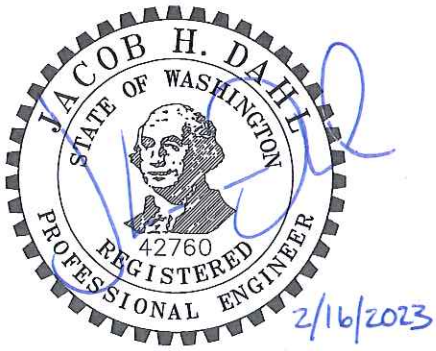
DRAINAGE REPORT

FOR:

CAMANO SUBSTATION

SNOHOMISH COUNTY PUD
PUBLIC UTILITY DISTRICT NO. 1



Prepared By:

SNOHOMISH COUNTY P.U.D. NO. 1

Date Prepared:

February 16, 2023

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EXECUTIVE SUMMARY

Public Utility District No.1 of Snohomish County (District) is rebuilding Camano Substation. The project is part of the District's Electric System Capital Program to upgrade electrical distribution facilities and to increase electric service reliability on Camano Island.

The site is 2.16 acres in size and is bordered by agricultural farmland to the north, E. North Camano Drive to the south, a cemetery to the east, and an Island County fire station to the west. The property is currently developed as an electrical distribution substation that was constructed in the 1960's. Aside from the fenced substation yard, most of the property is maintained as lawn with ornamental landscaping along the front of the station.

On-site soils generally consist of loose to medium dense sand with variable silt and gravel content above a medium stiff to stiff silt and sandy silt layer over a deeper deposit of stiff, sandy silt to clayey silt and clayey silt to silty clay.

Site topography is relatively flat with a slight downward slope towards a type F stream and type B wetland system along the eastern side of the site and a roadside ditch/type F stream along the north side of E. North Camano Drive. Any surface water runoff generated on-site drains to the on-site streams and wetland. A subsurface drain tile system exists along the north, west and east side of the substation yard that collects water subsurface and outlets to the roadside ditch/stream and the wetland/stream on the east side of the property.

The existing improvements will be demolished, and a new substation facility will be constructed in its place. The footprint will be enlarged to the north and west to minimize impacts to the critical areas. The driveways will access the county road at the same locations and will be upgraded to improve vehicular access to the substation. The substation yard area will be graded and shaped to mimic the existing site drainage pattern.

The runoff characteristics post development will closely mimic the existing condition. New hard surfaces will replace lawn cover. A large portion of the lawn area will be converted to landscape screening with topsoil/compost amended soils surfaced with mulch, and densely planted vegetative cover, all of which will improve the hydrologic condition and lower the runoff potential. The runoff potential will also be reduced in the wetland/stream buffer mitigation area where lawn cover will be replaced with native vegetation and ground cover. Site drainage improvements also include a new underdrain system replacing the old drain tile system.

Temporary erosion and sediment control measures will be implemented during construction in accordance with state and county stormwater management requirements. All on-site soils disturbed by construction activities will be replanted and stabilized prior to the removal of any temporary erosion and sediment control measures.

The rebuild project includes replacing the power transformer. The new transformer contains approximately 8,200-gallons of insulating oil. Oil pollution prevention is regulated under Federal Regulation 40 CFR Part 112. The District has an agency wide Spill Prevention, Control and Countermeasure Plan (SPCC Plan) in place, and the site- specific SPCC plan will be updated for the upgraded substation as part of the Clean Water Act section 401 compliance. The response measures outlined in the SPCC Plan, and the proposed secondary containment system described herein are intended to prevent oil from leaving the site.

1.0 PROJECT SUMMARY

1.1 PROPERTY DESCRIPTION

The site is in a portion of the southeast quarter of the southwest quarter of Section 20, Township 32 North, Range 03 East, W.M. in Island County, Washington. More specifically, the site is located at address 531 E. North Camano Drive; Parcel No. R33220-120-1780.

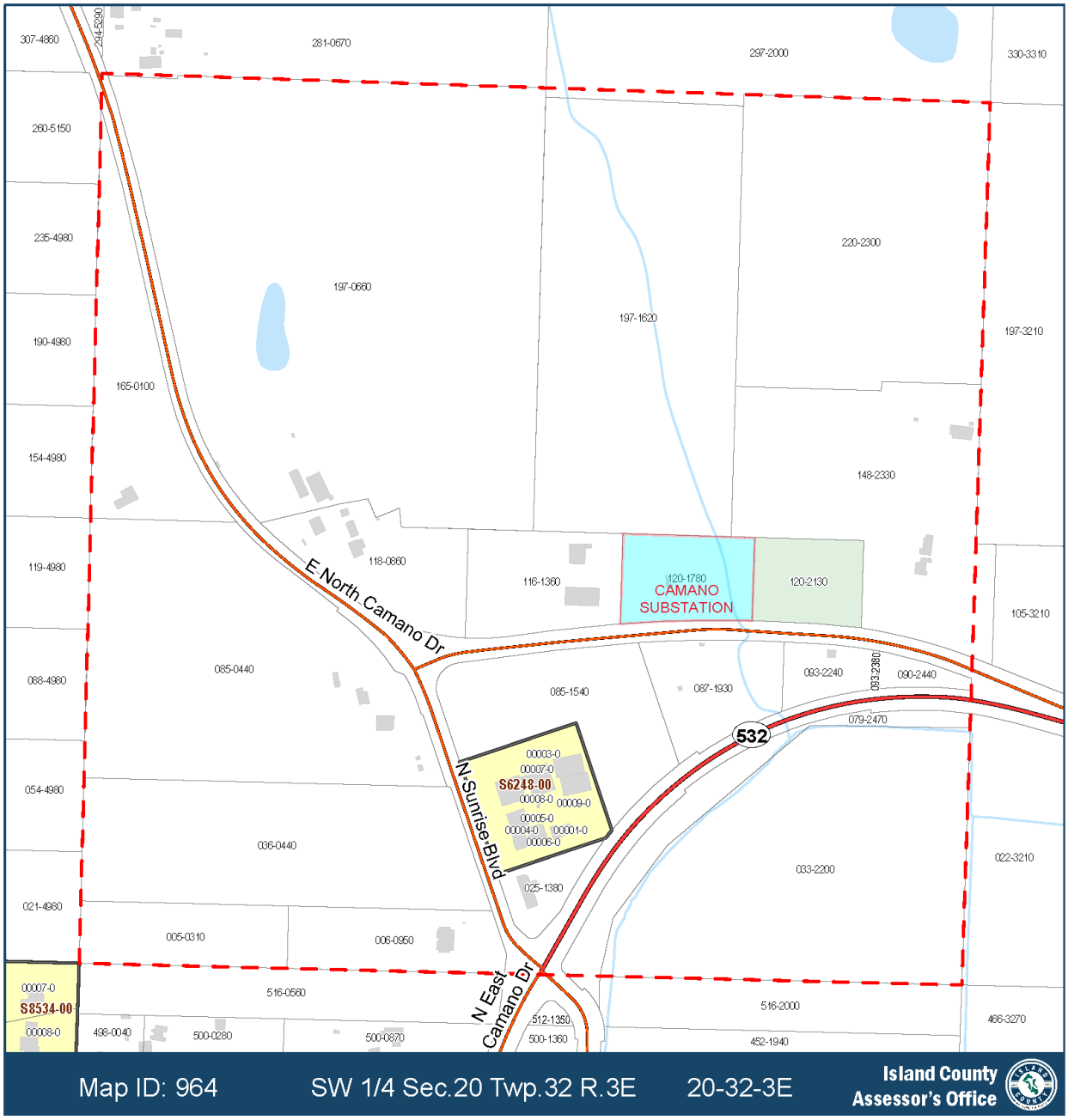


Figure 1: Vicinity map, not to scale.

1.2 EXISTING CONDITIONS

The site is 2.16 acres in size and is bordered by agricultural farmland to the north, E. North Camano Drive to the south, a cemetery to the east, and an Island County fire station to the west.

The site is developed as an electrical distribution substation that was constructed in the 1960's. The fenced substation yard is approximately 0.6 acres, and most of the property is maintained as lawn with ornamental landscaping along the front of the station.

Ingress and egress are by way of two paved driveways off E. North Camano Drive. Spanning between the two driveways and parallel to the county road is a gravel driveway used for accessing the utility poles in front of the station.

Trees line the east property line and a combination of trees and dense brush line the north and east property lines.

Site topography is relatively flat with a slight downward slope towards a type F stream and type B wetland system along the eastern side of the site and a roadside ditch/type F stream along the north side of E. North Camano Drive.

Any surface water runoff generated on-site will drain to the on-site streams and wetland. A subsurface drain tile system exists along the north, west and east side of the substation yard that collects water subsurface and outlets to the roadside ditch/stream at two locations and one location along the wetland/stream on the east side of the property.

The following is a general summary of the site soil conditions. For complete detail refer to the Geotechnical Engineering Report prepared by Zipper Geo Associates, LLC (ZGA).

On-site soils generally consist of loose to medium dense sand with variable silt and gravel content to depth of approximately 2-4.5-ft below existing grade. Immediately below the sand is a medium stiff to stiff silt and sandy silt layer over a deeper deposit of stiff, sandy silt to clayey silt and clayey silt to silty clay.

