

NRSP: Peri-Urban Interface

R6880 ZE0050

***Development of Methods of peri-urban
natural resource information collection,
storage, access and management:
Interim Report***

GIS-based village level planning system

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Village Level Planning Case Study: Swedru

1. Background

Project R6880 is adapting information technology techniques, including RS (remote sensing) and GIS (Geographical Information Systems), to demonstrate improved methods of collecting, storing, accessing and managing natural resource and socio-economic information in the peri-urban environment of Kumasi, Ghana.

Part of the project has been concerned with determining and testing the most appropriate scales and types of remotely-sensed imagery from which to derive important peri-urban parameters. Another important aspect of the project has been to assess how best the remotely-sensed data may be used to involve local participants in the assessment of natural resource importance ranking and mapping. A further aspect of the project had been to investigate methods of collecting, storing and displaying socio-economic and qualitative information collected together with any natural resource information.

Another key component of the project is to develop a user-friendly information system for natural resource assessment and management for a wide range of potential users, partly to illustrate the importance of natural resource information collection and utilisation in the context of peri-urban development. It is felt that the key worth of natural resource and socio-economic information will only really be appreciated when integrated into a system which allows users to evaluate and rank the likely impact of development on these resources by running “what-if” scenarios and assessments.

The KUMINFO database (developed by the Kumasi Natural Resource Management project – R6799) currently stores a range of natural resource and socio-economic datasets and allows the user to display and overlay these datasets for any chosen area. KUMINFO has so far been developed with minimum analysis capabilities as detailed user requirements have not yet been specified. Planners (regional, district, city, town and environmental) are certainly one group of users who would derive much benefit from using a GIS such as KUMINFO.

As part of this project, we were concerned with the development of a prototype GIS application that showed how natural resource and other information may be used to evaluate possible development scenarios, where possible at a local level. One of the major applications of information that could be collected by methods derived in this project is planning. The KNRM project has developed applications at the regional planning level. We were keen to show how the type of information we have collected within this project may be useful to evaluate development options at a local level. One of the most important parameters of change in the peri-urban interface has been the allocation of land, in particular, the rapid conversion of agricultural land to housing. In order to illustrate the impact of potential new housing on a village community, we developed a prototype GIS application that showed areas suitable and not suitable for new housing (based on current planning guidelines), and allowed a relative

comparison of alternative new housing areas. We developed and applied it over the village of Swedru where a certain amount of research had already taken place, and for which a number of datasets had already been collated. The application is illustrative of the sort of system that may be available if data for other villages are analysed. The interface has been developed in such a way that ultimately, after testing and further refinement, it could be integrated into the main KUMINFO system, and used in other areas where the data could be collated.

This planning application was designed after discussion and consultation with other projects within the RNRRS Programme, in particular the Kumasi Natural Resource Management Project which included a large component of planning (by Keith Williams, Nottingham University). Although a specific user requirement study was not carried out with village planners in Ghana, both teams on the above projects contributed their knowledge and experience of the planning process to help design a prototype system. The detailed nature of the text in this report and its appendices and figures enables it to be used as a manual and training guide for the prototype application as well as an interim report.

2. Village-Level Planning

A workshop on *Information Needs for Planning* was held in Kumasi on 28 September 1998. This workshop, attended by development planners, town and planning officers, and a number of academics from UST, had the following objectives:

1. disseminate material on planning and aspects of the Village Characterisation Survey (VCS) likely to be of value to planners;
2. publicise KUMINFO;
3. invite feedback on planners' information needs; and
4. determine planners' willingness to become active suppliers and users of KUMINFO.

The main priority for village-level planning addressed during this meeting was the need for a detailed base map at 1:2,500 scale showing individual buildings and land use information. These base maps could indeed be prepared from the Aerial Digital Photographic (ADP) images flown over Kumasi in December 1997 by Bath Spa University College (Koh and Edwards, 1997). This survey covered a total area of 290 sq.km., consisting of 1360 images at a nominal resolution of 23 cm. When these images are geo-corrected and resampled to 1m resolution they are at a scale suitable for the preparation of village layouts and for surveying natural resources and agricultural land.

It is important for town planners to have detailed contours overlain onto the 1:2,500 base map in order to know where steep slopes are and to highlight areas prone to flooding. The ideal contour interval is 5-10 feet. The slope maps which are used in this planning application have been derived from a 1:50,000 contour coverage with a 50 feet interval. This level of detail is clearly not sufficient for actual village planning and layout preparation but is adequate for illustration purposes.

Other data required for village level planning include:

1. land use plots and ownership;
2. some indication of land value and land pressure (perhaps in terms of soil fertility and fallow/non-fallow period);
3. the extent of the village boundary;
4. the distribution of resources such as woodland, sand winning sites and water supplies;
5. population density; and
6. up-to-date roads, tracks and footpaths.

Town and country planners currently should adhere to two documents detailing planning standards in Ghana:

- Evolution of Planning Standards, this contains a section on Standards for Planning within a Rural Setting (*i.e.* villages with populations of 2,000 to 10,000)
- Planning Standards for all Settlements in Ghana. The Housing Section refers to designated residential neighbourhood areas with a catchment population of between 5,000 and 15,000 persons. According to this document, “settlements with populations below 5,000 persons each will be grouped together where distances between villages are less than 5 km, and regarded as a neighbourhood and provided, at a central location, with all the basic community services”.

Although Swedru’s population is currently less than 2,000 we have assumed that it is a Rural Setting rather than being amalgamated with other villages to create a residential neighbourhood. The planning criteria used in the planning application (Section 5) *i.e.* that a house should be a minimum distance of 150 ft and a maximum distance of 0.25 miles from a public toilet, is therefore applicable only to a Rural Setting.

