

# Module 5: Physical Storage Management

## Exercise 1: Managing Physical Storage

### Objectives

This exercise focuses on enabling you to do the following:

- Examine local storage tiers
- Expand an aggregate
- Create an aggregate

### Case Study

Zarrot Industries has purchased additional storage space for its NetApp ONTAP system. After the service professional has installed an additional disk shelf, the disks need to be joined into a local storage tier (aggregate) before they can be used. Rather than adding the new disks to an existing nearly full aggregate, it was decided to create an aggregate for the additional storage space.

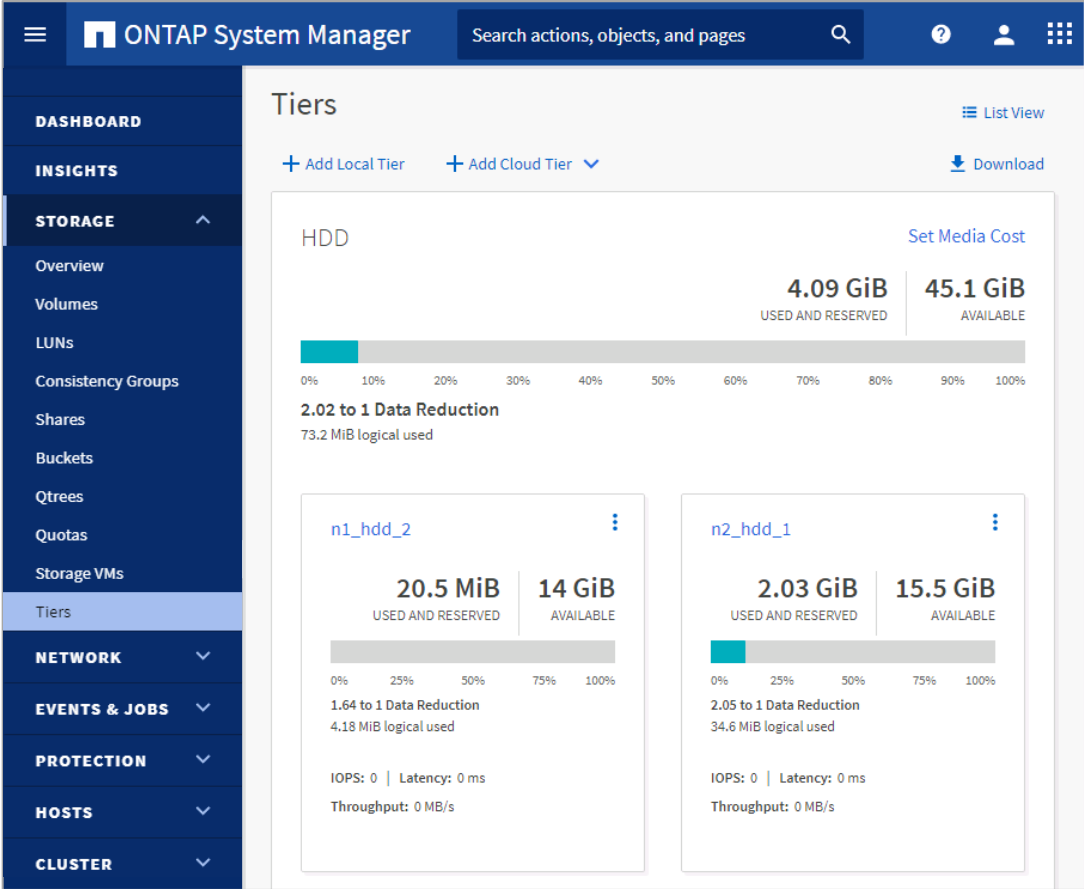
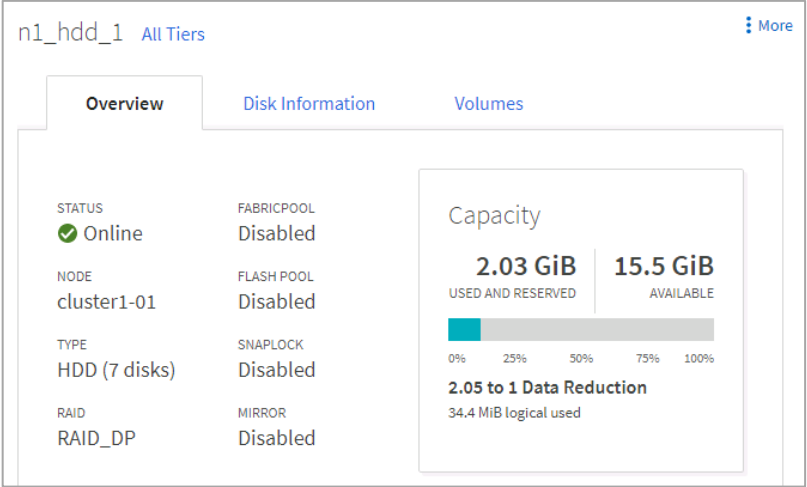
Your colleague George forgot to include all the newly installed disks in the aggregate that he created. You need to add the remaining unused disks (which are not needed as hot spares) into the new aggregate.

