HOT BLOCKING[1]

Stephen Forgan[*]

Hot blocking is a crime mapping method that highlights sections of road (or blocks) where the risk of crime is the highest. This paper demonstrates how hot blocking was used to support Operation Trafalgar; a police led operation intended to reduce crime rates in the west end of London in 2012. The case study below sets out how hot blocking was used to rapidly generate geographic intelligence suggesting where and when police should be deployed to reduce violent crime and disorder. Hot blocking is a relatively straightforward crime mapping method to replicate. The technical guidance provided in this paper demonstrates that hot blocking can be delivered with standard analytical software and in time limited scenarios. The results of hot blocking should, however, be quality assured by a crime analyst experienced with the use of geographical information software and aware of the data quality issues often associated with intelligence analysis.

INTRODUCTION

In recent years, the author has developed a data analysis and data visualising method for identifying streets within a city, town or suburb where violent crime is the most prevalent. The method, which for the purposes of this paper will be called "hot blocking", was designed as a way of rapidly generating hot route maps. Maps for displaying geographic

[1] Using geographic information systems (GIS) to combine street network data and crime incident data to identify streets where violent crime is prevalent. A Case Study and a step-by-step guide to implementation.

[*] Crime Analyst, Greater London Authority, London UK. Research fields: Environmental Criminology & Problem Oriented Policing.

intelligence are regarded as key for planning police deployment for operational activity intended to deter crime in public places.

The use of hot blocking in Operation Trafalgar, by Westminster police in 2012, was regarded as crucial for achieving a year on year 33% reduction in violent crime in the West End of London. This was a reduction in violent crime that compared favourably with an 18% reduction across London as a whole over the same period. While no causal link can be proven between the "hot blocking" method and lower crime rates, the results are consistent with similar approaches documented.

Hot routing is a crime mapping method, suggested in the crime analyst manual *Become a Problem Solving Crime Analyst: Clarke, Eck 2003*, as being particularly suitable for communicating where police deployment will have the most benefit for deterring crime and disorder in public places.

Hot blocking was developed by the author to allow such hot route maps to be produced in a timely manner and in doing so support operational police requirements. The method is documented below and does require access to GIS software. However, it has been developed with an emphasis on reducing requirements for technical expertise. ArcView is used here, however the general concept for hot blocking may be useful for those using other types of GIS software.

A key consideration, for those who might use this paper as a resource for developing geographic intelligence, is the recognition of the operational context. Hot blocking was used as a means of rapidly generating geographic intelligence to assist in deciding where and when police might optimally be deployed to reduce crime rates. It was used in combination with other data analysis and expertise to achieve this objective.

In isolation, hot blocking may not be suitable for presenting crime data to other audiences. For instance, evaluating if policy or police operations have been successful or for producing an overview of crime rates for a managerial or general audience.

A case study in the Application of hot blocking follows (from pg 2 to 4). A guide for implementing hot blocking is then covered from page 4 of the paper onward.

I. CASE STUDY: OPERATION TRAFALGAR

A. Policing the West End of London in 2012

Superintendent Steve Osborne of Westminster Police approached the author in 2011 to assist him with data analysis in planning Operation Trafalgar. Operation Trafalgar would be a police led operation calling on the

deployment of 400 additional police with the stated intention of making the West End of London more safe, secure and enjoyable.

The author provided data analysis that helped plan police deployment and tactics over the course of the operation. Hot blocking was regarded as significant part of this process.

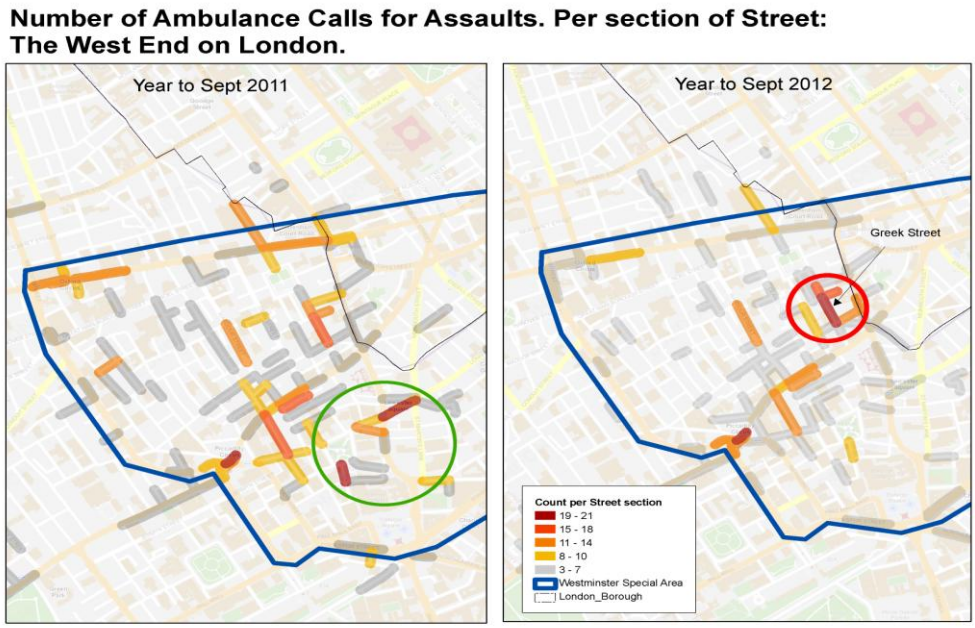
Superintendent Steve Osborne, Westminster Police, had the following comments about hot blocking and the other data analysis provided:

> We used hot blocking in Operation Trafalgar to pinpoint parts of the West End which had the most Ambulance calls to assaults. This helped us deploy officers to the West End so to reduce violence and anti-social behaviour (disorder).
>
> We often have issues associated with pubs and clubs and it was important that we profile these places affected in a clear and meaningful way, so we could respond effectively.
>
> Similarly we needed clear data about our Violence and ASB hotspots. Where and when generally speaking, Violence and disorder had been occurring in the West End so I could plan to prevent crime with the best data to hand.

B. From Data Analysis to Action

Along with hot blocking the author also identified specific Pubs, Clubs and other venues experiencing disproportionate levels of violence and disorder in the West End. The following are further comments from Superintendent Steve Osborne about the additional data provided with hot blocking.

> It was clear where the ambulance crew had to enter specific venues to attend to the aftermath of violent incidents. Having this data to hand was very important for persuading venues to adopt better practice. E.g. Monday night student drink discounts were linked to assaults at a particular venue. Despite the commercial loss in abandoning the Monday nights drink offer, the data supplied helped us persuade the venue to do exactly this.
>
> It was clear where the emerging problem streets in the West End were. And in turn the businesses, hostels, restaurants, pubs and clubs along those streets that appear to be very close to where the action is.
>
> We can now take a closer look at these places. Ask the businesses what their concerns might be, see if there are any opportunities there to tackle the issues in their street. Eg. Reviewing door policy. Giving door staff photos of known offenders to look out for.



Above: Hot blocking. A tool for targeting problem streets.

We identified specific sections of street to focus on. (The area circled in green, on the map to the left.) They improved significantly through Operation Trafalgar.

Hot blocking allowed a clear insight into where and when, generally speaking, Violence Crime had been occurring in the West End, so I could plan to prevent violence and ASB with the best data to hand.

The author provided geographic intelligence for Operation Trafalgar similar to the above, which clearly demonstrated the sections of street (or blocks) where violent crime had been the most prevalent. This was regarded as crucial for making optimal decisions about police deployment.

Further Insight: "Timeslot" analysis, below, was used to identify the times of week when "hot blocks" where at highest risk of violent crime.

Time of week (or timeslot analysis) was also provided to support planning for Operation Trafalgar. It allowed another dimension to be considered in the targeting of police activity. Charts, similar to those seen below, where used to demonstrate when (the peak timeslots) violent crime occurred in different parts of Westminster.

Time of Week Analysis

Around Greek Street (Circled) Year to 2012

Hour of Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Incidents by Hour of Day
12 - 1am	0	0	2	0	0	0	0	2
1 - 2am	1	0	0	0	0	3	0	4
2 - 3am	1	1	1	1	1	2	4	11
3 - 4am	3	1	2	1	3	3	1	15
4 - 5am	2	0	1	0	1	3	1	8
5 - 6am	0	0	0	0	0	0	0	0
6 - 7am	0	0	0	0	0	0	0	0
7 - 8am	0	0	0	0	0	0	0	0
8 - 9am	0	0	0	0	0	0	0	0
9 - 10am	0	0	0	0	0	0	0	0
10 - 11am	0	0	0	0	0	0	0	0
11 - 12pm	0	0	0	0	0	0	0	0
12 - 1pm	0	0	0	0	0	0	0	0
1 - 2pm	0	0	0	0	0	0	0	0
2 - 3pm	0	0	0	0	0	0	0	0
3 - 4pm	0	1	0	0	0	0	0	1
4 - 5pm	0	0	0	0	0	0	0	0
5 - 6pm	0	0	0	0	0	0	0	0
6 - 7pm	0	0	0	0	0	1	0	1
7 - 8pm	0	0	0	0	0	0	0	0
8 - 9pm	0	0	1	0	0	0	0	1
9 - 10pm	1	0	1	0	0	0	0	2
10 - 11pm	0	1	2	0	0	0	0	3
11 - 12pm	0	0	0	0	1	1	1	3
Incidents by day of Week	8	4	10	2	6	8	7	50

