Agility, Ability and the Human Side of Surveying When Disaster Strikes

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ABSTRACT

Flooding in late February, March and early April of 2022 caused significant damage along large sections of the Australian east coast, in particular locations within the Northern Rivers of NSW. Only days preceding the peak of the first flood event in early March, the NSW State Emergency Service (SES) reached out to NSW Public Works to devise a strategy to engage and brief surveyors for capture of Peak Water Level (PWL) as a priority and Current Water Level (CWL) to a lesser degree for SES flood intelligence, as soon as possible. Several DCS Spatial Services and local private surveyors utilised Global Navigation Satellite System (GNSS) Continuously Operating Reference Station (CORS) Real-Time Kinematic (RTK) across defined areas within the Clarence Valley, Richmond Valley, Lismore and Kyogle Local Government Areas (LGAs) where reliable evidence defined PWL, recording Australian Height Datum (AHD) height, photos, notation of physical evidence and location on SES intelligence maps via the ArcGIS Collector application. A subsequent severe weather event, which hit Byron Shire in late March 2022, required DCS Spatial Services surveyors to continue further PWL intelligence gathering for SES and Byron Shire Council at key hydrology and flood affected locations. Overall, the survey project captured 651 PWLs and 27 CWLs across five LGAs in just over a month, with a capture rate of more than 85% on specifically requested locations. However, this paper discusses more than the survey technique, project outcomes, statistics and lessons learnt. It tells a story of grieving and healing, resilience, power of community after a natural disaster, and the delicate situation the surveyors found themselves in when capturing this much-needed data during this time. This project will serve to enhance future planning of SES emergency response, understand deficiencies and 'pinch-points' in local infrastructure, and improve agility to provide survey resources in case of future severe weather events.

KEYWORDS: *Flooding, emergency response, intelligence, resilience, empathy, agility.*

1 INTRODUCTION

Public authority surveyors have been, and expectantly will continue to be, the public's first physical contact in the field when planning or executing surveys for state-government-funded

infrastructure projects, public space or Crown land adjustments, environmental projects and state survey infrastructure or mapping projects, to name a few. Often, being in the field on these projects, some of which are contentious, will be at a time when public emotions are 'raw' and tensions are high. Interactions with the public can be challenging, confronting and intimidating. From one of the author's many years of experience in the field, misinformation, lack of information and/or fear of the 'unknown' can contribute to the above. This presents an opportunity to empathise, inform, prepare and enlighten the affected public. Realistically, not all the disaffected public will 'receive' the public surveyor well. However, being a public servant, we must all attempt to build understanding and repour, even if that takes a little more time than we would like.

The NSW State Emergency Service (SES) flood intelligence gathering project in late February, March and early April of 2022, following the devastating historical Northern NSW weather events, was one such project that revealed all the above. The agility of public authority surveyors who collaborated to plan and execute this project on behalf of the SES Intelligence Gathering team, as soon as access allowed and augmented with a human touch on the ground, transpired into a well-received NSW government agency initiative that was humbling, inspiring and rewarding for those involved, and which provides a template for future disaster responses.

This paper not only discusses the surveying technique, project outcomes, statistics and lessons learnt from this project. It also tells a story of grieving and healing, resilience, power of community after a natural disaster, and the delicate situation the surveyors found themselves in when capturing the much-needed data during this challenging time.

2 FEBRUARY & MARCH 2022 WEATHER EVENTS IN SOUTHEAST QUEENSLAND AND NORTH-EASTERN NSW

Following two years of La Niña conditions (BOM, 2022a), catchments in southeast Queensland and north-eastern NSW were already saturated. There was above average rainfall 4-5 months preceding the severe weather events in late February and March 2022 (Figures 1 & 2), causing down-river towns and villages to be susceptible to flooding at any time if an 'east-coast low' were to form and persist over these catchments.

As shown in Figure 1, the cumulative rainfall exceeded the 90th percentile at the Alderley rain gauge. East Coast Lows (ECLs) coming out of southeast Queensland have a profound effect on north-eastern NSW catchments, due to their size and proximity to southeast Queensland just across the border. As ECLs have a natural tendency to move in a southerly direction, the northern extents of the Clarence River, Richmond/Wilsons River, Tweed River and the smaller Brunswick River and Marshalls Creek catchments are collecting large volumes of precipitation prior to an ECLs reaching major north-eastern NSW towns (Figure 3).

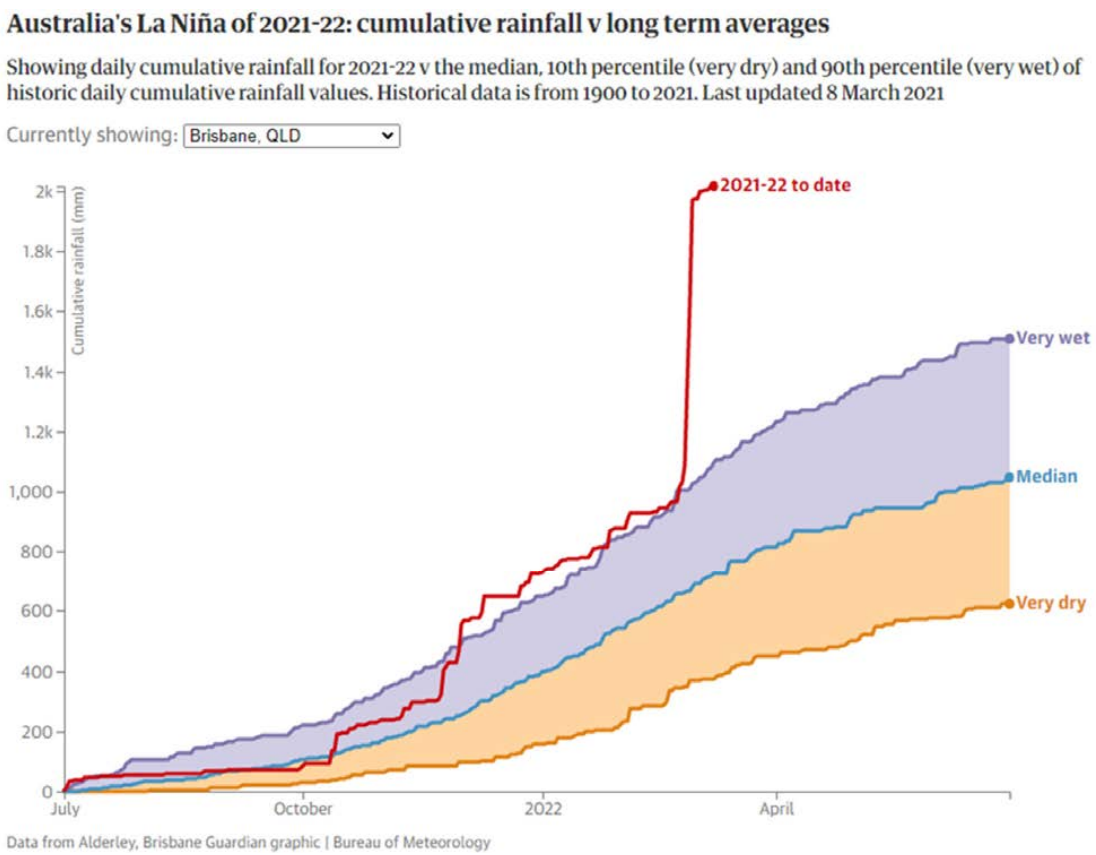


Figure 1: Brisbane cumulative rainfall vs. long-term averages to 08/03/2022 (Evershed and Nicholas, 2022).

