DETERMINATION OF WATER RESOURCE CLASSES AND RESOURCE QUALITY OBJECTIVES FOR THE LOWER ORANGE CATCHMENT

Resource Quality Objectives Workshop – WETLANDS

Presented by: Shavaughn Davis

Date: 29 October 2025

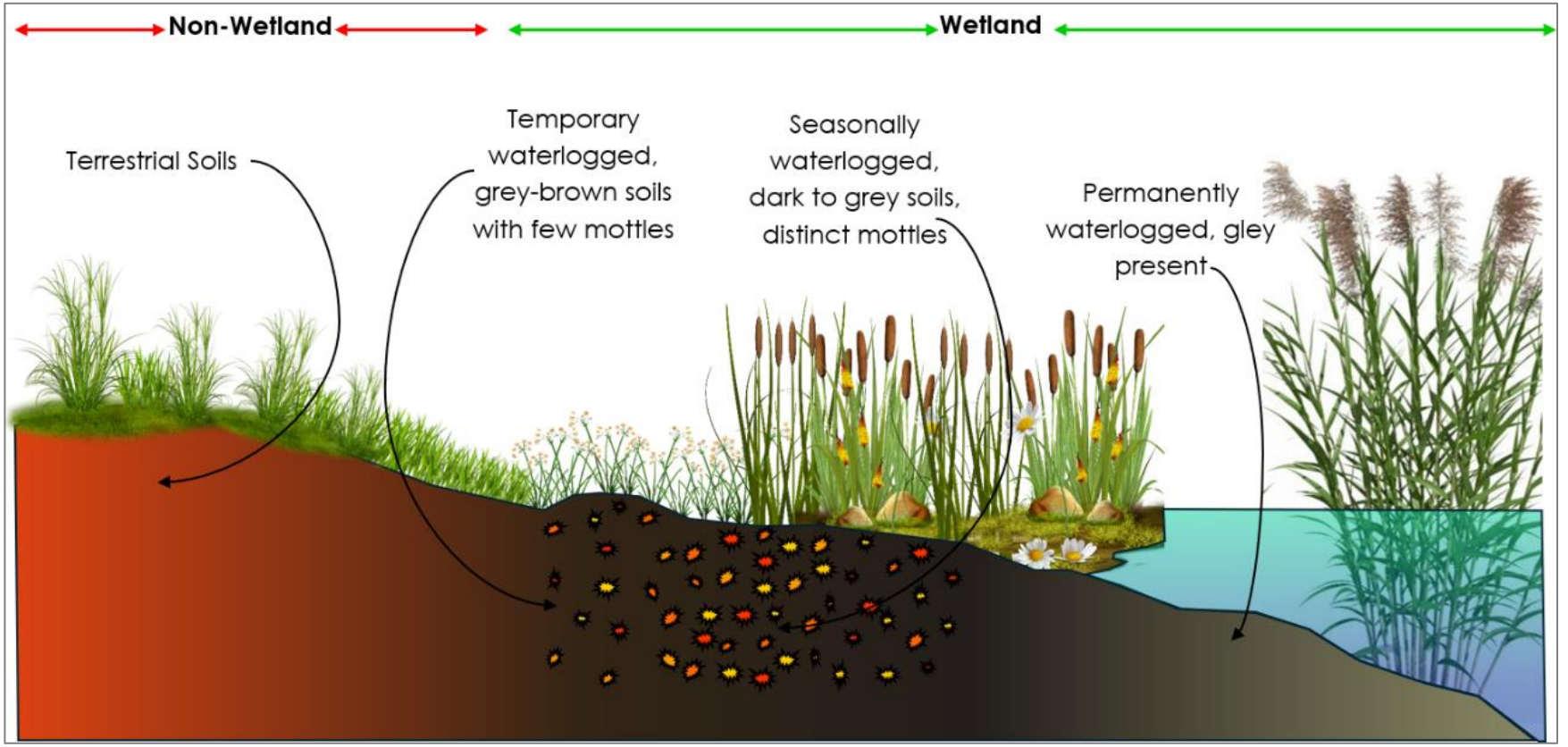
WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation

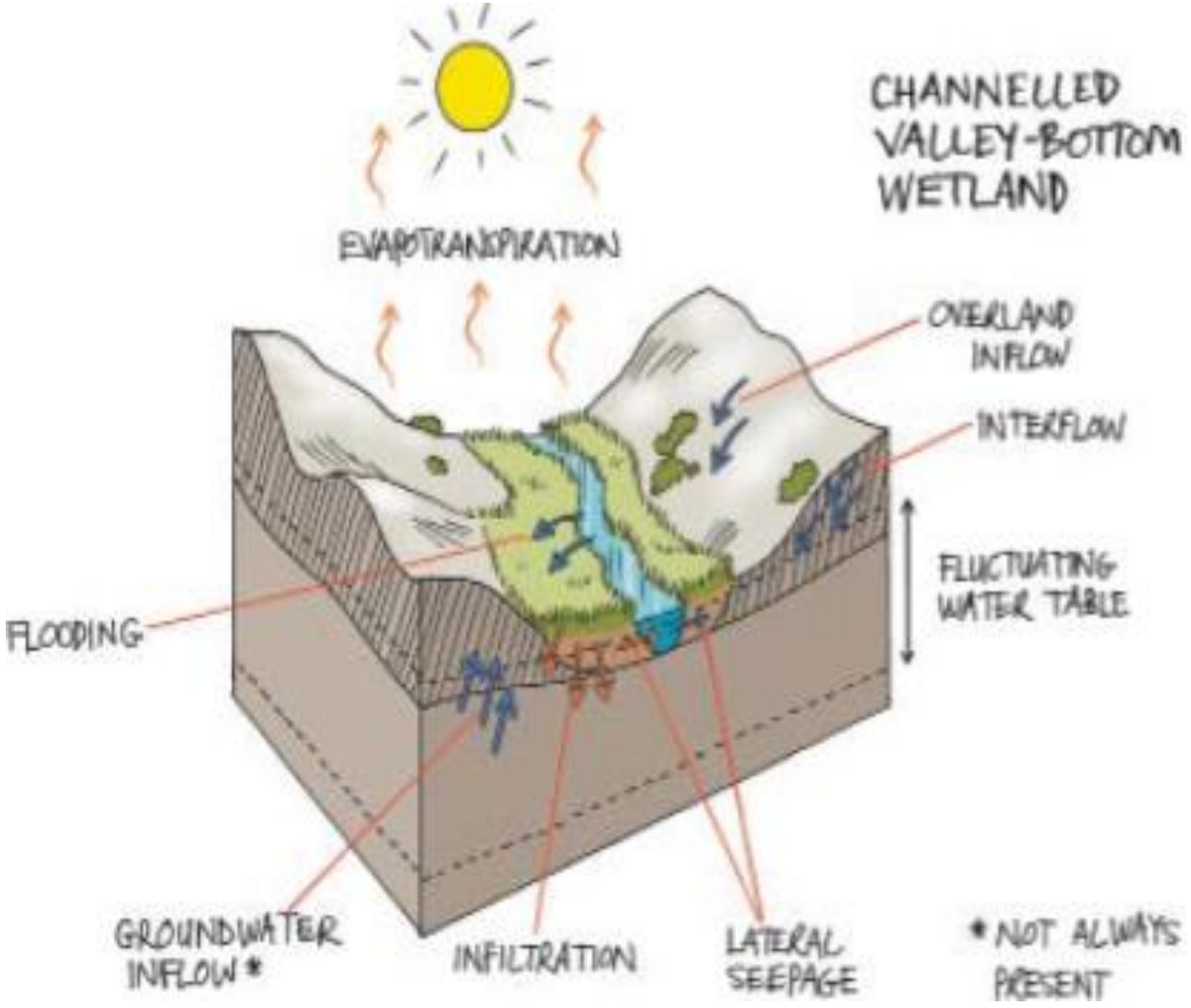
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

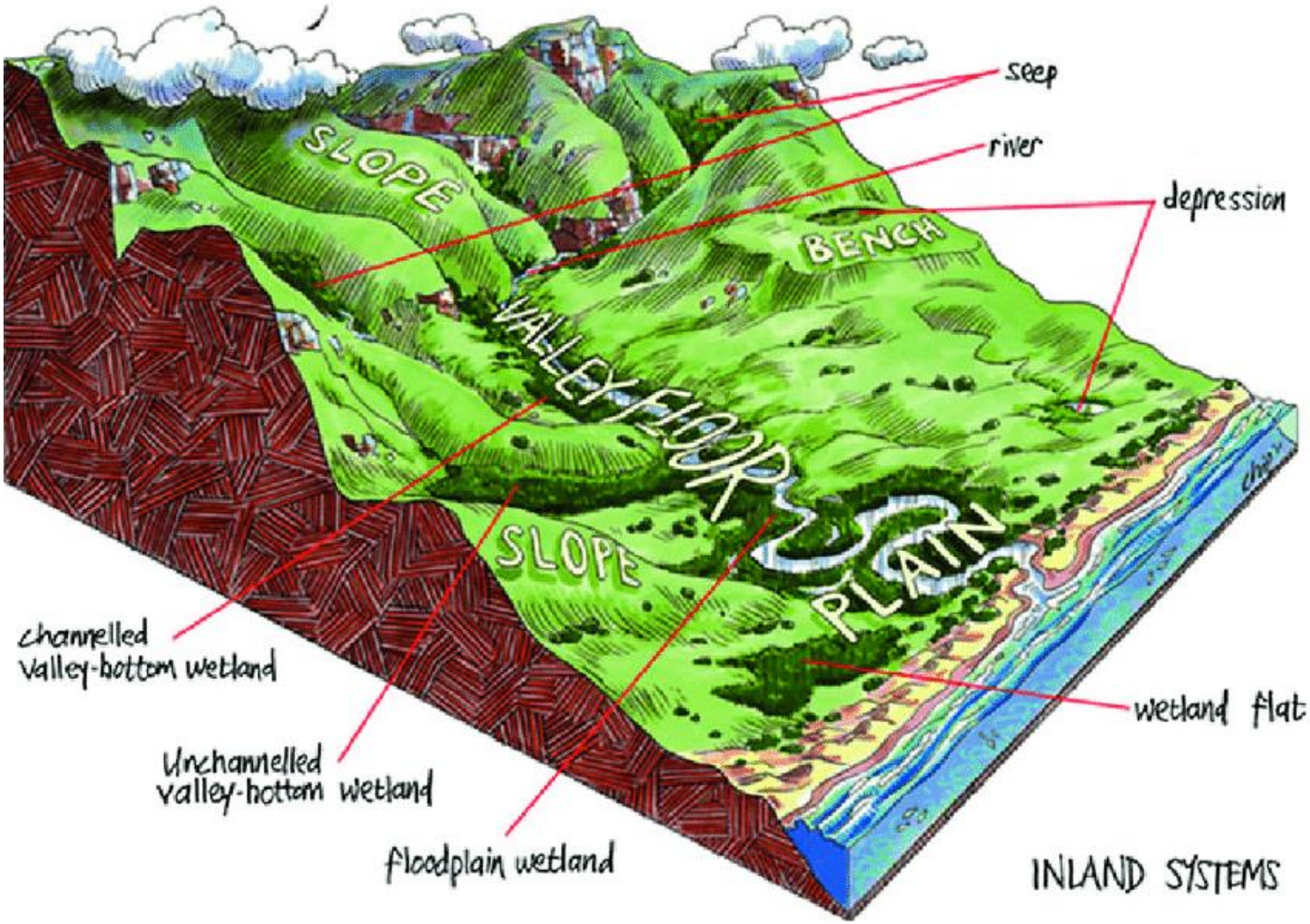
WHAT ARE WETLANDS?



WHERE DOES THE WATER COME FROM?



