QUALITY ASSURANCE PROJECT PLAN

Pierce County Phase I Municipal Stormwater Permit Stormwater Flow Reduction Strategy Monitoring

Prepared for

Pierce County Public Works and Utilities
Surface Water Management

April 2011

QUALITY ASSURANCE PROJECT PLAN

Pierce County Phase I Municipal Stormwater Permit Stormwater Flow Reduction Strategy Monitoring

Prepared for

Pierce County Public Works and Utilities
Surface Water Management
2702 South 42nd Street, Suite 201
Tacoma, Washington 98409-7322

Prepared by

Herrera Environmental Consultants
1220 Fourth Avenue East
Olympia, Washington 98506
Telephone: 360.754.7644

April 14, 2011

Signature Page

QUALITY ASSURANCE PROJECT PLAN

Sprinker Recreation Center: Stormwater LID Retrofit Flow Monitoring Project

April 2011

Approved by:

Dan Wrye, Water Quality and Watersheds Manager, Pierce County Date

John Collins, Project Manager, Pierce County Date

Windy Kruse, Monitoring Lead, Pierce County Date

Vince McGowan, NPDES Permit Coordinator, Ecology Date

Distribution List

Name	Affiliation	Title	Phone	Address/E-mail
Dan Wrye	Pierce County Public Works and Utilities Surface Water Management	Program Manager	253-798-4672	Pierce County Public Works and Utilities Surface Water Management 2702 S. 42nd Street Tacoma, Washington 98409-7233
John Collins	Pierce County Public Works and Utilities Surface Water Management	Project Manager	253-798-4652	Pierce County Public Works and Utilities Surface Water Management 2702 S. 42nd Street Tacoma, Washington 98409-7233 jcollins@co.pierce.wa.us
Carla Vincent	Pierce County Public Works and Utilities Surface Water Management	Quality Control Coordinator	253-798-4653	Pierce County Public Works and Utilities Surface Water Management 2702 S. 42nd Street Tacoma, Washington 98409-7233 cvincent@co.pierce.wa.us
Windy Kruse	Pierce County Public Works and Utilities Surface Water Management	Field Sampling Lead	253-798-3092	Pierce County Public Works and Utilities Surface Water Management 2702 S. 42nd Street Tacoma, Washington 98409-7233 wkruse@co.pierce.wa.us
Vince McGowan	Ecology	Ecology Project Manager	360-407-7320	Washington State Department of Ecology 300 Desmond Drive SE Lacey, Washington 98503 vmcg461@ecy.wa.gov

Ecology: Washington State Department of Ecology

Contents

Signature Page i

Distribution List iii

Introduction 1

Background 3

- Low Impact Development 3
- NPDES Monitoring Requirements 3

Project Description 5

Organization and Schedule 9

- Project Organization and Key Personnel 9
- Project Budget 10
- Project Schedule 10

Quality Objectives 11

- Precision 11
- Bias 12
- Representativeness 13
- Completeness 13
- Comparability 13

Sampling Process Design 15

- Drainage Area Description 15
- Monitoring Stations 16
- Data Collection 16
- Data Analysis Overview 19

Sampling Procedures 21

- Precipitation Monitoring 21
- Discharge Monitoring 21
- Rain Garden Bypass Frequency 22

Measurement Procedures 25

Quality Control 27

- Measurement Validation Checks 27
- Equipment Calibration Checks 27
- Equipment Maintenance Checks 28

Data Management Procedures 29

Audits and Reports 31

Data Verification and Validation 33

Data Quality (Usability) Assessment 35

Data Usability Assessment 35
Data Analysis Procedures 35
Data Pre-processing 36
LID Performance Evaluation 36
Rain Garden Performance Evaluation 37

References 39

Appendix A Monitoring Equipment Technical Specifications
Appendix B Field Forms
Appendix C Permeable Surface Installation Specifications

Tables

Table 1. Pierce County personnel responsibilities. 9
Table 2. Project schedule and milestones..... 10
Table 3. Monitoring stations to be established for the Sprinker Recreation Center LID performance monitoring project..... 18

Figures

Figure 1. Vicinity map..... 6
Figure 2. Plan view of the Sprinker Recreation Center parking facility and LID installations and monitoring stations..... 7
Figure 3. Monitoring schematic for station PP-Underdrain. 17
Figure 4. Monitoring schematic for station RG-BP. 23

Introduction

NPDES Phase I permits issued to municipalities with a population greater than 100,000, require stormwater monitoring, targeted stormwater management program effectiveness monitoring, and stormwater treatment and hydrologic best management practices evaluation monitoring. To fulfill the hydrologic best management practice monitoring requirement, Pierce County will monitor the flow reduction capabilities of specific Low Impact Development (LID) features installed in the parking lot of the Sprinker Recreation Center in Tacoma, Washington. These features were installed under an Ecology Stormwater Implementation Grant, and this monitoring will also meet the requirements of the grant agreement.

This document is the Quality Assurance Project Plan (QAPP) for monitoring at the project site, and was jointly prepared by Pierce County (County) and Herrera (Herrera). The goal of this QAPP is to document procedures used for data collection, processing, and analysis to ensure that project monitoring results are scientifically and legally defensible. It was prepared in accordance with Ecology's *Guidelines for Quality Assurance Project Plans* (Ecology 2004), and includes the following:

- **Background** – An explanation of why the project is needed.
- **Project Description** – Project goals and objectives, and the information required to meet the objectives.
- **Organization and Schedule** – Project roles and responsibilities, and the schedule for completing the work.
- **Quality Objectives** – Performance (or acceptance) thresholds for collected data.
- **Sampling Process Design** – The sampling process design for the study, including sample types, monitoring locations, and sampling frequency.
- **Sampling Procedures** – A detailed description of sampling procedures and associated equipment requirements.
- **Measurement Procedures** – Laboratory procedures that will be performed on collected samples.
- **Quality Control** – Quality control (QC) requirements for both laboratory and field measurements.
- **Data Management Procedures** – How data will be managed from field or laboratory recording to final use and archiving.

- **Audits and Reports** – The process that will be followed to ensure this QAPP is being implemented correctly and the quality of the data is acceptable.

- **Data Verification and Validation** – The data evaluation process, including the steps required for verification, validation, and data quality assessment.

- **Data Quality (Usability) Assessment** – The procedures that will be used to determine if collected data are of the right type, quality, and quantity to meet project objectives.

Background

Low Impact Development

Stormwater runoff from impermeable surfaces (e.g., pavement and rooftops) often contains high levels of pollutants such as suspended solids, heavy metals, and petroleum products. Also, concentrated runoff from impermeable surfaces can increase erosion in nearby streams. Stormwater flow control has traditionally focused on “end-of-pipe” solutions, where flow is routed via curbs, drains, and pipes to a structural best management practice (BMP) facility. These facilities (typically a pond, vault, or swale) are designed to attenuate or infiltrate flows to decrease discharge rates.

Recent research (Booth et al. 2002) suggests that traditional BMPs may be less effective at mitigating stormwater impacts than previously thought. In addition, numerous studies indicate that Low Impact Development (LID) features that facilitate onsite infiltration offer superior runoff reduction when compared to traditional BMPs (Dietz 2007). By mimicking natural hydrological processes, LID reduces both the rate and volume of peak flows. In areas characterized by larger quantities of impermeable surface, this can be accomplished by: increasing stormwater infiltration in those adjacent areas that remain permeable, or by installing permeable alternatives to traditional impermeable surfaces, or by directing runoff to onsite, small-scale water retention features, e.g., rain gardens.

Permeable pavement systems have been shown to produce 93 percent less surface runoff than traditional impermeable pavement systems (Dreelin et al. 2006). Rain gardens can reduce surface runoff by more than 98 percent (Dietz et al. 2005). Results such as these have contributed to an increasing interest in the use of LID features for treating stormwater runoff across the United States.

NPDES Monitoring Requirements

The Washington State Department of Ecology (Ecology) issued the current NPDES and Phase I Permit on January 17, 2007. The Phase I Permit applies to all entities in Washington State that are required to have stormwater permit coverage under U.S. Environmental Protection Agency (EPA) stormwater regulations. This includes unincorporated portions of counties whose populations exceed 100,000 in the 1990 census, specifically Pierce County.

Ecology requires each permittee to conduct a comprehensive long-term stormwater monitoring program in order to provide a basis for implementation of future stormwater runoff reduction strategies. Under Section S8.F.7 of the Permit, the County is required to monitor the effectiveness of one flow reduction strategy addressing the following criteria:

- Monitor the effectiveness of one flow reduction strategy that is in use or planned for installation within the County.
- Monitoring of a flow reduction strategy shall include continuous rainfall and surface runoff monitoring.
- Flow reduction strategies shall be monitored through either a paired site study or against a predicted outcome.

To fulfill the requirements specified by Section S8.F.7, County will monitor the flow reduction capability of LID features installed at the Sprinker Recreation Center in Tacoma Washington. The experimental design relies upon comparison to a predicted (modeled) outcome. A detailed description of the site features that will be monitored and the project goals is contained in the following section.

Project Description

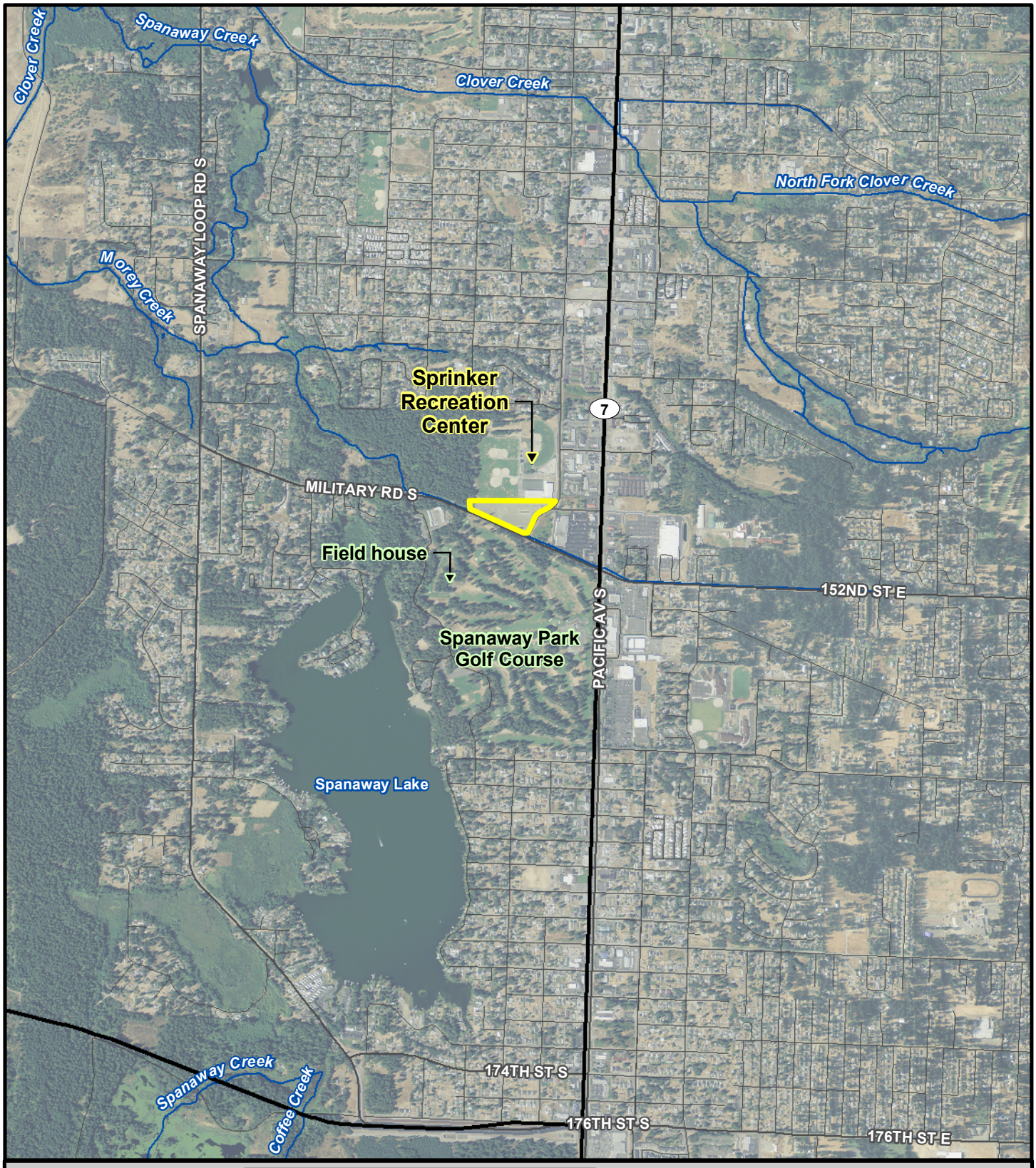
In fiscal year 2007, the County received funding through Ecology's Stormwater Implementation Grant Program to retrofit the parking facility of the Sprinker Recreation Center with permeable pavement and rain garden features. The retrofits were constructed in 2008. The site is located in Tacoma, Washington and is bounded by Military Road South, C Street South and 14th Street South (Figure 1).

The retrofit of the parking facility incorporated approximately 2.32 acres of permeable surface (a combination of permeable concrete and permeable asphalt) into the existing 7.27-acre parking facility, and added three rain gardens. The majority of rainfall intercepted by the parking facility is routed via surface flow either to the permeable sections or one of three rain gardens (Figure 2) where the water will infiltrate. The monitoring associated with this project involves evaluating the performance of some of the installed LID features, as described below.

As stipulated under Section S8.F.7 of the NPDES Phase I permit, and by Ecology's LID grant program, the flow reduction capability of at least one of the installed LID features at the site will be monitored. The County contracted with Herrera to design a monitoring program and prepare this QAPP. The objectives of this QAPP are as follows:

- Compare storm event peak flow rates and runoff volumes from a drainage area containing both permeable and impermeable surfaces, to *modeled* flow rates and runoff volumes to an equivalent area of entirely impermeable (asphalt) surface, and an entirely forested condition. The modeled data for the entirely impervious scenario will be used to evaluate whether this LID feature met the performance standard treatment (i.e., infiltrating 91 percent of the average annual runoff during the monitoring period) (Ecology 2008).
- Measure duration and frequency of bypass (overflow) from a rain garden that receives runoff from a portion of the impermeable asphalt to compare the performance of the rain garden to a "no-runoff" standard, and to verify that rain garden bypass does not significantly contribute to total site runoff volume.

To meet these objectives, the experimental design for this project requires monitoring of the hydrologic conditions of several features at the site and computerized modeling. Discharge via a perforated underdrain pipe (Figure 2) that contributes to total site runoff will be continuously monitored from a section of permeable pavement that receives runoff from adjacent impermeable surfaces. A pressure transducer will be installed in a stilling well adjacent to the bypass of one of the primary rain gardens to record the frequency and duration of time periods when the garden's capacity has been exceeded. Modeling output required to meet the project objectives identified above will be obtained from a continuous simulation hydrologic model (e.g., WWHM3).



Legend

- Study area
- Highway
- Street
- Stream

Figure 1. Vicinity map.

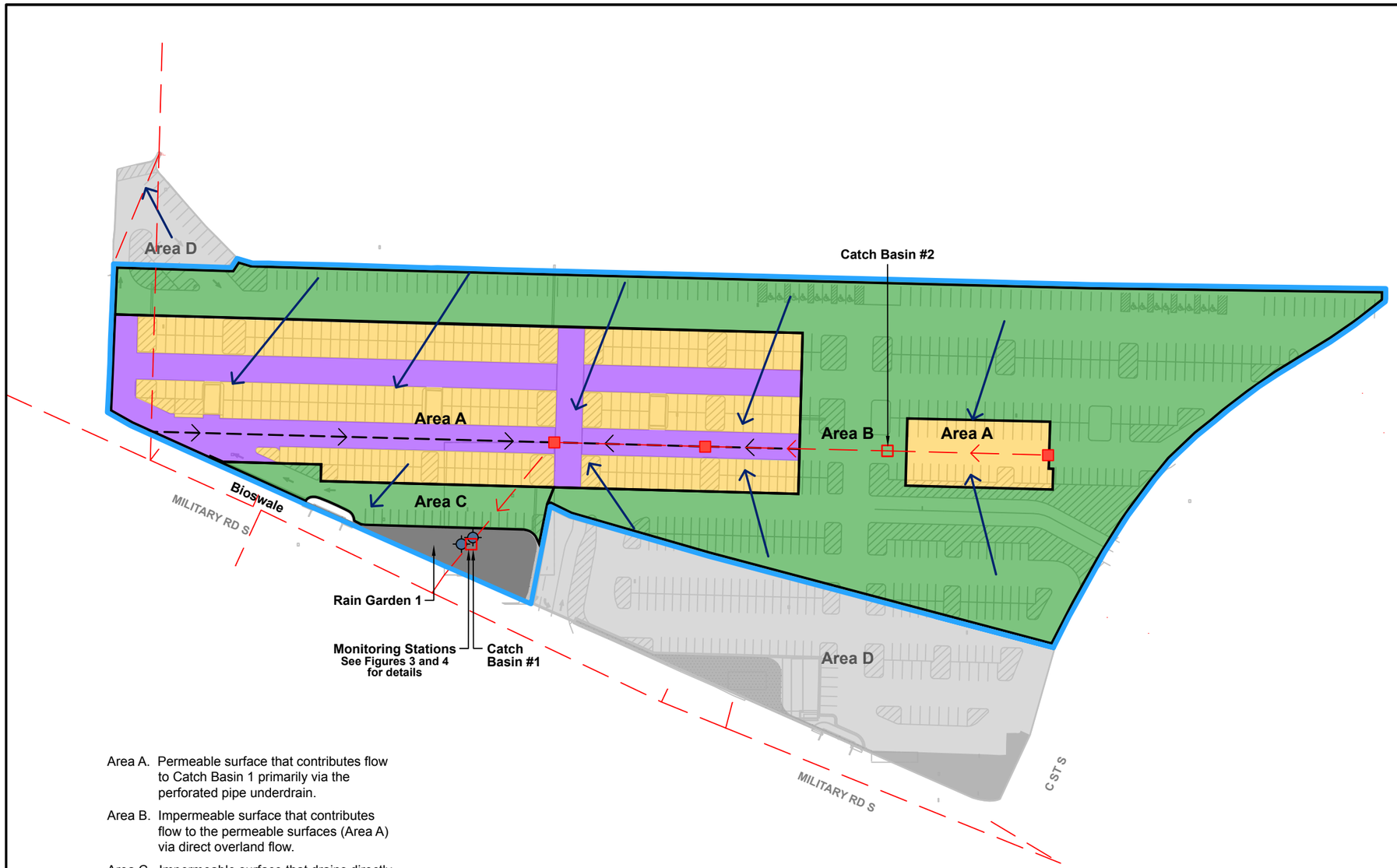
N

0 1,000 2,000 4,000 Feet

HERRERA

Aerial: USDA, 2009

K:\Projects\08-04032-003\Project\vicinity_map-sprinker_rec_center.mxd



Area A. Permeable surface that contributes flow to Catch Basin 1 primarily via the perforated pipe underdrain.

Area B. Impermeable surface that contributes flow to the permeable surfaces (Area A) via direct overland flow.

Area C. Impermeable surface that drains directly to rain garden or bioswale.

Area D. Surfaces drain away from project area.

Figure 2.
Plan view of the Sprinker Recreation Center parking facility and LID installations and monitoring stations.

Legend

- AREA THAT DRAINS TO CATCH BASIN #1
- POROUS ASPHALT
- POROUS CONCRETE
- IMPERMEABLE SURFACE
- RAIN GARDENS
- AREA BOUNDARY
- PERFORATED PIPE
- DRAINAGE FLOW DIRECTION
- MONITORING SITE
- EXISTING CONCRETE LINE
- GRATED CATCH BASIN
- SOLID LID CATCH BASIN

N

0 50 100 200
scale in feet

HERRERA

G:\Graphics\08-04032-003\drainage_areas

Organization and Schedule

Project Organization and Key Personnel

As described above, this study is being conducted to characterize the stormwater treatment benefit(s) of LID features at the Sprinker Recreation Center Site. Pierce County Public Works and Surface Water Management will oversee the project. Key personnel involved in this effort are:

Pierce County Public Works and Utilities Surface Water Management
2702 S. 42nd Street
Tacoma, Washington 98409-7233
(253) 798-2725

Dan Wrye, Program Manager
John Collins Project Manager
Windy Kruse, Monitoring Lead
Rod Gratzer, Quality Control Coordinator

Washington State Department of Ecology
300 Desmond Drive SE
Lacey, Washington 98503
(360) 407-6000

Vince McGowan, Regional Contact

Table 1 (below) identifies the specific roles of Pierce County personnel involved with this project.

Table 1. Pierce County personnel responsibilities.

Staff Name	Role	Assigned Responsibilities
Dan Wrye	Program Manager	▪ Final approval of QAPP ▪ Project oversight
John Collins	Project Manager	▪ Monitor and assess quality of work ▪ Ensure compliance with corrective action requirements ▪ Supervise monitoring and equipment maintenance activities
Windy Kruse	Monitoring Lead	▪ Equipment maintenance and calibration ▪ Data download/upload ▪ Data entry and preliminary QA audits
Carla Vincent	Quality Control Coordinator	▪ Perform QA audits on data collected ▪ Identify and initiate corrective action ▪ Data analysis ▪ Report writing

Project Budget

Design and construction of the LID features on the SRC project site are being funded in part through a grant from Ecology's Stormwater Implementation Grant Program. The total grant award from Ecology is $637,500 for these costs, with the County providing $213,000 in matching funds. The County is also providing additional in-kind resources to fund some elements of the project, including the monitoring that will be performed pursuant to this QAPP.

Project Schedule

Initial characterization monitoring associated with this study began in October 2010 before this QAPP was approved and therefore it was not carried out utilizing all of the equipment and methodology set out in this QAPP. The equipment and sampling that will be initiated in February 2011 will follow the details laid out in this QAPP. Monitoring to meet this QAPP began February 14, 2011 and will continue until December 31, 2012. The final report will be organized to evaluate and present the results of data collected during this monitoring period. In keeping with this schedule, project milestones have been identified in Table 2.

Table 2. Project schedule and milestones.

Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
		Calendar Year 2011		
QAPP development	December, 2010	January 2011	Draft QAPP submitted to Ecology	January 17, 2011
QAPP approval	January, 2011	February 2011	QAPP approved by Ecology	February 15, 2011
Equipment installation	February, 2011	February 14, 2011	Equipment installed according to QAPP	NA
Monitoring	February 14, 2011	Ongoing through December 31, 2012	Continuous precipitation, flow, and water level data	NA
		Calendar Year 2012		
Annual reporting	January, 2012	March 31, 2012	Annual report and quality assurance memorandum submitted to Ecology	March 31, 2012
		Calendar Year 2013		
Project final report	January, 2013	March 31, 2013	Final report and quality assurance memorandum submitted to Ecology	March 31, 2013

Quality Objectives

The primary goal of this QAPP is to ensure that the data collected for this study are scientifically and legally defensible. To meet this goal, the collected data will be evaluated based on the following data quality indicators:

- Precision: A measure of the variability in the results of replicate measurements due to random error.
- Bias: The systematic or persistent distortion of a measurement process that causes errors in one direction (i.e., the measured mean is different from the true value).
- Representativeness: The degree to which the data accurately describe the conditions being evaluated based on the selected sampling locations, sampling frequency and duration, and sampling methods.
- Completeness: The amount of data obtained from the measurement system.
- Comparability: The ability to compare data from the current project to data from other similar projects, regulatory requirements, and historical data.

Measurement quality objectives (MQOs) are performance or acceptance criteria that are established for each of these data quality indicators. Monitoring for this project will involve water level measurements using a pressure transducer in a control structure (weir) and stilling well. The MQOs for these data are defined in subsections below. If the MQOs are not met, the data will be either flagged as an estimate (*J*) or rejected (*R*) (see *Data Verification and Validation* section).

Precision

The precision of the pressure transducers used in this study will be assessed before they are deployed and after the project is completed. Precision will be assessed by submerging the gauges in a 2-liter graduated cylinder covered with foil. The gauge reading will be recorded on a 5-minute time step for 4 hours at approximately 25 degrees Celsius, and for 4 hours at approximately 5 degrees Celsius. The resultant data will be grouped by temperature and the coefficient of variation will be calculated for each group using the following equation:

$$C_v = \frac{\sigma}{\mu} \times 100\%$$

Where: C_v= Coefficient of variation
σ = Standard deviation
μ = Average gauge reading

The C_v will be calculated for the data collected at 25 degrees Celsius and the data collected at 5 degrees Celsius. For each group of data, the MQO will be a C_v of no more that 5 percent.

Rain gauge precision will be estimated by repeatedly releasing a known volume of water into the tipping bucket mechanism and recording the volume required to tip the bucket mechanism. This process will be repeated 10 times and the resultant C_v will be calculated using the above equation. The MQO for rain gauge precision will be 5 percent.

Because control structures are rigid devices that do not vary under repeated measurement, the data quality indicator of precision does not apply to these devices. However, due to the potential for irregular construction of the device, control structures are subject to bias, which is addressed below.

Bias

Bias associated with the pressure transducers will be assessed both in the laboratory before deployment and in the field. In the laboratory, gauges will be placed in a 2-liter graduated cylinder. The cylinder will be filled with water to three different known depths and the resultant level gauge readings will be compared with the “true” measured values. This process will be repeated three times. The MQO for level measurements will be a difference of no more than 10 percent between the instrument readings and independently measured level values.

In the field, bias in the level gauges will be assessed based on comparisons of monitoring equipment readings to an independently measured “true” value. In this case the true value will be derived from a manual measurement of water level at each monitoring location. If the monitoring equipment is not affected by drift or other operational problems, the difference between the equipment’s reading and the manual measurement of water level (“instrument drift”) should remain at zero over time and with varying water depths. In reality the instruments will drift and equipment readings and manual readings will diverge. Therefore, bias in these data will be assessed based on the change in the instrument drift value relative to all previous measurements. Specifically, a change in the instrument drift value of plus or minus 2 standard deviations relative to the mean from all previous measurements will trigger an assessment of the monitoring equipment to determine proper functioning.