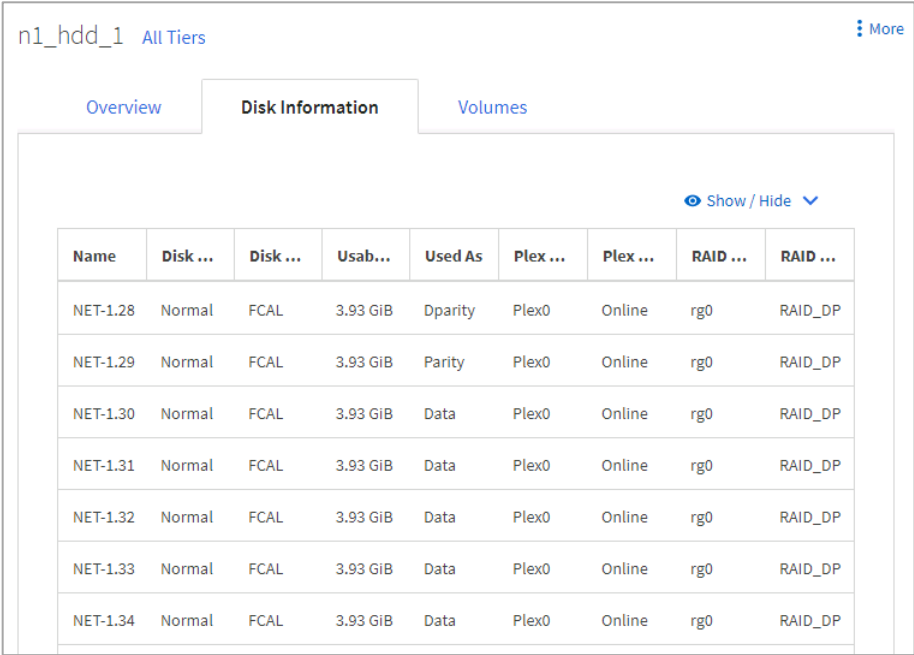
### Lab Equipment

Use the following equipment to complete the exercise:

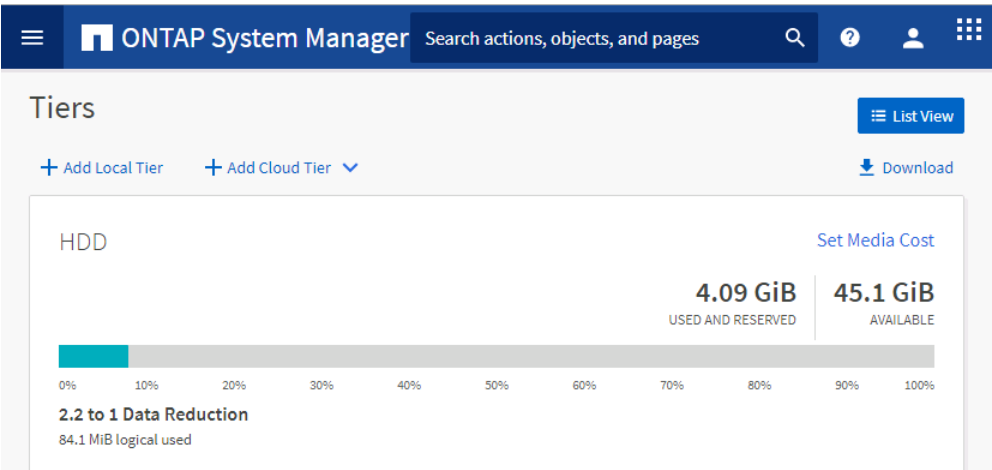
System	Host Name	IP Addresses	User Name	Password
Windows Server	jumphost	192.168.0.5	DEMO\Administrator	Netapp1!
ONTAP cluster-management LIF (cluster1)	cluster1	192.168.0.101	admin (case-sensitive)	Netapp1!
ONTAP cluster-management LIF (cluster2)	cluster2	192.168.0.102	admin (case-sensitive)	Netapp1!

# Task 1: Examine Local Storage Tiers

Step	Action
1-1	<div><div>From the NetApp ONTAP System Manager menu for <b>cluster1</b>, in the navigation pane, select <b>Storage &gt; Tiers</b>.</div><div></div></div>
1-2	<div><div>Click <b>n1_hdd_1</b> to view the aggregate details.</div><div></div></div>

Step	Action
1-3	<p>Click the <b>Disk Information</b> tab to view the disks that compose the aggregate.</p> 
1-4	Click the <b>All Tiers</b> link to return to the Storage Tiers page.
1-5	Repeat Steps 1-2 through 1-4 to examine the configuration of all the local storage tiers.

## Task 2: Expand an Aggregate

Step	Action
2-1	<p>In the Storage Tiers page, click <b>List View</b>.</p> 

Step

Action

2-2

Select n1\_ssd\_3.

Tiers

Card View

Local Tiers

Cloud Tiers

+ Add

SearchDownloadShow / HideFilter

Name	Status	Type	Capacity	Logical...	Data Red...
n1_hdd_1	Online	HDD	17.6 GiB 2.05 GiB used and reserved15.5 GiB available	42.3 MiB	2.43 to 1
n1_hdd_2	Online	HDD	14.1 GiB 240 KiB used and reserved14.1 GiB available	0 Bytes	1 to 1
n1_ssd_3	Online	SSD	2.64 GiB 164 KiB used and reserved2.64 GiB available	0 Bytes	1 to 1
n2_hdd_1	Online	HDD	17.6 GiB 2.03 GiB used and reserved15.5 GiB available	41.7 MiB	2.03 to 1

2-3

Notice the number of disks in the aggregate.

