DIGITAL TRANSFORMATION OF THE BYDA WORKFLOW FOR ESSO AUSTRALIA

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Please note: All data is for demonstration purposes only.

Abstract

The Before You Dig Australia (BYDA) – formerly Dial Before You Dig (DBYD) – internal Esso review and assessment workflow has historically been manual and paper-based with a significant amount of data double-handling. Leveraging Esri Australia's SmarterWX Automate system and our Esri ArcGIS Online environment, has enabled us to transition this paper-based workflow into a more optimized integrated digital solution.

With SmarterWX, BYDA requests are automatically classified as 'no impact' or 'impact' (based on business rules). 'No impact' events are automatically processed. For 'impact' events, a Pipeline Surveillance Officer (PSO) engages with the requestor (or site contact) to assess the request in more detail and to ensure applicable safety standards are met. This may be done over the phone or during a site visit depending on the activity type and proximity to infrastructure.

For 'impact' events, PSO's can now complete these requests dynamically in the field. A mobile mapping application shows active requests and provides spatial context. From this map, a smart survey form is launched (via a custom URL) and BYDA data (job and sequence number, requestor details, etc.) is passed to the survey form along with the request polygon, thus removing manual duplication of data and reducing human error.

Scope, impact, and safety discussions feed directly into the digital survey form, and once complete this survey is exported to a PDF report and emailed to the requestor, closing out the Esso BYDA review and assessment workflow. The end-to-end workflow can be completed entirely on a tablet (or laptop) in the field. All components are cloud hosted allowing access to third party contractors supporting our pipeline surveillance team and work programs.

This digital approach gives us a real-time spatial view of BYDA requests, highlights active requests, and better helps PSO's manage site visits with their routine field activity. We are also able to integrate BYDA data into our other workflows, particularly routine easement patrols, both ground and aerial. This allows PSO's to cross-reference data in the field to verify activity and scope as patrols are carried out.

Efficiencies with this integrated digital workflow are seen in time saving for PSO's, as well as improved data management, visualization, querying, and reporting.

Introduction

Esso Australia operates just over 1000 km of onshore pipeline running through approximately 285 km of easements (Figure 1).

Figure 1: *The Esso Australia pipeline network in Victoria*

The Esso internal review and assessment workflow (Figure 2) is a formal process enabling Pipeline Surveillance Officers (PSO) to understand the potential risks involved in proposed work request from BYDA.

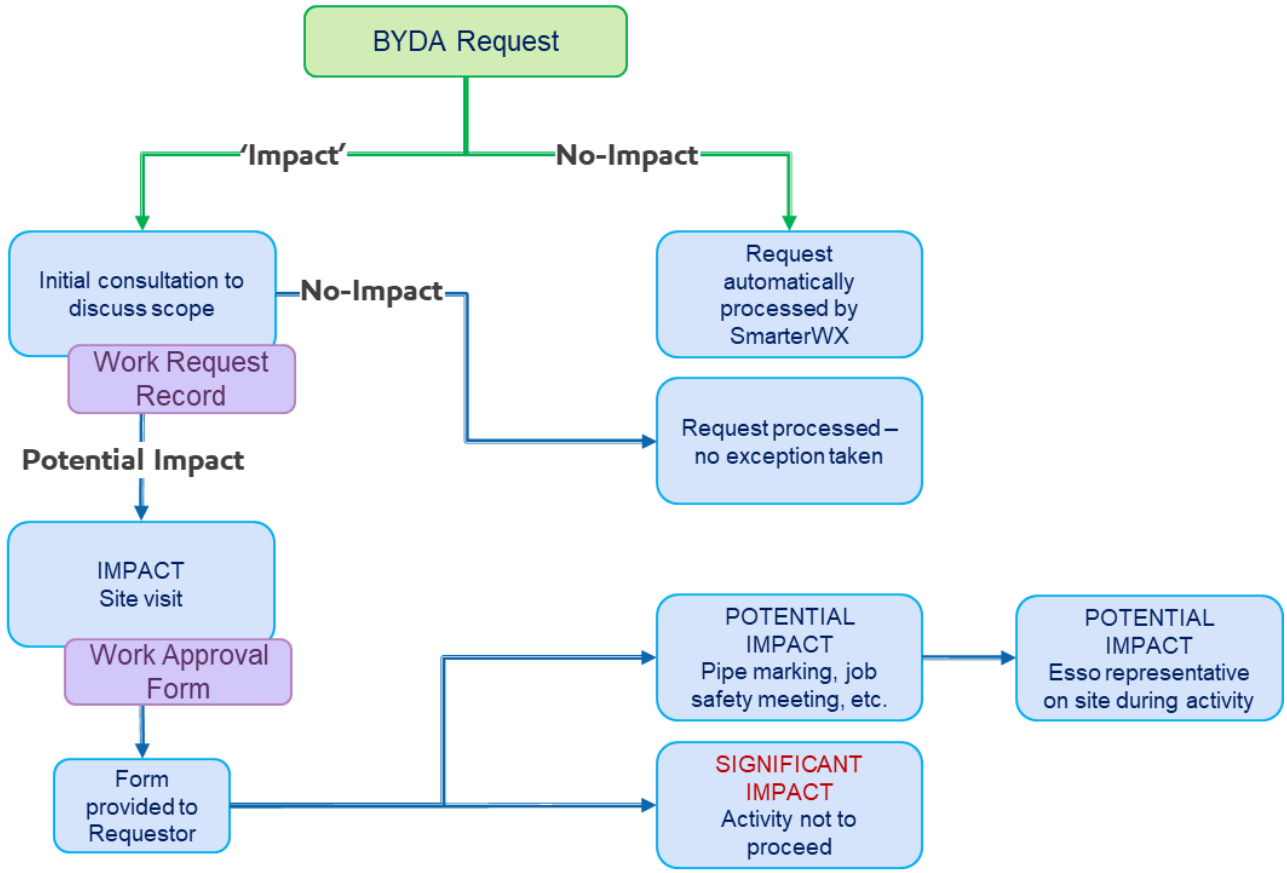


Figure 2: *Simplified internal BYDA assessment workflow*

Esso directly engages with BYDA requests classified as 'impact' by business rules defined in SmarterWX within up to 1 km of its pipelines (based on pipeline radiation contours) (Figure 3). This is to ensure correct safety measures are undertaken during any work activity, and to discuss the responsibilities (of both parties) relating to a petroleum pipeline easement.

Figure 3: *Pipeline radiation contour example showing area of interest either side of pipeline*

That is, an Esso representative will review the BYDA request, contact the requestor to discuss the proposed work to review any potential impact and where applicable discuss easement considerations and responsibilities. If there could be a potential impact to pipelines, this is further escalated to a site visit (if not already part of the initial engagement) and more detailed discussion around scope of work and safety requirements.

