

# MOLAND Lite - land use modelling for SEA alternatives development and assessment



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- Office of Radiological Protection
- Office of Communications and Corporate Services

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**EPA Research Programme 2014–2020**

**Developing and Assessing Alternatives in Strategic Environmental Assessment**

# **MOLAND Lite – land use modelling for SEA alternatives development and assessment**

**2013-SL-DS-1**

## **EPA Research Report**

Developing and assessing alternatives in Strategic Environmental Assessment – good practice guidance available for download online <http://erc.epa.ie/safer/reports>

Prepared for the Environmental Protection Agency

by

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## **ACKNOWLEDGEMENTS**

This report is published as part of the EPA Research Programme. The Research Programme is administered on behalf of the Department of the Environment, Community and Local Government by the Environmental Protection Agency, which has the statutory function of co-ordinating and promoting Irish environmental research.

The authors wish to thank Berna Grist and Brendan Williams, University College Dublin, for their advisory role in the preparation of this guidance, and Dr Harutyun Shahumyan, University College Dublin, who provided assistance and use of the MOLAND software. Thanks are due to the steering committee, composed of Cian O'Mahony and Eamonn Merriman, Environmental Protection Agency, Gabrielle McKeown, Department of the Environment, Community and Local Government, Linda Patton, National Parks and Wildlife Service, Gerry Clabby, Fingal County Council, and Teresa O'Reilly, West Regional Authority. Thanks are also extended to the external reviewers Tadhg O'Mahony, Environmental Protection Agency, Thomas Fischer, University of Liverpool, and Rob Verheem, Netherlands Commission for Environmental Assessment.

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The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

**EPA RESEARCH PROGRAMME 2014–2020**  
Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-84095-605-4

Price: Free

Online

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# 1 Introduction

MOLAND is a land use computer model based on socio-economic and demographic data. It was created by the Research Institute for Knowledge Systems (RIKS) and the Joint Research Centre (JRC) of the European Commission and implemented in the GEONAMICA software environment.<sup>1</sup> It was originally applied in Ireland as a support tool for the development of Regional Planning Guidelines for the Greater Dublin Area, comprising counties Fingal, South Dublin, Dublin City, Dun Laoghaire-Rathdown, Wicklow, Kildare, Louth and Meath. As a result, the model has been calibrated for the Greater Dublin Area. In order for the model to be used with full confidence nationally, calibration would be necessary across the Republic of Ireland. Therefore, MOLAND “Lite”, resulting from the SEA Alternatives project, has been developed only as a demonstration model, in order to demonstrate its applicability to the development and assessment of alternatives in Strategic Environmental Assessment (SEA).

MOLAND’s aim is to function as a spatial planning tool to assess, monitor and model changes and developments in urban and rural environments. It requires five digital maps as inputs: (1) *land use types*; (2) *accessibility* (transport networks); (3) *land use zoning* maps (zoning of land parcels for industrial, residential, green infrastructure, etc.); (4) *socio-economic characteristics* (population, employment); and (5) *suitability maps*, which indicate how suitable a site or an area is for development according to geomorphic features, elevation, soil type, etc. (this is explained in section 2). A basic user of the model would change the *quantum* and *distribution* of population and/or the quantum of employment while leaving the land use, zoning and accessibility components fixed.

In terms of SEA development and assessment, MOLAND has applicability in terms of spatial and temporal planning; it is a tool that mainly addresses the “location” aspect of the *Need, Mode, Location and Timing* elements of the toolkit in the main guidance document. The model can be run to ascertain what land use planning alternatives will look like over set time periods, and therefore it can be used to assess and compare alternatives. To do this the spatial outputs need to be compared with a set of reference criteria in order to measure and compare the impact on land use of one alternative over another. These criteria can be broadly described as environmental and socio-economic impacts and performance, and they act to outline constraints on, or benefits of, allowing a particular land use to occur in a particular location. For the purposes of the demonstration, the key criterion used will be the impact of the model outputs on Natura 2000 areas and other green infrastructure, as measured in square kilometres. To understand how the model works, it is easiest to consider its two sub-models.

## 1.1 Macro-scale model

The macro-scale model takes population and economic activity (as measured by number of jobs) in a region as inputs, and these are then split between the counties within that region. For example, estimates of the population within residential land use types in the region will be provided, along with associated estimates of the economic activity generated within commercial, industrial and service land uses.

## 1.2 Micro-scale model

The aforementioned provision for population and economic activity is translated into a picture of future development patterns by the model. The micro-model is based on a cellular automaton algorithm. Cellular automata get their name from the fact that they consist of cells – like the squares on a chessboard – and cell states may evolve according to a simple transition rule, the automaton. The fundamental idea is that the state of a cell at any time depends on the state of the cells

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<sup>1</sup> The applicability of the MOLAND model to alternative assessment and development was investigated over a 3-month period and represents an extension of previous work carried out on behalf of the Environmental Protection Agency (EPA) for the Urban Environment Project (UEP, 2006). Lasting over 3 years, the UEP applied MOLAND (a model co-developed by the EU Joint Research Centre, Ispra, Italy) to the Irish spatial planning context to link development, space and the environment.

within its neighbourhood. The land use type assigned to any given cell is determined by such an algorithm, which aims to satisfy the demands for land use in each *time step*. In essence, each cell is a parcel of land and each time step is bracketed by two points in time; for example, year 0 to year 0 + 6 would be the equivalent of a 6-year period.

The *neighbourhood effect* represents the attraction (positive) and repulsion (negative) effects of the various land uses and land covers within the neighbourhood. Each land use that occurs in a cell has an effect on the possible future occurrence of each land use function in all cells within the neighbourhood; to some extent, that is dependent on the distance between the two cells.

## 2 Basics of the model

It is not necessary for the practitioner to understand the internal workings of MOLAND. However, it is useful to understand and have an appreciation of what layers are used to run the model. Practitioners should make themselves familiar with each of these layers to understand the impact they have on the development of alternatives.

The following attributes are used (Figure 2.1).

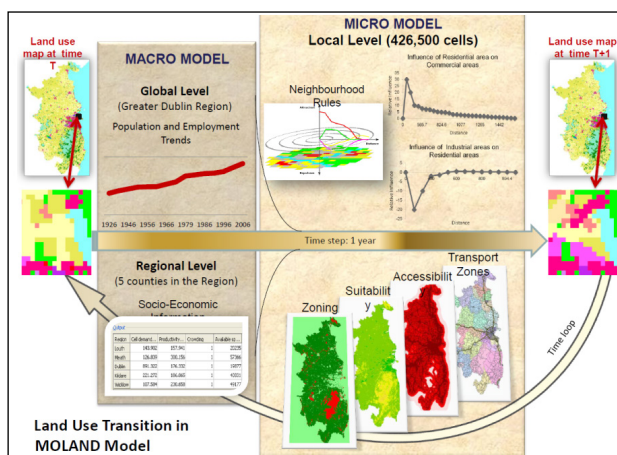


Figure 2.1. Land use transition in MOLAND.

### 2.1 Land use maps

The MOLAND classification system is based on the CORINE land cover database; the 2006 version of CORINE is used in this iteration of the model, as the 2012 CORINE dataset was not available until late 2014.

### 2.2 Suitability maps

Suitability maps are created for all functional land uses. The suitability maps used are interpreted in terms of their suitability on a 0–10 ranking for industrial, commercial or residential development (10 being the most suitable). These interpreted maps are then combined in one overlay. The base maps used to create suitability maps are soils, elevation and slope. Suitability maps for the urban categories *Residential*, *Industry* and *Commerce* are the same, as they are all urban functions with comparable interests in the physical characteristics of an area.

