NS-5 CLEAR WATER DIVERSION

BMP Objectives

- ☒ **Perimeter Control**
- ☒ **Slope Protection**
- ☐ **Borrow and Stockpiles**
- ☒ **Drainage Areas**
- ☐ **Sediment Trapping**
- ☒ **Stream Protection**
- ☐ **Temporary Stabilizing**
- ☐ **Permanent Stabilizing**

Definition and Purpose

Clear water diversions consists of various structures and measures that intercept clear runoff upstream of a project site, transport it around or through the work area, and discharge it downstream with minimal water quality degradation by either the project construction operations or the construction of the diversion. Isolation techniques are methods that isolate near-shore work from a water body. Structures commonly used for clear water diversions include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, filter fabric or turbidity curtains, drainage and interceptor swales, pipes, or flumes.

Appropriate Applications

- A clear water diversion is typically implemented where work must be performed in a live stream or water body.
- Clear water diversions are appropriate for isolating construction activities occurring within or near a water body such as stream bank stabilization or culvert, bridge, pier, or abutment installation. They may also be used in combination with other methods, such as clear water bypasses or dewatering.
- Pumped diversions are suitable for intermittent and low-flow streams.
- Excavation of a temporary bypass channel or passing the flow through a flume is appropriate for the diversion of streams less than 20 feet wide, with flow rates less than 100 cubic feet per second.
- Clear water diversions incorporating clean washed gravel may be appropriate for use in salmon spawning streams.

Limitations

- Diversion/encroachment activities will usually disturb the waterway during installation and removal of diversion structures.
- Special permits or mitigation measures may be required.
- Diversion/encroachment activities may constrict the waterway, which can obstruct flows and cause flooding or washouts.
- Diversion or isolation activities are inappropriate in deep water unless designed or reviewed by a hydraulic engineer.
- Diversion or isolation activities should not completely dam stream flow.
- Dewatering and removal may require additional sediment control or water treatment (see NS-2 [Dewatering Operations]).

General Considerations

- Divert clear water to clear water. This means that a diversion should be of sufficient length to completely bypass the area impacted by construction. If clear water is returned to a waterway too soon, it will exacerbate the sediment control problem rather than mitigating it by increasing the volume of sediment laden water on the job site.
- Where working areas encroach on live streams, barriers adequate to prevent the flow of muddy water into streams shall be constructed and maintained between working areas and streams. During construction of the barriers, muddying of streams shall be held to a minimum.
- Where possible, diversion/encroachment impacts shall be avoided or minimized by scheduling construction during periods of low-flow or when the stream is dry (see also the project special provisions for scheduling requirements). Scheduling shall also consider seasonal releases of water from dams, fish migration and spawning seasons, and water demands due to crop irrigation.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to storms, flash floods, etc.
- Heavy equipment driven in wet portions of a water body to accomplish work shall be cleaned of dirt and petroleum residue prior to the work, and may require vegetable based hydraulic oil.
- Excavation equipment buckets may reach out into the water for the purpose of removing or placing fill materials. Only the bucket of the crane/excavator/backhoe may operate in a water body. The main body of the crane/excavator/backhoe shall not enter the water body, except as necessary to cross the stream to access the work site.
- Stationary equipment such as motors and pumps, located adjacent to a water body, shall be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained, or placed in operation, sufficient water shall, at all times, be allowed to pass downstream to maintain aquatic life.

- Equipment shall not be parked below the ordinary high water mark overnight unless allowed by a permit.
- Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations, and as shown on the project plan sheets. Precautions shall be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation shall be replaced with the appropriate soil stabilization measures.
- Riparian vegetation, when removed pursuant to the provisions of the work, shall be cut off no lower than ground level to promote rapid re-growth.
- Drip pans shall be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.
- Diversion structures shall be constructed with materials free of potential pollutants such as soil, silt, sand, clay, and petroleum products.
- A "Diversion Plan" shall be submitted to the Engineer for review prior to commencing any clear water diversion activities. This plan should include, at a minimum, the following:
    - Predicted diversion flow rates
    - Pump capacities (if required)
    - Material to be used (i.e., piping, plastic sheeting)
    - Appropriate permits and approvals (as required)
    - Contingency plans
    - Additional BMP (as required)
    - Removal and restoration plan

Temporary Diversions/Encroachments

- In high flow velocity areas, stabilize slopes of embankments and diversion ditches using an appropriate liner, in accordance with EC-11 (Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats) or use rock slope protection.
- Where appropriate, use natural streambed materials such as large cobbles and boulders for temporary embankment/slope protection or other temporary soil stabilization methods.
- Provide for velocity dissipation at transitions in the diversion, such as the point where the stream is diverted to the channel and the point where the diverted stream is returned to its natural channel. See also SC-6 (Inlet/Outlet Protection).

