# White Paper: **National Tree Map™ Applications**

*"You'll be astonished what you can do with NTM™"*


## Abstract

The National Tree Map™ (NTM™) is a unique map which contains the location, height and spread of almost every tree in England and Wales. The map is already widely used among tree managers and practitioners. There are a wealth of applications for such an important source of information and this paper, which highlights some of these applications, is aimed at anyone involved in tree management. The paper also gives technical details and an overview of how the map was created, the input data, and it's continual evolution.



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## Executive Summary

This paper is aimed at providing the reader with an introduction to Bluesky's National Tree Map™ (NTM™) product; this unique mapping product provides the user intelligence about the height, size and location of trees in the UK.

Trees, woodlands and forests have a very special place in UK culture and have provided us with many of the essentials of life through history. Their health is essential for our wellbeing and prosperity. They shape our landscapes and street scenes. Our choices today will shape our future and the future of the environment. UK Government ambition is for a major increase in the area of woodland in Britain, better management of existing woodlands and a renewed commitment to conserving and restoring ancient woodlands. Forests and woodlands must play a full part in achieving a resilient and coherent ecological network across Britain.

Trees have an impact on public health; it is estimated that health benefits are worth about £300 per person per year if they live within sight of trees and green space. Conversely certain trees produce huge amounts of pollen which affect hay fever sufferers.

***Figure 1*** *- NTM™ can be used in conjunction with many other datasets*

The UK has hundreds of millions of trees. In general, these trees are very poorly mapped, particularly in urban areas and there is no standard for those that have been spatially recorded. Currently the mapping and managing of these valuable assets is carried out in an ad-hoc fashion often involving costly fieldwork, or using 'broad brush' techniques which rely on data inputs from non-specialists. This presents a range of problems for both public and private sector organisations. NTM™ has been developed to change this. NTM™ is a digital map database of trees derived from high-resolution aerial photography, accurate surface models and other geographic data, including infrared imagery, that provides a cost-effective solution to custodians responsible for the effective mapping and management of trees in our various environments.

This white paper discusses NTM™, what it is, how it was made and why it has become essential to many mainstream applications.

## Introduction - What is NTM™?

NTM™ is a digital map layer and database accurately depicting and recording the location and extent of trees. Designed as a tool to aid local authority officers, insurance assessors, property developers and asset managers to name but a few; NTM™ details the spatial location and height of individual trees, together with the circumference of its crown. From this information many potential impacts can be assessed.

The maximum and average heights of the crown and the size of the crown of each tree are calculated automatically using robust algorithms applied to a range of Bluesky's own highly accurate geographic data, including aerial photography, colour infrared, LiDAR and digital surface models. Bluesky's team of editors, trained in accurate photo-interpretation, examine the resulting data to ensure consistency and quality control.

The initial LiDAR data can be further enhanced using additional post processing, some of which can be automated and some are manual. Further processing utilises the multiple return signals from each laser pulse. By evaluating the time differences between the multiple return signals the post processing system can differentiate between buildings and other structures, vegetation, and the ground surface. This process is used to remove surface features to produce bare earth models - Digital Terrain Models (DTM), and other enhanced data products. For example, it is also possible to do selective feature extraction, such as the removal of trees and other vegetation to leave just the buildings.

## NTM™ Data

NTM™ is delivered in formats suitable for use in desktop Geographical Information Systems (GIS), web mapping applications and Computer Aided Design (CAD) packages. The fact that NTM™ comprises both 2D location and 3D height measurements means it can be viewed and interrogated in both 2D and 3D GIS and CAD software. It should be noted that as NTM™ is simply a database it can be provided in all common database, text or spreadsheet formats.

The data itself comes with three layers, one showing the actual outline of the tree canopy as an irregular vector polygon. This has then been idealised as a circle with the same area, which can be used for illustrative purposes, and the final layer is a simple point file which displays a point at the position of the highest point of the tree. All three layers are attributed with several metrics relating to the tree, including maximum & average height as well as the area of canopy coverage.

