

# Biodiversity GIS Land Use Decision Support (LUDS) tool: A semantic web-based tool for environmental and biodiversity planning in South Africa

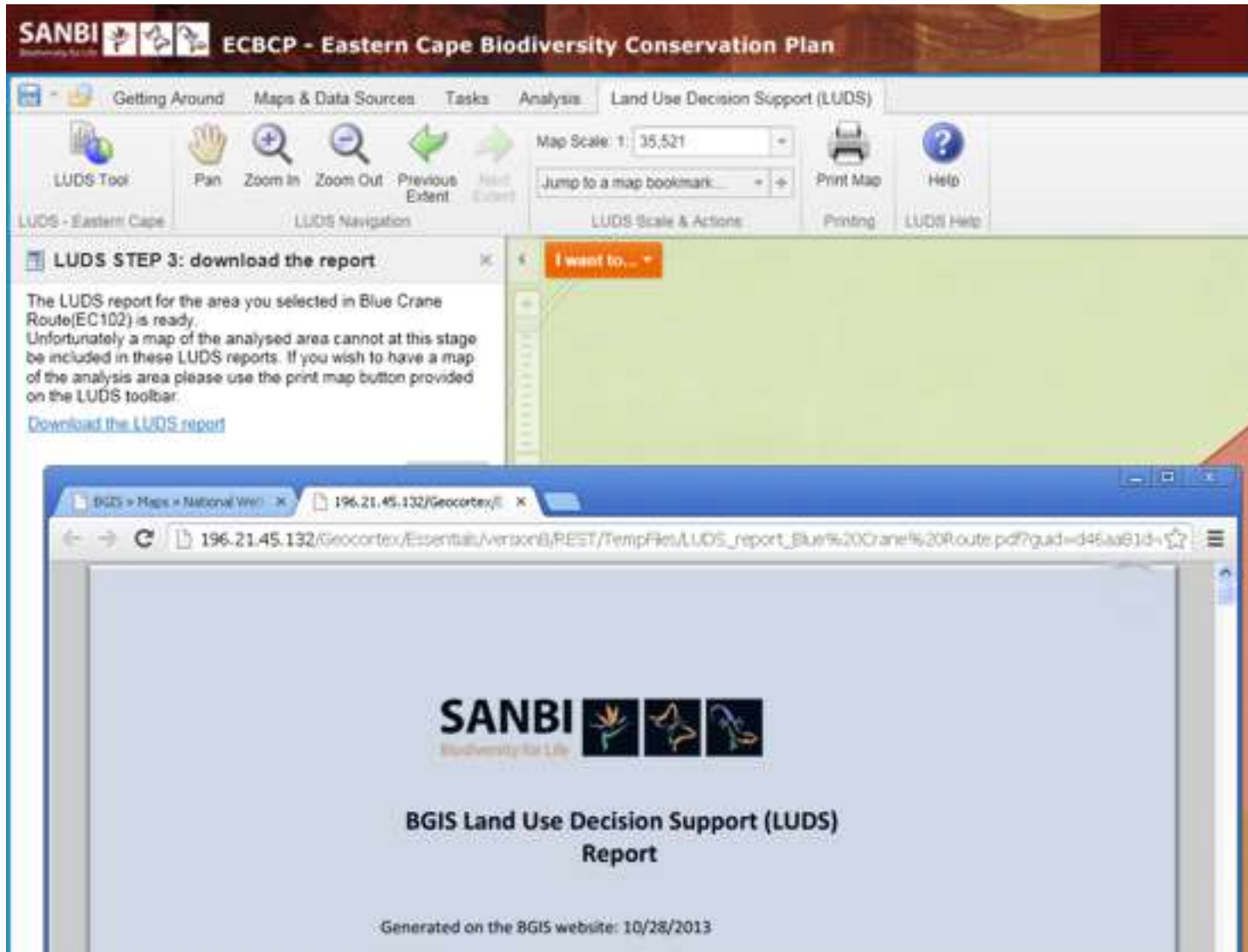
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University of the Western Cape

BIG thanks to Sediqa Khatieb, Fhatani Ranwashe & Fahiem Daniels.



UNIVERSITY of the  
WESTERN CAPE

# Recap of how user's LUDS tool experience



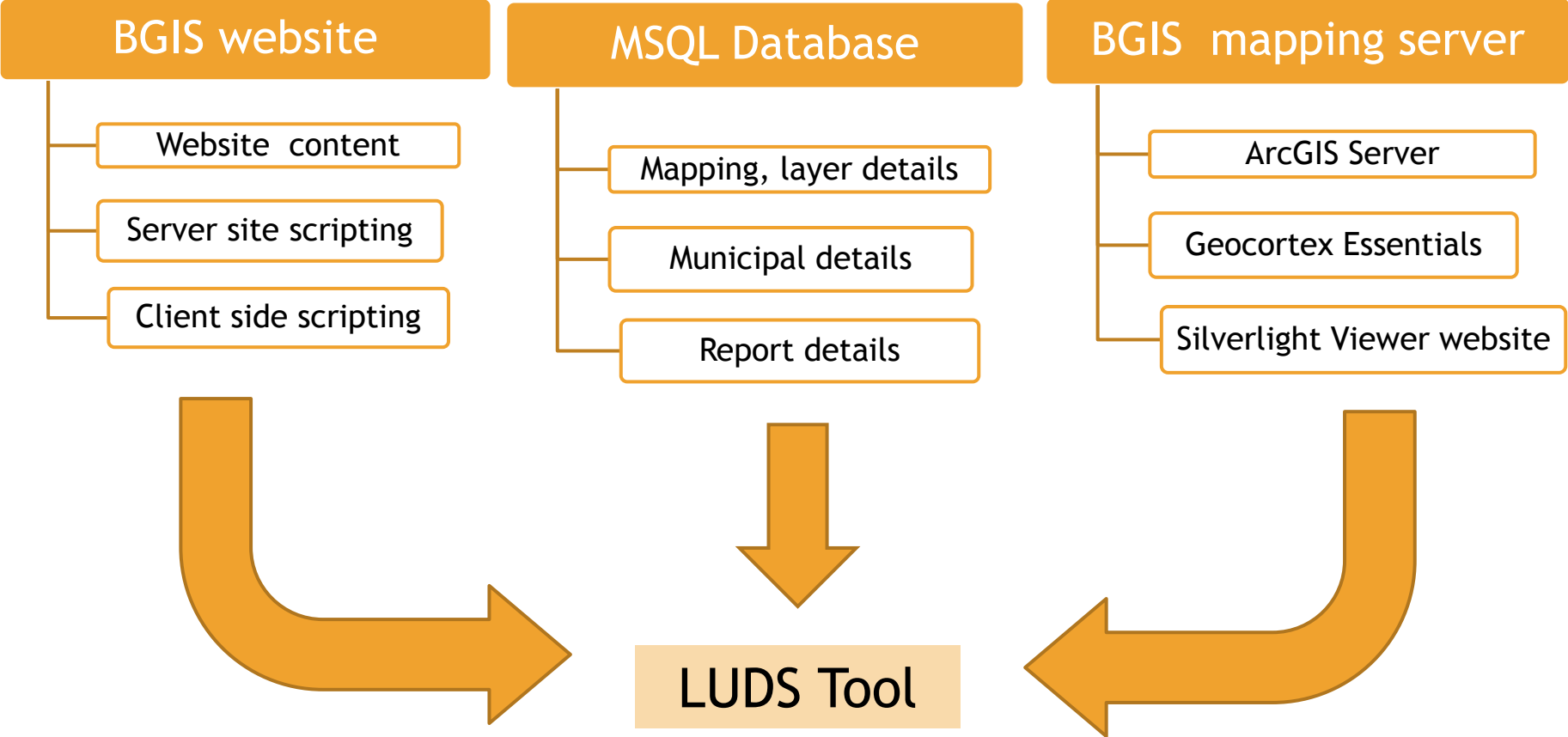
The image displays the user interface of the LUDS tool and a generated report. The top part shows the tool's interface with the title "SANBI ECBCP - Eastern Cape Biodiversity Conservation Plan". The interface includes a menu bar with "Getting Around", "Maps & Data Sources", "Tasks", "Analysis", and "Land Use Decision Support (LUDS)". Below the menu bar is a toolbar with icons for "LUDS Tool", "Pan", "Zoom In", "Zoom Out", "Previous Extent", "Next Extent", "Map Scale: 1: 35,521", "Jump to a map bookmark...", "Print Map", and "Help".

