Reviewing CKAN Natural Asset Register-Data Portal (NAR-DP) performance on mobile devices and suggested improvements

RESAS1.4.1 [D6 Review of mobile device access to environmental information]

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Executive summary

In this technical report we review performance of the Scottish Government funded Natural Asset Register-Data Portal (NAR-DP) on mobile devices, summarise some recent developments with open data portals, and present a suggestion for improving the NAR-DP to enhance the interactive data visualization based on identified use cases. The primary audience for this report is the NAR-DP Steering Group: which comprises of colleagues from across Scottish Government and its agencies e.g. SEPA and SNH, and the SEFARI institutes involved in Theme One of the Strategic Research Programme.

Through a series of meetings, workshops and consultations with potential users of the NAR-DP, we have learned there are two main uses that we are currently supporting: viewing metadata about the datasets and visualising the datasets on desktop devices (use case A), and downloading of the datasets to desktop devices in several formats including shapefile, CSV and web mapping services (use case B). Due to the trend towards mobile devices, part of this review is focussed on assessing the performance of NAR-DP on mobile devices, for example: viewing metadata about the datasets and visualising the spatial datasets on mobile devices (use case C). This review seeks to ask '**if any changes are required to the NAR-DP to better support current use cases A and B, and for mobile devices (use case C)**'.

The objectives of this technical report are: 1) to assess the performance of the CKAN-based NAR-DP using standard mobile performance tests (e.g. performance in relation to use case C); 2) provide a brief overview of recent developments in open data portals; and 3) to explore options for improving how users can interact with spatial data in the NAR-DP (use cases A and C). **It is on this latter suggestion, that we would like feedback from the NAR-DP Steering Group.**

CKAN is still widely used for open data portals. Currently, we are not planning to move the NAR-DP from CKAN to a bespoke code base, or to use the Frictionless Data tools or the Esri open-data portal. **We welcome feedback from the Steering Group on this topic.**

Our main suggestion for how we could improve a user's experience (use cases A and C) of the NAR-DP is to provide more interactive geospatial data visualization, in addition to or as an alternative to the current CKAN map viewer. We find users of the NAR-DP are interested in viewing the spatial datasets, currently a map with very limited interactivity is provided, i.e. only zooming and panning of the display. Our proposal consists of two options to enable more interactive viewing of the NAR-DP data. The first option is to develop a relatively simple native mobile app in the Android and Apple operating systems. The second option is to extend the CKAN application itself by writing a new web mapping display page. This would over-ride the default mapping display and implement the Esri API for JavaScript. The second option is our preferred option, based on balancing resources required for development and testing, with the benefits gained by colleagues who use the NAR-DP. **We welcome feedback from the Steering Group on these options.**

