APPENDIX 13.1 – EFFECTS OF AFFORESTATION
AND DEFORESTATION ON HYDROLOGY

1.0 EFFECTS OF AFFORESTATION AND DEFORESTATION ON HYDROLOGY

1. This Appendix presents a summary of the potential effects of afforestation and deforestation on a water quality and catchment response to rainfall.

1.1 Afforestation

2. Afforestation of an upland environment such as the development area has the potential to impact surface water runoff rates through both the impacts of ploughing and planting and the subsequent impacts of the established forest canopy.

3. Ploughing prior to planting disrupts the upper acrotelm layer of the peat and creates furrows which act as drains. The effects of ploughing, and any additional drainage introduced prior to planting, potentially results in a general compaction and drying of the peat with increased moisture deficits and mineralisation of the peat. During this period therefore, surface water runoff rates are typically ‘flashy’, a response that is accentuated by the disruption of the vegetation by ploughing, and the resultant decline in evaporation, as well as the release of previously stored water via increased drainage. Significant erosion and sediment losses can also occur at this time.

4. Once the forest canopy is developed, interception rates (and subsequent evaporation) are higher than prior to afforestation. Therefore once the forest is established a higher proportion of incident rainfall is effectively lost from the catchment via interception and evapotranspiration.

5. Interception losses within upland catchments of the UK are reported to be in the range of 25 to 49% of the total rainfall (IoH Report No.116, 1995), although research carried out at Plynlimon also indicated that forests do not maintain their highest rates of evaporation throughout the growth cycle, taking some years to reach maximum rates and then declining as the trees approach their economic zenith and the more productive, potentially more evaporating, tree stands are preferentially felled. For short periods, during and after clear felling, erosion and sediment losses can also occur at this time.


2 Institute of Hydrology, 1992, Report no.119. Forestry impact on upland water quality

water resources from forested catchments may even be greater than from equivalent areas of moorland.  

6. The Forestry Commission (2011) reports water yields from upland catchments containing significant proportions of closed-canopy conifer forest are less than yields from moorland or grassland catchments, due to higher interception losses. Losses are greatest in the wetter and windier parts of the UK and increase with forest height and canopy development. This research suggests there may be a 1.5–2% reduction of potential water yield for every 10% of a catchment under mature conifer forest. Water yields from newly planted, young or felled forests are unlikely to differ significantly from moorland catchments until canopy closure is achieved. 

7. The resultant reduction in the proportion of rainfall forming infiltration or surface water runoff can lead to further drying of the peat and alters the flow characteristics of the receiving watercourses. Studies have shown that the increase in peak flow and baseflow associated with ploughing prior to planting, lasts for a number of years after afforestation (IoH Report No.133, 1998). The study of the effects of afforestation at Coalburn, and reported by IoH, indicated that peak flows remained elevated for up to 10 years after tree planting. However, after 20 years the total water yield from the catchment was lower than prior to afforestation. This response to tree planting would be expected at the proposed development site.

1.2 Deforestation

8. There is a consistent increase in catchment yield following deforestation, although the magnitude of this change varies with, inter alia, the annual rainfall of the catchment, the proportion of the cover removed, the type of cover removed, the time since felling and the vegetation that follows the forest. However, intuitively, the increase should ultimately mirror the decrease discussed above as long as the vegetation cover is similar to that which preceded the forest. 

9. Notwithstanding this, in the short term, the disruption associated with the deforestation activities may increase overall catchment yield with surface water runoff rates being typically ‘flashy’.

10. Tree removal (felling) can increase nitrogen mineralisation and nitrification, which can promote nitrate leaching and enhance acidity and aluminium solubility in waters draining some soils. The effect usually lasts for two to five years after felling, depending upon the rate at which vegetation re-establishes. As with the

---

5 Forestry Commission, 2011, Forests and Water UK Forestry Standard Guidelines
afforestation stage, significant erosion and sediment losses can also occur during tree felling.

11. The Forestry Commission (2011) report forest “establishment and growth appear to have a small effect (decrease) on peak flows, with the impact of clearfelling (increase) often being difficult to detect. Overall, research suggests that the contrasting effects of the different stages of the forest cycle (cultivation, drainage, road construction, forest growth and harvesting) will even out at the catchment scale, especially as forest areas become more diverse in age. As a result, upland forests are unlikely to adversely affect downstream flood risk”. 