The main content area shows a window titled "LUDS STEP 3: download the report". The text in this window reads: "The LUDS report for the area you selected in Blue Crane Route(EC102) is ready. Unfortunately a map of the analysed area cannot at this stage be included in these LUDS reports. If you wish to have a map of the analysis area please use the print map button provided on the LUDS toolbar." Below this text is a blue link: "Download the LUDS report".

The bottom part of the image shows a browser window displaying the generated report. The browser address bar shows the URL: "196.21.45.132/Geocortex/Essentials/Version8/PEST/TempFiles/LUDS\_report\_Blue%20Crane%20Route.pdf?guid=d46ad81d...". The report content includes the SANBI logo and the text: "BGIS Land Use Decision Support (LUDS) Report". At the bottom of the report, it says: "Generated on the BGIS website: 10/28/2013".



# BGIS Online Mapping System architecture





# Features of Geocortex Essentials

## Geocortex Essentials Manager

Application Settings | Help | Logout | Sites | Security

Configure Site: *devEasternCape*

Save Site | Close Site

- Site
- Site info
- Map
- Layer Themes**
- Overview Map
- GIS Services
- Data Connections
- Print Templates
- Named Extents
- North Arrow
- Tables
- Workflows
- Permissions
- Viewers

### Layer Themes

Manage Layer Themes Include All Exclude All

ECBCP Terrestrial CBAs

<input type="checkbox"/>	Latitude-longitude grid squares (ArcGIS Dynamic Map Service)		
<input checked="" type="checkbox"/>	Eastern Cape biodiversity conservation plan boundaries (ArcGIS Dynamic Map Service)		
<input checked="" type="checkbox"/>	Towns and boundaries (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	Roads and railways (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	Contours lines (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	National river catchments (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	National rivers (NFEPA) (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	National wetlands (NFEPA) (ArcGIS Dynamic Map Service)		
<input checked="" type="checkbox"/>	National protected areas (ArcGIS Dynamic Map Service)		
<input type="checkbox"/>	National indigenous forest patches (NIFA) (ArcGIS Dynamic Map Service)		

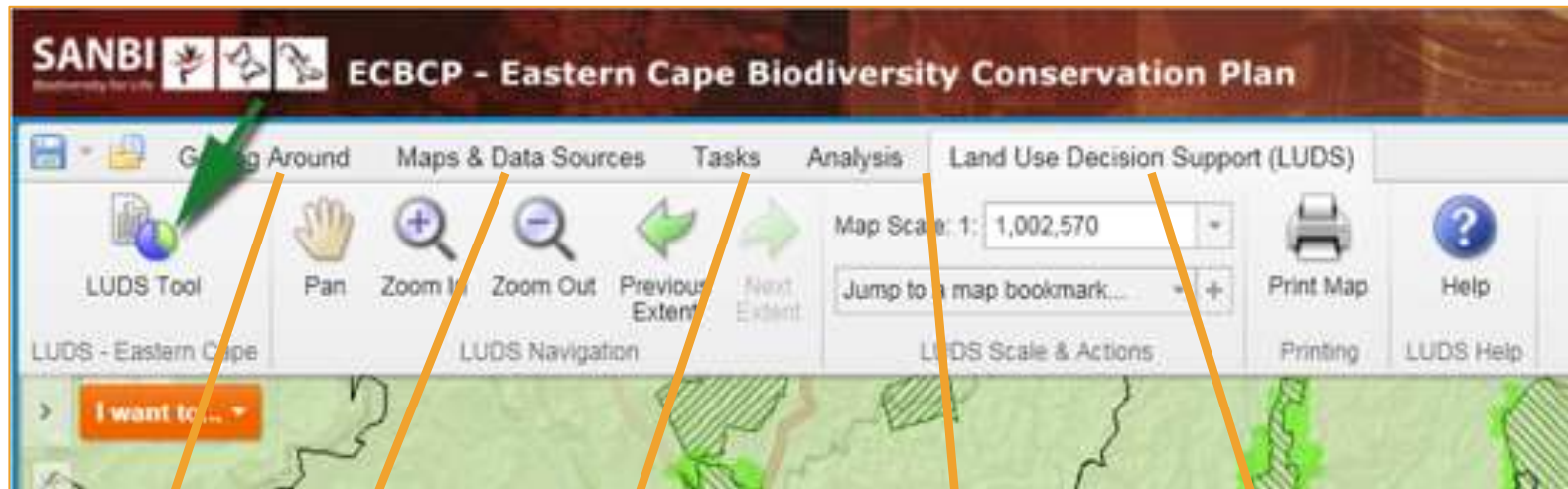
[Properties](#)

Apply Changes

Map Preview | Layer List Preview

Sources: Esri, HERE, DeL...