WETLAND TYPES



Taken from Ollis et al. (2013)

APPROACH

Step 1	▪ **Identify the priority Quaternary and Sub-Quaternary catchments** that are potentially important due to the presence, extent or condition of a water resources , with a focus on wetlands units
Step 2	▪ **Select priority wetland areas** that will be investigated as part of this study
Step 3	▪ Determine the **reference condition** of the wetland (using **existing baseline data**)
Step 4	▪ Conduct a **site survey** to some of the priority wetlands and record **current land-use and impacts**
Step 5	▪ Calculate the **Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS)** of the priority wetland units
Step 6	▪ Determine the **Recommended Ecological Category (REC)** for the priority wetlands
Step 6	▪ Determine the **Resource Quality Objectives (RQOs)** for the priority wetlands and evaluate the results with stakeholders

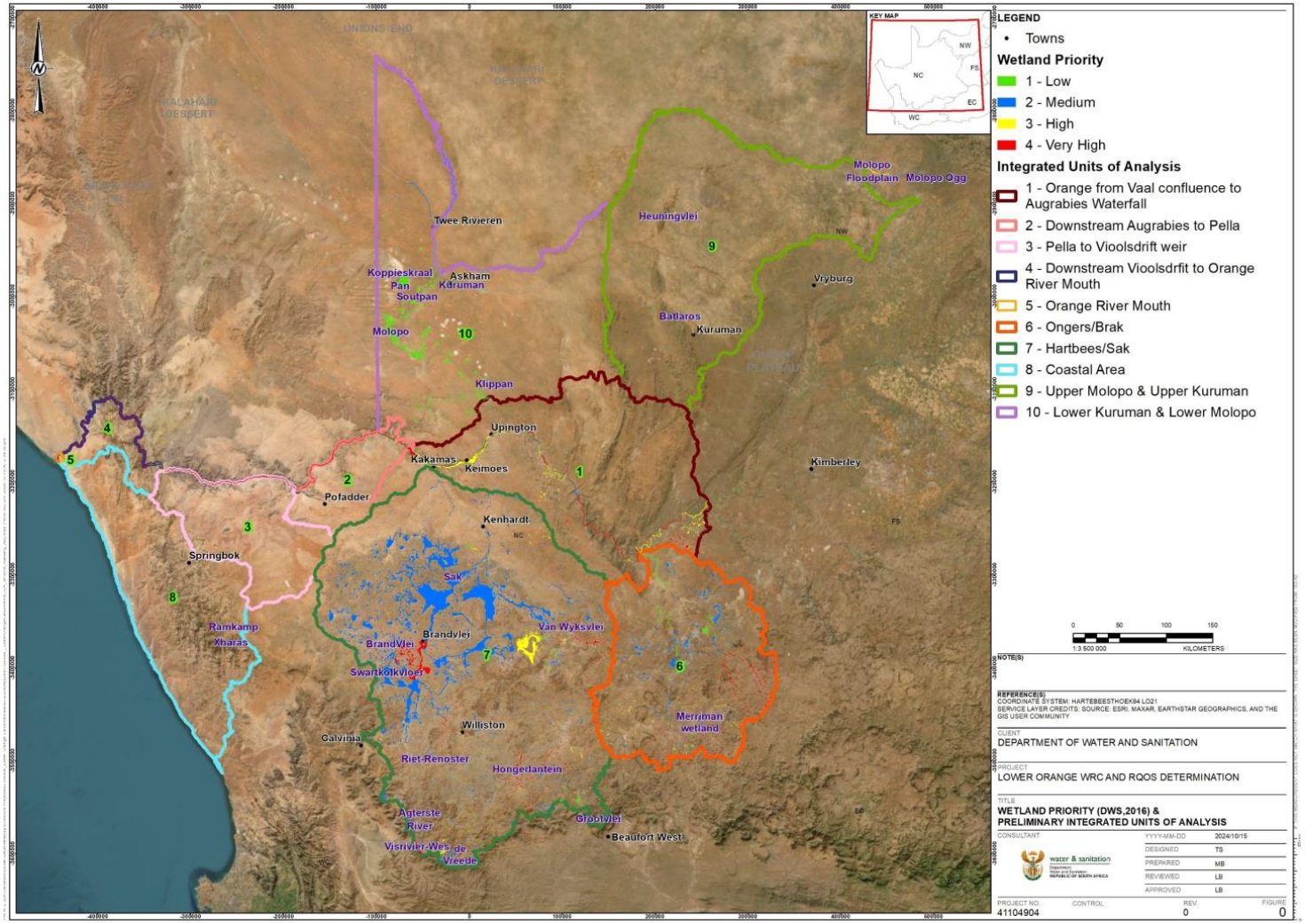
PURPOSE

Determine **RQOs for the 20 selected priority wetlands** within the Lower Orange River catchment.

Priority Wetland	Catchment	IUA	IUA Name	Wetland	Type
1	D61A	6	Brak Catchment	Merriman	In-channel wetlands
2	D52B	7	Hartbees/Sak Catchment	Agterste River	In-channel wetlands
3	D57C	7		Brandvlei	Depression
4	D56A	7		De Vreede	Channelled Valley Bottom wetland
5	D55A	7		Grootvlei	Channelled and Unchannelled Valley Bottom wetland
6	D57D	7		Grootvloer	Depression
7	D55K	7		Hongerlantein	In-channel wetlands
8	D57D	7		Narooga Pan	Depression
9	D58A, D51C, D56J	7		Riet-Renoster	In-channel and Channelled Valley Bottom wetland
10	D58C	7		Swartkolkvloer	Depression
11	D54C	7		Van Wyksvlei	Depression
12	D52A	7		Visrivier-wes	Channelled and Unchannelled Valley Bottom wetland
13	F30 & F50	8	Coastal Areas	Ramkamp	Unchannelled Valley Bottom wetland
14	F30	8		Xharas	Valley head seep and Channelled Valley Bottom wetland
15	D41L	9	Upper Molopo and Upper Kuruman	Batlaros	Channelled Valley Bottom wetland
16	D41H	9		Heuningvlei	Depression & Hillslope Seepage wetlands
17	D41L	9		Kuruman	Channelled Valley Bottom wetland
18	D42D	10	Lower Molopo and Upper Kuruman to confluence with the Orange River	Klippan	Depression
19	D42D	10		Koppieskraal	Depression
20	D42D	10		Soutpan	Depression

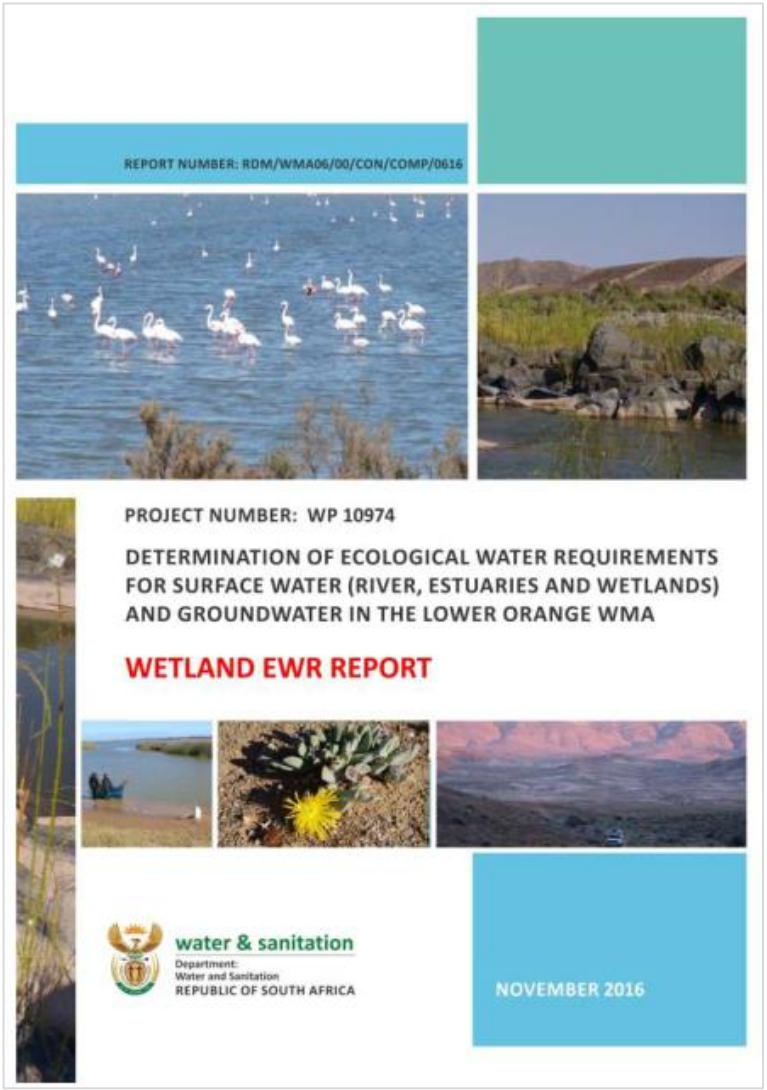
PURPOSE

Determine **RQOs for the 20 selected priority wetlands** within the Lower Orange River catchment.



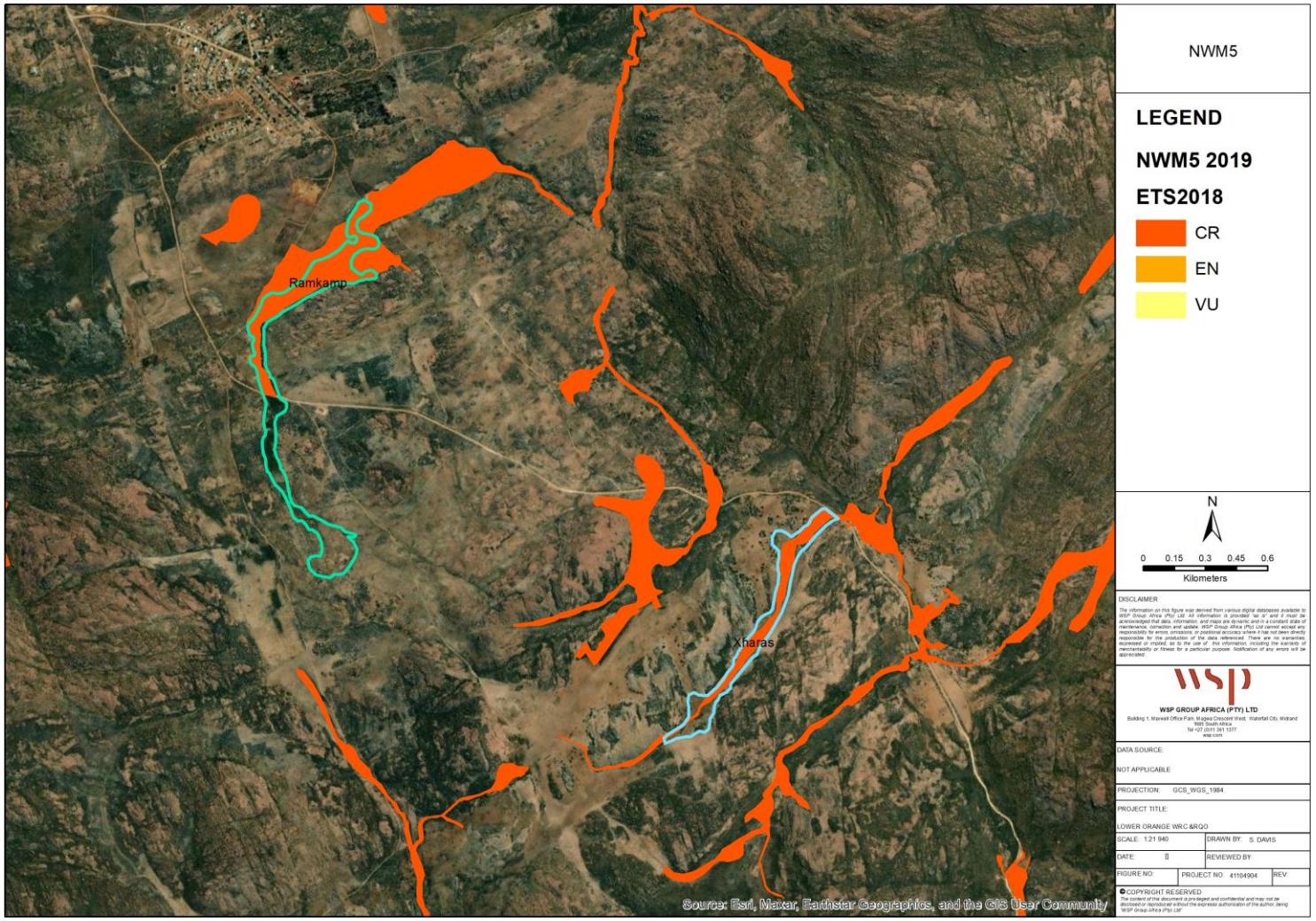
WETLAND BASELINE DATA

- Lower Orange Reserve Determination Study (2016).
- Scientific articles and theses, technical reports and rehabilitation/monitoring reports.
- 2025 Surveys



