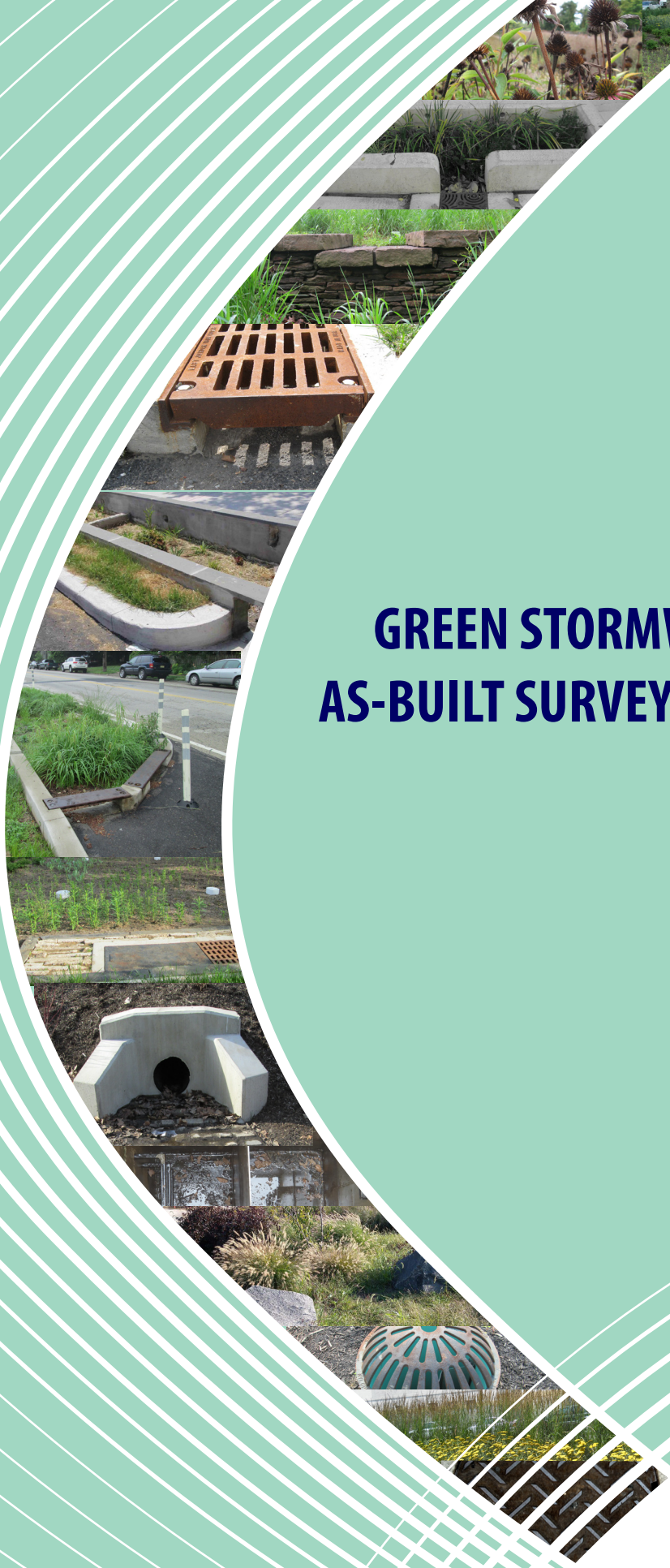

GREEN STORMWATER INFRASTRUCTURE AS-BUILT SURVEY AND DRAFTING MANUAL

PREPARED FOR:

PHILADELPHIA WATER
EST. 1801

PREPARED BY:

AKRF

JUNE 2015

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INTRODUCTION

This Green Stormwater Infrastructure (GSI) As-Built Survey and Drafting Manual describes procedures for collecting and drafting as-built survey data for GSI systems in the City of Philadelphia. These standards and sample drawings may be used to guide the survey process and to draft survey drawings that are clear, accurate, and ready for approval.

NEED FOR AS-BUILT DATA

The Philadelphia Water Department (PWD) uses as-built surveys for many purposes. As-built drawings provide elevation data, descriptive information, and maintenance information.

Survey data will help confirm that a stormwater management practice (SMP) can capture and treat the volume of water it was designed to manage. Elevation data can prove that built SMPs capture water as designed. Information about materials, locations, shape, and size can help crews maintain the SMPs easily and efficiently. PWD enters this information into maps and databases that require highly specific formatting. The manual presents detailed instructions for collecting and presenting survey data in a manner that integrates smoothly with PWD's existing records and processes.

NOTE

Accurate as-built data provides important information for the evaluation of PWD's GSI program, and is used by various functional groups within PWD for a variety of applications.

HOW TO USE THIS MANUAL

The manual consists of two major sections: As-Built Survey Standard Operating Procedures (SOPs) and Drawing SOPs. **Survey SOPs** list the survey points and descriptive data that must be collected during construction and after construction. **Drawing SOPs** describe the layers, linetypes, and labels needed to prepare an approved as-built record drawing.

Survey SOPs are organized by GSI feature (e.g., inlets, pipes, surface storage, etc.) and include definitions of the feature, descriptions of each required survey point, photos, and maps depicting where to obtain survey points to capture various features. Features are grouped into two sections: those that must be surveyed during construction, and those that must be surveyed post construction.

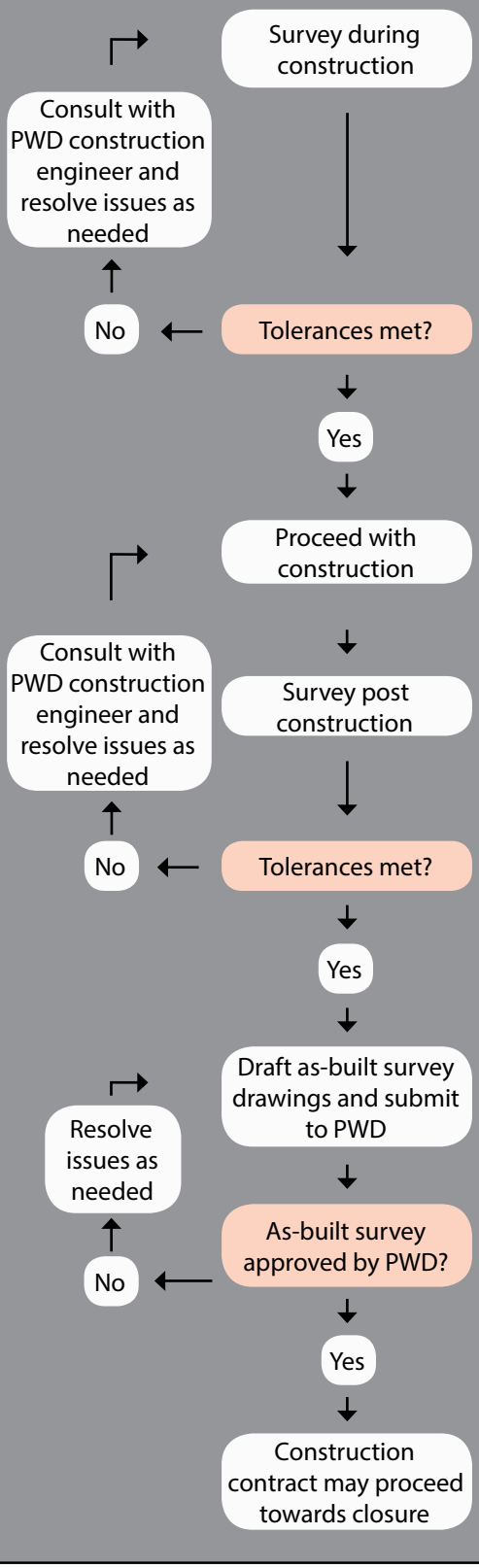
Drawing SOPs are organized into three sections: drafting instructions, drafting standards, and allowable annotation values. These sections contain step-by-step guidance for constructing linework from as-built survey data; importing existing linework; standard linestyles, blocks, layouts, legend, and plot styles; and preparing drawings for final review.

Together these materials contain all the information necessary to complete an as-built survey and submit an approved record drawing. These checklists are hyper-linked to detailed photos, tables, drawings, and instructions for the collection and representation of data.

INTRODUCTION

GENERAL INFORMATION

AS-BUILT PROCESS OVERVIEW



MATERIALS PROVIDED BY PWD

PWD provides a bid package for GSI projects to the project contractor prior to construction. The bid package includes:

- Hard copies of construction documents and specifications
- Standard as-built template file (*.dwg) supplying layers, blocks, linestyles, legend, and plot style standards
- Standard CAD plot style file (*.ctb)

These materials can be used to compare the position, material, dimensions, and components of constructed features against proposed conditions, and to identify and document deviations from the design during construction.

SUBMISSION PROCESS

PWD requires that all survey submissions follow a standard process (see diagram at left). Both during and after construction, as-built survey data must be reviewed and compared to construction documents. If features are found to not meet PWD acceptable tolerances, these issues should be reviewed with the PWD construction engineer and resolved as needed.

After construction, the as-built surveyor will submit all final survey data to PWD in the format described on the following page. One drawing should be prepared for each GSI system, showing all newly constructed features and all features modified during GSI construction.

PWD will review this submission for completeness. If survey data are acceptable, PWD will approve the survey and the project will move forward toward closeout. If the submission is rejected, all PWD comments must be resolved before acceptance of the as-built survey.

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SUBMISSION REQUIREMENTS

The checklist presented below lists all data required for a complete as-built survey submission. Files are to be submitted to PWD Records and GIS units on a CD or DVD labeled with the contractor name, PWD work number, and date of submission. **All *.dwg files should be saved in DWG 2000 file format for submission.**

Submission Requirements Checklist

Requirement Description	Required Submission Format	
Drawing showing all newly constructed features and all features modified during GSI construction.	*.dwg (DWG 2000) file for each GSI project (in general, one *.dwg plan shows one city block).	☐
Survey point data from all newly constructed features and all features modified during GSI construction.	*.txt file in tab-delimited format. At a minimum, columns must consist of point number, northing, easting, elevation, and point description/type.	☐
Construction contractor red line mark-ups of as-built features.	*.pdf file for each plan sheet.	☐

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AS-BUILT SURVEY STANDARD OPERATING PROCEDURES

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HOW TO USE THIS SECTION

GENERAL

As-Built Survey SOPs, outlined in the pages that follow, define the survey data points and descriptive data required to complete a GSI As-Built Survey. This data will be used to construct and annotate as-built drawings according to specification, outlined in the As-Built Drawing SOPs.

ORGANIZATION OF SURVEY SOPs

Some GSI features are inaccessible after construction is complete (e.g., underdrains, pipe bends and connections, etc.). These GSI features must be surveyed during construction, and prior to backfill. All other GSI features must be surveyed post-construction. Consistent with this schedule, the As-Built Survey SOPs are organized into two sections: During Construction and Post-Construction. Both sections include a checklist with definitions of all required GSI features to be surveyed, followed by detailed SOPs for each GSI feature. Each SOP contains the following information:

- Definition of the GSI features to be surveyed;
- List of the survey points required for each GSI feature;
- Description of each required survey point;
- Example photos and plans/profiles as needed to illustrate each survey point;
- List of additional documentation required to prepare drawings (material, dimensions, etc.); and
- References to related sections as applicable.

In each section, text boxes like these shown on the right, are included to highlight important documentation needed for preparation of the as-built drawing, and to reference related GSI features and SOPs.

DOCUMENT

- ✓ Information needed for completion of the as-built drawing

RELATED SECTIONS

- ✓ Features/SOPs that are structurally connected

DURING CONSTRUCTION

The first phase of the survey process is conducted during construction for all GSI features that are inaccessible following backfill. These features are:

- Subsurface Storage SMPs
- Pipes and Fittings

POST CONSTRUCTION

The second phase of the survey process is conducted post-construction for all GSI features that remain accessible following backfill. These features are:

- Inflow & Outflow Controls
- Access Structures
- Monitoring Structures
- Surface Storage SMPs
- Pavement and Curbs

NOTE

All survey points documented must include **both** horizontal and vertical points.

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HOW TO USE THIS SECTION

SURVEY DATA COLLECTION

Survey data must be collected according to the following guidelines:

- Horizontal data must be collected in NAD 1983 State Plane Pennsylvania South FIPS 3702 Feet.
- Vertical data must be collected in Philadelphia City Datum.
- All survey points must include horizontal and vertical data.
- The survey shall be completed with instrumentation that provides accuracy to hundredths of a foot.
- The contractor shall establish a local temporary benchmark, related by survey from an established benchmark in City Plan elevation. Each temporary benchmark shall be described and identified on the as-built drawings as appropriate.

