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Typhonium Survey 2025

Sweetwater/Keep Northern Territory

19 May 2025

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Document Control

AAM Investment Group

Sweetwater/Keep Northern Territory

Version	Revision	Purpose	Author	Reviewer	Submitted	
					Form	Date
Report	Rev A	Initial Report	GM	DP	Electronic (email)	6/5/2025
	Rev B	Include Soil analysis	GM	DP	Electronic (email)	19/5/2025

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1 Introduction

AAM Investment Group is managing the development of an extension of the Ord River agricultural project into the Keep River/Sweetwater section of the western Northern Territory (Figure 1).

AAM aim to commence environmental investigations within the Spirt Hills pastoral lease area as part of the Sweetwater Stage 1 phase of the expansion.

As part of these projects, a targeted survey of *Typhonium sp*. Kununurra is required. The species is dormant during the dry season; and emerges after rain, therefore, it is highly time critical to investigate these areas as soon as possible.

Typhonium sp Kununurra (AN Start ANS 1467) is a flora species listed within the Western Australia Threatened Species listings and is anticipated to be listed within the Commonwealth Government's Environmental Protection and Biodiversity Protection Act (EPBC Act Cwth 1999) as a threatened species.

Ecosystem Solution were contracted by AAM Investment group (AAM) to investigate the area of the proposed agricultural expansion and provide advice as to the presence and possible density of *Typhonium sp* Kununurra (TsK) within the proposed area.

This report outlines the methodology and results of a targeted survey for the species in February 2025.

2 Scope

The scope of this report is to present the methodology and results of a targeted survey for *Typhonium sp* Kununurra on proposed areas of future development in the Keep River/Sweetwater area of the proposed Ord River agricultural area expansion. This area is immediately to the east of the Knox Plain area which has already been developed and terminates at the WA/NT border. The site is approximately 55km from Kununurra in WA, along the Moonamang/Legune Road (Figure 1).

The overall aim was to broadly determine if there were likely TsK populations present within the proposed development area and that future, more detailed survey of this and other flora/fauna and communities, could be developed as the planning process of the project progressed with more detail.

Three stages were proposed. Stage 1 covers 4,524 ha and is directly alongside the WA/NT border. Stage 2 is approximately 10 m kms south of Stage 1 and is 2,951 ha in area. Stage 3 is to the east of the Keep River and covers 19,665 ha in area. These are shown in Figure 1[1]. The areas targeted were determined from locations where previous studies have shown higher probability of the species occurring (based on soil type and vegetation associations) and focusing on Stage 1 with a higher level of survey points, with less quadrats in Stage 2, and Stage 3. This is because of the availability of resources and the timing to get the surveys completed in a time when the species is more likely to evident.

[1] Note that these calculations are derived from shapefiles provided and GIS analysis.

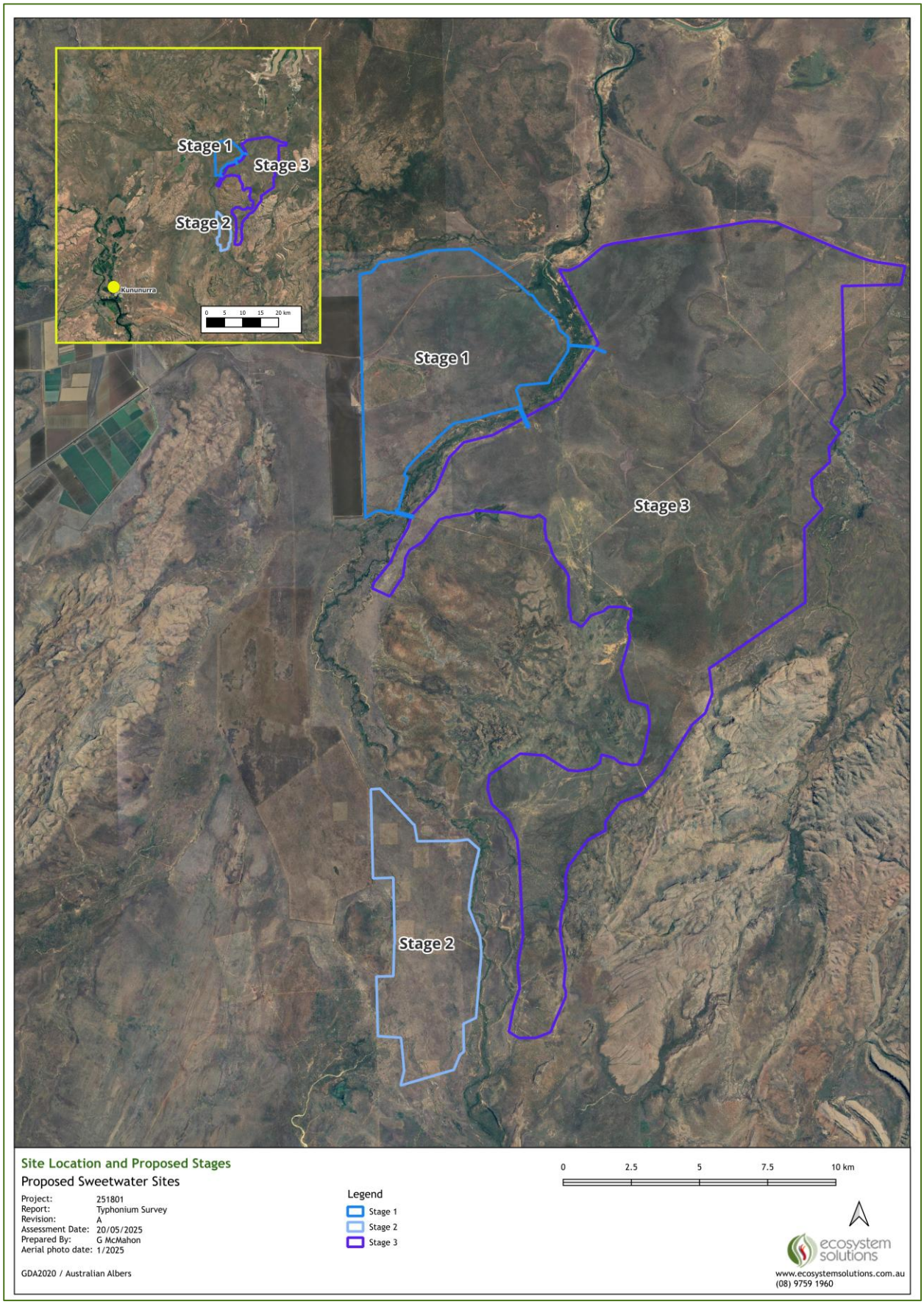

Figure 1: Site Location with Stages

3 *Typhonium sp* Kununurra

The genus Typhonium is a perennial herb in the Araceae family. It is found in southern and eastern Asia, Papua New Guinea and Australia and within Australia are mostly found in higher rainfall areas of the north (Bickerton *et al*, 2020). There are nineteen species of Typhonium that have been recorded in the Northern Territory, five have been assessed as threatened under the Environmental Protection and Biodiversity Conservation Act (1999)- (EPBC Act), five are data deficient and nine have restricted distribution (Bickerton et al, 2020).

Typhonium sp Kununurra (TsK) was discovered in December 2001, approximately 5km north of the Kununurra Airport in WA. It has since been found in several more locations within Western Australia (WA) and into the Northern Territory (NT) (Start, 2017). It is anticipated to be listed as threatened under the EPBC Act, hence the target of this survey and report.

It is a cormous perennial herb found on grey vertosol/black soils. The habitat of TsK is restricted to the cracking clay alluvial soils of the old course of the Ord River (Start, 2017) with soil mapping used to target survey areas, in particularly the seven phases of the Cununurra and Aquitane clays of the Ord River Plain (Atkins, 2015, cited in Umweld, 2021). During the dry season it persists as a dormant subterranean corm. Leaves emerge after approximately 200 mm of rain have saturated the soils early in the wet season (December to January) (Start, 2007). Thereafter, leaves and reproductive organs usually present as long as soil moisture conditions exist. Start (2017) states that not all mature plants emerge or flower every year and that when gilgais are flooded, the leaves usually emerge from areas above the water surface, but the corms can be below the inundation level.

Intensive field studies of the Knox Plain area (immediately to the west of the Keep River/Sweet Water site) in 2021 mapped the species and analysed the results to consider the occurrence, distribution and population density of TsK via vegetation and soil characteristics. 2021 Habitat suitability was evaluated considering the density of plants in each habitat, with Very High suitability (density of 20/plants per ha) within Bt habitat types and High suitability (10-15 plants per ha) within Bm and C habitat types.

Bt habitat is broadly defined as: “Woodland dominated by *Bauhinia cunninghamii* with *Terminalia volucris* present on normal or leached brown gypsic phases of Cununurra clay or greyish phase 1 Aquitaine clay soils”

Bm habitat is described as: “Woodland dominated by *Bauhinia cunninghamii* with *Eucalyptus microtheca* present on the normal phase Cununurra clay plains close to waterways and on river banks:

C habitat is defined as “Tree stratum dominated by *Corymbia bella* on the floodplains of normal phase Cununurra clay and normal phase Keep Clay soils” (Umweld, 2021).

4 Approach/Methodology

Ecosystem Solutions were advised that heavy rain in mid-January 2025 would likely promote the emergence of TsK, hence a survey was conducted in from 11th February to 13th March 2025.

Soil landscape data was obtained from the Northern Territory Government Natural Resources Maps website (https://nrmaps.nt.gov.au/nrmaps.html accessed 10/4/2025) and overlaid with data sets obtained by AAM (Figure 3) over the proposed sites to determine suitable survey sites.

Initial potential survey site locations were identified, using the available soil and vegetation mapping of the area and attempting to get a representative number of sites with varying soil and vegetation within the proposed project though emphasising Stage 1. These are shown in Figure 4.

Each potential survey site location was earmarked for a 100m x 100 m quadrats for survey (as outlined in Bickerton *et al* 2020) with each quadrat walked and inspected by a team of two using appropriately spaced transects (distance apart determined on site based on habitat characteristic) within each quadrat but anticipated at approximately 15-20 m apart. A typical example of a quadrat/transect is shown in Figure 2

Figure 2: Example of a Quadrat and walked transect on site

Each team consisted of one member that was an experienced ecologist/botanist with previous experience in *Typhonium* survey and identification or had received training from the WA Department of Primary Industries and Regional Development (DPIRD) on *Typhonium* sp Kununurra identification.

Track log of the sites walked and the locations of any *Typhonium* sp. Kununurra were recorded using a Garmin hand-held GPS and Trimble Juno equipped with Arpad software.

Given the season, it was determined that vehicle access to areas away from the main road were unlikely due to water inundation and therefore a helicopter and pilot were also contracted for a number of days during the survey.

