Photo 235

Photo 236

Photo 237

11 | Investigation Area 2

11.1 Drainage Issues

The drainage network in IA2 is within a research facility of the University of Western Sydney and drains into an unnamed creek which flows south into Rickabys Creek (Figure 89). After crossing a high voltage transmission line easement the creek drops steeply through bushland and there did not appear to be anything inhibiting the flow through this part of the creek (Photo 238).

The locations of each photograph referred to in the text can be found in Figure 90.

11.1.1 Field observations

Within the investigation area the terrain is quite flat and sits at an elevation of between 5m and 20m AHD with the section of drain which was investigated during the field work (highlighted in Figure 89) being in terrain no lower than 14m AHD. This meant that it only partly flooded during March and that flooding would have been relatively shallow and of shorter duration compared to other parts of the floodplain. While there were some minor drainage obstructions and locations where the drains need maintenance, there was no obvious damage to infrastructure or pastures due to long term inundation.

Two dams on the site (Photo 239 and Photo 240) were full and were controlling the water levels in the drains upstream of them. However, the following observations were made of possible improvements to the drainage system.

A pipe under an access track appears to be only about 300mm in diameter (Photo 241) and has a capacity much less than the channel. This would be a significant constriction to flow when the channel is more than half full.

A long length of channel is choked with vegetation (Photo 242) which would slow flow through this reach. However, the vegetation has the advantage of removing nutrients from the runoff from the surrounding paddocks which were stocked with cattle. Periodic partial removal of the vegetation would probably be best compromise between water quality improvement and drainage efficiency.

There is some accumulation of sediment and debris in the channel upstream of the culverts running under the transmission line access road (Photo 243). These should be removed to prevent further accumulation causing significant blockage of flow which could in turn lead to overtopping and erosion of the access road.

There appears to have been some minor sedimentation and vegetation growth within the channel at few locations (Photo 244 and Photo 245) which is creating minor restrictions to flow in low flow conditions. It appears this may have been caused by some minor bank slumping causing sediment to fall into the drain. These should be monitored and, should the constrictions increase, removal of the vegetation and sediment and stabilisation of the banks should take place.

There are a few locations where cattle have been crossing the drainage channel and this has pushed sediment into the base of the channel (Photo 246, Photo 247 and Photo 248). While this constricts flow local under low flow conditions, the channel is so deep at these locations that it would not have an impact on the drainage of the surrounding farmland.

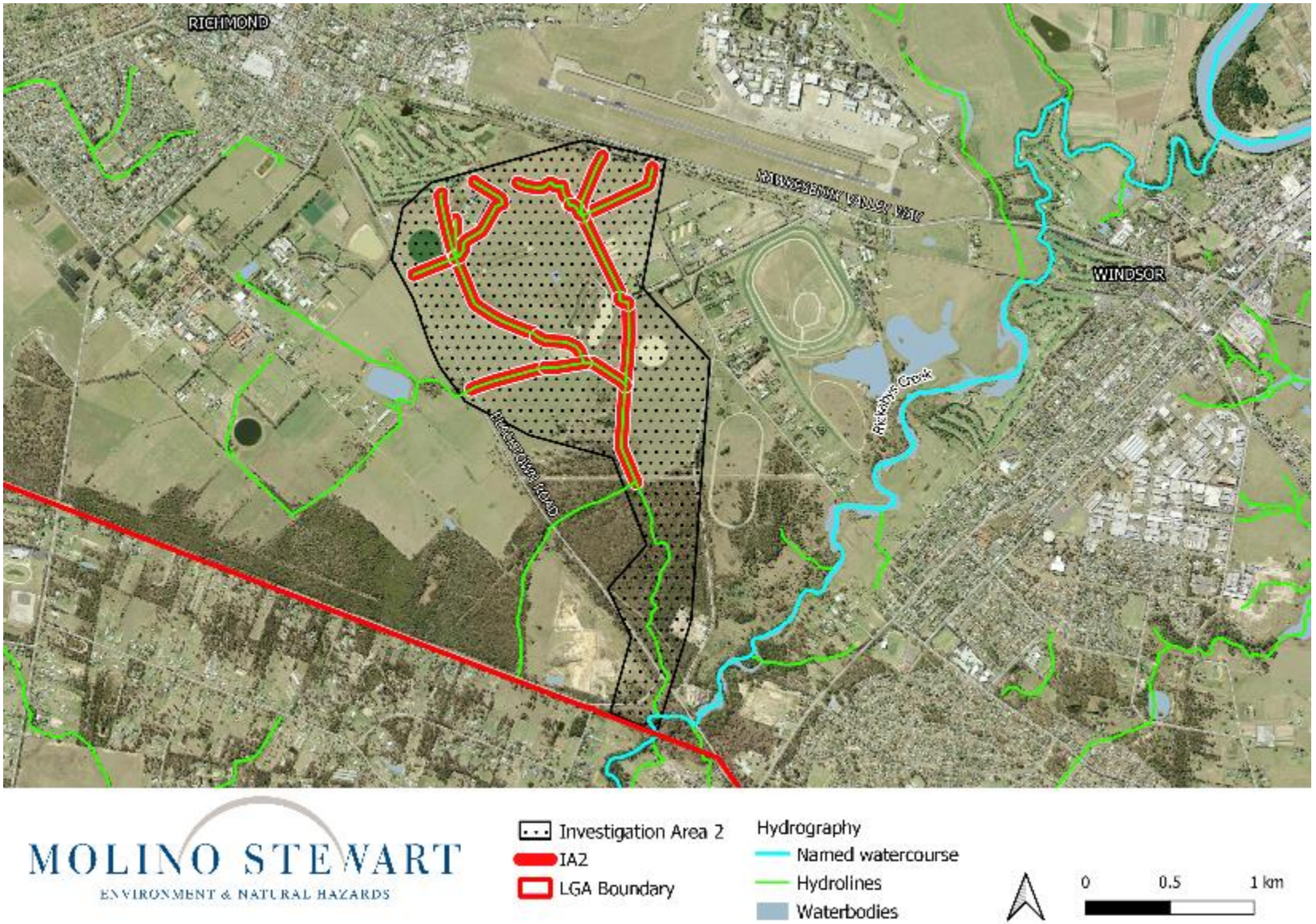


Figure 89: Investigation Area 2 Drainage Route (IA2)

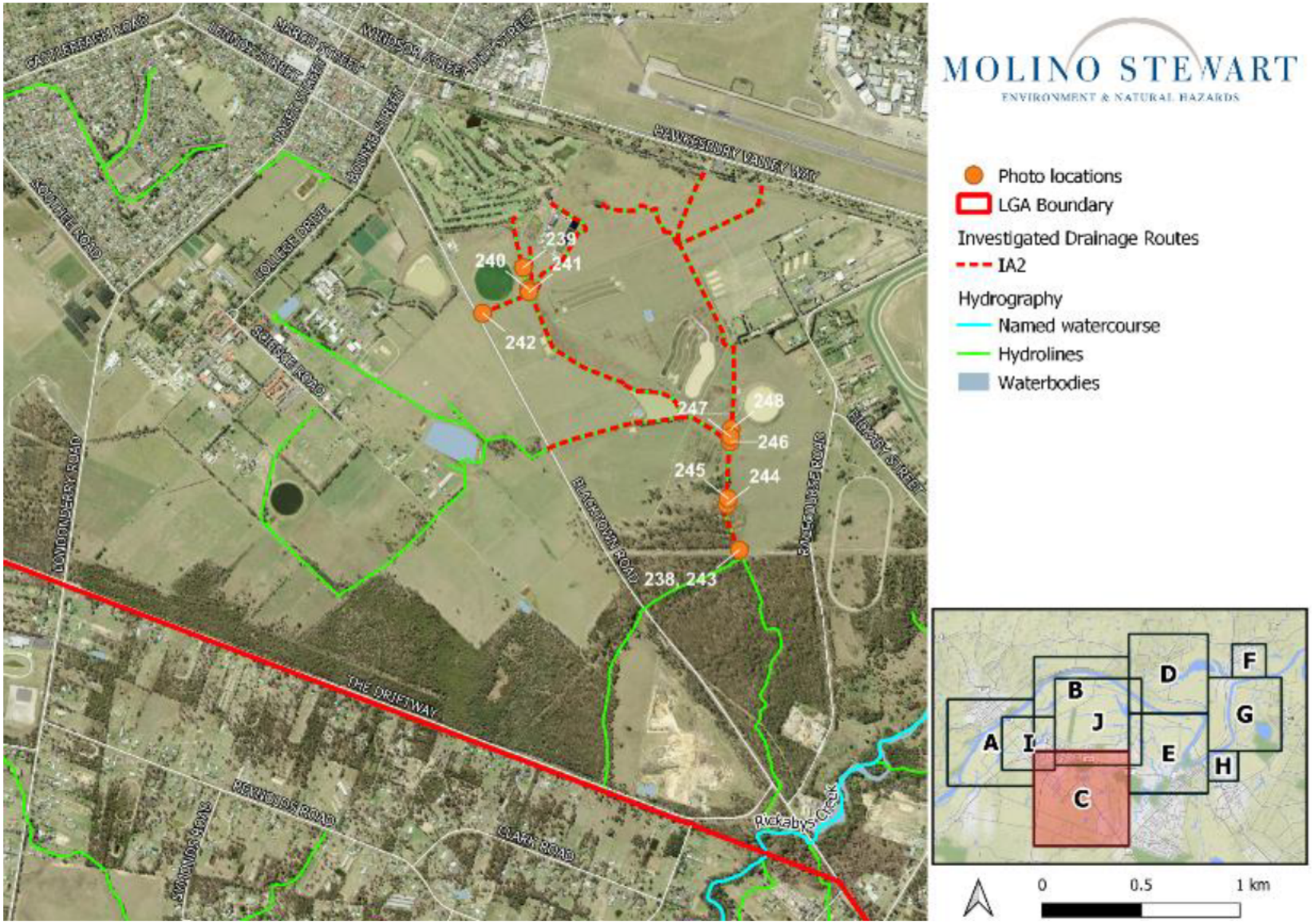


Figure 90: Photo locations for IA2

Photo 238

Photo 239

Photo 240

Photo 241

Photo 242

Photo 243

Photo 244

Photo 245

Photo 246

Photo 247

Photo 248

11.1.2 Probable Causes

Blockage of the culverts under the road at the downstream end of IA2 could cause the water in the channel to build up and overflow the road, causing erosion of the road. Where there was some blockage of the pipes with silt and debris, there was no evidence that recent flooding had caused the road to be overtopped and damaged by flooding.

