Cameron Hyland

Hi Cam,

With regards to today's opening of the Milford Track.

As soon as USeD were advised of the issue they immediately brought together a response team.

The response team worked to isolate the issue, starting with server capacity as this was the most likely fault. 20 servers were turned on for the opening day and analysis showed that no single server was operating at great than 20%, this confirmed it was not a server capacity issue.

The response team them begin running tests on response times and eventually narrowed it down to very slow response time for to a specific query, however no changes had been made to the query, so it was not clear why this was an issue.

USeD then increased the capacity of the databases that support that particular query to see if that would resolve the issue.

At his point in time the best advice we have is that this is the problem and USeD advise us that if it is then upscaling the databases will resolve the issue, this work is done, and we are monitoring for results and will continue to liaise with USeD.

Next Steps.

Once USeD have confirmed and then resolved the issue they will begin a Root Cause Analysis and will provide a full report.

We will be looking for assurances that there is no repeat of this issue next week when we open the remaining Great Walks, nor when we open bookings for Huts and Campsites soon after.

Cam, I know you and your team worked hard to cross check every detail, and check against any issue that had presented in the past.
We have not seen this error previously, and we will take steps to ensure we do not see it again.

I appreciate the consequences that will arise as a result of this morning's slow start for your team and more widely for DOC. I will ensure USeD is also made aware of the consequences.

Please expect a fuller detailed response once we have certainty on the issue and the cause.

Regards
s.9(2)(a)
Account Executive
REDMAN SOLUTIONS
discover. empower. support.

M s.9(2)(a)

Head Office 139 Gotha Street, Fortitude Valley, QLD 4006

s.9(2)(a)

From:	s.9(2)(a) @redmansolutions.com>
Sent:	Friday, 21 April 2023 9:30 am
To:	Cameron Hyland
Cc:	s.9(2)(a)
Subject:	GW Incident - RCA
Attachments:	Root Cause Analysis for NZ GW Event.docx

Hi Cam,

Please find attached the RCA for yesterday's incident.

Please review the document and let me know if it is sufficient.

I believe the specific concerns about server capacity and load testing are addressed, but if you want further detail in any area please let me know.

Regards
s.9(2)(a)

Root Cause Analysis for NZ GW Event

Summary of Event

Prior to the GW on-sale event, infrastructure was scaled up to handle the load from the on-sale event based on the volumes and success from last year's event. During the on-sale event, requests spiked as expected and most of the infrastructure handled the increase in volume. Due to a stored procedure change, the query to return availability performed poorly and caused a bottleneck within the database. Attempts were made to tune the database to fix the issue, but those attempts were unsuccessful. Ultimately, customers were unable to make their bookings until the stored procedure was fixed. Once the stored procedure was updated, the site performed as expected and customers were able to make their bookings.

Root Cause Analysis

The cause of the issue was a bad performing stored procedure. This stored procedure is used to return bookings availability. On 9/22/2022, a bug was fixed where availability was not showing correctly for dates in the past. The stored procedure was updated to return data from the past 6 years (prior to the update, it only returned data from the present into the future). When the site is used by a small number of people, the data is returned in a timely manner, which caused this issue to go unnoticed at the time the change was made. The fix to the stored procedure reverted the availability check to return data from the present forward.

To prevent this from occurring the future, the following actions will be taken:

- A load test will be performed before the next on-sale event on 4/26 to provide assurance that the site can handle the load for the next event.
- Prior to the first, and largest, on-sale event in subsequent years, a load test will be performed to ensure issues like this do not go unnoticed.
- Extra scrutiny and testing will be performed going forward on changes to queries and parts of the application that receive high traffic.
- A review of the stored procedures is being performed to identify other potential bottlenecks/improvements.

Other Notes/Suggestions

- Infrastructure will remain at the current scaled up levels. Additional server resources would not have prevented this issue.
- NZ GW currently uses the legacy Saturn version. Upgrading to Mercury to take advantage of additional caching provided by RDR can provide additional performance benefits.

