Bioscience

Integrating Resource Management

Nutrient and Irrigation Management Plan: Lot 88 Bingham Rd, Bullsbrook 6084

Plantrite
Western Australia
October, 2017

Nutrient and Irrigation Management Plan
88 Bingham Rd, Bullsbrook WA 6084

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Document Control

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*Amendments are highlighted in yellow

Contents

1 Summary of the Land Use Proposal 6
2 Project Setting 6
3 Land Use, Nutrient Application, Staff and Livestock 6
3.1 Land Use and Nutrient Application 6
3.2 Staff and Livestock 7
4 Local Rainfall, Evaporation and Interception 7
5 Soils and Landform Description 7
5.1 Land Contours 7
5.2 Soil Type 7
5.3 PRI 8
5.4 Acid Sulphate Soil 8
5.5 Proposed Earthwork Details 8
5.6 Imported Soil Amendments 8
6 Water Resources Description and Use 8
6.1 Sensitive Water Resources 8
6.1.1 Wetlands 8
6.1.2 Groundwater Users 8
6.2 Seasonal or Occasional Flooding 9
6.3 Groundwater Description 9
6.3.1 Aquifer Description 9
6.3.2 Groundwater Flow, Discharge and recharge 9
6.3.3 Groundwater Level 9
6.3.4 Groundwater Quality 9
6.4 Source of Irrigated Water 10
6.5 PDWSA 10
7 Site Management 10
7.1 Irrigation System 10
7.1.1 Crops 10
7.2 Nutrient Application 10
8 Drainage and Contaminant Leaching Control 11
8.1 Drainage Management 11
8.2 Contaminant Leaching Control 11
8.2.1 Fertiliser Use Efficiency 11
8.2.2 Water Use Efficiency 11

9 Protection of Natural Water Resources 12
10 Contaminant Transport Model 13
11 Vegetation Management 13
11.1 Clearing 13
11.2 Erosion Control 14
11.3 Water and Nutrient Application Matching Plant Needs 14
11.4 Buffers for Remnant Vegetation 14
12 Pesticide and Storage Use 14
References 15

This Nutrient and Irrigation Management Plan (NIMP) was prepared by Bioscience Pty Ltd, as per the advice and recommendations of WQPN 33, on behalf of Plantrite.

1 Summary of the Land Use Proposal

Proponent's name: David Lulfitz of Plantrite

Contact details: 08 9571 3055

Site location: Lot 88 Bingham Rd, Bullsbrook WA 6084

Project description: Plantrite is a nursery producing Australian Native Plants. The business is being expanded to meet increasing demand for “waterwise” native flora for a range of applications including commercial and domestic landscaping and for bushland rehabilitation.

Timetable: Production on site will start as soon as development approval is obtained. Operations will last over 30 years.

2 Project Setting

The site, located 36 km north east of Perth CBD, is generally slopes from south to north, and as former grazing land, is mostly cleared save for wetland areas. It is sandy soil of the Bassendean dunes formation. A layout map is presented in Figure 1.

The site is zoned "General Rural" under the City of Swan's local planning scheme, and is surrounded by properties of the same zoning. Land to the west and north is mostly uncleared bushland. The land is on the northern boundary of the City of Swan, with the Shire of Chittering to the north.

Fertiliser application rates for production on site is low, reflecting the nutritional requirements of native flora

3 Land Use, Nutrient Application, Staff and Livestock

3.1 Land Use and Nutrient Application

Plantrite intends to develop a further 4.7 ha of the land for the production of native plants grown in pots and tubes. The proposed development will be intensive, yet will require low levels of fertilizers. Fertiliser will be applied as slow release, low analysis formulations added to the propagation media.

Plants are grown outdoors, on weed matting, using overhead sprinklers for irrigation.

Plantrite is an Accredited Nursery under the Nursery Industry Accreditation Scheme of Australia (NIASA), meaning it is routinely audited to remain certified that it uses Industry Best Practice regarding plant heath, efficient use of resources, and control of pests and disease.

3.2 Staff and Livestock

A peak number of 50 people will be working on site. Workers will park on neighbouring farm. Livestock will not be established on site.

4 Local Rainfall, Evaporation and Interception

The climate of the area is characterized by Mediterranean climate comprising cool wet winters and hot dry summers. Temperature ranges from cool to cold (i.e. 1 degree) during winter months (May to August) and could reach up to 45 degrees during summer months.

Average annual rainfall (Bureau of Meteorology) recorded at Pearce RAAF weather station (located 5.7 km away) is 655 mm, with the majority of rain falling between May and September. Table 1 shows the monthly average rainfall at Pearce RAAF weather station.

Evaporation is likely to be similar to the Perth area, which has an annual evaporation of 1716mm and exceeds the annual average rainfall by a factor of 2.61. Monthly rainfall typically only exceeds evaporation during 4 months, from May to August.

Surface soil on site consists mostly of medium to coarse textured sand (Geological Survey of Western Australia). Infiltration in such soils is in the order of 10^{-4}- 10^{-5} m sec-1(Lock 2007). This translates to the capacity of soil to handle rainfall in excess of 36 – 360 mm per hour. Accordingly, in heavy rainfall events (1h 20 year ARI), rain water in the undeveloped parts of the property will infiltrate soils and not lead to runoff. In the heaviest events (1h 100 year ARI), water may transiently pool before infiltration.

Table 1: Rainfall and Evaporation at Pearce RAAF Weather Station (Bureau of Meteorology)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Rainfall (mm)	7.6	12.2	15.1	34.8	84.9	132.3	133.8	104.2	70.1	36.2	23.7	10.6	655
Average Evaporation (mm)	257	218	195	120	78	57	71	102	99	148	189	253	1716

5 Soils and Landform Description

5.1 Land Contours

Overall, the site slopes down towards the east, from an elevation of 67 mAHD on the north end corner of the site to 53 mAHD at the eastern boundary (Figure 2). Elevations also drop within the vicinity of the wetland areas.

5.2 Soil Type

The Geological Survey of WA's Environmental Geology Map (Muchea, sheets 20341 describes the site as (Figure 3):

- S8, Bassendean Sand, occurring in the Western and central part of the property;

- S10, Thin Bassendean Sand over Guildford Formation, occurring in the eastern and northern part of the property.

5.3 PRI

Bassendean sands system is known to have very low PRI, ranging between 2 and 5 mg/L within the vicinity of the site (Safstrom and Short 2012). In this development, manufactured soils (potting mixes based on composted pine bark)

5.4 Acid Sulphate Soil

The ASS Risk Map defines the area as Class 2 - moderate to low risk of ASS for depths within 3m below natural ground (Figure 4).