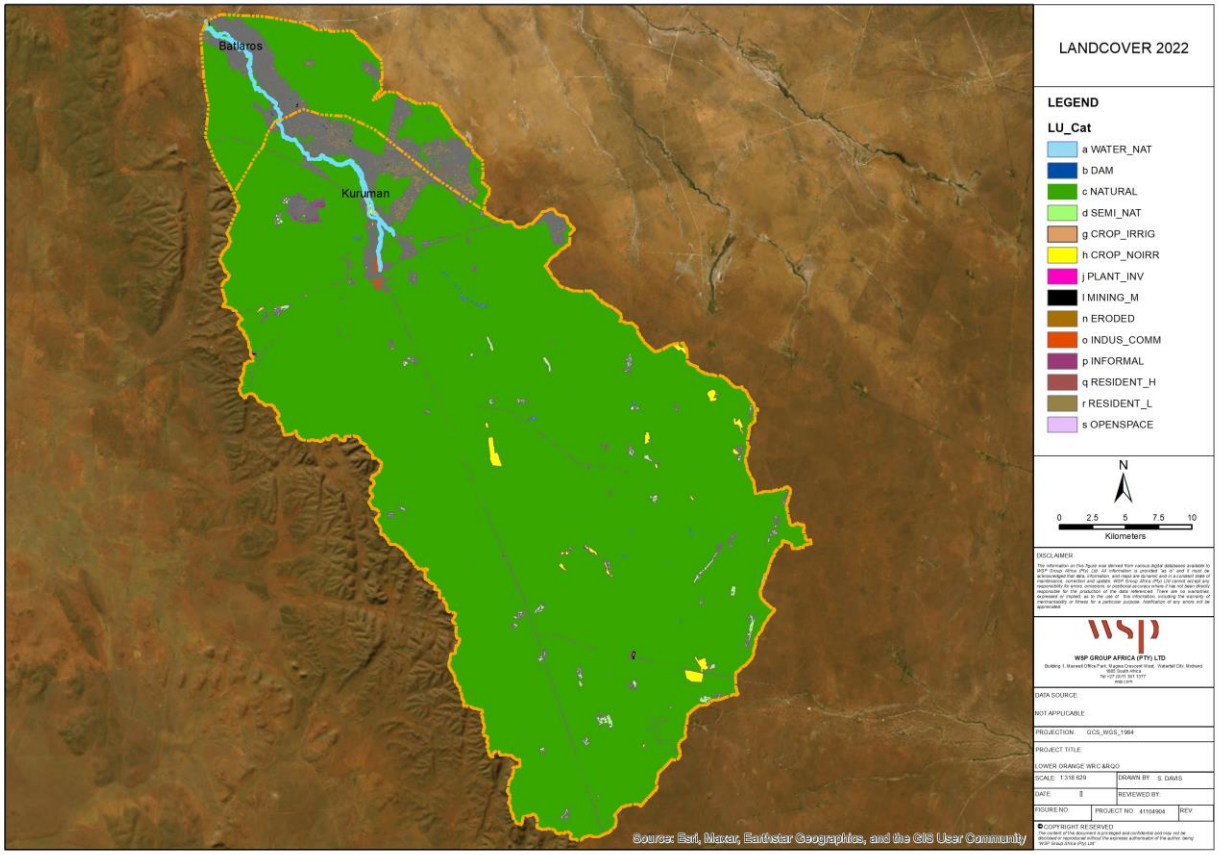
WETLAND BASELINE DATA

- Delineation - National Wetland Map 5 and desktop mapping using ArcGIS



WETLAND BASELINE DATA

- Categorisation:
  - PES: Wet-Health Level 1 (MacFarlane et al., 2020) desktop assessment using 2020 National Landcover data as the basis;
  - IS – Desktop assessment using the method described in Rountree et al. (2013).



WETLAND RQO LIMITATIONS

- Current wetland information is limited, often due to access limitations.
- Limited to no flow or water quality data (especially updated information) are available for the majority of the priority wetlands.
- RQO's for the wetlands are qualitative.
- Due to limited data, confidence in the quantity and quality components is low and moderate for habitat and biota.

IUA6: BRAK

Merriman

IUA6: MERRIMAN

Wetland Characteristics

- Wetland type: In channel wetland
- Located within the Ongers River and is ±18 km long in length.
- Wetland size: ±250Ha

IUA6: MERRIMAN

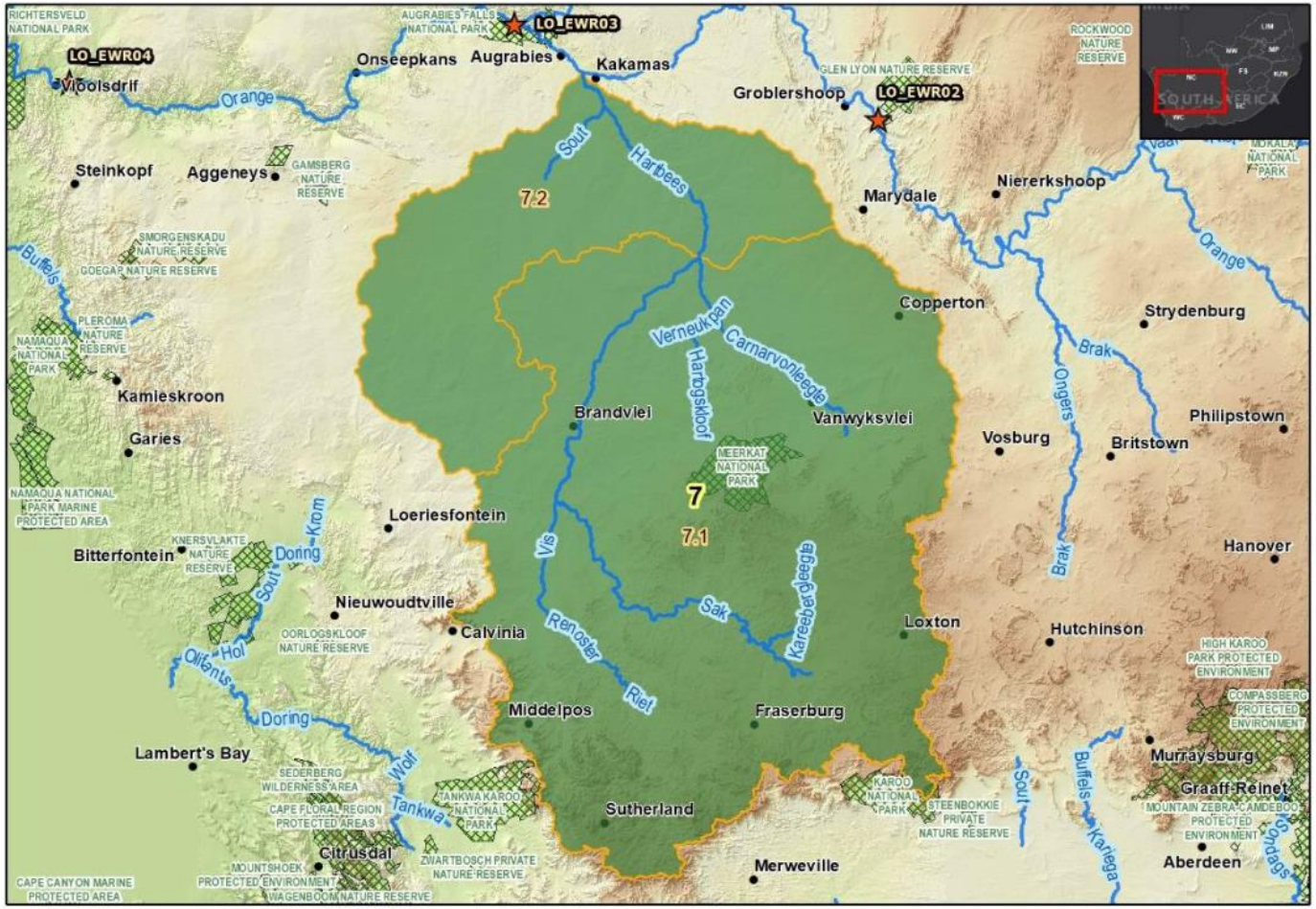
IUA6: MERRIMAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
6	**Merriman**	In channel wetland	D	Moderate	D	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should sustain the ecological state. Salinity levels must be maintained to sustain the ecological state. pH must be maintained within the prescribed range. Total suspended solids (TSS) and/or turbidity must remain within the prescribed range for aquatic ecosystems.	Orthophosphate (PO_4) Total Inorganic Nitrogen Electrical Conductivity pH range	PES score as specified for Habitat PO_4 – 0.125 mg/l TIN – 4.0 mg/l EC - ≤85 mS/m pH: variation of 0.5 or by 5% from background values
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land	

IUA6: MERRIMAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category. Manage livestock grazing at or below carrying capacity to limit further vegetation degradation and sediment mobilisation.	Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 60%

IUA7: HARTBEES/SAK



- Agterste River
- Brandvlei
- De Vreede
- Grootvlei
- Grootvloer
- Hongerlantein
- Narooga Pan
- Riet-Renoster
- Swartkolkvloer
- Van Wyksvlei
- Visrivier-wes

IUA7: AGTERSTE RIVER

Wetland Characteristics

- In channel wetland
- Located on the Agterste River and not a large system, but still one of the most intact wetland areas in the upper- to mid-reaches of the Visrivier catchment.
- The wetland is ±2.7 km long in length and ±10Ha in size.
- Limited impact in wetland aside from weir structures.
- Historical catchment disturbances noted as a consequence of agriculture.

IUA7: AGTERSTE RIVER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Agterste River Wetland**	In channel wetland	C	Moderate	C	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D52B)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range.	Orthophosphate (PO_4) Total Inorganic Nitrogen Electrical Conductivity pH range	PES score as specified for Habitat Habitat PO_4 – 0.058 mg/l TIN – 2.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.,* 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the	PES score above 75%

IUA7: AGTERSTE RIVER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
								wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	

IUA7: BRANDVLEI

Wetland Characteristics

- Depression
- A major ephemeral depression wetland linked to the Grootvloer depression wetland via the Sak River.
- NFEPA Wetland
- ±1 345Ha
- extensive diversion of the ephemeral river flows in the wetlands catchmen for irrigation purposes.
- Historical disturbance and grazing

IUA7: BRANDVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Brandvlei**	Depression	D	High	C/D	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D57C)	PES score as specified for Habitat

IUA7: BRANDVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride.	Maintain the water chemistry pan type applicable Baseline monitoring - Sample April every year (when surface water present)
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane et al., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every	PES score above 55%

IUA7: BRANDVLEI

<table>
<tr><th>IUA</th><th>Wetland</th><th>Wetland Type</th><th>PES</th><th>EIS</th><th>REC</th><th>Component</th><th>RQO</th><th>Indicator</th><th>Numerical Criteria</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td></td><td></td><td>5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.</td><td>PES score above 55%</td></tr>
<tr><td>Biota</td><td>The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.</td><td>Indicator Branchiopod species - No previous surveys conducted in this RU. Monitor annually.