Cameron Hyland

From:	Cameron Hyland
Sent:	Monday, 24 April 2023 4:13 pm
To:	Catherine Wilson; Richard Kay
Cc:	Aaron Fleming; Mark Ingram
Subject:	Upcoming Great Walk booking openings & Milford Track issue
Attachments:	Root Cause Analysis for NZ GW Event.docx

Hi all,

Following the issues we experienced with the Milford Track bookings opening, we've received a root cause analysis report from the booking system vendor, attached.

In summary, the issue we encountered was new, having been introduced with a change made in September and was not revealed until the system was hit with heavy traffic. The issue impacted a specific part of the booking process (namely the availability search) and was resolved early afternoon on Thursday. At the point that the vendor advised they had resolved the issue, we did see the system functionality immediately return to normal.

The vendor are confident that if this specific issue had not occurred, that the system would have operated normally as the Milford Track bookings opened. However they will be performing load testing on the system overnight tonight, focused on the booking process, to provide additional assurance. They have also provided some information from their monitoring tools which show that actual server usage at the peak time on Thursday remained well within normal levels.

I'll have the results of that load testing tomorrow morning, and will share these once received. Provided that the testing doesn't raise any further issues, I am confident that we have the issue resolved and so I recommend that we proceed with opening bookings for the remaining Great Walks as planned.

If any issues are raised, I will discuss next steps with the vendor tomorrow – in this case it is likely that delaying the remaining openings would be the best course of action.

Let me know if you have any questions, or have concerns about opening the remaining walks. And sorry for the late email, I know it doesn't give a lot of time to respond, but I needed to get a bit more information from the vendor to be sure that this was the right course of action.

Thanks,
Cam

Cameron Hyland (he/him)
Booking Services Manager
Heritage and Visitor Unit
Department of Conservation —*Te Papa Atawhai*
DDI: s.9(2)(a)

National Office
13-27 Manners St | PO Box 10 420, Wellington 6143
T: +64 4 471 0726

Conservation leadership for our nature *Tākina te hī, Tiakina te hā, o te ao Tūroa*

www.doc.govt.nz

From:	s.9(2)(a) @tylertech.com>
Sent:	Wednesday, 3 May 2023 2:55 pm
To:	Cameron Hyland; Richard Kay; Will Chaney
Cc:	s.9(2)(a)
	s.9(2)(a) @redmansolutions.com.au
Subject:	Re: Great Walks Incident Report | INC0391422

Team,

The two main efforts for today were:

1. QA Testing has been completed
2. Additional tweaks and adjustments were made to the stored procedure, views and indexes in the load testing environment.

As far as next steps, I have a couple items to update the team on and to coordinate dates for a production push.

1. As discussed yesterday, we know dropping and re-creating the stored procedure will fix the issue with poor performance, but we are working with both our internal database team and with AWS for a better long term solution.
2. We would like to validate our results from the load testing server in prod. We would do this for searching only, we will not make any bookings.
   a. This would require us to push some changes into your production environment in order for us to perform this validation.
3. The last item we may want to discuss is the Queue-it module. Not a requirement at this time, but we have leveraged in the past for high volumes in different environments. We can walk you through a demo of it if you are interested or answer any questions around it.

Would you like me to set up a meeting to walk through the production change pushes or any other items? If not, do you have times you prefer for us to run load testing and to make the change?

After these production changes we will have additional changed needed at later date.

Those 2 changes are:

1. Cloudfront changes
   a. We are still currently building out cloudfront for prod.
   b. This will assist with faster image load times and speed up the webservers.
   c. When we make this change we will need to coordinate with your team to make a DNS change.
2. Adding more webnodes servers to prod
   a. We saw some overloading and this will assist with handling this better.

Thank you.

s.9(2)(a)

From: Cameron Hyland <chyland@doc.govt.nz>
Date: Tuesday, May 2, 2023 at 1:35 AM
To: s.9(2)(a) @tylertech.com>, Richard Kay <rkay@doc.govt.nz>, Will Chaney <wchaney@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>, s.9(2)(a) @tylertech.com>, s.9(2)(a)

s.9(2)(a) @redmansolutions.com>, s.9(2)(a) @redmansolutions.com.au
s.9(2)(a) @redmansolutions.com.au>

Subject: RE: Great Walks Incident Report | INC0391422

Hi s.9(2)(a) thanks for this update – I really appreciate the detail and the thorough approach being taken.

