4 SENSITIVITY ANALYSIS

4.1 Biophysical Environment

4.1.1 Fauna and Flora (Ecology)

The objective of this biodiversity screening assessment is to establish a reference point for the biophysical and biological sensitivities of the study area by means of the Ecosystem Approach or Landscape Ecology. The Ecosystem Approach is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

For the purpose of this particular study a local/ regional scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that cause disturbance to these attributes. In laymen's terms it implies that if sensitive habitat types/ ecosystems (frequently associated with biodiversity elements of high sensitivity or conservation importance) are protected, species that are highly sensitive to changes in the environment will ultimately be protected. Species conservation is therefore largely replaced by the concept of habitat conservation. This approach is regarded effective since the protection of sensitive ecosystems will ultimately filter down to species level.

It is inevitable that the Landscape Ecology Approach will not function effectively in all cases since extremely localised and small areas of sensitivity do occur scattered in the study area, which can not always be captured on available databases or might have been missed during the site investigations. In addition to the compilation of basic species lists and the identification and description of localised ecological habitat it was also regarded important to identify areas of sensitivity on a local scale and, where possible, communities or species that are considered sensitive in terms of impacts that are likely to result from the proposed development.

- ***Sensitivity Categories***

Subsequent to the preliminary delineation of ecological habitat types on available aerial images, a sensitivity value is ascribed to each unit, based on a selection of criteria that contributes to the ecological sensitivity or conservation potential of the particular habitat type. Sensitivity is placed in three categories, namely:

- **Low Sensitivity** - Associated with transformed habitat, not likely to contain biodiversity attributes of sensitivity, considered suitable for proposed development, expected impacts regarded to be of low significance, possible to mitigate through generic mitigation measures. The status of specific areas is also influenced by the presence of nearby sites of sensitivity;
- **Medium Sensitivity** - Associated with natural/ pristine regional habitat, moderate likelihood of harbouring species and habitat of concern, moderate suitability for proposed development. Even with careful site selection, expected impacts could be potentially significant, but possible to mitigate through site-specific mitigation measures and site selection; and
- **High Sensitivity** - Areas of atypical habitat, conservation areas, riparian and wetland habitat, known presence of plant species of concern, not regarded suitable for proposed development, expected impacts likely to be unacceptable on a local or regional scale, adverse impact not possible to mitigate

- ***Sensitivity Analysis***

In spite of certain limitations, this preliminary assessment is regarded sufficient to indicate areas where the proposed development is not expected to result in significant and severe impacts on the terrestrial biodiversity component. As a result of limited remaining natural terrestrial environment that remains on a local and regional scale, a particularly high premium is placed on these parts of the study area.

The preliminary sensitivity analysis revealed the presence of only High and Low sensitivity areas. The high sensitivity category is the result of the presence of certain biophysical attributes within the study area, including wetlands and wetland related habitat and remaining areas of natural grassland habitat that comprises the conservation statuses of Endangered and Vulnerable. The Low sensitivity category comprises all areas where natural habitat has been sterilised by agriculture, mining, road infrastructure or other land use categories that resulted in the complete transformation of natural grassland.

It should be noted that remaining areas of natural vegetation might not necessarily be in a pristine status. It is actually more likely that grassland is in a slightly degraded status as a result of high grazing pressure. Visual observations and previous investigations in the surrounding areas revealed that grazing plays an important role in the status of these grasslands, particularly since there is little left. Most of the remaining areas of natural grasslands are associated with drainage lines and hillslope seepages where cultivation is not particularly successful. While these areas are currently ascribed a high sensitivity value, this might be degraded to a medium-high, or even medium, status upon investigation. Furthermore, the wetland shapefile is not regarded detailed to a local scale, since it does not include lower categories of wetland habitat types such as seepages and smaller non-perennial streams and drainage lines.

It is therefore strongly recommended that areas where the terrestrial biophysical sensitivity is regarded as High, is excluded as suitable sites for the proposed development.

