De Lank Geomorphology Review

A combination of Wollman count analysis, and qualitative sediment review was carried out on the De Lank, in order to gain an understanding and evidence on the scale and nature of impacts of the de Lank Quarry on sediment transport processes.

The assessment confirms the expectation that the quarry creates a complete discontinuity in sediment transport for all material above sand sizes. The upper catchment is a rich source of granite bed load, providing sands, through to gravels and cobles.

The only mobile bed load that is received from the De Lank below the quarry is from the small tributaries and from valley slope erosion. This is limited in size and quantity.

The Hydrology of the river may also have been affected the quarry, leading to a reduction in the mobility of the remaining bed material.

A net result is that downstream of the quarry, bed material is dominated by sand and immobile boulders. Further downstream, coarse material is gradually introduced, however, much of this remains highly mobile. The result is that even at the downstream limit of the river, the larger clasts remain immobile, with a sand dominated mobile bed load (up to 45mm) filling in between.

Figure 1. Sediment analysis summary

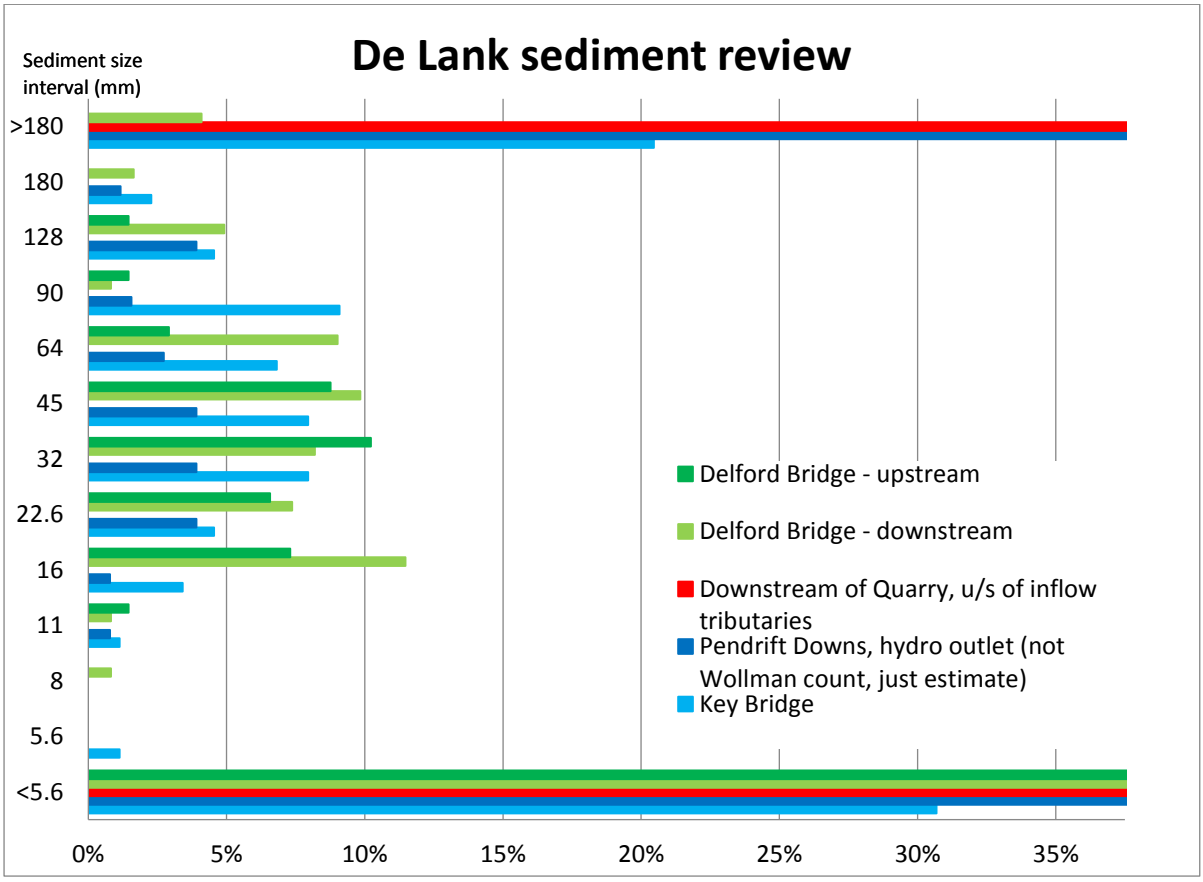
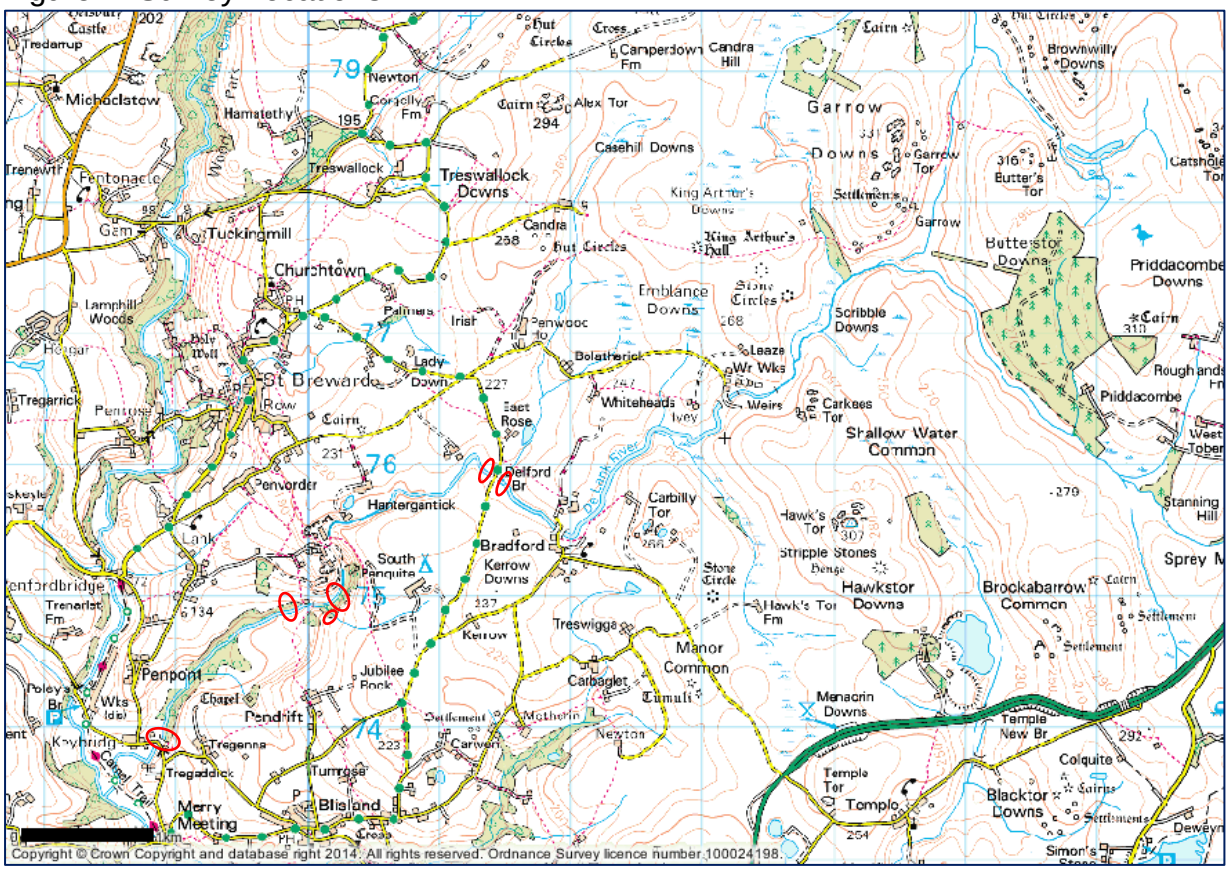


