

GARDEN ROUTE DAM DEVELOPMENT

BIODIVERSITY SENSITIVITY ANALYSIS

**PREPARED FOR SHARPLES ENVIRONMENTAL SERVICES
REPRESENTING THE GEORGE MUNICIPALITY**

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CONSERVATION MANAGEMENT SERVICES

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1. INTRODUCTION

1.1 BACKGROUND AND TERMS OF REFERENCE

Ken Coetzee of *Conservation Management Services* was contracted on 23/11/2006 by John Sharples of *Sharples Environmental Services* to do a biodiversity sensitivity analysis for the remainder of Portion 464 (Portion A) by owner and client George Municipality.

In November 2012, Mr Carel Venter, representing the George Municipality, appointed Ken Coetzee of *Conservation Management Services* to update the original 2007 sensitivity analysis for the same area. This was due to the discovery of a rare and endangered plant on the site and because the vegetation cover had recovered significantly after a fire and the removal of the pine tree plantations.

The site was visited on a number of occasions during January and February 2007 to collect site and biophysical information. The site was surveyed, together with the CREW group, during October 2012, to locate the rare and endangered *Gladiolus fourcadei*. The site was surveyed in November 2012 to collect the necessary updated information and photographs.

Due to a considerable time interval (six years) and notable changes within the study site from the time of the updated biodiversity sensitivity analysis (Coetzee, 2012) to date, a new biodiversity sensitivity analysis was required.

On 8 December 2018, Ken Coetzee of *Conservation Management Services* was contracted once again by John Sharples of *Sharples Environmental Services*, to undertake a revised biodiversity sensitivity analysis to highlight opportunities and constraints of the study site portion 464 Portion A (See Figure 1A&B). Bruce Taplin of *Conservation Management Services* was designated as the primary author and Ken Coetzee as the report reviewer.

The site was visited on the 10th and 13th of December 2018. During these site visits, important site-related information was collected which has been included

into this report.

The majority of the property was a former pine plantation area which has undergone substantial disturbance. The study site has been exposed to no less than three uncontrolled burns during the last 12 years and has been substantially invaded by alien invasive plants during this period.

The terms of reference for the undertaking includes the following:

- Compile a vegetation map of the study area (464, Portion A);
- Provide a detailed description of each vegetation unit;
- Compile a plant checklist;
- Evaluate the vegetation in terms of general sensitivity to disturbance and provide a sensitivity map;
- Consider the importance of the study area in terms of landscape connectivity and;
- Highlight the opportunities and constraints for the receiving environment.

1.2 DECLARATION OF INDEPENDENCE AND COMPETENCY

As the report reviewer I, Ken Coetzee trading as *Conservation Management Services*, hereby declare that I comply with all the conditions of PWC: DEA&DP for a person appointed in terms of the NEMA EIA Regulations to compile a specialist report, viz:

- I am independent;
- Have the required expertise, including knowledge of the NEMA, the EIA Regulations and any guidelines that have relevance to the proposed activity and specialist input or study;
- Perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant;
- Comply with NEMA, the EIA Regulations and all other applicable legislation;

- Disclose to the applicant, EAP and the Department all material information in the possession of the person that reasonably has or may have the potential of influencing –
 - (i) any decision to be taken with respect to the application by the competent authority in terms of these Regulations; or
 - (ii) the objectivity of any report, plan or document to be prepared by the person in terms of these Regulations for submission to the competent authority;

- Ensure EIA best practice and clear communication on the methodologies used, and the assumptions, uncertainties and gaps in knowledge; and

- Adhere to the National Environmental Management principles contained in Section 2 of NEMA and the general objectives of Integrated Environmental management contained in Section 23 of NEMA.

1.3 AUTHORS CREDENTIALS

The primary author, Mr Taplin holds a National Diploma in Nature Conservation and graduated with a Cum Laude from the school of Natural Resource Management, Faculty of Science, Nelson Mandela Metropolitan University.

Mr Taplin has 16 years of relevant experience in the field of nature conservation and resource management, the most recent three years of which were self-employed as a biodiversity specialist consultant, involved in a wide variety of nature conservation, landscape planning, commercial game ranch and development projects.

The report reviewer, Mr Ken Coetzee, is registered with the South African Council for Natural Scientific Professions (Reg No 400099/08) as a “Professional Natural Scientist”, in the field of Ecological Science.

Mr Coetzee is a Master of Technology graduate of the School of Forestry and Nature Conservation of the Nelson Mandela Metropolitan University in the field of Ecological Science.

Mr Coetzee has 38 years of relevant experience in the field of nature conservation and management, the most recent 16 years of which were self-employed as a biodiversity specialist consultant, involved in a wide variety of nature conservation, landscape planning, commercial game ranch and development projects.

2. DESCRIPTION OF THE AREA

2.1 LOCALITY

The study area is located at the eastern edge of the George Municipal Area, bordering on Stander and Mayor Streets of the Loerie Park suburb of George.

It is situated on the southern shores of the Garden Route Dam, between the eastern edge of town and the spillway of the dam to the east. The Saasveld Road lies along the southern boundary (See Figure 1A&B).



FIGURE 1A: Locality of the study area adjacent to George in the Western Cape (Google, 2018).



FIGURE 1B: The study site, George Dam Portion 464 A (Google, 2018).

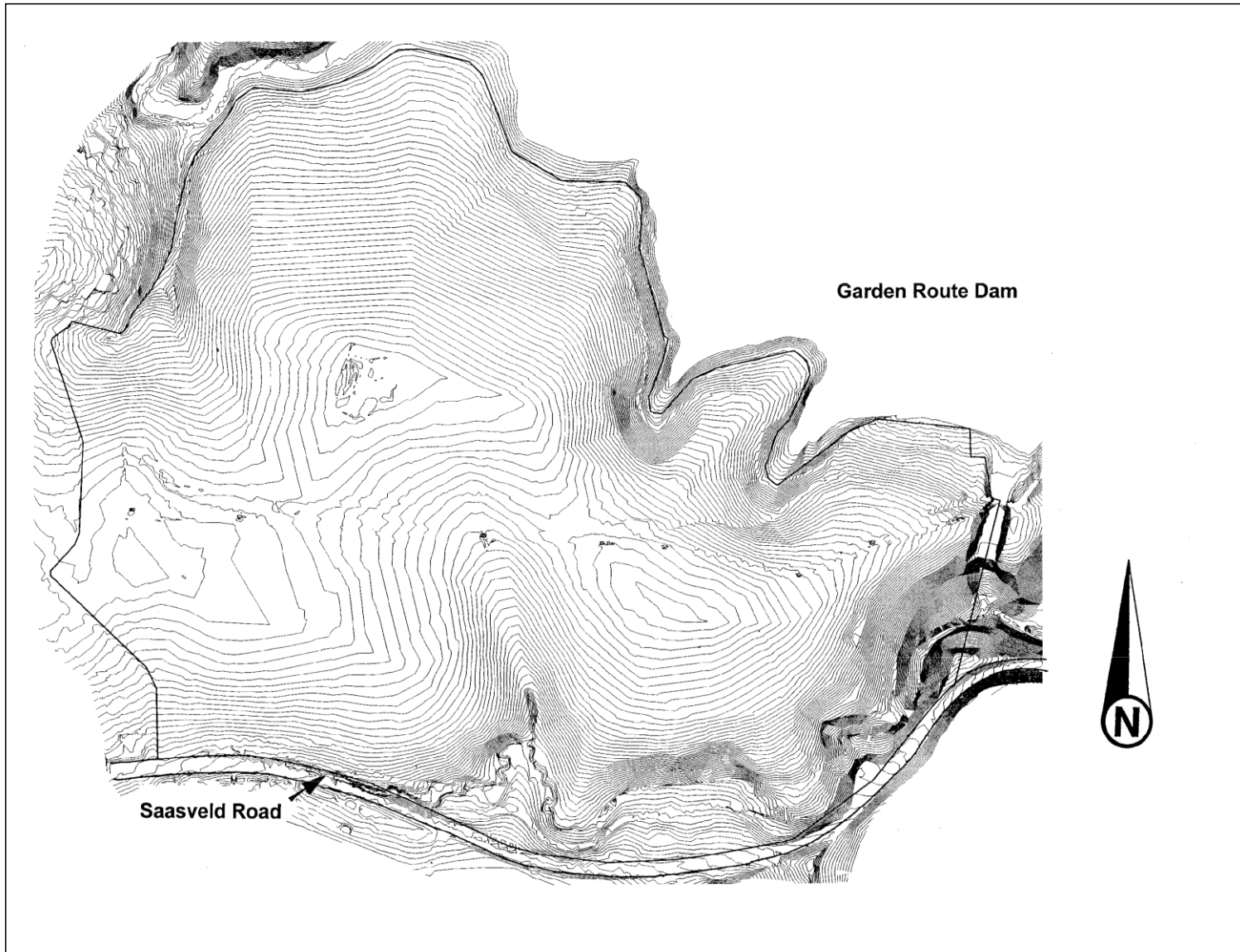


FIGURE 1C: Topography of the study area Portion 464 A (Contour interval:1m).