These engagements were historically captured through carbon copy paper forms (Figure 4), with the **Work Request Record** being required for all 'impact' requests, and the **Work Approval Form** required if a site visit and further review deemed necessary.

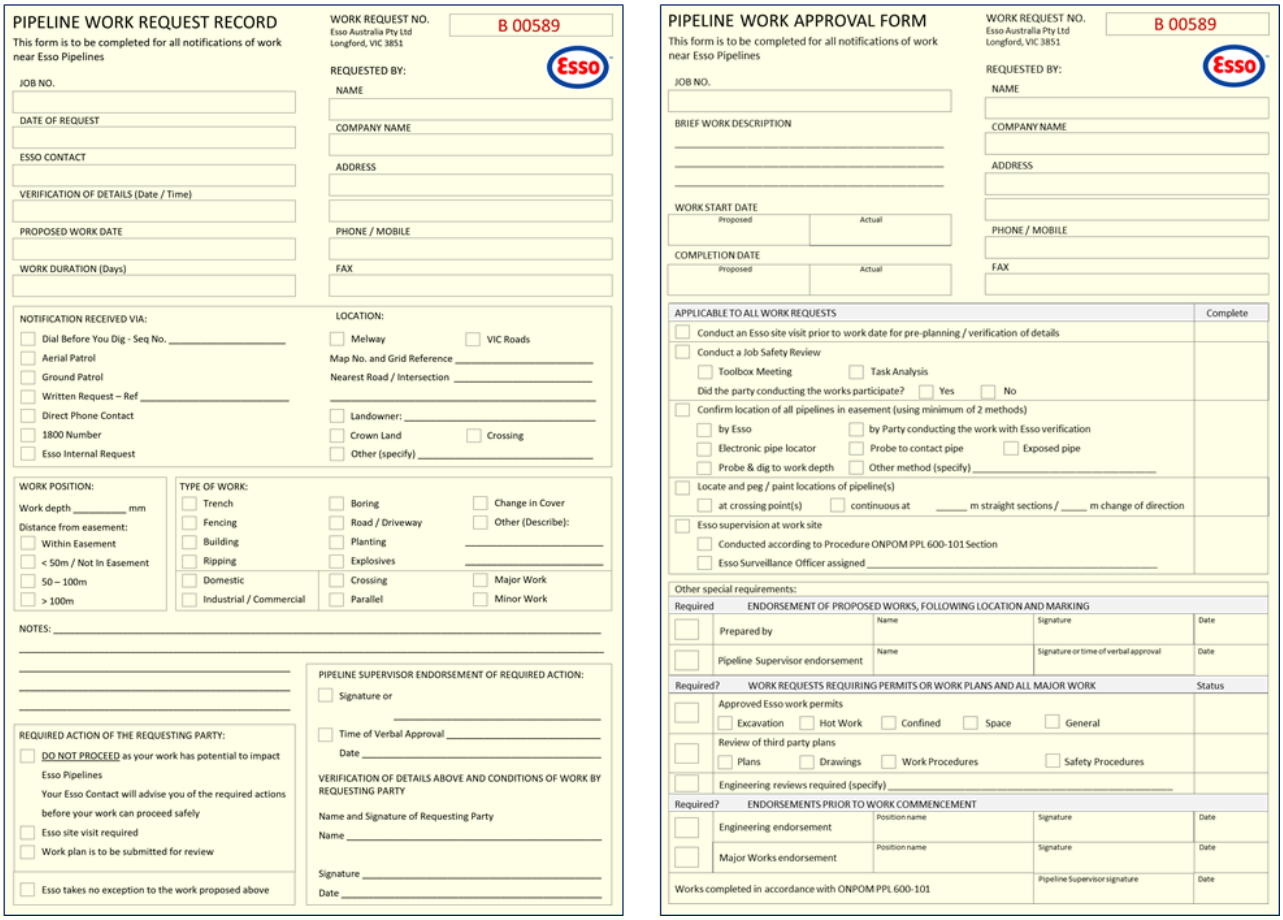


Figure 4: *Work Request Record (left) and Work Approval Form (right) carbon copy (paper) forms*

Historically the BYDA request would come via email with a GML (Geography Markup Language file for a GIS application) and GIF (image) file representing the spatial nature of the request. Following this email, a discussion would take place with the requestor and the paper form/s completed. Once the form/s were complete, the data would be transcribed into a master spreadsheet (Figure 5).

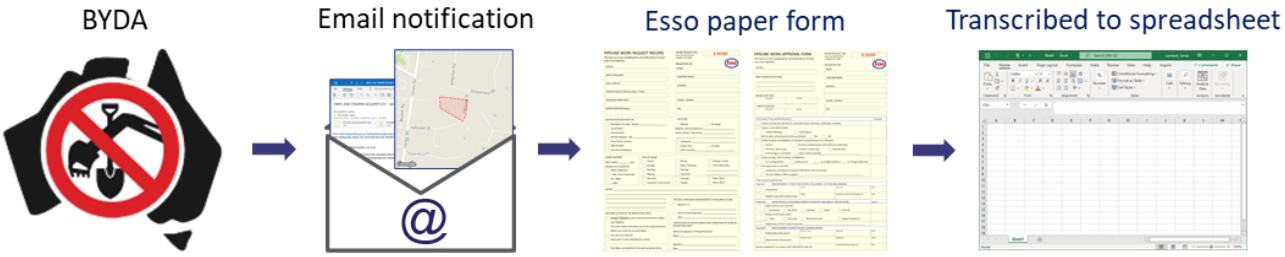


Figure 5: *Historical review and approval workflow showing pre-SmarterWX simplified workflow*

With the adoption of SmarterWX Automate in 2019, this allowed us to bring the BYDA data into our ArcGIS Online organisation environment (Figure 6) using the 'write to GIS' function.

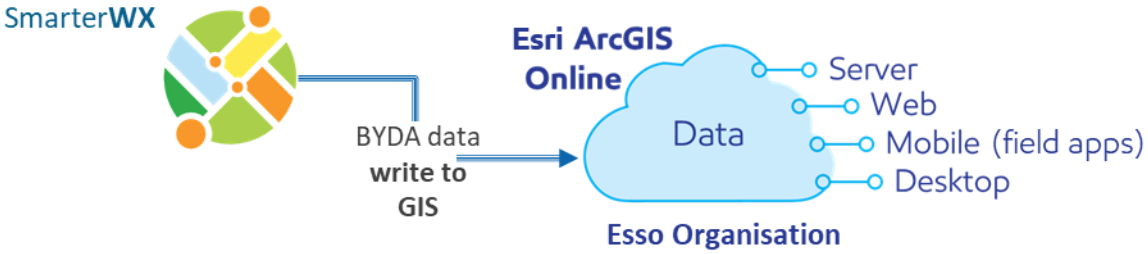


Figure 6: *SmarterWX BYDA data feed to Esso ArcGIS Online environment (simplified). Through ArcGIS Online cloud-hosted data is shared across web, mobile, desktop, and server applications.*

While improving access and visibility to BYDA data by making it available through digital maps, it did not eliminate the paper forms and manual transcribing from form to spreadsheet (Figure 7).