n1\_ssd\_3All Tiers

More

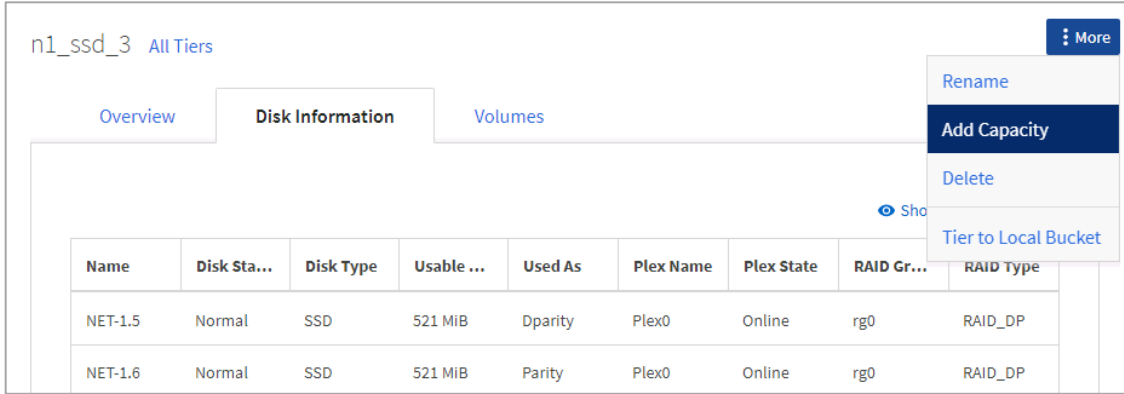

Overview

Disk Information

Volumes

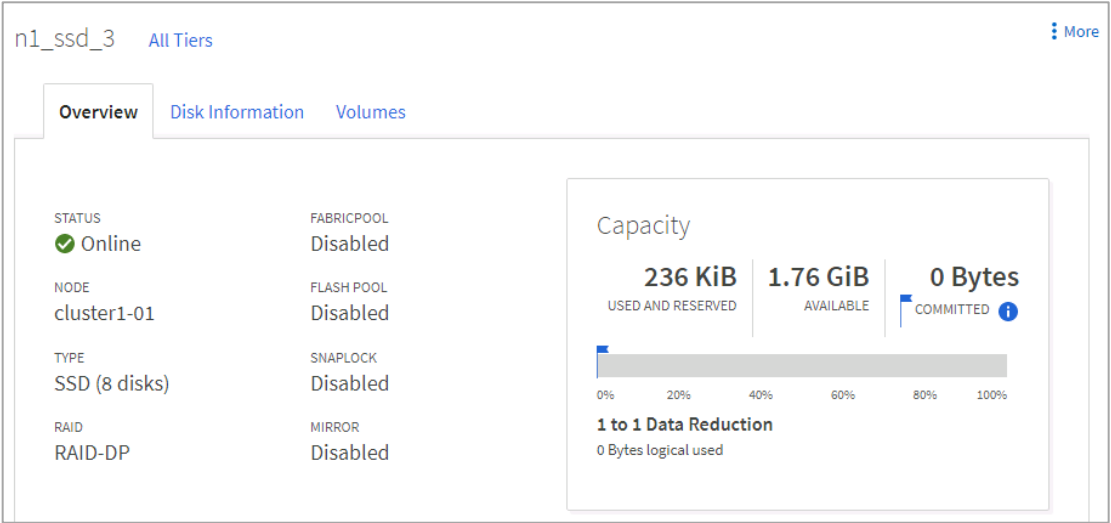
Show / Hide

Name	Disk Sta...	Disk Type	Usable ...	Used As	Plex Name	Plex State	RAID Gr...	RAID Type
NET-1.5	Normal	SSD	521 MiB	Dparity	Plex0	Online	rg0	RAID_DP
NET-1.6	Normal	SSD	521 MiB	Parity	Plex0	Online	rg0	RAID_DP
NET-1.7	Normal	SSD	521 MiB	Data	Plex0	Online	rg0	RAID_DP
NET-1.8	Normal	SSD	521 MiB	Data	Plex0	Online	rg0	RAID_DP
NET-1.9	Normal	SSD	521 MiB	Data	Plex0	Online	rg0	RAID_DP
NET-1.10	Normal	SSD	521 MiB	Data	Plex0	Online	rg0	RAID_DP

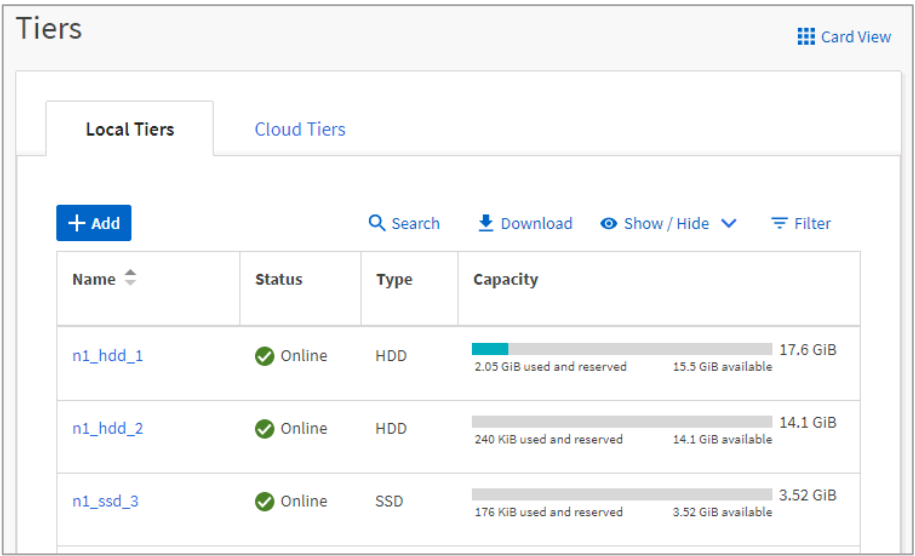
Step	Action																											
2-4	<p>Click <b>More</b>, and then click <b>Add Capacity</b>.</p>  <table><tr><th>Name</th><th>Disk Sta...</th><th>Disk Type</th><th>Usable ...</th><th>Used As</th><th>Plex Name</th><th>Plex State</th><th>RAID Gr...</th><th>RAID Type</th></tr><tr><td>NET-1.5</td><td>Normal</td><td>SSD</td><td>521 MiB</td><td>Dparity</td><td>Plex0</td><td>Online</td><td>rg0</td><td>RAID_DP</td></tr><tr><td>NET-1.6</td><td>Normal</td><td>SSD</td><td>521 MiB</td><td>Parity</td><td>Plex0</td><td>Online</td><td>rg0</td><td>RAID_DP</td></tr></table>	Name	Disk Sta...	Disk Type	Usable ...	Used As	Plex Name	Plex State	RAID Gr...	RAID Type	NET-1.5	Normal	SSD	521 MiB	Dparity	Plex0	Online	rg0	RAID_DP	NET-1.6	Normal	SSD	521 MiB	Parity	Plex0	Online	rg0	RAID_DP
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NET-1.6	Normal	SSD	521 MiB	Parity	Plex0	Online	rg0	RAID_DP																				
2-5	<div><p>ONTAP System Manager attempts to add all the available drives to the aggregate while retaining sufficient spare drives.</p><p>Disregard the message of insufficient space that is caused by the limitations of the training environment and enter the correct number of drives to add.</p></div>																											
2-6	Click <b>More Options</b> .																											

