



## Exercise 8.4: Using a ResourceQuota to Limit PVC Count and Usage

The flexibility of cloud-based storage often requires limiting consumption among users. We will use the ResourceQuota object to both limit the total consumption as well as the number of persistent volume claims.

1. Begin by deleting the deployment we had created to use NFS, the pv and the pvc.

```
student@cp:~$ kubectl delete deploy nginx-nfs
```

```
deployment.apps "nginx-nfs" deleted
```

```
student@cp:~$ kubectl delete pvc pvc-one
```

```
persistentvolumeclaim "pvc-one" deleted
```

```
student@cp:~$ kubectl delete pv pvvol-1
```

```
persistentvolume "pvvol-1" deleted
```

2. Create a yaml file for the ResourceQuota object. Set the storage limit to ten claims with a total usage of 500Mi.

```
student@cp:~$ vim storage-quota.yaml
```

YAML

storage-quota.yaml

```
1 apiVersion: v1
2 kind: ResourceQuota
3 metadata:
4   name: storagequota
5 spec:
6   hard:
7     persistentvolumeclaims: "10"
8     requests.storage: "500Mi"
```

3. Create a new namespace called small. View the namespace information prior to the new quota. Either the long name with double dashes --namespace or the nickname ns work for the resource.

```
student@cp:~$ kubectl create namespace small
```

```
namespace/small created
```

```
student@cp:~$ kubectl describe ns small
```

```
Name:          small
Labels:        <none>
Annotations:    <none>
Status:        Active
```

```
No resource quota.
```

```
No resource limits.
```

4. Create a new pv and pvc in the small namespace.

```
student@cp:~$ kubectl -n small create -f PVol.yaml
```

```
persistentvolume/pvvol-1 created
```

```
student@cp:~$ kubectl -n small create -f pvc.yaml
```

```
persistentvolumeclaim/pvc-one created
```

5. Create the new resource quota, placing this object into the `small` namespace.

```
student@cp:~$ kubectl -n small create -f storage-quota.yaml
```

```
resourcequota/storagequota created
```

6. Verify the `small` namespace has quotas. Compare the output to the same command above.

```
student@cp:~$ kubectl describe ns small
```

```
Name:          small
Labels:         <none>
Annotations:    <none>
Status:         Active

Resource Quotas
Name:          storagequota
Resource       Used   Hard
-----
persistentvolumeclaims 1    10
requests.storage      200Mi 500Mi

No resource limits.
```

7. Remove the namespace line from the `nfs-pod.yaml` file. Should be around line 11 or so. This will allow us to pass other namespaces on the command line.

```
student@cp:~$ vim nfs-pod.yaml
```

8. Create the container again.

```
student@cp:~$ kubectl -n small create -f nfs-pod.yaml
```

```
deployment.apps/nginx-nfs created
```

9. Determine if the deployment has a running pod.

```
student@cp:~$ kubectl -n small get deploy
```

```
NAME          READY  UP-TO-DATE  AVAILABLE  AGE
nginx-nfs     1/1    1           1          43s
```

```
student@cp:~$ kubectl -n small describe deploy nginx-nfs
```

```
<output_omitted>
```

10. Look to see if the pods are ready.

```
student@cp:~$ kubectl -n small get pod
```

NAME	READY	STATUS	RESTARTS	AGE
nginx-nfs-2854978848-g3khf	1/1	Running	0	37s

11. Ensure the Pod is running and is using the NFS mounted volume. If you pass the namespace first Tab will auto-complete the pod name.

```
student@cp:~$ kubectl -n small describe pod \
    nginx-nfs-2854978848-g3khf
```

```
Name:          nginx-nfs-2854978848-g3khf
Namespace:     small
<output_omitted>

Mounts:
  /opt from nfs-vol (rw)
<output_omitted>
```

12. View the quota usage of the namespace

```
student@cp:~$ kubectl describe ns small
```

```
<output_omitted>

Resource Quotas
Name:          storagequota
Resource      Used  Hard
-----
persistentvolumeclaims 1    10
requests.storage      200Mi 500Mi

No resource limits.
```

13. Create a 300M file inside of the `/opt/sfw` directory on the host and view the quota usage again. Note that with NFS the size of the share is not counted against the deployment.

```
student@cp:~$ sudo dd if=/dev/zero of=/opt/sfw/bigfile bs=1M count=300
```

```
300+0 records in
300+0 records out
314572800 bytes (315 MB, 300 MiB) copied, 0.196794 s, 1.6 GB/s
```

```
student@cp:~$ kubectl describe ns small
```

```
<output_omitted>
Resource Quotas
Name:          storagequota
Resource      Used  Hard
-----
persistentvolumeclaims 1    10
requests.storage      200Mi 500Mi
<output_omitted>
```

```
student@cp:~$ du -h /opt/
```

```
301M    /opt/sfw
41M     /opt/cni/bin
41M     /opt/cni
341M    /opt/
```