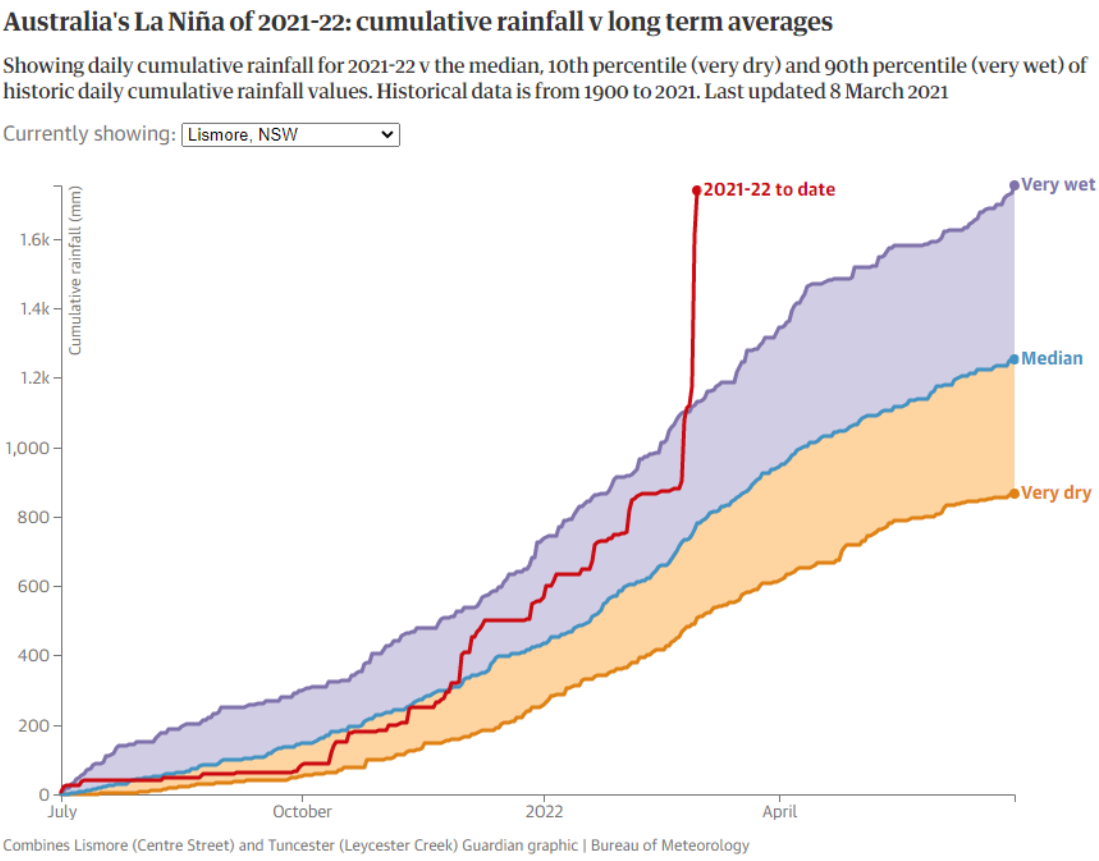


Figure 2: Lismore cumulative rainfall vs. long-term averages to 08/03/2022 (Evershed and Nicholas, 2022).

Figure 3: River catchments shown in dark blue (NSW SES GEM mapping).

As such, already saturated catchments and the catchments being pre-primed in their upper reaches, combined with well-above 'localised' rainfall within major Northern River towns, villages and localities (Figure 4), leading to some of the worst flooding on record. Figure 5 shows only one example from Lismore – others can be found in Bath (2022).

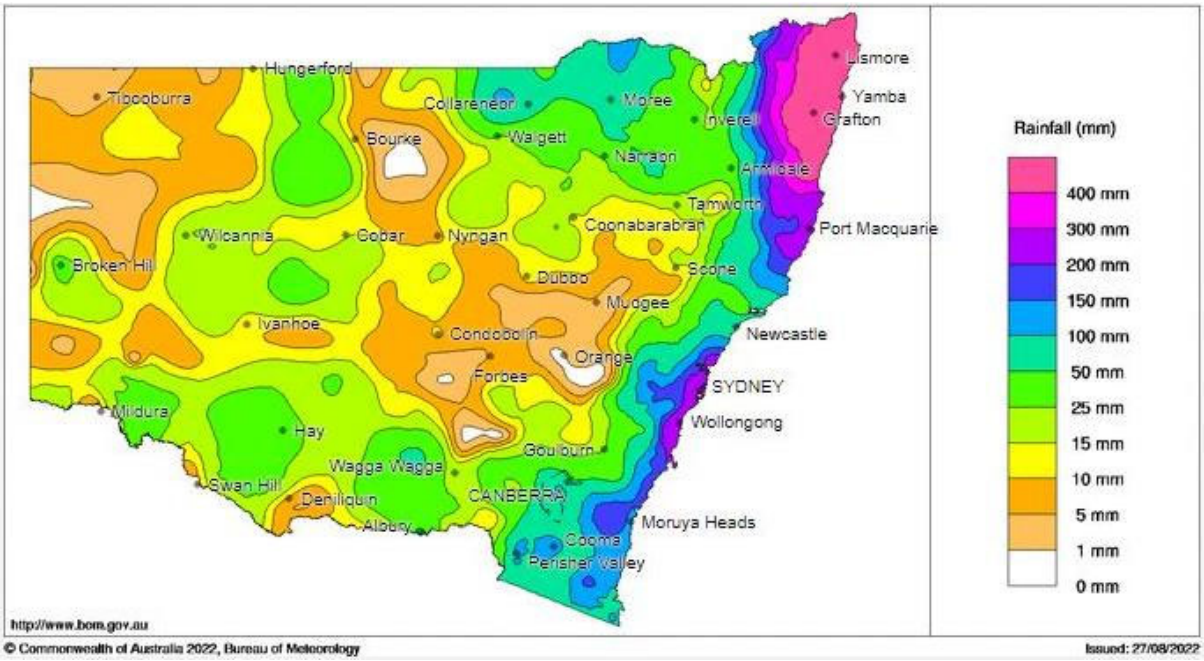


Figure 4: Weekly rainfall totals for NSW (23/02/2022 – 01/03/2022), showing 200+ mm to 400+ mm in the subject catchments.

Figure 5: Lismore McDonald's before and at or near the flood peak (Guardian newspaper).

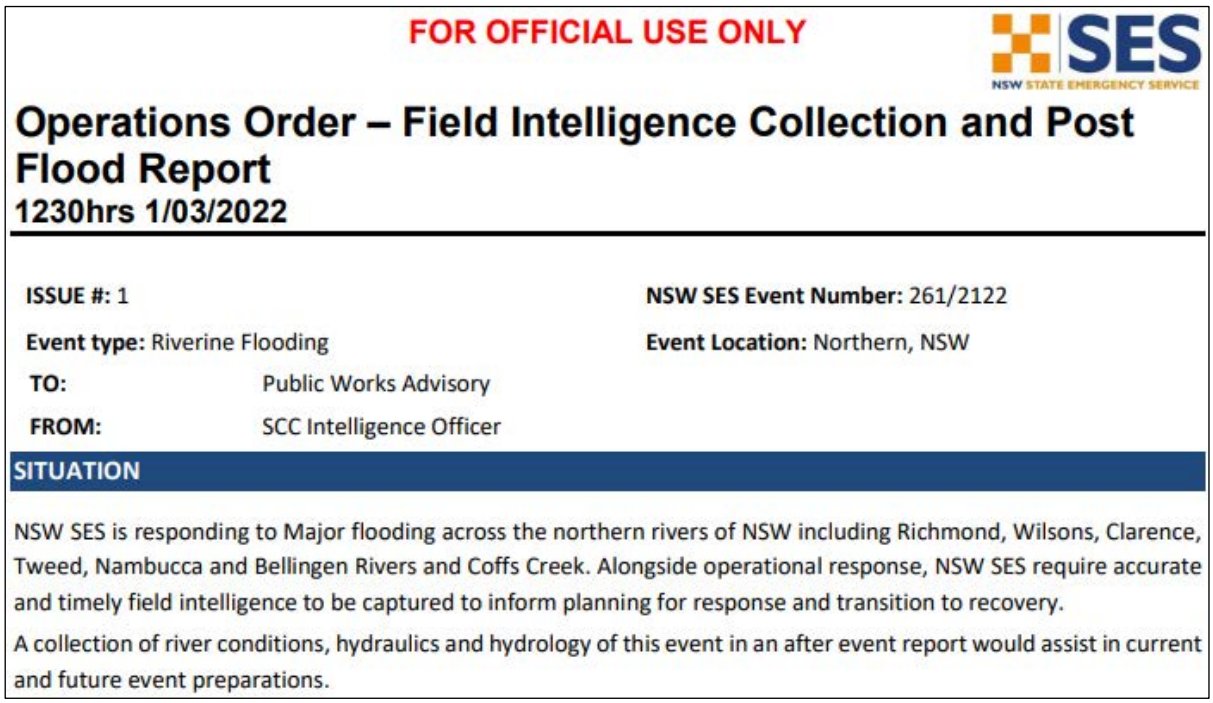
3 THE SES FLOOD INTELLIGENCE GATHERING PROJECT

3.1 NSW SES Operations Order

At or within 24 hours post major flood peak levels of the Northern Rivers systems, including Wilson (Lismore at approximately 3 pm on Monday, 28 February 2022), Richmond, Tweed and Clarence rivers, NSW SES issued an Operations Order for field intelligence collection and post flood report of peak water levels to the Public Works Advisory (PWA), now NSW Public Works in the Department of Regional NSW (Figure 6). PWA Project Manager/Engineer Fred Spain received the order for dissemination, requesting assistance in planning and project managing field reconnaissance, collecting information and intelligence for validation of flooding that occurred in the Richmond, Wilsons, Brunswick, Clarence and lower Tweed rivers and Marshalls Creek river systems.

