Detailed Project Description:

The **Kalmar Nyckel Living Shoreline and Riparian Habitat Improvement Project** is an ecological restoration initiative designed to transform the degraded riverine shoreline of the Christina River into a resilient, multi-functional habitat that benefits both the environment and the local community. The site is a former capped brownfield that has already undergone ecological restoration and this project is a project to further improve the site. Key elements of the project include:

1. **Living Shoreline Installation:**
   A hybrid living shoreline will be constructed along the Kalmar Nyckel Foundation site. This shoreline enhancement combines natural and engineered elements, including:
   - **Coir logs and fiber mats** to stabilize sediment and serve as a substrate for native vegetation.
   - **Freshwater mussel beds** to filter water, improve clarity, and create structural complexity beneficial for aquatic species.
   - **Native intertidal vegetation** to be planted along the shoreline to anchor soil, attenuate wave energy, and provide habitat for pollinators and other native species.
2. **Impact on the Riverine Shoreline:**
   Currently, the shoreline is dominated by rip-rap and invasive vegetation, with limited ecological function. The project will replace these hard, homogeneous features with a soft, biologically rich interface between land and water. This transformation is expected to:
   - Reduce shoreline erosion by buffering wave energy.
   - Enhance water quality through biological processes, such as mussel filtration and vegetative nutrient uptake.
   - Create a habitat mosaic that supports a wide range of aquatic and terrestrial species.
   - Reduce local flooding issues through the planting of native vegetation bioswales.
3. **Ecological Uplift:**
   By integrating diverse habitat features, the project will:
   - Establish an ecosystem that promotes native biodiversity, including species such as juvenile fish, aquatic invertebrates, amphibians, and pollinators.
   - Improve ecological resilience by allowing the shoreline to adapt naturally to sea-level rise and climate change.
   - Restore natural processes, such as sediment deposition and nutrient cycling, which have been disrupted by urbanization.
4. **Community and Educational Enhancement:**
   The site will serve as a model for local urban ecological restoration, providing opportunities for community engagement and education. Specific benefits include:
   - **Volunteer programs** involving nearby residents and youth groups in planting, monitoring, and maintenance activities.

    - **Educational signage** and guided tours to highlight the environmental and cultural significance of the site, fostering public appreciation for restoration efforts.
    - **Improved aesthetics and recreational opportunities**, connecting residents with the Christina River and demonstrating how ecological restoration can coexist with urban development.

This project demonstrates a balanced approach to addressing ecological, social, and cultural goals, transforming the Christina River shoreline into a vibrant, functional, and sustainable asset for the Delaware Estuary.

Moreover, it follows a pipeline of projects for remediation and restoration in the Christina River through the Christina-Brandywine River Remediation Restoration Resilience (CBR4) project CBR4 is an initiative to address legacy toxic contamination, restore the native ecology, and prepare for the changing climate as well as other threats to river health in the lower Christina River and tidal Brandywine River. This proposed project is a direct result of the effort put in by many partners in the CBR4 project to evaluate opportunities for restoration and improvement of the Christina and Brandywine Rivers in Wilmington. It will provide benefits to the local neighborhoods such as Southbridge and Northeast, which have been heavily impacted by past contamination and flooding and should benefit from and have a say in remediation, restoration, and recreational activities.

General Analysis of Coastal Effect:

The Kalmar Nyckel Living Shoreline and Riparian Habitat Improvement Project will have foreseeable effects on Delaware’s coastal area and resources. These effects encompass both direct and indirect impacts, with clear implications for the Christina River shoreline's ecological health, water quality, and recreational use. The project aligns with DCMP’s approved list of federal actions expected to impact Delaware’s coastal zone.

Direct Effects:
The project will produce immediate and localized changes to the riverine shoreline by:

- Replacing rip-rap and invasive vegetation with a hybrid living shoreline that stabilizes sediments and buffers wave energy.
- Improving water clarity and quality through the deployment of freshwater mussels, which filter suspended particles and nutrients.
- Enhancing habitat complexity by integrating native vegetation and mussel beds, providing critical refugia for fish, amphibians, pollinators, and other wildlife.

These activities will directly affect the shoreline’s physical structure, water quality, and biodiversity at the project site, creating tangible benefits for ecological function and coastal resilience. While these effects are localized to the project site, their benefits extend regionally as part of a broader strategy to restore ecological function and promote sustainable development in the Christina River watershed.

Indirect and Cumulative Effects:
The project's incremental impacts, when combined with other past and foreseeable restoration efforts CBR4 project pipeline as well as others within the Delaware Estuary, contribute to broader ecological and community benefits:

- **Biodiversity Enhancement**: Establishing a functional habitat mosaic supports the resilience of species populations across the estuary, promoting genetic diversity and ecosystem stability.
- **Climate Adaptation**: By fostering natural elevation-building processes and integrating vegetative stormwater filtration, the project helps mitigate the long-term effects of sea-level rise and increased storm intensity.
- **Community Benefits**: The aesthetic improvements and educational components of the project are expected to attract recreational use, support environmental awareness, and enhance community engagement with the Christina River.

Consistency with DCMP Policies:
This project addresses enforceable policies in the DCMP, particularly those related to wetlands management, coastal waters management, pollution prevention, and living resource conservation. As such, it aligns with Delaware's goals for sustaining coastal uses while enhancing natural and recreational resources.