In order to create such a huge and multifaceted dataset some very complex algorithms had to be developed and applied to a source of accurate and detailed input data. This was initially done by Bluesky's team of GIS and Remote Sensing experts using Bluesky off-the-shelf data, including aerial photography, near infrared data and digital elevation data. The first iteration of NTM™ took several years to perfect, but was slow to process. Continuing product development of NTM has improved not only the overall quality of the data but the speed of processing. This has been done by developing new dedicated algorithms from scratch rather than using proprietary software, and introducing dedicated servers to perform the processing. NTM™ 2.0 is now even more accurate with more trees captured, and the future of the continual update of NTM™ has been secured, with NTM™ now being a standard product of the Bluesky portfolio, which is updated every three years.

***Figure 2*** *- The 3 layers of NTM™ (crowns, canopy & height points)*

# NTM™ Applications

There is a broad scope of applications for NTM™ with new uses regularly being discovered, but what is very apparent is that knowledge of the location and size of individual trees provides additional benefits to practitioners working in many market sectors. Whilst trees are beautiful, enhance the landscape, bring an element of tranquillity to a busy city centre, they can often also present significant challenges. NTM™ can help to meet these challenges. The main applications have been detailed below.

## Tree Management

Anyone that needs to 'manage trees', from Local Authority practitioners to agriculturalists to ecologists, all need to know the location of the trees. Many of these practitioners work from out-of-date information and manually compiled data, which often contains inaccuracies. A tree recorded even a few metres away from its true location can make a big difference to infrastructure or shading.

Local Authorities have a mandate to manage trees in public spaces and green spaces. Due to budget constraints this is not always done as effectively as it could be. A step in the right direction is to know the location and size of every tree. This can help with Tree Preservation Order management, planning, canopy cover statistics and biomass calculations and even prevention of blocked drains. Planting new trees too closely to other established trees can lead to growth being suppressed and ultimately a tree failing and being removed. NTM™ has been successfully deployed in several Local Authority systems, including Cambridge and Carlisle City Councils, Central Bedfordshire and Milton Keynes. The data is used to model and manage urban greenspace, calculate how many trees are on council land and aid in the planning of tree planting strategies, and the effects of climate change. Using NTM™ data can replace more traditional surveys and inform arboriculturalists where existing trees are without the need for ground survey work.

Concern about the location of trees is often a major worry to house owners, not only when trees cause damage through subsidence but also because the proximity of trees can jeopardise house purchases, lead to insurance claims, affect planning applications and mortgage loans, and even cause disputes between neighbours. Effective management can ease concerns and reduce claims against councils in relation to damage created from trees under their jurisdiction.


***Figure 3*** *- Each NTM™ data point contains height and spread of each tree*

## Insurance

Building subsidence is estimated to cost the insurance industry in excess of £500 million after each dry year and is usually the second most expensive insured peril after fire. Trees are implicated in 70% of reports of subsidence and heave on clay soil, with the South East being most prone, particularly those homes built on London clay. Trees greater than 26ft (8m) tall within 33ft (10m) of a property cause the most concern. A mature deciduous tree can draw up to 500,000 litres of water a year from the surrounding soil, in the summer such withdraw leads to the soil drying out and this can lead to foundation subsidence. It is crucial that insurance companies know the locations of such trees in order to mitigate the risk.

Several large insurance companies are using the NTM™ tree data to assist in policy creation and claim management. NTM™ has been shown to help in these areas and is an easy to use product that saves insurance companies time and money. As well as subsidence trees can cause other issues for insurance companies. Falling trees can cause damage and knowing the location of trees in an area can assist with claims management or help an insurer identify risk before an event, such as windstorm.

***Figure 4*** *- NTM™ clearly identifies the location and size of every tree*



***Figure 5*** *- Knowing the location of trees can help with maintenance of underground assets*

## Ecology & Habitats

Lone trees, woodland and trees in hedgerows create important ecologies. For those who work in this sector, knowledge of the location of trees in order to manage and maintain ecological areas and habitat pathways is essential. NTM™ has been used by organisations to help them understand and manage ecologically sensitive areas, but also to identify where habitat can be improved by replanting. Conversely planting new trees too closely to other established trees can lead to growth being suppressed and ultimately a tree failing and being removed. Using NTM™ to aid area planning and future expansion of tree planting is proving essential to mitigate against such risks.