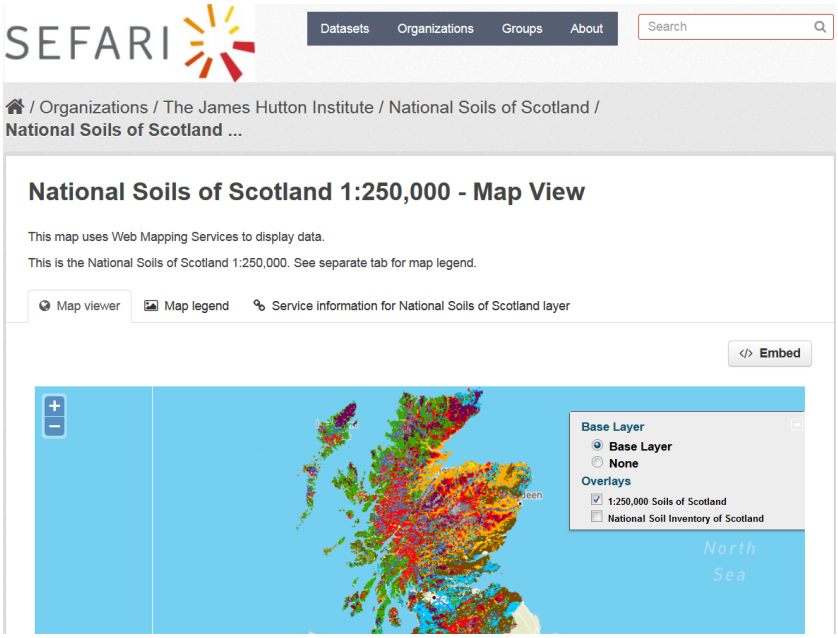
1. Introduction

In this technical report we review performance of the Scottish Government funded Natural Asset Register-Data Portal (NAR-DP) on mobile devices, summarise some recent developments with open data portals, and present a suggestion for improving the NAR-DP to enhance the interactive data visualization based on identified use cases. The primary audience for this report is the NAR-DP Steering Group: which comprises of colleagues from across Scottish Government and its agencies e.g. SEPA and SNH, and the SEFARI[1] institutes involved in Theme one of the Strategic Research Programme. Over the past year we have set-up the CKAN-based NAR-DP, and improved it through feedback gained from the recent consultation exercise (Macleod and Donnelly, 2018).

1.1 Current performance of CKAN based NAR-DP web application

The NAR-DP uses the CKAN data management system[2], which is described as a content management system for data. CKAN is open source and its Github[3] repository demonstrates active development since the release of v1.0 in 2010[4] with the latest version having been released in July 2018. The CKAN developer community have established appropriate governance structures: an association, steering group and technical team to guide its development. It is used around the world by various governments and organisations[5] to produce open data portals. The CKAN application is built with Python[6] on the backend and JavaScript[7] on the frontend[8], and uses PostgreSQL[9] as its main database.

Figure 1. An example of current map view of spatial data



[1] https://sefari.scot/
[2] https://ckan.org/
[3] https://github.com/ckan/ckan
[4] https://blog.okfn.org/2010/05/18/ckan-v10-released/
[5] https://ckan.org/about/instances/
[6] https://www.python.org/
[7] https://developer.mozilla.org/bm/docs/Web/JavaScript
[8] https://en.wikipedia.org/wiki/Front-end_web_development
[9] https://www.postgresql.org/

We are pleased with the responsive design[10] of the main CKAN interface on desktop and mobile devices i.e. it responds to smaller screen sizes. However, we think the current display of mapped information using a Web Mapping Service[11] (e.g. Figure 1) could be improved in terms of presentation and interactivity. In this report we present options for improving this mapping interface, and will canvas views from the Steering Group and colleagues on what improvements may be required.

1.2 Increasing use of mobile devices and their differences to desktop devices

Increasingly web applications (web app), like the NAR-DP, are being accessed on mobile devices, for example the combined traffic, from mobile and tablet devices, to many websites e.g. www.gov.uk[12] is greater than that from desktop devices. In the UK mobile phones and tablets accounted for a similar number of website page views (January 2018) as laptops and desktop devices[13]. A larger proportion of all UK adult age groups accessed the internet using mobile phones, than desktop computers in 2018[14]. It is now essential to make web apps mobile-friendly[15].

In this report we use the term 'mobile' to include both mobile phones and tablets, and 'desktop' to cover desktop and laptop devices. Mobile devices differ from desktop devices in terms of: 1) different physical attributes e.g. smaller screen size and default orientation on mobile phones is normally vertical, and often they have lower processing power and storage; 2) often different access to fixed and mobile broadband e.g. more likely to be connection limited (or the user may want to limit data downloads); and 3) differing user behaviours and requirements e.g. mobile more likely to be used for immediate information, rather than processing or downloading of large spatial data sets.

1.3 Current and future uses of the NAR-DP

Through a serious of meetings, workshops and consultations with potential users of the NAR-DP, we have learned there are two main uses that we are currently supporting: viewing metadata about the datasets and visualising the datasets on desktop devices (**use case A**), and downloading of the datasets to desktop devices in several formats including shapefile, CSV and web mapping services (**use case B**).