5.5 Proposed Earthwork Details

No substantial earthworks are proposed on site. Soils will be with plastic woven membranes.

5.6 Imported Soil Amendments

All plants are grown in imported potting mixes made primarily from composted pine bark.. Such materials are removed from the site with the sale of plants.

6 Water Resources Description and Use

6.1 Sensitive Water Resources

6.1.1 Wetlands

The site contains five geomorphic wetlands (Figure 5):

- UFI 8781 - Conservation wetland, located 375 m SE from PB1;
- UFI 8899 - Resource Enhancement wetland, located 200 m E from PB1;
- UFI 13402 - Resource Enhancement wetland, located 550 m E from PB1;
- UFI 15732 - Multiple Use wetland, located 375 m SE from PB1; and,
- UFI 8898 - Resource Enhancement wetland, located theoretically 35 m N from PB1, yet Nearmap reveals that this area is completely cleared of wetland vegetation suggesting the wetland geomorphic dataset classification may require revision.

6.1.2 Groundwater Users

Figure 6 presents the location of groundwater users within the vicinity of the site. Existing groundwater users in the area were assessed through the Department of Water's Water Register database.

Seven groundwater users are abstracting water from the Superficial Aquifer within a 1 km radius of Lot 88 (150) Bingham Rd (PB1 as centre point). Table 2 below provides details on those users.

Table 2: Groundwater Users Abstracting Water within the Superficial Aquifer

Licence No.	Number of Bores	Allocation (kL/yr)	Sub-Area	Approx. Distance from PB1
GWL 46800	1	22,150	Radar	340 m S
GWL 64824	2	24,300	Radar	760 m S
GWL 180997	1	9,600	Radar	860 m S
GWL 50844	1	19,200	Radar	940 m SW
GWL 175274	1	7,550	Radar	1000 m SW
GWL 150372	3	178,650	Radar	1000 m SE
GWL 174425	3	134,700	Radar	1000 m SE
GWL 180797	1	5,000	Radar	800 m N

6.2 Seasonal or Occasional Flooding

Occasional flooding might happen in the area depicted as wetland on the WA Atlas (Figure 5). The development will be avoided in this area.

6.3 Groundwater Description

6.3.1 Aquifer Description

A large groundwater resource occurs in the regional unconfined aquifer known as the superficial aquifer. The Gnangara Groundwater Mound that defines the flow of groundwater is influenced by topography, drainage lines and the hydraulic characteristics of the sediments. Within the vicinity of the site, the average saturated thickness of the aquifer is around 36 m.

6.3.2 Groundwater Flow, Discharge and recharge

According to the Perth Groundwater Atlas, the groundwater flow within the vicinity of the site is in an east south-easterly direction towards the Ellen Brook (Figure 7).

The groundwater in the Superficial aquifer is recharged by direct infiltration of rainfall, with peak groundwater levels occurring between August and October. Low lying areas experience inundation in winter months, with wetlands and groundwater dependant ecosystem reliant on the seasonal rise in groundwater levels.

6.3.3 Groundwater Level

Shallow groundwater levels fluctuate seasonally by about 1.4 m and have long term changes that are function of geology, groundwater throughflow, rainfall and abstraction (Smith and Shams 2002).

6.3.4 Groundwater Quality

Groundwater is generally fresh but is locally saline at the watertable, mainly in the southern part of the catchment where the surface geology comprises Guildford Clay. This higher salinity is due to the low hydraulic conductivity (less than 0.2 m/d) of the plastic Guildford

Clay and the concentration by evaporation from the very shallow watertable (Smith and Shams 2002).

6.4 Source of Irrigated Water

The site is associated with GWL109292 and GWL 17972 collectively allow the abstraction of 144,000 kL/annum. It is also noted on 17 May 2016, The Trustee for the DP Property Trust (operating as Plantrite) entered into an agreement with Mr Hassiotis and Ms Hassiotou of 21 Bingham Rd to lease an additional 130,000 kL per annum water entitlement from GWL 151965 (for the Perth Superficial aquifer) to support an expansion of their nursery. Locations of the production bores are provided in Figure 1.

6.5 PDWSA

The site is not within or near any Public Drinking Water Supply Areas.

7 Site Management

7.1 Irrigation System

7.1.1 Crops

Overhead precision sprinklers will be used on site to irrigate the crops. Because of very close plant spacing, and high water holding capacity potting mixes, such systems as very efficient.

The correct use of overhead sprinklers provides an ideal soil moisture level for plant growth. The irrigation time interval depends on the rate of water evaporation, temperature, the stage of plant development, and will be judged by the grower's many years of experience. The irrigation interval will be determined by weather forecasts with the greatest demand during summer months.

Potted plants are irrigated to less than their drained upper limit, as a means of encouraging maximum root growth. Frequent, short waterings mean that run-off from potting mix is minimised. Within production bays, some plants pots will be in impervious trays to monitor whether any drainage is occurring. Soil moisture monitors will be in other pots.

7.2 Nutrient Application

Nutrient will be applied solely by the application of slow release, low analysis commercial fertilisers specifically developed for native plants. Fertilisers are blended into the potting mix according to the specific varieties being planted. These have low phosphorous, medium levels of nitrogen and higher levels of potassium, and release rates of 3, 6 or 9 months depending on the anticipated time from planting to sale.

8 Drainage and Contaminant Leaching Control

At times some water runoff is unavoidable, for example during heavy winter rains. The placement of plants on a woven plastic mesh structure ensures soil and nutrient losses are minimised.

On site, effort will go into:

- Minimising the volume of external drainage affecting the site;
- Preventing rainfall runoff from hitting or moving over bare soil;
- Creating 'safe' stable pathways that slow runoff water to a walk and allow any nutrient-laden sediment to drop out before it leaves the property or enters watercourses.
- Rehabilitation of the cleared land between production areas and wetlands with planting endemic native vegetation to act as nutrient attenuators removing any nutrients from groundwater before it enters wetlands and nutrient sensitive ecosystems (Figure 5). The species to be planted will be those already present n the wetland areas, being *Melaleuca pressiana, Taxandria linearfolia, Astartea scoparia, Pultenaea reticulosa, Meeboldina scariosa, Juncus pallidus and Baumea rubiginosa*.