The locked record explanation is also helpful, sounds like that is probably not related to our DB write issues.

I see s.9(2)(a) has provided our list of these issues – this list specifically covers what we experienced on the Great Walks system during/following the Milford Track opening. We are compiling a similar list for the Huts and Campsites system – the support team are already across most of the issues there, but there is overlap between the issues we're experiencing on the two systems, so we want to make sure we've ticked every box in readiness for reopening.

To that end, once we have the 'primary' issue with this stored procedure resolved I think we'll need to know the other relevant/high-use stored procedures have been reviewed for both systems, especially where timeouts/poor performance may be linked to our other issues.

We'll provide the Huts & Campsites list via s.9(2)(a) tomorrow our time, and obviously the current Great Walks work takes precedence.

Cheers
Cam

From: s.9(2)(a) @tylertech.com>
Sent: Tuesday, May 2, 2023 11:27 AM
To: Cameron Hyland <chyland@doc.govt.nz>; Richard Kay <rkay@doc.govt.nz>; Will Chaney <wchaney@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>; s.9(2)(a) @tylertech.com>; s.9(2)(a)
s.9(2)(a) @redmansolutions.com>s.9(2)(a) @redmansolutions.com.au
Subject: Re: Great Walks Incident Report | INC0391422

Team:

My apologies for the long-winded email. Hopefully it does not get too complex or difficult to follow. I am going to get a little technical, but we can also discuss in our next meeting, if we need to talk through it.

We discovered a pretty key piece of information this morning.

Today, while running performance tests in our load environment, we experienced the same issue of slowness as in production prior to the Abel Talesman opening. As you probably recall from our meeting last week, we didn't have this issue when we performed our performance testing the day before the opening and we weren't sure why it passed our tests prior and the very next day we had issues.

We previously identified a stored procedure as the main cause of the performance issue, but today we were able to pinpoint why the performance of this stored procedure has varied at different times.

Every morning, we have a job that rebuilds the database indexes and updates statistics. Both of these actions are standard maintenance operations to keep a database tuned. However, after statistics are updated, the execution plan used by the poor performing stored procedure is inefficient. Using this inefficient execution plan, the performance of the site is quite bad. Once the execution plan is cleared from cache (either by manually removing it or re-creating the stored procedure), the execution plan used by the stored procedure is efficient and runs quickly.

Looking back to the Milford opener, the stored procedure was identified as the problem. A change was made to the stored procedure, and server performance immediately returned to normal levels. Although the change to the stored procedure made it more efficient, it also caused the bad execution plan to be cleared.

2

Last Monday, when we load tested in prod, we tested the stored procedure with 2 different variations. We did not observe a performance difference between these two variations, but because we updated the stored procedure testing those variations, the bad execution plan ran was removed. Therefore, our performance tests all looked good. On Tuesday, after the re-index and statistics update job ran in the morning, the bad execution plan for the stored procedure was cached again. This caused the site to not be able to handle the traffic leading up to the Abel Talesman opener and is also the reason we saw the poor performance during load tests the day after the planned opener.

Today's activities:
1. Load tests with a combination of bookings and searches
2. Identification of the bad execution plan caused by the daily job updating database statistics
3. More performance tuning involving:
    a. Adding additional DB indexes
    b. Tweaked database function
    c. Removing past inventory records from a table
    d. Adding an additional web node to the load testing environment
4. Begin QA on the stored procedure and CDN changes

In our load testing environment today, we were able to perform the production equivalent of 1000 bookings and 8500 searches per minute.

I will send out another email update tomorrow evening.

Cam,

It would be good to go through the list, once you have compiled everything.

In reference to item #4:

We deleted records from a lock table (around 200,000 items). Basically, when someone selects a great walk to book, an entry is added to this table to "lock" that inventory item to them. After they make their purchase or the lock expires we don't remove them from the table. Our plan is to create a cleanup process for these items in the future, although removing those records did not have much of an overall impact with our load testing.