2.2 TOPOGRAPHY

The topography of the site can be described as a low, flat-topped ridge with gentle to moderately steep sloping sides and featuring indents where the landscape has been eroded into small valleys by drainages. A larger drainage valley lies along the southern boundary and the Garden Route Dam shoreline lies close to the northern boundary. Slopes on the southern edge are steep, while those beyond the northern half are more gradual, except for the drainage valleys, which are relatively steep. (See Figure 1C).

An artificial spillway for the dam lies within a steep-sided valley at the north-eastern edge of the study area.

2.3 VEGETATION DESCRIPTION

The study area falls within the Garden Route Shale Fynbos and Garden Route Granite Fynbos vegetation units of the Vegetation Map of South Africa, Lesotho and Swaziland (Mucina et al, 2012) (See Figure 2A).

According to the CAPE Project Broad Habitat Units of the CAPE Floristic Kingdom (Cape Nature Conservation Board, 2002 & Cowling et al., 1999), the study area falls within the Knysna Afromontane Forest broad habitat unit.

Neither of these landscape mapping initiatives are at a fine enough scale for precise mapping of a unit as small as the study area (approximately 124ha). The above vegetation description does, however, help to give an indication of what the historical situation may have been, which is a mosaic of Shale Fynbos on the fire-prone ridges and Forest in the fire-protected valleys.

The entire study area can be described as a highly disturbed and formerly transformed habitat. The majority of the study area was covered by a commercial pine tree plantation in the past. Only a very narrow belt along the Garden Route Dam shore, the public picnic area and the small river along the southern boundary was free of pine trees.

Originally the area would have consisted of Fynbos on the flatter “upland” areas and Forest / Thicket in the valleys and on valley slopes. Some remnants of these natural vegetation types persisted during the forestry cultivation period and are the source for the current vegetation cover (i.e. since the pine trees were removed).

The study area consists of four broad habitat types, namely: (See Figure 2B).

- Pioneer Fynbos;
- Pioneer Thicket / Forest;
- Highly disturbed areas with an ephemeral weed cover;
- Wetland habitat.

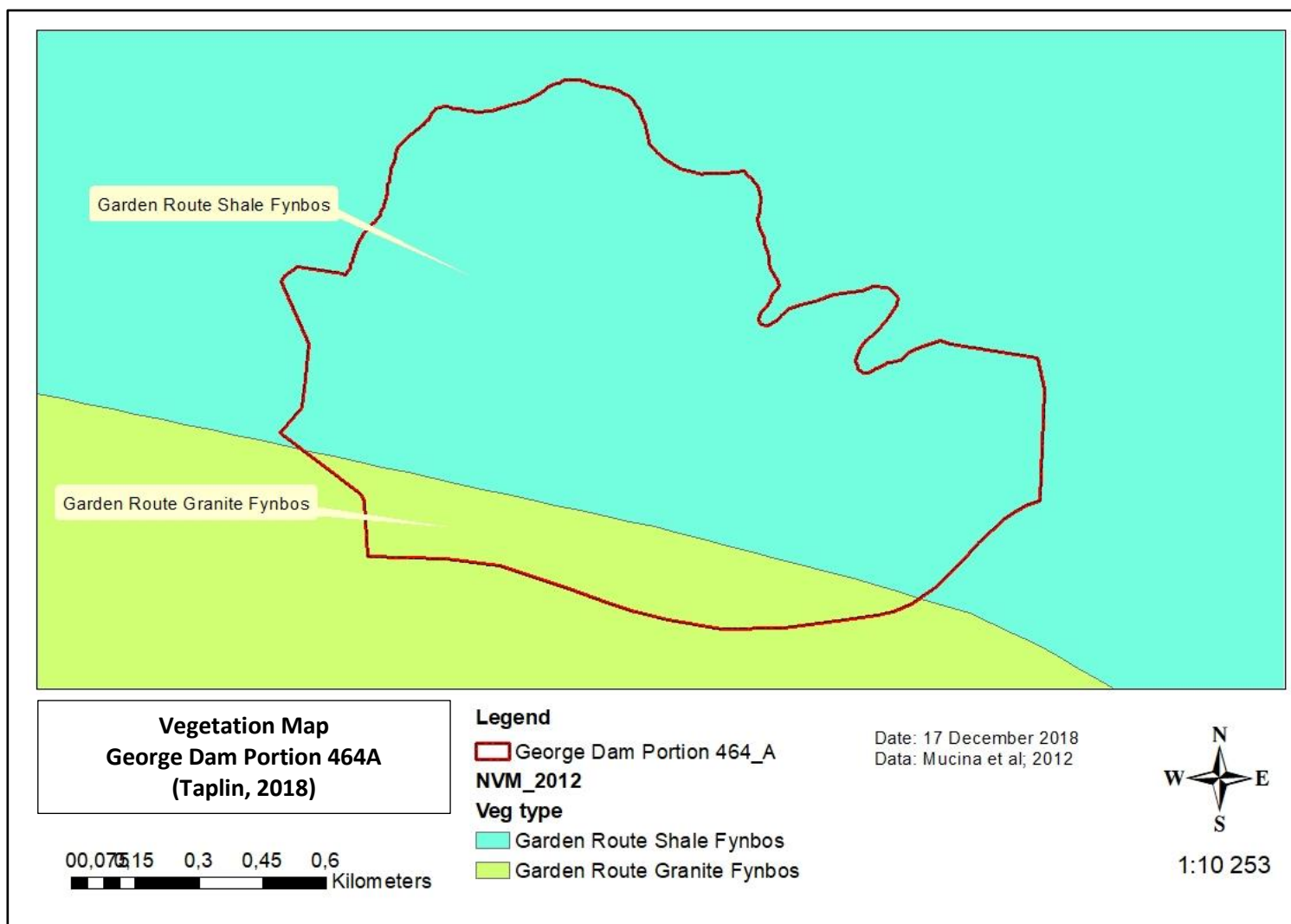


FIGURE 2 A: The study site (George Dam Portion 464A), represents Garden Route Shale Fynbos and Garden Route Granite Fynbos according to Mucina & Rutherford's 2012, Vegetation Map of South Africa, Lesotho and Swaziland.

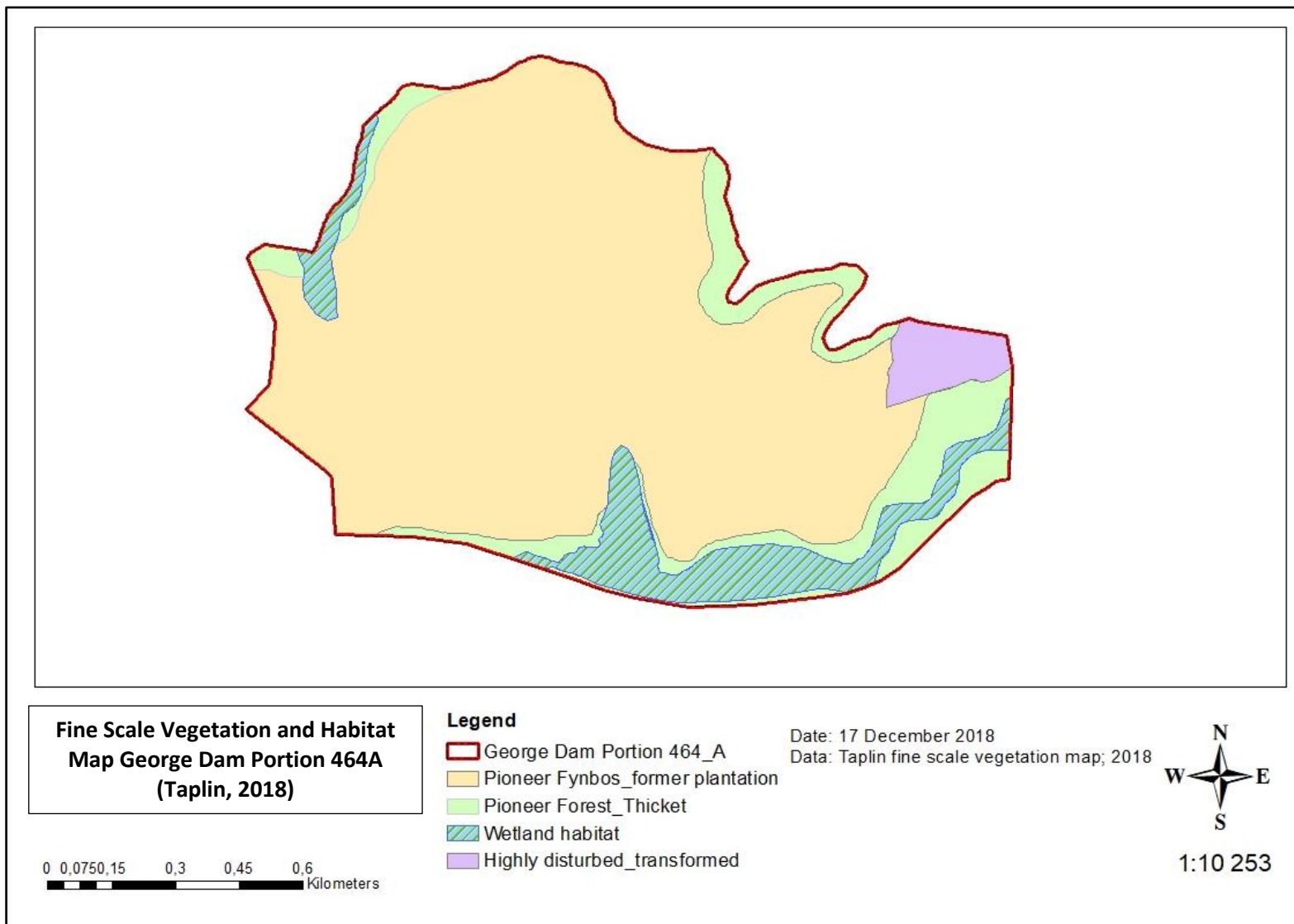


FIGURE 2B: Fine scale vegetation and habitat units of the study site (Taplin ,2018).