# Features of Geocortex Essentials Silverlight Viewer



Navigation tools  
e.g. panning and  
zooming

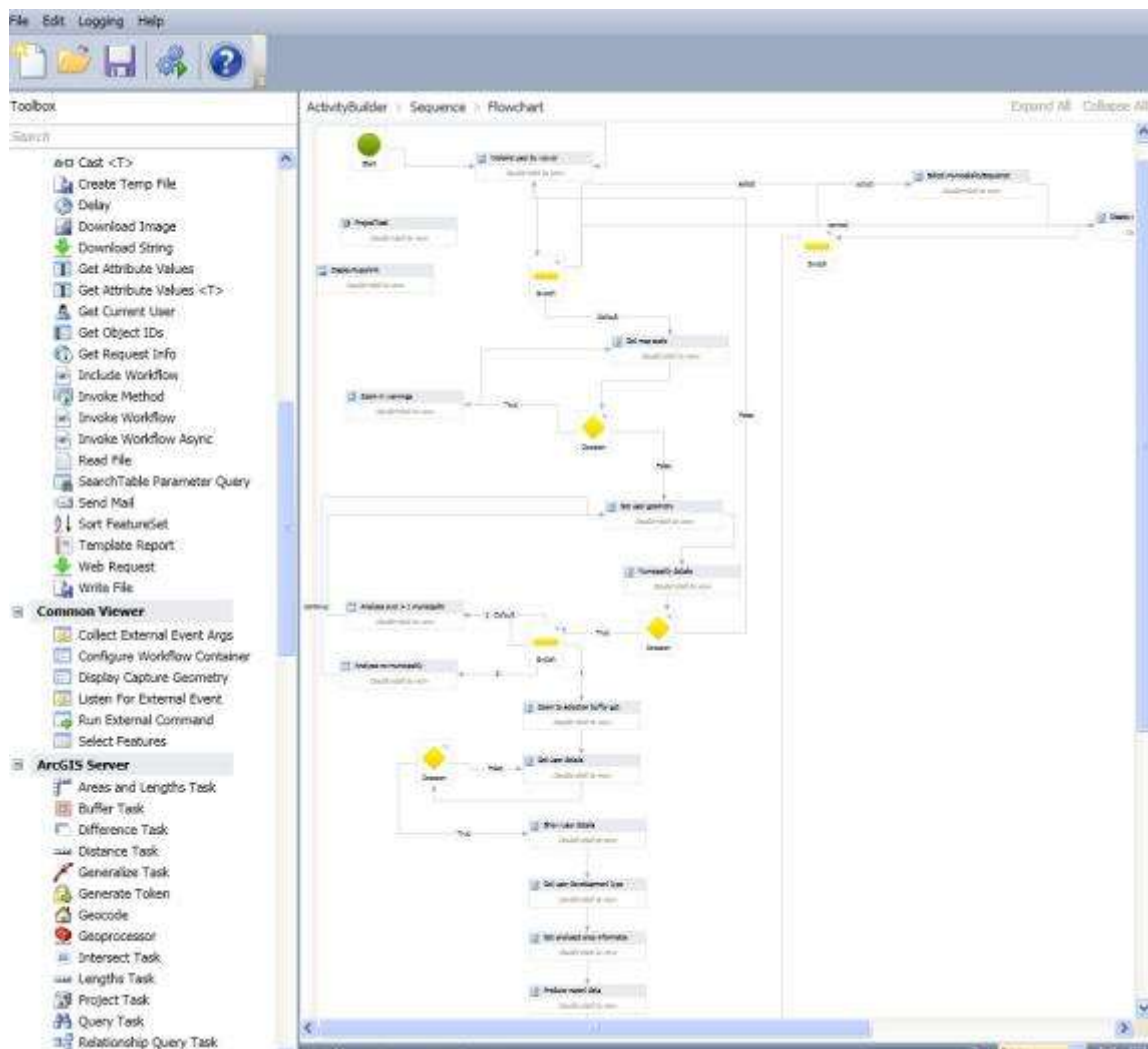
Task tools e.g.  
printing or adding  
markups

Data tools e.g.  
adding shapes or  
xy points

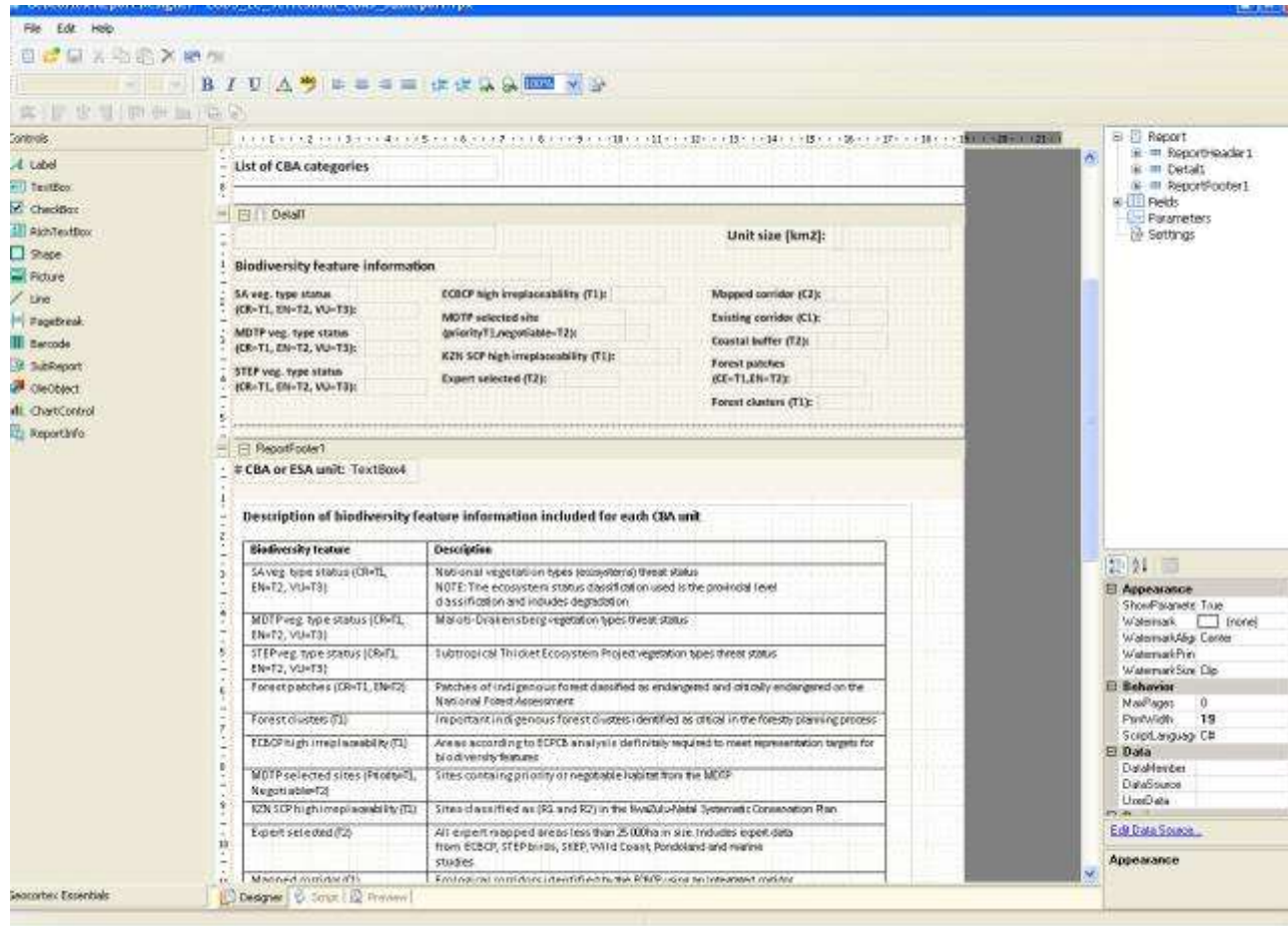
Analysis tools e.g.  
layer attribute or  
location  
identifications  
tools

