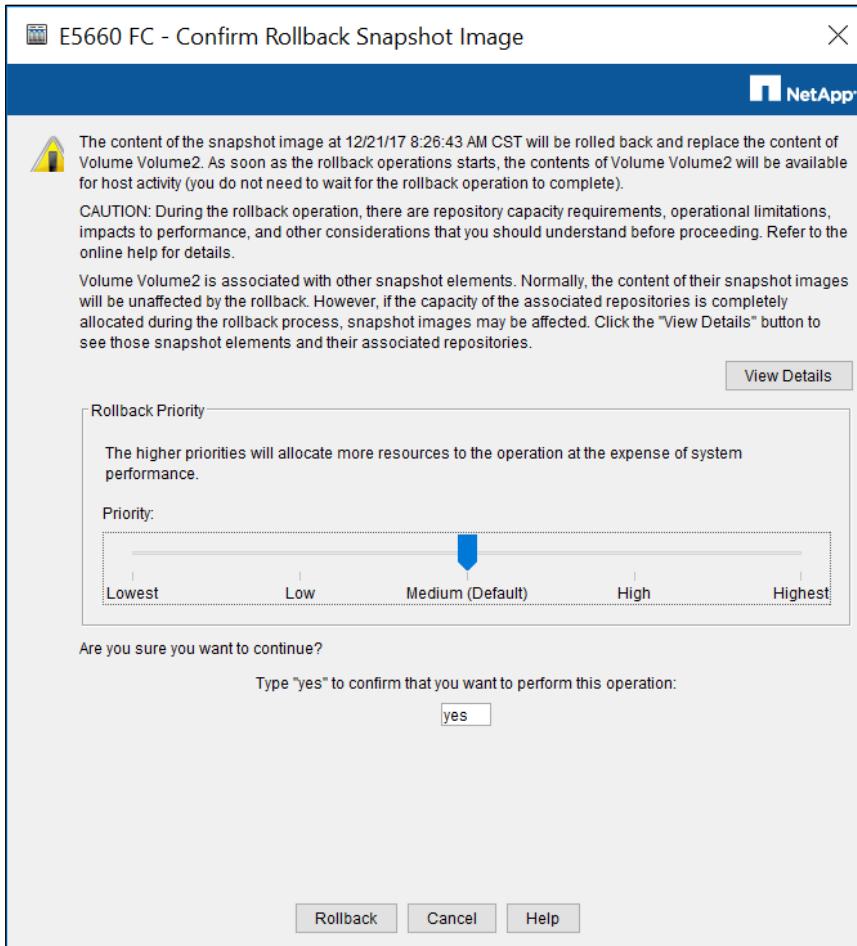
- On the Snapshot Images screen of the base volume to be rolled back, select the image with the desired timestamp for the rollback.



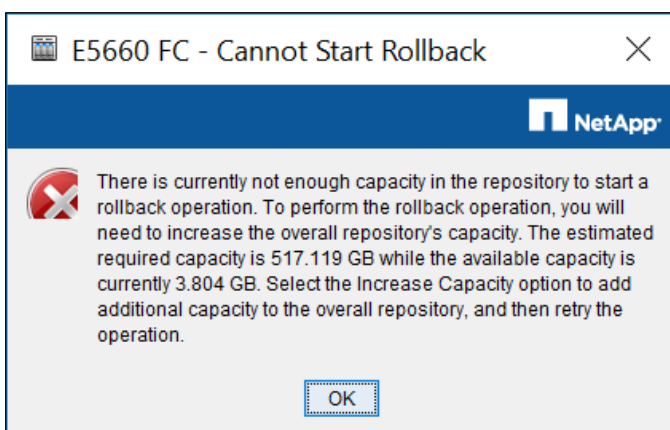
- From the Copy Services tab, select Snapshot Image > Rollback > Start. If rolling back to a consistency group image, the administrator would select Consistency Group Snapshot Image > Rollback > Start.