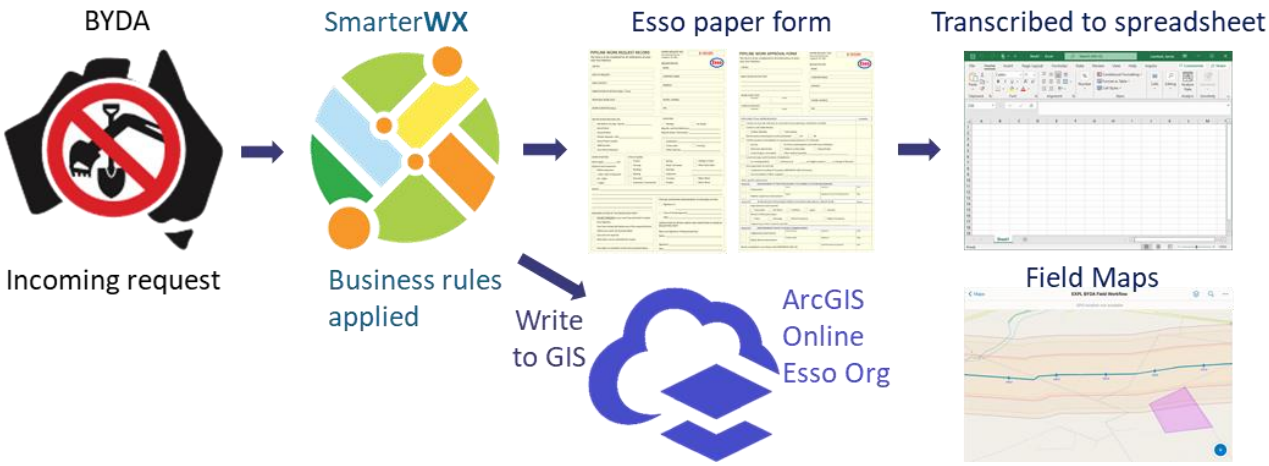


Figure 7: *Historical review and approval workflow showing post-SmarterWX, pre-digital forms simplified workflow*

With SmarterWX and the 'write to GIS' function pushing BYDA requests directly into our ArcGIS Online Organisation site, we were able to begin the digital transformation of our internal review and approval workflow, eliminating paper forms and manual transcribing of data (Figure 8).

Figure 8: *The (simplified) data flow originating with a BYDA request which is then processed with SmarterWX and pushed to Esso's ArcGIS Online Organisation where it is pulled into a digital form*

Digital Transformation Process

The digital transformation process consisted of three key parts: creating a digital form, creating a PDF report template, and creating and configuring a map for the field.

Review and Assessment Digital Form

The original paper forms were converted to a single digital 'smart' form using ArcGIS Survey123 which uses the XLSForms open standard framework (https://xlsform.org/en/) and is configured using Microsoft Excel (Figure 9). There are several advantages to using Survey123; it is integrated into our ArcGIS Online environment and there are several logical functions we can use to optimise the user experience, such as relevance, calculations, and filters. We can also leverage drop-down fields, radio buttons, and check boxes. Survey123 also has extensive URL parameters, allowing us to integrate with other ArcGIS applications to pass attribute and spatial data to the survey form.

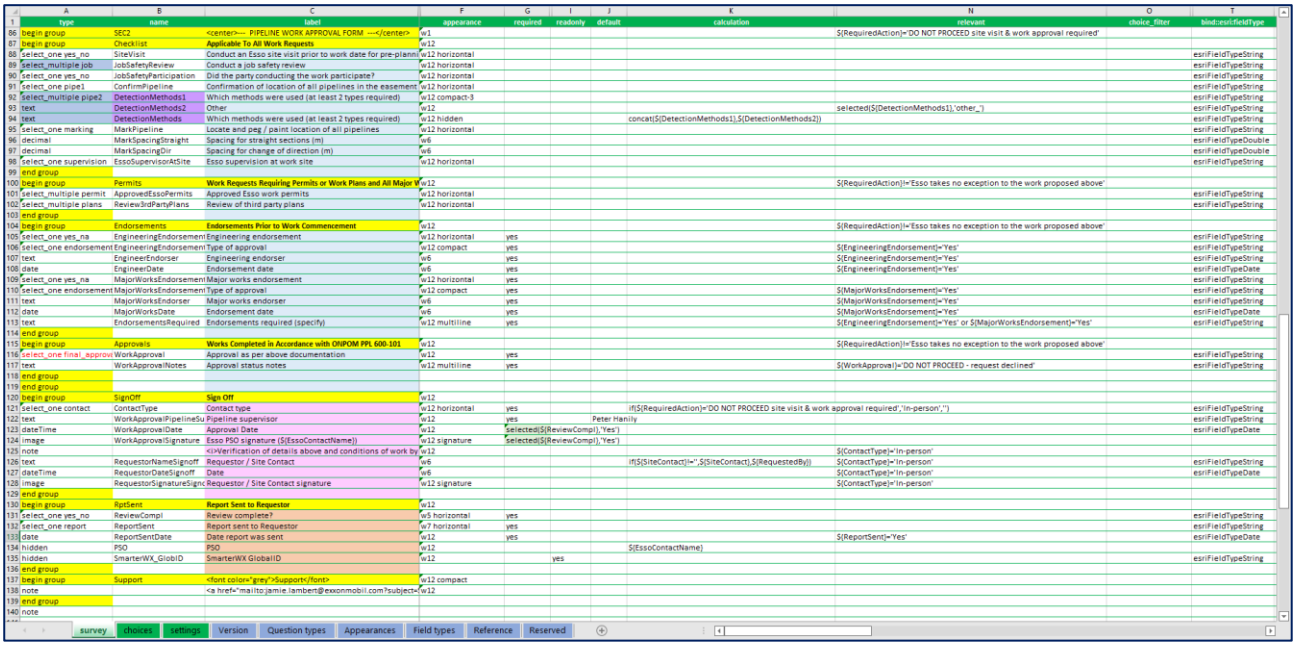


Figure 9: *Configuration of a Survey123 form via a spreadsheet using Survey123 Connect*

Combining the paper forms into one smart form allowed for the removal of duplication between the two forms and ensured one record per BYDA request. Treating the forms as a single form also allowed for better flow between sections, with visibility of questions managed through relevance or skip logic, and a single sign-off rather than one for each section.