The Operations Order's mission outlined three key objectives:
1) Understand real-time flood consequences to inform the ongoing response, resupply and potential recovery.
2) Provide detailed hazard and consequence information to validate and update NSW SES flood plans.
3) Provide detailed report of river conditions, hydraulics and hydrology of this event in an after-event report.

The general outline for the execution noted:
- How data was to be collected.
- Priority area.
- Types of data to be collected.
- Property access requirements.
- Administration and logistics.
- Work Health and Safety (WHS) and key risks.
- SES command, control and communications contacts.



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SES
NSW STATE EMERGENCY SERVICE

Operations Order – Field Intelligence Collection and Post Flood Report
1230hrs 1/03/2022

ISSUE #: 1
NSW SES Event Number: 261/2122
Event type: Riverine Flooding
Event Location: Northern, NSW
TO: Public Works Advisory
FROM: SCC Intelligence Officer

SITUATION

NSW SES is responding to Major flooding across the northern rivers of NSW including Richmond, Wilsons, Clarence, Tweed, Nambucca and Bellingen Rivers and Coffs Creek. Alongside operational response, NSW SES require accurate and timely field intelligence to be captured to inform planning for response and transition to recovery.

A collection of river conditions, hydraulics and hydrology of this event in an after event report would assist in current and future event preparations.

Figure 6: Extract from SES Operations Order to PWA.

3.2 PWA Internal Project Planning (02/03/2022)

The PWA Principal Surveyor held internal meetings with the PWA Project Manager and other key PWA staff to plan and strategize the execution of the SES Operations Order. An agile plan was required to allow for the timely capture of key ‘on-the-ground’ intel prior to further follow-up weather events ‘corrupting’ available evidence.

The PWA Surveying & Spatial team worked closely together to:

- Identify strategically located and available survey field staff to collect field data.
- Create and provide instruction on how to ‘capture’ intel in SES’s preferred GIS app.
- Provide datum, survey methodology and quality control parameters.
- Determine data delivery attributes and format.
- Determine point capture density.
- Identify and allocate the Areas of Interest (AOIs) – updated throughout the project.

Access due to flooding to, in and around the AOIs, as well as survey operatives identified to possibly engage in this project, may be directly or indirectly flood-affected themselves. Consequently, the operational decisions of this time-sensitive project were required to be strategic and flexible but maintaining continuity. Therefore, frequent project updates would be required between survey staff on the ground, their managers, the PWA Surveying & Spatial team and SES.

3.2.1 Stand-Up of Floodplain Working Group

The NSW Department of Planning and Environment’s (DPE’s) Floodplain division engaged the services of WMA Water, a well-established consultancy group specialising in hydrological and hydraulic studies of waterways and floodplains, and the development of long-term strategies and designs for management of flood and water resource risks.

DPE and WMA met regularly with local authority (council) floodplain engineers in the weeks following the event to coordinate a response to impacted areas, of which the flood intelligence capture requirement was emphasised as a priority. During this period, strategic locations were identified for intel gathering, which would best serve SES's needs and also provide knowledge for future floodplain management.

3.2.2 Engagement of DCS Spatial Services – Survey Operations Regional (03/03/2022)

The PWA Principal Surveyor reached out to DCS Spatial Services, a unit of the NSW Department of Customer Services (DCS), in particular its Survey Operations Regional (SOR) Manager/Senior Surveyor to ask for assistance from SOR staff located within the proximity of affected areas specified in the SES Operations Order. SOR staff from Coffs Harbour (2) and Lismore (2) were contacted by their manager after his initial contact and briefing from PWA to convey the SES request and to check for staff availability to commence work on the SES flood intelligence gathering project as soon as possible.

An MS Teams briefing was set up by PWA with SOR staff for Thursday afternoon, just 48 hours after the SES Operations Order was issued. Of the four SOR field surveyors, two were ready to respond as soon as possible. One was assisting their parents who were flooded in Lismore, and another had already been active for 8 days with Grafton City SES. As such, the latter two were unavailable until the following Monday.

3.2.3 Engagement of Private Sector Surveyors via Fee-For-Service (03/03/2022)

PWA also engaged several private sector surveying consultancies located in the Northern Rivers region to assist with the on-the-ground works. The key contacts for the consultancies were very willing to assist and offered resources to be available within 48 hours of initial contact. The consultancies engaged and respective key contacts were:

- RCS Group – Tony Riordan.
- Newton Denny Chapelle – Jeff Pickford.
- Fletcher and Associates – Andrew Fletcher.

3.3 Intel Capture

This paper aims to conveys the project experiences of, and between, SOR, PWA and SES. Its focus is therefore on agility and flexibility of the public authority surveyor, with the support of their senior managers, to execute surveys that prioritise the NSW community, and not commercial gain, in time of natural disasters or emergencies within NSW. This includes experiences and stories from those in the field, what they saw collecting data for this project, the people they interacted with, and an attempt to convey the delicate human nature of this project after such devastation and loss. This does not take away from the contribution of the private fee-for-service surveyors and survey firms, who shared similar experiences and without their involvement achieving a timely outcome for the SES Operations Order may not have been possible (Table 1).

It should be noted that PWA reached out to local authorities, who may have had 'staff surveyors' on board, to see if they were able to contribute to the intel capture project. Understandably, affected Local Government Areas (LGAs) were accessing and dealing with major impacts to their infrastructure, such as road, bridges and landslips, and were driven to overcome those impacts as soon as possible for their rate payers and residents.

During and after the event, PWA received survey data from the following LGA survey contacts:

- Ballina Shire Council – David Kelly (surveyor).
- Tweed Shire Council – Mitchell Liddell (surveyor).

Table 1 (extracted from the Survey Data Report – North Coast Flooding 03-2022 Emergency Flood Survey Works) has been expanded to include villages and localities on the Orara River, which feeds the Clarence River, for the purpose of this paper. While this was not part of the original SES Operations Order, communication from Folley (also Grafton City SES – Deputy Unit Commander) to PWA outlined that flood intelligence for impacted villages and localities on the Orara River would be of considerable benefit to the organisation. PWA confirmed this need with the SES Clarence Valley Deputy Local Commander, who clarified and expanded the locations where intelligence would be of most benefit.

Table 1: Towns, villages and localities captured (SOR in blue and purple, private surveyors in orange).

SES Description	Town	LGA
Tweed	Uki	Tweed
	Murwillumbah	Tweed
	Condong	Tweed
	Tumbulgum	Tweed
	Chinderah	Tweed
	Tweed Heads	Tweed
Marshalls Creek	Billinudgel	Byron Shire
	Ocean Shores and South Golden Beach	Byron Shire
Smaller Tweed Coast Catchments	Pottsville	Tweed
	Burringbar	Tweed
	Clothiers Creek	Tweed
Brunswick River	Mullumbimby (including Main Arm and Durrumbul)	Byron Shire
	Brunswick Heads	Byron Shire
Richmond/ Wilsons River	Goolmangar	Lismore
	Lismore	Lismore
	Kyogle	Kyogle
	Casino	Richmond Valley Council
	Greenridge	Richmond Valley Council
	Codrington	Richmond Valley Council
	Coraki	Richmond Valley Council
	Woodburn	Richmond Valley Council
Clarence River	Grafton	Clarence Valley
	Southgate	Clarence Valley
	Ulmarra	Clarence Valley
	Brushgrove	Clarence Valley
	Lawrence	Clarence Valley
	Maclean	Clarence Valley
	Crystal Waters	Clarence Valley
	Yamba	Clarence Valley
	Iluka	Clarence Valley
	Harwood	Clarence Valley
	Chatsworth Island	Clarence Valley
	Ashby	Clarence Valley
Orara River	Kangaroo Creek (Upper & Lower)	Clarence Valley
	Coutts Crossing & surrounding localiities	Clarence Valley

3.3.1 Intel Capture Platform

The SES Operations Order directed the use of, and supplied instruction of, the ArcGIS Collector app (Esri, 2023) for all intel capture. SES provided a project-specific login and password for access to their intelligence gathering maps that allow real-time ingestion into their statewide mapping and intelligence gathering systems. Part of the Esri Geospatial Cloud, ArcGIS Collector (now migrating to ArcGIS Field Maps), is a mobile data collection app that makes it easy to capture accurate data and return it to the office by using web maps on mobile devices to capture and edit data. ArcGIS Collector works even when disconnected from the internet and integrates seamlessly into ArcGIS.

