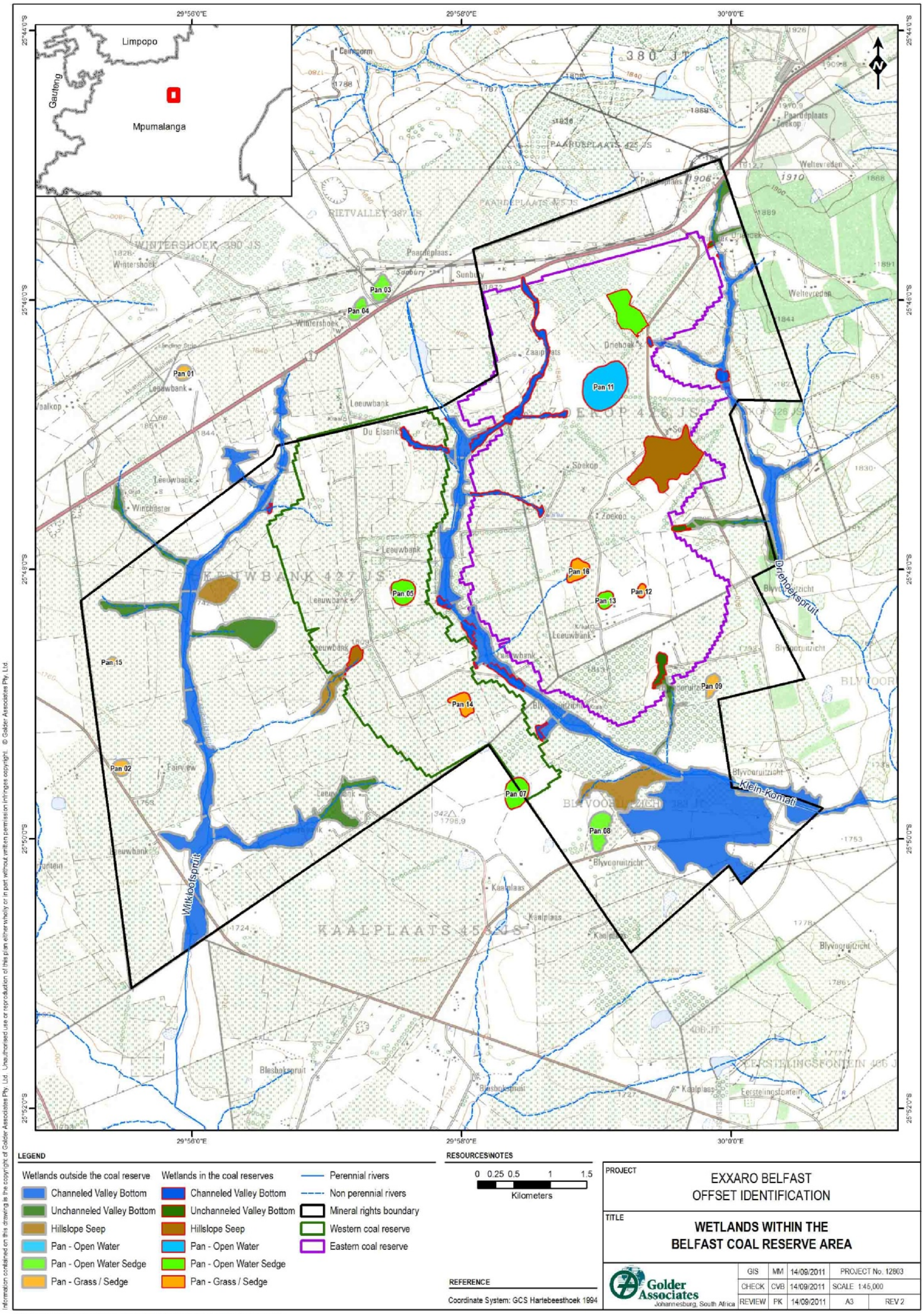

Figure 8: Delineated wetland types within and outside of the two proposed Exxaro Belfast coal reserve area

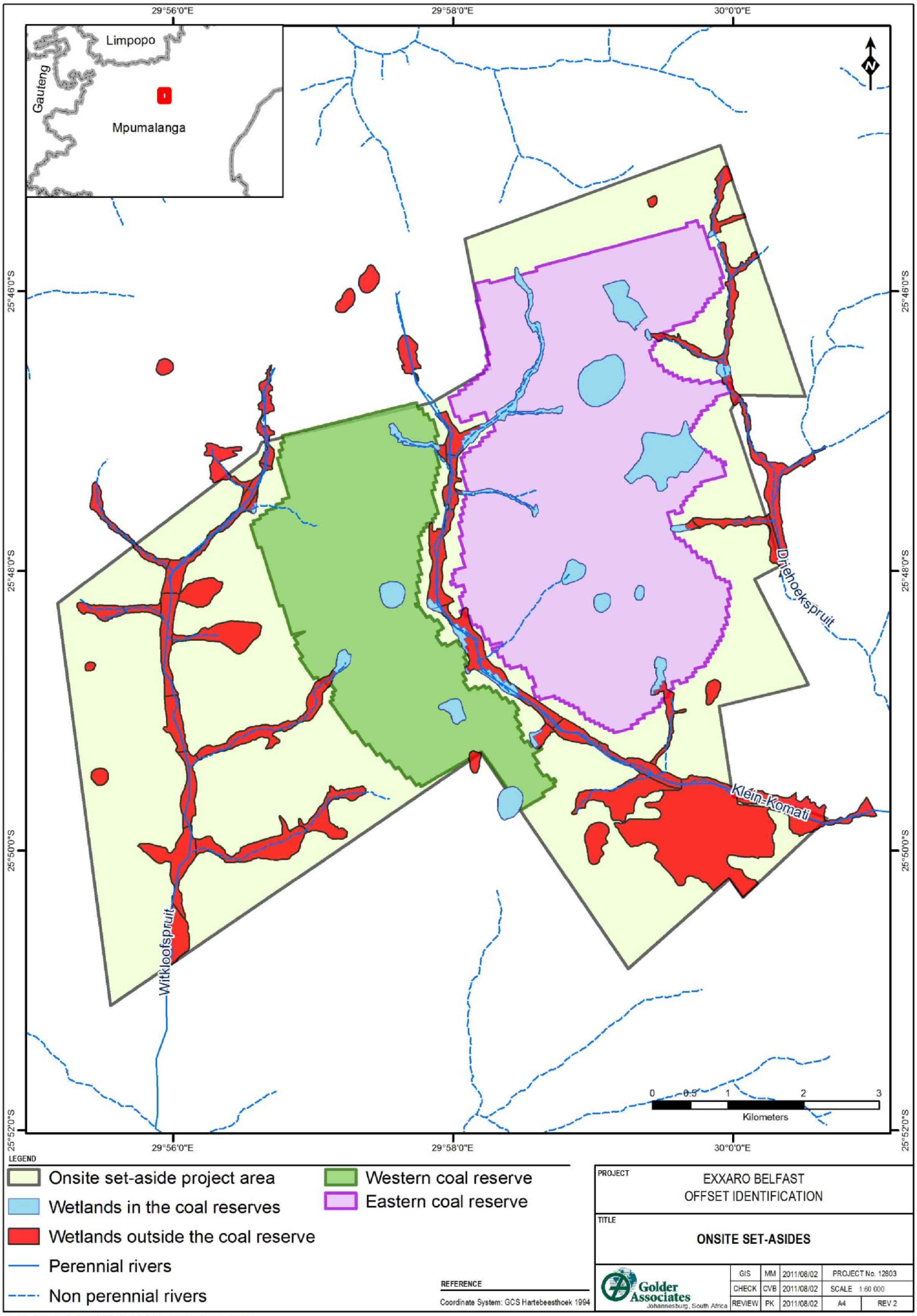

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Figure 9: Potential onsite set-aside project area within the Belfast mine lease area, indicating the wetlands and pans outside of the two coal reserves

The rehabilitation and restoration criteria for these on site-set asides would include:

- Improvement of the current Integrated Habitat Integrity (IHI) scores for each of these systems (Figure 10) in order to improve the baseline PES categories;
- Implementation of an Exxaro, land-owner and MTPA wetland management forum for the onsite set aside wetlands;
- Limitation of agricultural impacts due to cattle overgrazing and trampling, and crop encroachment into the wetland areas;
- Implementation of wetland mitigation identified in the impact assessment phase for wetlands that may be impacted from the proposed project, especially those directly outside of the two proposed coal reserve areas;
- Implementation of a fire-management programme;
- Implementation of an alien and exotic vegetation management programme;
- Revegetation of disturbed areas and areas of wetland loss; and
- Implementation of a wetland biomonitoring programme.

These criteria for the onsite set-aside wetlands will form the basis for the implementation and management plan for the offset programme in fulfilment of the restoration criteria of the BBOP mitigation hierarchy (Figure 4).

4.1.2 Offsite offset identification, rehabilitation and protection criteria

For the pans and hillslope seeps and valley bottom wetlands that will be lost within the two proposed coal reserves, offsite offsets would have to be identified. Table 7 shows the results of the *Total offset area required* calculations for the three pan types of the six pans that will be lost due to the proposed Belfast project. Based on these calculations 14.6 ha of Grass / sedge pans; 42.9 ha of Open water pans; and 17.4 ha of Open water sedge pans should be offset. However, due to the closed ecosystem units that pans are, a hectare offset ratio may not be suitable. Therefore, similar characteristics are used in this offset identification process.

Table 7: Calculation of recommended pan offset areas

Belfast pans	Pan types	Area (ha)	PES	PES %	PES Area (ha)	Recommended offset area (ha)	Total Recommended offset area
Pan 12	Grass/ sedge pans	1.6	4.52	90.4%	1.5	2.9	**14.6**
Pan 14		5.7	3	60.0%	3.4	6.8	
Pan 16		6.10	2	40.0%	2.4	4.9	
Pan 11	Open water pans	27.8	3.86	77.2%	21.5	42.9	**42.9**
Pan 05	Open water sedge pans	8.2	3.55	71.0%	5.8	11.6	**17.4**
Pan13		3.8	3.86	77.2%	2.9	5.8	

*PES area = Affected area x PES %; **2:1 offset ratio

Table 8 shows the results of the *Total offset area required* calculations for the hillslope seeps and valley bottom wetlands that will be lost due to the proposed Belfast project. Based on these calculations Exxaro should negotiate 1788.5 ha of offset mitigation on hillslope seep and valley bottom wetlands with Working for Wetlands (WfWet). The Integrated Habitat Integrity (IHI) scores for each of these systems and areas associated with the Belfast project will be used in the total offset area calculations. Figure 10 shows the wetland systems and the IHI classes.

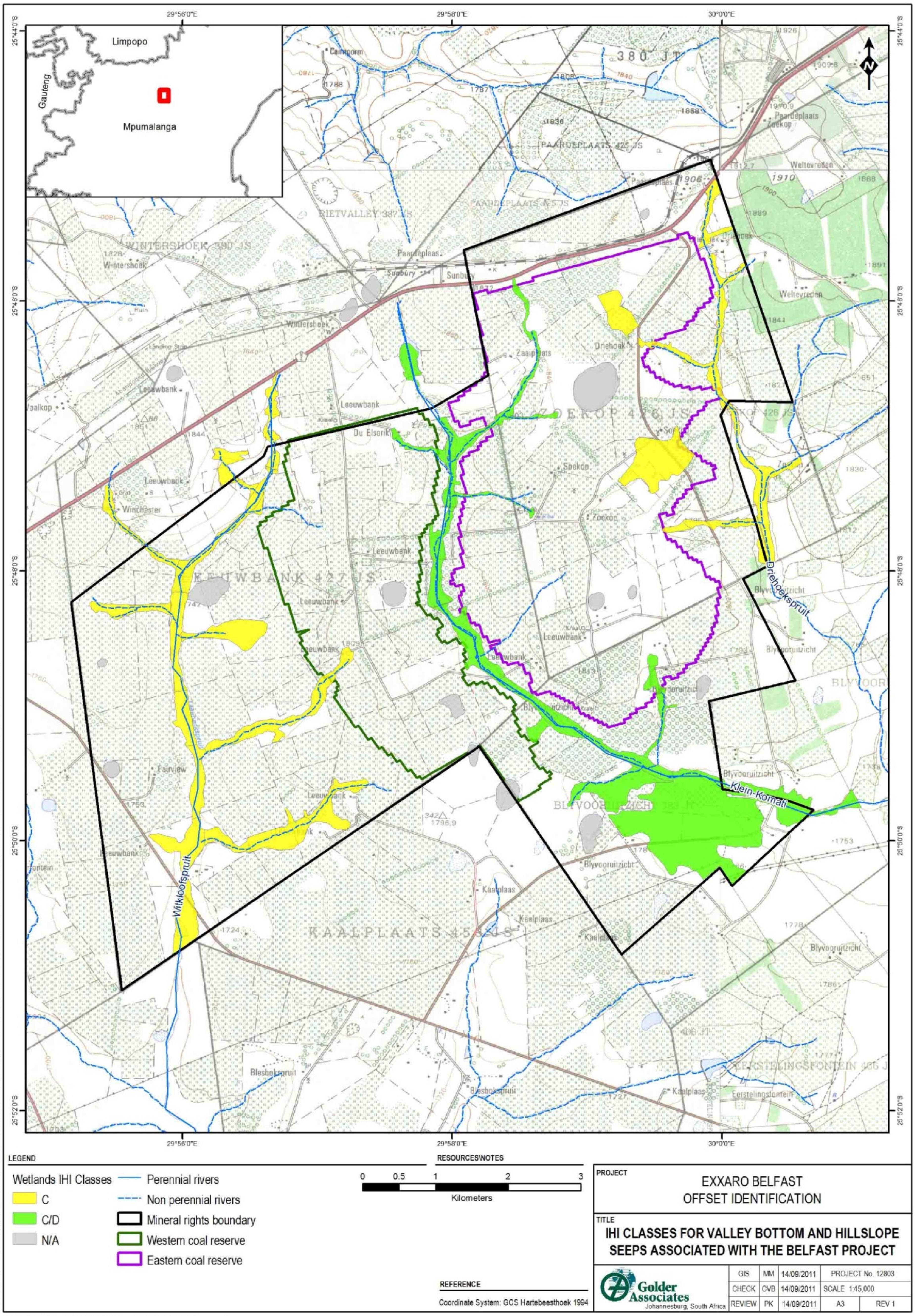

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Figure 10: IHI classes for the hillslope and valley bottoms associated with the onsite set-aside wetlands

Table 8: Calculation of recommended valley bottom and hillslope seep offset area

Belfast hillslope and valley bottom wetland systems	IHI PES (%)	Affected area (ha)	PES Area* (ha)	Recommended offset area** (ha)
Driehoekspruit	63.0%	140.1	88.3	176.5
Klein-Komati River	57.6%	1004.8	578.7	1157.5
Leeubankspruit	69.3%	327.9	227.2	454.5
Total recommended offset area				**1788.5**

*PES area = Affected area x PES %

**2:1 offset ratio

In order to select a study area in which candidate pans and wetland areas would be identified, a 50 km buffer zone was established around the proposed Belfast mine lease area. This is due to the fact that it was felt that further than 50 km away from the proposed project area would not only diminish the likelihood of similarity, but would also prove cumbersome from a management perspective should the offset sites be such a distance away from the mining project. As a starting point, pans were used to identify the potential offset areas due to the uniqueness of these ecosystems as single unit ecosystems. Once a potential offset area was identified, the wetlands associated with this area would be considered for offsite offset areas.

