TEMPORARY STREAM DIVERSION

1. SCOPE

This item consists of furnishing all materials, equipment, and labor necessary to protect streams during work within the channel by constructing temporary diversions to maintain stream flows and water quality while providing a dry work area at designated locations as shown on the Drawings, Special Conditions, and as directed by the ENGINEER.

2. MATERIALS

2.1. **Filter Fabric**: Shall conform to the "Filter Fabric" technical specification.

2.2. **Geotextile Bags**: Shall be sand or stone filled bags consisting of materials, which are resistant to ultra-violet radiation, tearing and puncture, and woven tightly enough to prevent leakage of fill material (i.e., sand, fine gravel, etc.) and conforming to the "Silt Control" technical specification.

2.3. **Aggregate**: Shall conform to the "Crushed Aggregate and Channel Lining" technical specification. Size of aggregate is listed on the Drawings, Special Conditions, and/or AML Standard Details. There shall be no earth, sands, silts, clays, or organic material used for construction within the waterway channel. Washed coarse aggregate (3/4 inch to 4 inches) referenced, as AASHTO designation No. 1 shall be the minimum acceptable aggregate size for temporary stream diversions. Larger clean aggregates such as Class II/III riprap will be allowed.

2.4. **Impervious Sheeting**: Shall consist of polyethylene or other material that is impervious and resistant to puncture and tearing.

3. DESIGN PLANNING

Gather necessary temporary diversion sizing parameters and determine the appropriate diversion technique. Selection and design of temporary diversion methods should convey the baseflow and storm flow around the work area without damaging either the work area, adjacent unprotected stream channel (for in-stream diversions), and/or the diversion channel. The temporary stream diversion shall not cause a significant water level difference upstream or downstream of the project site (water surface elevation change (not to exceed 1% or 0.5' of baseflow whichever is more restrictive) and the velocity should be maintained at a rate similar to existing flow conditions.

Pumping or piping water around the work area may be necessary and is generally for short duration projects with low baseflows. Larger flows may require construction of a berm around the work area within the stream channel to force the water to one side of the channel around the work area. The work area is then pumped dry during construction.

3.1. In-stream Channel Diversion

This method involves rerouting water around the work area either with restricted but open channel flow, piping, or pumping water around the work area. EARTHEN BERMS/DAMS ARE NOT PERMISSIBLE

All berms will allow the passage of high flows and aquatic organisms, while maintaining downstream flows and withstanding anticipated erosive forces. The height of the diversion structure shall be one-half the distance from the streambed to stream bank plus one foot (min.). Base the material selection upon the site conditions, type and length of construction time, and if the diversion must remain throughout construction or if removal for storm flows is appropriate. All in-stream diversions left in place during a storm event must allow for the conveyance of the 2-year peak flow past the work area without causing damage to the streambank or bed and not overtopping the diversion structure.

Use sizing methodology to determine the design flow rate and existing channel slope. Perform initial channel sizing calculations using Manning's Equation and ensure the restricted channel can still pass the flow without creating erosion problems on the opposite bank. The berm shall be of sufficient height to provide a minimum of 0.5 feet of freeboard.

3.1.1. Sandbag-Conduit Diversion/Berm

These materials are used to isolate work areas from flow during the construction of in-stream projects. Diversions that have an insufficient flow capacity can fail and severely erode the disturbed channel section under construction. Therefore, in-channel construction activities should occur only during periods of low rainfall. This temporary measure may not be practical in large channels.

If a major storm event is expected, stabilize the site in preparation for it and this may include removing and/or replacing them with a more suitable diversion. The conduit shall have the hydraulic capacity to handle the flow rate of 30 cubic feet per second per square mile of drainage area above the site.

3.1.2. Sandbag-Stone Diversion/Berm

These materials are used to isolate work areas from flow during the construction of in-stream projects. Diversions that have an insufficient flow capacity can fail and severely erode the disturbed channel section under construction. Therefore, in-channel construction activities should occur only during periods of low rainfall. The temporary channel should be able to convey the 2-year storm event. Install the diversion structure from upstream to downstream. Cover the structure with plastic sheeting anchored with sandbags. Sheeting shall be overlapped such that the upstream portion covers the downstream portion with at least an 18-inch overlap.

3.1.3. Aggregate Berm

These consist of appropriately sized clean aggregate placed in the stream with the base and upstream side lined with a medium weight-nonwoven filter fabric. Cover the upstream face of the fabric with a smaller stone such as No. 2 aggregate. Sandbags may be added along the base to stop the flow of water under the berm.