Similarly, the locations where the slumping of channel banks and bank degradation by cattle crossing had caused ponding in the channel, there was no evidence that this had inhibited the drainage of the surrounding paddocks to the extent that additional damage had occurred.

11.1.3 Possible Solutions

Regular inspection and clearing of the culverts will prevent overtopping of the access road. It is possible that the access track and the culverts under it are the responsibility of the owners of the transmission line and the holders of the easement. This should be investigated to determine who is responsible for keep the culverts and the drain immediately upstream of them clear of debris.

Intervention at other locations within the drainage system is not warranted at this stage.

Possible solutions for IA2 are shown in Figure 91.

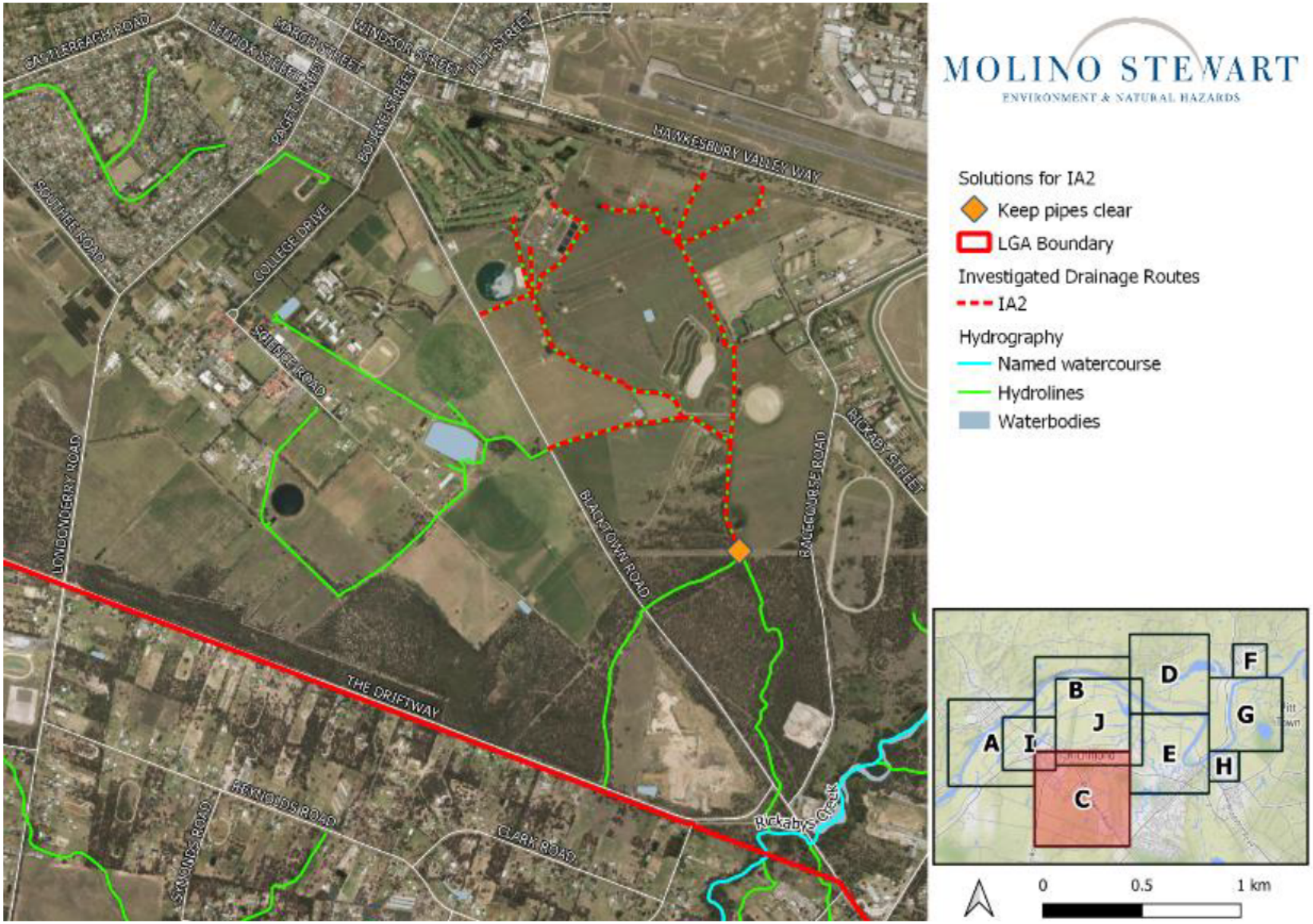


Figure 91: Solutions for IA2

11.2 Environmental Constraints

While no works other than clearing of debris from some culverts is suggested for Investigation Area 2, the following environmental constraints are noted should it be proposed to remediate the creek banks.

a) Zoning

The drainage network in Investigation Area 2 traverses land zoned as SP1 – Special Activities (Figure 92) and is identified as having the purpose of 'Education, Agriculture, and Research Station'. For land zoned as SP1 maintenance of existing drainage channels is permissible without consent, reinstatement/rectification works are prohibited, unless carried out by, or on behalf of, a public authority in which case they are permissible without consent.

b) Contamination

There is a single EPA contaminated land record of notice in the vicinity of the Investigation Area 2 drainage network at Western Sydney University Hawkesbury Campus (Figure 4). This contaminated site is currently under assessment by the EPA though the extent of the contamination is not provided on the EPA record of notices. This contaminated site need only be investigated further if excavations in its vicinity are required for any drainage improvement works.

The upper reaches of IA2 are within the off-site PFAS Management Area for Richmond RAAF Base (Figure 93). At this point no works are suggested within the management area, but if this were to change those works would require consultation with the Department of Defence prior to commencing any works.

c) Acid Sulphate Soils

The entire Investigation Area 2 drainage network is surrounded by class 5 land on the HLEP Acid Sulphate Soils Map (Figure 94).

According to the HLEP 2012 Part 6.1, development consent in Class 5 land is required for works within 500 m of adjacent Class 1, 2, 3 or 4 land that is below 5 m Australian Height Datum and by which the watertable is likely to be lowered below 1 m Australian Height Datum on adjacent Class 1, 2, 3 or 4 land. Development consent cannot be granted unless an ASS management plan has been prepared for the proposed works in accordance with the ASS Manual.

However, development consent is not required if the works involve the disturbance of less than 1 tonne of soil or are not likely to lower the water table (*HLEP 2012* Part 6.1 (6)); if a preliminary assessment (prepared in accordance with the ASS Manual) indicates that an ASS management plan is not required (*HLEP 2012* Part 6.1 (4)); or if works are conducted by a public authority and are either emergency work or routine maintenance work as described in the HLEP Part 6.1 (5).

Bank remediation works would not be close enough to other classes of ASS nor would they lower the water table so ASS considerations would not be a constraint.

d) Heritage

i) HLEP Heritage Items

There are no HLEP heritage items in the vicinity of IA2 (Figure 95).

ii) AHIMS Heritage Items

An AHIMS Basic Search of constraints extent C returned 14 Aboriginal Sites. One site appears to be surrounded by IA2 (Figure 96). However, the exact location and nature of Aboriginal sites is not known from a Basic Search. Therefore, for any bank stabilisation works in IA2, a Basic Search of the specific

works extent should be conducted to confirm whether any Aboriginal Sites are nearby. If an initial basic search returns any Aboriginal Sites, an AHIMS Extensive Search is required.

e) Wetlands and Coastal Areas

There are no wetlands or coastal management areas mapped along IA2 (Figure 97).

f) Ecology

i) PCT Mapping

PCT 835 is the only PCT along the IA2 Drainage Network and surrounds the southernmost 400 m (approximately) of drainage channel (Figure 98). Any remediation of bank slumps in this area would need to consider the impacts on vegetation.

ii) Terrestrial Biodiversity

The area of PCT 835 is also mapped as Significant Vegetation (Figure 99) which is a consideration if bank remediation works are proposed along this reach of the drain. This PCT is referrable to Threatened Ecological Communities (TECs) under both the Biodiversity Conservation Act as equivalent to the endangered River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, and the Environment Protection Biodiversity Conservation Act as equivalent to the critically endangered River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

iii) Biodiversity Values

None of IA2 is mapped as 'Biodiversity Value' on the DPE Biodiversity Values Map. The northern ends of IA2 near Hawkesbury Valley Way border a BV mapped area, although no works are expected in this vicinity (Figure 100).

iv) Threatened Species Records

Figure 101 shows that there have been many threatened plant and animal sightings in the vicinity of IA2 but not along any of the drainage network. Nevertheless, given the extensive sightings and the significant vegetation along the lower section of the drain, any bank remediation along this reach should consider potential impacts on threatened species.

v) Key Fish Habitat

While Rickabys Creek is KFH (Figure 102) it does not extend into the drainage network in IA2.