Bias in flow measurements may also result from manufacturing defects or installation discrepancies in the control structures. Bias will be assessed by taking independent flow measurements during six separate storm events. The MQO for level measurements will be a

difference of no more than 20 percent between the instrument reading and an independently measured level values. Details on how these independent flow measurements will be carried out are presented in the Field Quality Control Procedures section.

Bias in precipitation depth data collected through this study will be assessed based on a comparison of the rain gauge's actual readings to its theoretical accuracy as specified by the manufacturer. The rain gauge's actual readings will be determined by measuring the volume of water required to initiate one tip of the tipping bucket mechanism by adding incremental drops of water with a pipette. The resultant value will then be compared to the manufacturer's specifications for this volume. The MQO for precipitation depth will be a difference of no more than 5 percent between the rain gauge's actual reading and the volume specified by the manufacturer.

Representativeness

The representativeness of the hydrologic data for the flow monitoring will be ensured by the proper installation of the monitoring equipment, including primary and secondary devices. Additionally, monitoring will be conducted for at least 2 years in order to capture a range of flow conditions.

Completeness

Completeness will be assessed on the basis of the occurrence of gaps in the data record for all monitoring equipment. The associated MQO is less than 5 percent of the total data record missing due to equipment malfunction or other operational problems. Completeness will be ensured through routine maintenance of all monitoring equipment and implementation of corrective actions within 24 hours, if problems arise.

Comparability

Although there is no numeric MQO for this data quality indicator, standard monitoring procedures, units of measurement, and reporting conventions will be applied in this study to meet the quality indicator of data comparability.

Sampling Process Design

The experimental design for this project entails continuous monitoring of runoff volume from two non-contiguous sections of permeable cement or permeable asphalt that receive runoff water from approximately 3.57 acres of impermeable surface. The water level in a rain garden, which receives runoff not intercepted and infiltrated by the permeable pavement, will also be continuously monitored to determine frequency and duration of overflow. The following subsections identify the specific monitoring stations that will be established to facilitate this monitoring, the data collection procedures that will be used in association with these stations, and the steps that will be followed in the analysis of the collected data.

Drainage Area Description

Four drainage areas have been delineated in Figure 2 to help clarify the hydrology of the site. Areas A, B, and C (total 5.74 acres) are within the area that contributes runoff to the monitoring stations (Figure 2). Area D does not contribute flow to the monitoring stations due to the grade of the site. Although they represent part of the LID features of the site, they are not included in the study and therefore will not be discussed further. A set of engineering drawings is attached as Appendix C and provides additional construction details pertaining to the LID installations that are illustrated schematically in Figure 2.

Area A spans approximately 2.32 acres and is comprised of discrete sections of permeable concrete and permeable asphalt. Although the two materials have different engineering and infiltration characteristics, the purpose of this study is to monitor the combined flow reduction performance of both surface types. Therefore, no further distinction will be made between the two materials, and they will be referred to herein as permeable surface.

The two non-contiguous sections of Area A each receive water as sheet flow from the adjacent impermeable surfaces delineated as Area B (3.20 acres) in Figure 2, as well as rainfall that falls directly on the permeable surfaces. The permeable surfaces of Area A are constructed on a gravel and sand base placed directly on top the native Spanaway Outwash soil (Appendix C). Due to the moderately rapid permeability of the soil (NRCS 2010), no formal underdrain system was constructed. However, an existing perforated pipe (Figure 2 and Appendix C), hydrologically connects the two permeable surfaces, and may intercept some of the infiltrated water and transport it to Catch Basin 1, which is located in Rain Garden 1.

A small portion (approximately 0.23 acres) of the impermeable surface (Area C) discharges into Rain Garden 1 directly or via a bioretention swale located along the southern edge of the project area, upgradient from Rain Garden 1 (Figure 2). Additionally, any water not infiltrated by the permeable surface would also flow into the rain garden or bioswale, via a series of curb-cuts extending along the northern edge of the rain garden and bioswale. Detailed drawings of the rain garden and bioswale are contained on sheets 7, 9, and 10 in Appendix C.

Note: The southern edge of the bioswale, and the southern and eastern edge of the rain garden are bounded by solid curbs preventing the contribution of runoff from the adjacent side walk and parking lot areas.

Previous site visits during storm events indicate that, even during intense rainfall, Rain Garden 1 is capable of infiltrating all of the stormwater runoff it receives due to the high permeability of the underlying soil. However, Catch Basin 1 (Figure 2 and Figure 3) serves as a bypass (overflow) structure should the infiltration capacity and storage volume of the rain garden be exceeded. Water entering Catch Basin 1 either from rain garden bypass, or via the underdrain pipe (Figures 2 and 3) is discharged through a series of catch basins and pipes to Spanaway Creek which is outside the study area.

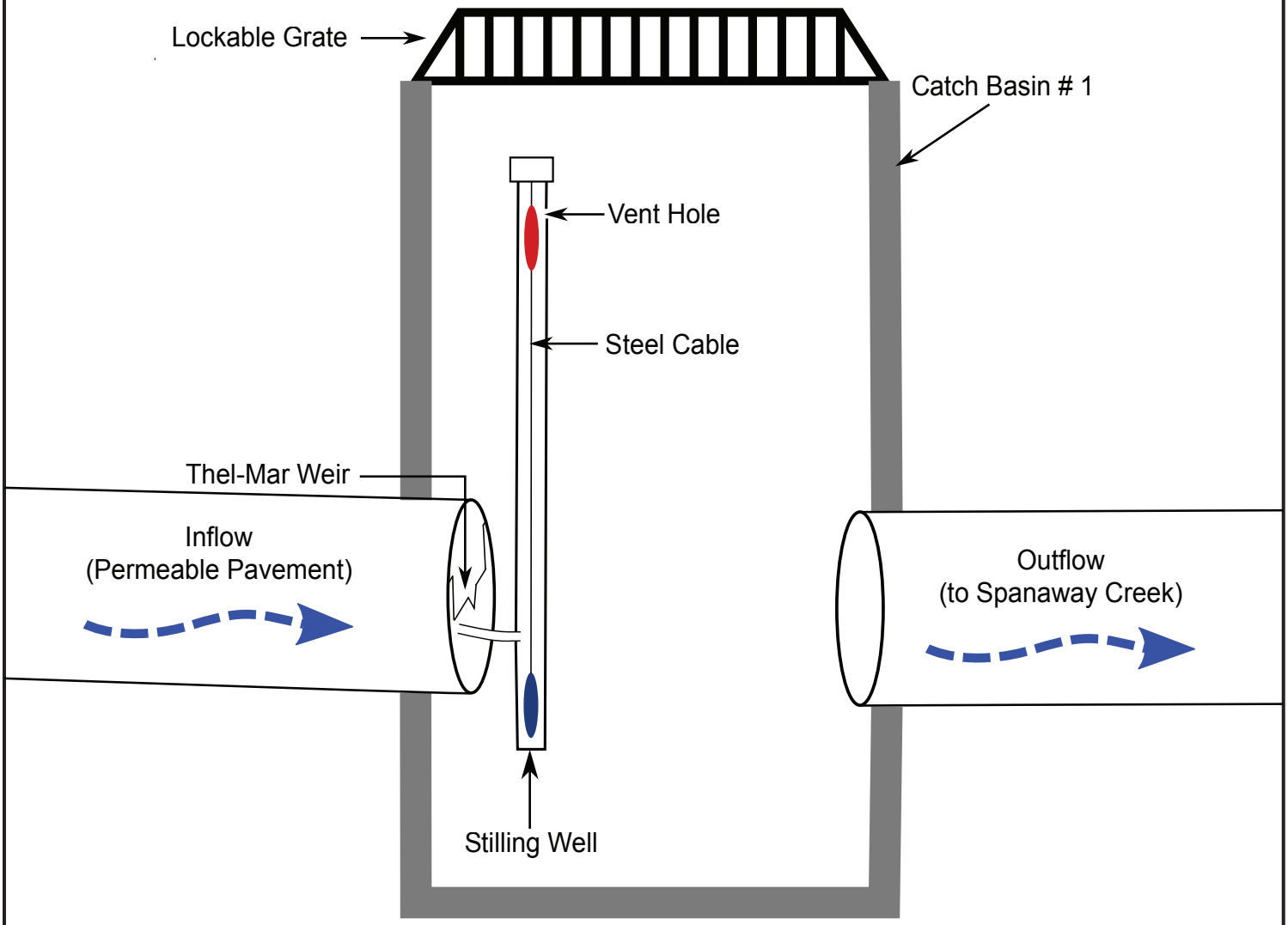
Monitoring Stations

To facilitate the monitoring described above, a total of three monitoring stations will be established in connection with this project. The name and purpose of each station is presented in Table 3 with a short description of its location and associated monitoring equipment. The specific location of each monitoring station is also shown in Figure 2. A detailed site diagram shows the drainage area of the LID features that will be monitored (Figure 2).

Data Collection

Data-Logging pressure transducers and a tipping bucket rain gauge will be the primary data collection devices used for this monitoring project. Pressure transducers will be installed at the two monitoring locations shown in Figure 2. The data loggers will be programmed to record data every 15 minutes over the duration of the nearly 2-year monitoring period extending from February 14, 2011 through December 31, 2013. The rain gauge will be installed at the Spanaway golf course located approximately 0.2 miles from the Sprinker Recreation Center site. Power for the pressure transducer data loggers will be maintained by an internal battery which is specified by the manufacturer to last longer than the project duration (Appendix A). Power for the rain gauge will be supplied by a 12-volt battery.

Data from each monitoring station will be uploaded by County staff on a bi-monthly basis between October 15 and April 15, and monthly throughout the rest of the year. On a routine basis, the uploaded data will be transferred to a Microsoft Access data base, managed by the County for post-processing. Post-processing will include drift and offset corrections, gap filling, and spike deletion.



Legend

- Barologger
- Pressure transducer

Figure 3.
Monitoring schematic for station PP-Underdrain.

Not to scale

HERRERA

G:\Graphics\08-04032-003\pp-underdrain

Table 3. Monitoring stations to be established for the Sprinker Recreation Center LID performance monitoring project.

Station Name	Station Purpose	Station Description
PP-Underdrain	This station will be used to continuously monitor the flow from the drainage area depicted in Figure 2. Flow volumes at this site will be compared with *modeled* site flows for both an entirely impervious scenario (i.e., no LID), and an entirely forested condition. This will allow an evaluation of the flow control provided by LID features at the site relative to the forested condition target.	The flow volume measured at this station originates from the drainage area depicted in Figure 2. The sources of flow at this site are; runoff from impermeable asphalt surfaces routed via the underdrain pipe system shown in Figure 2, and water that has been infiltrated through the permeable pavement and asphalt (Figure 2.) and has entered the under drain underdrain pipe (Figure 2). A Thel-Mar style weir and pressure transducer will be installed in the pipe to measure the outflow volume from the above listed sources.
RG-BP	This station will be used to monitor the frequency of bypass in a representative rain garden on the project site. Based on the high permeability of the soil at the site it is expected that bypass will never occur. The primary purpose of this site is to verify that runoff (if any) from the permeable surfaces (Figure 2), and the small section of impermeable surface adjacent to the rain garden (Figure 2) does not contribute to total site flow.	Rain Garden 1 receives runoff from the permeable area, as well as small section of impermeable area (Figure 2). A stilling well and pressure transducer will be installed adjacent to the bypass structure in Rain Garden 1 (Figure 2). Water level will be continuously monitored to identify periods when the water level of the rain garden is higher than the bypass structure (i.e., stormwater is discharged from the rain garden).
PG (precipitation gauge)	This station will be used to continuously measure rainfall (volume and intensity). Rainfall data will be used to identify qualifying storm events (i.e., pre- and post storm antecedent dry periods, and total volume).	A tipping bucket rain gauge will be installed at the Spanaway Golf Course field house (Figure 1).

Data Analysis Overview

The continuous monitoring data that is collected from the stations identified in Table 3 will be used to evaluate the effectiveness of the LID features at reducing flow volumes and peak discharge rates. To perform this evaluation, the data from each individual monitoring station will be processed to identify individual storm "events" based on measured rainfall amounts and user-defined limits for pre- and post-storm antecedent dry periods. Once these events are defined, summary statistics will be calculated for each event (e.g., peak discharge, storm volume, rainfall total, flow duration, etc.) from the continuous monitoring data. Using these data, the following analyses will be performed:

- The performance of the permeable pavement for reducing runoff volumes and peak flow rates will be evaluated by comparing area-weighted flow data to the modeled area-weighted flow data for the unmitigated (i.e., entirely impermeable) condition. Hypothesis testing (e.g., Wilcoxon signed rank tests) will be performed on these data to determine if there are significant differences between the existing condition and an unmitigated condition. A rainfall-runoff relationship will also be developed for existing conditions (i.e., a blend of impermeable and permeable surfaces) based on rainfall data from the rain gauge.

- Rain garden water level data will be evaluated to determine the frequency and duration of bypass (overflow). Based on soil type (Spanaway Sandy Loam) present beneath the rain garden it is predicted that the all water that enters the rain garden will infiltrate. The primary purpose of the rain garden monitoring station is to document that rain garden bypass does not contribute to total site runoff. If bypass occurs, the duration of bypass will be regressed with storm event characteristics (i.e., rainfall intensity and duration) to identify storm event characteristics that cause the rain garden performance to fall short of the expected zero runoff result.

Sampling Procedures

This section identifies the field sampling procedures that will be used to obtain the data described in the previous section. This information is presented under separate subsections for precipitation, discharge, and rain garden bypass frequency monitoring.

Precipitation Monitoring

Rainfall will be measured using a Hobo S-RGB M-002 tipping bucket rain gauge. A HOBO Weather Station U30 data logger will be programmed to record the measured rainfall and air temperature data, at 5-minute intervals. A 12-volt battery will provide the power for all instrumentation. A solar panel will be attached to the battery. The rain gauge will be mounted to a piece of 2-inch conduit attached to the side of the Spanaway Golf Course Club House. Technical specifications for the rain gauge and data logger can be found in Appendix A.

Discharge Monitoring

As described in the *Sampling Process Design* section, discharge will be continuously measured at PP-Underdrain. Table 3 provides a brief description of this monitoring station and the equipment that will be installed to facilitate the discharge monitoring. More detailed descriptions of the equipment installation configuration and discharge monitoring procedures are provided herein. Technical specifications for the discharge monitoring equipment (pressure transducers, weir, and data loggers) are presented in Appendix A.

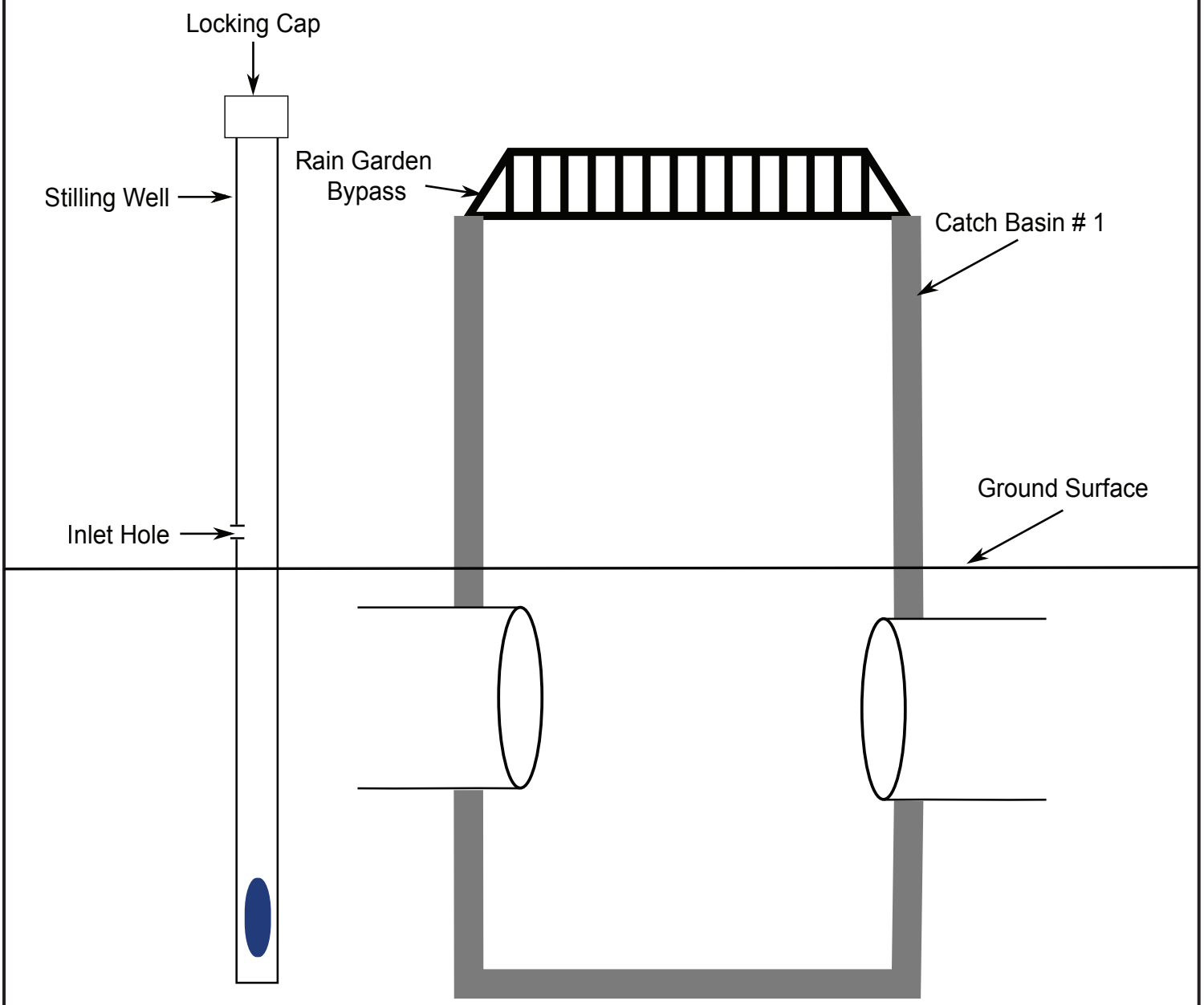
A Thel-Mar style weir (see weir specifications in Appendix A) will be installed at the PP-Underdrain. The weir will be installed in the outlet of the 12-inch pipe that discharges to the catch basin identified as Catch Basin 1 in Figures 2 and 3. In this structure, the pipe in which flow will be monitored is at an equal or slightly lower elevation than the discharge pipe from the catch basin structure. The weir that will be installed will be custom designed such that it raises the water level in the monitored pipe by approximately 2 inches higher than a typical Thel-Mar weir to ensure that backflow conditions cannot occur. A hole will be drilled through the face of the weir, and a reinforced 3/8-inch internal diameter (ID) polyethylene tubing will be connected to the hole. The other end of the tubing will be connected to 1.5-inch ID polyvinyl chloride (PVC) stilling well, which will be inserted into a heavy gauge square steel tube (to prevent vandalism) anchored to the interior wall of the monitoring catch basin shown in Figure 2.

A Hobo U20-001 data logging pressure transducer (see specifications in Appendix A) set to record water level data at 15-minute intervals will be suspended from a steel cable set inside the stilling well to measure water level. A Second Hobo U20 pressure transducer will also be installed in the stilling well to continuously measure and record atmospheric pressure. A generalized diagram for the weir installation configuration is shown in Figure 3. After measuring

the appropriate offset for referencing water levels in the stilling well to water levels in the Thel-Mar weir, the water level measurements from pressure transducers will be converted to discharge measurements based on a compound weir equation (see *Measurement Procedures* section). Water level will be logged by the pressure transducer at 15-minute intervals.

Rain Garden Bypass Frequency

A stilling well and a Hobo U20-001 data logging pressure transducer will be installed (see specifications in Appendix A) and set to record water level data at 15-minute intervals. The stilling well will be located adjacent to the overflow control structure identified in Figure 2 and Figure 4. The stilling well will be constructed of 1.5-inch ID PVC pipe. The well will be installed so that approximately 2 feet of pipe extends below the mulch and soil surface of the rain garden. A 3/8-inch ID hole will be drilled in the PVC stilling well pipe slightly above the mulch and soil surface of the rain garden, but at a lower elevation than elevation of the grate of the catch basin. This hole allows the water level in the stilling well to equilibrate to the elevation of the surface water within the rain garden. A generalized diagram for the water level monitoring well installation configuration is shown in Figure 4. The pressure transducer offset will be determined relative to the inlet hole. The elevation of the stilling well inlet hole will also be surveyed relative to the elevation overflow control structure grate, so that the height of water in the rain garden (stilling well) relative to the overflow structure can be determined. Bypass periods will be documented when the rain garden water surface elevation is above the elevation of the overflow control structure.



Legend

Pressure transducer

Figure 4.
Monitoring schematic for station RG-BP.

Not to scale

HERRERA

G:\Graphics\08-04032-003\rain_garden_bypass

Measurement Procedures

Discharge monitoring for this project will require water level measured in primary measuring devices to be converted to estimates of discharge.

Discharge Rates at PP-Underdrain will be calculated using the following equations for converting stage measurements to discharge measurements in a compound weir (Grant 1997).

Constants (*K)* will be obtained from Grant (2007) once the weir has been fabricated.

V-Notch Cross-Section

$$Q_{v-notch} = KH^{2.5}$$

Where: $Q_{v\text{-}notch}$ = Flow rate through the v-notch segment of the weir
K = Constant dependent on notch angle and unit of measure
H = Head (height above tip of v-notch)

Rectangular Cross-Section

$$Q_{rectanaular} = K(L - .02H)H^{1.5}$$

Where: $Q_{rectangular}$ = Flow rate through the rectangular segment of the weir
K = Constant dependent on unit of measure
L = Crest length (the distance across the rectangular section)
H = Head (height above top of v-notch)

Total Flow

$$Q_{total} = Q_{v-notch} + Q_{rectantular}$$

Where: Q_{total} = Total flow rate through both the v-notch and rectangular portion of the weir

All water level data will be corrected for atmospheric pressure difference based on measurements from the pressure transducer installed at PP-Underdrain.

Quality Control

The quality control procedures for this project will involve the following activities to ensure that data collected for this project are of a known and acceptable quality:

- Measurement validation checks
- Equipment calibration checks
- Equipment maintenance checks

The specific procedures that will be used during these activities are described in the following subsections.

Measurement Validation Checks

Measurement validation checks will be performed during a minimum of 6 storm events each year (12 events total). Each validation check will be targeted to capture a range of storm event sizes to obtain measurements at different flow rates. During these checks, the discharge rate at PP-Underdrain will be manually measured and compared to the calculated discharge rate from the continuous monitoring equipment. Discharge will be measured at this site by catching water flowing over the v-notch in the weir in a 1,000 mL graduated cylinder. The time to fill the cylinder to the 1,000 mL mark will be measured with a stopwatch, and will be used to calculate the discharge rate in liters per minute. This procedure will be conducted three times in succession and the average of the three times will be assumed to be the “true” discharge rate.

Equipment Calibration Checks

At least 6 site visits will be made on an annual basis (12 total) to check pressure transducer calibration at each monitoring station. These checks will occur every other month. Timing of these events will coincide with periods when there is no runoff occurring at PP-Underdrain, and the level water level in the rain garden is below the inlet hole in the stilling well at RG-BP. The pressure transducers at PP-Underdrain and RG-BP will be calibrated using the following procedures.

- **PP-Underdrain:** Field personnel will insert an inflatable bladder into the pipe behind the weir and inflate the device until a seal forms between the bladder and the interior wall of the pipe. The pipe will then be filled with water until it flows through the v-notch. Once the flow has decreased to zero and the water level is equal with the bottom of the v-notch, the pressure transducer will be calibrated to zero. The offset between the pressure transducer elevation and the v-notch elevation will be recorded during each calibration event. Offset values will be tracked over time by

means of control charts to detect potential instrument drift and other operational problems. This information will be used to assess the MQOs that are identified in the *Quality Objectives* section above. If the data do not meet the specific MQOs defined for each indicator, corrective actions will be implemented.

- **RG-BP:** The calibration of the pressure transducer in the stilling well at Station RG-BP will also be checked by manually. The stilling well casing will be filled until water spills out the inlet hole. Once water has stopped flowing, and the depth is equal with the inlet hole, the pressure transducer will be calibrated to zero. The offset between the pressure transducer elevation and the depth of the stilling well inlet hole will be recorded during each calibration event. Offset values will be tracked over time by means of control charts to detect potential instrument drift and other operational problems. This information will be used to assess the MQOs that are identified in the *Quality Objectives* section above. If the data do not meet the specific MQOs defined for each indicator, corrective actions will be implemented.

- **PG:** The rain gauge is a robust instrument that will only require annual calibration. On an annual basis water will be metered into the rain gauge with a pipette until the tipping bucket mechanism triggers. This will be repeatedly conducted and adjustments on the rain gauge will be made until an equivalent volume of water triggers the tipping mechanism in either direction. Each bucket tip is calculated as equivalent to 0.01 inches of rain, consequently the volume of water that should initiate a bucket tip equals 0.01 inches multiplied by the area (in square inches) of the top of the rain gauge. This is the target volume that will be used when rain gauges are calibrated.

Equipment Maintenance Checks

In addition to the routine equipment validation and calibration measurements, the following equipment maintenance inspections will be carried out during all field visits:

- Check battery voltage and associated power connections for the rain gauge

- Remove any debris that may interfere with the operation of volumetric weirs, or inlet holes to stilling wells. Verify data logger time and proper functioning.

Results from these inspections will be documented on the standardized field forms (see example in Appendix B).