2.3.1 PIONEER FYNBOS

This vegetation occurs on the northern slope, flatter upper and plateau areas and persisted within the plantations, along with pioneer “weedy” species which germinated after the intense disturbance of pine tree harvesting. Persistent species include *Passerina vulgaris* and *Otholobium bracteolatum*. Pioneer Fynbos plants include *Selago corymbosa*, *Chrysanthemoides monilifera* and *Helichrysum petiolare*. *Pteridium aquilinum* occur throughout the study site in large stands and were found to dominate specific areas. Sedges and grasses are well represented. (See Plates 1 A to D).

In addition to these species, invasive alien plants are invading the entire study site. The most important and ecologically concerning invasives are *Acacia mearnsii* (black wattle), *Acacia melanoxylon* (blackwood) and *Solanum mauritianum* (bugweed). Other alien weeds like *Amaranthus* sp., *Conyza bonariensis*, *Cirsium vulgare* and alien grasses like *Paspalum* sp. and *Cortaderia selloana* (pampas grass) can be found throughout the study area. (See Plates 1 C&D).

In summary, this vegetation can be described as formerly transformed and thus highly disturbed. Areas of pioneer Fynbos highlighted as “Sensitive Fynbos Restoration Opportunity” on the vegetation and habitat sensitivity map and located on the slope of the northern portion of the study site (see Figure 4) can be classified as more sensitive (Coetzee 2007 and 2012 and Coetzee & Taplin 2018) and do have the potential to be rehabilitated into an improved ecological state with suitable management intervention.

2.3.2 PIONEER FOREST / THICKET

These habitats are restricted within the valleys and on the slopes of the valleys and along drainages. These small forest patches are typical of drainage vegetation in the area and consist chiefly of *Rhamnus prinoides*, *Diospyros dichrophylla*, *Rapanea melanophloeos*, *Kiggelaria capensis* and *Rhoicissus digitata*. (See Plate 2 A&B).

Outside of the small valleys and along the south-facing slopes, the habitat is more thicket-like, currently consisting of pioneer Thicket and Forest trees returning after the removal of the pine plantations. The most important pioneer species are *Halleria lucida*, *Rhus lucida*, *Burchellia bubalina*, *Trimeria grandifolia*, *Gymnosporia buxifolia* and

Rapanea melanophloeos. Seedlings and saplings of these forest pioneers have emerged in large numbers in some areas since the removal of the plantations. These Thicket / Forest areas, however, are also infested with invasive alien trees, mostly black wattle, blackwood and bugweed. With committed management, these habitats can be fully rehabilitated into useful conservation corridor areas.

2.3.3 HIGHLY DISTURBED AND TRANSFORMED AREAS

These areas include the roads and road verges, public picnic area and similar areas of disturbance. The most prominent pioneers on these areas are grasses like *Paspalum dilatatum* and *Paspalum urvillei* (both alien) and *Eragrostis curvula*, *Cynodon dactylon* and *Ehrharta* species (indigenous). Being disturbed, these areas are also invaded by a host of weedy pioneers, both alien and indigenous (See Plate 3 I & J).

A recent fire (October 2018) is estimated to have burnt at least 40% of the study area (see Figure 5) and both pioneer Fynbos and Pioneer Forest / Thicket have been affected. From what can be ascertained during the site visit, due to the high density of alien plants on site and dry conditions prior to the fire, the fire burnt extremely hot and has scorched large areas of topsoil, making these areas susceptible to further alien infestation and erosion. The pioneer stages of both Fynbos and Forest / Thicket are likely to persist, along with aggravated alien plant infestation (See Plate 3 J, K & L).

2.3.4 WETLAND

A small fluvial wetland occurs along the southern boundary of the study area. The small stream is fed by drainage from the study area and the Saasveld road, in the form of seepage and runoff after rains. The original wetland vegetation is completely dominated by invasive alien plants such as *Acacia mearnsii*, *A. melanoxylon* and *Solanum mauritianum*. Much of the original wetland cover has been lost due to this invasion (See Plate 2 G & H). A smaller wetland area occurs on the north western boundary, which later converges into a drainage line and feeds into the dam. This area is also heavily infested by *Acacia mearnsii*, *A. melanoxylon* and *Solanum mauritianum*.



PLATE 1: Typical pioneer Fynbos on former pine tree plantation areas can be seen in images A to D. **A)** Shows extensive stands of *Pteridium aquilinum* dominating the landscape. **B)** Shows *Helichrysum petiolare* and *Passerina vulgaris*. **C)** Shows *Conyza bonariensis* and **D)** Shows *Acacia mearnsii* (black wattle) and *Acacia melanoxylon* (blackwood) aggressively invading the pioneer Fynbos areas.



PLATE 2: E&F) Represent pioneer Forest / Thicket on south-facing slopes within the former pine plantation area. Typical pioneer species *Halleria*, *Searsia* and *Chrysanthemoides* dominate this vegetation type. **G&H)** Represent the wetland/drainage area along the southern boundary of the study area.



PLATE 3: **I)** Highly disturbed road verge dominated by grasses and weedy pioneers. **J)** The head of a drainage leading into the dam. **K)** Pioneer Fynbos consisting mainly of *Chrysanthemoides monilifera*, *Halleria lucida* and *Passerina vulgaris*, which is now burnt and a dense mat of *Pteridium aquilinum* replaces the previous vegetation. **L)** Scorched earth as a result of hot fires driven by dense alien plant infestations and dry conditions.

2.3.5 PLANT CHECKLIST

A comprehensive plant list was compiled during the most recent site visits on the 10th and 13th of December 2018. Due to an estimated 40% of the area being transformed by the recent fires (see Figure 5), not all the plant species associated with the identified habitat and vegetation type were present during these site visits.

It was felt that plant species not located during the current site evaluation but listed to occur in this area by Mr Coetzee during his March 2007, October and November 2012 site visits would further support the current biodiversity sensitivity analysis. These additional plant species were included in the plant checklist.

STUDY SITE PLANT CHECKLIST		
No:	Species name	Comment
1	<i>Acacia mearnsii</i>	Alien plant
2	<i>Acacia melanoxylon</i>	Alien plant
3	<i>Agrostis bergiana</i> var. <i>bergiana</i>	
4	<i>Arctotheca calendula</i>	
5	<i>Asclepias physocarpa</i>	
6	<i>Asparagus capensis</i>	
7	<i>Berzelia intermedia</i>	
8	<i>Briza maxima</i>	Alien plant
9	<i>Briza minor</i>	Alien plant
10	<i>Buddleja saligna</i>	
11	<i>Buddleja salviifolia</i>	
12	<i>Burchellia bubalina</i>	
13	<i>Callistemon viminalis</i>	Alien plant
14	<i>Chironia baccifera</i>	
15	<i>Chrysanthemoides monilifera</i>	
16	<i>Cinnamomum camphora</i>	Alien plant
17	<i>Cirsium vulgare</i>	Alien plant
18	<i>Cliffortia</i> species	
19	<i>Conyza bonariensis</i>	Alien plant
20	<i>Conyza scabrida</i>	
21	<i>Cortaderia selloana</i>	Alien plant
22	<i>Cullumia aculeata</i>	
23	<i>Cynodon dactylon</i>	
24	<i>Cyperus marginatus</i>	
25	<i>Cyperus papyrus</i>	Alien plant
26	<i>Cyperus textilis</i>	Alien plant
28	<i>Datura ferox</i>	Alien plant
29	<i>Dietes iridioides</i>	Alien plant
30	<i>Diospyros dichrophylla</i>	
31	<i>Ehrharta longiflora</i>	
32	<i>Eragrostis curvula</i>	

