St Catherine's Hill and Town Common
Management Plan

HYDROLOGICAL APPRAISAL EXECUTIVE SUMMARY

Client: St Catherine's Hill and Town Common Management Plan Steering Group
c/o Robin Harley, Countryside Officer
Christchurch Borough Council, Christchurch, Dorset
Site: Land at St Catherine's Hill, Town Common, Christchurch
Project: Hydrological Appraisal
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EXECUTIVE SUMMARY

Pine woodland at St Catherine's Hill

Introduction

The purpose of this hydrological appraisal is to bring together such information as is available and to develop conclusions about the hydrology of St Catherine's Hill so that the Management Plan Steering Group can advise on site management in such a way as to reduce the risk of adverse hydrological effects given a scheme of heathland restoration.

Note that this report is for guidance only and in the absence of any management proposals for the site, cannot offer detailed proposals

We have undertaken an extensive desk study of available maps and published information (including that on plant communities, geology, soils, hydrology and landform and the water relations of trees and heathland) and have visited householders where there are current drainage problems. We have walked much of the Hill itself making visual appraisals of the landform, geology and vegetation and looked for evidence of past erosion or landslipping.

Given this information, we have undertaken a careful analysis of what is known about the likely hydrology of the hill and used this to estimate the potential hydrological effects (changes in surface and groundwater flows) of different management scenarios in relation to the reduction in tree cover and heathland regeneration. Our analysis has taken account of the geology, slope and vegetation of a series of contrasted sample areas.

While we have drawn conclusions from our work, it is important to point out that there are many unknown factors in relation to the precise geological and soil conditions on the site and to the condition and vigour of the trees (which will be different to those in published studies).

While (and because of these uncertainties) we have had to make many assumptions, it is our opinion that given a range of scenarios and levels of mitigation, a limited and phased scheme of tree removal could be undertaken on slopes given careful consideration to the size, positioning and monitoring of any felling areas, and especially learning from the results of each felling and heathland restoration operation.

Landform

The site comprises a linear hill with a summit area (partly quarried) and sides with slopes of varying angles and containing a number of small valleys and gullies cutting back into the hill side. The hill side also has a number of historic banks and ditches. Mapping these features allows the plotting of a series of sub-catchments.

Geology and soils

The hill has a capping of gravels (Terrace Deposits) containing flint stones in a medium and coarse sandy matrix but also containing clayey layers; the gravels therefore are of varying permeability. Over a broad part of the western slope, these gravels extend down the valley side forming a layer of unknown thickness.

Below the gravels are stoneless sands (Branksome Sand) comprising both finer and coarser sand grains and locally cemented into sandstone and also with clayey layers. These deposits also have variable permeability but are likely to be less permeable overall than the gravelly deposits. Below the sands is a far less permeable clayey layer (Parkstone Clay) and which has only a very small ability to transmit water downwards.

Soils vary from very droughty nutrient poor soils on gravels and droughty soils on sands through to peaty soils affected by high groundwater and to clayey soils affected by perched groundwater and surface water.

There is thus a wide range of geological and soil conditions.

Hydrology

Given gentle rainfall, water passes either down between the trees to reach the ground or is intercepted by branches and passed down the tree stem where it is absorbed by leaf litter and passes into the soil. Some of the water is taken up by the tree roots and passed up within the stem to the leaves where it is evaporated to the atmosphere. Some of the water is evaporated from the soil surface while other water is retained in the soil and some passes downwards to reach the water table. Once the water reaches less permeable layers, and especially the Parkstone Clay, the water sits on these layers and builds up a perched water table, the water flowing sideways to emerge as springs and seepages on the hill side. The rate at which water flows through the hill and sideways to emerge on the sides depends upon the permeability of the different layers and the extent to which water is intercepted by pine woodland and heathland vegetation.

Given heavy rainfall or storm conditions, the surface soil layers rapidly become saturated and water will flow downhill over the surface of the land rather than sink into the ground. Such flows can remove the soil surface pine litter later and cause surface erosion.