All the pans identified on the 1:50 000 topographical maps and satellite imagery (Google Earth) were then delineated using ArcGIS software. This resulted in an initial set of 406 candidate pans Figure 11. The pans which fell outside of the 50 km zone were eliminated, as well as those that were identified to have irreparable impacts such as mining and severe alteration of the pans geomorphology. Due to the large number of candidate pans that were to be investigated, the pans were spatially grouped and representative sites of the groups were sampled.

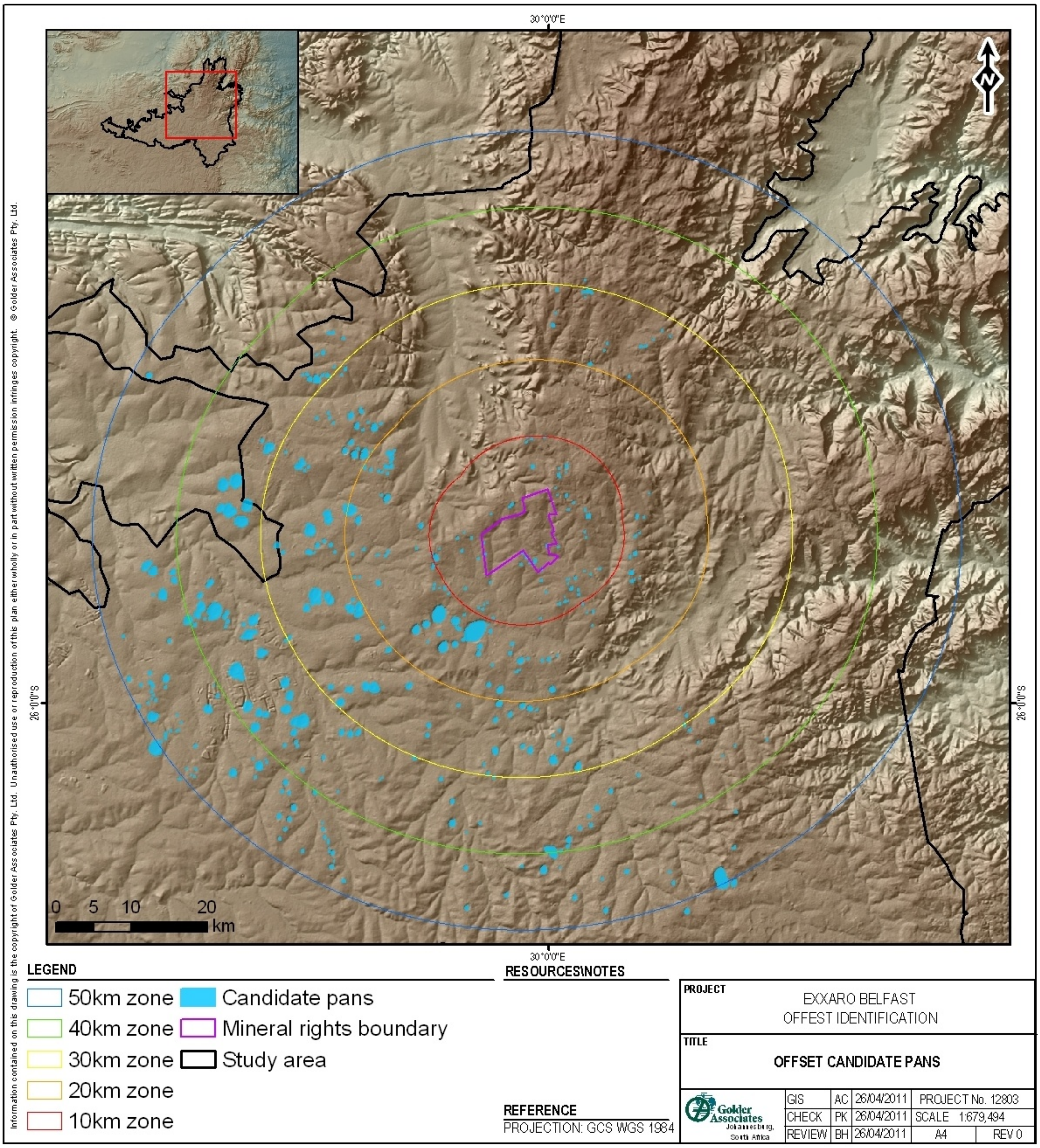

Figure 11: Initial offset candidate pans

4.1.3 Pan Field Surveys

Of the 406 pans identified within the 50 km priority zone, 92 were Open water pans, 113 were Open water sedge pans, and 201 were grass pans. A total of 73 pans were sampled in the field (Figure 12). Of the 92 Open water pans 20 were sampled in the field, with 26 Open water sedge pans sampled of the 113 identified, and 27 of the 201 grass pans sampled in the field.

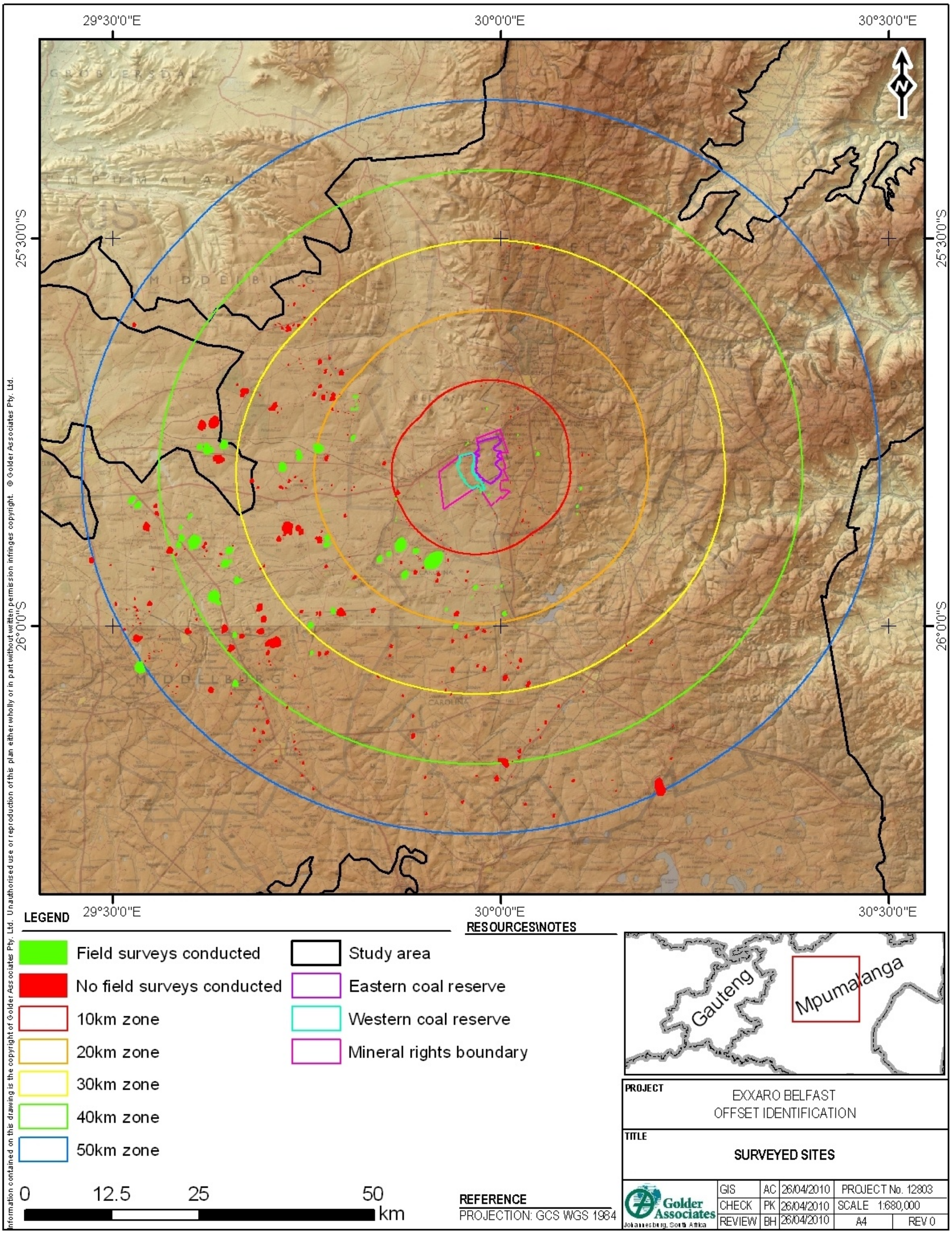

Figure 12: Map illustrating the sites that were surveyed

4.1.4 Statistical spatial correlation of pan data

Statistical spatial correlation of pan assessment data was conducted using the PRIMER statistical software (Ludwig, et al., 1988) in order to determine pans of similar attributes to the pans of within the proposed Belfast coal reserve areas.

Due to the relative abundance of grass pans within the 50 km buffer zone it was decided that the focus would be place on finding suitable Open water and Open water sedge pans first and then looking for grass pans in the same vicinity. At this point the reader is reminded of what the study is attempting to find with regards to the pans. It is as follows:

- 42.9 ha of Open water and 17.4 ha Open water sedge pans that have fresh water; and
- 14.6 ha of grass pans in the vicinity of the Open water / Open water sedge pans.

The following field data from the candidate pans within the 50 km buffer zone was used in the PRIMER analysis:

- *In situ* Total Dissolved Solids (TDS) as an indication of pan water salinity;
- Turbidity: based on observed depth of clarity in centimetres (cm);
- Pan specific macroinvertebrates including:
  - Cladocera (Water fleas);
  - Ostracoda (Ostracods);
  - Copepoda (Copepods);
  - Conchostraca (Clam shrimps);
  - Triops sp. (Tadpole shrimps)

Displaying community patterns through Cluster Analysis and Non-metric Multi-dimensional Scaling (MDS)

The filed data from the candidate pans was analysed using Hierarchical Cluster analysis and Non-metric Multi-dimensional Scaling (MDS).

The results of the hierarchical cluster analysis are provided in Figure 13. From the results it can be seen that, based on the TDS concentrations, turbidly and pan-specific aquatic macroinvertebrates assemblages of the candidate pans, similarity clustering grouped the pans into seven distinct groups at a 70 % similarity/resemblance slice.

The MDS clustering was performed on each of the separate components:

- TDS concentration clustering of the pans is shown in Figure 14.
- Turbidity clustering of the pans is shown in Figure 15.

As a result of the highly unpredictable seasonal changes in the water regime, endorheic pans may range from being freshwater ecosystems, when the wet season prevails, to virtually saline systems, as the dry season progresses and evaporation intensifies (Allan, et al., 1995). The physical and chemical properties of the substrata and water of pans therefore varies seasonally and regionally. Furthermore, within each inundation, considerable changes in the physical and chemical properties take place (Allan, et al., 1995).

Based on the results, there was a similarity in the TDS and observed turbidly, where pans with higher TDS levels generally had higher observed turbidity.

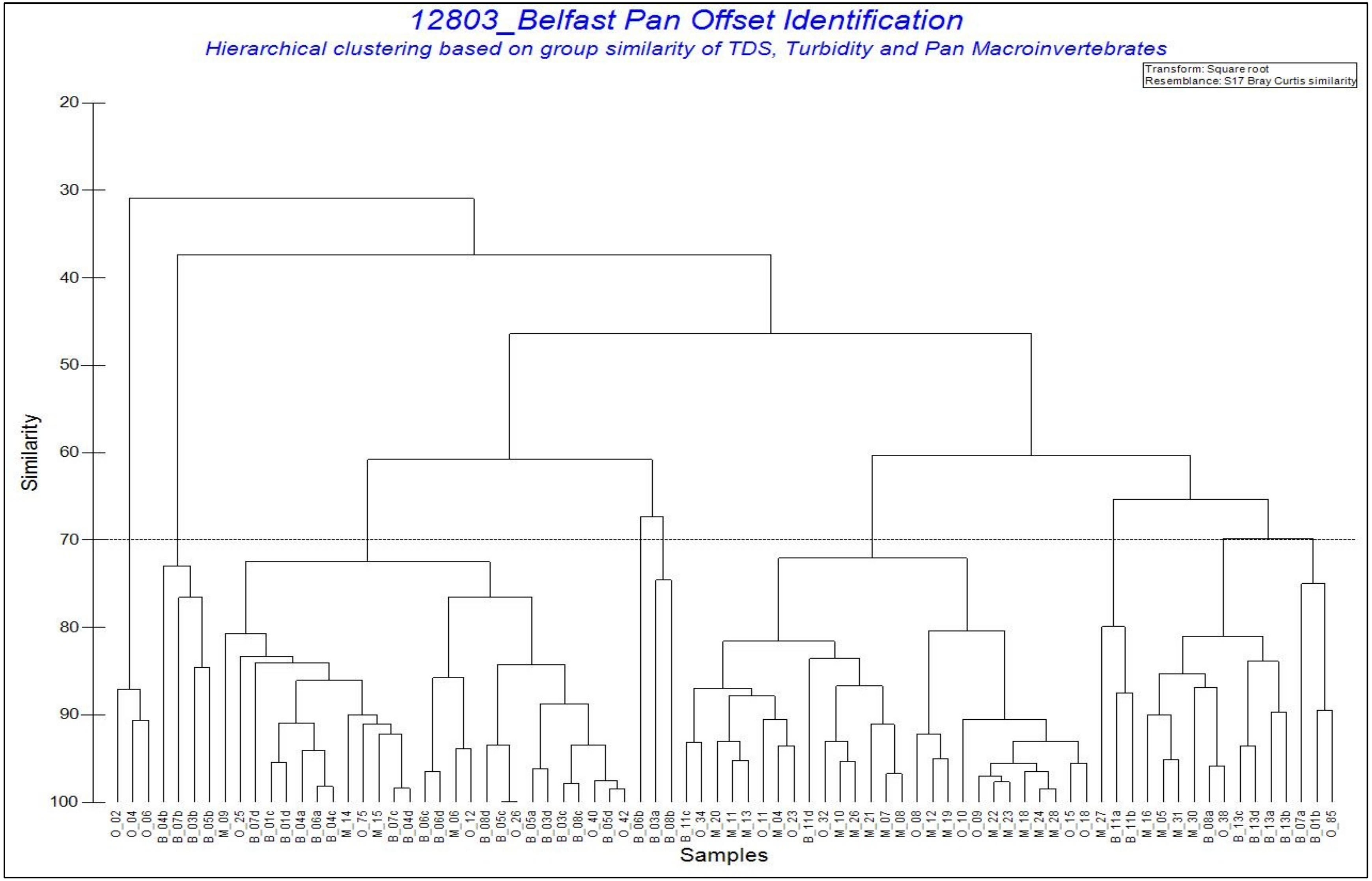

Figure 13: Hierarchical clustering of all of the pans, based on TDS, turbidity and pan-specific aquatic macroinvertebrates