3. Case Study: Swedru

Swedru was chosen to demonstrate this planning application for a number of reasons:

1. ADP imagery had already been processed to mosaic form;
2. Swedru had been used as one of the PRA (Participatory Rural Appraisal) villages undertaken by the Kumasi Lead Research Team;
3. Cranfield University (Silsoe College) had already collected data during their field visit in March 1998.

One aim of the Cranfield University (Silsoe College) field visit was to test, in the field, the application of large-scale ADP derived image maps for collecting natural resource and socio-economic data in the context of a Village Characterisation Survey (VCS). Various groups of villagers (the Chief and village development committee, women, and young men) were asked to interpret this false colour image and try to

locate notable features and landmarks around the village. This they achieved with varying degrees of success (Thomas *et al.*, 1999).

Swedru is located in Kwabre district and lies approximately 14 km north of Kumasi city. The current population is estimated around 1500 (Blake *et al.*, 1997.) with the majority of inhabitants engaged in farming or farm-related activities. More than 90% of the farmers have farms in the village. Major crops grown are food crops such as cassava, tomatoes, okra and maize. Vegetable crops are becoming very popular due to the proximity of the Kumasi market and recent improvements in the road network.

The major change in the village over the past decade has been the expansion of new housing. Figure 1 shows the large area of new housing, which has more than doubled the village extent over the last five years and encroached on lands suitable for food crops. Backyard gardens (mainly planted with plantain) are common around these new houses, often as areas “staked out” by people planning to build on them.

A village layout plan is still being developed by the regional Town and Country Planning Department. The chief has the right to allocate land for development so any prospective housing developer must first inform him.

4. Datasets

Many of the datasets used in this application were derived by interpreting the ADP image map for Swedru, using local knowledge from the villagers during the field trip in March 1998, and described more fully in Thomas *et al* (1999).

4.1 ADP Image Mosaic

The ADP image is shown in Figure 2. It is a false colour composite of several ADP images overlaid on a SPOT panchromatic image. Although each ADP image has a nominal resolution of 23cm, the composite was made at a resolution of 1m. Its characteristics are more fully described in Thomas *et al* (1999).

4.2 Built Environment

A map showing the “built environment” of Swedru (Figure 3) was created prior to visiting Swedru by tracing over a 1:3,500 scale image hardcopy. This was later amended and improved by using the villagers’ local knowledge during a walk around the village. Features such as boreholes, churches, schools, cemeteries, sacred groves and houses were identified and labelled. Villagers also contributed the approximate period of housing thus allowing the age of the housing and therefore the growth of the village to be mapped (Figure 1). The image interpretations which were initially made on hard copies were then digitised into ArcView. The actual datasets produced are in ArcView shapefile format and are named as follows:

houses.shp

Polygon theme categorising the houses within Swedru according to age. The classes are as follows:

ID	Description
1	Houses built in the last 5 years
2	Houses built 1920-42
3	Houses built 1920-63
4	Oldest house 1920
5	Chief Mawere Poku's house
6	Houses being rebuilt

schools.shp

Polygon theme describing type of school and comprising five polygons as follows:

ID	Description
1	Middle level
2	New middle level-being constructed
3	Upper primary
4	Lower primary
5	Kindergarten

refuse.shp

Polygon theme showing the location of the village refuse tip.

sacred.shp

Polygon theme showing the location of the sacred grove.

townfeat.shp

Polygon theme describing various town features. There are five polygons as follows:

ID	Description
1	Originally used as a playing field- current use uncertain.
2	Christian cemetery
3	Toilets
4	True Faith Church
5	Methodist Church

borehole.shp

Point theme showing the distribution of the three village boreholes .

These datasets may be displayed using the Display menu on the village planning interface (see Appendix A).

4.3 Land Use

The land use datasets used in this planning application and shown in Figure 4 were also interpreted from the ADP mosaic. Although these datasets have not been fully

verified in the field they nonetheless demonstrate the value of land use data for the planning process and show how such data may be integrated into the GIS application.

Because of the way that the interpretations were made and digitised, there is a separate shapefile for each land use class as shown in the table below.

<i>Shapefile Name</i>	<i>Description</i>
bushfall.shp	Bush Fallow
year1agr.shp	Year 1 Crops
year2agr.shp	Year 2 Crops
wood.shp	Woodland
riv_veg.shp	Riverine Vegetation
villbound.shp	Village Boundary
sacred.shp	Sacred Grove
roads.shp	Roads

These datasets may be displayed using the Display menu on the village planning interface (see Appendix A). In more conventional image interpretation exercises, a single layer of several land use classes may be expected.

4.4 Slope

The slope theme was derived from a digital elevation model (DEM) of the Swedru area, which in turn was generated from contours taken from the 1:50,000 topographic basemap. The resolution of the elevation model is only 50 feet. The DEM and derived slope map are shown in Figure 5. For real planning applications, more precise elevation data would be essential.

4.5 Rivers and Drainage

The stream and river network was taken directly from the existing 1:50,000 topographic base maps. Those streams and rivers within the Swedru village boundary were then edited and updated by referring to the underlying ADP image. The resulting shapefile is used to generate a buffer zone around rivers within which no development should take place (according to the planning guidelines).

The value of this dataset, in the planning assessment scenarios, could be improved further by using local knowledge to label streams according to whether they are seasonal or perennial and to note their importance as a source of water supply to the village.