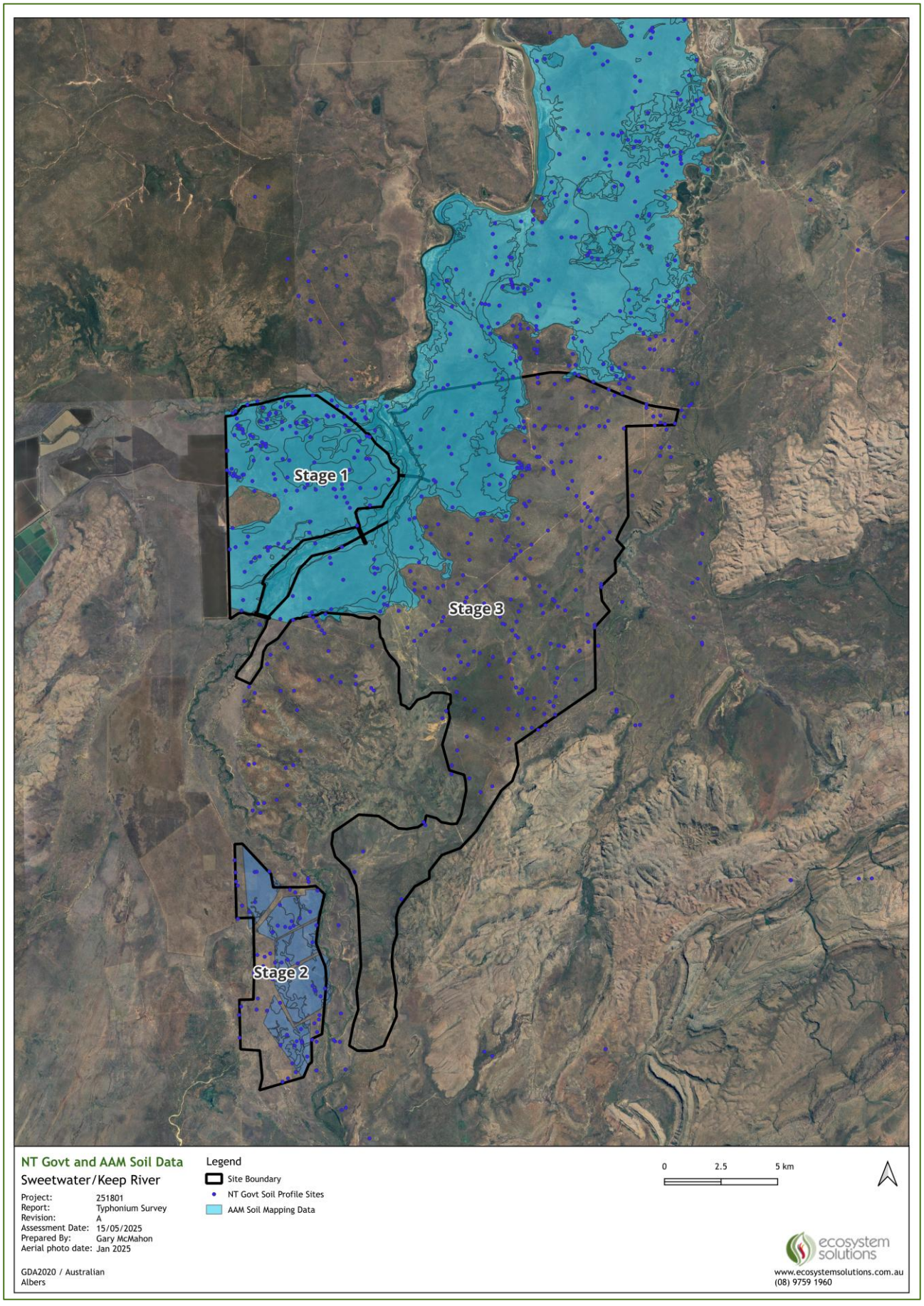

Figure 3: Soil Data over site

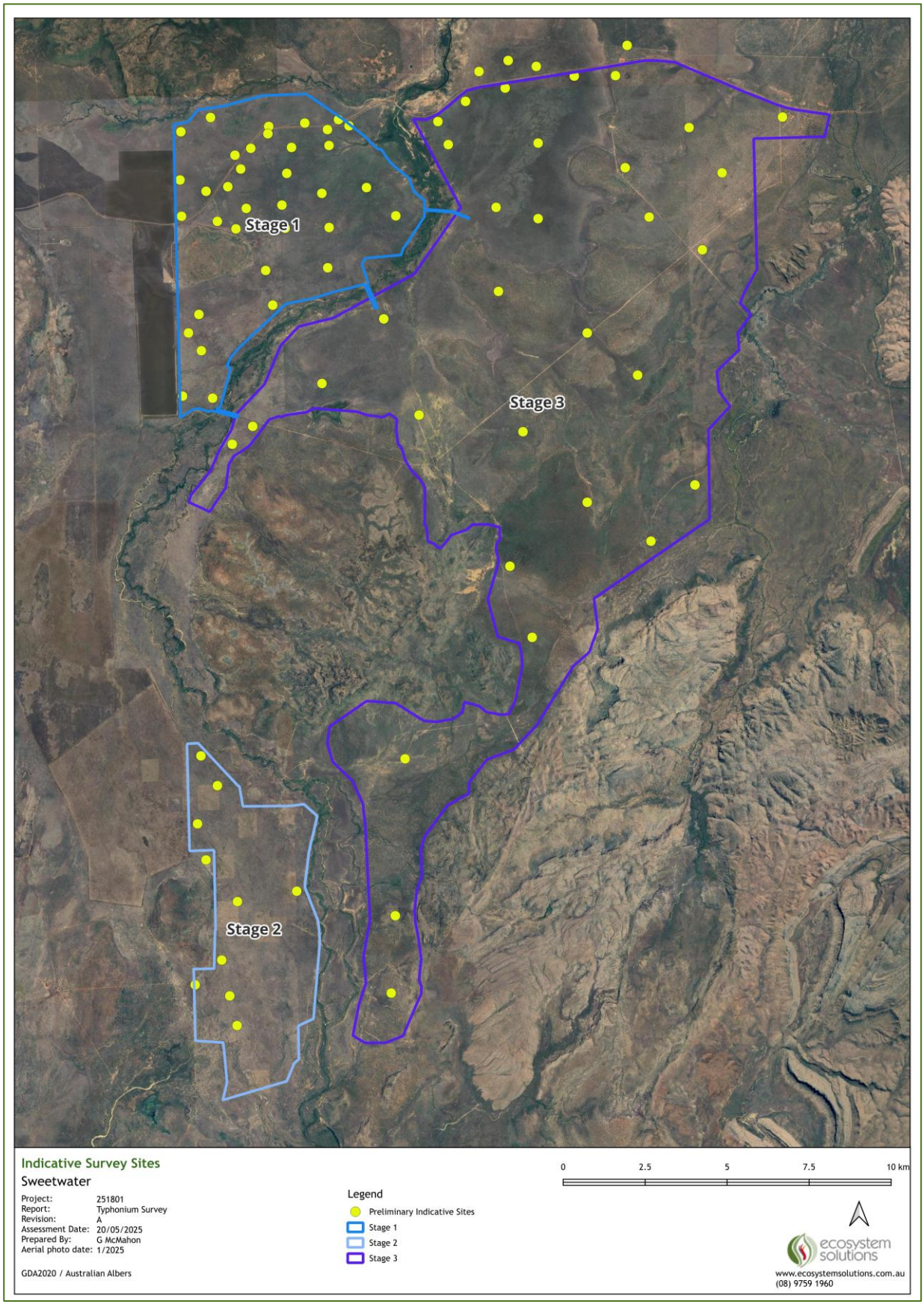

Figure 4: Proposed Indicative Survey Sites

5 Outcome/Results

5.1 Survey Details

The Ecosystem Solutions team arrived in Kununurra on 10th February 2025 and met with a team from Gelganyem Group, who were to assist with the surveys. Their team included personnel that had significant experience in botanical identification. A known location of TsK was visited near Kununurra, and the field crews were reacquainted with the morphology and habitat of TsK that were emergent at the site.

The survey commenced on the 11thf February 2025, with plans for the two botanists from Ecosystem Solutions to each form a team of two with staff from Legune Station, and the other team of Gelganyem to form a third. Approximately 40 mm of rain fell on the 10th February with higher falls in Legune, and consequently their field staff couldn't leave the station due to flooding for the duration of the survey effort. As such two teams of two were utilised from the 11th to the 20th February 2025, with a team of two from Gelganyem conducting follow up surveys on the 6th-7th and 11th-13 March 2025. The additional follow up surveys allowed for analysis of water conditions and possible emergence trends for future surveys.

Using the indicative survey locations,100m x 100m quadrats were identified with flagging tape and internal transects approximately 15-20 m apart were walked to search for TsK (as shown in Figure 2)

Internal vehicle tracks through the site were impassable, therefore sites along the Moonamang/Legune Road were targeted initially.

Surveys were conducted on the 11 and 12th February on sites accessible from the road by walking and it became evident how much water was present and that it was not dispersing quickly. The helicopter was booked for the 13th and an initial overfly inspection of the entire site was conducted (Figure 4). Most of the area was still inundated with significant depth of water that would make searching for TsK impractical so further sites that were accessible off the roadway were surveyed.

After the 15th February, no plants were found in the areas surveyed via the quadrat method and given time constraints, a walked transect option was implemented, with higher level survey via quadrat conducted when the species was found.

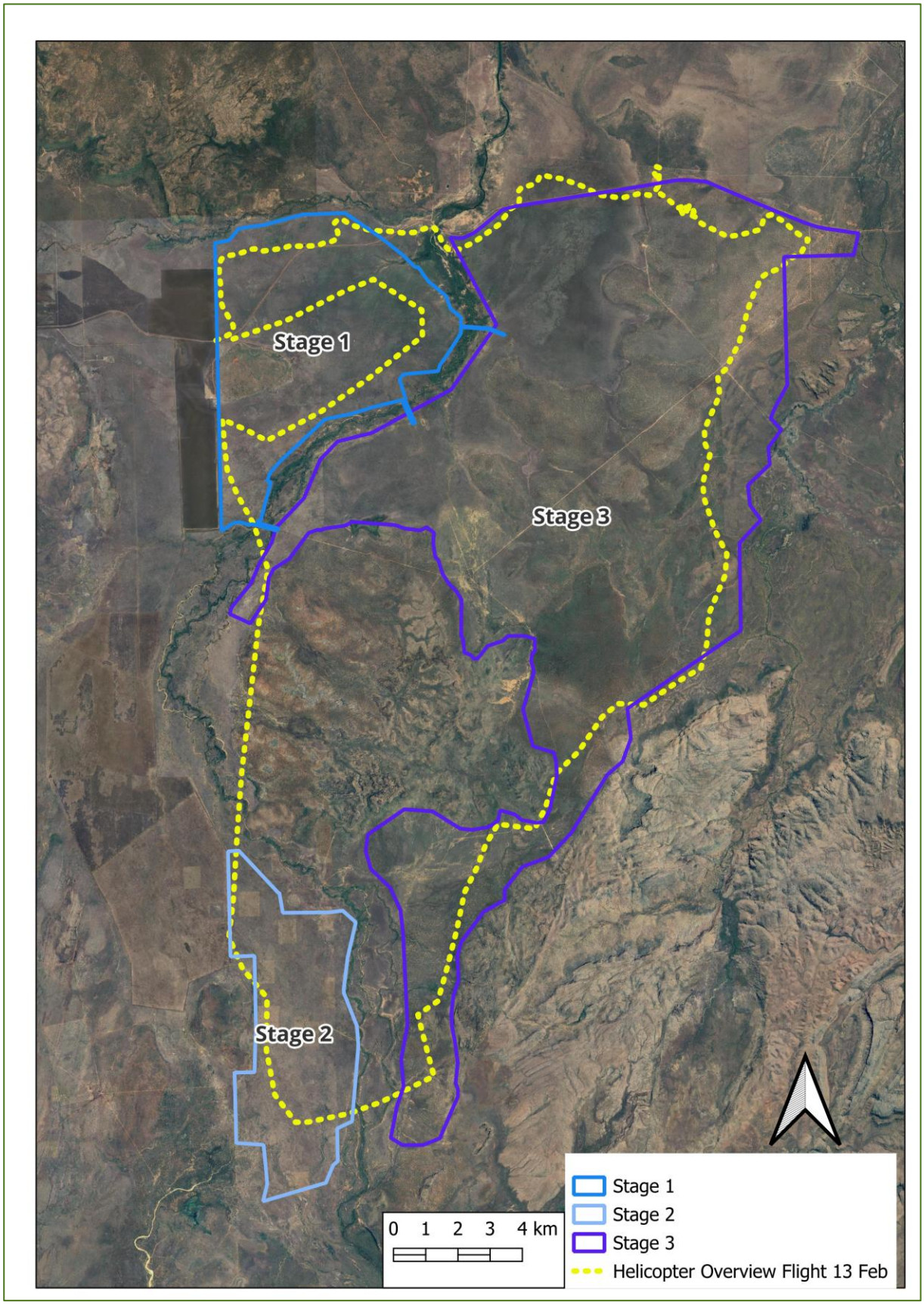

Figure 5:Route of Helicopter inspection 13th February.