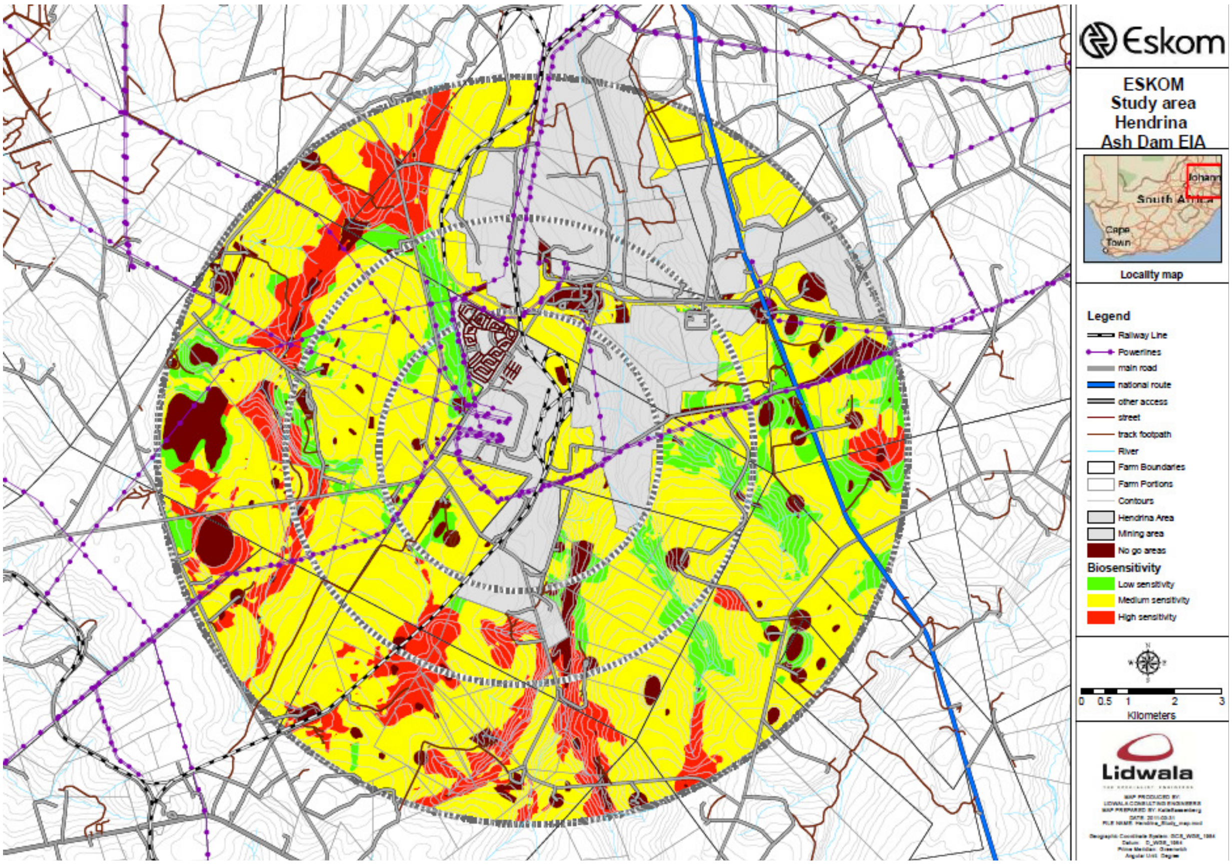

Figure 4.1: Preliminary biophysical sensitivities for the study area

4.1.2 Avifauna

Using various GIS layers, 1:50 000 topographical maps and google earth images, key features within the study area were identified and mapped using ARCGIS 9.3 and were assigned a sensitivity rating as is tabled below.

Table 4.1: Sensitivity analysis

Category	Description
Lower Sensitivity	Built up areas, roads, mines, existing ash dams, railway lines and high voltage power lines
Medium Sensitivity	Remaining cultivated lands and farm lands
Higher Sensitivity	Wetlands, rivers and streams, farm dams, CWAC sites,

In addition all Sensitivity areas were buffered as follows:

- 250m for high sensitivity areas
- 100m for high voltage Eskom lines
- 200m for sensitivity areas.

Many of the abovementioned Red Listed species preferred habitat that is grassland, wetlands, river courses, dams, all of which are prevalent in the study area. Key species which will be attracted to these areas include Greater and Lesser Flamingo, African Marsh-Harrier, African Grass Owl, Yellow-billed Stork, etc. Such areas have therefore been allocated as High Sensitivity areas.

Arable or cultivated land represents a significant feeding area for many bird species in any landscape for the following reasons: through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources readily accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. Arable lands are scattered throughout this study area, mostly planted to maize. Relevant bird species that will be attracted to these areas include most importantly the Black-winged Pratincole, Blue Korhaan, Denham's Bustard, Lesser Kestrel, White Stork and assorted non red listed species.

Cultivated lands have therefore been assigned Medium Sensitivity.

Areas assigned Low Sensitivity are all disturbed areas (built-up areas, mines, existing ash dams, roads, etc.) and are regarded as less important areas for avifauna. These areas are preferred for construction of the proposed Ash Dam.