Step	Action
2-7	<p>In the Add Capacity window, enter the following information to expand the aggregate by two drives:</p> <ul style="list-style-type: none"><li>Disk Type: <b>SSD on node cluster1-01</b></li><li>Number of Disks: <b>2</b></li></ul> <div><div><div>Add Capacity</div><div>×</div></div><div><div>LOCAL TIER</div><div>n1_ssd_3</div></div><div><div>DISK TYPE</div><div>SSD on node cluster1-01</div><div>Contains disks of 521 MiB each.</div></div><div><div>NUMBER OF DISKS</div><div>2</div><div>Minimum: 1 for RAID-DP. Maximum: 21.</div></div><div><div>RAID configuration</div></div><div><div>RAID TYPE</div><div>RAID-DP</div></div><div><div>RAID GROUP SIZE</div><div>24</div></div><div><div><input type="checkbox"/> Add disks to new RAID group</div></div><div><div>▼ RAID Allocation</div></div><div><div>EXISTING USABLE CAPACITY</div><div>1.758 GiB</div></div><div><div>NEW USABLE CAPACITY</div><div>2.637 GiB Estimated (Available after update 2.637 GiB)</div></div><div><div>Add</div><div>Cancel</div></div></div>

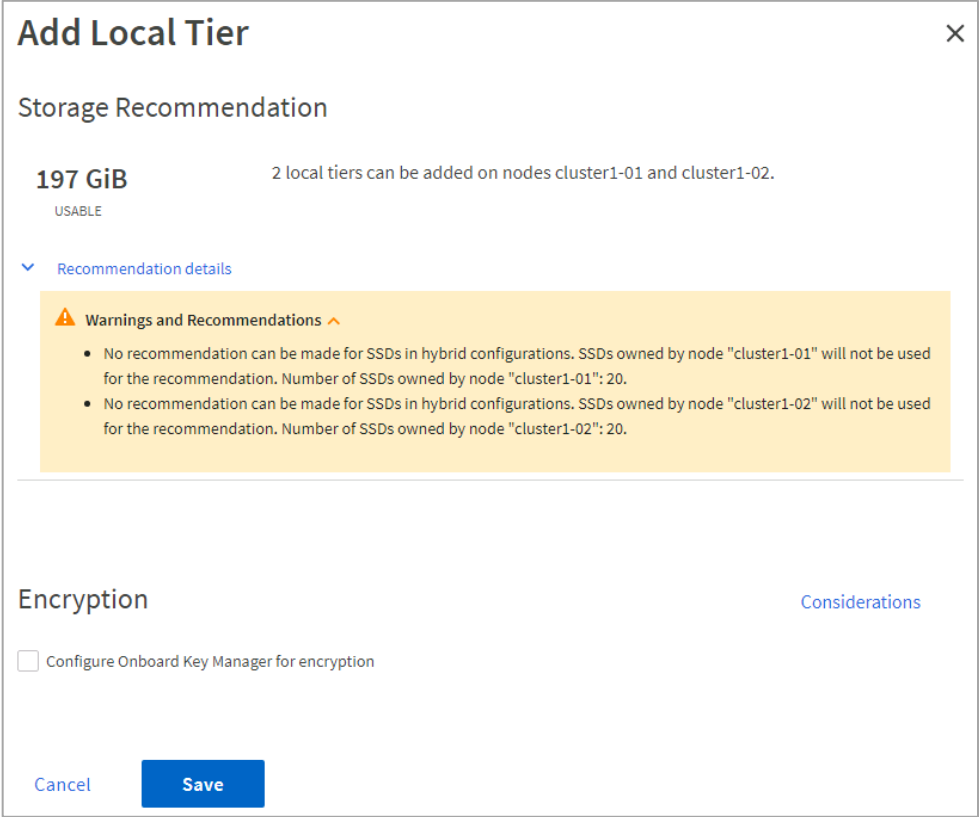
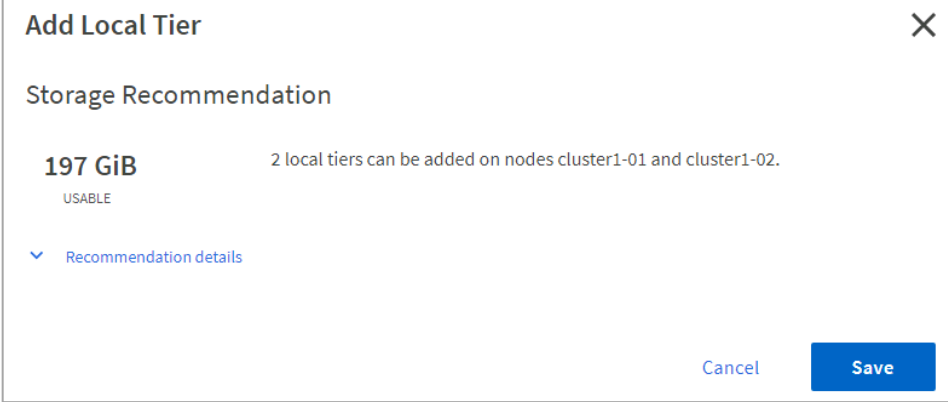
Step	Action
2-10	<div>In the RAID configuration section, observe the new configuration of the RAID group.</div> <div><div><div>RAID configuration</div><div><div>RAID TYPE</div><div>RAID-DP</div><div>RAID GROUP SIZE</div><div>24</div><div><input type="checkbox"/> Add disks to new RAID group</div><div><div>RAID Allocation</div><div>8 disks in one RAID group.</div><div><div>rg0</div><div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div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Step	Action
2-13	<p>Verify that the additional space is available in the n1_ssd_3 aggregate.</p> 
2-14	Click the <b>All Tiers</b> link to return to the Storage Tiers page.