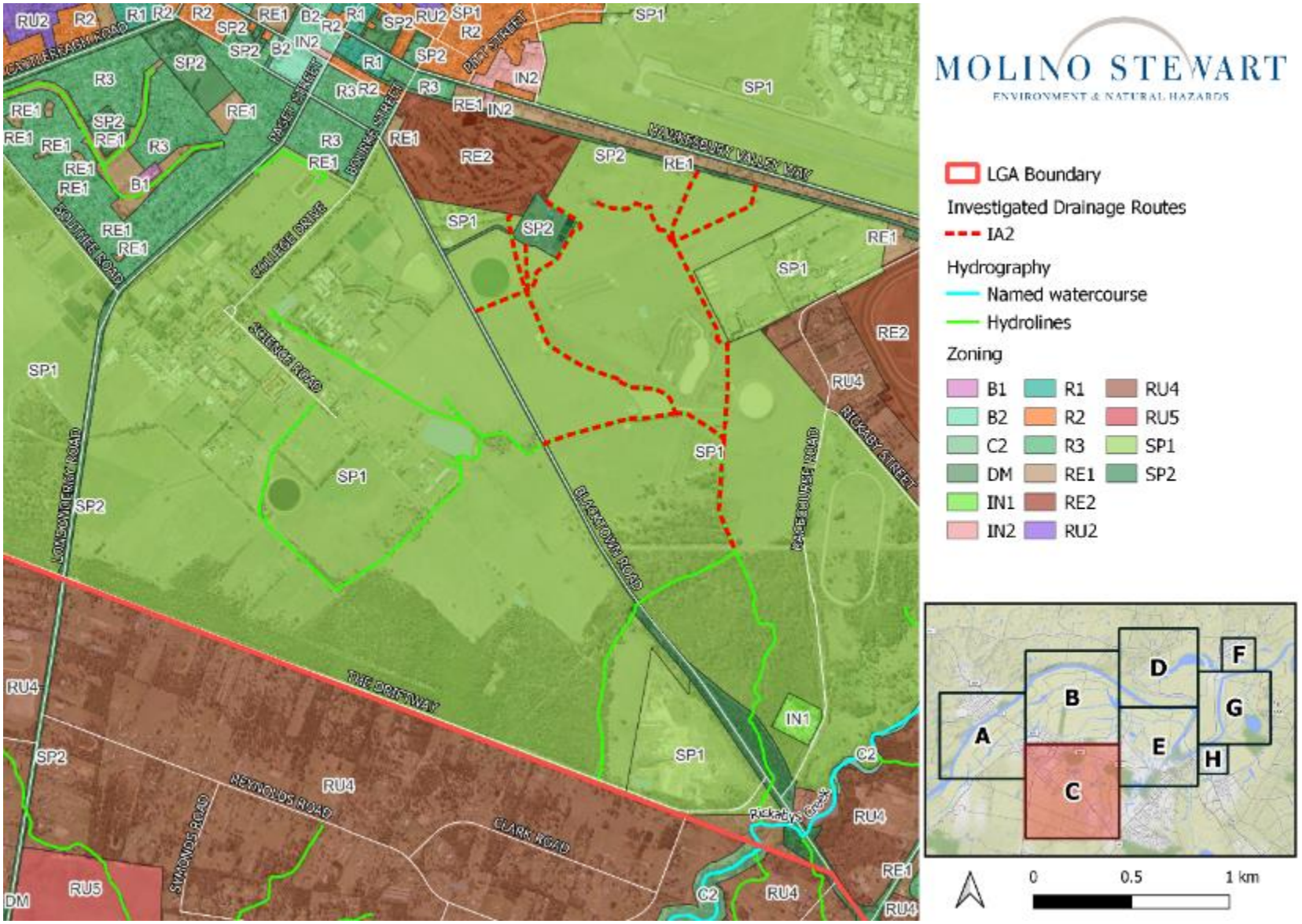


Figure 92: Land zoning (Extent C)

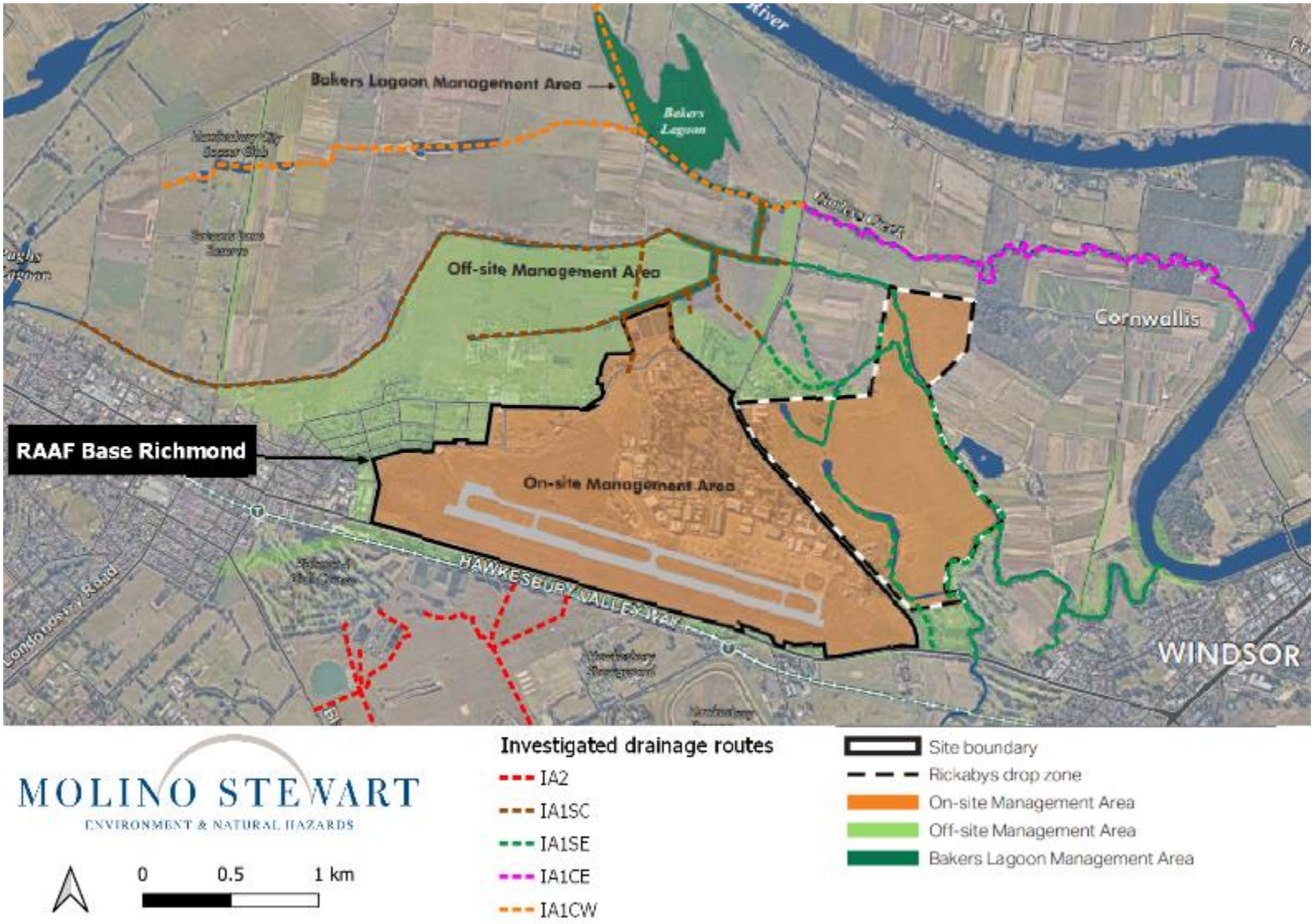


Figure 93: PFAS Mangement Areas

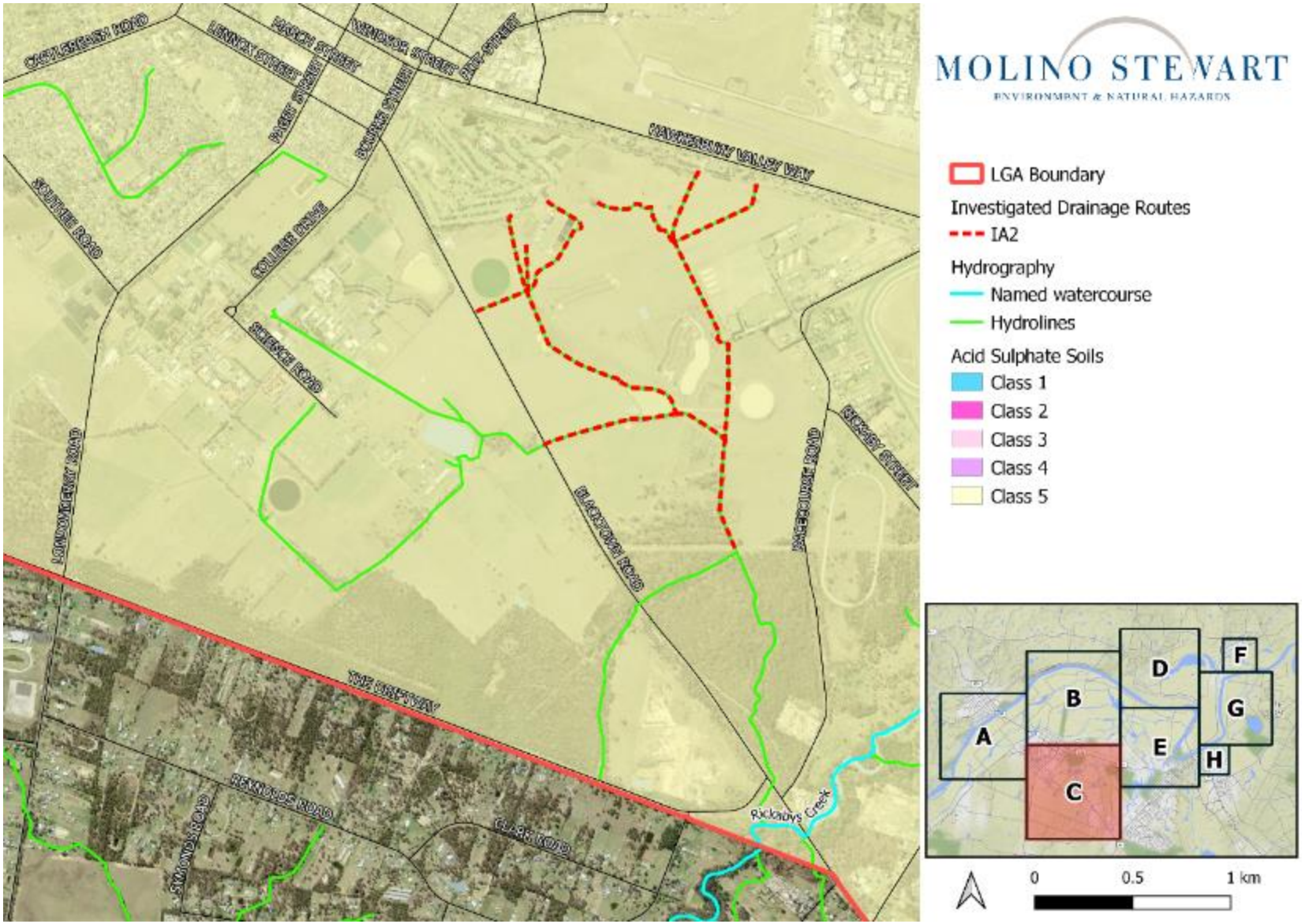


Figure 94: Acid Sulphate Soils (Extent C)

