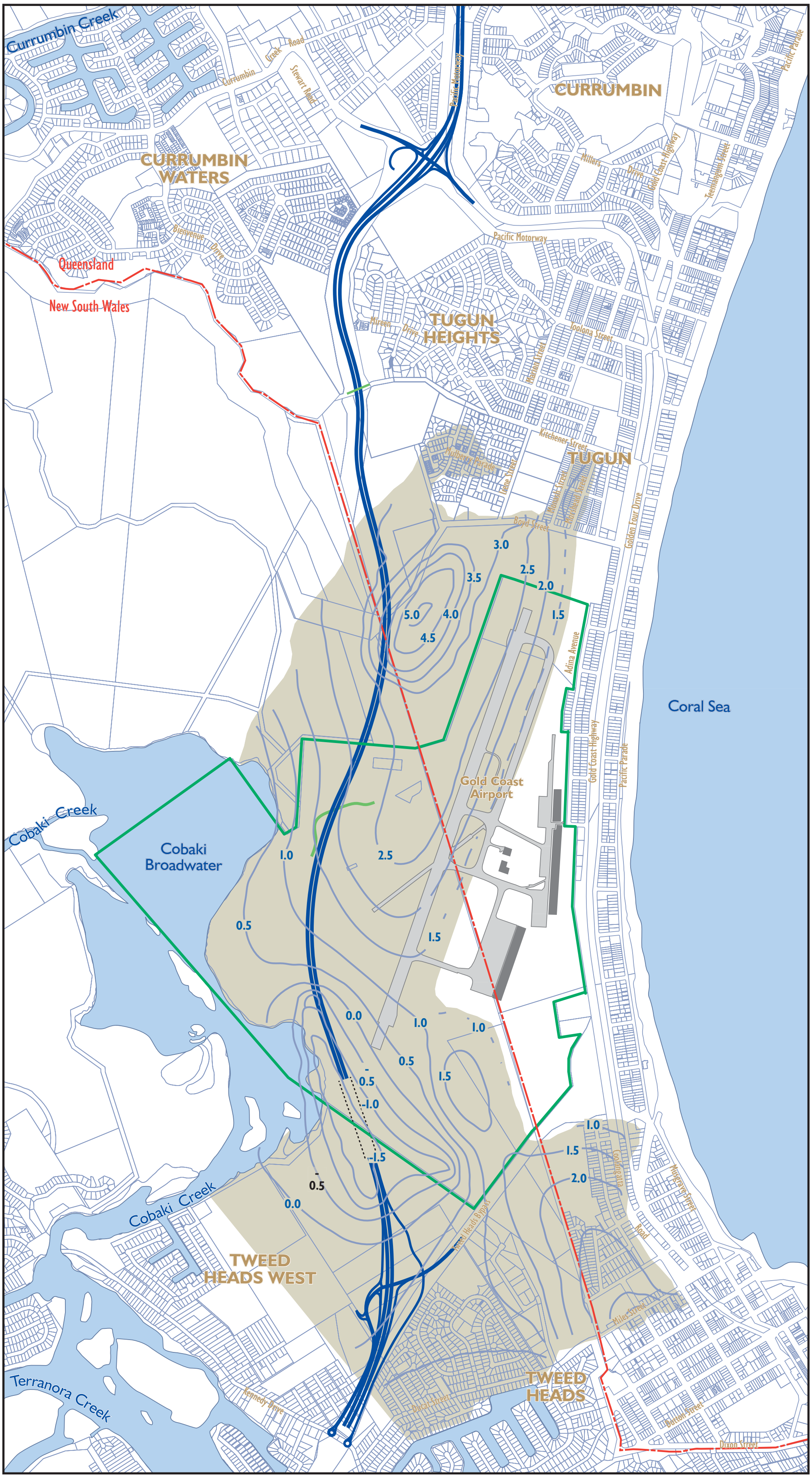

Proposed Tugun Bypass
Gold Coast Airport Boundary
Queensland/NSW Border
Proposed Access Bridges
Tunnel
—0.5— Modelled Groundwater Elevation Contours (mAHD)
Model Limit