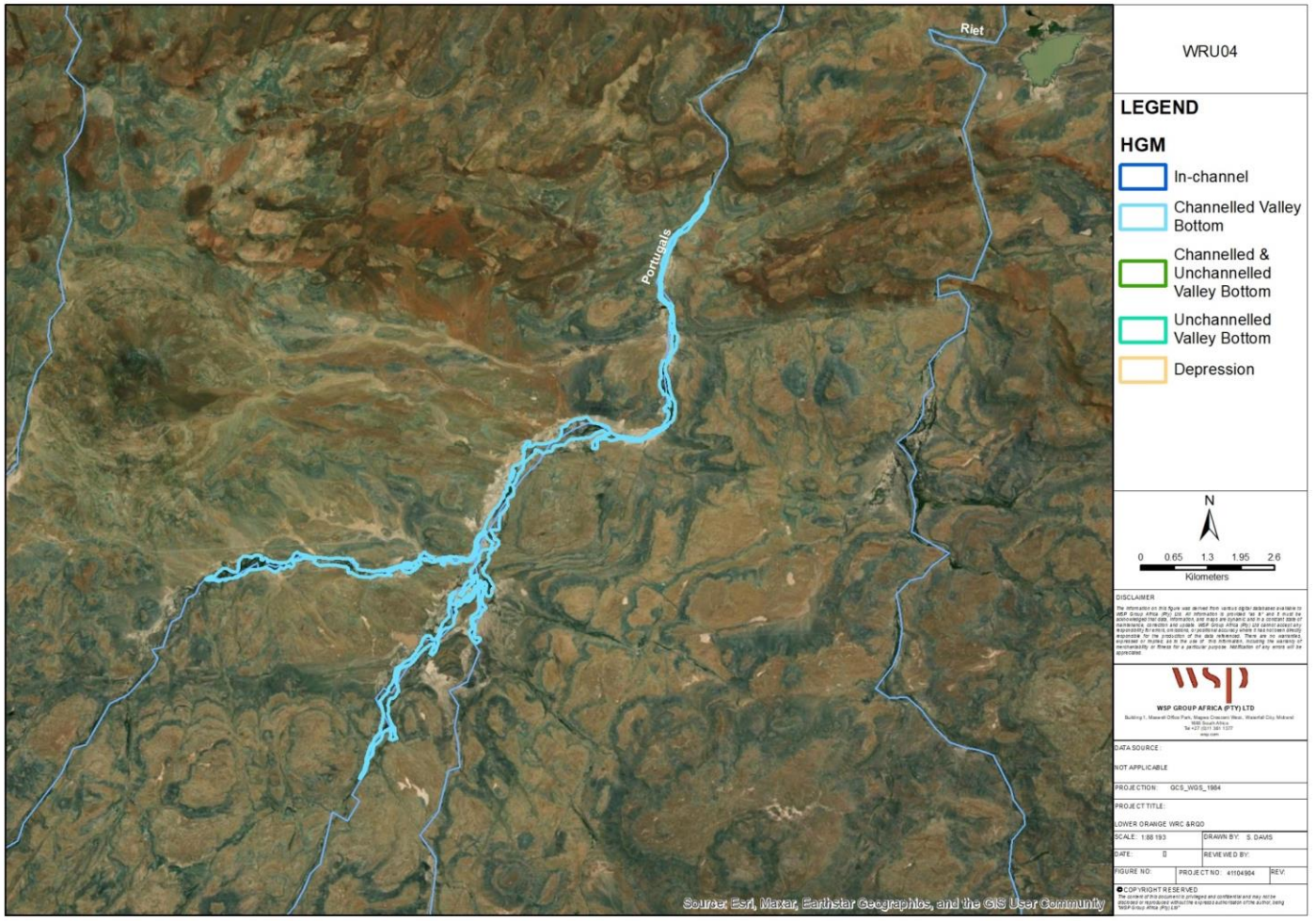
OR

Wetland Present Ecological State as surrogate.</td><td>Branchiopod inventory absent and required, but species recorded in adjacent catchment D57D include:<table><tr><th>Species</th><th>Status</th></tr><tr><td>Branchipodopsis dayae</td><td>CR</td></tr><tr><td>Branchipodopsis karroensis</td><td>EN</td></tr><tr><td>Branchipodopsis transversus</td><td>EN</td></tr><tr><td>Branchipodopsis browni</td><td>LC</td></tr><tr><td>Pumilibranchipus deserti</td><td>LC</td></tr><tr><td>Streptocephalus cafer</td><td>LC</td></tr><tr><td>Streptocephalus indistinctus</td><td>LC</td></tr><tr><td>Streptocephalus ovamboensis</td><td>LC</td></tr><tr><td>Streptocephalus papillatus</td><td>LC</td></tr><tr><td>Streptocephalus purcelli</td><td>LC</td></tr><tr><td>Branchipodopsis hutchinsoni</td><td>VU</td></tr><tr><td>Streptocephalus valkyrie</td><td>VU</td></tr></table>See numerical limit for Habitat</td></tr>
</table>

IUA7: DE VREEDE

Wetland Characteristics

- Channelled Valley Bottom wetland
- Falls within the central portion of the Hantam-Roggeveld Centre of Endemism on the Portugals River.
- ±256Ha



IUA7: DE VREEDE

- There are **limited impacts within the wetland** itself, with only small-scale historical and current localised cultivation activities. Impacts on the wetland's catchment are also **minimal.**

- This area is considered one of the **largest and most well-preserved** wetland clusters in the Great Escarpment of the Upper Karoo, situated within the central part of the **Hantam-Roggeveld Centre of Endemism.**

- The Hantam-Roggeveld Centre of Endemism is a **key region** in South Africa's Northern and Western Cape provinces, recognized for its **significant number of endemic plant species**.

IUA7: DE VREEDE

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**De Vreede**	Channelled Valley Bottom	B	Very High	B	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D56A)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should support and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range.	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.02 mg/l TIN – 0.75 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane et al., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off	PES score above 80%

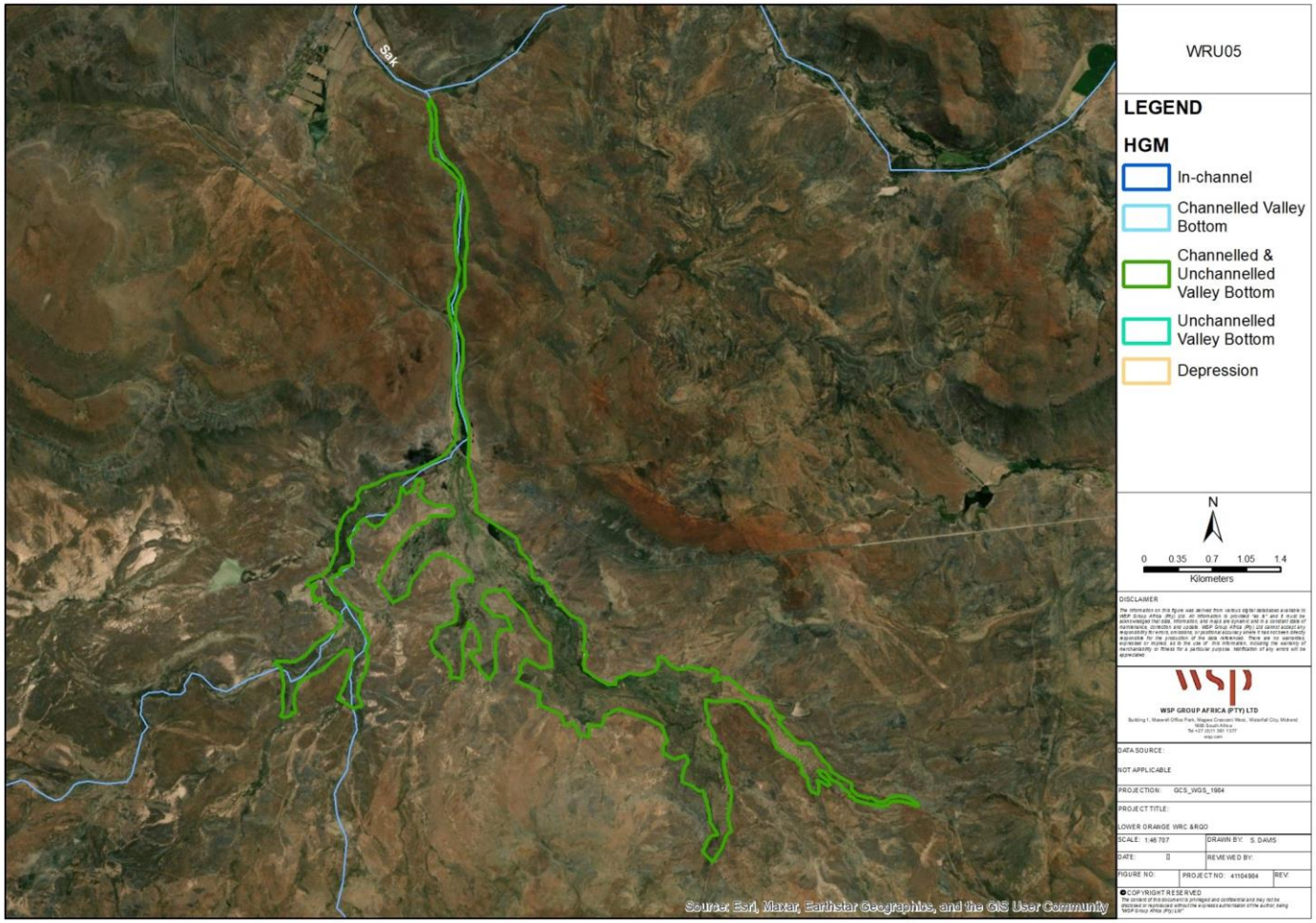
IUA7: DE VREEDE

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
								latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	
						Biota	Hantam-Roggeveld Centre of Endemism – Maintain or improve habitat and vegetation condition to support potentially present fauna and flora species of conservation concern	Vegetation condition	PES vegetation score at or above 70%

IUA7: GROOTVLEI

Wetland Characteristics

- Wetland type: Channelled and Unchannelled Valley Bottom wetland
- Located close to the Karoo National Park, and lying partially within a National Protection Areas Expansion Strategy (NPAES) focus area
- The wetland is ±7km in length and lies within the Sak River.
- Wetland size: ±459Ha



IUA7: GROOTVLEI

- One of the largest wetlands in the Upper Karoo and remains largely undisturbed and natural. Catchment also remains largely natural.

IUA7: GROOTVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Grootvlei**	Channelled Valley Bottom and Un-channelled Valley Bottom	C	High	B/C	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D55A)	PES score as specified for Habiat
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range. Total suspended solids (TSS) and/or turbidity must remain within the prescribed range for aquatic ecosystems.	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.025 mg/l TIN – 1.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.,* 2020). For the PES assessment the latest available	

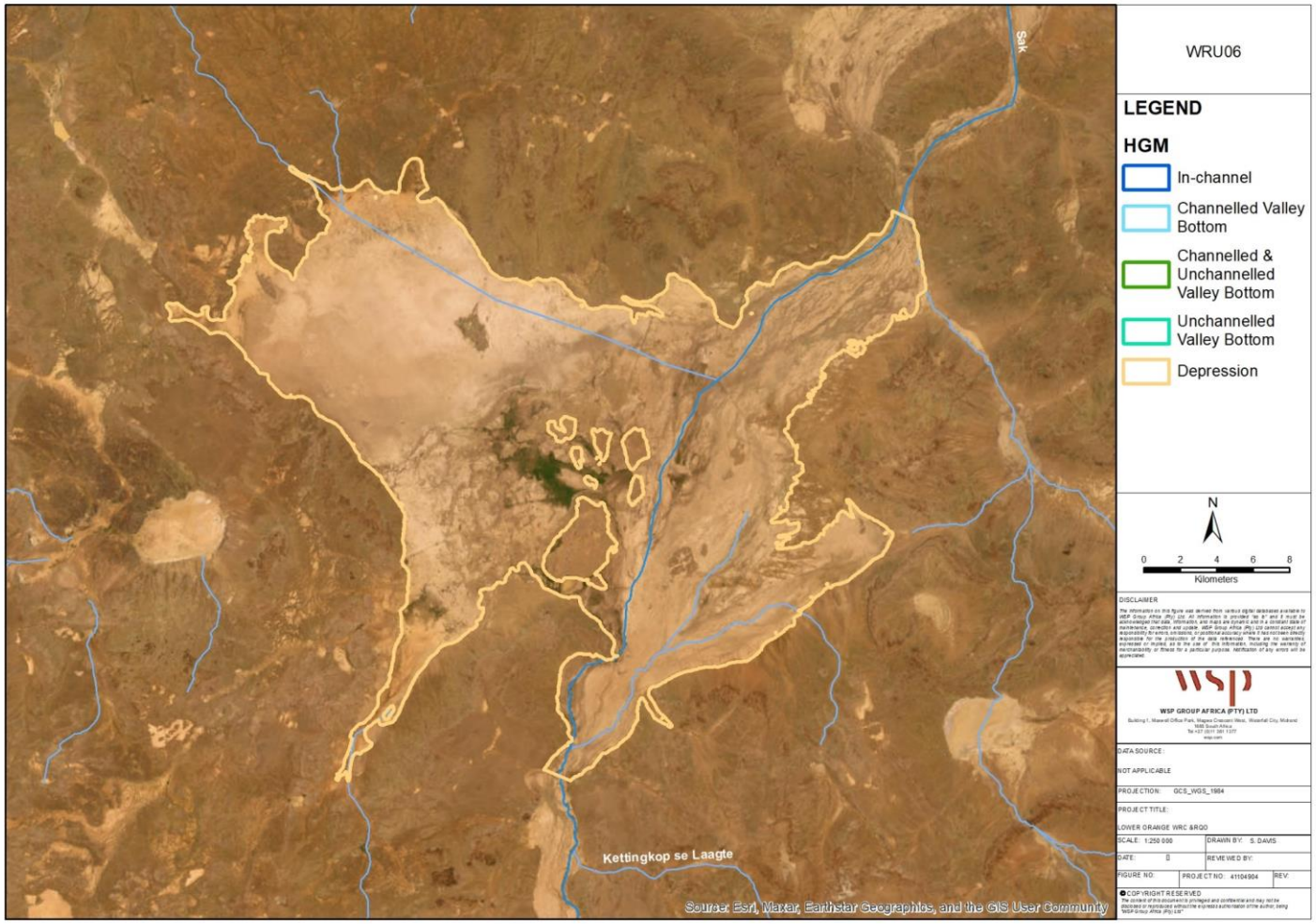
IUA7: GROOTVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category. Manage alien invasive species within the wetland, such as *Populus* ssp.	National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 75%
						Biota	Overall diversity and populations of aquatic/wetland dependent bird species must be maintained.	SABAP 2 reporting rates for aquatic/wetland dependent Red Data bird species: • Blue Crane • Maccoa Duck Verify from monitoring records and recorded sightings from available avifaunal reporting data. Report annually.	Over the next 5 years the reporting rate for each species must not decline from the SABAP2 reporting rates (as of 31 August 2025): • Blue Crane (~2.85%) • Maccoa Duck (~25%)