5.2 Survey Results

Sixty-two survey plots were surveyed, covering 87.4 ha of area over the survey period. 211 people hours of survey effort, covering a walked transect distance of 48.2 km were conducted (Figures 7-13).

Ten individual *Typhonium sp* Kununurra plants (examples shown in Figures 5 and 6) were found during the surveys, four within Stage 1 and 6 to the north of Stage 3 along the roadside, immediately east of the Keep River Bridge (Figures 14 17).

Table 1 outlines the details of the populations identified with information collected to align with previous DPLH (WA) survey data to enable comparison if required.

Table 2 summarises the soil and landscape associations that the populations were found.

TsK plants 1-6 were found on the last two days of the formal survey from Ecosystem Solutions, however Gelganyem Group were contracted to conduct a survey for a further 5 days between the 6-18 March 2025. This included follow up surveys on the initial roadside site as there were signs of emergent juveniles when initially found. This was when the additional 4 plants were located. (TsK 7-10).

The follow up surveys found that the TSK1, 2, 3 and 4 had wilted significantly by the 13th March 2025, a period of 22 days, hence highlighting the tenuous nature of the species. It was noted that the water level was significantly less by mid-March than in the February survey period.

Figure 6: Typhonium sp Kununurra

Figure 7: Typhonium sp Kununurra

Table 1: Typhonium Data Sheets

Date	Plant ID	Latitude	Longitude	Site No	Plant Cond	Stage	Leaf Details	Comments
19/02/2025	TsK 1	-316580.8	-1639721.4	3	Emerged	2 x Adults	Lobed/Lanceolate 200mm max length	On black soil on edge of Gilgai filled with water
						5 x Juvenile		
19/02/2025	TsK 2	-316577.5	-1639710.9	3	Emerged	Adult	Lobed/Lanceolate 100mm max length	5 Muli stemmed. On Gilgai edge, wet.
20/03/2025	TsK 3	-319888.4	-1639607.1	5	Emerged	Adult	Lanceolate 120mm 4 stemmed	Dry area Newly emerged on Black soil, not near Gilgai under Themeda triandra
20/03/2025	TsK 4	-319877.8	-1639630.9	5	Emerged	Adult	Lobed/Lanceolate Single leaf 80mm	Edge of termite mound, Black Soil
20/02/2025	TsK 5	-321016.5	-1645022.1	2	Emerged	Adult	3 leaf Lobed lanceolate 120mm	On black soil under Themeda triandra
20/02/2025	TsK 6	-321019.5	-1645005.3	2	Emerged	Adult	4 stemmed lobed lanceolate Wilted and predated	On Black Soil
6/03/2025	TsK 7	-316575.6	-1639718.8	3	Emerged & Emerging	Adult and 2 juveniles	Lobed/Lanceolate 450mm,3 leaves	Healthy on black soils, multiple emerging

Date	Plant ID	Latitude	Longitude	Site No	Plant Cond	Stage	Leaf Details	Comments
6/03/2025	TsK 8	-316577.0	-1639721.5	3	Emerged	Adult	Lobed/Lanceolate 4 leaves 300mm	Healthy on black soils, multiple emerging
6/03/2025	TsK 9	-316575.0	-1639721.3	3	Emerged & Emerging	Adult	Lobed/Lanceolate 5 leaves 200mm	Healthy on black soils, multiple emerging
6/03/2025	TsK 10	-316704.0	-1639729.4	50	Emerged	Juvenile	Lobed/Lanceolate 7 leaves 95mm	Healthy, dryer soils Black under Bauhinia

Table 2: Soil and Landscapes of found populations of TsK

Typhonium sp Kununurra populations	Soil & Landscape description
TsK 1, 2 7, 8, 9 & 10.	Cununurra Ord Soil Family – ASC – Epicalcareous Epipedal, Black Vertosol Site Summary – Level Plain (alluvial), <1% slope, normal Gilgai microrelief, occasional termitaria, very slow run off, slow permeability, imperfectly drained, Very deep, black cracking clays. Vegetation commonly – *Chrysopogon fallax*, *Panicum decompositum*, low closed tussock grassland. (Carnavas & Burgess, 2019).
TsK 3,4, 5 & 6	Cununurra Ord Soil Family ASC – Haplic, Epipedal, Black Vertosol. Site Summary – Level alluvial clay plain, 1% slope, Normal gilgais – vertical interval 0.2m horizontal interval 2m, slow runoff, slow permeability, moderately well to imperfectly drained. Vegetation commonly - *Corymbia bella, Eucalyptus microtheca, Bauhinia cunninghamii(*now *Lysiphyllum cunninghamii)*, mid open woodland (Carnavas et al, 2019).