Suitability represents the degree of relevance of each cell to each land use type, according to a set of predefined criteria. Thus, land use suitability displays locations that fulfil a suitability criterion defined for each land use class. Various additional datasets may be used, such as flood risk and groundwater vulnerability. As an example of the suitability component, if a cell (parcel of land) is positioned close to transport infrastructure, that might influence its suitability for future development, or, if a cell is adjacent to a water body, that may make that cell more suitable for port activity. Importantly, the suitability component of the model also allows the user to input various future land use scenarios based, for example, on spatial variations in the quantum and distribution of population in a plan area.<sup>2</sup> This requires that the user increase or decrease the suitability of an area using a Geographic Information System (GIS) application, and then reimport the adjusted suitability into the model.

### 2.3 Zoning maps

Zoning maps are available for residential, industry, commerce, agriculture, conservation and utility land uses. This is because these broad categorisations represent the main types of zoning used in Irish land use planning. Locations that are defined as Natura 2000 areas, or areas zoned as agriculture or zoned for conservation, are incorporated into the model as *Development restrictions*, as no urban development is allowed on those locations. In the preparation of the model, these areas are coded as category 3 areas (i.e. development is “not permitted”).

The MOLAND zoning map uses the following categories for each land use type to denote potential change in land use activity with time (or a single category for all urban land uses if there is no difference):

- zoning period 0: from start date of simulation ( $t=t_0$ ) until first date set by user ( $t=t_1$ );

<sup>2</sup> In the demonstration of the model using Wexford County Development Plan 2013, in the suitability component of the model the quantum and distribution of population are varied in order to create spatial visualisations of the impact of choosing one alternative or another.

- zoning period 1: from first date set by the user ( $t=t_1$ ) until second date set by user ( $t=t_2$ );
- zoning period 2: from second date set by the user ( $t=t_2$ ) until the end of simulation;
- not permitted.

Based on the zone description, a new zoning field was created for this iteration of the model, with the values described above linked to *MyPlan* generalised zone type (GZT) descriptions.<sup>3</sup> *MyPlan* combines existing zoning layers with plan images from the zoning map from each published plan with GZTs. The latter GZTs are a consistent zoning scheme that has been applied to all zoning data nationally. For example, agriculture zonings and quarrying are re-categorised as *primary sector* under the GZT categorisation. In this way, a zoned area will be either permitted for development and categorised as 0, 1, 2, depending on when the development would be allowed, or categorised as 3 (if the zoned area is for a land use such as conservation or agriculture).

### 2.3.1 Zoning summary

- Development plans constitute the basic policy document of the land use and development system in Ireland. The approach taken to the zoning of land varies between planning authorities. However, in general, most, if not all, land within an urban designation is zoned for a particular objective, whereas, in the case of many rural areas, specific land use zoning objectives are not designated. The interpretation of each zoning objective may be further refined through the inclusion of a matrix in which a large number of potential land uses are classified under each zoning objective as “Acceptable”, “Open for consideration” or “Not acceptable”. In the preparation of the model, the Department of the Environment, Community and Local Government’s (DECLG’s) *MyPlan* was used to classify each zoning according to whether development was (1) permitted; (2) open for consideration over time; or (3) not permitted.
- The use and further development of *MyPlan* nationally is critical to the success of future modelling, as the standardisation of zoning will help overcome the current lack of homogeneity in zone coding systems between counties.
- Three zoning periods are used to reflect whether zoning is permitted immediately, time 0; permitted at a subsequent time, time 1; or reserved for strategic use in the longer term (until the end of the model simulation, which runs until 2022), time 2. In the preparation for the model, time 0 is taken as 2010. The rationale behind this choice was the publication of the higher planning tier Regional Planning Guidelines (RPGs) in 2010. Time 1 is taken as 2014 (as City and County Development Plans are published at different times, it was necessary to take a point that would best reflect this variation). Time 2 is taken as 2018 and runs until 2022. Taking 4-year time periods means that those periods are evenly split within the RPGs plan period of 2010–2022.

## 2.4 Accessibility/transport network maps

In addition to suitability and zoning, accessibility to transport networks is an important input into the MOLAND model, as, arguably, the most important driver of land use change is the degree to which services, markets and people can be reached. Although the model cannot differentiate localised factors (e.g. natural community gravitations towards one area over another) accessibility maps capture the relative importance of access to the transport networks for the various land uses. The influence of accessibility is computed as a function of the distance to the nearest transport network and the relative importance of this network. These parameters are set for each land use separately.

For accessibility mapping, the key data required are the position of motorways and primary and secondary road junctions. MOLAND can be run without the transport sub-model if necessary, but it is included in this iteration. For the purposes of this model counties are used as transport zones, but in future iterations practitioners could potentially use electoral area boundaries or similar delineations to create their own transport zones.

## 2.5 Social and economic information

MOLAND requires socio-economic data for a modelled county. These are given as *population count*, *population projections* and *employment count* by broad industrial grouping and population projection. Population projections are taken from the RPGs’ population targets for each of Ireland’s regions.

<sup>3</sup> www.myplan.ie

There are about 17 sub-categories in the Central Statistics Office (CSO) employment datasets. These were reclassified to fit the broad classification of services, commercial and industrial. Employment data are input as *place of work*, and the relevant data were obtained from the CSO Place of Work Census of Anonymised Records (POWCAR), with 2006 data used as the reference year. For future iterations, the CSO Place of Work (and School) Census of Anonymised

Records for 2011 should be used. However, certain classifications of employment activity changed between 2006 and 2011. This means, for example, that some employment records previously classified as *industrial* in 2006 are now classified as *services*. Future iterations would therefore require special tabulations from the CSO so that 2006 and 2011 data are comparable. This does not affect the applicability of the current model, as it also uses CORINE land use from 2006.

## 3 Running a simulation

Before running a land use simulation the practitioner should be aware of three strategic elements. The first is setting the drivers which help determine where future population growth will occur. The second are the indicators that are chosen to assess the impact on land use of different alternatives and the third is the analysis of the land use impact.

### 3.1 Step 1 – Setting the drivers

Operationally, it is first necessary to **set the drivers**: population, zoning, suitability, etc., although, by and large, these drivers are already fixed for the practitioner. The development of an integrated scenario requires a set of values for each driver such as:

- the population demand in terms of number of people to 2022 using DECLG population targets;
- the demand for industrial and commercial areas to 2022.

It is within this component that **policy options** and **user options** are input by the user of the model. The practitioner/planner will be able to select various alternatives according to a set of pre-agreed criteria based on best practice guidance on the development and assessment of alternatives. In the case of the demonstration below, policy options are contextualised for Wicklow County by the higher tier of planning (i.e. the Greater Dublin Area RPGs) and two other alternatives. The RPGs constrain the quantum and distribution of development into selected locations (see section 4.4 for further detail).

### 3.2 Step 2 – Running the simulation

Before running the simulation, the user must select which integrated scenario to run. In the demonstration, these are outlined as “Dispersed”, “North County” and “North and South County”. Practitioners will define these alternatives prior to running the simulation, and they will tell the model where to push the population according to their preference (as stated previously, this is carried out in GIS).

Individual maps can be created and exported for analysis. An animation shows changes in the land use, indicators or other model results over time. Animations

are stored in the form of .gif files. A link to Microsoft Excel can also be created through which all selected model block results are directly exported. This can be used for analyses and post-processing. The steps to be carried out prior to running the simulation are summarised below.

To run MOLAND, double click the model icon and go to *Open* (Figure 3.1).

To select the land use map, click *Maps*, then *Land-use*. Similarly, to select zonings click *Maps*, then *Zonings*. You can have multiple screens (*Suitability*, *Zoning*, *Land-use*) open at once. Having selected the land use map, click *Show Names* to see the names of major growth centres across the region (Figure 3.2).

