# Appendix E Banksia Woodland Community Assessment (Patch 1)

# Morley-Ellenbrook Line Planning

# Banksia Woodland Community Assessment

PUBLIC TRANSPORT AUTHORITY OF WESTERN AUSTRALIA

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**Morley-Ellenbrook Line Planning Banksia Woodland Community**

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# 1. INTRODUCTION

## 1.1 Project Overview

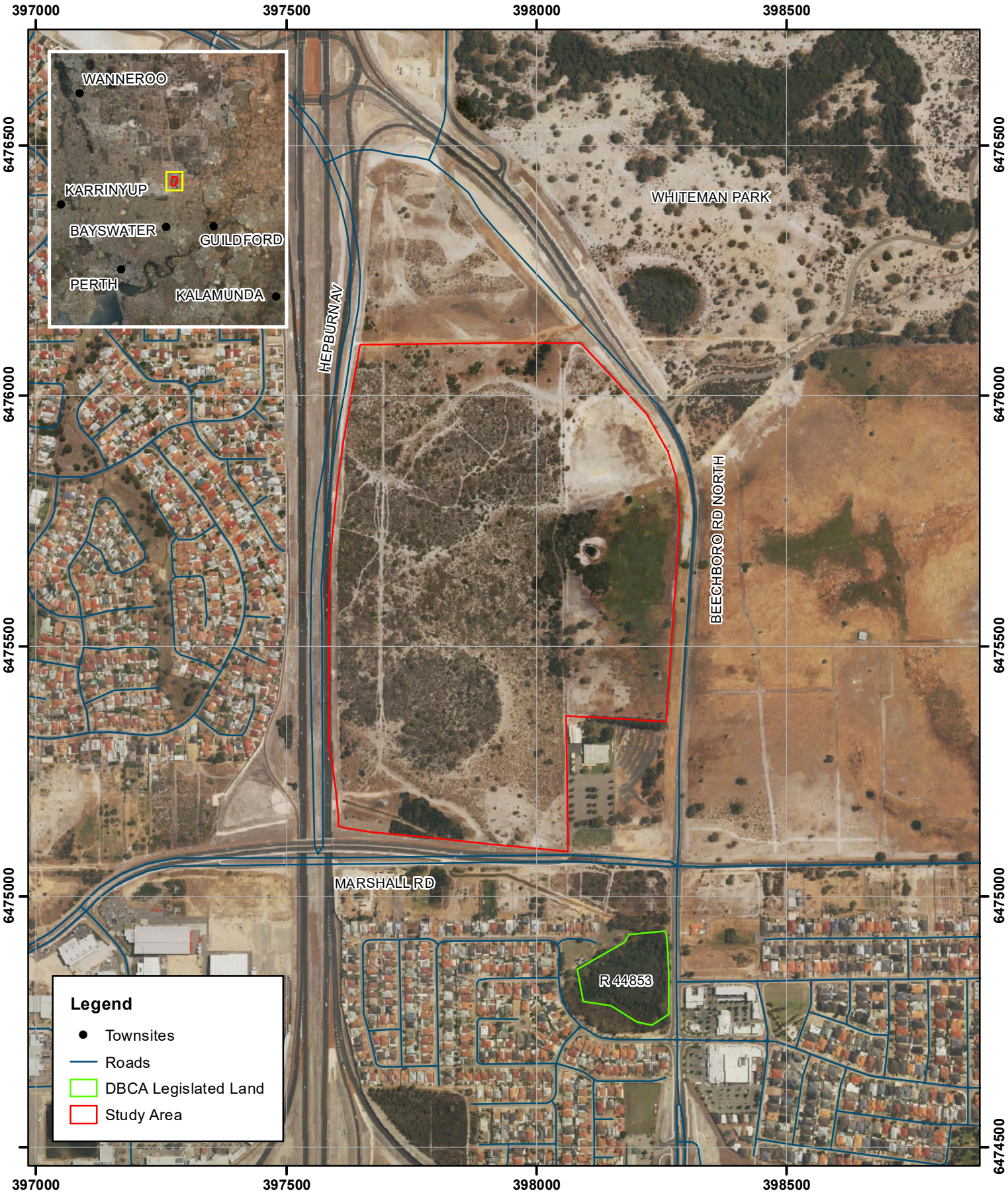
Metronet is responsible for delivering construction of the Metronet light rail development on behalf of the Public Transport Authority of Western Australia (PTA). The Metronet light rail development includes the Morley-Ellenbrook Line which runs from Malaga, east through Whiteman Park to Bennett Springs East Station, then north to Ellenbrook running adjacent to Lord Street (the Project). The line spans a distance of approximately 21 km.

Flora and vegetation surveys of the Morley-Ellenbrook Line indicative development envelope undertaken by RPS Australia West Pty Ltd (RPS) (RPS 2020) identified and mapped an area of the Banksia Woodlands of the Swan Coastal Plain TEC (Endangered) at Malaga.

Metronet commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to review flora and vegetation information relating to the Project and identify and map areas of ecological importance, including areas mapped as the Banksia Woodlands of the Swan Coastal Plain TEC to support the approvals process.

## 1.2 Study Area Definition

Metronet has provided the Project Study Area (the Study Area), as shown on Figure 1. The Study Area is 59.73 ha in size, located approximately 12 km north of Perth City at the location of the proposed Malaga rail station. The Study Area is comprised of freehold land.

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| **Study Area Location** | Author:Alison Saligari | N |
| | WEC Ref: PTA20-24-01 | |
| WOODMAN ENVIRONMENTAL | Filename: PTA20-24-01-f01 | **Figure** |
| | Scale: 1:10,000 (A4) | 1 |
| | Projection: GDA 1994 MGA Zone 50 | |
| This map should only be used in conjunction with WEC report PTA20-24-01. | Revision: A - 20 May 2020 | |

## 1.3 Aim and Objectives

The primary aim of this assessment was to identify and map areas of ecological importance within the Study Area, including the assessment of the extent of the Commonwealth listed Banksia Woodland TEC, to the current regulatory standard. This assessment was conducted as per the Scope of Works (SoW) provided by Metronet (Appendix A).

The overall objectives of the assessment were to:

- Review of available flora and vegetation information relating to the Study Area;
- Undertake an analysis of the existing quadrat data relevant to the Study Area with the original Swan Coastal Plain (SCP) dataset (Gibson et al. 1994) and amended SCP dataset (Keighery et al. 2012);
- Identify, map and describe vegetation that occurs within the Study Area that is one of the following (hereafter referred to as significant vegetation):
    - Listed Threatened Ecological Communities (TEC) under the EPBC Act;
    - TEC as classified by the Department of Biodiversity, Conservation and Attractions (DBCA) and endorsed by the Western Australian (WA) Minister for the Environment;
    - Priority Ecological Communities (PEC) as classified by DBCA;
    - Area of wetland or riparian vegetation that is ground or surface water-dependent; and
    - Other significant vegetation as defined by Environmental Protection Authority (EPA) (2016a; b).

The survey and reporting works comply with the following documents:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a);
- Environmental Factor Guideline – Flora and Vegetation (EPA 2016b); and
- Approved Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain TEC as described in the formal listing advice (Threatened Species Scientific Community (TSSC) 2016).

Other specific guidance documents used as part of this survey are detailed in the results section of this report.

# 2. METHODS

## 2.1 Desktop Review

A review of all publicly available flora and vegetation data relevant to the Project was undertaken to identify all known information with regard to Banksia Woodlands of the Swan Coastal Plain TEC, and its presence in the Study Area. This included obtaining and reviewing copies of reports of previous biological surveys carried out within the Study Area, and interrogation of relevant databases and other sources as listed in Table 1.

**Table 1: Sources of Information Reviewed for the Desktop Study**

| Report / Dataset | Source | Purpose |
|---|---|---|
| Swan Coastal Plain (SCP) dataset | Gibson *et al.* (1994) (extracted from *NatureMap* (DBCA 2007-)) | • Physical location of SCP quadrats relevant to this assessment;<br>• Species composition SCP quadrats relevant to this assessment. |
| Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset | Keighery *et al.* (2012) (extracted from *NatureMap* (DBCA 2007-)) | • Physical location of SCP quadrats relevant to this assessment;<br>• Species composition SCP quadrats relevant to this assessment. |
| A Floristic Survey of the southern Swan Coastal Plain report | Gibson *et al.* (1994) | • Summary of relevant significant vegetation, including 'typical taxa', 'other common taxa' and mean species richness;<br>• Differences between related community types. |
| Detailed Flora and Vegetation Assessment Metronet Morley-Ellenbrook line. | RPS (2020) | • Location of quadrats in the Study Area;<br>• Species composition of quadrats;<br>• Vegetation type mapping and condition mapping of Study Area;<br>• Method and results of statistical analysis. |
| Level 2 Flora and Vegetation Assessment, Perth-Darwin National Highway | Prepared by Coffey Services Australia Pty Ltd (Coffey) (2015) for Main Roads WA | • Location of quadrat SVB014A in the Study Area;<br>• Species composition of quadrat SVB014A;<br>• Vegetation type mapping and condition mapping of Study Area;<br>• Method and results of statistical analysis. |
| DBCA TEC and PEC lists | Review of current DBCA TEC and PEC lists (DBCA 2018, 2019) | • Identify any DBCA listed TECs or PECs which could occur within the Study Area. |

## 2.2 Personnel and Licensing

Table 2 lists the personnel involved in fieldwork for the survey. All field personnel have had extensive previous experience (Greg Woodman >25; Years; Alison Saligari >7 years) in conducting similar flora surveys in the SCP bioregion. All plant material was collected under the *Flora Taking (Biological Assessment) licences* and *Authorisation to Take or Disturb Threatened Species* pursuant to the *Biodiversity Conservation Act* 2016, sections 40, 274 and 275, as listed in Table 2.

**Table 2: Personnel and Licensing Information**

| Personnel | Flora Collecting Permit (BC Act/WC Act) | Role |
|---|---|---|
| Greg Woodman | FB62000053<br>TFL19-1819 | Field survey |
| Alison Saligari | FB62000048<br>TFL25-1819 | Field survey / Project Manager |

## 2.3 Field Survey Methods

Field survey was undertaken on the 11th of May 2020. The field survey involved traversing the Study Area to verify the presence and boundary of significant vegetation, including the

Banksia Woodlands of the Swan Coastal Plain TEC. This included reviewing previously mapped vegetation boundaries and vegetation condition (section 2.6). The field survey involved recording data and observations based on the four key diagnostic characteristics for the Banksia Woodlands of the Swan Coastal Plain TEC as described in the Approved Conservation Advice (TSSC 2016).

## 2.4 Pattern Analysis

Classification analysis methods generally followed those presented in Gibson *et al.* (1994). As per Gibson *et al.* (1994), singletons (i.e. any taxon occurring only once in the quadrat dataset) were removed from the dataset prior to analysis. Hybrids were also excluded, as well as taxa whose identification was unclear because of poor available material, except when such a taxon (with multiple records in the dataset) was known to be unique in the dataset (i.e. although not identifiable to species level, there was enough material to indicate a unique taxon). As per Gibson *et al*. (1994), introduced taxa were included in the dataset.

As per Gibson *et al.* (1994), a single-layer data matrix (i.e. presence/absence data only) was used in the classification analysis, with PATN (V3.12) (Belbin and Collins 2009) utilised to perform the classification and ordination analysis of the data matrix. Also as per Gibson *et al.* (1994), the Bray-Curtis coefficient was used to generate an association matrix for the classification analysis. This association matrix consisted of pairwise coefficients of similarities between quadrats based on floristic data. Agglomerative hierarchical clustering, using flexible Unweighted Pair Group Method with Arithmetic Mean (UPGMA) (ß=-0.1), was used to generate a quadrat classification dendrogram (Sneath and Sokal 1973).

Classification analyses were conducted using; the six RPS / Coffey quadrats located in the Study Area and DBCA's amended SCP floristic quadrat dataset ('amended SCP dataset') (Keighery *et al.* 2012), as well as the six RPS / Coffey quadrats and DBCA's original SCP dataset (Gibson *et al.* 1994). The amended SCP dataset contains those quadrats established by Gibson *et al.* (1994), as well as over 500 additional sites (quadrats and relevés) established by the DBCA subsequent to that survey. Analyses were conducted using the six Study Area quadrats as a group and also as single quadrat insertions into the larger datasets. The analyses were conducted with the aim of examining the relationship of the six RPS Coffey quadrats (PTAQ08, PTAQ09, PTAQ10, PTAQ11, PTAQ12 and SVB014A) to those in the SCP quadrat datasets, and therefore their relationships to the vegetation of the wider southern SCP. The resultant dendrogram and taxon group matrices were examined; of particular focus was whether the quadrat groups produced by the first classification analysis were maintained in the subsequent classification analysis dendrograms.

