Conventional pollutants, such as TSS and oil & grease can have adverse effects on human health and environment. For example, habitat degradation can result from increased suspended particulate matter that reduces light penetration and thus primary productivity. Suspended solids in the water column can have a direct effect on the fish either killing them, or reducing their growth rate and/or resistance to disease, preventing successful development of fish eggs and larvae, modifying fish movement and migration and reducing the abundance of food available to fish. Settleable materials which blanket the bottom of the water bodies cause benthic smothering, damage invertebrate populations and can alter spawning grounds and feeding habitat. Oil and grease can have lethal effect on fish, by coating surface gills causing asphyxia, or depleting oxygen levels due to excessive biological demand, or reducing reaeration because of surface film. Oil and grease can also have detrimental effects on waterfowl by destroying the buoyancy and insulation of their feathers. Bioaccumulation of oil substances can cause human health problems including tainting of fish and bioaccumulation of carcinogenic polycyclic aromatic compounds.

Benefits of this proposed rule include elimination of toxic, conventional, and nonconventional pollutants, or reduction to levels below those considered to impact receiving water's biota, and elimination or reduced impacts on human health. Potential benefits may ultimately include reduced aquatic habitat degradation; improved recreational fisheries; improved subsistence and personal use fisheries (important to low-income anglers and Alaska's Native anglers, etc.); improved commercial fisheries; improved aesthetic quality of waters; improved recreational opportunities; and decreased harm to threatened or endangered species in Gulf of Mexico and Cook Inlet.

*B. Quantitative Estimate of Benefits*

(1) Gulf of Mexico. The Gulf of Mexico benefits associated with produced water include: (a) non-monetized benefits (*i.e.*, (i) review of case studies of environmental impacts of produced water that document adverse chemical and biological impacts resulting from its discharge into coastal waters in the Gulf of Mexico; (ii) modeled water quality benefits expressed as reduction/elimination in exceedances of human health or aquatic life state water quality standards; and (iii) estimated reduction of total point source toxic loading contribution to Texas and Louisiana estuarine drainage systems, and (b) monetized benefits (*i.e.*, (i) estimated reduction of carcinogenic risk from consumption of seafood contaminated with $Ra^{226}$ and $Ra^{228}$ based on limited observations and modeled levels; and (ii) estimated ecological benefits of zero discharge of produced water.))

(a) Quantified Non-Monetized Benefits.

(i) Documented Case Studies. A comprehensive review of available data identified 25 study sites (12 in Louisiana and 13 in Texas) that examined impacts of produced water discharges on coastal environment. The majority of evaluated study sites are in water depths less than 3 meters, and include variable environments (*i.e.*, wetlands, saltmarshes, and fresh or brackish marshes), and both relatively low and high energy areas. The documented impacts show elevated hydrocarbons and metals in water column and sediments, and reveal impacts on biota (*i.e.*, depressed community structure such as abundance or diversity) up to 1,000 meters (and more) from the produced water discharge. The salinity effects are typically detected up to 300 meters from the discharge, and up to 800 meters in dead-end canals. A benthic dead zone (no benthic fauna) is documented up to 15 meters and severely depressed benthic communities are noted to 150 to 400 meters from produced water outfalls.

(ii) Projected Water Quality Benefits. The effects of toxic pollutants in current (BPT) produced water discharges on receiving water quality and benefits of proposed effluent guidelines are evaluated. Plume dispersion modeling is performed to project in-stream concentrations of 66 pollutants (representing subcategory-wide produced water discharge) at the edge of the state-prescribed mixing zones for Texas and Louisiana at one and three meters water depths. The in-stream concentrations are compared to Texas and Louisiana state standards; Texas has standards for 12 of the pollutants and Louisiana for 14. The results based on the mean discharge rate show one pollutant (silver) in Texas exceeds its chronic standard at the one meter depth; in Louisiana, one pollutant (copper) exceeds two acute standards (daily average and maximum), two pollutants (copper and lead) exceed two chronic standards, and one pollutant (benzene) exceeds two human health standards at the one meter depth, and at three meter depth one pollutant (copper) exceeds its acute standard, and one pollutant (benzene) exceeds two human health standards at the three meter depth. The proposed BAT zero discharge option would eliminate all projected exceedances.

(iii) Projected Reduction of Point Source Toxic Loading Contribution to Texas and Louisiana Estuarine Drainage Systems. The watershed pollutant loadings from produced water are compared to other industrial and municipal point sources (*i.e.*, excluding pollutant loadings from nonpoint sources and atmospheric deposition) for Texas and Louisiana estuarine drainage systems. At the current (BPT) discharge level, produced water in Texas contributes about 20 percent, and in Louisiana about 60 percent of total point source mass pollutant loadings into their respective watersheds. The proposed zero discharge would eliminate produced water pollutant loading contribution to the Texas and Louisiana coastal watershed.

(b) Quantified Monetized Benefits. (i) Projected Cancer Risk Reduction Benefits. Upper bound individual cancer risks from consuming fish contaminated with $Ra^{226}$ and $Ra^{228}$ from current produced water discharges are estimated for recreational and subsistence anglers, and aggregate human cancer risks are projected and monetized. Risks are estimated using two types of data: (1) Measured field seafood data (*i.e.*, because background levels could not be adequately determined average $Ra^{226}$ and $Ra^{228}$ levels were used based on field samples of fish, crabs and oysters collected within 3,000 meters of produced water discharges in coastal subcategory areas of Louisiana), and (2) modelled effluent data (*i.e.*, using current subcategory-wide produced water concentrations of $Ra^{226}$ and $Ra^{228}$ and plume dispersion model at mean outfall discharge rates to estimate $Ra^{226}$ and $Ra^{228}$ levels in seafood). [Using the estimated $Ra^{226}$ and $Ra^{228}$ concentrations in seafood, EPA estimates individual cancer risks assuming two different consumption rates of 147.3 g/day for subsistence anglers and 15 g/day for recreational anglers]. In addition, all individual cancer risks are adjusted by factors of 0.2 and 0.75 to account for ingestion of seafood from locations some of which are not contaminated with the $Ra^{226}$ and $Ra^{228}$ in coastal produced water discharges. Projected individual cancer risks for both risk assessment approaches are at $10^{-4}$ level for subsistence anglers, and at $10^{-6}$ level recreational anglers. The proposed zero discharge of produced water will eliminate these estimated cancer risks over time. Based on measured field data, the proposed BAT is projected to