There is an option to zoom in and out if necessary. Other options are available through *View*, such as elevation and transport networks. There are two main options for the user to change socio-economic or population drivers. Go to the *Macro-scale* window (Figure 3.3).

Select a county. Click on the *Population* box. Click the *Population growth* box. Change the *Total Demand for Activity* to target populations. Save changes. Click *Options*, then click *Link to Excel*. Click *Options*, then click *Animations*, turn on animations, then click *Options – Log*, choosing a log interval of every “X” years.

Select the *Population* sub-model in the *Macro-scale dynamics* system diagram. Next select *Regional Population* in the *Population* window to open the *Population – regional* dialogue window. The latter will display the actual population for the selected county: in the *Population – regional* dialogue window the current number of inhabitants will appear. Specify the county for which you want to see the information by clicking in the desired county in the little map on the lower left part of the *Macro-scale dynamics* window, or on the name in the list in the upper left part of this window.

Now start the simulation (you will notice how the population will be allocated on the land use map taking into account the other elements of the model) by selecting *Simulation*, then *Pauses*. Select the start year and the numbers of years between pauses. Once the model runs, it will stop or pause at times designated by the user. For example, running the model from 2000, the

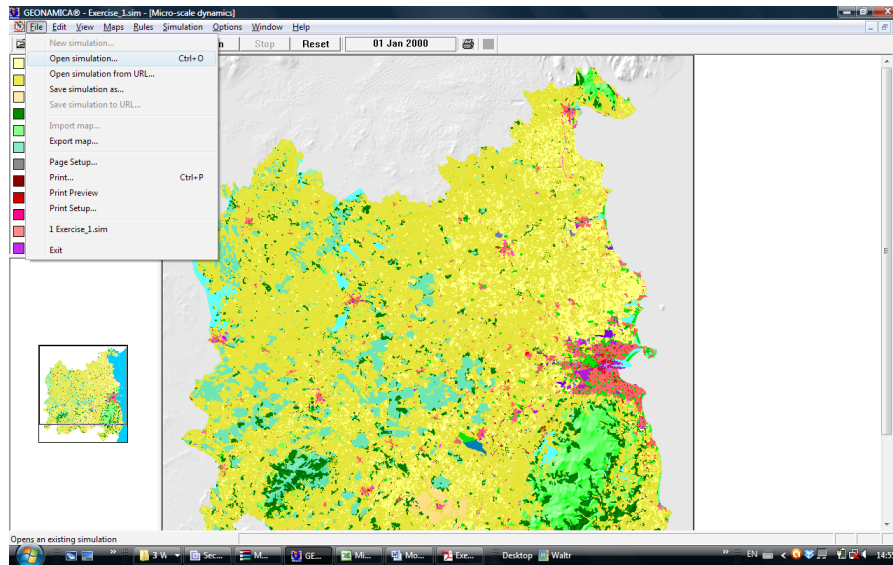


Figure 3.1. Sample screen shot of the interface. Courtesy of Geonamica, Research Institute for Knowledge Systems (RIKS).

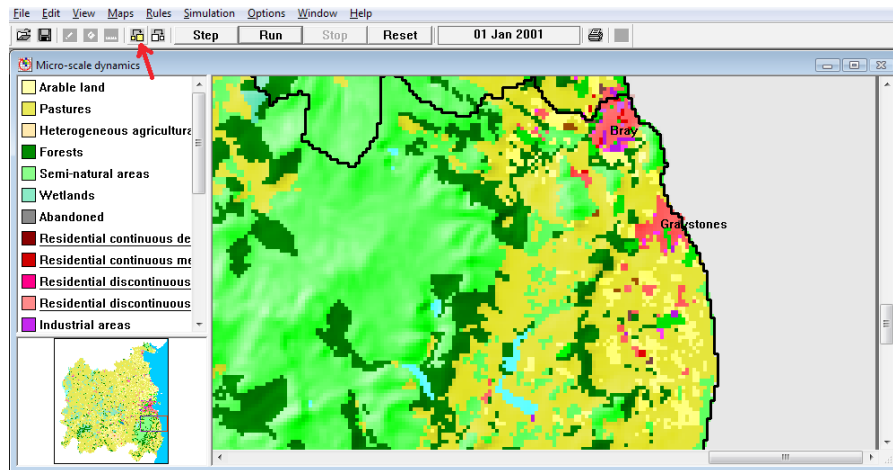


Figure 3.2. Zoomed in sample showing place names. Courtesy of Geonamica, Research Institute for Knowledge Systems (RIKS).

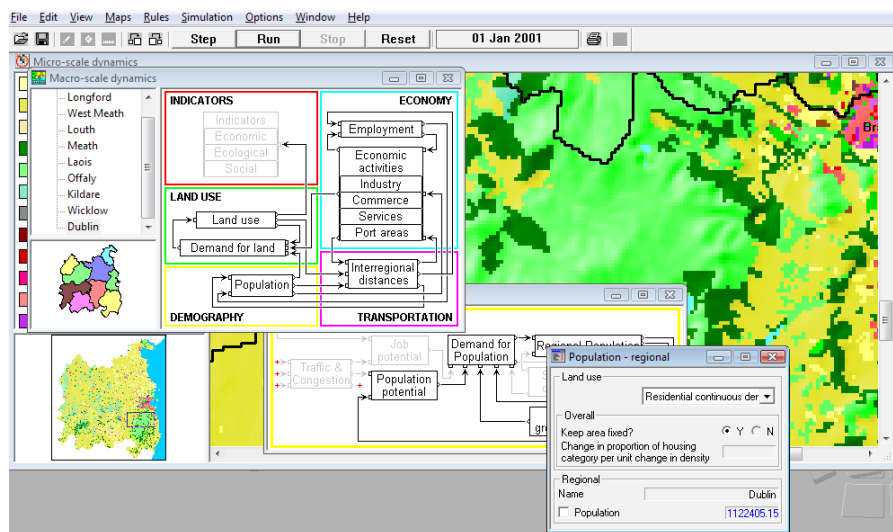


Figure 3.3. Sample macro-scale window. Courtesy of Geonamica, Research Institute for Knowledge Systems (RIKS).

first pause could be selected as 2010, and a pause selected for every fifth year after that would include the years 2015 and 2020.

Click *Run* on the toolbar or select *Simulation*, then *Run*.

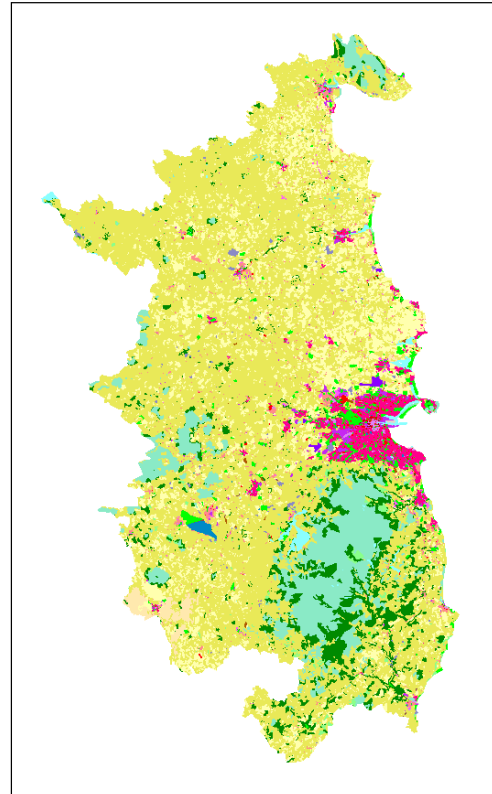
### 3.3 Step 3 – Visualising results

After the simulation is finished, the model offers several options to analyse results. The first option is to visualise the land use map and the indicators that are being calculated by the system.