West End Area Year to 2012

Hour of Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Incidents by Hour of Day
12 - 1am	8	3	9	7	9	16	12	64
1 - 2am	4	9	4	9	6	23	17	72
2 - 3am	4	8	10	9	10	27	21	89
3 - 4am	13	14	14	18	22	39	43	163
4 - 5am	6	7	4	4	9	25	19	74
5 - 6am	0	4	2	2	2	9	9	28
6 - 7am	1	1	0	2	2	3	4	13
7 - 8am	0	0	1	0	1	3	6	11
8 - 9am	0	0	0	1	0	1	1	3
9 - 10am	0	0	1	1	0	1	1	4
10 - 11am	0	0	0	1	0	0	0	1
11 - 12pm	1	2	1	1	0	0	1	6
12 - 1pm	1	1	0	1	0	0	1	4
1 - 2pm	1	1	1	1	0	1	0	5
2 - 3pm	1	0	0	0	1	2	0	4
3 - 4pm	2	1	1	2	2	2	1	11
4 - 5pm	2	1	2	2	2	2	2	13
5 - 6pm	1	3	1	4	1	1	2	13
6 - 7pm	2	2	0	0	0	5	3	12
7 - 8pm	1	2	2	1	4	1	1	12
8 - 9pm	1	1	2	0	5	2	1	12
9 - 10pm	4	2	3	3	6	4	4	26
10 - 11pm	1	4	7	8	7	6	1	34
11 - 12pm	5	4	4	7	14	10	3	47
Incidents by day of Week	59	70	69	84	103	183	153	721

Rest of Westminster Year to 2012

Hour of Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Incidents by Hour of Day
12 - 1am	7	10	9	8	7	19	10	70
1 - 2am	7	4	8	6	13	23	22	83
2 - 3am	9	5	6	15	7	22	17	81
3 - 4am	5	11	7	11	12	18	31	95
4 - 5am	4	10	5	5	4	9	23	60
5 - 6am	3	3	1	0	1	8	6	22
6 - 7am	2	0	1	2	3	0	3	11
7 - 8am	1	5	0	1	4	3	6	20
8 - 9am	4	5	3	1	1	3	6	23
9 - 10am	3	3	2	2	2	4	2	18
10 - 11am	3	5	0	1	4	4	2	19
11 - 12pm	6	2	6	5	4	3	2	28
12 - 1pm	3	4	11	4	8	4	1	35
1 - 2pm	6	6	5	4	10	5	1	37
2 - 3pm	6	7	6	2	6	3	6	36
3 - 4pm	5	5	9	9	6	8	9	51
4 - 5pm	10	7	13	6	9	12	10	67
5 - 6pm	4	5	11	6	10	8	10	54
6 - 7pm	5	5	5	7	5	13	6	46
7 - 8pm	9	13	8	8	3	8	3	52
8 - 9pm	7	5	6	12	17	11	10	68
9 - 10pm	12	13	6	4	12	7	12	66
10 - 11pm	14	13	6	6	13	15	17	84
11 - 12pm	8	9	12	15	13	11	14	82
Incidents by day of Week	143	155	146	140	174	221	229	1208

Further guidance notes and software for hot blocking and timeslot analysis can be provided by contacting the author at *londoncrimeview@gmail.com.*

C. Evaluation

A statistical evaluation of Operation Trafalgar, undertaken by Westminster Police, shows that violent incidents requiring ambulance attendance fell by 33% between 2011 and 2012 in the West End. Over the same time, these types of incidents fell by 18% for all of London.

Superintendent Steve Osborne had the following comments on reviewing the work associated with hot blocking:

> With the support of hot blocking to target our activities, ambulance call-outs to violence dropped by a third in the first half of 2012 compared to the first half of 2011 in the West End. (down from 361 incidents to 239)
>
> This compares well to the overall drop in 18% in ambulance recorded assaults across London over the same period.
>
> Hot blocking provided clarity about where and when particular police activities should be targeted so as to maximize our efforts to cut violent crime.

II. A STEP-BY-STEP GUIDE TO HOT BLOCKING

This section is intended to support GIS users who may wish to visualise crime data as a "hot route" map as depicted in the JDI's 55 steps manual.[2]

[2] Become a Problem Solving Crime Analyst: Clarke, Eck 2003.

A. Introduction

The approach documented here, is what the author has devised for the specific purpose of providing geographical intelligence in a time-limited scenario. In the case study above, the following steps where taken to identify the key street sections (or blocks) affected by violent crime. Despite the need to produce the intelligence rapidly, the author and all involved in using the maps, were confident in their accuracy and the context and clarity with which they were presented.

The difference with hot blocking, from approaches readers may be familiar with, is that hot blocking does not involve rendering the street line data itself. It involves creating buffer zones around all but the shortest of lines, and then calculating the number of crime incident data points that fall within each zone.

B. Technical Requirements

1. In brief

GIS Software (Arcview used here for purposes of demonstration)

Street network data [UK Ordnance Survey: Integrated Transport Network Layer (ITN) *Roadlink* data was found by the author to be particularly suited to generating the hot block layer]

Incident location point data (Ambulance Data used in case study)

2. Key Steps

Buffer zones around street route data:

For your area of interest, use your GIS software to create buffer polygons around all street line sections (filtered by length over 30 meters) from your Street network data. The ability to "buffer" line segments is available with standard licenses of Arcview or MapInfo.

The Ordnance survey website describes Roadlink data as follows: "Individual sections of road are represented by RoadLink features, which show the general alignment of the carriageway. RoadLink features have attribution to describe the type and nature of the road".

The author found that this generalised representation of street and road sections lend themselves to hot blocking more than a more detailed representations of the roads might (e.g. with double line to represent dual carriageway).