Thank you.

s.9(2)(a)

Senior Director of Software Engineering - Recreation Solutions
Tyler Technologies
s.9(2)(a) @tylertech.com
s.9(2)(a) (m)

From: Cameron Hyland <chyland@doc.govt.nz>
Date: Friday, April 28, 2023 at 5:25 PM
To: s.9(2)(a) @tylertech.com>, Richard Kay <rkay@doc.govt.nz>, Will Chaney <wchaney@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>, s.9(2)(a) @tylertech.com>, s.9(2)(a) s.9(2)(a) @redmansolutions.com>, s.9(2)(a) @redmansolutions.com.au

s.9(2)(a) @redmansolutions.com.au>

Subject: RE: Great Walks Incident Report | INC0391422

Thanks for the update Allen, it does sound like good progress.

One thing I'm interested in getting a bit more detail on is item 4 below, the database lock records. We do see occasional writing issues when using the system and it would be good to know whether these are related and if we'll see improvement in that area as a result. We also experience the write issues on our Huts & Campsites system.

My team are putting together a summarised list of those issues which we'll provide through to s.9(2)(a) at Redman – it would be helpful to have them reviewed. The work below takes precedence though obviously, so we can pick this up afterwards.

Cheers
Cam

From: s.9(2)(a) @tylertech.com>
Sent: Saturday, April 29, 2023 8:59 AM
To: Richard Kay <rkay@doc.govt.nz>; Will Chaney <wchaney@doc.govt.nz>; Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>; s.9(2)(a) @tylertech.com>; s.9(2)(a)
s.9(2)(a) @redmansolutions.com>s.9(2)(a) @redmansolutions.com.au
Subject: Re: Great Walks Incident Report | INC0391422

Hi Richard,

We made some great progress today and we are track to being functional testing and for load testing beginning Monday.

1. Perform additional tests on re-written stored procedure - **Completed**
2. Write bookings and searches load testing script. - **Completed**
3. Move static content to Cloudfront. – **Completed**
4. Perform DB tuning (remove unneeded lock records and add DB index) – **Completed**
5. Perform functional QA testing of the changes and remediate any findings. – **targeted to begin Monday, May 1st**
6. Run bookings load testing script and remediate any findings. – **targeted to begin Monday, May 1st**
7. Deploy changes to Production
8. Repeat availability load tests.

My next update will be towards the end of the day here Monday.

As always, please let me know if you have any questions or would like further conversation.

Thank you.

s.9(2)(a)

Senior Director of Software Engineering - Recreation Solutions
Tyler Technologies
s.9(2)(a)
s.9(2)(a) (m)

From: s.9(2)(a) @tylertech.com>
Date: Thursday, April 27, 2023 at 5:27 PM
To: Richard Kay <rkay@doc.govt.nz>, Will Chaney <wchaney@doc.govt.nz>, Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>, s.9(2)(a) @tylertech.com>, s.9(2)(a)
s.9(2)(a) @redmansolutions.com>, s.9(2)(a) @redmansolutions.com.au
s.9(2)(a) @redmansolutions.com.au>
Subject: Re: Great Walks Incident Report | INC0391422

Richard,

We wanted to provide you and the team with an update on where we are today.

We have performed additional load tests with the newly written stored procedure and are seeing improved speeds. We have also completed development of the new load test scripts and ran some preliminary loads in the load test environment, but these scripts need to be tested by our quality assurance team before we move them into production. We have started the process to improve the load speed of images on the website for faster user experience. We have also been in communication with Amazon today on an open database ticket and they have provided us some additional scripts to create and to run tomorrow.

We are currently targeting Monday, May 1st to start our quality assurance validation process for all of the changes we have made and are currently making. We are also targeting Monday to be the date we start heavy load testing cycles in our non-production environments. After we the tests all meet our approval we would like to coordinate moving those changes into production and running additional load testing validation with you.

Do these timeframes align with turnaround expectations for your timetables?

