During in situ groundwater remediation, a chemical or biological amendment is introduced into the aquifer to degrade the groundwater contaminant. In this type of remediation, mixing of the amendment and the contaminated groundwater, through molecular diffusion and pore-scale dispersion, is necessary for reaction to occur. Since the length scale of dispersion is small compared to the size of the contaminant plume, reactions are limited to a relatively narrow region where the amendment and contaminant are close enough to mix. Spreading, is defined as the reconfiguration of the plume shape due to spatially-varying velocity fields, increasing the size of the region where reaction occurs and increasing concentration gradients, both of which can lead to enhanced mixing and reaction. Spreading can occur passively by heterogeneity of hydraulic conductivity or actively by engineered injection and extraction (EIE), in which clean water is injected or extracted at an array of wells surrounding the contaminant plume. Several studies have shown that active spreading by EIE enhances contaminant degradation in homogeneous porous media compared to remediation without EIE. Furthermore, studies have also shown that combining EIE with passive spreading by heterogeneity can lead to even more degradation compared to EIE alone. In this study, we investigate the relationship between passive and active spreading to better understand their combined impact on mixing and reaction during EIE. Using various combinations of hetero-geneity patterns (e.g., high and low hydraulic conductivity inclusions) and simple injection and extraction flow fields typical to EIE, we determine how the particular spreading of the amendment and contaminant plume under each heterogeneity/flow field combination controls the amount of mixing and reaction enhancement. We find that the injection and extraction flow fields can be designed to complement the topological features generated from specific heterogeneity structures, thereby increasing the amount of mixing and reaction enhancement. Since the subsurface is inherently heterogeneous, insights gained from this research will provide crucial information for the optimal design of EIE systems in the field.