## 2.5 Significant Vegetation Definition, Mapping and Description

Vegetation Types (VTs) were not defined as part of this survey as this did not form part of the scope for this assessment (Appendix A). Significant vegetation was defined and mapped within the Study Area based on the data from quadrats previously established in the Study Area by RPS (2020), as well as observations recorded in the field from the current survey. Therefore, significant vegetation was defined using a combination of floristic composition classification (i.e. via a floristic classification analysis as outlined in Section 2.4), and structural

vegetation classification undertaken in the field, as defined in the technical guidance for flora and vegetation surveys (EPA 2016a). Significant vegetation was mapped and described based on the diagnostic characteristics for the Banksia Woodlands of the Swan Coastal Plain TEC as described in the Approved Conservation Advice (TSSC 2016).

The locations of previously established quadrats (RPS 2020; Coffey Environments Australia Pty Ltd (Coffey) 2015) were used in conjunction with aerial photograph interpretation and field notes taken during the current survey to develop significant vegetation mapping polygon boundaries. These mapping polygon boundaries were then digitised using Geographic Information System (GIS) software.

## 2.6 Vegetation Condition Mapping

Vegetation condition was described using the vegetation condition scale presented in the Approved Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain TEC (TSSC 2016). (see Table 3). The condition scale descriptions presented in the conservation advice have some minor differences to those presented in the Technical Guidance for vegetation surveys (EPA 2016a). Vegetation condition was recorded during the field survey via foot traverses undertaken within the Study Area. Vegetation condition category polygon boundaries were developed using this information and were digitised using GIS software as for VT polygon boundaries.

**Table 3: Vegetation Condition Categories and Indicative Measures/Thresholds for Assessment (TSSC 2016)**

| Condition Ranking | Description | Indicative condition measures/thresholds | |
|---|---|---|---|
| | | Typical native vegetation composition | Typical weed cover |
| Pristine | No obvious signs of disturbance. | Native plant species diversity fully retained or almost so[5] | Zero or almost so weed cover / abundance |
| Excellent | Vegetation structure intact; Disturbance only affecting individual species; Weeds are non-aggressive species. | High native plant species diversity[5] | Less than 10%. |
| Very Good | Vegetation structure altered; Obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing. Aggressive weeds present. | Moderate native plant species diversity[5] | 5 – 20% |
| Good | Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance, e.g. from partial clearing, dieback, logging, grazing. Presence of very aggressive weeds. | Low native plant species diversity[5] | 5 – 50% |
| Degraded | Basic vegetation structure severely impacted by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density | Very low native plant species diversity[5] | 20 – 70% |

| Condition Ranking | Description | Indicative condition measures/thresholds | |
|---|---|---|---|
| | | Typical native vegetation composition | Typical weed cover |
| Completely Degraded | Vegetation structure is no longer intact and the area is completely or almost completely without native flora. Equivalent to 'Parkland Cleared'. | Very low to no native species diversity[5] | Greater than 70% |

[5]Relative to expected natural range of diversity for that vegetation unit (e.g. Floristic Community Type), where comparative data exists.

## 2.7 Significant Vegetation

As per EPA (2016b), vegetation may be significant for a range of reasons, including, but not limited to the following:

- Being identified as a TEC or PEC (formally listed significant vegetation – includes vegetation listed under Commonwealth legislation, endorsed as a TEC by the Western Australian Government, or classified as a PEC by DBCA);
- Having restricted distribution;
- Degree of historical impact from threatened processes;
- A role as a refuge; and
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

The vegetation described by the study of the southern SCP by Gibson *et al.* (1994), together with supplementary vegetation description to this study published in Government of Western Australia (2000) as well as formal lists of TECs and PECs, is the current baseline used when assessing the significance of vegetation on the southern SCP. The vast majority of terrestrial TECs and PECs that occur on the southern SCP are Floristic Community Types (FCTs) described by this Study; the Study also provides information on the distribution of all FCTs described, as well as their conservation status.

Consequently, floristic analyses were undertaken to determine relationships between quadrats previously established in the Study Area and SCP FCTs defined by Gibson *et al.* (1994), with the aim of aligning these quadrats with SCP FCTs. However, as there is no formal guidance available on the most appropriate way to undertake this process, several different analytical approaches were employed, in an attempt to build supporting evidence for aligning quadrats with SCP FCTs. These were:

- Analysis of the six RPS / Coffey quadrats in the Study Area with the original SCP dataset (Gibson *et al.* 1994);
- Analysis of the six RPS / Coffey quadrats in the Study Area with the amended SCP dataset (Keighery *et al.* 2012), which includes more than 500 additional survey sites;
- Single site insertion analysis of the six RPS / Coffey quadrats in the Study Area, with the original SCP dataset (Gibson *et al.* 1994); and
- Single site insertion analysis of the six RPS / Coffey quadrats in the Study Area, with the amended SCP dataset (Keighery *et al.* 2012).

It should be noted that the metadata for the amended SCP dataset explicitly states that it is not suitable for FCT analysis due to "inconsistencies in the grouping and splitting of some species compared to that used in the Gibson *et al.* (1994) analysis". However, the exact dataset that DBCA used which included the more than 500 additional sites established on the SCP subsequent to the Gibson *et al.* (1994) study, which is referred to in the aforementioned metadata, does not appear to be publicly available. Therefore, the amended SCP dataset was used for analysis by this assessment, as the alternative of not using this dataset, and hence not considering a significant volume of data, was considered inappropriate in the absence of formal guidance on analysis methods. The argument that "inconsistencies in the grouping and splitting of some species compared to that used in the Gibson *et al.* (1994) analysis" is not considered to be reason enough to discount the dataset in this context; such issues are likely to frequently arise when a historical dataset is only periodically updated to reflect current taxonomic concepts. However, it considered unlikely that such issues would have a significant bearing on analysis results in this current context.

Further to this, as noted above, a dataset similar to the amended SCP dataset has been re-analysed by the DBCA on behalf of the former Department of Environmental Protection (Government of Western Australia 2000), with supplementary SCP FCT descriptions published as a result; however, the methods of this analysis are not documented in Government of Western Australia (2000), and apparently were never fully documented (V. English *pers. comm.* 2015). It is apparent that DBCA used the ALOC non-hierarchical classification technique, whereby the groups of quadrats that formed the basis of the original SCP FCTs were 'locked' in place, and additional quadrats were allocated to these groups or to new groups via analysis (V. English *pers. comm.* 2015). It is assumed, although there is no documented evidence, that the single site insertion approach was then used, whereby quadrats were added singly to the locked dataset. FCTs were then assigned to the additional survey sites contained in the amended SCP dataset based on the results of the analyses (Keighery *et al.* 2012). It is assumed that these methods were used as re-analysis of the entire amended SCP dataset would have caused significant disruption (based on previous unpublished analyses conducted by Woodman Environmental) to the original quadrat groupings that were used to define FCTs in Gibson *et al.* (1994), given such a large volume of data was added. The original FCTs described by Gibson *et al.* (1994) could not have been maintained using this approach. The ALOC analysis approach does not appear to be widely used; the DBCA does not appear to have published any studies that have used this method, with recent studies published by the DBCA using the classification methods outlined in Section 2.4.

Analysis methods and parameters were the same as used for the analysis of the quadrats in the Study Area as outlined in Section 2.4; as noted in Section 2.4, these are the same methods utilised by Gibson *et al.* (1994).

The resultant analysis dendrograms were then reviewed to determine the position of quadrats in the Study Area in relation to quadrats from the SCP quadrat datasets; from this, FCT relationships were inferred. It should be noted that there is inherent uncertainty in the inferences made, as all of the analytical approaches outlined above do not maintain the original quadrat groupings that formed the basis for the original FCTs defined by Gibson *et al.* (1994) in resultant dendrograms. Taxon lists of the six RPS / Coffey quadrats in the Study Area

were also compared to the typical species lists for SCP FCTs presented in Gibson *et al.* (1994), as well as quadrat taxon lists, soils, topography and geographical distribution data from this study; this was to provide further support for the inferences made following dendrogram examination. Note that quadrats from the amended SCP dataset were not considered as part of this process.

With regard to other TECs and PECs listed in Western Australia that were not described in the Gibson *et al.* (1994) study, only broad descriptions generally are provided in the respective TEC and PEC lists published by the DBCA to allow for diagnosis. The vegetation of the Study Area was therefore manually compared to such descriptions to determine whether any vegetation may represent such a TEC or PEC. A similar process was followed for TECs listed under the EPBC Act, with the vegetation of the Study Area assessed against the appropriate listing and conservation advice for any TECs likely to occur in the Study Area.

# 3. LIMITATIONS OF SURVEY

This assessment did not include an audit of the data collected by RPS (2020) and Coffey (Coffey 2015). The taxa listed in the quadrats are assumed to be correct and the analysis has been undertaken on the supplied data. Conclusions drawn therefore are wholly based on this data. Additionally, portions of the Study Area not containing quadrats could not be assessed against the SCP datasets to determine likely SCP FCTs.

In terms of the field assessment undertaken by Woodman Environmental for the Project, the timing was outside the recommended survey timing for vegetation surveys for the south-west province (spring) (EPA 2016a). An out of season survey was considered adequate given the purpose of the current survey was primarily to determine the condition and boundary extent of the Banksia Woodland TEC. However, it is recognised that weed cover in early May (when the survey was undertaken) would be much lower than weed cover levels present in spring, which is an important factor to consider when assigning condition rankings to vegetation. To mitigate this, searching for all signs of weeds (including old dead weeds) was undertaken and this issue was taken into consideration when assigning condition categories.

The vegetation condition of the Study Area has been subjected to various previous disturbances (discussed further in section 4.3). The high level of disturbance evident has resulted in significant impacts to vegetation structure in some areas of vegetation, particularly in the south-east corner of the Study Area, making it difficult to discern which vegetation type previously occurred in the area. In these cases, the vegetation was not mapped as the Banksia Woodland TEC as it was not possible to accurately conclude that the community was previously there, despite there being some indicators (such as soil type, topography, remaining taxa present, etc.) that the community may have been present in the area previously.

The description of vegetation condition category rankings presented in the EPA Technical Guidance (EPA 2016a) differ slightly between the categories presented in the approved conservation advice for the Banksia Woodland TEC (TSSC 2016). Condition rankings of the Study Area presented in the flora and vegetation assessment by RPS (2020) was undertaken as per the current Technical Guidance as recommended for flora and vegetation surveys (EPA

2016a). In the current assessment the condition scale from the conservation advice was used TSSC 2016) as the focus of this assessment was on the presence and condition of the Banksia Woodland TEC. As a result, variations in condition rankings between this assessment and the RPS (2020) assessment may be influenced by differences between the two condition scales.

# 4. RESULTS AND DISCUSSION

## 4.1 Review of Local Flora and Vegetation Surveys

Two flora and vegetation surveys which are relevant to this assessment, have been undertaken within the Study Area. Data from five quadrats assessed by RPS (2020) and one quadrat assessed by Coffey (Main Road WA 2015) was used in the analysis undertaken for this assessment. A brief overview of these survey reports is provided below (Table 4).

**Table 4: Summary of Flora and Vegetation Surveys Previously Conducted in the Local Area**

| Report Title and Author | Location and Scope | Key Findings (Flora and Vegetation only) |
|---|---|---|
| Detailed Flora and Vegetation Assessment Metronet Morley-Ellenbrook line (RPS 2020) | Overlaps the Study Area Detailed and Targeted Survey – 1,358.61 ha | • Recorded 374 taxa from 74 families and 211 genera.<br>• 32 quadrats (10 x 10 m) and 16 relevés - 19 quadrats were surveyed twice with the remaining 13 quadrats proposed for re-survey in Autumn 2020.<br>• Field survey was conducted in spring 2017, spring 2018, autumn 2019 and spring 2019.<br>• Three significant taxa were recorded including *Cyathochaeta teretifolia* (P3), *Anigozanthos humilis* subsp. *chrysanthus* (P4) and *Tetraria* sp. Chandala (G.J. Keighery 17055) (P2).<br>• Recorded 84 introduced taxa.<br>• 21 vegetation units mapped within survey area.<br>• Three listed significant vegetation communities were identified and mapped during the survey including Banksia woodlands of the Swan Coastal Plain ecological community TEC (Endangered);, FCT21c – Low-lying Banksia attenuata woodlands or shrublands PEC (P3) and FCT23b - Swan Coastal Plain Banksia attenuata - Banksia menziesii woodlands (P3). |
| Level 2 Flora and Vegetation Assessment, Perth-Darwin National Highway Prepared by Coffey for Main Roads WA (Main Roads WA 2015) | South end of the Project Area overlaps the Study Area<br>Level 2 Survey (now a Detailed and Targeted Survey) – 765 ha | • Recorded 456 taxa from 73 families and 234 genera.<br>• 93 quadrats (10 x 10 m) and 27 relevés.<br>• Field survey was conducted in September and November 2014.<br>• Nine significant taxa were recorded including *Caladenia huegelii* (T), *Grevillea curviloba* subsp. *incurva* (T), *Millotia tenuifolia* var. *laevis* (P2), *Poranthera moorokatta* (P2), *Cyathochaeta teretifolia* (P3), *Anigozanthos humilis* subsp. *chrysanthus* (P4), *Hypolaena robusta* (P4), *Ornduffia submersa* (P4) and *Stylidium striatum* (P4).<br>• Recorded 99 introduced taxa.<br>• 60 vegetation associations mapped within survey area.<br>• 11 listed significant vegetation communities were identified and mapped during the survey including<br>○ Clay Pans on the Swan Coastal Plain; *Casuarina obesa* association (PEC; P1)/Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs (PEC; P1 and Critically Endangered under the EPBC Act),<br>○ Mound Springs TEC (Critically Endangered)<br>○ SCP02 (Southern wet shrublands): TEC (Endangered)<br>○ SCP20a (Banksia attenuata woodlands over species rich dense shrublands): TEC (Endangered),<br>○ SCP21c (Low lying Banksia attenuata woodlands or shrublands): PEC (P3)<br>○ SCP22 (Banksia ilicifolia woodlands): PEC (P2)<br>○ SCP23b (Northern Banksia attenuata – Banksia menziesii woodlands): PEC (P3),<br>○ SCP24 (Northern Spearwood shrublands and woodlands): PEC (P3),<br>○ Banksia dominated woodlands of the Swan Coastal Plain PEC (P3) / TEC (Endangered) under the EPBC Act |

## 4.2 Assessment of Banksia Woodlands of the Swan Coastal Plain TEC (Endangered)

A total of 23.23 ha was mapped as the Banksia Woodlands of the Swan Coastal Plain TEC (Endangered) (Figure 2). This was based on a combination of field observations and the quadrat data from the Study Area. The boundaries of the community are relatively obvious for the most part, with cleared areas or wetland vegetation bordering much of this area. There is a gradual grading of the vegetation into a wetland community on the east side where the border is somewhat unclear, however, the loss of typical Banksia Woodland species and increased presence of wetland indicator species such as *Hypocalymma angustifolium* at this location were utilised to verify this boundary.