Due to the trend towards mobile devices, part of this review is focussed on assessing the performance of NAR-DP on mobile devices, for example: viewing metadata about the datasets and visualising the spatial datasets on mobile devices (**use case C**). This review seeks to ask 'if any changes are required to the NAR-DP to better support current use cases A and B, and for mobile devices (use case C)'? For example, unless there is significant demand from users for the NAR-DP to

[10] https://en.wikipedia.org/wiki/Responsive_web_design
[11] https://en.wikipedia.org/wiki/Web_Map_Service
[12] https://www.gov.uk/performance/site-activity/device-type#from=2016-11-01T00:00:00Z&to=2018-07-01T00:00:00Z
[13] https://www.statista.com/statistics/507402/share-of-web-page-views-in-the-united-kingdom-uk-by-device/
[14] https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2018#mobile-phones-or-smartphones-still-most-popular-devices-used-to-access-the-internet
[15] https://developers.google.com/search/mobile-sites/

be available as a native mobile application, we are not proposing to create a complete, fully functional native mobile version e.g. written in Swift for iOS devices; as this would require substantial development and testing. However, we consider a native mobile app with only a map view of the NAR-DP datasets and a menu to configure this view to be an option worth considering. CKANs approach to mobile devices seems to be to make it mobile-friendly, and not produce native mobile versions, however, the standard map view has limited functionality and could be improved on.

1.4 Objectives of this technical report

The objectives of this technical report are: 1) to assess the performance of the CKAN-based NAR-DP using standard mobile performance tests (e.g. performance in relation to use case C); 2) provide a brief overview of recent developments in open data portals; and 3) to explore options for improving how users can interact with spatial data in the NAR-DP (use cases A and C).

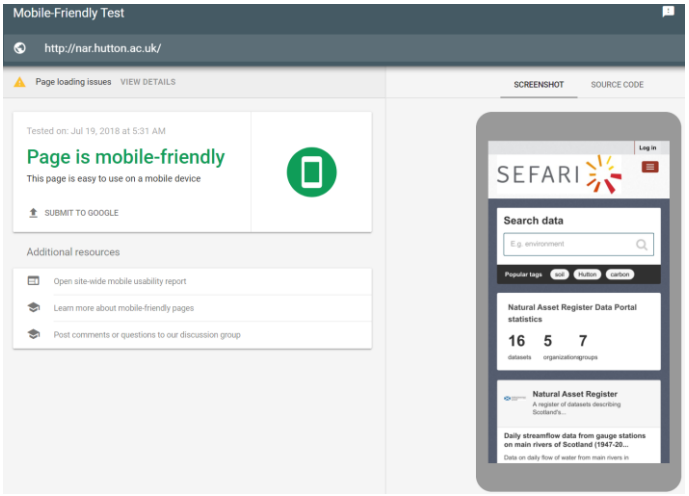
In section 2, we evaluate the current CKAN based NAR-DP. In section 3, we summarise some recent changes in open data portals, and in section 4 we set out how we think a user's experience of interacting with the spatial data could be improved. **It is on this latter suggestion, that we would like feedback from the NAR-DP Steering Group.**

2. Evaluation of current CKAN NAR-DP instance on mobile devices

To evaluate the performance of the current NAR-DP we carried out four sets of tests: Google's Mobile-Friendly Test, Google's Page Speed Test, Google's Lighthouse, and finally physical testing on representative mobile devices. To aid interpretation of the results, when appropriate, we have included results from other data portals that are using CKAN.

2.1 Google's Mobile-Friendly test and results

Figure 2. Results from Google's Mobile-Friendly test



2.1.1 The test

To use the Mobile-Friendly test tool[16] involved typing in the full URL of the web page you want to test. Results of the test were rapidly returned (often taking less than a minute); the results included a screenshot of how the page looks to Google on a mobile device, along with any problems that it finds.

2.1.2 Test results

The NAR-DP passed the test, with three randomly selected pages being classed as 'page is mobile-friendly' (see Figure 2).

2.2 Google's Page Speed test and results

2.2.1 The test

Page Speed Insights provided information on the real-world performance of a page for mobile and desktop devices and provides suggestions how that page maybe improved[17]. Once again it involved typing in the full URL of the web page to test, and the results of the test were returned (often taking less than a minute). The results included data from the Chrome User Experience Report (CrUX)[18], and provided an assessment of the state of optimisation for mobile (and desktop) devices.