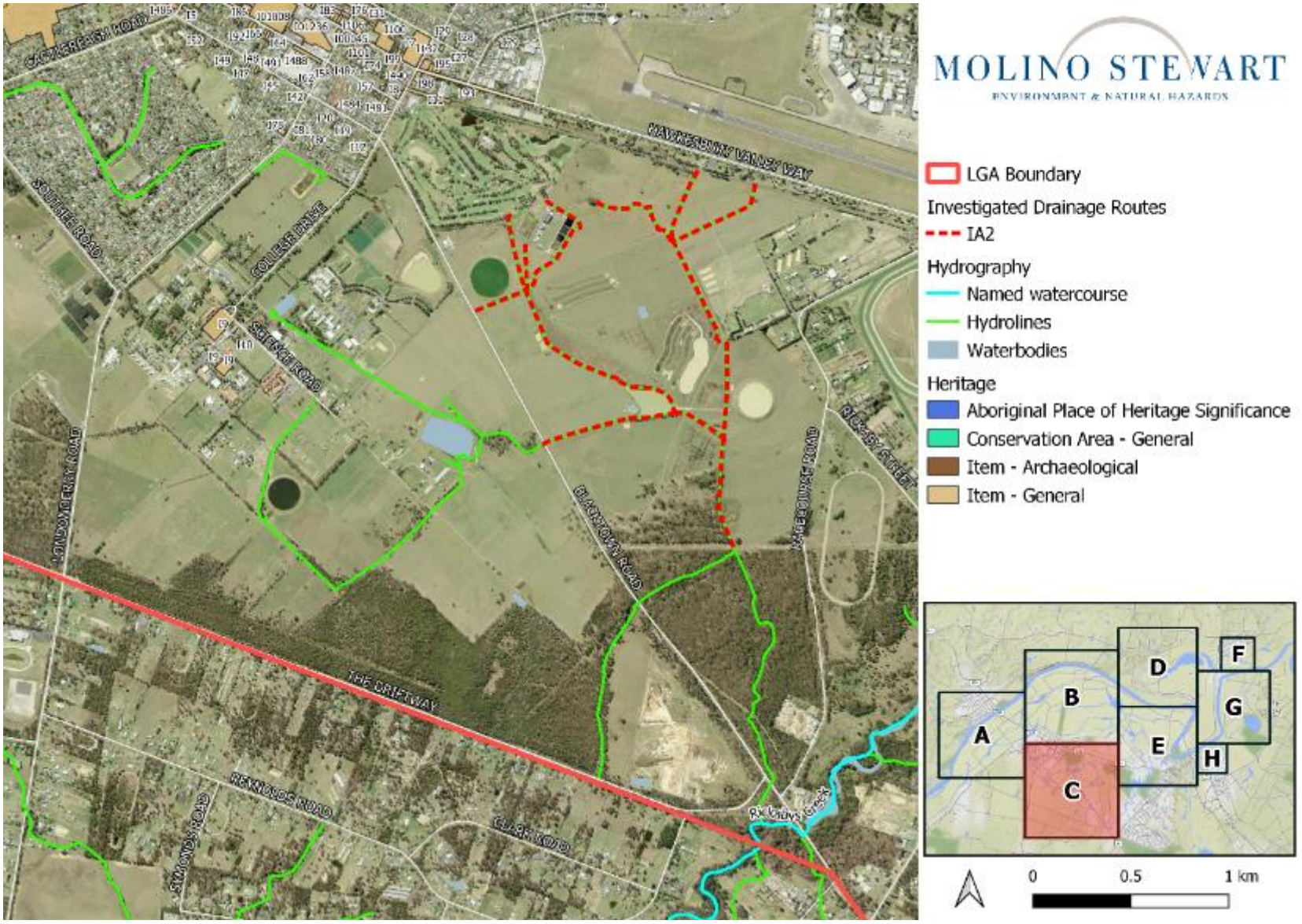


Figure 95: HLEP Heritage Places, Areas and Items (Extent C)

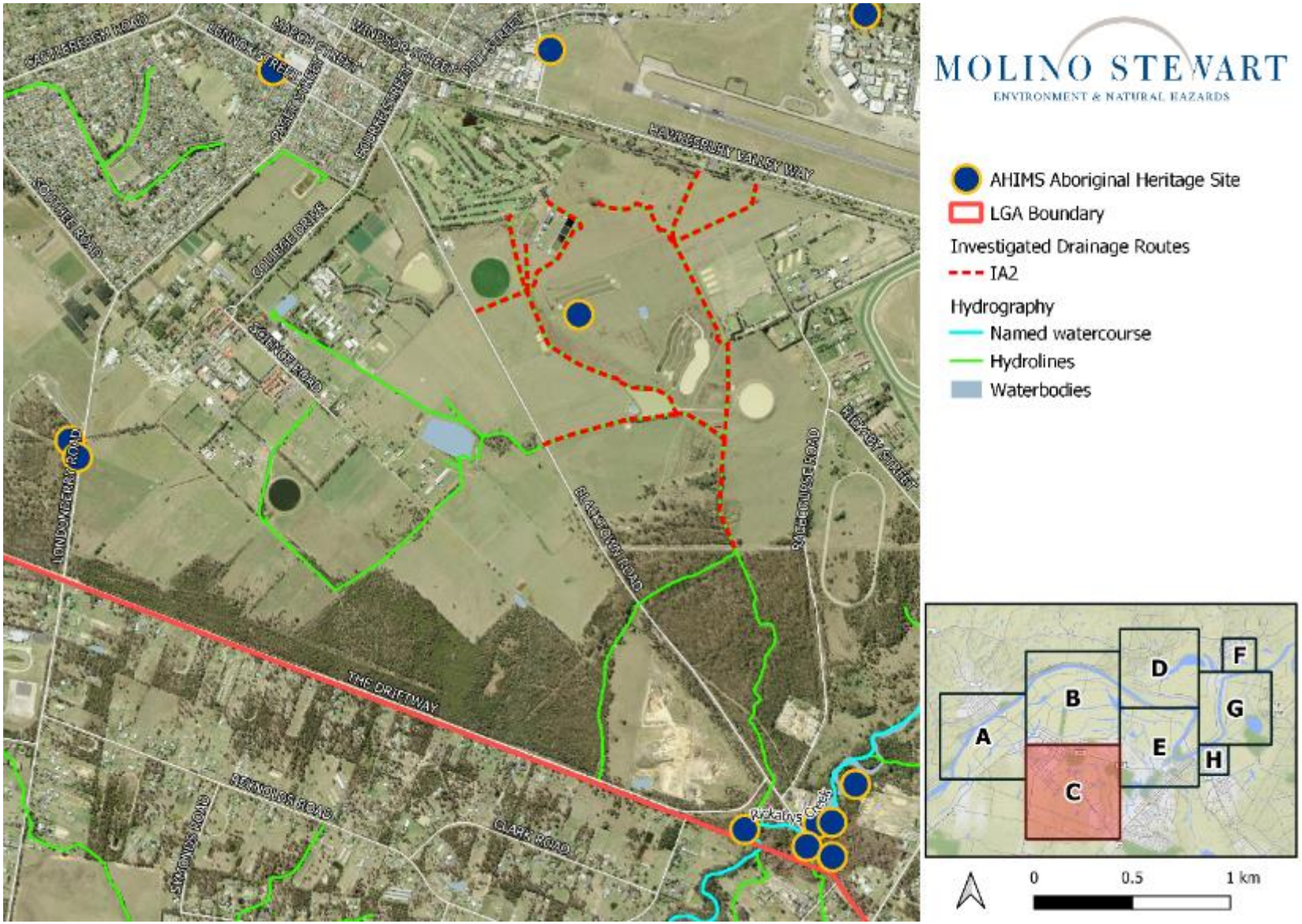


Figure 96: AHIMS Aboriginal Sites (Extent C)