The vegetation in the south-east of the Study Area is Degraded (condition is discussed further in section 4.3), with vegetation structure severely impacted and consisting predominantly of *Nuytsia floribunda* over *Xanthorrhoea preissii* (Plate 1). It was not possible to accurately conclude which vegetation community was previously in this area, despite there being some indicators (such as topography, remaining taxa present, etc.) that a Banksia community may have been present in the area previously. Therefore, this area was not mapped as the Banksia Woodlands of the Swan Coastal Plain TEC in this assessment.

**Plate 1: Degraded Vegetation within the South-East Corner of the Study Area**

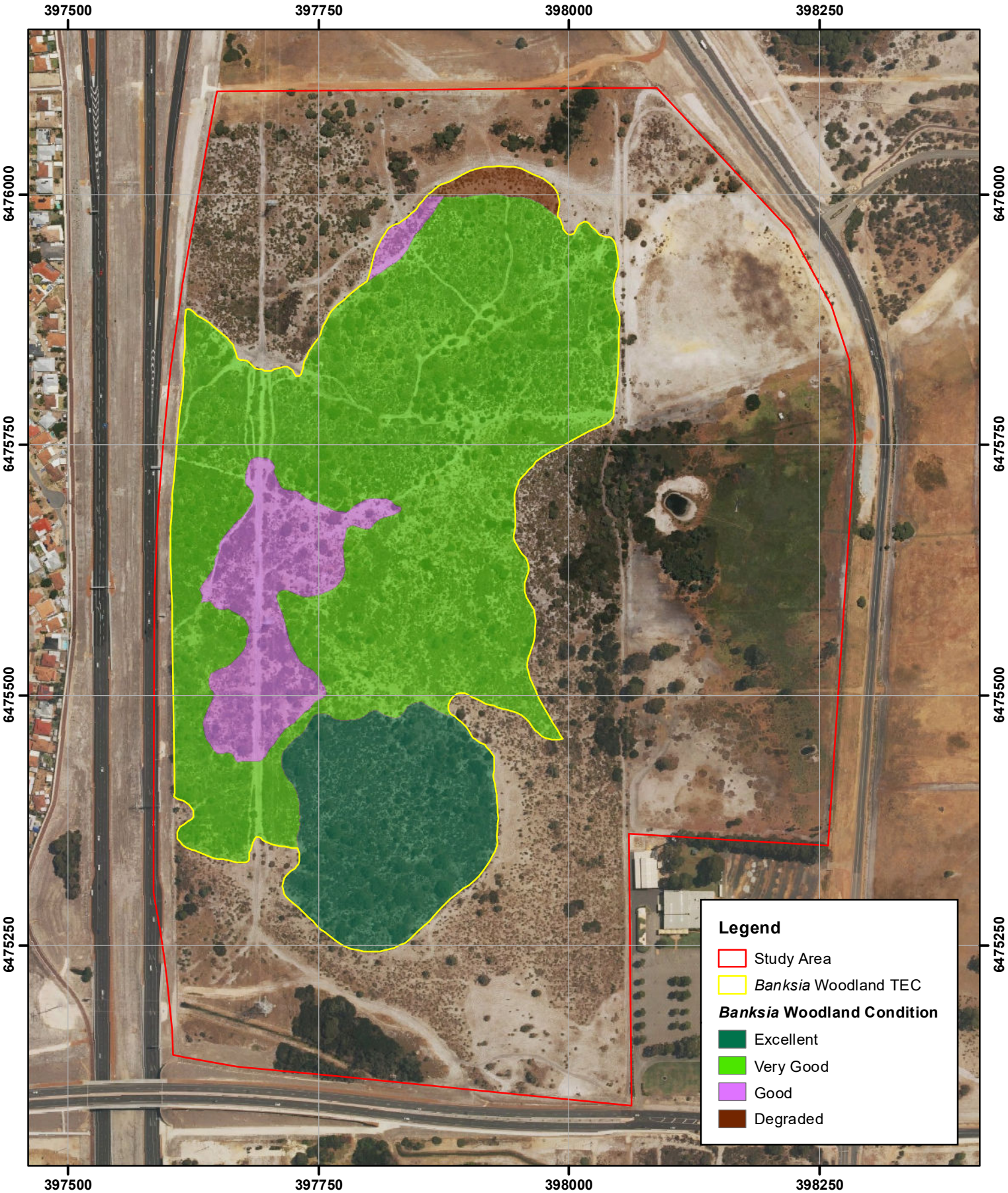
## 4.3 Condition of Banksia Woodlands of the Swan Coastal Plain TEC (Endangered)

Vegetation condition was assessed for the area mapped as the Banksia Woodlands of the Swan Coastal Plain TEC by this assessment. The majority of the TEC was in Very Good

condition (16.08 ha) with the dune in south rated as Excellent (4.1 ha) and two smaller areas of Good vegetation (2.75 ha). There is also a small area mapped as Degraded (0.3 ha) on the north border of the community. Condition mapping is presented on Figure 2.

The Study Area has been subjected to numerous previous disturbances including disturbance associated with large populations of kangaroo and rabbits, transmission line construction, possible historical grazing and weeds. In addition, Dieback Disease (*Phytophthora cinnamomi*) has been mapped throughout the lower lying areas of the Study Area (Glevan Consulting 2020) (Plate 2) which has severely impacted the vegetation structure through the low lying areas and especially in the south-east corner of the Study Area.

**Plate 2: Open Banksia Woodland Community in Low Lying Areas**

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| **Banksia Woodlands of the Swan Coastal Plain TEC (Endangered) - Condition** | Author:Alison Saligari | N |
| | WEC Ref: PTA20-24-01 | |
| WOODMAN ENVIRONMENTAL | Filename: PTA20-24-01-f02 | **Figure** |
| | Scale: 1:5,000 (A4) | 2 |
| | Projection: GDA 1994 MGA Zone 50 | |
| This map should only be used in conjunction with WEC report PTA20-24-01. | Revision: A - 20 May 2020 | |

## 4.4 Relationships of Quadrats to SCP FCTs

As described in Section 2.4, classification and ordination analysis was undertaken to determine relationships between quadrats assessed in the Study Area and SCP FCTs defined by Gibson *et al.* (1994), with the aim of aligning quadrats with SCP FCTs. Several different analytical approaches were employed to build supporting evidence for aligning quadrats with SCP FCTs. Additionally, taxon lists of RPS / Coffey quadrats were also compared to the typical species lists for SCP FCTs presented in Gibson *et al.* (1994), as well as soils, topography and geographical distribution data from this study. **Error! Reference source not found.** presents a summary of the results of this process.

Excerpts from classification analysis dendrograms are presented in appendices as follows:

- Analysis of the RPS / Coffey quadrats with the original SCP dataset (Gibson *et al.* 1994) – Appendix B;
- Analysis of the RPS / Coffey quadrats with the amended SCP dataset (Keighery *et al.* 2012) – Appendix C;
- Single site insertion analysis of RPS / Coffey quadrats, with the original SCP dataset (Gibson *et al.* 1994) – Appendix D; and
- Single site insertion analysis of RPS / Coffey quadrats, with the amended SCP dataset (Keighery *et al.* 2012) – Appendix E.

As discussed in Section 2.7, because of the lack of formal guidance regarding the appropriate methodology for aligning vegetation with SCP FCTs, and also the lack of information regarding how new quadrats contained in the amended SCP dataset were assigned to SCP FCTs, the quadrat-FCT alignment determinations presented in Table 5 cannot be considered absolutely conclusive. However, the determinations were generally supported by the results of multiple analyses, including analyses that follow DBCA's standard analysis methods. Comparisons of quadrat taxon lists also supported the determinations in all cases. There were a few cases where the results of one or a few of the analyses did not entirely support the final determination made. These are discussed in Table ***5***.

It should also be noted that Study Area quadrats were often classified into groups with a subset of quadrats from SCP FCTs, rather than all quadrats. This was expected; quadrat groupings usually change, sometimes significantly, when data is added to or removed from a dataset and analysed, particularly where the base dataset is not a comprehensive sample of the area sampled and even if exactly the same parameters are used. Further to this, many quadrats that were originally classified together can be re-classified in completely different groups when such changes are made. However, it is not considered appropriate to 'lock' existing groups in place prior to adding data to a dataset in this context; this results in the relationships between all quadrats in the data not being fully considered, as the assumption is made that the quadrats within the existing groups must be most similar to each other. This therefore eliminates the scenario that some quadrats in the group may be better classified in other groups following the addition of new data to a more comprehensive dataset. In the case of SCP FCTs, the original SCP study (Gibson *et al.* 1994) defined the FCTs with what is considered to be a limited dataset of only around 500 quadrats across a very large spatial extent, and within an area renowned for high endemism and β diversity. To 'lock' the original groups, prior to essentially doubling the size of the dataset for the analysis of the amended

SCP dataset, does not seem particularly appropriate, as it essentially assumes a complete understanding of the characteristics of the original FCTs.

Overall, the results of the analyses undertaken combined with a review of the quadrat data and FCT vegetation descriptions and distributions indicate that all six quadrats represent FCT 23a (Table 5).

**Table 5: Summary of Analyses and Comparisons to Determine Relationships of Quadrats to SCP FCTs**

| Quadrat | Analysis with all Study Area and amended SCP dataset | Analysis with all Study Area and original SCP dataset | Single insertion – amended SCP dataset | Single insertion – original SCP dataset | Final determination |
|---|---|---|---|---|---|
| PTAQ08 | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 23a**<br>Quadrat PTAQ08 singly inserted – classified within a large group of SCP quadrats which predominantly represent FCT 23a, except for five quadrats that represent FCT 20a. | **FCT 23a**<br>Quadrat PTAQ08 singly inserted – classified within a large group of SCP quadrats that all represent FCT 23a, except for a single quadrat that represent FCT 23b. | **FCT 23a**<br>Comparison of FCT description also supports this determination, as does species richness compared to most closely related quadrats and the distribution of FCT23a. |
| PTAQ09 | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that predominantly represent FCT 23a, except for a small grouping of quadrats that represent FCT 23b/23a. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 23b**<br>Quadrat PTAQ09 singly inserted – classified within a group of SCP quadrats that all represent FCT 23b, except for a single adjacent quadrat representing FCT 23a. | **FCT 23a**<br>Quadrat PTAQ09 singly inserted – classified within a group of SCP quadrats that predominately represent FCT 23a. Group also includes quadrats that represent FCT 23b and FCT 20a. Quadrat situated on the periphery of the FCT 23a group. | **FCT 23a**<br>Comparison of FCT description also supports this determination as does the distribution of FCT23a. Quadrat PTAQ09 is relatively species poor in comparison to quadrats within FCT23a and 23b, however, this is likely to be related to the vegetation condition / disturbance rather than it being a different FCT. |
| PTAQ10 | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a.. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 23a**<br>Quadrat PTAQ10 singly inserted – classified within a large group of SCP quadrats that all represent FCT 23a. | **FCT 23a**<br>Quadrat PTAQ10 singly inserted – classified within a large group of SCP quadrats that all represent FCT 23a, except for a single quadrat that represent FCT 23b. | **FCT 23a**<br>Comparison of FCT description also supports this determination, as does species richness compared to most closely related quadrats and the distribution of FCT23a. |
| PTAQ11 | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 20c**<br>Quadrat PTAQ11 singly inserted – classified within a large group of SCP quadrats that represent a variety of FCTs including FCT 20c, 21c and 28, located within the small grouping of quadrats that represent FCT 20c. | **FCT 20c**<br>Quadrat PTAQ11 singly inserted – classified within a large group of SCP quadrats that represent a variety of FCTs including FCT 20b, FCT 21a and 20c, located within the small grouping of quadrats that represent FCT 20c. | **FCT 23a**<br>Comparison of FCT description also supports this determination, as does species richness compared to most closely related quadrats and the distribution of FCT23a (FCT 20c is distributed further to the east). |
| PTAQ12 | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 23a**<br>Quadrat PTAQ12 singly inserted – classified within a large group of SCP quadrats that predominantly represent FCT 23a,except for five quadrats that represent 20a. | **FCT 23a**<br>Quadrat PTAQ12 singly inserted – classified within a large group of SCP quadrats that all represent FCT 23a. | **FCT 23a**<br>Comparison of FCT description also supports this determination, as does species richness compared to most closely related quadrats and the distribution of FCT23a. |