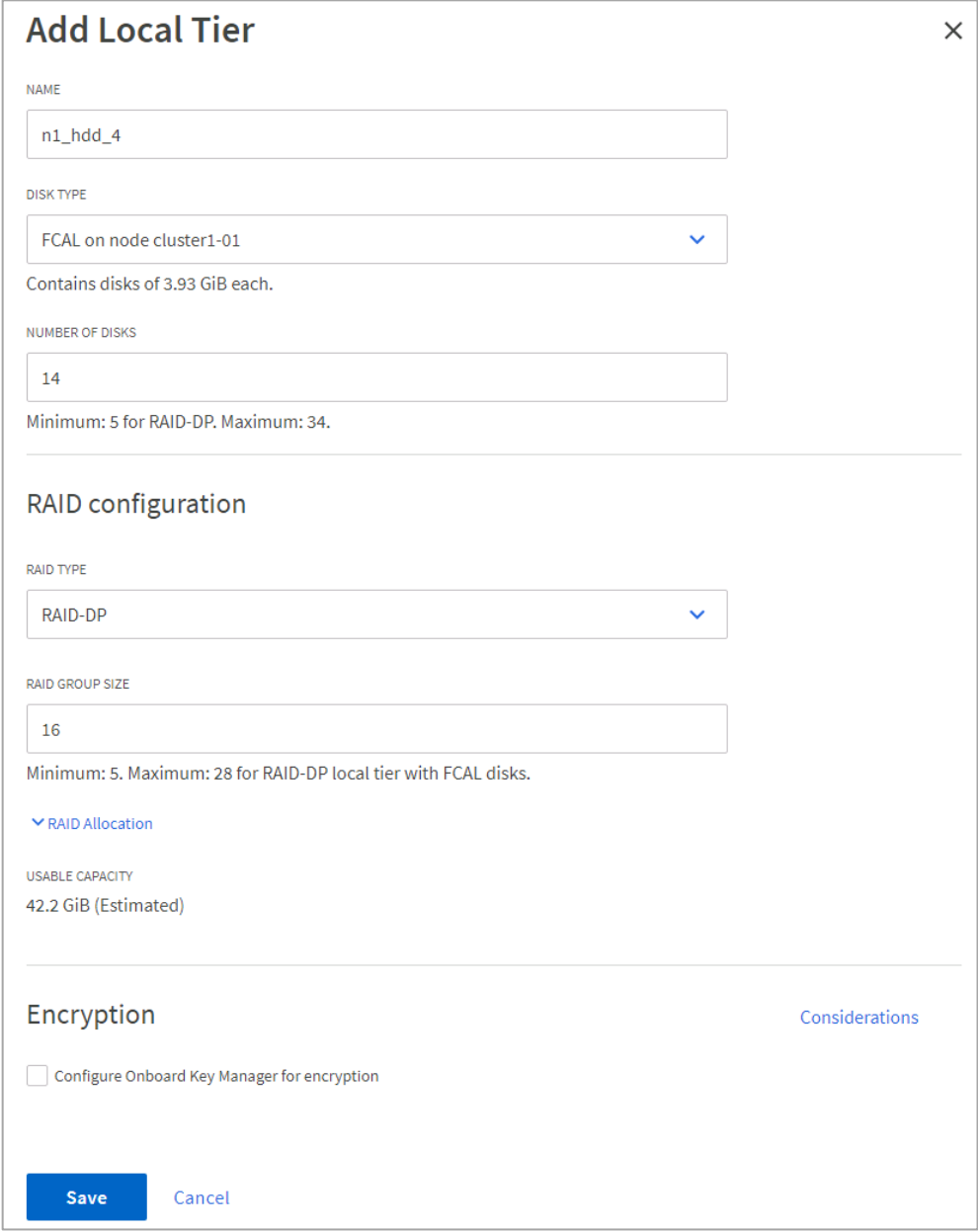
### Task 3: Create an Aggregate


Step	Action
3-1	<p>Click <b>Add</b> to create a new local data aggregate.</p> 

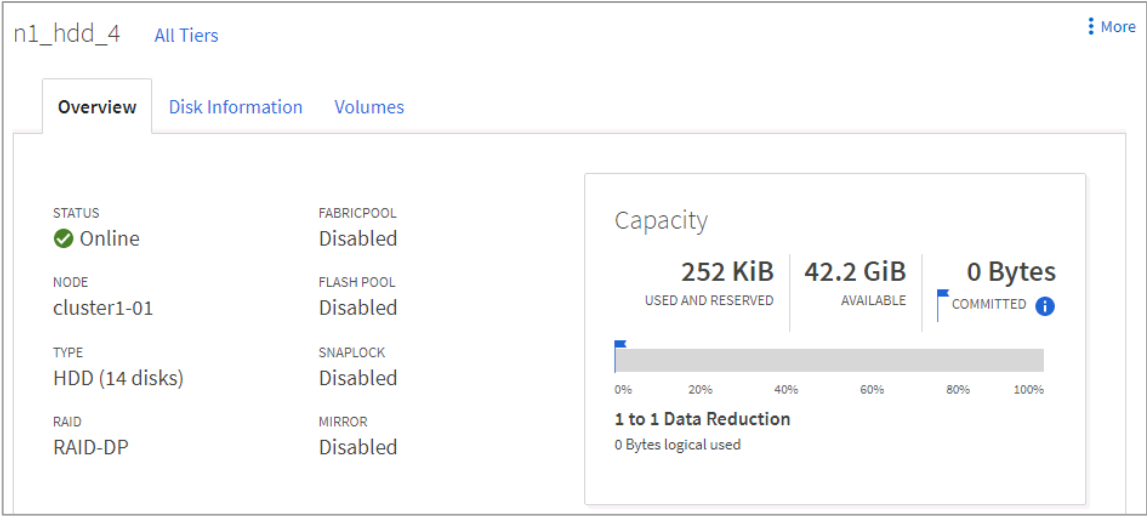


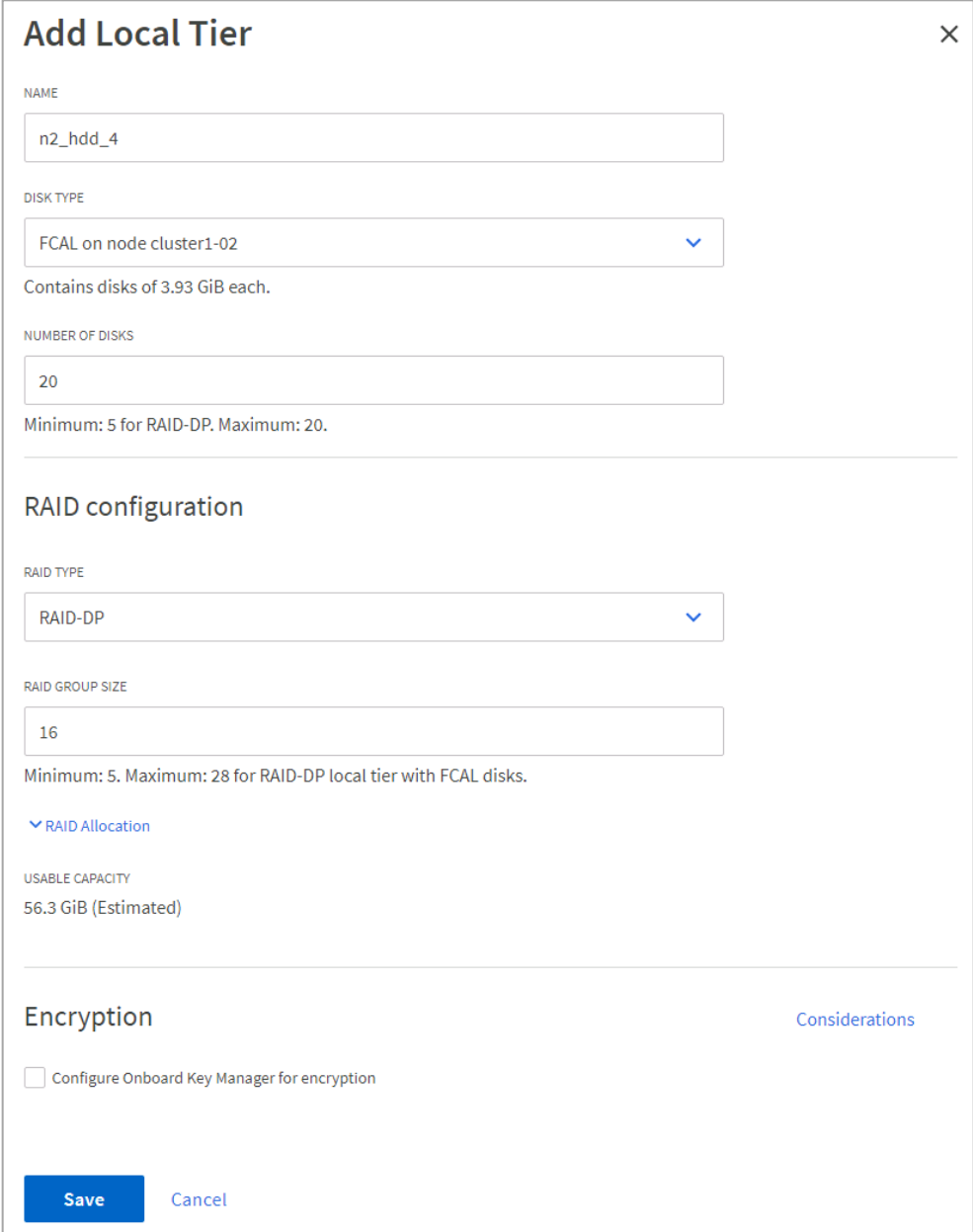
Step	Action
3-2	<p>In the Add Local Tier window, unselect the checkbox to prevent enabling the Onboard Key Manager. You will configure the Onboard Key Manager to manage encryption keys in a later exercise.</p> 
3-3	<p>In the Add Local Tier window, expand the <b>Recommendation details</b>.</p> 

