Exhibit E – Routine Maintenance & Repair Methods

This document lists all the Maintenance Methods utilized in the field to complete projects. These maintenance methods include stormwater Best Management Practices (BMP's) which may be utilized to minimize the adverse effects of routine maintenance activities. These Maintenance Methods and associated BMP's are listed under seven distinct categories. Some or all of these maintenance methods may be utilized in order to accomplish the maintenance activities listed in Exhibit C – Routine Maintenance Activities. The seven maintenance methods are:

1. **Delineation of Work Areas**
2. **Temporary Bypass of Stream Flow & Fish Removal**
3. **Vactoring and Jetting**
4. **Excavating**
5. **Bank/Retaining Wall Stabilization**
6. **Habitat Restoration or Maintenance**
7. **Site Restoration/Landscaping**

1. Delineation of Work Areas

Environmentally sensitive areas are identified and protected to keep people and equipment out of them (unless the project area lies within a sensitive area) and to limit the impact of construction activities on the site. Staging areas are used to secure materials and equipment. Identifying staging areas is necessary to initiate project site work. Other work areas may include temporary access roads or stream access points. The extent of the project needs to be established and actions taken to limit any soil disturbing activities outside of the established project area. Delineation of these areas may include use of flagging, fencing, mulch, coir rolls, or other appropriate materials that must be maintained throughout construction.

2. Temporary Bypass of Stream Flow & Fish Removal

Dewatering work areas and fish removal are standard practices to minimize impacts to aquatic species. To reduce turbidity, construction areas that occur within natural drainage systems and shorelines or pipe infrastructure are isolated before and during project work to prevent scour and eliminate the transport of sediment downstream. This method includes removing all fish from the isolated area using methods approved by WDFW and initiated by a qualified fisheries biologist. Isolation nets are installed and several attempts to relocate fish are completed before bypass operations begin.

The following bypass scenarios may be utilized during routine maintenance activities:

- **Temporary bypass for stream flow in a partial channel***:* Occurs when a full bypass is not required because work occurs in a limited area of a stream. This method requires fish removal before installation of the bypass.
- **Temporary bypass for stream flow in a full channel.** Occurs when a full bypass is required because work occurs within a full channel. This method requires that fish be removed before installation of the bypass.
- **Isolating the work area in large waterbodies**. Typically, this method involves using a silt curtain to isolate the work area and contain any turbidity created during maintenance. This method usually requires curtains to remain in place until turbidity has subsided which may take several days.
- **Isolation/dewatering of piped infrastructure***.* This method involves bypassing stormwater that discharge to a creek or other waterbody from piped stormwater infrastructure. It can also require removal and treatment of wastewater resulting from maintenance activities.

In most cases, a gravity or pump system will bypass stream flow from an upstream containment berm or dam around the project site to a location immediately downstream of the construction zone. The length of the isolated stream channel can vary, depending on project size. All projects will have a method to dissipate flow at the downstream end of the diversion. Upon project completion water flow back into the work area is regulated to minimize turbidity.

3. Vactoring and Jetting

Vactoring is removal of sediment and turbid water using vactor trucks with suction hoses. Jet cleaning (jetting water into a culvert) is occasionally required to loosen sediment in a pipe or culvert. Typically, material is flushed down to a catch basin or sump where it can be captured and vactored out. Vehicles are staged adjacent to the work area, typically in an upland area. Vactored material is stored in trucks and disposed of at one of the City's vactor waste facilities.

To prevent the migration of sediment and turbid waters downstream, the system being cleaned is isolated or plugged at the downstream end. The vactor truck stages at this location and captures all sediment and debris entering the structure. A temporary bypass of stream flow may be required to manage the water before it enters the work area.

4. Excavating

This method is used to remove accumulated sediments and other debris from around culverts or outfalls, within creek channels, in-line/off-line sedimentation ponds, fish ladders and habitat restoration areas. Excavation removes accumulated sediment below the OHW line - or wetted perimeter where no OHW exists - that impedes conveyance and increases flooding risk.