The Intelligence Gathering (All Events) – Collector map was utilised for this project, one of several in a suite of maps utilised for various intelligence gathering activities by SES or by organisations gathering information on behalf of SES (Figure 7). For example, the Australian Army utilised the Damage Assessment map within the ArcGIS Collector app for building assessments of flood-affected, damaged or non-inhabitable housing post flood in Lismore.

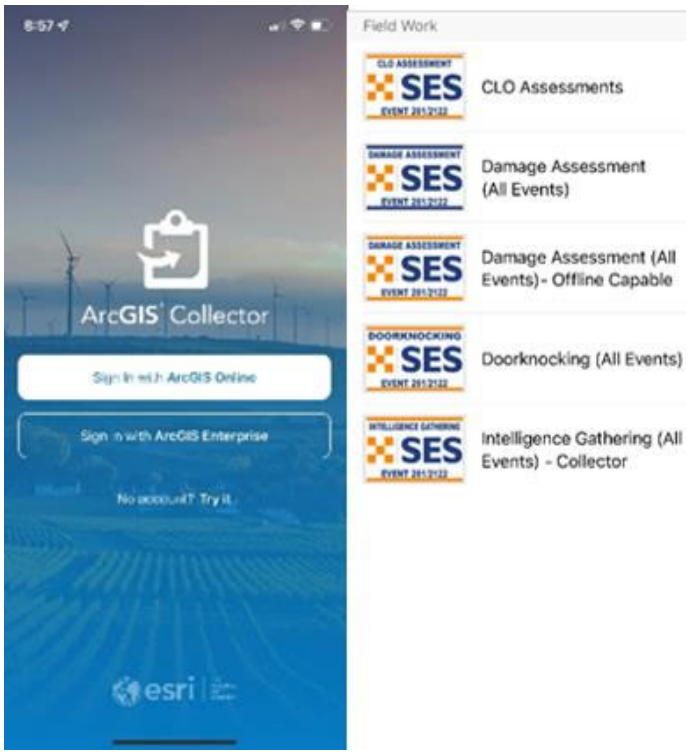

Figure 7: ArcGIS Collector app and SES intelligence/assessment maps.

Being a geospatial tool, capture locations were accurately ‘pinned’ on the map, evidence photos taken and stored, as well as comments noted about evidence surveyed and accurate Australian Height Datum (AHD – e.g. see Janssen and McElroy, 2021) values surveyed at the location of the evidence found (Figure 8). Positioning data was collected using the Global Navigation Satellite System (GNSS) Continuously Operating Reference Station (CORS) Real-Time Kinematic (RTK) technique. Positions were obtained through CORSnet-NSW, Australia’s largest state-owned and operated GNSS CORS network providing fundamental positioning infrastructure for a wide range of applications (e.g. Janssen et al., 2016).

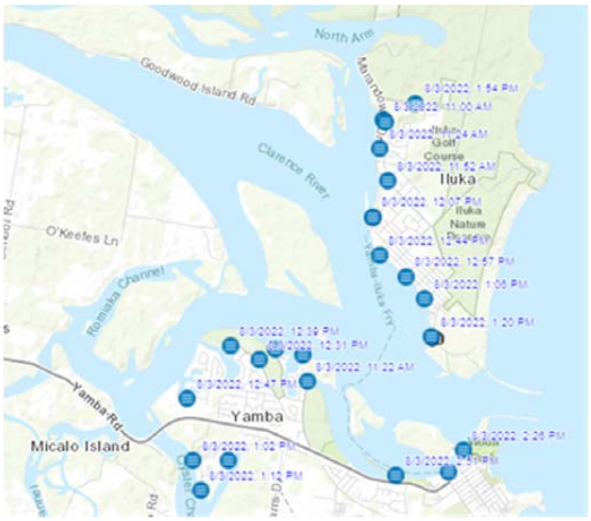

Figure 8: Sample of captured points within ArcGIS Collector.

3.3.2 Intel Capture: Datum, Methodology, Data Delivery Codes and Format

Most importantly, all captured evidence required accurate AHD heights for SES to capture the Peak Water Level (PWL) in this event and collate intelligence to assist the SES Planning and Intelligence Officers (e.g. flood analysts) in the preparation for any future events (Figure 9).

Coordinate System

MGA 2020

Height Datum

AHD (AUSGeoid2020)

Collection Method

GNSS - CORSnet RTK (single base or Network)

GNSS – Local single base using local established and approved SCIMS mark(s)

Note: Check shots to be made to accessible established and approved SCIMS mark(s) where possible

Field data collection

- Main objective is to determine peak levels of the flood.
- Any comments should be made using Code#Comment. The comment should specify how the peak water level was determined. Example;
  PWL#debris line

Code list

Code	Description
PWL	Peak Water Level
CWL	Current Water Level

Export format

- P,E,N,H,C,D,T
- Point Number, Easting, Northing, Height, Code, Date, Time.
- Example: 1000,333000.000,6500000.000,15.000,PWL#debris line,03/03/2022,1130

Figure 9: Extract from PWA survey briefing document.

PWA and SES determined a 500 m density sample rate for evidence to be captured. This capture density was applied as a rule of thumb for most of the areas within the AOIs. However, as time progressed, external inputs come forth to focus or direct the capture parameters.

As mentioned earlier, the SES flood intelligence gathering project received input from the DPE Floodplain group, which included affected council area's flood engineers and consultants who specialise in water engineering and flood modelling. Their involvement was likely to assist in identifying 'pinch-points' for this event and contribute to local water authorities future planning and mitigation for these types of events into the future.

The Byron Shire LGA capture was dictated by specified localities around watercourses, watercourse infrastructure (e.g. culvert or bridge), residential localities where waterflows (both riverine and stormwater) could be affected, and where evidence would contribute to later analysis (Figure 10).

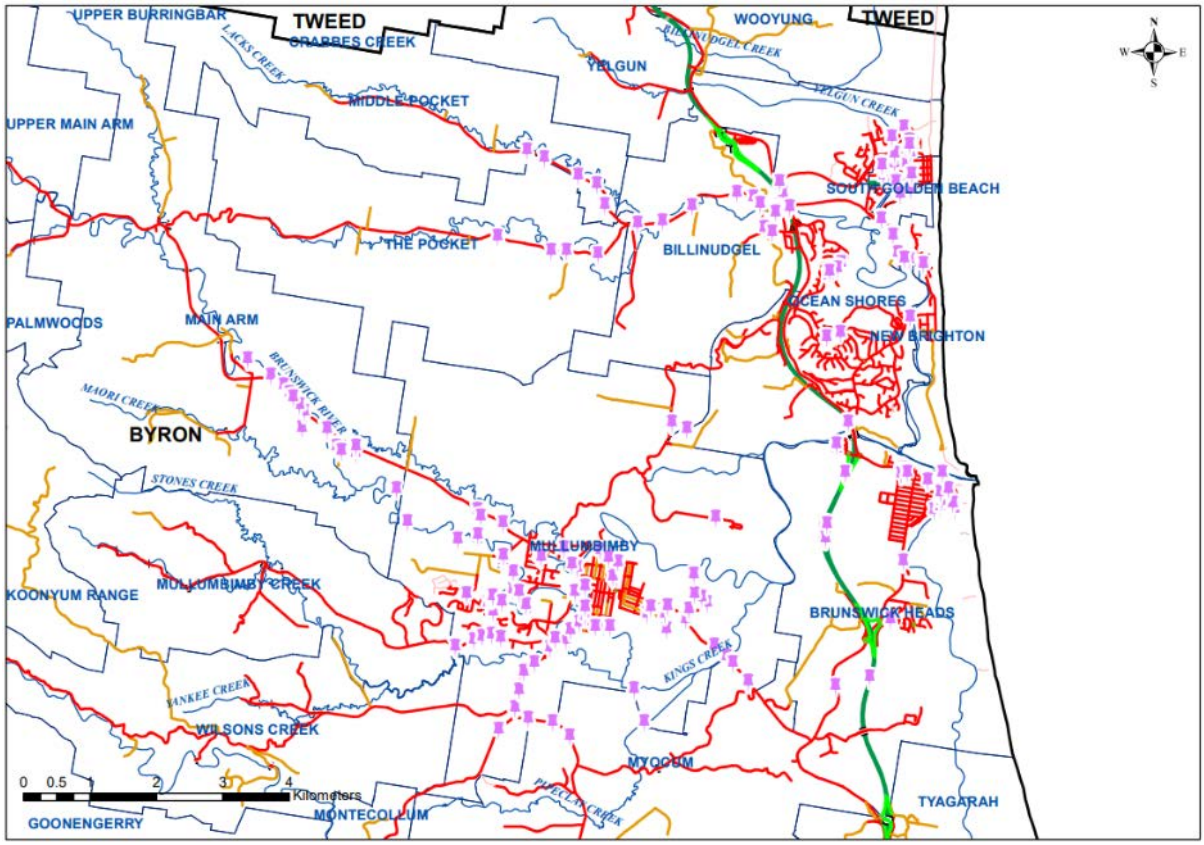

Figure 10: Capture locations provided in KMZ format for Byron Bay (first event).