While advancing borings, groundwater was observed at depths of approximately 12-14-ft. A groundwater monitoring well was installed at one of the borings, and as of December 2022, the groundwater depth has risen to approximately 2.15-ft below ground surface.

The fine-grained soils below the sand layer, in combination with shallow seasonal high groundwater, are conditions that are not conducive to stormwater infiltration.

1.3 DEVELOPED CONDITIONS

The proposal is to rebuild Camano Substation so it can continue to serve customers on Camano Island with increased system capacity for future load growth, and improved system reliability. The substation is not a manned facility and is infrequently visited for maintenance.

The substation converts power delivered to the substation from 115,000 Volts (115kV) to 12,000 Volts (12kV) and distributes it to the District's electrical grid to serve customer power needs. The substation will generally consist of:

a) One 28 Mega-Volt-Ampere (MVA) power transformer
b) One metal-clad switchgear enclosures with 12kV circuit breakers and ancillary equipment
c) One metal-clad control enclosure
d) 115kV and 12kV switches
e) 115kV circuit breakers
f) Overhead aluminum bus and conductors
g) Galvanized steel transmission line termination (dead-end), switch, and bus support structures
h) Conduit and vaults for underground power cables and control wires
i) Transmission and distribution poles for the incoming/outgoing 115kV transmission lines and 12kV distribution circuits

Related site work for the substation includes demolition and removal of the old substation facilities; site grading; a stormwater system to replace the old drain tile system; an oil spill containment system for the transformer; security fencing; electrical grounding system; reconstructed driveways; landscaping; and a landscape irrigation system.

Surficial vegetation and topsoil will be stripped from the substation yard expansion area. Stripped topsoil will be reused on-site to the extent practicable. Native sand excavated from the site will be reused as structural fill to the maximum extent practicable for raising the substation yard grade and backfilling excavations. Granular fill material will also be imported to raise grade and provide a suitable base for the driveways and the substation yard area.

The driveways will access the county road at the same locations. The driveways will be re-graded, shaped, and repaved to improve vehicular access to the substation. The substation yard area will be graded and shaped to mimic the existing site drainage pattern.

The substation yard and the 3-foot-wide perimeter area outside the fence will be surfaced with coarse crushed rock to serve as an all-weather surface that also acts as an insulating layer to minimize electrical step and touch potential.

Temporary erosion and sediment control measures will be implemented during construction in accordance with state and county stormwater management requirements. All on-site soils disturbed by construction activities will be stabilized with permanent surface materials consisting of asphalt pavement, crushed rock, topsoil, mulch, and plants. All other disturbance will be restored in-kind and stabilized prior to the removal of any temporary erosion and sediment control measures.

The runoff characteristics post development will closely mimic the existing condition. Hard surfaces on-site will increase approximately fifteen percent; however, the hard surfaces are replacing lawn cover with moderate

runoff potential. Furthermore, a large portion of the lawn area will also be converted to landscape screening with topsoil/compost amended soils surfaced with mulch, and densely planted vegetative cover, all of which will improve the hydrologic condition and lower the runoff potential. The runoff potential will also be reduced in the wetland/stream buffer mitigation area where lawn cover will be removed and replaced with native vegetation and ground cover.

Site drainage improvements will consist of a new underdrain system replacing the old drain tile system. The new system will have a single outlet to the roadside ditch/stream, and wetland/stream outlet on the east side of the property will be eliminated.

2.0 MINIMUM REQUIREMENTS

Development activity in Island County is subject to the provisions in Island County Code (ICC) 11.03 – Stormwater and Surface Water. Activities such as land disturbing activities and the creation of impervious surfaces must be approved by Island County and shall comply with the Island County Stormwater Design Manual and the adopted Drainage Manual, *The Washington State Department of Ecology Stormwater Management Manual for the Puget Sound Basin, The Technical Manual* (The Drainage Manual).

Volume I-2.4 of The Drainage Manual specifies the application of minimum requirements for new development and redevelopment. The site is already developed and will undergo more than 5,000 sq. ft. of redevelopment; therefore, the new development Minimum Requirements #1 through #11 apply to the portion of the site that is being redeveloped, source control BMPs shall be applied to the entire site, and a stormwater site plan shall be prepared.

2.1 MR #1 –Erosion and Sediment Control

Land disturbing activities will exceed one acre; therefore, the project is required to comply with the erosion and sediment control requirements 1-14 In Volume I-2.5 of The Drainage Manual. Furthermore, the construction activities require coverage under the Washington State Department of Ecology Construction Stormwater General Permit (CSWGP) because disturbance will exceed one acre and there is a potential for discharge of stormwater to surface waters of the State.

A Stormwater Pollution Prevention Plan (SWPPP) is required in accordance with the CSWGP. The SWPPP consists of two parts: the plan, and the narrative. The SWPPP is provided in the drawing set submitted with the site development and construction permit applications to Island County. The narrative portion is provided in a separate SWPPP report, also included in the permit submittal documents.

The SWPPP addresses all thirteen elements described in the CSWGP. It is presumed the SWPPP meets or exceeds the erosion and sediment control requirements of ICC 11.03.230 and The Drainage Manual.

2.2 MR #2 – Preservation of Natural Drainage Systems

The proposed redevelopment activity will not alter the existing drainage patterns of the site. Any surface water runoff generated on-site will continue draining to the roadside ditch/stream and/or the wetland/stream on the east side of the property. The natural drainage systems will be preserved and unaltered.

2.3 MR #3 – Source Control of Pollution

The existing transformer and oil spill containment system will be replaced. The new transformer contains nearly 8,200-gallons of insulating oil (aka, mineral insulating oil). The insulating oil is highly refined mineral oil that is essentially equivalent to food grade oil except for color. Refer to Appendix B for further description.

Oil pollution prevention is regulated under Federal Regulation 40 CFR Part 112. This part establishes procedures, methods, equipment, and other requirements to prevent the discharge of oil into or upon navigable waters of the United States. As required by federal law, oil storage of 1,320-gallons or more requires the owner of said facility to have a Spill Prevention Control and Countermeasure Plan (SPCC Plan).

The District has a SPCC Plan for each of its substation facilities with oil-filled equipment. As utilized at many of the District substations, a secondary oil containment system will be constructed for the transformer as part of the rebuild. The transformer will be placed within an oil containment basin comprised of a concrete slab and a perimeter curb.

Runoff within the containment basin will collect at catch basins located at low points within the containment slab. Discharge out of the containment basin will be controlled by an AFL Industries Oil Stop Valve (OSV).

The OSV has only one moving part, a ballasted float set at a specific gravity between that of oil and water. Under normal operation, the OSV remains open allowing stormwater collected in the containment basin to pass through the OSV. In the event of an oil spill, the float loses buoyancy as the oil level increases until and seats on the discharge port containing the oil spill. Refer to Appendix C for oil containment system details.

With the OSV engaged, oil is contained upstream of the valve and within the containment basin. Downstream of the OSV is an oil trap (aka Tee-type or down-turned elbow oil water separator) in-place as a second level of defense to help keep minor leakage of oil from escaping the containment system during closure of the OSV.

The District has an agency wide SPCC Plan in place, and a site- specific SPCC plan will be updated for Camano Substation as part of the Clean Water Act section 401 compliance. The response measures outlined in the SPCC Plan are intended to prevent any oil from leaving the site.

Should a catastrophic leak occur, the oil filled equipment will no longer operate properly. The District's Supervisory Control and Data Acquisition (SCADA) will be alerted, and District personnel will be dispatched to investigate.

The District also conducts periodic inspection of existing stations by qualified personnel. Part of the inspections includes checking equipment for oil leakage.

In the event of an oil spill to the environment, the District will notify authorities, recover, and cleanup an oil discharge in accordance with Washington Administrative Code (WAC), Chapter 173-303 – Dangerous Waste Regulations, Section 173-303-145 – Spills and Discharges to the Environment.

2.4 MR #4 – Runoff Treatment

The existing driveways will be reconstructed to improve access for utility trucks and large electrical equipment transportation. The substation is not a staffed facility. Trips to the substation are made for operation and maintenance activities, generally no more than twice a month. Trips to the substation will remain the same after redevelopment. As a result, an increase in pollutant loads and concentrations in stormwater runoff are not expected, therefore runoff treatment BMPs are not proposed.

2.5 MR #5 – Streambank Erosion Control

The stormwater quantity control minimum requirements are set forth in the Island County Stormwater Design Manual, Section 3.1. Section 3.1.2.a.i states, "The post-development peak stormwater discharge rates from the development site for the 25-year, 24-hour duration storm events shall at no time exceed the pre-developed peak stormwater runoff rates for the same design storm events, except as expressly permitted herein." For

stormwater discharges directly or indirectly to streams listed in Section 3.2.c.ii, additional streambank erosion protection is required by limiting the post-development peak stormwater discharge rate to fifty percent of the pre-development 2-year, 24-hour duration storm event.