0 1.0
Km

Figure 5.4 **Hydraulic Heads After Six Months Without Mitigation**

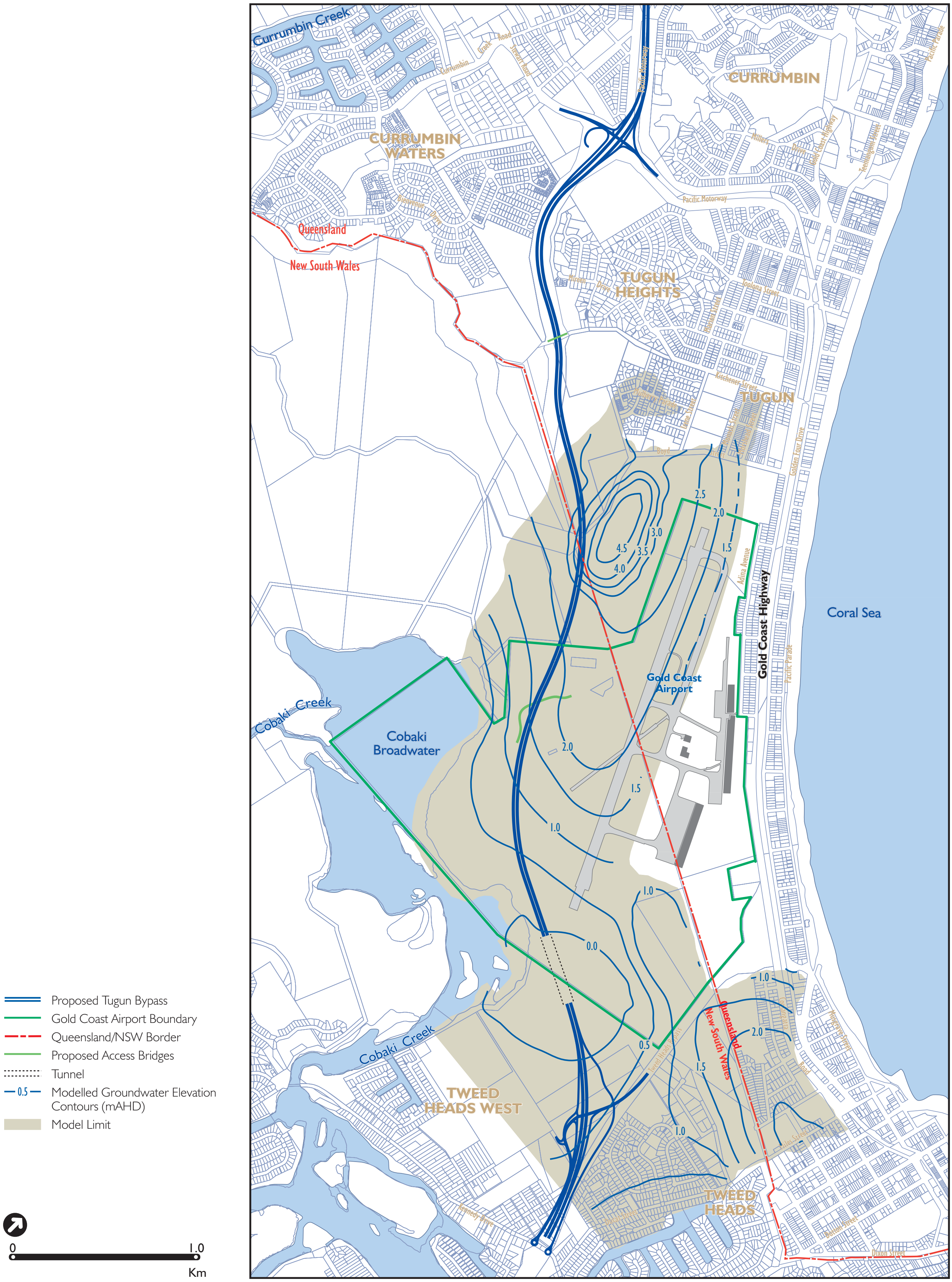

Figure 5.5 **Hydraulic Heads After 12 Months Without Mitigation**

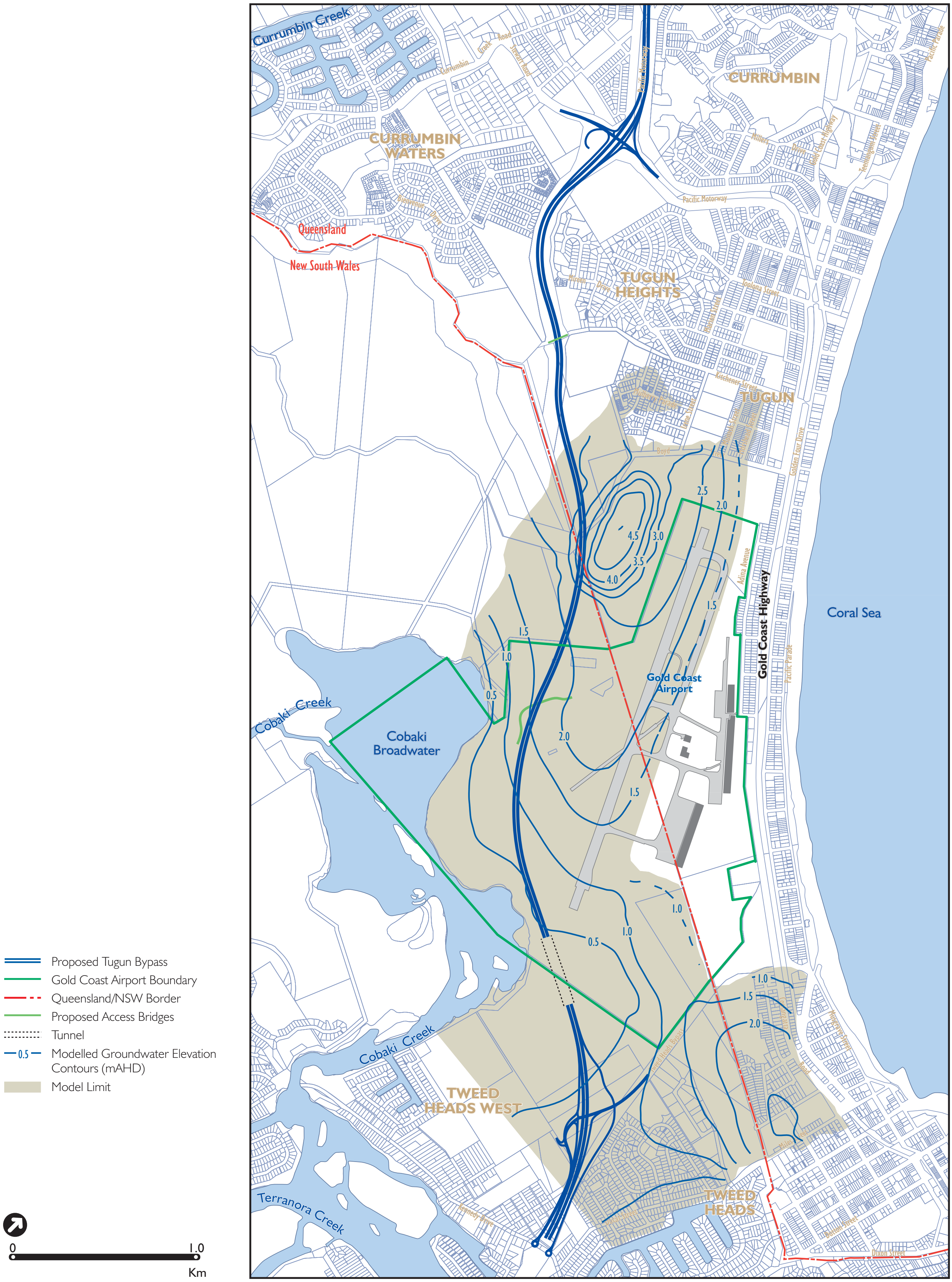

Figure 5.6 **Hydraulic Heads After 18 Months Without Mitigation**

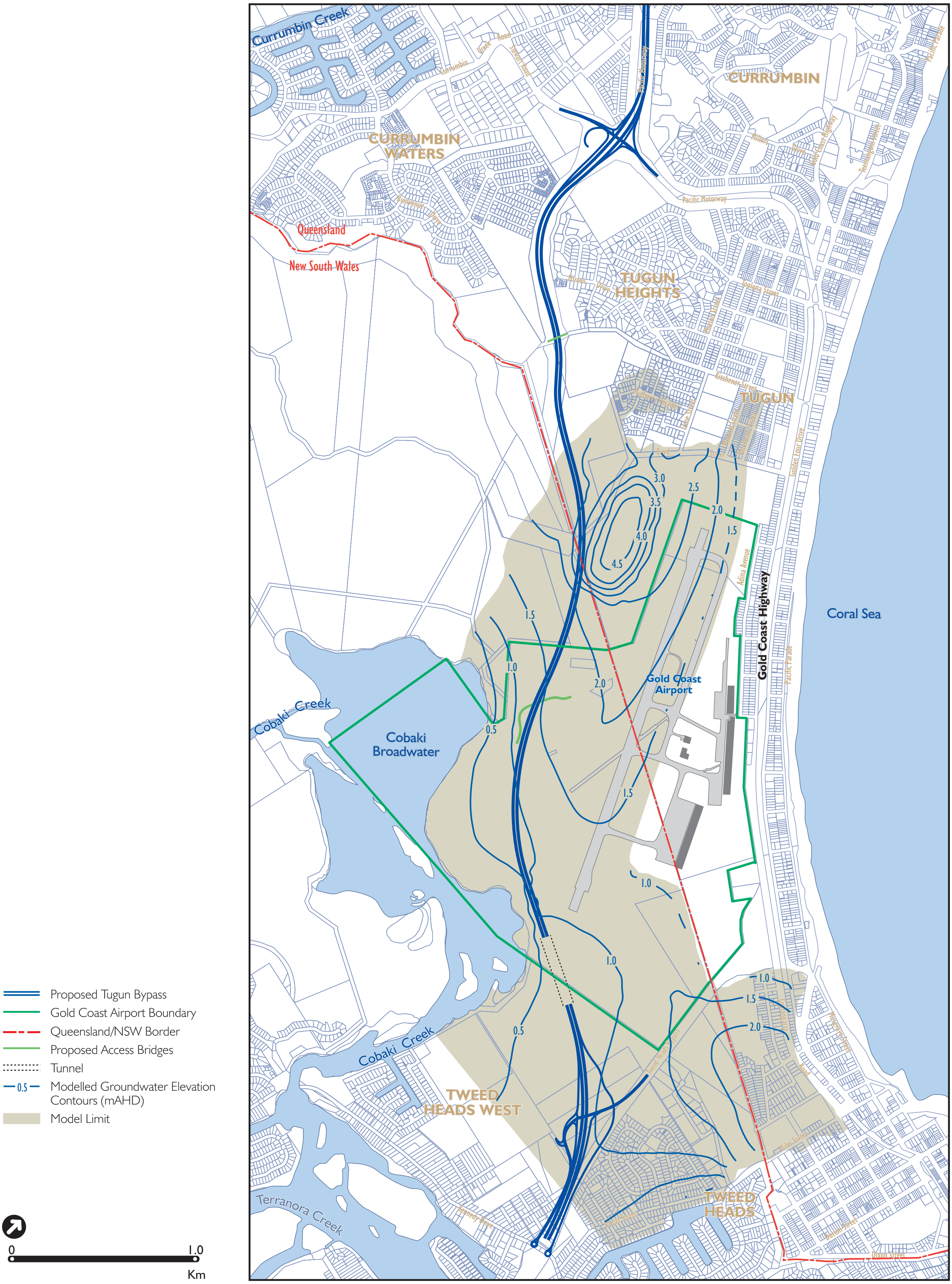

Figure 5.7 **Hydraulic Heads After 36 Months Without Mitigation**

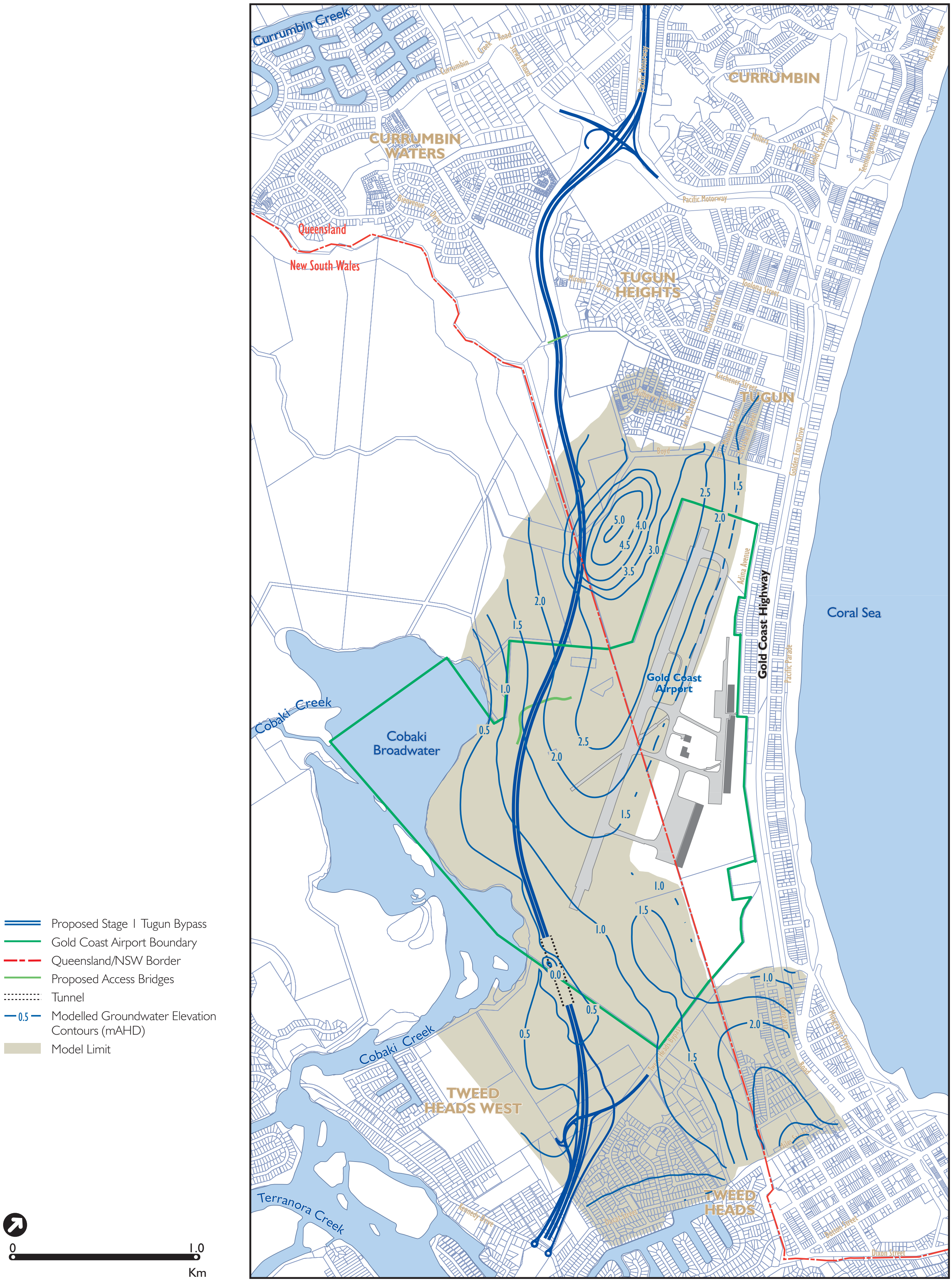

Figure 5.8 **Hydraulic Heads After Six Months With Mitigation**

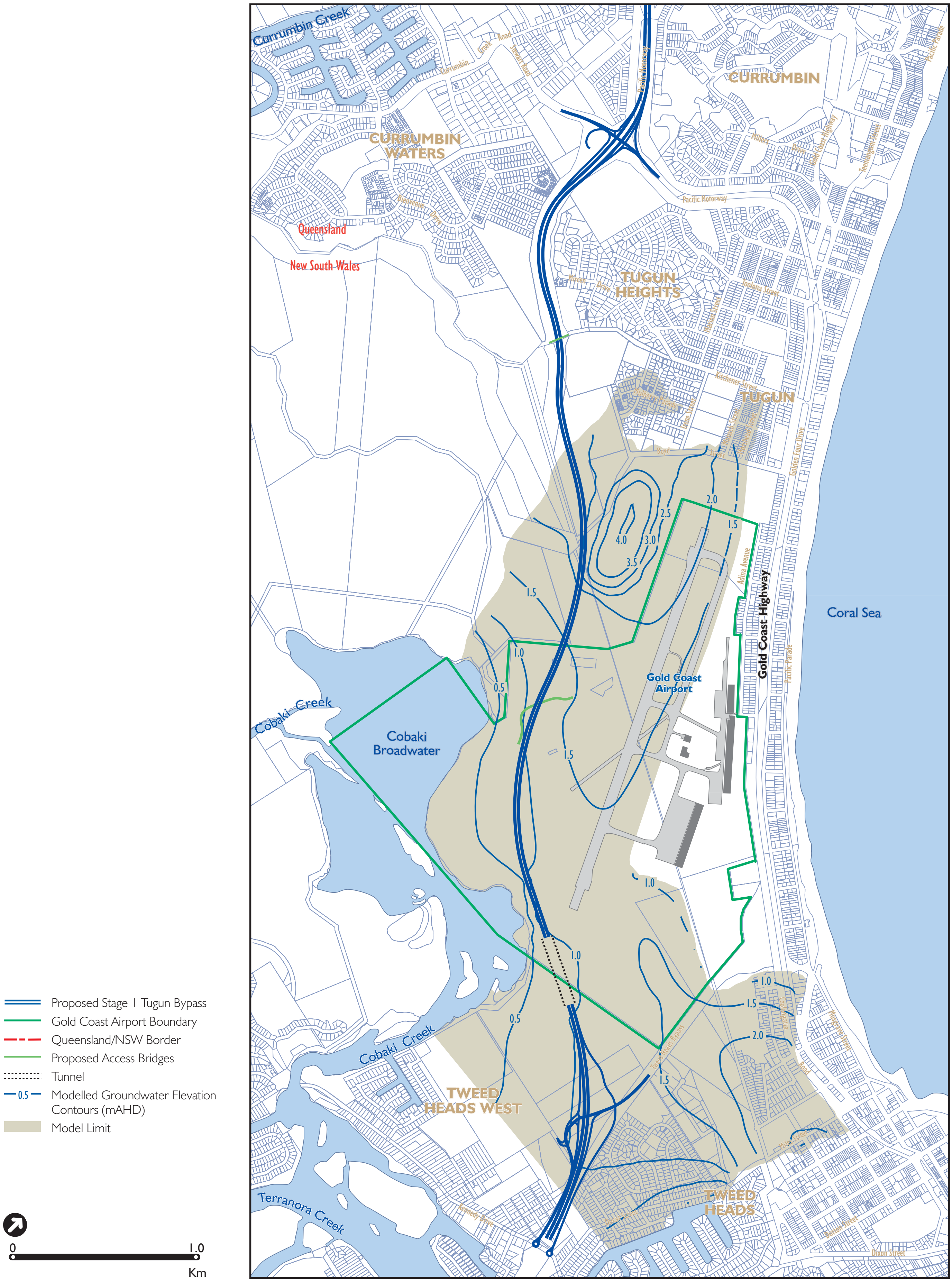

Figure 5.9 **Hydraulic Heads After 12 Months With Mitigation**

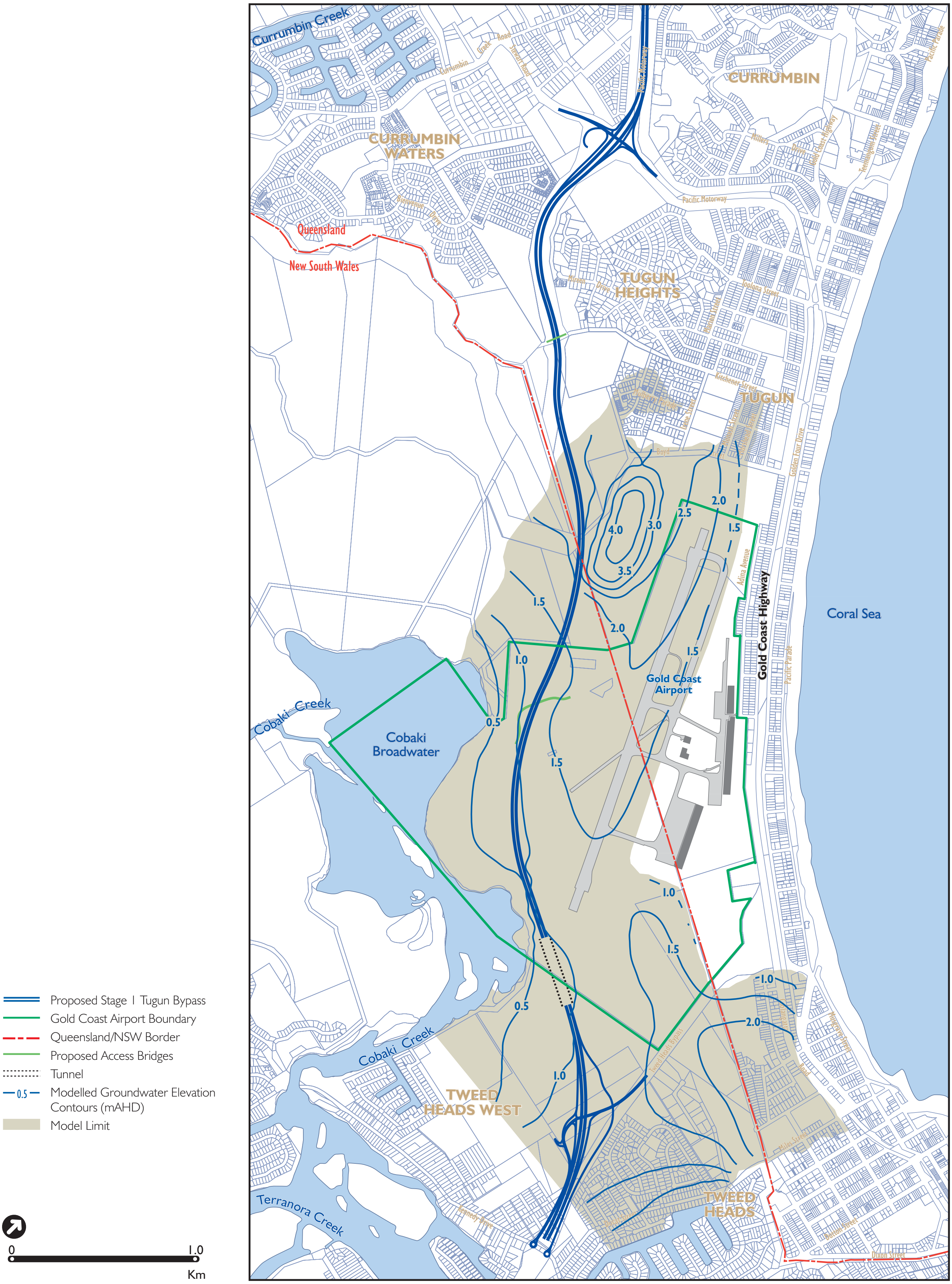

Figure 5.10 **Hydraulic Heads After 18 Months With Mitigation**