TOLERANCE STANDARDS

If features are found to not meet PWD acceptable tolerances, these issues must be reviewed with the PWD construction engineer and resolved as needed.

TYPICAL SMP SURVEY WORKFLOWS

The following pages provide summary step-by-step workflow diagrams to guide the survey of common types of SMPs, including tree trenches, subsurface storage, permeable pavement, rain gardens, and planters/bumpouts. These typical workflows refer to more detailed technical guidance provided in the body of the As-Built Survey SOPs.

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TYPICAL SMP SURVEY WORKFLOWS

TYPICAL SMP SURVEY WORKFLOW

TYPICAL SMP SURVEY WORKFLOWS

TREE TRENCH

1. DURING CONSTRUCTION

STORAGE STONE

Once final subgrade has been approved, survey subsurface storage perimeter and internal points, and document materials, configuration, and dimensions (see page 21).

PIPES

Pipes can be installed once subgrade preparations have been set and approved. Survey the pipe inverts and fittings, and document materials and configurations (see page 23).

2. POST-CONSTRUCTION

INLETS

Following final installation of the system, survey the inlet locations, surface elevations, dimensions of concrete apron, and inverts of all pipe connections, and document inlet type, dimensions, and presence of features within inlet (see page 28).

SUMPS, TRAPS, & HOODS

Survey structure sumps, and document the presence as well as material type of any inlet hoods and/or traps (see page 31).

ORIFICES

Survey the invert and diameter of orifices, and document material (see page 36).

CLEANOUTS

Survey cleanout cover rim, and document material, dimensions, and direction of sweeps (see page 43).

OBSERVATION WELLS

Survey observation well cover rim, an invert of observation well bottom, and document materials and diameter (see page 46).

STORMWATER TREES

Survey location of trunk, perimeter and internal points of each tree pit, and document trunk diameter (see page 49).

CURBS

Survey top and bottom of curblines, and document direction of gutter slope (see page 52).

CAUTION: This typical workflow is meant to guide survey steps and does not provide a comprehensive list of all possible system configurations and scenarios for tree trench SMPs.

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TYPICAL SMP SURVEY WORKFLOW

SUBSURFACE STORAGE TRENCH

1. DURING CONSTRUCTION

STORAGE STONE

Once final subgrade has been approved, **survey** subsurface storage perimeter and internal points, and **document** materials, configuration, and dimensions (see page 21).

PIPES

Pipes can be installed once subgrade preparations have been set and approved. **Survey** the pipe inverts and fittings, and **document** materials and configurations (see page 23).

2. POST-CONSTRUCTION

INLETS

Following final installation of the system, **survey** the inlet locations, surface elevations, dimensions of concrete apron, and inverts of all pipe connections, and **document** inlet type, dimensions, and presence of features within inlet (see page 28).

SUMPS, TRAPS, & HOODS

Survey structure sumps, and **document** the presence as well as material type of any inlet hoods and/or traps (see page 31).

ORIFICES

Survey the invert and diameter of orifices, and **document** material (see page 36).

MANHOLES & PORTS

Survey manhole and maintenance port rim elevations and bottom of access structures. **Document** material of structure and cover, and diameter of structure cover (see page 42).

CLEANOUTS

Survey cleanout cover rim, and **document** material, dimensions, and direction of sweeps (see page 43).

OBSERVATION WELLS

Survey observation well cover rim, an invert of observation well bottom, and **document** materials and diameter (see page 46).

CAUTION: This typical workflow is meant to guide survey steps and does not provide a comprehensive list of all possible system configurations and scenarios for subsurface storage trench SMPs.

TYPICAL SMP SURVEY WORKFLOW

TYPICAL SMP SURVEY WORKFLOWS

RAIN GARDEN

1. DURING CONSTRUCTION

STORAGE STONE

Once final subgrade has been approved, **survey** subsurface storage perimeter and internal points, and **document** materials, configuration, and dimensions (see page 21).

PIPES

Pipes can be installed once subgrade preparations have been set and approved. **Survey** the pipe inverts and fittings, and **document** materials and configurations (see page 23).

2. POST-CONSTRUCTION

INLETS

Following final installation of the system, **survey** the inlet locations, surface elevations, dimensions of concrete apron, and inverts of all pipe connections, and **document** inlet type, dimensions, and presence of features within inlet (see page 28).

CONTROL STRUCTURES

Survey the location, grate elevations, and invert of all pipe connections. **Document** standard type, dimensions, and features (see page 29).

DOMED RISERS

Survey the rim elevation of domed riser structures, and **document** the diameter of both grate and riser pipe, the material of grate and riser pipe, and the presence of other features (see page 30).

SUMPS, TRAPS, & HOODS

Survey structure sumps, and **document** the presence as well as material type of any inlet hoods and/or traps (see page 31).

SPILLWAYS & WEIRWALLS

Survey the crest of weir, corners of spillway or weir wall, and the surface elevation upslope and downslope of spillway or weirwall, and **document** the material and shape (see page 32).

TRENCH DRAINS

Survey the lowest point and top of grate of trench drain and dimensions of concrete apron, and **document** channel and cover materials and type of trench drain cover (see page 34).

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TYPICAL SMP SURVEY WORKFLOW

RAIN GARDEN [CONT.]

ORIFICES

Survey the invert and diameter of orifices, and document material (see page 36).

SPLASH PADS

Survey the perimeter of splash pad, and document the material (see page 37).

SUBSURFACE WEIRS

Survey the crest of the weir and the corners of spillway or weirwall, and document invert of weir crest, high and low point of weir crest, weir shape, and material (see page 38).

ENDWALLS

Survey the location of the endwall, and document the type of endwall, the angle of the wingwall, material, and the presence of a splash pad (see page 39).

MANHOLES & PORTS

Survey manhole and maintenance port rim elevations and bottom of access structures. Document material of structure and cover, and diameter of structure cover (see page 42).

CLEANOUTS

Survey cleanout cover rim, and document material, dimensions, and direction of sweeps (see page 43).

OBSERVATION WELLS

Survey observation well cover rim, an invert of observation well bottom, and document materials and diameter (see page 46).

SURFACE STORAGE

Survey top of bank, bottom of bank, and interior points of surface storage SMPs. Document the vegetation (see page 47).

STORMWATER TREES

Survey location of trunk, perimeter and internal points of each tree pit, and document trunk diameter (see page 49).

CAUTION: This typical workflow is meant to guide survey steps and does not provide a comprehensive list of all possible system configurations and scenarios for rain garden SMPs.

TYPICAL SMP SURVEY WORKFLOW

TYPICAL SMP SURVEY WORKFLOWS

PLANTER / BUMPOUT

1. DURING CONSTRUCTION

STORAGE STONE

Once final subgrade has been approved, **survey** subsurface storage perimeter and internal points, and **document** materials, configuration, and dimensions (see page 21).

PIPES

Pipes can be installed once subgrade preparations have been set and approved. **Survey** the pipe inverts and fittings, and **document** materials and configurations (see page 23).

2. POST-CONSTRUCTION

INLETS

Following final installation of the system, **survey** the inlet locations, surface elevations, dimensions of concrete apron, and inverts of all pipe connections, and **document** inlet type, dimensions, and presence of features within inlet (see page 28).

CONTROL STRUCTURES

Survey the location, surface elevations, and invert of all pipe connections. **Document** standard type, dimensions, and features (see page 29).

DOMED RISERS

Survey the rim elevation of domed riser structures, and **document** the diameter of both grate and riser pipe, the material of grate and riser pipe, and the presence of other features (see page 30).

SUMPS, TRAPS, & HOODS

Survey structure sumps, and **document** the presence as well as material type of any inlet hoods and/or traps (see page 31).

SPILLWAYS & WEIRWALLS

Survey the crest of weir, corners of spillway or weir wall, and the surface elevation upslope and downslope of spillway or weirwall, and **document** the material and shape (see page 32).

TRENCH DRAINS

Survey the lowest point and top of grate of trench drain and dimensions of concrete apron, and **document** channel and cover materials and type of trench drain cover (see page 34).

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TYPICAL SMP SURVEY WORKFLOW

PLANTER / BUMPOUT [CONT.]

CURB OPENINGS

Survey corners of curb opening, and document presence and material of wheel stops (see page 35).

ORIFICES

Survey the invert and diameter of orifices, and document material (see page 36).

SPLASH PADS

Survey the perimeter of splash pad, and document the material (see page 37).

SUBSURFACE WEIRS

Survey the crest of the weir and the corners of spillway or weirwall, and document invert of weir crest, high and low point of weir crest, weir shape, and material (see page 38).

CLEANOUTS

Survey cleanout cover rim, and document material, dimensions, and direction of sweeps (see page 43).

OBSERVATION WELLS

Survey observation well cover rim, an invert of observation well bottom, and document materials and diameter (see page 46).

SURFACE STORAGE

Survey top of bank, bottom of bank, and interior points of surface storage SMPs. Document the vegetation (see page 47).

STORMWATER TREES

Survey location of trunk, perimeter and internal points of each tree pit, and document trunk diameter (see page 49).

CURBS

Survey top and bottom of curblines, and document direction of gutter slope (see page 52).

CAUTION: This typical workflow is meant to guide survey steps and does not provide a comprehensive list of all possible system configurations and scenarios for planter/bumpout SMPs.

TYPICAL SMP SURVEY WORKFLOW

PERMEABLE PAVEMENT

1. DURING CONSTRUCTION

STORAGE STONE

Once final subgrade has been approved, **survey** subsurface storage perimeter and internal points, and **document** materials, configuration, and dimensions (see page 21).

PIPES

Pipes can be installed once subgrade preparations have been set and approved. **Survey** the pipe inverts and fittings, and **document** materials and configurations (see page 23).

2. POST-CONSTRUCTION

MANHOLES & PORTS

Survey manhole and maintenance port rim elevations and bottom of access structures. **Document** material of structure and cover, and diameter of structure cover (see page 42).

CLEANOUTS

Survey cleanout cover rim, and **document** material, dimensions, and direction of sweeps (see page 43).

OBSERVATION WELLS

Survey observation well cover rim, an invert of observation well bottom, and **document** materials and diameter (see page 46).

PERMEABLE PAVEMENT

Survey the surface points of the permeable pavement, and **document** the material (see page 53).

CAUTION: This typical workflow is meant to guide survey steps and does not provide a comprehensive list of all possible system configurations and scenarios for permeable pavement SMPs.

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DURING CONSTRUCTION SURVEY

DURING CONSTRUCTION

The first phase of the survey process is conducted during construction for subsurface GSI features that will be inaccessible following backfill. The During Construction section of the manual describes each of those features to be surveyed, and presents Survey SOPs, photos, details, and a survey completion checklist with all required features (below).

SURVEY COMPLETION CHECKLIST: DURING CONSTRUCTION

Manual Section	Feature Description	All Required Data Collected?	Tolerances Met?	All required testing has been completed and approved by PWD
Subsurface Storage SMPs (page 21)	Subsurface Storage SMPs consist of the horizontal and vertical extents of the area used to store stormwater (e.g., a stone bed with underdrain or layer of rain garden media). Stone storage is not to be confused with stone backfill, which is not designed to provide storage of stormwater.	☐	☐	☐
Pipes (page 23)	Pipes are structures used to convey water (e.g., distribution pipe, underdrain).	☐	☐	☐
Pipe Fittings (page 23)	Pipe Fittings are pre-fabricated connections, joints, or accessories located at pipe ends or pipe segment connections (e.g., wye, elbow, collar, plug, sleeve, tee, vent, summit, valve).	☐	☐	☐

All survey points documented must include **both** horizontal and vertical points.

In addition to the survey requirements described in this manual, all construction must be consistent with PWD standards and project construction specifications for design and proper geotechnical and material testing for GSI systems. All applicable criteria must be documented and approved by PWD construction supervisors prior to backfill of excavation areas.

SUBSURFACE STORAGE SMPs

SUBSURFACE STORAGE SMPs

DURING CONSTRUCTION SURVEY

OVERVIEW

- ✓ Subsurface storage is the horizontal and vertical extent of the area used to store stormwater (e.g., a stone bed with underdrain or a system of concrete vaults).
- ✓ Stone storage areas should not be confused with stone backfill, which is not designed to provide storage for stormwater volume.

