**Overview, Design concepts and Details (ODD) protocol**

1. **Purpose and patterns**

Travellers are moving across a cost raster surface (created in ArcGIS) from point A to point B. This cost raster represents Mount Melville Park in Albany WA, and the agents are moving from the start and end point of a new proposed ‘cultural walk’. This cost raster includes the following variables:

1. Slope: the smaller the slope, the lesser the cost
2. Existing trails: the closer to existing trails within the park, the smaller the cost
3. Vegetation: Non-vegetated areas have a high cost, and vegetated areas have a low cost.

The traveller moves through the landscape towards the end point of the walk, finding the least cost path (that is, ensuring that each patch the agent travels through has the lowest possible cost associated with it whilst still moving towards the goal).

1. **Entities, state variables and scales**

The model’s entities are patches (grid cells) and agents: travellers and the goal/target (the end point of the walk). The traveller has all x- and y- coordinates for movement, is always facing the goal during the simulation, and is trying to reach this goal using the least cost path through the world. The patches have a 30m x 30m resolution and based off the average walking pace (1.42m per second), it will take the travellers around 20 seconds to pass through a patch in one time step. Each patch has an access value between 0 and 1, with 0 being no access and 1 being very high-level access. The ‘world’ is a cost surface raster of Mount Melville Park imported from ArcGIS.

1. **Process overview and scheduling**

Each time step (tick), the simulation asks the agent its location in the landscape. If the agent is in the same patch as the target, the agent will stop. If not, the agent will move towards the target at a rate of 1 patch per tick. The agent will pick the patch from its surrounding eight neighbours that has the highest access value and will move into that patch.

1. **Design Concepts**

*Basic principles*

This model draws on the theory that when moving through the landscape, a traveller will always try to choose a path that has the least cost associated with it (for example, going around a mountain rather than over it).

*Emergence*A clear least cost path emerges based on the interactions between the travellers and the environment. These decisions are governed by the process models built into the model.

*Adaptation*Adaptation is not modelled directly into this ABM, as the models representing agent responses are fixed (the agent will always try to pick the lowest cost path).

*Objectives*

The agent’s objective is to reach the end point of the walk (the goal) following the least cost path. At each tick / decision point, the agent decides on which direction to go based on which surrounding patch has the highest access level, whilst still moving towards the goal.

*Learning*

There is no learning included in this model, as the rules agents use to make decisions do not change over time. However, there is an opportunity to include a leader/follower model so that any following agents will pick a similar path by learning from the ‘leader’.

*Prediction*

There are no prediction models included in this model.  *Sensing*

Each agent knows their position in the landscape and is aware of the access variable of each patch. This information informs the travellers decisions. *Interaction*

Travellers interact with the target agent by walking towards it and stopping once they reach the target. The travellers also interact with their environment, by observing the access level of each of their surrounding patches and making movement decisions from this interaction.  *Stochasticity*

There is no stochasticity included in this model; all individual travellers start facing the goal, are given the same data and will follow the same route. *Observation*

The observer is looking to see the output of the agent’s movement, which is represented as a line shown across the landscape tracking the agent’s movements. This will be outputted and further analysed in ArcGIS. The length of this trail will be calculated in a plot to estimate approximate time taken to travel the route.

1. **Initialization**

The cost surface raster is loaded from an ascii file. The landscape is coloured on a green gradient representing each patches’ access value (with white = an access value of 0 and dark green = an access value of 1). The start and end point of the walk is loaded from a GIS shapefile. A traveller is initialised at the start point of the walk.

1. **Input data**

Cost raster surface imported as an ascii file from GIS (details above), and the start and end point of the walk imported as a shapefile, also from GIS.

1. **Submodels**

*Update-Plot*

This will create a plot that will plot the access value of each patch the traveller walks through. This will be used to determine areas of higher and lower access along the route

*Store-Output*This identifies patches that have been accessed, and then exports these as an ascii raster file to be used for further analysis in GIS.