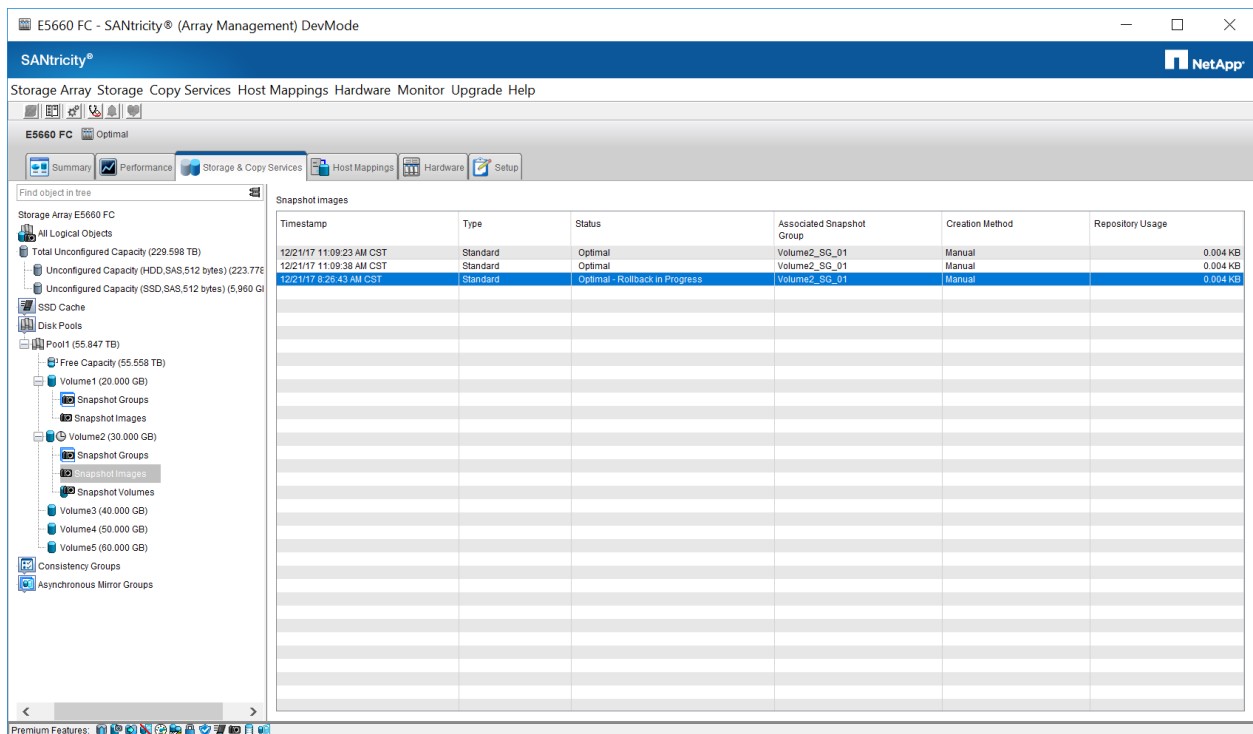
- Select the priority of the rollback, enter `yes` to confirm, and click Rollback.



Storage Manager estimates the repository capacity required for the rollback, and if it is not enough, AMW displays an error message. The administrator will need to increase the repository capacity before attempting the rollback again.



If the repository capacity is enough, Storage Manager AMW now shows the rollback in progress.