IUA7: GROOTVLOER

Wetland Characteristics

- Depression
- Connected to the Sak River and forms part of Bushmanland endoreic pans, one of the most extensive salt pan systems in South Africa.
- Possibly South Africa's largest pan overall.
- ±60 472Ha
- Diversion of catchment flows- irrigation.
- Ephemeral flooding makes it a key Branchiopod habitat



IUA7: GROOTVLOER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Grootvloer**	Depression	C	High	B/C	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D57D)	PES score as specified for Habitat
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous,	Maintain the water chemistry pan type applicable. Annual baseline monitoring PES score as specified for Habitat

IUA7: GROOTVLOER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
							Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D57D)	
						Quality	chemistry pan type applicable.	Silica, Fluoride Ammonia, Nitrate and Fluoride.	Sample April every year (when surface water present)
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 60%

IUA7: GROOTVLOER

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<tr><th>IUA</th><th>Wetland</th><th>Wetland Type</th><th>PES</th><th>EIS</th><th>REC</th><th>Component</th><th>RQO</th><th>Indicator</th><th>Numerical Criteria</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Biota</td><td>The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.</td><td>Indicator Branchiopod species - No previous surveys conducted in this RU. Monitor annually.

OR

Wetland Present Ecological State as surrogate.</td><td>Branchiopod inventory limited and requires expansion, but species recorded in RU and in catchment D57D include:

<table>
<tr><th>Species</th><th>Status</th></tr>
<tr><td>Branchipodopsis browni</td><td>LC</td></tr>
<tr><td>Branchipodopsis transversus</td><td>EN</td></tr>
<tr><td>Streptocephalus cafer</td><td>LC</td></tr>
<tr><td>Streptocephalus indistinctus</td><td>LC</td></tr>
<tr><td>Streptocephalus ovamboensis</td><td>LC</td></tr>
<tr><td>Streptocephalus papillatus</td><td>LC</td></tr>
<tr><td>Streptocephalus purcelli</td><td>LC</td></tr>
<tr><td>Streptocephalus valkyrie</td><td>VU</td></tr>
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IUA7: HONGERLANTEIN

Wetland Characteristics

- In channel wetland
- The wetland is located within the Hongerkloof se Leegte River and is ±1.4 km long.
- ±3.5Ha
- Represents one of very few wetland areas in the wider landscape and is **relatively intact**.
- Localised aliens and agricultural pressure.

IUA7: HONGERLANTEIN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Honger-lantein**	In-Channel	C	Moderate	C	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D55K)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range Total suspended solids (TSS) must remain within the prescribed range for aquatic ecosystems	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.058 mg/l TIN – 2.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane et al., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover	PES score above 75%

IUA7: HONGERLANTEIN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
								within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	

IUA7: NAROOGA PAN

Wetland Characteristics

- Depression
- Moderately large saline pan to the northwest of Brandvlei.
- Forms part of Bushmanland endoreic pans, one of the most extensive salt pan systems in South Africa.
- 316Ha

Branchipodopsis transversus	EN
Streptocephalus cafer	LC
Streptocephalus papillatus	LC

IUA7: NAROOGA PAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Narooga Pan**	Depression	B	High	B	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quantity	Groundwater RQO applies. Shallow aquifer levels must be maintained to support the above aquatic ecosystem.	Shallow aquifer groundwater level	See groundwater level numerical limits for relevant groundwater GRU.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride.	Maintain the water chemistry pan type applicable. Undertake baseline monitoring Sample April every year (when surface water present)

IUA7: NAROOGA PAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.,* 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 80%
						Biota	The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.	Indicator Branchiopod species – Limited previous surveys conducted in this RU. Monitor annually. OR Wetland Present Ecological State as surrogate.	Branchiopod inventory limited and requires expansion, but species recorded in RU include:

IUA7: NAROOGA PAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
									<table><tr><th>Species</th><th>Status</th></tr><tr><td>Branchipodopsis transversus</td><td>EN</td></tr><tr><td>Streptocephalus cafer</td><td>LC</td></tr><tr><td>Streptocephalus papillatus</td><td>LC</td></tr></table>
							Overall diversity and populations of aquatic/wetland dependent bird species must be maintained.	SABAP 2 reporting rates for aquatic/wetland dependent Red Data bird species: • Greater Flamingo Verify from monitoring records and recorded sightings from available avifaunal reporting data. Report on this every year.	Over the next 5 years the reporting rate for each species must not decline from the SABAP2 reporting rates (as of 31 August 2025): • Greater Flamingo (~50%)

IUA7: RIET-RENOSTER

Wetland Characteristics

- In-channel and Channelled Valley Bottom wetland
- Wetland lies at the confluence of the Riet and Renoster Rivers.
- It located within a Critical Biodiversity Area (CBA) Irreplaceable
- It is ±10km in length within the Riet River.
- ±117Ha

IUA7: RIET-RENOSTER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Riet-Renoster**	In Channel and Chanelled Valley Bottom	D	Moderate	D	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D55K)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range. Total suspended solids (TSS) must remain within the prescribed range for aquatic ecosystems	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.125 mg/l TIN – 4.0 mg/l EC - ≤85 mS/m pH: variation of 0.5 or by 5% from background values
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover	PES score above 55%

IUA7: RIET-RENOSTER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
								within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	

IUA7: SWARTKOLKVLOER

Wetland Characteristics

- Depression wetland
- Large, ephemeral salt pan forming part of the Bushmanland endoreic pan system.
- Located within a Critical Biodiversity Area (CBA) - Irreplaceable.
- ±6420Ha

IUA7: SWARTKOLKVLOER

Recently identified as a palaeontological site which classifies the system as a **paleolake environment**.

IUA7: SWARTKOLKVLOER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Van Wyksvlei**	D	C	High	B/C	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as CaCO3, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride.	Maintain the water chemistry pan type applicable. Sample April every year
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For	PES score above 60%

IUA7: SWARTKOLKVLOER

<table>
<tr><th>IUA</th><th>Wetland</th><th>Wetland Type</th><th>PES</th><th>EIS</th><th>REC</th><th>Component</th><th>RQO</th><th>Indicator</th><th>Numerical Criteria</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Habitat</td><td>Maintain or improve current PES category.</td><td>PES Category - As a National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.</td><td>PES score above 90%</td></tr>
<tr><td>Biota</td><td>The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.</td><td>Indicator Branchiopod species - No previous surveys conducted in this RU. Monitor annually.
OR
Wetland Present Ecological State as surrogate.</td><td>Branchiopod inventory absent and required, but species recorded in wetlands in region include:
<table><tr><th>Species</th><th>Status</th></tr><tr><td>Branchipodopsis dayae</td><td>CR</td></tr><tr><td>Branchipodopsis karroensis</td><td>EN</td></tr><tr><td>Branchipodopsis transversus</td><td>EN</td></tr><tr><td>Branchipodopsis browni</td><td>LC</td></tr><tr><td>Pumilibranchipus deserti</td><td>LC</td></tr><tr><td>Streptocephalus cafer</td><td>LC</td></tr></table></td></tr>
</table>

IUA7: SWARTKOLKVLOER

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria

Species	Status
Streptocephalus indistinctus	LC
Streptocephalus ovamboensis	LC
Streptocephalus papillatus	LC
Streptocephalus purcelli	LC
Branchipodopsis hutchinsoni	VU
Streptocephalus valkyrie	VU

IUA7: VAN WYKSVLEI

Wetland Characteristics

- Depression wetland
- One of South Africa's largest pans and connected to inflowing and outflowing minor drainage lines.
- Forms part of Bushmanland endoreic pans complex.
- ±24 975Ha
- Potential key branchiopod habitat due to ephemeral flooding.
- Relatively intact, localised farming impact.

IUA7: VAN WYKSVLEI

IUA	Wetland	Wetland Type	PES	EIS	RC	Component	RQO	Indicator	Numerical Criteria
7	**Van Wyksvlei**	Depression	C	High	B/C	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride. Sample April every year	Maintain the water chemistry pan type applicable
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available	