Customised tabs  
and tools e.g.  
LUDS tab and tool

# Geocortex Essentials workflows: Guiding users through the steps of a GIS process



# Template reports: integrate GIS layer attribute data and information to interpret it



**List of CBA categories**

Unit size [km2]:

**Biodiversity feature information**

SA veg. type status (CR-T1, EN-T2, VU-T3): ECBCP high irreplaceability (T1): Mapped corridor (C2):  
 MDTP veg. type status (CR-T1, EN-T2, VU-T3): MDP selected site (priority T1, negotiable T2): Existing corridor (C1):  
 STEP veg. type status (CR-T1, EN-T2, VU-T3): KZN SCP high irreplaceability (T1): Coastal buffer (T2):  
 Expert selected (T2): Forest patches (CR-T1, EN-T2):  
 Forest clusters (T1):

**Description of biodiversity feature information included for each CBA unit**

Biodiversity feature	Description
SA veg. type status (CR-T1, EN-T2, VU-T3)	Natural vegetation types (ecosystems) threat status NOTE: The ecosystem status classification on used is the provincial level classification and includes degradation
MDP Veg. type status (CR-T1, EN-T2, VU-T3)	Makro-Bioikensberg vegetation types threat status
STEP veg. type status (CR-T1, EN-T2, VU-T3)	Subtropical Thicket Ecosystem Project vegetation types threat status
Forest patches (CR-T1, EN-T2)	Patches of indigenous forest classified as endangered and critically endangered on the National Forest Assessment
Forest clusters (T1)	Important indigenous forest clusters identified as critical in the forestry planning process
ECBCP high irreplaceability (T1)	Areas according to ECBCP analysis identified as definitely required to meet representation targets for biodiversity features
MDTP selected sites (Priority T1, Negotiable T2)	Sites containing priority or negotiable habitat from the MDCP
KZN SCP high irreplaceability (T1)	Sites classified as (R2 and R3) in the Iiyaziyo-Natal Systematic Conservation Plan
Expert selected (T2)	All expert mapped areas less than 25 000ha in size. Includes expert data from ECBCP, STEP birds, STEP Wild Coast, Pondoland and marine studies
Manned corridors (T1)	Ecological corridors identified by the RFRP as an important feature

# Creating LUDS tool 1: Getting the user's analysis area geometry

The screenshot displays the SANBI Addo Biodiversity Sector Plan Land Use Decision Support (LUDS) tool interface. The top navigation bar includes 'Getting Around', 'Maps & Data Sources', 'Tasks', 'Analysis', and 'Land Use Decision Support (LUDS)'. The main toolbar contains icons for 'LUDS Tool', 'Pan', 'Zoom In', 'Zoom Out', 'Previous Extent', and 'Next Extent'. The map area shows a green landscape with a red rectangular selection area and a purple line representing a municipal border. A dialog box titled 'LUDS STEP 2: Municipal border error!' is open on the left, with the following text: 'At the moment the LUDS tool will only analyse an area within a single municipality. You have selected an area which crosses a municipal border (indicated in purple on the map). Please click "Continue" to redraw your selection without crossing a municipal border.' A 'Continue' button is visible at the bottom of the dialog box.



# Creating LUDS tool 2:

## National layer content and workflow process

- Form part of all the LUDS tool reports
- GIS layer include:
  - Listed threatened ecosystems, National vegetation map, indigenous forest patches
  - Soils
  - Protected areas formal and informal
  - Aquatic information (NFEPA): wetlands, rivers and sub-catchments
- Workflow activities:
  1. Query each national layer in the relevant ArcGIS mapping service using user's geometry to create feature set
  2. Feature set translated to data table
  3. Data table added to LUDS report dataset
  4. Dataset amalgamated with sub-report template for each national layer which are combined into the main report templates
  5. Combined report data sent to a pdf report

# Creating LUDS tool 2: National layer content and workflow process

## 1. Information extracted from national datasets

The information below is extracted for the analysed area from national datasets available on BGIS. There is a short description of the dataset under each heading and the URIs to the webpage on BGIS with further information.

### 1.1. National terrestrial information

#### 1.1.1. National list of threatened terrestrial ecosystems

BGIS source: National list of threatened terrestrial ecosystems for South Africa (2011) – original extents

A list of all threatened ecosystem patches which original extent intersects the analysed area. Note: the data represents the original extents of the threatened ecosystems. In other words, natural areas which have been converted to agriculture, mining and urban areas have been included. Please view the area using the BGIS online map viewer Bing maps or Google maps tool in order to see whether any natural vegetation may still exist.

BGIS project overview and report: <http://bgis.sanbi.org/ecosystems/project.asp>  
BGIS download metadata and layer: <http://bgis.sanbi.org/ecosystems/map.asp>

Ecosystem Name	Code	Status
# threatened ecosystems: 0		

#### 1.1.2. National vegetation types

BGIS source: Vegetation Map of South Africa, Lesotho and Swaziland (Mucina & Rutherford 2006)

A list of all the national vegetation types the corresponding number of patches of each which original extents covered the analysed area. Note that this list is based on the estimated original extents of the vegetation types prior to any transformation. Please view the area using the BGIS online map viewer Bing maps or Google maps tool in order to see whether any natural vegetation may still exist.

BGIS project overview and report: <http://bgis.sanbi.org/vegmap/project.asp>  
BGIS download metadata and layer: <http://bgis.sanbi.org/vegmap/map.asp>

Instructions on how to find Mucina & Rutherford (2006) vegetation type descriptions using BGIS online map: [http://bgis.sanbi.org/vegmap/Veg\\_Map\\_instructions.pdf](http://bgis.sanbi.org/vegmap/Veg_Map_instructions.pdf)

The map code below refers to the short code used on the wall map and BGIS interactive maps which helps to accurately identify a vegetation type given the complexity of the map's legend colours.

### 1.2.1. Wetlands (NFEPA Wetlands/National Wetlands Map 4)

BGIS source: National Freshwater Ecosystem Priority Areas (NFEPA) Wetland Map/National Wetlands Map 4 and NFEPA wetland clusters

A list of all Wetland units found within the analysed area, should these belong to a wetlands cluster its information is also included. Wetlands and wetland clusters which were selected as freshwater ecosystem priority areas (FEPAs) are indicated. A key to the information codes used is given below.