3.4 Intel Capture: Byron Bay – Second Extreme Weather Event

Following 4 weeks of flood intelligence gathering from the first severe event, a second isolated weather event hit Byron Bay and Suffolk Park to the south on Tuesday, 29 March 2022. Heavy rain lashed the popular North Coast destination overnight and through the early morning of Wednesday, 30 March 2022 (BOM, 2022b), causing flash flooding and inundation throughout the Central Business District (CBD) and low-lying residential areas (Figure 11).

Figure 11: Flooding in Byron Bay, corner Jonson St & Byron St (30/03/2022) (Guardian newspaper).

Rainfall totalling almost 300 mm in 2 days (131 mm & 164 mm) fell in two of Byron Bay's flood management areas, Belongil Creek and Tallow Creek (Figures 12 & 13). Residents said flooding in the Tallow Creek flood area would have been devastating had Tallow Creek not been opened to the sea the previous month, which at that stage was at capacity with water levels about that captured in this project.

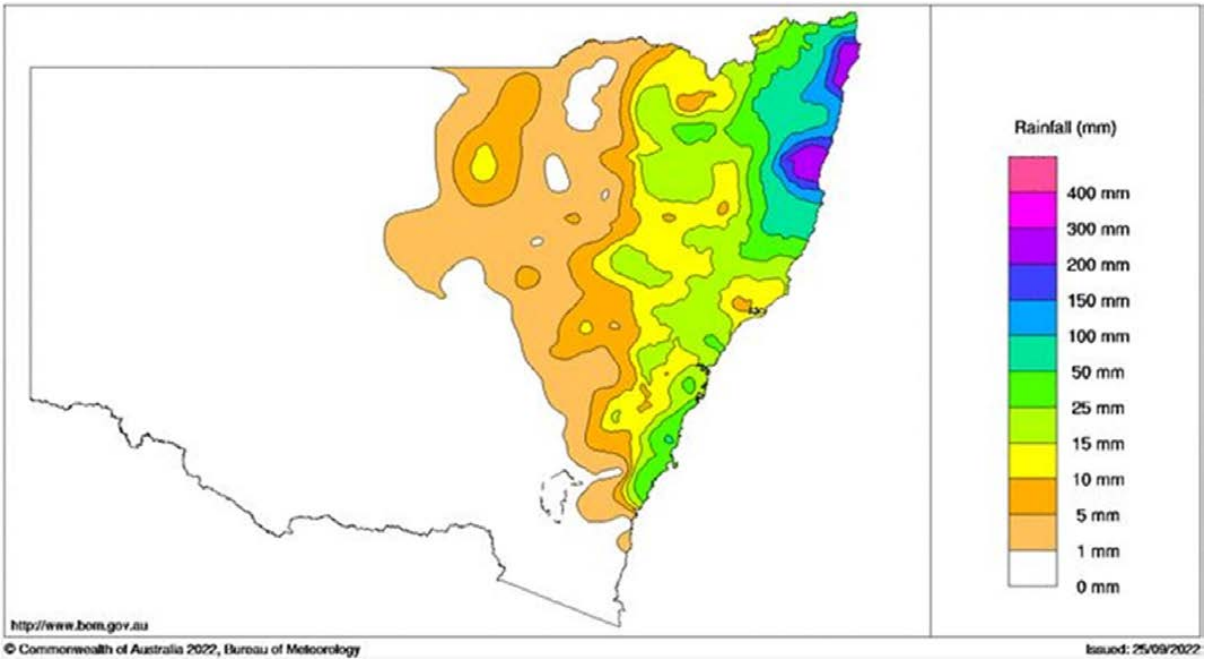

Figure 12: North Coast rainfall in the 24 hours to 9 am (30/03/2022).

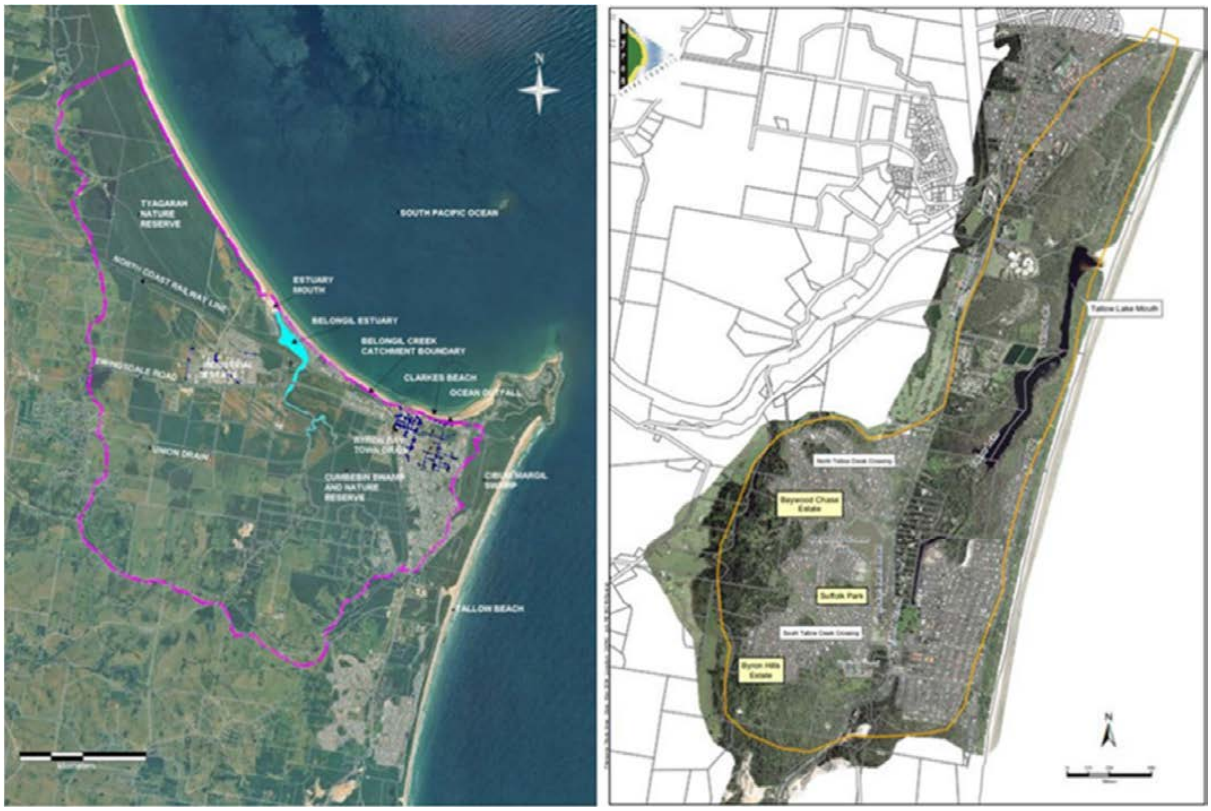

Figure 13: Byron Bay's flood areas – Belongil Creek (3,000 ha) and Tallow Creek (450 ha) (courtesy Byron Shire Council).

3.5 Intel Capture: PWL Evidence

Two types of flooding were encountered by SOR surveyors on this project: riverine (catchment) and stormwater (localised). Both had an overwhelming theme of PWL evidence, while the location of capture also perpetuated the trend of PWL evidence.