Temporary Dry Construction Areas

- When dewatering behind temporary structures to create a temporary dry construction area, such as coffer dams, pass pumped water through a sediment settling device, such as a portable tank or settling basin, before returning water to the water body; see also NS-2 (Dewatering Operations).

- If the presence of polluted water or sediment is identified in the contract, the Contractor shall implement dewatering pollution controls as required by the contract documents. If the quality of water or sediment to be removed while dewatering is not identified as polluted in the contract documents, but is later determined by observation or testing to be polluted, the Contractor shall notify the Engineer and comply with IDEQ requirements.
- Any substance used to assemble or maintain diversion structures, shall be non-toxic and non-hazardous.
- Any material used to minimize seepage underneath diversion structures, such as grout, shall be EPA-approved, non-toxic, non-hazardous, and as close to a neutral pH as possible.

Stream Diversions

Definition and Purpose

Stream diversions consists of a system of structures and measures that intercept an existing stream upstream of the project, transports it around the work area, and discharges it downstream. The selection of which stream diversion technique to use depends upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

Appropriate Applications

- Where dewatering is necessary.
- Work areas that require isolations from flows.

Limitations

- Pump diversions have limited flow capacity.
- Pumped diversions require frequent monitoring of pumps.
- Large flows during storm events can overtop dams.
- Flow diversion and re-direction with small dams involves in-stream disturbance and mobilization of sediment.

Standards and Specifications:

- Installation guidelines will vary based on existing site conditions and type of diversion used.
- Diversions shall be sized to convey design flood flows.
- Pump capacity must be sufficient for design flow. Adequate energy dissipation must be provided at the outlet to minimize erosion.
- Materials used to create dams upstream and downstream of the diversion should be erosion-resistant. Materials such as steel plates, sheet piles, sandbags, continuous berms, inflatable water bladders, etc., would be acceptable.
- Construction of a diversion channel shall begin with excavation of the channel at the proposed downstream end, with work proceeding upstream. Once the watercourse to be diverted is reached, and the excavated channel is stable, the upstream end shall be breached, and water shall be allowed to flow down the new channel. Once flow has been

established in the diversion channel, the diversion weir shall be installed in the main channel; this will force all water to be diverted from the main channel.

Maintenance and Inspection

- Conduct inspections as required by the NPDES permit or contract specifications.
- Monitor pumps, which may be required frequently for pumped diversions.
- Remove debris and repair linings and slope protection as required. Repair holes, gaps, or scour.
- Upon completion of work, remove the diversion or isolation structure and redirect flow through the new culvert or back into the original stream channel. Recycle or re-use if applicable.
- Re-vegetate areas disturbed by BMP removal, if needed.

Isolation Techniques

Isolation techniques are methods that isolate near-shore work from a water body. Techniques include sheet pile enclosures, water-filled geotextile (Aqua Dam), gravel berm with impermeable membrane, gravel bags, cofferdams, and K-rail.

Filter Fabric Isolation Technique

Definition and Purpose

A filter fabric isolation structure is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water.

Appropriate Applications

- If spawning gravel is used, all other components of the isolation can be removed from the stream, and the gravel can be spread out and left as salmonid spawning habitat. Whether spawning gravel or other types of gravel are used, only clean washed gravel should be used as infill for the gravel bags or continuous berm.
- This is a method that should be used in relatively calm water and can be used in smaller streams.

Limitations

- Do not use if the installation, maintenance, and removal of the structures will disturb sensitive aquatic species of concern.
- Not appropriate for projects where dewatering is necessary.
- Not appropriate to completely dam stream flow.

Standards and Specifications

- For the filter fabric isolation method, a non-woven or heavy-duty fabric is recommended over standard silt fence. Using rolled geotextiles allows non-standard widths to be used. This method involves placement of gravel bags or continuous berms to “key-in” the fabric and subsequently stake the fabric in place.
- Filter fabric shall be anchored with gravel bags filled with clean, washed gravel. Sand shall not be used.

- For the continuous berm method, a continuous gravel-filled bag berm is made with a Continuous Berm Machine. The length of the berm is usually limited to 20 feet for ease of handling.