2.2.2 Test results

The results in Table 1 indicate that all of the CKAN sites could be improved for mobile devices. For the NAR-DP the results suggest improving the optimising of images and greater leveraging of browser caching; we will investigate these.

Table1. Comparing NAR-DP with other CKAN sites based on Google's Page Speed test

Site and version of CKAN	Optimisation (mobile)
http://nar.hutton.ac.uk/ ckan 2.6.2	Low 54/100
https://data.gov.ie/ ckan 2.8.0	Medium 60/100
https://data.cnra.ca.gov/ ckan 2.7.3	Low 37/100

[16] https://search.google.com/test/mobile-friendly
[17] https://developers.google.com/speed/docs/insights/about?hl=en-US&utm_source=PSI&utm_medium=incoming-link&utm_campaign=PSI
[18] https://developers.google.com/web/tools/chrome-user-experience-report/

2.3 Google's Lighthouse

2.3.1 The test

Lighthouse[19] is an open-source, automated tool for improving the quality of web pages. You can install Lighthouse as a Chrome extension and when clicked a report is produced for the active web page. Lighthouse provides scores under a series of tests: performance, progressive web app (PWA)[20], accessibility, best practices and search engine optimization (SEO).

2.3.2 Test results

Results from running the Lighthouse test suite on the NAR-DP and other CKAN data portals are presented in Table 2. The NAR-DP scores were classed as medium (50-89), apart from the PWA score; the NAR-DP is not configured as a PWA. Compared with the data.gov.ie and data.cnra.ca.gov sites, then the NAR-DP site could be improved in relation to best practices and search engine optimisation (Table 2). Lighthouse returns a Performance score between 0 and 100[21] . Several of the performance audits contribute to the score including First Meaningful Paint audit which measures when a user perceives that the primary content of a page is visible. The Google Lighthouse pages provide guidance on the performance audits and what can be done to improve them e.g. First Interactive[22].

Table 2. Lighthouse test scores

Lighthouse scores			
	nar.hutton.ac.uk	**https://data.gov.ie/**	**https://data.cnra.ca.gov/**
Performance	71	43	26
Progressive Web App**	42	31	27
Accessibility	64	48	76
Best Practices	73	93	67
SEO	80	90	90

*Ignore this as NAR-DP is not currently set up to be a PWA.

2.4 Testing on physical mobile devices

2.4.1 The test

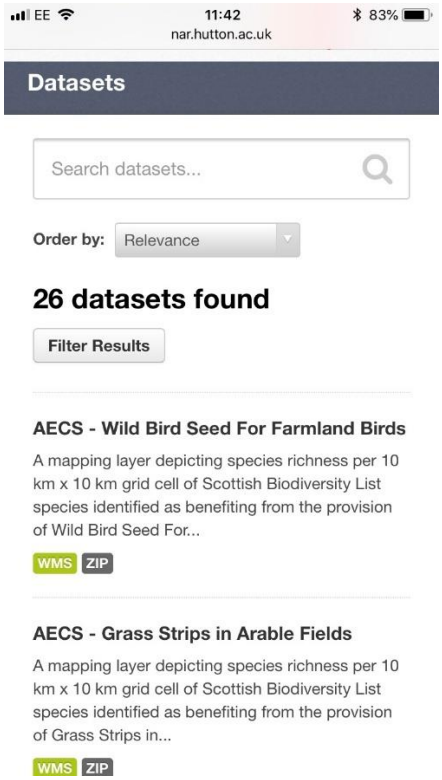
To see first-hand how the NAR-DP performed in terms of user-experience, we tested the current site on a 5" mobile phone (Moto G 2nd generation, running Android version 6.0), a 10" tablet (Amazon Fire HD 10 2017) an Apple iPhone 7 (4.7" screen), and an Apple iPad Air 2 (9.7" screen). The test involved opening the NAR-DP site (nar.hutton.ac.uk), and assessing the general usability and if the pages and sections rendered correctly, and if we were able to navigate to subsequent pages about specific datasets.