Figure 2. Survey Locations

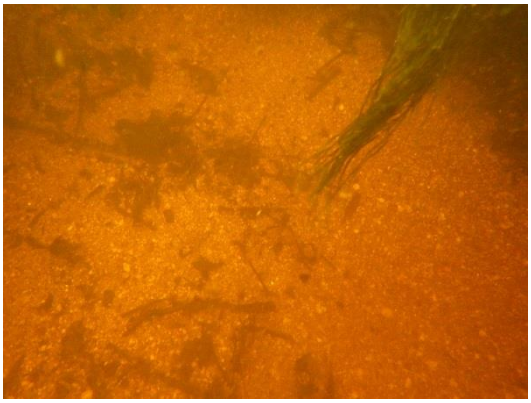


Survey site descriptions

The channel at Keybridge has a distinct split in its bed load material. There is a highly mobile fraction, which is dominated by sands, but includes up to small cobbles of around 45mm. Beyond this, are mainly immobile stones from around 64mm up to large boulders. The stones are mainly granite with some slate.

Closer to the quarry the proportion of mobile sands increases. The steepening channel results in an increase in the size of mobile material, such that only boulders remain fixed. At the hydro scheme outfall location, there is a very small fraction of mobile gravels to small cobbles collected within pockets on the bed. Counts were taken of material within these pockets to give an indication of size range, however, this is not a formal Wollman count.

Upstream of the tributary from South Penquite, the bed is entirely absent of any coarse material, with sands infilling between large boulders. Wollman counts were impossible, however, the underwater photograph (see right) confirms the absence of coarse material between the boulders.



The tributary from South Penquite was too small and braided to carry out a Wollman count. However, by visual inspection it was supplying sands through to small boulders up to 90mm diameter (see photos below). A similar range of material was noted in the steep eroding valley slopes alongside the main channel.

Upstream of the quarry, the moors are formed of weathered granite which provides an effectively unlimited supply of sands through to small boulders (see photo below). Delford Bridge is located upstream of the incised valley that leads to the quarry. As such, it is likely to be unrepresentative of the coarser bed load (90 – 180mm or greater range) that are liable to be generated from the bed and banks in the downstream channel.

The catchment upstream of the Quarry represents some 90% of the catchment. This gives an indication that bed load supply should be at least 9 times greater than experience at present. When considering the topography of the catchment, the natural sediment supply from the upper catchment is liable to have a far greater contribution than this simple areal comparison suggests.

Recommendations

Restoration of the open channel through the quarry site will not only provide fish passage, but would also restore the sediment transport continuity down the river, and ultimately to the River Camel downstream of the confluence. In the long term this should be the preferred option.

However, with quarrying having been carried out since the mid-nineteenth century, it is likely that this sediment supply has been interrupted for at least 100 years. This will have created a legacy of sediment starvation in both the downstream 3km of the De Lank River and the River Camel downstream of their confluence. Restoration of an open channel alone will not lead to immediate recovery of bed load.

Bed load augmentation is therefore recommended:-

- To mitigate for the current ongoing impacts of the quarry on sediment supply. This should be carried out as soon as is practical and be ongoing until the channel is opened up upstream. The intent would be to restore bed load conditions in the downstream 3km of the De Lank River. The focus would be to input bed load as close to the quarry (or the hydro scheme) as possible, although an initial augmentation could be more distributed along the river to ensure more rapid restoration of the entire reach.
- To mitigate for historic interruption of bed sediment load. This could consider augmentation to both the De Lank River and the River Camel downstream of their confluence. This scale of augmentation should be distributed along the downstream river channel reaches, and could be carried out as a single operation or phased over a number of years.
- In the short term after restoration of an open channel past the quarry, continuation of reduced scale augmentation to the De Lank may be required until the natural transport past the site has re-established itself.

Bed load augmentation should ideally use granites, with the quarry being the most suitable source. The size range should be between 6mm to 300mm with a D_{50} stone size in the range of 32-64mm. An augmentation to the River Camel, should look to a coarser size distribution, focusing on the 16mm to 300mm range with potential use of coarser stones up to 450mm (which may be present between Delford Bridge and the quarry).

A hydrological assessment is recommended to assess the scale and nature of the impact of the quarry on attenuating flood flows. If there was significant attenuation, especially flattening off of any peak flood flows, then there may be implications for sediment transport. This may require a reduction in the maximum stone size of any augmentation until the river past the quarry is fully restored.