| Quadrat | Analysis with all Study Area and amended SCP dataset | Analysis with all Study Area and original SCP dataset | Single insertion – amended SCP dataset | Single insertion – original SCP dataset | Final determination |
|---|---|---|---|---|---|
| SVB014A | **FCT 20a**<br>Quadrat classified within a large group of SCP quadrats that are a mixture of FCT 20a 23b and 28, located within the small grouping of quadrats that represent FCT 20a. | **FCT 23a**<br>Quadrat classified within a large group of SCP quadrats that all represent FCT 23a, except for three quadrats that represent FCT 23b. | **FCT 23b**<br>Quadrat classified within a large group of SCP quadrats that are predominantly 23b, although there are numerous quadrats which represent FCT S09 and one quadrat representing FCT 20a, located within the small grouping of quadrats that represent FCT 23b, S09 and 20a. | **FCT 20a**<br>Quadrat classified within a large group of SCP quadrats that are a mixture of FCT 20a and 20c, located within the small grouping of quadrats that represent FCT 20a. | **FCT 23a**<br>Although the analyses returned mixed results, the vegetation description and distribution is more similar to FCT 23a. Quadrat SVB014A is relatively species poor in comparison to quadrats within FCT23a, however, this is likely to be related to the vegetation condition / disturbance rather than it being a different FCT. The lower species richness of this quadrat is likely to have reduced the association of this quadrat with any single SCP FCT within the regional datasets and resulted in the large variation in determinations observed utilising the different analyses. |

## 4.5 Patch Assessment of Banksia Woodlands of the Swan Coastal Plain TEC

The Approved Conservation Advice (TSSC 2016) for this community stipulates a four-step process for identifying this community. These steps are followed in the context of identifying whether vegetation of the Study Area represents this TEC, as outlined below. The first step involves key diagnostic characteristics (location and physical environment, soils and landform, structure, and composition). The Study Area has a single occurrence of vegetation meeting the description of Banksia Woodland (referred to as a Patch in the Approved Conservation Advice) that satisfies all four key diagnostic characteristics, as it:

- Occurs within the Swan Coastal Plain IBRA bioregion (Commonwealth of Australia 2012));
- Occurs on well drained, low nutrient soils on a sandplain landform; and
- Has a basic structure of a low woodland; and
- Is dominated by *Banksia attenuata* and *Banksia menziesii*, over a relatively diverse understorey.

The second step is the condition threshold of a Patch; The Approved Conservation Advice for this TEC then specifies that a patch of the TEC must meet the Good vegetation condition category as per Table 3 in the Conservation Advice for the community (TSSC 2016) to be considered a Patch of the TEC under the EPBC Act. As the condition of this Patch was predominantly mapped as Good / Very Good / Excellent, it therefore satisfies the condition threshold, and therefore is considered to be a Patch of the TEC under the EPBC Act.

The size of the Study Area Patch is 23.23 ha with no significant gaps other than a Western Power transmission line corridor that is partially cleared running South to North in the western side of the Study Area. This corridor is currently around 20m wide and therefore does not constitute a large enough gap to split the Patch. Condition rankings for the Patch are presented in section 4.3 and on Figure 2.

## 4.6 *Caladenia huegelii* (Threatened) Habitat Assessment

The Recovery Plan for *C. huegelii* (Department of Environment and Conservation (DEC) 2009), provides the following habitat description:

- Mixed woodland of *Eucalyptus marginata*, *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* and *Corymbia calophylla* over dense shrubs of *Stirlingia latifolia*, *Hypocalymma robustum*, *Hibbertia hypericoides*, *H. subvaginata*, *Xanthorrhoea preissii*, *Adenanthos cuneatus* and *Conostylis* species.
- Tends to favour areas of dense undergrowth.
- Soil is usually deep grey-white sand associated with the Bassendean sand-dune system.

The Recovery Plan states the critical habitat to be the area of occupancy of important populations, areas of similar habitat surrounding important populations, and additional occurrences of similar habitat (DEC 2009).

Hoffman, Brown and Brown (2019) states that *C. huegelii* grows in deep sandy soil in mixed *E. marginata*, *Banksia* woodland on the Swan Coastal Plain.

The advice of native orchid experts Andrew Brown (DPaW) and Kingsley Dixon (BGPA) has previously been sourced to obtain detailed descriptions of *C. huegelii* habitat preferences.

Andrew Brown (pers. comm. 2015) indicated that *C. huegelii* occurs on Bassendean sands of the Swan Coastal Plain in *Banksia* woodland anywhere in undulating land. *C. huegelii* can grow in association with but not always, *C. arenicola, C. paludosa, C. longicauda* subsp. *calcigena*.

Kingsley Dixon (pers. comm. 2015) stated that, in its northern range the habitat that *C. huegelii* occurs in tends to be woodland, varying from open to fairly closed *Banksia* dominated woodland. Plants may be found anywhere within the landscape of this habitat type. Vegetation types that can conclusively be excluded as potential habitat are lowland (damp land) vegetation communities, where the vegetation composition is composed of species that are not normally associated with *C. huegelii*.

Woodman Environmental has conducted numerous searches for *C. huegelii* over the past 17 years and has a thorough understanding of the variable vegetation and topographical habitat preferences of the orchid, including the recording of plants within degraded vegetation.

The nearest record of this taxon to the Study Area is located 2 km to the SSW within Lightning Swamp Reserve, with another located approximately 5 km to the North associated with the NorthLink Project area near Ellenbrook, within similar habitats to those present in the Study Area. Despite Targeted previous surveys of the Study Area (RPS 2020) for this taxon not identifying any *C. huegelii* individuals, the Banksia Woodland portion of the site meets the definition and is of suitable condition to be regarded as critical habitat for *C. huegelii.*

The Interim Recovery Plan defines Critical Habitat for this species as “Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. Jarrah/Banksia woodland on Bassendean sands), as these areas provide potential habitat for natural range extension and are necessary to support viable populations of the associated mycorrhizal fungus and pollinating wasp species crucial to the orchid’s survival, and to allow pollinators to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations”.

The Malaga development site contains vegetation and soils typical of known habitat for this species however it is disjunct from areas of similar habitat (closest habitat and population is 2 km to the SSW). The site has considerable pressures from grazing, physical disturbance, weeds and Phytophthora dieback that significantly reduce the potential for the site to host a population of the orchid into the future without substantial management inputs. It is currently unknown whether the symbiotic mycorrhizal fungus or pollinating wasp (necessary for pollination and survival of the orchid) are present on the site and this would be a significant issue to resolve prior to establishing the potential for the site to be a suitable

translocation site in future. Perhaps more significantly, the site is currently not held in secure tenure which would be an important consideration in the selection of translocation sites.

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# Appendix A: Scope of Works

This survey was undertaken as per the following SoW provided by Metronet, as listed below:

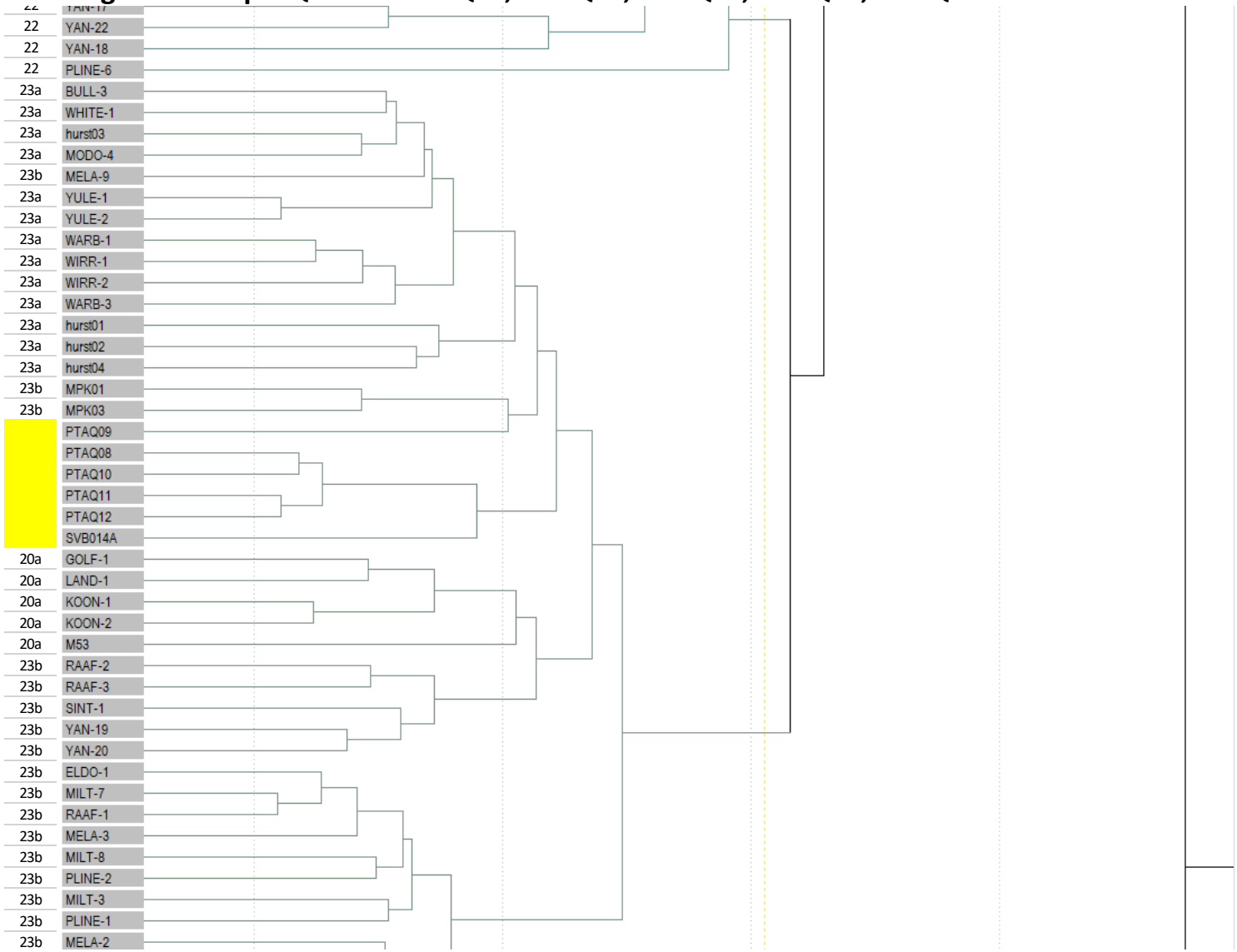
1. Undertake a desktop review of available flora and vegetation information (reports provided) relating to the Study Area (known Banksia Woodland TEC at Malaga, which is bound by Marshall Road, Beechboro Road North and Tonkin Highway);
2. Analyse RPS Quadrat / Releve data associated with the Banksia Woodland TEC at Malaga (Spring 2017 and Autumn 2019), utilising PATN and selecting multiple analysis pathways (or alternatives as suggested by Woodman Environmental based on the available data);
3. Interpret the analysis outputs to determine the FCT that the site quadrats most closely resemble;
4. If required, undertake a site visit to determine the condition and out of season boundary extent of the Malaga Banksia Woodland TEC
5. Identification and mapping of areas of ecological importance, which includes Woodman Environmental assessment of the extent of the Banksia Woodland TEC and Vegetation Condition (including provision of IBSA data package)
6. Recommendations and/or management measures
7. A progress update email on the results of the assessment and analysis, prior to PTA receiving the draft deliverable.

# Appendix B: Classification Analysis Dendrogram (Excerpts) of the RPS / Coffey Quadrat Dataset from the Study Area with the Original SCP Quadrat Dataset (Gibson *et al.* 1994)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994); and
- Yellow shading denotes RPS / Coffey quadrats from the Study Area.