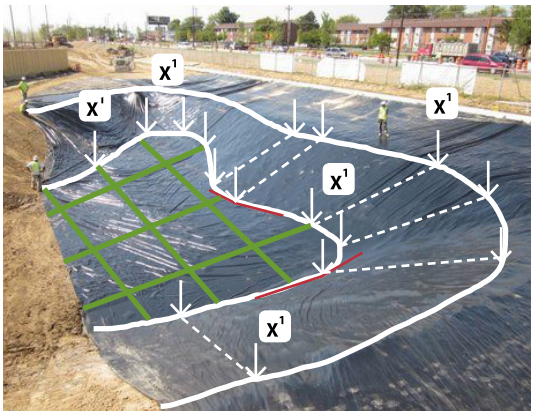
RELATED SECTIONS

- ✓ Pipes and Fittings
- ✓ Surface Storage SMPs

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Subsurface Storage SMPs	X¹ Perimeter points	Survey lowest bottom elevation and top elevation for all corners and at weir locations. For shapes with linear perimeters, corners are defined as intersections; for curvilinear shapes, corners are defined as distinct points of inflection.
	Interior points	Where bottom exceeds 50 ft. width, survey entire footprint using a grid with maximum spacing of 50 ft.

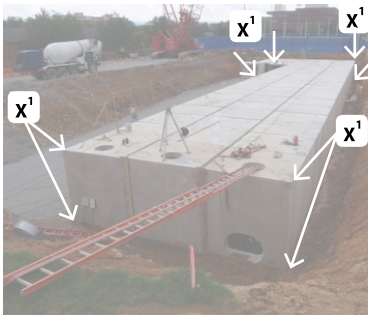
All survey points documented must include **both** horizontal and vertical points.



Curvilinear shape: perimeter points are to be taken at all points of inflection or in a maximum 50 ft grid spacing.

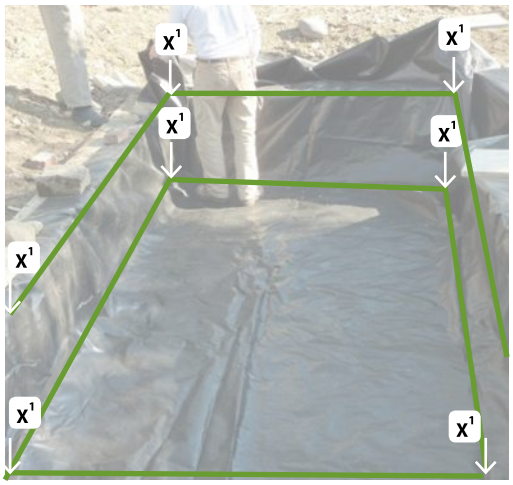
DOCUMENT

- ✓ Storage backfill material type (e.g., stone, crates, etc.)
- ✓ Level or non-level bottom
- ✓ Presence of liner and/or geotextile with manufacturer and type
- ✓ For arch systems, include diameter and number of arches in callout.

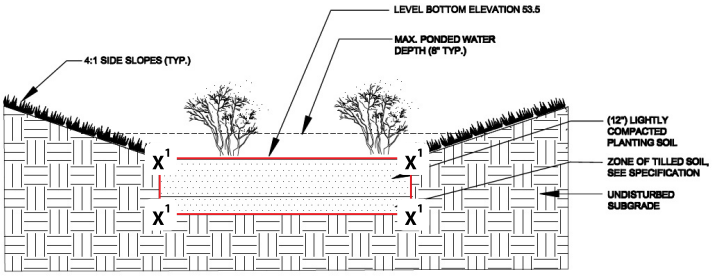


Rectilinear: subsurface vault storage SMP.

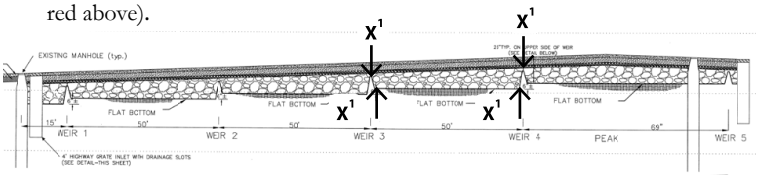
Arched: subsurface storage SMP.



Linear shape: top and bottom of subsurface storage are to be taken. Middle points are only to be taken at straight-line intersects with a maximum distance of 50 ft.



Subsurface Storage: horizontal and vertical extents of storage (outlined in red above).



Subsurface weirs: section of a permeable pavement and subsurface weir system. Survey points represent top and bottom extents of area between weirs.

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PIPES & FITTINGS

PIPES & FITTINGS

DURING CONSTRUCTION SURVEY

OVERVIEW

- ✓ Pipes are structures used to convey water (e.g., distribution pipe, underdrain, arch conveyance structures).
- ✓ Fittings are pre-fabricated connections, joints, or accessories located at pipe ends or joints (e.g., wye, elbow, collar, plug, sleeve, tee, vent, summit, valve).

RELATED SECTIONS

- ✓ Surface Storage SMPs
- ✓ Inlets & Outlets
- ✓ Access Structures

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Pipe	X^1 **Invert** in and out at every pipe end or deflection point.	Bottom interior elevation of pipe at each end of the termination or deflection point.
Fitting	X^2 **Location** of fitting	Top/center point of each fitting.

All survey points documented must include **both** horizontal and vertical points.

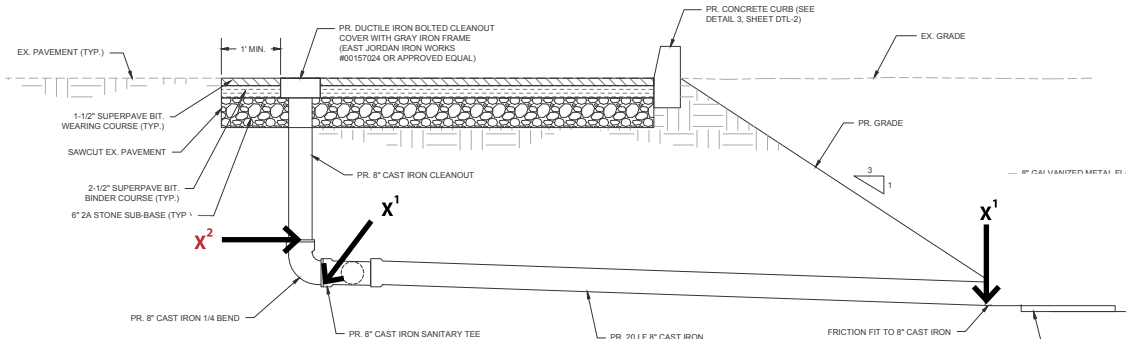
DOCUMENT: FITTINGS

- ✓ Type: wye, elbow, collar, plug, sleeve, tee, vent, valve, plug.
- ✓ Material*
- ✓ Diameter
- ✓ Bend Angle

*See list of acceptable material values in Drawing section page 67.

DOCUMENT: PIPES

- ✓ Perforations
- ✓ Function (distribution, underdrain, lateral)
- ✓ Interior diameter and shape (of all variations)



Sample design profile: location of fitting and pipe invert.

Pipe invert: bottom interior elevation of pipe at end.

Location: of fitting.

Location: of fitting.

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POST-CONSTRUCTION SURVEY

POST-CONSTRUCTION

The second phase of the survey process is conducted post-construction for all GSI features that remain accessible following backfill. The Post-Construction section of the manual describes each of those features to be surveyed, and presents Survey SOPs, photos, details, and a survey completion checklist with all required features (below).

SURVEY COMPLETION CHECKLIST: POST-CONSTRUCTION

Manual Section	Feature Description	All Required Data Collected?	Tolerances Met?
Inflow & Overflow Controls (page 27)	Inlet Structures allow water to flow into or out of an SMP.	☐	☐
	Control Structures regulate the amount of water going in or out of an SMP.	☐	☐
	Domed Risers establish a high water level and regulate the overflow of stormwater from surface storage SMPs.	☐	☐
	Sumps, Traps, and Hoods are features sometimes present within an inlet, where sediment, and trash are collected or sewer gas is blocked from escaping the structure.	☐	☐
	Spillways & Weir Walls are structures that establish a high water level and can provide a controlled overflow of stormwater from an SMP.	☐	☐
	Swales are vegetated surface conveyance systems that direct water towards an SMP.	☐	☐
	Trench Drains are typically concrete channels with solid or grated covers that can convey stormwater runoff to SMPs under areas of pedestrian traffic such as sidewalks.	☐	☐
	Curb Openings are breaks in curbing that allow stormwater runoff to flow into an SMP.	☐	☐
	Orifices are openings created within a pipe cap, inlet structure, or plate that controls stormwater release rate.	☐	☐
	Splash Pads are structures that dissipate energy and reduce the velocity of stormwater flows to prevent erosion.	☐	☐
	Subsurface Weirs are structures that are located within an inlet structure or below grade that establish a high water level and can provide a controlled overflow of stormwater from an SMP.	☐	☐
	Endwalls (or flared end sections) are structures located at the downstream end of conveyance pipes that protect side slopes from erosion.	☐	☐
Access Structures (page 41)	Manholes and Maintenance Ports are structures that provide surface access to subsurface infrastructure.	☐	☐
	Cleanouts are solid vertical pipes (typically 6" - 8" PVC) that provide surface access to subsurface pipes	☐	☐
Monitoring Structures (page 45)	Observation Wells are perforated vertical pipes that allow for monitoring of water levels within an SMP.	☐	☐
Surface Storage SMP (page 47)	Surface Storage SMP consist of depressed areas (i.e., basin, blue roof, bumpout, green roof, planter, rain garden, wetland, etc.) where stormwater runoff is collected and stored.	☐	☐
Stormwater Trees (page 49)	Stormwater Trees are trees planted within a surface or subsurface storage footprint of an SMP.	☐	☐
Pavement & Curblines (page 51)	Curblines mark the point where curbs meet the edge of the roadway.	☐	☐
	Permeable pavement is a structural surface that allows stormwater to infiltrate through a stone subbase.	☐	☐

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INFLOW & OVERFLOW CONTROLS

INLET STRUCTURES

OVERVIEW

- ✓ Inlets are structures or openings that allow water to flow into or out of an SMP.
- ✓ Inlets can come in several different forms (e.g., highway, open mouth grate (OMG), city, or non-standard).
- ✓ Pretreatment structures may be present: water quality inserts, sumps, and inlet traps.

RELATED SECTIONS

- ✓ Orifice
- ✓ Subsurface Weir
- ✓ Sumps, Inlet traps, and Hoods
- ✓ Domed Risers

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Inlet Structures	X^1 Inlet location	Horizontal center of grate or manhole cover as applicable.
	X^2 Curb Opening of city or OMG inlets	Bottom of curb elevation at midpoint point across curb opening (if city inlet).
	X^3 Invert of all pipe connections	Bottom interior elevation of the pipe end.
	X^4 Concrete Apron Dimensions	Grade changes of concrete apron along the gutter line, plus apron extent opposite inlet opening (if city inlet).

All survey points documented must include **both** horizontal and vertical points.

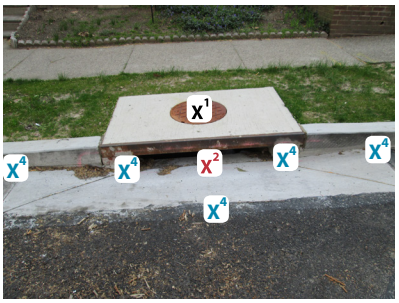
Invert: of pipe connection.

DOCUMENT

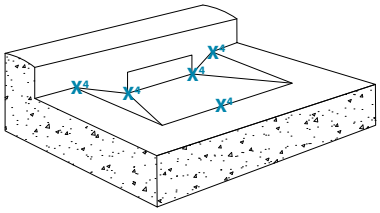
- ✓ Standard inlet type, if applicable*
- ✓ Surface dimensions if non-standard
- ✓ Presence of water quality insert, manufacturer and model number of insert*
- ✓ Presence of an orifice, subsurface weir, inlet sump, inlet trap, and/or inlet hood (if present, see feature SOP for required survey points)
- ✓ Invert of all pipe connections
- ✓ Depth of concrete apron depression

*See list of acceptable material values in Drawing section on page 70.

Highway Grate Inlet: survey centroid of grate.



City Inlet: survey midpoint across curb opening and concrete apron dimensions.



Concrete apron dimensions: Grade changes of concrete apron along the gutter line, plus apron extent opposite inlet opening.