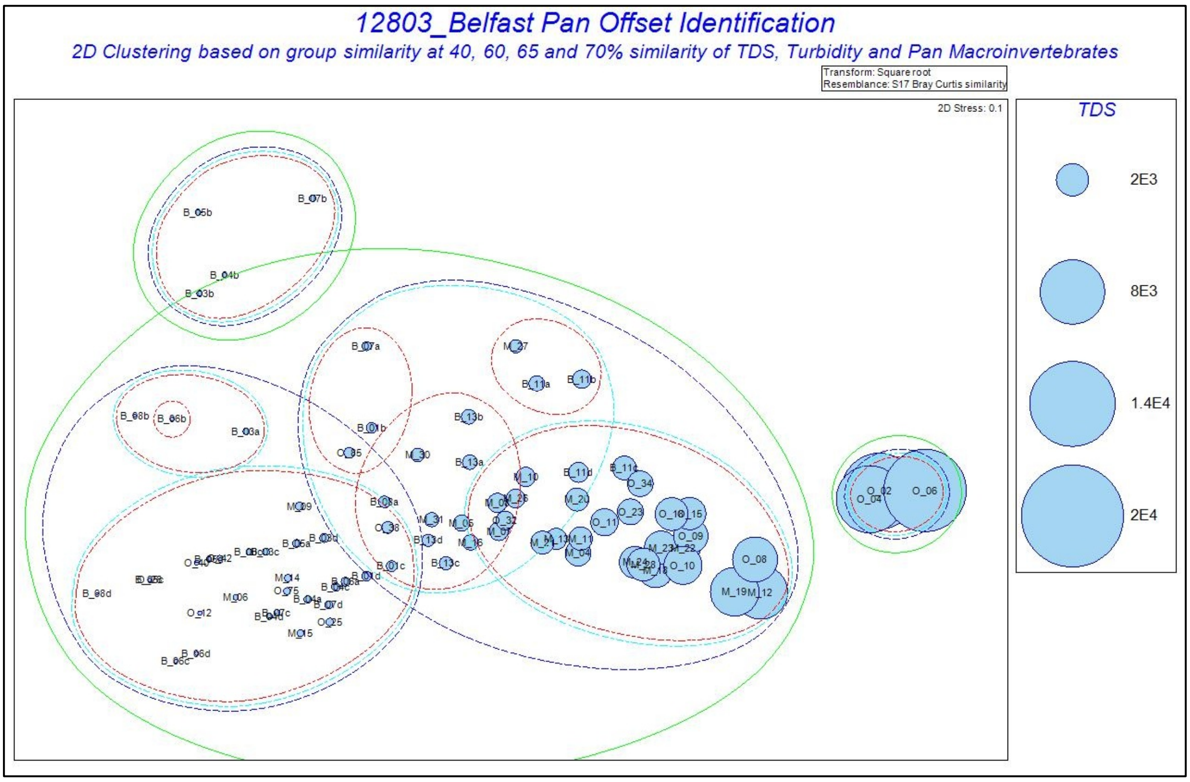

Figure 14: MDS clustering of the pans according to TDS concentrations at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

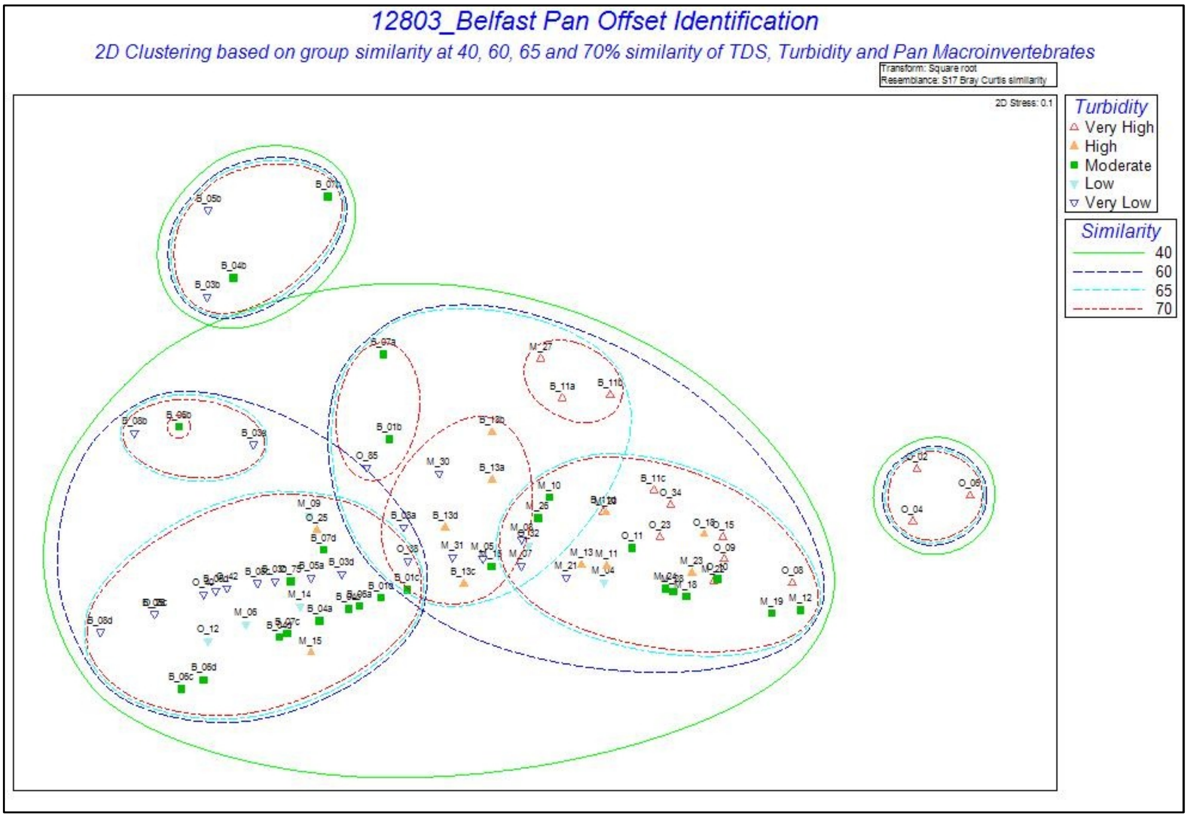

Figure 15: MDS clustering of the pans according to observed turbidity at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

- Pan specific macroinvertebrate MDS clustering:
  - Cladocera (Water fleas) clustering of the pans is shown in Figure 16; and
  - Ostracoda (Ostracods) clustering of the pans is shown in Figure 17.

Based on the results, it was shown that the Cladocera and Ostracoda had similar spatial clustering and that these were generally in pans with lower TDS (Figure 14) and lower turbidity (Figure 15). It was thus suggested that this clustering was characteristic of these two organisms, however as shown by the Cladocera (Figure 16), certain species of either taxa group may occur in pans with higher TDS or turbidity (e.g. Pan O_02 Figure 16).

Cladocera, commonly known as water fleas are a diverse and widespread genera. Most of the South African species belong to the group Anomopoda and are most commonly found in ponds and temporary waters (WRC, 2000).

Ostracoda is a class of small, bean-shaped crustaceans, commonly called seed shrimps. Ostracods have a cosmopolitan distribution in benthic freshwaters and marine environments, several terrestrial taxa are also known (WRC, 2001). Most of the species of the Class Ostracoda are associated with temporary water bodies (WRC, 2001). Ostracods are small crustaceans, typically around one mm in size, but varying between 0.2 and 30 mm, laterally compressed and protected by a bivalve-like, chitinous or calcareous valve or "shell". Most ostracod species are relatively unselective scavengers and graze on diatoms and littoral macrophytes, thus forming an important part of the aquatic ecosystem (WRC, 2001).

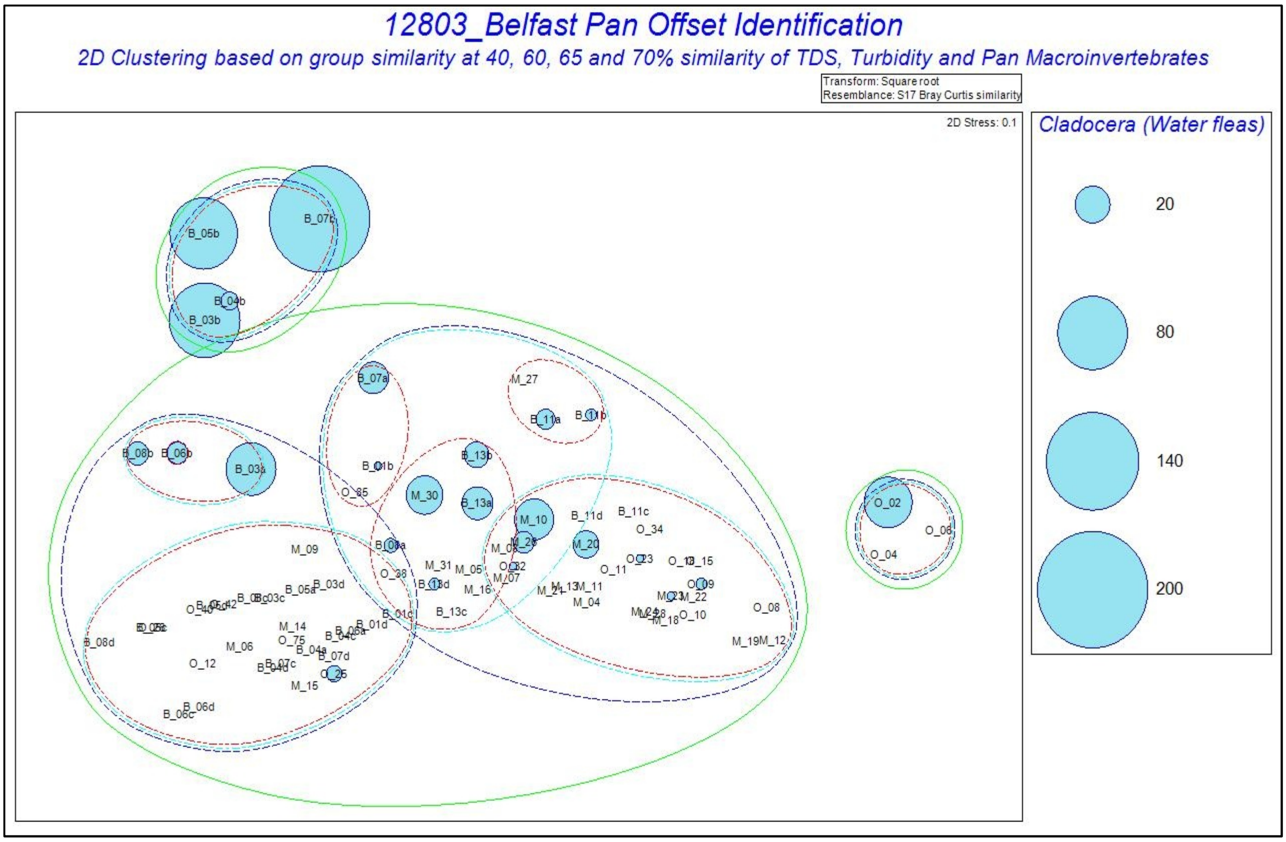

Figure 16: MDS clustering of the pans according to the Cladocera (Water flea) taxa group at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

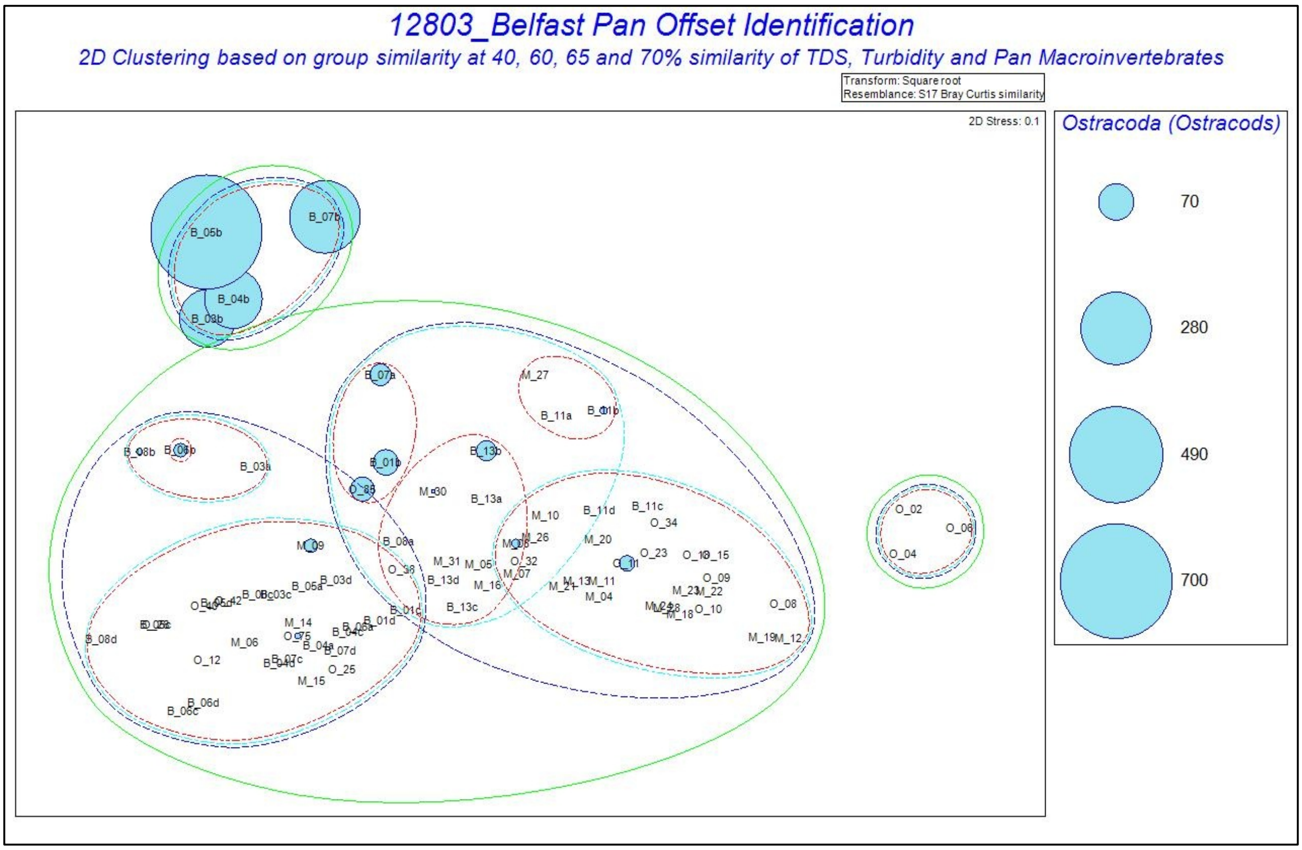

Figure 17: MDS clustering of the pans according to the Ostracod taxa group at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

- Copepoda (Copepods) clustering of the pans is shown in Figure 18;
- Conchostraca (Clam shrimps) clustering of the pans is shown in Figure 19;
- Triops sp. (Tadpole shrimps) clustering of the pans is shown in Figure 20.