BGIS project overview and report (National Wetlands 4/Wetland clusters):  
<http://bgis.sanbi.org/nfeпа/project.asp>  
BGIS download metadata and layer (National Wetlands 4/Wetland clusters):  
<http://bgis.sanbi.org/nfeпа/NFEPAmap.asp>

#### Wetlands

Wetland type	Description	Condition	NFEPA rank	FEPA status
# wetland units: 0				

#### Wetland clusters

Wetland cluster ID	Vegetation type	Wetland units	FEPA status
# wetland clusters: 0			

#### Key for NFEPA wetlands condition information codes

NFEPA condition	Description	% of total wetland area
AA	Percentage natural land cover > 75%	47
D	Percentage natural land cover 25-75%	18
DEF	Riverine wetland associated with a D, E, F or Z ecological category river	2
Z1	Wetland overlaps with a 1:50 000 'artificial' inland water body from the Department of Land Affairs: Chief Directorate of Surveys and Mapping (2005-2007)	7
Z2	Majority of the wetland unit is classified as 'artificial' in the wetland locality GIS layer	4
Z3	Percentage natural land cover < 25%	20

\* This percentage excludes unassessd wetlands, which includes those that have been irreversibly lost due to draining, ploughing and concreting.



# Creating LUDS tool 3: National layer template reports

ReportHeader1

River name	FEPA status	River type	Condition	Mainstem	Flagship

detail

ReportFooter1

# river units:

**Key for NFEP sub-quaternary catchment and river units information codes**

FEPA status	River types	River condition
Summarized FEPA status using a text description, where:  <b>FEPA</b> = freshwater ecosystem priority area <b>FISHFSA</b> = fish support area <b>FISHCORRID</b> = corridor critical for movement of threatened fish between habitats <b>PHASE2FEPA</b> = phase 2 freshwater ecosystem priority area <b>UPSTREAM</b> = upstream management area  In instances where several of these map categories overlapped, the status took the following order of precedence: "FEPA", "PHASE2FEPA", "FISHFSA" or "FISHCORRID", and then "upstream management area"	Used by NFEP which comprises:  the level 1 ecoregion number hyphen (-)  <i>followed by the flow</i> <b>N</b> = not permanent/flashy <b>P</b> = permanent or seasonal hyphen (-)  <i>followed by the geomorphological zone</i> <b>M</b> = mountain stream <b>U</b> = upper foothills <b>L</b> = lower foothills <b>F</b> = lowland river	Used by NFEP, A or B is considered intact and able to contribute towards river ecosystem biodiversity targets.  <b>A</b> = unmodified, natural <b>B</b> = largely natural with few modifications <b>AB</b> = A or B above <b>C</b> = moderately modified <b>D</b> = largely modified <b>E</b> = seriously modified <b>F</b> = critically extremely modified <b>EF</b> = E or F above <b>Z</b> = Tributary condition modeled as not intact, according to natural land cover

Report

- ReportHeader1
- detail
- ReportFooter1
- Fields
  - Bound
  - Calculated
    - Field1
    - Field2
    - Field3
- Parameters
- Settings