1. Perform additional tests on re-written stored procedure - **Completed**
2. Write bookings and searches load testing script. - **Completed**
3. Move static content to Cloudfront. – **Active**
4. Perform DB tuning (remove unneeded lock records and add DB index) - **Active**
5. Perform functional QA testing of the changes and remediate any findings. – **targeted to begin Monday, May 1st**
6. Run bookings load testing script and remediate any findings. – **targeted to begin Monday, May 1st**
7. Deploy changes to Production
8. Repeat availability load tests.

Please let us know if you would like to schedule a call to discuss any of these items or any other items not listed.

Thank you.

s.9(2)(a)

s.9(2)(a)
Senior Director of Software Engineering - Recreation Solutions
Tyler Technologies
s.9(2)(a) @tylertech.com
s.9(2)(a) (m)

From: s.9(2)(a) @tylertech.com>
Date: Wednesday, April 26, 2023 at 6:59 PM
To: Richard Kay <rkay@doc.govt.nz>, Will Chaney <wchaney@doc.govt.nz>, Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>, s.9(2)(a) @tylertech.com>, s.9(2)(a)
s.9(2)(a) @redmansolutions.com>, s.9(2)(a) @redmansolutions.com.au
s.9(2)(a) @redmansolutions.com.au>
Subject: Re: Great Walks Incident Report | INC0391422

We definitely want to do a prod validation, as well. I'd like to get through a few more of our internal steps and then we can coordinate that with you.

Thanks,

s.9(2)(a)

From: Richard Kay <rkay@doc.govt.nz>
Sent: Wednesday, April 26, 2023 6:54:07 PM
To: s.9(2)(a) @tylertech.com>; Will Chaney <wchaney@doc.govt.nz>; Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>; s.9(2)(a) @tylertech.com>; s.9(2)(a)
s.9(2)(a) @redmansolutions.com>; s.9(2)(a) @redmansolutions.com.au
s.9(2)(a) @redmansolutions.com.au>
Subject: RE: Great Walks Incident Report | INC0391422

And testing prod?

We'd be open to do a prod test at say 3am NZT if possible? We just want to rule out any differences between environments.

From: s.9(2)(a) @tylertech.com>
Sent: Thursday, April 27, 2023 11:33 AM
To: Richard Kay <rkay@doc.govt.nz>; Will Chaney <wchaney@doc.govt.nz>; Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>; s.9(2)(a) @tylertech.com>; s.9(2)(a)
s.9(2)(a) @redmansolutions.com>; s.9(2)(a) @redmansolutions.com.au
Subject: Re: Great Walks Incident Report | INC0391422

Hi Richard,

We were able to consistently reproduce it in our lower level environments and in our load testing environment. We were also able to see improvements from the stored procedure changes we have made so far. We will continue to send daily updates as we progress on our open items we have outstanding.

Action items:

1. Perform additional tests on re-written stored procedure
2. Write bookings and searches load testing script.
3. Move static content to Cloudfront.
4. Run bookings load testing script and remediate any findings.
5. Perform functional QA testing of the changes and remediate any findings.
6. Deploy changes to Production
7. Repeat availability load tests.
8. Perform DB tuning (remove unneeded lock records and add DB index)

6

Thank you.

s.9(2)(a)

███████

Senior Director of Software Engineering - Recreation Solutions
Tyler Technologies
s.9(2)(a) @tylertech.com
s.9(2)(a) (m)

From: Richard Kay <rkay@doc.govt.nz>
Date: Wednesday, April 26, 2023 at 6:25 PM
To: s.9(2)(a) @tylertech.com>, Will Chaney <wchaney@doc.govt.nz>, Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>, s.9(2)(a) @tylertech.com>, s.9(2)(a)
s.9(2)(a) @redmansolutions.com>, s.9(2)(a) @redmansolutions.com.au
s.9(2)(a) @redmansolutions.com.au>
Subject: RE: Great Walks Incident Report | INC0391422

Thank you, this looks positive. So were you able to consistently reproduce the issue?