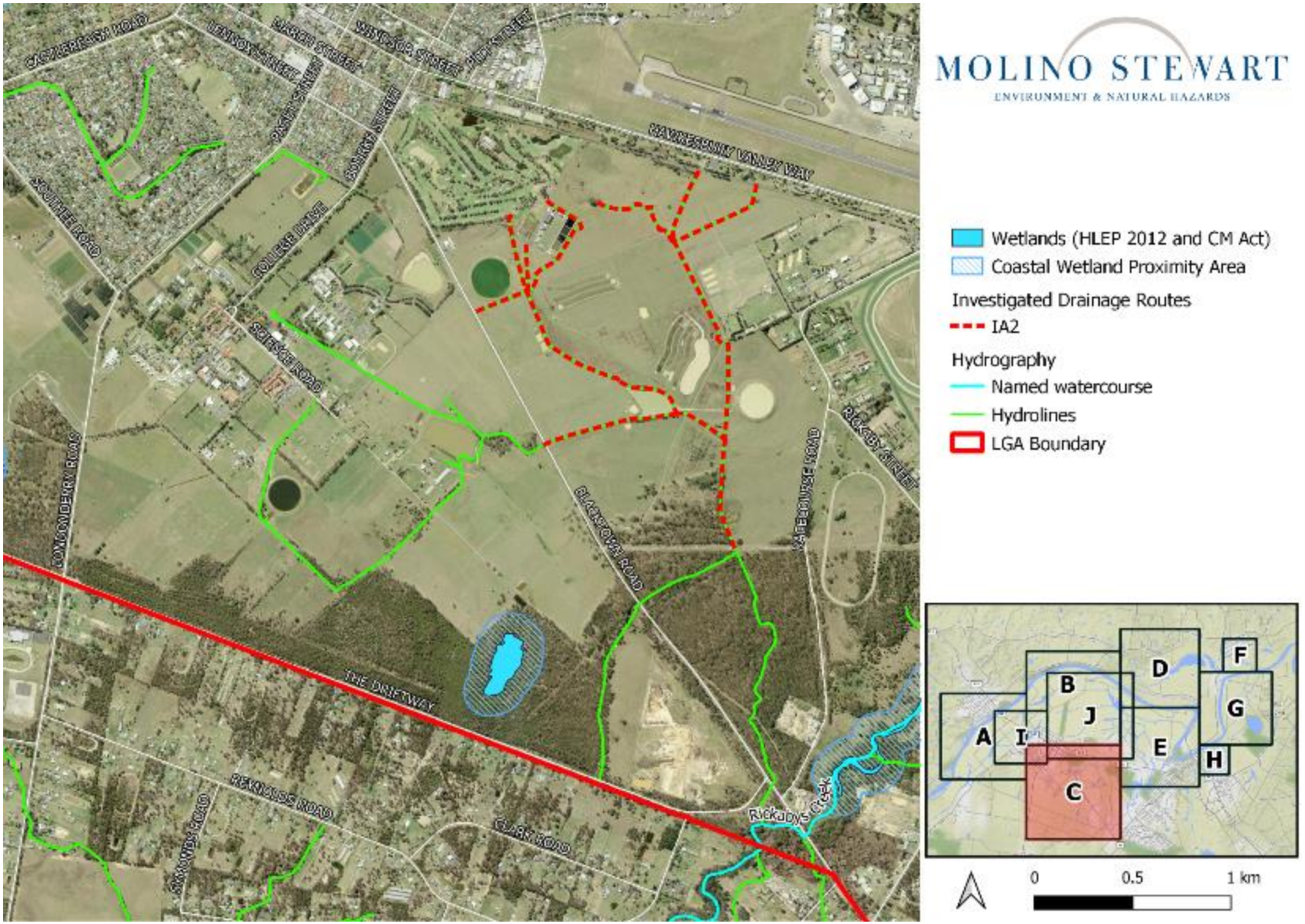


Figure 97: Wetlands (Extent C)

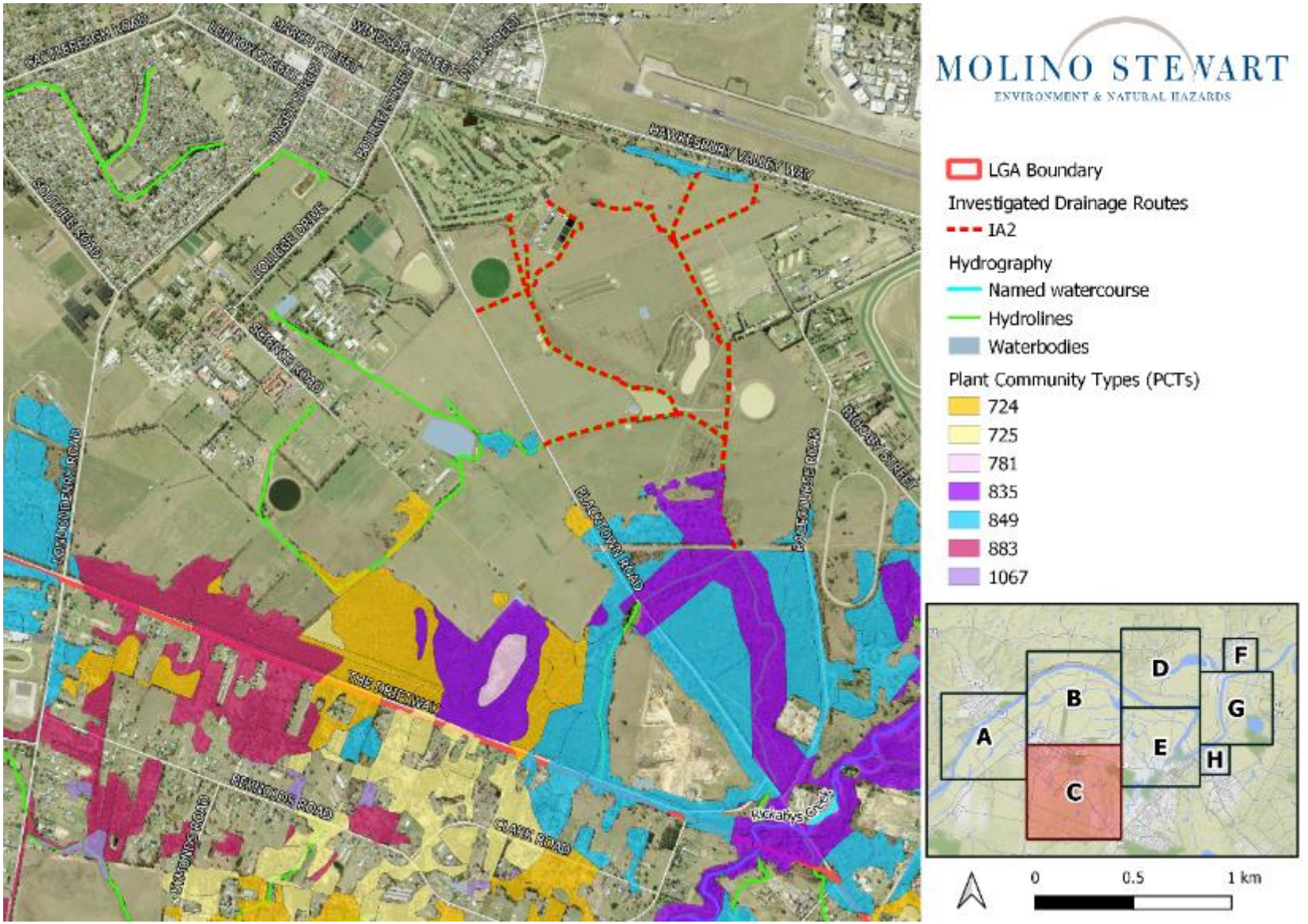


Figure 98: Plant Community Types (Extent C)

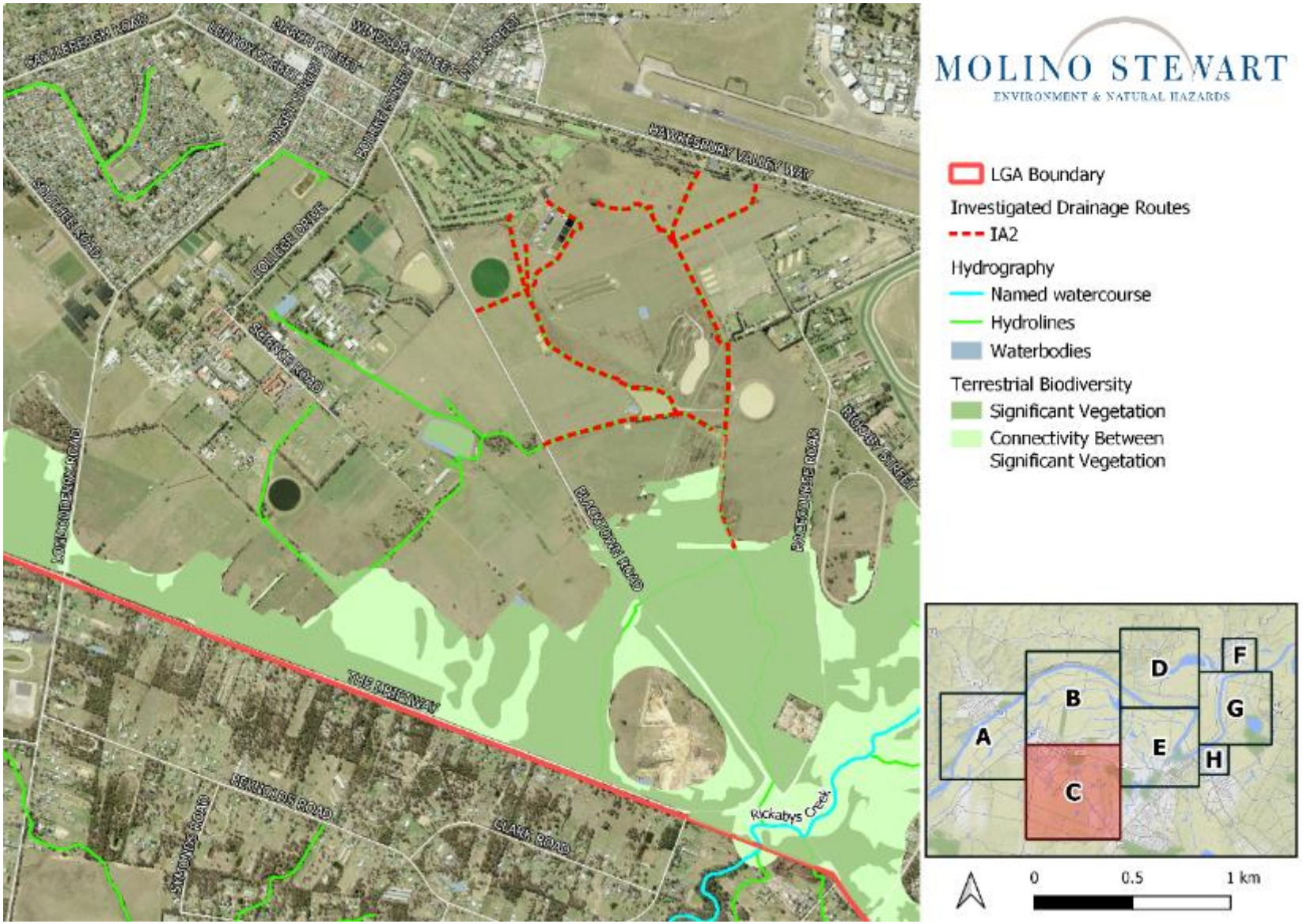


Figure 99: Terrestrial Biodiversity (Extent C)