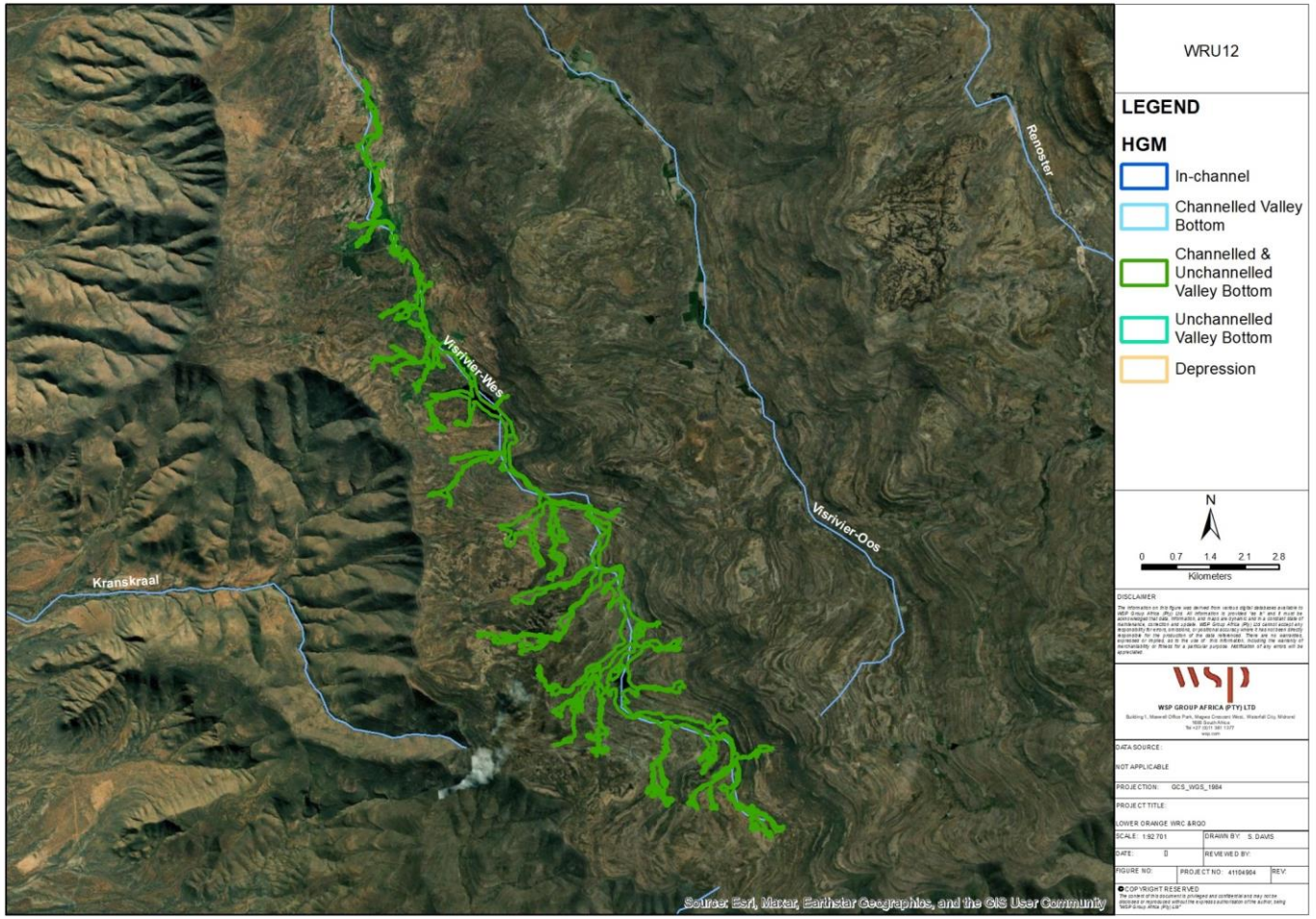
IUA7: VAN WYKSVLEI

<table>
<tr><th>IUA</th><th>Wetland</th><th>Wetland Type</th><th>PES</th><th>EIS</th><th>REC</th><th>Component</th><th>RQO</th><th>Indicator</th><th>Numerical Criteria</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Habitat</td><td>Maintain or improve current PES category.</td><td>the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.</td><td>PES score above 60%</td></tr>
<tr><td>Biota</td><td>The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.</td><td>Indicator Branchiopod species - No previous surveys conducted in this RU. Monitor annually.
OR
Wetland Present Ecological State as surrogate.</td><td>Branchiopod inventory absent and required, but species recorded in wetlands in catchments D54E AND D54E include:
<table>
<tr><th>Species</th><th>Status</th></tr>
<tr><td>Branchipodopsis browni</td><td>LC</td></tr>
<tr><td>Branchipodopsis hutchinsoni</td><td>VU</td></tr>
<tr><td>Streptocephalus ovamboensis</td><td>LC</td></tr>
<tr><td>Streptocephalus papillatus</td><td>LC</td></tr>
</table></td></tr>
</table>

IUA7: VISRIVIER-WES

Wetland Characteristics

- Channelled and unchannelled valley bottom wetland
- Wetland lies within the Visrivier-Wes River.
- Located within a Critical Biodiversity Area (CBA) Irreplaceable and it is ±25km in length.



IUA7: VISRIVIER-WES

Falls within the Hantam-Roggeveld Centre of Endemism

- Wild Rye - *Secale africanum* (CR) – has experienced significant decline.
- *Ixia thomasiae* (EN),
- Cape Waterstar - *Pauridia alticola* (NT)

The wetland has experienced extensive cultivation both historically and currently; parts of its natural vegetation are heavily grazed, and about 10% of the wetland area is covered by dams.

IUA7: VISRIVIER-WES

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
7	**Visrivier-Wes**	CVB and UVB	B to C	Very High	B/C	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D52A)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range. Total suspended solids (TSS) must remain within the prescribed range for aquatic ecosystems	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.025 mg/l TIN – 1.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest	

IUA7: VISRIVIER-WES

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 70% average for full wetland extent
						Biota	Hantam-Roggeveld Centre of Endemism – Maintain or improve habitat and vegetation condition to support confirmed and potentially present fauna and flora species of conservation concern	Presence of populations of: • Wild Rye - *Secale africanum* (CR) • *Ixia thomasiae* (EN) • Cape Waterstar - *Pauridia alticola* (NT)	Continued presence of populations of: • Wild Rye - *Secale africanum* (CR) • *Ixia thomasiae* (EN) • Cape Waterstar - *Pauridia alticola* (NT)

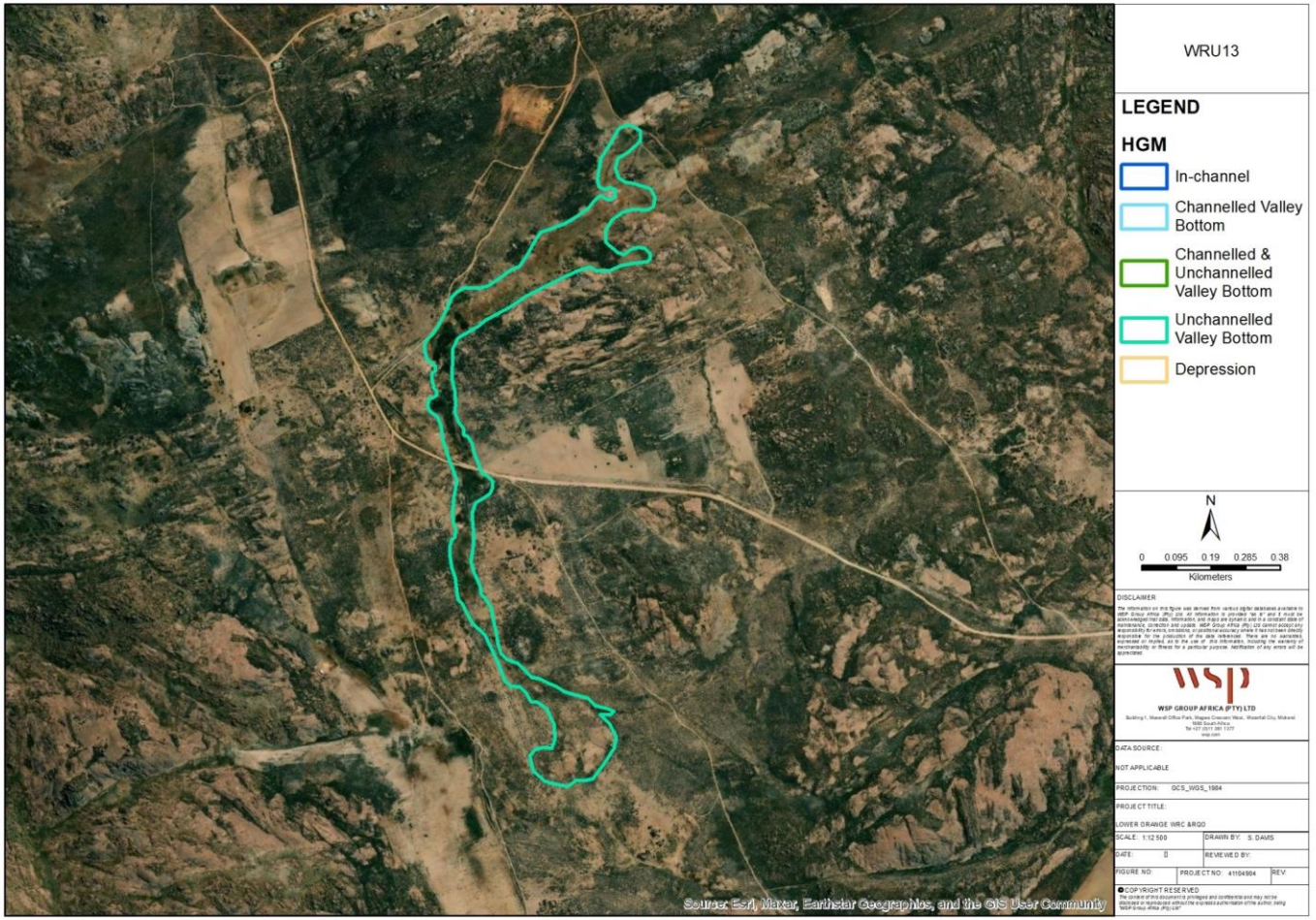
IUA8: COASTAL AREAS

- Ramkamp
- Xharas

IUA8: RAMKAMP

Wetland Characteristics

- Unchannelled valley bottom
- One of the largest and most intact wetland systems falling within the Kamiesberg Uplands and falling within the Kamiesberg Centre which hosts a high number of endemic flora.
- ±18Ha



IUA8: RAMKAMP

- Namaqua district **aquatic critical biodiversity areas (**Marsh et al., 2009) recognises the **Kamiesberg Uplands** as having the **highest priority**. In addition, wetlands within the Kamiesberg Uplands have been identified as **special habitats** in need of particular conservation attention.

IUA8: RAMKAMP

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
8	**Ramkamp**	Unchannelled	C	High	B	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (F30A)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state. pH must be maintained within the prescribed range.	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.058 mg/l TIN – 2.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.,* 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover	

IUA8: RAMKAMP

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 75%

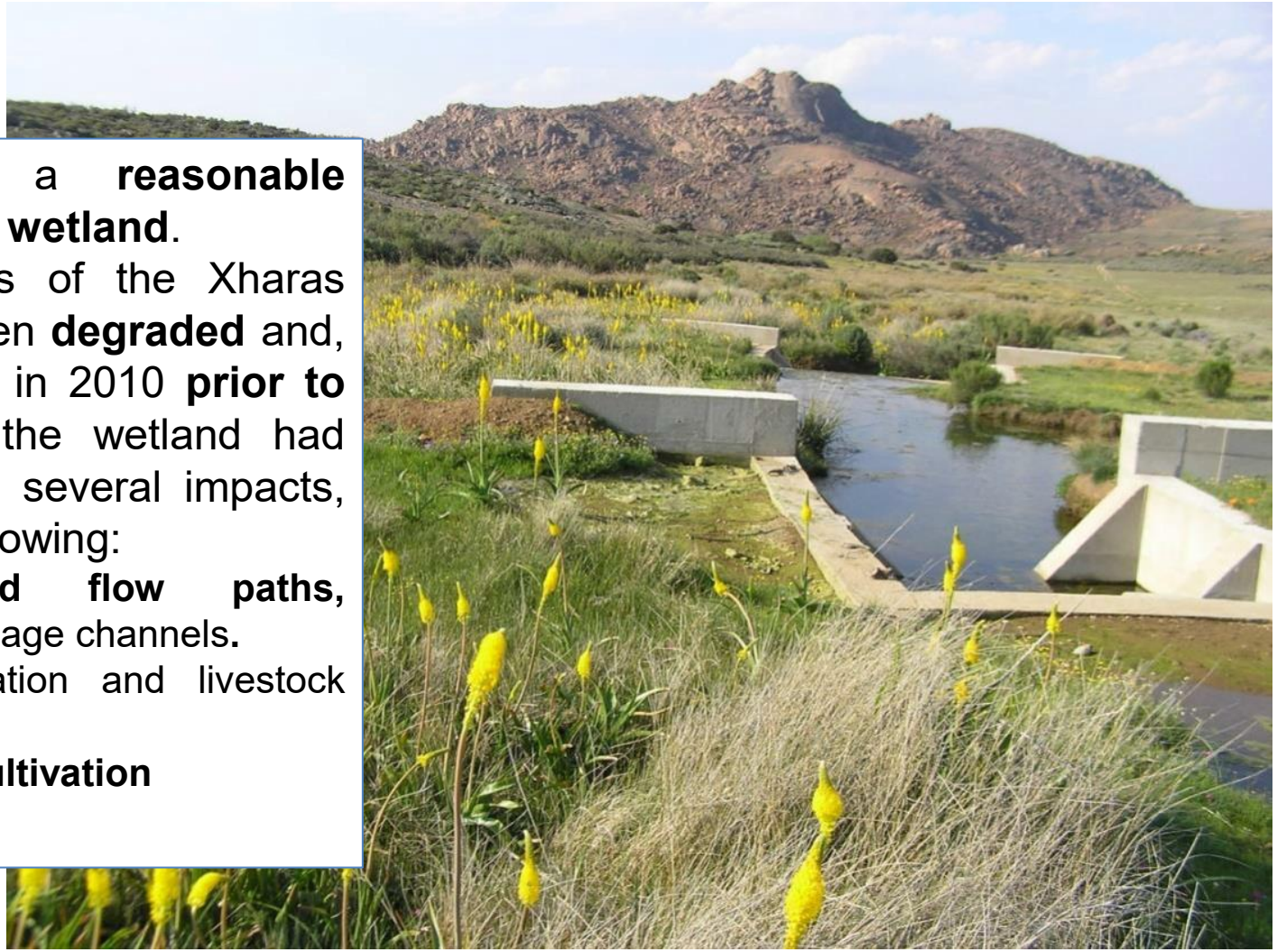
IUA8: XHARAS

Wetland Characteristics

- Valley head seep and Channelled Valley Bottom wetland
- Hillslope seepage transitioning into a valley bottom and lies in a valley head position within the Kamiesberg Uplands.
- The wetland also falls within the Kamiesberg Centre of Endemism.
- Wetland size: ±10Ha