The first result the practitioner will see is the land use map for the current year ( $t=0$ ). The second result is the calculated indicators for the current simulation year. The indicators are required as the maps may not be easy to interpret at first glance, requiring timely examination (Figure 3.1). In this regard, indicators make the land use change and impact more perceptible.

### 3.4 Step 4 – Analysing results

The final step of the impact assessment study is to analyse results within an integrated scenario (e.g. the temporal evolution of an integrated scenario) (see Figure 3.4). This will show the impact of a given alternative on land use at time 1, time 2 and the end of the model run and, as stated previously, can be displayed as an animation. The analysis of impact must be placed in a policy context and may lead to adjustment of existing alternatives or development of new alternatives to test within the model.



**Figure 3.4. Sample MOLAND output for the Greater Dublin Region.**

Indicators are organised into two groups, namely environmental indicators and socio-economic indicators.

For example, the model allows the practitioner to examine the impact of his or her chosen alternative on agricultural areas (arable and pasture lands – measured in square metres). In this manual we concentrate solely on environmental and land use impact indicators.

## 4 Demonstration of the MOLAND model – the case of Wicklow

Although MOLAND can be iteratively adapted to include additional layers of information and for use across sectors, its current applicability lies in spatial land use planning.<sup>4</sup> Alternatives should firstly be identified and developed using the toolkit and can then be input into the model. For demonstration purposes, hypothetical context and alternatives were outlined for an existing plan, namely the Wicklow County Development Plan 2010–2016. The quantum of population is determined by the higher tier of planning, the Regional Planning Guidelines for the Greater Dublin Area, 2010–2022. Suitability buffers were created outside the model using GIS (ArcGIS). These were imported back into the model to tell it where to push projected population growth. Three alternatives were proposed: (1) a *Managed Dispersal Scenario*, which maintains the status quo suitability component and permits and distributes population according to the limiting elements of the other layers; (2) *North County Development*, which increases the suitability around the towns of Bray and Greystones based on the assumption of improvements to transport and wastewater treatment infrastructures; and (3) *North and South County Development*, which increases development in all the major coastal towns based on assumptions of infrastructure development being delivered. These are explained in greater detail below.

### 4.1 Contextualisation from Regional Planning Guidelines

Firstly, it is necessary to understand the economic and population projections for the county in question. The economic projections are set using the CSO POWSCAR data on employment. The population projections (targets) are explained below but should be understood in the context of the overall alternatives toolkit.

<sup>4</sup> National-level calibration of the model (see <http://www.uep.ie/downloads/viewer.php?id=156>); further cleaning of national zoning layers by local authorities and integration of new layers of data such as Flood Risk Assessment will greatly increase the usefulness of the model.

The RPGs allocate a total county population of 164,280 in 2016 and 176,800 in 2022:

- Between 2006 and 2016, this equates to a population growth of 38,084 persons.
- Between 2006 and 2022, this equates to a population growth of 50,604 persons.

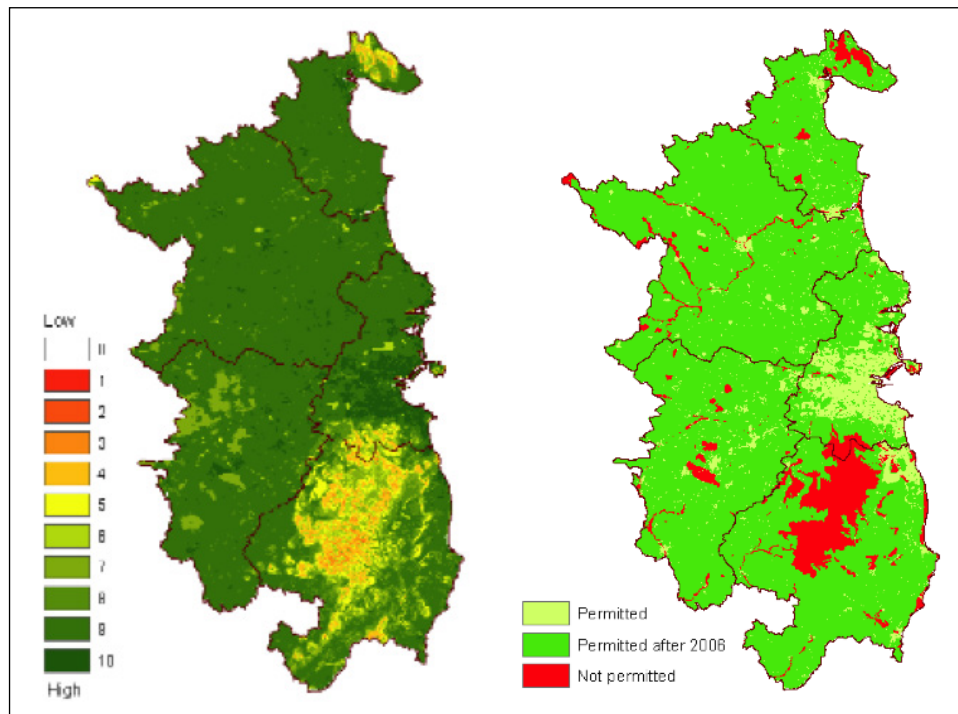
The RPGs required that 42% of the total growth be allocated to the metropolitan area settlements and that the majority of the remainder be allocated to the growth towns, weighted towards the large growth towns in the settlement hierarchy and particularly towards towns with rail-based public transport. The four largest growth centres, representing almost two-thirds of the projected county growth, are reliant on the co-operation and financing of the National Roads Authority and the Railway Procurement Agency (Bray), an extended wastewater treatment plant (Greystones), augmented water supply (Wicklow) and a wastewater treatment plant that has been, inter alia, tied up in the courts for 17 years (Arklow), and it is not possible to predict the outcomes of these with any accuracy whatsoever.

The combined growth allowed in Bray and Greystones up to 2016 is 17,617 persons, and up to 2022 is 25,617 persons. This equates to 46% of the growth allocated by the RPGs up to 2016 and 51% of the growth allocated up to 2022 (Table 4.1).

Figure 4.1, the absolute permission map (on the right), shows where population growth is and is not permitted

**Table 4.1. Population targets**

Population targets	2016	2022
State (DECLG)	4,997,000	5,375,200–5,523,000
Mid-East Region (DECLG)	594,600	639,700–657,200
Mid-East Region (RPG)	594,600	639,700
Wicklow (RPG)	164,280	176,800
Wicklow County Development Plan	164,280	176,800



**Figure 4.1. Steady-state suitability (left) and absolute permissions (right) maps for County Wicklow.**

over time. These zonings are fixed using zoning layers. The suitability map (on the left) shows areas considered most suitable for growth on a scale of 0–10 (10 being most suitable). The greener in appearance an area is, the more suitable it is for development. Figure 4.1 shows the steady state, but this can be changed to increase suitability. This does not change the effects that the other component layers of MOLAND (such as accessibility, zoning and land use type) have on where the model decides to distribute future growth. If, for example, a broad area of cells is given a suitability of 10, MOLAND will be more inclined to put development into that area than an area in the county with a suitability below 10; however, if there is a zoning restriction that prohibits development within the area given a suitability of 10, MOLAND will not allow development in the cells that have that zoning restriction.

## 4.2 Developing alternatives – Wicklow theoretical scenarios

Three theoretical scenarios were developed for an existing plan, and in order to add realism actual policy outcomes from 2010 were used to develop alternatives. The user is referred to Table 4.2 and back to the toolkit for specifics on alternative development, and the results are shown in section 4.4.