The first section of the digital form, the 'Pipeline Work Request Record' (Figure 10), captures the BYDA request information, which gets passed directly to the form from the SmarterWX feed, including the polygon information representing the request area. Also captured here as part of the discussion with the requestor is additional detail and/or clarification on the proposed work. In addition to this, an option to attach images to the record is included for reference. These images would then be tied directly to the relevant record in the database.

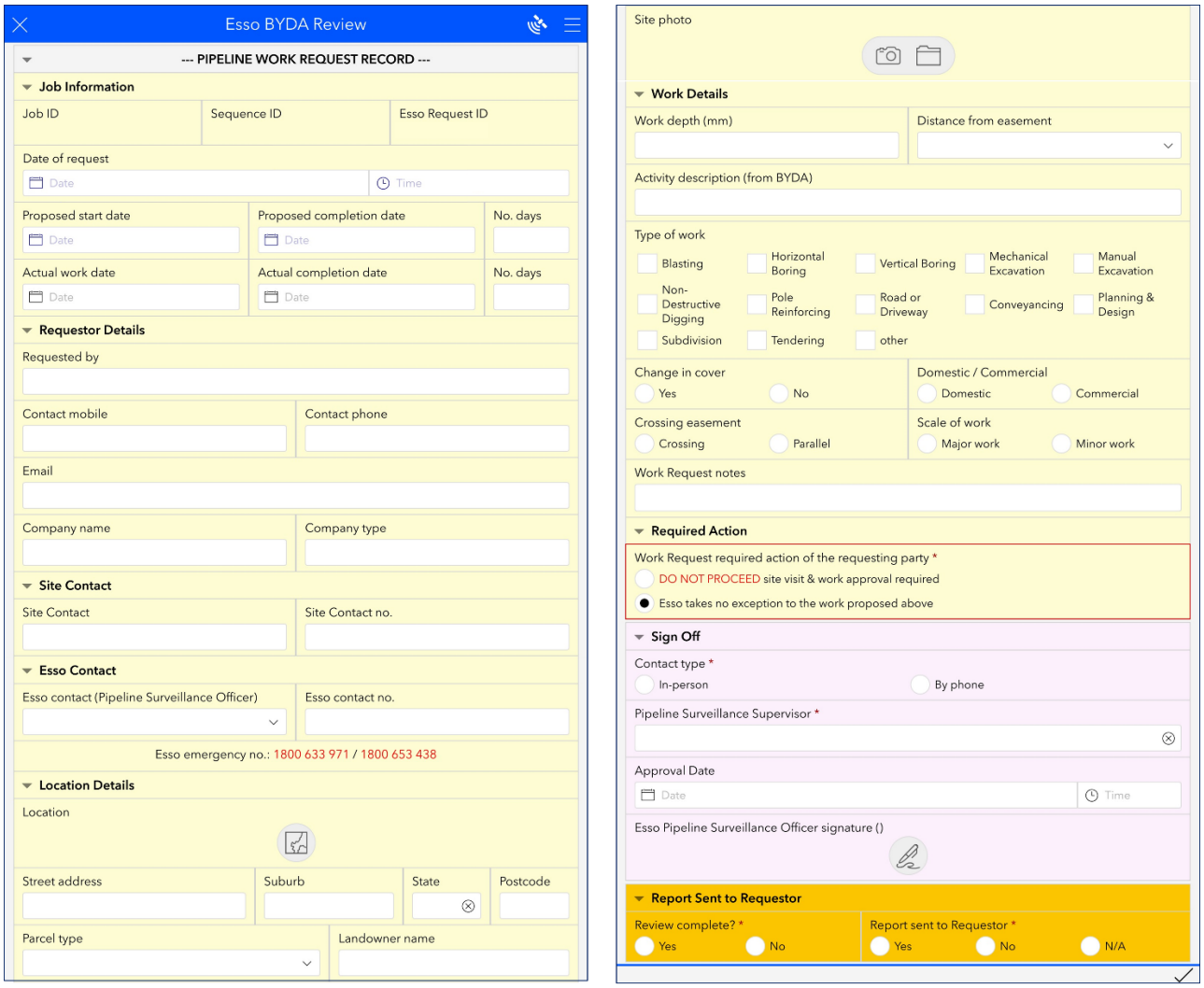


Figure 10: *Digital form section 1: Pipeline Work Request Record*

If the proposed work raises no exception, the internal assessment process ends here. Where a more detailed review and site visit is required, we progress to the second section of the digital form, the 'Pipeline Work Approval Form' (Figure 11). In this section, specifics of the activity are captured, as well as safety discussions, procedures, and work permits. As part of the engagement between Esso and the requestor, both parties can sign off on the discussion and agree to any required actions, or the proposed activity can be declined where appropriate.