All PWL evidence surveyed needed to be definitive and 'trusted' (Table 2). Physical evidence was one source of evidence captured. SOR surveyors worked as one main team, therefore sometimes capturing points was quick and simple. However, often it was a time-consuming process, making contact, talking to residents, accessing their properties, identifying and confirming reliable evidence, or having access and offset locations that were difficult to take a 'quality' RTK shot at. Many PWL points had been marked up by residents, volunteers and workers, physically marking a surface (e.g. building, structure or road) with paint or Texta. Examples of various physical evidence are shown in Figures 14-23.

Table 2: Types of evidence captured.

Type of Evidence	Source or Located	Likely Source
Silt	Vegetation, buildings, structures	Riverine
Large debris	Roads, banks, paddocks, bridges, wire fence	Riverine
Scouring	Fences and concrete structures	Both
Fine debris	Fences, windows, screens	Stormwater
Markings	Buildings and structures (residents)	Riverine
Photos	Provided by residents or business owners	Both

Figure 14: Silt line on vegetation and structures.

Figure 15: Large debris remains near rivers.

Figure 16: Debris on the road and in paddocks (edge of large area flooding).

Figure 17: Scouring caused by debris moving past a structure.

Figure 18: Small debris requiring horizontal offsets.

Figure 19: Debris on underside of bridge structures, requiring vertical offsets.

Figure 20: Light debris remains on motorised vehicles.

Figure 21: Marking provided by residents, volunteers and/or workers.

Figure 22: Photographic PWL evidence captured by resident (time/date captured).

Figure 23: Photographic PWL evidence captured by resident (time/date captured).

3.5.1 Intel Capture: PWL & CWL Captured

Overall, there were 651 PWLs and 27 CWL values collected across the project, which included the initial event and secondary event later in March around Byron Bay. However, in July 2022, as a result of a proactive community engagement campaign by local authorities post flood events, residents who had captured or recorded PWLs, either by physically marking or via photo or video evidence, could register their interest in sharing their intel with their local authority for capture in the flood intelligence gathering project. A private fee-for-service survey contractor was engaged to capture that evidence, with those responses contributing a further 108 PWLs.

Originally, flood intelligence was captured with the ArcGIS Collector app (photo evidence, type and source of evidence, AHD level surveyed), with .CSV survey data (containing all relevant metadata, including time, date, position and AHD level) sent from surveyors to PWA at the finalisation of their capture commitment. However, access to SES intelligence gathering maps were time sensitive, limiting access to a wider user audience. Therefore, PWA made the decision to import and share all .CSV data between SES, councils, PWA and DPE through MS Teams and Esri software (Figures 24-28).

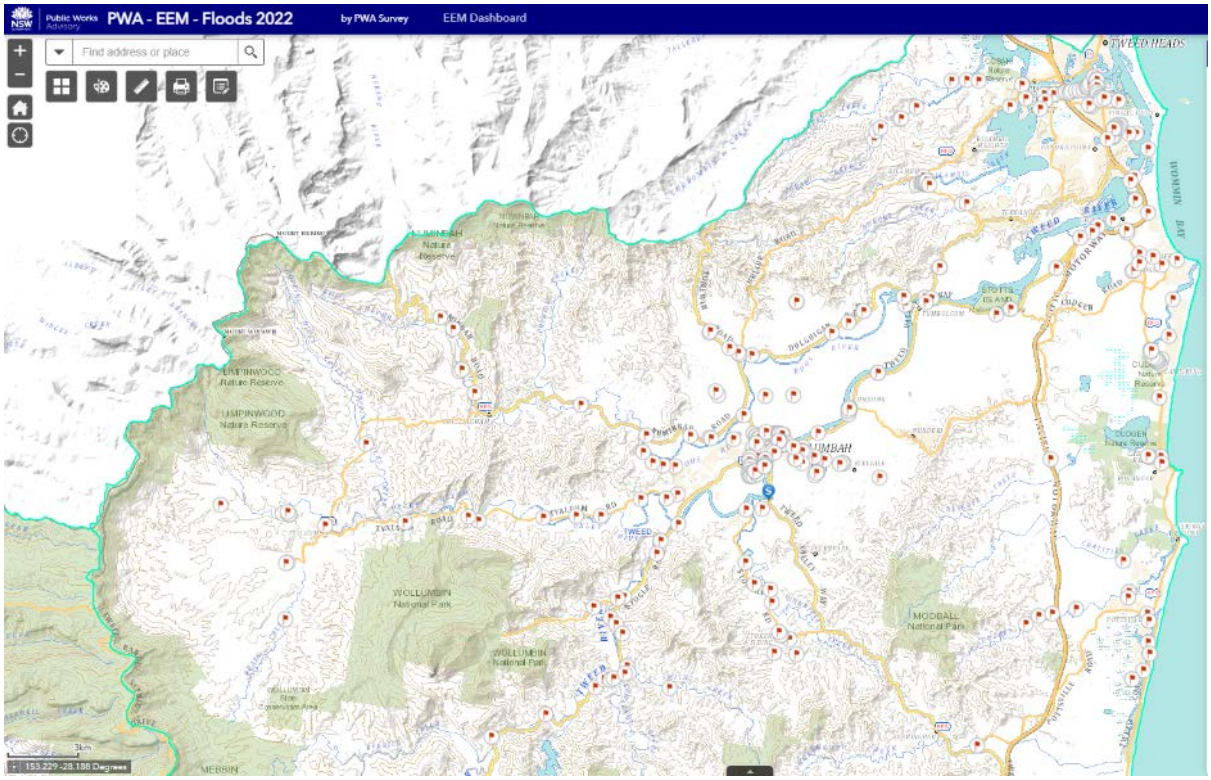

Figure 24: Tweed River and smaller Tweed Coast catchments.

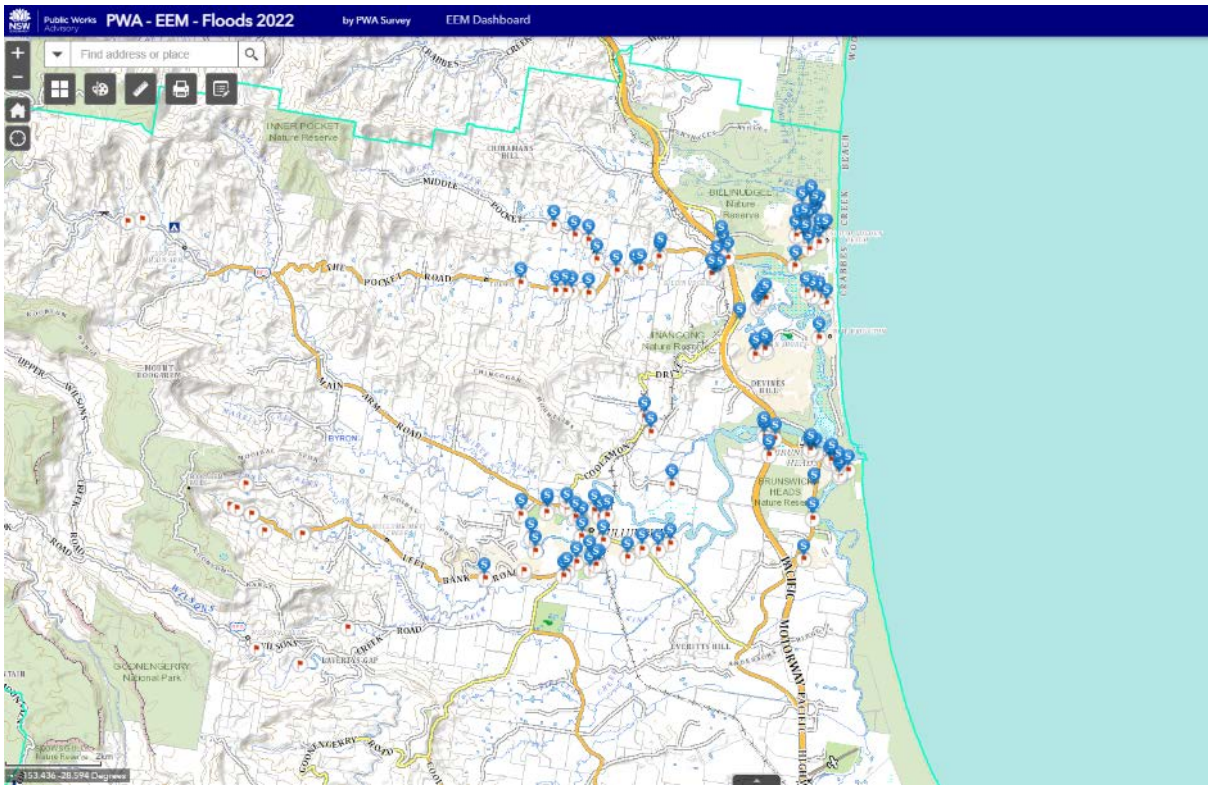

Figure 25: Brunswick River / Marshall Creek catchments, Byron Shire.