Non-Standard Inlet: dual trap inlet.

PHILADELPHIA WATER

CONTROL STRUCTURES

OVERVIEW

- ✓ Control structures regulate the amount of water going into or out of an SMP.
- ✓ Control structures may contain a single chamber, or multiple chambers connected by an orifice or other opening.
- ✓ Pretreatment structures may be present: water quality inserts, sumps, and inlet traps.

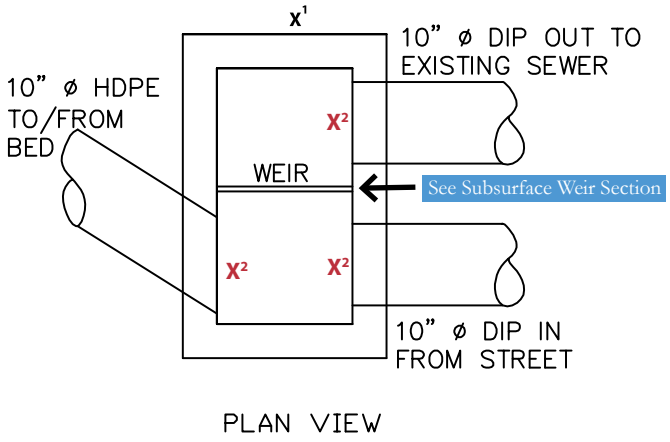
RELATED SECTIONS

- ✓ Orifice
- ✓ Subsurface Weir
- ✓ Sumps, Inlet traps, and Hoods
- ✓ Domed Risers

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Control Structures	X¹ Control structure location	Horizontal center of grate, manhole, or other cover as applicable.
	X² Invert of all pipe connections	Bottom interior elevation of the pipe end.

All survey points documented must include **both** horizontal and vertical points.



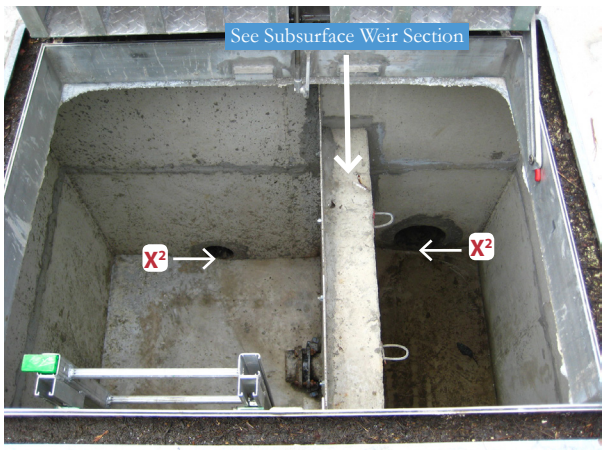
Multiple Flow-Control Structures example

DOCUMENT

- ✓ Standard inlet type, if applicable*
- ✓ Surface dimensions if non-standard
- ✓ Presence of water quality insert, manufacturer and model number of insert*
- ✓ Presence of an orifice, subsurface weir, inlet sump, inlet trap, and/or inlet hood (if present, see feature SOP for required survey points)
- ✓ Invert of all pipe connections

*See list of acceptable material values in Drawing section on page 72

Control Structure: if elevated, must verify dimensions of the structure itself along with the non-standard openings. Also must provide centroid at top of grate.



Control Structure: make sure to survey the invert of all pipe connections

POST CONSTRUCTION SURVEY

DOMED RISERS

OVERVIEW

- ✓ Risers typically establish a high water level and regulate the overflow of stormwater from storage basins (e.g., rain gardens, stormwater bumpouts, etc.).
- ✓ Domed risers typically consist of a vertical pipe with a grated cover.
- ✓ Materials: concrete, metal (e.g., steel, cast iron, etc.), or plastic (e.g., HDPE, PVC, etc.).

RELATED SECTIONS

- ✓ Inlet Structures
- ✓ Pipes & Fittings

REQUIRED SURVEY POINTS

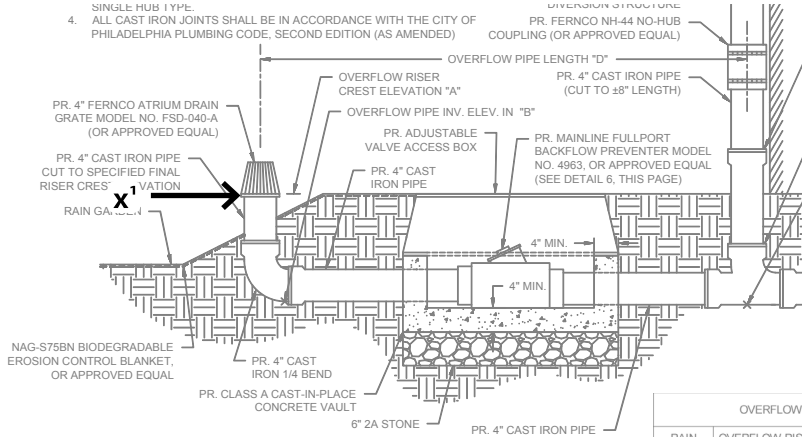
Feature	Required Survey Point	Description of Survey Point
Domed Risers	X[1] **Rim elevation** of riser structure	Lowest level of the grate where water would enter the riser.

All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

- ✓ Diameter of **both** grate and riser pipe
- ✓ Material of grate and riser pipe*
- ✓ Presence and model/manufacturer of water quality insert*

*See list of acceptable material values in Drawing section on page 72



Rim elevation: the lowest level of the grate where water would enter the riser.

Rim elevation: the lowest level of the grate where water would enter the riser.

Rim elevation: the lowest level of the grate where water would enter the riser.

PHILADELPHIA WATER

SUMPS,TRAPS,&HOODS

OVERVIEW

- ✓ An inlet sump is the area within an inlet below the lowest pipe invert elevation.
- ✓ Inlet traps are cast iron structures installed over sewer laterals within inlet structures to prevent the escape of sewer gas.
- ✓ Inlet hoods are structures installed over a lateral or distribution pipe to provide protection from floatable trash and debris.
- ✓ These features will not be present in all inlets.

RELATED SECTIONS

- ✓ Inlet Structures
- ✓ Orifice
- ✓ Subsurface Weir
- ✓ Pipes and Fittings

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Inlet Sump	X[1] Bottom of box	Defined as the bottom interior elevation of an inlet structure (referred)

All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

- ✓ Presence of a inlet hood and/or trap
- ✓ Material* of inlet hood and/or trap

*See list of acceptable material values in Drawing section on page 70

Inlet hood: view from above.

Refer to the Inlet Structures and Pipes and Fittings sections of this manual for guidance on surveying the pipe invert at termination point.

Bottom of box: Survey the bottom interior elevation of the inlet.

Sumps, traps, and hoods may not be present in all inlets!

POST CONSTRUCTION SURVEY

SPILLWAYS&WEIRWALLS

OVERVIEW

- ✓ Spillways and weir walls are structures that establish a high water level and can provide a controlled overflow of stormwater.
- ✓ Surface weirs can be various shapes (e.g., rectangular, v-notch, etc.) and materials (e.g., concrete, masonry, metal, earthen materials, etc.) are typical.

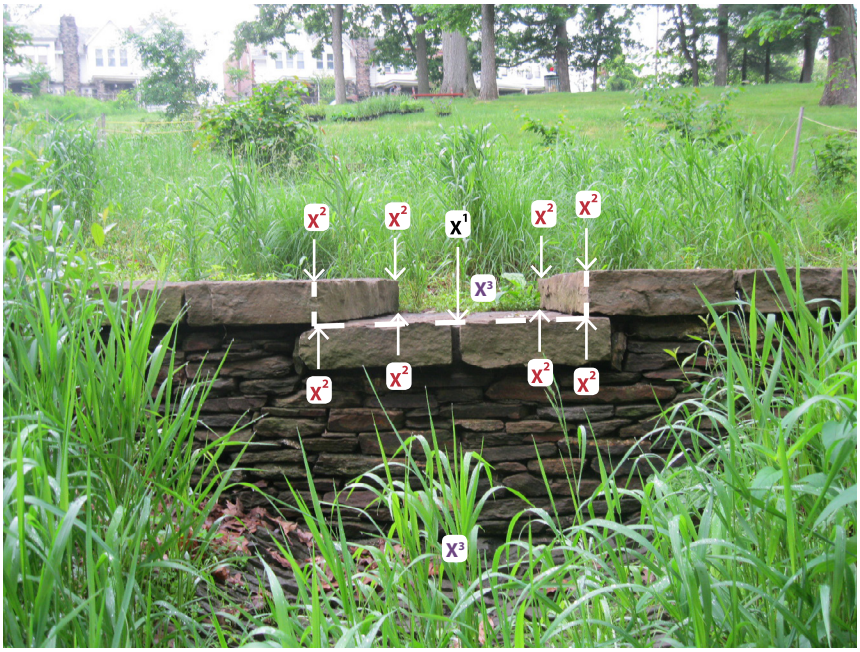
RELATED SECTIONS

- ✓ Surface Storage SMPs
- ✓ Splash Pads
- ✓ Swales

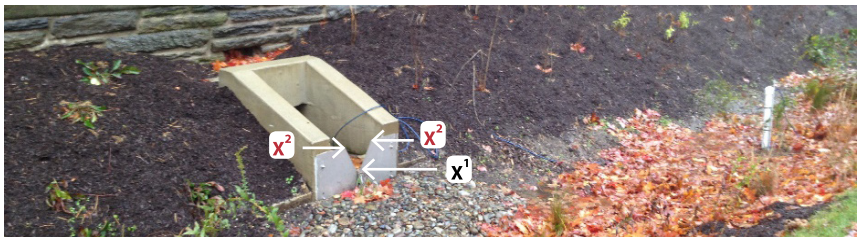
REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Spillways and Weir Walls	X^1 **Crest** of weir	Bottom most elevation where stormwater flows over the spillway or weir wall (i.e., crest).
	X^2 **Corners** of spillway or weir wall	Corners at the top and bottom edges of the spillway or weir crest. If weird is broad-crested, include front and rear points.
	X^3 **Surface elevation** upslope and downslope of weir	Lowest point directly upslope and downslope of weir (point must be in-line with spillway or weir crest midpoint).

All survey points documented must include **both** horizontal and vertical points.



Spillway: crest, corner points, and surface elevations.

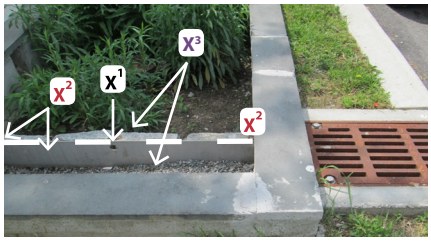


V-Notch Weir: crest and corner points (photo courtesy of Villanova University).

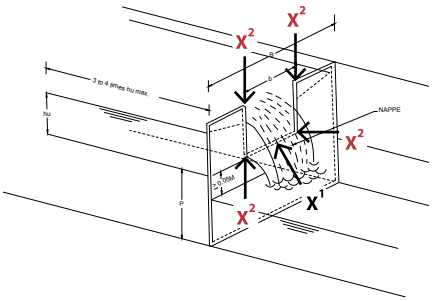
DOCUMENT

- ✓ Material*
- ✓ Shape: rectangular or V-notch
- ✓ Broad-crested or sharp-crested

*See list of acceptable material values in Drawing section on page 72



Weir Wall: crest, corner points, and upslope surface elevation.



Sharp Crested weir section: crest and corner points.

PHILADELPHIA WATER

SWALES

OVERVIEW

- ✓ Swales are open channels that convey stormwater towards or away from an SMP. These channels may provide some infiltration, storage, and water quality treatment.
- ✓ Various channel materials such as grasses, herbaceous plants, shrubs, trees, and riprap channel armor are typical for both the bottom and side slopes.