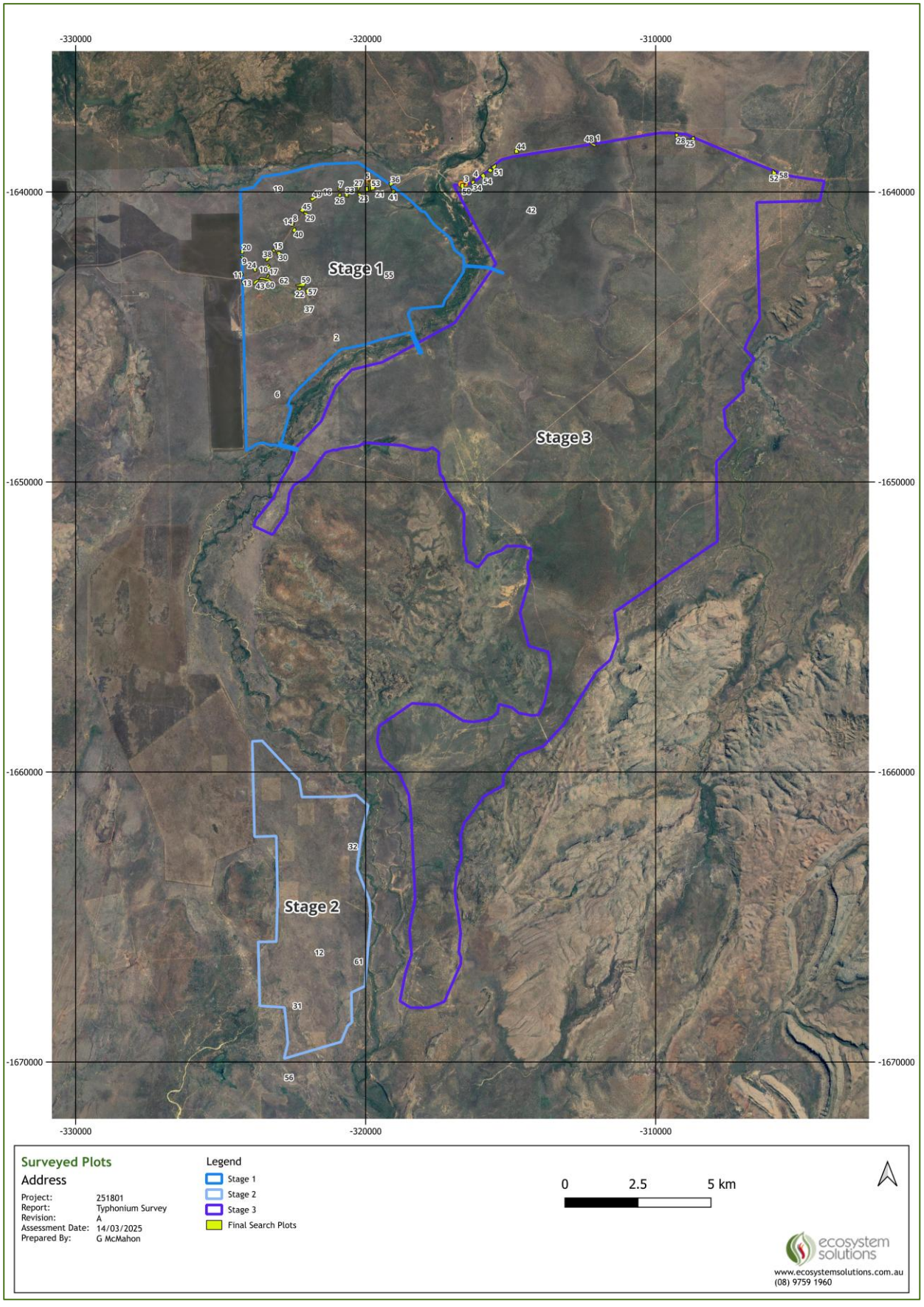

Figure 8: Survey Plots Entire Site

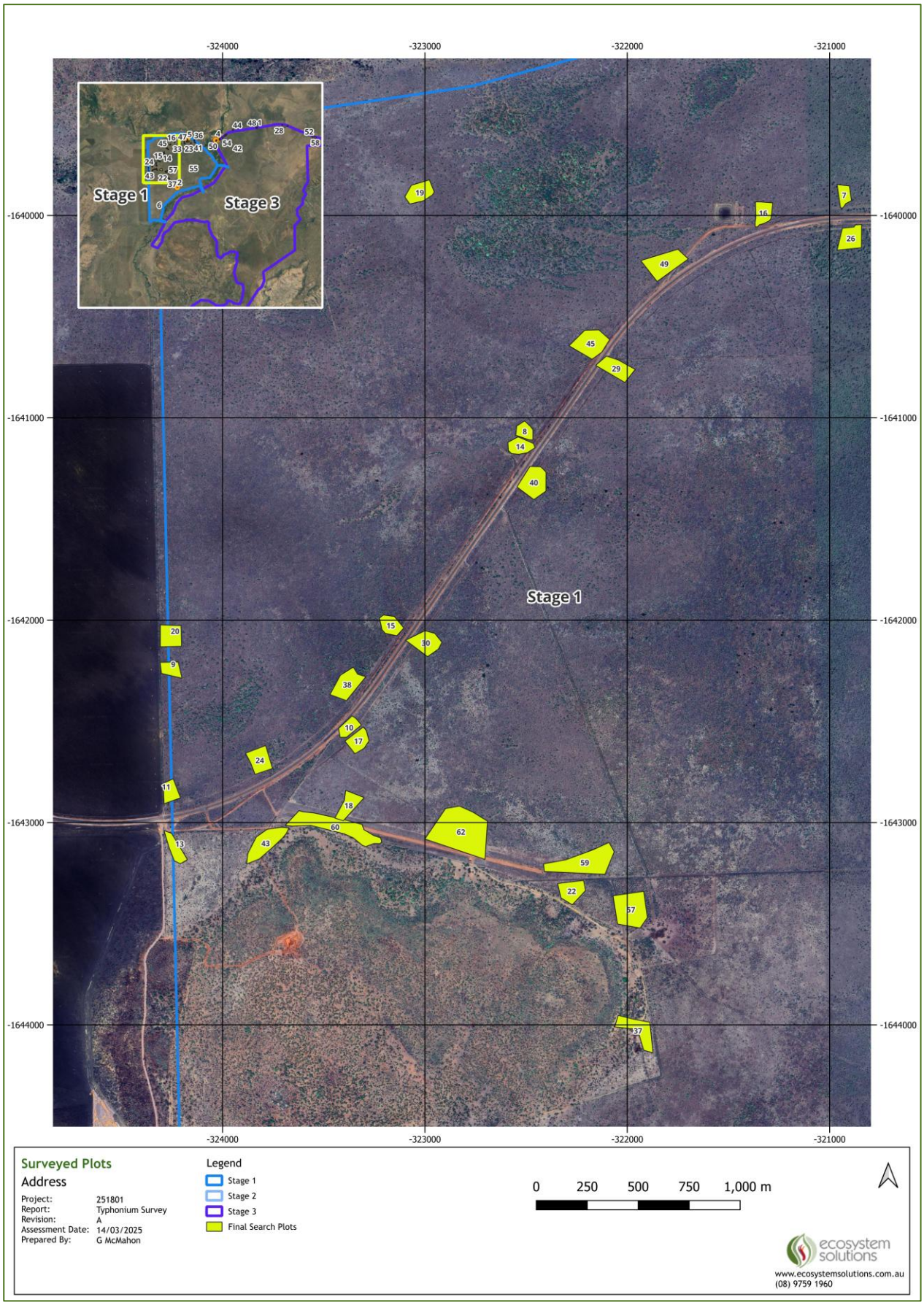

Figure 9: Survey Plots Enlarged - Map A

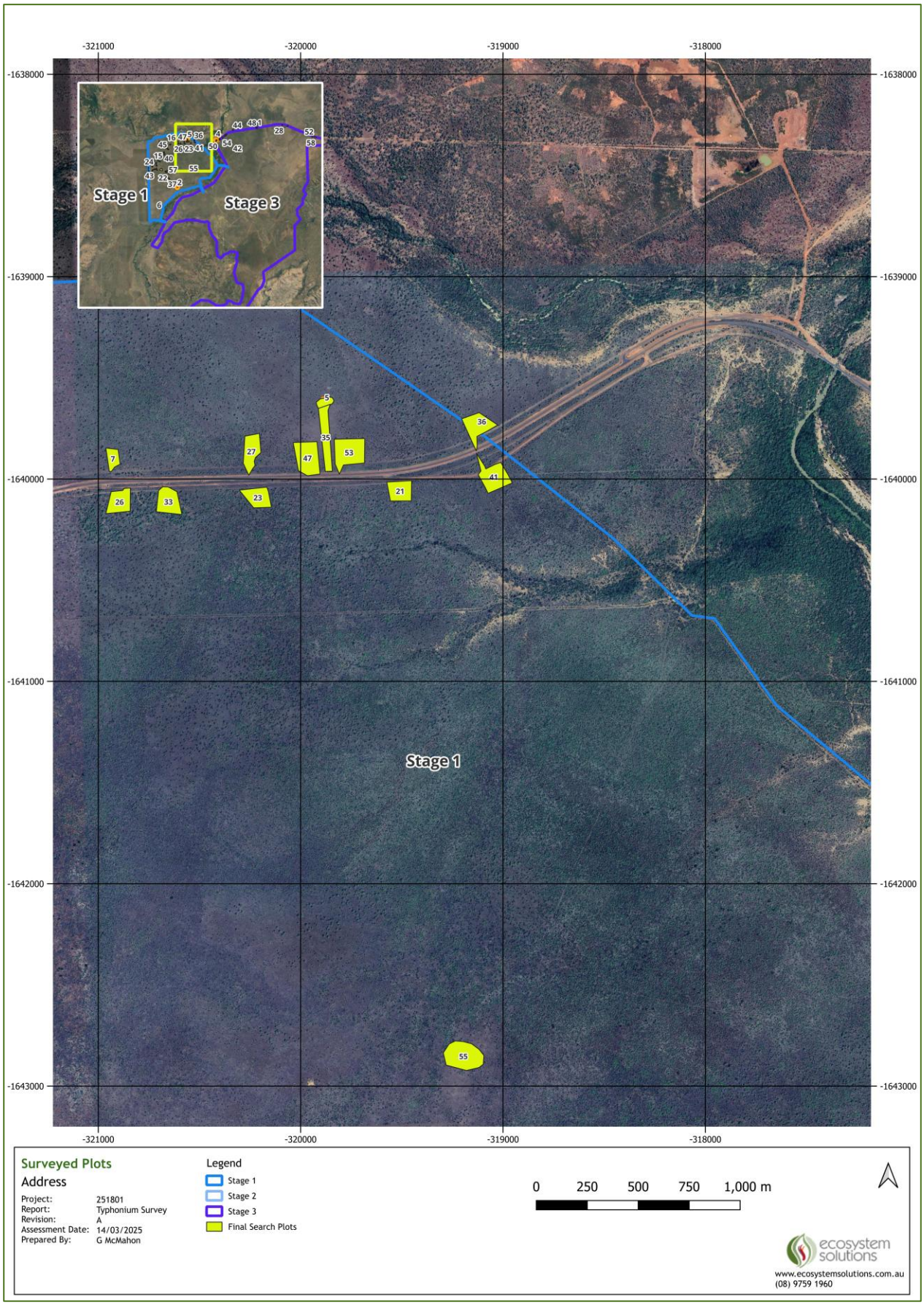

Figure 10: Survey Plots Enlarged Map B

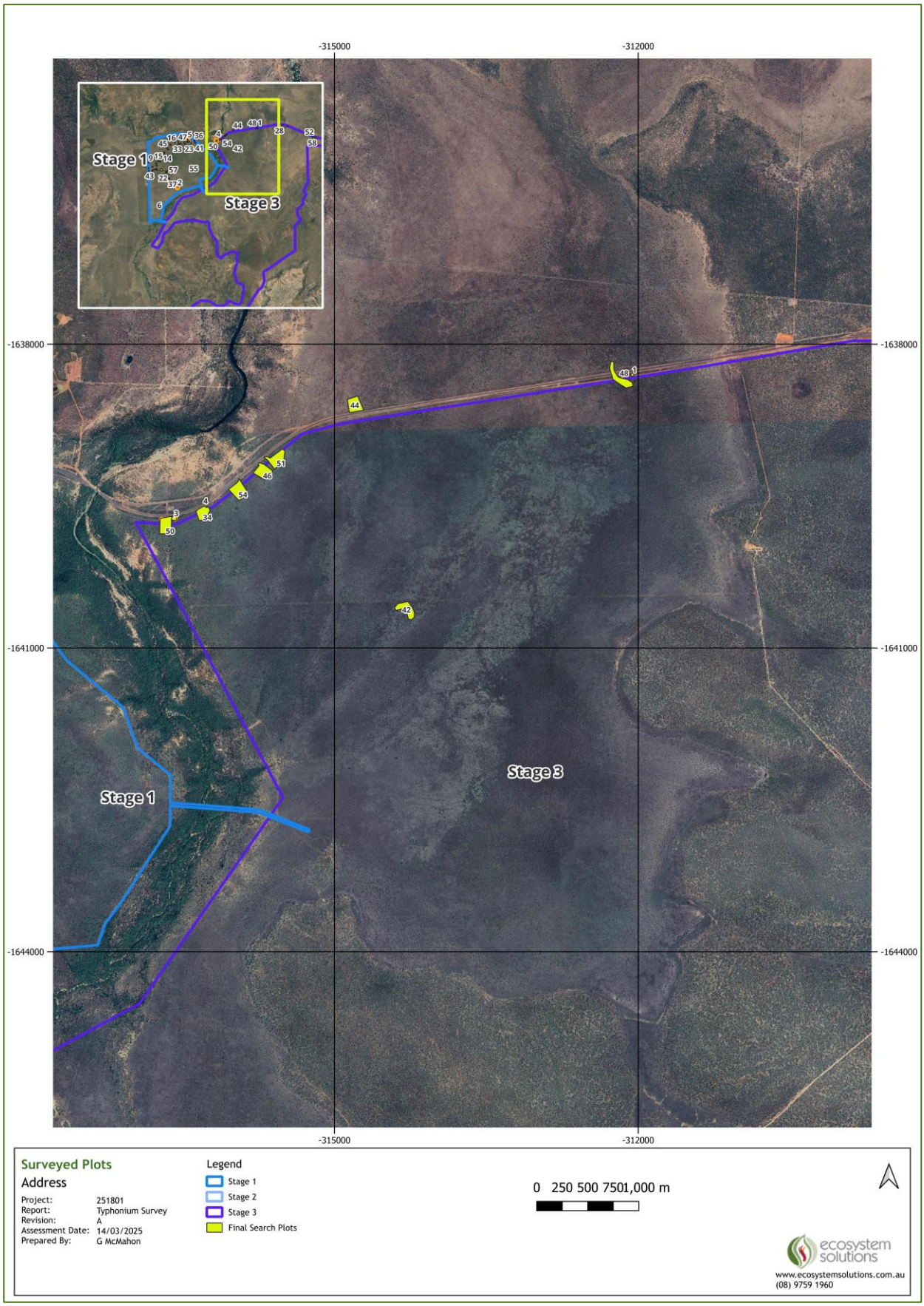

Figure 11: Survey Plots Enlarged Map C

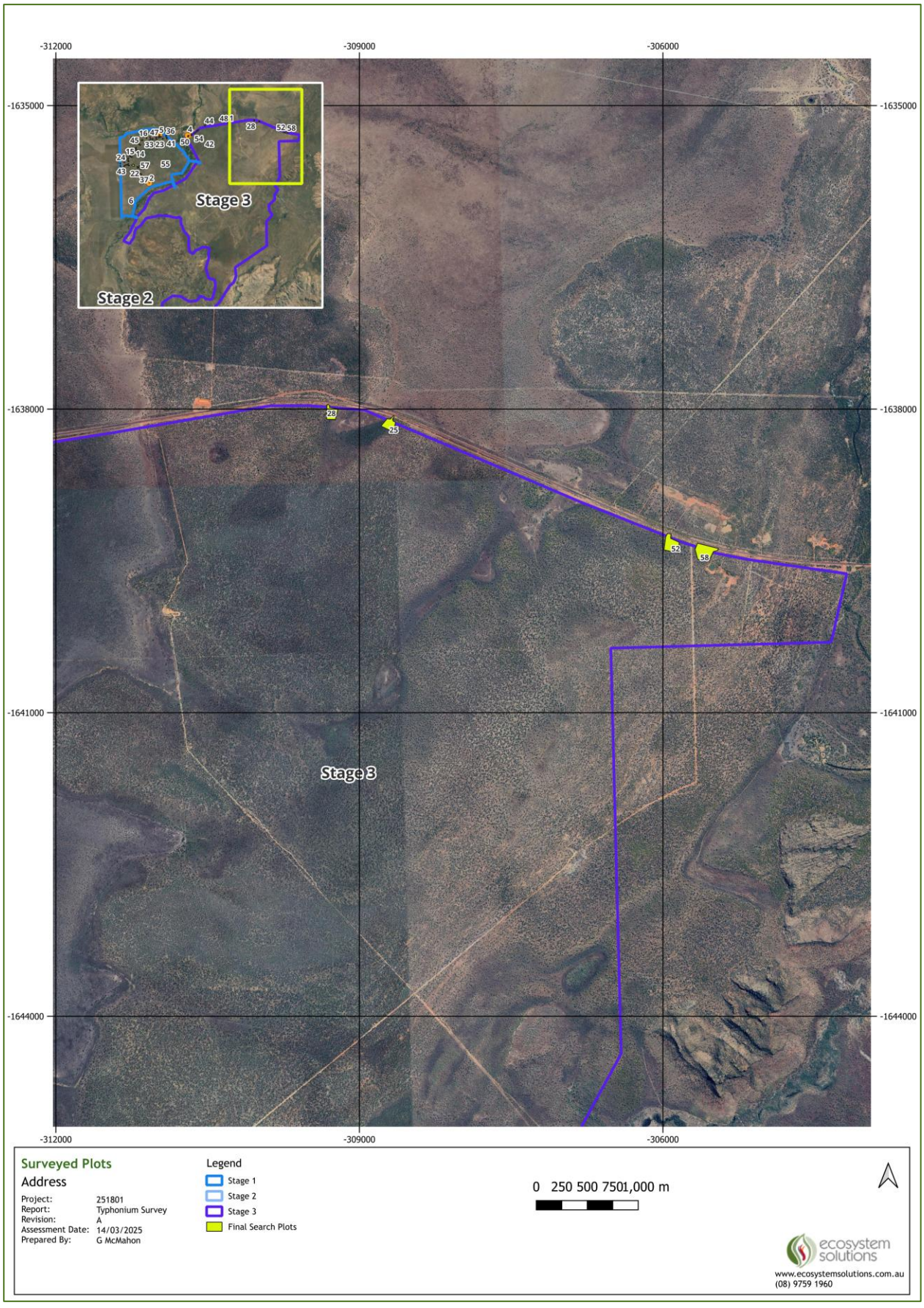

Figure 12: Surveyed Plots Enlarged Map D

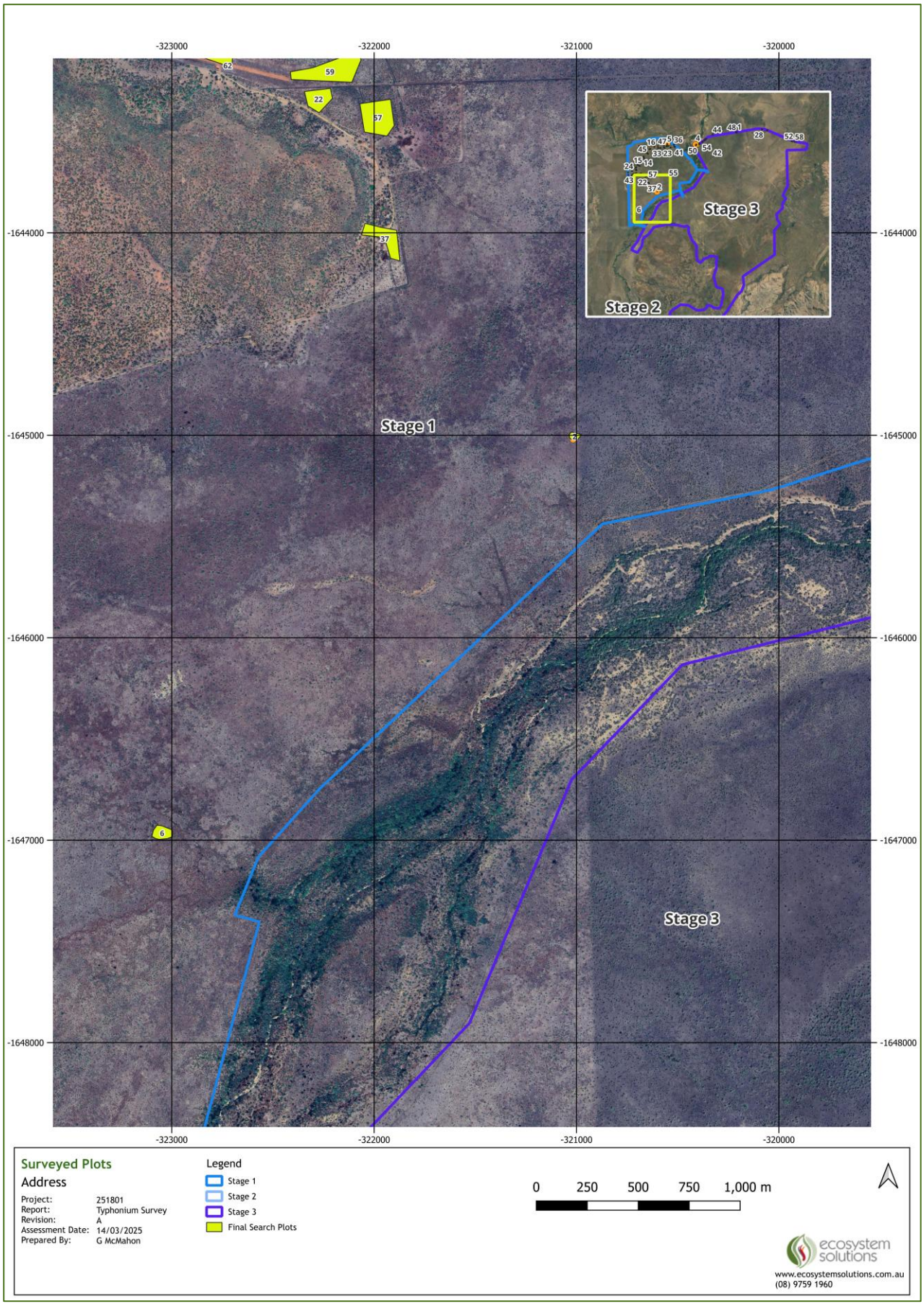

Figure 13: Surveyed Plots Enlarged Map E

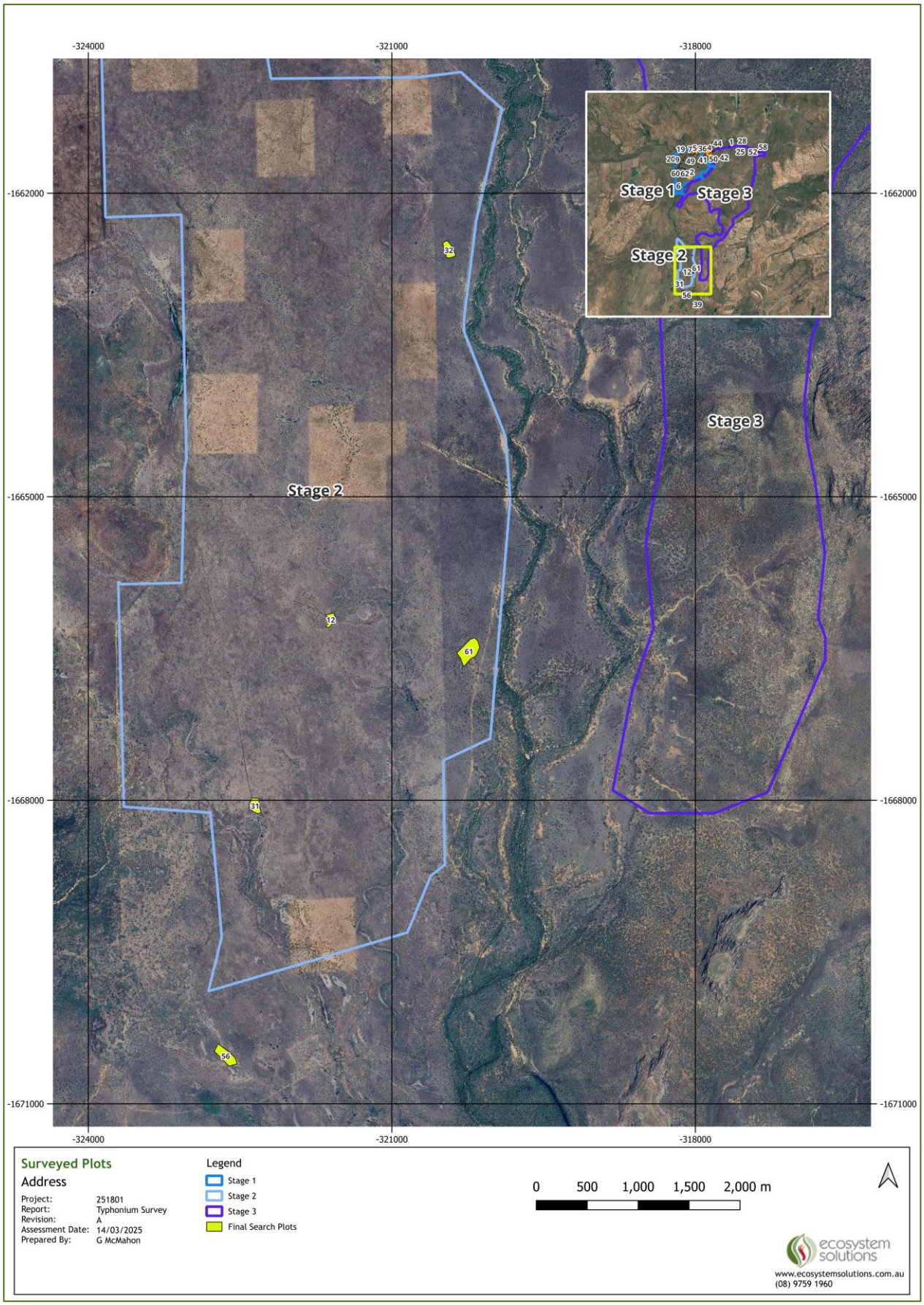

Figure 14: Surveyed Plots Enlarged Map F

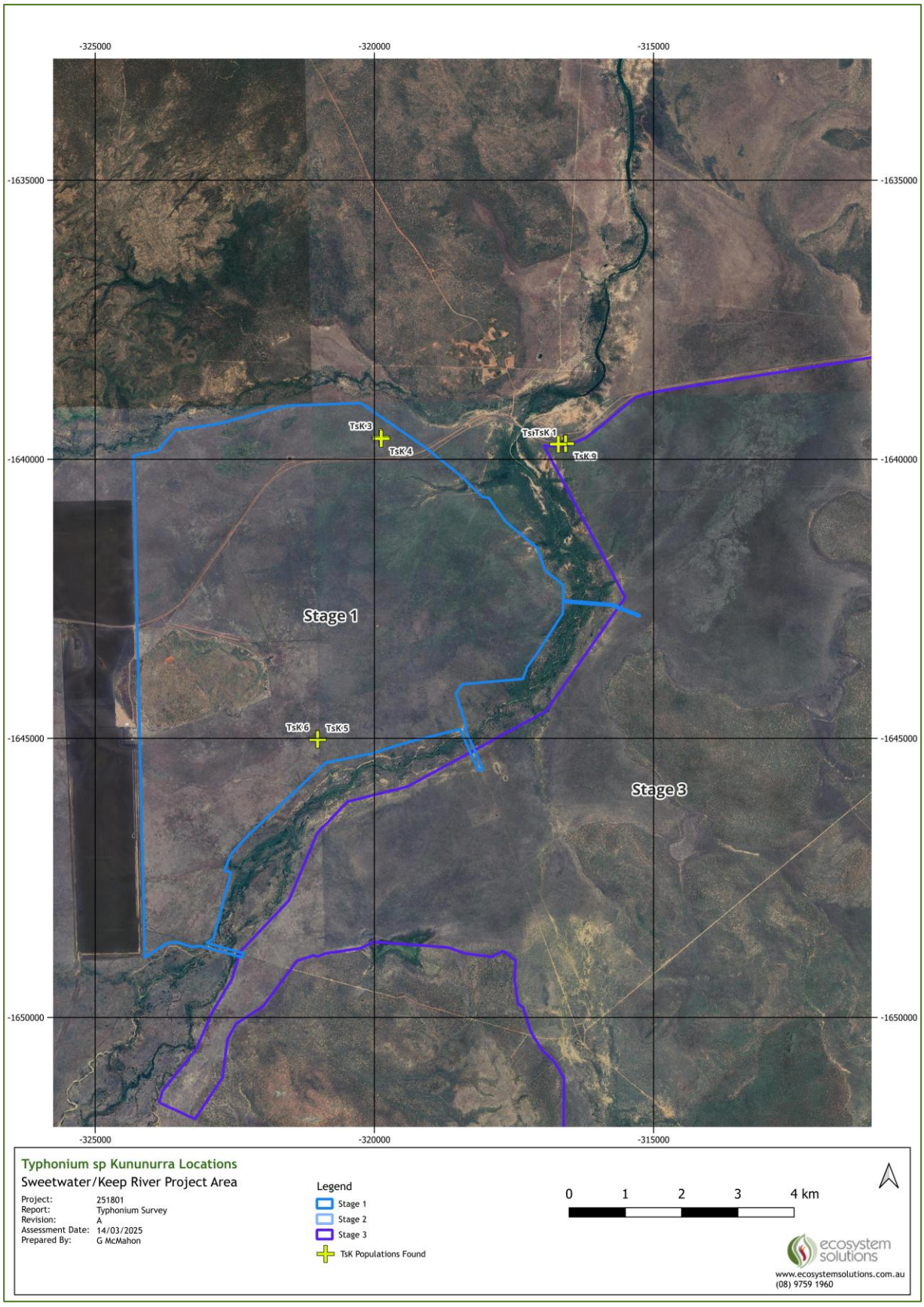

Figure 15: Typhonium sp Kununurra Locations Overview

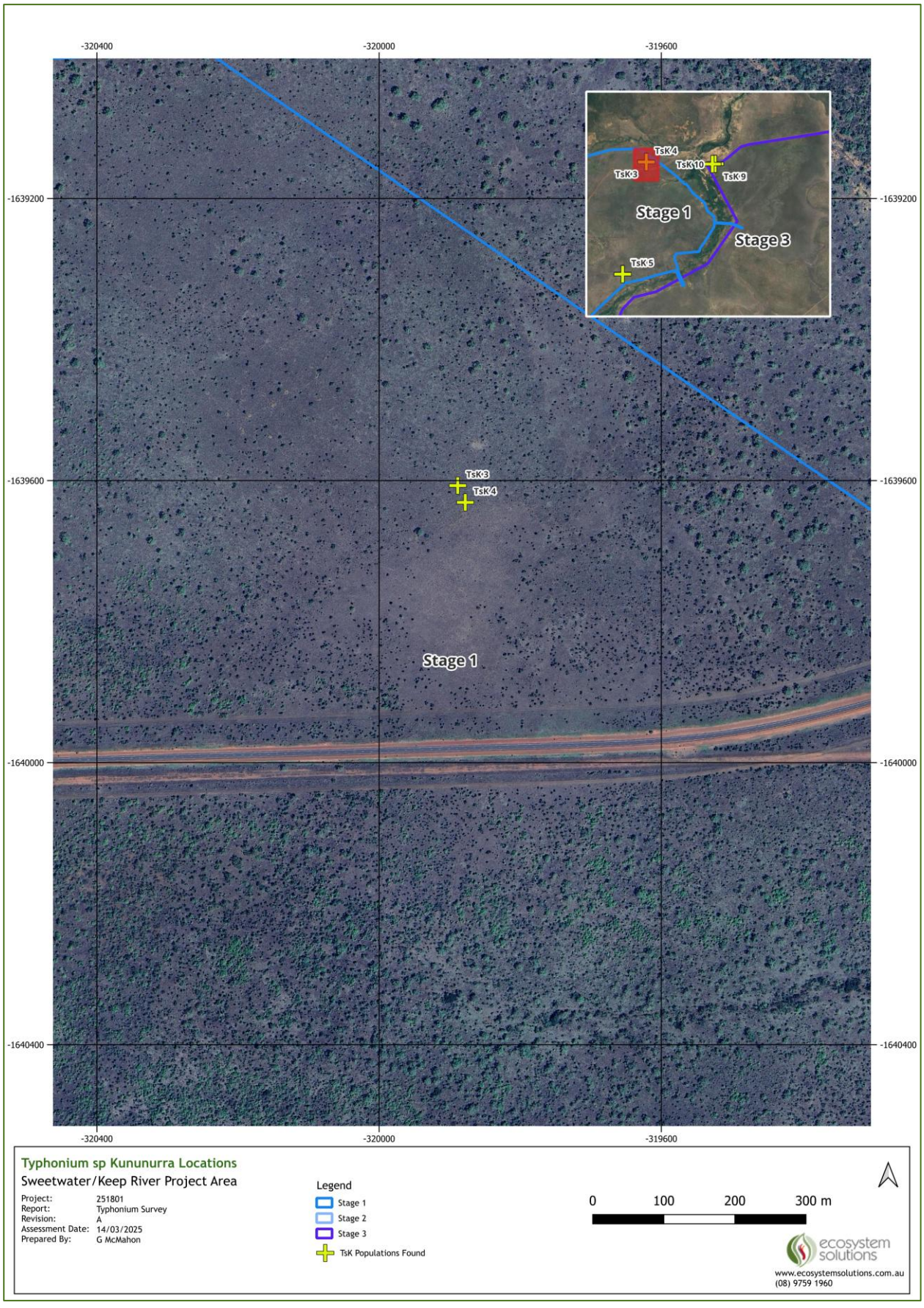

Figure 16: Typhonium sp Kununurra Locations Enlarged Map A