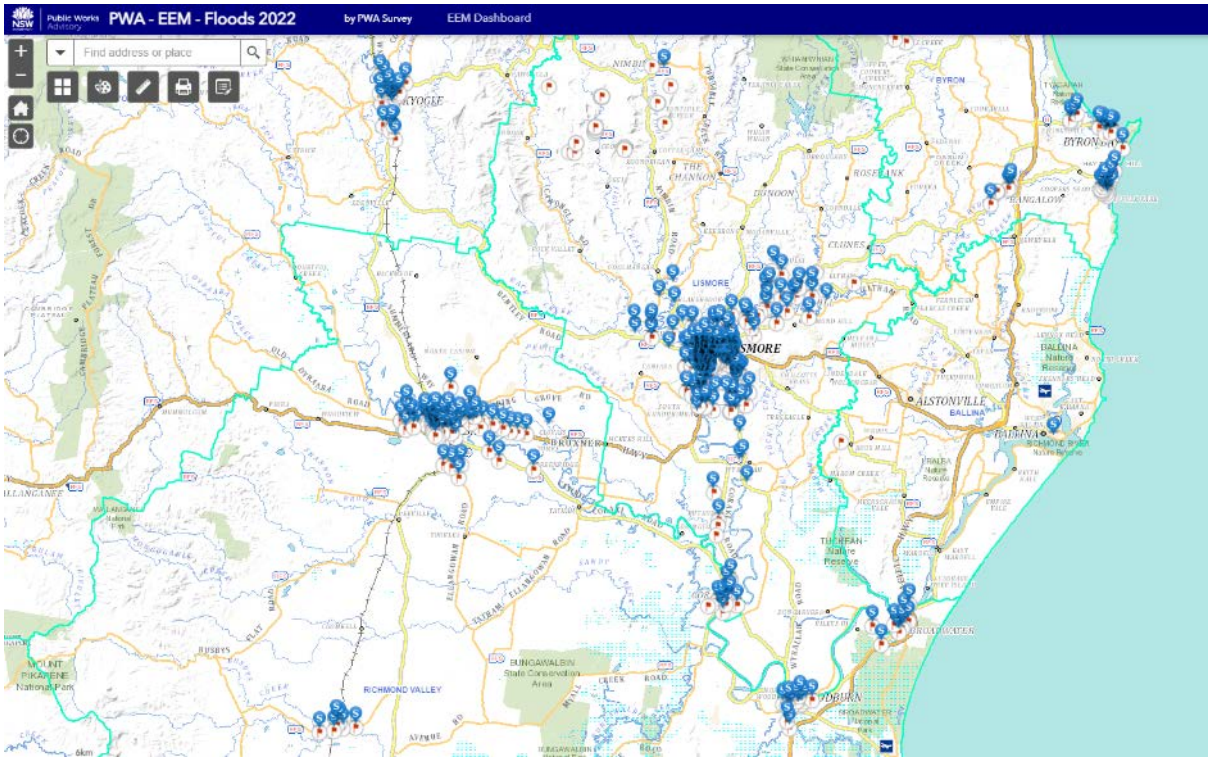

Figure 26: Richmond and Wilson River catchments (also shows Rappville & Byron – not in catchment).

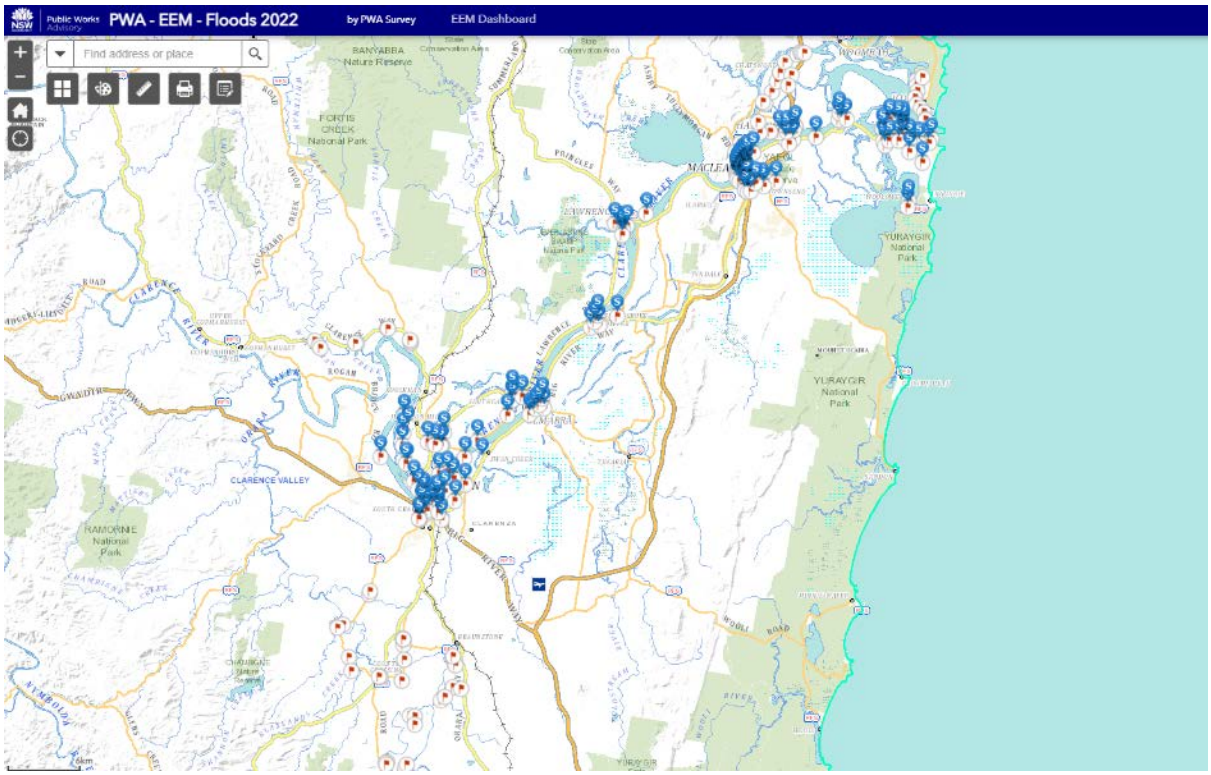

Figure 27: Clarence River and Orara River (feeds Clarence River) catchments.

