Best Practice Form

Best Practice Title:	Use of Earthen Benches and Other Technologies to Support Remediation and Removal of Contaminated River Structures		
DOE Site:	Hanford Site	**Facility Name:**	181-N, 181-NE, and 1908-NE Intake and Outfall Structures
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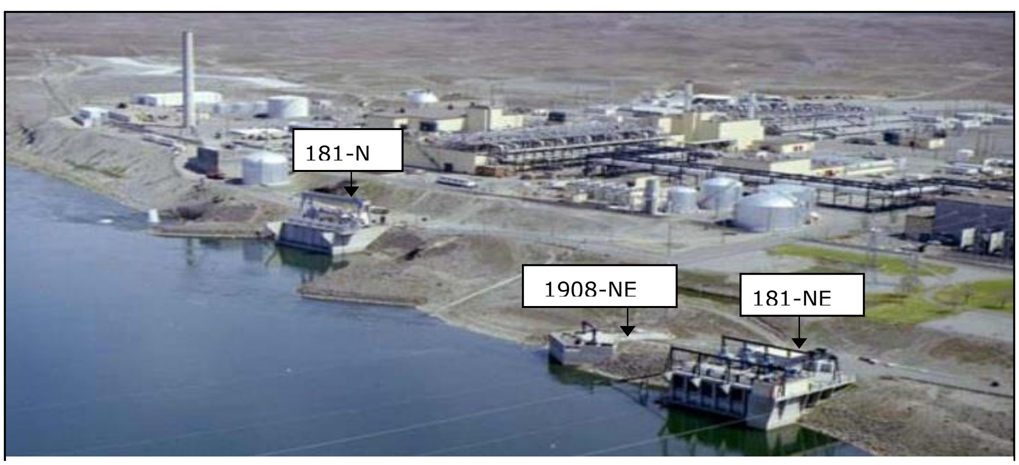
Brief Description of Best Practice: (a short, "abstract-like" description of the best practice)

The 100-N river structures included two pump houses (181-N and 181-NE) and an outfall structure (1908-NE). The structures were built in the early 1960s to support the N Reactor operations, the world's first dual-purpose reactor, which produced plutonium and provided steam to the Hanford Generating Plant for electricity production. The structures were constructed of steel-reinforced concrete with walls up to 4-ft thick.

Washington Closure Hanford (WCH), as part of the River Corridor Cleanup (RCC) Project, was contracted to demolish the three structures that were located directly in the Columbia River. The project's original work scope included pre-demolition removal of contaminated equipment followed by demolition of the structures. However, the final work scope included extensive additional requirements. These included intensive agency, tribal, and regulator consultation; removal of contaminated equipment; manufacture and replacement of concrete panel sluice gates to isolate the intake structures; removal of contaminated sediment; use of acoustic deterrence to protect fish near the structures; monitoring fish activity and sediment turbidity; installing earthen benches (described in Summary) in front of the river structures to isolate them from the river; placement of clean sand in the structures to control pH during demolition; using conventional demolition methods to remove the structures themselves; and ending with the restructuring of the shoreline to restore a shallow water habitat. The proximity of the work to the Columbia River made environmental management an integral component in the planning and design process. Developing and maintaining a good working relationship with environmental and regulatory agencies is essential on any project, but especially those located on bodies of water or in culturally sensitive areas. This best practice describes the use of earthen benches and other technologies used to support the remediation and removal of the contaminated river structures.



Contaminated Structures along the Columbia River: 181-N and181-NE Pump Houses, 1908-NE Outfall Structure

Summary:

The design process for the river structure project went through extensive contractual, regulatory, tribal, and public evaluations. It took WCH approximately 1½ years to prepare the structures for demolition. Accomplishments that satisfied the U.S. Department of Energy (DOE) contractual and environmental regulatory requirements included:

- Removed 14 pumps and 12 traveling screens (ranging from 30,000 to 80,000 lb and 55 to 65 ft in length) from the two former intake structures
- Removed 7 metal sluice gates and installed 36 concrete sluice gates to seal off intakes from the river
- Removed contaminated sediment from the bottom of the structures
- Designed and constructed haul roads to effectively transport material for bench construction
- Filled structures with sand to 3 ft above the bench using a rock thrower (conveyer belt system)
- Toppled the 62-ft 181-NA Guard Tower for removal
- Constructed isolation benches around the structures
- Demolished and loaded out the 181-N, 181-NE pump house intake and 1908-NE outfall structures
- Recontoured the benches following demolition to closely match the adjacent shoreline and provide shallow water habitat for fish per U.S. Fish and Wildlife Service requirements.

The river structures were the home to 14 motors and pumps that potentially contaminated the sediment resting at the bottom of the structures. The project regulator (Washington State Department of Ecology) wanted all fine sediment particles removed before demolition. In order to protect the river during sediment removal, the intake structures were isolated by concrete sluice gates that were fabricated and lowered into slots in the existing structures. The specialized dive and environmental restoration subcontractor team (Global Dive and Clean Harbors) provided a custom designed pumping and filtration skid. The sediment removal system chosen as a "best practice" involved a multi-step filtration process that used a screened suction unit from a submersible hydraulic pump and a surface pump. The bulk sediment filtration occurred in a large oblong perforated plastic bag (GeoTube®) that sat inside a protective catch basin and was then pumped into an 18,000-gal weir tank. From the weir tank, water was subsequently filtered through sand filters, bag filters, and carbon filters to remove smaller particles. The decontaminated water was then pumped back into the river structures.