From: s.9(2)(a) @tylertech.com>
Sent: Thursday, April 27, 2023 11:19 AM
To: Richard Kay <rkay@doc.govt.nz>; Will Chaney <wchaney@doc.govt.nz>; Cameron Hyland <chyland@doc.govt.nz>
Cc: s.9(2)(a) @tylertech.com>; s.9(2)(a) @tylertech.com>; s.9(2)(a)
s.9(2)(a) @redmansolutions.com>; s.9(2)(a) @redmansolutions.com.au
Subject: Great Walks Incident Report | INC0391422

Richard,

Please find attached the results of the Root Cause Analysis the team conducted over the past 24 hours.

Digital Solutions Division I&H Incident Report

Incident Number	*INC0391422*
Apps/Services Impacted	New Zealand Great Walks
Business Impact	New Zealand was forced to cancel their sales opening due to the site not performing.
Issue Reported Time	*4:15 PM CT*
Impact Start Time	*4:15 PM CT*
Impact End Time	*5:22 PM CT*
Impact Duration	Ongoing
Incident Description	Tyler became aware of performance issues starting at 4:15 PM CT. A spike in the number of users in the system caused the servers to become unresponsive. A stored procedure that was used heavily in availability searches had long response times which had a downstream impact to the web servers. Due to the site not being available, a maintenance page was presented to customers while the upcoming season inventory was shutoff. Once the inventory was updated, the maintenance page was removed and site access was restored.
Root Cause	The leading cause of the issue was a poor performing stored procedure that led to query queuing within the database and the site to become unresponsive.
Remediation Steps	1. Analyze logs and data from New Relic and Database Performance Analyzer. 2. Re-write the poorly performing stored procedure. 3. Perform additional load tests in the load testing environment.
Related Tickets	
Follow Up Actions	1. The poor performing stored procedure has been re-written. Initial tests indicate a 10x improvement in performance. Additional testing is ongoing. 2. A high number of requests to static assets was seen on the web servers. These assets are being moved to a Content Delivery Network (CDN) in order to reduce unnecessary load on the servers. 3. Additional load tests are being written to test the end-to-end booking functionality under load.

4. Some database requests had a higher than normal duration spent in the "open connection" phase of the request. We are requesting a ticket be opened with AWS for this issue.

We greatly appreciate your patience and understanding as we worked through this process. Please let us know if you would like to schedule a call to review/discuss our findings.

We are committed to providing the Department of Conservation with a reliable and highly performant booking platform and are prepared to make the necessary investments.

Kind Regards,

s.9(2)(a)

Senior Director of Software Engineering - Recreation Solutions
Tyler Technologies
s.9(2)(a)
s.9(2)(a)   (m)

Digital Solutions Division I&H Incident Report

Incident Number	*INC0391422*
Apps/Services Impacted	New Zealand Great Walks
Business Impact	New Zealand was forced to cancel their sales opening due to the site not performing.
Issue Reported Time	*4:15 PM CT*
Impact Start Time	*4:15 PM CT*
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Incident Description	Tyler became aware of performance issues starting at 4:15 PM CT. A spike in the number of users in the system caused the servers to become unresponsive. A stored procedure that was used heavily in availability searches had long response times which had a downstream impact to the web servers. Due to the site not being available, a maintenance page was presented to customers while the upcoming season inventory was shutoff. Once the inventory was updated, the maintenance page was removed and site access was restored.
Root Cause	The leading cause of the issue was a poor performing stored procedure that led to query queuing within the database and the site to become unresponsive.
Remediation Steps	1. Analyze logs and data from New Relic and Database Performance Analyzer. 2. Re-write the poorly performing stored procedure. 3. Perform additional load tests in the load testing environment.
Related Tickets	
Follow Up Actions	1. The poor performing stored procedure has been re-written. Initial tests indicate a 10x improvement in performance. Additional testing is ongoing. 2. A high number of requests to static assets was seen on the web servers. These assets are being moved to a Content Delivery Network (CDN) in order to reduce unnecessary load on the servers.

3. Additional load tests are being written to test the end-to-end booking functionality under load.
4. Some database requests had a higher than normal duration spent in the "open connection" phase of the request. We are requesting a ticket be opened with AWS for this issue.