IUA8: XHARAS

- Still contains a **reasonable extent of intact wetland**.
- Extensive areas of the Xharas wetland had been **degraded** and, when assessed in 2010 **prior to rehabilitation**, the wetland had been subject to several impacts, including the following:
  - **Concentrated flow paths,** artificial drainage channels**.**
  - Alien vegetation and livestock trampling.
  - **Historical cultivation**



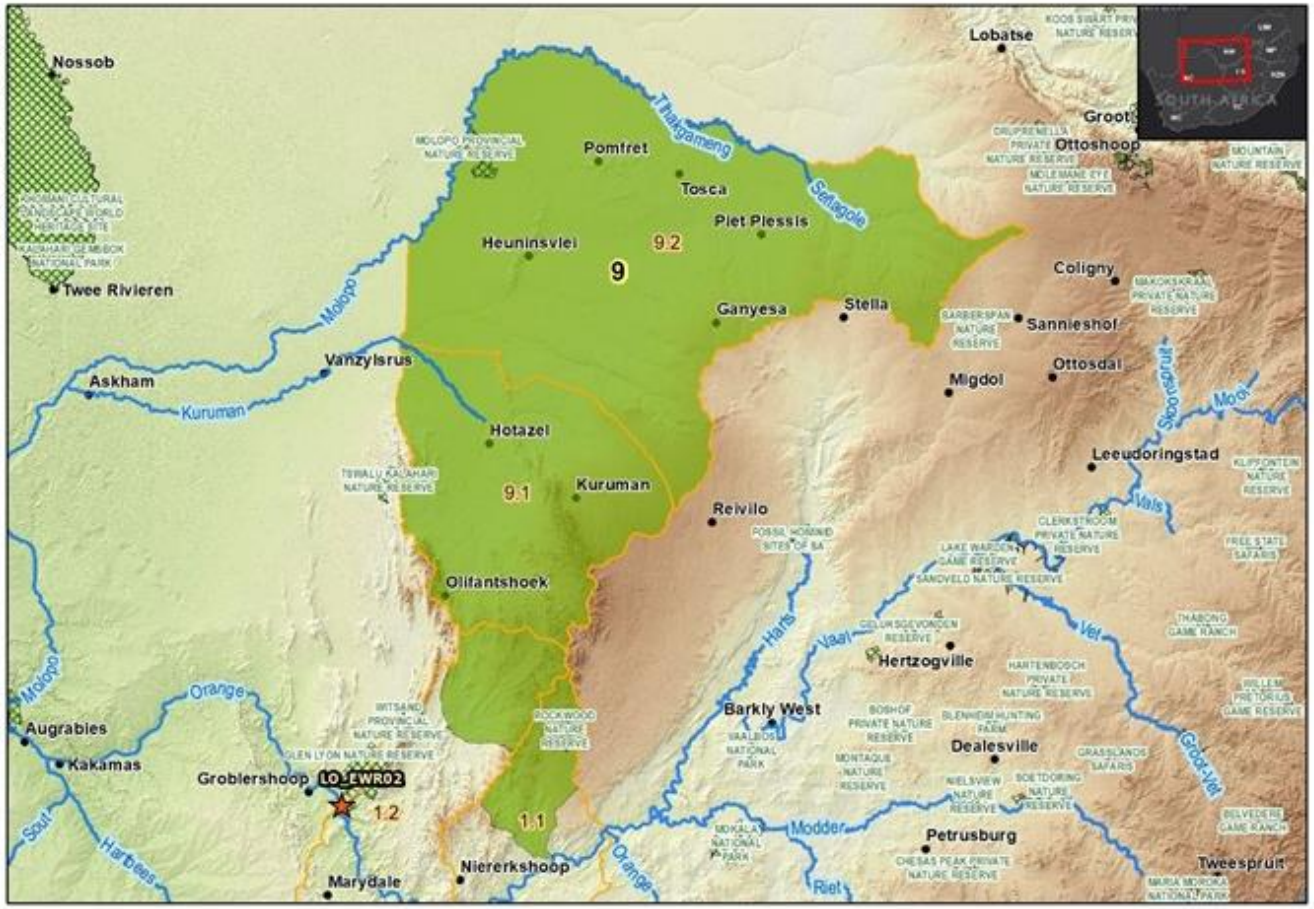
IUA8: XHARAS

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
8	**Xharas**	CVB and HS	C	High	B	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (F30A)	PES score as specified for Habitat
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state. pH must be maintained within the prescribed range.	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range	PO_4 – 0.058 mg/l TIN – 2.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.,* 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover	

IUA8: XHARAS

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 75%

IUA9: UPPER MOLOPO AND UPPER KURUMAN



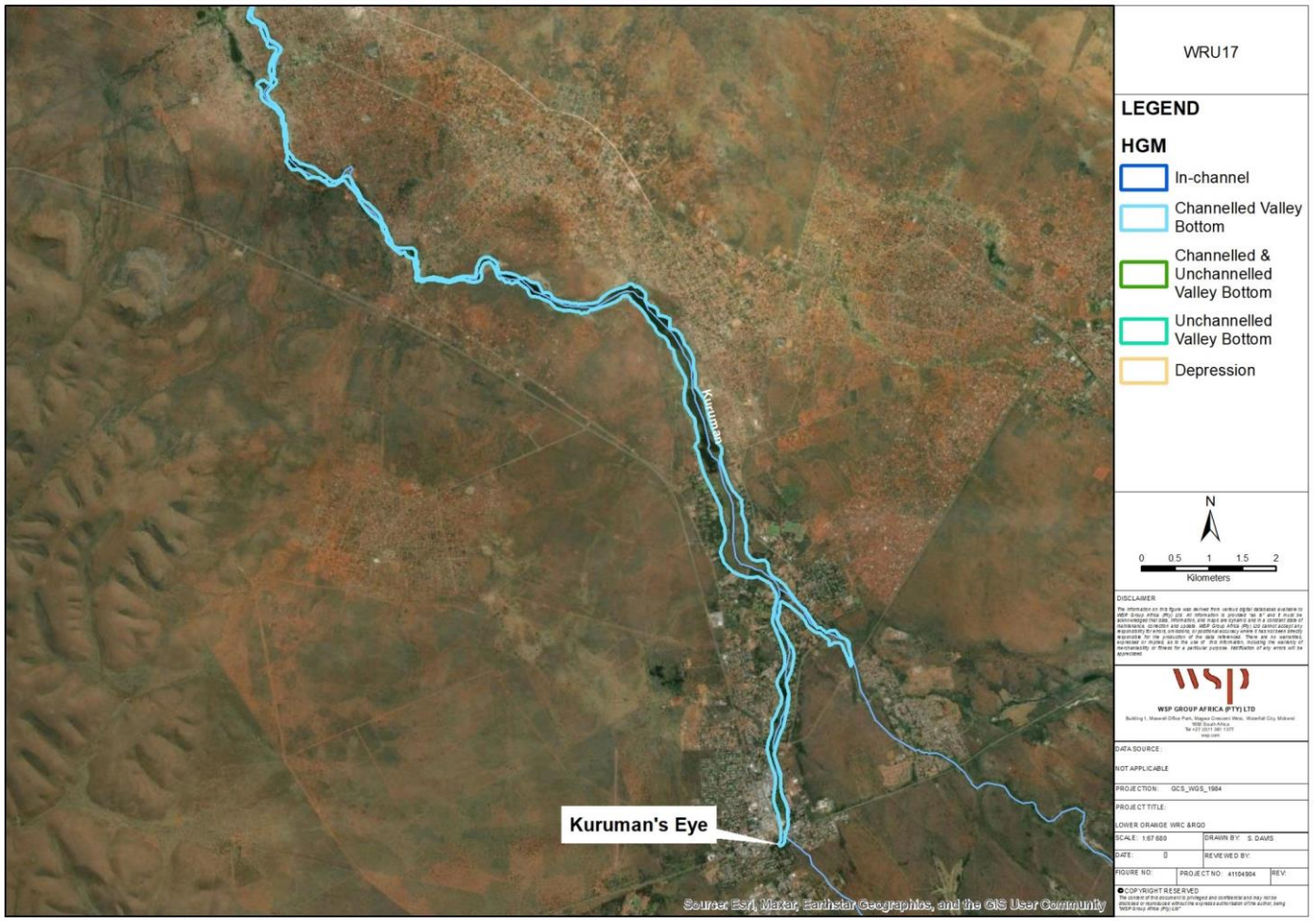
- Kuruman
- Batlaros
- Heuningvlei

IUA9: KURUMAN

Wetland Characteristics

Wetland type: Channelled Valley Bottom wetland

- Lies on the north of the town of Kuruman on the Kuruman River, downstream of the noteworthy Kuruman's Eye Spring.
- The wetland is ±18 km long in length.
- Wetland size: ±254Ha



IUA9: KURUMAN

- Southern mouth brooder (*Pseudocrenilabrus philander*)
- 20-million litres of potable water daily

IUA9: KURUMAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
9	**Kuruman Eye and Valley Bottom**	Channelled Valley Bottom and Spring	D	Very High	C/D	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC (driven by groundwater quantity RQOs)	PES score as specified for Habitat
						Quantity	Groundwater RQO applies Groundwater aquifer levels must be maintained to support the above aquatic ecosystem.	Groundwater level	See groundwater level numerical limits for relevant groundwater GRU.
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range. Total suspended solids (TSS) must remain within the prescribed range for aquatic ecosystems The presence of pathogens should not pose a risk to human health or aquatic biota	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range *Escherichia coli*	PO_4 – 0.125 mg/l TIN – 4.0 mg/l EC - ≤85 mS/m pH: variation of 0.5 or by 5% from background values *E. coli* <130 counts/100ml D41L - 02333 in catchment D41L

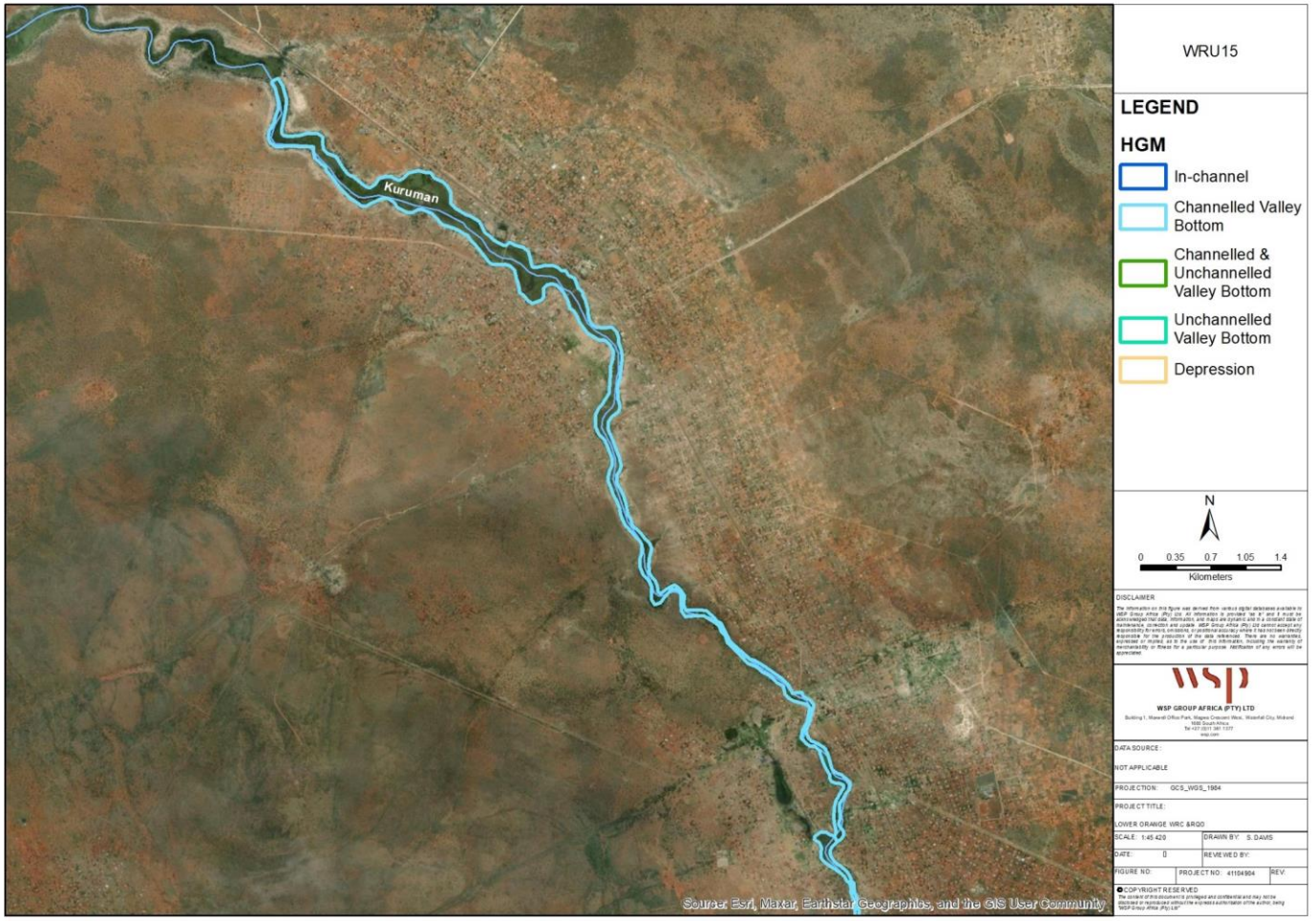
IUA9: KURUMAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 60%

IUA9: BATLAROS

Wetland Characteristics

- Channelled Valley Bottom wetland
- Lies on the north of the town of Kuruman on the Kuruman River.
- The wetland is ±12 km long in length and ±131Ha in size
- NB water source, grazing resource, and used by surrounding settlements.
- In stream weirs constructed (WfWet) to address channel impacts.