8.1 Drainage Management

Runoff water from production areas is directed to walkways between production bays for infiltration. These uncultivated sandy strips surround each side of the production area. Grass headlands to the east will reduce the speed of and filter sediment from any runoff water.

8.2 Contaminant Leaching Control

8.2.1 Fertiliser Use Efficiency

On site, Plantrite will use the following best management practices to improve fertiliser use efficiency:

- Fertiliser applications will be based on soil slow release granules in media with high water holding capacity and ion exchange capacity.
- Fertiliser applications will be recorded to assist future fertiliser management decisions.
- Fertilisers will be applied to potting media only prior to planting out. Nutrients will be applied close to the plant root zone to ensure that plant nutrient uptake is maximised.

Plantrite understands that over-watering can cause poor plant production performance, thus uses irrigation scheduling to get media wet to less than their drained upper limit.

8.2.2 Water Use Efficiency

On site, water use efficiency will be based on the following:

- The decision of when and how much to irrigate will be based on weather forecasts, soil moisture levels, plant requirements and the grower's many years of experience.

- Small volumes of water will be applied frequently rather than occasional heavy applications.
- High precision, low flow sprinkler irrigation is designed to spread water only over the plant bays. This method of irrigation, when properly managed, results in minimal irrigation runoff and zero leaching of nutrients.
- The grower and his staff regularly (daily) inspect the irrigation and will ensure that repairs are carried out promptly should they be needed.
- Selected plants from irrigation blocks are contained within impervious plastic bowls which can be easily inspected to confirm there is no drainage.
- A number of in pot moisture sensors are being trialled to provide further information on water use efficiency.

9 Protection of Natural Water Resources

As described in Section 6, the site is upstream of 2 sensitive wetland environments, and with the best management practice used for irrigation and fertiliser application, prospects for any outside impacts are minimised. To ensure no nutrient leaching, nor undesired impacts on wetlands occurs, permanent groundwater monitoring bores will be installed between the production area and the wetlands. The precise location and construction details of these bores will be upon the advice of DBCA. Bores will be regularly monitored as a condition of groundwater licensing, with data also reported to DBCA. Upon clarification by DBCA, such bore may also be equipped with data loggers to better understand both short and long term groundwater level variations.

Monitoring will start upon development approval and will follow the below commitments (Table 3). Should the monitoring program be approved, an Access Request form for GN24 will be submitted to DoW.

Table 3: Monitoring Commitment

Commitment	Location	Frequency
Flow meter reading	PB1	Monthly
Groundwater level measurements	GN24, MB1, MB2	Quarterly
Sample and water analysis	GN24, MB1, MB2	Quarterly
Annual report	n/a	Annually

Flow meter readings will be recorded at the end of each month, at least 20 days apart. Water sampling will be conducted as per AS/NZS 5667.11:1998. Water quality analyses will be carried out by Bioscience and will test the following:

- pH
- EC
- TDS

- Ion
- Potassium
- Calcium
- Magnesium
- Nitrate N
- Ammonium N
- Total N
- Reactive P
- Total P
- Sodium
- Chloride
- Sulphate

Note that the monitoring of nutrients will be undertaken as a requirement of the NIMP on advice from the Department of Biodiversity, Conservation and Attractions (DBCA).

As contingency, should downstream bores (MB1 and MB2) N or P values continue to exceed upstream bore (GN24) values by more than 2 standard deviations, an investigation will be carried out into the source of the nutrients and proper management will be implemented:

1) Change in fertiliser regime; if no change is observed at the next monitoring round, then,
2) Change the propagation mix; if no change is observed after this management response, then,
3) A closed drainage system whereby drainage water from plant sis captured by plastic membranes and directed into lined evaporation basins will be envisaged.

Also, rate of drawdown will be inferred from the water level monitoring. Should the rate be significantly higher than the current rate of 0.027 m/yr and should rainfall patterns be within the current trend, the pumping rate of the production bore will be reduced (and subsequently irrigation period will decrease). Rate of drawdown will be assessed once a year. If the groundwater level in GN24 falls below 59m AHD, no irrigation will be allowed.

10 Contaminant Transport Model

A farm operated under modern systems of irrigation and nutrient management as described means it is possible to operate without export of contaminated water or nutrients.

11 Vegetation Management

11.1 Clearing

The site is substantially cleared of endemic vegetation. A significant number of native trees and other vegetation exist in wetlands to the east and south east. These will not be cleared.

11.2 Erosion Control

The following practices will be used on site to improve soil structure and control erosion:

- Heavy machinery is not used on the site.
- Heavy traffic roadways are reinforced with limestone aggregate.

11.3 Water and Nutrient Application Matching Plant Needs

As previously explained in *Section 7.1.1*, the irrigation intervals and duration will be determined by weather forecasts. The demand for water is greatest during summer months.

11.4 Buffers for Remnant Vegetation

A 50 m will be provided for the Conservation Category Wetland existing on the property. Such buffer is adequate to protect riparian areas (should they exist) within wetlands (WRC 2000). As described in Section 8, these areas will be replanted with endemic native vegetation as a further safeguard.

12 Pesticide and Storage Use

The use of pesticides in Australian agriculture is regulated through the Australian Pesticides and Veterinary Medicines Authority. The increasing trend in registration of products is to restrict the use of insecticides, fungicides and fumigants which have half lives of more than a few days. Environmentally persistent pesticides have been progressively deregistered and removed over the last 20 years.

The proponent currently adopts integrated pest management (IPM) systems. Generally pesticide use is avoided wherever possible. The major disease pressure is from foliar fungal pathogens in winter. This is managed by protective foliar sprays, and by constant, low dosing of irrigation water with copper ions (produced by electrolysis). The major pest pressure is insects, particularly thrips in summer. This is managed by targetted application of synthetic pyrethroid insecticides.

All use of chemical pesticides adheres to industry best practice principles:

- Follow regulations set by the Australian Pesticides and Veterinary Medicines Authority governing the use, storage, and disposal of pesticides and fungicides and training of applicators and pest control advisors.
- Follow manufacturers' recommendations and label directions.
- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule) and use the minimum amount of chemical needed for the job.
- Do not mix and prepare pesticides within 30m of any well, stream or pond.
- Do not get rid of unused pesticides by washing them down drains.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Clean pavement and sidewalk if chemicals are spilled on these surfaces.

All chemicals are stored in a locked area (concrete floor). All applications of chemicals are entered into a log book.