The best practice of using earthen benches was used to isolate the structures from the water of the Columbia River. The benches were constructed to an elevation above the ordinary high-water mark to allow work to continue year round, concurrent with sensitive and regulated aquatic life activities, and alleviated the need to comply with strict turbidity limitation requirements. They provided a stable platform for access to the structure's pump houses via the sides of the structures and helped attenuate sound during demolition activities. The benches included a core made of borrow material surrounded by a layer of large "rip rap" material to help prevent erosion to the bench. The fill was placed by the edge of the structures in the river and progressively bulldozed into the river (rather than dropped, to minimize turbidity) until a bench and pathway around each structure was created.

Earthen benches used to isolate structures from the Columbia River

Summary (continued):

WCH protected the river and the endangered fish by running equipment with biodegradable oil during all bench construction and demolition activities near the river in the event of hydraulic line leakage or rupture. The project also used an absorbent boom that was stationed near the river edge and designed for deployment for retaining and absorbing oil and spills in the event of an equipment leak. After demolition and removal of the rubble, the entire face of the benches and remaining below-grade concrete structures were covered in the native cobble and recontoured to resemble the adjacent shoreline. The final revegetation effort stabilized the shoreline against erosion, provided habitat, and helped to blend the project area with adjacent habitats.

One of the more impressive accomplishments of this project is the completion of all haul road construction, bench construction, and river structure demolition operations without a single recordable safety incident.

Why the best practice was used: (Briefly describe the issue/improvement opportunity the best practice was developed to address)

WCH needed to minimize disruptions to the Columbia River during demolition of the river structures while still satisfying multiple regulators, tribes, and environmental agencies. There were many design considerations while planning the structures' demolition including:

- Short, infrequent "in water" work windows due to endangered aquatic life
- Minimization of impacts to the river's threatened and endangered species
- Methods to allow isolation from the river to remove contaminated sediment and for year-round work access
- Methods to remove contaminated sediment
- Prevention of noise transmissions to the river
- Maintenance of river water quality
- Prevention of disturbances to culturally sensitive areas
- Accommodation of daily and seasonal changes in water elevations
- Complete removal of polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCBs)
- Control of water pH during concrete fracturing
- Facilitation of "end-state" shoreline restoration.

What problems/issues were associated with the best practice: (Briefly describe the problems/issues experienced with the initial deployment of the best practice that, if avoided, would make the deployment of this best practice easier the" next time".)

The best practice is a direct result of many issues and challenges of cleaning up and restructuring the shoreline to the satisfaction of multiple stakeholders. The need to protect endangered fish resulted in the use of acoustic deterrence and fish monitoring systems.

The stretch of the Columbia River associated with these river structures is home to endangered Chinook salmon and threatened steelhead, and designated as a critical habitat for bull trout. The DOE requested consultation under Section 7 of the Endangered Species Act with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service, who requested "reasonable and prudent measures" taken to ensure minimal disruptions to the threatened fish populations during the construction of the benches. The NMFS requested the use of physical barriers (silt curtains and/or seining nets) to protect the fish, but due to high river velocities and strong lateral velocity vectors in the project area (water levels were abnormally high), neither barrier system was successfully installed. Further attempts would risk habitat damage to the lower river reaches should the silt curtains or nets break free and get dragged down river by the water forces. As the use of physical barriers was impractical, an acoustic deterrent system was suggested by DOE and approved by NMFS. The system consisted of an aqua sonic speaker system combined with a generator to produce noise that uses the natural response of fish to deflect them away from the structures. Surveys that included underwater sonar (fish finder) and video camera sweeps of the project area were conducted to verify effectiveness.

An example of an engineering challenge that was overcome on the project was the removal of 60,000-lb screens that were stuck.

During the 181-NE pre-demolition removal of six traveling screens, each weighing in excess of 60,000 lbs, the 300-ton crane had difficulty breaking the screens free from their locations. As a result, an alternative method was required to safely remove the screens. The project was able to use a hydraulic 1,000-ton picking system, already in use in the 300 Area, consisting of four rams that were placed on each corner of the traveling screen. The hydraulic unit would send fluid slowly to each ram and alternate around the traveling screen slowly lifting each corner. Once broken free, the crane was able to safely pick the screens and lay them down for size reduction and load out. A lesson learned is that any legacy equipment that has not been operated or moved for an extended period of time may require a contingency plan for removal.

How the success of the Best Practice was measured: (What data/operating experience is available to document how successful the best practice has been?)

The stakeholders' acceptance of the best practice implementation plans, as well as the results after project completion, are the two measures of the success of the best practice. Had a more conventional remediation process been followed, the resultant impact on the fish and the river ecosystem would have been much greater.

What are the benefits of the best practice: (Briefly describe the benefits derived from implementing the best practice.)

- Minimization of impacts to the river's threatened and endangered species and all other species
- Minimization of contaminant sediments to the river bottom
- Allowed isolation from the river to remove contaminated sediment and for year-round work access saving time and money
- An efficient and effective system for removal of contaminated sediment
- Prevention of permanent harm to the animal species from loud noise transmissions to the river
- Maintenance of river water quality
- Prevention of disturbances to culturally sensitive areas
- Accommodation of daily and seasonal changes in water elevations for remediation and removal operations
- Completion of removal of PAHs and PCBs
- Control of water pH during concrete fracturing
- Facilitation of "end-state" shoreline restoration.

View of Site Along the Columbia River, February 2013

Alternative solutions considered: (Other solutions to the issue/improvement opportunity considered prior to implementing the best practice?)
The alternative solution would have been to follow a more standard demolition and removal operation, which would have resulted in poorer water quality (turbidity), major impact on the fish, and the release of low levels of contaminated silts to the river bottom.

Additional Information	
Reference:	"Use of Earthen Benches and other Technologies to Support River Structures' Demolition Activities," Best Practice