A hydrologic analysis was performed utilizing the Soil Conservation Service (SCS) TR-55 method to demonstrate the post-development peak stormwater discharge rate of 0.44 cubic feet per second for the 25-year, 24-hour duration storm event does not exceed the pre-developed peak stormwater runoff rate of 0.44 cubic feet per second for the same design storm event. Refer to Appendix D. Stormwater will not be discharged directly or indirectly to the streams listed in Section 3.2.c.ii; therefore, additional streambank erosion protection is not required.

2.6 MR #6 – Wetlands

The requirements of Minimum Requirement #6 do not apply to the proposed development activity. Stormwater discharge from the site will not be directed into a wetland.

2.7 MR #7 – Water Quality Sensitive Areas

The agricultural drainage ditch downstream of Camano Substation may be considered a water quality sensitive area. According to the Department of Ecology Water Quality Atlas, the waterbody is identified as Livingston Creek and is 303(d) listed for fecal coliform bacteria. The proposed development is not expected to impact water quality.

2.8 MR #8 – Off-Site Analysis and Mitigation

A Level 1 downstream analysis was conducted in accordance with the Island County Stormwater Design Manual, Section 2.3.3. The study area consisted of the upstream portion of the tributary drainage area that drains to the site and one-fourth of a mile downstream thereof.

The Island County website was reviewed for information on existing and potential water quality, runoff volume and rates, flooding, and streambank erosion problems within the study area. The best information available came from the Island County Maps website where interactive maps and GIS data are available to help identify critical areas, watersheds, mapped stormwater infrastructure, and FEMA flood zones. Aside from FEMA flood map information, no water quality, runoff volumes and rates, or streambank erosion information were found.

Following the desktop review, the study area was visually inspected to verify the upstream tributary drainage area versus the GIS data and to investigate the downstream drainage system.

In summary, where the downstream reaches were accessible, no evidence of potential contamination of surface waters or groundwater overtopping, scouring, bank sloughing, sedimentation, siltation, or stream incision were observed. The proposed development activity is not expected to cause significant adverse drainage impacts downstream. No off-site mitigation is proposed.

Field observations of the makeup and general condition of the downstream drainage system are described below.

Runoff enters the site at the northeast corner as a stream (Figure 2) and at the southwest corner as a roadside ditch/stream (Figure 3). Both streams flow to the southeast corner of the property where they converge and enter a pipe conveyance system that begins with a 30-inch diameter CMP pipe crossing under E. North Camano Drive (Figure 4). On the south side of E. North Camano Drive, the 30-inch CMP enters a type II catch basin where the stream flow redirects towards the southwest through a series of 60-inch diameter CMPs and type II catch basins traversing Freedom Park, the Terry's Corner Park and Ride and the adjacent commercial business area. Refer to Figures 5 through 10.

The pipe system outfalls on the south side of State Route 532 near the intersection of State Route 532 and N. Sunrise Blvd. The outfall appears to be on private property, plus the terrain is steep and heavily brushed, so the outfall was considered inaccessible. Based on the Island County interactive map, the receiving waterbody is an agricultural drainage ditch that follows the toe of slope on the eastside of N. Sunrise Blvd and continues south where it drains into Livingston Bay, approximately one mile downstream of Camano Substation.

Figure 2: Looking North. Stream A traversing the property.

Figure 3: Looking west. The roadside ditch/Stream B.

Figure 4: Looking south. The convergence of both streams at a 30-inch diameter CMP inlet crossing E. North Camano Drive.

Figure 5: Looking southwest and downstream through the 60-inch CMP exiting the type II catch basin on the southside of E. North Camano Drive.

Figure 6: Looking northeast back towards E. North Camano Drive from a type II catch basin in Freedom Park.

Figure 7: Looking northeast and upstream through a 60-inch CMP at the catch basin in Figure 6.

Figure 8: Looking southwest at a type II catch basin in the park and ride parking lot.

Figure 9: Looking southwest and downstream through a 60-inch CMP at the catch basin in Figure 8.

Figure 10: Looking southeast from the last type II catch basin and downstream towards the outfall on the south side of State Route 532.

Figure 11: Looking north and upstream through a 60-inch CMP at the catch basin in Figure 10.

Figure 12: Looking southeast from State Route 532 in the direction of an agricultural drainage ditch the pipe system outfalls to. The outfall was inaccessible due to the steep terrain, thick vegetation, and location on private property.

Figure 13: Looking east from N. Sunrise Blvd towards the receiving water body – an agricultural drainage ditch.

2.9 MR #9 – Basin Planning

There are no known Basin/Watershed Plans for which this project is subject to that require more stringent minimum requirements than those required by ICC and the Stormwater Design Manual.

2.10 MR #10 – Operation and Maintenance

All stormwater systems proposed for this project will be located on District property. Stormwater facilities within the substation security fence will only be accessible by District personnel qualified to enter substations. Said facilities will be inspected and maintained by the District's Substation Construction and Maintenance Department. Stormwater facilities located outside the security fence will be inspected and maintained by the District's Facilities Maintenance Department.

The operation and maintenance manual for the stormwater facilities is provided in Appendix E.

REFERENCES

Island County Code - *Chapter 11.03 - Stormwater and Surface Water*

Island County (1998). *Island County Stormwater Design Manual*

Washington State Department of Ecology (1992). *Stormwater Management Manual for the Puget Sound Basin (The Technical Manual).*

Zipper Geo Associates, LLC. (December 14, 2022). *Geotechnical Engineering Report Camano Substation Rebuild.*

Wetland Resources, Inc. (March 3, 2023). *Critical Area Study, Biological Site Asssessment, and Mitigation Plan.*

APPENDIX A

Maps

- Exhibit 1 – Existing Conditions
- Exhibit 2 – Developed Conditions
- Exhibit 3 – Off-Site Upstream Map
- Exhibit 4 – Off-Site Downstream Map

EXISTING CONDITIONS MAP

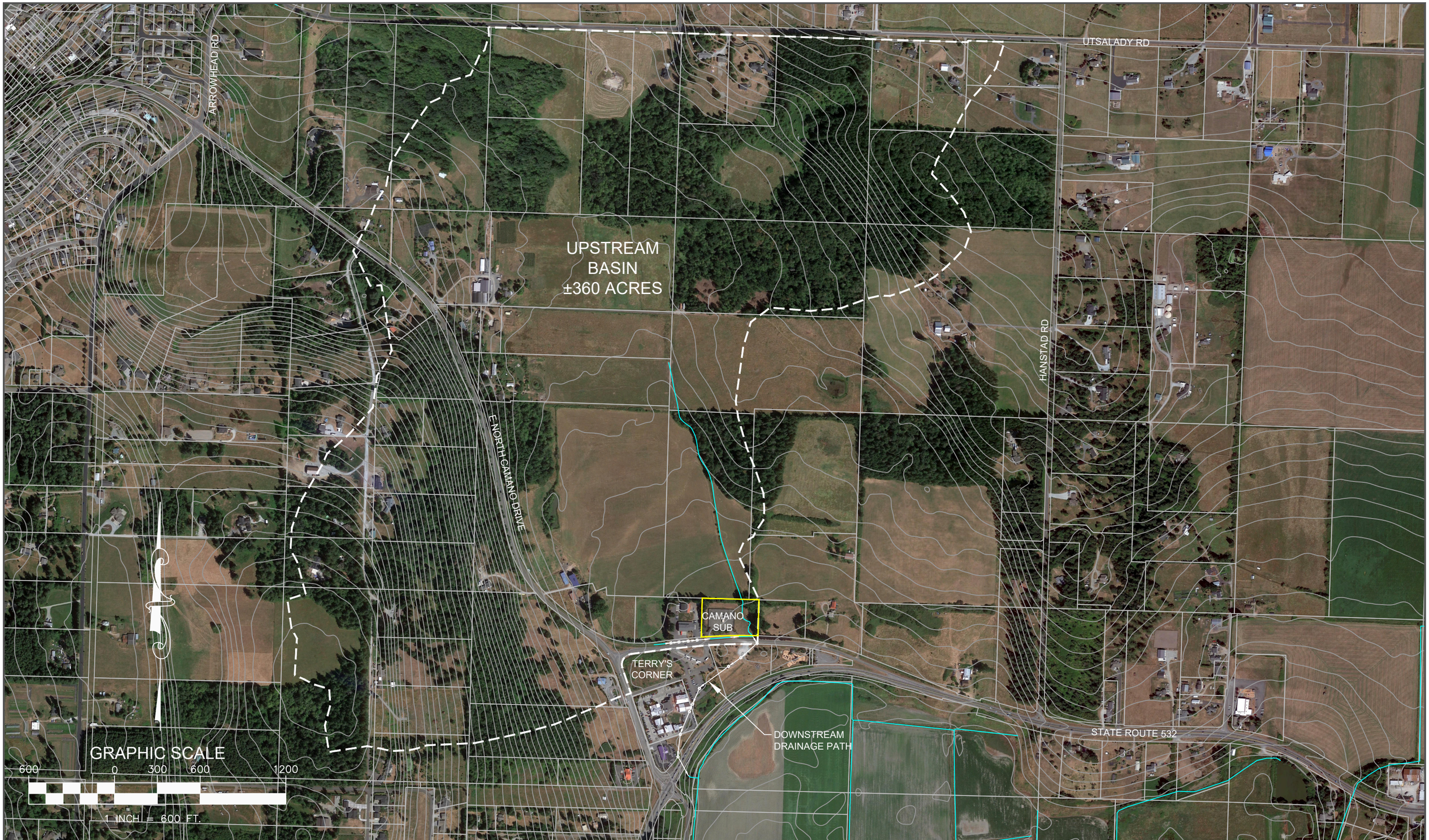
EXHIBIT 1

PUBLIC UTILITY DISTRICT NO. 1 OF SNOHOMISH COUNTY | CAMANO SUBSTATION

DEVELOPED CONDITIONS MAP

EXHIBIT 2

PUBLIC UTILITY DISTRICT NO. 1 OF SNOHOMISH COUNTY | CAMANO SUBSTATION



OFF-SITE UPSTREAM MAP

EXHIBIT 3

PUBLIC UTILITY DISTRICT NO. 1 OF SNOHOMISH COUNTY | CAMANO SUBSTATION

OFF-SITE DOWNSTREAM MAP

EXHIBIT 4

PUBLIC UTILITY DISTRICT NO. 1 OF SNOHOMISH COUNTY | CAMANO SUBSTATION

APPENDIX B

Department of Ecology Fact Sheet #95-157-TCP – Mineral Insulating Oil Cleanup Standard