The Woodland Trust use NTM™ nationally to undertake assessments of tree cover, as it is the most accurate and up-to-date source of tree information available. They also use NTM™ in urban areas to develop resilient "treescapes". Assessment of habitats, linking of woodland patches, soil consolidation, insect pollinator habitats and protection are some other additional applications that are being applied.

***Figure 6*** *- NTM™ is invaluable in the management and maintenance of woods, forests and associated habitats*

## Maintenance and Management

### Overhead Powerlines

Vegetation infringement on overhead power lines is one of the major causes of power outages in the UK. During severe weather events, falling trees bring down or damage overhead cables, in addition the effect of a tree brushing against a cable can also cause problems. NTM™ informs those responsible for keeping overhead lines (both power, rail and telecoms) clear of infringing vegetation, by highlighting the proximity of trees to the line. NTM™ has been used very successfully by Distribution Network Operators (DNOs) to assess their network and put risk based cutting plans in place, which allows for much more targeted cutting, based on the risk imposed on each individual span. This method of determining proactive cutting plans has been proven to save DNO's many millions of pounds annually.

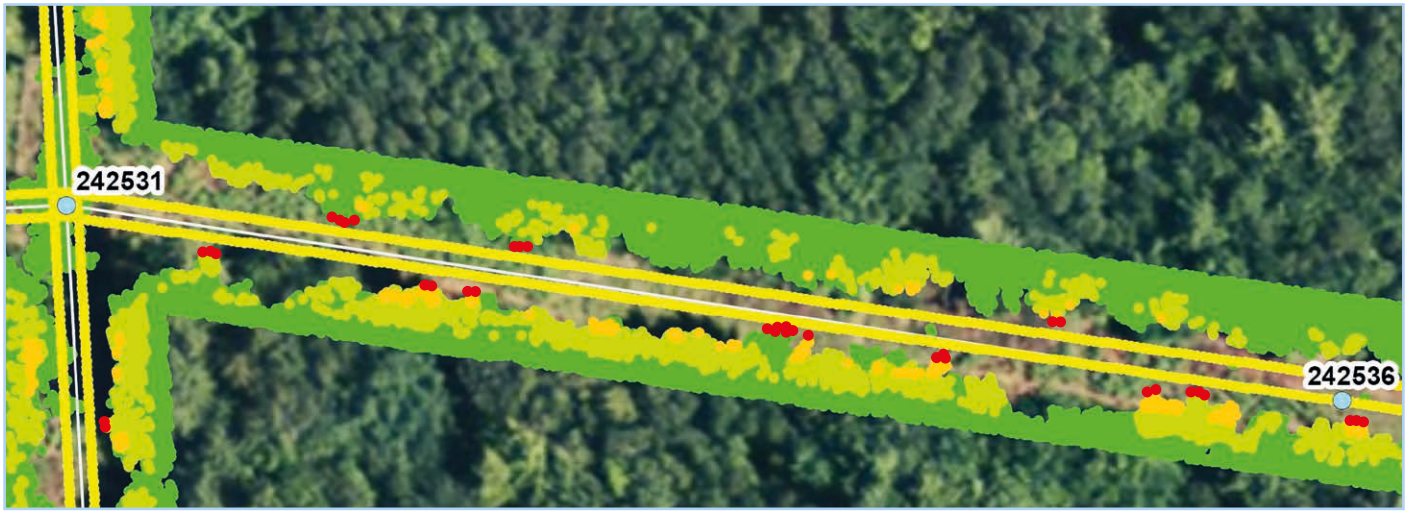


***Figure 7** - NTM™ can be used to prevent damage caused by trees on overhead powerlines*

### Railways

"Leaves on the line" is a common issue for rail travellers so understanding the size and location of vegetation is of great value to railway operators in order to manage their maintenance programme. Just like DNO's, effective targeting of maintenance crews saves significant time and money.