33	<i>Eragrostis capensis</i>	
34	<i>Eragrostis plana</i>	
35	<i>Erica formosa</i>	
36	<i>Erica glandulosa</i> (yellow form)	
37	<i>Euclea crispa</i>	
38	<i>Ficinia</i> species	
39	<i>Gladiolus fourcadei</i>	Critically Endangered
40	<i>Gladiolus rogersii</i>	
41	<i>Gymnosporia buxifolia</i>	
42	<i>Halleria lucida</i>	
43	<i>Helichrysum dasyanthum</i>	
44	<i>Helichrysum felinum</i>	
45	<i>Helichrysum petiolare</i>	
46	<i>Helichrysum simillimum</i>	
47	<i>Hibbertia scandens</i>	Alien plant
48	<i>Hibiscus trionum</i>	Alien plant
49	<i>Hypocalyptus oxilidifolius</i>	
50	<i>Hypoxis haemerocallidea</i>	
51	<i>Indigofera stricta</i>	
52	<i>Kiggelaria africana</i>	
53	<i>Lobelia coronopifolia</i>	
54	<i>Metalasia pungens</i>	
55	<i>Monopsis unidentata</i>	
56	<i>Olea capensis</i>	
57	<i>Otholobium bracteolatum</i>	
58	<i>Panicum maximum</i>	
59	<i>Paspalum dilatatum</i>	Alien plant
60	<i>Paspalum urvillei</i>	Alien plant
61	<i>Passerina vulgaris</i>	
62	<i>Pelargonium betulinum</i>	
63	<i>Pelargonium capitatum</i>	
64	<i>Pelargonium multicaule</i>	
65	<i>Pennisetum clandestinum</i>	Alien plant
66	<i>Pentaschistis airoides</i>	
67	<i>Pentaschistis glandulosa</i>	
68	<i>Phormium tenax</i>	Alien plant
69	<i>Phyllica axillaris</i>	
70	<i>Pinus radiata/pinaster</i>	
71	<i>Plantago lanceolata</i>	Alien plant
72	<i>Podalyria burchellii</i>	
73	<i>Polygala fruticosa</i>	
74	<i>Psidium guajava</i>	Alien plant
75	<i>Pteridium aquilinum</i>	
76	<i>Rapanea melanophloeos</i>	
77	<i>Rhamnus prinoides</i>	
78	<i>Rhynchosia chryscias</i>	
79	<i>Rubus fruticosus</i>	Alien plant
80	<i>Schistostephium umbellatum</i>	
81	<i>Searsia chirindensis</i>	
82	<i>Searsia laevigata</i>	

83	<i>Searsia lucida</i>	
84	<i>Searsia tomentosa</i>	
85	<i>Sebea aurea</i>	
86	<i>Selago corymbosa</i>	
87	<i>Senecio elegans</i>	
88	<i>Senecio ilicifolia</i>	
89	<i>Setaria sphacelata</i>	
90	<i>Solanum mauritianum</i>	Alien plant
91	<i>Solanum nigrum</i>	Alien plant
92	<i>Sporobolus africanus</i>	
93	<i>Stenotaphrum secundatum</i>	
94	<i>Strelitzia nicolai</i>	Alien plant
95	<i>Struthiola myrsinites</i>	
96	<i>Tarchonanthus camphoratus</i>	
97	<i>Tetraria</i> species	
98	<i>Trimeria grandifolia</i>	
99	<i>Ursinia anthemoides</i>	
100	<i>Verbena bonariensis</i>	Alien plant
101	<i>Virgillia oroboides</i>	
102	<i>Wachendorfia thyrsiflora</i>	

TABLE 1: Plant checklist of the study site Portion 464 A (Coetzee 2012 & Coetzee and Taplin 2018).

2.4 VERTEBRATE FAUNA

The study area lies at the George municipal urban edge and has been regularly subjected to a high incidence of anthropogenic disturbances like forestry activities, municipal maintenance activities, public recreational use of the area and even squatting. Predatory domestic dogs and cats from the adjacent residential areas have also contributed to faunal disturbance.

As a result of this long and persistent disturbance, only the most tolerant of the larger vertebrates still occur in the study area. Examples are bushbuck (*Tragelaphus scriptus*), bushpig (*Potamochoerus porcus*) and baboon (*Papio ursinus*), all of which generally persist in the area, even in pine tree plantations. The more sensitive habitat specialist species like blue duiker, grysbok, leopard and honey badger have retreated into areas of lower disturbance in the mountains and forests to the north and east.

The table below, representing vertebrate fauna diversity and occurrence, tabulates species which are either confirmed to occur by Coetzee (2007 and 2012) and more

recently by Coetzee & Taplin (2018) or are likely to occur due to the typical habitat which is represented within the GRD and surrounding area.

VERTEBRATE FAUNAL OCCURRENCE				
Vertebrate	Species	Confirmed	Likely	Possible
Amphibians	11	1	7	3
Reptiles	40	3	31	6
Mammals	53	3	31	19
Birds	156	6	150	150

TABLE 2: Vertebrate faunal occurrence for the study site, (Coetzee 2005 and 2012 and Coetzee & Taplin, 2018).

3. BIODIVERSITY SENSITIVITY

3.1 VEGETATION AND HABITAT

According to Mucina and Rutherford 2012, both Garden Route Shale Fynbos (GRSF) Garden Route Granite Fynbos (GRGF) are classified as Endangered vegetation types and have a conservation target of 23%. Only about 8% of GRSF is protected in formal conservation areas and private reserves, while only 1% of GRGF is currently protected.

However, as discussed under the vegetation section of the report, the majority of the original and natural vegetation of the study site has been impacted upon and can now be regarded as transformed when compared with intact and natural GRSF and GRGF vegetation types.

Sensitive habitat variations and important ecological areas suitable for ecological processes and restoration efforts were, however, able to be identified within the study site. These are listed and described as vegetation and habitat sensitivity classes below (Coetzee 2007 and 2012 and Coetzee & Taplin 2018) and are spatially presented in Figure 4.

3.1.1 HIGHLY SENSITIVE *GLADIOLUS FOURCADEI* HABITAT

Surprisingly, one important and interesting survivor of the original Fynbos vegetation occurs along the south-facing slopes above and adjacent to the drainage line that

lies along the southern boundary. This is the bulb geophyte *Gladiolus fourcadei* (see Plate 5 M & N), which has either been dormant as a bulb during the period when the area was covered with pine trees (in more than one rotation of trees, up to 50 years) or was able to flower and produce despite the alien pine tree cover.

Gladiolus fourcadei was discovered on the study area by members of the local CREW group prior to this assessment in 2012. Approximately 200 individual plants were counted after a fire event by the CREW group. Following this discovery, a survey of the area was carried out by the local CREW group and *Conservation Management Services*, represented by Mr Coetzee, to determine the exact extent of the plant (2012). The survey revealed only 39 flowering plants, but a much higher density of flowering plants can be expected after a fire event, as the species responds positively to fire. The known extent of the *Gladiolus fourcadei* population is shown in Figure 3.

The endemic *Gladiolus fourcadei* is classed as a Red Data listed species, categorized as Critically Endangered with a continuously decreasing distribution (Raimondo et al, 2012). It is thus a species under threat of extinction and, as such, should be afforded the highest level of protection, together with the habitat within which it occurs.



PLATE 5: M) The Critically Endangered *Gladiolus fourcadei*. **N)** The habitat in which *G. fourcadei* occurs on a southern slope.

The following are GPS co-ordinates for 12 of the located flowering *G. fourcadei*:

- S33 58.095 E22 30.208
- S33 58.100 E22 30.204
- S33 58.101 E22 30.199
- S33 58.091 E22 30.093
- S33 58.080 E22 30.187
- S33 58.079 E22 30.187
- S33 58.079 E22 30.187
- S33 58.083 E22 30.185
- S33 58.078 E22 30.186
- S33 58.078 E22 30.186
- S33 58.078 E22 30.183
- S33 58.073 E22 30.184

3.1.2 SENSITIVE WETLAND HABITAT

The wetlands along the drainage on the southern and western boundaries have been impacted upon by alien invasive plants and substantial eutrophication, which seem to be the most concerning impacts. These impacts have affected the wetlands structurally and functionally. Plate 4 O affords a visual of the wetland on the southern boundary. The wetlands can, however, still be considered as sensitive areas which provide important habitat and ecological functioning. These areas should be restored where possible and afforded protection. The areas classified as sensitive wetland habitats are well aligned to the aquatic Critical Biodiversity Areas listed in the Western Cape Spatial Biodiversity Plan, 2017.



PLATE 4 O: The minor drainage and associated wetland in the southern portion of the study site is infested by *Acacia mearnsii* and *Solanum mauritianum*. Additionally, the area has been subjected to extensive eutrophication.

3.1.3 SENSITIVE FYNBOS HABITAT RESTORATION OPPORTUNITY

The sloped contour area situated across the northern portion of the study site and previously identified as “Sensitive Fynbos Restoration Opportunity” (Coetzee, 2012) has almost completely burnt during the recent fires in October 2018 (see Figure 5 and Plate 5P). It was therefore difficult to ascertain the exact sensitivity status across the full extent of the area during the most recent site visits.

The following observations were made and support the previous sensitivity classification undertaken in 2012, as well as the current classification process:

- The areas classified as “Sensitive Fynbos Restoration Opportunity” by Coetzee in 2012 that remain unaffected by the recent fire represent a healthy diversity of fynbos species representative of pioneer Fynbos which has successively improved over time. This demonstrates the ability that the transformed vegetation has to regain natural vegetation integrity.
- The classified area provides a well-positioned ecological corridor to

compliment the already declared Katriver Nature Reserve Protected Area.

- The area supports and provides an ecological linkage between the natural wetland in the west and the artificial aquatic system (Garden Route Dam) to the north.



PLATE 5 P: Formerly classified as Sensitive Fynbos Restoration Opportunity Area (Coetzee, 2012) and now completely transformed after the fires experienced in October 2018 (Coetzee & Taplin 2018).