4.6 Other Datasets

Other datasets collected during the field survey, although not used directly in the planning application, have also been incorporated into the Swedru case study. These are mainly qualitative in nature and are not georeferenced in the same manner as a traditional map or image map. Examples include the PRA sketch map drawn up by the villagers, photographs taken in the field, and diagrams. These datasets are integrated

into the GIS by a technique known as *hotlinking* which basically attaches any scanned maps and photographs to a spatial feature *i.e.* a point, line, or polygon. When the user clicks on that feature then the attached map or photo is opened up for display in a separate window. The inclusion of these serves to illustrate how qualitative information in different formats (sketches, photos, textual files, etc), may be attached to areas they concern so that the user (planner) may access them and assess their importance as appropriate.

Several digital photos were taken of key features in the built environment around Swedru but only nine are included here for reference. Four of these are shown in Figure 6 linked to the points they were taken from on the Swedru map.

5. Overview of Village Level Planning Procedure using the GIS

This application takes the planner through the various steps necessary to assess the effects of siting one or more new housing developments in the village. The procedure is as follows:

- show constraints to development;
- define polygon(s) for new development area;
- generate a report;
- assess and compare new development options.

The first stage, then, is to show all constraints to development. The constraints have been included from the planning guidelines, but their parameters are largely user-defined. For example, the planning guidelines state that building should not be carried out in too steep slopes, so the application includes the ability to shade in the areas above a certain slope, with a possibility for the user to enter the value of slope that he wishes to view. Similarly the application allows the user to mask out areas within a certain distance of a stream or river, and the user can enter the particular distance (in feet or metres). The user can then combine constraints. As an example, Figure 7 shows the amalgamation of three constraints: (i) slopes of more than 6 degrees; (ii) areas within 50 ft of a river or stream, and (iii) areas within 100 feet of a sacred grove.

Once the constraints have been calculated and displayed, the next stage is to define an area on the screen corresponding to the proposed new development. The user does this by digitising the outline of the polygon using the mouse. The polygon is given a system-defined ID and the user may also add a short description which is useful for labelling purposes. More than one new development polygon may be defined at this stage. Figure 8 shows four hypothetical new development areas which have been defined for Swedru.

Having digitised several options for development the system can calculate and let the user compare the impact of each of the new development areas on such issues as loss of agricultural land, distance to nearest facilities, *etc.* A report is produced for each new development area which gives:

- total area (sq.ft) ,

- composition of current land uses,
- average elevation,
- distance to nearest feature such as roads or rivers, and
- minimum and maximum distances to nearest water supply, toilet facility, and various categories of school.

The latter is compared with planning guidelines laid down by town and country planners for villages in a Rural Setting (see Section 2). By comparing these distances to those in the recommended planning guidelines it will be obvious when a proposed new site fails to meet the minimum and/or maximum distance criteria.

Appendix B contains the reports produced for the four new development areas shown in Figure 8.

The final stage then is to show, in chart format, the land use composition for each of the new development areas (Figure 9).

A more detailed guide to using this planning application is given in Appendix A.

6. Conclusions and Recommendations

This application has been designed as an illustrative first-stage example of how the planning procedure at village level may benefit from using a simple GIS interface to assess, plan and monitor village growth and development. The procedure should be presented to potential users in Ghana and feedback invited. The application may then be further refined through addition of relevant datasets and/or modifications to the interface design and analysis procedures.

Conclusions/Recommendations:

- The ADP imagery is a valuable resource for the generation of village-level base maps at a variety of scales. Up-to-date village layouts, required for the planning process, could be created for villages in the Kumasi peri-urban area using this imagery.
- We have shown only three *development constraints* in order to illustrate the procedure. These could be refined further or additional constraints added. For example, the KMA use 100-200 ft to define the stream flood plain, depending on slope. There is certainly a need for more detailed slope data.
- A more detailed land use map could be derived from the ADP imagery, given adequate field work and local knowledge.
- Locally derived estimates of crop production, when combined with field areas, would allow yield estimates, and possibly an economic value to be derived. These could then be incorporated into the report, thus showing not only loss of crop area but also loss in terms of yield and monetary value.

- Techniques should be developed to enable the estimation of population density from the ADP images. This could be based on average number of persons occupying a dwelling of type a and x number of storeys. This information would be very valuable to the village planning process.
- The application currently uses shortest path distances when calculating minimum and maximum distances to features and facilities, such as roads and schools. It would clearly be more realistic to measure distance in terms of time taken to travel along the road and footpath network. This would involve generating a detailed track/footpath map by interpreting the ADP image and verifying this with local knowledge. It would also involve using the Network module of ArcView to measure these distances along the network.

7. Refernces

Koh, A. and Edwards, E., 1997. *Color Infrared Aerial Digital Photographic System Survey of Kumasi, Ghana, 17 December 1997*, Bath Spa University College, June 1998, Interim report, 10pp + associated CD's.

Thomas, G., Taylor, J.C. and Marshall, D.C., 1999. *Application of Aerial Digital Photography to Rapid Rural Mapping*, Cranfield University (Silsoe College), January 99, Interim Report, 24pp + 15 figures.

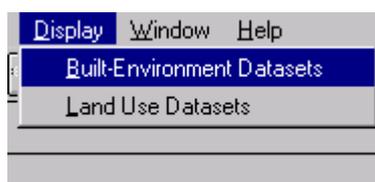
Blake, B., Kasanga,K., Adam,M., Nsiah-Gyabaah,K., Pender,J., Quashie-Sam,J., Warburton,H., and Williams, K. 1997. Kumasi Natural Resource Management Research Project Inception Report: Volume 2: Report of Component Studies, October 97 (project R6799).