**Table 4.2. Interface between MOLAND and the development and assessment of the alternatives toolkit**

Drivers in development	Detail
External influences	Demand for land use functions
Policy options	As determined by best practice guidance – see toolkit
Other user options	As determined by the practitioner in MOLAND
Set policy drivers	Socio-economic drivers Population drivers Spatial maps/layers
Assessing	Detail
Impact measurement	Land use change

- Scenario 1: Managed Dispersal Scenario (as outlined by Regional Planning Guidelines for the Greater Dublin Area 2010). In this scenario the suitability and zoning are maintained as is (steady state), with no attempt to push development into one area over another.

- Scenario 2: North County – Bray and Greystones. For this scenario the suitability for development is increased around Bray, Greystones, Delgany, Kilcoole and Newtownmountkennedy. The theoretical assumptions made are (1) High-capacity Dublin Area Rapid Transport line from Maynooth/Dunboyne (M3) to Bray/Greystones (2018) and (2) a wastewater treatment plant for Greystones (2013). The capacity for the treatment plant will increase to 40,000 population equivalent. The treatment plant also serves Delgany, Kilcoole and Newtownmountkennedy, as per Wicklow Development Plan 2010.
- Scenario 3: Selected North and South County Development (Arklow and Wicklow). In this scenario Arklow wastewater treatment plant is built in 2014 with an augmented water supply for Wicklow town.

### 4.3 Assessing alternatives – sustainability indicators

MOLAND allows the user to examine the impact of alternatives on the different land classes by exporting results to Microsoft Excel. For the Wicklow example, Figure 4.6 shows the difference for *pasture land* (given in square metres) between the three scenarios. The impact on land use consumed by growth patterns across a county can be analysed in this way for any of the 24 land use classes.

#### 4.3.1 Encroachment on protected areas (SPAs, SACs, NHAs)

To investigate the extent of encroachment upon protected areas, all Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Natural Heritage Areas (NHAs) within the study area were merged using GIS. To allow a by-county analysis, this polygon was intersected with a county shapefile. A special tool (UEP Cell Count Tool) was developed using the ArcGIS Model builder to calculate cell statistics within these buffers and the results were compared using Microsoft Excel.

The calculation of development within a buffer zone from NHAs/SPAs/SACs using GIS is summarised and illustrated below. To create a buffer and then to calculate the land use development encroachment within it, the NHAs', SPAs' and SACs' GIS layers are merged and clipped using the tools in Figures 4.2 and 4.3.

The model in Figure 4.4 was created in the ArcGIS 10.1 Model Builder environment for calculation of land use in square metres in a 1-km buffer zone from NHAs/SPAs/SACs for different scenarios.

The model accepts the buffer distance and the land use layer as parameters. Thus, it is flexible enough to be run for different buffer sizes and for land use layers from different scenarios. The snapshots of each step in the model are presented in Figure 4.5.

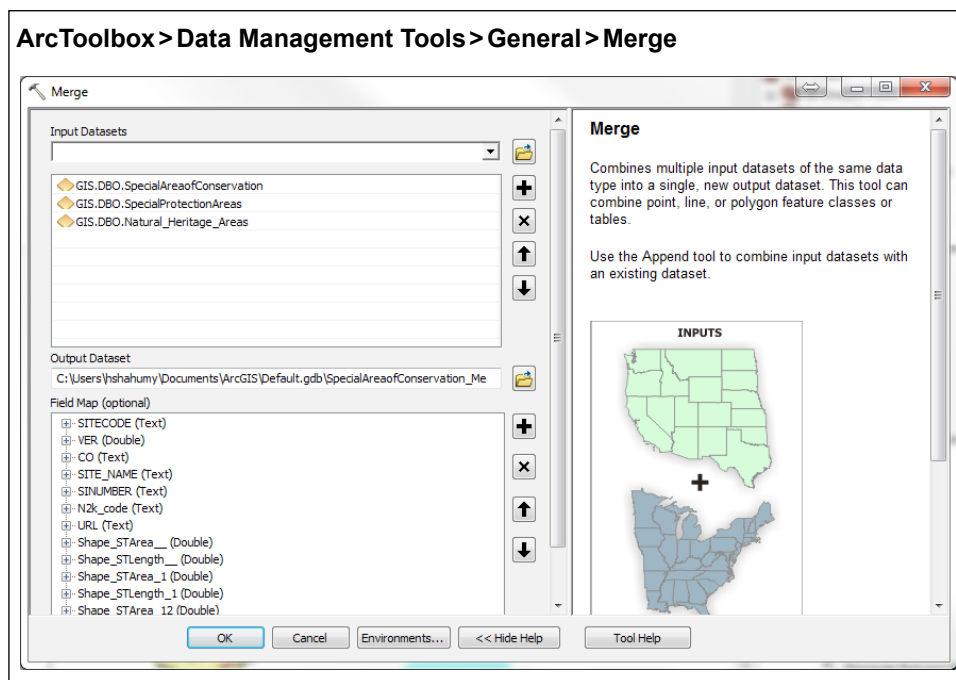


Figure 4.2. Merging layers to calculate land use change within buffers.

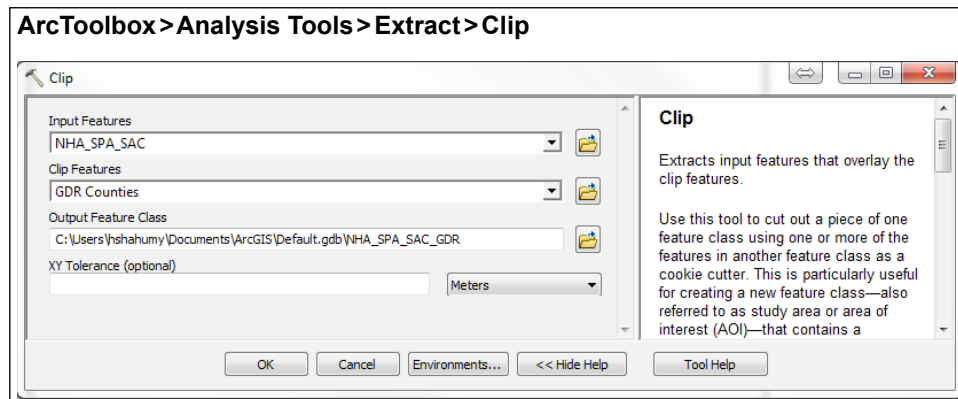


Figure 4.3. Creation of a new feature for land use calculation within buffers.

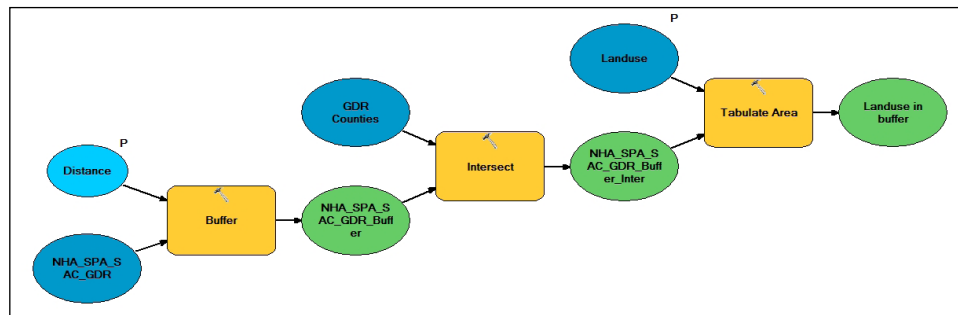


Figure 4.4. Natura 2000 model that accepts buffer distances and land use layers as parameters.