Data Management Procedures

The hydrologic data from each monitoring station will be downloaded on a twice-monthly basis and be imported directly into an Access database developed by the County for subsequent analysis and archiving purposes. These data will be immediately checked for evidence of an equipment malfunction or other operational problem. To the extent possible, gaps in flow data will be interpolated. The data will be stored and presented in a manner that identifies which data that are from direct equipment measurements and which are interpolated.

Audits and Reports

Audits will be performed to detect potential deficiencies in the hydrologic data collected for this project. Audits for hydrologic data will occur following each twice-monthly download. The data collected from each monitoring station over the sampled storm events will be compared to data from prior storms and data from the rain gauge station to identify potential data quality issues. This audit will include an examination of the data record for gaps, anomalies, or inconsistencies between the discharge and water level data from previous monitoring events. Any data generated from calibration checks that were performed at a particular monitoring station will also be entered into control charts and reviewed to detect potential instrument drift or other operational problems.

If QA issues are identified on the basis of these audits, measures will be taken to troubleshoot the problem(s) and to implement corrective actions if necessary. Further, if bias in the hydrologic record is detected, the data will be corrected to the extent possible based on the calibration measurements from the associated station. All corrective actions or adjustments to the data will be documented in the database.

Reporting for this project will involve preparation of annual data summaries and a final project memorandum. The annual data summaries will consist of graphical and tabular representations of the compiled monitoring data.

The annual and final reports will present and summarize all hydrologic data that were collected during this study. The reports will begin by identifying the specific goals of the monitoring program and then describe the monitoring procedures that were implemented to achieve those goals. They will present and evaluate the compiled monitoring data using supporting graphical and/or tabular representations of the data as appropriate. Results from any statistical analyses that were performed on these data will also be presented and discussed in detail. Finally, major conclusions from the monitoring program will be presented in the final report. Appendices to the report will include tabular compilations of all raw monitoring data, field data sheets, and a data validation memorandum. This report will be submitted by the County to Ecology for review, comment, and approval.

Data Verification and Validation

Data collected for this project will be verified and validated before it is analyzed. The verification and validation process will include the following steps:

1. Precipitation data for the study will be reviewed to identify any significant gaps. If possible, these gaps will be filled using data obtained from the USGS maintained Puyallup gauge station (Site #12092000), located approximately 24 miles from the project site.

2. The available discharge and water level data from PP-Underdrain will be verified based on comparisons of the associated hydrograph to the hyetographs for individual storm events. Gross anomalies (e.g., data spikes), gaps, or inconsistencies that are identified through this review will be investigated to determine if there are quality assurance issues associated with the data that limit their usability.

3. Validation and calibration data collected during routine site visits will be reviewed to determine whether the specific MQOs specified in the *Quality Objectives* section have been met.

4. If minor quality assurance issues are identified in any portion of the discharge record or in the water level data from a particular station and storm event, the data from that station and event will be considered as an estimate and assigned a (*j*) qualifier. If major quality assurance issues are identified in any portion of the data from a particular station and /or storm event, the data from that station and event will be rejected and assigned an (*r*) qualifier. Estimated values will be used for evaluation purposes while rejected values will not.

Data Quality (Usability) Assessment

Procedures that will be used to assess the usability of the data and then analyze the data are presented in the following subsections.

Data Usability Assessment

Based on the results of the data verification and validation process described in the previous section, a data quality assessment will be prepared to summarize quality control results, identify when data quality objectives were not met, and discuss the resulting limitations, if any, on the use or interpretation of the data. The specific quality assurance information that will be noted in the data quality assessment report includes:

- Changes in and deviations from the monitoring and quality assurance plan
- Results of performance and/or system audits
- Significant quality assurance problems and recommended solutions
- Data quality assessment results in terms of precision, bias, representativeness, completeness, comparability, and reporting limits
- Discussion of whether the quality assurance objectives were met, and the resulting impact on decision-making
- Limitations on use of the measurement data

Data Analysis Procedures

The sections below present data analysis procedures that will be used to evaluate how effectively LID features reduce flow volumes and peak discharge rates. Data pre-processing procedures for this analysis are described in the subsection below. Subsequent sections then present the data analysis procedures that will be used to evaluate the performance of the permeable pavement, rain gardens, and the entire project site. The Pacific Northwest typically experiences between 100 and 110 runoff producing storm events each water year (Ecology 2008). Flow data for this project will be collected and recorded at 15-minute intervals throughout the project duration. Given the large number of events for which data will be recorded, it is expected that there will be adequate data to perform all statistical tests with sufficient rigor.

Data Pre-processing

The continuous monitoring data that is collected from the stations identified in Table 3 will be analyzed to evaluate the effectiveness of the LID features on the SRC project site at reducing flow volumes and peak discharge rates. To perform this analysis, the data from each individual monitoring station will be processed to identify individual storm "events" based on measured rainfall amounts and user-defined limits for pre- and post-storm antecedent dry periods. Once these events are defined summary statistics for each event (e.g., peak discharge, storm volume, rainfall total, flow duration, etc.) will be calculated from the continuous monitoring data. These data will then be used in the analyses described in the subsections below.

LID Performance Evaluation

To evaluate the flow control performance of the permeable pavement, analyses will be completed on the modeled runoff data set to identify a subset of storms that had sufficient precipitation totals and/or intensities to produce runoff from an entirely impermeable surface. All modeling will be performed using an approved continuous simulation hydrologic model (e.g., WWHM3). The precipitation data gathered during the course of the study will be formatted and imported into the model. Evaporation data for the study period will be estimated using Puyallup gage evaporation data, adjusted for the project location. Statistical analyses will then be performed on the data from the PP-Underdrain and for these potentially runoff-producing storms to compare flow control performance of the permeable pavement and impermeable pavement, respectively. The specific null hypotheses (H_o) and alternative hypotheses (H_a) for these analyses are as follows:

Hypothesis 1:

H_o: The runoff volumes from the PP-Underdrain station are equal to or higher than the area normalized modeled surface runoff volumes as predicted by WWHM3 for an entirely impermeable surface.

H_a: runoff volumes from the PP-Underdrain station are lower than the area normalized modeled surface runoff volumes as predicted by WWHM3 for an entirely impermeable surface.

Hypothesis 2:

H_o: The peak discharge rates measured at PP-Underdrain are equal to or higher than the area normalized modeled surface runoff volumes as predicted by WWHM3 for an entirely impermeable surface.

H_a: The peak discharge rates measured at PP-Underdrain are lower than the area normalized modeled surface runoff volumes as predicted by WWHM3 for an entirely impermeable surface.

To evaluate these hypotheses, runoff volumes and peak discharge rates measured at the PP-Underdrain and modeled runoff will be analyzed using a Wilcoxon signed rank test to determine if there are significant differences between the two conditions.

In all tests that are performed on these data, statistical significance will be assessed based on an alpha (α) level of 0.05.

In addition to the hypothesis testing, the following will be computed:

- Measured rainfall runoff relationship for the current site conditions.
- Modeled rainfall runoff relationship for the entirely forested condition.
- Percent difference between seasonal mean storm event peak flows measured at PP-Underdrain and the modeled seasonal mean storm event peak flow for the entirely impermeable and entirely forested scenarios.
- Percent difference between annual runoff volume measured at PP-Underdrain and modeled annual runoff volumes for the entirely impermeable and entirely forested scenarios.

Rain Garden Performance Evaluation

Rain garden performance will be evaluated based on comparison to a “zero runoff standard”. The rain garden will be considered to meet the “zero runoff standard” if the elevation of the water in the rain garden never exceeds the elevation of the bypass control structure. If bypass does occur, linear regression analysis will be performed to evaluate the relationship between bypass duration and storm event characteristics such as rainfall intensity, duration and storm event volume. Regression statics will be compared throughout the course of the project to determine whether the relationship between bypass duration and storm event characteristics remains constant over time.

References

Booth, D.B., D. Hartley, and R. Jackson. 2002. Forest Cover, Impermeable-Surface Area, and the Mitigation of Stormwater Impacts. *Journal of the American Water Resources Association* 38(3):835-845.

Dietz, M. 2007. Low Impact Development Practices: A Review of Current Research and Recommendations for Future Directions. *Water, Air, & Soil Pollution* 186(1):351-363.

Dietz, M. and J.C. Clausen. 2007. A Field Evaluation of Rain Garden Flow and Pollutant Treatment. *Water, Air, & Soil Pollution* 167(4):123-138.

Dreelin, E.A., L. Fowler, and C.R. Carroll. 2006. A Test of Porous Pavement Effectiveness on Clay Soils During Natural Storm Events. *Water Research* 40(4):799-805.

Ecology. 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Publication No. 04-03-030. Washington State Department of Ecology, Olympia, Washington.

Ecology 2008. Guidance for Evaluating Emerging Stormwater Treatment Technologies. Publication No. 02-10-037. Washington State Department of Ecology, Olympia, Washington.

Grant, D.M., and B.D. Dawson. 1997. Isco Open Channel Flow Measurement Handbook. Fifth Edition. Isco Inc., Lincoln, Nebraska.

NRCS, 2010. Spanaway Soil Official Series Description. http://www2.ftw.nrcs.usda.gov/osd/dat/S/SPANAWAY.html.

APPENDIX A

Monitoring Equipment Technical Specifications

Hobo S-RGB M-002 Rain Gauge Specifications

Measurement Range: 0–12.7 cm or 0–5 in. per hour; maximum 4000 tips per interval

Operating Range: 0° to 50°C (32° to 122°F); survival -40° to 75°C (-40° to +167°)

Mechanism: Tipping bucket, stainless steel shaft with brass bearings

Resolution: 0.2 mm and 0.01 inch models

Calibration: Requires annual calibration; can be field calibrated by user or returned to factory

Calibration Accuracy: ±1.0% at up to 20 mm or 1" per hour

Housing: Aluminum housing and collector

Dimensions: 22.8 cm height x 15.4 cm diameter (9" height x 6" diameter), 154 mm receiving orifice (6.06")

Approximate Weight: 1 Kg (2 lbs)

Cable Lengths: 2 meter, 6 meter (6.5 feet, 20 feet)

***Note**:* Comes with side brackets for post or tripod mount and feet for surface mount. If mounting separate from main tripod, order with 6m cable and an additional 1.5m mast. If mounting on main tripod, order with guy wire kit.

Hobo U30 Data Logger Specifications

Normal operating range: -20°C to 40°C (-4°F to 104°F)

Extended operating range: -40 to 60°C (-40 to 140°F) - see "Rechargeable Battery service Life" for impact of operations in Extended Operating Range.

Sensor Inputs: 5 standard; option to expand to 10

Smart Sensor Compatibility: Compatible with most Onset smart sensors, except for the S-BPA, S-TMA and S-THA

Data Channels: Maximum of 15 (some sensors use more than one data channel)

Alarm Output Relay: Can be configured to be activated, deactivated or pulsed on user-defined sensor alarms. The relay can be configured as normally open or normally closed, and is rated for 30 V and 1 amp max.

Expansion Slot: One expansion slot is available for factory-installed expansion port.

Local Communication: Full Speed USB via USB mini-B connector

Size: 17.8 H x 11.7 D x 19.3 W cm (7.0 H x 4 .6 D x 7.6 W inches)

Weight: 2 kg (4 lbs 10 oz)

Materials: Outer Enclosure: ABS blend with stainless steel hinge pins and bronze inserts
- **Inner Enclosure**: Polycarbonate with bronze inserts
- **U-Bolts**: Steel with zinc dichromate finish
- **Gaskets**: Silicone rubber
- **Cable entry channel**: EPDM rubber
- **Cable entry bars**: Aluminum with ABS plastic thumb screws

Data Storage Memory: Nonvolatile flash data storage, 512K bytes local storage

Memory Modes: Stop when full, wrap around when full

Operational Indicators: Up to six (depending upon options) status lights provide basic diagnostics

Logging Interval: 1 second to 18 hours, user-specified interval

Battery Type: 4 Volt, 4.5 AHr or 10 AHr, Rechargeable sealed lead-acid

Rechargeable Battery Service Life: Typical 3–5 years depending upon conditions of use. Operation within the extended operating range (but outside the normal range) will reduce battery service life.

Time Accuracy: 0 to 2 seconds for the first data point and ±5 seconds per week at 25°C (77°F)

Environmental Rating: Weatherproof enclosure, tested to NEMA 6. (Requires proper installation of cable channel system)

Mounting: 3.8 cm (1.5 inch) mast or wall mount

Enclosure Access: Hinged door secured by two latches with eyelets for securing with user-supplied padlocks

Sensor Network Cable Length: 100 m (328 ft) maximum

External Power: External power is required. The system optionally accepts the following Onset solar panels:

- SOLAR-1.2W
- SOLAR-3W
- SOLAR-6W

Alternatively it accepts an AC power adapter:

- AC-U30

Optional Analog Sensor Port Specifications

Input Channels: Two, single-ended

Field Wiring: Two- or three-wire via screw terminals on detachable connector, 16–24 AWG.
Replacement detachable connectors: Part of spares kit, Part No. A-FS-CVIA-7P-1

Input Range: User-configurable: 0–20 mA DC, 0–20 VDC (suitable for 2.5, 5, 10V sensors)

Minimum / Maximum Input Voltage: 0 / 24 VDC

Minimum / Maximum Input Current: 0 / 24 mA DC

Minimum Current Source Impedance: > 20 KΩ

A**ccuracy**: ± 0.25% of FSR from 50mV to FSV

ADC Resolution: 12 bits

Excitation Power: Switched 12 VDC, up to 50 mA; user-selectable warm-up from 5msec to 2 minutes

HOBO U20 Water Level Data Logger - U20-001-01

30-Foot Depth

Measures:

Barometric Pressure, Temperature, Water Level

Features:

- Lightning protection - no long signal wires, and electronics are shielded in stainless steel housing (see the Water Level logger sensor location drawing)
- HOBOware Pro software provides easy conversion to accurate water level reading, fully compensated for barometric pressure (see demo) temperature, and water density.
- Multiple-rate sampling (see demo) allows faster sampling at critical times such as when pumping starts or stops.
- Available in 4 depth ranges
- Ideal for use in wells, streams, lakes, wetlands and tidal areas
- No-vent-tube design for easy reliable deployment
- Available in stainless and titanium versions
- Durable ceramic pressure sensor

Qty	1-9	10-99	100+
$US	$495	$458	$421

Contact Onset at 1-800-564-4377

Description:

The HOBO Water Level data logger features high accuracy at a great price and ease-of-use, with no cumbersome vent tubes or desiccants to maintain. This data logger is ideal for recording water levels and temperatures in shallow wells, streams, lakes and freshwater wetlands. The HOBO Water Level Titanium is recommended for saltwater deployment for recording water levels and temperatures in brackish wetlands and tidal areas.

View how the HOBO Water Level Logger compares to the Competition.

Featured Resources

- Sensor location drawing
- Barometric Pressure Compensation Assistant Demo
- Multi-rate Sampling Demo

Detailed Specifications:

Pressure Sensor
Operation range: 0 to 207 kPa (0 to 30 psia); approximately 0 to 9 m (0 to 30 ft) of water depth at sea level, or 0 to 12 m (0 to 40 ft) of water at 3,000 m (10,000 ft) of altitude

Factory calibrated range: 69 to 207 kPa (10 to 30 psia), 0° to 40°C (32° to 104°F)

Burst pressure: 310 kPa (45 psia) or 18 m (60 ft) depth

Water level accuracy*: Typical error - 0.05% FS, 0.5 cm (0.015 ft) water

Maximum error: - 0.1% FS, 1.0 cm (0.03 ft) water

Raw pressure accuracy**: 0.3% FS, 0.62 kPa (0.09 psi) maximum error

Resolution: < 0.02 kPa (0.003 psi), 0.21 cm (0.007 ft) water

Pressure response time: 90% < 1 second

Thermal response time (90%)†: Approximately 10 minutes in water to achieve full temperature compensation of the pressure sensor

* With accurate reference water level measurement and Barometric Compensation Assistant data
** Absolute pressure sensor accuracy includes all pressure drift, temperature, and hysteresis-induced errors
† Maximum error due to rapid thermal changes is approximately 0.5%

Temperature Sensor
Operation range: -20° to 50°C (-4° to 122°F)

Accuracy: 0.37°C at 20°C (0.67°F at 68°F), see Plot A

Resolution: 0.1°C at 20°C (0.18°F at 68°F) (10-bit)

Response time (90%): 3.5 minutes in water (typical)

Stability (drift): 0.1°C (0.18°F) per year

Logger
Real-time clock: ± 1 minute per month 0° to 50°C (32° to 122°F)

Battery: 2/3 AA, 3.6 Volt Lithium, factory-replaceable

Battery life (typical use): 5 years with 1 minute or greater logging interval

Memory (non-volatile): 64K bytes memory (approx. 21,700 pressure and temperature samples)

Dimensions: 2.46 cm (0.97 inches) diameter, 15 cm (5.9 inches) length; mounting hole 6.3 mm (0.25 inches) diameter

Weight: Approximately 210 g (7.4 oz)

Wetted materials: 316 stainless steel, Viton® o-rings, acetyl cap, ceramic sensor

Shock/drop :Logger is sensitive to shocks. Handle with care and avoid any impact. Always use proper packaging when shipping the logger.

Logging interval: Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to HOBOware software manual.

Launch modes: Immediate start and delayed start

Offload modes: Offload while logging; stop and offload

Battery indication: Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.

The CE Marking identifies this product as complying with the relevant directives in the European Union (EU).

HOBO® Data Loggers

1-800-LOGGERS

VOLUMETRIC WEIRS

For measuring flows in Manholes and Open End Pipes

WEIR SET
(refer to back page for details)

15" WEIR WITH 18" ADAPTER

WEIR WITH BUBBLER TUBE

The most practical, economical instrument for testing new sewer lines - night flow studies of existing lines – free flow from open end pipe.

A VOLUMETRIC calibrated weir is a portable flow measuring device that is used to determine infiltration in newly installed sewer lines, or measure substantial flows in existing lines.

THE THEL-MAR VOLUMETRIC weir is basically a compound weir that incorporates the advantage of a 90° V-notch for measuring small infiltration flow where accuracy is of prime importance. The V-notch section measures from 57 gallons to 3700 gallons per 24 hours, which is the range of normal Acceptance Test Requirements. The rectangular section of the weir is capable of measuring in gallons per day up to 35% of pipe capacity.

A BUBBLE LEVEL is mounted at the top of the weir's face plate for easy visibility. Thel-Mar weirs are calibrated in U.S. GALLONS PER 24 HOURS (METRIC WEIRS CUBIC METERS PER HOUR) in large, easy to read type. Calibration lines are in 2 millimeter increments.

DISCHARGE CALIBRATIONS for the Volumetric Weir were accurately determined in a hydraulic laboratory where manhole conditions were duplicated. Therefore, there are no induced errors by insufficient drop of the nappe or by contractions, velocity of approach, submergency, or drawdown.

RUGGED CONSTRUCTION and noncorroding materials make the Thel-Mar weir extremely reliable. There are no loose parts that require assembly. Installation is quick and positive and the weir requires a minimum of care.

A COMPOUND WEIR offers minimum restriction to flow and is relatively free from becoming clogged by debris from sewage. Thel-Mar weirs can be installed for extended periods of time without accumulation of sediment.

ERRORS IN EXCESS OF 100% exist in other calibrated V-notch weirs. Unlike the Thel-Mar weir these were calibrated by the cone formula.

EASY TO READ FLOW RATE Simply check water level at the face plate. The figure above the line matching the water level gives you the rate of flow in GALLONS PER 24 HOURS (METRIC WEIRS-CUBIC METERS PER HOUR).

BUBBLER FLOW METERS Especially designed for use with Bubbler Flow Meters, all Volumetric Weirs are now available with an attached "Bubbler Tube". These weirs are manufactured with a 1/8 inch O.D. stainless steel tube attached to the right side of the adjustable ring. The bubbler tube protrudes forward approximately two inches from near the top of the ring for easy connection to a line. It runs from there down the inside of the ring to approximately 1 3/8-inch behind and below the V-notch. This bubbler tube does not in any way affect the function of the Volumetric Weir.

INSTALLATION INSTRUCTIONS
Prior to installation, the interior edge of the incoming pipe should be cleared of sediment and foriegn matter to assure seal of the gasket.

Turn thumb-wheel to extreme right. Place hand through weir opening, wiht thumb and index finger compress spring. Insert weir into incoming pipe about 1", and release tension from spring. Secure by turning thumb-wheel to left and finger tighten.

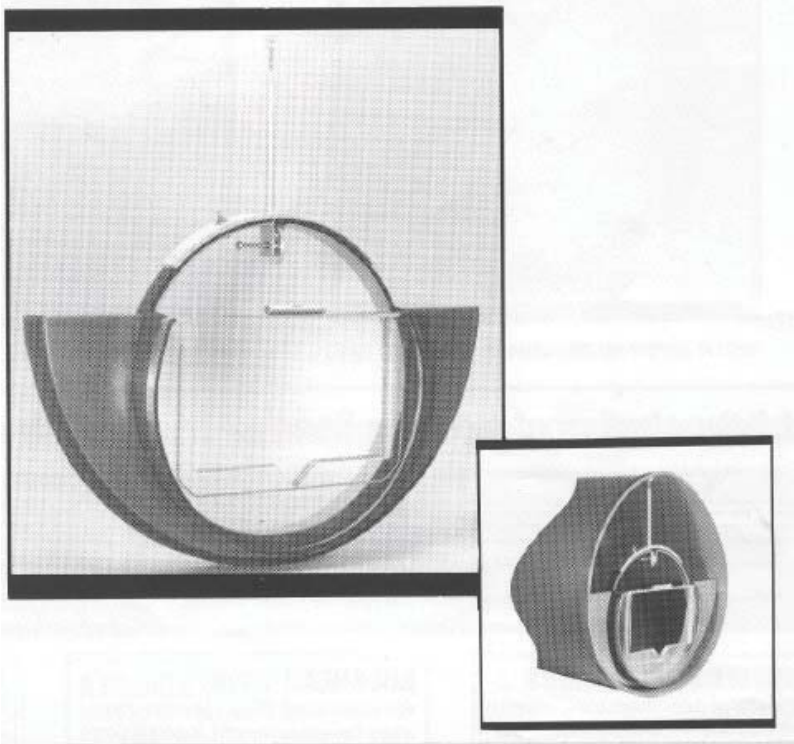
Allow sufficient time for water to back up and behind the weir and establish a uniform flow; five to ten minutes for existing flow to an hour for accurate infiltration readings.

15” WEIR WITH ADAPTOR INSTALLED IN 24” PIPE

Individual Volumetric Weirs are available for 6", 8", 10", 12", 14", 15" and 16" pipe. The 14" weir uses a 12" face plate. Adaptors for 18", 21", 24", 27", 30", 36", 42" and 48" pipe are used in conjunction with the 15" weir.

Volumetric Weirs are also available in a set. Set A consists of 6", 8", 10’, 12" and 15" weirs with an 18” adaptor and carrying case with handle and hasp. It measures 191/2"W x 191/2"D x 71/2"H. Set B is similar and designed to be used with Bubbler Flow Meters.

Adaptors are available individually or in a set. Set C consists of 21" through 48" adaptors. No carrying case included.



WEIR CAPACITIES AND HEAD

CAPACITIES*			HEAD**
6"	57 to 3700 GPD within V-notch,	rectangular to 46,000 GPD	2.8437
8"	57 to 3700 GPD within V-notch,	rectangular to 124,000 GPD	4.0000
10"	57 to 3700 GPD within V-notch,	rectangular to 234,000 GPD	5.1250
12"	57 to 3700 GPD within V-notch,	rectangular to 361,000 GPD	5.8125
14"	57 to 3700 GPD within V-notch,	rectangular to 361,000 GPD	5.8125
15"	57 to 3700 GPD within V-notch,	rectangular to 610,000 GPD	7.3125
16"	57 to 3700 GPD within V-notch,	rectangular to 610,000 GPD	7.3125
Bulkhead Weir	57 to 3700 GPD within V-notch,	rectangular to 610,000 GPD	7.3125

* Calibration lines are in 2 millimeter increments.
** In inches from top of rectangular opening to bottom of V-notch.