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Mineral Insulating Oil Cleanup Standard

Recommended Approach to the Cleanup of Mineral Insulating Oil Contaminated Sites

Based on the unique characteristics of mineral insulating oil and of substation and distribution stations, Ecology is recommending that cleanup actions be conducted for historical releases of non-PCB mineral insulating oil (ASTM D-3487) at sites where contamination levels exceed 2000 mg/kg (ppm).

Ecology does not recommend the completion of risk-based evaluations at Washington electric utility substations and distribution stations due to the unique site characteristics of these facilities and the low toxicity and environmental behavior of mineral insulating oil. Mineral insulating oil is acknowledged as very different in its physical/chemical nature as compared to other petroleum hydrocarbon products. For current and historical mineral insulating oil spills that are small and well defined, electric utility resources should be dedicated to the cleanup of the site and not to extensive risk-based evaluations. Historical mineral insulating oil spills refers to those spills that have remained beneath heavy transformers in high-voltage substation or distribution stations and switchyards for longer than six months.

Technical Utility Industry Issues

Electric utility site characteristics. Electric utility sites where mineral insulating oil is used are unique because of the standards associated with the generation and storage of energy, electric voltage loads, and transmission of electric energy. The utility industry also maintains unique requirements for safety, land use, and environmental resource protection. For sites where historical release residues remaining onsite exceed the 2000 mg/kg (ppm), monitoring shall be conducted as an institutional control. Future land use must also remain in an industrial setting and within the ownership of the Washington electric utility industry or Bonneville Power Administration, where institutional controls are in place, given the industrial setting. If property is transferred for uses other than industrial utility use, residential standards may apply. The historical contamination should be addressed in accordance with the intended land use.

These types of sites include high-voltage substation or distribution stations or switchyards as defined by the Bonneville Power Administration Definitions, DOE/BP-2279, April 1994. Pad- and pole-mounted electrical transformers are not considered in this fact sheet. The Toxics Cleanup Program, Department of Ecology, will consider additional data as it becomes available. High-voltage substations or distribution stations and switchyards are carefully controlled, fenced areas with special working surface areas (crushed gravel, compacted soils and clays) to eliminate static electricity or electrical arcs.

Chemical characteristics of mineral insulating oil. Mineral insulating oil used in electrical equipment is a highly refined petroleum distillate. Mineral insulating oil is used as an insulating and cooling medium in electrical equipment. Physical/chemical properties of mineral oil are strictly controlled by federal regulation and product specifications. Synonyms for mineral insulating oil include mineral oil, liquid petroleum, liquid paraffin, paraffin oil, medicinal oil and medicinal white oil, white oil and white mineral oil, good grade oil and good grade white oil, and technical white oil.

Biological Effects and Environmental Issues

ASTM D-3487 Toxicity. Mineral insulating oil poses a low potential for toxicity, and is similar to mineral

(Over)

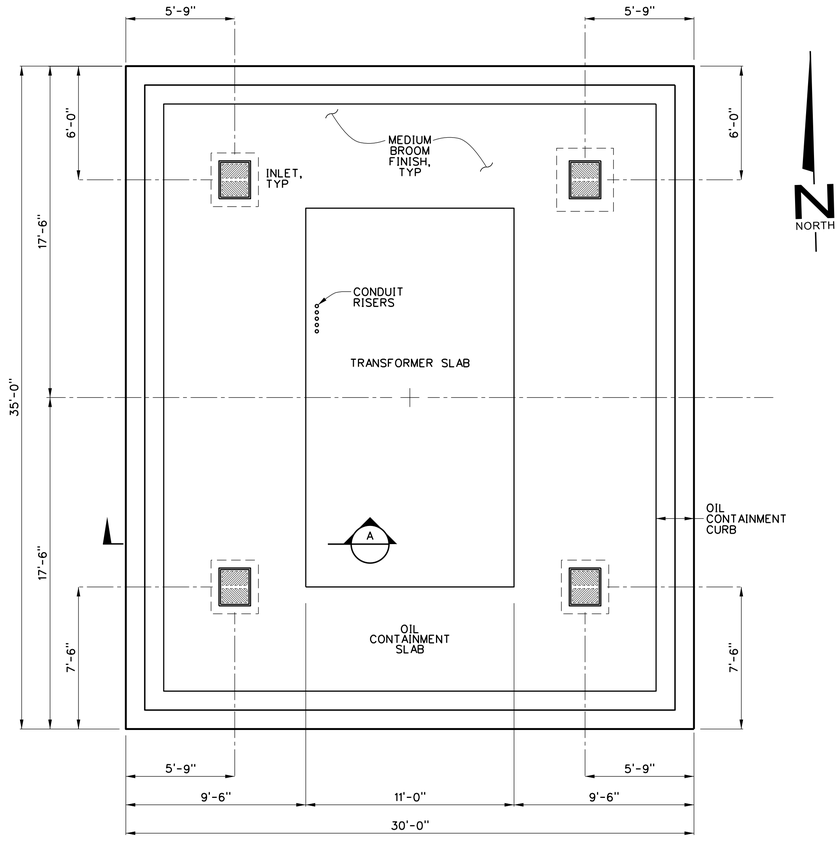
oil used for food packaging and processing (21 CFR 178.3620). Known information from acute, subchronic and chronic toxicity tests shows little evidence of adverse health effects. Animal toxicity tests using mineral oils shows no evidence of carcinogenicity, nor adverse reproductive or developmental effects. Mineral insulating oil is similar to mineral oil used for cosmetics and pharmaceuticals (USP XXII, CTFA), in that it is non-irritating to the skin and eyes, is non-sensitizing and non-allergenic,and exhibits minimal systemic toxicity via multiple routes of exposure. The 2000 mg/kg (ppm) cleanup level for mineral insulating oil was selected because of low acute (LD_{50} > 5000 mg/kg), subchronic (no observed effect level > 1500 - 4350 mg/kg-day) and chronic toxicities (no observed effect level > 1200 - 6000 mg/kg-day) using different animal species and routes of exposure. There is no data showing mineral oil to be mobile or to present a threat to groundwater at soil concentrations at less than 2000 mg/kg.

Behavior in the environment. Based on the physical/chemical properties of mineral insulating oil, the threat of cross-media contamination of groundwater from release of mineral insulating oil from electrical equipment is minimal. Mineral insulating oil (ASTM D-3487) is non-volatile, insoluble (hydrophobic), and highly adsorbs to organic particles in soil.

Conclusion and Recommendation. Ecology recommends a clear distinction in the Model Toxics Control Act (MTCA) cleanup standards between electric utility mineral insulating oil and other types of petroleum hydrocarbons. Design characteristics of electric substations or distribution stations preclude direct human exposure and environmental releases of historic mineral insulating oil. Cleanup standards for (non-PCB contaminated) electric utility industry mineral insulating oil must acknowledge the difference in mineral insulating oil chemical composition, toxicity, and behavior in the environment.