3.1.4. Piped Diversion

Use sizing methodology to determine temporary diversion design flow rate. Select a pipe of sufficient size the pipe to accommodate the design flow using no more than 80 percent of the pipe full flow capacity. Select a Manning's n value based on the type of pipe material that will be used (concrete n = 0.013 [typ.], corrugated metal pipe n = 0.024 [typ.]).

3.1.5. Pumped Diversion

Use sizing methodology to determine the design flow rate. Select a backup pump (or pumps) with capacity equal to or greater than the design flow rate should be on site and in good working order at all times. Designate a method for filtering of sediment-laden water created because of the construction activities. Non-sediment laden bypass water does not require filtering, however, it still must discharge onto a non-erodible, energy-dissipating surface prior to rejoining the stream flow.

3.2. Stream Channel Diversion

For large, continuous flows during construction, a temporary channel diversion shall be required. It consists of constructing a berm to divert the water from the original channel into a temporary new channel during construction. The temporary new channel is lined with non-erodible materials.

Use sizing methodology to determine the appropriate size, geometry, and slope of the temporary diversion necessary to convey a 2-year storm event without damaging the temporary channel. The steepest side slope allowable is two horizontal to one vertical (2:1). A maximum depth of 1-foot is allowed for flows less than 20 cfs and a maximum of 3 feet for flows less than 100 cfs. Provide a minimum of 0.5 feet of freeboard above the designed water surface elevation. Construct the downstream and upstream connection to the natural channel under dry conditions.

3.3. CONSTRUCTION

The CONTRACTOR will provide the ENGINEER with a plan for the rapid removal of equipment and materials with potential to contribute pollutants to runoff from the waterway in advance of imminent runoff with the potential to exceed diversion capacity. The plan will designate an individual (in addition to the ENGINEER'S representative) who will be on the site throughout most of the construction project with the authority to order that work be halted and equipment and materials with potential to contribute to storm water pollution be moved to high ground outside of the active channel. Identify where equipment and materials removed from the channel will be stored temporarily during a runoff event that is expected to exceed temporary diversion capacity. List the phasing of stream impacting work operations to minimize the amount of area disturbed and time required for the disturbance. The ENGINEER must approve the plan prior to any disturbance. **All personnel responsible for performing the work and oversight will participate in a pre-disturbance meeting to discuss the final approved plan.**

Prior to large storm events, the CONTRACTOR may be required to restore full flow to the stream channel excluding areas being protected to prevent excessive erosion of bank materials. The temporary removal and replacement of any diversions is incidental to the overall bid item(s) or scope of work unless explicitly noted otherwise in the contract documents (Special Conditions/Notes and/or Bid Item Description).

Whenever possible, time the work in streams and waterways to take place during low or no-flow conditions. Low flow conditions are flow at or below the normal water elevation. All materials shall be on-site prior to channel construction. Diversion and stream work is to be quickly and carefully installed, well maintained, and removed as soon as possible when the construction area is stable. Removal or reconfiguration may be required for storm events.

Erosion and sediment control devices shall be in place prior to starting construction to prevent sediment from entering the diversion or the main stream. All materials used in construction must be sound, and capable of withstanding the loads applied. The materials must also be durable and maintain their integrity for the life of the project. Soil or soil covered aggregate is not acceptable diversion material. Remove accumulated sediment from construction activities from the stream at least weekly.

All work, installation and removal, shall begin at the downstream end and proceed upstream. All excavated materials shall be stockpiled outside of the 100-year floodplain and temporarily stabilized to prevent re-entry into the stream channel. The process of excavation and stabilization shall be a continuous (uninterrupted) operation.

No dewatering of the construction area shall alter the water quality or cause erosion or sedimentation in the stream or the temporary stream diversion. Piped and pumped water shall discharge to a non-erodible energy-dissipating surface prior to reentering the stream. All sediment-laden water must be filtered to remove sediment. Possible options for sediment removal include baffle systems, anionic polymers systems, dewatering bags, or other appropriate methods. Water shall have sediment removed prior to being re-introduced to the downstream

waterway. Discharge water is considered clean if it does not result in a visually identifiable degradation of water clarity.