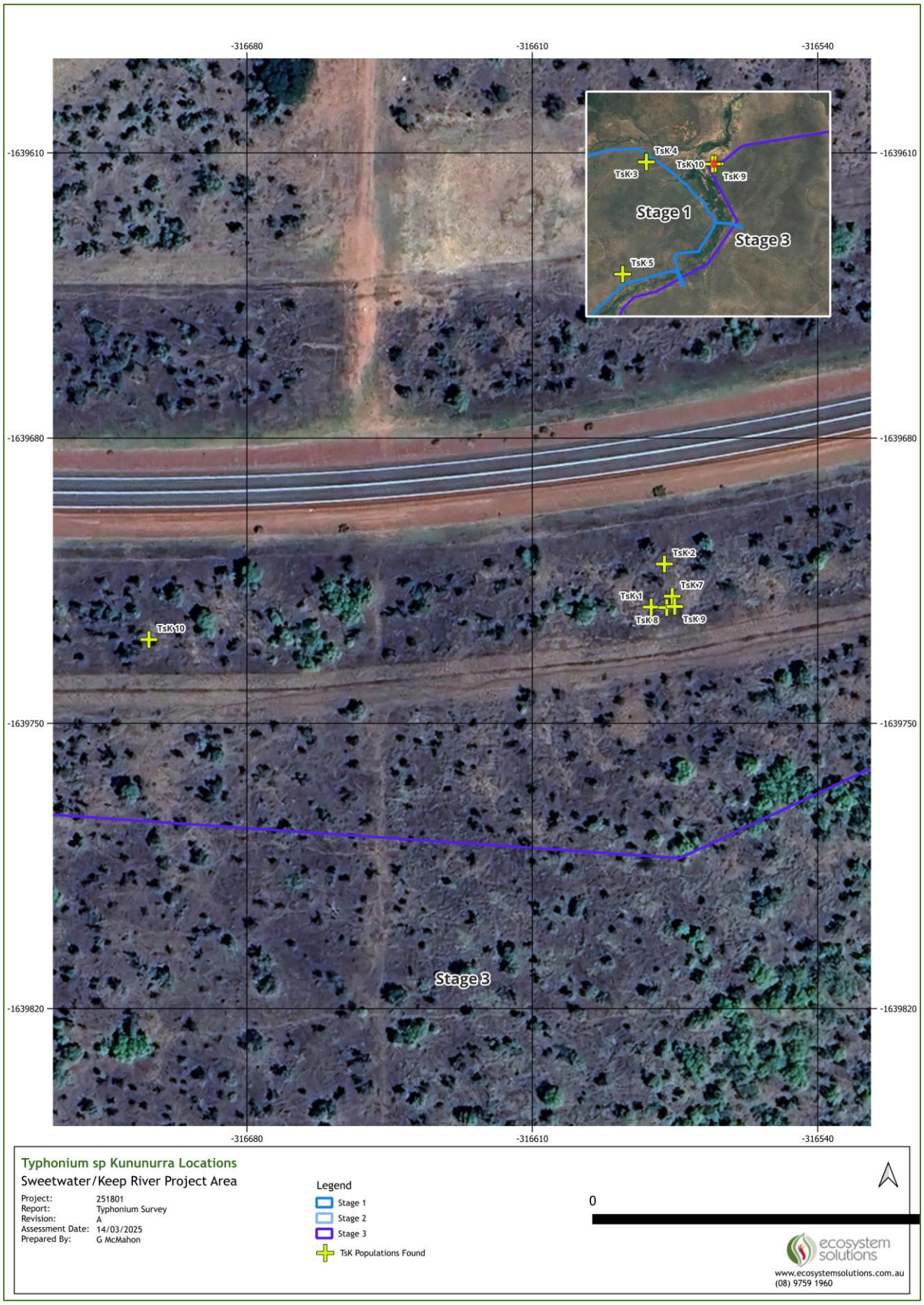

Figure 17: Typhonium sp Kununurra Locations Enlarged Map B

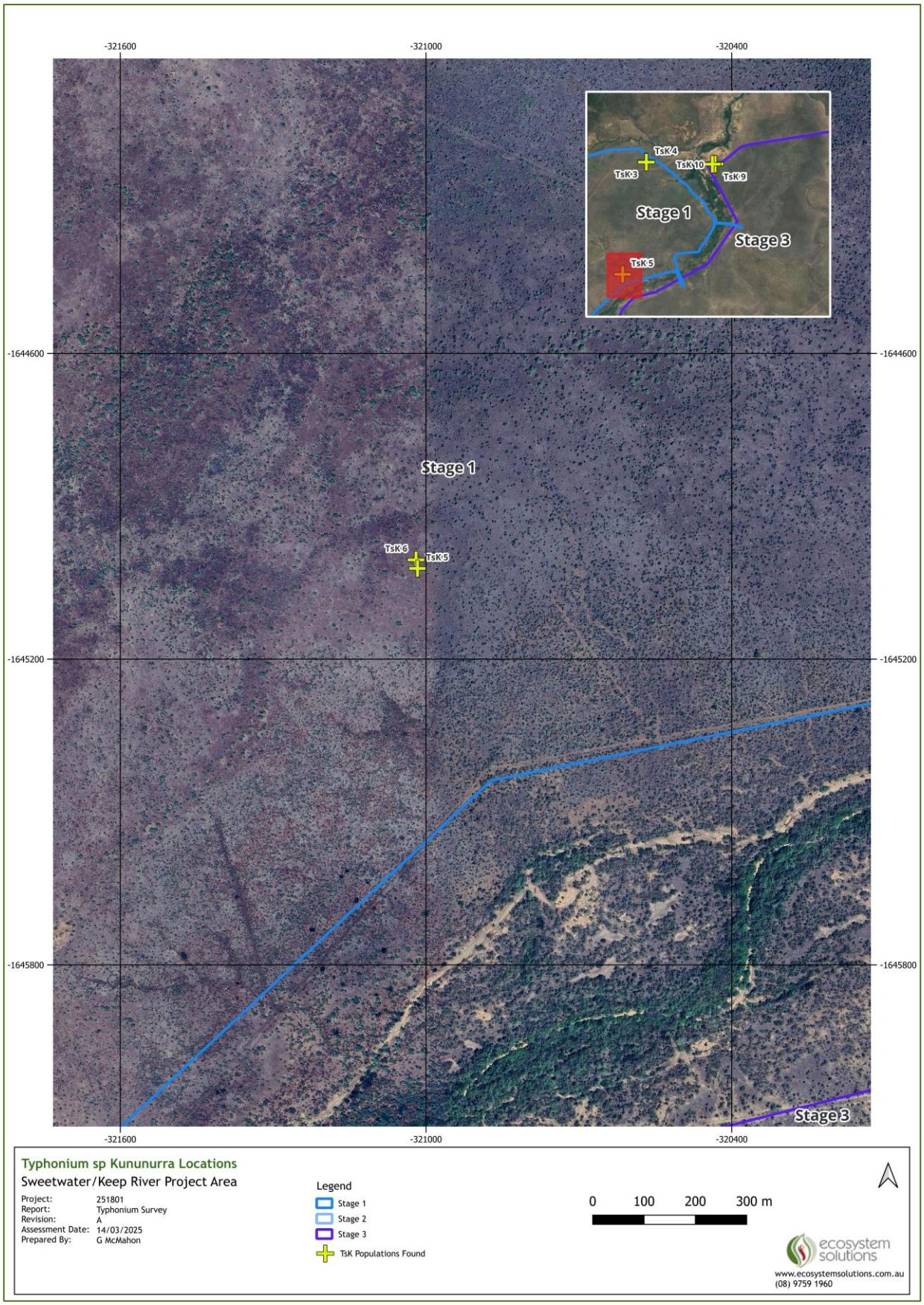

Figure 18: Typhonium sp Kununurra Locations Enlarged Map C

6 Discussion

Ten *Typhonium sp* Kununurra plants were located during the surveys. They were all found on grey vertosol/black soils of the Cununurra and Aquitane clays of the Ord River Plain, as outlined by Start (2017). (Table 2 & Figure 19).

The NT Government soil data sets also reinforce that the vertosols associations appear to support the TsK species (Figure 20) This also aligns with the data found in Umweld in 2021.

This confirms that TsK is present within the Sweetwater/Keep River expansion area in the same soil types as previously found in other surveys within Western Australia (Umweld, 2021).