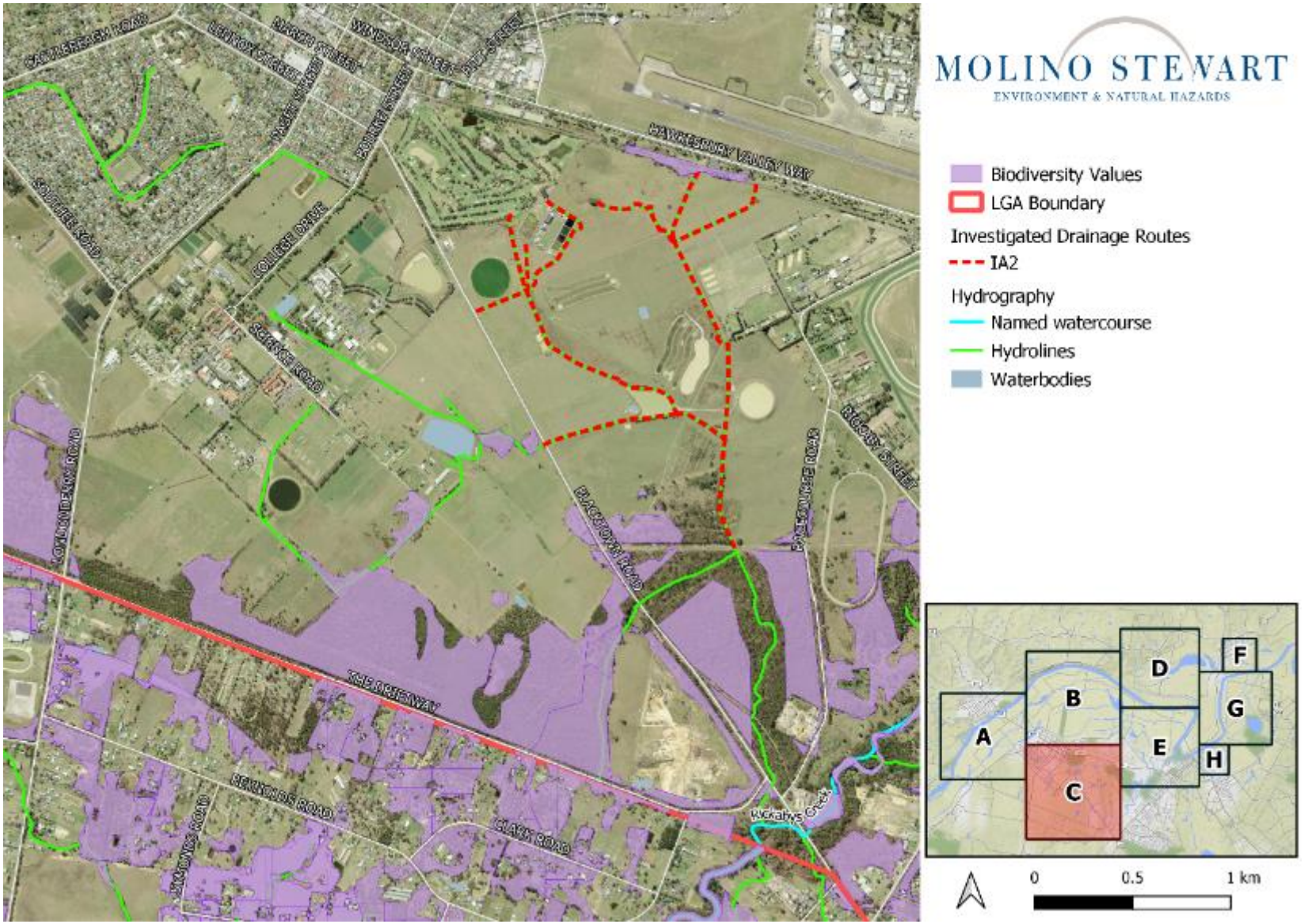


Figure 100: Biodiversity Values (Extent C)

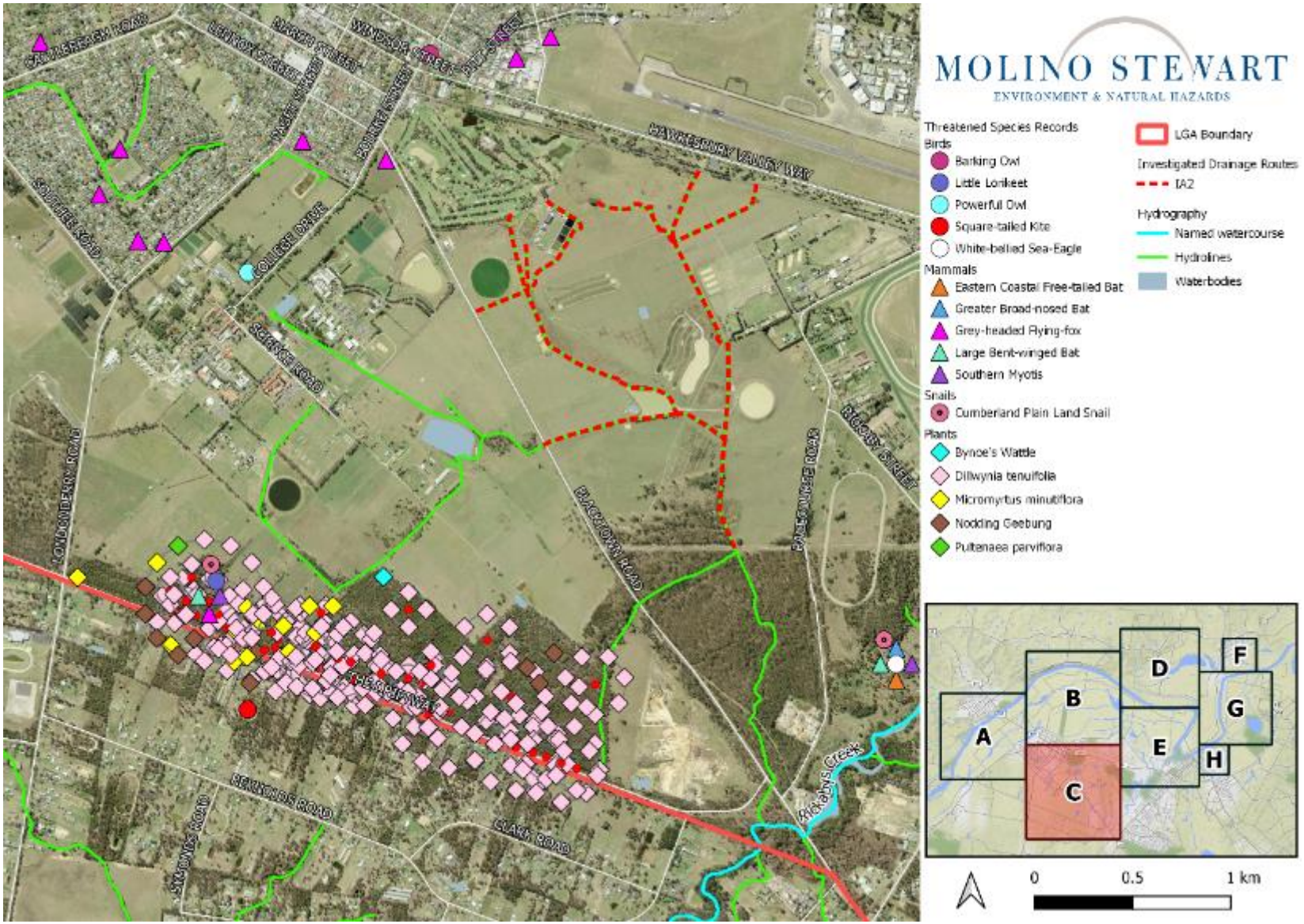


Figure 101: Threatened Species Records (Extent C)

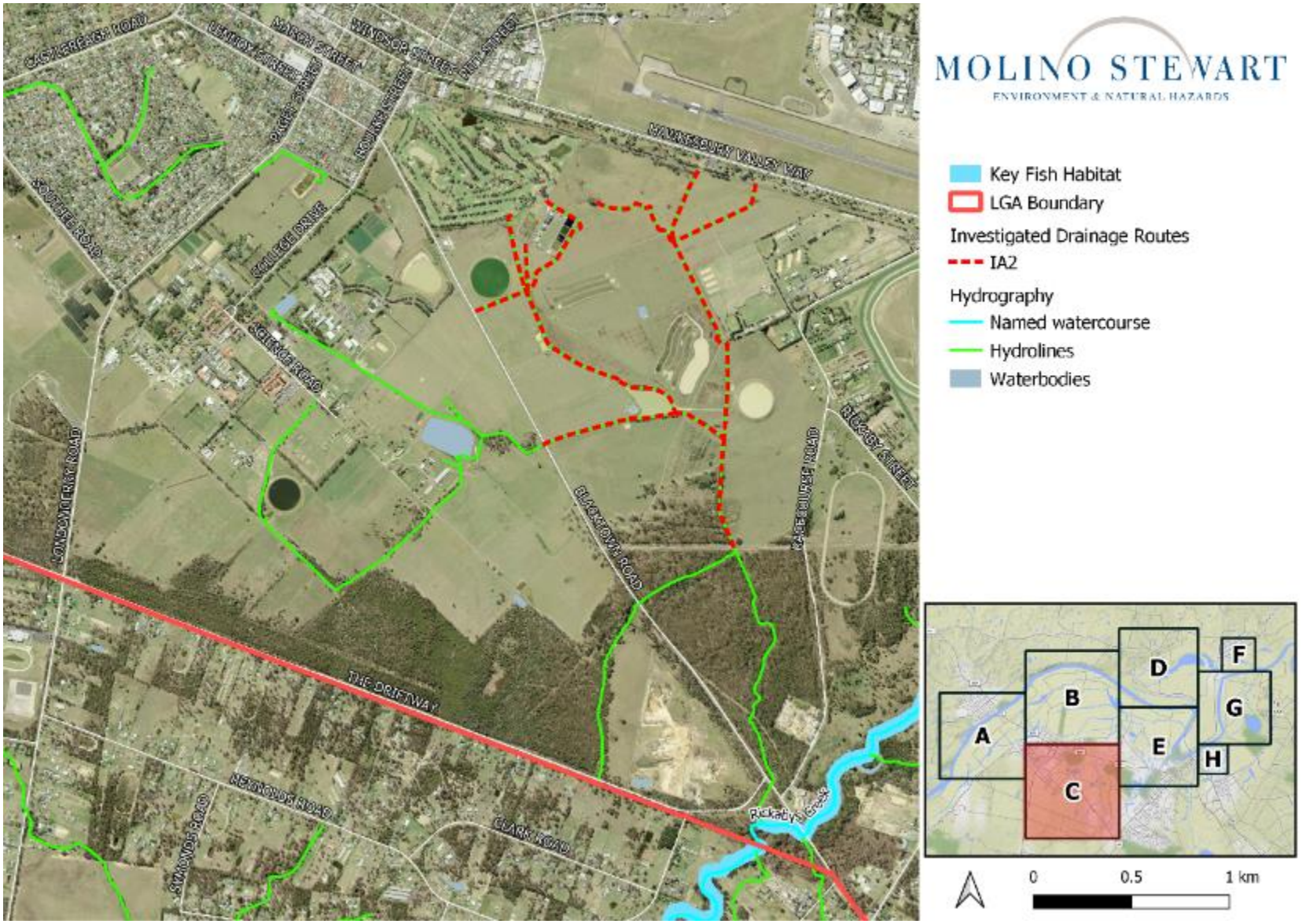


Figure 102: Key Fish Habitat (Extent C)

12| Investigation Area 3

There are two separate drainage networks in IA3 which, for the purposes of this report have been given the designation IA3 North (IA3N) and IA3 South (IA3S) (Figure 103).