PARSON ENVIRONMENTAL

Parson Environmental Products, Inc. * P.O. Box 4474 * Reading, PA 19606
Toll Free: (800) 356-9023 * Voice: (610) 582-6060 * Fax: (610) 582-6064
WEB SITE: www.parsonenvironmental.com

APPENDIX B

Field Forms

FIELD LOG SHEET

Field Staff: _____ Site: _____ Weather: _____

Maintenance Visit

Date/Time:

Station Name: **PP-Underdrain**

Logger Time Correct? _____

Gauge Level: _____

Measured Level: _____

Weir Obstructed? _____

Logger Battery Voltage _____

Station Name: **RG-BP**

Logger Time Correct? _____

Gauge Level: _____

Measured Level: _____

Logger Battery Voltage _____

Station Name: **Rain Gauge**

Logger Time Correct? _____

Rain Gauge Obstructed? _____

Logger Desiccant _____

Logger Battery Voltage _____

Other Notes:

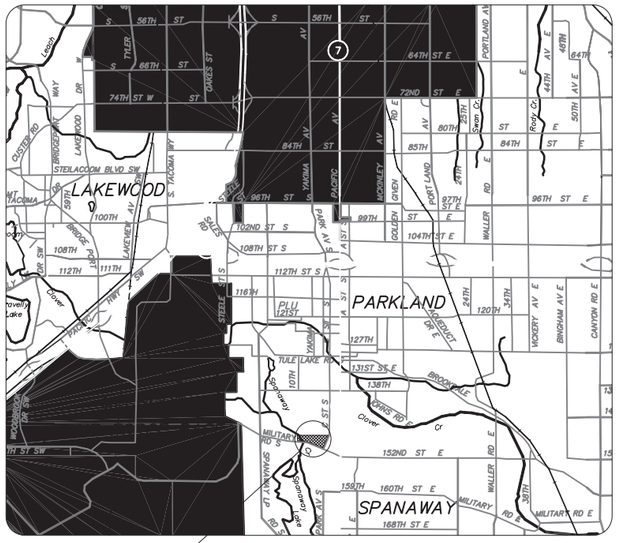
APPENDIX C

Permeable Surface Installation Specifications

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

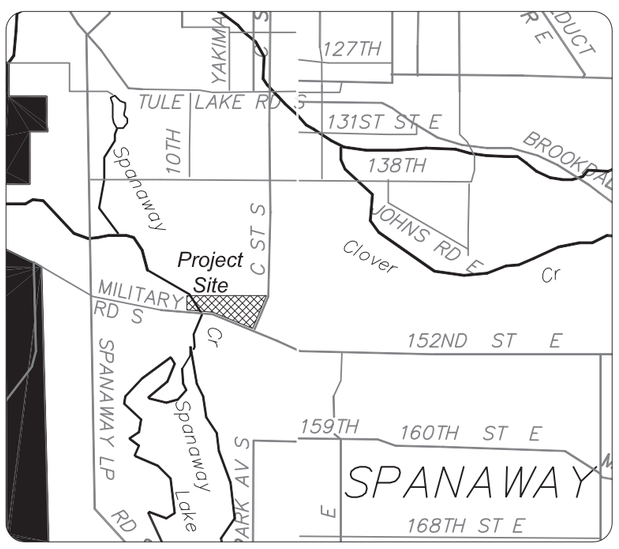
SPRINKER PARKING LOT LID PHASE 2
C.I.P. # D212-006

S. 21, T. 19 N., R. 3 E., W.M.



PROJECT SITE

VICINITY MAP
(NOT TO SCALE)



PROJECT MAP
(NOT TO SCALE)

SHEET INDEX

COVER SHEET ____ 1
SUMMARY OF QUANTITIES AND QUANTITY TABS ____ 2
STRUCTURE NOTES, COORDINATES, AND DETAILS ____ 3
STAGING PLAN SHEET ____ 4
DEMOLITION PLAN SHEET ____ 5
PLAN SHEET ____ 6
BIORETENTION AREAS PLANS AND PROFILES ____ 7-8
CROSS SECTIONS AND DETAILS ____ 9-10
BIORETENTION PLANTING PLANS AND DETAILS ____ 11-12
SIDEWALK PLANS AND DETAILS ____ 13-14
IRRIGATION PLANS AND DETAILS ____ 15-16
TRAFFIC CURB AND JOINT PLAN ____ 17
SIGNAGE AND STRIPING PLANS AND DETAILS ____ 18-19

Pierce County
SURFACE WATER MANAGEMENT

PROPOSED LEGEND

- PERFORATED UNDERDRAIN
- IRRIGATION LINE
- CONDUIT LINE
- 345 — CONTOUR LINE (ELEV. AS NOTED)
- SWALE CENTERLINE LINE
- BIORETENTION AREA
- TF — TEMPORARY FENCE
- BP — BURIED POWER
- POROUS CONCRETE
- POROUS ASPHALT
- EDGE OF ASPHALT
- CONCRETE CURB
- CONCRETE CURB AND GUTTER
- TYPE 5 (CEMENT CONCRETE) EXTRUDED CURB
- CATCH BASIN TYPE 1L
- SIGN
- X / Y — X = DETAIL NUMBER, Y = SHEET NUMBER
- POROUS CONCRETE
- POROUS ASPHALT
- BIORETENTION AREA
- VEGETATED SWALE AREA
- QUARRY SPALLS
- RECYCLED RUBBER SIDEWALK

EXISTING LEGEND

- MONUMENT (FOUND 10/06/06– AS NOTED)
- IRON PIPE (FOUND 10/06/06– AS NOTED)
- REBAR & CAP
- STORM DRAIN CATCH BASIN
- STORM DRAIN CATCH BASIN TYPE 2
- SEWER MANHOLE
- WATER METER
- WATER VALVE
- FIRE HYDRANT
- SPRINKLER HEAD
- UTILITY POLE
- GUY POLE
- P — POWER VAULT
- POWER TRANSFORMER
- POWER METER
- ELECTRICAL JUNCTION BOX
- TELEPHONE JUNCTION BOX
- TELEPHONE PEDESTAL
- GAS VALVE
- LIGHT POLE WITH ARM
- YARD LIGHT
- COMMERCIAL SIGN
- DOUBLE COMMERCIAL SIGN
- TRAFFIC SIGN
- ROCK
- DECIDUOUS TREE (A=APPLE, CH=CHERRY, D=DECIDUOUS, M=MAPLE, POP=POPLAR
- CONIFEROUS TREE (C=CEDAR, F=FIR, P=PINE, S=SPRUCE)
- VEGETATION
- RIGHT–OF–WAY LINE
- RIGHT–OF–WAY CENTERLINE
- EASEMENT LINE
- PROPERTY LINE
- EDGE OF PAVEMENT
- CURB
- CONCRETE
- TRAFFIC/PARKING LINE
- IRRIGATION LINE
- X — CHAIN LINK FENCE
- W — WATER LINE
- SD — STORM DRAIN LINE
- BP — BURIED POWER LINE
- BT — BURIED TELEPHONE LINE
- G — GAS LINE

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD
COVER SHEET
C.I.P. # D212-006

Date: Dec 28, 2010 10:41:13 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

SUMMARY OF QUANTITIES

ITEM NO.	QUANTITY	UNITS	ITEM DESCRIPTION
			PREPARATION
1	LUMP SUM	L.S.	MOBILIZATION
2	11,650	S.Y.	REMOVING ASPHALT CONC. PAVEMENT
3	1,975	L.F.	TEMPORARY FENCE
			GRADING
4	6,100	C.Y.	PARKING LOT EXCAVATION INCL. HAUL
5	1,950	C.Y.	GRAVEL BASE
			DRAINAGE
6	45	C.Y.	QUARRY SPALLS
7	2	EACH	SOLID METAL COVER AND FRAME FOR CATCH BASIN
			STORM SEWER
8	1	EACH	CATCH BASIN TYPE 1L
9	690	L.F.	4" PERFORATED UNDERDRAIN
10	560	C.Y.	DRAINAGE SAND
			HOT MIX ASPHALT
11	4,645	S.Y.	ASPHALT CONC. PAVEMENT CL. D PG 70-22
12	215	S.Y.	ASPHALT CONC. PAVEMENT RESTORATION
			CEMENT CONCRETE PAVEMENT
13	5,380	S.Y.	POROUS CONCRETE PAVEMENT
14	4	EACH	CONCRETE BEAMS WALKWAY
			IRRIGATION AND WATER DISTRIBUTION
15	LUMP SUM	L.S.	IRRIGATION SYSTEM
16	1,910	L.F.	IRRIGATION SLEEVE
			EROSION CONTROL AND PLANTING
17	12	DAY	ESC LEAD
18	EST. 10,000	DOL.	EROSION / WATER POLLUTION CONTROL
19	95	C.Y.	BARK OR WOOD CHIP MULCH
20	755	C.Y.	BIORETENTION SOIL MIX
21	7	EACH	PLANT SELECTION - WESTERN SERVICEBERRY (2" CAL.)
22	47	EACH	PLANT SELECTION - TUFTED HAIRGRASS (1 GAL.)
23	42	EACH	PLANT SELECTION - IDAHO FESCUE (1 GAL.)
24	21	EACH	PLANT SELECTION - VINE MAPLE (2 GAL.)
25	39	EACH	PLANT SELECTION - ISANTI REDTWIG DOGWOOD (1 GAL.)
26	51	EACH	PLANT SELECTION - TALL OREGON GRAPE (1 GAL.)
27	23	EACH	PLANT SELECTION - MOCK ORANGE (2 GAL.)
28	25	EACH	PLANT SELECTION - PACIFIC NINEBARK (2 GAL.)
29	45	EACH	PLANT SELECTION - RED FLOWERING CURRANT (2 GAL.)
30	79	EACH	PLANT SELECTION - SNOWBERRY (1 GAL.)
31	31	EACH	PLANT SELECTION - DWARF ARCTIC WILLOW (1 GAL.)
32	29	EACH	PLANT SELECTION - RED HUCKELBERRY (2 GAL.)
			TRAFFIC
33	715	L.F.	CEMENT CONC. TRAFFIC CURB AND GUTTER
34	1,235	L.F.	CEMENT CONC. TRAFFIC CURB
35	47	L.F.	EXTRUDED CURB
36	LUMP SUM	L.S.	PAVEMENT MARKING
37	9	EACH	PAINTED TRAFFIC ARROW
38	16	EACH	PAINTED ACCESS PARKING SPACE SYMBOL WITH BACKGROUND
39	LUMP SUM	L.S.	PERMANENT SIGNING
40	LUMP SUM	L.S.	PROJECT TEMPORARY TRAFFIC CONTROL
41	1	EACH	PORTABLE CHANGEABLE MESSAGE SIGN
42	1,008	HR	OPERATION OF PORTABLE CHANGEABLE MESSAGE SIGN
			OTHER ITEMS
43	LUMP SUM	L.S.	SURVEYING
44	308	S.F.	RECYCLED RUBBER SIDEWALK
45	EST. 10,000	DOL.	MINOR CHANGE
46	LUMP SUM	L.S.	SPCC PLAN
47	6	EACH	LID SIGN INSTALLATION

Date: Dec 28, 2010 10:42:03 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

DRAWING NO.: SEE SIDE STAMP
SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM
DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM
BOOK NO.: ---
CHECKED BY: AL ZEHNI, P.E.
DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID
PHASE 2
700 SOUTH MILITARY ROAD

SUMMARY OF QUANTITIES AND QUANTITY TABULATIONS

C.I.P. # D212-006

STRUCTURE NOTES

NOTE:
THE FIRST NUMBER OF "CODE" REFERS TO THE SHEET NUMBER OF THE CONTRACT PLANS. THE SECOND NUMBER REFERS TO THE CONSTRUCTION FEATURE FOUND ON THE PARTICULAR SHEET.

SHEET NO.	AREA / LOCATION	QUARRY SPALLS C.Y.	CATCH BASIN TYPE 1L EACH	SOLID LOCKING METAL COVER AND FRAME FOR CATCH BASIN EACH	4" PERFORATED UNDERDRAIN L.F.	GENERAL NOTES
6-1	N: 658295.51 E: 1156890.26 TO N: 658394.06 E: 1156931.18				105	1
6-2	N: 658144.95 E: 1156917.02 TO N: 658135.13 E: 1157286.08			1	368	1
6-3	N: 658135.13 E: 1157286.08 TO N: 658131.41 E: 1157420.48			1	133	1
6-4	N: 658131.41 E: 1157420.48 TO N: 658129.38 E: 1157497.46				84	1
7-1	N: 657974.02 E: 1157305.57 TO N: 657943.42 E: 1157374.87	0.5				2,3
7-2	N: 657943.42 E: 1157374.87 TO N: 657928.20 E: 1157442.30	8				2,3
7-3	N: 657943.45 E: 1157425.76 TO N: 657928.98 E: 1157443.31	2.5				2,3
7-4	N: 657942.15 E: 1157474.54 TO N: 657928.15 E: 1157474.17	1.5				2,3
7-5	N: 657941.18 E: 1157510.91 TO N: 657891.30 E: 1157496.74	3				6
7-6	N: 657892.66 E: 1157522.54 TO N: 657885.32 E: 1157506.47	2				2,3
7-7	N: 657856.94 E: 1157570.95 TO N: 657890.49 E: 1157494.77	1				3
7-8	N: 657890.49 E: 1157494.77 TO N: 657913.22 E: 1157475.33	4				3
8-1	N: 658119.37 E: 1156977.42 TO N: 658058.43 E: 1157113.75	1.5				2,3
8-2	N: 658058.43 E: 1157113.75 TO N: 658038.62 E: 1157201.74	10.5				2,3
8-3	N: 658057.91 E: 1157185.31 TO N: 658039.40 E: 1157202.75	3				2,3
8-4	N: 658056.23 E: 1157248.28 TO N: 658038.20 E: 1157247.80	2				2,3
8-5	N: 658037.27 E: 1157269.83 TO N: 658036.93 E: 1157251.39	2				2,3
8-6	N: 658002.74 E: 1157263.08 TO N: 658018.07 E: 1157247.31	3				2,3
8-7	N: 658028.01 E: 1157197.23 VICINITY		1			4,5,7
	TOTAL	**45**	**1**	**2**	**690**	

GENERAL NOTES:

1. 4" PERFORATED UNDERDRAIN SHALL BE LAID ALONG BOTTOM OF EXCAVATED AREA AND TIED INTO EXISTING CATCH BASIN(S) AS SHOWN ON THE PLANS. WHERE UNDERDRAIN PIPE TIES INTO EXISTING CATCH BASINS, THE EXISTING CATCH BASIN SHALL BE CORED AND RESTORED (OR REPAIRED) TO THE ENGINEER'S SATISFACTION, SEE SPECIAL PROVISION. "DRAINS".
2. CURB CUTS ARE INCIDENTIAL, SEE CURB CUT DETAIL SHEET 9 AND SPECIAL PROVISIONS.
3. INSTALL 1' MINIMUM COMPACTED DEPTH OF QUARRY SPALLS. QUARRY SPALLS SHALL MATCH ADJACENT FINISHED GRADE ELEVATION AND TO BE CONCAVE IN NATURE FOR WATER RUNOFF.
4. INSTALL BEEHIVE GRATE. SEE PIERCE COUNTY STANDARD DRAWING PC.B1.3 (TO BE INCIDENTIAL TO CATCH BASIN TYPE 1L).
5. SEE WSDOT CATCH BASIN TYPE 1L STANDARD PLAN B-5.40-00.
6. INSTALL 6" MINIMUM COMPACTED DEPTH OF QUARRY SPALLS. QUARRY SPALLS SHALL MATCH ADJACENT FINISHED GRADE ELEVATION.
7. WSDOT INSPECTION AND APPROVAL STAMP REQUIRED FOR ALL CONCRETE STRUCTURES.

POROUS ASPHALT POINT COORDINATES

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
A1	N: 658380.17	E: 1156894.11	MATCH EXISTING	POROUS ASPHALT
A2	N: 658386.45	E: 1156922.26	MATCH EXISTING	POROUS ASPHALT
A3	N: 658390.21	E: 1156928.08	MATCH EXISTING	POROUS ASPHALT
A4	N: 658388.37	E: 1156929.48	MATCH EXISTING	POROUS ASPHALT
A5	N: 658377.05	E: 1156930.77	MATCH EXISTING	POROUS ASPHALT
A6	N: 658329.14	E: 1156972.78	MATCH EXISTING	POROUS ASPHALT
A7	N: 658300.38	E: 1157001.18	MATCH EXISTING	POROUS ASPHALT
A8	N: 658292.20	E: 1156995.98	MATCH EXISTING	POROUS ASPHALT
A9	N: 658295.51	E: 1156890.26	MATCH EXISTING	POROUS ASPHALT
A10	N: 658315.15	E: 1156890.57	MATCH EXISTING	POROUS ASPHALT
A11	N: 658327.20	E: 1156891.73	MATCH EXISTING	POROUS ASPHALT
A12	N: 658249.40	E: 1156888.50	MATCH EXISTING	POROUS ASPHALT
A13	N: 658162.03	E: 1156884.76	MATCH EXISTING	POROUS ASPHALT
A14	N: 658150.08	E: 1156905.71	MATCH EXISTING	POROUS ASPHALT
A15	N: 658118.62	E: 1156975.44	MATCH EXISTING	POROUS ASPHALT
A16	N: 658122.72	E: 1156977.29	MATCH EXISTING	POROUS ASPHALT
A17	N: 658117.69	E: 1156988.45	MATCH EXISTING	POROUS ASPHALT

NOTE: SEE PLAN SHEET 6 FOR LOCATIONS.

POROUS CONCRETE POINT COORDINATES

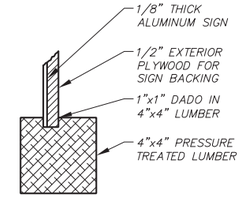
POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
P1	N: 658248.76	E: 1156912.32	MATCH EXISTING	POROUS CONCRETE
P2	N: 658215.78	E: 1156911.44	MATCH EXISTING	POROUS CONCRETE
P3	N: 658238.69	E: 1157289.62	MATCH EXISTING	POROUS CONCRETE
P4	N: 658205.70	E:1157288.74	MATCH EXISTING	POROUS CONCRETE
P5	N: 658238.05	E: 1157313.61	MATCH EXISTING	POROUS CONCRETE
P6	N: 658205.06	E: 1157312.73	MATCH EXISTING	POROUS CONCRETE
P7	N: 658232.84	E: 1157508.54	MATCH EXISTING	POROUS CONCRETE
P8	N: 658199.85	E: 1157507.66	MATCH EXISTING	POROUS CONCRETE
P9	N: 658191.79	E: 1156910.60	MATCH EXISTING	POROUS CONCRETE
P10	N: 658175.29	E: 1156910.36	MATCH EXISTING	POROUS CONCRETE
P11	N: 658174.35	N: 1156945.54	MATCH EXISTING	POROUS CONCRETE
P12	N: 658157.86	E: 1156945.10	MATCH EXISTING	POROUS CONCRETE
P13	N: 658190.16	E: 1156971.62	MATCH EXISTING	POROUS CONCRETE
P14	N: 658157.18	E: 1156970.74	MATCH EXISTING	POROUS CONCRETE
P15	N: 658189.76	E: 1156986.62	MATCH EXISTING	POROUS CONCRETE
P16	N: 658156.77	E: 1156985.74	MATCH EXISTING	POROUS CONCRETE
P17	N: 658184.84	E: 1157170.66	MATCH EXISTING	POROUS CONCRETE
P18	N: 658151.85	E: 1157169.97	MATCH EXISTING	POROUS CONCRETE
P19	N: 658184.44	E: 1157185.65	MATCH EXISTING	POROUS CONCRETE
P20	N: 658151.45	E: 1157184.97	MATCH EXISTING	POROUS CONCRETE
P21	N: 658181.71	E: 1157288.10	MATCH EXISTING	POROUS CONCRETE
P22	N: 658148.72	E: 1157287.21	MATCH EXISTING	POROUS CONCRETE
P23	N: 658181.07	E: 1157312.09	MATCH EXISTING	POROUS CONCRETE
P24	N: 658148.08	E: 1157311.21	MATCH EXISTING	POROUS CONCRETE
P25	N: 658179.48	E: 1157371.73	MATCH EXISTING	POROUS CONCRETE
P26	N: 658146.49	E: 1157370.85	MATCH EXISTING	POROUS CONCRETE
P27	N: 658179.08	E: 1157386.72	MATCH EXISTING	POROUS CONCRETE
P28	N: 658146.09	E: 1157385.84	MATCH EXISTING	POROUS CONCRETE
P29	N: 658175.86	E: 1157507.02	MATCH EXISTING	POROUS CONCRETE
P30	N: 658142.87	E: 1157506.14	MATCH EXISTING	POROUS CONCRETE
P31	N: 658131.32	E: 1157039.72	MATCH EXISTING	POROUS CONCRETE
P32	N: 658116.33	E: 1157039.32	MATCH EXISTING	POROUS CONCRETE
P33	N: 658115.33	E: 1157076.81	MATCH EXISTING	POROUS CONCRETE
P34	N: 658100.33	E: 1157076.41	MATCH EXISTING	POROUS CONCRETE
P35	N: 658124.72	E: 1157286.57	MATCH EXISTING	POROUS CONCRETE
P36	N: 658094.74	E: 1157285.77	MATCH EXISTING	POROUS CONCRETE
P37	N: 658124.09	E: 1157310.56	MATCH EXISTING	POROUS CONCRETE
P38	N: 658094.10	E: 1157309.76	MATCH EXISTING	POROUS CONCRETE
P39	N: 658118.88	E: 1157505.50	MATCH EXISTING	POROUS CONCRETE
P40	N: 658088.89	E: 1157504.69	MATCH EXISTING	POROUS CONCRETE

NOTE: SEE PLAN SHEET 6 FOR LOCATIONS.

CURB POINT COORDINATES

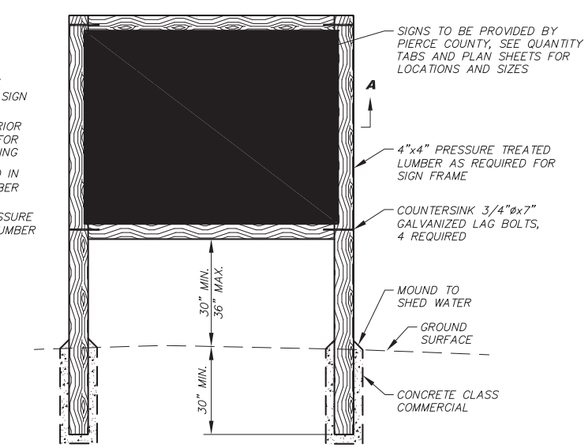
POINT NO.	NORTHING	EASTING	RADIUS	ELEVATION	DESCRIPTION
C1	N: 658187.53	E: 1156971.51	N/A	MATCH EXISTING	CEMENT CONC. CURB
C2	N: 658160.54	E: 1156970.83	N/A	MATCH EXISTING	CEMENT CONC. CURB
C3	N: 658187.13	E: 1156986.55	N/A	MATCH EXISTING	CEMENT CONC. CURB
C4	N: 658160.14	E: 1156985.78	N/A	MATCH EXISTING	CEMENT CONC. CURB
C5	N: 658182.25	E: 1157170.79	N/A	MATCH EXISTING	CEMENT CONC. CURB
C6	N: 658155.26	E: 1157170.07	N/A	MATCH EXISTING	CEMENT CONC. CURB
C7	N: 658181.85	E: 1157185.78	N/A	MATCH EXISTING	CEMENT CONC. CURB
C8	N: 658154.86	E: 1157185.06	N/A	MATCH EXISTING	CEMENT CONC. CURB
C9	N: 658176.96	E: 1157371.66	N/A	MATCH EXISTING	CEMENT CONC. CURB
C10	N: 658149.97	E: 1157370.94	N/A	MATCH EXISTING	CEMENT CONC. CURB
C11	N: 658176.25	E: 1157386.88	N/A	MATCH EXISTING	CEMENT CONC. CURB
C12	N: 658149.57	E: 1157385.93	N/A	MATCH EXISTING	CEMENT CONC. CURB
C13	N: 658121.40	E: 1156977.79	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C14	N: 658083.03	E: 1157062.90	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C15	N: 658084.64	E: 1157075.55	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C16	N: 658074.47	E: 1157098.62	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C17	N: 658064.06	E: 1157105.95	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C18	N: 658079.14	E: 1157061.81	N/A	MATCH EXISTING	CEMENT CONC. CURB
C19	N: 658079.51	E: 1157070.87	N/A	MATCH EXISTING	CEMENT CONC. CURB
C20	N: 658067.56	E: 1157098.00	N/A	MATCH EXISTING	CEMENT CONC. CURB
C21	N: 658060.63	E: 1157103.80	N/A	MATCH EXISTING	CEMENT CONC. CURB
C22	N: 658060.30	E: 1157114.46	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C23	N: 658056.51	E: 1157256.29	15'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C24	N: 658038.64	E: 1157270.61	15'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C25	N: 658000.30	E: 1157263.11	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C26	N: 657992.04	E: 1157259.47	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C27	N: 657975.31	E: 1157305.47	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C28	N: 657945.29	E: 1157375.59	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C29	N: 657941.32	E: 1157524.34	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C30	N: 657889.82	E: 1157522.97	N/A	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C31	N: 657889.48	E: 1157535.44	3'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C32	N: 657886.69	E: 1157538.38	3'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C33	N: 657883.34	E: 1157538.30	4'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C34	N: 657879.59	E: 1157540.69	4'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C35	N: 657872.56	E: 1157556.62	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C36	N: 657862.26	E: 1157563.61	12.25'	MATCH EXISTING	CEMENT CONC. CURB & GUTTER
C37	N: 657865.87	E: 1157555.49	N/A	MATCH EXISTING	CEMENT CONC. CURB
C38	N: 657877.89	E: 1157528.26	N/A	MATCH EXISTING	CEMENT CONC. CURB
C39	N: 657877.50	E: 1157519.23	N/A	MATCH EXISTING	CEMENT CONC. CURB
C40	N: 657880.43	E: 1157538.80	N/A	MATCH EXISTING	CEMENT CONC. CURB
C41	N: 657882.99	E: 1157532.99	12.25'	MATCH EXISTING	CEMENT CONC. CURB
C42	N: 657881.40	E: 1157520.29	12.25'	MATCH EXISTING	CEMENT CONC. CURB

NOTE: SEE PLAN SHEET 6 FOR LOCATIONS.



