Evaporation losses from open water bodies are likely to increase under climate change (CC), largely due to changes in temperature and vapour pressure deficit. This will affect the fresh water supply available for large metropolitan areas. Added to this is the increase in demand as city populations expand, and concern over the availability of water supply increases. By modelling the future open water evaporation losses we can forecast and plan for shortages in supply of water under CC conditions. Five global CC scenarios were downscaled to the Quinary Catchments level for South Africa (SA), and overlayed with a spatial database of open water bodies in SA. A model was developed which calculates the additional losses due to open water body evaporation using the Penman-Monteith equation, in SA. Results show additional evaporation losses of as much as 2025 million m$^3$ in the intermediate future (2046 - 2065) from all water bodies in SA. This equates to the total capacity as SA’s third largest dam, the Vaal dam, in additional evaporation losses. This may have a major impact on water supply to cities as SA is a water scarce country and depends largely on water from dams for urban demands. By projecting future impacts on water supply, planners can put into place measures to increase water storage capacity to ensure adequate supply in the future.