[19] https://developers.google.com/web/tools/lighthouse/
[20] https://developer.mozilla.org/en-US/docs/Web/Apps/Progressive
[21] https://developers.google.com/web/tools/lighthouse/v3/scoring
[22] https://developers.google.com/web/tools/lighthouse/audits/first-interactive

2.4.2 Test results

The NAR-DP rendered clearly on both the 5" and 10" Android and Apple devices due to the responsive design provided by the Bootstrap[23] JavaScript library (see Figures 3 and 4). Only two minor defects were noted: the first was overlapping of text (organizations and groups), and the second related to the drop-down menu (from the button in the top right hand side) taking up more space than it probably should. The high resolution of the Apple iPad's *Retina* screen meant that the display was rendered exactly as it would be on a desktop computer.

Figure 3. Screen from iPhone (4.7")

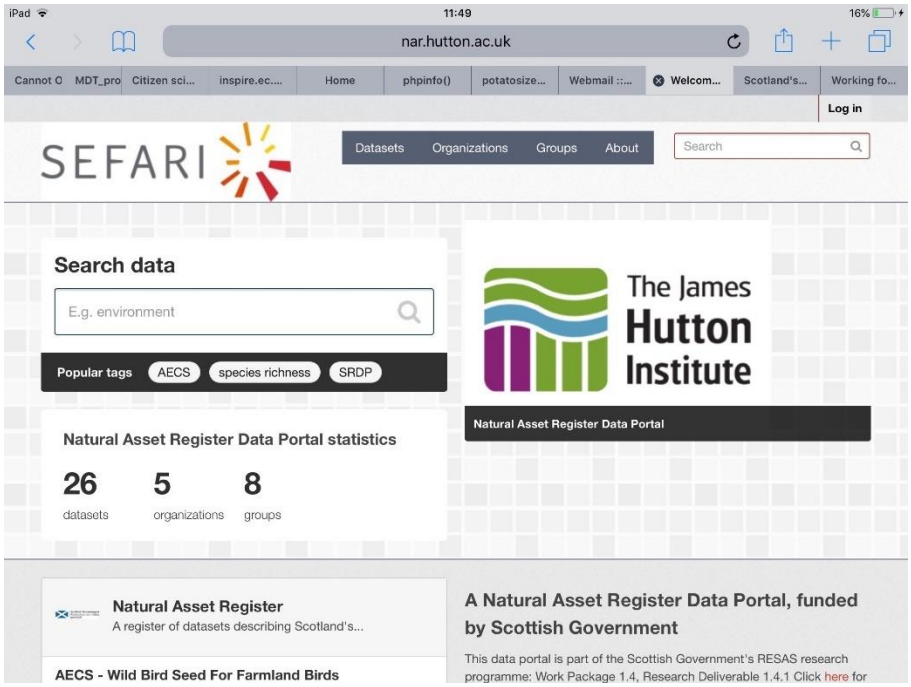


2.5 Overview/interpretation of test results

These test results are satisfactory in that they demonstrate that the current NAR-DP is mobile friendly. We will use these results to improve the web app based on the Page Speed test and Lighthouse test results; especially where we are able to configure the CKAN NAR-DP implementation without modifying the main CKAN code base, as there are advantages of using the existing code e.g. the ease of upgrading to newer versions. The CKAN software has been used for over 10 years on leading open data portals and the developers use the popular responsive, mobile-first front-end library Bootstrap[24] (v3 from v2.8; Bootstrap v4 was released in January 2018). However, one of the disadvantages of using an existing (and large) free and open source code base like CKAN is that there is often a delay in the developers implementing the latest versions of libraries like Bootstrap.

[23] https://getbootstrap.com/`
[24] http://docs.ckan.org/en/latest/maintaining/tracking.html

Figure 4. Screen from iPad (9.7")



3. Overview of recent developments in open data portals

CKAN is still widely used for open data portals[25]. However, some well-established large open data portals e.g. data.gov.uk (as part of GOV.uk) have recently stopped using CKAN and been redesigned to better meet the wider needs of government departments and the developers for a common design system[26]. Over the past couple of years a wider range of digital tools to aid the sharing of research data have become available. For example the Frictionless Data initiative aims to reduce the friction around the discoverability, structure, standardisation and tooling[27]. Open Knowledge International[28] is the organisation behind CKAN and Frictionless Data. Another open data initiative is Esri's open-data that they make available through ArcGIS Hub[29]. One potential advantage of this approach is a wider/different range of users may be able to discover your data. A number of organisations in the UK are providing their spatial data this way, for example the Forestry Commission's Open Data[30].