As sediments accumulate in and adjacent to ponds, culverts, outfalls, ditches and drainage structures, these sediments are periodically removed. Work is typically done when the water level is low to minimize the amount of work required within the wetted perimeter. For work that occurs in the dry, a tractor or backhoe is operated directly from upland staging areas. Sediments are excavated and hauled to an upland disposal site. If work in the wetted perimeter is necessary, sediments are removed with hand tools or, if mechanized equipment is used, only an extension arm and bucket operate in the water. A temporary bypass of stream flow may be required to manage the water before it enters the work area. If deemed necessary, an environmental bucket may be employed to reduce incidental sediment fall back into the wetted area. Large quantities of excavated sediment (larger quantities are typical for ponds) must often be staged on site to dewater before removal to a disposal site. The location must be selected to avoid incidental draining back into the pond.

5. Bank/Retaining Wall Stabilization

This method is the replacement or repair of existing banks, construction of new bank stabilization, and placement of toe/logs in various waterbodies. Stabilization measures are structural remedies to arrest eroded or slumped streambanks. Banks need stabilization when projects call for removing, repairing, or maintaining fixed structures. Bank stabilization may also be needed in areas of high slope erosion and to address storm damage. Stabilizing disturbed or unstable water edges eliminates upland erosion deposition of sediment into a waterbody. Bank stabilization is used to improve the stability of existing structures, to enhance habitat for juvenile salmonids, to prevent erosion and scour, and to minimize the risk of failure of adjacent roadways, utilities or other public facilities.

Bank stabilization includes these activities:

- Rehabilitation or replacement of existing headwalls and retaining walls.
- Construction of log or rock toes.

Erosion control methods that use ecological principles and techniques to achieve stabilization of the bank while enhancing habitat (creation of coves), improving aesthetics and reducing costs will be considered first before any other bank protection method. Where appropriate, large woody debris, vegetation, and other natural materials will be used to protect streambanks and maintain shallow water and shallow gradients to re-establish the integrity of the stream bank.

6. Addition or Maintenance of Habitat Elements

Habitat elements are organic or inorganic objects that—when placed in or near aquatic areas—increase fish and wildlife habitat and protect infrastructure. Habitat elements include large wood, root wad, baffles, boulders, rock, and weirs. When placed into waterbodies, these objects can slow or alter flow directions and provide complex habitat including riffles, pools and appropriate substrate that create food and hiding places for fish and wildlife. Habitat restoration and maintenance also protect infrastructure and drainage lines.

Habitat restoration or maintenance work may require using heavy or light equipment, hand labor or a combination of these methods. Many projects including those in parks require establishing a temporary construction access. The following is the construction technique for habitat restoration or maintenance:

- Select design and installation of habitat elements in accordance with the WDFW *Integrated Streambank Protection Guidelines* (WDFW et al. 2003).
- Instream or floodplain restoration materials (e.g. large wood and boulders) shall mimic as much as possible those found in a natural environment. Such materials may be salvaged or reused from the project site or hauled in from offsite but cannot be taken from streams, wetlands, or other sensitive areas.
- Various anchoring techniques are sometimes required to prevent the movement of structures when their movement could damage downstream infrastructure or channel integrity. If anchoring is required, bury the habitat element—such as woody debris or boulders—into the banks. Use chain or concrete blocks only sparingly in project design and only when conditions do not exist to anchor woody debris naturally between riparian trees or into the banks. Use concrete sparingly when necessary to anchor boulders to concrete weirs to create a more natural effect.

7. Site Restoration/Landscaping

Site restoration stabilizes the site after maintenance is complete and the staging and access areas are vacated. This prepares the site for replanting and protects disturbed soil from erosion and invasive weeds. Inspect rough grading to ensure final slopes will not generate erosive energy affecting sensitive areas. When necessary, loosen compacted access roads, staging, and stockpile areas. Scatter and place stockpiled woody debris. Coir logs or jute matting with mulch can be utilized to stabilize surfaces while native vegetation is established.

Upon project completion, spread or remove stockpiled materials. All imported soil or rock must be removed, and the covered surface regraded and replanted to original conditions upon project completion.