## Dendrogram Excerpt: Quadrat PTAQ08, PTAQ09, PTAQ10, PTAQ11, PTAQ12 and SVB014A

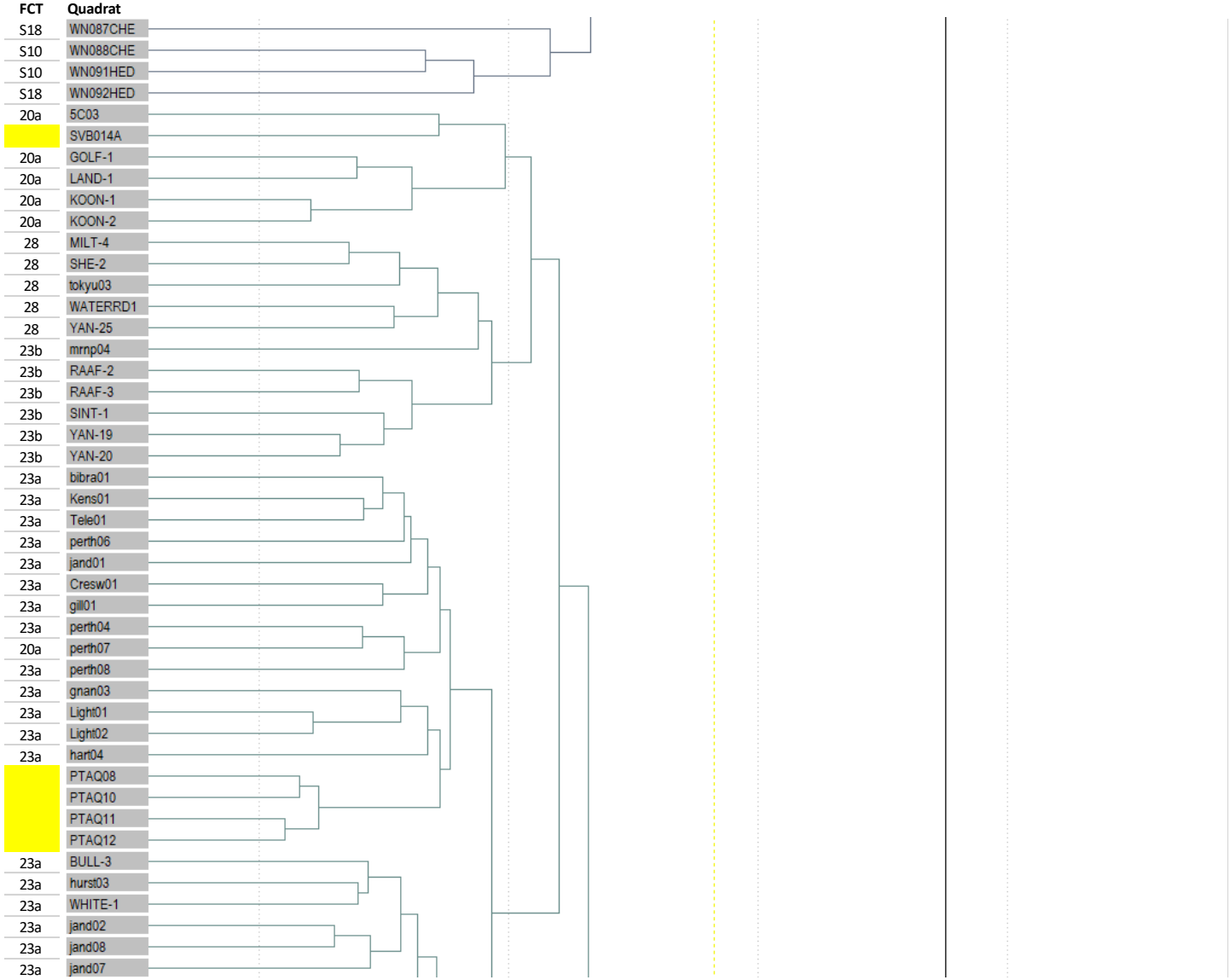


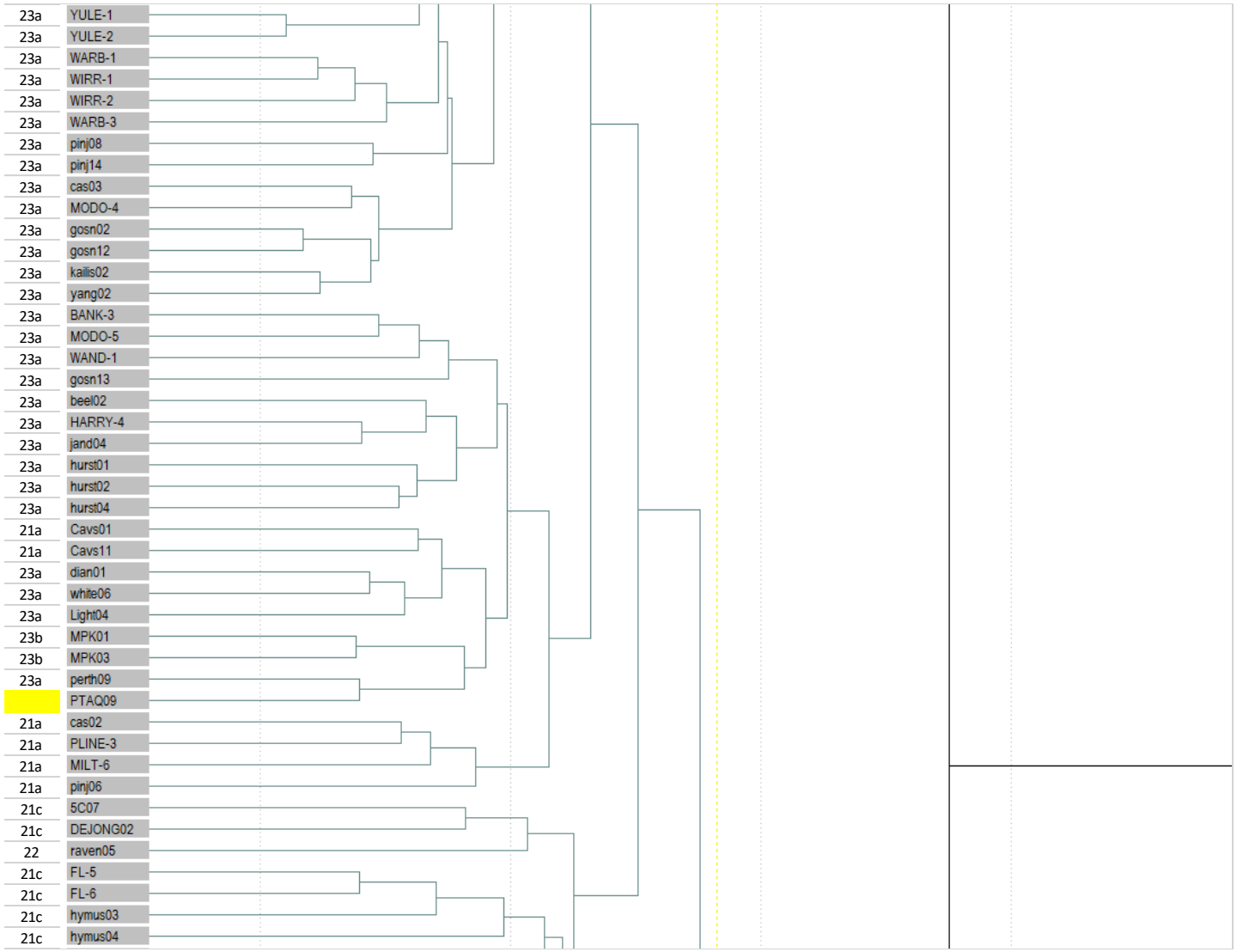
# Appendix C: Classification Analysis Dendrogram (Excerpts) of the RPS / Coffey Quadrat Dataset from the Study Area with the Amended SCP Quadrat Dataset (Keighery *et al.* 2012)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994) and
- Yellow shading denotes RPS / Coffey quadrats from the Study Area.

# Dendrogram Excerpt – Quadrats PTAQ08, PTAQ09, PTAQ10, PTAQ11, PTAQ12 and SVB014A




23a YULE-1
23a YULE-2
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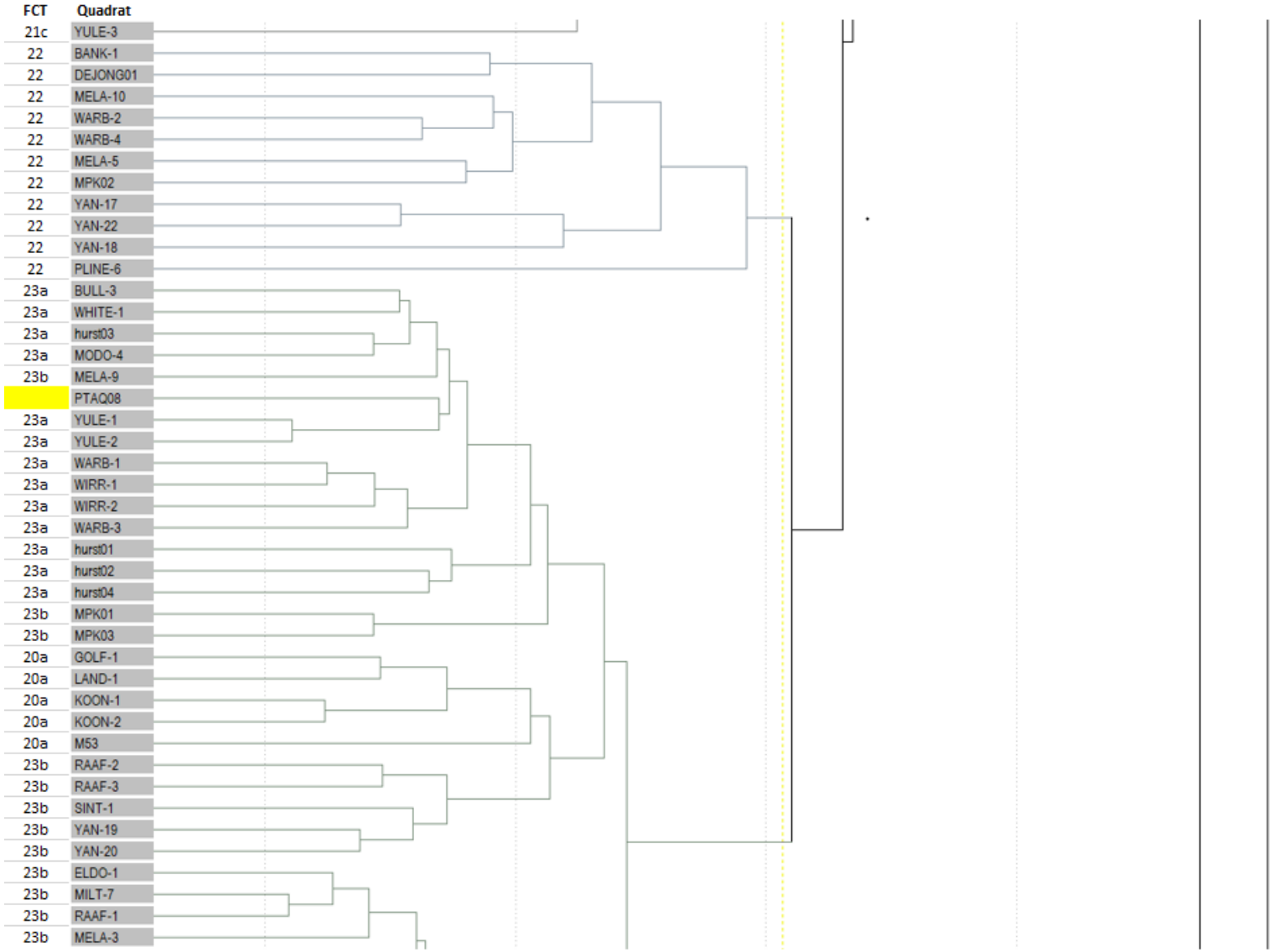
23a WIRR-1
23a WIRR-2
23a WARB-3
23a pinj08
23a pinj14
23a cas03
23a MODO-4
23a gosn02
23a gosn12
23a kailis02
23a yang02
23a BANK-3
23a MODO-5
23a WAND-1
23a gosn13
23a beel02
23a HARRY-4
23a jand04
23a hurst01
23a hurst02
23a hurst04
21a Cavs01
21a Cavs11
23a dian01
23a white06
23a Light04
23b MPK01
23b MPK03
23a perth09
PTAQ09
21a cas02
21a PLINE-3
21a MILT-6
21a pinj06
21c 5C07
21c DEJONG02
22 raven05
21c FL-5
21c FL-6
21c hymus03
21c hymus04

# Appendix D: Single Site Insertion Classification Analysis Dendrograms (Excerpts) of RPS / Coffey Quadrats from the Study Area with the Original SCP Quadrat Dataset (Gibson *et al.* 1994)