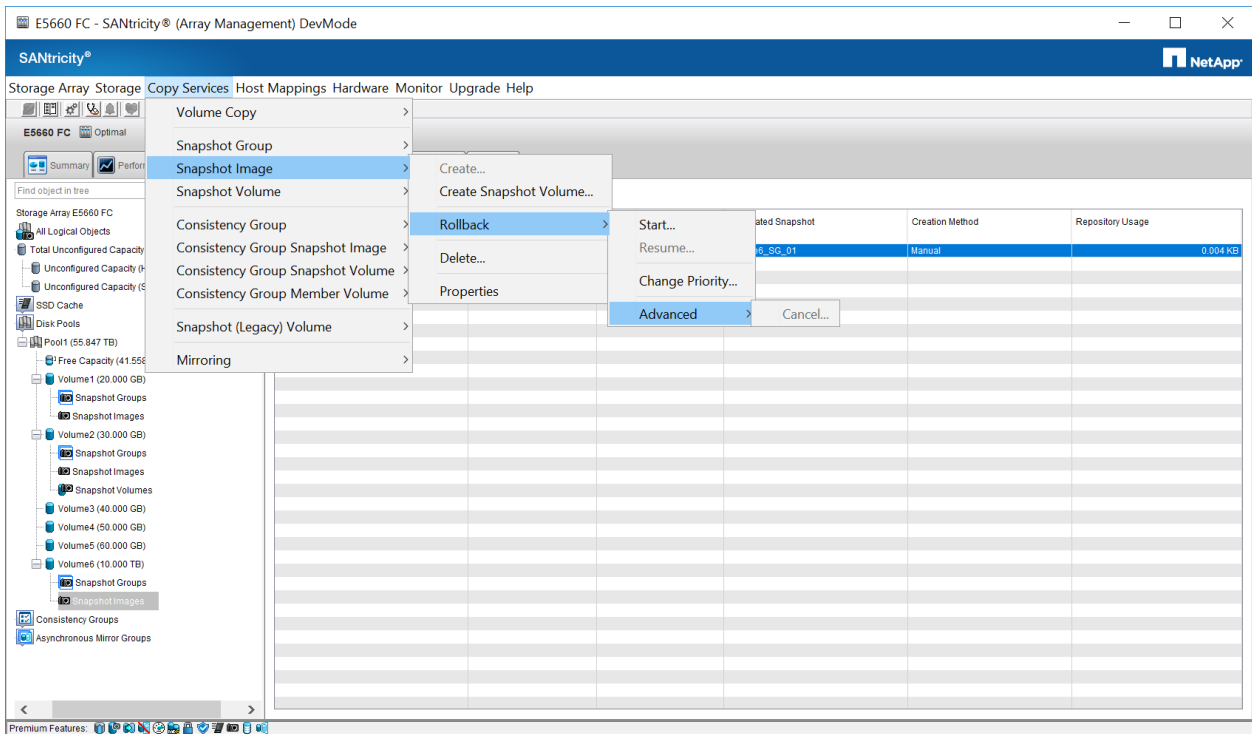


## Cancel a rollback in Storage Manager AMW

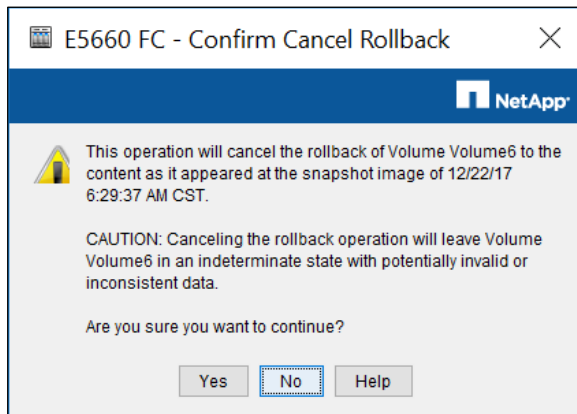
To cancel a rollback in Storage Manager AMW, complete the following steps:

While a rollback is in progress, it can be canceled. Cancellation should be an extremely rare event, because the base volume will be left in an undetermined state. One reason for canceling a rollback might be if the administrator inadvertently chose the wrong Snapshot image for the rollback and wants to roll back to an image with a different timestamp.

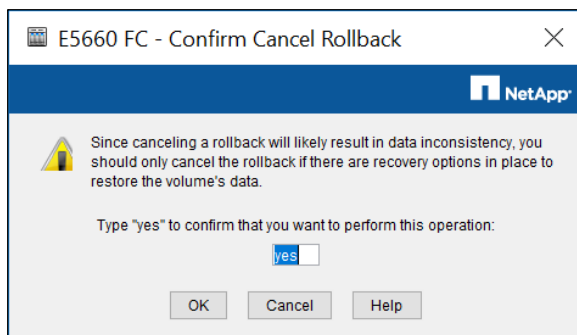
1. Select the in-progress rollback, then from the Copy Services tab, select Snapshot Image > Rollback > Advanced > Cancel.



2. Note the warning and click Yes to cancel the rollback.



3. Storage Manager asks for a second confirmation. Enter `yes` and click OK.



## Conclusion

The NetApp SANtricity Snapshot feature provides a convenient and efficient way to accomplish several operations for an IT administrator. You can create a single point-in-time image of a volume or multiple images on a schedule, and volumes can be grouped into consistency groups enabling consistent Snapshot images across all members. The Snapshot feature also delivers the ability to easily roll back to an earlier point in time if a failure occurs.

SANtricity software creates Snapshot images using a copy-on-first-write methodology, thus minimizing performance impact and the overhead of reserved capacity usage. A copy from the base to reserved capacity is required only the first time an area of the base volume is updated by the host. Any subsequent writes to the same area do not require the copy operation.

Snapshot images are quite versatile, with the ability to deliver substantial functionality. They can be used for protecting against failures or accidental deletions, testing a new version of software before going live, and for online backup applications, along with many other applications.

## Where to find additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

- NetApp SANtricity System Manager online help  
<http://mysupport.netapp.com/NOW/public/eseries/sam/index.html>
- SANtricity SMcli User Guide  
<http://docs.netapp.com/ess-11/index.jsp?topic=%2Fcom.netapp.doc.ssm-cli-115%2Fhome.html>
- E-Series and SANtricity 11 Resources page  
<https://mysupport.netapp.com/info/web/ECMP1658252.html>
- NetApp Product Documentation  
<https://www.netapp.com/us/documentation/index.aspx>

## Version history

Version	Date	Document version history
Version 0.1	February 2019	Initial document release.
Version 2.0	July 2020	Added array models to Table 1.
Version 3.0	January 2022	Reformatted with latest TR template.
Version 4.0	July 2023	Updated for SANtricity 11.80 and add EF300



Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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