APPENDIX C

Oil Containment Slab, Oil Stop Valve (OSV), and Oil Trap Details



TYPICAL TRANSFORMER OIL SPILL CONTAINMENT SLAB PLAN

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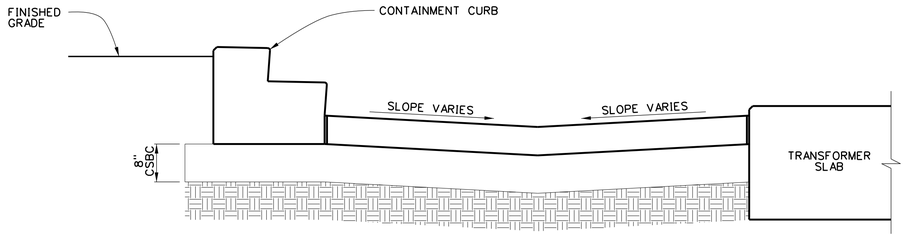
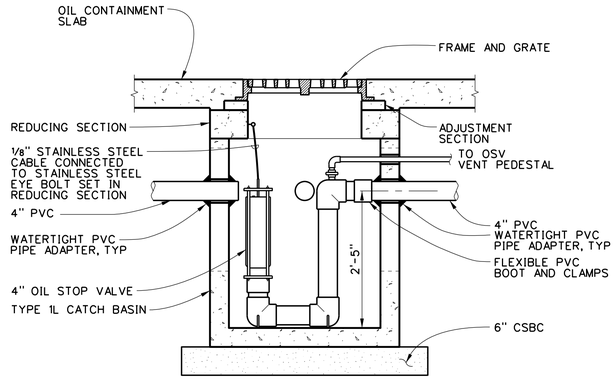


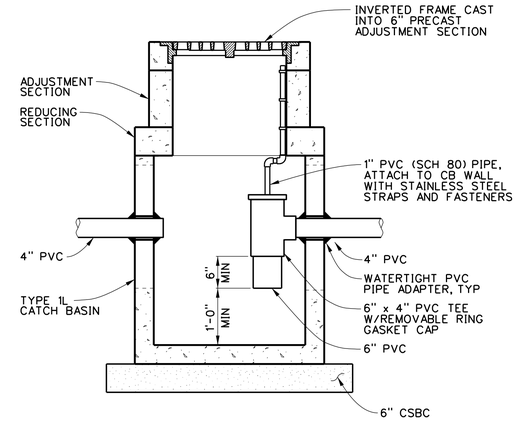
OIL CONTAINMENT SLAB SECTION A

3/4" = 1'-0"



OIL STOP VALVE CATCH BASIN DETAIL 1

3/4" = 1'-0"



OIL TRAP CATCH BASIN DETAIL 2

3/4" = 1'-0"

1/4" = 1'-0" SCALE IN FEET

3/4" = 1'-0" SCALE IN FEET

No	DATE	BY	DESCRIPTION	ENGR	CHKR	APVD

REVISIONS

JACOB H. DAHL
STATE OF WASHINGTON
42760
REGISTERED
PROFESSIONAL ENGINEER

SNOHOMISH COUNTY PUD
PUBLIC UTILITY DISTRICT NO 1

ORDER	100016205
OPERATION	
SCALE	NOTED
DFTR	
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CAMANO SUBSTATION

OIL CONTAINMENT SLAB, OIL STOP VALVE (OSV), AND OIL TRAP DETAILS

REV	DRAWING
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FILE: S:\Projects - Substation Name\Camano\2020-23 Camano Rebuild WO 100016205\8.0 Grading and Drainage\Storm Drainage Report\Revision 0\Containment Exhibit C.dgn
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AFL Industries

Oil Stop Valve

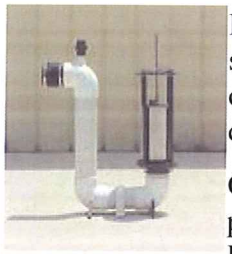
Function

- Prevents discharge of separated oil to sewers/streams

Features

- Dependable gravity operation
- Single moving part
- Large flow capacity
- Self-opening (optional)
- No power requirement
- Corrosion resistant construction
- Flow rates to 1400 GPM through a single valve

Application Uses



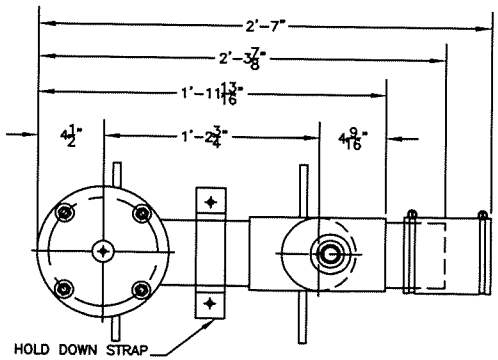
Large, unpredictable oil spills can defeat the most conservatively designed pollution control system. But while the cost of such a system can be prohibitive, the consequences of not controlling a spill can be equally catastrophic. The AFL/Clark Oil Stop Valve (OSV) is designed to solve these problems.

Oil Stop Valves confine even large oil spills to the premises. The OSV is available from AFL prepackaged in a fiberglass or steel catch basin or as an option on AFL oil/water separators. In addition, the OSV is available separately for installation in existing separators, catch basins or manholes.

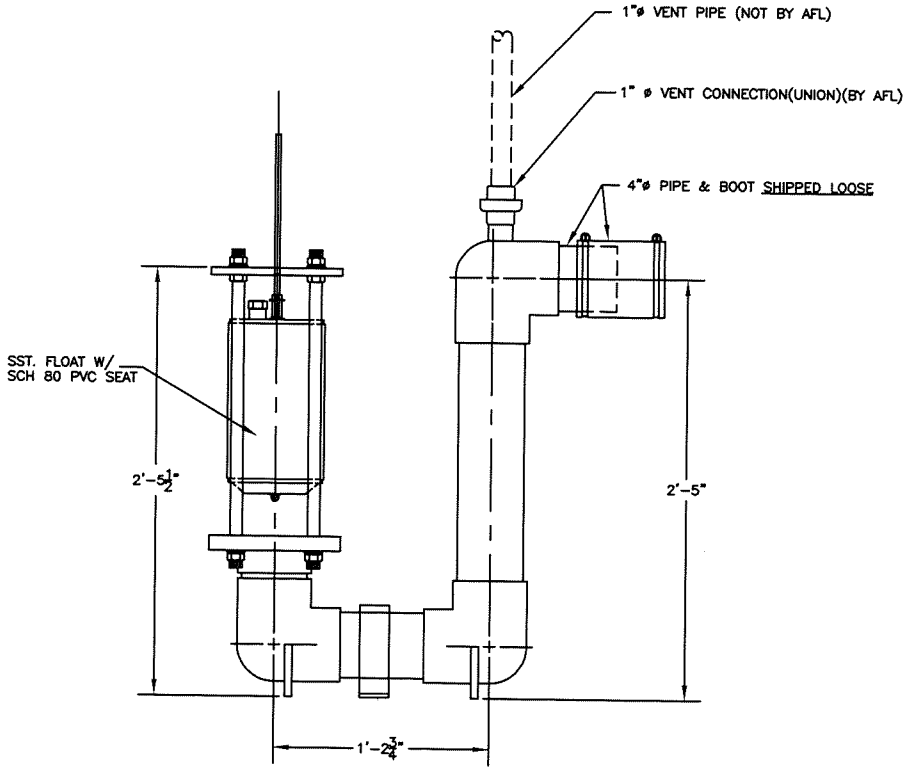
The OSV has only one moving part, a ballasted float set at a specfic gravity between that of oil and water. When an oil spill occurs, the float loses buoyancy as the oil level increases until it finally seats itself on the discharge port. Thus, the oil spill is confined.

The Oil Stop Valve is fabricated from non-corrosive PVC and stainless steel. Standard sizes are 4", 6", 8", 10", 12" discharge piping. Larger piping systems can be accommodated by manifolding units together. Optional screening can be provided if necessary to prevent the dicharge of large floating solids.

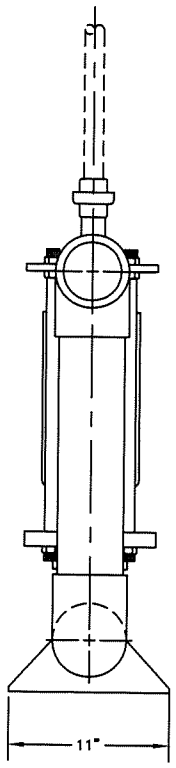
Consider the OSV for those applications where oil spills are possible, but unpredictable such as electrical transformers, oil storage areas, and transportation fueling systems. The Oil Stop Valve is the most cost effective method to prevent a major disaster.



PLAN



SIDE VIEW



OUTLET VIEW

NOTES

FOR PROPER VALVE OPERATION THE STEPS AS LISTED BELOW MUST BE FOLLOWED:

1. VENT PIPE IS TO BE FURNISHED BY CUSTOMER AND MUST EXTEND ABOVE CONTAINMENT AREA.
2. AFTER VALVE IS INSTALLED, THE SUMP MUST BE FILLED WITH WATER UNTIL THE LIQUID LEVEL IS AT THE INVERT OF DISCHARGE PIPE.
3. MANUALLY OPEN VALVE BY LIFTING THE FLOAT IN A VERTICAL DIRECTION ONLY. TO FACILITATE MANUAL OPENING OF THE VALVE ATTACH 1/16"ø WIRE TO FLOAT STEM AND THE OTHER END TO A EASILY ACCESSIBLE AREA. MAKE SURE THERE IS ENOUGH SLACK IN WIRE FOR THE VALVE(FLOAT) TO CLOSE.
4. AFTER A SPILL, THE SPILLED LIQUID MUST BE EVACUATED UNTIL WATER ONLY IS IN THE SUMP. ADD WATER IF WATER LEVEL IS BELOW THE INVERT.(SEE NOTE#2)
5. MANUALLY REOPEN VALVE.
6. FOR ADDITIONAL INSTRUCTIONS REFER TO INSTALLATION, OPERATION, & MAINTENANCE(I-O-M) MANUAL.

FAILURE TO FOLLOW ABOVE PROCEDURES MAY CAUSE OIL TO BE DISCHARGED.