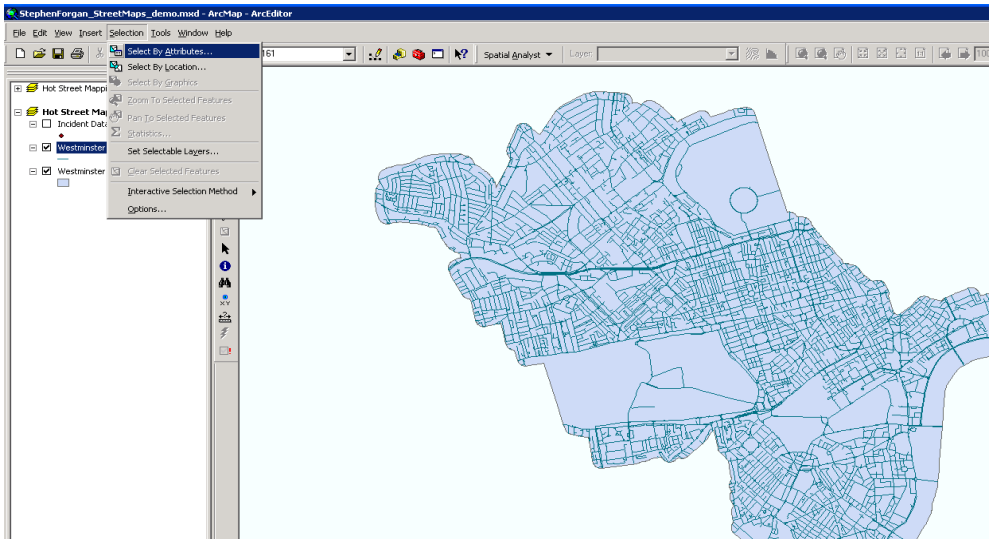
Count the number of crime incidents that occur near each section of

street:

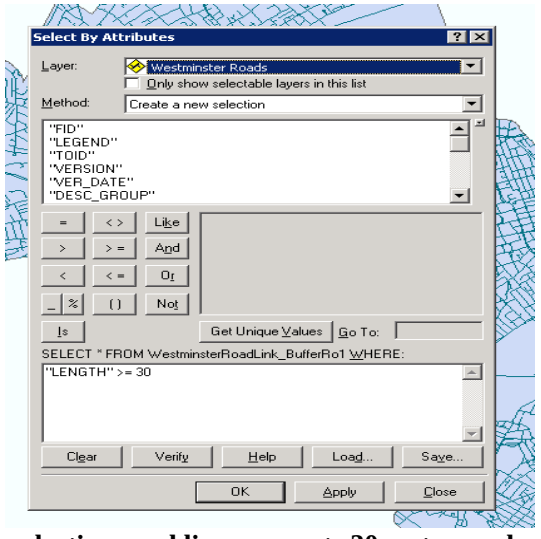
Using your GIS software, calculate the number of occurrences per street line section buffer where there is a geographical intersection with your selected Incident Location data.

a. Steps for Creating Street Line Buffer Layer for Geographic Analysis

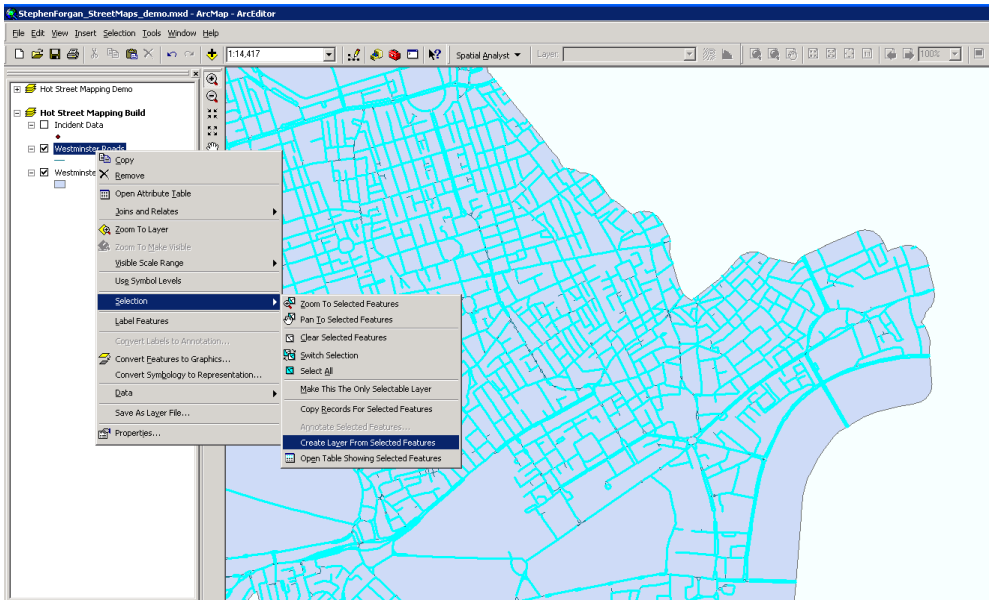
Selecting out all the line segments from the street line coverage that are greater than thirty metres.



Above: Opening the "Select by Attributes tool" in ArcView.



Above: Tool for selecting road line segments 30 metres or longer in Arcview.