3.1.4 SENSITIVE FOREST / THICKET HABITAT RESTORATION OPPORTUNITY

The “Sensitive Forest / Thicket Restoration Opportunities” habitat areas listed by Coetzee in 2012 remain mostly unaffected by the recent fire, apart from a narrow band of Thicket that is situated in the north-eastern portion of the study site which was burnt. The majority of these areas were not part of the previous pine plantations. These two factors facilitated the more comprehensive classification of these habitat areas.

Thicket and forest succession has taken place over time and these areas are positively contributing as ecological corridors, providing cover and suitable habitat for an array of species. Despite alien clearing efforts which have taken place over the last few years, the habitat has become far more aggressively invaded by alien invasive plants such as *Acacia mearnsii*, *Acacia melanoxylon* and *Solanum mauritianum* which are currently threatening the structure and function of this habitat type. If restoration efforts

are undertaken successfully, further benefits such as habitat heterogeneity and landscape connectivity can be achieved. These areas therefore remain sensitive habitats which provide valuable ecological connectivity potential.

3.1.5 LOW SENSITIVITY DISTURBED FORMER PLANTATION

This habitat accounts for the largest portion of the study site and was exclusively used as a plantation area in the last fifty years. The area has been exposed to continued disturbance since the removal of the pines and no fewer than three fires have been through the area in the past 10 years. Roads and high loads of alien invasive plants are just a few of the disturbances present on the site. Due to the continued disturbance, pioneer Fynbos has persisted in a very degraded state and is dominated in most areas by a single plant species such as *Pteridium aquilinum*, *Helichrysum petiolare* or *Passerina vulgaris*.

3.1.6 HIGHLY DISTURBED AND TRANSFORMED

These are areas that have been completely transformed and consist mainly of roads, picnic sites, car parks, mowed road verges and alien plants. These are the least sensitive and most transformed areas of the study site.

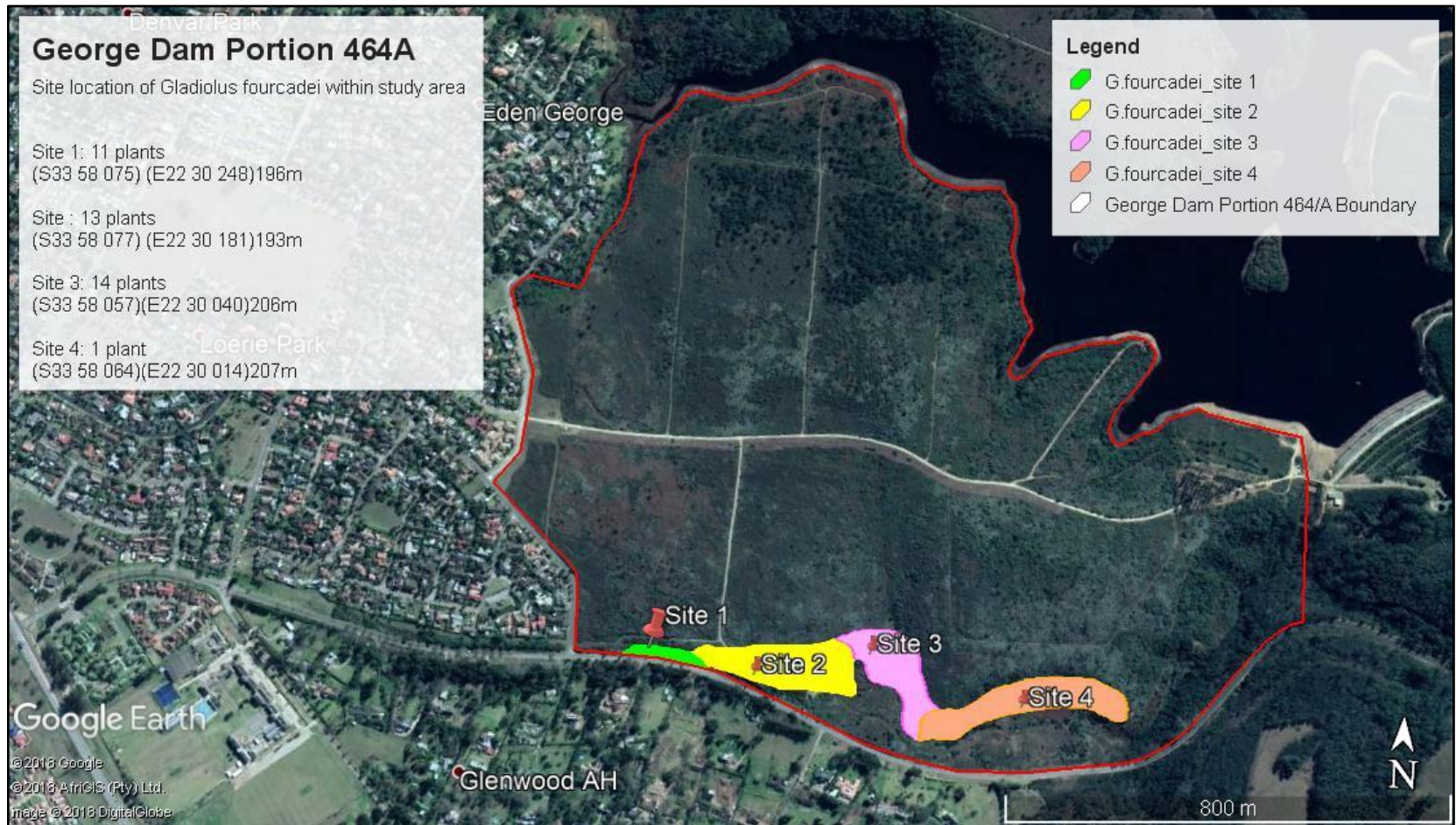


FIGURE 3: Approximate search areas/sites for *G. fourcadei* and numbers of plants located at each site (Coetzee, 2012)

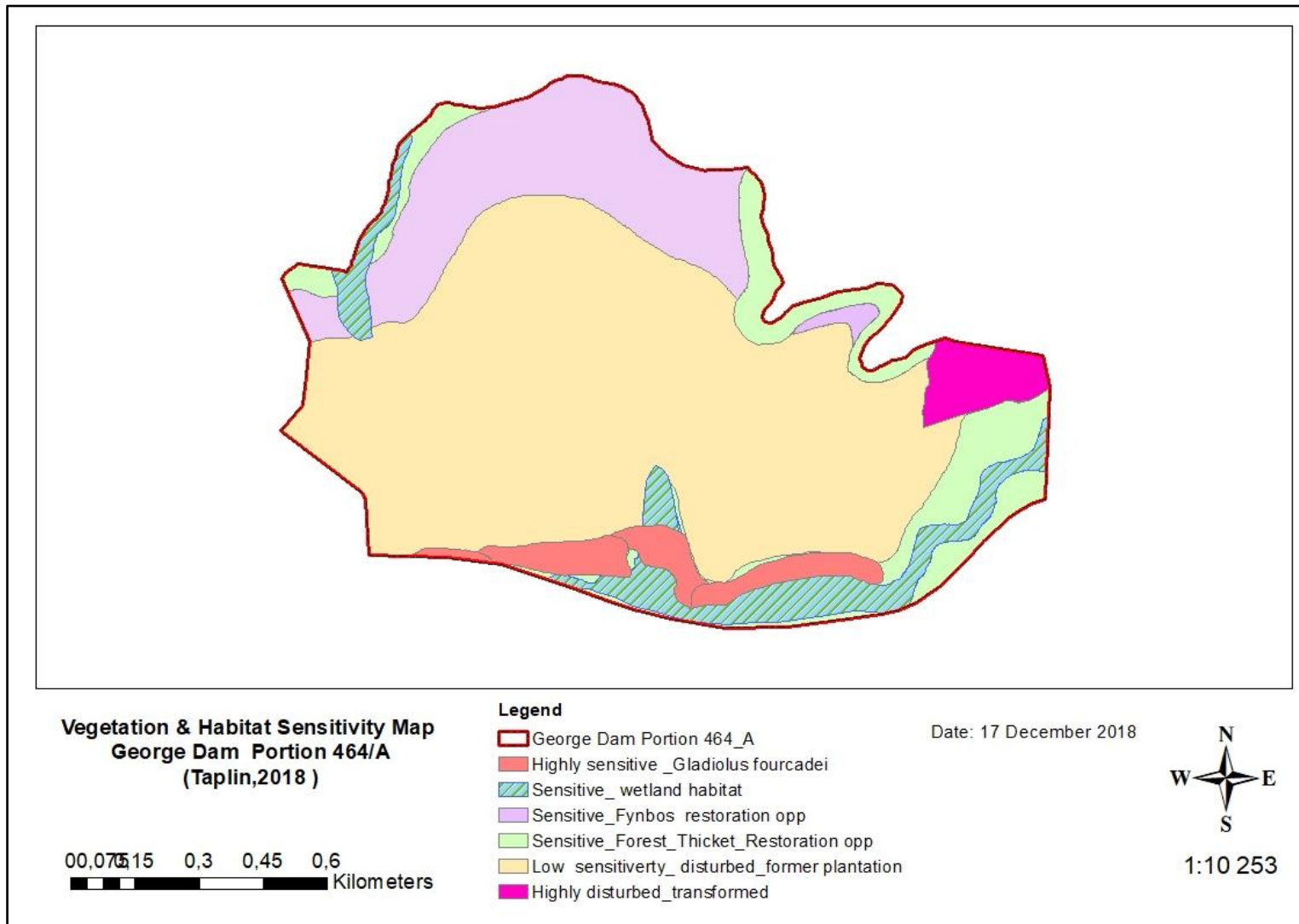


FIGURE 4: Vegetation and habitat sensitivity of the Garden Route Dam area, Portion 464A, (Taplin 2018).