#### 4.3.2 Development proximity to public transport corridors

To assess this indicator, a 1-km buffer can be created around the transport nodes for each scenario. Cell counts within these buffers are calculated using the UEP Cell Count Tool.

#### 4.3.3 MOLAND statistics

MOLAND allows the user to examine the impacts of alternatives on the different land classes by exporting the results to Microsoft Excel. For the Wicklow example, Figure 4.6 shows the difference for pasture, arable and residential land between the three scenarios (1=Dispersed; 2=North County; 3=North and South County). The impact on land use consumed by growth patterns across a county can be analysed in this way for any of the 24 land use classes. Firstly, *residential discontinuous urban fabric* is analysed. For both scenario 2 and scenario 3, it can be seen that more development is pushed in or around urban areas. Similarly, the *Managed Dispersal Scenario* has a negative impact on arable land, with considerably less being available

after the model is run than in scenarios 2 and 3, which both pushed development into urban areas owing to increased suitability around key growth centres in the north and south of County Wicklow.

## 4.4 Results of Wicklow demonstration

To encourage the development in the designated areas according to the proposed scenarios, the “suitability” function and maps within the MOLAND model have been used. Suitability in MOLAND operates on a probability basis, rather than the standard “zoning” function, which is limited to absolute permitted/non-permitted designations. This makes it relevant for our study purposes. In particular, the default suitability map of the region was altered using ArcGIS Raster Calculator to decrease the suitability of urban development in the areas outside the proposed areas in the scenarios. In scenario 1, growth is evenly dispersed across the county of Wicklow over the time period. In Figure 4.7 the main growth centres of Bray, Greystones, Wicklow and Arklow stand out clearly as the areas of greatest concentration of residential development.

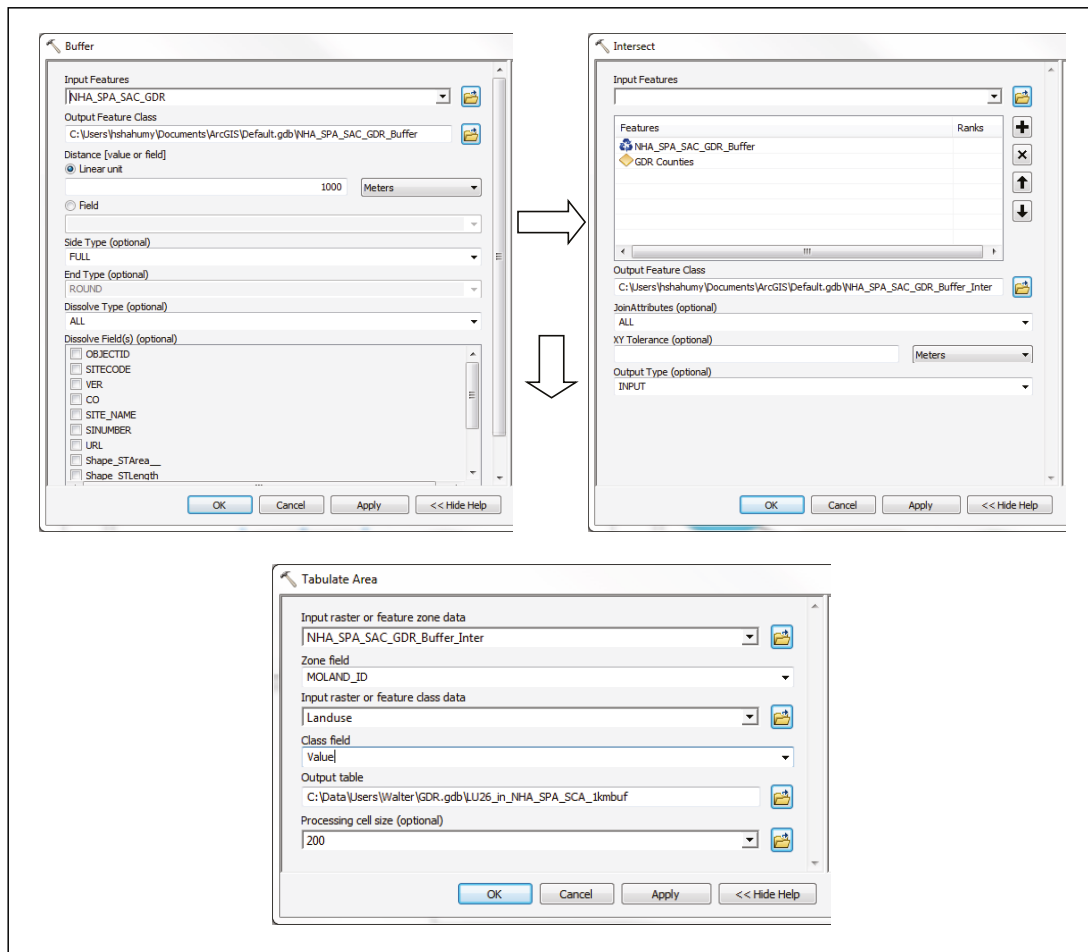


Figure 4.5. Model builder steps.