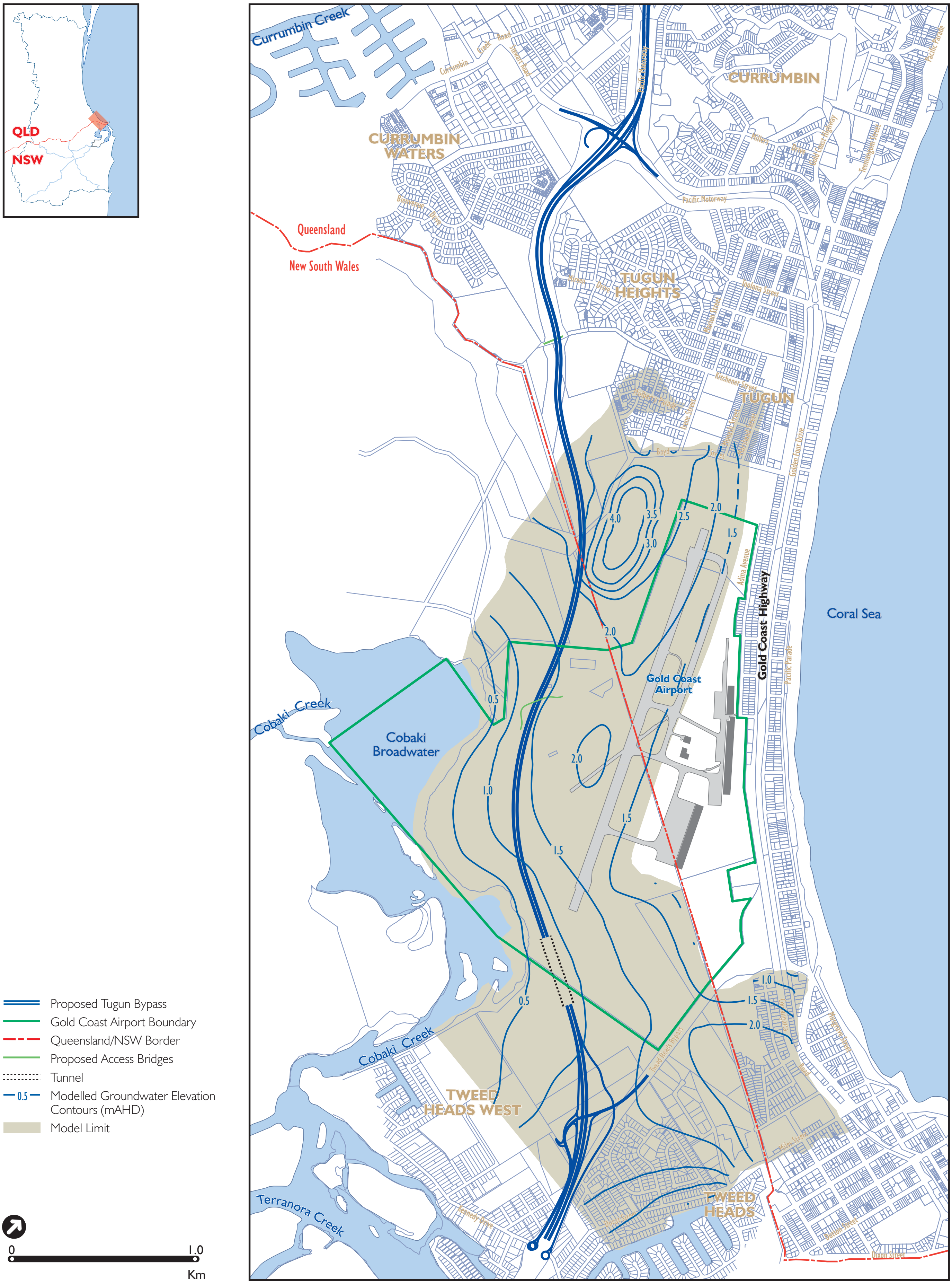

Figure 5.11 **Hydraulic Heads After 36 Months With Mitigation**

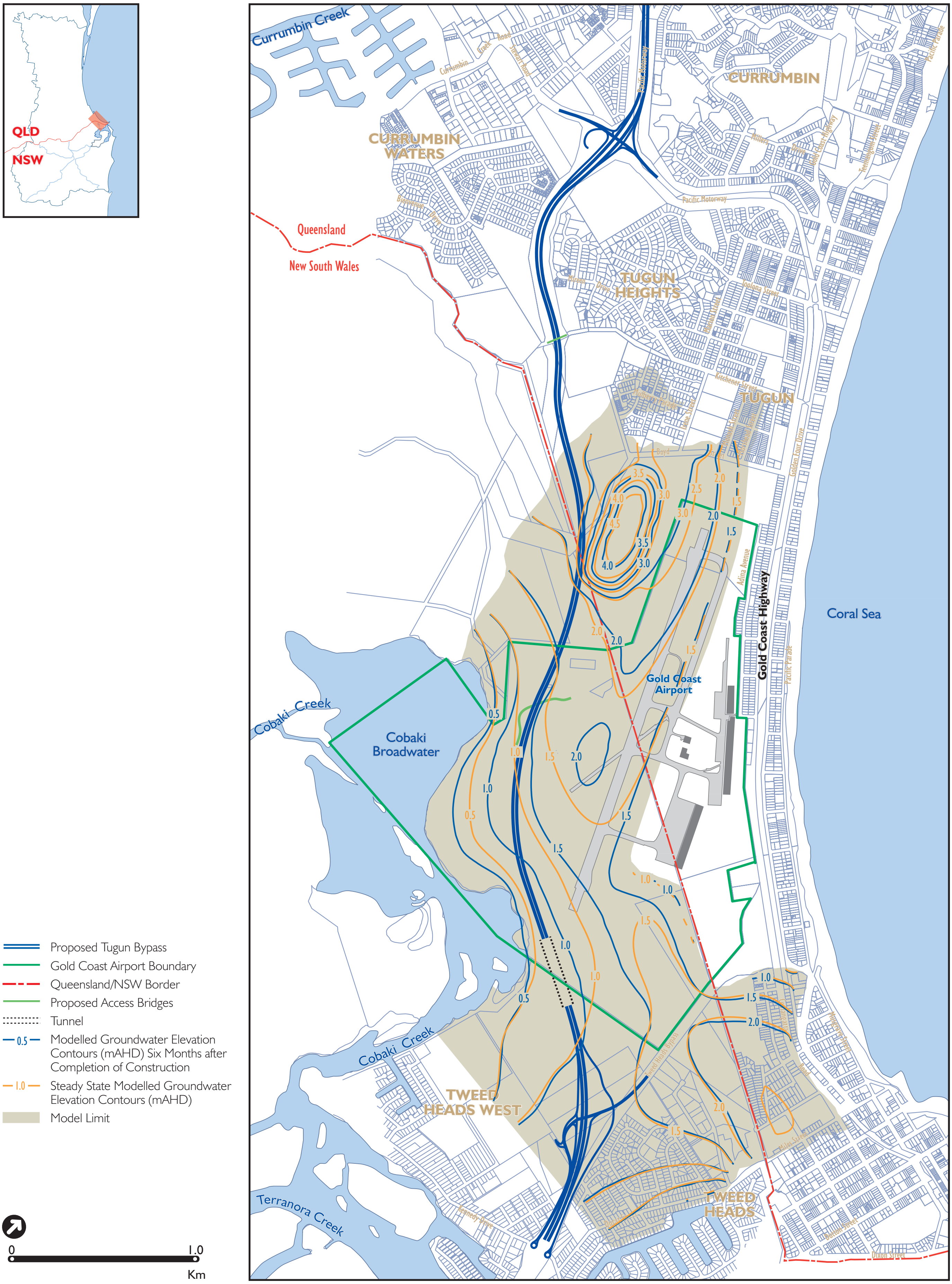

Figure 5.12 **Comparison Between Steady-State (Representing Pre-disturbance Conditions) and Road Operational Groundwater Levels**

5.3 Modelled Impacts

5.3.1 Construction Phase

The model showed that dewatering for slurry wall construction would lower water levels by 2 m adjacent to the tunnel, becoming zero at the Cobaki Broadwater (because the Broadwater was modelled as a constant head) and extending some 450 m on the other side of the tunnel. During approach-ramp and tunnel construction water would be removed at the same time as the subsurface material is excavated. This would have a similar but less widespread effect as dewatering for the slurry walls.