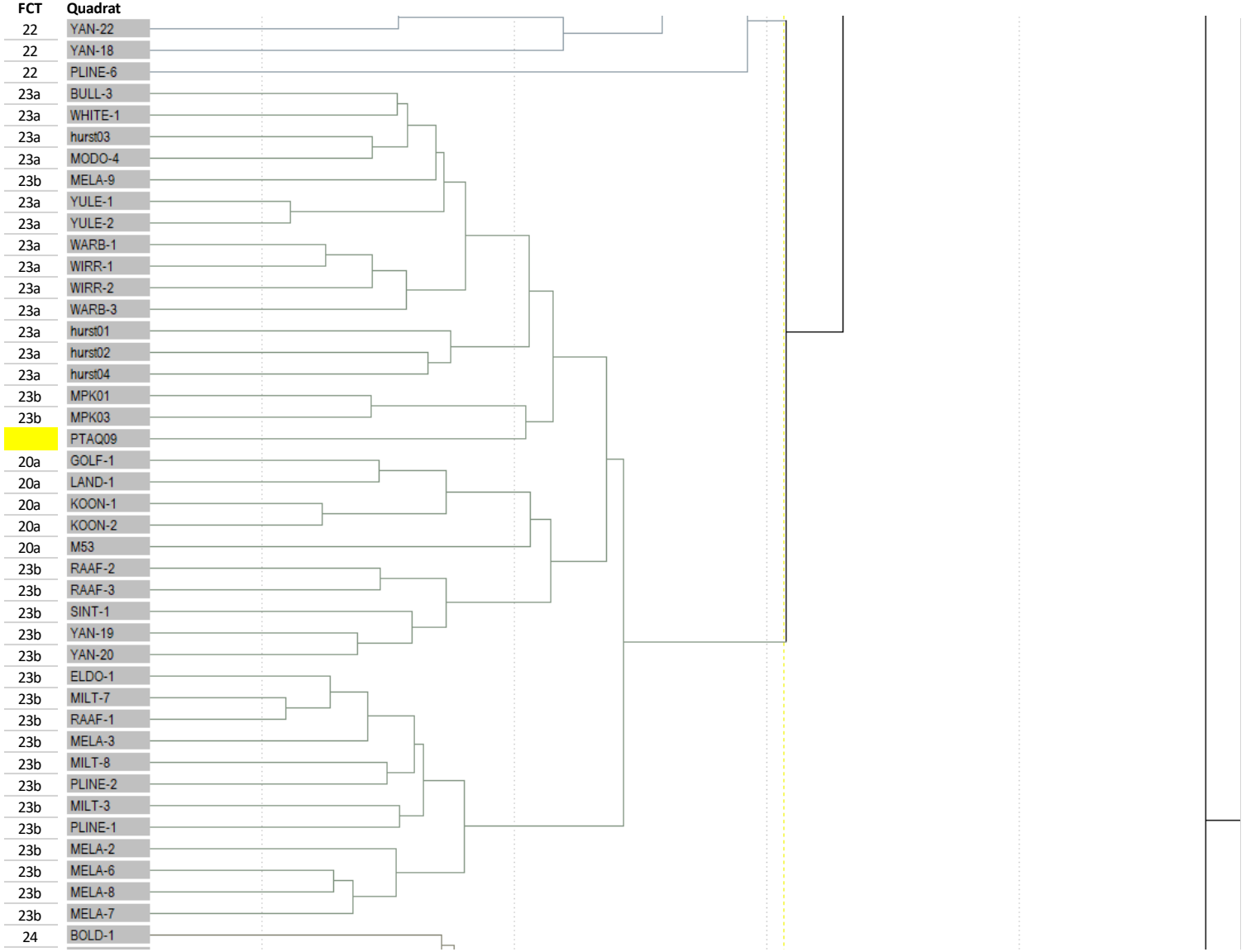
Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994); and
- Yellow shading denotes RPS / Coffey quadrats from the Study Area.