All remaining mixtures are disposed of according to label instructions. All equipment used for pesticide preparations will be triple rinsed both inside and out to minimize pesticide residues.

References

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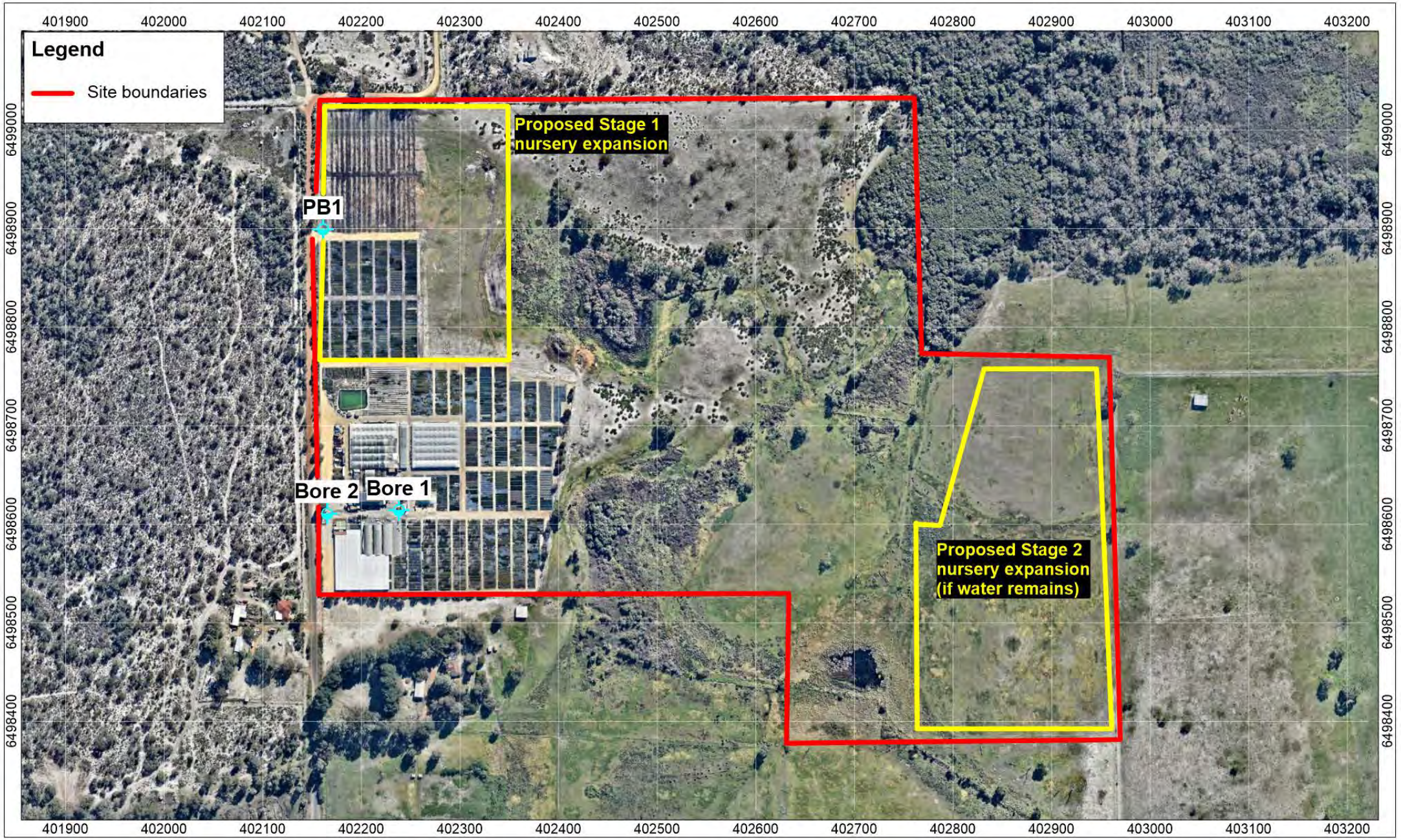
Figures



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Project Title: NIMP: Lot 88 Bingham Rd
Client: Plantrite
Date: 11/10/2017
Drawn: DA
Checked: PK
Revision: 1

0m 50m 100m 150m

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FIGURE 1. Proposed Development and Production Bore Locations