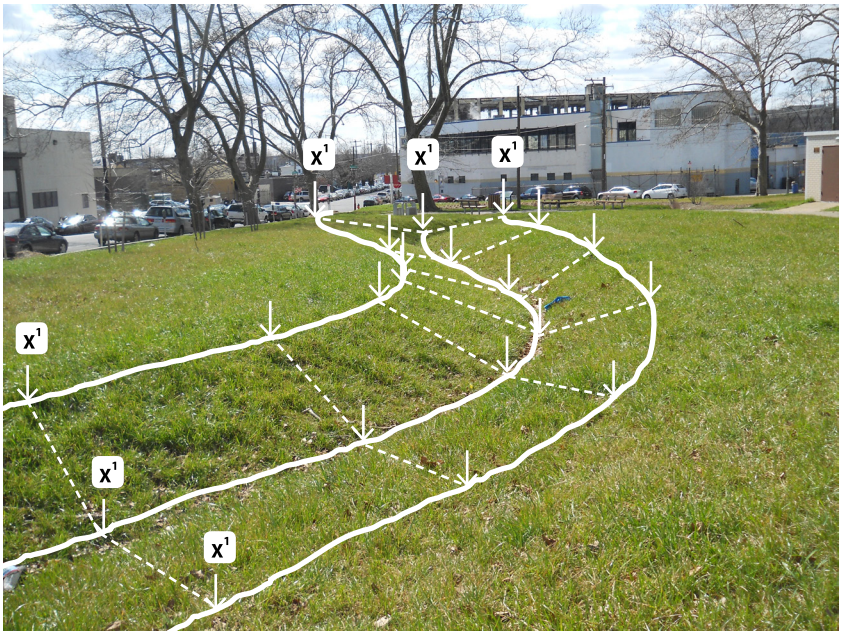
RELATED SECTIONS

- ✓ Surface Storage SMPs
- ✓ Splash Pads
- ✓ Spillways and Weir Walls

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Swale	X¹ Perimeter points	Survey lowest bottom elevation(s) and highest elevation(s) for entire length of swale. Use a 50 ft. maximum for survey point increments.

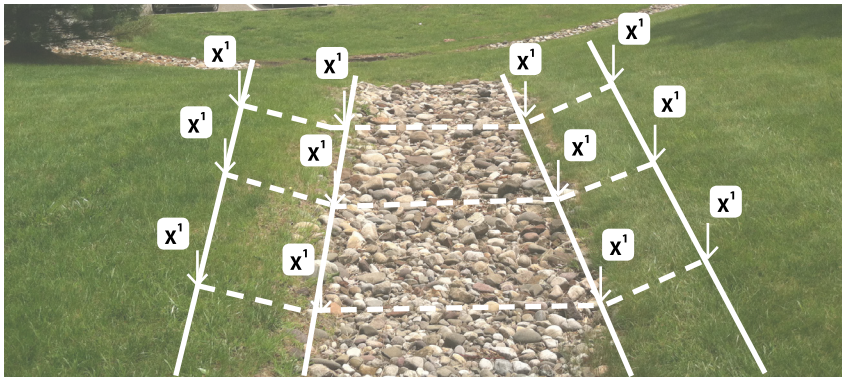
All survey points documented must include **both** horizontal and vertical points.



Swale perimeter points: at bottom and top of swale. Arrows represent typical locations for all survey points. Points taken using a 50 ft. maximum spacing.

DOCUMENT

- ✓ Surface material of swale on bottom and side slopes.



Swale with flat bottom and mild side-slopes: arrows represent typical locations for all survey points. Points taken using a 50 ft. maximum spacing.

POST CONSTRUCTION SURVEY

TRENCH DRAINS

OVERVIEW

- ✓ Trench drains are typically concrete channels with solid or grated covers that can convey stormwater runoff to SMPs under areas of pedestrian traffic such as sidewalks.
- ✓ Typically constructed of concrete or plastic with cast iron or plastic covers.

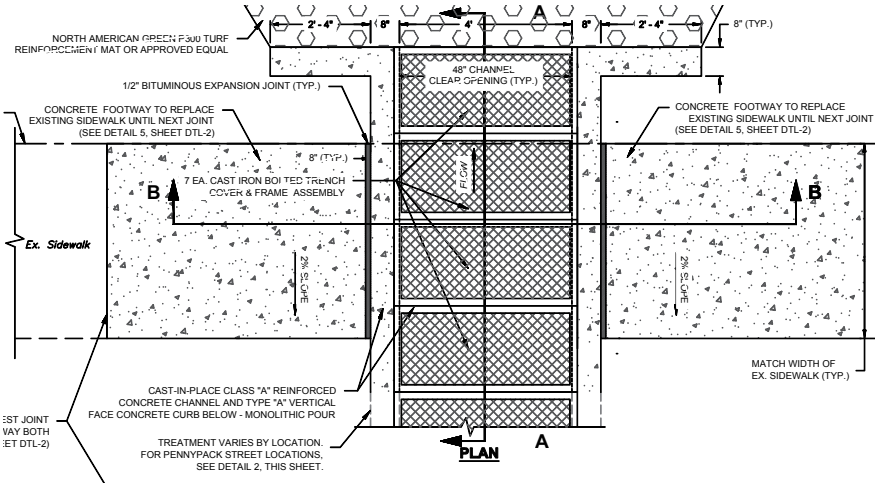
RELATED SECTIONS

- ✓ Splash Pads

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Trench Drain	X^1 Lowest point of trench drain	Lowest points at both upslope and downslope locations along the length of the channel.
	X^2 Top of grate	Top/center elevation on front and back of grate (width of trench drain to be included).
	X^3 Concrete Apron Dimensions	Grade changes of concrete apron along the gutter line, plus apron extent opposite trench drain opening.

All survey points documented must include **both** horizontal and vertical points.



Trench drain: plan view drawing showing construction details.

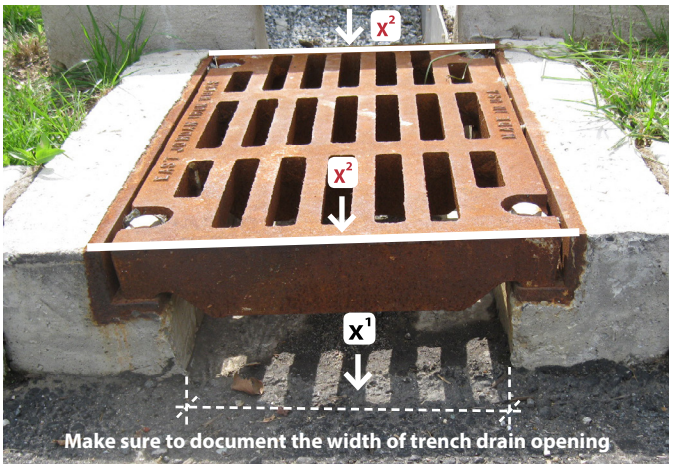
DOCUMENT

- ✓ Channel and cover materials*
- ✓ Type of trench drain cover (e.g., slotted, solid, etc.)
- ✓ Depth of concrete apron depression

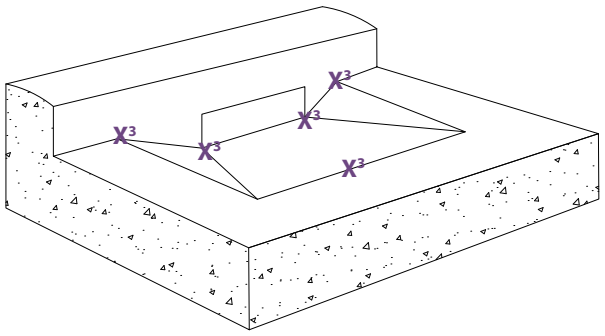
*See list of acceptable material values in Drawing section on page 72

NOTE

The lowest points of each trench drain do not always fall at the midpoint of the trench!



Trench drain: lowest point of trench drain, top of grate, and width of the grate.



Concrete apron dimensions: Grade changes of concrete apron along the gutter line, plus apron extent opposite trench drain opening.

PHILADELPHIA WATER

CURB OPENINGS

OVERVIEW

- ✓ Curb openings are breaks in curbing that let stormwater runoff flow into the SMP.
- ✓ Curb openings may have a wheel stop installed above the opening to protect the SMP from vehicles or bicycles.

RELATED SECTIONS

- ✓ Trench Drains
- ✓ Pavement & Curbs

REQUIRED SURVEY POINTS

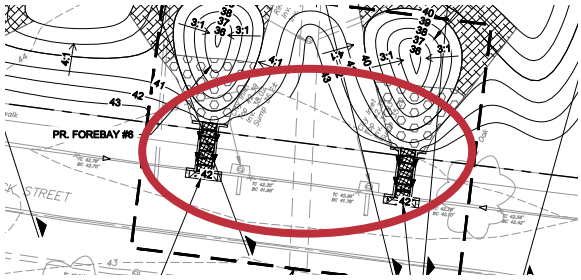
Feature	Required Survey Point	Description of Survey Point
Curb Opening	X[1] Corners of curb opening	Top (only if curb is >10") and bottom of curb at edges of curb opening where most constricted.

All survey points documented must include **both** horizontal and vertical points.

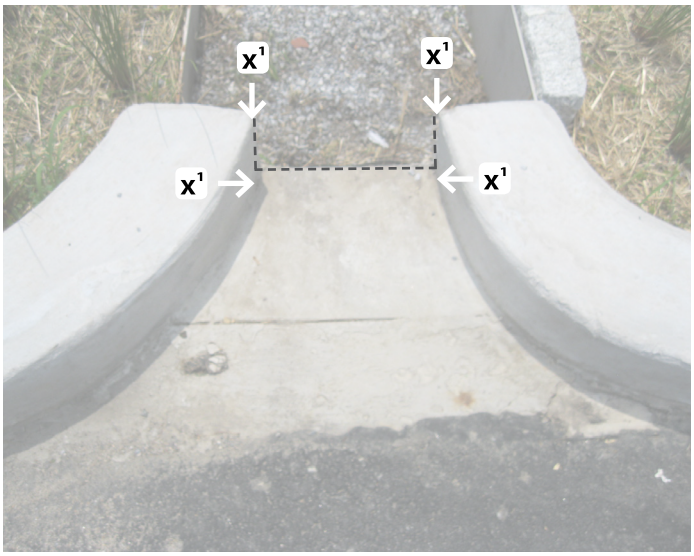
Curb Cut: along street right-of-way.

DOCUMENT

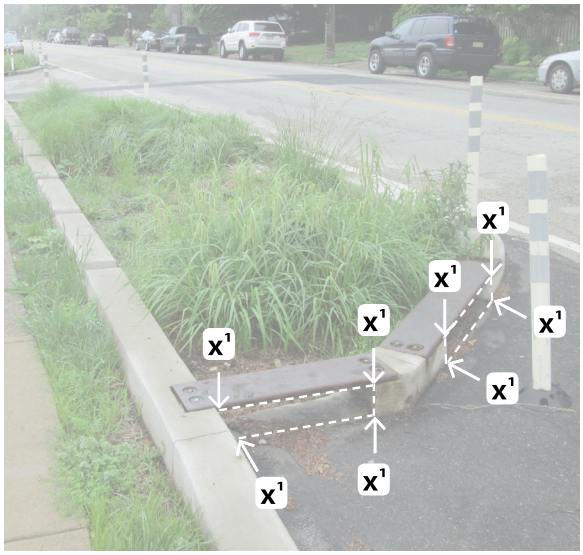
- ✓ Presence and material of wheel stops (if applicable)



Sample design plan detail: showing curb cuts into an SMP.



Curb Cut (open top): top of curb cuts and corner points.



Curb Cut with wheel stop: corner points.

POST CONSTRUCTION SURVEY

ORIFICES

OVERVIEW

- ✓ An orifice is a pipe opening or plate used to control stormwater release or overflow.
- ✓ Not all subsurface pipes within inlets will have an orifice, only document if applicable.
- ✓ Typically made of or set in metal (e.g., steel, cast iron, etc.) or plastic (e.g., HDPE, PVC, etc.).

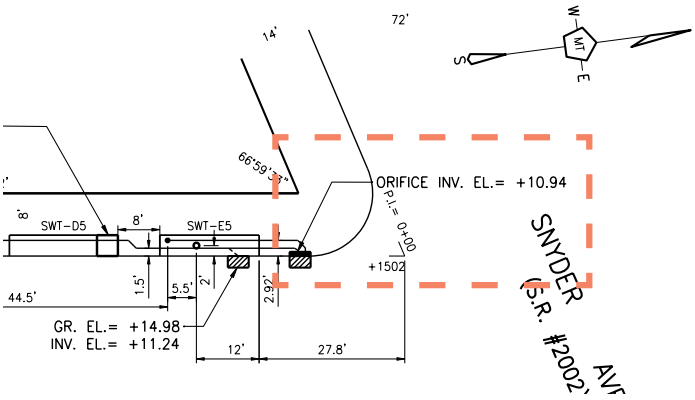
RELATED SECTIONS

- ✓ Pipes & Fittings
- ✓ Inlet Structures
- ✓ Domed Riser
- ✓ Maintenance Port

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Orifice	X^1 Invert of orifice	Bottom interior elevation of the orifice opening
	X^2 Diameter of orifice	The diameter of the orifice opening

All survey points documented must include **both** horizontal and vertical points.