Effect of vegetation

Generally, pine trees intercept more water than both grassland and heathland and so it would be expected that felling trees would result in more water reaching the water table. However, it should be noted that there is considerable overlap in water use values between pines and heathland and the relatively old maritime pine and Scots pine trees at St Catherine's Hill are growing mostly on droughty nutrient poor soils and appear to be of low vigour with much more open canopies than actively growing forest crop pines for which research data exists. Because of this, the water relations of the pines at St Catherine's Hill may not be that much different from well developed heathland.

The assessment

In our assessment we have taken a precautionary approach and assumed that the pine trees have a greater water use through the year than heathland. Our assessment also takes account of the complex geology and slope features of the site and we find that taking down large areas of trees at one time can significantly increase the flow of water to the ground and this amount increasing with the land area involved. The amount of water increase will depend upon the density of the trees, the vigour of the trees, the slope of the ground, and the complexity and water holding capacity of the subsurface geology.

General conclusions

The risk of adverse hydrological effects is thought to be greatest from tree felling on lower slopes close to the junction with the Parkstone Clay, especially in areas of complex geology such as where there are nearby thin gravels on the slopes over the Branksome Sand. There is a more intermediate risk when felling trees on thin gravel spreads on slopes, and least risk given felling on the Branksome Sands. It follows that areas with higher risk require greater levels of mitigation to reduce that risk to acceptable levels.
The risk of adverse hydrological effects on downslope urban areas is reduced by:

1. Avoiding felling on lower slopes adjacent to the urban boundary or on, or close to, the Parkstone Clay;
2. Felling small areas initially and restricting these areas to a. the top of the hill and uppermost slopes, to b. areas remote from housing and also c. locations where excess water can be more easily drained off-site;
3. Restricting felling so that only one area is felled initially within any one subcatchment and no more than five to six areas initially;
4. Avoiding felling on the steepest slopes where they occur close to housing;
5. Thinning trees in critical areas such that a more open woodland canopy can allow heathland to develop on the woodland floor (wood heath);

6. Using appropriate mitigation to reduce surface flows and encourage evaporation;
7. Closely monitoring the effectiveness of the heathland regeneration and any hydrological effects and proceeding with further phased felling when an assessment of the first phase felling confirms that it is safe to do so; and
8. Ensuring that all drains and ditches around the site, and any leading offsite, are maintained and functioning.

We recommend that initial first phase fellings on upper slopes should be on the restricted to five or six small areas of about 750sqm, equivalent to strips of about 10m x 75m. If larger areas are to be restored to heathland, these should be restricted to the plateau surfaces or consideration given to thinning rather than clear felling (or a mixture of both). The results of these initial fellings should be closely monitored, compared to control areas, and the results of such monitoring carefully considered prior to any further phased fellings.

Appropriate mitigation should be used to cope with the open ground situation in the time between felling and heathland establishment.

We have seen no evidence of past slumping or landslipping, the hillside having had many thousands of years to stabilise since the end of the last ice age and especially since the Bronze Age (or earlier) when woodland would have first been removed and heathland established. Given the precautionary approach to felling discussed above, landslipping would not be expected.

We have seen some evidence of the effects of surface washing below the existing pines leading to a slightly lowering of the sloping land surface; also the accumulation of material (such as upslope of tree stems). We assume that this slight erosion may arise when heavy storms have washed away leaf litter and exposed the sandy soils to surface washing. Heathland establishment would give better ground cover and reduce the potential for such erosion however, care would be needed to prevent such erosion in the time period between felling and heathland establishment.

We have noted that many of the tall mature pines have stems sloping back towards the hillside and that slight erosion on the downslope side of the tree stems may be destabilising some of the trees. We recommend that an assessment of their health and safety should be undertaken. Removal of any unsafe trees may provide opportunities for heathland regeneration in those locations.