Design

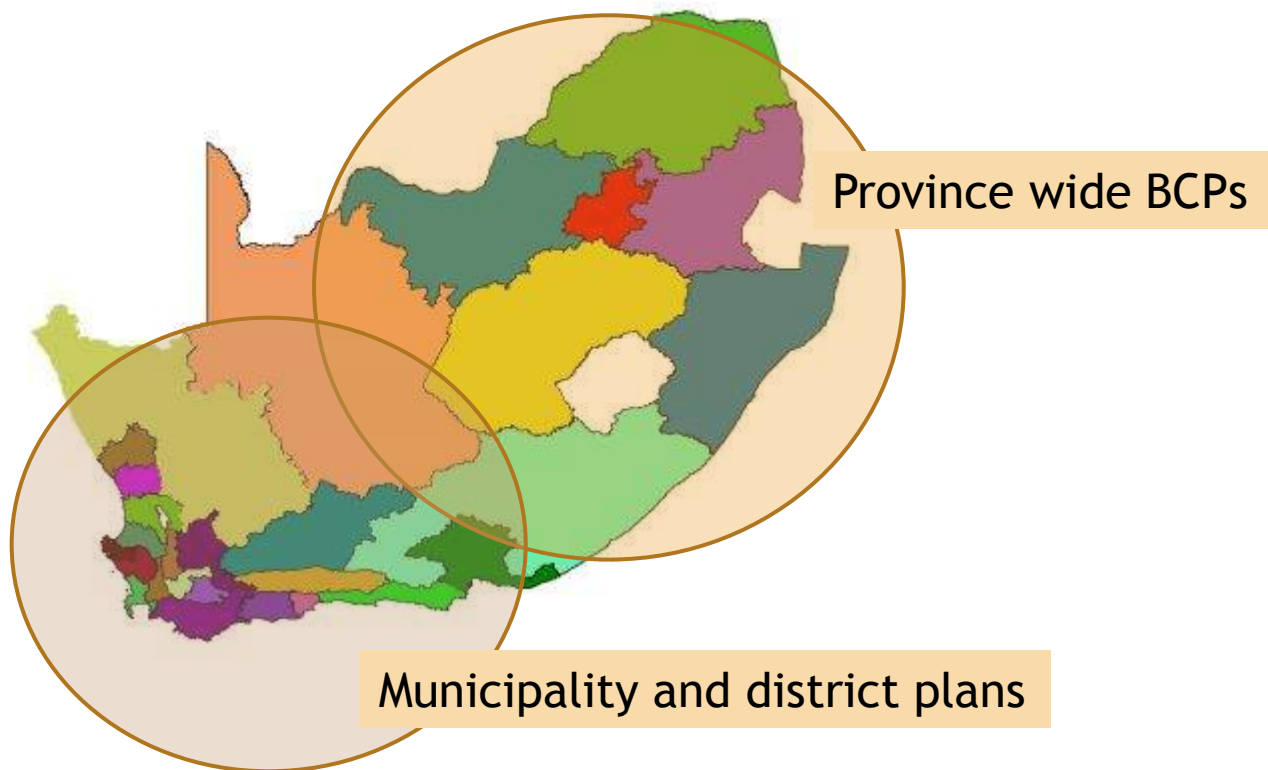
(Name)	Field2
--------	--------

Misc

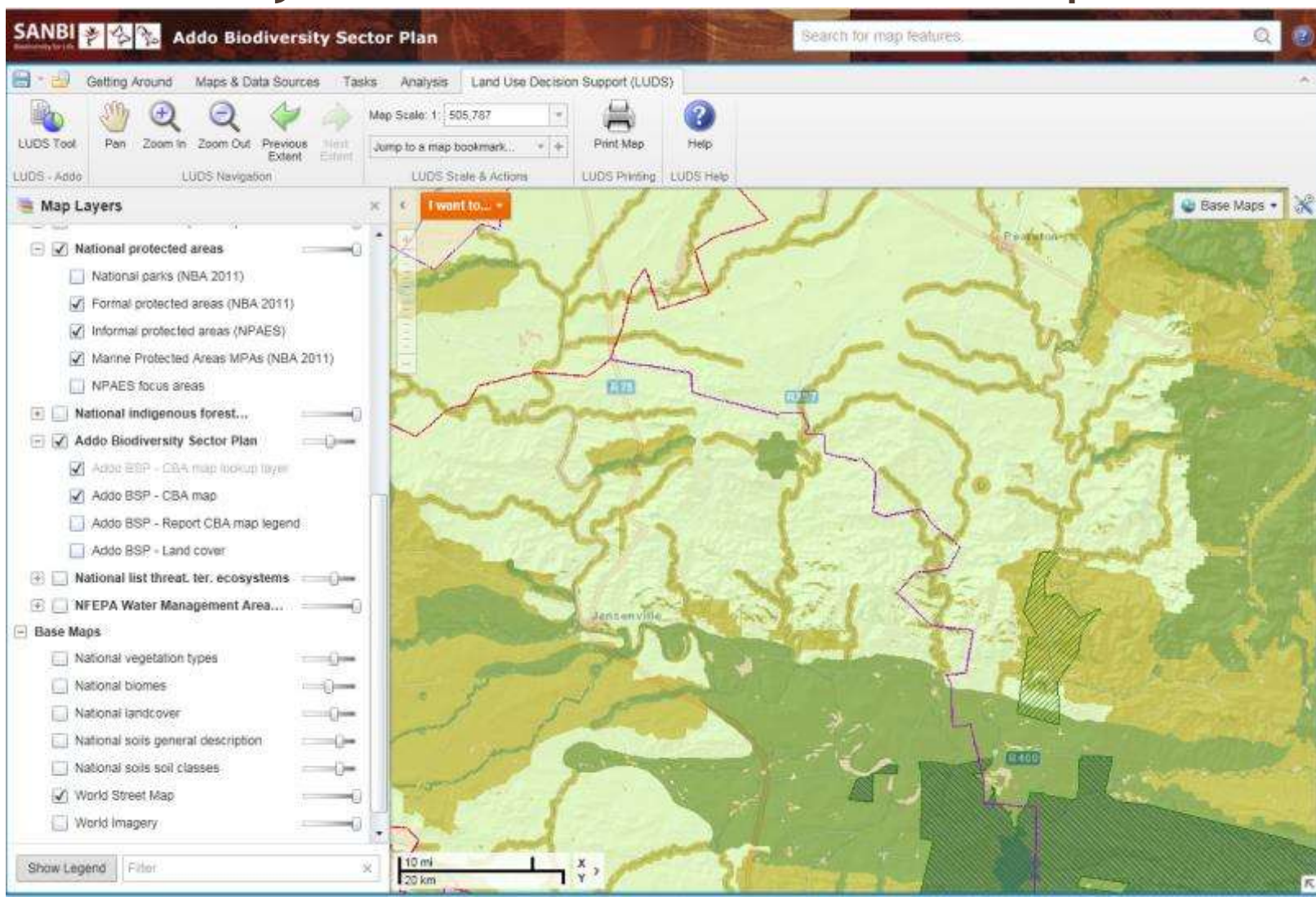
DefaultValue	""
FieldType	String
Formula	=(FFRFLAGSHP=="1"? "Yes":

# Creating LUDS tool 4: Biodiversity Conservation Plan (BCP) problem

Cover either province, district or part there of or municipality



# Creating LUDS tool 4 cont.: Biodiversity Conservation Plan LUDS map



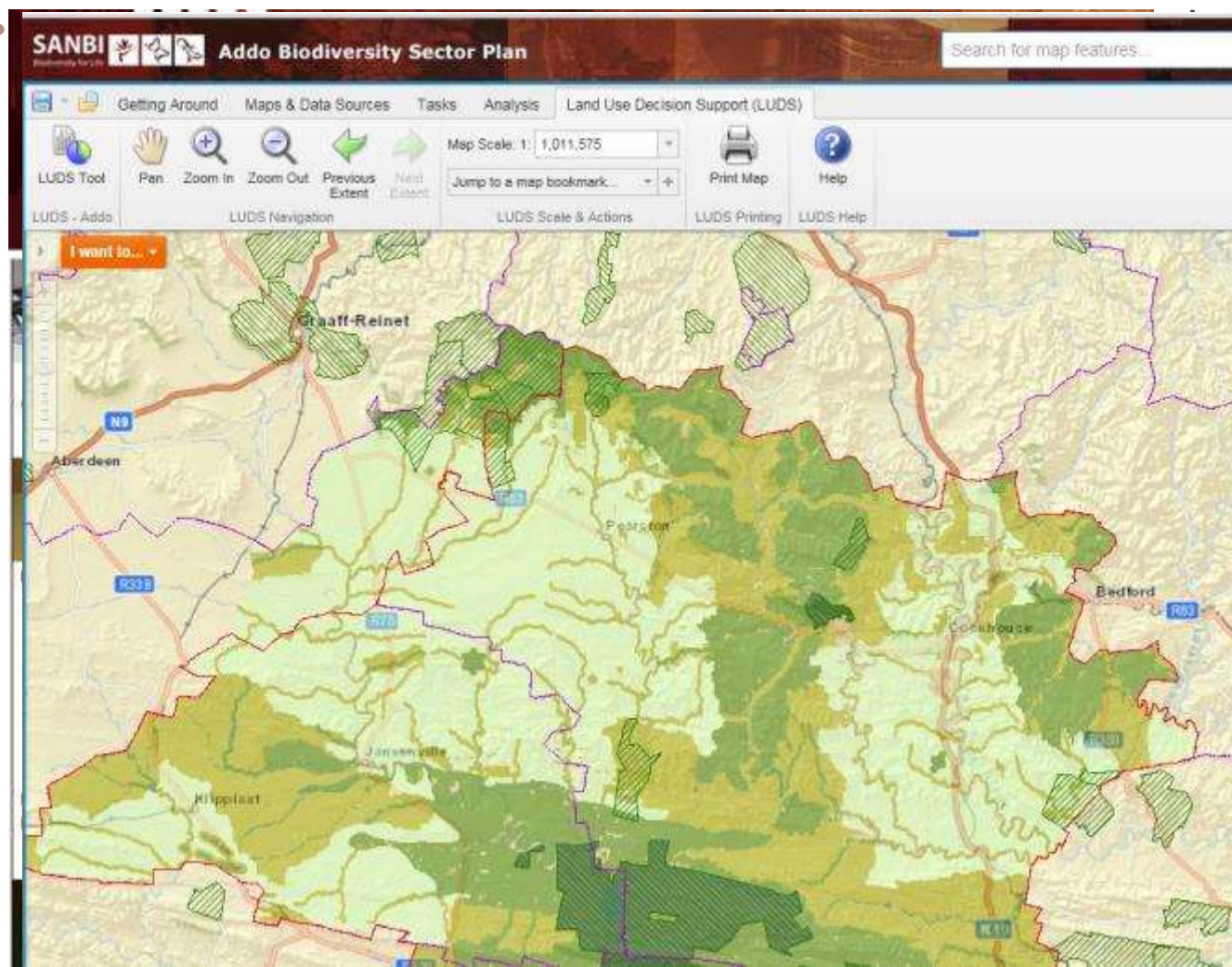
The screenshot displays the SANBI LUDS tool interface. The title bar reads "SANBI Addo Biodiversity Sector Plan". The main menu includes "Getting Around", "Maps & Data Sources", "Tasks", "Analysis", and "Land Use Decision Support (LUDS)". The toolbar contains icons for "LUDS Tool", "Pan", "Zoom in", "Zoom Out", "Previous Extent", "Next Extent", "Map Scale: 1: 505,787", "Jump to a map bookmark...", "Print Map", and "Help".