IUA9: BATLAROS

IUA9: BATLAROS

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
9	**Batlaros**	Channelled Valley Bottom	C	Very High	B/C	Quantity	Flow and inundation regime through seasonal river inflow and groundwater contribution must be maintained to attain good wetland condition.	REC category (driven by groundwater quantity RQOs) (D41L)	PES score as specified for Habitat
						Quantity	Groundwater RQO applies Groundwater aquifer levels must be maintained to support the above aquatic ecosystem.	Groundwater level	See groundwater level numerical limits for relevant groundwater GRU.
						Quality	Nutrient levels should not deteriorate and should support aquatic ecosystem and sustain the ecological state. Salinity levels must be maintained to support aquatic ecosystem and sustain the ecological state pH must be maintained within the prescribed range. The presence of pathogens and toxins should not pose a risk to human health or aquatic biota	Ortho-phosphate Total Inorganic Nitrogen Electrical Conductivity pH range *Escherichia coli*	PO_4 – 0.058 mg/l TIN – 2.0 mg/l EC - ≤55 mS/m pH: variation of 0.5 or by 5% from background values *E.coli* <130 counts/100ml D41L-02064 in catchment D41L

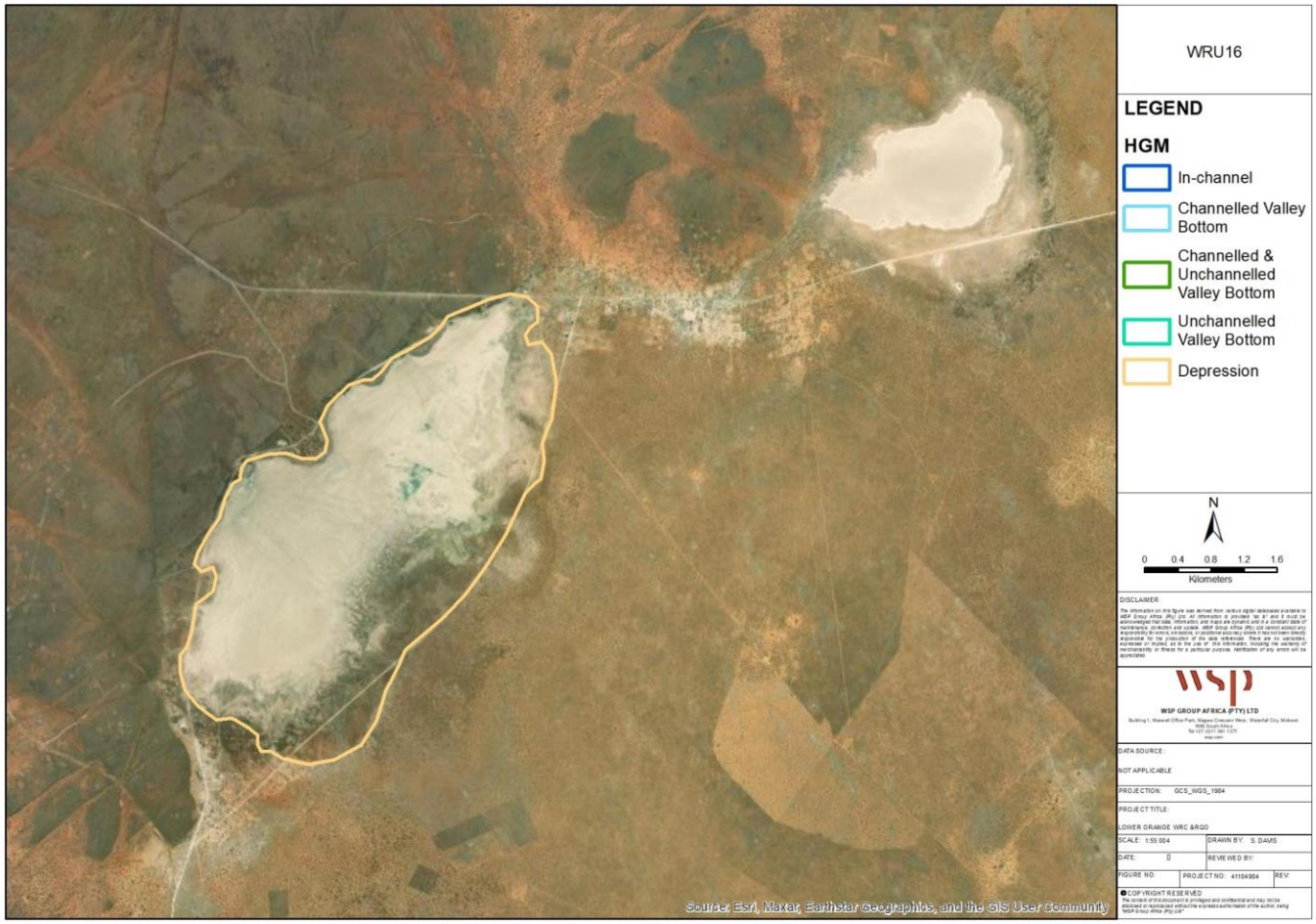
IUA9: BATLAROS

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 68%

IUA9: HEUNINGVLEI

Wetland Characteristics

- Depression & Hillslope Seepage wetlands
- A large saline depressional wetland within the Eastern Kalahari Bushveld Bioregion.
- Fed by permanent freshwater springs (formalised)
- NFEPA wetland and CBA1
- ±1 413Ha



IUA9: HEUNINGVLEI

IUA9: HEUNINGVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
9	**Heuningvlei**	Depression and Hillslope Seep	C	Very High	C	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quantity	Groundwater RQO applies Shallow aquifer levels must be maintained to support the above aquatic ecosystem.	Shallow aquifer groundwater level	See groundwater level numerical limits for relevant groundwater GRU.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride.	Maintain the water chemistry pan type applicable

IUA9: HEUNINGVLEI

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
								Sample April every year (when surface water present).	
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 70%
						Biota	The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.	Indicator Branchiopod species – No previous surveys conducted in this RU. Monitor annually. OR Wetland Present Ecological State as surrogate.	Branchiopod inventory required. See numerical limit for Habitat

IUA10: LOWER MOLOPO AND UPPER KURUMAN TO CONFLUENCE WITH THE ORANGE RIVER

- Kykomspan
- Koppieskraal
- Soutpan

IUA10: KYKOMSPAN

Wetland Characteristics

- Depression wetland
- Kykomspan is a moderately sized ephemeral saline pan in the Kalahari Duneveld.
- Smaller interdune depression forms an important water resource (brackish rather than saline).
- Not evidently linked to GW and seldom inundates.
- ±525Ha

IUA10: KYKOMSPAN

IUA10: KYKOMSPAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
10	**Kykomspan**	Depression	B	Moderate	B	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride.	Maintain the water chemistry pan type applicable. Baseline monitoring Sample April every year (when/if surface water present)
								PES Category - As a minimum undertake a WET-Health Level 1a PES	

IUA10: KYKOMSPAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 80%

IUA10: KOPPIESKRAAL

Wetland Characteristics

- Depression wetland
- Ephemeral, saline, endoreic pan in the Kalahari.
- FEPA and located within a Critical Biodiversity Area (CBA - Irreplaceable.
- ±9 524Ha

Branchipodopsis dayae	CR
Pumilibranchipus deserti	LC

IUA10: KOPPIESKRAAL

IUA10: KOPPIESKRAAL

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
10	**Koppies-kraal**	Depression	A	High	A	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride. Sample April every year (when/if surface water present)	Maintain the water chemistry pan type applicable
								PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al.*, 2020). For	

IUA10: KOPPIESKRAAL

<table>
<tr><th>IUA</th><th>Wetland</th><th>Wetland Type</th><th>PES</th><th>EIS</th><th>REC</th><th>Component</th><th>RQO</th><th>Indicator</th><th>Numerical Criteria</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Habitat</td><td>Maintain or improve current PES category.</td><td>the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.</td><td>PES score above 80%</td></tr>
<tr><td>Biota</td><td>The suitability of the local mosaic of depression wetland habitats for aquatic macroinvertebrates (Branchiopods) must be maintained.</td><td>Indicator Branchiopod species – Limited previous surveys conducted in this RU. Monitor annually.

OR

Wetland Present Ecological State as surrogate.</td><td>Branchiopod inventory limited and requires expansion, but species recorded in RU include:

<table><tr><th>Species</th><th>Status</th></tr><tr><td>Branchipodopsis dayae</td><td>CR</td></tr><tr><td>Pumilibranchipus deserti</td><td>LC</td></tr></table></td></tr>
</table>

IUA10: SOUTPAN

Wetland Characteristics

- Depression wetland
- Moderately sized, ephemeral, saline pan.
- ±994Ha
- Groundwater linked.
- FEPA and CBA Irreplaceable.
- Ongoing salt mining.

IUA10: SOUTPAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
10	**Soutpan**	Depression	B	High	B	Quantity	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs must be maintained.	Water quantity impacts must be managed so as not to undermine the ecological value of the pan. In particular, abstraction or artificial water inputs should be limited in the pan and pan catchment so that the depth and duration of inundation is maintained within the normal range for high, average and low rainfall years. Extent of dams and Surface Flow Reduction (SFR) activities (e.g. irrigated cultivation, plantations, etc.)	The relationship between the extent, depth and frequency of inundation to local rainfall and water inputs in the pan and pan catchment must not on average indicate a negative trend (reduction in inundation extent in relation to antecedent summer rainfall [October to April]). No increase from current extent of dams and SFR activities within the catchment.
						Quantity	Groundwater RQO applies Shallow aquifer levels must be maintained to support the above aquatic ecosystem.	Shallow aquifer groundwater level	See groundwater level numerical limits for relevant groundwater GRU.
						Quality	Water quality impacts to the pan system must be restricted to ensure that the water and sediment chemistry remain within an acceptable normal range (anion and cation concentration to pan volume relationship) for the water chemistry pan type applicable.	pH, Electrical Conductivity, TDS, Total Alkalinity as $CaCO_3$, Sodium, Calcium, Magnesium, Sulphate, Iron, Chloride, Potassium, Magnesium, Manganese, Aluminium, Phosphorous, Silica, Fluoride Ammonia, Nitrate and Fluoride. Sample April every year (when surface water present)	Maintain the water chemistry pan type applicable

IUA10: SOUTPAN

IUA	Wetland	Wetland Type	PES	EIS	REC	Component	RQO	Indicator	Numerical Criteria
						Habitat	Maintain or improve current PES category.	PES Category - As a minimum undertake a WET-Health Level 1a PES assessment (as per the method described by Macfarlane *et al*., 2020). For the PES assessment the latest available National or Provincial Land Cover datasets should be utilised for the wetland catchment, while detailed manual digitising of land cover within the wetland should be undertaken off latest available aerial imagery and supplemented through field verification by an experienced wetland specialist. Repeat as soon as new National or Provincial land cover data is available but at least every 5 years if possible and report on this with a view to assess if there have been any changes in the state of the system.	PES score above 80%