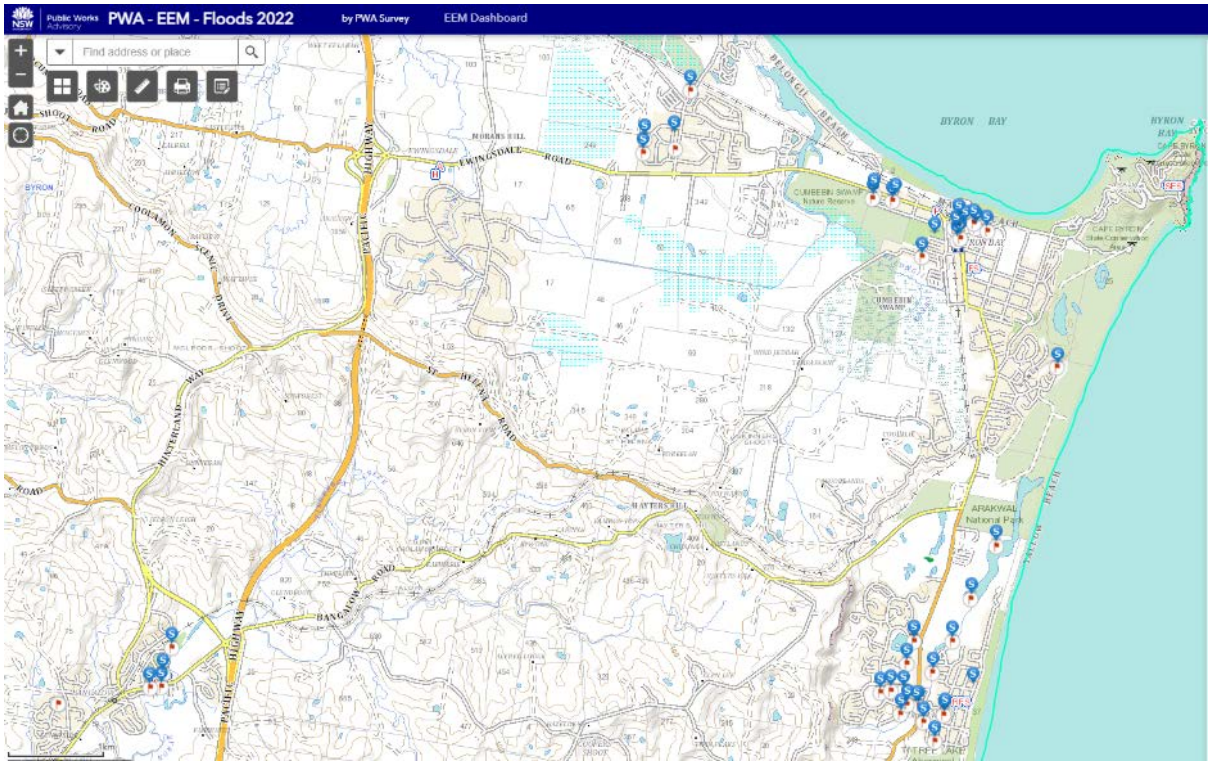

Figure 28: Byron Bay, Suffolk Park / Tallow Beach and Bangalow – second severe weather event.

4 THE PUBLIC SURVEYORS' EXPERIENCE

4.1 What Would We See and What Would Be the Public Reception?

The SES Operations Order included under 'Safety', its 'Key Risks'. According to the Order, the first two key risks which exist in any flood event are:

- Exposure to traumatic incidents or scenes.
- Distraught or outraged residents: Residents may take out their frustrations about the situation on teams. Use all courtesies and empathy when dealing with this type of resident and do not engage in arguments. Refer any people that may require flood rescue or other assistance to NSW SES 132500, for life threatening emergencies call 000. Remove yourself from the property immediately, if you feel threatened in any way and report the issue.

Digital media outlets and social media had been quite critical of the NSW and federal government's response, as well as that of the emergency services and the Australian Defence Force (ADF), post flooding in the Northern Rivers and surrounding areas. Was this going to be the same for SOR surveyors, with their vehicles easily identifiable and the need to talk with residents and seek access to private residences to capture intel?

4.2 The Scenes Were Humbling

Just like seeing and hearing your relatives' or friends' photos and stories after their recent travels, it is hard to capture the vastness, beauty or feel for a location if you have not seen it for yourself. To travel down streets one after the other, locality after locality, to see houses that have been gutted and their contents stacked, waiting to be picked up in a mass clean up (Figures 29 & 30). Cars with their doors, boots and bonnets opened with the hope of drying out before more rain comes.

Some areas were a hive of activity, some had the feel of a ghost town, as people were either busily trying to restore normality after the past few weeks or had sort living arrangements in other locations until damage assessments and insurance work could see them return. Displaced residents form all over the Northern Rivers could be found 'pitching a tent' somewhere where services were available, living in their cars with all their 'worldly possessions', or if they were lucky enough, using NSW government vouchers to gain temporary accommodation in all directions outside the disaster zone. One of the authors had to seek accommodation in South Tweed (over 50 km from their current AOI), where displaced residents were the main occupants of the motel and several others in the local area.

The coming months would see some suburbs look like trailer parks as residents bought and lived in caravans outside their homes as an already 'strained' building industry from the COVID-19 pandemic and supply chain issues added to delays in the recovery. At the end of 2022, the Northern Rivers was still over-coming the flood earlier in the year, with residents and businesses being displaced, local infrastructure in disrepair, accommodation (both residential or holiday) under reconstruction or tired owners broken and selling up. Local services have been reduced, with unaffected areas carrying the burden.

Figure 29: South Golden Beach, Byron Shire LGA (17/03/2022).

Figure 30: Lismore drone capture of clean up (NCA NewsWire / Danielle Smith).

4.3 The Public's Reception to SOR Surveyors Collecting Intel

It was not long for SOR surveyors to develop their 'greeting' speech when interacting with the residents of affected areas. Generally, dialogue would usually start with "Hi, how have you been getting on the last week or two?", which may include "Do you live here?" and then… just listen! This would give the resident the opportunity to tell their story of how they, their neighbour(s), their family or friends had been affected, and the type of challenges they had faced during and post flooding.

Most residents were more than willing to 'open up' and be very transparent. This would usually lead to the question of "What are you doing?", to which our response was generally along the lines of "We work for NSW Spatial Services, the old Central Mapping Authority" (this is generally our normal greeting in our day-to-day work, as no one usually knows of DCS Spatial Services). "We have been engaged by Public Works to capture Peak Water Levels from the recent flood event for the NSW SES." Some would accept that answer, some would ask, "What's that for?", which was generally replied to with "The SES is gathering flood intelligence to understand what happened and share the information with other authorities to better plan to deal with any future events."

We also experienced some resistance or negativity. However, this was counteracted by either our empathetic approach or the realisation that the 'authorities' were being 'pro-active' so soon after the event and wanted the public's assistance to do so, or a combination of both. The public opened up such that we got the sense we were being part of the healing process. The residents just having someone to listen to their stories and knowing someone was doing something that may assist them, even if that was not something tangible at the time, was very powerful. The surveyors felt privileged and grateful to be part of the public's road to recovery, but also be the face of government agencies assisting the public after such devastation and emotional turmoil. At times, collecting points or intel was very time consuming, with plenty of offers to come inside to see the damage and/or have a cup of tea, but we believe the time was well spent for all involved, particularly knowing word was getting around of why we were there!

4.4 Stories from the Field

Matisse Thiering was talking to a business owner in Maclean. He said his son was out and about at around 10 pm (28/02/2022) and noticed that the levee was starting to fracture at a location in the CBD. This was circulated on social media, which soon had members of the public in full swing, sand-bagging the weakened location. This action may have prevented a major impact as the levee wall continued to be sand bagged into the following day for several hundred metres, and most flooding was from localised rain inside the levee.

Graeme Davies visited a family at Gundirimba, close to the river, who had an earth mound built up in the paddock where they put their vehicles, machinery and four horses, high and dry, and had saved them in the 2017 flood. This time they put all the vehicles, tractors, horse float, and the horses (in a temporary yard) on the same hill. However, this time the flood level exceeded any previous ones by almost 2 metres, meaning that the water went over the top of everything and two of the horses perished where they stood while two others were found somewhere downstream a few days later. In the distraught young couples' words: "We made a death trap".

Graeme Davies' Ducati dealer and mechanic, Arthur Davis has a bunch of flooded motorcycles at his shop from all over the area. He was told that one bloke from Coraki lost his bike and put

in an insurance claim. The insurance company replied that they may need a receipt or paperwork, etc. He said: "Mate, I have been past my house in a boat a couple of times this week, I can barely see the roof. Not sure where that paperwork will be!"

Stewart Folley talked to a landlord who was attending his cluster of villas in Brunswick Heads to allow insurance accessors carry out their duties. He was told: “We had my father at our place not far from here, he was going through home palliative care. He died on the night of the flooding, and we had to wrap him in plastic and store him in the back of my ute until the flood waters receded so an ambulance could pick up the body.” This was accompanied by a photo of his father in the back of his ute, mummified in cling-wrap, where he had to remain for several days.

Stewart Folley spoke to a middle-aged disabled guy who was in a wheelchair and was awoken to flood water. He had nowhere to go, and the water was up to his chest and neck. He was just lucky that the water level did not go any higher.

5 CONCLUDING REMARKS

Following the devastating flooding in north-eastern NSW in late February, March and early April of 2022, this paper has discussed the surveying technique, project outcomes, statistics and lessons learnt from the SES flood intelligence gathering project. It has also told a story of grieving and healing, resilience, power of community after a natural disaster, and the delicate situation the surveyors found themselves in when capturing the much-needed data during this challenging time.

The importance and value of the public authority surveyor has been demonstrated many times throughout this paper. A rapid and practical solution was required to respond to the SES Operations Order, which involved collaborating effectively with many stakeholders including those that could hit the ground running. Challenges always arrive in emergency situations and the ability for the surveyor to adapt to unpredicted field events and continue to deliver is often overlooked. On the grand scale of the event, the flood intelligence capture operations were quite small, but they were critical and very fulfilling for all parties involved.

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