TOTAL UNIT WT: 35 lbs.

DIMENSIONAL TOLERANCE ± 1/8"

ENGINEERING A BETTER ENVIRONMENT

AFL INDUSTRIES, INC.
1751 WEST 10TH STREET, RIVIERA BEACH, FLA. 33404

SCALE: NONE		DRAWN BY: TMB
DATE: 5/14/07		CHECKED BY:
MODEL: 4" ø OIL STOP VALVE STANDARD		AFL JOB No. 5204
JOB: AFL INDUSTRIES		DRAWING No. 3S2150

FILE:OSV-4 1=6 5/14/07

APPENDIX D

SCS TR-55 Hydrology Report

Project Description

File Name ..... 2022 1026 Camano SSA EX.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Oct 26, 2022	00:00:00
End Analysis On	Oct 27, 2022	00:00:00
Start Reporting On	Oct 26, 2022	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:06:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	25 YR	Intensity	inches	WA	Island	25	2.50	SCS Type 1A

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	EX_CONDITIONS	2.16	484.00	86.46	2.50	1.27	2.75	0.44	0 00:59:52

Subbasin Hydrology

Subbasin : EX_CONDITIONS

Input Data

Area (ac)	2.16
Peak Rate Factor	484.00
Weighted Curve Number	86.46
Rain Gage ID	Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods	0.22	C	70.00
Grass	1.07	C	86.00
Wetland	0.10	C	100.00
Stream	0.04	C	100.00
Gravel	0.62	C	89.00
Asphalt	0.06	C	98.00
Concrete	0.02	C	98.00
Landscaping	0.03	c	78.00
Composite Area & Weighted CN	2.16		86.46

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.55	0.00	0.00
Flow Length (ft) :	139	0.00	0.00
Slope (%) :	1.74	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.35	0.00	0.00
Velocity (ft/sec) :	0.04	0.00	0.00
Computed Flow Time (min) :	58.69	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	39	0.00	0.00
Slope (%) :	4.6	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.50	0.00	0.00
Computed Flow Time (min) :	0.43	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.03	0.00	0.00
Flow Length (ft) :	120	0.00	0.00
Channel Slope (%) :	2.5	0.00	0.00
Cross Section Area (ft²) :	1.2	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	2.69	0.00	0.00
Computed Flow Time (min) :	0.74	0.00	0.00

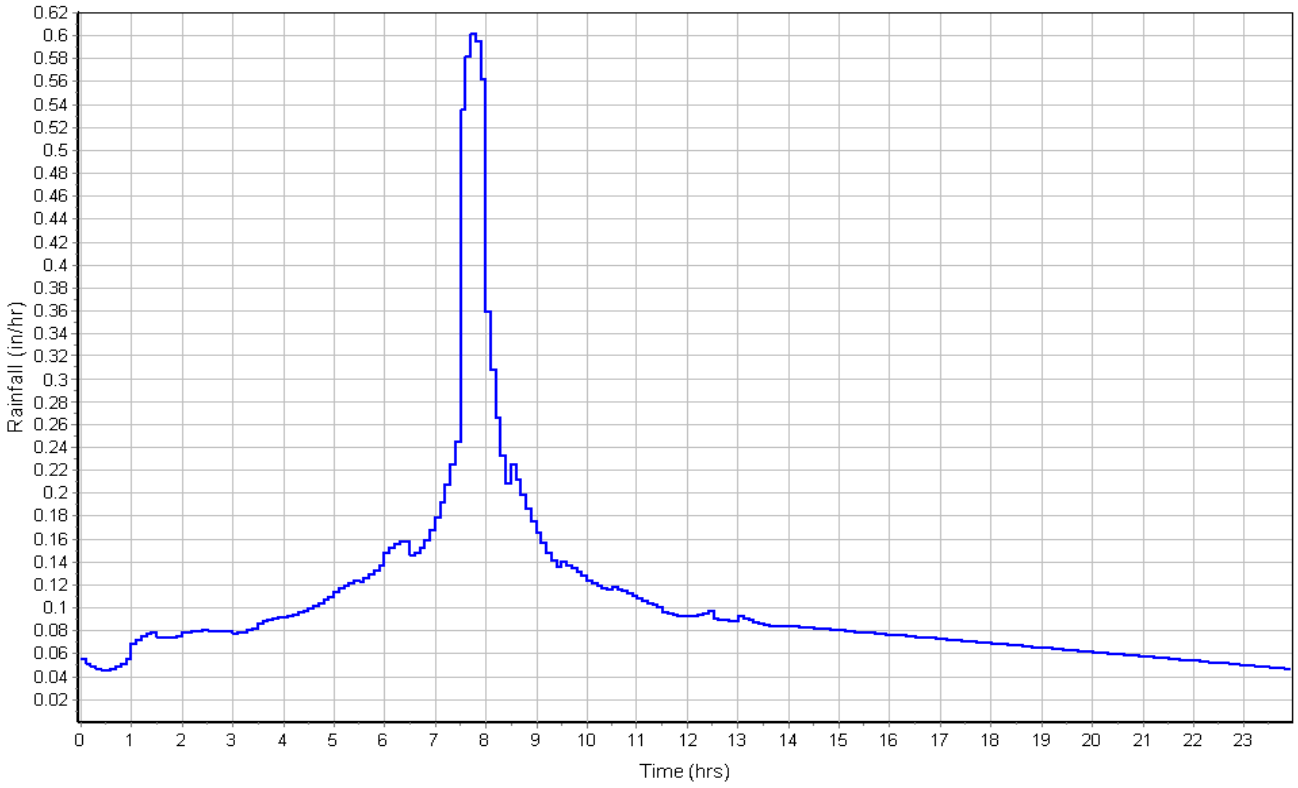
Total TOC (min) 59.87

Subbasin Runoff Results

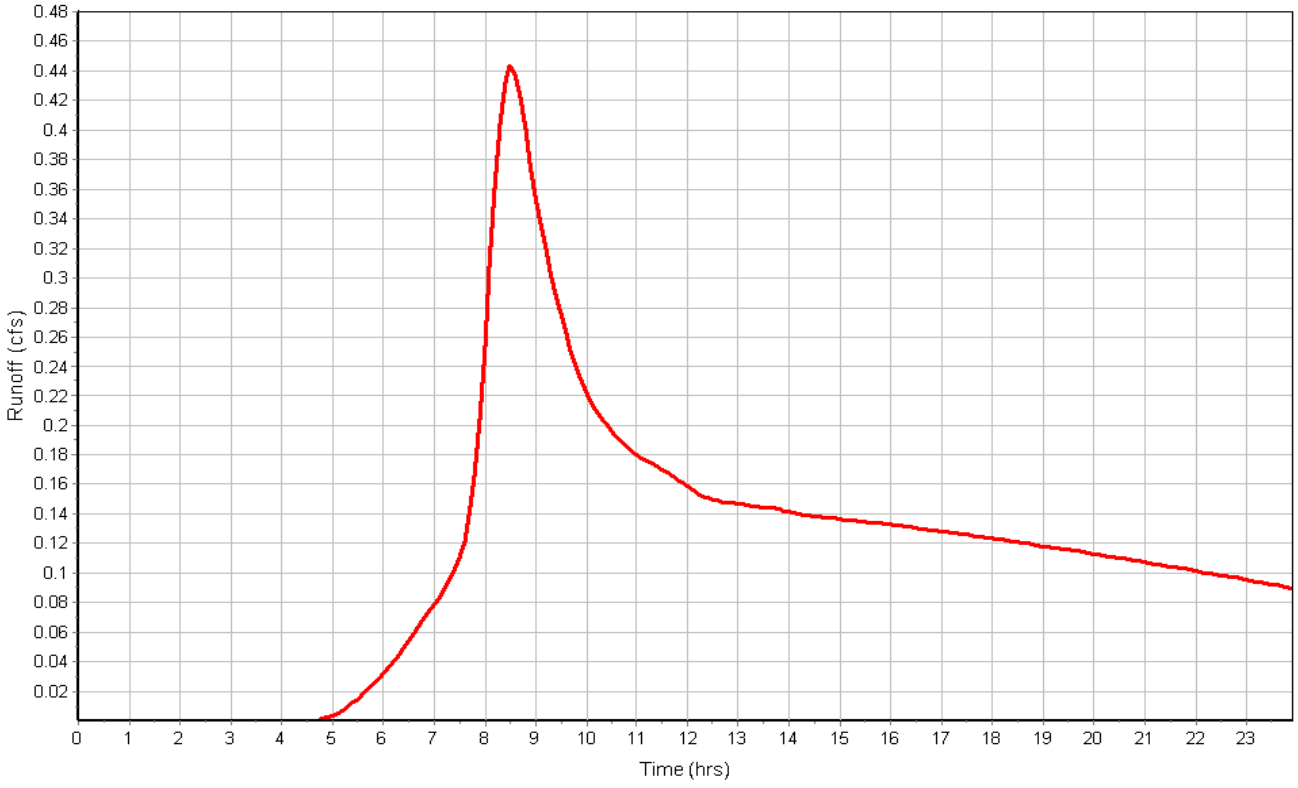
Total Rainfall (in)	2.50
Total Runoff (in)	1.27
Peak Runoff (cfs)	0.44
Weighted Curve Number	86.46
Time of Concentration (days hh:mm:ss)	0 00:59:52