Currently, we are not planning to move the NAR-DP from CKAN to a bespoke code base, or to use the Frictionless Data tools or the Esri open-data portal. The latter may be most appealing but these

[25] https://ckan.org/about/instances/
[26] https://gds.blog.gov.uk/2018/06/22/introducing-the-gov-uk-design-system/
[27] https://frictionlessdata.io/
[28] https://okfn.org/
[29] http://hub.arcgis.com/pages/open-data
[30] http://data-forestry.opendata.arcgis.com/

options would need to be thoroughly reviewed against a range of user requirements and organisational constraints. **We welcome feedback from the Steering Group on this topic.**

4. Options for how to improve interactive data visualization on mobile and desktop devices

As highlighted in the introduction, our main suggestion for how we could improve a user's experience (use cases A and C) of the NAR-DP is to provide more interactive geospatial data visualization, in addition to or as an alternative to the current CKAN map viewer (Figure 1). We find users of the NAR-DP are interested in viewing the spatial datasets, currently a map with very limited interactivity is provided, i.e. only zooming and panning of the display.

Our proposal consists of two options to enable more interactive viewing of the NAR-DP data. The first option is to develop a relatively simple native mobile app in the Android and Apple operating systems. For this we would use the ArcGIS API for Android[31] and iOS[32] (Apple). This app would use the WMS (Web Mapping Services) and REST (Representational State Transfer) services already created for use in the NAR-DP but would use more of their capability to enable the user to click/tap on locations to query the data and also for this attribute information to be displayed as the user roams the map view. The app would also allow a menu driven choice of base layers (topographic maps, basic outline, aerial/satellite etc.) and transparency settings. This functionality is already implemented in our SIFSS[33] (Soil Indicators for Scottish Soils) app, meaning that an app for the NAR could re-use and extend existing software components. A significant obstacle to the implementation of the native app approach is the additional effort required to ensure that datasets newly added to NAR-DP are always available to users of the app. If it is decided to proceed with creating mobile app versions of the NAR-DP, then the possibility of the app running a self-updating routine by accessing the CKAN API must be investigated.

The second option is to extend the CKAN application itself by writing a new web mapping display page. This would over-ride the default mapping display and implement the Esri API for JavaScript. This option would more tightly integrate the mapping display pages to the existing CKAN site than the first option (standalone native apps) and would retain the look and feel of the rest of the site. This option would also benefit desktop users as the improved mapping would be available on all platforms. This option could re-use code written to create existing web-mapping pages which have been produced by the NAR-DP team. However, the Hutton NAR-DP team has no previous experience in extending CKAN in this way and it is possible that it would be more technically challenging and require more time to develop than the first option. A recent review of web-mapping technologies summarised the advantages and limitations of using the Esri ArcGIS API for JavaScript, compared to other options (Macleod and Hewitt, 2018).

The second option is our preferred option based on balancing resources required for development and testing, with the benefits gained by colleagues who use the NAR-DP. **We welcome feedback from the Steering Group on these options.**

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[31] https://developers.arcgis.com/android/latest/
[32] https://developers.arcgis.com/ios/latest/
[33] https://itunes.apple.com/gb/app/sifss/id581872368?mt=8

5. Summary and next steps

This technical report will be shared with the NAR-DP Steering Group. The authors will present and discuss its contents at a Steering Group meeting; in particular we will seek feedback on how we can improve user experience across mobile and desktop devices. If the Steering Group does not object to our suggestion of additional interactive geospatial data visualization functionality, then we will start to implement and test this feature. In the meantime, we will examine the test reports and look to make improvements to the NAR-DP site- so that it is more mobile-friendly.

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