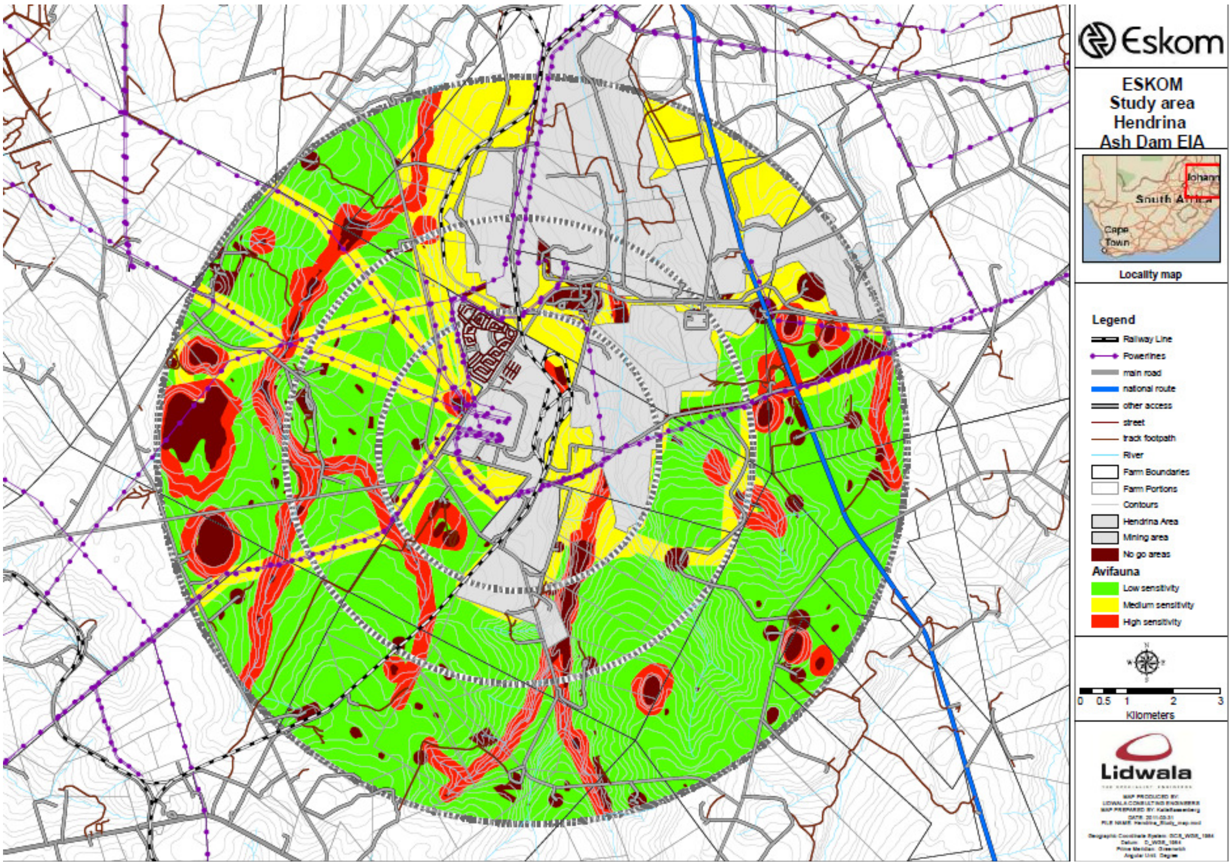

Figure 4.2: Avifaunal sensitivity map

4.1.3 Surface water

- ***Literature Review and Desktop Study***

A desktop study was undertaken to determine site location, applicable information with regard to the greater catchment area, associated ecoregions, nature of the drainage systems and overall catchment utilisation. References from Mucina and Rutherford (2006) and from the National Spatial Biodiversity Assessment (Nel *et al*., 2004) were used to study the surrounding area.

- ***Baseline data***

The following baseline data was used in mapping surface water hydrology associated with the study area:

- 1:50 000 river line shapefiles for quarter degree 2529 and 2629 obtained from the Surveyor General.
- South African Wetland Inventory shapefile obtained online from SANBI (2010). This dataset includes the permanent zone associated with channelled, un-channelled and pan systems in the study area (http://wetlands.sanbi.org/wfwet/resource.php).
- 90 m Shuttle Radar Topography Mission (SRTM) data was obtained from the USGS server (ftp://e0srp01u.ecs.nasa.gov/srtm/version2/SRTM3/).

- ***Terrain Analysis***

The following standard terrain analyses were executed on 90m STRM dataset:

- Pit removal by flooding to ensure hydraulic connectivity within the watershed.
- Computation of flow directions and slopes.
- Contributing area using single and multiple flow direction methods.
- Multiple methods for the delineation of channel networks including curvature-based methods sensitive to spatially variable drainage density.
- Objective methods for determination of the channel network delineation threshold based on stream drops.
- Stream ordering
- Delineation of watersheds and subwatersheds draining to each stream segment and association between watershed and segment attributes for setting up hydrologic models.
- Specialized functions for terrain analysis, including:
    - Wetness index

From the original terrain analysis the River Network Raster Function was obtained using the following inputs.