14. Now let us illustrate what happens when a deployment requests more than the quota. Begin by shutting down the existing deployment.

```
student@cp:~$ kubectl -n small get deploy
```

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
nginx-nfs	1	1	1	11m

```
student@cp:~$ kubectl -n small delete deploy nginx-nfs
```

```
deployment.apps "nginx-nfs" deleted
```

15. Once the Pod has shut down view the resource usage of the namespace again. Note the storage did not get cleaned up when the pod was shut down.

```
student@cp:~$ kubectl describe ns small
```

```
<output_omitted>
Resource Quotas
Name:          storagequota
Resource      Used  Hard
-----
persistentvolumeclaims 1    10
requests.storage 200Mi 500Mi
```

16. Remove the pvc then view the pv it was using. Note the RECLAIM POLICY and STATUS.

```
student@cp:~$ kubectl -n small get pvc
```

NAME	STATUS	VOLUME	CAPACITY	ACCESSMODES	STORAGECLASS	AGE
pvc-one	Bound	pvvol-1	1Gi	RWX		19m

```
student@cp:~$ kubectl -n small delete pvc pvc-one
```

```
persistentvolumeclaim "pvc-one" deleted
```

```
student@cp:~$ kubectl -n small get pv
```

NAME	CAPACITY	ACCESSMODES	RECLAIMPOLICY	STATUS	CLAIM
STORAGECLASS	REASON	AGE			
pvvol-1	1Gi	RWX	Retain	Released	small/pvc-one 44m

17. Dynamically provisioned storage uses the ReclaimPolicy of the StorageClass which could be Delete, Retain, or some types allow Recycle. Manually created persistent volumes default to Retain unless set otherwise at creation. The default storage policy is to retain the storage to allow recovery of any data. To change this begin by viewing the yaml output.

```
student@cp:~$ kubectl get pv/pvvol-1 -o yaml
```

YAML

```
....
2   path: /opt/sfw
3   server: cp
4   persistentVolumeReclaimPolicy: Retain
5   status:
6     phase: Released
```

18. Currently we will need to delete and re-create the object. Future development on a deleter plugin is planned. We will re-create the volume and allow it to use the Retain policy, then change it once running.

```
student@cp:~$ kubectl delete pv/pvvol-1
```

```
persistentvolume "pvvol-1" deleted
```

```
student@cp:~$ grep Retain PVol.yaml
```

```
persistentVolumeReclaimPolicy: Retain
```

```
student@cp:~$ kubectl create -f PVol.yaml
```

```
persistentvolume "pvvol-1" created
```

19. We will use `kubectl patch` to change the retention policy to Delete. The yaml output from before can be helpful in getting the correct syntax.

```
student@cp:~$ kubectl patch pv pvvol-1 -p \
'{"spec":{"persistentVolumeReclaimPolicy":"Delete"}}'
```

```
persistentvolume/pvvol-1 patched
```

```
student@cp:~$ kubectl get pv/pvvol-1
```

NAME	CAPACITY	ACCESSMODES	RECLAIMPOLICY	STATUS	CLAIM
STORAGECLASS	REASON	AGE			
pvvol-1	1Gi	RWX	Delete	Available	2m

20. View the current quota settings.

```
student@cp:~$ kubectl describe ns small
```

```
....
requests.storage      0      500Mi
```

21. Create the pvc again. Even with no pods running, note the resource usage.

```
student@cp:~$ kubectl -n small create -f pvc.yaml
```

```
persistentvolumeclaim/pvc-one created
```

```
student@cp:~$ kubectl describe ns small
```

```
....
requests.storage      200Mi      500Mi
```

22. Remove the existing quota from the namespace.

```
student@cp:~$ kubectl -n small get resourcequota
```

NAME	CREATED AT
storagequota	2019-11-25T04:10:02Z

```
student@cp:~$ kubectl -n small delete resourcequota storagequota
```

```
resourcequota "storagequota" deleted
```

23. Edit the storagequota.yaml file and lower the capacity to 100Mi.

```
student@cp:~$ vim storage-quota.yaml
```

YAML

```
1 .....
2 requests.storage: "100Mi"
```

24. Create and verify the new storage quota. Note the hard limit has already been exceeded.

```
student@cp:~$ kubectl -n small create -f storage-quota.yaml
```

```
resourcequota/storagequota created
```

```
student@cp:~$ kubectl describe ns small
```

```
....
persistentvolumeclaims      1      10
requests.storage            200Mi   100Mi

No resource limits.
```

25. Create the deployment again. View the deployment. Note there are no errors seen.

```
student@cp:~$ kubectl -n small create -f nfs-pod.yaml
```

```
deployment.apps/nginx-nfs created
```

```
student@cp:~$ kubectl -n small describe deploy/nginx-nfs
```

```
Name:                nginx-nfs
Namespace:           small
<output_omitted>
```