Based on the MDS clustering of the Copepods (Figure 18), Conchostraca (Figure 19) and *Triops sp*. (Figure 20), it was shown that these taxa generally indicated the opposite clustering in comparison to the Cladocera (Figure 16) and Ostracods (Figure 17). This suggests that these taxa generally require higher TDS and turbidity and are specific to pans with these characteristics. The *Triops sp.* was only found in one pan (Pan M_27 Figure 20), and this may be due to season occurrences or the uniqueness/rarity of these species in pans.

Copepoda is a large class (more than 8000 species) of small bullet-shaped crustaceans with prominent first antennae. Copepods represent an extremely important link in aquatic food chains. They have a wide distribution, most occurring in temporary, often brackish waters (WRC, 2001). In southern Africa freshwater Copepoda occupy a wide variety of habitats ranging from open water in large impoundments, to temporary water bodies and backwaters of rivers and wetlands. In the study area, these are restricted to pans (WRC, 2001). Freshwater Copepoda range in size from less than 1 mm to 5 mm in length (WRC, 2001).

Conchostraca (clam shrimps) generally live in temporary rain-water pools that periodically dry up completely or partially, common in South Africa. Conchostracans are mainly benthic (WRC, 2000).

Tadpole Shrimps *(Triops sp.)* more commonly referred to as *Triops* are Crustacea which belong to the order *Notostraca. Triops sp.* inhabit temporary bodies of water and have a short life cycle which is completed in 20 to 90 days. This life cycle is driven by the changing nature of the temporary waters they inhabit, surviving dry periods by remaining in an egg form (WRC, 2000).

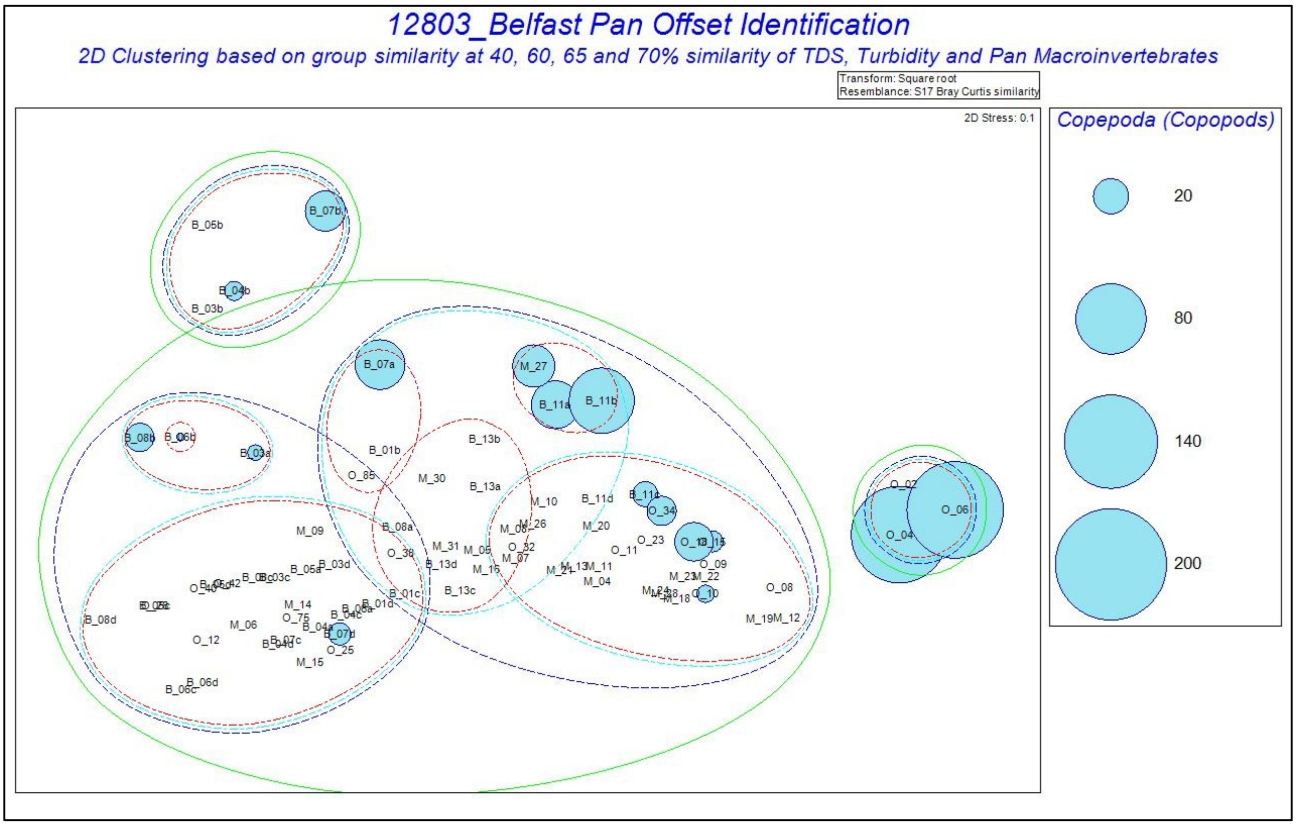

Figure 18: MDS clustering of the pans according to the Copepod taxa group at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

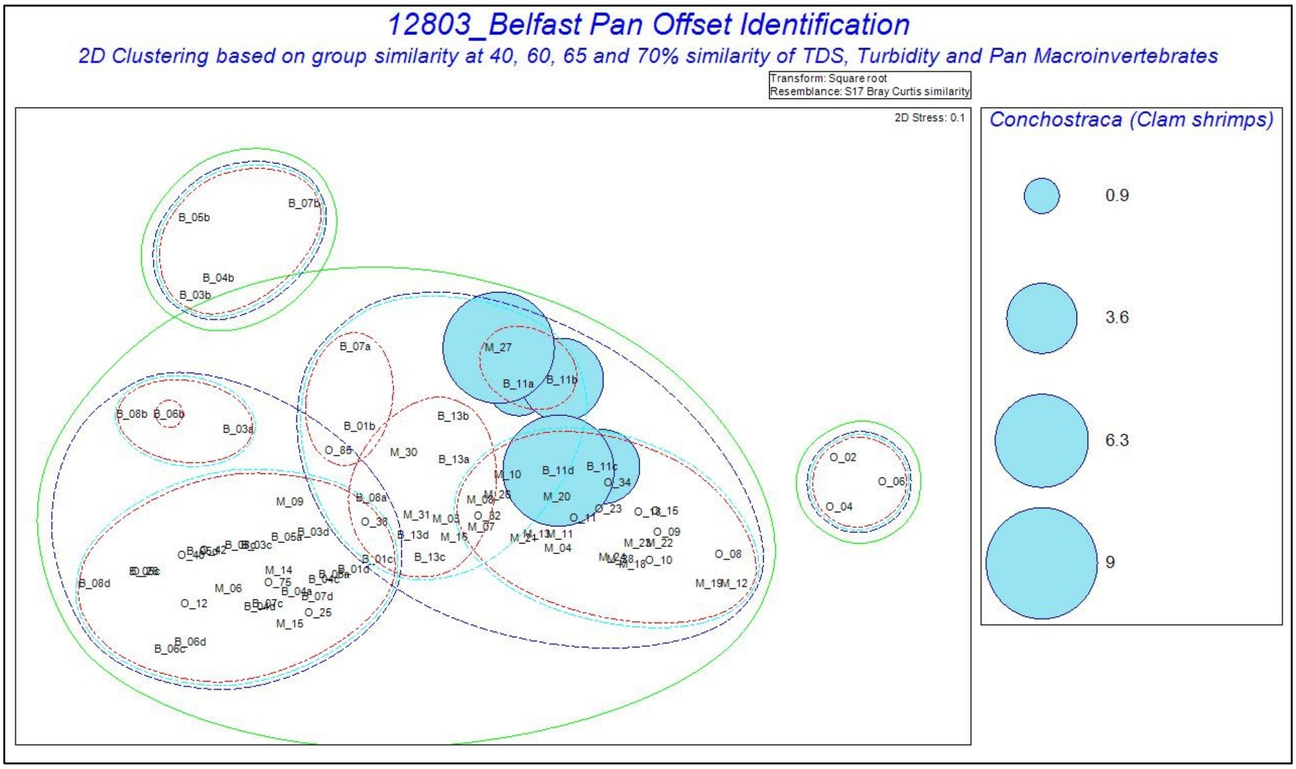

Figure 19: MDS clustering of the pans according to the Conchostraca taxa group at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

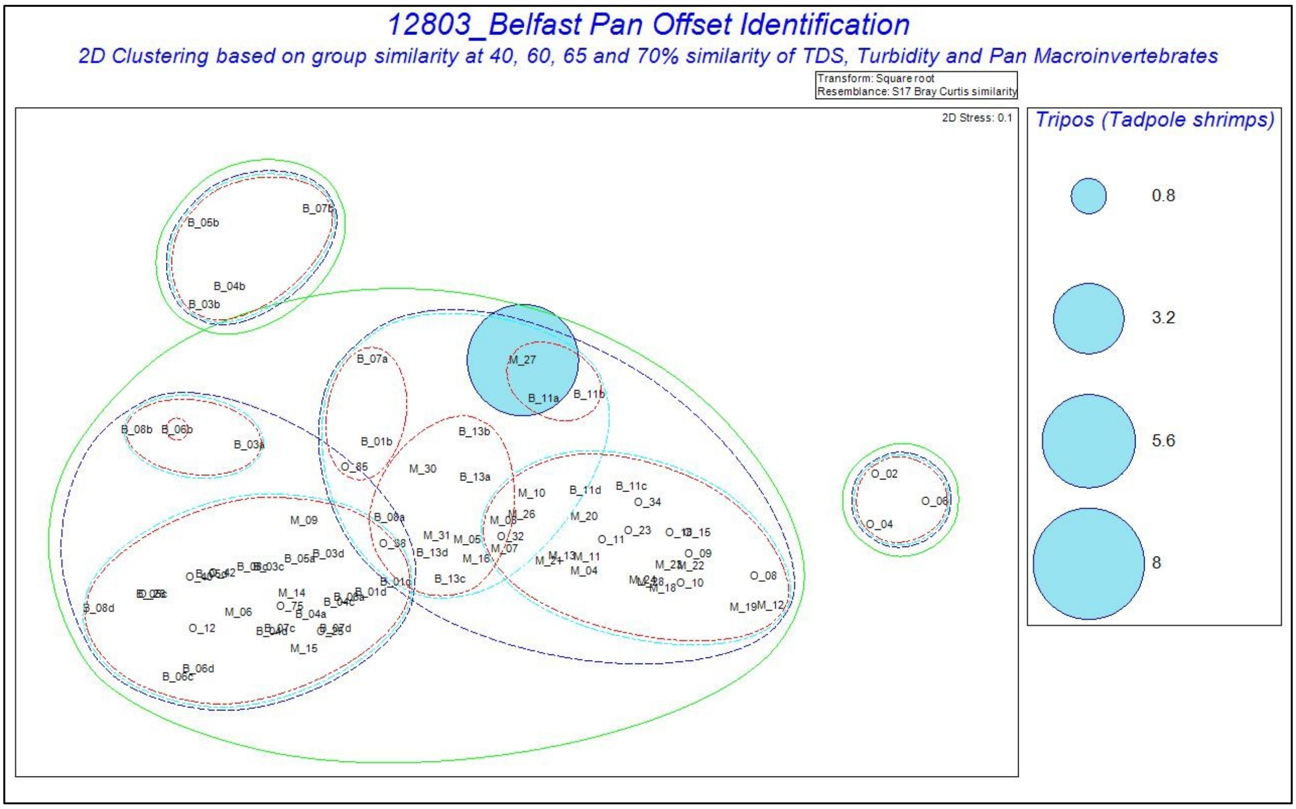

Figure 20: MDS clustering of the pans according to the Triops sp. taxa group at a similarity of 40 (red), 60 (turquoise), 65 (dark blue) and 70 (green) % similarity based on TDS, turbidity and pan macroinvertebrate assemblages

Based on the hierarchical and MDS clustering of the pan data, similar pans to those of the Belfast pans were then compared in order to identify similar pans for offsetting. The groupings and the similarity of the Belfast pans within the groupings of the candidate pans is shown in Figure 21. Seven distinct groups were similar at 70 %. The groupings were then analysed using SIMPER analysis within the PRIMER software in order to view the similarity of groupings based on the data variables.

- Groups 5, 6 and 7 were similar at 60 %;
- Groups 3 and 4 were similar at 60 %;
- Groups 3 – 7 were similar at 50 %; and
- Groups 1 and 2 were similar to the other groups at less than 40 %.

Within the groups, Groups 6 and 7 had the lowest average dissimilarity of 33.34 %. Table 9 presents the results of breaking down the dissimilarity between the two groups. The more abundant a species is within a group, the less it contributed to the intra-group dissimilarity and was said to typify a site (Clarke, et al., 1994). Only those species responsible for >80 % of the cumulative contribution are listed.