IA3N is a network of constructed drains, mostly through turf farms, which drain into Bushells Lagoon to the east.

IA3S on the other hand is a drainage depression between two natural levees along the bank of the river. It drains eastward before turning sharply south and directly entering the Hawkesbury River. Most of this has been formalised with a shallow drain and culverts.

12.1 Drainage Issues

The locations of each photograph referred to in the text can be found in Figure 104 (IA3N) and Figure 105 (IA3S).

12.1.1 Field observations

a) IA3N

There are four arms to IA3N. The northern most arm runs in a southerly direction on the western side of Hibberts Lane before turning east and flowing under Hibberts Lane into a pond (Photo 249). The inspection commenced downstream of the pond which discharges through a series of pipes under and access road (Photo 250). The property owner advised that during the March event stormwater flows which came down Hibberts Lane overtopped the pond and the road and caused the erosion that can be seen in the photo.

Downstream of the pond is a reed bed (Photo 251) which discharges over an access road and across a paddock (Photo 252) before passing through a pipe under an access road. The inlet to the pipe was partially blocked with debris and flow has eroded a bypass passage under the road to the left of the pipe (Photo 253). Despite there being flow in the channel, the pipe was dry at its outlet (Photo 254). The channel downstream from here is deeply incised (Photo 255) before running across lower, flatter ground (Photo 256). There are numerous piped crossings along this reach with the crossings spaced to facilitate the passage of travelling irrigators over the channel. There are also concrete slabs used as bridges for the irrigators (Photo 257).

Along this reach there is a long access road raised about 0.5m above the paddock (Photo 258) with a single large pipe through it at the drain (Photo 259). There are several transverse drains (Photo 260) draining into the eastern flowing main drain. The eastern flowing drain terminates in a large pond immediately to the west of Gorricks Lane, which then overflows through culverts under Gorricks Lane and into a wide depression. The depression leads into the upper reaches of Bushells Lagoon.

The middle arm begins as a depression running east from Hibberts Lane and into a large pond (Photo 261). That overflows via a culvert and then pipes under and access road on the neighbouring property (Photo 262). It flows north, on the eastern side of the access road (Photo 263) before cutting diagonally across the paddocks with all manner of crossing constructed to accommodate the travelling irrigators (Photo 264) before flowing north into the northern arm.

The southern most arm west of Gorricks Lane begins as a shallow depression east of the middle arm pond with low irrigator bridges and small diameter pipes under access tracks (Photo 265). Part way along there is an access road about 1m above the paddock (Photo 266) with a large pipe under it (Photo 267). The drain remains shallow with various irrigator crossings and degrees of siltation within the channel (Photo 268 and Photo 269). In places the pipes under crossings have silted up and the

channel has eroded a bypass (Photo 270). Debris has blocked some of the pipe inlets (Photo 271). When this channel reaches Gorricks Lane it heads north on the western side of the road until it reaches the crossing under Gorricks Lane and into Bushells Lagoon.

The fourth part of the network is east of Gorricks Lane and consists of a series of shallow drains around the perimeters of turf paddocks (Photo 272, Photo 273) which flow north towards Batchelors Wharf Road. The drain flows west along the southern side of Batchelors Wharf Road (Photo 274) before flowing in pipes under the road (Photo 275) at several locations into a small wetland (Photo 276).

The wetland overflows into Bushells Lagoon via a small pipe. On the day of the inspection the top water level in the wetland was below the invert of the pipe (Photo 277).

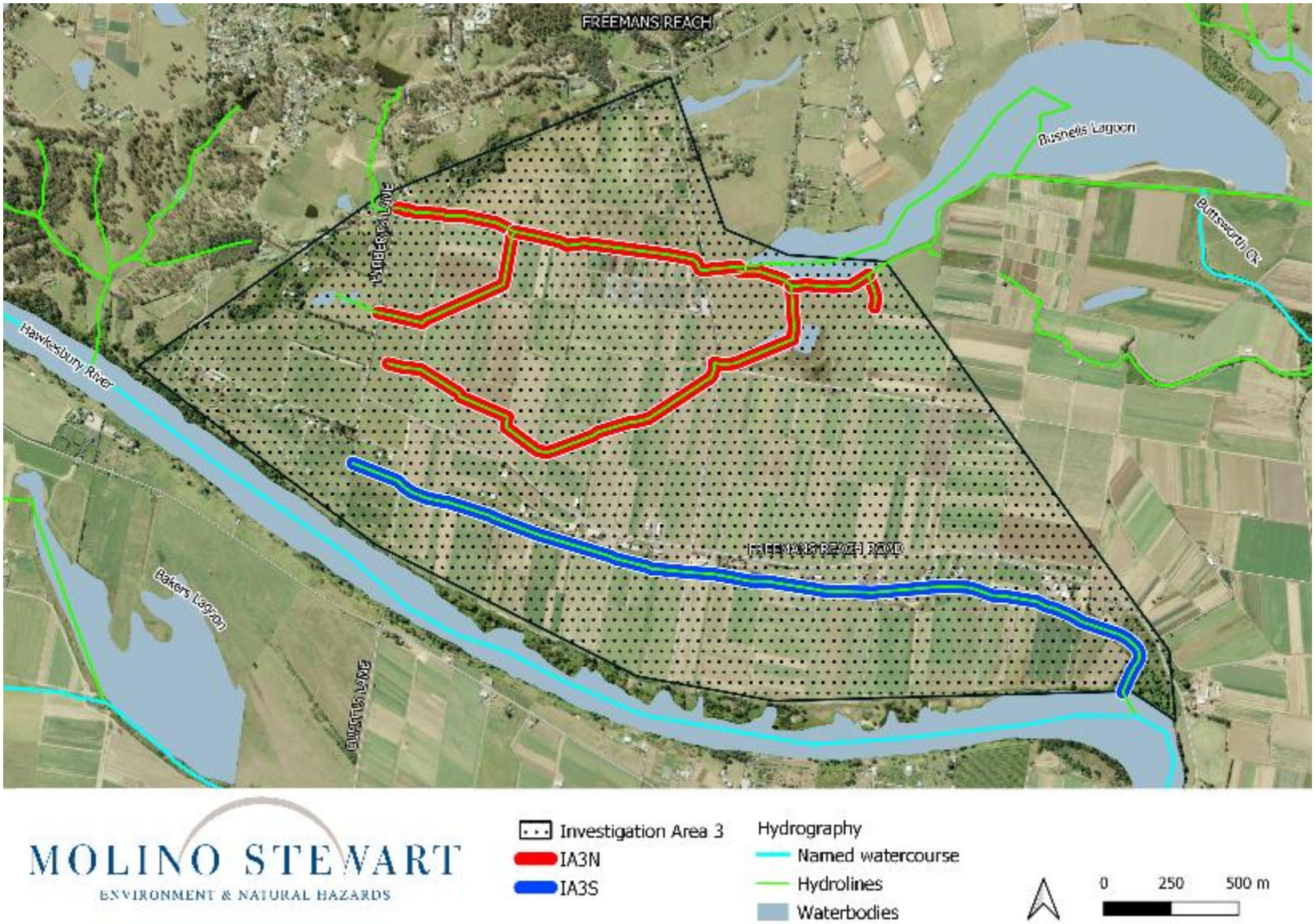


Figure 103: Investigation Area 3 Northern and Southern Drainage Routes (IA3N and IA3S)