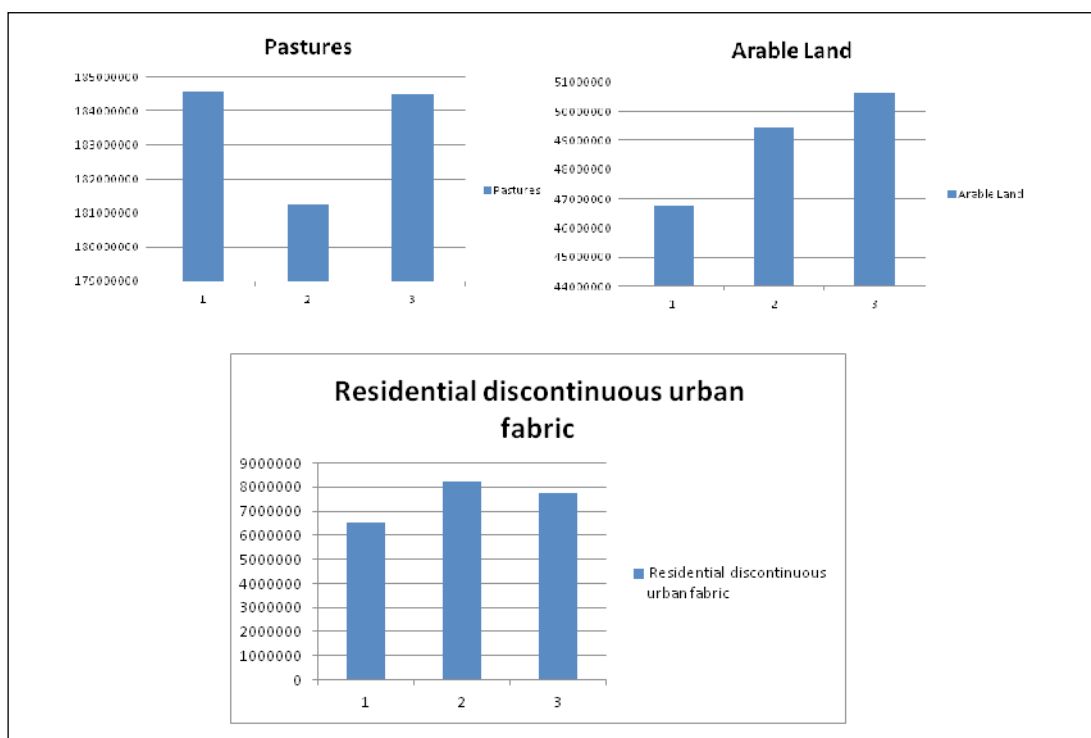
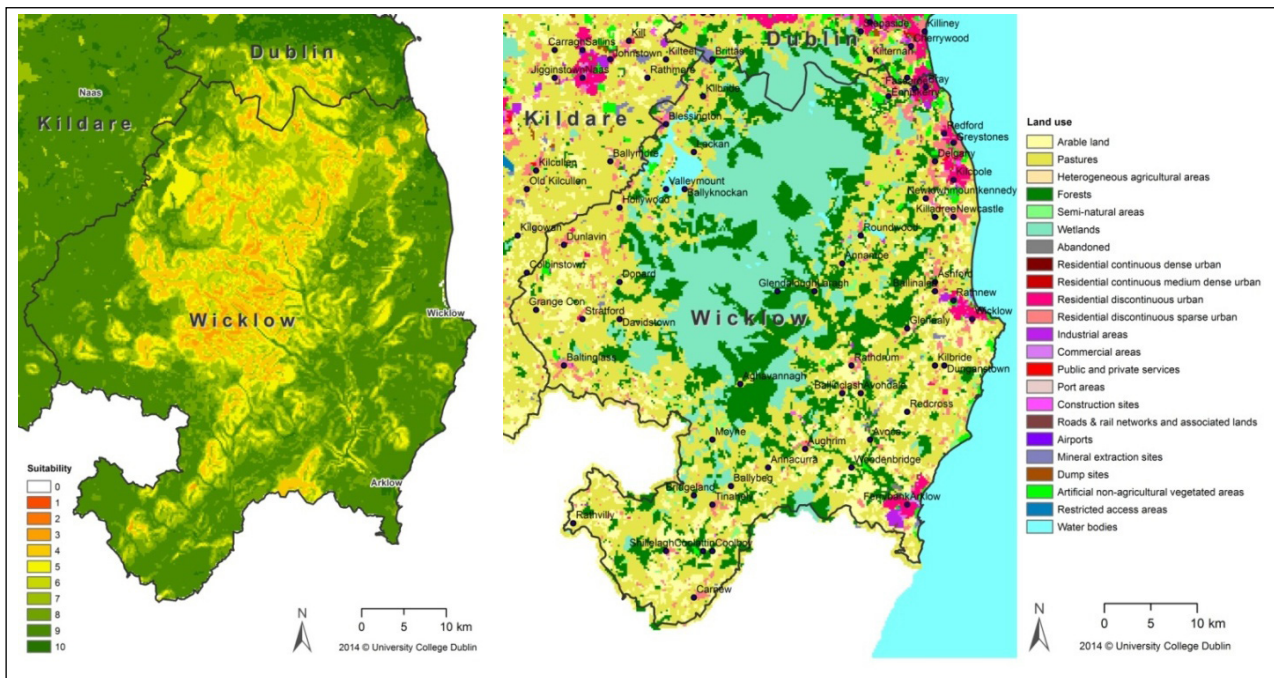


Figure 4.6. Sample land impact output from Excel files for Wicklow generated by MOLAND.

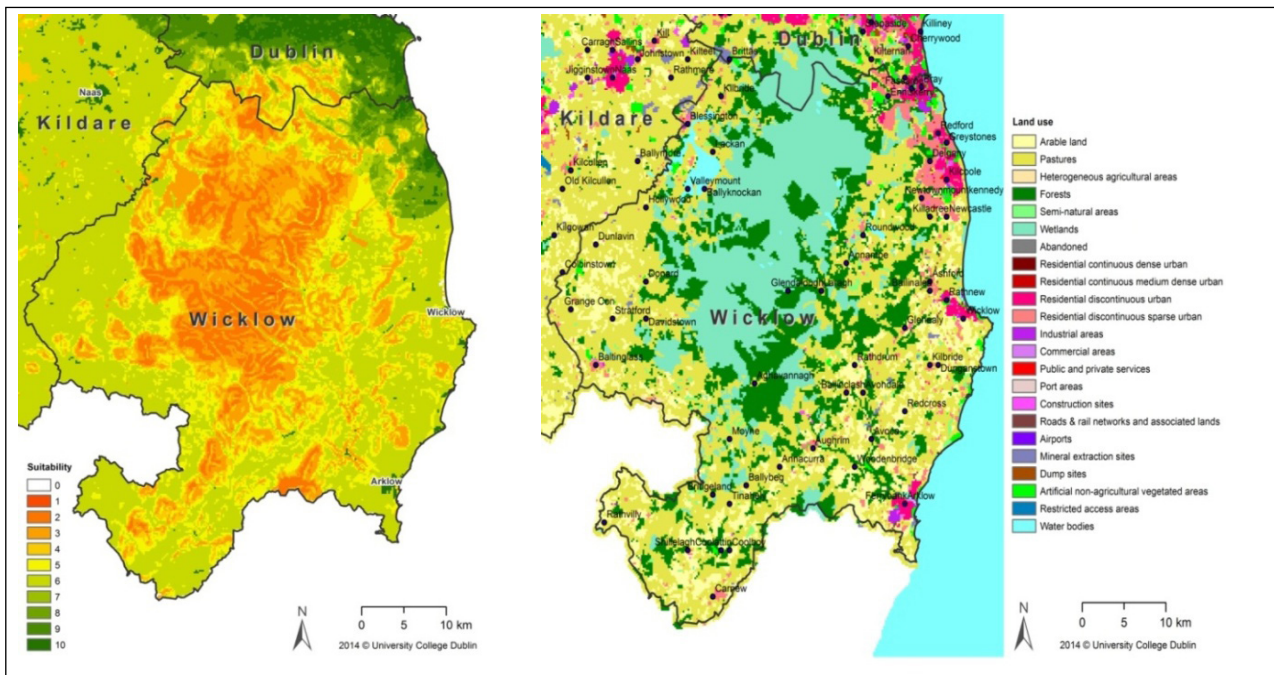


**Figure 4.7. Scenario 1 – Managed Dispersal suitability map (left) and land use map (right).**

Increased suitability in North County is created around key growth centres, as seen in Figure 4.8 (note the greener areas). This results in an increase in residential development in the north of the county. This is evidenced by an increased spread of residential urban

fabric (pink areas) in the north of the county (as shown on the right).

The model user should print and compare Figures 4.7, 4.8 and 4.9, referring back to the assessment of impact described in section 4.3.