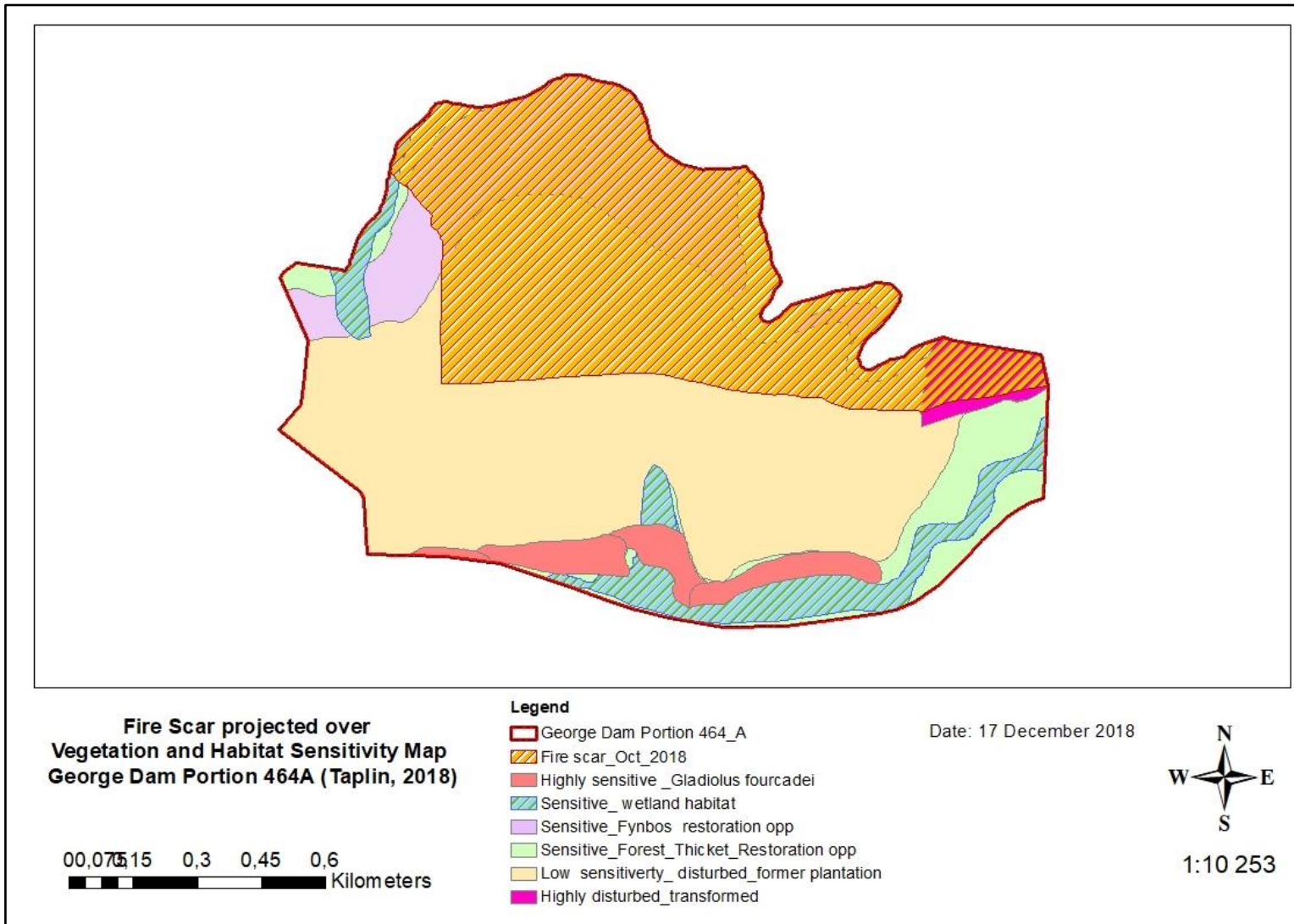


FIGURE 5: Fire scar projected on the vegetation and sensitivity map (Taplin 2018).

3.2 FAUNAL SENSITIVITY

Table 3 lists the Red Data vertebrate faunal species that are likely to occur on the GRD study area and surrounds. The Red Data species and distributions are according to Friedman & Daly (2004).

RED DATA SPECIES			
COMMON NAME	SCIENTIFIC NAME	RED DATA CATEG	PREDICTED OCCURRENCE
Long-tailed forest shrew	<i>Myosorex longicaudatus</i>	Near Threatened	Likely
Fynbos golden mole	<i>Amblysomus corriae</i>	Near Threatened	Likely
Cape golden mole	<i>Chrysochloris asiatica</i>	Data Deficient	Likely
Geoffroy's horseshoe bat	<i>Rhinolophus clivosus</i>	Near Threatened	Possible
Cape horseshoe bat	<i>Rhinolophus capensis</i>	Near Threatened	Possible
Temminck's hairy bat	<i>Myotis tricolor</i>	Near Threatened	Possible
White-tailed rat	<i>Mystromys albicaudatus</i>	Endangered	Possible
African striped weasel	<i>Poecilogale albinucha</i>	Data Deficient	Likely

TABLE 3: Red Data listed mammals that are predicted to occur on the GRD study area. (See Appendix 1 for details of Red Data categories).

The long-tailed forest shrew is listed as Near Threatened due to the increasing loss of forest habitat. The presence of this species is considered highly likely

because the Forest / Thicket habitat of the study site is very suitable for these indigenous forest-loving species. They are known to occur in the general area but are only known from true Forest or Forest / Fynbos transition areas.

The fynbos golden mole and Cape golden mole are considered likely to occur in the study area. The golden moles are restricted to fynbos and forest habitat.

The three bats are also classed as Near Threatened.

The white-tailed rat is considered to be Endangered due to large-scale loss of habitat which includes Fynbos, Renosterveld and southern Savannah Grassland. If this species does occur in the area, its continued existence will be ensured by retaining areas of the natural rehabilitating Fynbos habitat as open space.

The African wildcat is common and widespread, and used to be listed as a Red Data species, because they freely hybridize with domestic cats and no longer occur in genetically pure populations near to developed settlements.

The striped weasel is likely to occur in the study area and it is considered to be under threat due to habitat and prey reduction. On the study area, this species will have adequate habitat in the unaffected riverine, dam shore and forest areas.

RARE BIRD SPECIES

Two of the bird species that could possibly occur in the GRD area are classed as Red Data species (Barnes, 2000). They are the Stanley's bustard (*Neotis denhami*) and the grass owl (*Tyto capensis*) which are not really provided with suitable habitat in the study area, but may occur occasionally or temporarily. Their favoured habitat, open but tall, dense grassland is in any case artificial in the study area and is far too small to support sustainable natural populations of these birds.

In addition to the Red Data bird species, the endemic or near-endemic bird species of the study area should also be considered important because these species are endemic to the subregion, which is thus entirely responsible for their global survival. The endemic or near-endemic bird species which are predicted to occur within the study area are as follows in Table 4:

COMMON NAME	SCIENTIFIC NAME	PREDICTED OCCURRENCE
Jackal buzzard	<i>Buteo rufofuscus</i>	Confirmed
Cape francolin	<i>Francolinus capensis</i>	Confirmed
Knysna turaco	<i>Tauraco corythaix</i>	Confirmed
Karoo prinia	<i>Prinia maculosa</i>	Confirmed
Karoo robin	<i>Erythropygia coryphaeus</i>	Confirmed
Victorin's warbler	<i>Bradypterus victorini</i>	Possible
Fiscal flycatcher	<i>Sigelus silens</i>	Confirmed
Grass bird	<i>Spenoeacus afer</i>	Confirmed
Orange-breasted sunbird	<i>Nectarinia violaea</i>	Confirmed
Lesser double-collared sunbird	<i>Nectarinia chalybea</i>	Confirmed
Greater double-collared sunbird	<i>Nectarina afra</i>	Likely
Cape white-eye	<i>Zosterops senegalensis</i>	Confirmed
Southern tchagra	<i>Tchagra tchagra</i>	Likely
Cape weaver	<i>Ploceus capensis</i>	Possible
Swee waxbill	<i>Estrilda melanotis</i>	Likely
Cape bulbul	<i>Pycnonotus capensis</i>	Confirmed
Black korhaan	<i>Eupodotis afra</i>	Possible
Chorister robin	<i>Cossypha dichroa</i>	Possible

TABLE 4: Endemic and near endemic bird species which are predicted to occur on the study area (Barnes, 2000).

Most of these birds are associated with Fynbos or Thicket and Forest habitat, which confirms that the restoration of the more sensitive fynbos and forest/thicket vegetation would aid in the conservation of these endemic and near-endemic bird species.

In the vicinity of the study area, these habitats are well protected in the Groeneweide forests, seaward coastal forests and Fynbos areas. The Open Space areas on the Garden Route Dam study area will also provide valuable habitat for the conservation of these endemics and near endemics. The study area is thus not critical for the conservation of these species, but is and can become locally important bird habitat, or stepping-stone corridor habitat.