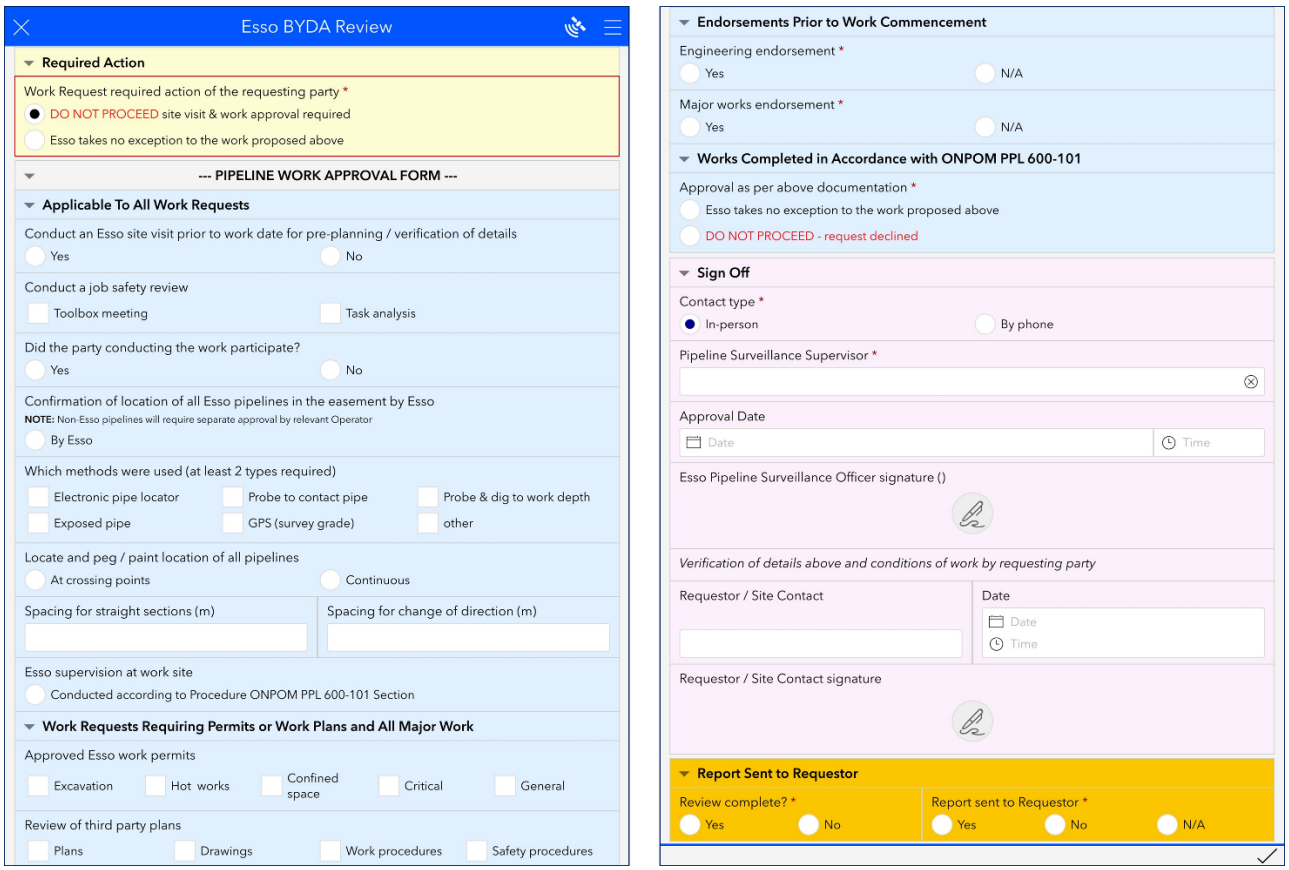


Figure 11: *Digital form, section 2: Pipeline Work Approval Form*

PDF Report Template

The data captured for the Esso assessment and review process is only available in a form format when viewed in the Survey123 app. To output a final report for the requestor, a template is created using a Microsoft Word document which references attributes in the feature dataset (Figure 12) and is applied when generating a PDF report from the Survey123 website (Figure 13). Two templates were created. The first only had the Pipeline Work Request Record section and the second had the Pipeline Work Request Record and Pipeline Work Approval Form sections.

Job Reference

Job ID:	Sequence ID:	Esso ID:
${JobID}	${SequenceID}	${EssoID}

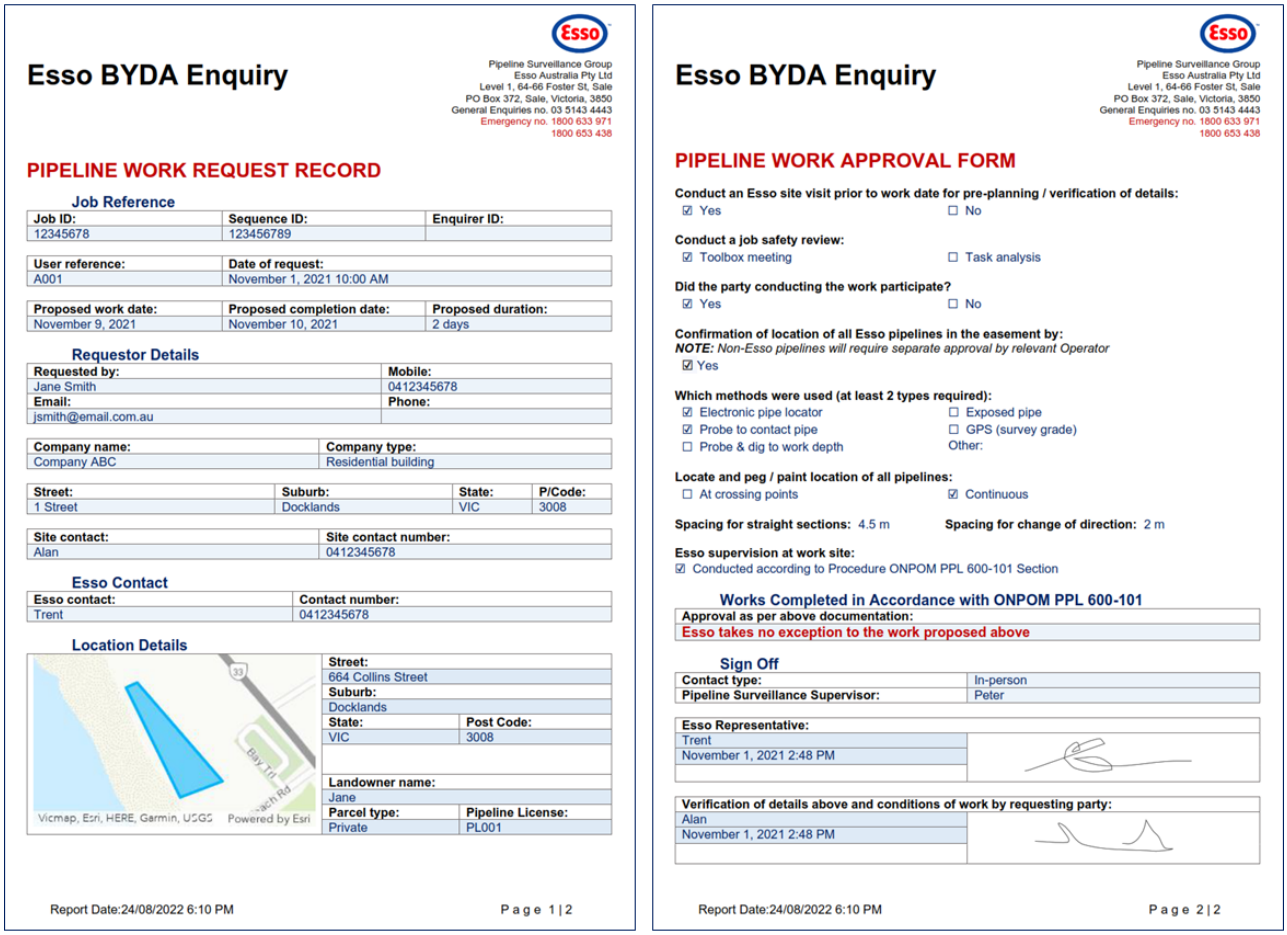
User reference:	Date of request:
${UserRef}	${DateOfRequest}

Proposed work date:	Proposed completion date:	Proposed duration:
${ProposedWorkDate}	${ProposedComplDate}	${ProposedDuration} days

Location Details

${Location | size:300:0}	Street:	
	${LocationStreet}	
	Suburb:	
	${LocationSuburb}	
	State:	Post Code:
	${LocationState}	${LocationPCode}
	Landowner name:	
	${LandownerName}	
	Parcel type:	
	${ParcelType}	