Subbasin : EX_CONDITIONS

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name ..... 2022 1026 Camano SSA DEV.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Oct 26, 2022	00:00:00
End Analysis On	Oct 27, 2022	00:00:00
Start Reporting On	Oct 26, 2022	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:06:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage	Time Series	25 YR	Intensity	inches	WA	Island	25	2.50	SCS Type 1A

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	DEV_CONDITIONS	2.16	484.00	86.33	2.50	1.27	2.73	0.44	0 00:59:52

Subbasin Hydrology

Subbasin : DEV_CONDITIONS

Input Data

Area (ac)	2.16
Peak Rate Factor	484.00
Weighted Curve Number	86.33
Rain Gage ID	Rain Gage

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods	0.22	C	70.00
Grass	0.51	C	86.00
Wetland	0.10	C	100.00
Stream	0.04	C	100.00
Gravel	0.86	C	89.00
Asphalt	0.08	C	98.00
Concrete	0.08	C	98.00
Landscape_Screening_plus_Wetland_Buffer_Enhancement	0.28	C	78.00
Composite Area & Weighted CN	2.17		86.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.55	0.00	0.00
Flow Length (ft) :	139	0.00	0.00
Slope (%) :	1.74	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.35	0.00	0.00
Velocity (ft/sec) :	0.04	0.00	0.00
Computed Flow Time (min) :	58.69	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	39	0.00	0.00
Slope (%) :	4.6	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.50	0.00	0.00
Computed Flow Time (min) :	0.43	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.03	0.00	0.00
Flow Length (ft) :	120	0.00	0.00
Channel Slope (%) :	2.5	0.00	0.00
Cross Section Area (ft²) :	1.2	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	2.69	0.00	0.00
Computed Flow Time (min) :	0.74	0.00	0.00

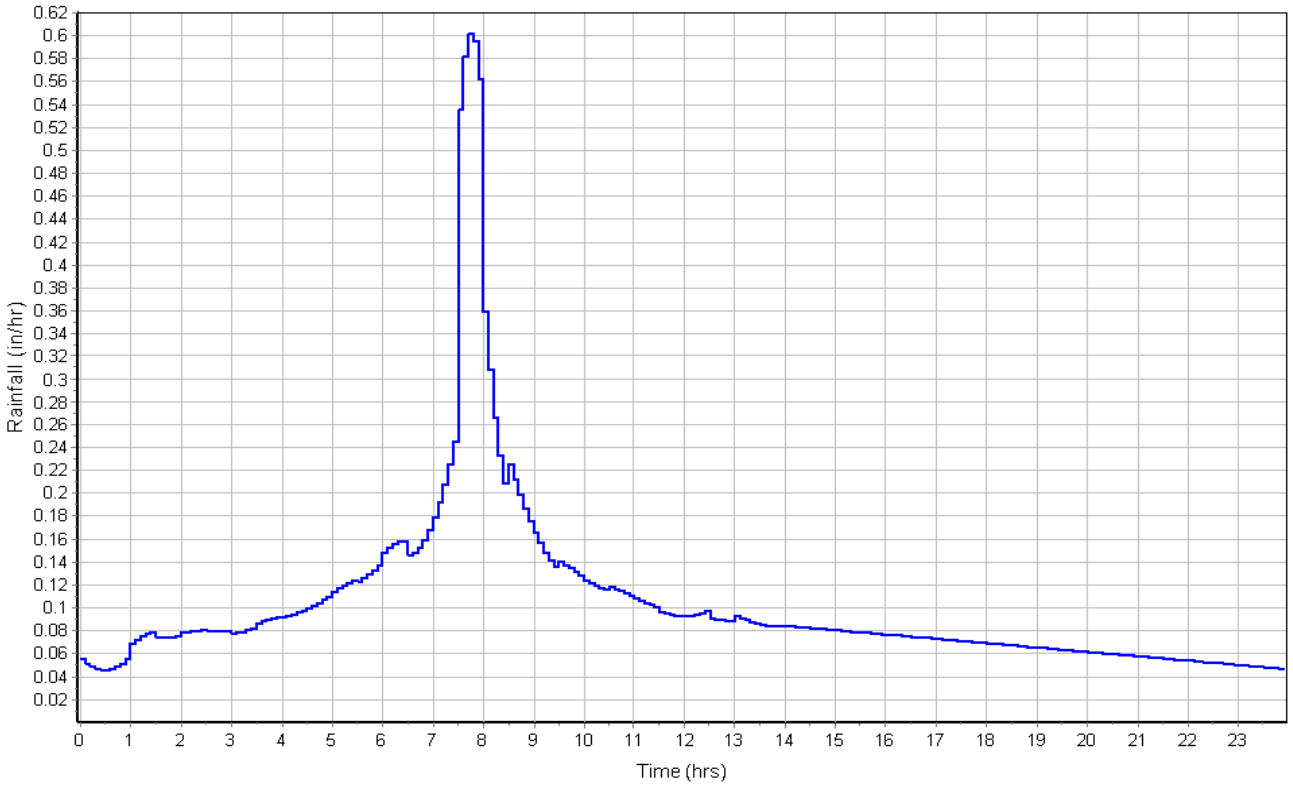
Total TOC (min) 59.87

Subbasin Runoff Results

Total Rainfall (in)	2.50
Total Runoff (in)	1.27
Peak Runoff (cfs)	0.44
Weighted Curve Number	86.33
Time of Concentration (days hh:mm:ss)	0 00:59:52

Subbasin : DEV_CONDITIONS

Rainfall Intensity Graph



Runoff Hydrograph

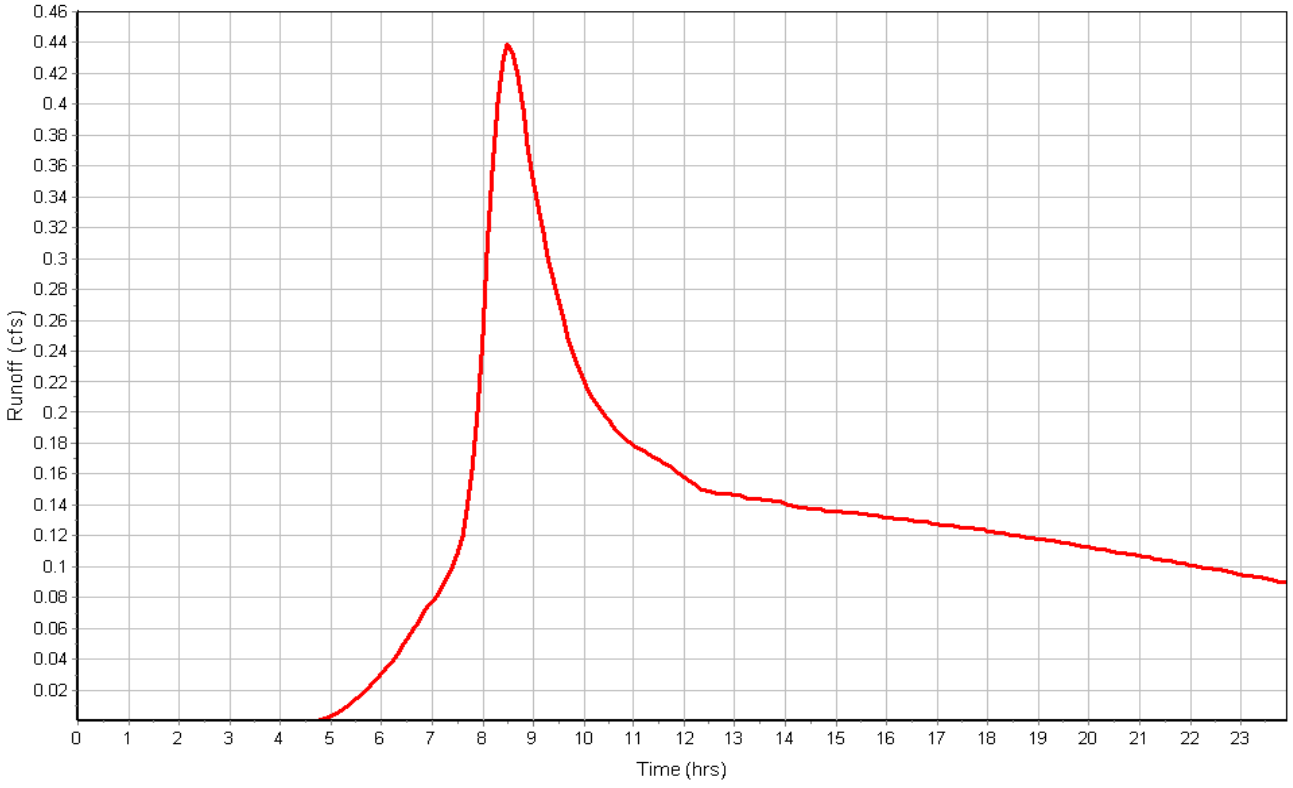


Table 2.2
Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group A	B	C	D
Curve Numbers for Pre-Development Conditions				
Pasture, grassland, or range-continuous forage for grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Curve Numbers for Post-Development Conditions				
Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)[1]				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs[2], driveways, etc. (excluding right-of-way)	98	98	98	98
Permeable Pavement (See Appendix C to decide which condition below to use)				
Landscaped area	77	85	90	92
50% landscaped area/50% impervious	87	91	94	96
100% impervious area	98	98	98	98
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, grassland, or range-continuous forage for grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77

Single family residential[3]: Dwelling Unit/Gross Acre	Should only be used for subdivisions > 50 acres	Average Percent impervious area[3,4]	
1.0 DU/GA		15	Separate curve number
1.5 DU/GA		20	shall be selected for
2.0 DU/GA		25	pervious & impervious
2.5 DU/GA		30	portions of the site or
3.0 DU/GA		34	basin
3.5 DU/GA		38	
4.0 DU/GA		42	
4.5 DU/GA		46	
5.0 DU/GA		48	
5.5 DU/GA		50	
6.0 DU/GA		52	
6.5 DU/GA		54	
7.0 DU/GA		56	
7.5 DU/GA		58	

PUD's, condos, apartments, commercial businesses, industrial areas & & subdivisions < 50 acres	%impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site

For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).