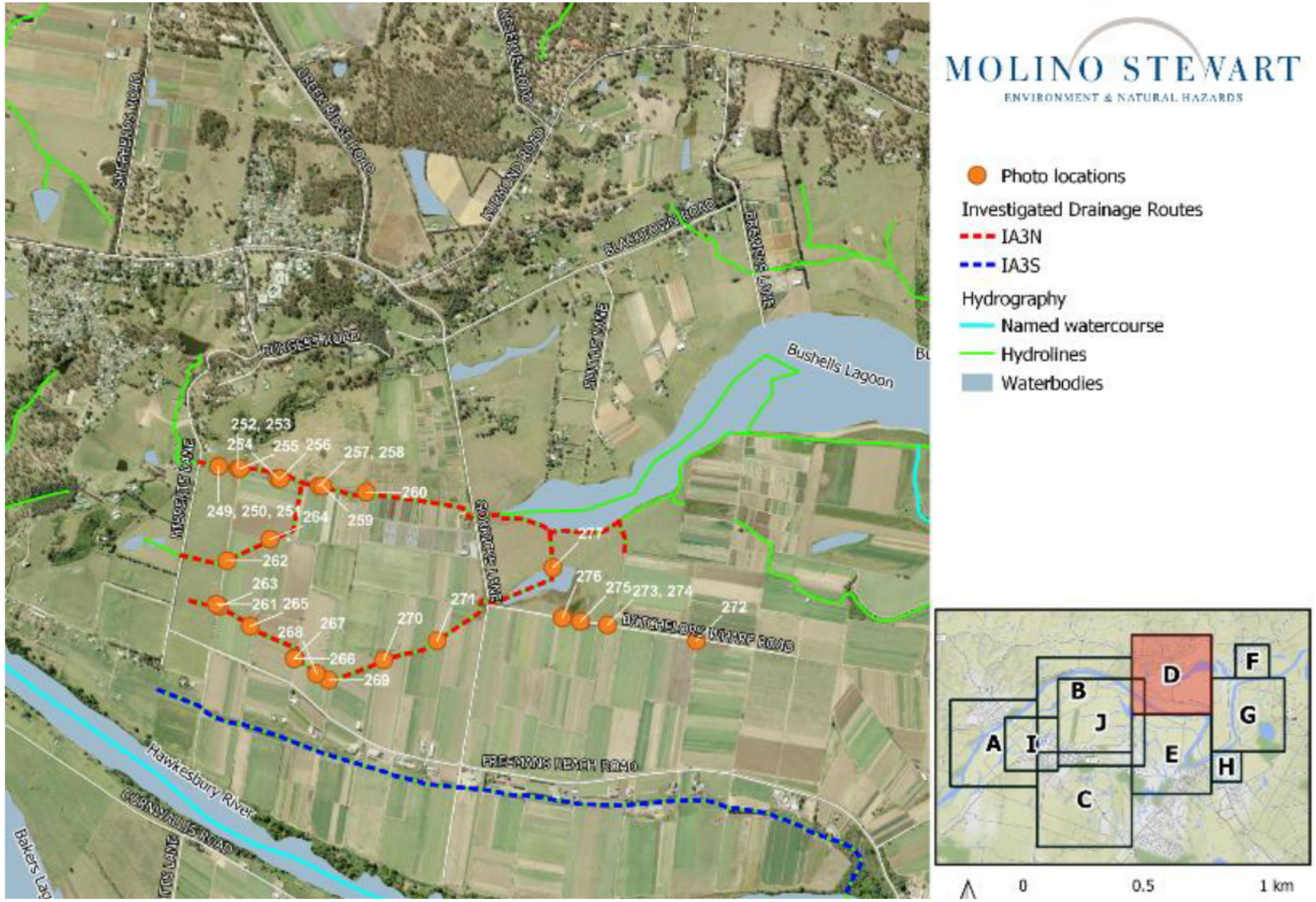


Figure 104: Photo locations in IA3N

Photo 249

Photo 250

Photo 251

Photo 252

Photo 253

Photo 254

Photo 255

Photo 256

Photo 257

Photo 258

Photo 259

Photo 260

Photo 261

Photo 262

Photo 263

Photo 264

Photo 265

Photo 266

Photo 267

Photo 268

Photo 269

Photo 270

Photo 271

Photo 272

Photo 273

Photo 274

Photo 275

Photo 276

Photo 277

b) IA3S

At the western most end of IA3S drain there is an internal farm access road (Photo 278) with a 450mm pipe under (Photo 279) which inhibits the free drainage of the paddocks on the neighbouring property upstream (Photo 280).

Immediately downstream of this there are two internal access tracks which also have 450mm pipes (Photo 281). Water appears to be ponding upstream of the upstream pipe because the paddock is lower than the invert of the pipe. However, the area further downstream is ponded to halfway up the pipe and this is because of an obstruction to flow further downstream.

The farm immediately downstream has constructed an access track which no provision for drainage (Photo 282) and this has effectively formed a dam across this part of the drain. The area only drains via seepage through the road embankment and a property owner on site advised that following the March flood water sat for weeks at an elevated level before dropping to the levels observed in the photos. The evidence of this can be seen in line between the green turf and dead turf which was killed by the prolonged submersion (Photo 281).

The rolling slopes observed in the paddocks upstream of this obstruction are likely typical of the natural shape of this part of the landscape. As will be noted in subsequent commentary, in many locations along the northern side of the drain, the land has been filled to elevate larger areas as work platforms for the farms and many accommodate sheds and plant and equipment parking areas.

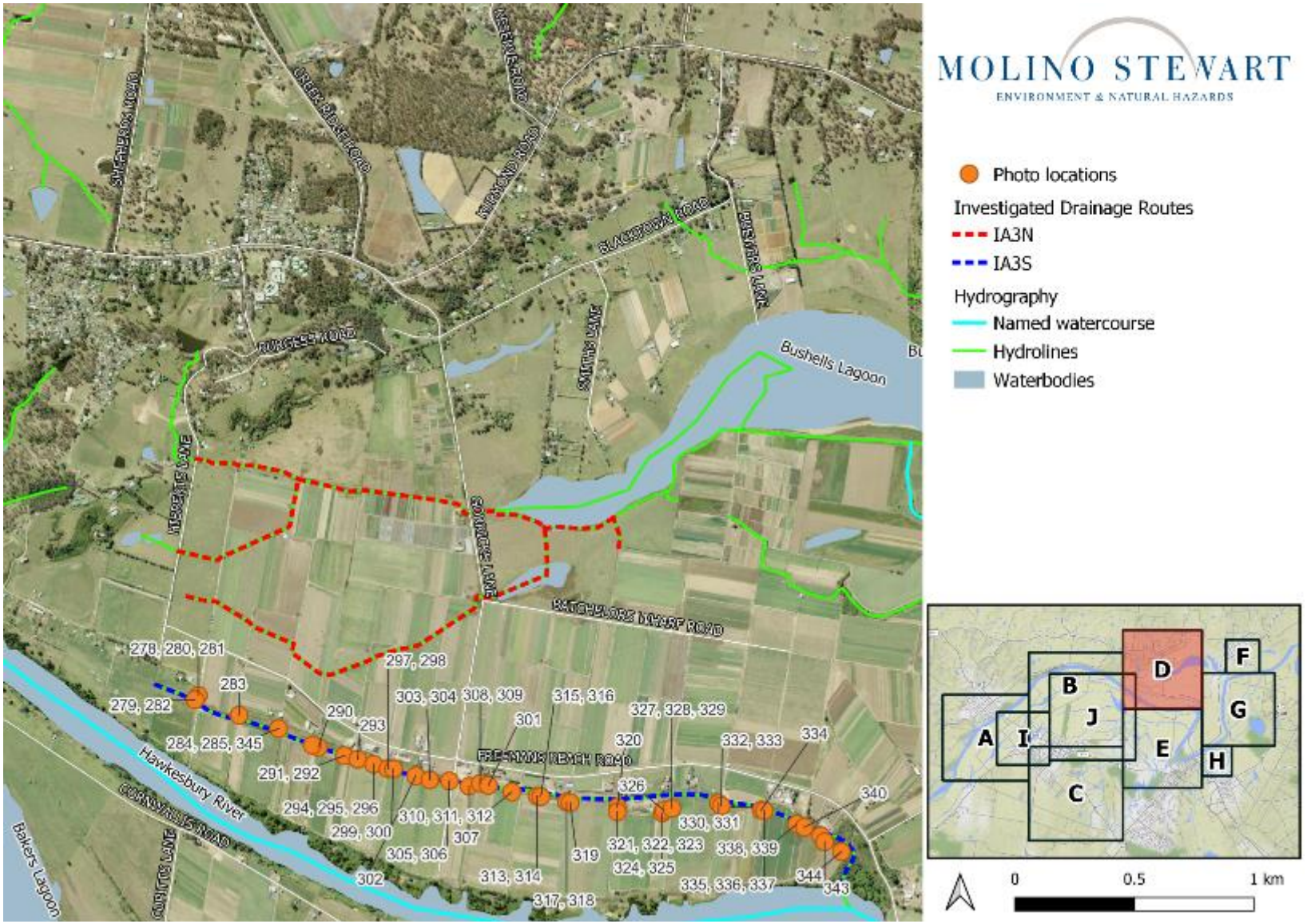
Downstream of the flow obstructing access road, the drain is reasonably formalised between the northern side of a farm access track and an area of fill to the immediate north (Photo 283). This section of drain terminates in a pile of fill. There is a poorly placed section of 300mm HDPE pipe (Photo 284) which diverts the flow into a less formalised section of drainage which has been offset by the fill (Photo 285).

Water is ponded in this next section of drain (Photo 286) because the end of this reach is filled with sediment (Photo 287) which has eroded from adjacent paddocks (Photo 288) and the 300mm outlet under an access road (Photo 289) is partially blocked and the water level is elevated in the next reach of drain (Photo 290 and Photo 291).

That reach ends with a section which is silted up and has a partially blocked pipe under an access road (Photo 292). Downstream of this location there appears to have been a recent effort to remove silt from the drain (Photo 293 and Photo 294). There are numerous minor crossings, with 300-450mm diameter pipes under, along this reach (Photo 295and Photo 296). These are probably for the passage of travelling irrigators. This reach terminates in another farm access road which crosses the drain with a half silted 450mm diameter pipe under (Photo 297).

From here the drain steps a few metres to the south and there is more evidence of recent desilting of the drain which appears to be incomplete (Photo 298 and Photo 299). The pipes under the minor crossings along this section are heavily silted (Photo 300). The end of this reach is blocked with silt and vegetation, after which there is a 600mm diameter pipe (Photo 301 and Photo 302).

In the next reach the drain is wider and shallower and was holding water (Photo 303) due to siltation of pipes and areas upstream of their inlets (Photo 304 and Photo 305). At the end of this reach the drain is diverted several meters further south to skirt a large area of earthfill which has been retained with concrete blocks (Photo 305). The drain is poorly defined along the southern toe of the retaining wall (Photo 306) and part way along there is a 300mm diameter pipe under the retaining wall (Photo 307) which emerges downstream in a drain which seems to reflect the drain's alignment before the placement of the fill (Photo 308).


MOLINO STEWART
ENVIRONMENT & NATURAL HAZARDS
Photo locations
Investigated Drainage Routes
IA3N
IA3S
Hydrography
Named watercourse
Hydrolines
Waterbodies
Bushells Lagoon
Hawkesbury River
Bakers Lagoon
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279, 282
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284, 285, 345
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