Table 9: Dissimilarity of pan data assemblages between Groups 6 and 7 based on TDS, turbidity and taxa contributions. Average dissimilarity = 33.34 % (Av.Abund = Average Abundance)

Species	Group 7	Group 6	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Conchostraca (Clam shrimps)	0.21	1.98	3.02	5.8	9.06	82.4
Ostracoda (Ostracods)	1.58	0.87	2.92	0.97	8.75	91.14

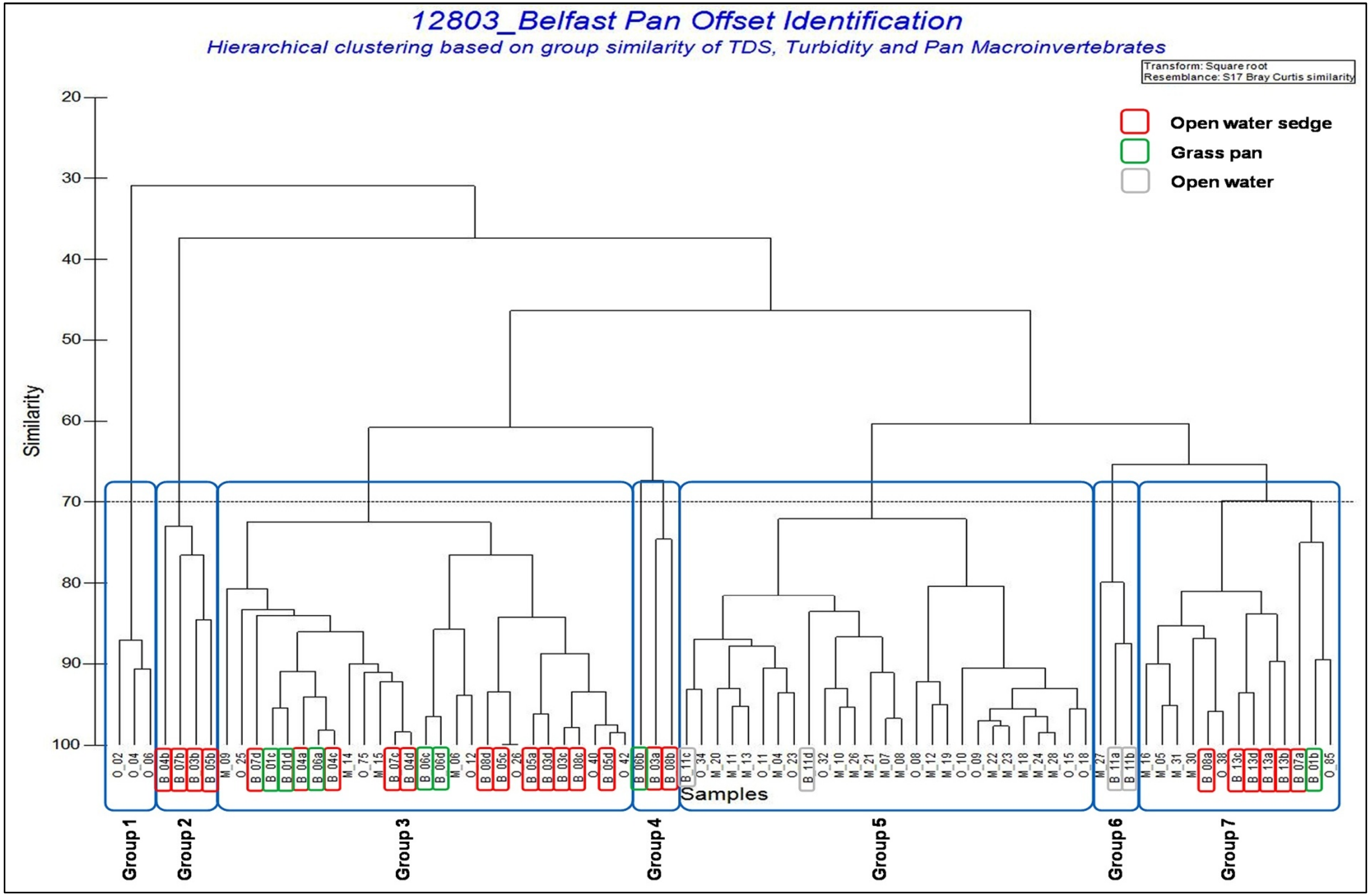

Figure 21: Hierarchical clustering and grouping of the Belfast pans (highlighted) in relation to the candidate pans within the 50 km buffer zone, based on TDS, turbidity and pan-specific aquatic macroinvertebrates

Between groups 6 and 7, the Conchostraca and Ostracoda contributed the most to the similarity of the pan samples (Table 9).

Table 10 presents the results of breaking down the dissimilarity between the groups 5 and 6. Only those variables responsible for >80 % of the cumulative contribution are listed. Between groups 5 and 6, the water turbidity and the Conchostraca contributed the most to the similarity of the pan samples (Table 10).

Table 10: Dissimilarity of pan data assemblages between Groups 5 and 6 based on TDS, turbidity and taxa contributions. Average dissimilarity = 35.17 %

Species	Group 6	Group 5	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Turbidity	1	2.85	2.46	0.99	7	83.86
Conchostraca (Clam shrimps)	1.98	0.19	2.33	4.05	6.64	90.5

Table 11 presents the results of breaking down the dissimilarity between the groups 3 and 4. Only those variables responsible for >80 % of the cumulative contribution are listed. Between groups 3 and 4, the water turbidity and the Ostracoda contributed the most to the similarity of the pan samples (Table 10).

Table 11: Dissimilarity of pan data assemblages between Groups 3 and 4 based on TDS, turbidity and taxa contributions. Average dissimilarity = 38.93 %

Species	Group 4	Group 3	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Turbidity	5.77	4.8	6.31	1.12	16.2	87.35
Ostracoda (Ostracods)	1.53	0.18	4.92	1.11	12.65	100

Table 12 presents the results of breaking down the dissimilarity between the groups 3 and 7. Only those variables responsible for >80 % of the cumulative contribution are listed. Between groups 3 and 7, the Ostracoda and Cladocera contributed the most to the similarity of the pan samples (Table 12).

Table 12: Dissimilarity of pan data assemblages between Groups 3 and 7 based on TDS, turbidity and taxa contributions. Average dissimilarity = 39.31%

Species	Group 7	Group 3	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Ostracoda (Ostracods)	0.18	1.58	3.92	0.7	9.97	83.79
Cladocera (Water fleas)	0.08	1.42	3.39	0.88	8.62	92.41

Table 13 presents the results of breaking down the dissimilarity between the groups 5 and 7. Only those variables responsible for >80 % of the cumulative contribution are listed. Between groups 5 and 7, the Ostracoda and Cladocera contributed the most to the similarity of the pan samples (Table 13).

Table 13: Dissimilarity of pan data assemblages between Groups 5 and 7 based on TDS, turbidity and taxa contributions. Average dissimilarity = 40.29%

Species	Group 7	Group 5	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
Ostracoda (Ostracods)	1.58	0.21	2.34	0.7	5.8	88.13
Cladocera (Water fleas)	1.42	0.57	2.21	0.95	5.49	93.62

Table 14presents the results of breaking down the dissimilarity between the groups 1 and 5. Only those variables responsible for >80 % of the cumulative contribution are listed. Between groups 1 and 5, the Ostracoda and Cladocera contributed the most to the similarity of the pan samples (Table 13).

Table 14: Dissimilarity of pan data assemblages between Groups 1 and 5 based on TDS, turbidity and taxa contributions. Average dissimilarity = 48.46%

Species	Group 5	Group 1	Av.Diss	Diss/SD	Contrib%	Cum.%
	Av.Abund	Av.Abund				
TDS	40.37	104.04	40.44	3.69	83.44	83.44
Copepoda (Copopods)	0.62	8.16	4.99	1.45	10.29	93.73

The Belfast pans fell within groups 2, 3, 4 and 7 (Figure 21). Based on these results pans within similar groups were prioritised for potential offsets. These similar pans are shown in Table 15. Of the similar pans, a number of duplicated pans were identified for each Belfast pan. These were given higher priority due to having repeated similarity to certain Belfast pans.

Table 15: Offset priority pans based on similarity to the Belfast pans

Data variable	Belfast Pans	Offset Potential Pans
TDS Clustering	B_11	M_27; O_02; M_20; O_04; M_21; O_06; and M_10
	B_13	M_30; O_32; M_31; M_05; M_16; M_07; M_08; and M_25
	B_03	M_09; O_85; M_14; O_38; M_15; O_75; M_06; and O_42
Turbidity	B_11	M_27; O_04; M_20; O_06; O_34; O_23; O_15; and O_09
	B_13	M_20; M_13; and M_11
	B_01	M_14; and O_75
	B_03	M_06; and O_38
	B_04	O_42
Ostracods	B_11	M_08 and O_11
	B_13	O_85
	B_06	M_09; and O_75
Cladocera	B_11	M_20; and O_32
	B_13	M_26; M_30; and O_23
	B_08	O_25
Conchostraca	B_11	M_27
Copopods	B_11	M_27; O_04; O_06; O_34; O_18; O_15; and O_10
Triops Clustering	B_11	M_27

A map indicating the similar pans that were used for the potential offset candidate pans is shown in Figure 22. Of priority was the potential for the offset areas to fall within Exxaro-owned land, preferably with pan and wetland rehabilitation potential due to existing mining activities. One potential candidate offset area was the Exxaro Strathrae Colliery to the southwest of the proposed Belfast NBC project. For the purposes of this elimination process the mine lease area of both the proposed Belfast NBC and the Strathrae Colliery were used as reference points on the maps.

Water Management Areas

The offsite area(s) would have to fall within the Inkomati Water Management Area (WMA: 05) (Figure 22).

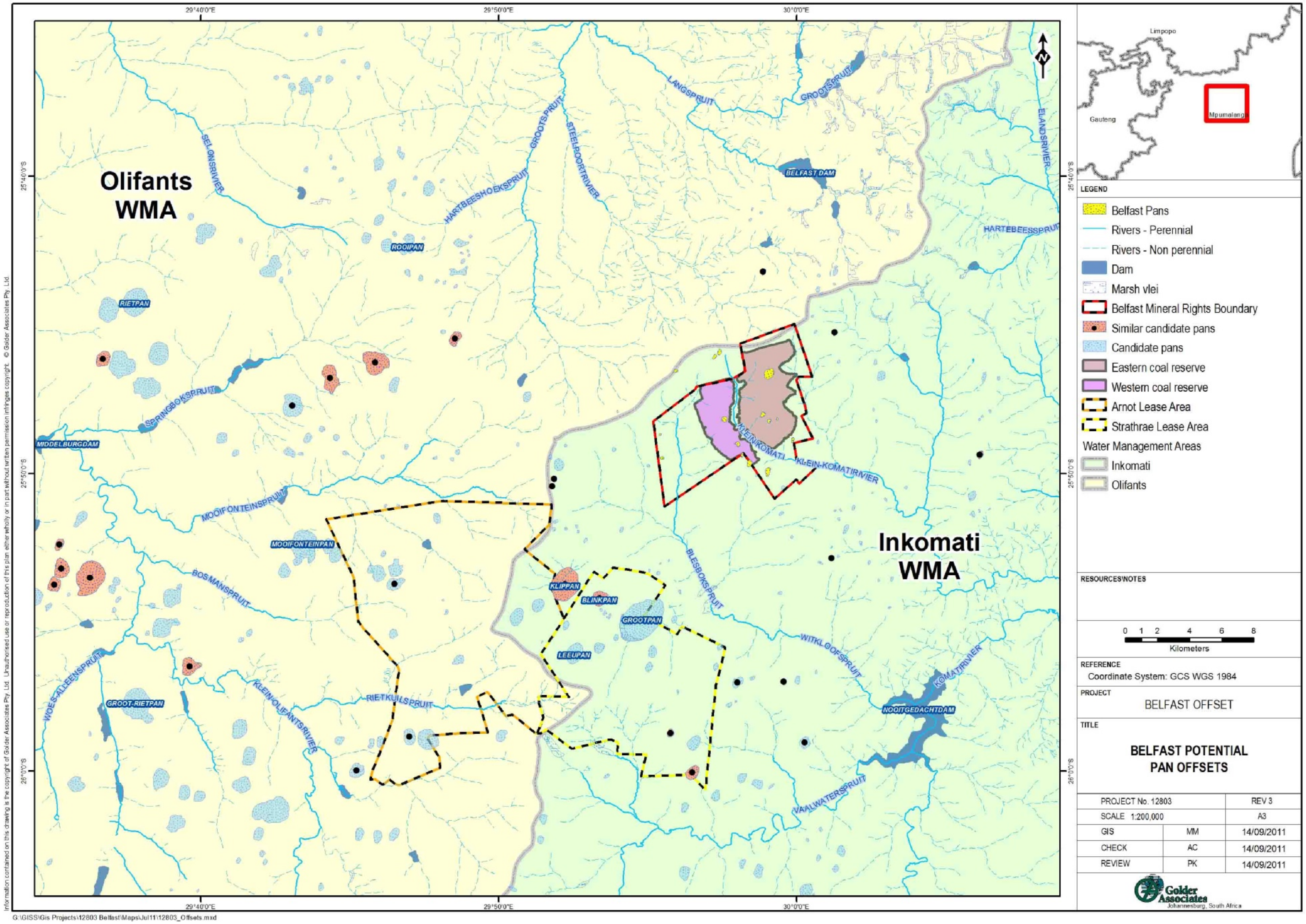

Figure 22: Candidate pans with similar characteristics to the Belfast pans, based on the statistical analyses. The Strathrae Colliery mine lease areas is also shown in relation to the proposed Belfast mine lease area

Based on the similarity of only a few of the candidate pans to those of the Belfast area, a calculation of the total area of these similar pans to the candidate pans was done (Table 16). As is shown, only a small percentage of the candidate pans were suitable for offsetting and that within the Inkomati WMA, only 13.08 % of the candidate pans were similar to the Belfast pans (Table 16).

Table 16: Calculated area of potential offset pans within the identified candidate pans of the Olifants and Inkomati WMAs

WMA	Total area of candidate pans (Ha)	Total area of potential offset pans (Ha)	Percentage of offset pans (%)
Inkomati	2432.65	318.20	13.08
Olifants	6740.54	1111.77	16.49

Geomorphic provinces

The offsite area(s) would have to fall within the same or similar geomorphic provinces. This is shown in Figure 23. From the map, it can be seen that the Belfast pans and wetlands fall within two geomorphic provinces (Highveld geomorphic province: 15, and the Mpumalanga Highlands geomorphic province: 20) (CSIR, 2011). Therefore, the offset sites would have to fall within the same geomorphic provinces.

With reference to Figure 23, the Belfast Project straddles the boundary between the Highveld and Mpumalanga Highlands geomorphic provinces. The Mpumalanga Highlands is a relatively small province that stretches to the east and north east from the Belfast Project. Alternatively the Highveld is a very large province covering substantial areas of the south and south west of Mpumalanga, southern Gauteng, eastern North West Province, and most of the Free State.

Vegetation zones

The offsite area(s) would have to fall within the same or similar vegetation zones. This is shown in Figure 24. From the map, it can be seen that the Belfast pans and wetlands fall within two vegetation zones (the Endangered – Eastern Highveld Grassland: Gm 12, and the Least Threatened – Eastern Temperate Freshwater Wetlands: AZf 3) (Mucina, et al., 2006). Therefore, the offset sites would have to fall within the same vegetation zones.

With reference to Figure 24, the Eastern Highveld Grassland is the dominant vegetation type covering the Belfast Project area and takes the shape of a crescent across the south western part of Mpumalanga with the Belfast Project situated in the North easterly part of the vegetation type. The Eastern Temperate Freshwater Wetlands are scattered across the province with an isolated area falling within the Belfast Project Area. This area is in fact one of the pans that will be mined out.