Above: Tool for creating a new layer including only the lines just selected.

Suggestion: After selecting street lines that are greater than 30 and look for any continuous stretches of sub 30 metre lines. If it looks like your crime data might not be captured in such areas of the map, you might consider adding a few zones manually to cover these areas.

b. Steps for Creating Buffer Zone Polygons Around Each Line Segment Layer You Selected

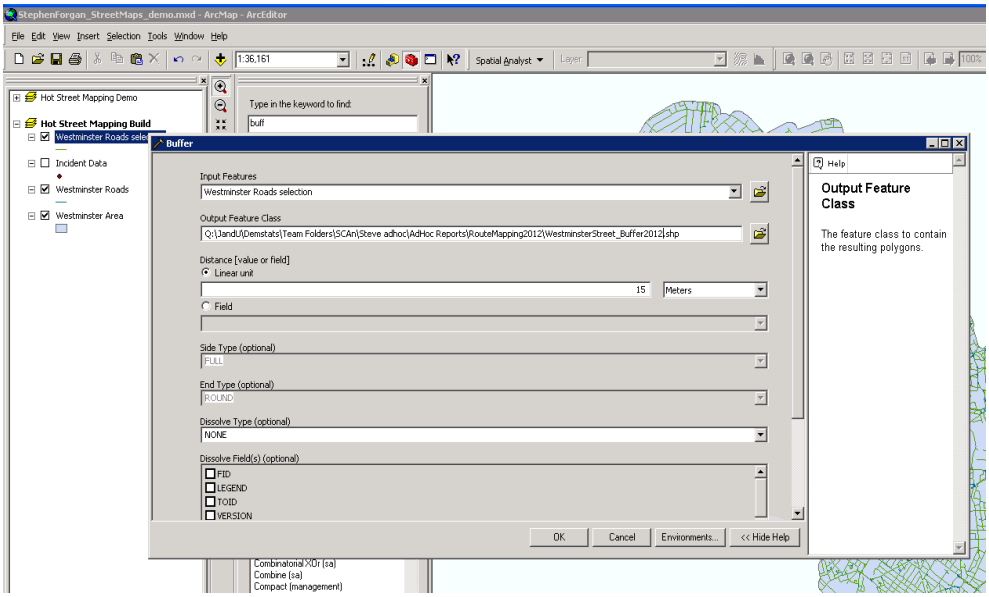
Using Arcview you can then generate a buffer polygon around each line. The case study above used a buffer of 15 metres. You will need to set the buffering tool to create individual buffer zones for each line segment (In Arcview, this requires keeping the default setting for dissolve: as shown below)

> Note: Some GIS users may find the subsequent generation of so many overlapping polygons off-putting. However, removing the small line segments, as suggested above, does reduce the cluttering of overlapping buffer zones. Further to this, having the streets "worms" overlap in this way can, using thematic rendering as set out below, create a "risk gradient" effect similar to density maps.

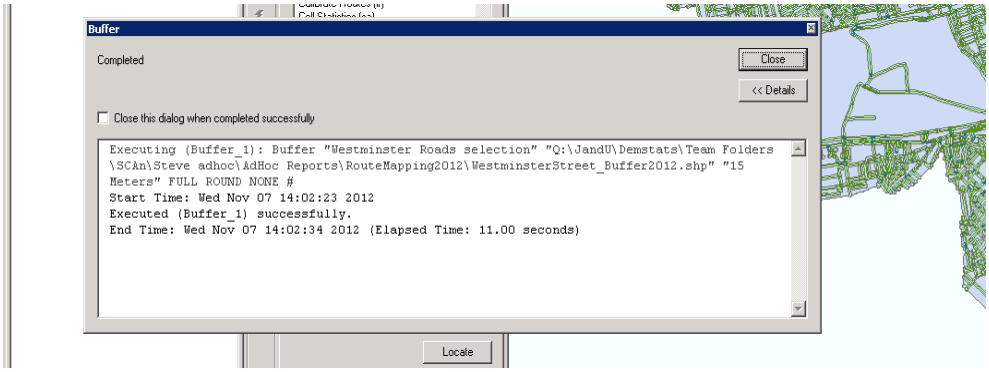
Below: Using the *Buffer* tool in Arcview. Being sure to:

- Set your layer of selected lines as the Input Feature.
- Setting your distance value to 15 metres.
- Keep the default setting for Dissolve Type as "None".

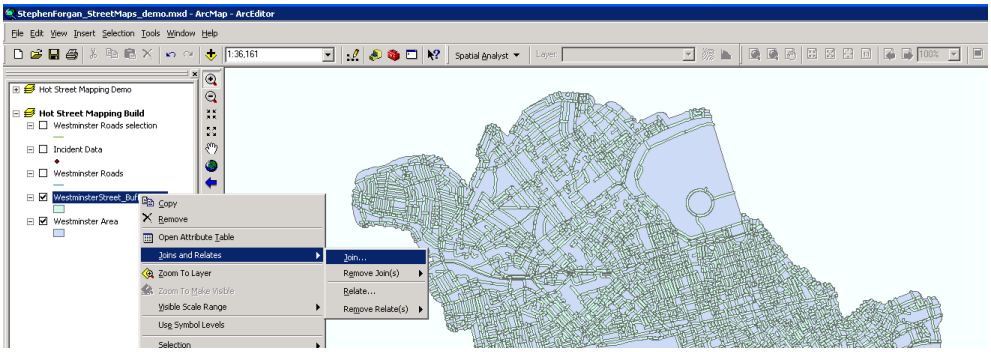
- Set “Output Feature Class” to suitably name and file the buffer file you are about to create.



