

應用數值模擬方法訂定臺北盆地地下水管理水位

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摘要

地下水為臺北盆地早期重要供水來源之一，然而大量抽取地下水造成了地下水位逐年下降，進而導致嚴重的地層下陷問題。自民國 57 年開始，地下水管制措施之推動使得地下水位上升且下陷情況減緩，然而，過高的地下水位將使工程施工成本增加並增加施工風險，且可能提高土壤液化潛勢。為了充份利用地下水資源與避免工程設施之風險，評估合理地下水管理水位仍是重要議題。本研究冀望在不引起顯著地層下陷情況下，訂定臺北盆地合理的地下水管理水位，其既能降低工程問題亦有效地規劃地下水資源之永續利用。

臺北盆地由古新店溪、大漢溪、基隆河堆積而成，沉積層分布呈現相當大的空間變異性，而建立適當的地質模型為數值模式之基礎。本研究彙整鑽探品質較佳之地質鑽探資料，將臺北盆地內第四紀地層，依照水文地質特性劃分為較低透水性之松山層以及其下方由透水性較佳之礫石、砂組成之主要含水層；之後應用馬可夫鏈與地質統計方法，建立松山層之異質性水文地質模型；而後挑選具長期觀測區間之地下水位、河川水位與降雨量資料，將水文觀測資料結合水文地質模型，透過地下水模擬系統（Groundwater Modeling System, GMS）中的 MODFLOW 模組，建立臺北盆地地下水數值模式並進行穩態模式率定，以得到符合現地狀況之水文地質參數空間分布，並獲得穩態地下水流場分布。後續將假定抽水情境進行地層下陷模式建置與模擬分析，比較不同條件下之地層下陷敏感度，用以評估合理的地下水管理水位；最後依據訂定之管理水位，進行地下水合理抽水量之時間與空間推估，研究成果將提供臺北盆地地下水資源管理之參考，使現有地下水資源得以妥善運用。

關鍵字：台北盆地、地下水、MODFLOW、地層下陷、地下水位管理

Evaluation of Groundwater Management Levels by Numerical Modeling in the Taipei Basin, Taiwan

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Abstract

In the past, the groundwater level in the Taipei Basin continued to decrease due to a large amount of pumping, which led to severe land subsidence. Later, the groundwater level increased due to a policy prohibiting groundwater pumping. However, this caused engineering problems, such as soil liquefaction. Therefore, effective groundwater resource management is crucial to mitigate the potential of these disasters and effectively use groundwater resources.

This study developed numerical models to quantify the groundwater level and land subsidence under different scenarios. Initially, a three-dimensional hydrogeological model in the study area was constructed. Non-consolidated sediment in the Taipei Basin is divided into two main layers. The first layer is the Songshan formation, primarily formed of fine grained materials, such as sand and clay. The second layer is a confined gravel layer below the Songshan formation. One-dimensional continuous-lag Markov chain and geostatistical methods were adopted to analyze and generate realizations of the heterogeneous hydrogeological model in the first layer. Secondly, the steady-state hydrological observation data was analyzed and combined with the hydrogeological model through MODFLOW packages in the Groundwater Modeling System (GMS) software, to calibrate the hydrological conditions and hydraulic parameter spatial distribution. Finally, several pumping scenarios will be proposed to evaluate the land subsidence. The numerical results assess the reasonable groundwater level and provide a reliable assessment for groundwater resource management in the Taipei Basin.

Keyword: Taipei Basin, Groundwater, MODFLOW, Land subsidence, Groundwater level management