Figure 12: *Example configuration of a section of a Survey123 report template referencing attributes from the dataset*



Esso BYDA Enquiry

Pipeline Surveillance Group
Esso Australia Pty Ltd
Level 1, 64-66 Foster St, Sale
PO Box 372, Sale, Victoria, 3850
General Enquiries no. 03 5143 4443
Emergency no. 1800 633 971
1800 653 438

PIPELINE WORK REQUEST RECORD

Job Reference

Job ID:	Sequence ID:	Enquirer ID:
12345678	123456789	

User reference:	Date of request:
A001	November 1, 2021 10:00 AM

Proposed work date:	Proposed completion date:	Proposed duration:
November 9, 2021	November 10, 2021	2 days

Requestor Details

Requested by:	Mobile:
Jane Smith	0412345678
Email:	Phone:
jsmith@email.com.au	

Company name:	Company type:
Company ABC	Residential building

Street:	Suburb:	State:	P/Code:
1 Street	Docklands	VIC	3008

Site contact:	Site contact number:
Alan	0412345678

Esso Contact

Esso contact:	Contact number:
Trent	0412345678

Location Details

Street:	
664 Collins Street	
Suburb:	
Docklands	
State:	Post Code:
VIC	3008
Landowner name:	
Jane	
Parcel type:	Pipeline License:
Private	PL001

Esso BYDA Enquiry

Pipeline Surveillance Group
Esso Australia Pty Ltd
Level 1, 64-66 Foster St, Sale
PO Box 372, Sale, Victoria, 3850
General Enquiries no. 03 5143 4443
Emergency no. 1800 633 971
1800 653 438

PIPELINE WORK APPROVAL FORM

Conduct an Esso site visit prior to work date for pre-planning / verification of details:
☑ Yes ☐ No

Conduct a job safety review:
☑ Toolbox meeting ☐ Task analysis

Did the party conducting the work participate?
☑ Yes ☐ No

Confirmation of location of all Esso pipelines in the easement by:
NOTE: *Non-Esso pipelines will require separate approval by relevant Operator*
☑ Yes

Which methods were used (at least 2 types required):
☑ Electronic pipe locator ☐ Exposed pipe
☑ Probe to contact pipe ☐ GPS (survey grade)
☐ Probe & dig to work depth Other:

Locate and peg / paint location of all pipelines:
☐ At crossing points ☑ Continuous

Spacing for straight sections: 4.5 m **Spacing for change of direction:** 2 m

Esso supervision at work site:
☑ Conducted according to Procedure ONPOM PPL 600-101 Section

Works Completed in Accordance with ONPOM PPL 600-101

Approval as per above documentation:
Esso takes no exception to the work proposed above

Sign Off

Contact type:	In-person
Pipeline Surveillance Supervisor:	Peter

Esso Representative:
Trent
November 1, 2021 2:48 PM

Verification of details above and conditions of work by requesting party:
Alan
November 1, 2021 2:48 PM

Figure 13: *Example output PDF report using a report template created with the Survey123 website in ArcGIS Online*

Field Map Configuration

With the digital version of the forms complete, the next step was to configure the map through ArcGIS Online Map Viewer (Figure 14) to enable integration with the survey form. As well as the value of data integration, the map view also allows the PSO to understand the spatial context to the request.

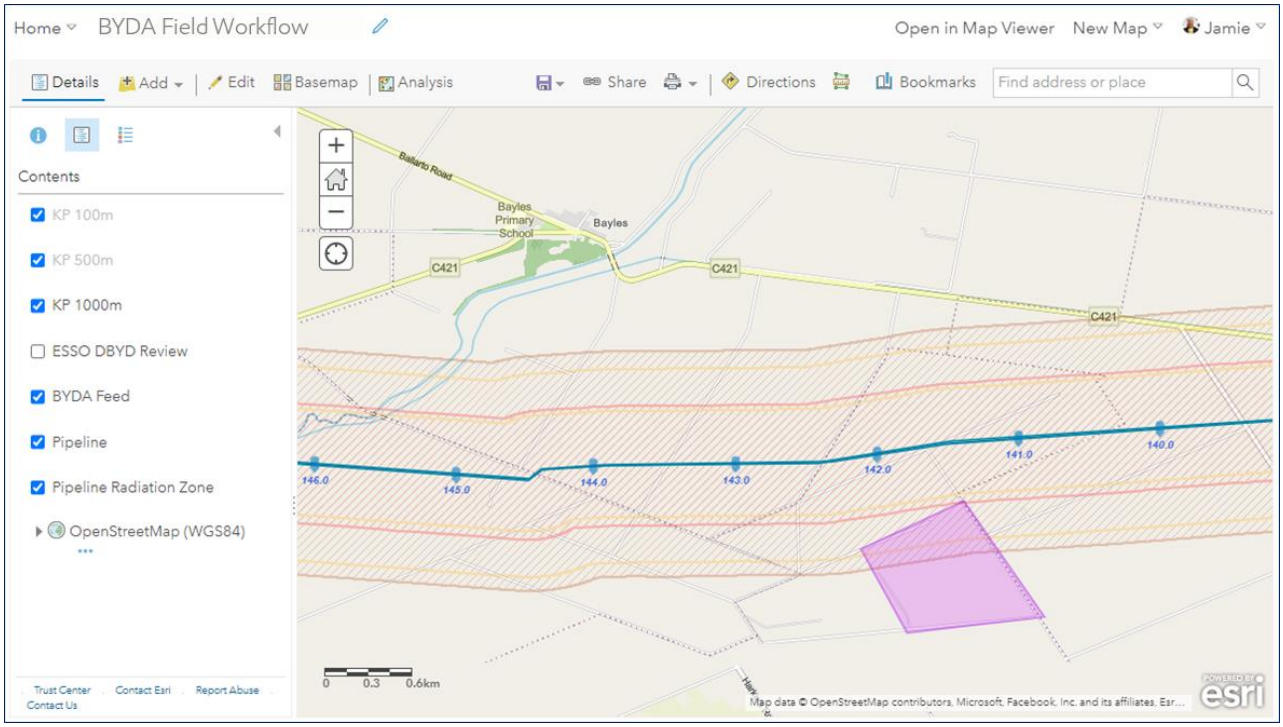


Figure 14: *Field map configuration within ArcGIS Online Map Viewer*

Within Map Viewer, the feature layer populated by the BYDA data feed from SmarterWX is filtered for 'activity type = impact' to show only 'impact' events and has an Arcade expression applied that converts the request polygon to a text string (Figure 15) allowing it to be passed to Survey123 (via a URL) and used as the input to build the polygon within the survey form. Arcade is an expression language specifically for ArcGIS.