- Pit Filled Elevation grid (fel).
- D8 Flow Direction grid (p).
- D8 Contributing Area grid (ad8).
- Dinf Slope Grid (slp).
- Dinf Contributing Area grid (sca).
- Network Order grid (gord)
- Longest Upslope Length grid (plen)
- Verified Flow Path grid (fdrn)
- Outlets Shapefile

The raster output file was used with the SANBI wetland shapefile to reflect the additional areas of wetness and the general direction of flow (intermittent or continuous).

- ***Sensitivity analysis***

Although the Area of Contribution, as part of the terrain analyses, helped in identifying areas likely to present surface soil wetness and periodic water flow, no distinct method exists to identify and visually illustrate the presence of hillslope seeps. In a precautionary attempt to account for abutting hillslope seeps into first order drainage lines, a conservative 100m highly sensitive area was allocated to areas showing permanent surface wetness. The allocation of this zone was substantiated by the terrain analysis showing the Area of Contribution.

It is expected that the 100 m highly sensitivity zone will be consistent with areas showing temporary wetness (i.e. those areas showing hydromorphic soil and vegetation indicators typical of short annual periods of oxygen deprivation in the first 50 cm of the soil profile). According to DWAF (2005) guidelines, the entire area up to the edge of the temporary zone is part of the watercourse. This approach also holds true for riparian zones in the study area. The buffer zone is allocated as areas of medium sensitivity. The integrity and functioning of rivers are directly dependant on their surrounding land area, which includes the local catchment and terrestrial habitat immediately bordering the river (Dodds & Oaks, 2008; Environmental Law Institute, 2008).

The buffer width recommended for a particular area depends upon the conservation significance of the river, the purpose/function of the buffer, as well as the local setting of the wetland and the surrounding land use. In addition, Regulation 4 (a) set out in GN 704 of June 1999, under the National Water Act 1998 states that no person may:

> *"locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 meters from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked."*

In line with this regulation a 100 m Medium Sensitivity buffer zone was allocated from the edge of the High Sensitivity zone. Following from this, **Table 4.2** provides the screening requirements for the sensitivity analysis for the surface water systems.

Table 4.2: Sensitivity analysis applied in this study.

	Description
Lower Sensitivity	Higher lying areas, reflecting terrestrial soils and no obligate, facultative hydrophilic vegetation.
Medium Sensitivity	100 m buffer zone from the edge of the temporary wet zones, or the edge of the riparian zones.
Higher Sensitivity	100 m zone from the edge of the permanent wet zone for valley bottom and pan systems.

Figures 4.3 to **Figure 4.6** show the surface water hydrology and assigned sensitivity zones. River line shapefiles (1:50 000) often reflected a discontinuous channel network, not always showing potential watercourses in the study area. Subsequent river network terrain analysis (**Figure 4.3**) provided continuous representation of first and second order drainage lines. To show the lateral extent associated with each drainage line the SANBI Nation Wetland Inventory shapefile was used (overlaid in **Figure 4.3**). All areas that do not reflect a lateral extent, but where the longitudinal extent is represented by the river network are excluded from the sensitivity analysis and will require ground truthing at a later stage. Also, not represented by **Figure 4.3** are the hillslope seepage areas. These

areas classify as watercourses, and in an attempt to include probable hillslope seepage areas, a Contributing Area analysis was done, the results of which are shown in **Figure 4.4**. A conservative approach was applied by adding 100m to the edge of permanent wet areas as reflected in the SANBI Nation Wetland Inventory shapefile (**Figure 4.5**). This represents areas of high sensitivity.

Buffer zones are allocated to identified watercourses that act as an ecological protective zone to the riverine and riparian zones (refer to section 1.4 for more detail). The buffer zone is designated as areas of medium sensitivity (**Figure 4.6**). The integrity and functioning of watercourses are directly dependant on their surrounding land area (Dodds & Oaks, 2008; Environmental Law Institute, 2008). A medium sensitivity buffer zone can therefore be defined as an area of vegetation starting from the boundary of a watercourse and extending outward for a certain distance which is dictated by soils, terrain and plant species composition.

The roles of surface water buffers are diverse and can be summarised under the protection or continuation of hydrological, biological and socio-economical beneficiary processes associated with wetland and riparian areas. Well designed naturally vegetated buffers have the potential to perform the following functions (Environmental Law Institute, 2008):

- Reduce the amount of surface runoff into river habitat by increasing the available area for infiltration.
- Reduce the likelihood of river erosion by decreasing runoff velocities and flow concentration.
- Removing sediments and associated pollutants from surface water runoff, by assimilating, detaining and detoxifying (transforming) nutrients and contaminants from upland sources, especially non-source point pollution.
- Contribute to the temperature regulation and maintenance of microclimates in water bodies.
- Help to maintain and provide foraging, breeding and dispersal habitat for aquatic, semi-aquatic and terrestrial species.
- Function as corridors between different habitat patches, including terrestrial and wetland areas.