Extrapolating this results across the site for Stages 1, 2 and 3, we would expect to find Tsk across the Cununurra and Aquitane vertosols of the site (11,504 hectares across Stages 1, 2 and 3 shown in yellow in Figure 21). The surrounding soil types (shown in Orange in Figure 21) would have less potential for TsK (587 ha) and the remaining soil types, including the larger areas to the east within Stage 3 (Red in Figure 21) would have no or minimal potential for TsK (15,049 ha).

This change to the eastern section was observed from the helicopter during the survey, with significant changes to the soil type and colour being evident during the fly overs. This appears to be supported by the NT soil data mapping.

Table 3 summarises the soil analysis. Note that these numbers were calculated from a mixture of GIS data sources (point and polygons) from different stakeholders, therefore these figures are indicative only and reflect the accuracy of the data provided.

Table 3: TsK Likelihood by Soil Type.

Stage	Higher Likelihood	Moderate-Low Likelihood	Unlikely
1	4,054 ha (90% of area)	167 ha (4% of area)	303 ha (6% of area)
2	1,620 ha (55% of area)	211 ha (7% of area)	1,120 ha (38% of area)
3	5,830 ha (30% of area)	209 ha (1% of area)	13,262 ha (69% of area)

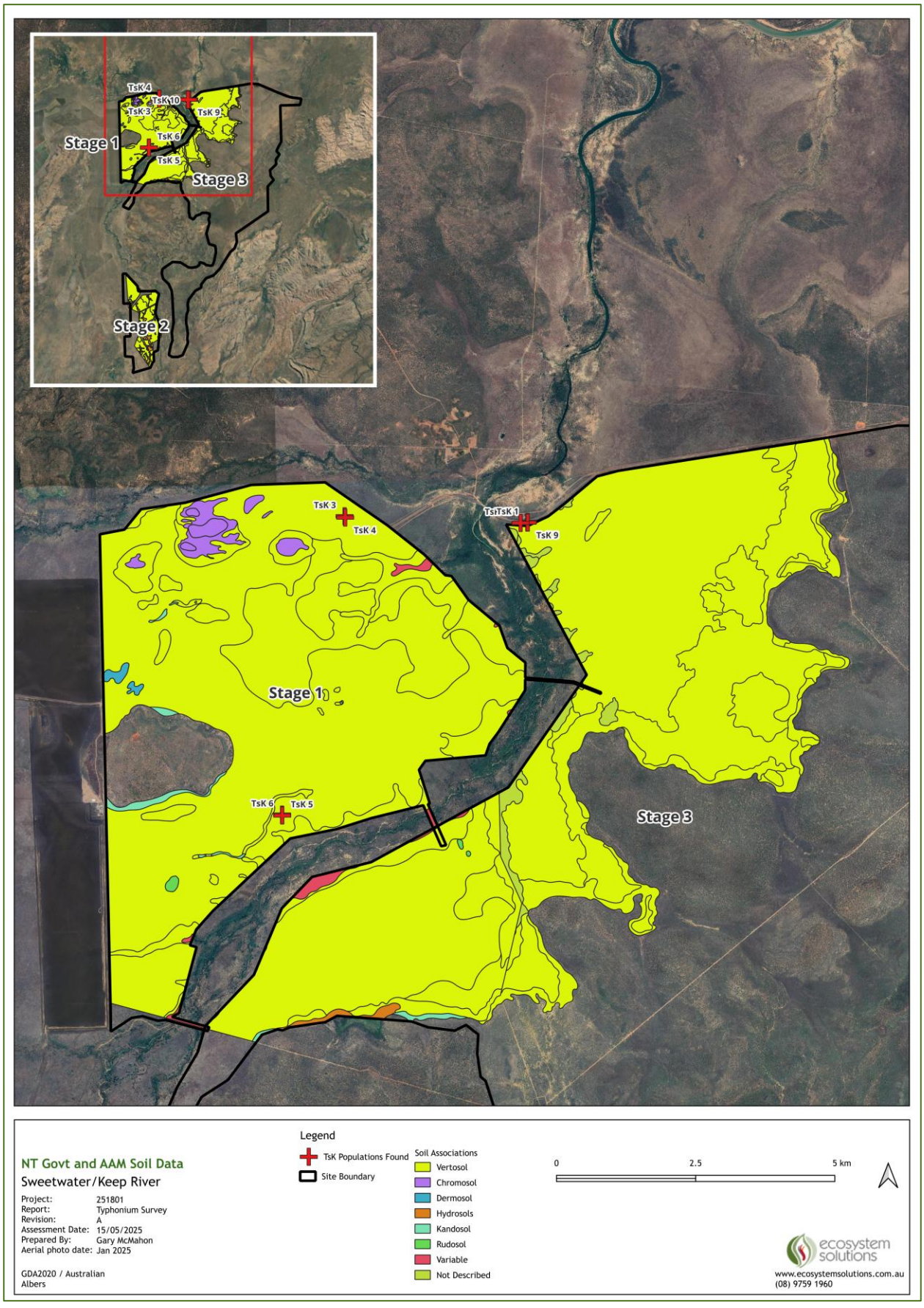

Figure 19: Soil Association and TsK populations found

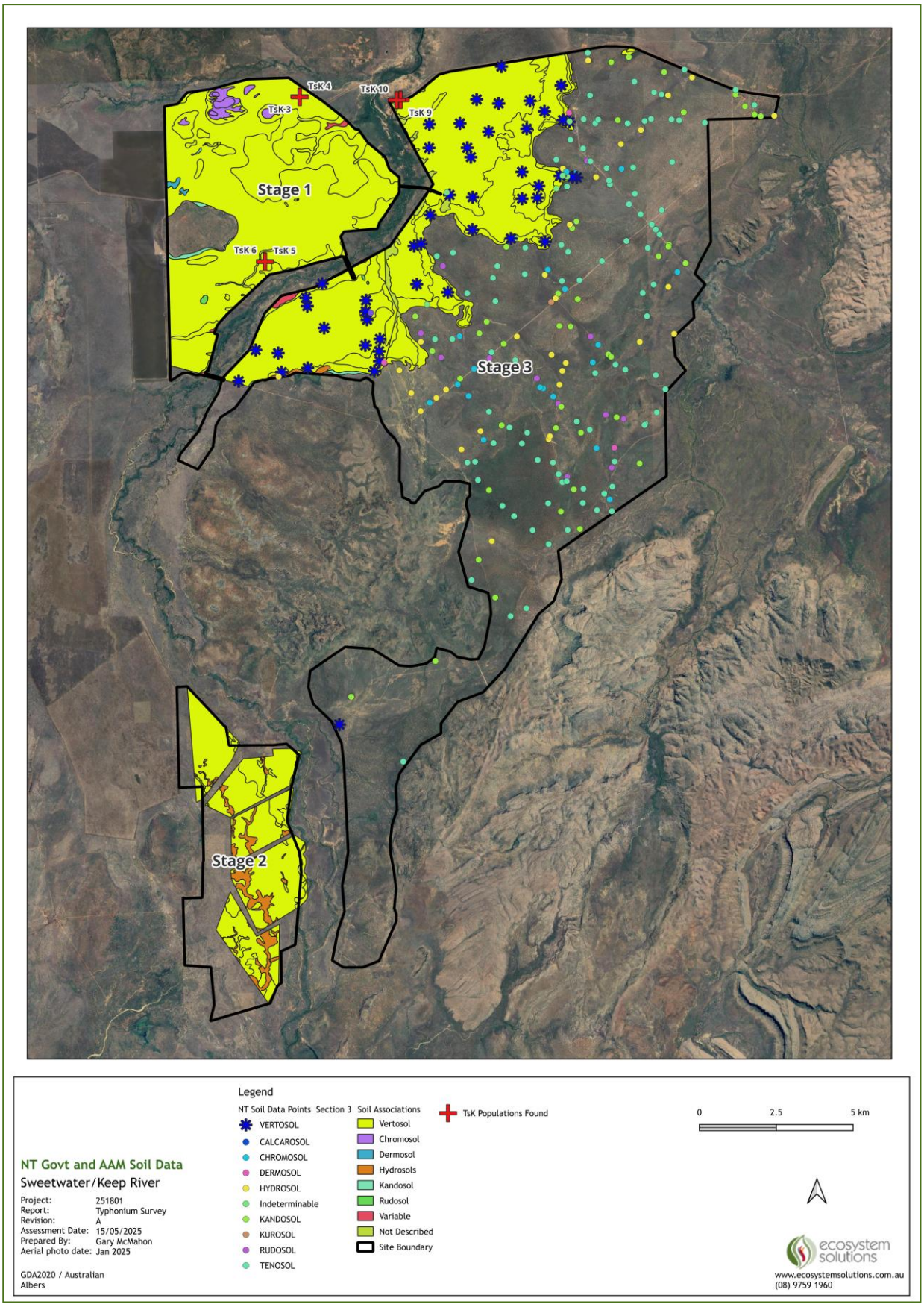

Figure 20: NT Data points (note Vertosols are highlighted with the blue asterix).