3.3 CONSERVATION STATUS

Prior to the completion of the 2017 Western Cape Spatial Biodiversity Plan (WCSBP), the study area did not lie within any part of a Critical Biodiversity Area (CBA) and in fact the study site was mapped as a transformed area. With the completion of the much improved WCSBP in 2017 and the revised conservation, biodiversity and connectivity

objectives much of the site now falls within biodiversity priority categories (See Figure 6).

With specific reference to the study area, the following biodiversity priority categories can be explained:

➤ **Protected Area (PA) Nature Reserve**

The Katrivier Nature Reserve extends into the northern areas of the study site. These areas should be kept in a natural state with a management focus of maintaining or improving the state of biodiversity. It can be stated that the PA is completely transformed and occupied with alien invasive plants.

➤ **Critical Biodiversity Area 1 (CBA 1) Aquatic / wetland**

The aquatic or wetland CBA 1 is located in the southern most drainage line of the study site. The area is currently invaded by alien invasive plants and considerably atrophied. The management focus should be to maintain the area in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are would be appropriate.

➤ **Critical Biodiversity Area 1(CBA 1) Terrestrial**

The terrestrial CBA 1 area is located in the south eastern corner of the study site. This area is currently completely invaded by invasive alien plants. The land use objective should be to maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

➤ **Critical Biodiversity Area 2 (CBA 2) Terrestrial**

The terrestrial CBA 2 occurs in a narrow band within the south eastern portion of the study site as well as in the north eastern side. During the site visit it was established that the majority of the north eastern areas are completely transformed and occupied with alien vegetation. The objective should be to maintain in a natural or near-natural

state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

➤ **Ecological Support Area 1 (ESA 1) Terrestrial**

The terrestrial ESA 1 represents the majority of the study area. If one refers to the Vegetation and Habitat Sensitivity Map (Figure 4), this area has mostly been classified as low sensitivity and highly disturbed and transformed, with the exception of the areas highlighted in pink which have been classified as sensitive Fynbos rehabilitation opportunity areas.

The most recent fire which has gone through the area has almost entirely burnt the terrestrial ESA 1 and scorched large areas of the soil due to hot fires caused by the alien vegetation and dry conditions. (See Figure 5 and Plate 3 J, K & L).

The land management objective, according to the revised WCSBP, is to maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.

➤ **Ecological Support Area 2 (ESA 2) Climate Corridor, River, Wetland**

The ESA 2 climate corridor, river and wetland areas occur in the southern portion of the study site. These areas are also invaded by alien plants and are in a transformed state. According to WCSBP, these areas should be restored and / or managed to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement.

The Red Listed and Critically Endangered *G fourcadei* falls within the river and climate corridor ESA 2, Terrestrial CBA 2 as well as the Aquatic / wetland CBA1. The applicable management priorities should be stringently enforced here.

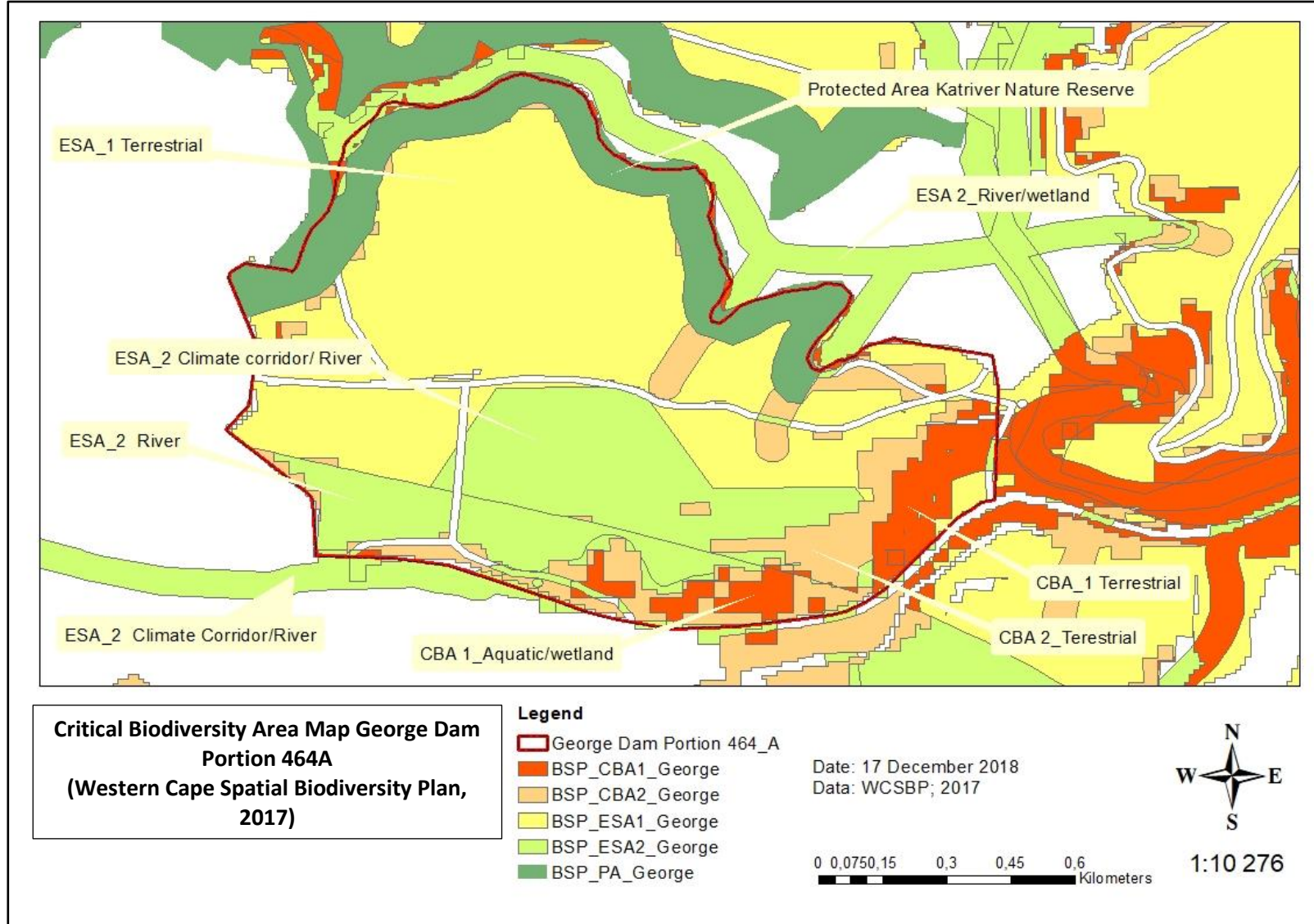


FIGURE 6: Critical Biodiversity Area Map of the George Dam study site portion 464A, (WCSBP, 2017).

4. OPPORTUNITIES AND CONSTRAINTS

As described, the majority of the study site has been subjected to considerable disturbance over an extended period of time and is completely transformed. The study site does however allow for conservation and development opportunities alike. Table 5 lists these opportunities and constraints, taking the biodiversity sensitivity analysis into consideration.

Opportunities and constraint list for the George Dam 464A study site	
1	Development opportunity
1.1	<p><u>Development locality</u> Due to the nature of the study site (completely transformed) there is an opportunity for development in the areas highlighted in Figure 7 as low sensitivity, disturbed and former plantation areas. These areas were extensively surveyed during the assessment (see site verification points) and no significantly sensitive areas or plant species were located.</p>
2	Development constraints
2.1	<p><u>Development locality and site placement</u> With reference to the proposed development of a college or university with residence , the layout of the development should fall within the areas marked as low sensitivity, disturbed, former plantation areas and more specifically on the flatter areas which fall within the areas mapped as “Development Opportunity Areas” (Figure 7).</p>
2.2	<p><u>Development and sensitivity</u> Careful consideration should be given to the following areas marked as environmentally sensitive areas (Figure 7):</p> <ul style="list-style-type: none"> > Highly sensitive <i>Gladiolus fourcadei</i> areas > Sensitive wetland areas > Sensitive Fynbos restoration areas opportunity areas > Sensitive Forest / Thicket restoration opportunity areas <p>Should any form of development be considered (road access and/or pipeline placement), the necessary mitigation measures will be required to ensure as little disturbance as possible.</p>

2.3	<p><u>Development- ecological processes and connectivity</u> Development considerations should include ecological process and connectivity areas from a site as well as regional scale. The proposed “Development Opportunity Areas” highlighted allow for these processes and connectivity across the landscape.</p>
2.4	<p><u>Development impact and mitigation</u> A suitable impact report as well as an open space management plan is required once the development layout has been drafted. This process should highlight and mitigate any further risks associated with the prospective development layout and type.</p>
3	<p>Conservation opportunity</p>
3.1	<p><u>Rehabilitation</u> Currently, large areas across the site and in particular the sensitive areas highlighted are at risk of becoming completely invaded by alien invasive plants. The loss of valuable and irreplaceable topsoil after the recent fires is also of major concern.</p> <p>There is opportunity for a well-planned and implemented alien invasive management initiative as well as a combating the soil erosion. This has the potential to improve biodiversity, increase water availability and reduce the frequency and severity of uncontrolled fire incidents.</p>
3.2	<p><u>Habitat heterogeneity</u> If the area is adequately rehabilitated and maintained there is great opportunity for habitat heterogeneity. Habitats that have the potential to be represented are; wetland areas (natural and artificial), sensitive Fynbos and Forest / Thicket areas.</p>
3.3	<p><u>Landscape connectivity</u> With open spaces adjacent to the study site as well as the possibility of improved habitat heterogeneity and biodiversity as a result of the rehabilitation, improved landscape connectivity will be possible.</p>
3.4	<p><u>Conservation and improvement of wetland areas</u> The natural wetland and drainage areas are considerably impacted upon at present and there is opportunity through well-managed alien plant eradication initiatives as well as improved waste water management to improve the structure and functionality of these important habitats.</p>