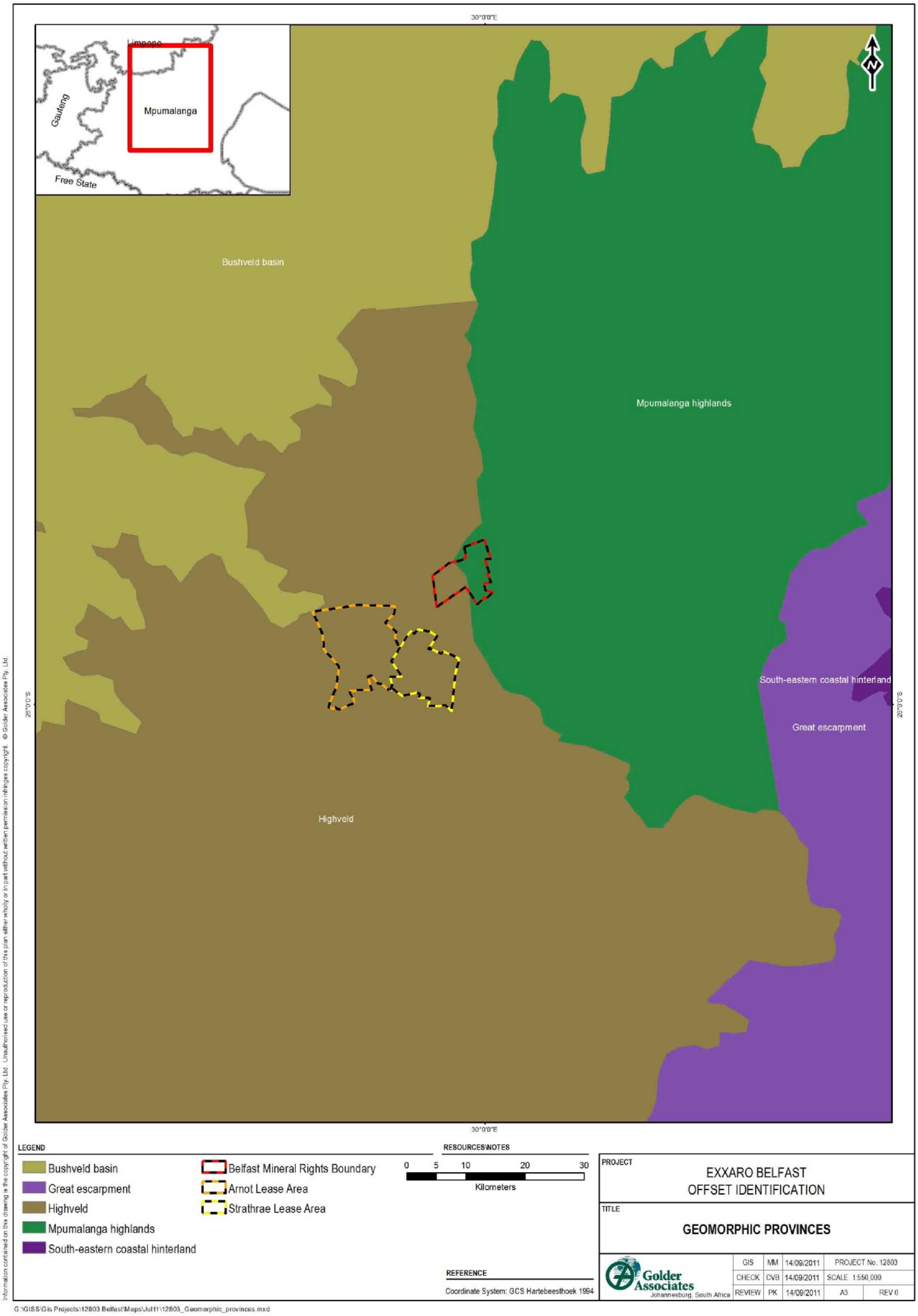

Figure 23: Geomorphic provinces associated with the proposed Belfast project area (CSIR, 2011)

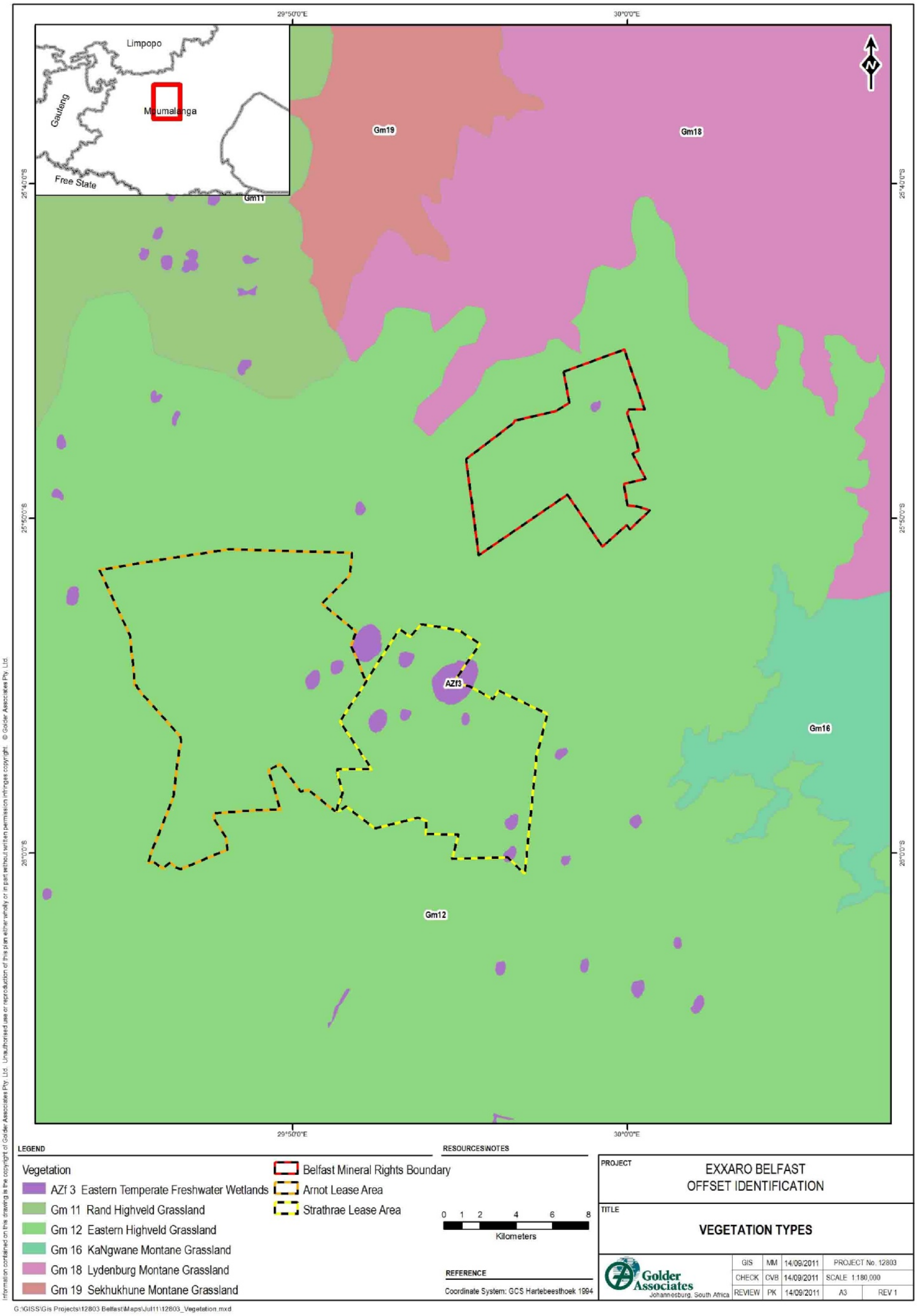

Figure 24: Vegetation types associated with the proposed Belfast project area (Mucina, et al., 2006)

Mpumalanga Biodiversity Conservation Plan (MBCP)

The offsite area(s) would have to fall within the same biodiversity conservation management areas. This is shown in Figure 25. From the map it can be seen that the Belfast pans and wetlands fall within two biodiversity conservation areas (the level 5 Ecosystem Maintenance area, and the level 3 Highly Significant area) (Ferrar, 2007). Therefore, the offset sites would have to fall within the same biodiversity conservation areas.

According to the Mpumalanga Parks and Tourism Agency (MTPA) Mpumalanga Biodiversity Conservation Plan (MBCP) (Ferrar, 2007), most of the area (>60%) is listed under the Aquatic Biodiversity Sub-catchments as “Ecosystem Maintenance”, with one area, closest to the cluster of pans on the western side of the Arnot Mine Lease Area (MLA) as “Highly Significant”. A map indicating the aquatic biodiversity sub-catchments for the study area is presented in Figure 25. The MBCP data indicates that the rivers within the Klein-Olifants River upstream of Middelburg Dam are Critically Endangered (Ferrar, 2007).

Ecosystem Maintenance Aquatic Biodiversity Sub-catchments

According to (Ferrar, 2007) biodiversity assets in these landscapes (Ecosystem Maintenance) contribute to natural ecosystem functioning, ensure the maintenance of viable species populations and provide essential ecological and environmental goods and services across the landscape. Although these areas contribute least to the achievement of biodiversity targets they have significant environmental, aesthetic and social values and should not be viewed as wastelands or carte-blanche development zones (Ferrar, 2007). Land-use planners are still required to consider other environmental factors such as socio-economic efficiency, aesthetics and the sense-of-place in making decisions about development. Prime agricultural land should also be avoided for all non-agricultural land uses. Land-use and administrative options for positive biodiversity outcomes include (Ferrar, 2007):

- Where this category of land occurs close to areas of high biodiversity value, it may provide useful ecological connectivity or ecosystem services functions. In these situations encouragement needs to be given to biodiversity-friendly forms of management and even restoration options where appropriate;
- Develop incentives to reverse lost biodiversity for selected parcels of land where buffer zones and connectivity are potentially important; and
- Standard application of EIA and other planning procedures.

Highly Significant Aquatic Biodiversity Sub-catchments

According to (Ferrar, 2007) biodiversity assets in these landscapes (Highly Significant) should be maintained as natural vegetation cover. Permissible land uses should be limited to those that are least harmful to biodiversity. All cultivation-based agriculture and all urban/industrial development should not be permitted. If development is unavoidable, it must be made sufficiently dispersed (sometimes clumped) and of the right scale to be as biodiversity friendly as possible. Specialist ecological advice will be required in such cases to reinforce standard EIA procedures. ‘Biodiversity reinforced EIA procedures’ require that a specialised biodiversity study be undertaken as part of the EIA. (Ferrar, 2007).

Land-use and administrative options for positive biodiversity outcomes include (Ferrar, 2007):

- All land in this category should be maintained as natural vegetation cover;
- Land-use planners to refer all development applications in Highly Significant land to MTPA and or Department of Agriculture & Land Administration (DALA) for evaluation by biodiversity specialists;
- Encourage cooperative conservation arrangements, e.g. Protected Environments or conservancies where appropriate;
- Conduct focused public awareness and/or extension effort on biodiversity values and uses of these areas, especially to land owners;

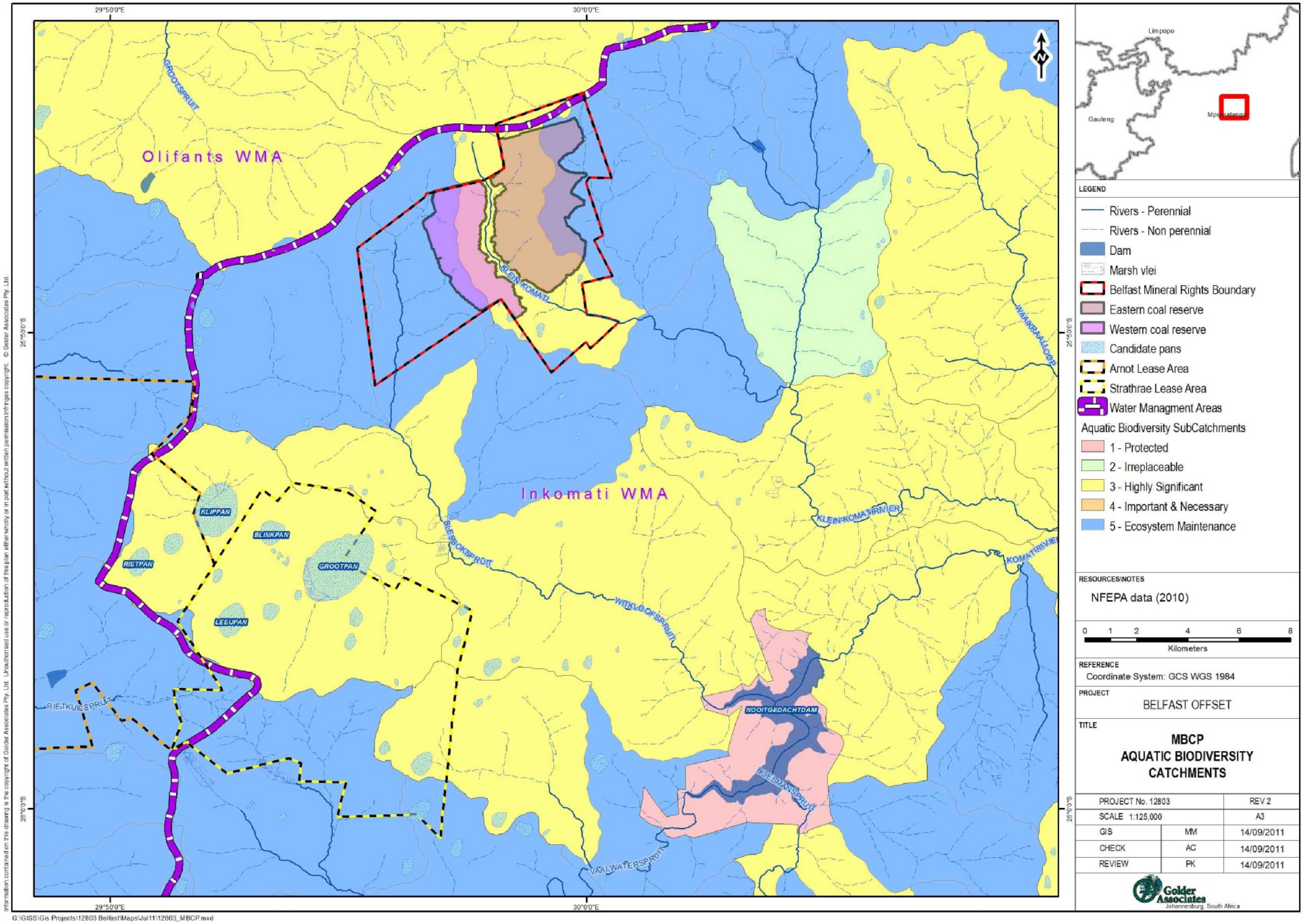

Figure 25: Aquatic biodiversity sub-catchments associated with the proposed Belfast and existing Strathrae mine lease areas, based on the MBCP data (Ferrar, 2007)

- Prioritise for MTPA/ Department of Agriculture & Land Administration (DALA) to carry out environmental monitoring and reporting on biodiversity status and/or change of land use;
- Develop a more detailed list of unsustainable land uses that are site- or area- specific, including relevant aspects of scale and extent;
- Require that a specialised biodiversity study be undertaken as part of the EIA for all development applications;
- Develop best practice guidelines for all permitted land uses;
- Devise new financial and other incentives (e.g. resource economic approaches) for achieving sustainable conservation management;
- Unavoidable development requires special mitigation measures such as dispersed and/or small scale placement of site;
- Consider special projects to develop biodiversity management / sustainable use guidelines and procedures for communal land; and
- Prioritise these areas for land care projects: i.e. MTPA, DALA, Working for Wetlands and Non-governmental Organisations (NGOs) to redirect their conservation projects, programmes and activities.

National Freshwater Ecosystem Protected Areas (NFEPA)

In terms of ecological function of the pans and wetlands within the Inkomati River catchment, the offsite area(s) would have to fall within the same National Freshwater Ecosystem Protected Area (NFEPA). The National Freshwater Ecosystem Protected Areas map (CSIR, 2011), indicating the condition of the river ecosystems and the location of any Freshwater Ecosystem Protected Areas (FEPAs) associated with the study area is presented in Figure 26.