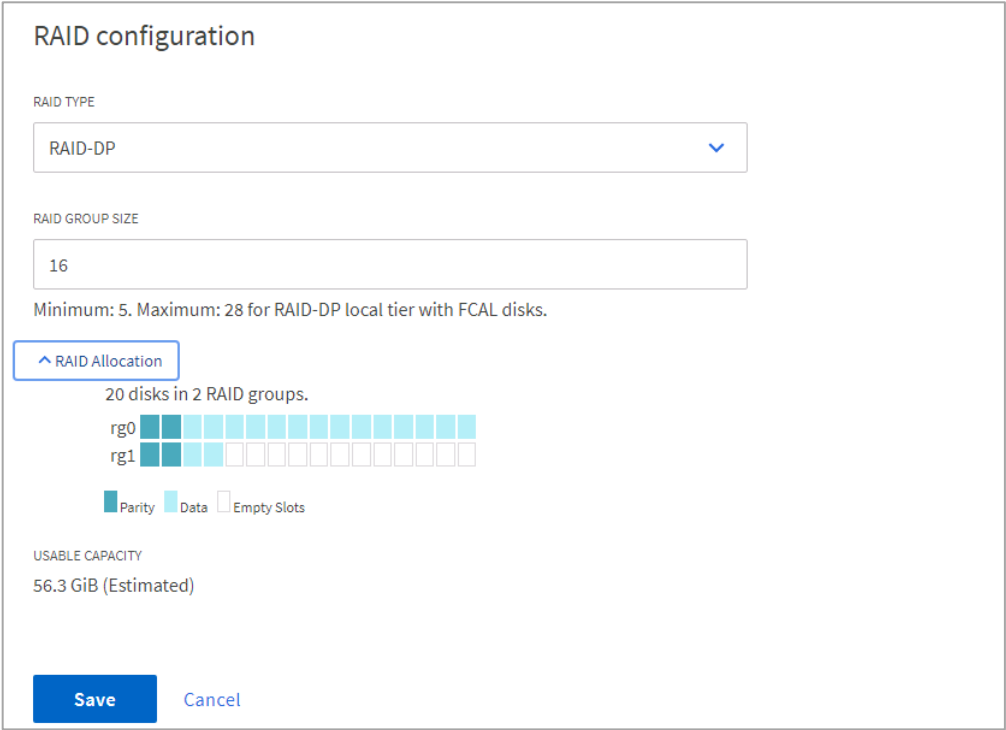
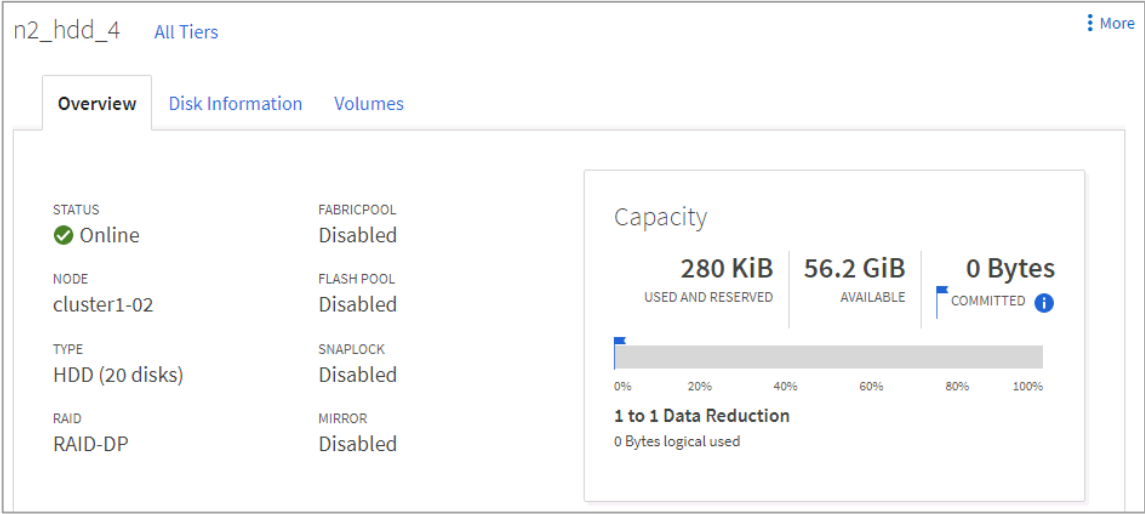


Step	Action
3-7	<p>In the Add Local Tier window, define an aggregate that is comprised of HDDs on node 1, with the following settings:</p> <ul style="list-style-type: none"> <li>• Name: <b>n1_hdd_4</b></li> <li>• Disk Type: <b>FCAL on node cluster1-01</b></li> <li>• Number of Disks: <b>14</b></li> <li>• RAID Type: <b>RAID-DP</b> (default)</li> <li>• RAID Group Size: <b>16</b> (default)</li> <li>• Configure Onboard Key Manager for encryption: <b>&lt;unselected&gt;</b></li> </ul>  <p>The screenshot shows the 'Add Local Tier' dialog box with the following configuration:</p> <ul style="list-style-type: none"> <li><b>NAME:</b> n1_hdd_4</li> <li><b>DISK TYPE:</b> FCAL on node cluster1-01</li> <li><b>Contains disks of 3.93 GiB each.</b></li> <li><b>NUMBER OF DISKS:</b> 14</li> <li><b>Minimum: 5 for RAID-DP. Maximum: 34.</b></li> <li><b>RAID configuration</b></li> <li><b>RAID TYPE:</b> RAID-DP</li> <li><b>RAID GROUP SIZE:</b> 16</li> <li><b>Minimum: 5. Maximum: 28 for RAID-DP local tier with FCAL disks.</b></li> <li><b>RAID Allocation:</b> (expanded)</li> <li><b>USABLE CAPACITY:</b> 42.2 GiB (Estimated)</li> <li><b>Encryption:</b> <a href="#">Considerations</a></li> <li><input type="checkbox"/> Configure Onboard Key Manager for encryption</li> <li><b>Buttons:</b> Save, Cancel</li> </ul>