Figure 15: *Arcade expression to convert polygon feature geometry to text string*

With the map configured and the Arcade expression in place, the BYDA feature layer pop-up dialogue box needs to be configured with a custom URL that will launch Survey123, pass data from the selected map feature to the specified survey form, including the string representing the polygon, and finally take the PSO to the Survey 123 web site to generate the PDF report upon form submission (Table 1). Emailing the final report to the requesting party closes out the review and assessment workflow.

URL Parameter	Function
arcgis-survey123://?itemID=*form ID*	Launch Survey123 application and open correct form
&field:*target1*={*source1*}&field:*target2*={*source2*}	Pass attributes from SmarterWX feed to survey form
&field:*target*={expression/expr0}	Reference the expression (Figure 15) to convert vertices to text string and pass to Survey123 to build feature geometry
&callback=https://survey123.arcgis.com/surveys/*form ID*	Upon submission of survey form, launch the Survey123 website

Table 1: *Map pop-up URL parameters*

Additional attributes can be passed as required using the convention &field:*target*={*source*}. The resulting URL added to the feature pop-up looking like the following example:

arcgis-survey123://?itemID=8552d862d2d647028c38c5d3a4878586&field:JobID={job_id}&field:SequenceID={sequence_id}&field:ActivityType={activity_description}&field:Location={expression/expr0}&callback=https://survey123.arcgis.com/surveys/8552d862d2d647028c38c5d3a4878586/data

This URL is added to the feature pop-up (Figure 16) and once the map is saved, available to users in their mobile map (ArcGIS Field Maps). Starting with the map, the digital workflow can now be executed from the field or the office using a smart device or laptop.

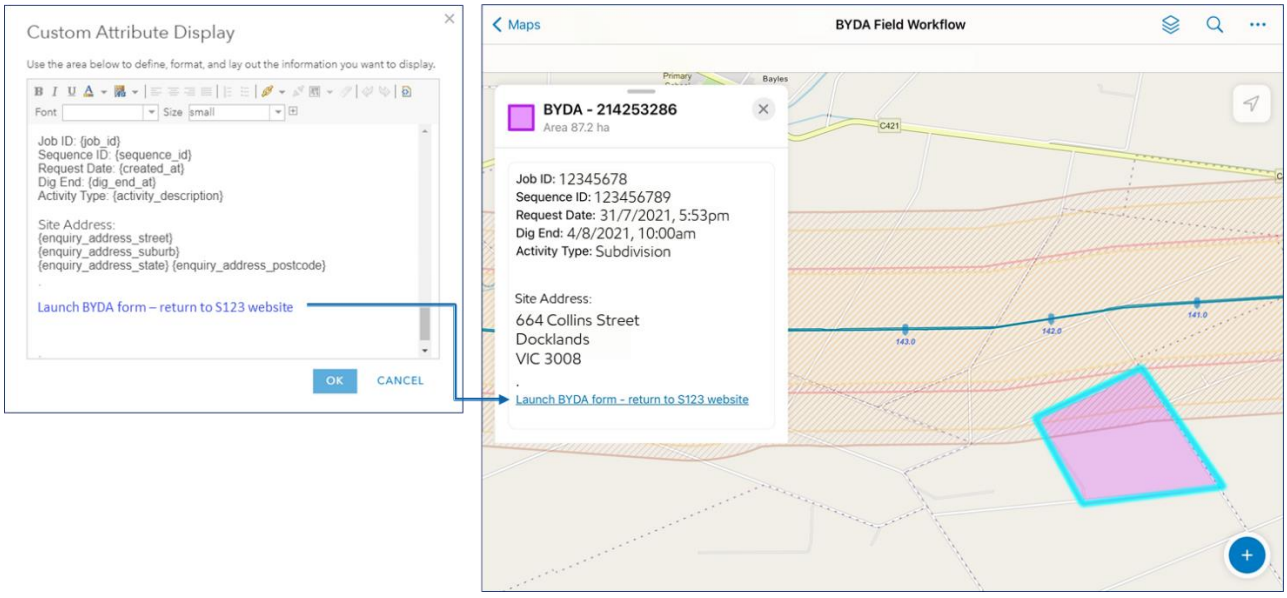


Figure 16: *Feature pop-up with custom URL; configuration and map view (ArcGIS Field Maps)*

Results

Averaging over 1500 records (classified as impact) per year over the last two years for manual review, streamlining of this workflow and transitioning to digital end-to-end (Figure 17) adds tremendous value from an efficiency and timeliness perspective.