When buffering is complete, the new file appears in your map view ready for the next step with an on screen message of completion similar to that seen below:



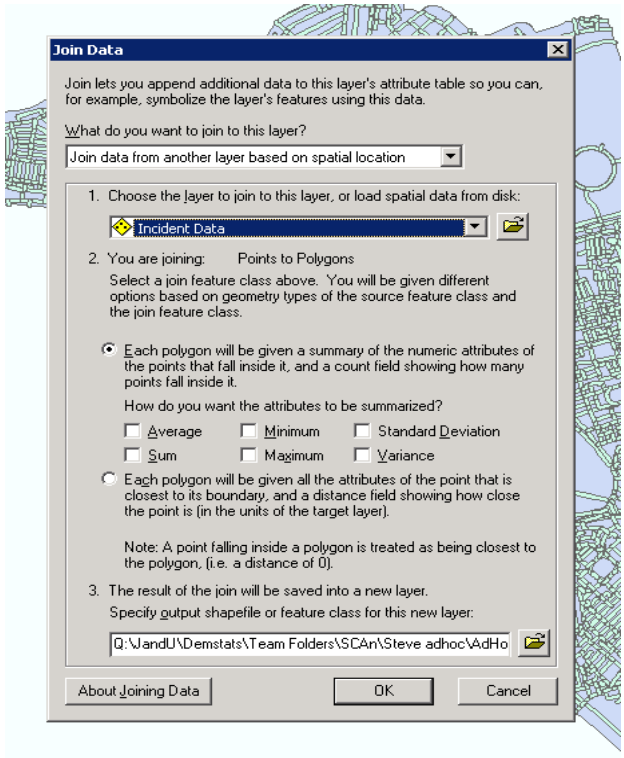
c. Steps for Calculating the Number of Incident Points Geographically Intersecting with Each Buffer Zone



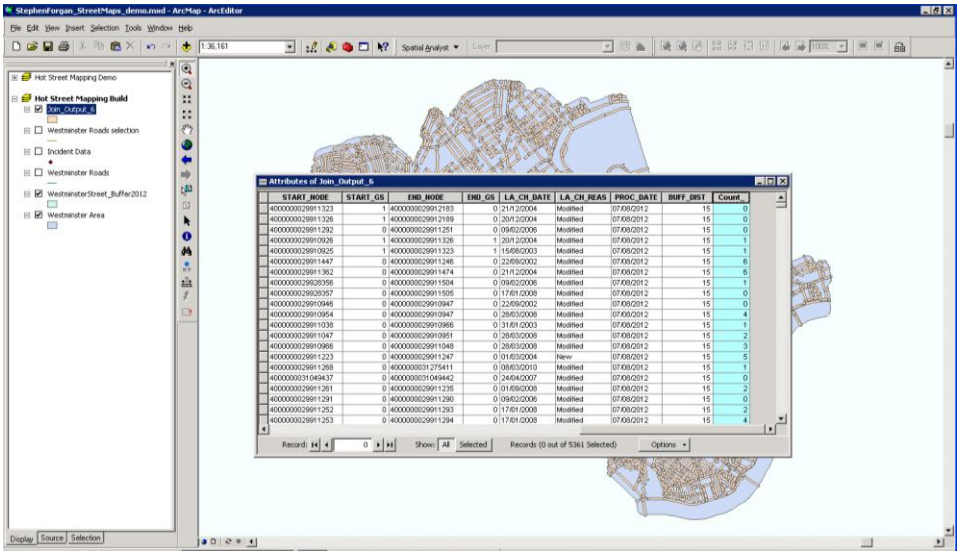
Above: Right click on the buffer file you just created and select "join".

In Arcview you can then use the "Join data based on Spatial Location" tool to calculate the number of incident data points that intersect with each buffer zone.