From the map, it can be seen that the proposed Belfast mine lease area and parts of the existing Strathrae mine lease area lie within a Freshwater Ecosystem Protected Area (FEPA). River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category. Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach (CSIR, 2011). The pans and wetalnds therefore would provide a vital role in contributing towards the ecological function of the streams and therefore need to viewed in this context for the offset area identification. Pan and wetland offsets within the Strathrae mine lease area partially provide the same ecological function to the FEPA and may also improve the Upstream of the Vaalwaterspruit.

Upstream Management Areas, shown in very pale green, associated partially with the existing Strathrae mine lease area, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale (CSIR, 2011).

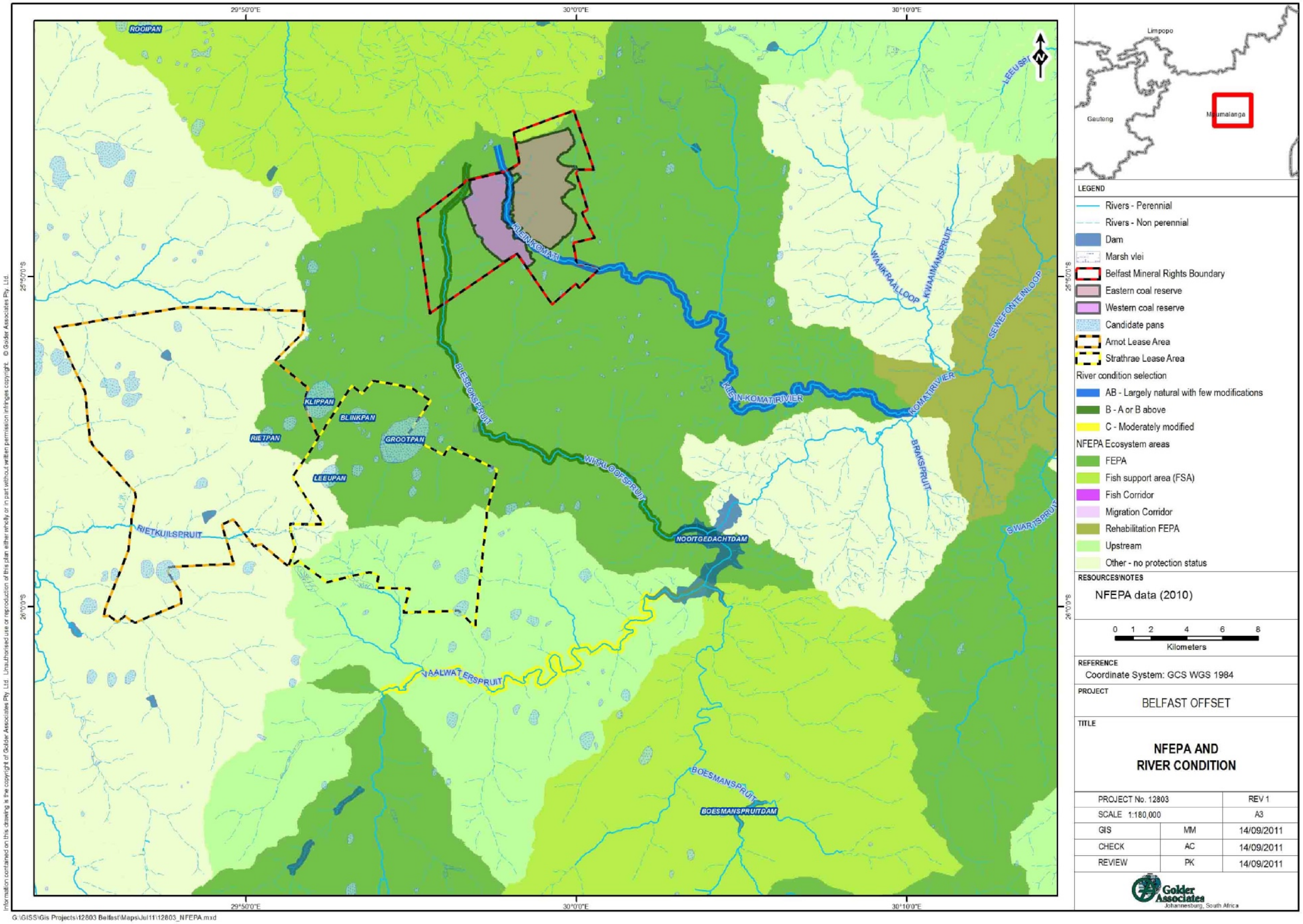

Figure 26: The National Freshwater Ecosystem Protected Areas (NFEPA) data and River Conditions associated with the proposed Belfast and existing Strathrae mine lease areas (CSIR, 2011)

4.1.5 Identified potential offset cluster

Based on this elimination process, it was shown that the Exxaro Strathrae mine lease area is suitable for offsetting of the Belfast pans as it fills the various criteria for the Belfast pan functions and source zone for the Inkomati River system. The area is dominated by large Open water pans in close proximity to one another, with a large number of smaller pans of different types in-between them. The occurrence of obsereved Lesser flamingo (*Phoenicopterus minor*), African marsh terrapin (*Pelomedusa subrufa*), Grey crowned crane (*Balearica regularum*), breeding pairs of Wattled cranes (*Bugeranus carunculatus*), Blue cranse (*Anthropoides paradisea*), and the Greater flamingo (*Phoenicopterus ruber*) at certain pans within the Pans cluster were considered to be of additional conservation importance.

Distinct features of the larger pans were the presence of rocky outcrops at the very edge of the pan (Figure 27). These outcrops were steep in gradient and often provide refugia for fauna and flora. These features are of particular importance when considering the pressure on the grassland and wetland areas and the relative scarcity of these rocky outcrop habitats. An example of the typical pan is shown in Figure 28.

A map indicating the similar candidate pans within the Strathrae cluster as well as the remaining pans that will be included in the offset programme are shown in Figure 29. The farm portions and land ownerships associated with these pans are shown in Figure 30. From the map, it can be seen that Exxaro-owned property consists of the majority of the farm potions and thus makes this a good cluster for the offset project. Wetlands associated with the Strathrae pan cluster, based on the Mpumalanga wetland priority map, are shown in Figure 31. These would be used as the offsite wetland offsets. To be noted is that current Exxaro mining activities at Arnot and Strathrae need to be considered in the stragegy for the offset areas, as some of the pans and wetlands may already be impacted. These impacts would have to be mitigated as part of the offset programme.

Figure 27: Photograph illustrating the rocky outcrops which provide refugia for flora and fauna

Figure 28: Example of the pans in the Strathrae cluster (Pan O_03)

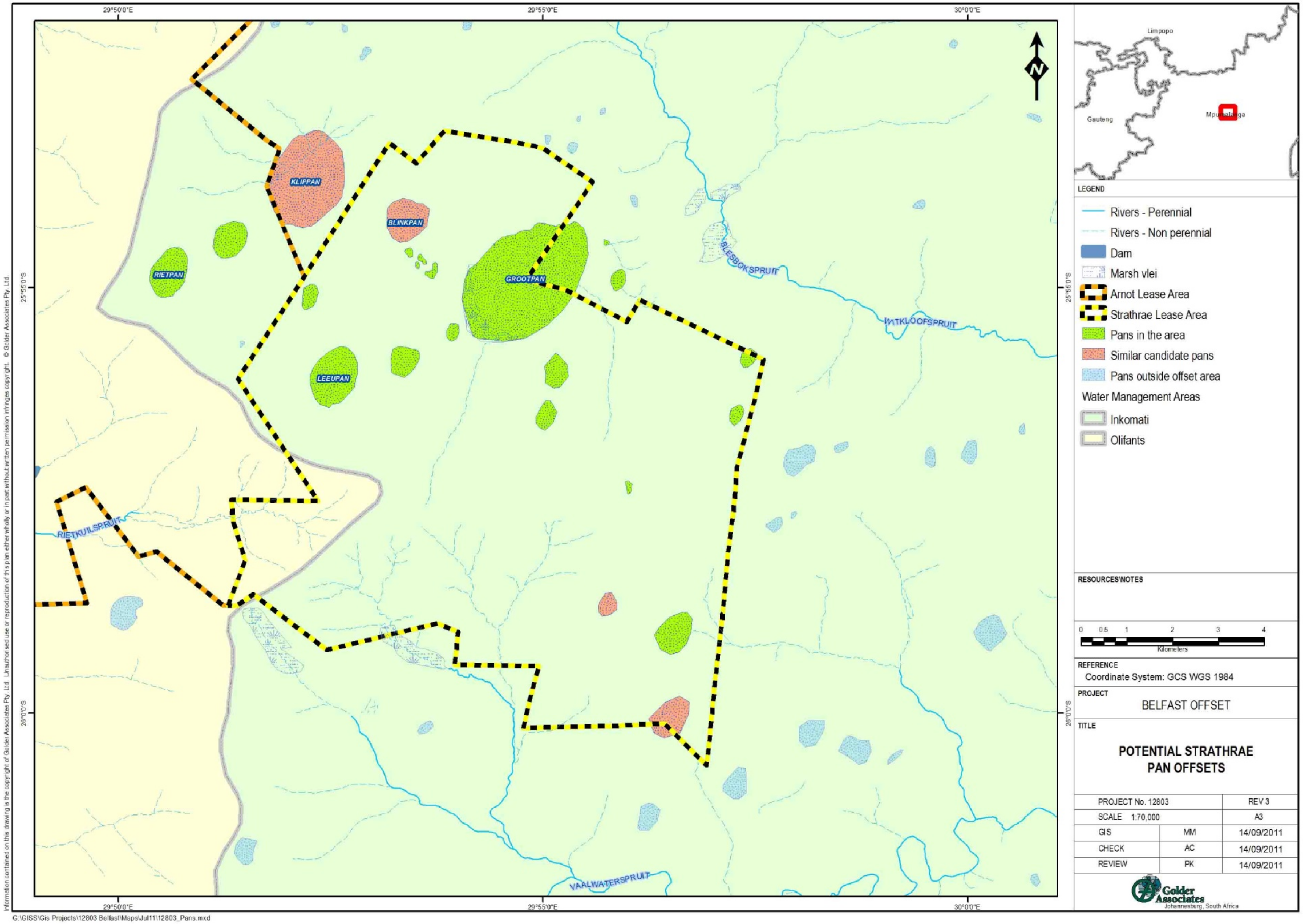

Figure 29: Candidate pans that are within the Strathrae mine lease area and those that are similar in characteristics to the Belfast pans (statistical analyses). The pan Klippan, Rietpan and the pan in-between were included due to their proximity and catchments

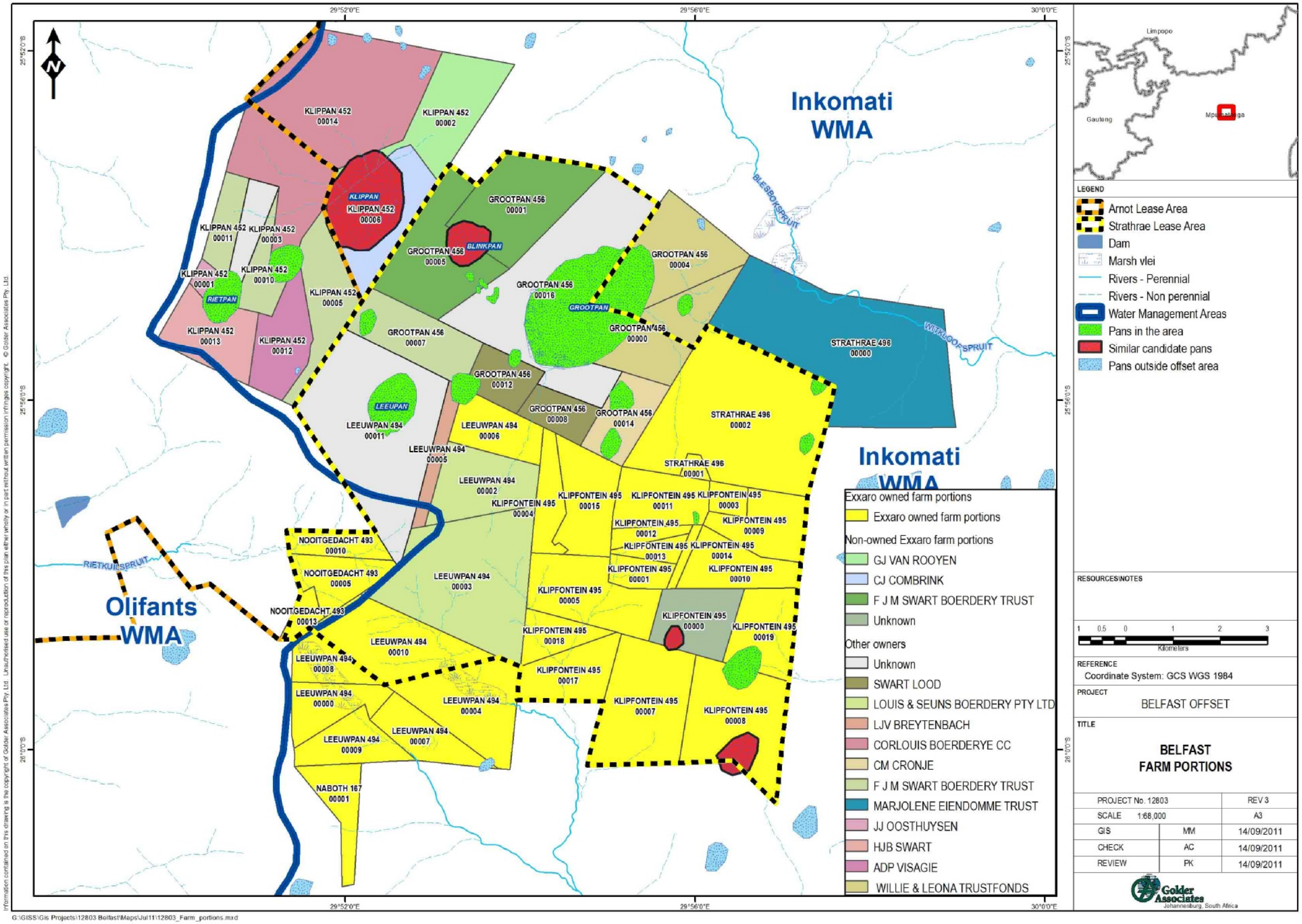

Figure 30: Potential offsite offset pans in relation to farm boundaries and the ownership of the farm portions. Exxaro own most of the area within the proposed offsite offset project area