Step	Action																																																												
3-8	<div><div></div><div>You select <i>only</i> the suggested number of disks (fourteen). Disks are limited, and if you use too many disks, you might run out before you complete the course.</div></div>																																																												
3-9	<div>Click <b>RAID Allocation</b>.</div> <div><div><div>RAID configuration</div><div><div>RAID TYPE</div><div>RAID-DP</div></div><div><div>RAID GROUP SIZE</div><div>16</div></div><div>Minimum: 5. Maximum: 28 for RAID-DP local tier with FCAL disks.</div><div><div>RAID Allocation</div><div>14 disks in one RAID group.</div><div>rg0</div><div><div><div></div>Parity</div><div><div></div>Data</div><div><div></div>Empty Slots</div></div></div><div><div>USABLE CAPACITY</div><div>42.2 GiB (Estimated)</div></div></div></div>																																																												
3-10	<div>Answer the following question:</div> <div>In a real-world environment, would the specified allocation be an efficient use of disks? _____</div>																																																												
3-11	Click <b>Save</b> .																																																												
3-12	<div>Examine the new aggregate:</div> <div><div><div>Tiers</div><div>Card View</div><div><div>Local Tiers</div><div>Cloud Tiers</div></div><div><div><div>+ Add</div><div><div>Search</div><div>Download</div><div>Show / Hide</div><div>Filter</div></div></div><table><tr><th>Name</th><th>Status</th><th>Type</th><th>Capacity</th><th>U...</th><th>L...</th><th>D...</th><th>IOP!</th><th>Late</th><th>Thrc</th></tr><tr><td>n1_hdd_2</td><td>Online</td><td>HDD</td><td><div><div>20.7 MiB used and reserved</div><div>14 GiB available</div></div>14.1 GiB</td><td>0 Byte:</td><td>4.46 M</td><td>1.44 to</td><td>0</td><td>0</td><td>0</td></tr><tr><td>n1_hdd_4</td><td>Online</td><td>HDD</td><td><div><div>252 KiB used and reserved</div><div>42.2 GiB available</div></div>42.2 GiB</td><td>0 Byte:</td><td>0 Byte:</td><td>1 to 1</td><td>-</td><td>-</td><td>-</td></tr><tr><td>n2_hdd_1</td><td>Online</td><td>HDD</td><td><div><div>2.03 GiB used and reserved</div><div>15.5 GiB available</div></div>17.6 GiB</td><td>0 Byte:</td><td>29.8 M</td><td>1.54 to</td><td>0</td><td>0</td><td>0</td></tr><tr><td>n1_hdd_1</td><td>Online</td><td>HDD</td><td><div><div>2.03 GiB used and reserved</div><div>15.5 GiB available</div></div>17.6 GiB</td><td>0 Byte:</td><td>27.8 M</td><td>1.47 to</td><td>0</td><td>0</td><td>0</td></tr><tr><td>n1_ssd_3</td><td>Online</td><td>SSD</td><td><div><div>180 KiB used and reserved</div><div>3.52 GiB available</div></div>3.52 GiB</td><td>0 Byte:</td><td>0 Byte:</td><td>1 to 1</td><td>0</td><td>0</td><td>0</td></tr></table></div></div></div>	Name	Status	Type	Capacity	U...	L...	D...	IOP!	Late	Thrc	n1_hdd_2	Online	HDD	<div><div>20.7 MiB used and reserved</div><div>14 GiB available</div></div> 14.1 GiB	0 Byte:	4.46 M	1.44 to	0	0	0	n1_hdd_4	Online	HDD	<div><div>252 KiB used and reserved</div><div>42.2 GiB available</div></div> 42.2 GiB	0 Byte:	0 Byte:	1 to 1	-	-	-	n2_hdd_1	Online	HDD	<div><div>2.03 GiB used and reserved</div><div>15.5 GiB available</div></div> 17.6 GiB	0 Byte:	29.8 M	1.54 to	0	0	0	n1_hdd_1	Online	HDD	<div><div>2.03 GiB used and reserved</div><div>15.5 GiB available</div></div> 17.6 GiB	0 Byte:	27.8 M	1.47 to	0	0	0	n1_ssd_3	Online	SSD	<div><div>180 KiB used and reserved</div><div>3.52 GiB available</div></div> 3.52 GiB	0 Byte:	0 Byte:	1 to 1	0	0	0
Name	Status	Type	Capacity	U...	L...	D...	IOP!	Late	Thrc																																																				
n1_hdd_2	Online	HDD	<div><div>20.7 MiB used and reserved</div><div>14 GiB available</div></div> 14.1 GiB	0 Byte:	4.46 M	1.44 to	0	0	0																																																				
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Step	Action
3-13	<p>Click <b>n1_hdd_4</b> and observe the aggregate details.</p> 
3-14	Click <b>All Tiers</b> to return to the Tiers page.
3-15	Click <b>Add</b> to create a second new local data aggregate.
3-16	In the Add Local Tier dialog box, expand the <b>Recommendation details</b> .
3-17	Click <b>Switch to Manual Local Tier Creation</b> .

Step	Action
3-18	<p>In the Add Local Tier window, define an aggregate that is comprised of HDDs on node 2, with the following settings:</p> <ul style="list-style-type: none"> <li>• Name: <b>n2_hdd_4</b></li> <li>• Disk Type: <b>FCAL on node cluster1-02</b></li> <li>• Number of Disks: <b>20</b></li> <li>• RAID Type: <b>RAID-DP</b></li> <li>• RAID Group Size: <b>16</b></li> <li>• Configure Onboard Key Manager for encryption: <b>&lt;unselected&gt;</b></li> </ul>  <p>The screenshot shows the 'Add Local Tier' dialog box with the following configuration:</p> <ul style="list-style-type: none"> <li><b>NAME:</b> n2_hdd_4</li> <li><b>DISK TYPE:</b> FCAL on node cluster1-02 (Contains disks of 3.93 GiB each.)</li> <li><b>NUMBER OF DISKS:</b> 20 (Minimum: 5 for RAID-DP. Maximum: 20.)</li> <li><b>RAID configuration:</b> <ul style="list-style-type: none"> <li><b>RAID TYPE:</b> RAID-DP</li> <li><b>RAID GROUP SIZE:</b> 16 (Minimum: 5. Maximum: 28 for RAID-DP local tier with FCAL disks.)</li> <li><b>RAID Allocation:</b> (Expanded view)</li> <li><b>USABLE CAPACITY:</b> 56.3 GiB (Estimated)</li> </ul> </li> <li><b>Encryption:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Configure Onboard Key Manager for encryption</li> <li><a href="#">Considerations</a></li> </ul> </li> </ul> <p>Buttons at the bottom: <b>Save</b> and <b>Cancel</b>.</p>

Step	Action
3-19	<p>Click <b>RAID Allocation</b>.</p> 
3-20	<p>Answer the following question:</p> <p>In a real-world environment, would the specified allocation be an efficient use of disks?</p> <p>_____</p>
3-21	Click <b>Save</b> .
3-22	<p>Click <b>n2_hdd_4</b> and observe the aggregate details.</p> 
3-23	Click <b>All Tiers</b> to return to the Tiers page.

### End of exercise