When floating wind turbines are placed at intermediate water depths (50m - 200m), the effect of nonlinear waves becomes more significant due to decreased water depth and increased wave steepness. This is the feature that a linear wave theory cannot capture. The effect of nonlinear wave loads on bottom-fixed wind turbines such as monopile and jacket has been studied using numerical wave tanks. However, there has been limited similar research work on floating wind turbines. One of the reasons is that the footprint of floating wind turbines is larger due to its mooring system which makes the database for pre-generated wave kinematics very large that normally exceeds the memory requirement of simulation tool for wind turbine. In accordance to the software memory barrier, a polynomial fitting method of wave kinematics has been developed [23] in order to scale down the data size to meet the memory requirement. The wave kinematics including wave elevation, velocity and acceleration are generated in a 2D numerical wave tank based on the Harmonic Polynomial Cell method. The wave kinematics obtained at pre-defined grid points in the wave field are fit to polynomial function representing location coordinates and corresponding coefficients. HAWC2 is used for coupled dynamic analysis with the obtained wave kinematics through polynomial fitting process as input. The hydrodynamic wave load is calculated using Morison's equation. The external DLL used to provide wave kinematics to HAWC2 is extended from 1D to 2D wave field to be applicable for floating wind turbine. Three wave-only regular wave cases with different wave steepness are selected to study the influence of fully nonlinear wave effect with different wave inputs: linear wave, fully nonlinear wave and stream function. Prediction of wave kinematics, motion and mooring line tension responses and computational efficiency are considered. The rapid development of computer capacity and numerical wave tank makes it practical to consider fully nonlinear wave effect in hydrodynamic analysis in an efficient way.