The real situation would be somewhat different in the following way:

- dewatering for slurry wall construction would be less significant than shown by the model because the slurry wall would be constructed in sections. Dewatering would be confined around each section and moves as the panel installation progresses. Thus the modelled continuous dewatering around the perimeter of the tunnel is greater than what would occur using this construction method. The detail could not be modelled; and
- dewatering for ramp and tunnel construction is continuous during the construction, thus drawdown could be modelled realistically and the modelled drawdowns are therefore what might be expected.

5.3.2 Operational Phase

The long-term changes to the groundwater flow are not discernible from the contour plans as they are in the vertical dimension. The impervious pavement imposes restrictions to groundwater flow and vertical pressure beneath these pavements would be greater than atmospheric pressure causing a buoyant force on the tunnel. The tunnel thus introduces changes to the vertical component of groundwater flow, this component is very small in the undisturbed state because the hydraulic gradients are low.

The presence of relatively low permeability layers at depth also limits this effect and although the tunnel restricts groundwater and forces some groundwater to move around it these flows are very small.

5.3.3 Groundwater Flow Volumes

Groundwater flow crossing the tunnel and ramp area was monitored by the model in zones parallel to the tunnel. The results, given in Table 5.6, show groundwater flow rates crossing the monitored zone before, during and after tunnel construction.

Table 5.6: Groundwater Flow Volume Measured by the Model

Measurement Period	Total Flow Across Zone (all layers) m^3/day
Before construction	115.6
End of slurry wall dewatering	408.6[1]
End of ramp dewatering	139.3
End of tunnel dewatering	104.6
Operational	106.8

Note 1: The flow rates increase due to the increased gradients and reflect the expected pumping rates. 408.6 m^3/day during slurry wall construction is higher than it would be in reality as explained in Section 5.3.1.

The increased flow during construction is due to increased gradients caused by dewatering. These flow rates are relatively constant with or without mitigation because:

- without mitigation the head drops but the drawdowns are deeper increasing the gradient; and
- with mitigation the head is retained by returning the water.

5.4 Monitoring

The impacts described in this and the previous sections are based on the conceptual model and the numeric model results. Monitoring would be required both to establish baseline trends before construction; during construction, to ensure that mitigation measures have the required effect; and during operation, to ensure that the drains continue working as expected.

The model has identified areas where impacts would be greatest (without mitigation). These areas plus the position of the most sensitive environmental areas would be targeted for monitoring bore positions. Three bores would be installed on each side of the tunnel (approximately 30 m) from the tunnel for monitoring purposes.

These bores would be constructed according to minimum standards for the construction of monitoring bores. They would be used for monitoring groundwater level changes, pH monitoring and water quality sampling. Similar monitoring would be possible, during the operational period of the tunnel, in the collector wells.

Additional pH monitoring of the pumped water would be undertaken during construction.