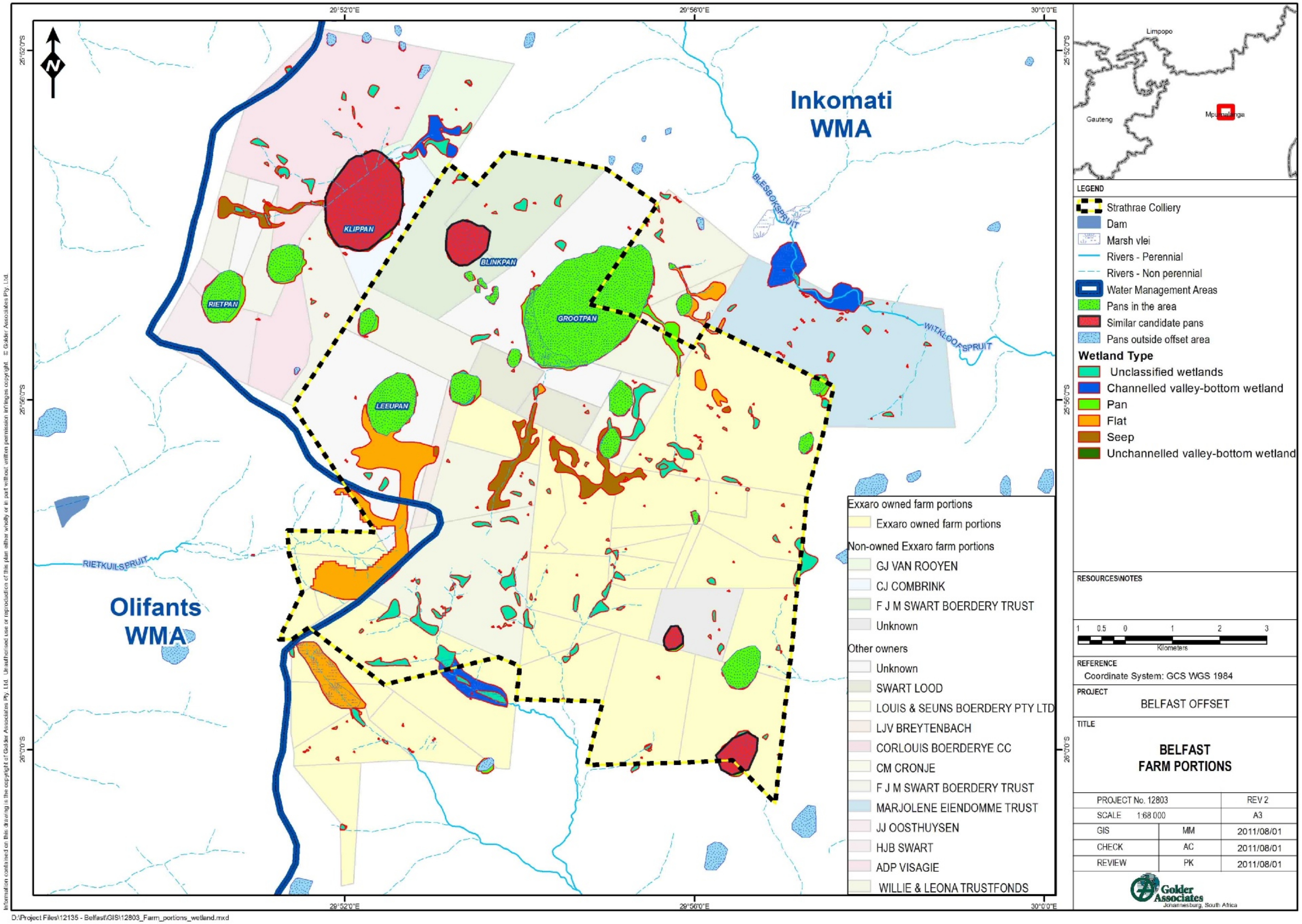

Figure 31: Potential offsite offset wetlands and wetland types in relation to farm boundaries and the ownership of the farm portions

The total area (hectares) of the wetlands in the proposed offsite offset area is 2502.85 ha. This is slightly over the recommended area of 1788.5 ha (Table 8). These wetland areas will however have to be delineated in order to accurately quantify the actual wetland boundaries and types.

4.1.6 Critical offset cluster criteria

In order to successfully implement the offset project on the identified cluster, Exxaro would need to determine the current mined-out coal reserves as well as any potential remaining coal reserves. This will have to be done in order to determine the potential for offsetting this cluster of pans and wetlands and securing them from future mining activities.

Exxaro would also have to engage with the surrounding landowners in order to successfully include all of the suggested pans within this cluster. This process would have to be facilitated by DWA and MTPA in order for the correct biodiversity planning and stakeholder engagement processes to be initiated. Once formalised, the rehabilitation and protection criteria can be structured.

4.1.7 Rehabilitation and protection criteria

The offsite off-set pans and wetlands would need to be managed in order to improve baseline conditions and mitigate any impacts associated with the proposed project. The rehabilitation criteria for these offsite set-asides would include:

- Implementation of an Exxaro, land-owner and MTPA pan and wetland management forum for the offsite set-aside wetlands;
- Limitation of agricultural impacts due to cattle overgrazing and trampling, and crop encroachment into the pan catchments and wetland areas;
- Implementation of pan and wetland mitigation and rehabilitation for pans and wetlands that may be impacted by existing mining impacts;
- Create and maintain linkages between the pans and wetlands for increased habitat connectivity;
- Implementation of a fire-management programme;
- Implementation of an alien and exotic vegetation management programme; and
- Implementation of a pan and wetland biomonitoring programme.

These criteria for the offsite offset pans and wetlands will form the basis for the implementation and management plan for the offset programme.

The protection criteria will include a plan to obtain protected status for each pan and wetland type within the MBCP as a driver for motivation within the National Protected Areas Act. No further mining activities will be allowed to occur on these wetlands and pans or within the catchments of the pans. This may require engagement with various government and provincial departments (DMR, DEAT, DWA and MTPA).

5.0 CONCLUSIONS AND RECOMMENDATIONS

The main objective of this study was to identify possible wetland offset areas as mitigation for the loss of wetland habitats due to the proposed open cast mining at the Exxaro Belfast NBC Coal Project.

Onsite set-asides were identified in which improved ecological catchment management and planning as well as implementation of the Belfast EMPR mitigation, can result in improved baseline conditions. These are shown in Figure 32. Offsite offsets were identified in which improved ecological catchment management and planning, as well as protection statues and no future mining activities, can result in offsets of the wetlands and pans lost within the proposed Belfast coal reserves. These are shown in Figure 33.

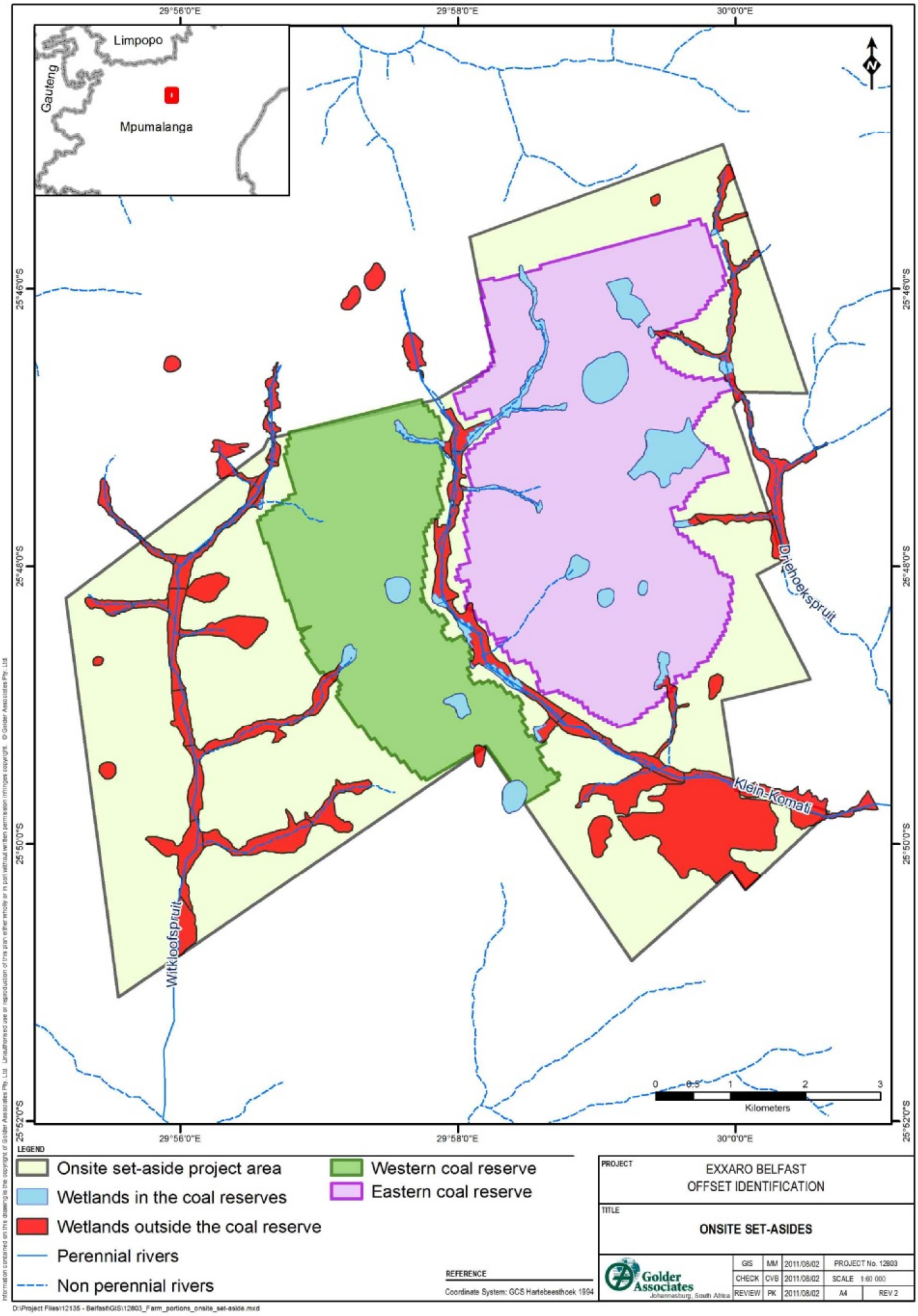

Figure 32: Summary of identified onsite set-aside pans and wetlands associated with the proposed Belfast project area

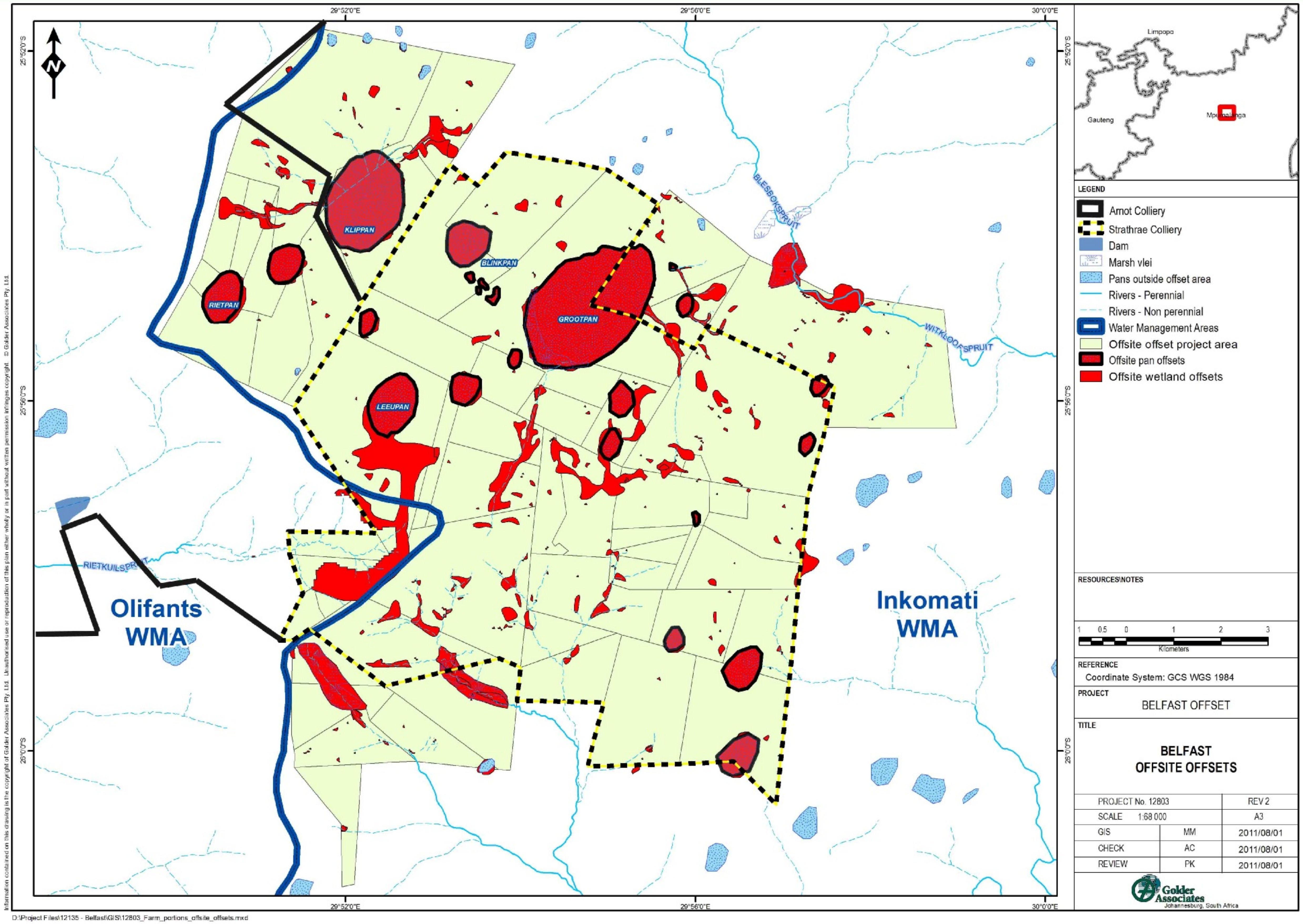

Figure 33: Summary of identified offsite offset pans and wetlands associated with the Strathrae mine lease area

As a way forward it is proposed that the mined out and remaining coal reserves within the Strathrae mine lease area are determined. The offset project area should then be approved for potential offsetting by Exxaro. Once Exxaro have approved the offset area, engagement with the Department of Mineral Resources (DMR) is required in order to sterilize any remaining coal reserves within the Strathrae offset area from future mining activities and list the area as an offset protected area. Once the above has been achieved the Phase two can be initiated which would involve the development of a management plan for the identified off-set areas to ensure that the ecological integrity of the site is maintained or bettered to compensate for the loss in ecological habitat within the proposed Belfast coal reserves.

The management plan will make provision for two Wetland Management Forums (WMFs) (legal stakeholder bodies that will be setup for the management and protection of the two biodiversity offset areas; Belfast mine lease area and the Strathrae mine lease area). These WMFs will include; Exxaro, affected landowners, the Mpumalanga Wetland Forum, DWA and MTPA. Their function will be to initiate a management and monitoring programme in order to monitor the management and any improvement the off-set areas (both the onsite set-aside and offsite offset areas), as well as develop and initiate a protection plan for the offsite offset area to prevent any further mining activities from impacting the offset pans and wetlands.

In order for this project to succeed, it is important to remember that the mitigations outlined in the Belfast EMPR need to be met in terms of the management hierarchy, before biodiversity offsets (compensation mitigation) can be considered. In the light of this project, rehabilitation of the lost pans and wetlands within the two proposed coal reserves at Belfast would not be feasible and therefore offsetting these specific pans and wetlands was considered as an option that would still allow the development to continue. Therefore engagement is required with the various regulatory bodies (DWA, DMR and MTPA) in order to consider this option and offset sites that have been identified.

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APPENDIX A

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