SECTION A-A

NOT TO SCALE



LID SIGN INSTALLATION DETAIL

NOT TO SCALE

Date: Dec 28, 2010 10:42:34 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

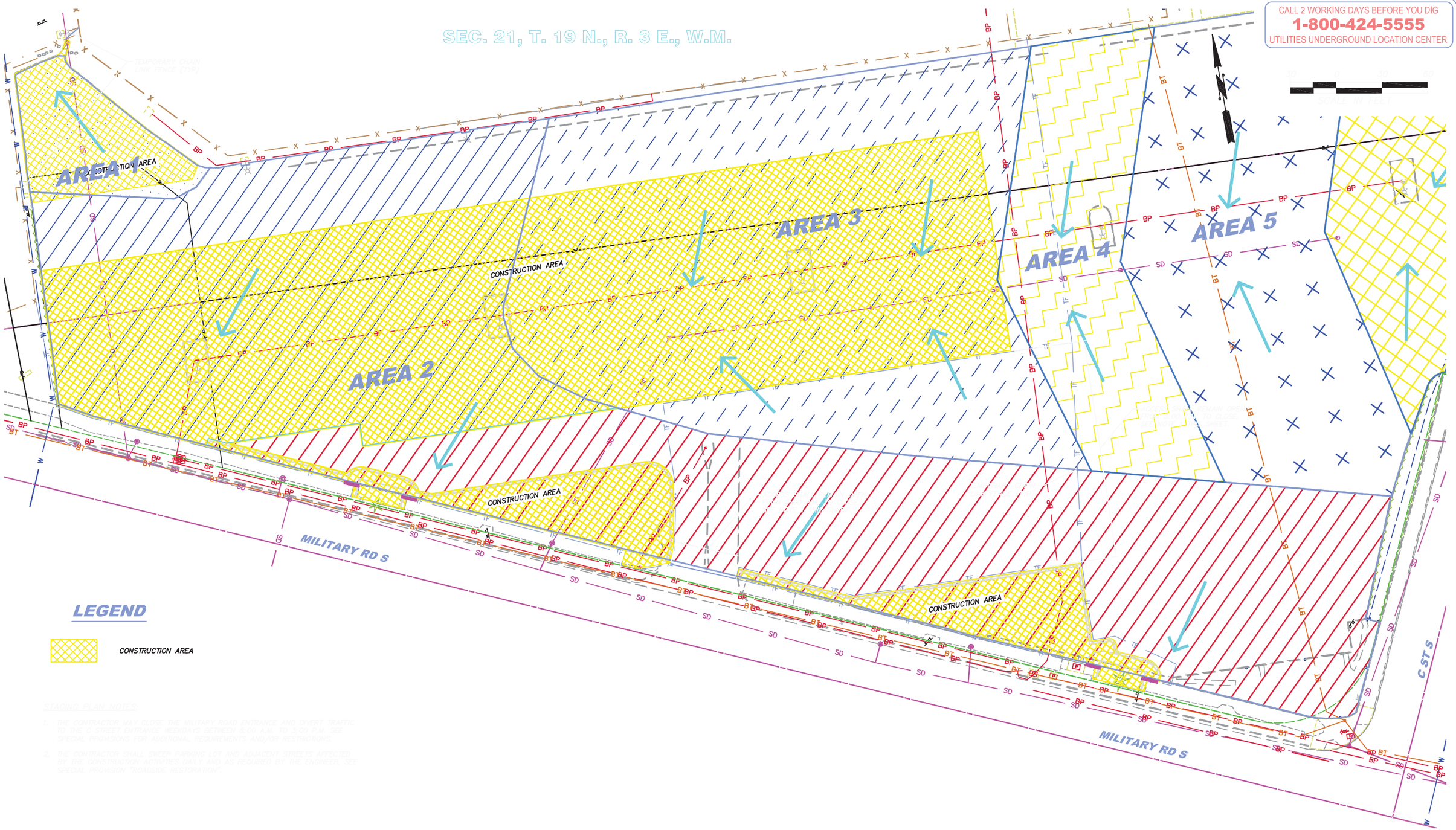
APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

700 SOUTH MILITARY ROAD

STRUCTURE NOTES, COORDINATES, AND DETAILS

C.I.P. # D212-006



STAGING PLAN NOTES:

1. THE CONTRACTOR MAY CLOSE THE MILITARY ROAD ENTRANCE AND DIVERT TRAFFIC TO THE C STREET ENTRANCE WEEKDAYS BETWEEN 8:00 A.M. TO 3:00 P.M. SEE SPECIAL PROVISIONS FOR ADDITIONAL REQUIREMENTS AND/OR RESTRICTIONS.
2. THE CONTRACTOR SHALL SWEEP PARKING LOT AND ADJACENT STREETS AFFECTED BY THE CONSTRUCTION ACTIVITIES DAILY AND AS REQUIRED BY THE ENGINEER. SEE SPECIAL PROVISION "ROADSIDE RESTORATION".

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

700 SOUTH MILITARY ROAD

STAGING PLAN SHEET

C.I.P. # D212-006

Date: Dec 28, 2010 10:44:33 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SEC. 21, T. 19 N., R. 3 E., W.M.

AREA 1

AREA 2

AREA 3

AREA 4

AREA 5

MILITARY RD S

C ST S

TO REMAIN

TO BE RELOCATED BY OTHERS

ELEV. 349.36

LEGEND

DEMOLITION LIMITS

SAWCUT LINE

DATUM

BASIS OF BEARING FROM
PIERCE COUNTY CORS NETWORK
NAD 83 (CORS 960)
NAD 83 (HARN 91)
HORIZONTAL DATUM: NAD 1983-1991
VERTICAL DATUM: N.A.V.D 88

POROUS CONCRETE AREA (TYP)

SAWCUT LINE AND ASPHALT CONCRETE PAVEMENT RESTORATION LIMITS

DEMOLITION PLAN NOTES:

1. DEMO ALL EXISTING CURBING WITHIN THE LIMITS OF DEMOLITION AS SHOWN. SEE QUANTITY TABULATIONS SHEET 2.
2. SEE PROFILE SECTIONS SHEETS 9 AND 10 FOR LIMITS AND DEPTHS OF "EXCAVATION AREAS". ALSO SEE QUANTITY TABULATIONS SHEET 2.
3. SWEEP THE PARKING LOT AND ADJACENT ROADS DAILY. SEE SPECIAL PROVISION "ROADSIDE RESTORATION".
4. UTILITIES SHOWN ARE BASED ON VISIBLE FEATURES AND SHALL BE FIELD VERIFIED PRIOR TO EXCAVATION.

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

700 SOUTH MILITARY ROAD

DEMOLITION PLAN SHEET

C.I.P. # D212-006

Date: Dec 28, 2010 10:45:08 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\0212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SEC. 21, T. 19 N., R. 3 E., W.M.

AREA 1

AREA 2

AREA 3

AREA 4

AREA 5

PERFORATED UNDERDRAIN

MILITARY RD S

C ST S

LEGEND

- POROUS CONCRETE
- POROUS ASPHALT
- BIORETENTION AREA
- VEGETATED SWALE AREA
- RECYCLED RUBBER SIDEWALK

PLAN NOTES:

1. SEE SHEET 3 FOR POROUS CONCRETE, POROUS ASPHALT, AND CURB POINT COORDINATE LOCATIONS.
2. SEE SHEETS 3, 6, 9, AND 17 FOR CURB DETAILS AND PLANS.
3. SWEEP THE PARKING LOT AND ADJACENT ROADS DAILY. SEE SPECIAL PROVISION "ROADSIDE RESTORATION".

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

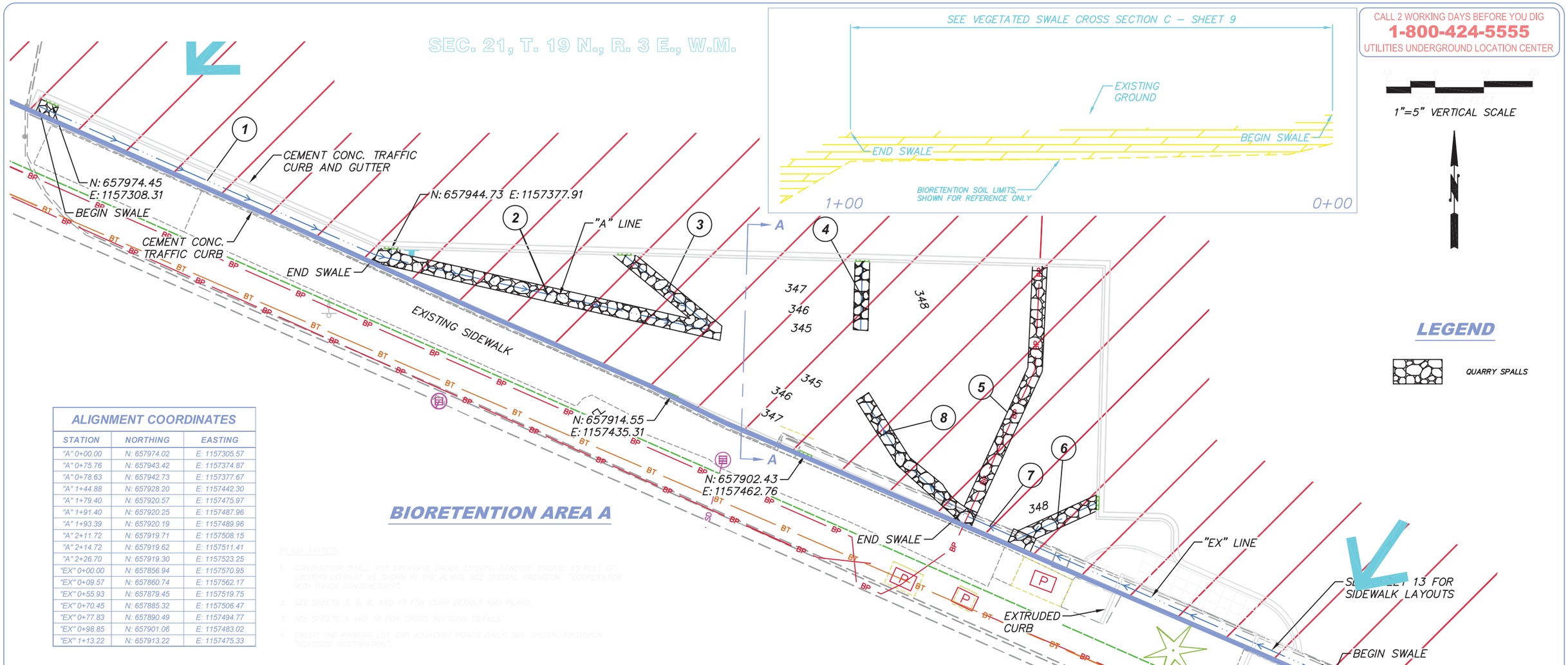
SPRINKER PARKING LOT LID PHASE 2

700 SOUTH MILITARY ROAD

PLAN SHEET

C.I.P. # D212-006

Date: Dec 28, 2010 10:45:35 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\0212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)



BIORETENTION AREA A

ALIGNMENT COORDINATES		
STATION	NORTHING	EASTING
"A" 0+00.00	N: 657974.02	E: 1157305.57
"A" 0+75.76	N: 657943.42	E: 1157374.87
"A" 0+78.63	N: 657942.73	E: 1157377.67
"A" 1+44.88	N: 657928.20	E: 1157442.30
"A" 1+79.40	N: 657920.57	E: 1157475.97
"A" 1+91.40	N: 657920.25	E: 1157487.96
"A" 1+93.39	N: 657920.19	E: 1157489.96
"A" 2+11.72	N: 657919.71	E: 1157508.15
"A" 2+14.72	N: 657919.62	E: 1157511.41
"A" 2+26.70	N: 657919.30	E: 1157523.25
"EX" 0+00.00	N: 657856.94	E: 1157570.95
"EX" 0+09.57	N: 657860.74	E: 1157562.17
"EX" 0+55.93	N: 657879.45	E: 1157519.75
"EX" 0+70.45	N: 657885.32	E: 1157506.47
"EX" 0+77.83	N: 657890.49	E: 1157494.77
"EX" 0+98.85	N: 657901.06	E: 1157483.02
"EX" 1+13.22	N: 657913.22	E: 1157475.33

PLAN NOTES:

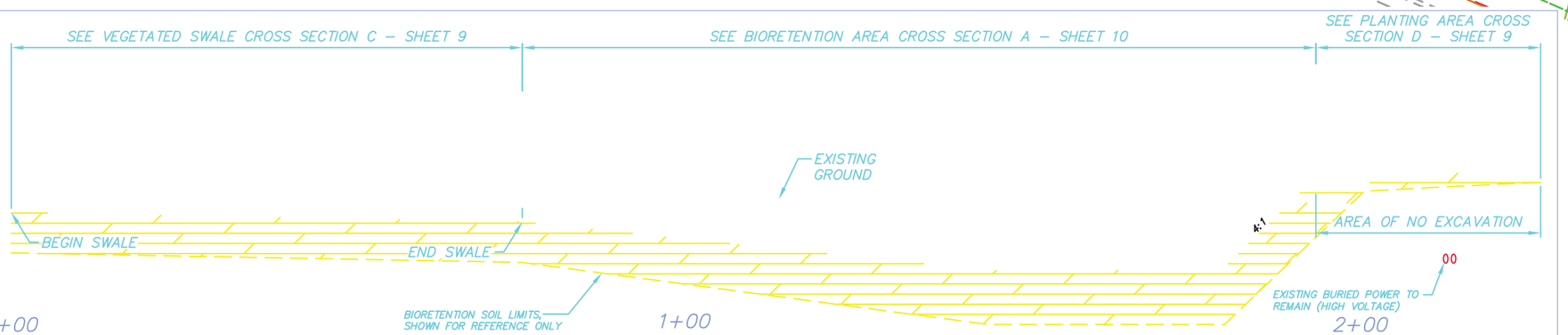
1. CONTRACTOR SHALL NOT EXCAVATE UNDER EXISTING CONDUIT, ENCASE 45 FEET OF EXISTING CONDUIT AS SHOWN IN THE PLANS. SEE SPECIAL PROVISION, "COOPERATION WITH OTHER CONTRACTORS".
2. SEE SHEETS 3, 6, 8, AND 17 FOR CURB DETAILS AND PLANS.
3. SEE SHEETS 9 AND 10 FOR CROSS SECTIONS DETAILS.
4. SWEEP THE PARKING LOT AND ADJACENT ROADS DAILY. SEE SPECIAL PROVISION "ROADSIDE RESTORATION".

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

1"=5" VERTICAL SCALE

LEGEND

QUARRY SPALLS



DRAWING NO.	SURVEYED BY:
SEE SIDE STAMP	W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

STATE OF WASHINGTON 33750 REGISTERED PROFESSIONAL ENGINEER

SPRINKER PARKING LOT LID PHASE 2

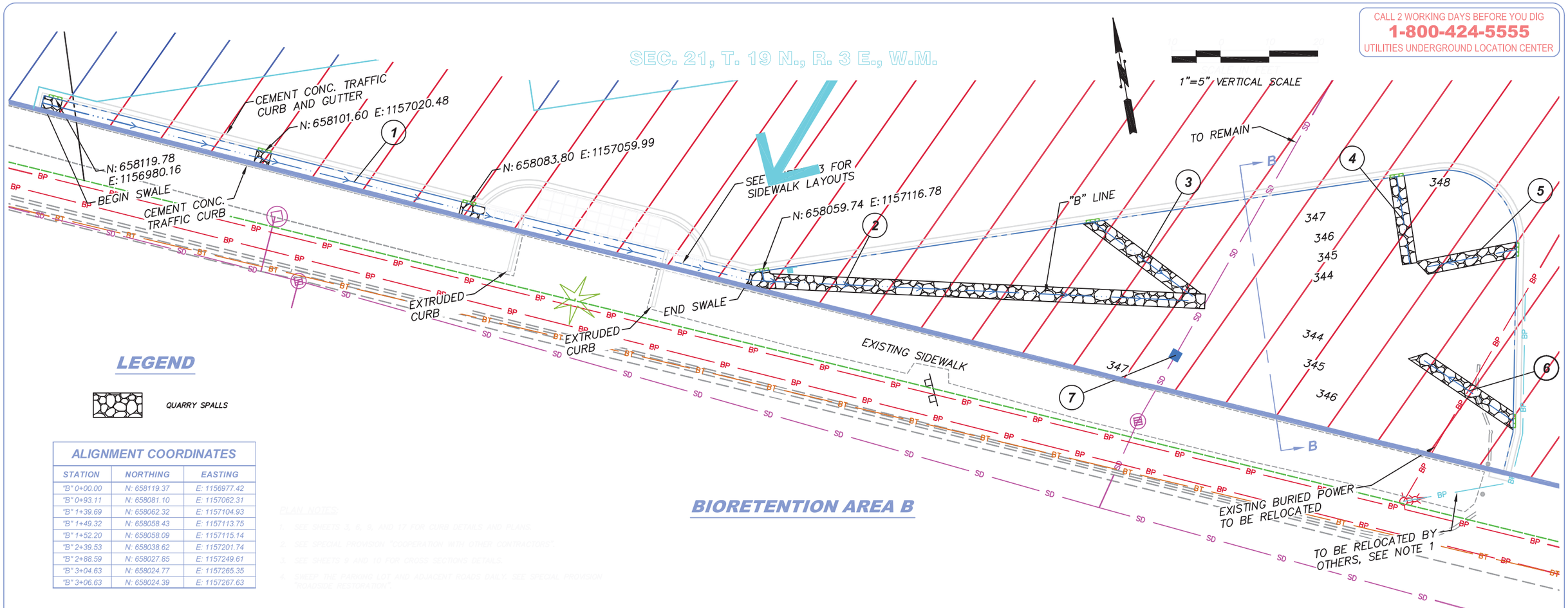
700 SOUTH MILITARY ROAD

BIORETENTION AREA A PLAN AND PROFILE

C.I.P. # D212-006

Date: Dec 28, 2010 10:46:12 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



LEGEND

QUARRY SPALLS

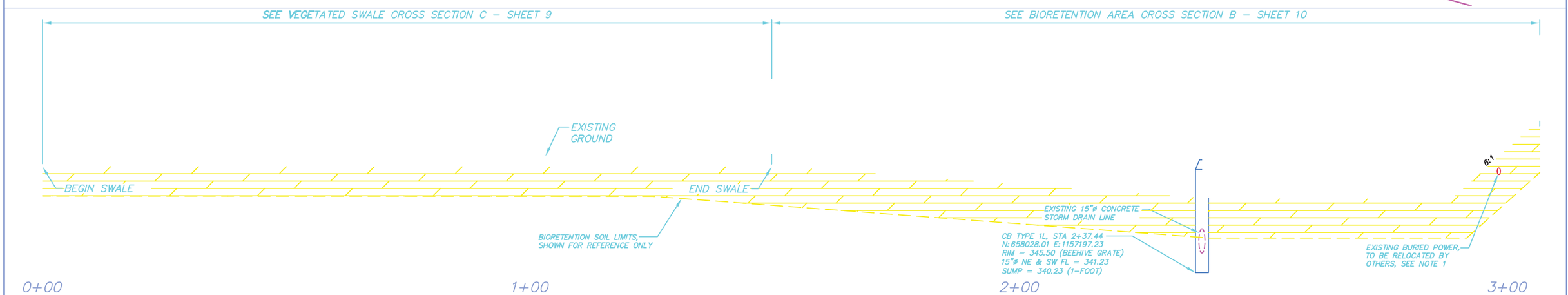
ALIGNMENT COORDINATES

STATION	NORTHING	EASTING
"B" 0+00.00	N: 658119.37	E: 1156977.42
"B" 0+93.11	N: 658081.10	E: 1157062.31
"B" 1+39.69	N: 658062.32	E: 1157104.93
"B" 1+49.32	N: 658058.43	E: 1157113.75
"B" 1+52.20	N: 658058.09	E: 1157115.14
"B" 2+39.53	N: 658038.62	E: 1157201.74
"B" 2+88.59	N: 658027.85	E: 1157249.61
"B" 3+04.63	N: 658024.77	E: 1157265.35
"B" 3+06.63	N: 658024.39	E: 1157267.63

BIORETENTION AREA B

PLAN NOTES:

1. SEE SHEETS 3, 6, 9, AND 17 FOR CURB DETAILS AND PLANS.
2. SEE SPECIAL PROVISION "COOPERATION WITH OTHER CONTRACTORS".
3. SEE SHEETS 9 AND 10 FOR CROSS SECTIONS DETAILS.
4. SWEEP THE PARKING LOT AND ADJACENT ROADS DAILY. SEE SPECIAL PROVISION "ROADSIDE RESTORATION".



DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W.-O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

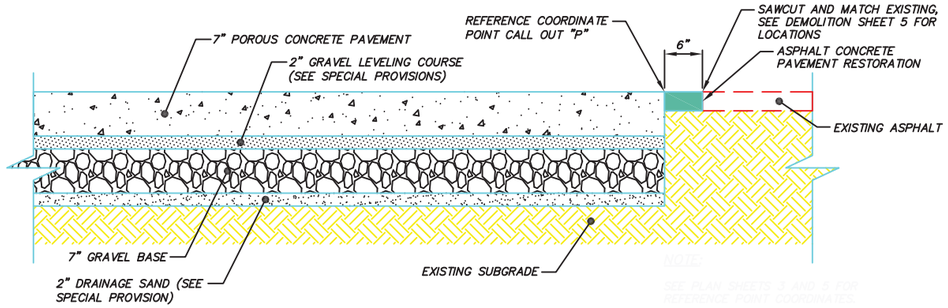
SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

BIORETENTION AREA B PLAN AND PROFILE

C.I.P. # D212-006

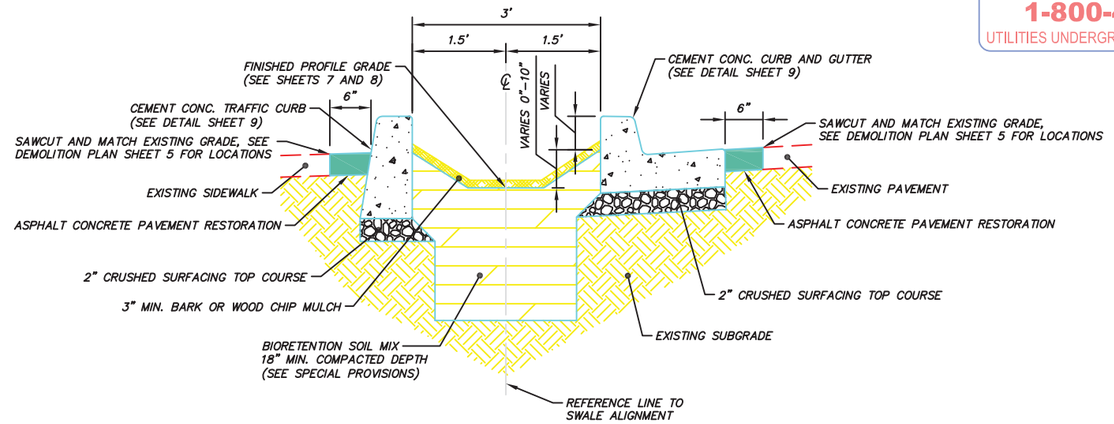
Date: Dec 28, 2010 10:46:36 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



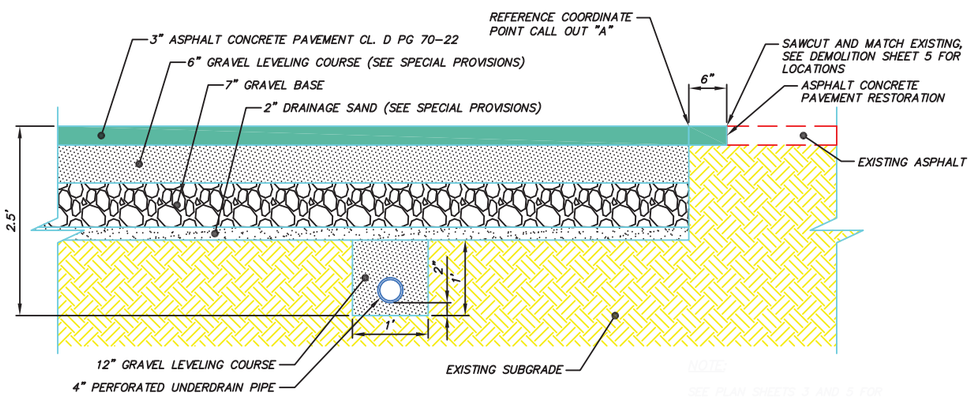
POROUS CONC. PAVEMENT CROSS SECTION

NOT TO SCALE



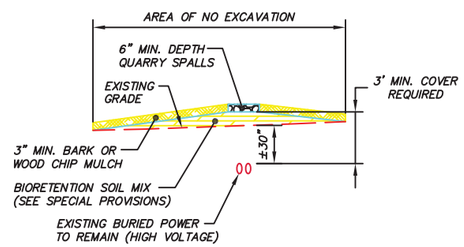
VEGETATED SWALE CROSS SECTION C

NOT TO SCALE
NOTE: SEE SHEETS 7 AND 8 FOR SECTION LIMITS.



POROUS ASPHALT CONC. PAVEMENT CL. D CROSS SECTION

NOT TO SCALE

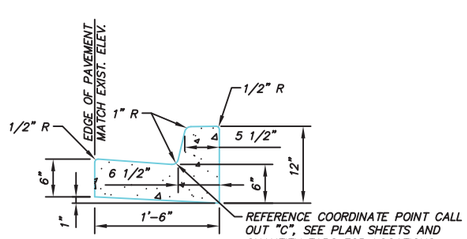


PLANTING AREA CROSS SECTION D

NOT TO SCALE
NOTE: SEE SHEET 7 FOR SECTION LIMITS.

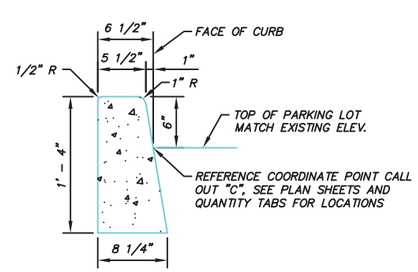
ASPHALT CONC. PAVEMENT RESTORATION NOTES:

1. HOT MIX ASPHALT CLASS 1/2 IN. PG 64–22, WITH MINIMUM COMPACTED DEPTH OF 3" OR EXISTING PAVEMENT DEPTH PLUS 1", WHICHEVER IS GREATER UP TO A MAXIMUM DEPTH OF 6". PLACE IN LIFTS PER WSDOT STANDARD SPECIFICATION 5–04, AND MACHINE ROLL FLUSH WITH EXISTING PAVEMENT.
2. 5/8" MINUS CRUSHED SURFACING TOP COURSE WITH MINIMUM COMPACTED DEPTH OF 2".
3. NEAT, UNIFORM, AND VERTICAL CUT (TYPICAL BOTH SIDES). CLEAN AND HEAT EDGES AND TACK WITH EMULSIFIED ASPHALT. SEAL JOINT WITH HOT ASPHALT CEMENT.
4. MINIMUM RESTORATION LIMITS UNLESS OTHERWISE DETERMINED BY THE ENGINEER. IF ANY PORTION OF A LONGITUDINAL PAVEMENT CUT AFFECTS A WHEEL TRACK AS DETERMINED BY THE ENGINEER, THE ENTIRE LANE SHALL BE REMOVED AND REPLACED. WHEREVER AN EXISTING PATCH OR CRACK IS IN CLOSE PROXIMITY TO THE NEW CUT, THE ENGINEER MAY REQUIRE REMOVAL OF THE EXISTING PATCH OR CRACK AND ANY INTERVENING PAVEMENT.
5. ALL PERMANENT FINAL PATCHES SHALL BE RECTANGULAR OR CIRCULAR IN SHAPE AND CONSTRUCTED TO BE PARALLEL AND PERPENDICULAR TO THE ROAD CENTERLINE.
6. WHEN REPLACING GRASS USE: SEEDING, FERTILIZING, MULCHING, AND TOP SOIL TYPE C. WHEN REPLACING GRAVEL USE 5/8" MINUS CRUSHED SURFACE TOP COURSE, 4" MINIMUM COMPACTED DEPTH.