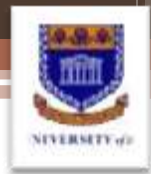
The "Map Layers" panel on the left is expanded, showing the following layers:

- National protected areas
  - National parks (NBA 2011)
  - Formal protected areas (NBA 2011)
  - Informal protected areas (NPAES)
  - Marine Protected Areas MPAs (NBA 2011)
  - NPAES focus areas
- National indigenous forest...
- Addo Biodiversity Sector Plan
  - Addo BSP - CBA map lookup layer
  - Addo BSP - CBA map
  - Addo BSP - Report CBA map legend
  - Addo BSP - Land cover
- National list threat. ter. ecosystems
- NFEPA Water Management Area...
- Base Maps
  - National vegetation types
  - National biomes
  - National landcover
  - National soils general description
  - National soils soil classes
  - World Street Map
  - World Imagery

The main map area shows a topographic map of the Addo region, with various colored overlays representing different land use and conservation zones. A scale bar at the bottom indicates 10 miles and 20 kilometers. The interface also includes a search bar at the top right and a "Show Legend" button at the bottom left.

# Creating LUDS tool 5: Finding the right LUDS map for a municipality





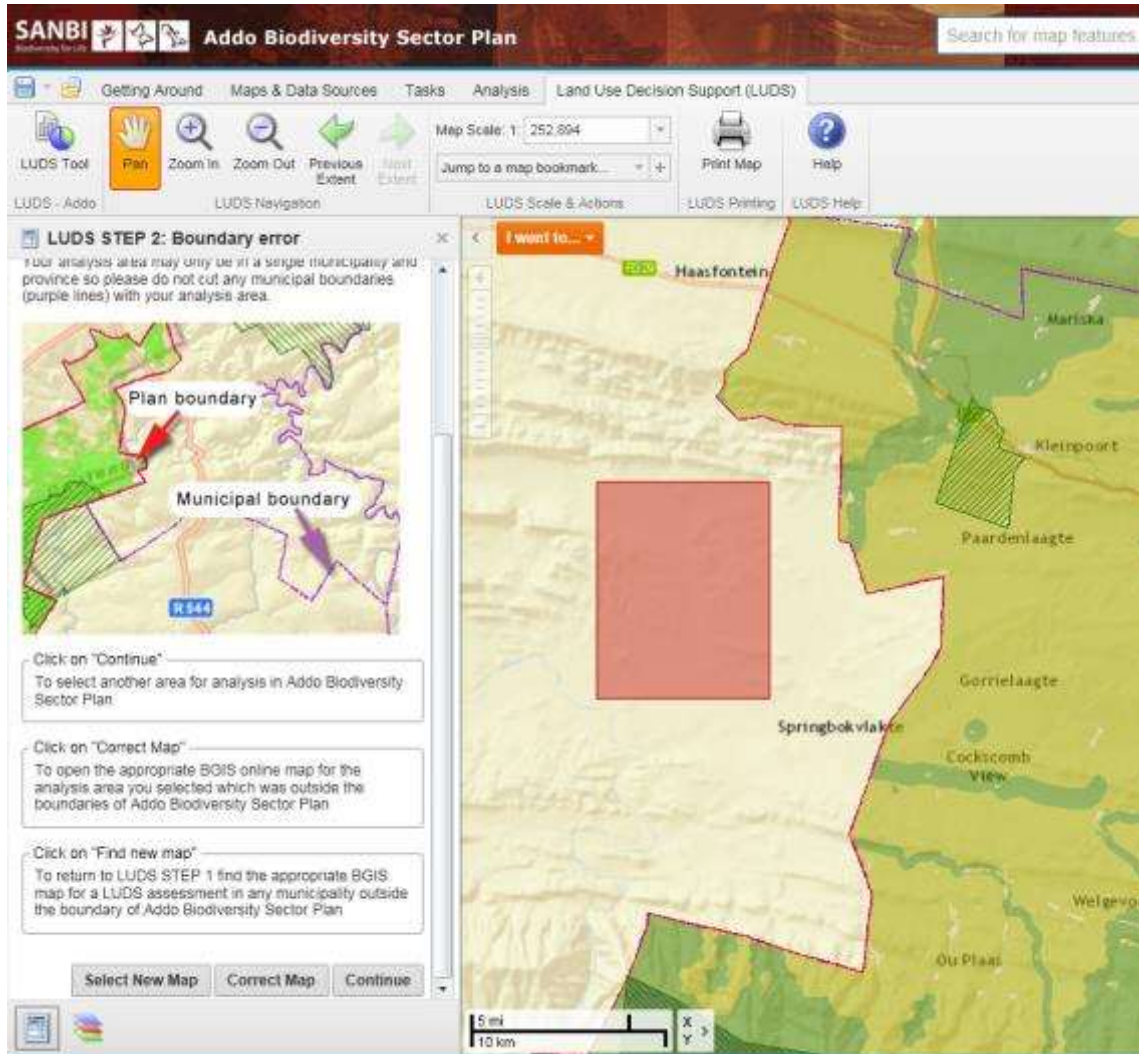
## Creating LUDS tool 6: Querying the most relevant BCP from the LUDS map

Workflow follows a unique path in each LUDS map

- In each LUDS map the workflow version is aware of its LUDS map ID as a constant
- This ID determines:
  - the GIS layers in the BCP ArcGIS mapping service which must be queried
  - the main report template which must be applied this contains the relevant BCP sub-reports templates for these layers.

Note: there is a different main report template for each LUDS map  
its BCP

# Creating LUDS tool 7: Keeping the analysis area within the BCP boundaries



**SANBI** Addo Biodiversity Sector Plan

Getting Around | Maps & Data Sources | Tasks | Analysis | Land Use Decision Support (LUDS)


Map Scale: 1:252,894

LUDS Tool | Pan | Zoom In | Zoom Out | Previous Extent | Next Extent

LUDS - Addo | LUDS Navigation | LUDS Scale & Actions | LUDS Printing | LUDS Help

### LUDS STEP 2: Boundary error

Your analysis area may only be in a single municipality and province so please do not cut any municipal boundaries (purple lines) with your analysis area.