Appendix A

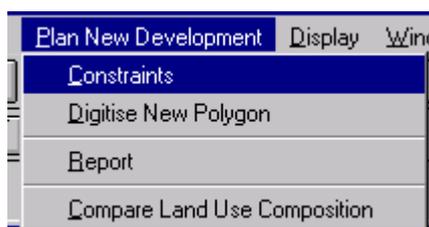
Detailed User Guide

This guide is intended to help you become familiar with the basic functions of the village level planning application. There are two main menus: *Display* and *Plan New Development*.

Display enables you to select one or more datasets, either from Built Environment or Land Use, that you would like to display.



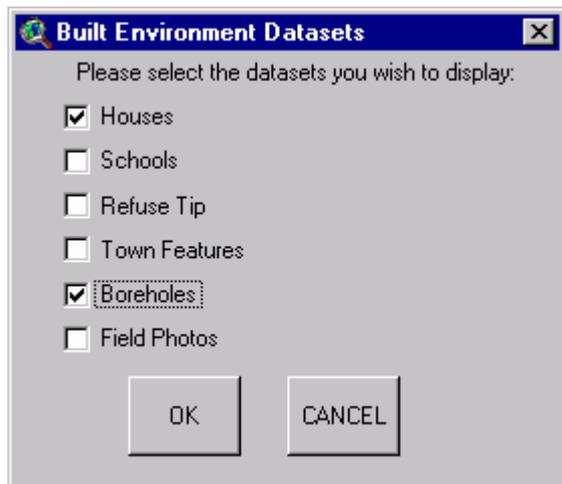
The *Plan New Development* menu has four options as shown below. This menu provides all the functions required to define and compare new areas for village development.



1. Display

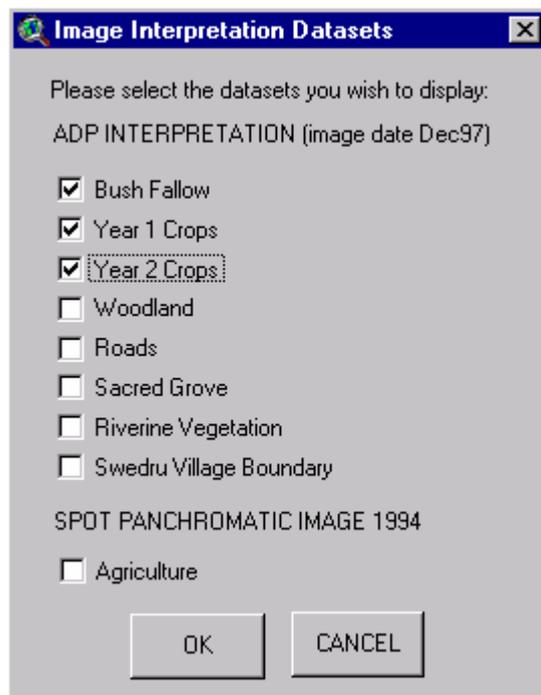
Built Environment Datasets

The user simply selects those datasets he wishes to add to the active View, in this case houses and boreholes.



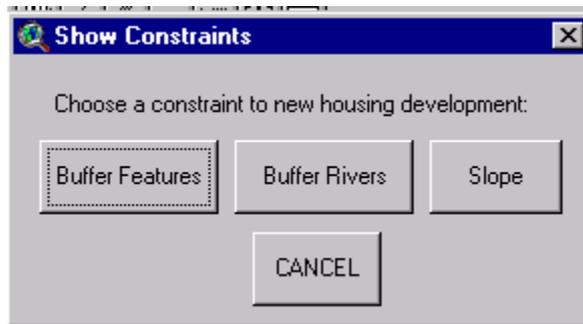
Land Use Datasets

This dialogue includes all the land use datasets which were interpreted from ADP imagery, plus an agriculture dataset interpreted from an earlier SPOT panchromatic image. In the example shown below, the user has chosen to display three layers: bush fallow, year 1 crops and year 2 crops.