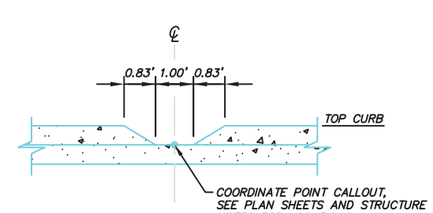
CEMENT CONC. TRAFFIC CURB AND GUTTER

NOT TO SCALE



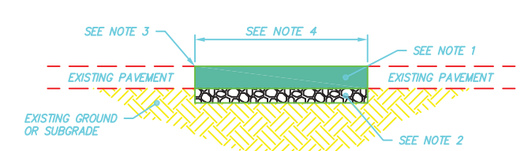
CEMENT CONCRETE TRAFFIC CURB

NOT TO SCALE



CURB CUT DETAIL

NOT TO SCALE



ASPHALT CONC. PAVEMENT RESTORATION

NOT TO SCALE

DRAWING NO.	SURVEYED BY:
SEE SIDE STAMP	W. O'NEIL
DRAWN BY:	DATE SURVEYED:
E. GRIMM	10/21/08
DESIGNED BY:	BOOK NO.
E. GRIMM	---
CHECKED BY:	DATE PLOTTED:
AL ZEHNI, P.E.	SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

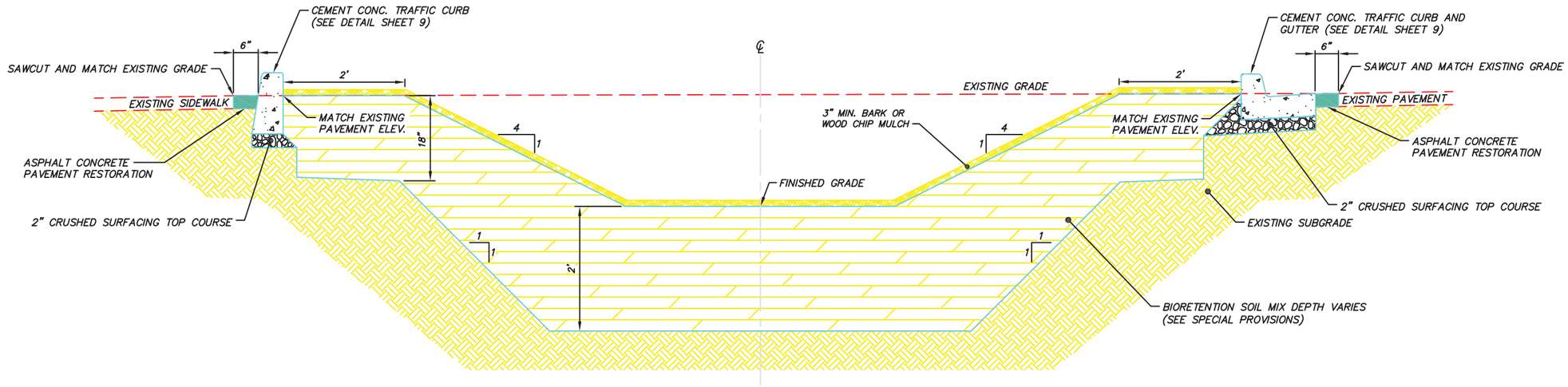
SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

CROSS SECTIONS AND DETAILS

C.I.P. # D212-006

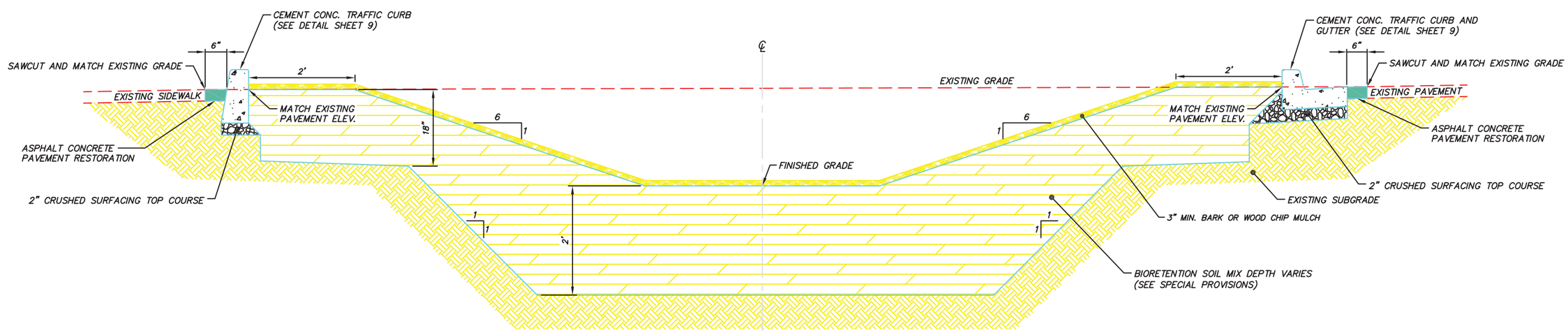
Date: Dec 28, 2010 10:47:07 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



BIORETENTION AREA CROSS SECTION A

NOT TO SCALE
NOTE: SEE SHEET 7 FOR SECTION LIMITS



BIORETENTION AREA CROSS SECTION B

NOT TO SCALE
NOTE: SEE SHEET 8 FOR SECTION LIMITS

Date: Dec 28, 2010 10:47:37 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

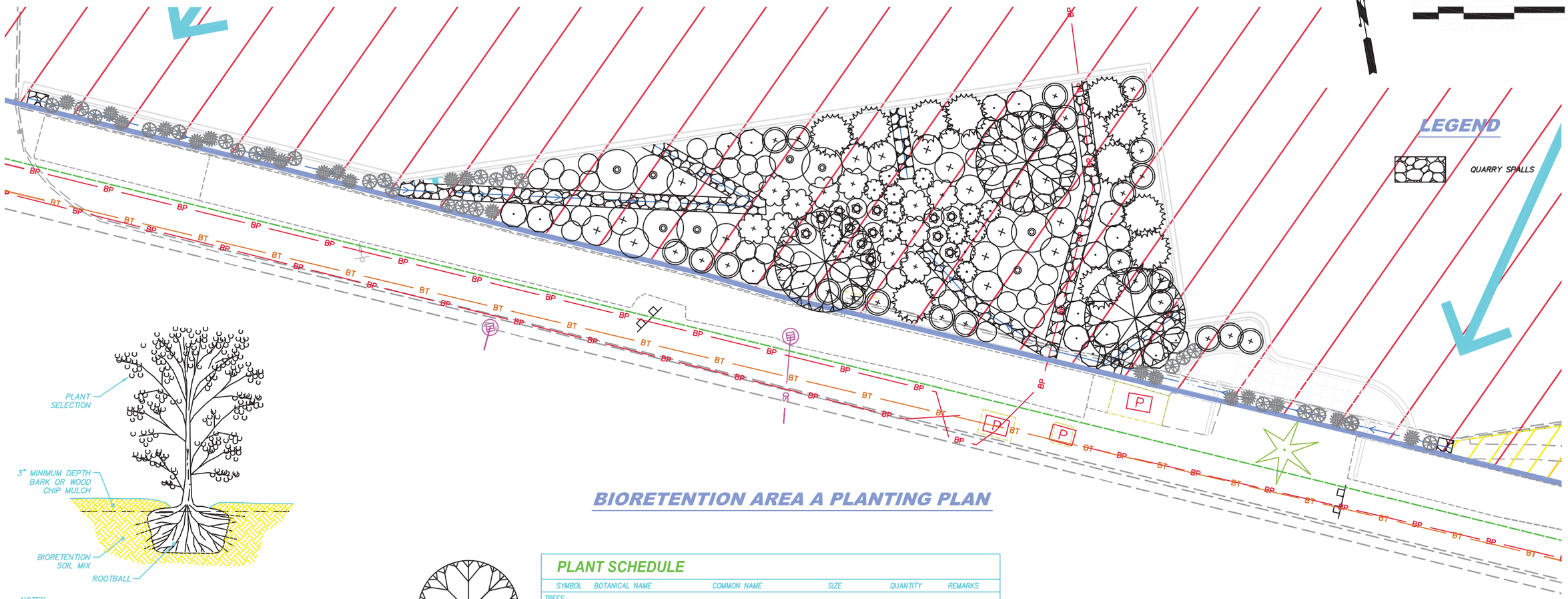
SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

BIORETENTION AREAS CROSS SECTIONS

C.I.P. # D212-006

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SEC. 21, T. 19 N., R. 3 E., W.M.



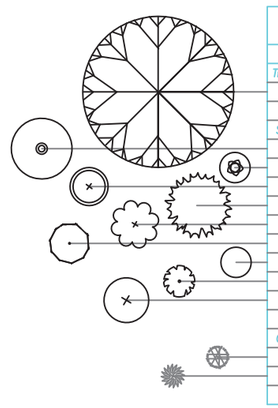
BIORETENTION AREA A PLANTING PLAN

NOTES:

1. PLANTS SHALL BE INSTALLED AFTER MULCH HAS BEEN COMPLETED. RAKE MULCH AWAY FROM PLANTING PITS AND SAVE FOR RE-MULCH AFTER PLANT INSTALLATION.
2. HOLE DEPTH SHALL BE DETERMINED BY ROOTBALL HEIGHT.
3. REMOVE PLANT FROM POT AND LOOSEN ROOTBALL. SPREAD ROOTS AND CUT TO FIT BEFORE PLANTING.
4. PLANTS WILL BE SET AS IN NOTE 2. ONCE PLANTED, MULCH SHALL BE REPLACED OVER THE PLANTING PITS WITH AN 18 INCH DIAMETER AROUND PLANT, 3 INCHES DEEP. FEATHER MULCH TOWARD THE BASE OF THE PLANT BUT DO NOT ALLOW MULCH TO TOUCH BASE.
5. SOAK PLANTING PIT MIDWAY AND AFTER PLANTING.
6. SEE SPECIFICATION "BIORETENTION MIX" AND "PLANTING".

1/11 **TREE / SHRUB PLANTING DETAIL TYP**

NOT TO SCALE



PLANT SCHEDULE

SYMBOL	BOTANICAL NAME	COMMON NAME	SIZE	QUANTITY	REMARKS
TREES					
AA	AMELANCHIER ALNIFOLIA	WESTERN SERVICEBERRY	2" CAL.	7	B&B
SHRUBS					
AC	ACER CIRCINATUM	VINE MAPLE	2 GAL.	21	8' O.C.
CS	CORNUS SERICEA 'ISANTI'	ISANTI REDTWIG DOGWOOD	1 GAL.	39	4' O.C.
MA	MAHONIA AQUIFOLIUM	TALL OREGON GRAPE	1 GAL.	51	5' O.C.
PL	PHILADELPHUS LEWISII	MOCK ORANGE	2 GAL.	23	6' O.C.
PN	PHYSOCARPUS CAPITATUS	PACIFIC NINEBARK	2 GAL.	25	6' O.C.
RS	RIBES SANGUINEUM	RED FLOWERING CURRANT	2 GAL.	45	5' O.C.
SA	SYMPHORICARPOS ALBUS	SNOWBERRY	1 GAL.	79	4' O.C
SP	SALIX PURPUREA 'NANA'	DWARF ARCTIC WILLOW	1 GAL.	31	4' O.C.
VP	VACCINUIUM PARVIFOLIUM	RED HUCKLEBERRY	2 GAL.	29	6' O.C.
GRASSES					
DC	DESCHAMPSIA CESPITOSA	TUFTED HAIRGRASS	1 GAL	47	3' O.C.
FI	FESTUCA IDAHOENSIS	IDAHO FESCUE	1 GAL	42	3' O.C.

LANDSCAPE INSTALLATION NOTES

1. PLANT MATERIAL SHALL CONFORM TO ANSI Z60.1-1996.
2. DECIDUOUS TREES SHALL BE 2 INCHES OF CALIPER AT 6 INCHES ABOVE GROUND LEVEL PER ANSI STANDARDS.
3. BARK MULCH: HEMLOCK OR FIR BARK, SHREDDED MEDIUM DOUBLE GRIND SIZE, FREE FROM NOXIOUS WEED SEED, DEBRIS, AND ALL FOREIGN MATERIAL. APPLY AT A 3 INCH MINIMUM DEPTH. MULCH SHALL BE REMOVED TO 6 INCHES FROM ROOT FLARE.
4. ALL LANDSCAPE PLANTS AND SEEDING SHALL BE FERTILIZED AT TIME OF PLANTING OR SEEDING.
5. ALL TREES SHALL BE STAKED AND GUYED.
6. ALL NEW LANDSCAPED AREAS SHALL BE IRRIGATED WITH A TEMPORARY DRIP IRRIGATION SYSTEM.
7. PLANT QUANTITIES LISTED FOR REFERENCE ONLY, CONTRACTOR SHALL INSTALL PLANTS AS SHOWN ON PLANS.

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PB
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

BIORETENTION AREA A PLANTING PLAN AND DETAILS

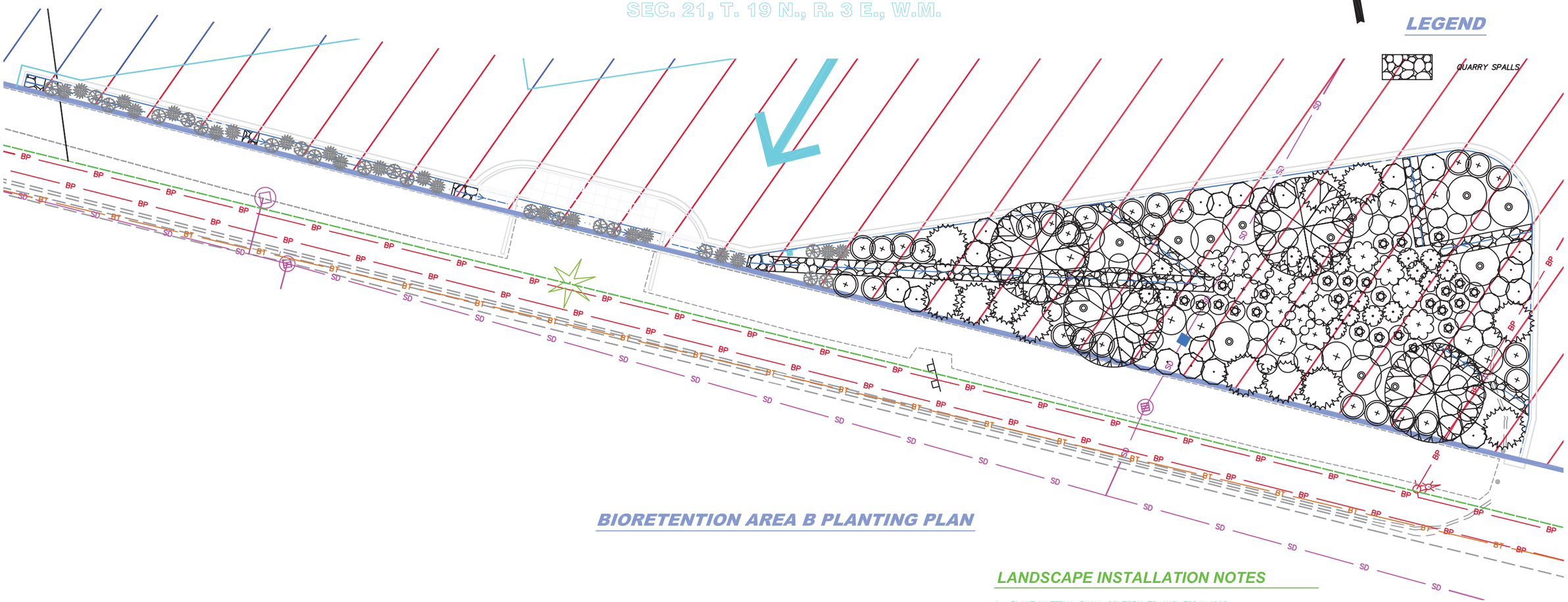
C.I.P. # D212-006

Date: Dec 28, 2010 10:47:57 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SCALE IN FEET

SEC. 21, T. 19 N., R. 3 E., W.M.



LEGEND

QUARRY SPALLS

BIORETENTION AREA B PLANTING PLAN

LANDSCAPE INSTALLATION NOTES

1. PLANT MATERIAL SHALL CONFORM TO ANSI Z60.1–1996.
2. DECIDUOUS TREES SHALL BE 2 INCHES OF CALIPER AT 6 INCHES ABOVE GROUND LEVEL PER ANSI STANDARDS.
3. BARK MULCH: HEMLOCK OR FIR BARK, SHREDDED MEDIUM DOUBLE GRIND SIZE, FREE FROM NOXIOUS WEED SEED, DEBRIS, AND ALL FOREIGN MATERIAL. APPLY AT A 3 INCH MINIMUM DEPTH. MULCH SHALL BE REMOVED TO 6 INCHES FROM ROOT FLARE.
4. ALL LANDSCAPE PLANTS AND SEEDING SHALL BE FERTILIZED AT TIME OF PLANTING OR SEEDING.
5. ALL TREES SHALL BE STAKED AND GUYED.
6. ALL NEW LANDSCAPED AREAS SHALL BE IRRIGATED WITH A TEMPORARY DRIP IRRIGATION SYSTEM.
7. PLANT QUANTITIES LISTED FOR REFERENCE ONLY, CONTRACTOR SHALL INSTALL PLANTS AS SHOWN ON PLANS.
8. SEE PLANTING DETAILS AND PLANT SCHEDULE SHEET 11.

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PB
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

STATE OF WASHINGTON 33750 REGISTERED PROFESSIONAL ENGINEER

SPRINKER PARKING LOT LID PHASE 2

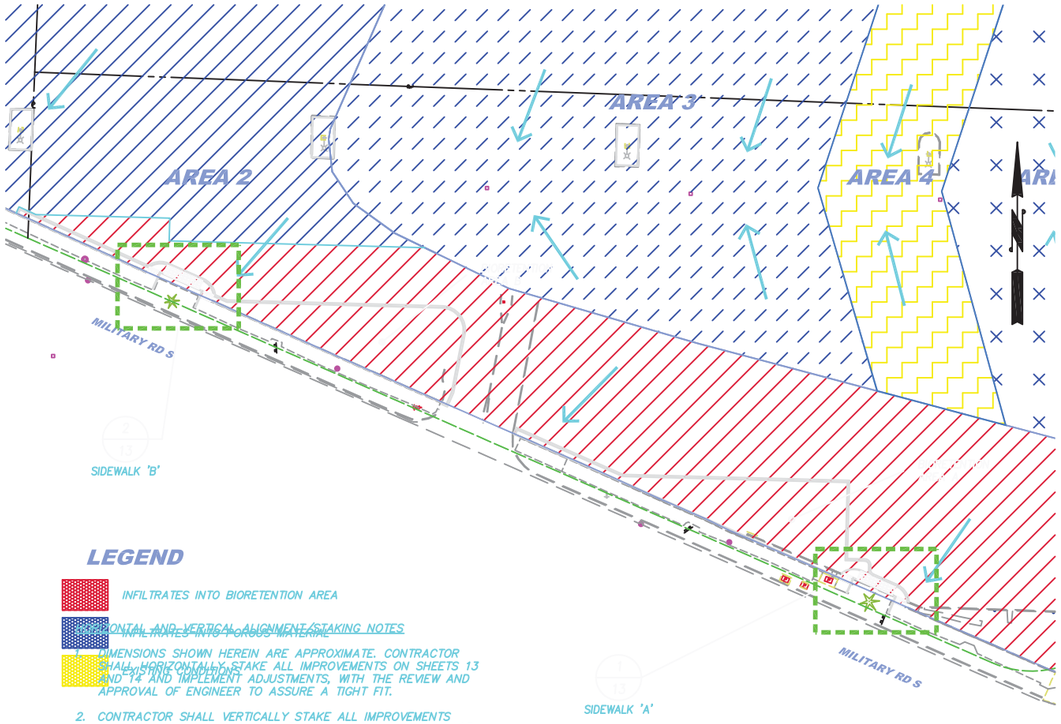
700 SOUTH MILITARY ROAD

BIORETENTION AREA B PLANTING PLAN

C.I.P. # D212-006

Date: Dec 28, 2010 10:48:36 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

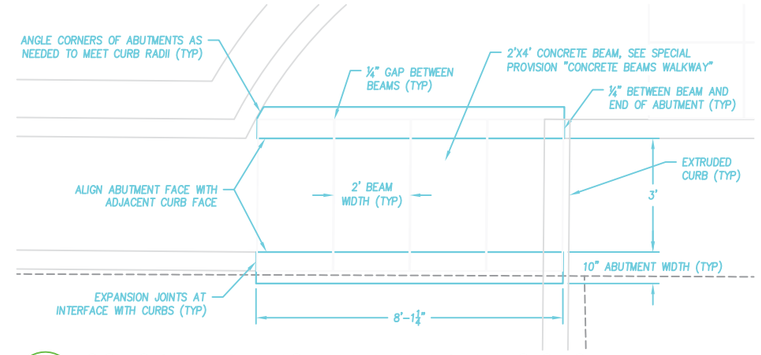


LEGEND

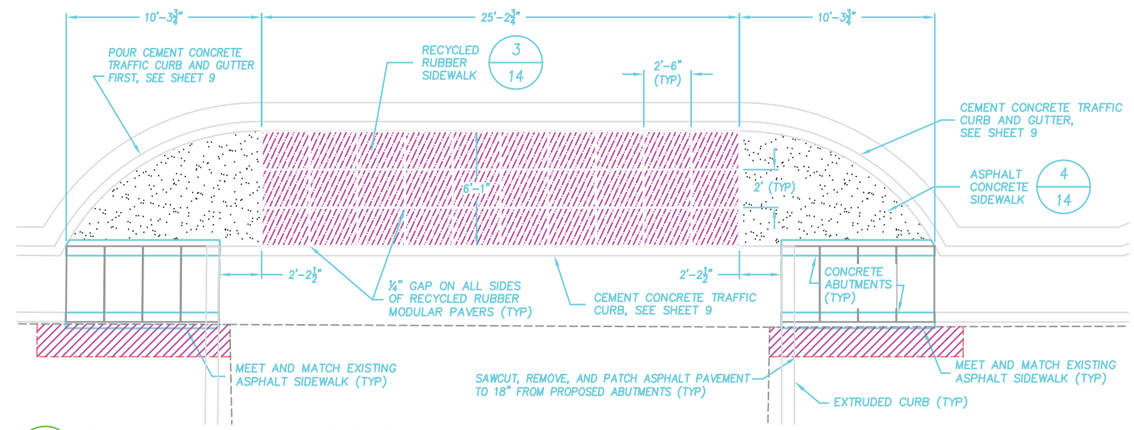
- INFILTRATES INTO BIORETENTION AREA
- INFILTRATES INTO POROUS MATERIAL
- CONTOUR

1. DIMENSIONS SHOWN HEREIN ARE APPROXIMATE. CONTRACTOR SHALL HORIZONTALLY STAKE ALL IMPROVEMENTS ON SHEETS 13 AND 14 AND IMPLEMENT ADJUSTMENTS, WITH THE REVIEW AND APPROVAL OF ENGINEER TO ASSURE A TIGHT FIT.
2. CONTRACTOR SHALL VERTICALLY STAKE ALL IMPROVEMENTS SHOWN ON SHEETS 13 AND 14 TO ASSURE POSITIVE DRAINAGE TOWARDS PROPOSED SWALE AND TO MEET AND MATCH EXISTING IMPROVEMENTS.
3. ENGINEER SHALL REVIEW AND APPROVE ALL STAKING PRIOR TO TRADE IMPLEMENTATION OF IMPROVEMENTS.