3.5	<p><u>Conservation of Critically Endangered plant (species of special concern)</u></p> <p>The appropriate land use management and regular monitoring of the Critically Endangered <i>Gladiolus fourcadei</i> population will ensure the persistence and possible expansion of the species into new and adjacent areas.</p>
4	<p>Conservation constraints / considerations</p>
4.1	<p><u>Rehabilitation</u></p> <p>Should the site be left untreated, it is predicted that the alien plant infestation will aggressively worsen and a monoculture of aliens will replace the limited pioneer Fynbos as well as Forest / Thicket vegetation. Should the existing soils erosion not be addressed, loss of top soil is inevitable.</p>
4.2	<p><u>Habitat heterogeneity</u></p> <p>Lack of rehabilitation and the increase of fire frequency as well as severity will lead to reduced habitat heterogeneity.</p>
4.3	<p><u>Landscape connectivity</u></p> <p>Ill planned development, impenetrable fences and unnecessary habitat transformation will lead to the loss of landscape connectivity.</p>
4.4	<p><u>Conservation and improvement of wetland areas</u></p> <p>Alien plants and waste water management are currently threatening the integrity of the wetlands and drainages. Ill planned development could further degrade these areas.</p>
4.5	<p><u>Conservation of Critically Endangered plant (species of special concern)</u></p> <p>Ill planned development, alien plants, absence of fire for extended periods and illegal harvesting could all negatively impact on the Critically Endangered <i>Gladiolus fourcadei</i> population.</p>

TABLE 5: A summary of opportunities and constraints for the study site.

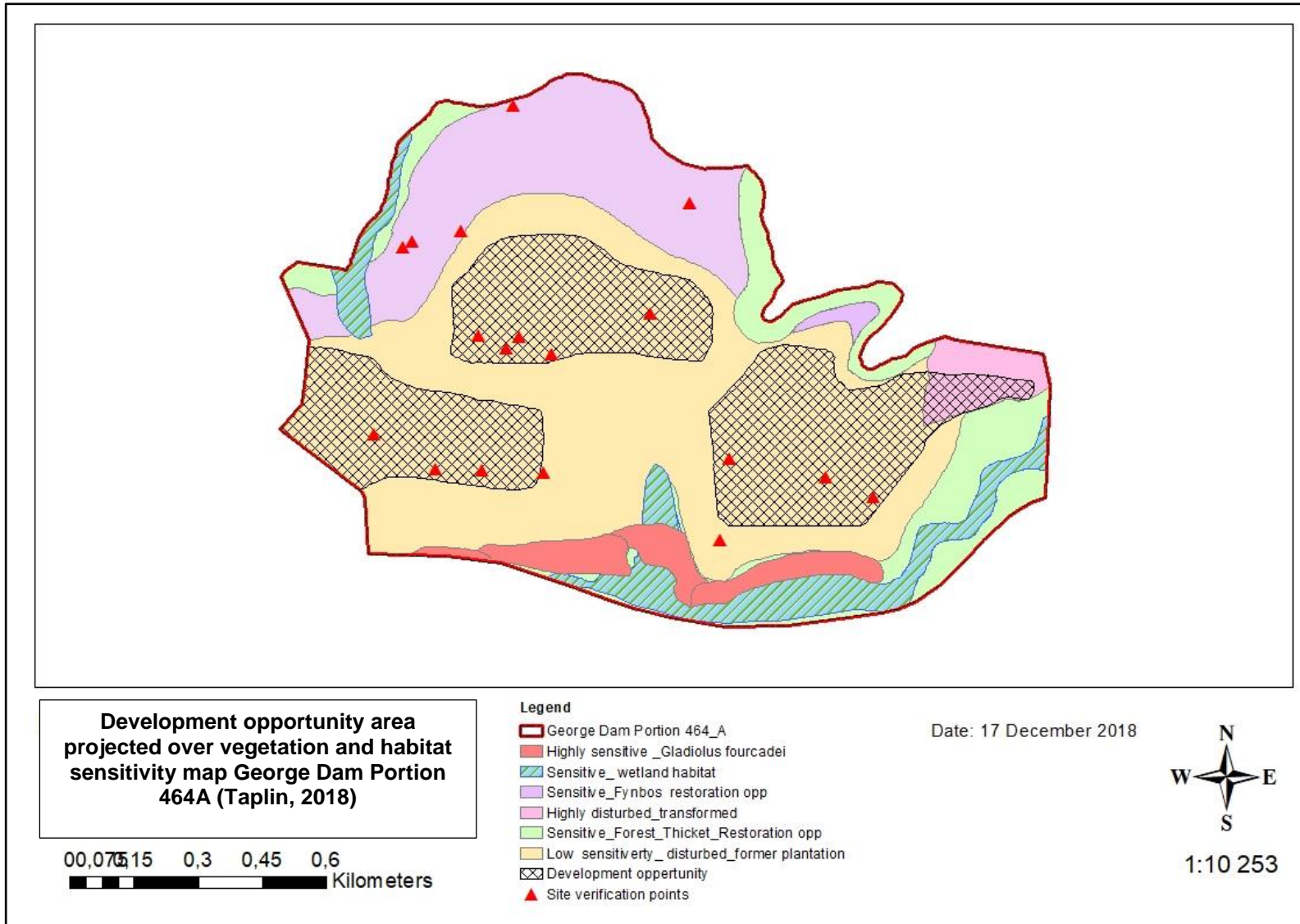


FIGURE 7: Development opportunity area projected over vegetation and habitat sensitivity map (Taplin 2018).

5. DISCUSSION

The study area consists of a formerly transformed landscape in which the original Forest and Fynbos vegetation was replaced by commercial pine tree plantations. In addition to this, the Garden Route Dam permanently replaced lower-lying valley floor and drainage line vegetation with an artificial water storage body.

With the (2005 - 2006) removal of the pine tree plantations, the entire study area vegetation was in a pioneer, or early, recovery stage when first surveyed in 2007 by Mr Coetzee.

When the study area was again surveyed in 2012, the former early pioneer vegetation had matured (over a period of 5 years), but still consisted of typical pioneer Fynbos vegetation and had become severely infested with alien vegetation. The areas of Forest / Thicket had also matured but were also more infested with invasive alien vegetation.

The most recent survey again highlights that the area has been exposed to constant disturbance and both the pioneer Fynbos and pioneer Forest / Thicket is still very much in a pioneer state. The area has experienced three fires since the first assessment, the most recent of which was in October 2018 and which burnt an estimated 40% of the total study site. The alien invasive plant situation has worsened. These alien invasive plants not only threaten biodiversity and reduce available water resources but also present an additional fire risk to the study area as well as the residential areas on the southern and western boundaries. It is clear that without a comprehensive suitable invasive alien management intervention, the entire area will soon be overrun with alien plants.

In summary, the study site has opportunity for both development and the conservation of biodiversity and landscape connectivity if developed suitably.

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APPENDIX 1

RED DATA LIST CATEGORIES FOR MAMMALS

(SOURCE: Friedman Y and Daly, B (editors) 2004. Red Data Book of the Mammals of South Africa: A conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa).

EXTINCT (EX)

A taxon is extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it is considered to be facing an extremely high risk extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment on its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

RED DATA LIST CATEGORIES FOR AMPHIBIANS

(SOURCE: Minter, L R; Burger, M; Harrison, J A; Braak, H H; Bishop, P J & Kloepfer, D (Eds) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series 9. Smithsonian Institution, Washington, DC.

EXTINCT (EX)

A taxon is extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it is considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it is

considered to be facing a high risk extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment on its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

RED DATA LIST CATEGORIES FOR BIRDS

(SOURCE: Barnes, K N (Ed) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

EXTINCT (EX)

A taxon is extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

REGIONALLY EXTINCT (RE)

A taxon is regionally extinct when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or disappeared from the region or, if a former visiting taxon, the last individual has died or disappeared from the region.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when available scientific evidence indicates that it is considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when available scientific evidence indicates that it is considered to be facing a very high risk extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available scientific evidence indicates that it is considered to be facing a high risk extinction in the wild.

NEAR THREATENED (NT)

A taxon which has been assessed but does not currently qualify for Critically Endangered, Endangered or Vulnerable, but is close to qualifying for or is likely to become Vulnerable in the near future. Also included here are taxa that are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

LEAST CONCERN (LC)

A taxon which has been assessed but does not qualify for Critically Endangered, Endangered, Vulnerable and does not qualify for Near Threatened.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment on its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.