Lot 88 (150) Bingham Rd, Bullsbrook

Source: Nearmap (24/06/2016), Coordinate system: UTM Zone 50S

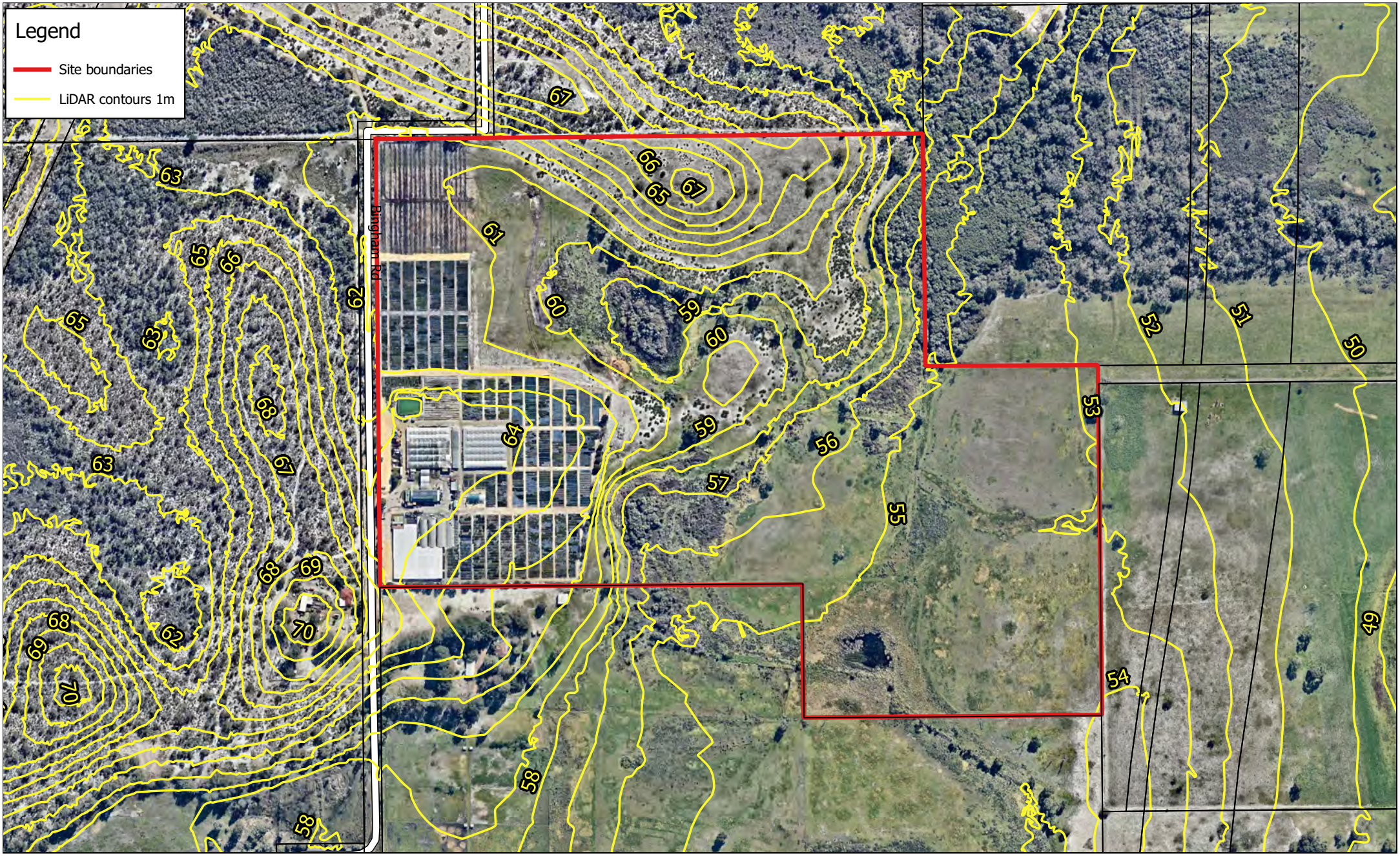

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FIGURE 2. Topography

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DoW GIS dataset, LiDAR data

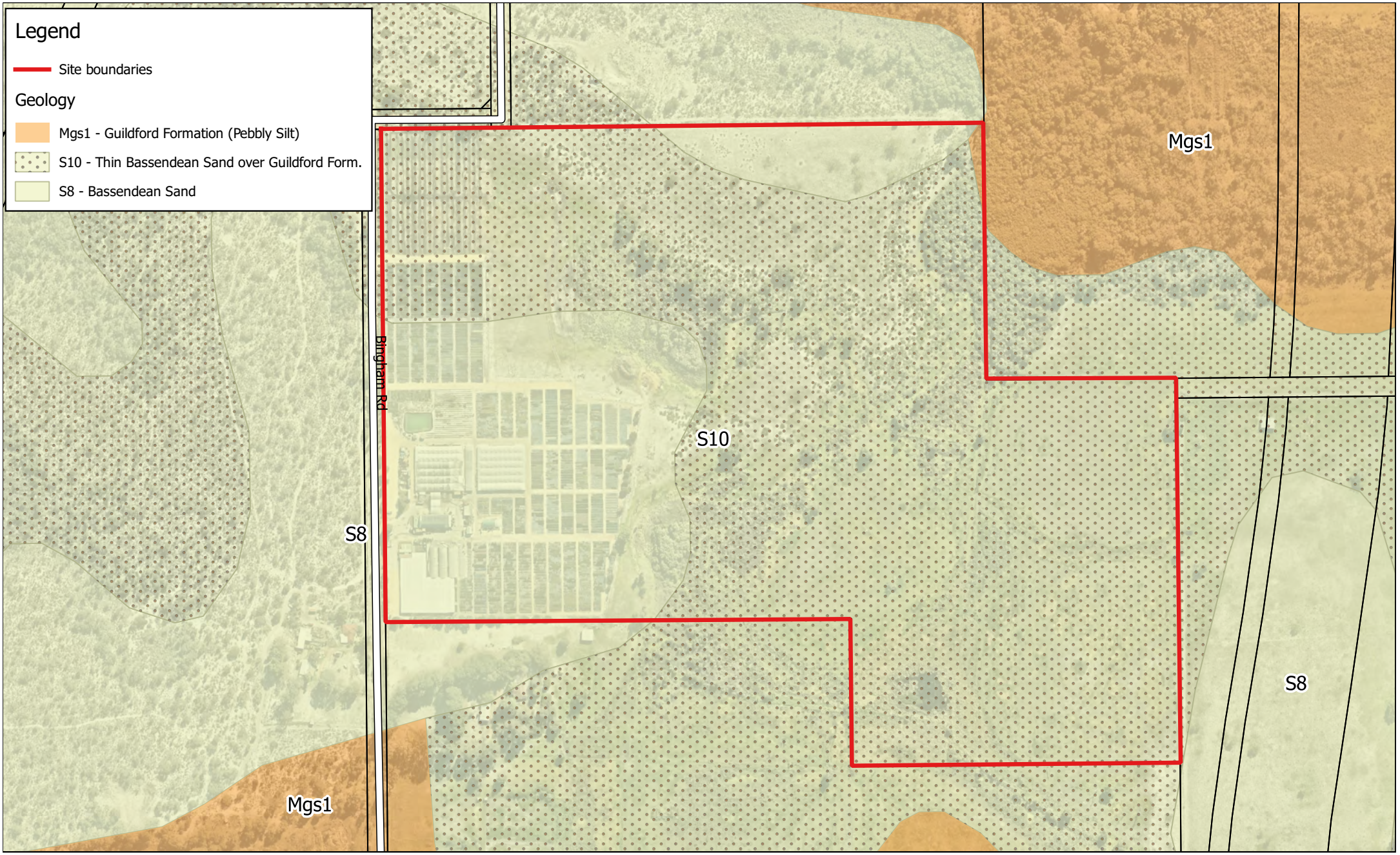

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FIGURE 3. Surface Geology

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DoW GIS dataset, GSWA Muchea map 20341