### Utilities

Cable and pipe avoidance is critical to the successful installation and maintenance of electricity, water, gas and communications infrastructure both above and below ground. Tree roots can cause significant damage to the water pipe network resulting in loss of water and disruption to customers. Work undertaken by Cranfield University demonstrated that sewers are 1.4 times more likely to be damaged if they are in proximity to a tree and 1.8 times if there are more than 3 trees nearby. This work has provided valuable evidence and insight into the level of damage caused by tree root incursion enabling maintenance crews to target potential weak spots in their infrastructure before they become a major incident.

## Leaves and Biomass

Understanding the location and size of trees can help with the calculation of biomass and the expected volume of leaves that will fall. This ensures that potential blocked of drains from leaf fall can be managed and effectively removed before they cause roads and property to flood, incurring significant clean up and repair costs. The London Borough of Bromley are using NTM™ to prioritise their autumn street cleaning program. Fallen leaves can cause a hazard and disruption to travel and drainage. Using NTM™ makes the leaf clear up more targeted and more efficient.

NTM™ can be used to estimate biomass of a given area which in turn can be used to assist with carbon sequestration calculations.

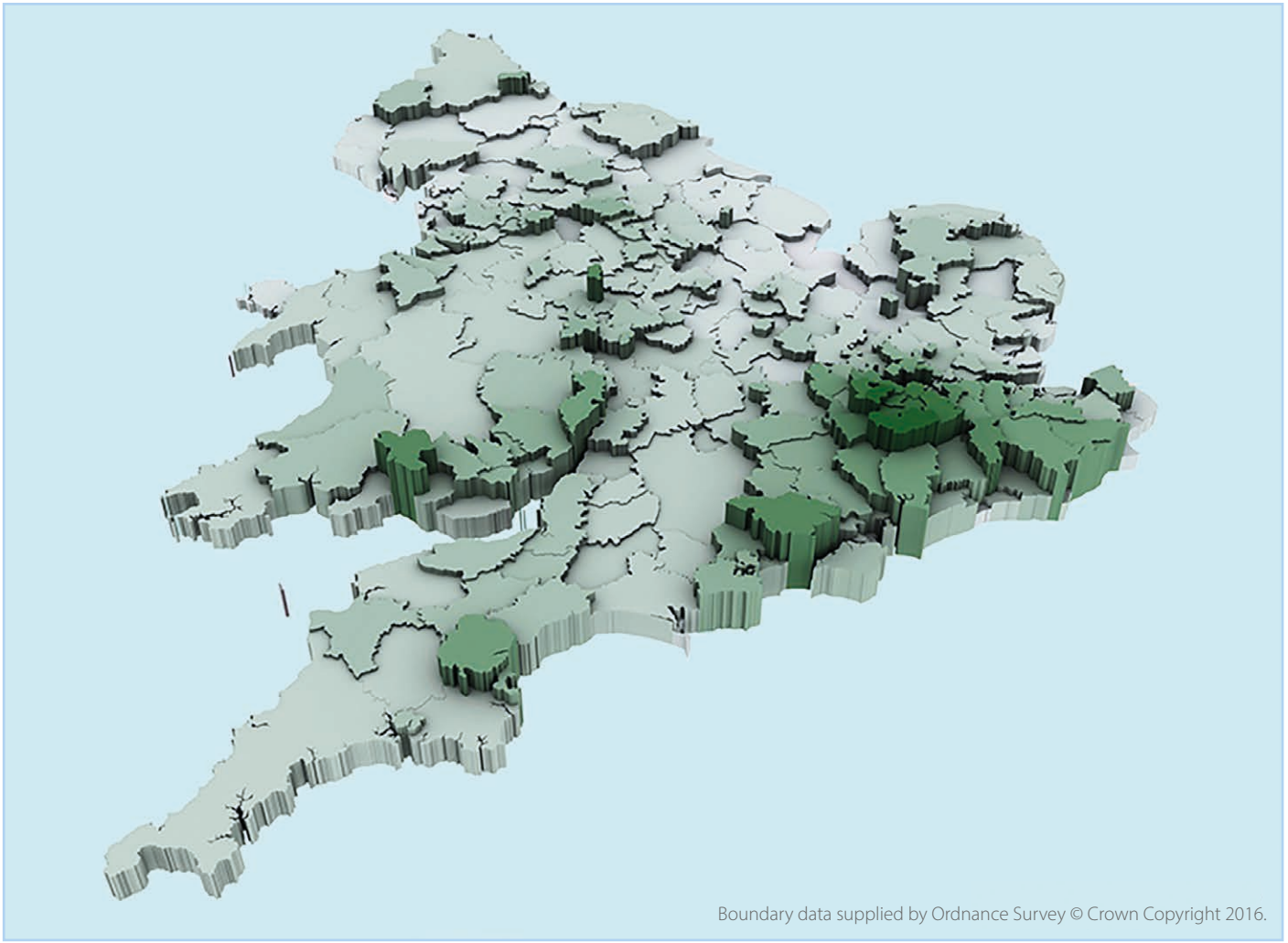


***Figure 8*** *- NTM™ data can be used for statistical analysis of biomass and carbon sequestration*

## Modelling

With the advent of Smart Cities, the modelling of our urban environment is becoming more commonplace. NTM™ provides a crucial ingredient for the modelling process when it comes to understanding the relationship between buildings, trees and air flow or visual impact for example. In some cases, trees impact the environment as much as buildings and roads. NTM™ data has already been used very successfully by the University of Leicester in advanced air quality modelling software; it has been demonstrated that the location of the trees has a huge impact of the behaviour of air pollution, from trapping pollution in some situations to helping circulate and clear the air in others. Trees can also have impact on other environmental factors such as:

* **Noise** - through shielding areas,

* **Flooding** - roots reduce surface water rates by creating channels to the ground water table and increasing infiltration

* **Health** - not only can they influence air quality but they can affect health through allergic reactions to tree pollen. Significant research has been carried out using NTM™ in relation to hay fever.

***Figure 9*** *- NTM™ used as 3D data can help visualise and model our urban environments*

## Emergency Access Planning

Not knowing enough information about trees can complicate vital decision-making when responding to emergency situations in the built environment. Large trees can restrict access to emergency vehicles if branches or canopies are too far across the main access route. Understanding potential pinch points and dealing with them with local land owners or local authorities will reduce access risk and ensure safety is not compromised.

## Line of Sight and Shading Analysis

Visual impact is a major part of many contentious planning applications, so the line of sight around the proposed development, whether it be a wind farm, or high rise structure needs to be determined. This can easily be done to include the terrain and buildings, but in fact trees often provide the best screen. NTM™ can be used to assist in planning applications and can help to visualise the effect on any given viewpoint. It is also possible to model the effect if certain trees were removed and how this would affect the line of sight.

Azimuth Land Survey has used NTM™ in a feasibility study for the siting of a new village development in the south west of England as part of a bigger modelling project. The use of NTM™ saved time and money spent on having to conduct a full site survey.

Trees also provide a huge amount of shade, which is very welcome. In many instances, however it can be useful to calculate the shade cast by a tree or group of trees over the year. This is specifically useful for calculating the yield from solar panels.