Plan boundary

Municipal boundary

R344

I want to...

Haasfontein

Mariska

Kleinpoort

Paardenlaagte

Gorrielaagte

Springbokvlakte

Cockscomb View

Welgevond

Ou Plaas

5 mi | 10 km

X | Y

Click on "Continue"  
To select another area for analysis in Addo Biodiversity Sector Plan

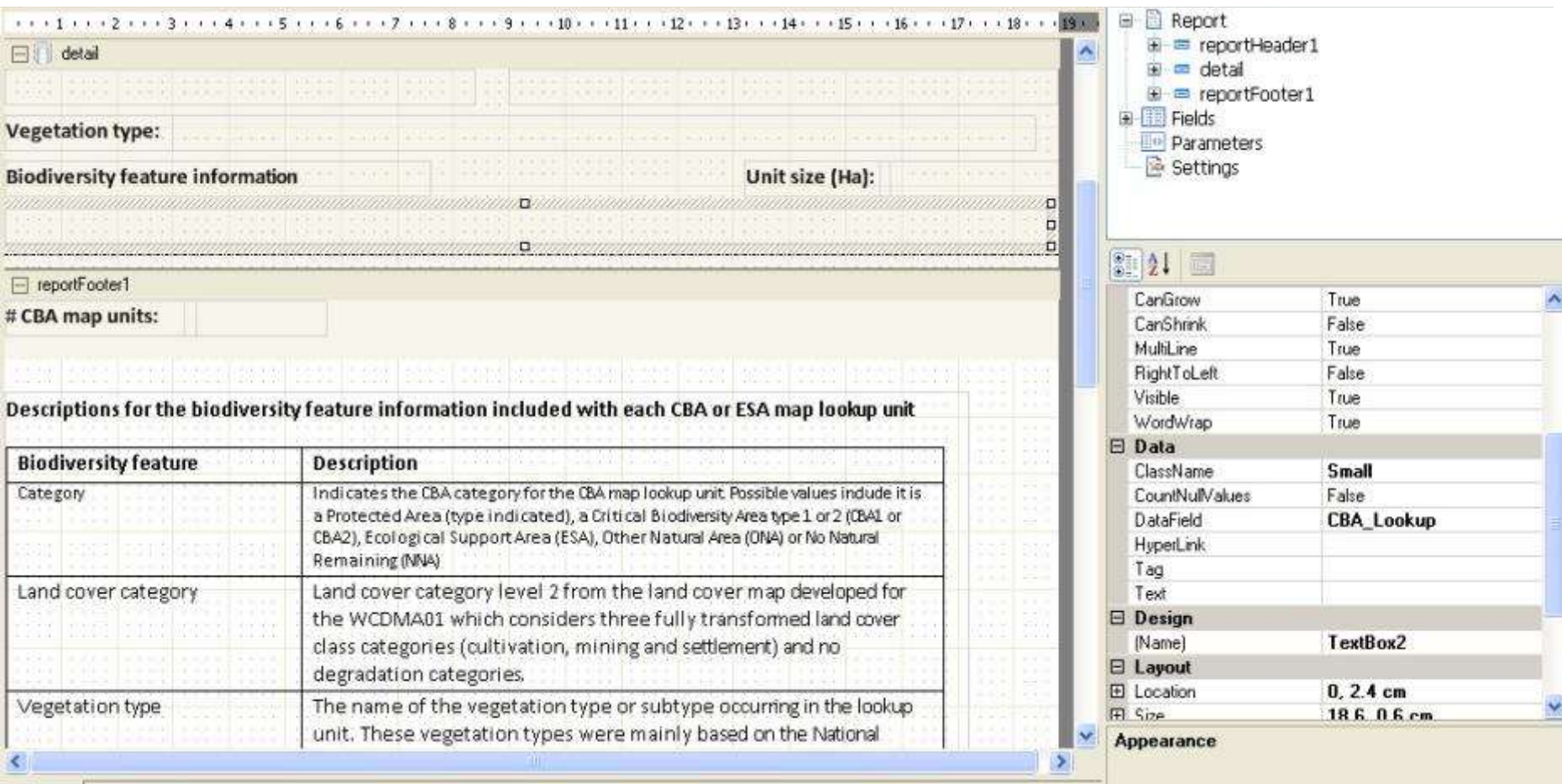
Click on "Correct Map"  
To open the appropriate BGIS online map for the analysis area you selected which was outside the boundaries of Addo Biodiversity Sector Plan

Click on "Find new map"  
To return to LUDS STEP 1 find the appropriate BGIS map for a LUDS assessment in any municipality outside the boundary of Addo Biodiversity Sector Plan

Select New Map | Correct Map | Continue



# Creating LUDS tool 8: BCP biodiversity feature reporting



The screenshot displays the LUDS tool 8 interface for creating a report. The main workspace shows a report design with a table titled "Descriptions for the biodiversity feature information included with each CBA or ESA map lookup unit". The table has two columns: "Biodiversity feature" and "Description".

Biodiversity feature	Description
Category	Indicates the CBA category for the CBA map lookup unit. Possible values include it is a Protected Area (type indicated), a Critical Biodiversity Area type 1 or 2 (CBA1 or CBA2), Ecological Support Area (ESA), Other Natural Area (ONA) or No Natural Remaining (NNA)
Land cover category	Land cover category level 2 from the land cover map developed for the WCDMA01 which considers three fully transformed land cover class categories (cultivation, mining and settlement) and no degradation categories.
Vegetation type	The name of the vegetation type or subtype occurring in the lookup unit. These vegetation types were mainly based on the National

The right sidebar shows the report structure and property settings:

- Report Structure:**
  - Report
    - reportHeader1
    - detail
    - reportFooter1
  - Fields
  - Parameters
  - Settings
- Property Settings:**
  - CanGrow: True
  - CanShrink: False
  - MultiLine: True
  - RightToLeft: False
  - Visible: True
  - WordWrap: True
  - Data**
    - ClassName: Small
    - CountNullValues: False
    - DataField: CBA\_Lookup
    - HyperLink:
    - Tag:
    - Text:
  - Design**
    - (Name): TextBox2
  - Layout**
    - Location: 0, 2.4 cm
    - Size: 18.6, 0.6 cm
  - Appearance**

# LUDS tool and the new municipal summaries information

- BGIS will be updated with any updated CBA map information
- The symbology for all layers used on the new Municipal Summaries maps will be adopted. Standard colours have already been applied for CBA map layer in LUDS maps
- LUDS tool will query the updated plan layers
- Municipalities will be updated to 2011 boundaries.
  
- NOTE: large changes in the Western Cape municipal boundaries 2011 with some municipalities that now fall into two plans

# LUDS tool conclusions

- User can enter area of interest in the form of various shapes
  - Integrate extracted data with necessary information for better understanding
  - Asynchronous extraction of data and report production (still to be added)
  - Very adaptable to the needs of any group of users.
- 
- BUT we should be aware of the amount of time it takes to integrate data and information to this level.