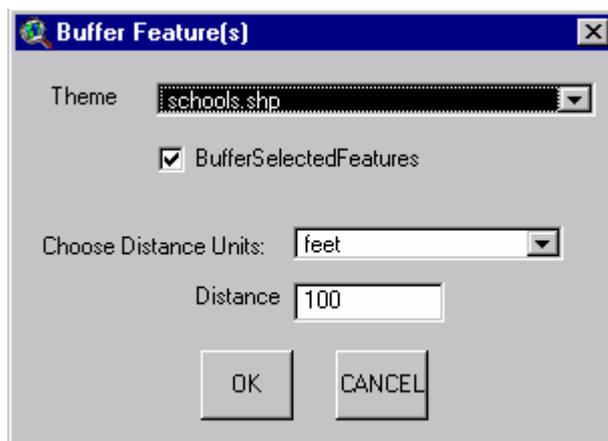
2. Plan New Development

2.1 Show Planning Constraints



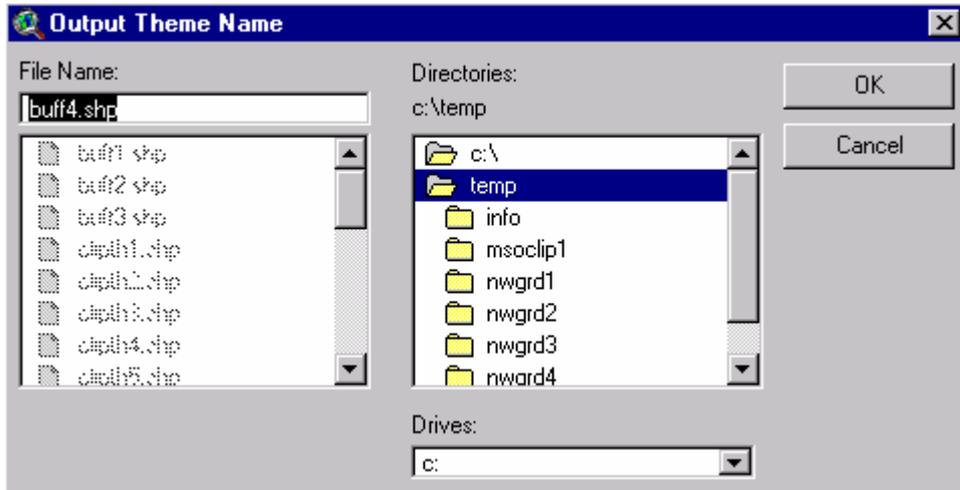
The *Constraints* option from the *Plan New Development* menu produces the dialog box shown above. There are currently three options: Buffer Features, Buffer Rivers, and Slope.

Buffer Features



This dialog first presents you with a scrolling list of themes which already exist in the Table of Contents. If the theme you choose already has selected features then the *Buffer Selected Features* check box is enabled and ticked on. For example, you may wish to place a buffer around only the nursery school in the school complex. To do this you would first select this feature from the schools theme (using standard ArcView functionality) then choose the Buffer Features option.

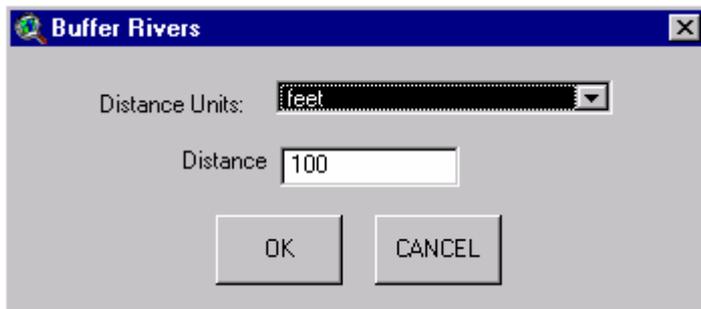
You also have to choose distance units and a distance value for the width of the buffer zone around the feature(s). When you have chosen all the required parameters press the OK button to begin the buffering process. A new buffer theme is created in c:\temp and if you are happy with the default name and directory location then press OK and the theme is added to the Table of Contents. You may of course change the theme name and directory location.



Once the new buffer theme is added to the TOC it may be switched on or off as required.

Buffer Rivers

This function is a modification of *Buffer Features* whereby only those rivers falling within the View display are buffered. This is a safeguard to prevent all the rivers in the coverage being buffered, a process which may be very time-consuming.



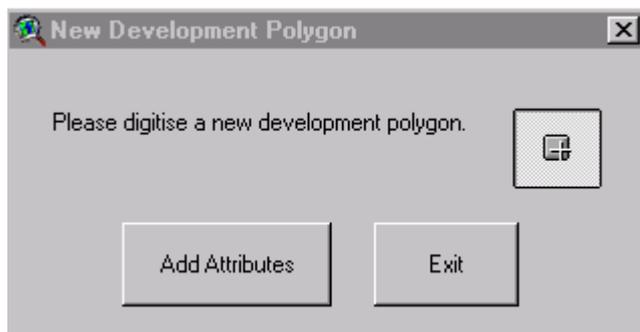
Again you choose distance units and a distance value before submitting the job using the OK button. A new buffer theme is created and added to the Table of Contents.

Slope

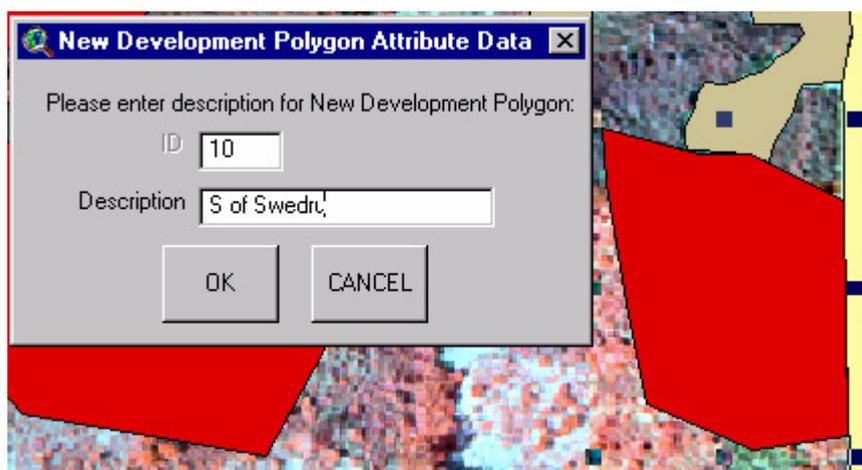
(needs updated- see old machine)

2.2 Digitise New Polygon

This option allows you to digitise a new polygon corresponding to a potential site for new housing development. The new polygon feature is added to existing features in the theme newdev.shp. The following dialog box is presented.