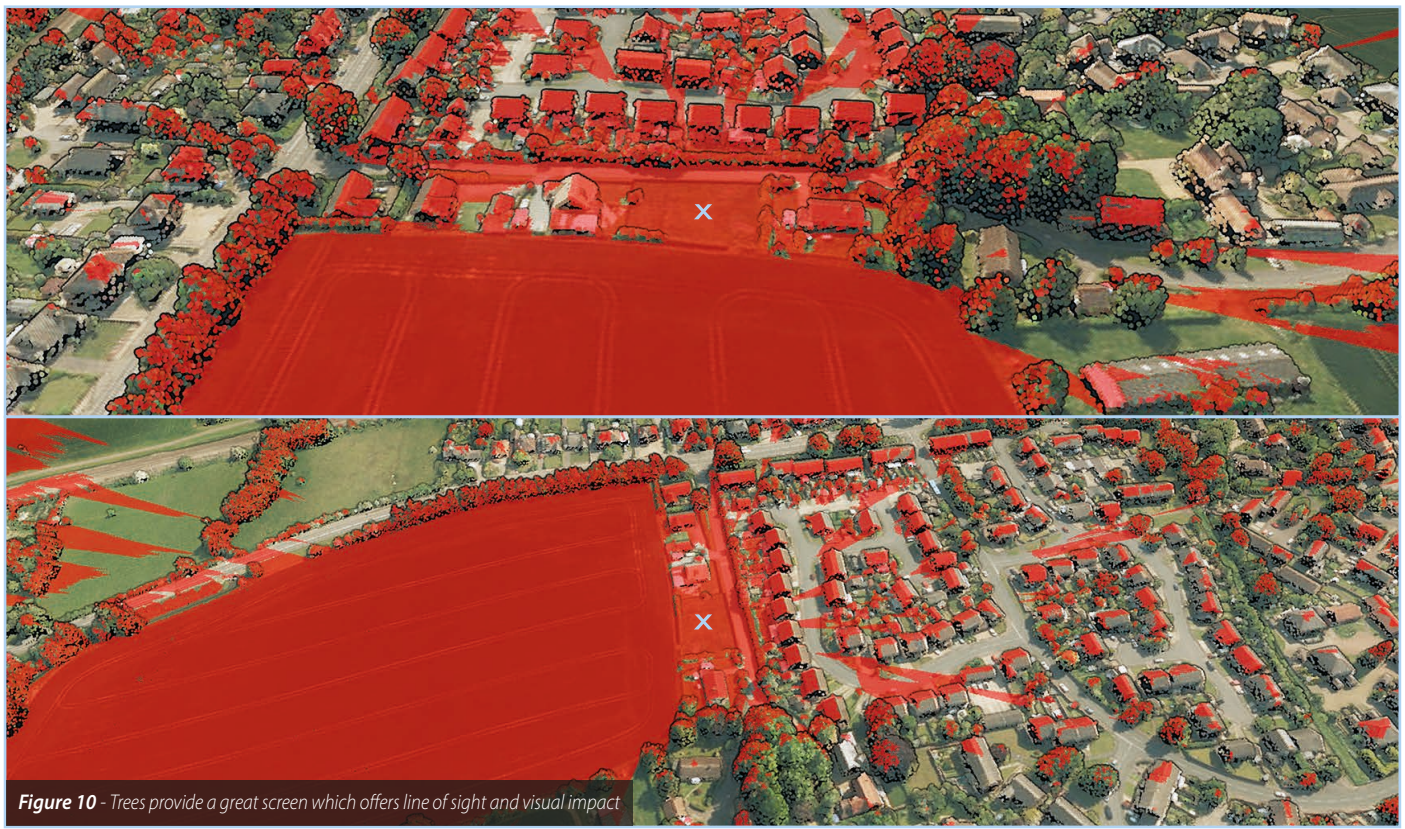

***Figure 10*** *- Trees provide a great screen which offers line of sight and visual impact*

## Conclusion

Understanding the location, size and height of trees is an invaluable source of information for anyone who needs to maintain infrastructure. It is also of significant value to those who need to understand and protect the environment, and those habitats reliant on individual or multiple trees. NTM™ can help inform in the relatively new field of urban modelling where trees not only impact upon infrastructure but can also be a consideration for public health.

NTM™ is a hugely beneficial resource for reducing costs associated with vegetation maintenance, but it is also proving to be extremely helpful for planning, protection and public health.

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**For more information on the National Tree Map™**

**Please call 01530 518518 or email trees@bluesky-world.com**

***Figure 11*** *- NTM™ overlaid over aerial photography*

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