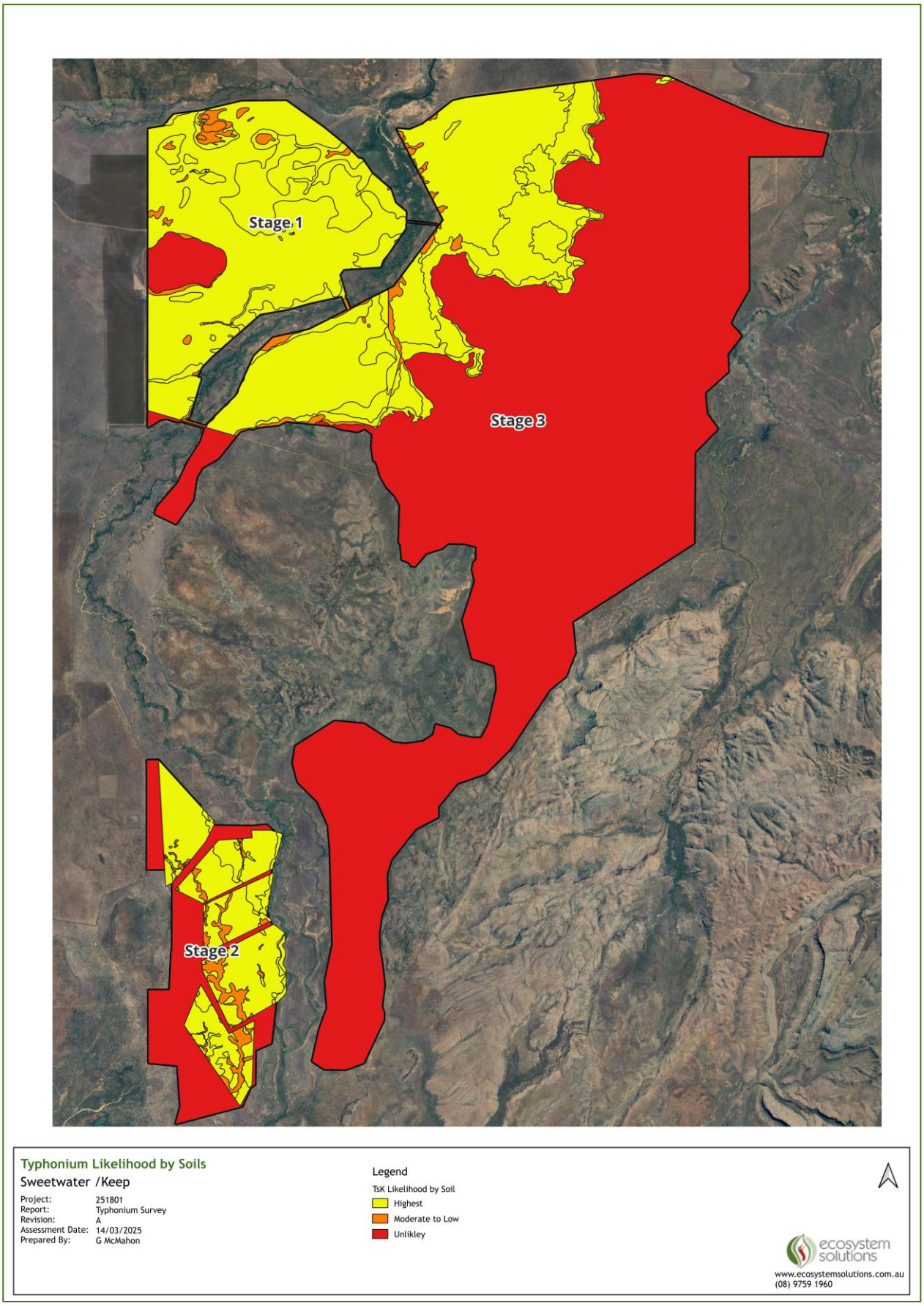

Figure 21: TsK Likelihood by Soils

It is acknowledged that due to the levels of standing water during the survey period, that a full detailed survey of the entire proposed NT site could not be conducted, there was significant survey effort to confirm the species presence within the locations

The numbers/density found were significantly less than that found in the adjoining Knox property in 2021 (Umwelt, 2021) and while this project's aim was to determine if *Typhonium* sp Kununurra was present within the site and hence did require the same survey effort as the Knox project, the number of plants located was less that would have been expected given similar soil types and vegetation associations.

Additional surveys for TsK were conducted in February 2025 in the WA section of the Knox and adjoining landscapes by DPIRD and other staff. They found similarly low numbers compared to previous years (H O'Dwyer pers comm).

There are a number of likely explanations for this result.

Firstly, there was a significant rainfall event in the area in late November-(102 mm falling between 21-30 November) and December 2024 (Figure 21). if using an approximately 200mm of rainfall as an emergent trigger as stated by Start (2017), then this would have been achieved by the 12th December 2024 (Commonwealth of Australia, 2025).

It is therefore highly likely that the species main emergent period started by late December 2024 and therefore had completed by the time of this survey. Those plants found could potentially be a secondary emergence. Given that the plants found had wilted within 22 days of our observations, any mature plants could have senesced by February and not be found if they had emerged and matured in December 2024.

Secondly, Start (2017) had stated that not all plants emerge every year. Detailed ecological knowledge of this species is unknown (albeit surveys and information are continually being obtained by WA DPIRD and other staff for the WA populations). The low numbers found may be an element of a natural variation in emergence of the species.

Lastly, and this is speculative only, but it was noticed that the water south of the Legune Road, remained in situ for a significant time during the survey. This was observed in the walked transects and the helicopter journeys to survey sites south of the roadway. Walking to the north of the road, was much easier and less wet and muddy overall, particularly the more eastern areas in the proposed Stage 3, than those areas to the south, The landscape is relatively flat, and the heavy soils would result in the water not flowing off rapidly. This is despite several culverts in the roadway and the Keep River itself. The road is elevated and does provide an artificial barrier for natural drainage and run off for water downstream to the ocean. While the full biology and ecology of TsK is unknown, the depth of water that remained on the site south of the road may be inhibiting emergence, or if emergence is occurring the water depth is too great for leaves to be observed. Similarly, the change of hydrological dynamics on the landscape may be altering the natural or previously observed live cycle of the species.

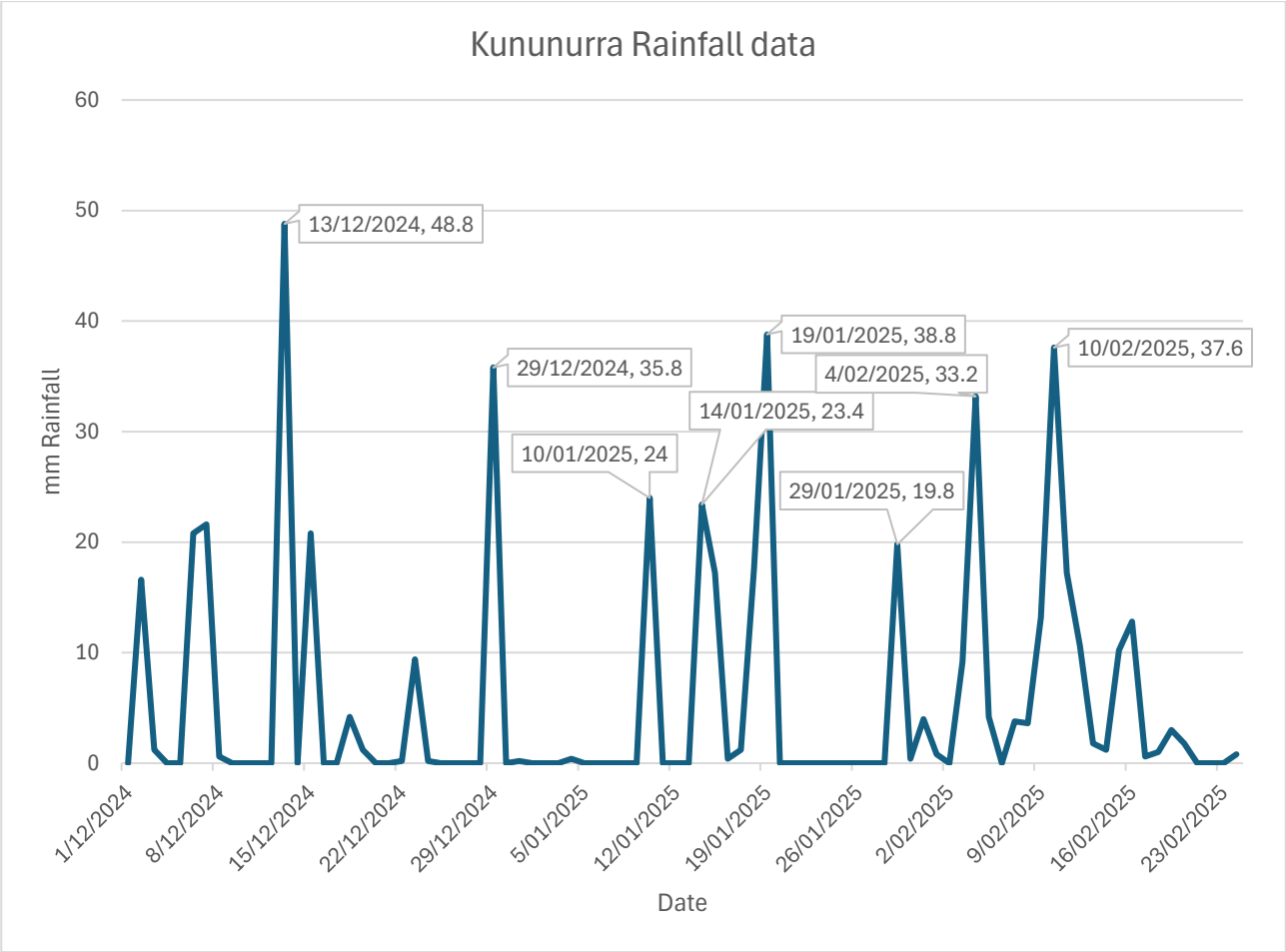

Figure 22: Rainfall Data for Kununurra Dec 2024 - Feb 2025

In summary, this survey's aim was to determine if TsK was present within the NT side of the proposed expansion area. The results confirmed that TsK does exist within the proposed extension area and would appear to be more likely in those areas with grey vertosol/black soils of the Cununurra and Aquitane clays. The abundance and density of the species could not be determined from this level survey and more detailed targeted surveys over a number of years would be required to provide that level of information. This will allow more analysis on annual variations and the interaction between the landscape hydrology and population density.

7 References

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