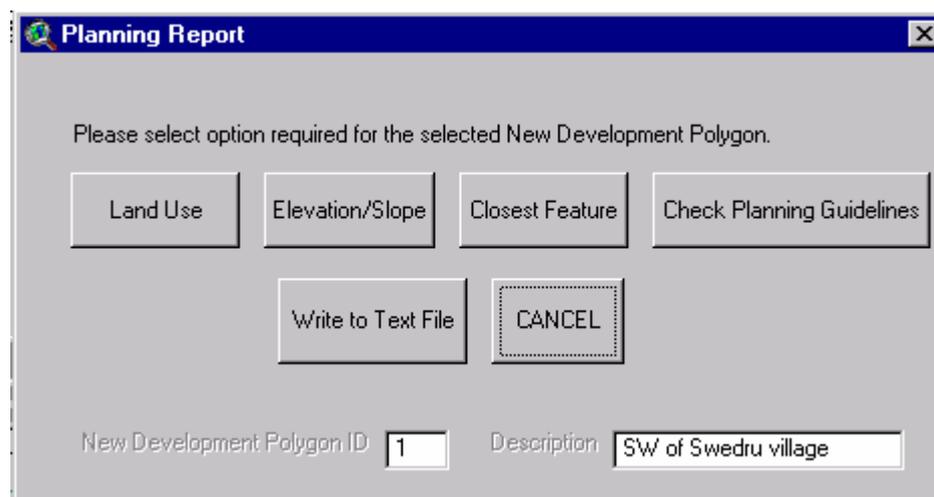


You simply click on the Digitise tool  and begin digitising the boundary of the new polygon using the mouse. To close the polygon simply double-click the mouse on the last vertex before the starting point *i.e.* there is no need to re-digitise the start point. After you have digitised the polygon you may add attributes to the feature using the Add Attributes button. The system automatically assigns an ID value (incrementing on the highest existing value) then you are prompted to add a description, although this is optional. When you are finished press OK and you are asked if you want to save the changes made. Confirm yes or no. You are then taken back to the Digitise New Development Polygon dialog box where you can either Exit or digitise another polygon.



2.3 Generate a Report

The Planning Report dialog calculates various parameters for the selected new development polygon. The ID and description of the selected polygon are shown at the bottom of the dialog. To change the selected polygon or if you have not yet selected one, use the ArcView select tool to click on the required new development polygon. If you have not selected a polygon when the dialog is opened then all the options will be disabled until such a selection is made.

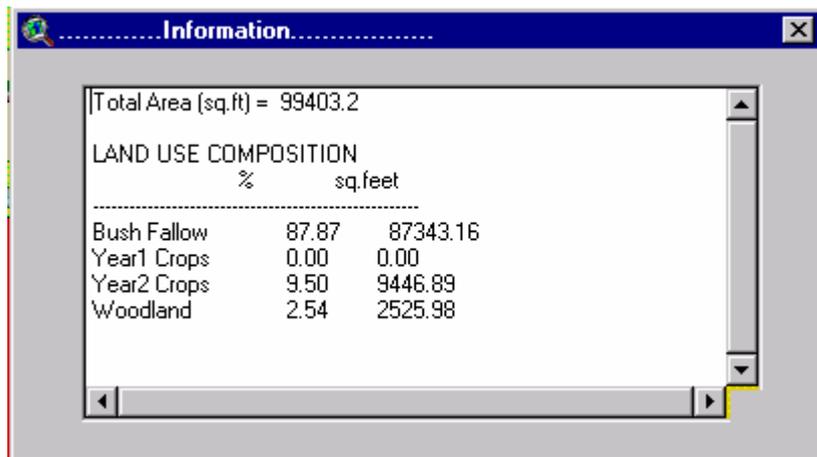


The four buttons in the first row of the dialog: Land Use, Elevation/Slope, Closest Feature and Check Planning Guidelines, calculate various parameters then add these as attributes to the relevant fields in the new development theme attribute table.

Land Use:	Calculates area of different land use classes for the new development polygon. These include bush fallow, year1 crops, year2 crops, and woodland.
Elevation/Slope	Calculates average elevation within the new development polygon.
Closest Feature	Calculates distance from centroid of new development polygon to the closest feature in the chosen theme.
Check Planning Guidelines	Calculates the minimum and maximum distances to nearest water supply, toilet facility and various categories of school.

Land Use

This function uses the new development polygon as a cookie-cutter on the various land use themes. The temporary clipped theme is used to calculate the area of land use which would be lost if that site was to be developed for housing. These areas, together with the total area for the new development polygon, are presented in a scrollable information box (shown below). Once calculated, they are then added as attributes to the new development theme's attribute table and can be written to a text file using the Write to Text File option on the Planning Report dialog.

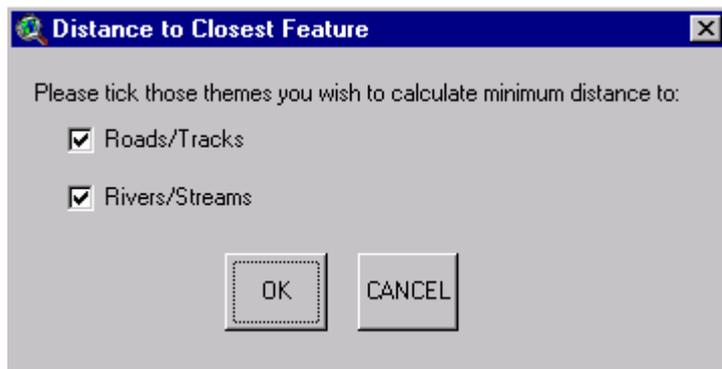


Elevation/Slope

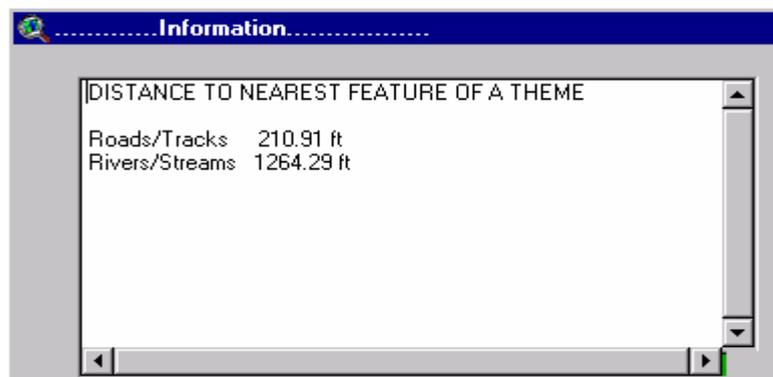
To be written.