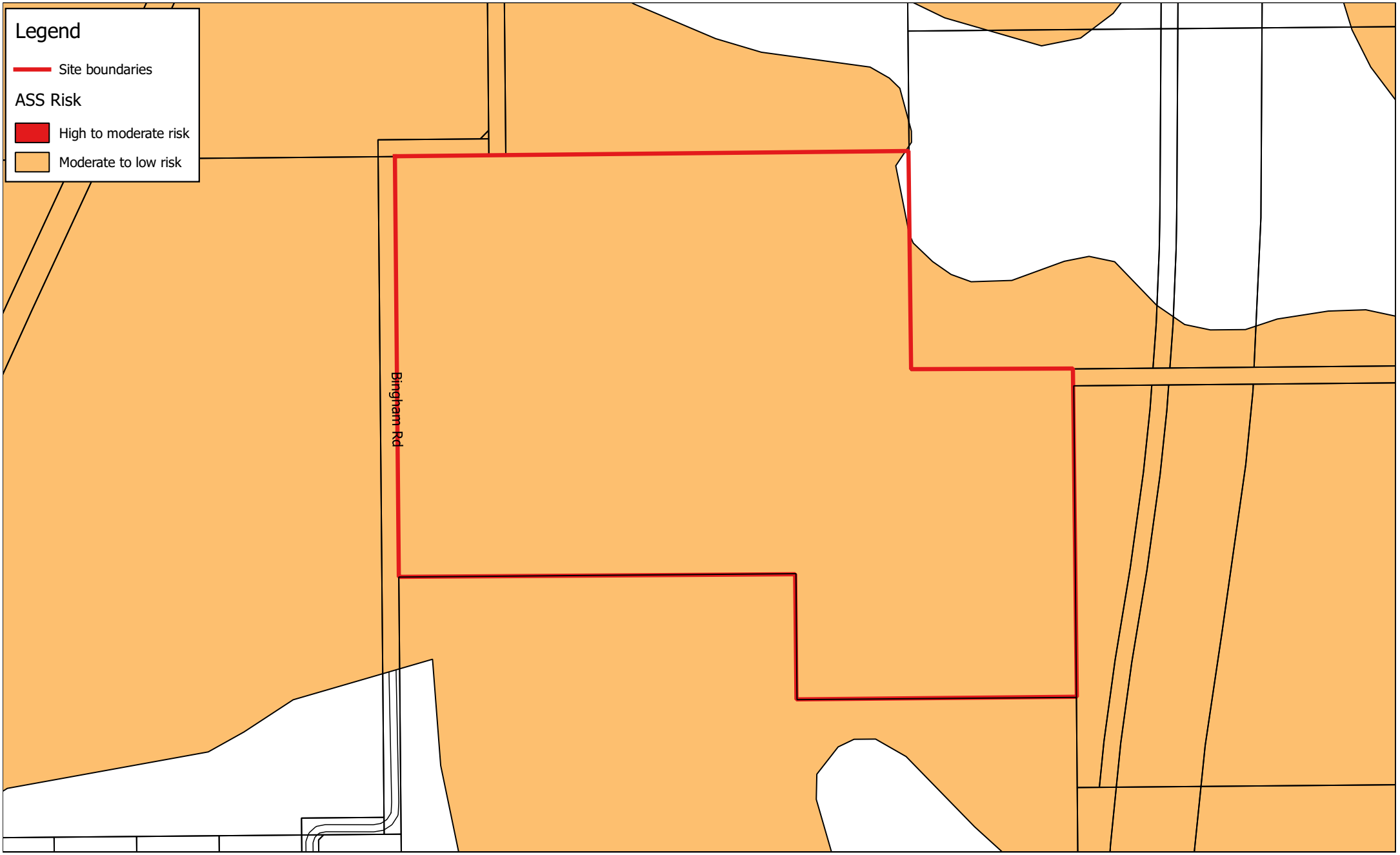

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FIGURE 4. ASS Risk Map

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DER 003 4283 mapping database

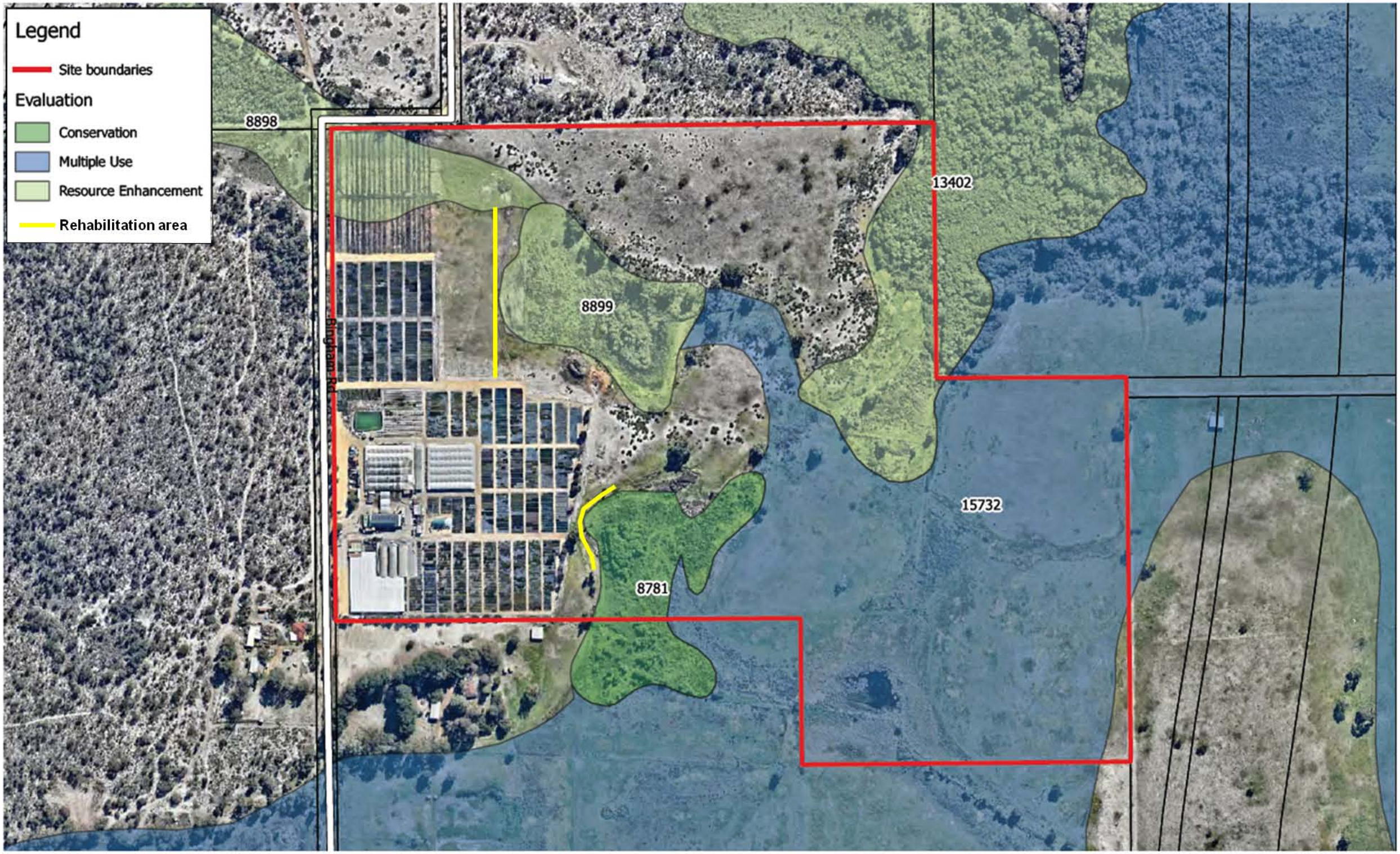

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FIGURE 5. Geomorphic Wetlands