26. Examine the pods to see if they are actually running.

```
student@cp:~$ kubectl -n small get po
```

NAME	READY	STATUS	RESTARTS	AGE
nginx-nfs-2854978848-vb6bh	1/1	Running	0	58s

27. As we were able to deploy more pods even with apparent hard quota set, let us test to see if the reclaim of storage takes place. Remove the deployment and the persistent volume claim.

```
student@cp:~$ kubectl -n small delete deploy nginx-nfs
```

```
deployment.apps "nginx-nfs" deleted
```

```
student@cp:~$ kubectl -n small delete pvc/pvc-one
```

```
persistentvolumeclaim "pvc-one" deleted
```

28. View if the persistent volume exists. You will see it attempted a removal, but failed. If you look closer you will find the error has to do with the lack of a deleter volume plugin for NFS. Other storage protocols have a plugin.

```
student@cp:~$ kubectl -n small get pv
```

NAME	CAPACITY	ACCESSMODES	RECLAIMPOLICY	STATUS	CLAIM
	STORAGECLASS	REASON	AGE		
pvvol-1	1Gi	RWX	Delete	Failed	small/pvc-one 20m

29. Ensure the deployment, pvc and pv are all removed.

```
student@cp:~$ kubectl delete pv/pvvol-1
```

```
persistentvolume "pvvol-1" deleted
```

30. Edit the persistent volume YAML file and change the persistentVolumeReclaimPolicy: to Recycle.

```
student@cp:~$ vim PVol.yaml
```

YAML

PVol.yaml

```
1 ....
2   persistentVolumeReclaimPolicy: Recycle
3 ....
```

31. Add a LimitRange to the namespace and attempt to create the persistent volume and persistent volume claim again. We can use the LimitRange we used earlier.

```
student@cp:~$ kubectl -n small create -f low-resource-range.yaml
```

```
limitrange/low-resource-range created
```

32. View the settings for the namespace. Both quotas and resource limits should be seen.

```
student@cp:~$ kubectl describe ns small
```

```
<output_omitted>
Resource Limits
  Type      Resource  Min  Max  Default Request  Default Limit  ...
  ---      -
Container  cpu       -    -    500m             1              -
Container  memory   -    -    100Mi            500Mi          -
```

33. Create the persistent volume again. View the resource. Note the Reclaim Policy is Recycle.

```
student@cp:~$ kubectl -n small create -f PVol.yaml
```

```
persistentvolume/pvvol-1 created
```

```
student@cp:~$ kubectl get pv
```

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	...
pvvol-1	1Gi	RWX	Recycle	Available	...

34. Attempt to create the persistent volume claim again. The quota only takes effect if there is also a resource limit in effect.

```
student@cp:~$ kubectl -n small create -f pvc.yaml
```

```
Error from server (Forbidden): error when creating "pvc.yaml":
persistentvolumeclaims "pvc-one" is forbidden: exceeded quota:
storagequota, requested: requests.storage=200Mi, used:
```

```
requests.storage=0, limited: requests.storage=100Mi
```

35. Edit the resourcequota to increase the requests.storage to 500mi.

```
student@cp:~$ kubectl -n small edit resourcequota
```

YAML

```
1 ....
2 spec:
3   hard:
4     persistentvolumeclaims: "10"
5     requests.storage: 500Mi
6 status:
7   hard:
8     persistentvolumeclaims: "10"
9 ....
```

36. Create the pvc again. It should work this time. Then create the deployment again.

```
student@cp:~$ kubectl -n small create -f pvc.yaml
```

```
persistentvolumeclaim/pvc-one created
```

```
student@cp:~$ kubectl -n small create -f nfs-pod.yaml
```

```
deployment.apps/nginx-nfs created
```

37. View the namespace settings.

```
student@cp:~$ kubectl describe ns small
```

```
<output_omitted>
```

38. Delete the deployment. View the status of the pv and pvc.

```
student@cp:~$ kubectl -n small delete deploy nginx-nfs
```

```
deployment.apps "nginx-nfs" deleted
```

```
student@cp:~$ kubectl -n small get pvc
```

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS	AGE
pvc-one	Bound	pvvol-1	1Gi	RWX		7m

```
student@cp:~$ kubectl -n small get pv
```

NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM	...
pvvol-1	1Gi	RWX	Recycle	Bound	small/pvc-one	...

39. Delete the pvc and check the status of the pv. It should show as Available.

```
student@cp:~$ kubectl -n small delete pvc pvc-one
```

```
persistentvolumeclaim "pvc-one" deleted
```

```
student@cp:~$ kubectl -n small get pv
```



NAME	CAPACITY	ACCESS MODES	RECLAIM POLICY	STATUS	CLAIM	STORA...
pvvol-1	1Gi	RWX	Recycle	Available		...

40. Remove the pv and any other resources created during this lab.

```
student@cp:~$ kubectl delete pv pvvol-1
```

```
persistentvolume "pvvol-1" deleted
```