Closest Feature

This function finds the distance from the centroid of the new development polygon to the closest feature in the theme which you select. You are currently able to calculate minimum distance to two themes: roads/tracks and rivers/streams. The dialog shown below allows you to check on one or both of these themes.



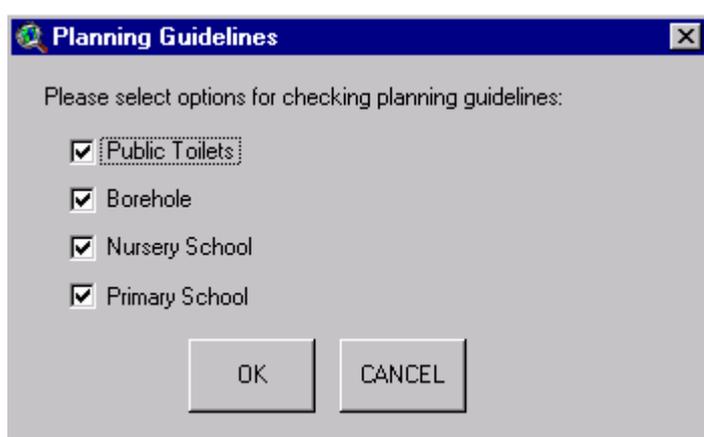
The function then calculates these distances and adds them as attributes to the new development theme. The values are then presented in an information box.



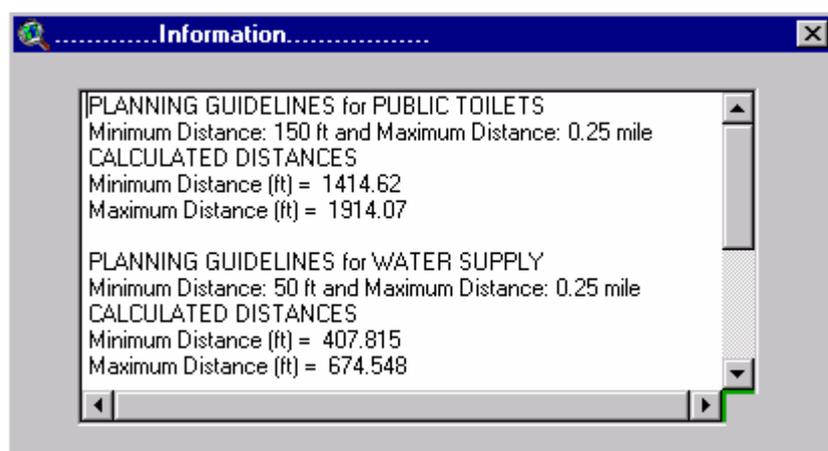
Check Planning Guidelines

This option calculates minimum and maximum distances from the new development polygon to the nearest toilet facility, water supply, and various categories of school. These distances are calculated from all vertices along the polygon boundary of the new development theme so that if you have digitised a large polygon you can calculate the distances from the nearest borehole, say, to the nearest and furthest points of the proposed new development. These distances are then compared with the recommended minimum and maximum distances as laid down by the Town and Country planners.

The first dialog you are presented with allows you to choose the facilities you wish to calculate distances to.



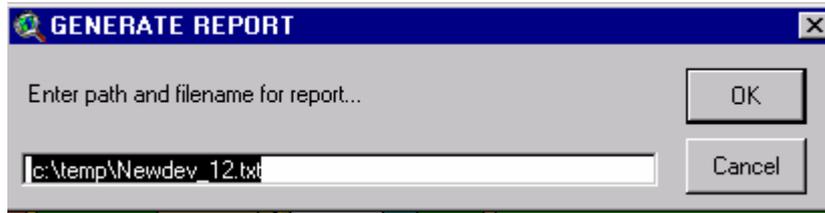
When you press OK the function then performs the distance calculations creating two temporary shapefiles in the process- just accept the default file names here. The calculated distances are then compared with recommended planning guidelines for that particular facility then presented in an information box as shown below.



Write to Text File

This option is enabled only once the land use figures have been calculated and added as attributes to the new development theme feature attribute table. The results of the

land use calculation, plus the results of the other options if they have been calculated, are written to a text file. The system presents you with the default path and filename for this report but you may change both its name and directory location.



This report summarises the results of all the options: Land Use, Elevation/Slope, Closest Feature and Check Planning Guidelines.

2.4 Compare Land Use Compositions

The final option in the *Plan New Development* menu is to create a chart display comparing land use compositions for each of the selected polygons. Before doing this you should first select the new development polygons you wish to compare land uses for. If you do not select any then the program will assume you wish to compare all the polygons. This program assumes that you have chosen polygons for which you have already performed the land use calculation described above.

A bar chart is produced showing, for each selected polygon, the area of each land use displaced.