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DoW GIS dataset, DPAW Geomorphic Wetlands

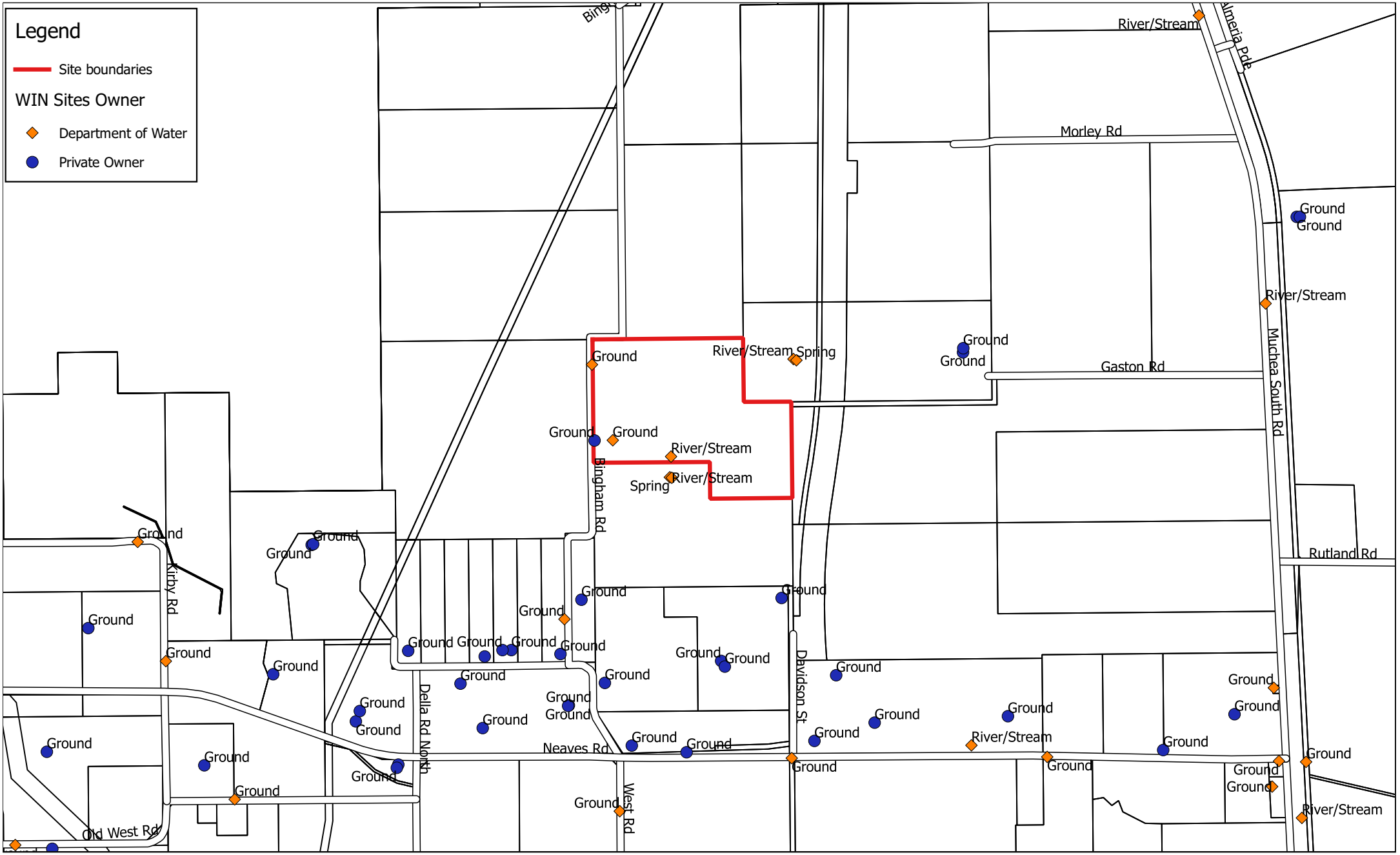

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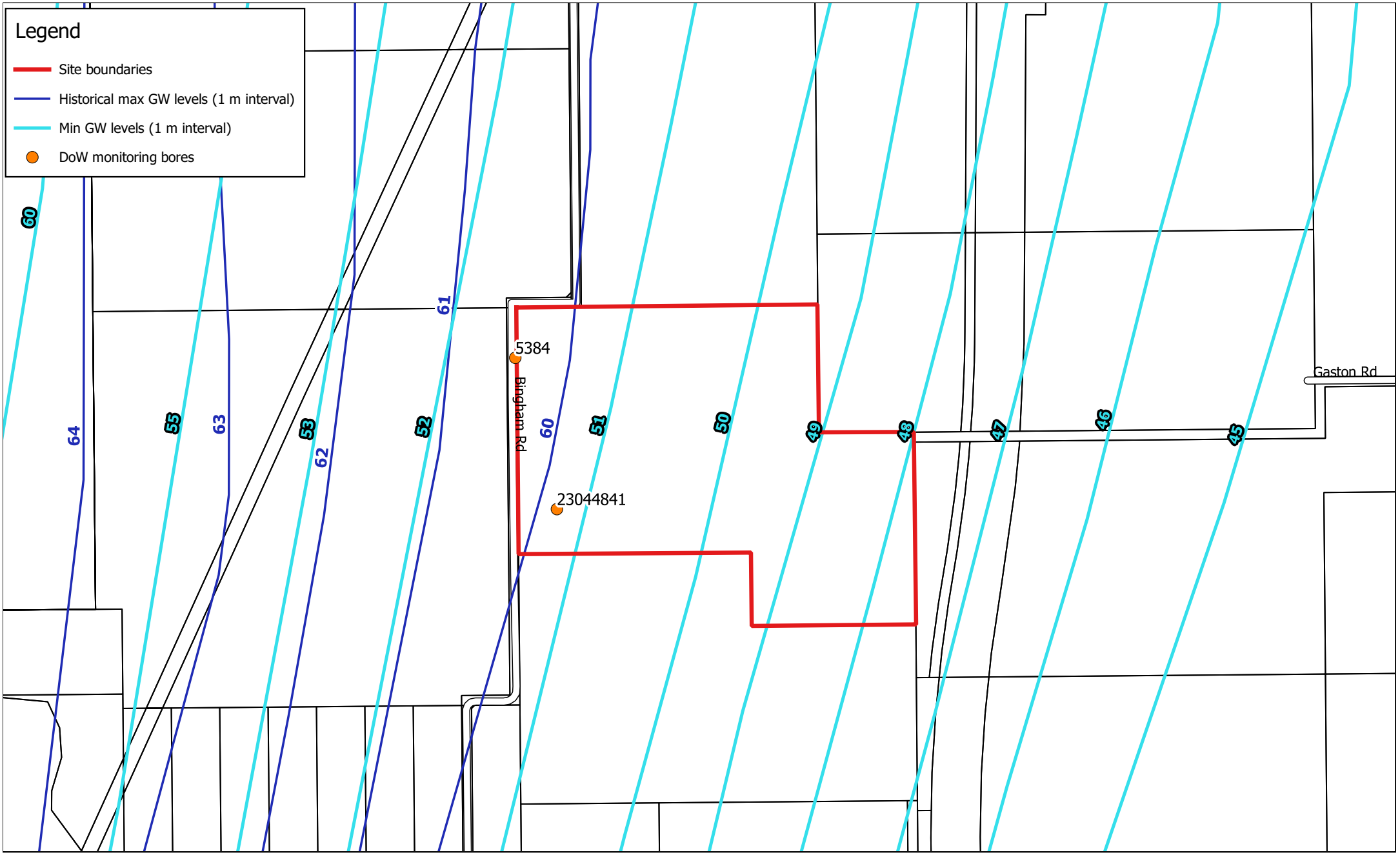
FIGURE 6. WIN Sites

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DoW GIS dataset



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100 0 100 200 m