4.1. In-stream Channel Diversion:

Construct all berms to allow the passage of high flows and aquatic organisms, while maintaining downstream flows, and withstanding anticipated erosive forces. Construct berms and dams from the upland area and no equipment may enter flowing water at any time. If the installation of the cofferdam cannot be completed from outside the stream and access is needed to reach the area to be isolated, other measures, such as the construction of a causeway, will be necessary to ensure that equipment does not enter the water. Once the berm/dam is in place and the isolated area is dewatered, equipment may enter the isolated area to perform the required work.

4.1.1. Sandbag/Stone Channel Diversion: Begin construction from upstream to downstream. The height of the sandbag/stone diversion is a function of the duration of the project in the stream reach. For projects with duration less than 2 weeks, the height of the diversion should be one-half the stream bank height, measured from the channel bed plus 1 foot (min.). For projects of longer duration, the top of the sandbag or stone diversion should correspond to bankfull height (~2-yr flood event). For diversion structures utilizing sandbags, the streambed should be hand prepared prior to placement of the base layer of sandbags in order to ensure a watertight fit. Additionally, it may be necessary to prepare the bank in a similar fashion.

Position the impervious sheeting on the diversion such that the upstream portion covers the downstream portion with at least an 18-inch overlap.

Sandbag or stone diversions should not obstruct more than 50% of the stream width. Additionally, bank stabilization measures should be placed in the constricted section if accelerated erosion and bank scour are observed during the construction time or if project time is expected to last more than 2 weeks.

4.1.2. Pipe Diversion: Route the water from the berm/dam into a pipe of sufficient size to handle the required design flow. Diversion pipes with an insufficient flow capacity can cause the channel diversion to fail thereby resulting in severe erosion of the disturbed channel section under construction. Therefore, in-channel construction activities should occur only during periods of low flow and contingency plans should be prepared if a large precipitation event were to occur during construction.

4.1.3. Pumped Diversion: Pump the water from upstream of the construction area to the existing downstream channel. Cover the intake of the water pipe with a screen with openings <3/32 inch to prevent entrainment of fish in the coffered area. Salvage and return fish trapped within the coffered area to the downstream channel. Stabilize the pump outlet location to prevent erosion. Do not discharge dewatering flow directly to the stream. Discharge the water onto a non-erodible, energy-dissipating surface. Filter sediment laden water prior to release back into the stream channel's flow.

4.2. Stream Channel Diversion:

Remove all debris such as rocks, sticks, etc. to make a smooth channel surface so that the fabric will rest flush with the channel at all points of contact. Place fabric so that the entire channel is lined with one piece. If overlaps are required, then overlap the traverse seam in accordance with the AML Standard Detail. Lap the upstream section over the downstream section. All overlaps are 2 feet minimum. Key the fabric into 2 x 2 foot trenches at the upstream edge and at 50-foot intervals with the overlap placed nearest to each 50 feet increment running from the top of channel to top of channel. Fill the trench with class II riprap mixed with No. 2 stone and install rock checks every 50' over the trench anchors. Secure the fabric sections with hold down pins and washers. Pin overlaps along transverse and longitudinal axes with spacing equal to 3 feet maximum. Longitudinal overlaps are not allowed. The fabric may be sewn together instead of overlapped to eliminate the requirement for transverse placement of the fabric.

5.1. MAINTENANCE

Because temporary diversions are one of the most critical BMPs for work in waterways, they must be inspected and maintained frequently to remain in effective operating condition. Inspect the temporary stream diversions at the end of each day, at a minimum to ensure that the structure is maintained and not damaged, the streambed and streambanks are stable, and that sediment is not entering the stream or blocking fish passage or migration. Inspect flow barriers at the start and end of each workday and at any time that excess water is noted in dry work areas. For diversion channels, inspect the diversion channel itself for signs of erosion, and repair or replace the lining if there are signs of failure. Check armoring at the diversion return point to the waterway, and add additional armoring if erosion is noted. Make any necessary repairs immediately. Remove all significant sediment accumulations to maintain the designed carrying capacity.

When storm events are anticipated appropriate measure must be taken to prevent damage to the work area and to adjacent areas including downstream. This may require the removal of or modification of existing diversions to prevent damage. Damage includes erosion of the stream bed and due to unstable conditions caused by the construction methods (including diversions), water backed upstream , and water backed up downstream caused by clogging of the stream with debris from the construction area.

5.2. REMOVAL

All temporary stream diversions shall be removed within two (2) calendar days after the structure is no longer needed. Unless prior written approval is obtained, all structures shall be removed and the area stabilized before winter. Remove the diversion from the downstream to upstream. After diversion of the stream back to the natural streambed, backfill and stabilize the temporary diversion channel.