Appendix B

Reports for Proposed New Development Areas

Report for New Development Theme Newdev.shp

Polygon ID: 1

Description: S of Swedru

Total Area (sq.ft) = 183795

ELEVATION

Mean Elevation 955.69 (ft)

Min Elevation 950.20 (ft)

Max Elevation 962.13 (ft)

LAND USE COMPOSITION

Fallow 181511 sq.ft 98.76 %

Year1 Crops 0 sq.ft 0.00 %

Year2 Crops 0 sq.ft 0.00 %

Woodland 0 sq.ft 0.00 %

MINIMUM DISTANCE TO ROAD THEME

Minimum Distance (ft) = 328.31

MINIMUM DISTANCE TO RIVER THEME

Minimum Distance (ft) = 227.36

PLANNING GUIDELINES for PUBLIC TOILETS

Minimum Distance: 150 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 1188.29

Maximum Distance (ft) = 1642.06

!!!NEW DEVELOPMENT POLYGON IS TOO FAR FROM PUBLIC TOILETS!!!

PLANNING GUIDELINES for WATER SUPPLY

Minimum Distance: 50 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 116.04

Maximum Distance (ft) = 611.68

PLANNING GUIDELINES for NURSERY SCHOOLS

Maximum Distance: 0.67 miles (3595.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 951.87

Maximum Distance (ft) = 1494.17

PLANNING GUIDELINES for PRIMARY SCHOOLS

Minimum Distance: 0.25 miles (1341.67 ft) and Maximum Distance: 2 miles (10733.32 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 1000.67

Maximum Distance (ft) = 1520.47

Report for New Development Theme Newdev.shp
Polygon ID: 2
Description: E of Swedru

Total Area (sq.ft) = 160781

ELEVATION

Mean Elevation 993.59 (ft)
Min Elevation 980.95 (ft)
Max Elevation 1000.00 (ft)

LAND USE COMPOSITION

Fallow 157905 sq.ft 98.21 %
Year1 Crops 0 sq.ft 0.00 %
Year2 Crops 0 sq.ft 0.00 %
Woodland 0 sq.ft 0.00 %

MINIMUM DISTANCE TO ROAD THEME

Minimum Distance (ft) = 505.34

MINIMUM DISTANCE TO RIVER THEME

Minimum Distance (ft) = 1234.94

PLANNING GUIDELINES for PUBLIC TOILETS

Minimum Distance: 150 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 594.3
Maximum Distance (ft) = 1124.23

PLANNING GUIDELINES for WATER SUPPLY

Minimum Distance: 50 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 68.2
Maximum Distance (ft) = 415

PLANNING GUIDELINES for NURSERY SCHOOLS

Maximum Distance: 0.67 miles (3595.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 211.13
Maximum Distance (ft) = 730.2

PLANNING GUIDELINES for PRIMARY SCHOOLS

Minimum Distance: 0.25 miles (1341.67 ft) and Maximum Distance: 2 miles (10733.32 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 281.93
Maximum Distance (ft) = 804.72

Report for New Development Theme Newdev.shp

Polygon ID: 3

Description: N of Swedru

Total Area (sq.ft) = 202771

ELEVATION

Mean Elevation 1000.00 (ft)

Min Elevation 1000.00 (ft)

Max Elevation 1000.00 (ft)

LAND USE COMPOSITION

Fallow 148861 sq.ft 73.41 %

Year1 Crops 4994.92 sq.ft 2.46 %

Year2 Crops 45968.9 sq.ft 22.67 %

Woodland 0 sq.ft 0.00 %

MINIMUM DISTANCE TO ROAD THEME

Minimum Distance (ft) = 204.63

MINIMUM DISTANCE TO RIVER THEME

Minimum Distance (ft) = 1583.71

PLANNING GUIDELINES for PUBLIC TOILETS

Minimum Distance: 150 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 0

Maximum Distance (ft) = 574.22

!!!NEW DEVELOPMENT POLYGON IS TOO CLOSE TO PUBLIC TOILETS!!!

PLANNING GUIDELINES for WATER SUPPLY

Minimum Distance: 50 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 372.13

Maximum Distance (ft) = 1157.6

PLANNING GUIDELINES for NURSERY SCHOOLS

Maximum Distance: 0.67 miles (3595.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 342.48

Maximum Distance (ft) = 889.88

PLANNING GUIDELINES for PRIMARY SCHOOLS

Minimum Distance: 0.25 miles (1341.67 ft) and Maximum Distance: 2 miles (10733.32 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 230.56

Maximum Distance (ft) = 808.45

Report for New Development Theme Newdev.shp

Polygon ID: 4

Description: W of Swedru

Total Area (sq.ft) = 175306

ELEVATION

Mean Elevation 997.77 (ft)

Min Elevation 986.48 (ft)

Max Elevation 1000.00 (ft)

LAND USE COMPOSITION

Fallow 148189 sq.ft 84.53 %

Year1 Crops 0 sq.ft 0.00 %

Year2 Crops 25720.8 sq.ft 14.67 %

Woodland 72.874 sq.ft 0.04 %

MINIMUM DISTANCE TO ROAD THEME

Minimum Distance (ft) = 517.64

MINIMUM DISTANCE TO RIVER THEME

Minimum Distance (ft) = 1211.02

PLANNING GUIDELINES for PUBLIC TOILETS

Minimum Distance: 150 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 717.29

Maximum Distance (ft) = 1251.32

PLANNING GUIDELINES for WATER SUPPLY

Minimum Distance: 50 ft and Maximum Distance: 0.25 miles (1341.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 316.4

Maximum Distance (ft) = 891.09

PLANNING GUIDELINES for NURSERY SCHOOLS

Maximum Distance: 0.67 miles (3595.67 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 807.73

Maximum Distance (ft) = 1371.13

PLANNING GUIDELINES for PRIMARY SCHOOLS

Minimum Distance: 0.25 miles (1341.67 ft) and Maximum Distance: 2 miles (10733.32 ft)

CALCULATED DISTANCES

Minimum Distance (ft) = 780.04

Maximum Distance (ft) = 1340.21