A generalized inverse of a real matrix $A$ is a matrix $H$ that satisfies the Moore-Penrose (M-P) property $AHA=A$. If $H$ also satisfies the M-P property, $HAH=H$, it is reflexive. When $A$ is symmetric, we may desire a symmetric $H$; while generally such a restriction on $H$ may not lead to a 1-norm minimizing reflexive generalized inverse. Letting the rank of $A$ be $r$, and seeking a 1-norm minimizing symmetric reflexive generalized inverse $H$, we give: a closed form when $r=1$ and when $r=2$ and $A$ is non-negative; an approximation algorithm for general $r$. Additionally, our symmetric reflexive generalized inverse is structured and has guaranteed sparsity. $H$ is ah-symmetric if $AH$ is symmetric, and ha-symmetric if $HA$ is symmetric. Seeking a 1-norm minimizing ah-symmetric (or ha-symmetric) reflexive generalized inverse $H$, we give: a closed form when $r=1$ and when $r=2$ and $A$ satisfies a technical condition; an approximation algorithm for general $r$. Additionally, our ah-symmetric (ha-symmetric) reflexive generalized inverse is structured and has better guaranteed sparsity than obtained via linear programming. This is joint work with Marcia Fampa and Luze Xu. (Received August 13, 2019)