Sample as-built plan element: orifice invert elevation call-out. Orifice diameter must also be recorded within the orifice call-out on the as-built plans.

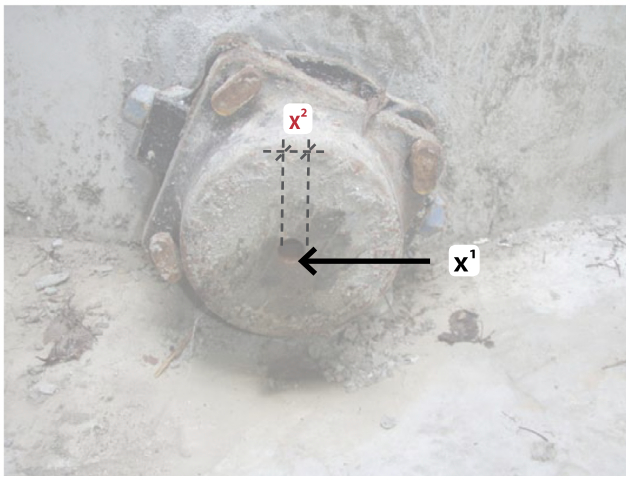
DOCUMENT

- ✓ Diameter of orifice opening
- ✓ Material in which orifice is located*

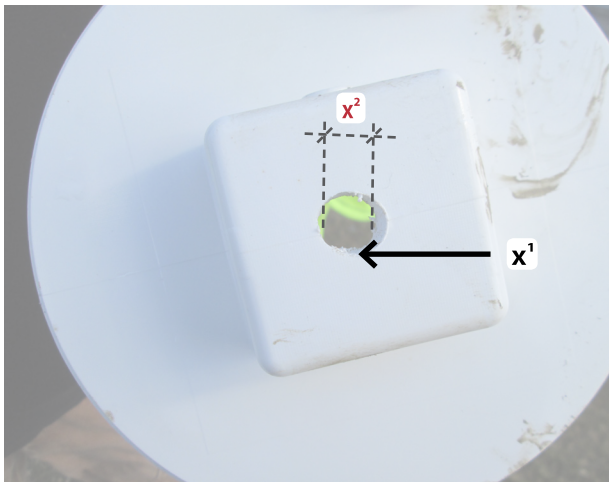
*See list of acceptable material values in Drawing section on page 73

NOTE

The orifice invert elevation, diameter of the as-built orifice, and material of where orifice is drilled should all be documented on the as-built plan. Contractor may need a measuring tape or calipers to document orifice size.



Metal Orifice: invert at bottom interior elevation of orifice opening and orifice diameter.



Plastic Orifice: diameter and invert at bottom interior elevation of orifice opening.

SPLASH PADS

OVERVIEW

- ✓ Splash pads are structures that dissipate energy and prevent erosion by reducing the velocity of water.
- ✓ Typical materials are: stone, concrete, or masonry.

RELATED SECTIONS

- ✓ Pipes & Fittings
- ✓ Spillways and Surface Weir Walls
- ✓ Trench Drains
- ✓ Curb Openings
- ✓ Endwalls

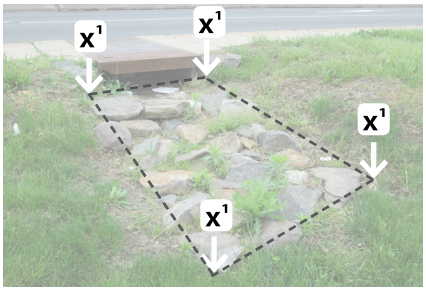
REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Splash pads	X¹ Perimeter of splash pad	Corners at most upslope and downslope points along the length of the splash pad (as needed to document the extent).

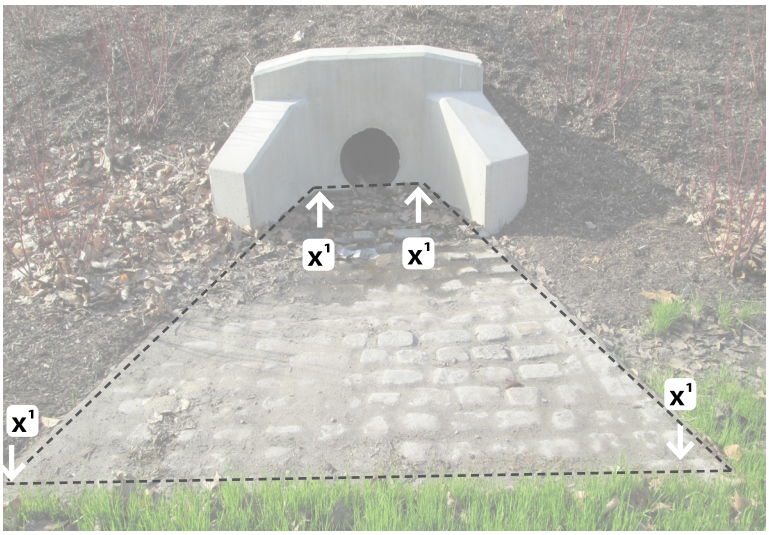
All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

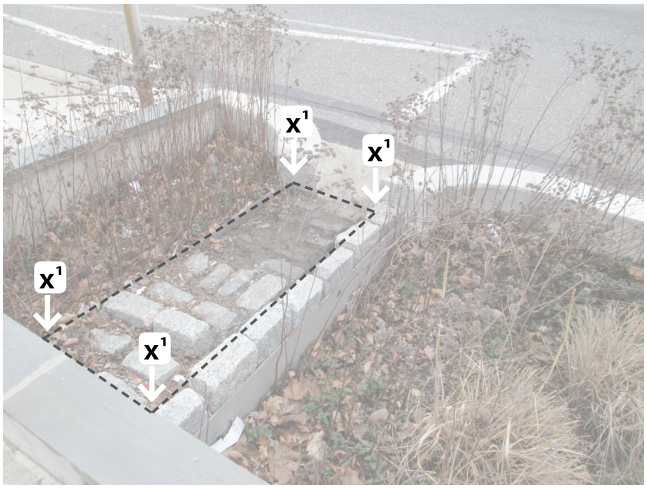
- ✓ Material



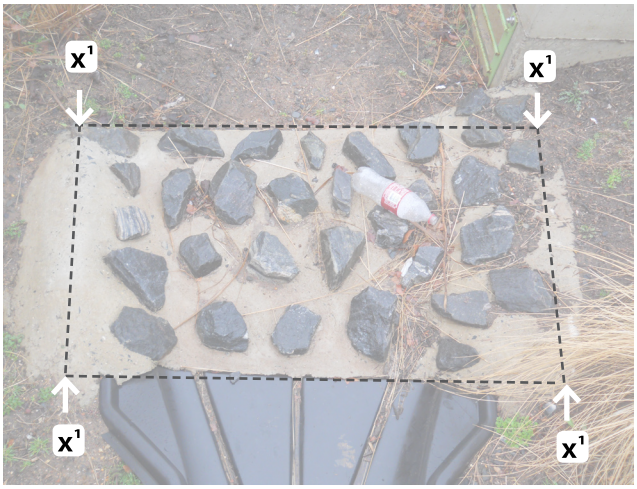
Perimeter points of stone splash pad.



Perimeter points of stone splash pad at endwall.



Stone splash pad within a planter box structure.



Perimeter points of concrete splash pad.

POST CONSTRUCTION SURVEY

SUBSURFACE WEIRS

OVERVIEW

- ✓ Subsurface weirs are structures that establish a high water level and can provide a controlled overflow of stormwater.
- ✓ Subsurface weirs are typically sharp-crested weirs and shapes (e.g., rectangular, v-notch, etc.) and materials (e.g., concrete, masonry, metal, etc.) can vary.

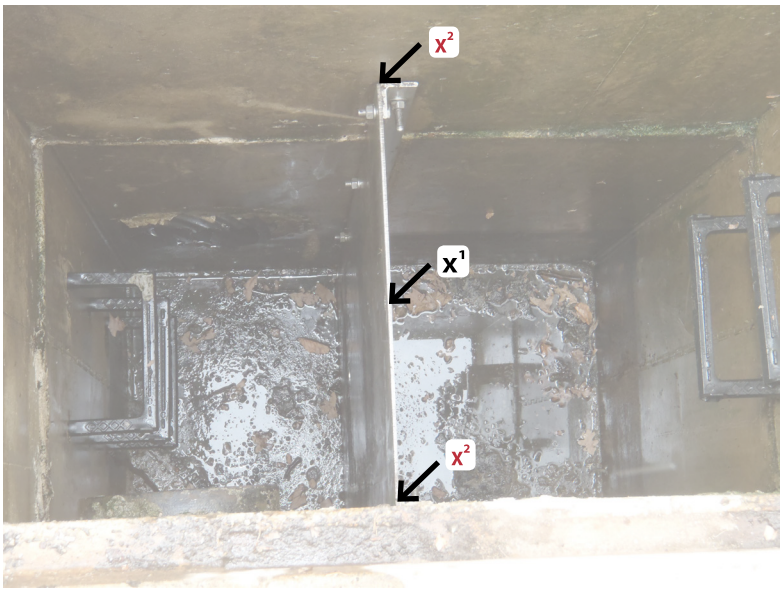
RELATED SECTIONS

- ✓ Inlet Structures: Non-standard, HWY Grate, OMG, City Inlets.
- ✓ Subsurface Storage SMPs

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Subsurface Weirs	X¹ Crest of weir	Weir edge where water flows over (also called the crest of the weir). Crest elevations should be taken at the midpoint of a weir with no notch and, if applicable, at both the high and low points of a notched weir.
	X² Corners of spillway or weir wall	Corners at the top and bottom edges of the spillway or weir crest.

All survey points documented must include **both** horizontal and vertical points.

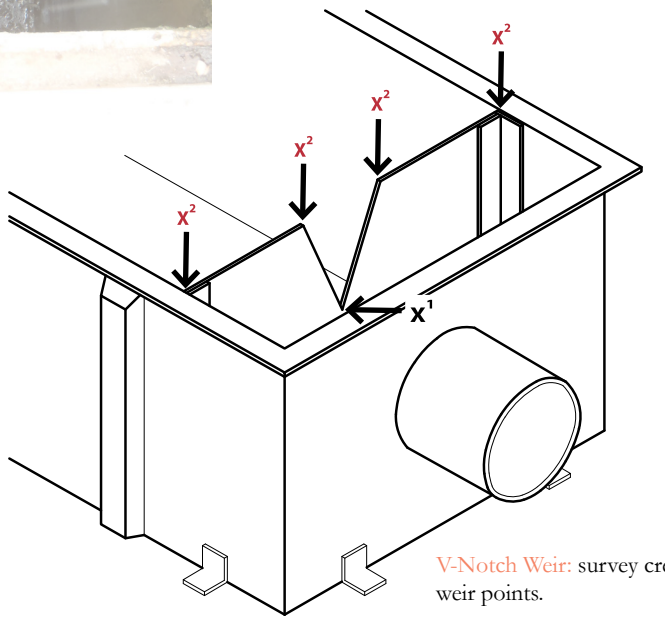


Rectangular weir: survey midpoint of crest and corners.

DOCUMENT

- ✓ Invert of weir crest
- ✓ High point and low point of weir crest (if applicable)
- ✓ Weir shape
- ✓ Material of weir*

*See list of acceptable material values in Drawing section on page 70



V-Notch Weir: survey crest of weir points.

PHILADELPHIA WATER

ENDWALLS

OVERVIEW

- ✓ Endwalls (or end sections) are structures located at the downstream end of conveyance pipes that protect side slopes from erosion.
- ✓ Splash pads are typically located downstream of endwalls.

RELATED SECTIONS

- ✓ Pipes & Fittings
- ✓ Splash Pads

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Endwall	X[1] **Location** of endwall or endwall section	Center point of endwall or endwall section above pipe discharge point.