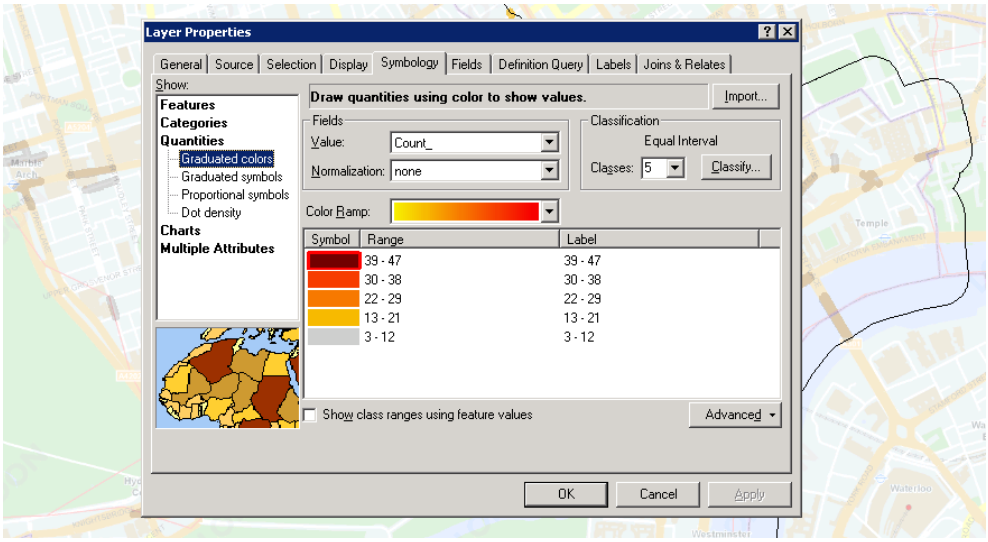
(This value is automatically added as a column to the new Join layer that will be created an added to your ArcView project). Once your "Join Data" tool looks like the image below, click Ok. The Spatial Joining process will then take a few minutes or more to run depending on the size of the data sets you are working with.



The join layer created will contain an additional column of data containing the count value for the number of incidents that occur within 15 metres of each street line segment (*see* column in table highlighted below).



d. Steps for Rendering the New Buffer Zone File on the Incident Count Field Created

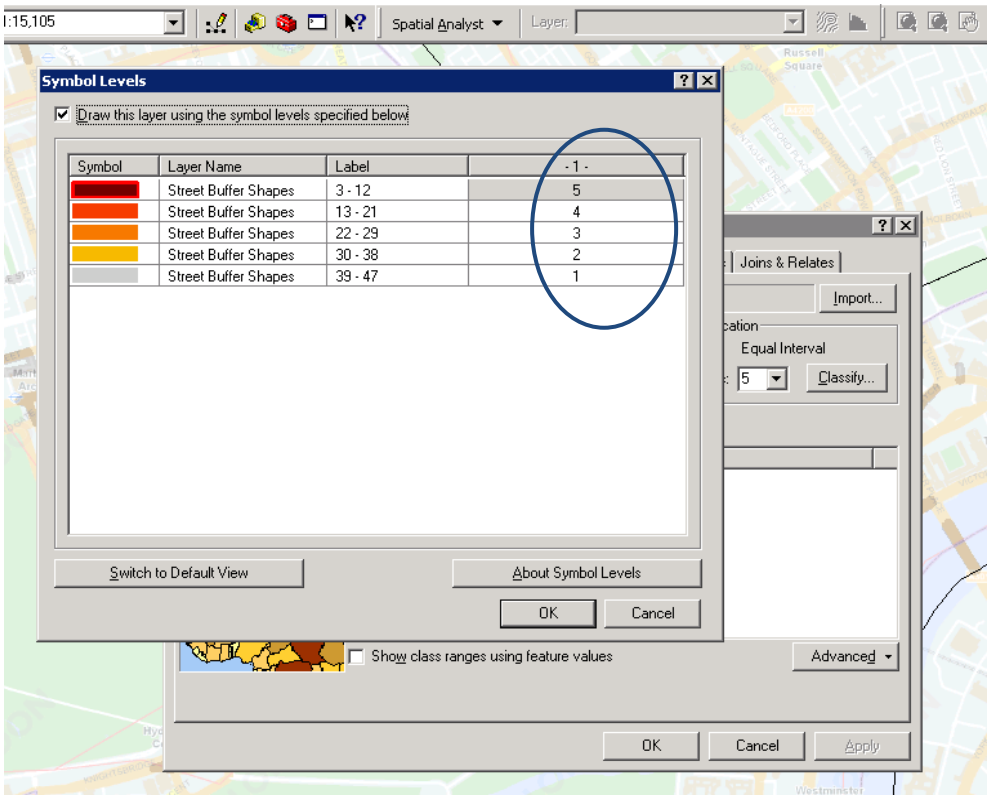


Above: In Arcview: Right Click on new data join layer and select "properties". Use a "graduated colours" scheme found under Layer properties/ Symbology/ Quantities.

Select a suitable colour scheme using the colour ramp options.

Right click under the symbol column and remove the outline from all symbols.