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FIGURE 7. Groundwater Contours (mAHD)

Lot 88 (150) Bingham Rd, Bullsbrook

Source: DoW GIS dataset

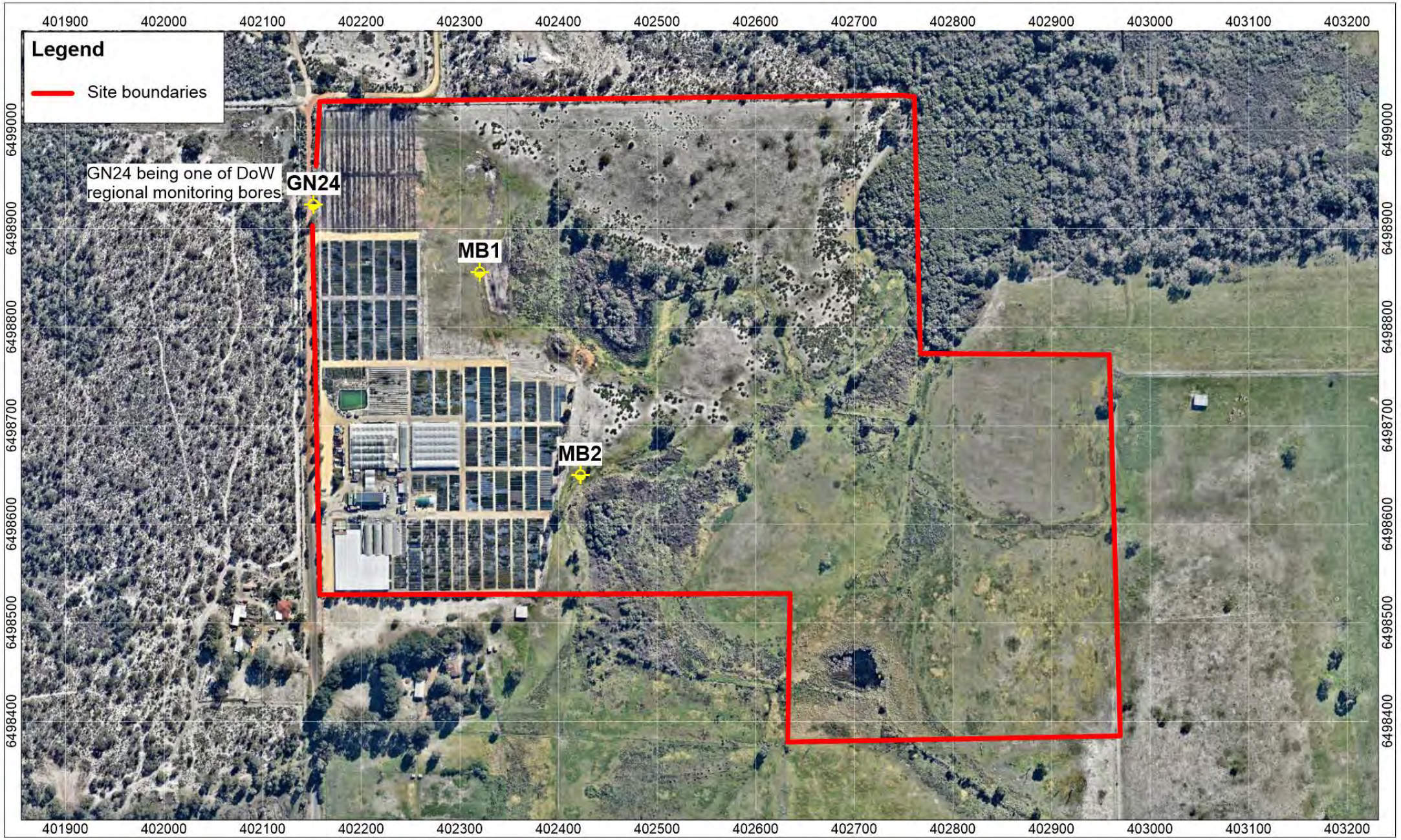

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FIGURE 8. Proposed Monitoring Bore Loc.

Lot 88 (150) Bingham Rd, Bullsbrook

Source: Nearmap (24/06/2016), Coordinate system: UTM Zone 50S