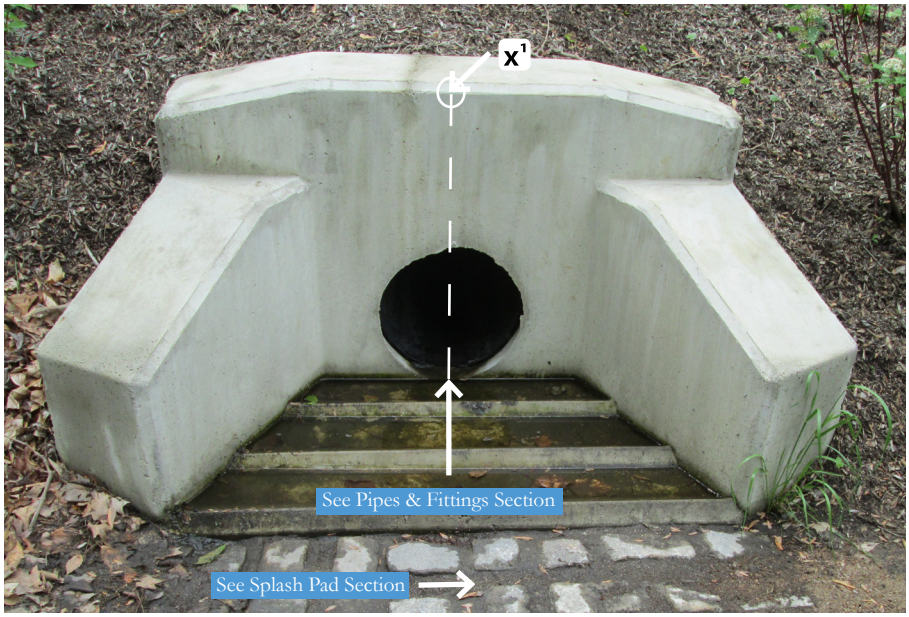
All survey points documented must include **both** horizontal and vertical points.

Plastic Endsection: survey location.

DOCUMENT

- ✓ Type of endwall (with or without wings)
- ✓ Angle of wingwall
- ✓ Material*
- ✓ Presence of a splash pad

*See list of acceptable material values in Drawing section on page 73



Endwall: survey location.

POST CONSTRUCTION SURVEY

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ACCESS STRUCTURES

MANHOLES&MAINTENANCEPORTS

ACCESS STRUCTURES

OVERVIEW

- ✓ Manholes and maintenance ports are structures that provide surface access to subsurface infrastructure and can be used for inspection, pipe cleaning, and entry of trained personnel.

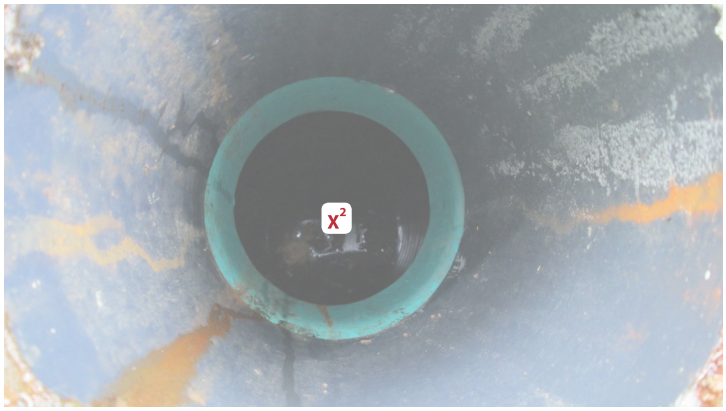
RELATED SECTIONS

- ✓ Pipes & Fittings

REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Manholes and Maintenance Ports	X^1 **Rim** elevation	Center point on top of manhole/maintenance port lid or cover.
	X^2 **Bottom** of access structure	Bottom interior elevation of the access structure.

All survey points documented must include **both** horizontal and vertical points.



Bottom of Access Structure: bottom interior level of the structure.

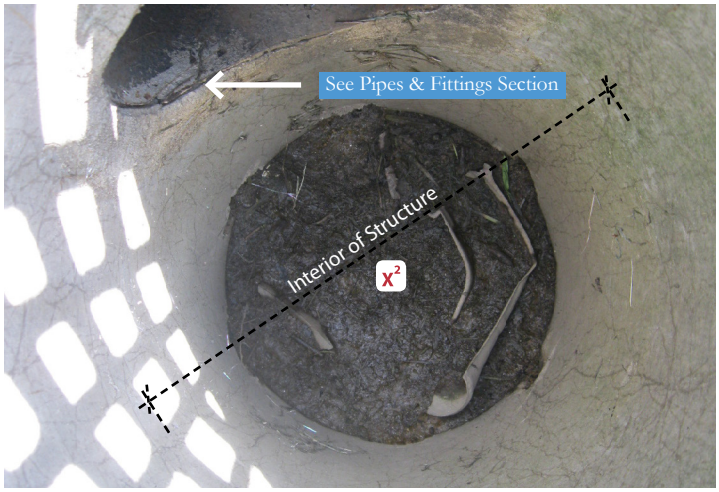
DOCUMENT

- ✓ Materials of structure and cover*
- ✓ Interior diameter of structure and diameter of structure cover.

*See list of acceptable material values in Drawing section on page 77

NOTE

Refer to the pipes and fittings sections for pipe invert at termination point.



Invert of Pipe Connections and Bottom of Access Structure: bottom interior elevation of pipe, and bottom interior level of the structure.

Rim Elevation: center point on top of cover or lid.

PHILADELPHIA WATER

CLEANOUTS

OVERVIEW

- ✓ Cleanouts are solid vertical pipes (typically 6" - 8" PVC) that provide surface access to subsurface pipes for inspection, and pipe cleaning.
- ✓ Directional "sweeps" connect cleanouts to subsurface pipes and typically are oriented in the downslope direction.

RELATED SECTIONS

- ✓ Pipes & Fittings

REQUIRED SURVEY POINTS

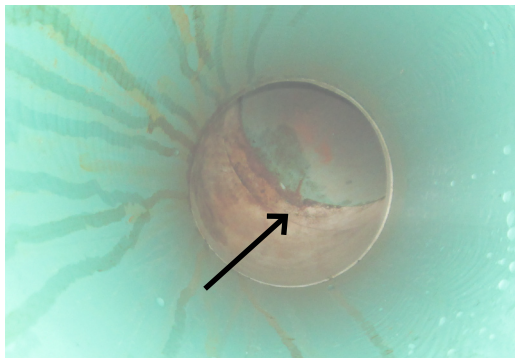
Feature	Required Survey Point	Description of Survey Point
Cleanout	X[1] Rim elevation	Center point and location of top of cleanout cover.

All survey points documented must include **both** horizontal and vertical points.

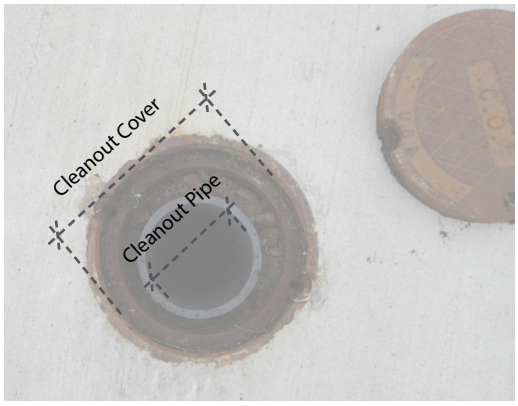
DOCUMENT

- ✓ Material of cleanout and cover*
- ✓ Diameter of cleanout pipe and cleanout cover
- ✓ Direction of sweep

*See list of acceptable material values in Drawing section on page 77

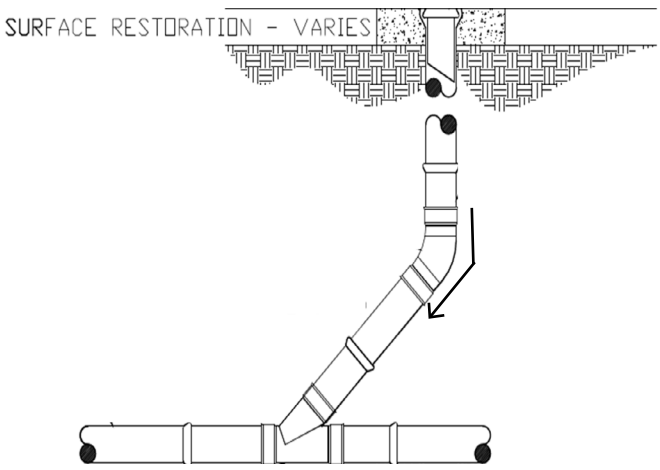


Cleanout: sweep direction (to document).



Diameter: of cleanout and cover (to document).

Rim elevation: center point at top of cleanout cover.



Design profile: showing sweep direction.

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MONITORING STRUCTURES

OBSERVATION WELLS

OVERVIEW

- ✓ Observation wells are perforated vertical pipes (typically PVC) with well cover at surface and capped at the bottom to allow monitoring access for collecting water level data in the storage volume of an SMP.

RELATED SECTIONS

- ✓ Subsurface Storage SMPs
- ✓ Surface Storage SMPs

REQUIRED SURVEY POINTS

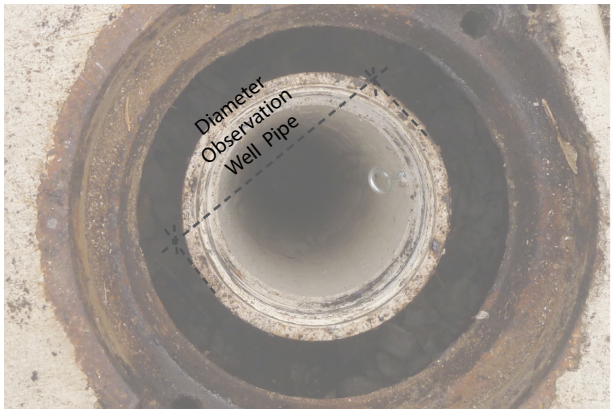
Feature	Required Survey Point	Description of Survey Point
Observation Well	X^1 Rim of cover	Center point on top of cover.
	X^2 Invert of structure bottom	Bottom interior elevation of observation well.

All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

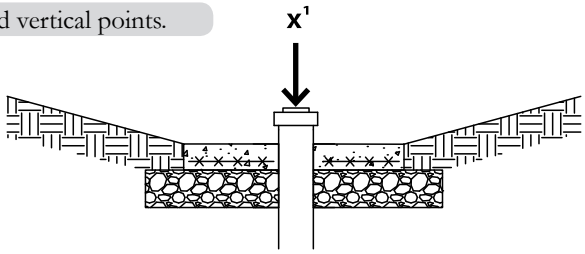
- ✓ Material of structure and cover*
- ✓ Diameter of observation well pipe

*See list of acceptable material values in Drawing section on page 80

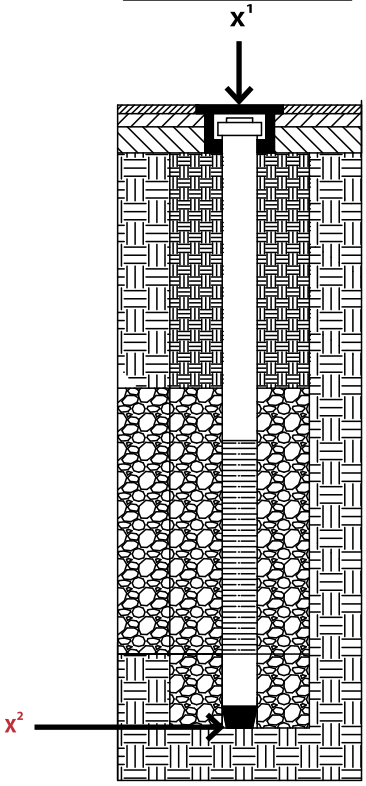


Open observation well showing view toward invert of structure bottom and diameter of observation well pipe.

Rim of cover: center point taken on top of cover. Diameter of observation well cover to be documented.



OBSERVATION WELL IN SOIL



OBSERVATION WELL IN FOOTWAY

Design plan detail: rim of cover and invert of structure bottom.

SURFACE STORAGE SMPs

SURFACE STORAGE SMPs

OVERVIEW

- ✓ Surface Storage SMP is a depressed area where stormwater runoff is collected and stored.
- ✓ Surface Storage SMPs consists of basin, blue roof, bumpout, green roof, planter, rain garden, and wetland.