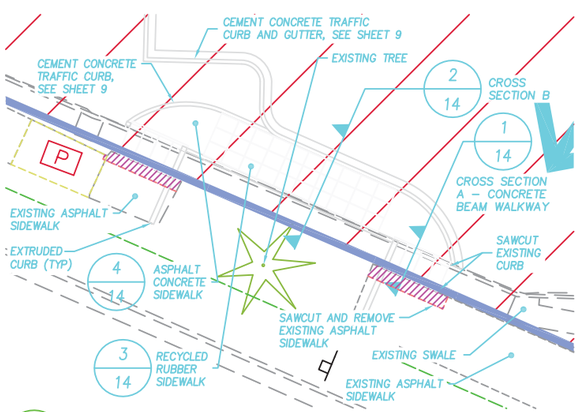
0 50 100 150
SCALE IN FEET



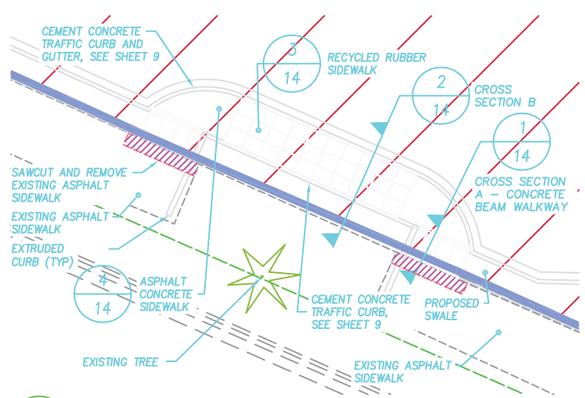
5/13 CONCRETE BEAMS WALKWAY DIMENSIONS
1/2" = 1'-0"



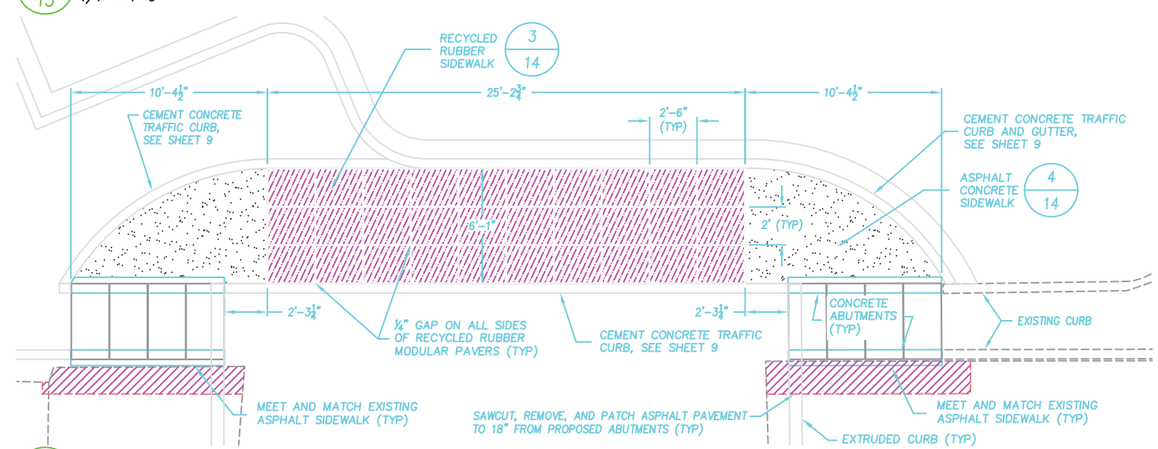
4/13 SIDEWALK 'B' DIMENSIONS
1/4" = 1'-0"



1/13 SIDEWALK 'A' LAYOUT
1" = 10'



2/13 SIDEWALK 'B' LAYOUT
1" = 10'



3/13 SIDEWALK 'A' DIMENSIONS
1/4" = 1'-0"

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

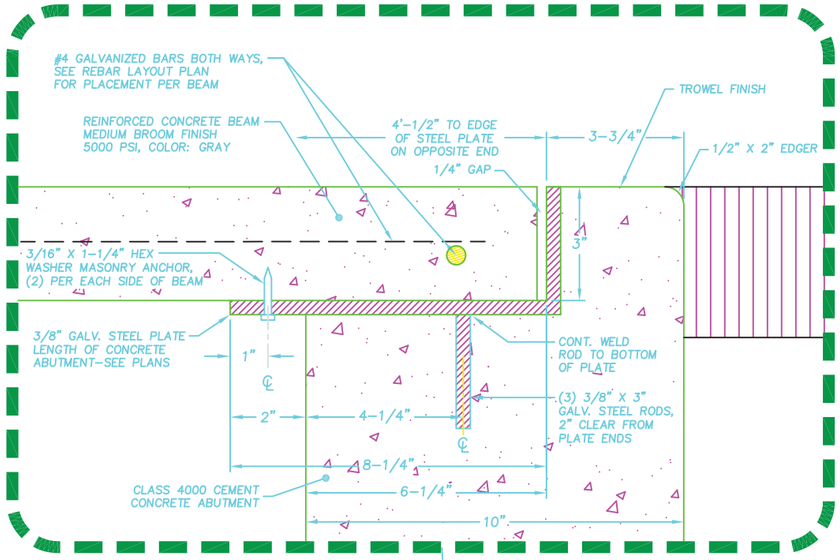
Robert W. Droll
Landscape Architect, PB
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322
APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD
SIDEWALK PLANS
C.I.P. # D212-006

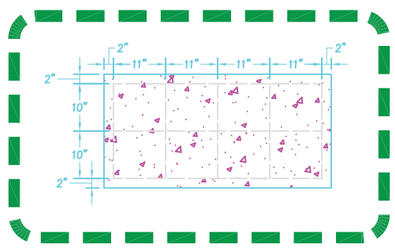
Date: Dec 28, 2010 10:49:05 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



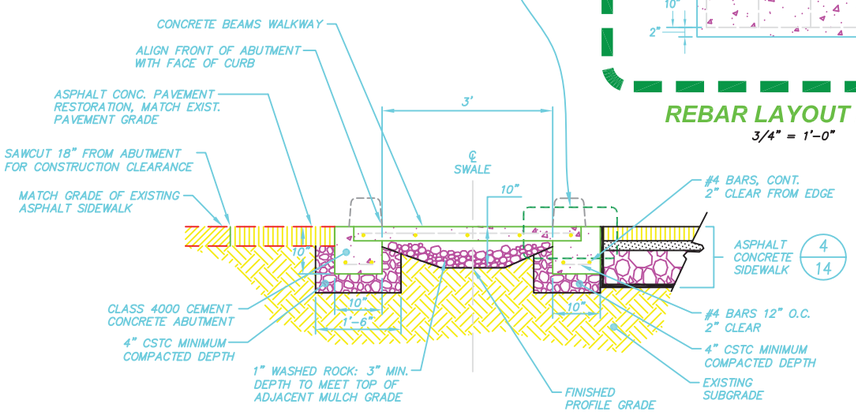
CONCRETE BEAM ATTACHMENT

1/2" = 1"



REBAR LAYOUT PLAN

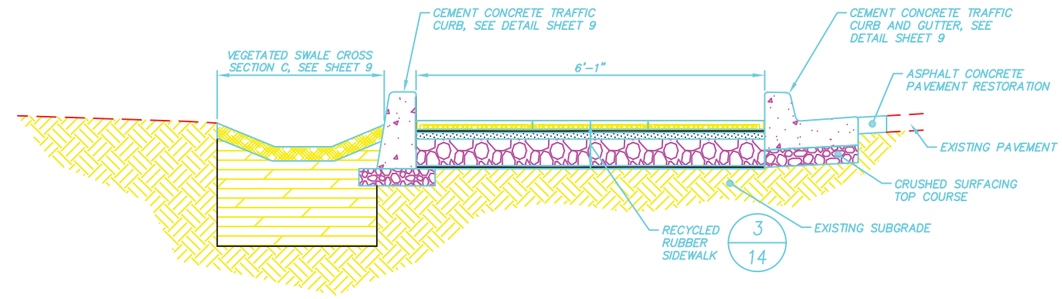
3/4" = 1'-0"



NOTE:
SEE SPECIAL PROVISION "CONCRETE BEAMS WALKWAY".

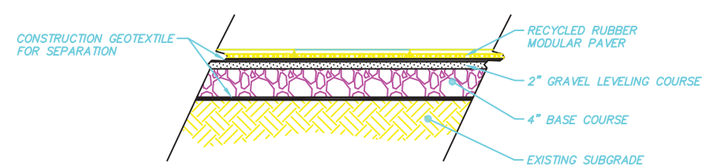
1/14 CROSS SECTION A - CONCRETE BEAMS WALKWAY

3/4" = 1'-0"



2/14 CROSS SECTION B - RECYCLED RUBBER SIDEWALK

3/4" = 1'-0"

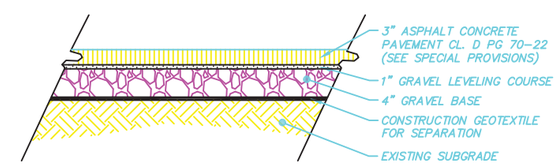


NOTES:

1. INSTALLATION SHALL BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. ALL SEAMS SHALL HAVE A 1/4" GAP.
3. SEE SPECIAL PROVISION "RECYCLED RUBBER SIDEWALK".

3/14 RECYCLED RUBBER SIDEWALK

NOT TO SCALE



NOTES:

1. MEASUREMENT AND PAYMENT FOR ASPHALT CONCRETE SIDEWALK SHALL BE PER "ASPHALT CONC. PAVEMENT CL. D PG 70-22.
2. SEE SPECIAL PROVISION "ASPHALT PAVEMENT CL. D PG 70-22".

4/14 ASPHALT CONCRETE SIDEWALK

3/4" = 1'-0"

HORIZONTAL AND VERTICAL ALIGNMENT/STAKING NOTES

1. DIMENSIONS SHOWN HEREIN ARE APPROXIMATE. CONTRACTOR SHALL HORIZONTALLY STAKE ALL IMPROVEMENTS ON SHEETS 13 AND 14 AND IMPLEMENT ADJUSTMENTS, WITH THE REVIEW AND APPROVAL OF ENGINEER TO ASSURE A TIGHT FIT.
2. CONTRACTOR SHALL VERTICALLY STAKE ALL IMPROVEMENTS SHOWN ON SHEETS 13 AND 14 TO ASSURE POSITIVE DRAINAGE TOWARDS PROPOSED SWALE AND TO MEET AND MATCH EXISTING IMPROVEMENTS.
3. ENGINEER SHALL REVIEW AND APPROVE ALL STAKING PRIOR TO TRADE IMPLEMENTATION OF IMPROVEMENTS.

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PS
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

700 SOUTH MILITARY ROAD

SIDEWALK DETAILS

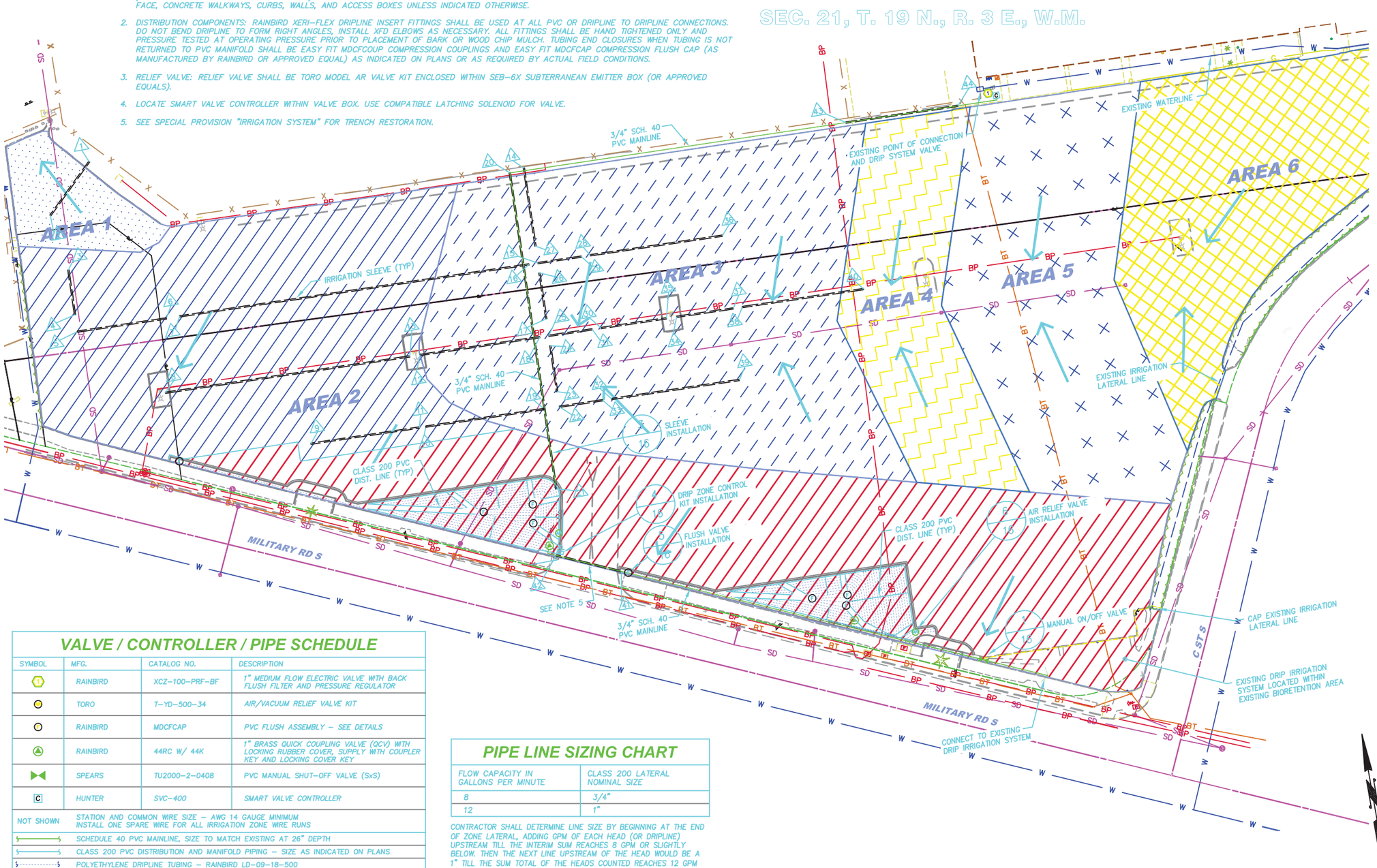
C.I.P. # D212-006

Date: Dec 28, 2010 10:49:26 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

IRRIGATION MATERIALS INSTALLATION NOTES

1. LANDSCAPE DRIPLINE: LANDSCAPE DRIPLINE TUBING SHALL BE RAINBIRD LF-09-18-500, STAKED AT 24" INTERVALS WITH A TIE DOWN STAKE (RAINBIRD TDS-050 OR RAINBIRD LD16TSK) AND COVERED WITH 3" MINIMUM BARK OR WOOD SHIP MULCH. ALLOW 6" CLEARANCE FROM BUILDING FACE, CONCRETE WALKWAYS, CURBS, WALLS, AND ACCESS BOXES UNLESS INDICATED OTHERWISE.
2. DISTRIBUTION COMPONENTS: RAINBIRD XERI-FLEX DRIPLINE INSERT FITTINGS SHALL BE USED AT ALL PVC OR DRIPLINE TO DRIPLINE CONNECTIONS. DO NOT BEND DRIPLINE TO FORM RIGHT ANGLES, INSTALL XFD ELBOWS AS NECESSARY. ALL FITTINGS SHALL BE HAND TIGHTENED ONLY AND PRESSURE TESTED AT OPERATING PRESSURE PRIOR TO PLACEMENT OF BARK OR WOOD CHIP MULCH. TUBING END CLOSURES WHEN TUBING IS NOT RETURNED TO PVC MANIFOLD SHALL BE EASY FIT MDCFCOUP COMPRESSION COUPLINGS AND EASY FIT MDCFCAP COMPRESSION FLUSH CAP (AS MANUFACTURED BY RAINBIRD OR APPROVED EQUAL) AS INDICATED ON PLANS OR AS REQUIRED BY ACTUAL FIELD CONDITIONS.
3. RELIEF VALVE: RELIEF VALVE SHALL BE TORO MODEL AR VALVE KIT ENCLOSED WITHIN SEB-6X SUBTERRANEAN EMITTER BOX (OR APPROVED EQUALS).
4. LOCATE SMART VALVE CONTROLLER WITHIN VALVE BOX. USE COMPATIBLE LATCHING SOLENOID FOR VALVE.
5. SEE SPECIAL PROVISION "IRRIGATION SYSTEM" FOR TRENCH RESTORATION.

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



SLEEVE INSTALLATION COORDINATES

SYMBOL NO.	NORTHING	EASTING	DESCRIPTION
1	N: 658357.21	E: 1156955.47	SLEEVE END
2	N: 658321.47	E: 1156918.68	SLEEVE END
3	N: 658277.44	E: 1156925.08	SLEEVE END
4	N: 658242.45	E: 1156924.14	SLEEVE END
5	N: 658229.19	E: 1156923.78	SLEEVE END
6	N: 658227.28	E: 1156993.27	SLEEVE END
7	N: 658227.10	E: 1157003.71	SLEEVE END
8	N: 658170.71	E: 1156982.61	SLEEVE END
9	N: 658112.28	E: 1157086.73	SLEEVE END
10	N: 658109.86	E: 1157176.70	SLEEVE END
11	N: 658110.00	E: 1157171.70	SLEEVE END
12	N: 658165.55	E: 1157173.84	SLEEVE END
13	N: 658165.33	E: 1157181.84	SLEEVE END
14	N: 658293.96	E: 1157286.19	SLEEVE END
15	N: 658219.56	E: 1157284.10	SLEEVE END
16	N: 658219.75	E: 1157277.11	SLEEVE END
17	N: 658175.84	E: 1157283.01	SLEEVE END
18	N: 658162.81	E: 1157275.59	SLEEVE END
19	N: 658107.38	E: 1157269.16	SLEEVE END
20	N: 658292.22	E: 1157274.82	SLEEVE END
21	N: 658044.75	E: 1157267.67	SLEEVE END
22	N: 658107.06	E: 1157281.10	SLEEVE END
23	N: 658118.86	E: 1157281.48	SLEEVE END
24	N: 658154.85	E: 1157282.45	SLEEVE END
25	N: 658162.60	E: 1157282.58	SLEEVE END
26	N: 658211.83	E: 1157283.98	SLEEVE END
27	N: 658232.82	E: 1157284.54	SLEEVE END
28	N: 658218.46	E: 1157325.09	SLEEVE END
29	N: 658218.65	E: 1157318.09	SLEEVE END
30	N: 658161.50	E: 1157323.57	SLEEVE END
31	N: 658161.69	E: 1157316.57	SLEEVE END
32	N: 658105.97	E: 1157322.08	SLEEVE END
33	N: 658106.15	E: 1157315.09	SLEEVE END
34	N: 658159.90	E: 1157382.71	SLEEVE END
35	N: 658160.12	E: 1157374.71	SLEEVE END
36	N: 658103.29	N: 1157422.05	SLEEVE END
37	N: 658158.52	E: 1157434.03	SLEEVE END
38	N: 658158.70	E: 1157427.03	SLEEVE END
39	N: 658215.67	E: 1157428.55	SLEEVE END
40	N: 658155.95	E: 1157528.99	SLEEVE END
41	N: 657993.84	E: 1157259.17	SLEEVE END
42	N: 657994.04	E: 1157258.72	SLEEVE END
43	N: 658285.33	E: 1157537.93	SLEEVE END
44	N: 658283.07	E: 1157625.53	SLEEVE END

VALVE / CONTROLLER / PIPE SCHEDULE

SYMBOL	MFG.	CATALOG NO.	DESCRIPTION
	RAINBIRD	XCZ-100-PRF-BF	1" MEDIUM FLOW ELECTRIC VALVE WITH BACK FLUSH FILTER AND PRESSURE REGULATOR
	TORO	T-YD-500-34	AIR/VACUUM RELIEF VALVE KIT
	RAINBIRD	MDCFCAP	PVC FLUSH ASSEMBLY – SEE DETAILS
	RAINBIRD	44RC W/ 44K	1" BRASS QUICK COUPLING VALVE (QCV) WITH LOCKING RUBBER COVER, SUPPLY WITH COUPLER KEY AND LOCKING COVER KEY
	SPEARS	TU2000-2-0408	PVC MANUAL SHUT-OFF VALVE (SxS)
C	HUNTER	SVC-400	SMART VALVE CONTROLLER
NOT SHOWN	STATION AND COMMON WIRE SIZE – AWG 14 GAUGE MINIMUM INSTALL ONE SPARE WIRE FOR ALL IRRIGATION ZONE WIRE RUNS		
	SCHEDULE 40 PVC MAINLINE, SIZE TO MATCH EXISTING AT 26" DEPTH		
	CLASS 200 PVC DISTRIBUTION AND MANIFOLD PIPING – SIZE AS INDICATED ON PLANS		
	POLYETHYLENE DRIPLINE TUBING – RAINBIRD LD-09-18-500		
SL	SCHEDULE 80 PVC SLEEVES AT 28" DEPTH, 4" DIAMETER NOMINAL SIZE		

PIPE LINE SIZING CHART

FLOW CAPACITY IN GALLONS PER MINUTE	CLASS 200 LATERAL NOMINAL SIZE
8	3/4"
12	1"

CONTRACTOR SHALL DETERMINE LINE SIZE BY BEGINNING AT THE END OF ZONE LATERAL, ADDING GPM OF EACH HEAD (OR DRIPLINE) UPSTREAM TILL THE INTERIM SUM REACHES 8 GPM OR SLIGHTLY BELOW. THEN THE NEXT LINE UPSTREAM OF THE HEAD WOULD BE A 1" TILL THE SUM TOTAL OF THE HEADS COUNTED REACHES 12 GPM OR SLIGHTLY LOWER AND THE NEXT LINE SIZE WOULD BE 1 1/2" AND SO ON.

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PE
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322
APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

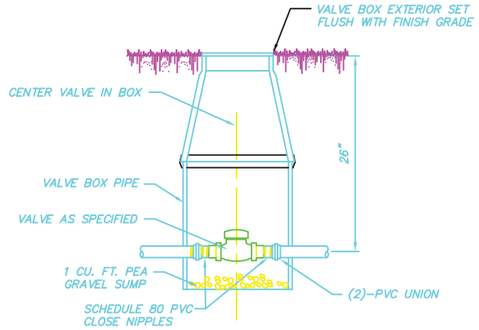
700 SOUTH MILITARY ROAD

IRRIGATION PLAN

C.I.P. # D212-006

Date: Dec 28, 2010 10:49:50 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

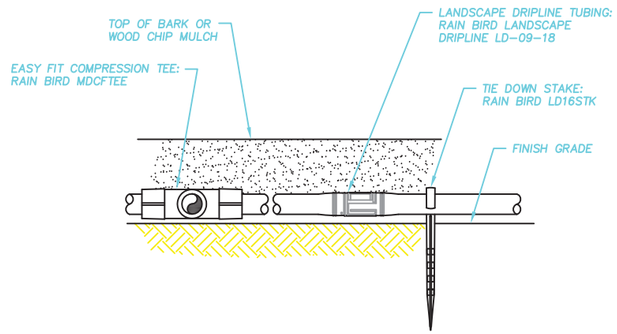
CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER



NOTE: SIZE ALL VALVE BOXES TO ALLOW SUFFICIENT ROOM FOR VALVE REPLACEMENT AND MAINTENANCE.

1/16 MANUAL ON / OFF VALVE

NOT TO SCALE

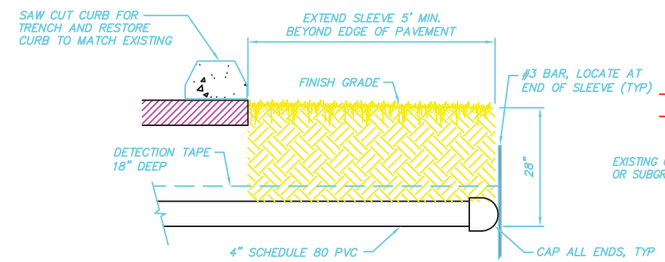


2/16 LANDSCAPE DRIPLINE ON GRADE

NOT TO SCALE

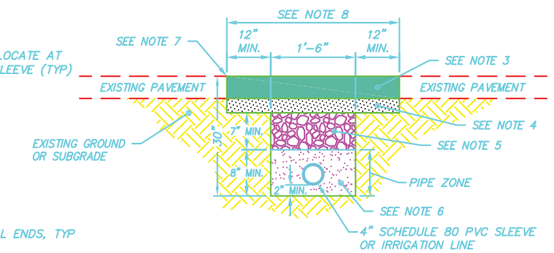
IRRIGATION SLEEVE TRENCH DETAIL NOTES:

1. COMPACTION: BEDDING AND BACKFILL SHALL BE COMPACTED TO 95% MAX. AS DETERMINED BY ASTM D1557.
2. KEEP TRENCH BOTTOM COMPACTED WITH UNIFORM GRADE. A BELL JOINT SHALL BE REQUIRED AT EACH JOINT FOR PROPER SUPPORT. NO TEMPORARY SUPPORTS, I.E. BLOCKS, WILL BE ALLOWED TO SUPPORT SLEEVE. TRENCH BOTTOM SHALL BE TO GRADE PRIOR TO SLEEVE INSTALLATION.
3. HOT MIX ASPHALT CLASS 1/2 IN. PG 64-22, WITH MINIMUM COMPACTED DEPTH OF 3" OR EXISTING PAVEMENT DEPTH PLUS 1", WHICHEVER IS GREATER UP TO A MAXIMUM DEPTH OF 6". PLACE IN LIFTS PER WSDOT STANDARD SPECIFICATION 5-04, AND MACHINE ROLL FLUSH WITH EXISTING PAVEMENT. HOT MIX ASPHALT CLASS 1/2 IN. PG 64-22 IS NOT REQUIRED WITHIN LIMITS OF POROUS CONCRETE AND POROUS ASPHALT.
4. 5/8" MINUS CRUSHED SURFACING TOP COURSE WITH MINIMUM COMPACTED DEPTH OF 2". CRUSHED SURFACING TOP COURSE IS NOT REQUIRED WITHIN LIMITS OF POROUS CONCRETE AND POROUS ASPHALT..
5. TRENCH BACKFILL SHALL BE NATIVE MATERIAL MEETING OR EXCEEDING WSDOT STANDARD SPECIFICATIONS 9-03.10 FOR GRAVEL BASE COMPACTED IN MAXIMUM 6" LIFTS TO 95% MAXIMUM DENSITY. ANY NATIVE MATERIAL USED SHALL BE TESTED FOR COMPACTION AND/OR GRADATION AS REQUIRED BY THE ENGINEER. WITHIN LIMITS OF POROUS CONCRETE AND POROUS ASPHALT, THE DEPTH OF TRENCH BACKFILL SHALL NOT EXCEED ABOVE AND BEYOND THE CROSS SECTION LIMITS, SEE CROSS SECTION DETAILS SHEET 9.
6. GRAVEL BACKFILL FOR PIPE ZONE BEDDING MATERIAL PER WSDOT STANDARD SPECIFICATIONS 9-03.12(3) COMPACTED TO 95% MAXIMUM DENSITY. DEPTH OF MATERIAL SURROUNDING PIPE SHALL BE ADEQUATE TO SUPPORT THE PIPE AND TRENCH.
7. NEAT, UNIFORM, AND VERTICAL CUT (TYPICAL BOTH SIDES). CLEAN AND HEAT EDGES AND TACK WITH EMULSIFIED ASPHALT. SEAL JOINT WITH HOT ASPHALT CEMENT.
8. MINIMUM RESTORATION LIMITS UNLESS OTHERWISE DETERMINED BY THE ENGINEER. IF ANY PORTION OF A LONGITUDINAL PAVEMENT CUT AFFECTS A WHEEL TRACK AS DETERMINED BY THE ENGINEER, THE ENTIRE LANE SHALL BE REMOVED AND REPLACED. WHEREVER AN EXISTING PATCH OR CRACK IS IN CLOSE PROXIMITY TO THE NEW CUT, THE ENGINEER MAY REQUIRE REMOVAL OF THE EXISTING PATCH OR CRACK AND ANY INTERVENING PAVEMENT.
9. ALL PERMANENT FINAL PATCHES SHALL BE RECTANGULAR OR CIRCULAR IN SHAPE AND CONSTRUCTED TO BE PARALLEL AND PERPENDICULAR TO THE ROAD CENTERLINE.
10. WHEN REPLACING GRASS USE: SEEDING, FERTILIZING, MULCHING, AND TOP SOIL TYPE C. WHEN REPLACING GRAVEL USE 5/8" MINUS CRUSHED SURFACE TOP COURSE, 4" MINIMUM COMPACTED DEPTH.
11. TRENCH WIDTH SHALL BE AS SPECIFIED IN SECTION 2-09.4 OF THE WSDOT STANDARD SPECIFICATIONS.
12. CONTROLLED DENSITY BACKFILL MATERIAL SHALL COMPLY WITH WSDOT STANDARD SPECIFICATIONS SECTION 2-09.3(1)E.
13. SEE SPECIAL PROVISION "IRRIGATION SYSTEM".