**Figure 4.8. Scenario 2 – North County Development suitability map (left) and land use map (right).**

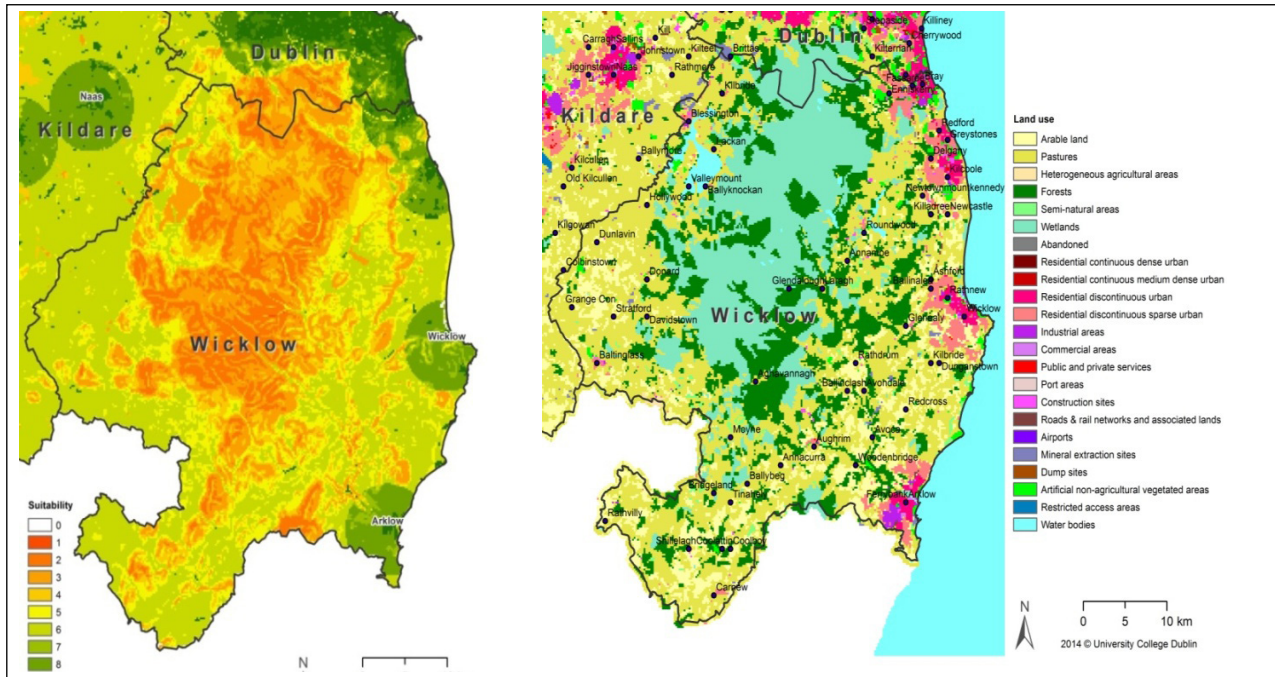


Figure 4.9. Scenario 3 – North and South County suitability map (left) and land use map (right).

## 5 Benefits of using an alternatives modelling tool

1. The model can be used not only for assessment of alternatives but also for their identification. At an early stage, the model can allow the practitioner to play with various alternatives and to establish which appear most reasonable in terms of environmental impact, sprawl or indeed in future iterations, infrastructure capabilities (e.g. wastewater treatment plant capacities). The last example, whereby local-level constraints are incorporated, could be particularly relevant in developing reasonable alternatives at county level. In this way, the model assists the identification of reasonable alternatives.
2. The model provides a means to visually compare and quantify a “do-nothing” scenario against reasonable alternatives (e.g. by visualising a square kilometre of encroachment into agricultural or green areas).
3. The model supplements the requirement to carry out a detailed environmental assessment of the preferred alternative, as it provides both an analysis component and hard evidence of the impact on land use.
4. The outputs of the model may uncover a new alternative that combines elements of other alternatives considered (as occurred in the formulation of alternatives for the Regional Planning Guidelines for the Greater Dublin Area 2010).
5. The model can be used to run contentious alternatives and, in that way, illustrate issues and tensions over settlement strategy options – or even contradict higher tiers of planning. It will provide visual and quantitative evidence of land use impact.
6. The model is inherently based on socio-economic and environmental evidence. In this regard, while alternatives chosen for simulation may not be acceptable per se, analysis of alternative impacts will identify which alternatives should be preferred.
7. The model combines spatial and temporal issues (i.e. illustrating the impact of an alternative over time). In this regard, it can influence positive impacts around the sequencing of development.
8. Use of a modelling tool can realise medium- to long-term resource efficiencies, and a model such as MOLAND can be iteratively built to widen its applicability to other sectors and to different scales.

### 5.1 Methodological considerations

1. The version used to demonstrate MOLAND was created and supplied under licence from RIKS. An updated generic forecasting tool for planners to simulate the integrated impacts of planning policy is available subject to a new licence.
2. MOLAND has been prepared for national-level application through the coding of the MyPlan zonings and the update of POWCAR data on economic activity at household level.
3. It is suggested that groundwater vulnerabilities be incorporated into the suitability layer of the model.
4. MOLAND has been previously calibrated for the Greater Dublin Area (Dublin and the Mid-East Region and County Louth). Calibration across the state is required in order to build greater levels of reliability into the results. Therefore, while the demonstration for Wicklow is reliable, national calibration would still be required in order for results to reliably inform policy.
5. CORINE land use data for 2012 has recently been made available, allowing the use of more up-to-date land cover data.
6. Land use zonings supplied by MyPlan are still being cleaned and are not totally reliable, and inconsistencies in the classification of land use type need to be clarified to run a usable model:
  - (a) Zoning periods are not stated for every zone case. In this instance, it is assumed that the zoning is available from the start of simulation and a code value of “0” is applied. At the moment, the zoning categorisation does not take account of restrictions. For example, certain commercial/industrial zones in Galway County Council (i) are subject to environmental

restrictions and must not impact on residential amenity or (ii) require a stated minimum proportion of residential development.

- (b) Where land is identified as “reserved” by MyPlan it was assumed, for the purposes of MOLAND coding, that it would not be immediately available for development and would be permitted only from zoning period 2 onwards.
- (c) Some zones have multiple identified uses. For example, the model will have identified industrial or employment opportunities, but a zone may also be identified as an area where amenity will be protected and/or enhanced. GZTs have in some instances categorised these zones under one heading (e.g. “commercial”).
- (d) Land zoned as agricultural in MyPlan was coded as “not permitted” in MOLAND. In reality, zonings can change from one plan period

to the next or through “variations” during a plan period. MOLAND is coded based on current zonings with an assumption that the status quo will alter over the period that the model runs for.

- 7. The demonstration shows the value of the development and assessment of alternatives in the model at county level, as realised by the release of national zonings, and, therefore, the model is limited only by the availability of data and resources.
- 8. The current limited demonstration of MOLAND in supporting the best practice guidance *Developing and Assessing Alternatives in SEA* indicates that the model can be used as a reliable forward planning tool to help assess the impacts of alternative choices – and that it could be applied on a wider scale once the methodological issues identified above are addressed and clarified.

# Acronyms and abbreviations

<b>CSO</b>	Central Statistics Office
<b>DECLG</b>	Department of the Environment, Community and Local Government
<b>GDR</b>	Greater Dublin Region
<b>GIS</b>	Geographic Information System
<b>GZT</b>	Generalised zone type
<b>NHA</b>	Natural Heritage Area
<b>RIKS</b>	Research Institute for Knowledge Systems, Maastricht, the Netherlands
<b>RPGs</b>	Regional Planning Guidelines
<b>SAC</b>	Special Area of Conservation
<b>SPA</b>	Special Protection Area





## AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Gníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaoil a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaoil a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

### Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

**Rialú:** *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gclóíonn leis na córais sin.*

**Eolas:** *Soláthraimid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírthe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

**Tacaíocht:** *Bimid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaoil atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaoil inbhuanaithe.*

### Ár bhFreagrachtaí

#### Ceadúnú

- Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaoil:
- saoráidí dramhaíola (m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- an diantalmhaíocht (m.sh. muca, éanlaith);
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe (OGM);
- foinsí radaíochta ianúcháin (m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha);
- áiseanna móra stórála peitрил;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

#### Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaoil.

#### Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuisc; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

### Monatóireacht, Anailís agus Tuairisciú ar an gComhshaoil

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil (m.sh. tuairisciú tréimhsiúil ar staid Chomhshaoil na hÉireann agus Tuarascálacha ar Tháscairí).

#### Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn

#### Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainaitheint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeraíde, an uisce agus na hinbhuanaitheachta.

#### Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaoil in Éirinn (m.sh. mórfhleananna forbartha).

#### Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

#### Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaoil ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaoil (m.sh. Timpeall an Tí, léarscáileanna radóin).
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

#### Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlacha a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

#### Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Measúnú Comhshaoil
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.



## ENVIRONMENTAL PROTECTION AGENCY

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