3. Advanced Symbology



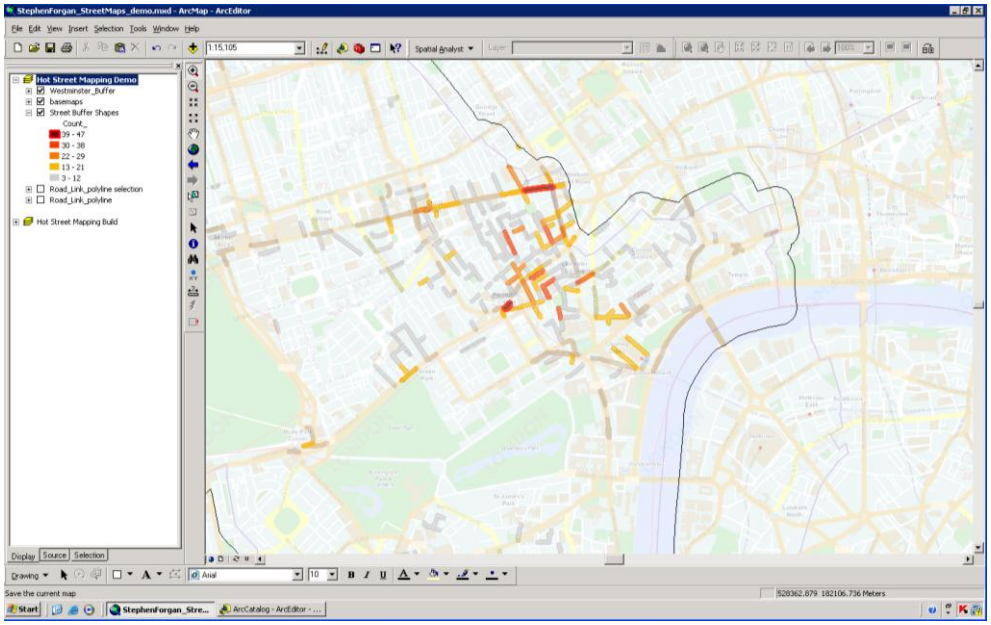
Above: Select "Advanced" in Symbology (Circled Below) to set the order with which the polygons are drawn in line with thematic range you just created.

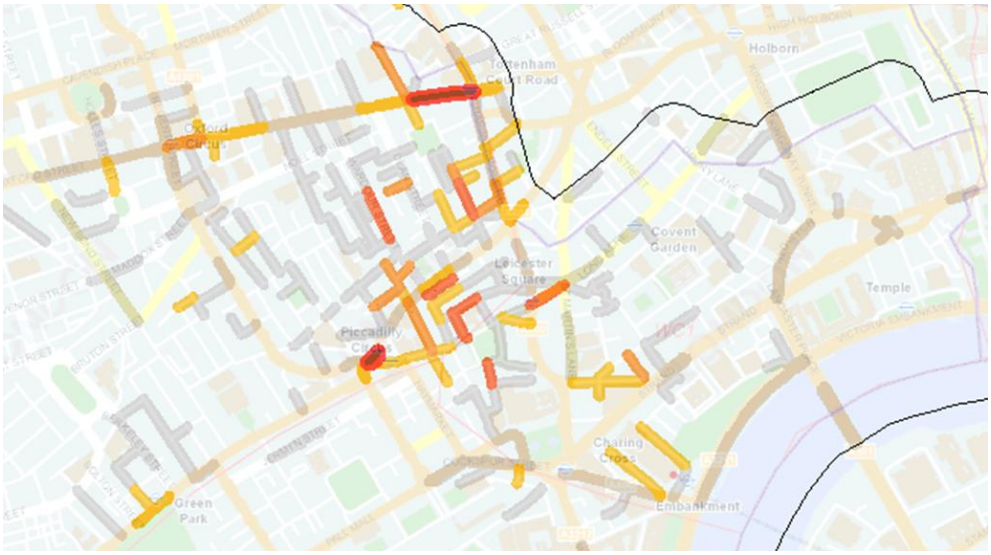
Set the numbers shown in the blue circle to set the order "weighting" of each symbol range. The higher the weighting, the higher the respective polygons will be displayed in the drawing order.

By applying advanced symbology in this way you are ensuring that the buffer zones with the higher values are drawn over the top of the less significant street sections when buffer zones overlap. With this you are working toward a clear way of presenting the geographic intelligence despite the apparent clutter of overlapping buffer zones generated from street line data.

Some other suggestions for refining the appearance of hot blocks:

- Making the layer semi transparent.
- Excluding buffer polygons with zero or low values.
- Background mapping to add context and clarity.





Above: Note how clear information about streets/ blocks can be derived with rendering techniques in GIS software, ArcView, despite the clutter of overlapping polygons.

CONCLUSION

In the case study, the author was able to generate multiple hot route maps rapidly, based on a template similar to that seen above. He was then able to reuse that template for further similar purposes with a minimum of

effort. This may be an important consideration for other crime analysts who are tasked in the provision of key geographic intelligence about crime patterns.

The crime prevention activities that hot blocking is particularly suited to, are set out in step 21 from the JDI's 55 steps manual as cited.

You may need to make some manual modifications to the street line buffer layer used in this process, but generally speaking it should be possible to follow the steps above to rapidly generate useful intelligence for activities such as identifying streets (blocks) that might benefit most from an enhanced or more intensified police presence.

You may find it more statistically elegant to normalize the data counts by the calculated area of each buffer zone (as the buffer zones vary in size and subsequently the probability with which they will capture crime incident locations), however, in the case study this did not appear to add significant value as a visual aid. In fact simple counts were probably an easier concept to communicate than a rate per area.

The intention of this paper was to provide ideas for adapting hot route mapping concepts for typical crime prevention contexts. Hopefully "hot blocking" as presented here will be of use to data analysts and the information here contained will allow ongoing improvement in analytical techniques resulting in improved crime prevention outcomes.