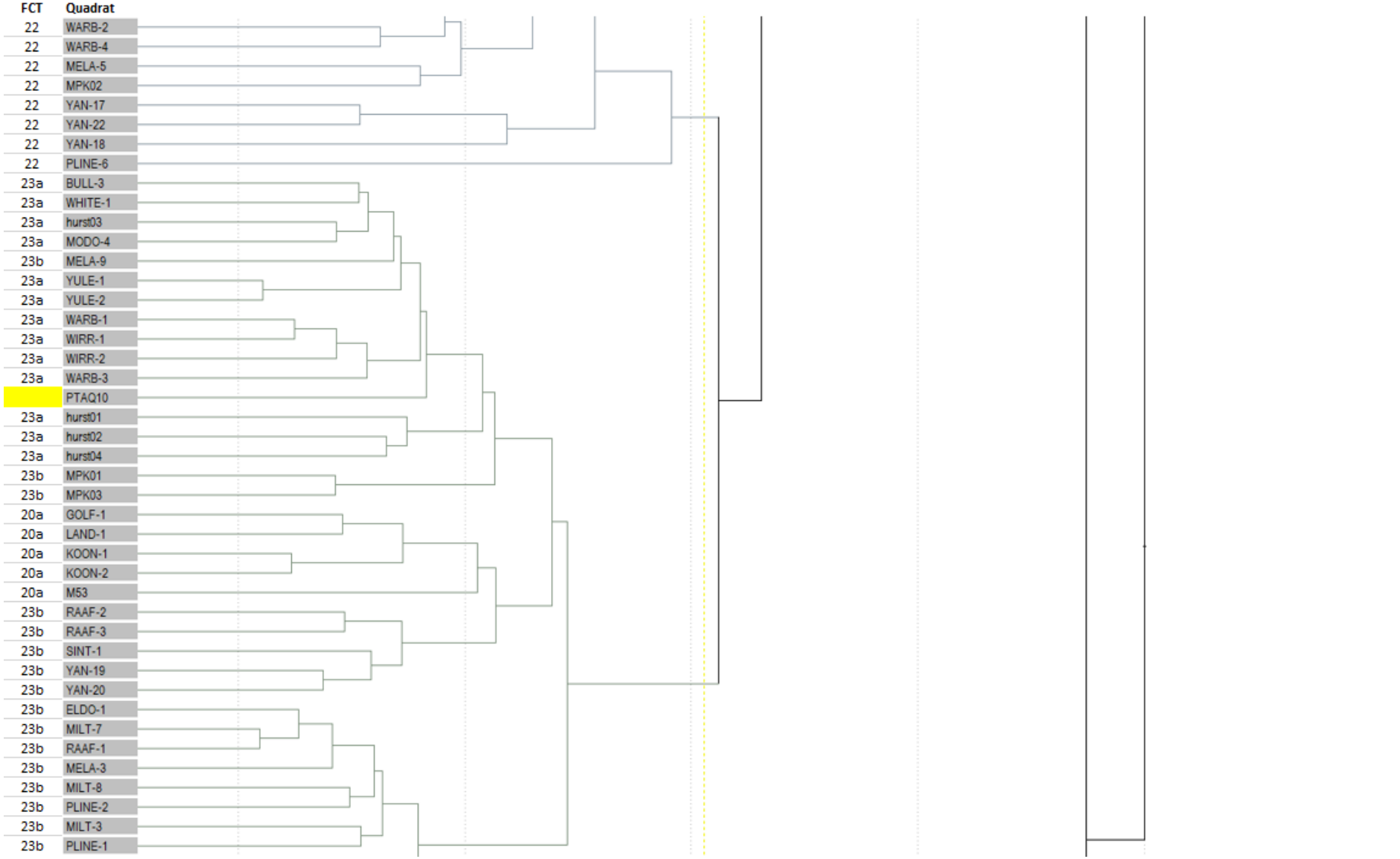
## Dendrogram Excerpt: Quadrat PTAQ08



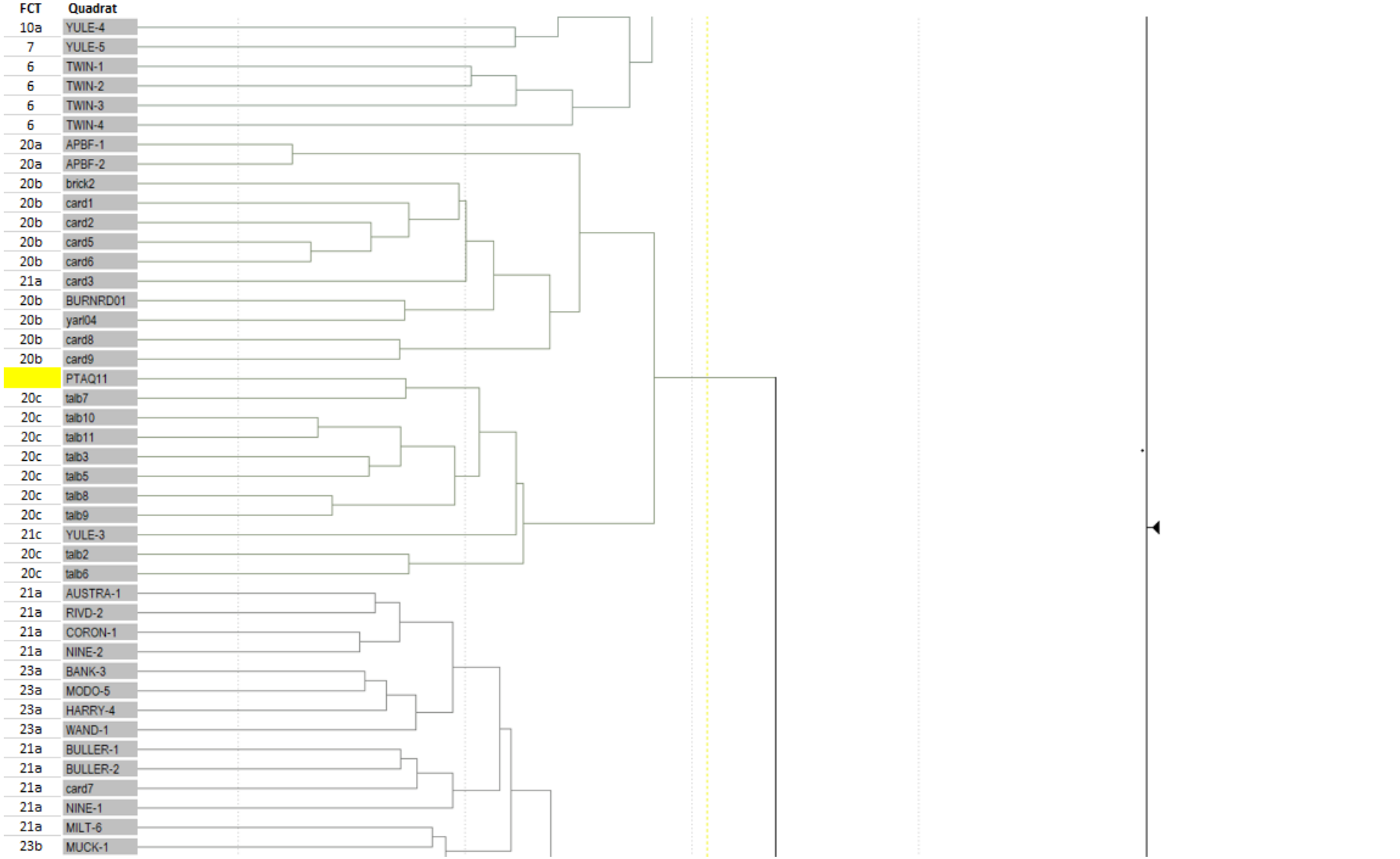
# Dendrogram Excerpt: Quadrat PTAQ09



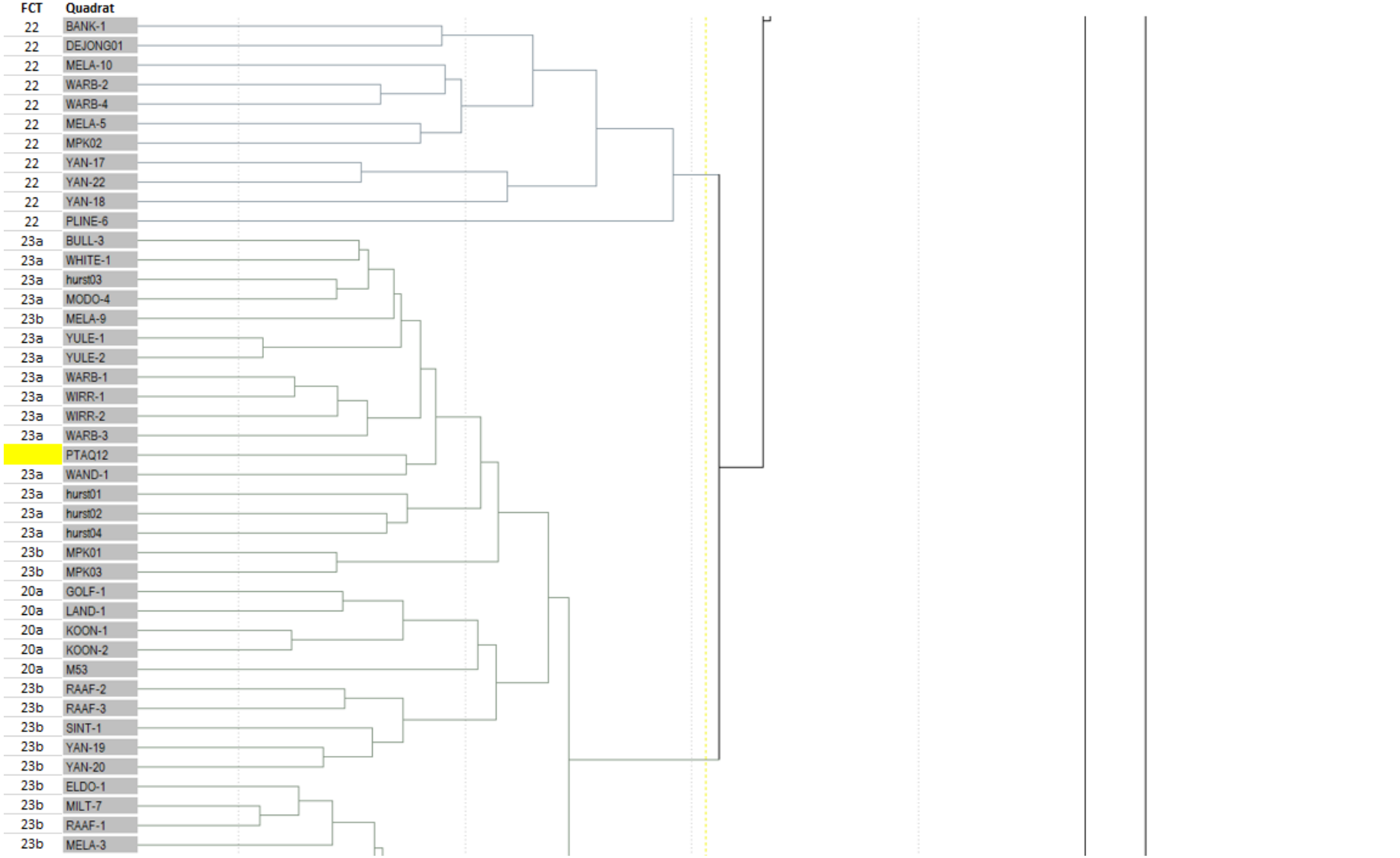
## Dendrogram Excerpt: Quadrat PTAQ10



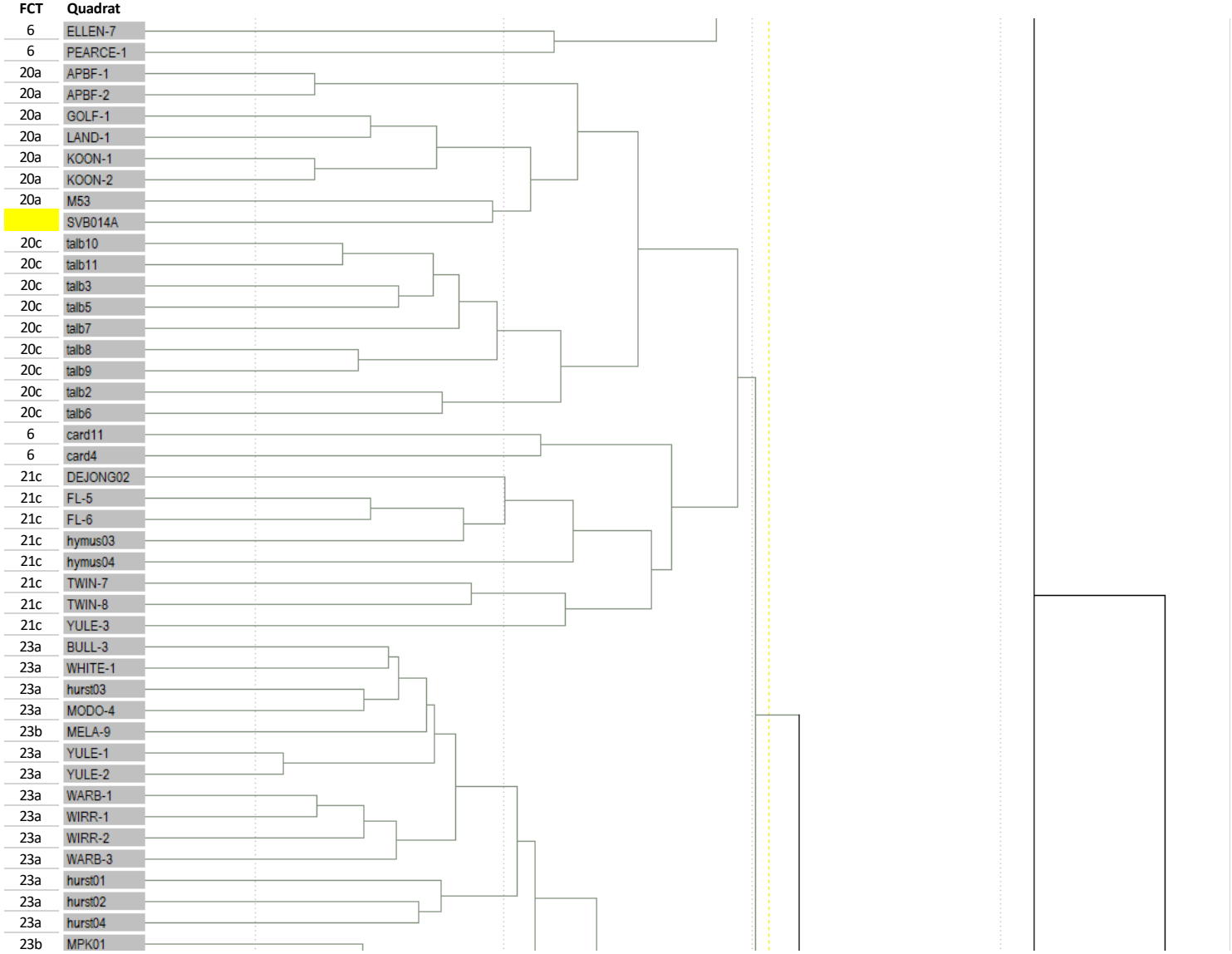
## Dendrogram Excerpt: Quadrat PTAQ11



## Dendrogram Excerpt: Quadrat PTAQ12



# Dendrogram Excerpt: Quadrat SVB014A

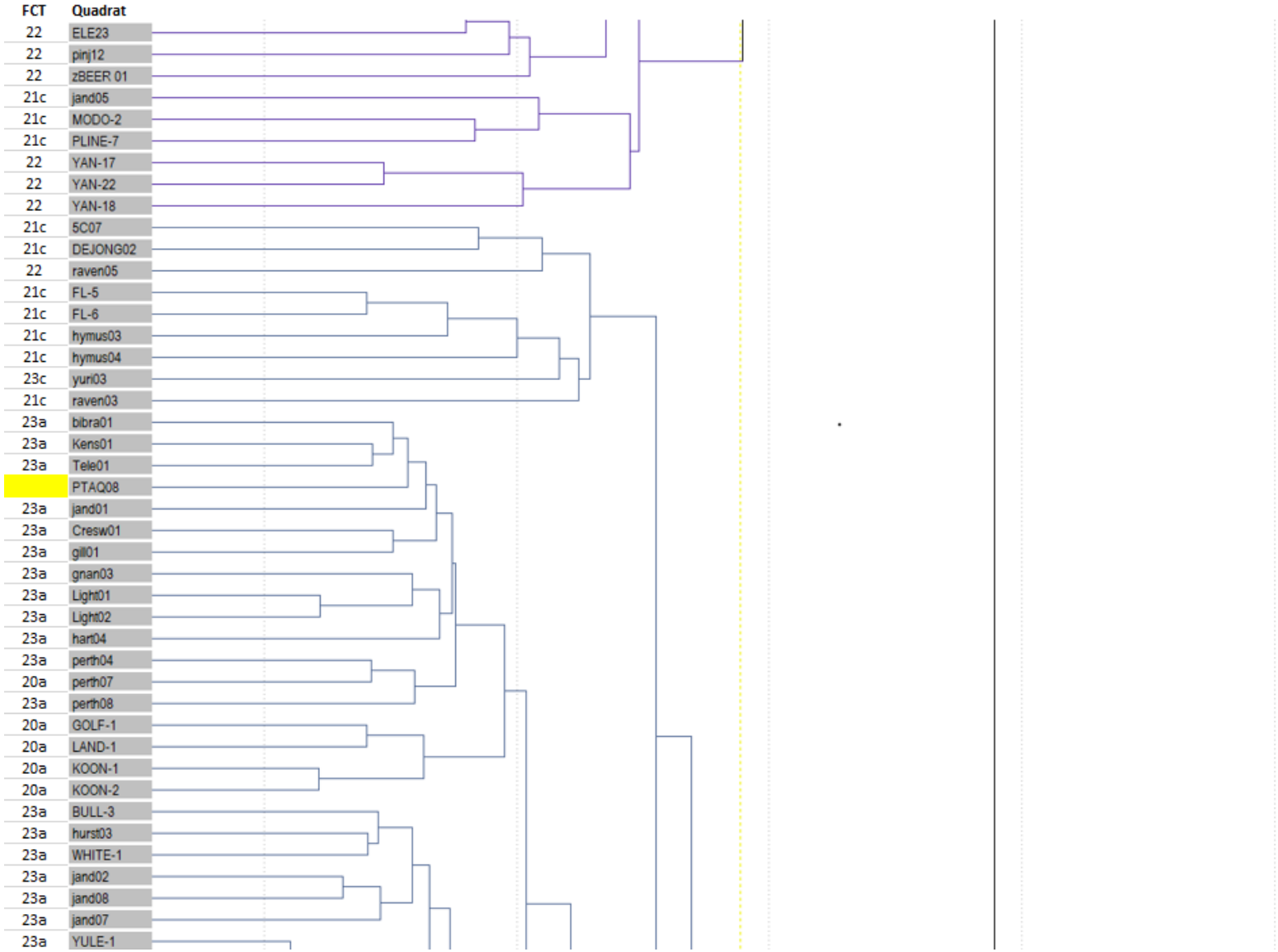


# Appendix E: Single Site Insertion Classification Analysis Dendrograms (Excerpts) of RPS / Coffey Quadrats from the Study Area with the Amended SCP Quadrat Dataset (Keighery *et al.* 2012)

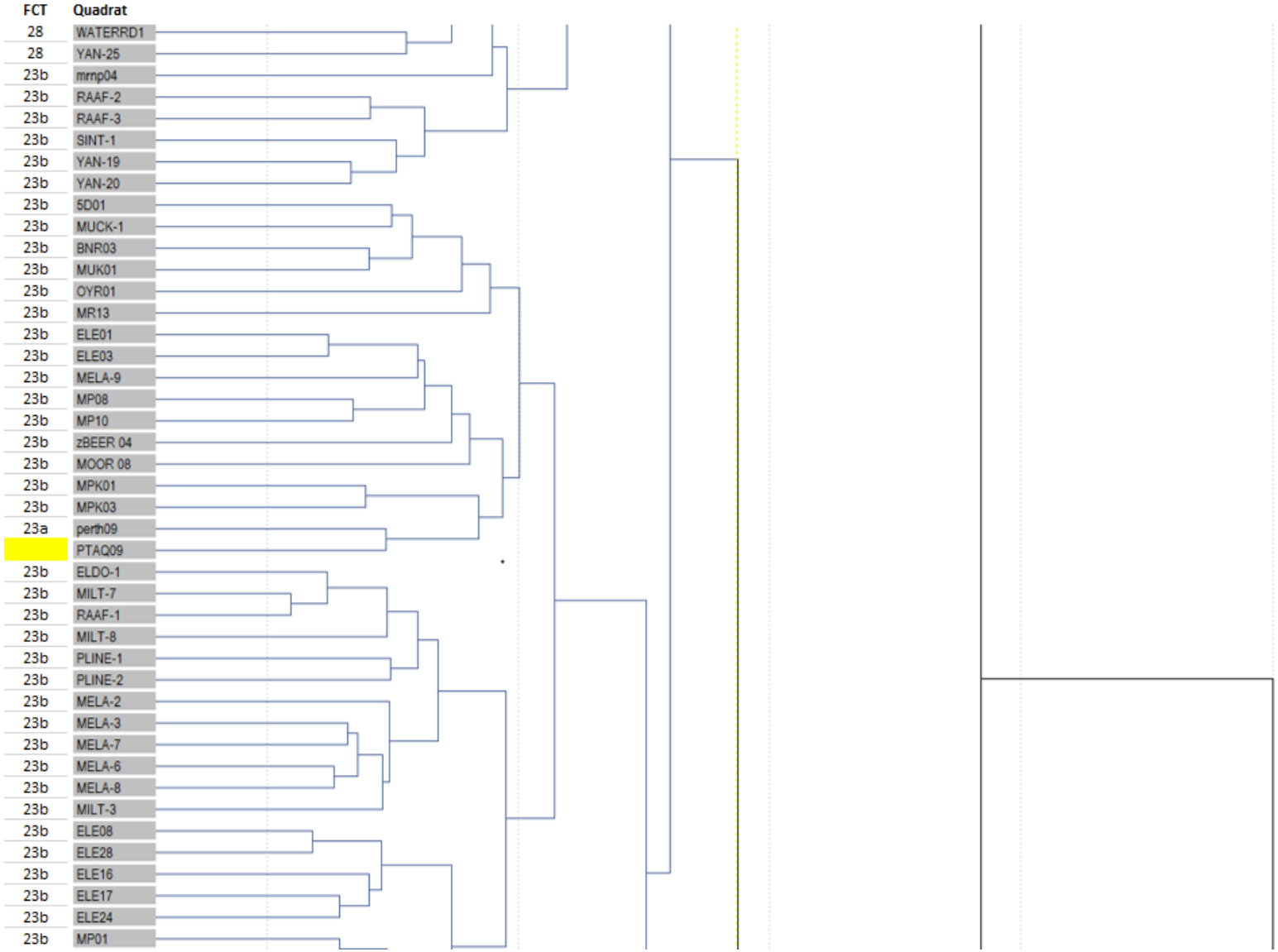
Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994) and
- Yellow shading denotes RPS / Coffey quadrats from the Study Area.