[1] Composite CN's may be computed for other combinations of open space cover type.

[2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" (Section 3.1.1), and "Flow Credit for Roof Downspout Dispersion" (Section 3.1.2).

[3] Assumes roof and driveway runoff is directed into street/storm system.

[4] All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

CAMANO SUBSTATION

Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

WASHINGTON

10 0 10 20 30 40 MILES

APPENDIX E

Stormwater Facilities Operation and Maintenance

TABLE OF CONTENTS

Purpose

The objective of this manual is to ensure that stormwater control facilities are adequately maintained and operated properly.

This manual is intended to meet all storm system operation and maintenance requirements in the Island County Stormwater Design Manual and The Drainage Manual.

Storm system maintenance is necessary to protect streams, lakes, wetlands, and groundwater. Proper maintenance assures that storm systems operate as they were designed, and that they are cleaned of pollutants that they trap, such as sediment and oils, so that the storm system is not overwhelmed and becomes a pollutant source.

Stormwater System Inspection Schedule

The drainage system shall be monitored periodically. For the first year after completion of construction, the system shall be monitored after every large storm event (> 1-in in 24-hrs), and, during the period Oct. 1- Mar. 31 inspections should be conducted monthly. From April 1-Sept. 30, the facility shall be monitored on a quarterly basis. Once the performance characteristics of the facility have been verified, the monitoring schedule can be reduced to an annual basis unless the performance data indicate that a more frequent schedule is required.

Catch Basin

A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

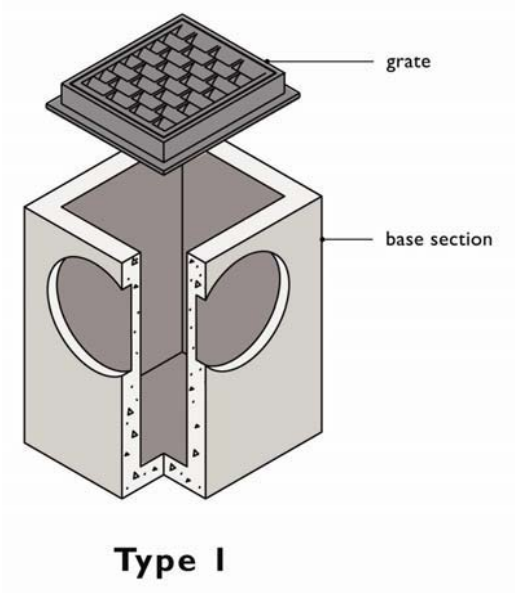
A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

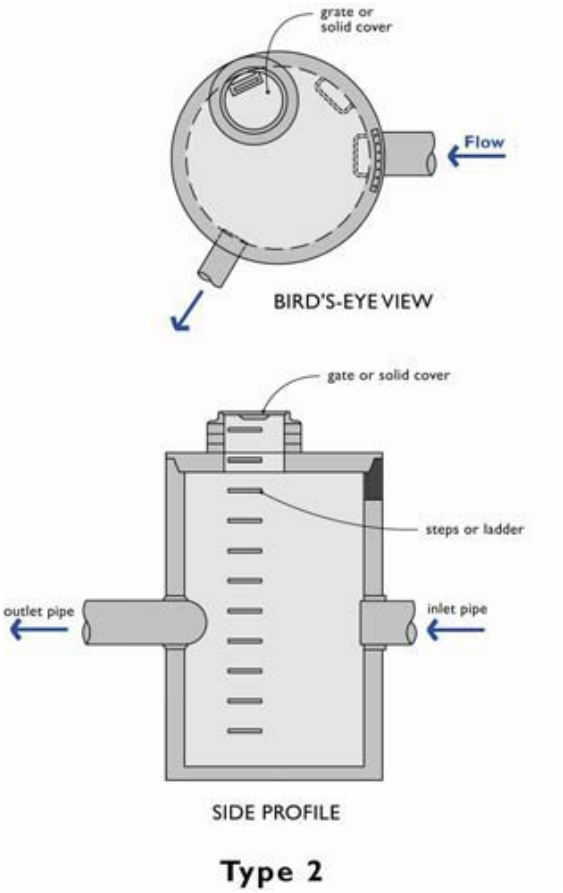
Type 2 catch basins, also commonly referred to as storm manholes, are round concrete structures ranging in diameter from 4 feet to 8 feet. Type 2 catch basins are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Type 2 catch basins typically have manhole steps mounted on the side of the structure to allow access.

Both types typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

The most common tool for cleaning catch basins is a truck with a tank and vacuum hose (vactor truck) to remove sediment and debris from the sump. A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch basins are typically associated with all stormwater facilities.





Catch Basins			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.

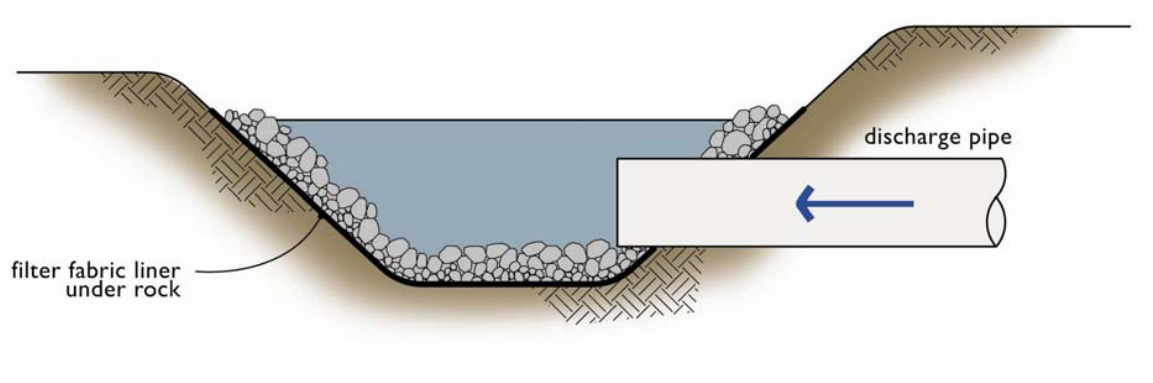
Catch Basins (Continued)			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Energy Dissipater

An energy dissipater is installed on or near the inlet or outlet to a closed pipe system to prevent erosion at these locations. There are a variety of designs, including wire gabion baskets, rock splash pads, trenches, and specially designed pools or manholes. The rock splash pad is typically constructed of 4- to 12-inch diameter rocks a minimum of 12 inches thick and is often lined with filter fabric. The rock pad should extend above the top of the pipe a minimum of 1 foot.

Facility objects that are typically associated with a energy dissipaters include:

- detention ponds
- infiltration basin
- wetponds
- treatment wetlands



Energy Dissipaters			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
Catch Basins	All Potential Defects	**See Catch Basins**	

Conveyance Stormwater Pipe

Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Storm sewer pipes convey stormwater. Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Stormwater pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

Conveyance Storm Pipe			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root. Do not put root-dissolving chemicals in storm sewer pipes. If necessary, remove the vegetation over the line.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Install upstream debris traps (where applicable) then clean pipe and remove material
	Debris barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier	Debris barrier present on all stormwater pipes 18 inches and greater

Oil Trap

An oil trap separates oil from water. The oil rises to the surface and floats on the water and sediment settles to the bottom. Oil traps are typically utilized in locations where oil concentrations in the stormwater runoff are anticipated. Oil traps are most commonly used as the first pre-treatment facility in a series of stormwater management facilities.

Oil Trap			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality (i.e. obvious oil or other contaminants present)	Effluent discharge from the oil trap should be clear with out thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of the catch basin exceeds 6-inches in depth.	No sediment deposits on catch basin bottom that would impede flow through the oil trap and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in catch basin, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from catch basin, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1-inch, at the surface of the water.	Extract oil from the catch basin by vactoring. Disposal in accordance with state and local rules and regulations.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
	Vent Pipe	One-half of the cross section of the vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Catch Bain	See Catch Basin	See Catch Basin