The roles of planetary waves (PWs) and gravity waves (GWs) are examined during a realistic major stratospheric sudden warming (SSW), simulated in the latest version of the National Center for Atmospheric Research Whole Atmosphere Community Climate Model (WACCM). This major SSW event is characterized by a well-separated warm polar stratopause layer during an extended period of polar wind reversal. Formed by adiabatic warming due to polar descent induced by westward GW drag (with phase speed less than 15 m s⁻¹), the early-winter stratopause layer appears at its climatological level (~55-60 km). With the incipient wind reversal during the SSW onset, this warm layer plunges nearly 20 km in time along the falling zero-wind line, as the amplified PW interacts with the mean flow. Recovery from SSW starts in the upper mesosphere when the GW drag becomes eastward (with phase speed greater than 15 m s⁻¹) due to the filtering effects of the underlying wind reversal. As part of this recovery, the stratopause reforms at an elevated altitude (around 70 km and typically associated with the mesosphere) due to adiabatic warming induced by strong PWs forcing in the upper mesosphere. The intensified downward motion resulting from the subsequent PW-mean flow interaction eventually descends in time along the zero-wind line, indicating the vortex recovery with the return of the polar eastward wind and the stratopause toward its climatological position.