Installation

- Place the fabric on the bottom of the stream, and place either a bag of clean, washed gravel or a continuous berm over the bottom of the fabric, such that a bag-width of fabric lies on the stream bottom. The bag should be placed on what will be the outside of the isolation area.
- Pull the fabric up, and place a metal t-post immediately behind the fabric, on the inside of the isolation area. Attach the fabric to the post with three diagonal nylon ties.
- Continue placing fabric as described above until the entire work area has been isolated, staking the fabric at least every 6 feet.

Maintenance and Inspection

- Conduct inspections as required by the NPDES permit or contract specifications.
- Immediately repair any gaps, holes, or scour.
- Remove sediment buildup.
- Remove BMP upon completion of construction activity. Recycle or reuse if applicable.
- Re-vegetate areas disturbed by BMP removal if needed.

Turbidity Curtain Isolation Technique

Definition and Purpose

A turbidity curtain is a relatively impervious fabric barrier used to isolate the near-shore work area. The barriers are intended to confine the suspended sediment. The curtain is a floating barrier and thus does not prevent water from entering the isolated area; rather, it prevents suspended sediment from getting out. This method is very good in isolating fine as well as coarse sediment.

Appropriate Applications

Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They are used when construction activities adjoin quiescent waters, such as lakes, ponds, lagoons, bays, and slow flowing rivers. The curtains are designed to deflect and contain sediment within a limited area and provide sufficient retention time so that the soil particles will fall out of suspension.

Limitations

- Turbidity curtains should not be used in flowing water; they are best suited for use in ponds, lakes, and very slow-moving rivers.
- Turbidity curtains should not be placed across the width of a channel.
- Removing sediment that has been deflected and settled out by the curtain may create a discharge problem through the re-suspension of particles and by accidental dumping by the removal equipment. Caution must be taken in removal.

Standards and Specifications

- Turbidity curtains should be oriented parallel to the direction of flow.
- The curtain should extend the entire depth of the watercourse in calm-water situations.
- In wave conditions, the curtain should extend to within 1 foot of the bottom of the watercourse, such that the curtain does not stir up sediment by hitting the bottom repeatedly. If it is desirable for the curtain to reach the bottom in an active-water situation, a pervious filter fabric may be used for the bottom 1 foot.
- The top of the curtain should consist of flexible flotation buoys, and the bottom shall be held down by a load line incorporated into the curtain fabric. The fabric shall be a brightly-colored impervious mesh.
- The curtain shall be held in place by anchors placed at least every 100 feet.
- The anchors shall first be placed, and then the fabric shall be towed out in a furled condition and connected to the anchors. The anchors should be connected to the flotation devices, not to the bottom of the curtain. Once in place, the furling lines shall be cut, and the bottom of the curtain shall be allowed to sink.
- Sediment that has been deflected and settled out by the curtain should be removed; however, consideration must be given to the potential for re-suspension of the particles or by accidental dumping of material during removal. It is recommended that the soil particles trapped by the turbidity curtain be removed only if there has been a significant change in the original contours of the affected area in the watercourse.
- Particles should always be allowed to settle for a minimum of 6 to 12 hours prior to their removal or prior to removal of the turbidity curtain.

Maintenance and Inspection

- Conduct inspections as required by the NPDES permit or contract specifications.
- Allow sediment to settle for 6 to 12 hours prior to removal of sediment or curtain. After removing sediment, wait an additional 6 to 12 hours before removing the curtain.
- To remove, install furling lines along the curtain, detach from anchors, and tow out of the water.

K-rail River Isolation

Definition and Purpose

This is temporary sediment control, or stream isolation method that uses K-rails to form the sediment deposition area, or to isolate the in-stream or near-bank construction area.

Barriers are placed end-to-end in a pre-designed configuration, and gravel-filled bags are used at the toe of the barrier and also at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

Appropriate Applications

The K-rail isolation can be used in streams with higher water velocities than many other isolation techniques.

Limitations

- The K-rail method does not allow for full dewatering.

Standards and Specifications

- To create a floor for the K-rail, move large rocks and obstructions. Place washed gravel and gravel-filled bags to create a level surface for K-rail to be placed on.
- Place plastic sheeting around the K-rails, and secure at the bottom with gravel bags.
- Further support can be added by pinning and cabling the K-rails together.
- Use large riprap and boulders to support either side of the K-rail, especially where there is strong current.

Maintenance and Inspection

- Conduct inspections as required by the NPDES permit or contract specifications.
- Any damage, movement, or other problems should be addressed immediately.
- Sediment should be allowed to settle for at least 6 to 12 hours prior to removal of sediment, and for 6 to 12 hours prior to removal of the barrier.