SLEEVE END TREATMENT SECTION

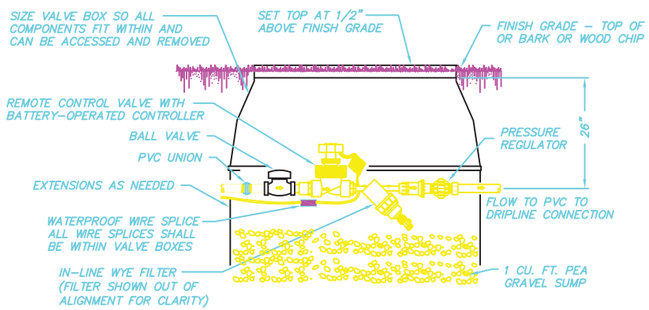
NOT TO SCALE



IRRIGATION SLEEVE ASPHALT PAVEMENT RESTORATION SECTION

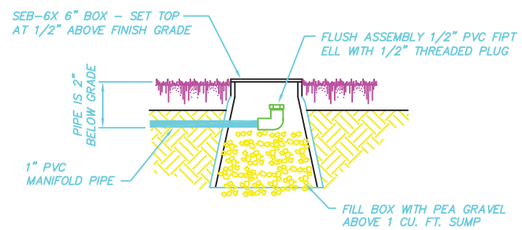
NOT TO SCALE

3/16 IRRIGATION SLEEVE TRENCH DETAIL



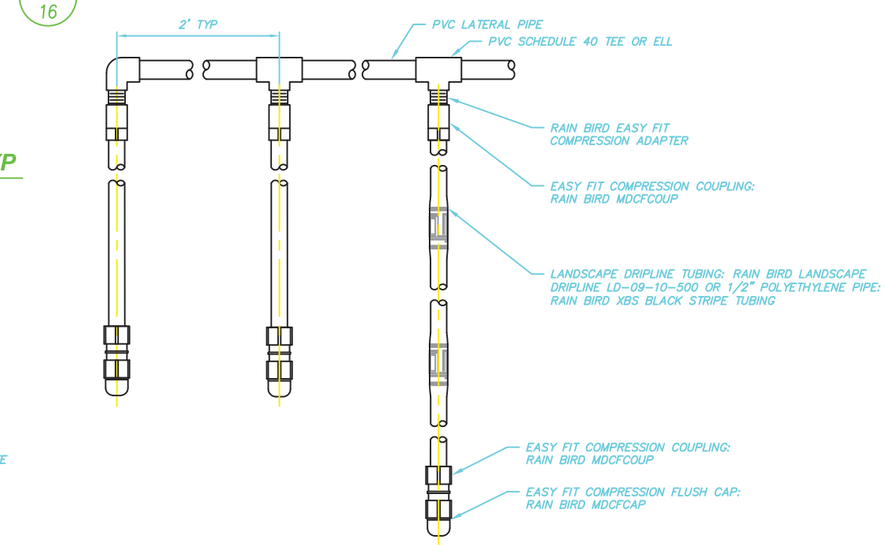
4/16 DRIP ZONE CONTROL KIT INSTALLATION TYP

NOT TO SCALE



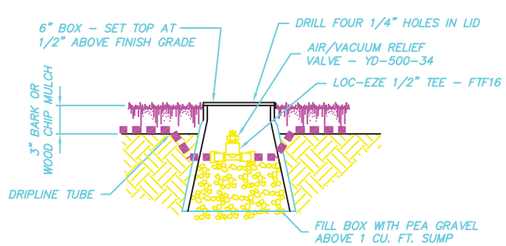
5/16 FLUSH ASSEMBLY (F) INSTALLATION TYP

NOT TO SCALE



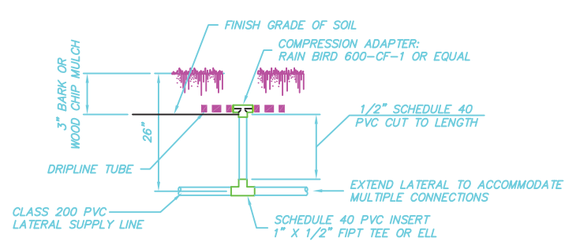
8/16 LANDSCAPE DRIPLINE LATERALS

NOT TO SCALE



6/16 AIR / VACUUM RELIEF VALVE (AR) INSTALLATION TYP

NOT TO SCALE



7/16 PVC TO DRIPLINE CONNECTION TYP

NOT TO SCALE

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PB
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

STATE OF WASHINGTON 33750 REGISTERED PROFESSIONAL ENGINEER

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

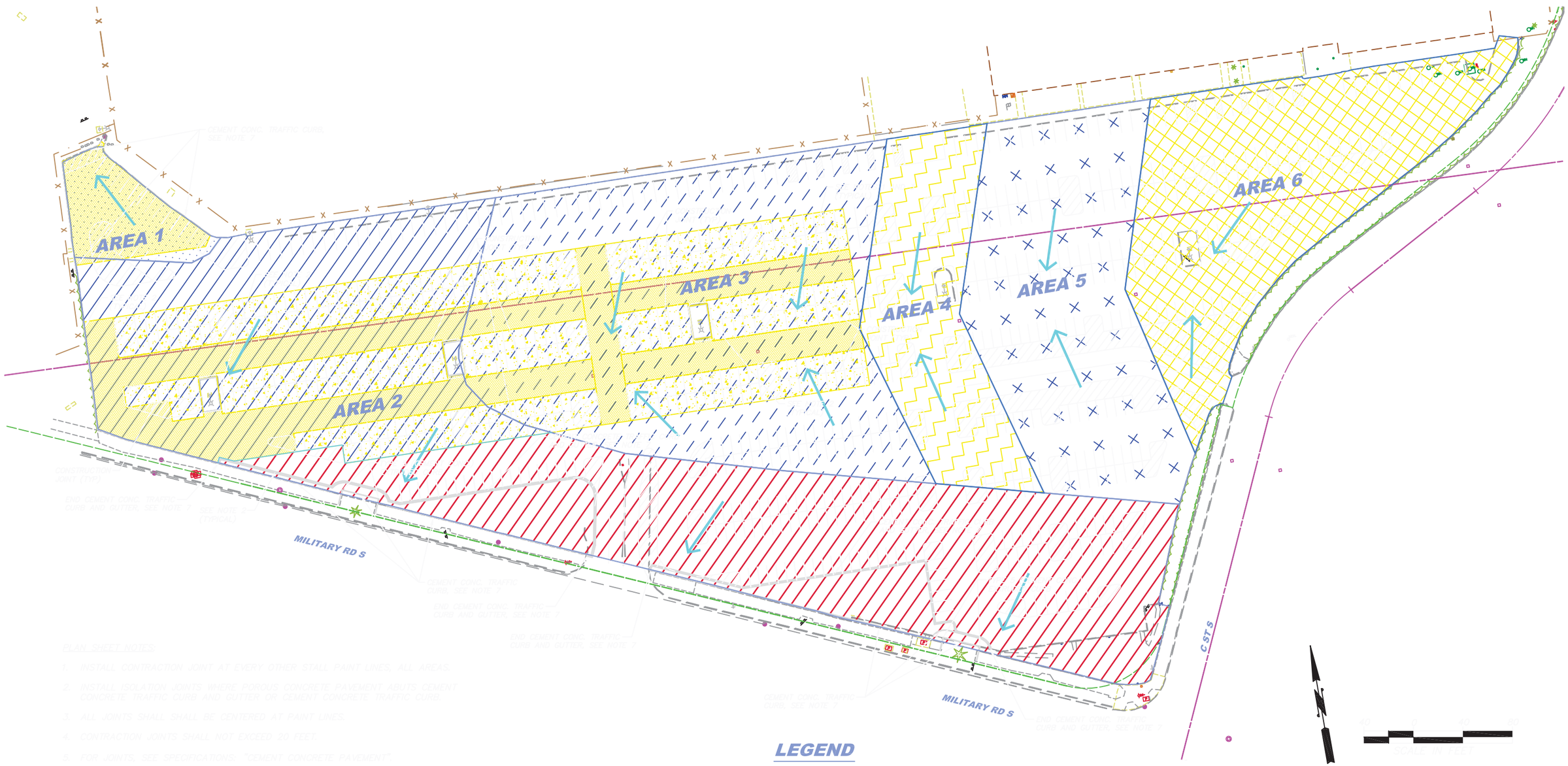
IRRIGATION DETAILS

C.I.P. # D212-006

Date: Dec 28, 2010 10:50:30 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SEC. 21, T. 19 N., R. 3 E., W.M.



PLAN SHEET NOTES:

1. INSTALL CONTRACTION JOINT AT EVERY OTHER STALL PAINT LINES, ALL AREAS.
2. INSTALL ISOLATION JOINTS WHERE POROUS CONCRETE PAVEMENT ABUTS CEMENT CONCRETE TRAFFIC CURB AND GUTTER OR CEMENT CONCRETE TRAFFIC CURB.
3. ALL JOINTS SHALL SHALL BE CENTERED AT PAINT LINES.
4. CONTRACTION JOINTS SHALL NOT EXCEED 20 FEET.
5. FOR JOINTS, SEE SPECIFICATIONS: "CEMENT CONCRETE PAVEMENT".
6. ANY IMPACTED EXISTING ITEMS, INCLUDING BUT NOT LIMITED TO, PAVEMENT MARKERS, EXTRUDED CURBING, GATE POSTS, BOLLARDS, ETC. SHALL BE RESET AND INCIDENTAL. SEE SPECIAL PROVISION: "PROJECT TEMPORARY TRAFFIC CONTROL".
7. SEE PLAN SHEETS 3, 5, AND 9 FOR COORDINATE CALLOUTS, LOCATIONS, AND DETAILS.

LEGEND

- CEMENT CONC. TRAFFIC CURB
- CEMENT CONC. TRAFFIC CURB AND GUTTER
- TYPE 5 (CEMENT CONC.) EXTRUDED CURB
- POROUS CONCRETE
- POROUS ASPHALT

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PS
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

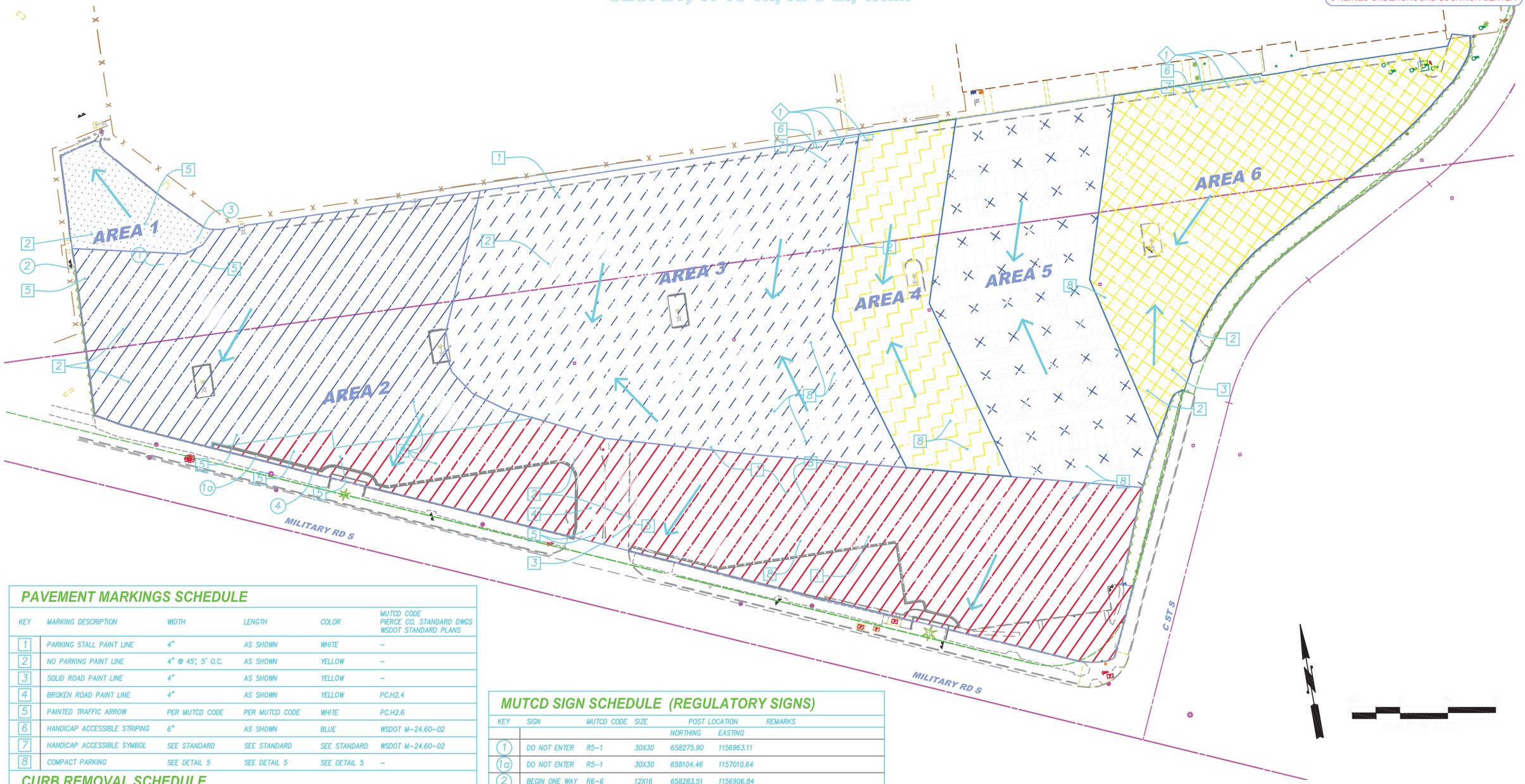
STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER 33750

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD
TRAFFIC CURB AND JOINT PLAN
C.I.P. # D212-006

Date: Dec 28, 2010 10:50:54 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

SEC. 21, T. 19 N., R. 3 E., W.M.



PAVEMENT MARKINGS SCHEDULE

KEY	MARKING DESCRIPTION	WIDTH	LENGTH	COLOR	MUTCD CODE PIERCE CO. STANDARD DWGS WSDOT STANDARD PLANS
1	PARKING STALL PAINT LINE	4"	AS SHOWN	WHITE	–
2	NO PARKING PAINT LINE	4" @ 45°, 5' O.C.	AS SHOWN	YELLOW	–
3	SOLID ROAD PAINT LINE	4"	AS SHOWN	YELLOW	–
4	BROKEN ROAD PAINT LINE	4"	AS SHOWN	YELLOW	P.C.H2.4
5	PAINTED TRAFFIC ARROW	PER MUTCD CODE	PER MUTCD CODE	WHITE	P.C.H2.6
6	HANDICAP ACCESSIBLE STRIPING	6"	AS SHOWN	BLUE	WSDOT M-24.60-02
7	HANDICAP ACCESSIBLE SYMBOL	SEE STANDARD	SEE STANDARD	SEE STANDARD	WSDOT M-24.60-02
8	COMPACT PARKING	SEE DETAIL 5	SEE DETAIL 5	SEE DETAIL 5	–

CURB REMOVAL SCHEDULE

KEY	DESCRIPTION
1	SAWCUT AND REMOVE EXTRUDED CURB AT ACCESSIBLE ROUTE STRIPING FULL WIDTH. REMOVE ALL EVIDENCE OF CURB.

MUTCD SIGN SCHEDULE (REGULATORY SIGNS)

KEY	SIGN	MUTCD CODE	SIZE	POST LOCATION NORTHING	POST LOCATION EASTING	REMARKS
1	DO NOT ENTER	R5-1	30X30	658275.90	1156963.11	
1a	DO NOT ENTER	R5-1	30X30	658104.46	1157010.64	
2	BEGIN ONE WAY	R6-6	12X16	658283.51	1156906.84	
3	END ONE WAY	R6-7	12X16	658290.58	1156933.05	
4	ONE WAY	R6-2	24X30	658084.32	1157055.32	ORIENTATE ARROW POINTING RIGHT

Date: Dec 28, 2010 10:54:02 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08
DESIGNED BY: E. GRIMM	BOOK NO. ---
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP

NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PS
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

SPRINKER PARKING LOT LID PHASE 2

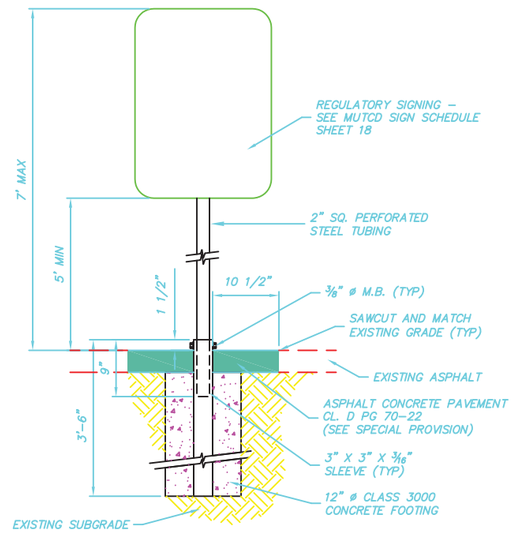
700 SOUTH MILITARY ROAD

SIGNAGE AND STRIPING PLAN

C.I.P. # D212-006

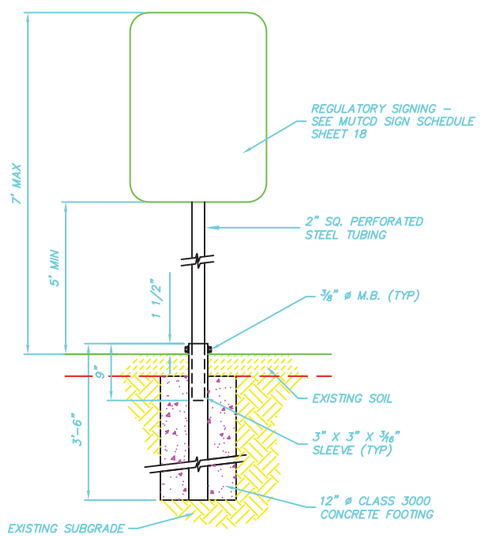
CALL 2 WORKING DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

1/19 NOT USED



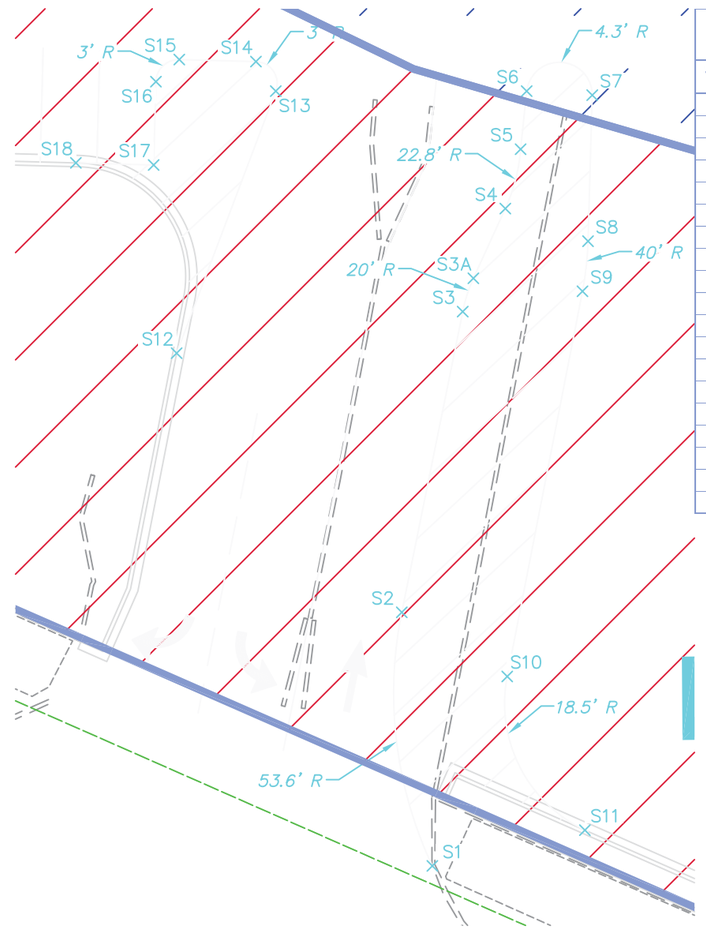
2/19 REGULATORY SIGN INSTALLATION IN EXISTING ASPHALT

NOT TO SCALE



3/19 REGULATORY SIGN INSTALLATION IN SOIL

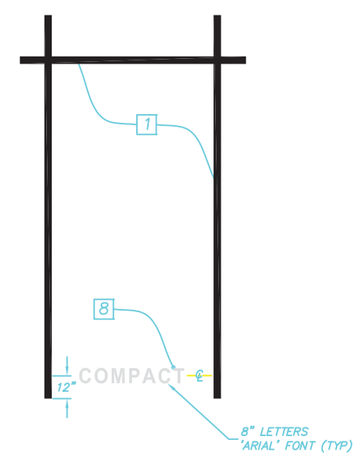
NOT TO SCALE



PAVEMENT MARKINGS SCHEDULE		
SYMBOL NO.	NORTHING	EASTING
S1	N: 657963.75	E: 1157302.94
S2	N: 657997.22	E: 1157298.90
S3	N: 658036.90	E: 1157306.95
S3A	N: 658041.30	E: 1157308.35
S4	N: 658050.49	E: 1157312.57
S5	N: 658058.34	E: 1157314.59
S6	N: 658066.00	E: 1157315.39
S7	N: 658065.46	E: 1157324.05
S8	N: 658046.19	E: 1157323.49
S9	N: 658039.58	E: 1157322.76
S10	N: 657988.76	E: 1157312.82
S11	N: 657968.48	E: 1157323.08
S12	N: 658031.42	E: 1157269.20
S13	N: 658066.00	E: 1157282.28
S14	N: 658069.90	E: 1157279.66
S15	N: 658070.17	E: 1157269.54
S16	N: 658067.25	E: 1157266.46
S17	N: 658056.25	E: 1157266.17
S18	N: 658056.53	E: 1157255.89

4/19 ENLARGED STRIPING PLAN

SCALE: 1"=10'-0"



5/19 COMPACT PARKING STALL LETTERING

NOT TO SCALE

DRAWING NO. SEE SIDE STAMP	SURVEYED BY: W. O'NEIL				
DRAWN BY: E. GRIMM	DATE SURVEYED: 10/21/08				
DESIGNED BY: E. GRIMM	BOOK NO. ---				
CHECKED BY: AL ZEHNI, P.E.	DATE PLOTTED: SEE SIDE STAMP	NO.	DATE	REVISION	BY	APPROVED

Robert W. Droll
Landscape Architect, PS
4405 7TH AVENUE SE, STE. 203
LACEY, WA 98503

Pierce County
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
SURFACE WATER MANAGEMENT
TACOMA MALL PLAZA BUILDING
2702 SOUTH 42nd STREET, SUITE 201
TACOMA, WA 98409-7322

APPROVED BY:
HAROLD SMELT, P.E. SURFACE WATER MANAGEMENT MANAGER

STATE OF WASHINGTON 33750 REGISTERED PROFESSIONAL ENGINEER

SPRINKER PARKING LOT LID PHASE 2
700 SOUTH MILITARY ROAD

SIGNAGE AND STRIPING DETAILS

C.I.P. # D212-006

Date: Dec 28, 2010 10:54:41 AM ()
Drawing: O:\PROJ\00-00099-000\CAD\08-04032-003\D212-CNSHTSQAPP.DWG
Xrefs: (DIESEL evaluation failed)