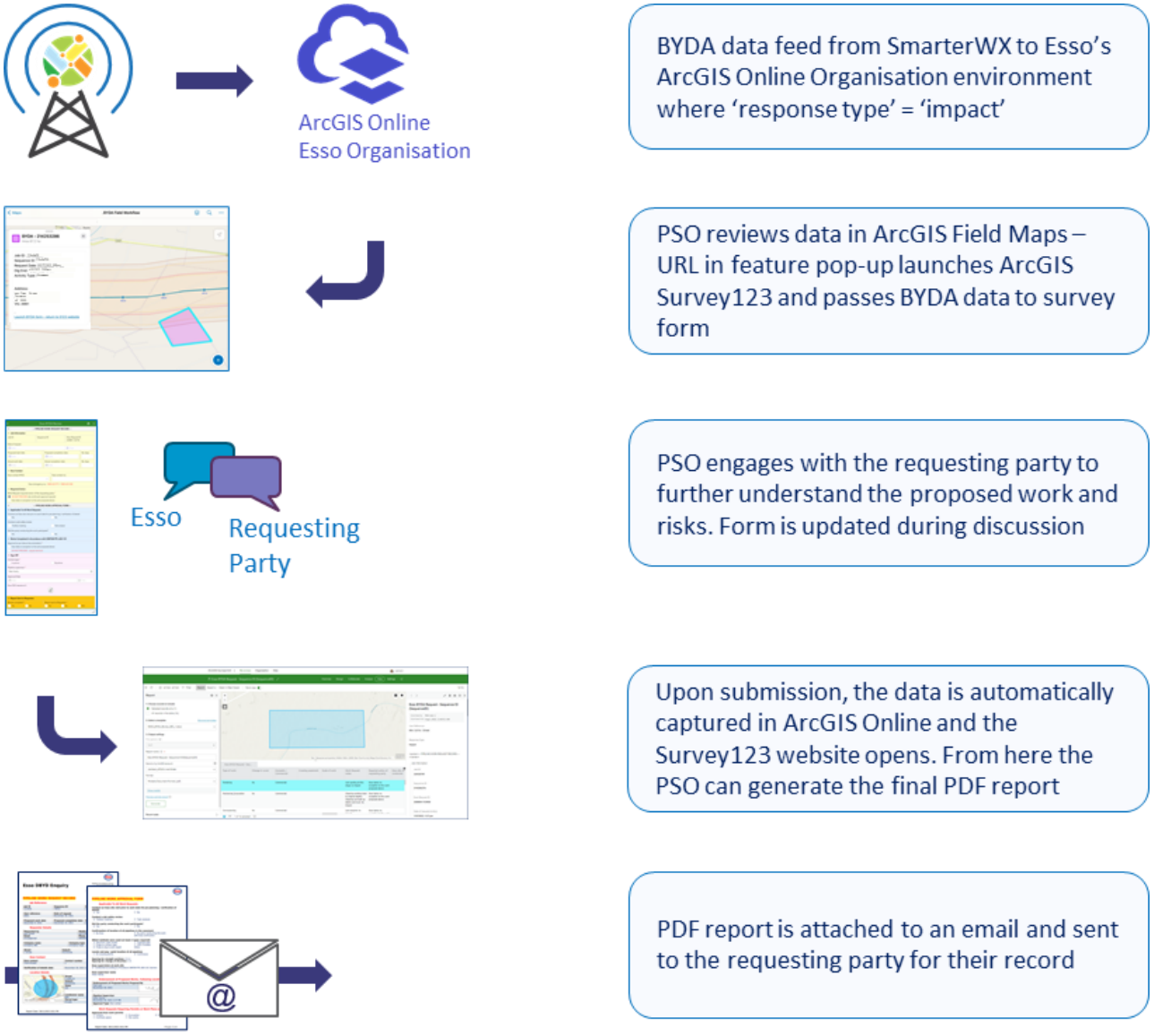


Figure 17: *Summary of resulting review and assessment digital workflow*

Overall savings are estimated at between 0.08 to 0.1 FTE or 40 to 50 minutes per day, and further efficiencies are seen in improved data management, data visualization, data querying, and reporting. Data is also enriched with spatial information (the request polygon), site photos as required, and passing additional attributes not previously captured by the forms. The additional spatial and attribute data is automated and is no extra effort on the part of the PSO.

Reducing or removing manual data entry also reduces the potential for human error. This has been achieved through enhancements in the form such as passing data digitally and using lists, and by eliminating the need to transcribe records. Also eliminating any potential confusion reading handwriting or damaged paper documents.

Physical forms no longer need to be carried, stocked, or archived (going forward). The digital form is more agile and can be updated dynamically then pushed to users as soon as updates are complete without disrupting workflows. Additionally, the output PDF can easily be shared from the requestor to other team members as required (for example, site lead, surveyors, builders, etc.) so all team members are informed.

Building the workflow within ArcGIS Online offers the advantages of a GIS environment (spatially aware, spatial analytics, visualisation of multiple datasets, etc.) as well as integration between data and applications. Moving between apps is automated in most cases through URL parameters. Simplification of the workflow enhances the user experience and minimizes the training required - essentially the user only needs to access the correct map within Field Maps and most of the workflow (launching the Survey123 mobile app, populating BYDA data, navigating to the Survey123 web site) is managed through the custom URL. The integration between data and application delivers a streamlined user experience.

Data is stored in a more robust database (versus Excel) and supports both text and spatial queries. Data can be accessed by multiple applications: web, mobile, desktop, and server and readily visualized. The internal assessment workflow can be tracked via ArcGIS Dashboards for example (Figure 18), with the dashboard highlighting status and overdue assessments. This can also be used to aid in KPI and regulatory reporting.

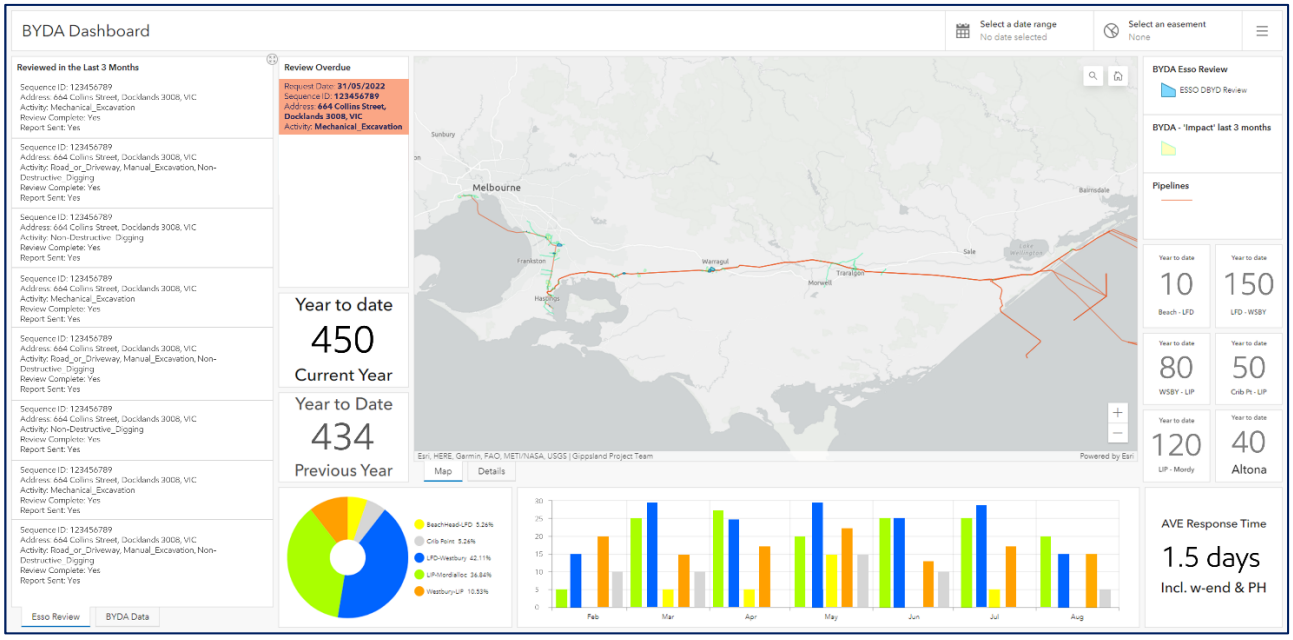


Figure 18: *Example Esso review and assessment tracking dashboard using ArcGIS Dashboards*

Applications and data are accessible to all users in real-time. The same data is available to office and field workers (including 3rd parties with credentials) providing a single source of truth.

This digital approach gives us a real-time spatial view of BYDA requests, highlights active requests, and better helps PSO's coordinate site visits with routine activity. We are also able to integrate BYDA data into our other workflows, particularly easement patrols, both ground and aerial, for validation and review. Review and assessment requests can be completed as part of routine patrols or opportunistically with equal ease. Additionally, this improved data access and visibility helps enhance the engagement with the requestor and other stakeholders.