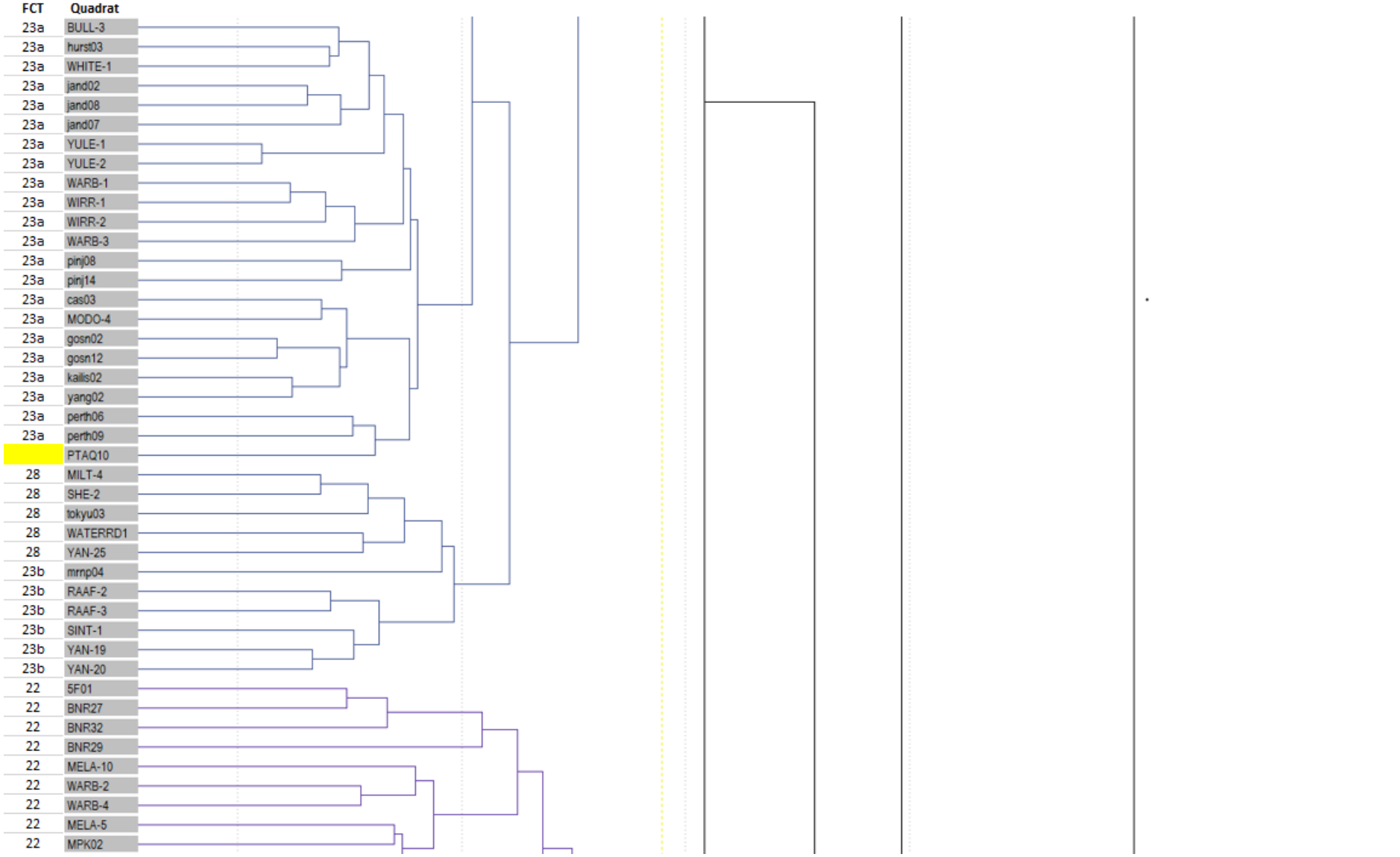
## Dendrogram Excerpt: Quadrat PTAQ08



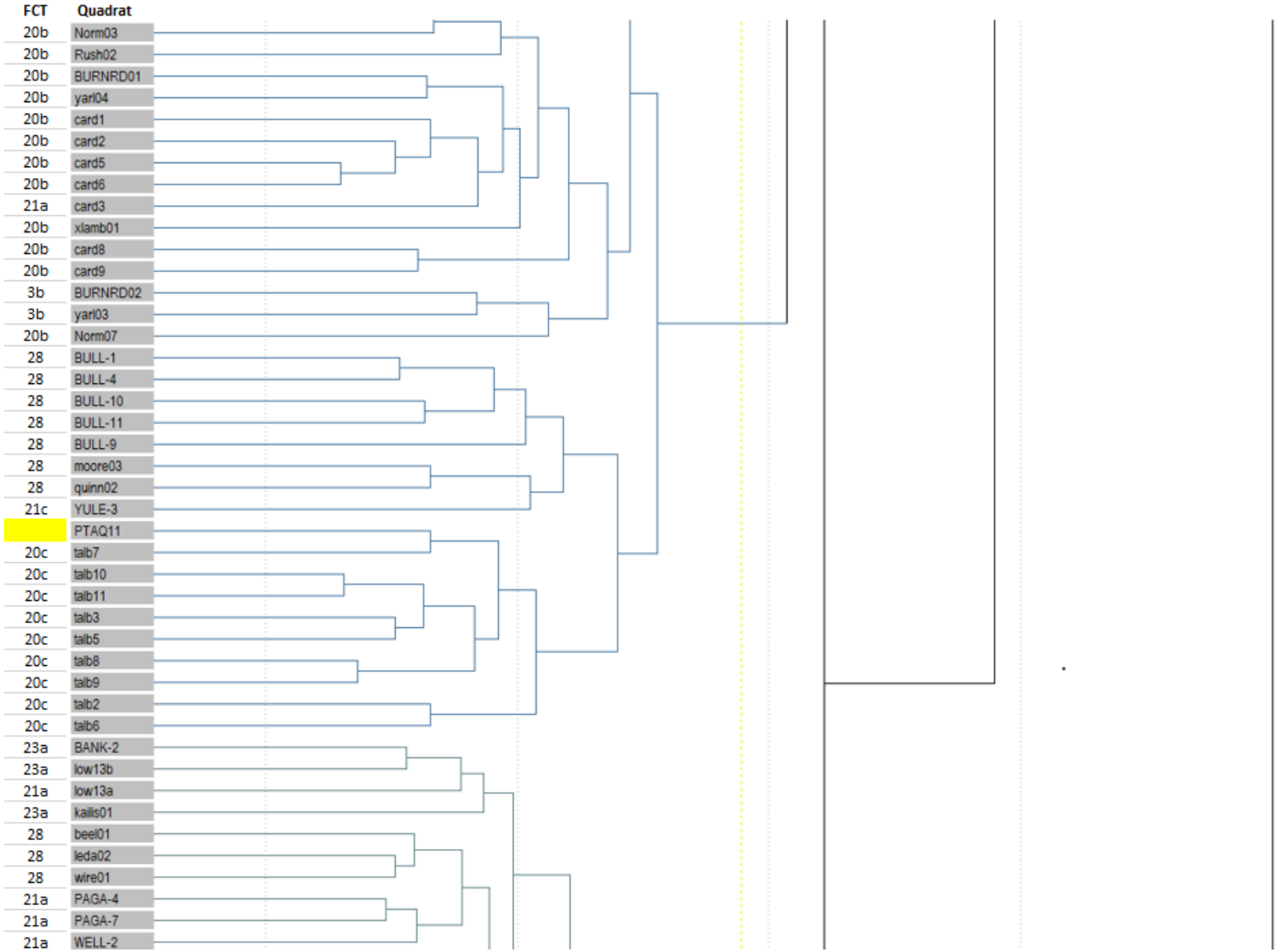
## Dendrogram Excerpt: Quadrat PTAQ09



## Dendrogram Excerpt: Quadrat PTAQ10



## Dendrogram Excerpt: Quadrat PTAQ11



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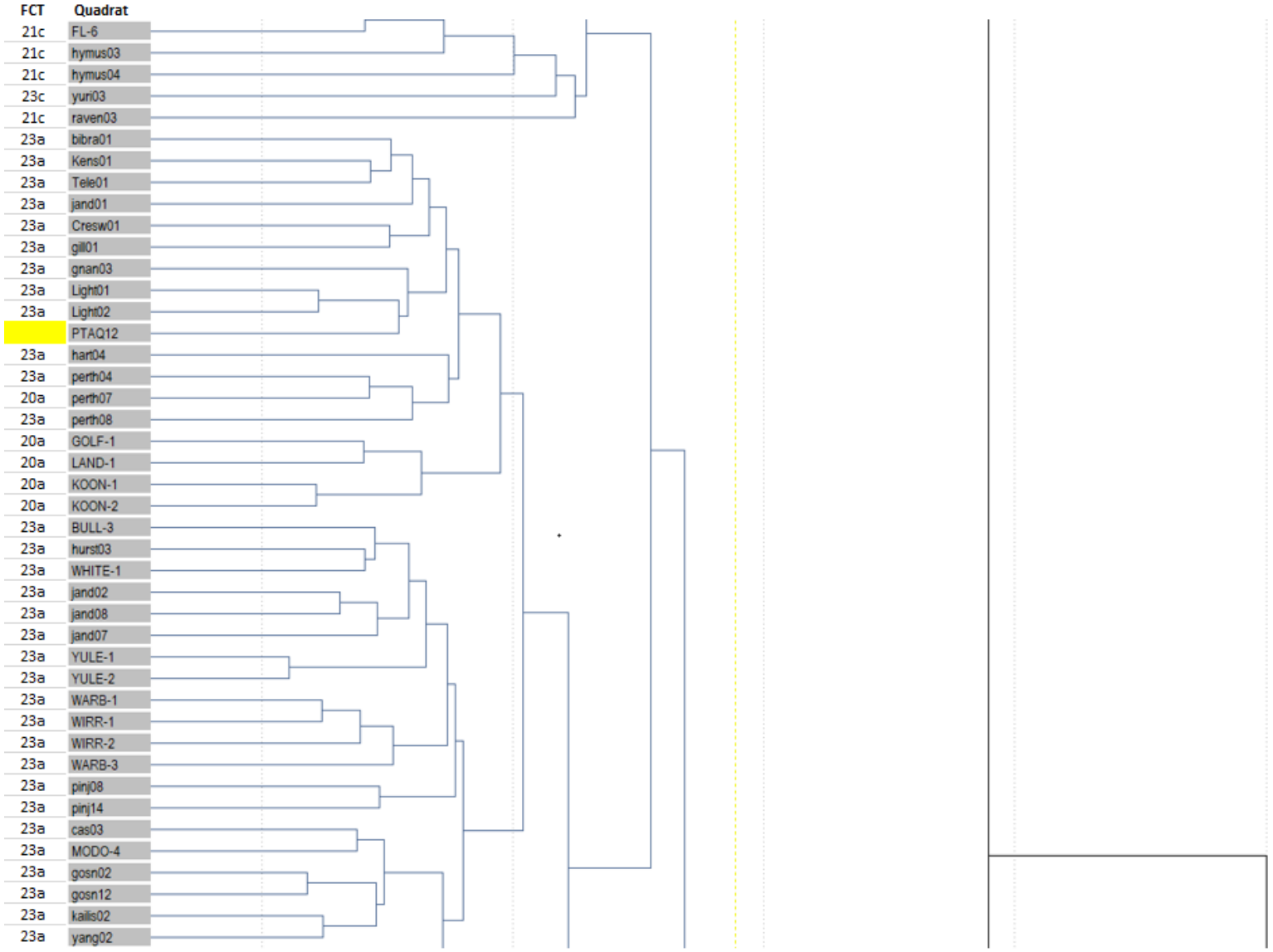

# Dendrogram Excerpt: Quadrat SVB014A