The congregation of the Episcopal Church of the Redeemer formed in 1862, several years before the church was built. The Right Reverend Stephen Elliott, the first Bishop of Georgia, met with the group on this date for the first parish communion in the home of Philip Clayton. A vestry (governing board of an Episcopal congregation) was established with Mr. Clayton, John Carmichael, and Philip Poole as members. The Rev. W. W. Lord, D.D., was identified as the Missionary. While vestry members of the fledgling church were male, which is typical for the time, the impetus for founding the congregation came from several women who had migrated from Charleston, South Carolina, to Savannah, Georgia due to the ongoing American Civil War. Here they met two families in Greensboro who were already Episcopalian.

The church leaders hired J. G. Barnett of Rome, Georgia, as builder and architect. Church historians indicate the building was completed in four months. According to references in the local Greensboro Herald, a church building existed by the end of 1867. Although, it is generally stated the church was constructed in 1868, the year in which the building was consecrated.

In a 1950 renovation, the exterior of the building was repainted in oxblood with a butter milk trim, to recreate what was believed to be the original color scheme. The building is cruciform in shape, with a small steeple-crowned spire on the north side, original to the structure. This is balanced on the south side with a wider steeple, added in the 1960s, which has a steeply gabled roof with flared eaves, matching the shape of the main roof over the church. The church, which holds approximately 80 people, has remained small in membership, and by the 1970s its rolls had dwindled to only three or four families. However, the creation of Lake Oconee in 1986, which initiated the rapid growth in golf and retirement lake communities, led to increased population in the area and membership in the church. In 2003, the vestry called a full-time priest for the first time in 30 years. The Church of the Redeemer never gave up having regular services and now holds the distinction of being the oldest continuously worshipping church in Greene County.