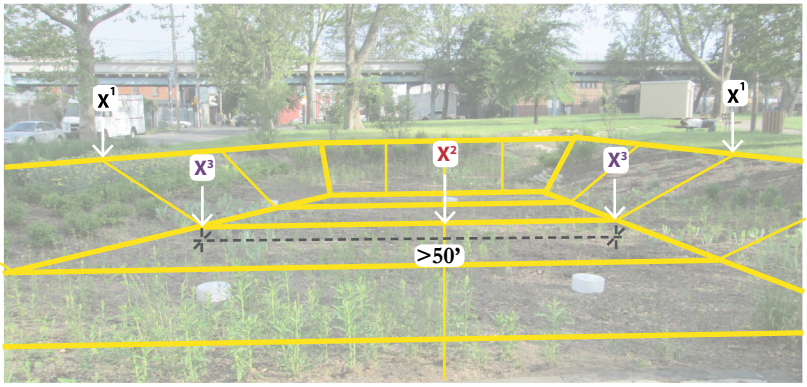
RELATED SECTIONS

- ✓ Subsurface Storage SMPs

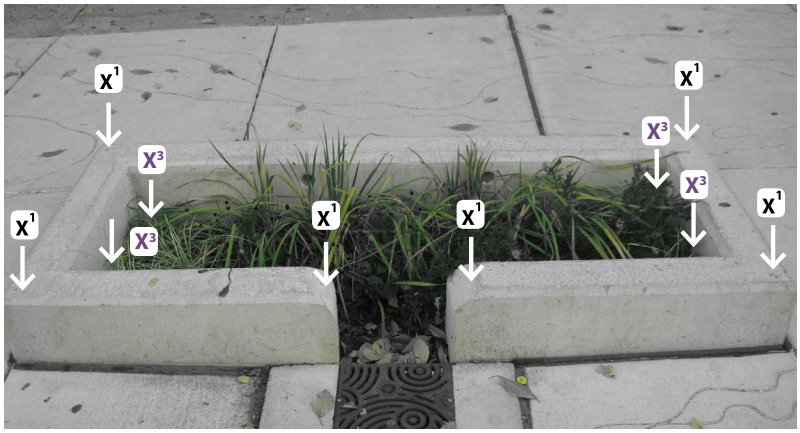
REQUIRED SURVEY POINTS

Feature	Required Survey Point		Description of Survey Point
Surface Storage SMPs	X^1	Top of bank or planter box	Survey top elevation for all corners. For shapes with linear perimeters, corners are defined as intersections; for curvilinear shapes, corners are defined as distinct points of inflection. Taken at the outside edge of curbline or planter box (if applicable).
	X^2	Midpoint of basin bottom	Survey midpoint if it is greater than 50' ft. from the outer corners.
	X^3	Bottom of bank or planter box	Survey lowest bottom elevation for all corners within the interior of the bank or planter box.
		Interior points	Where bottom exceeds 50 ft. width, survey entire footprint using a grid with maximum spacing of 50 ft.

All survey points documented must include **both** horizontal and vertical points.



Perimeter points: perimeter points, bottom points, and midpoint if it is greater than 50' ft. from the outer corners.

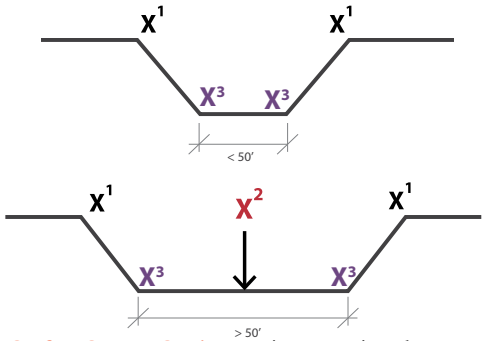


Planter Boxes: top of planter box and bottom of planter box at interior points.

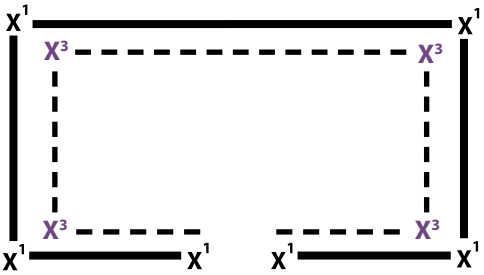
DOCUMENT

- ✓ Vegetation type (woody, herbaceous, tree, mixed)

*See list of acceptable material values in Drawing section on page 86



Surface Storage Section: perimeter points, bottom points, and midpoint if it is greater than 50' ft. from the outer corners.



Planter Box Plan: top of planter box and bottom of planter box at interior points.

PHILADELPHIA WATER

POST CONSTRUCTION SURVEY

STORMWATER TREES

STORMWATER TREES

POST CONSTRUCTION SURVEY

OVERVIEW

- ✓ Trees planted within the surface or subsurface storage footprint of an SMP.

RELATED SECTIONS

- ✓ Subsurface Storage SMPs
- ✓ Surface Storage SMPs
- ✓ Curb Openings

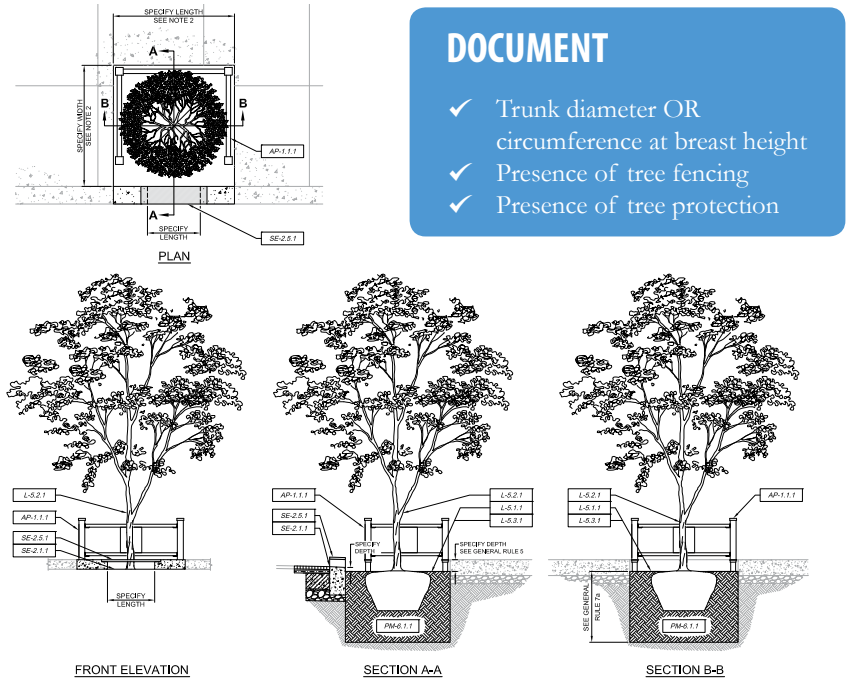
REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Stormwater Trees	X^1 Location of trunk	Trunk location at ground level.
	X^2 Perimeter of tree pit boundary	Points at all corners of the tree pit (may be paved or unpaved). Refer to curb openings section for tree pits as applicable.
	X^3 Internal points of tree pit	Points at all internal corners of the tree pit (may be paved or unpaved).

All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

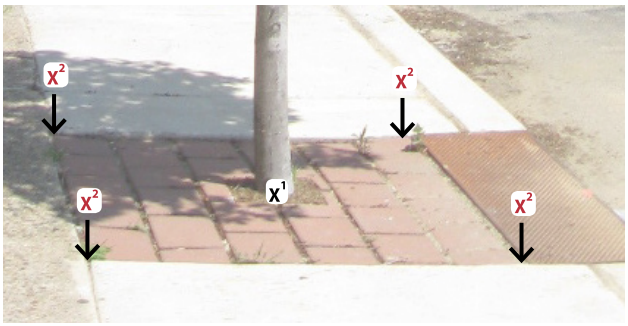
- ✓ Trunk diameter OR circumference at breast height
- ✓ Presence of tree fencing
- ✓ Presence of tree protection



Tree Pit Details

Location of trunk

Depressed Tree Pit: location of trunk and perimeter. The tree pit will be lower than adjacent grade.



Flush Tree Pit: location of trunk and perimeter. The tree pit will be flush with adjacent grade.

PHILADELPHIA WATER

PAVEMENT & CURBS

CURBLINES

OVERVIEW

- ✓ Curblines mark the point where curbs meet the edge of the roadway.
- ✓ New curblines may be placed for SMPs located within or adjacent to the right-of-way, or where the existing curb has been cut or relocated to allow water to enter the SMP.

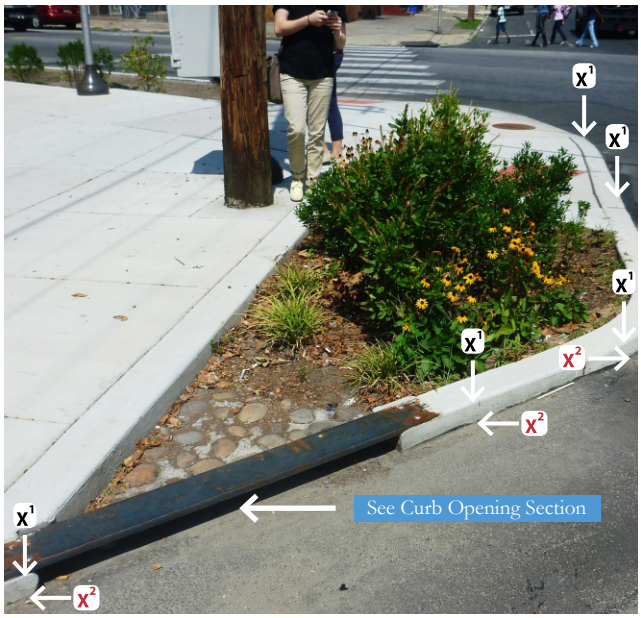
RELATED SECTIONS

- ✓ Inlet Structures
- ✓ Trench Drains
- ✓ Curb Openings

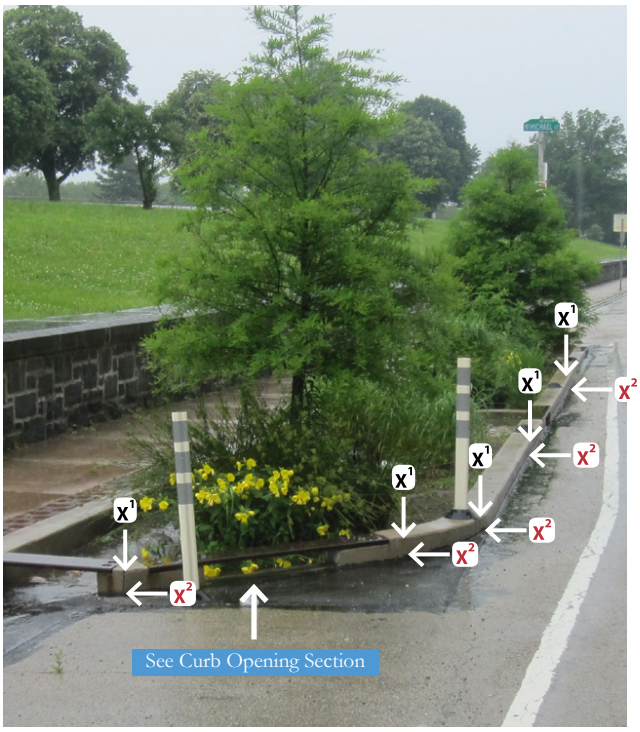
REQUIRED SURVEY POINTS

Feature	Required Survey Point	Description of Survey Point
Curblines	X^1 Top of curb	Points along the top of curb at intervals of every 5 ft.. and at points of inflection for the length of the new curbline.
	X^2 Bottom of curb	Points along the bottom of curb at intervals of every 5 ft.. and at points of inflection, for the length of the new curbline.

All survey points documented must include **both** horizontal and vertical points.



Newly Established Curbline: top and bottom of curb at intervals of every 5 ft. and at points of inflection.



Newly Established Curbline at bumpout: top and bottom of curb at intervals of every 5 ft. and at points of inflection.

DOCUMENT

- ✓ Direction of gutter slope

NOTE

The only time that survey points need to be taken for curbs is when the actual curb-line changes from the City Plan.

PERMEABLE PAVEMENT

OVERVIEW

- ✓ Permeable pavement is a structural surface that allows stormwater to infiltrate through a stone subbase.
- ✓ Subsurface storage may be present under some permeable pavement. If applicable, see Subsurface Storage section for appropriate survey points.

RELATED SECTIONS

- ✓ Subsurface Storage SMPs
- ✓ Subsurface Weirs

REQUIRED SURVEY POINTS

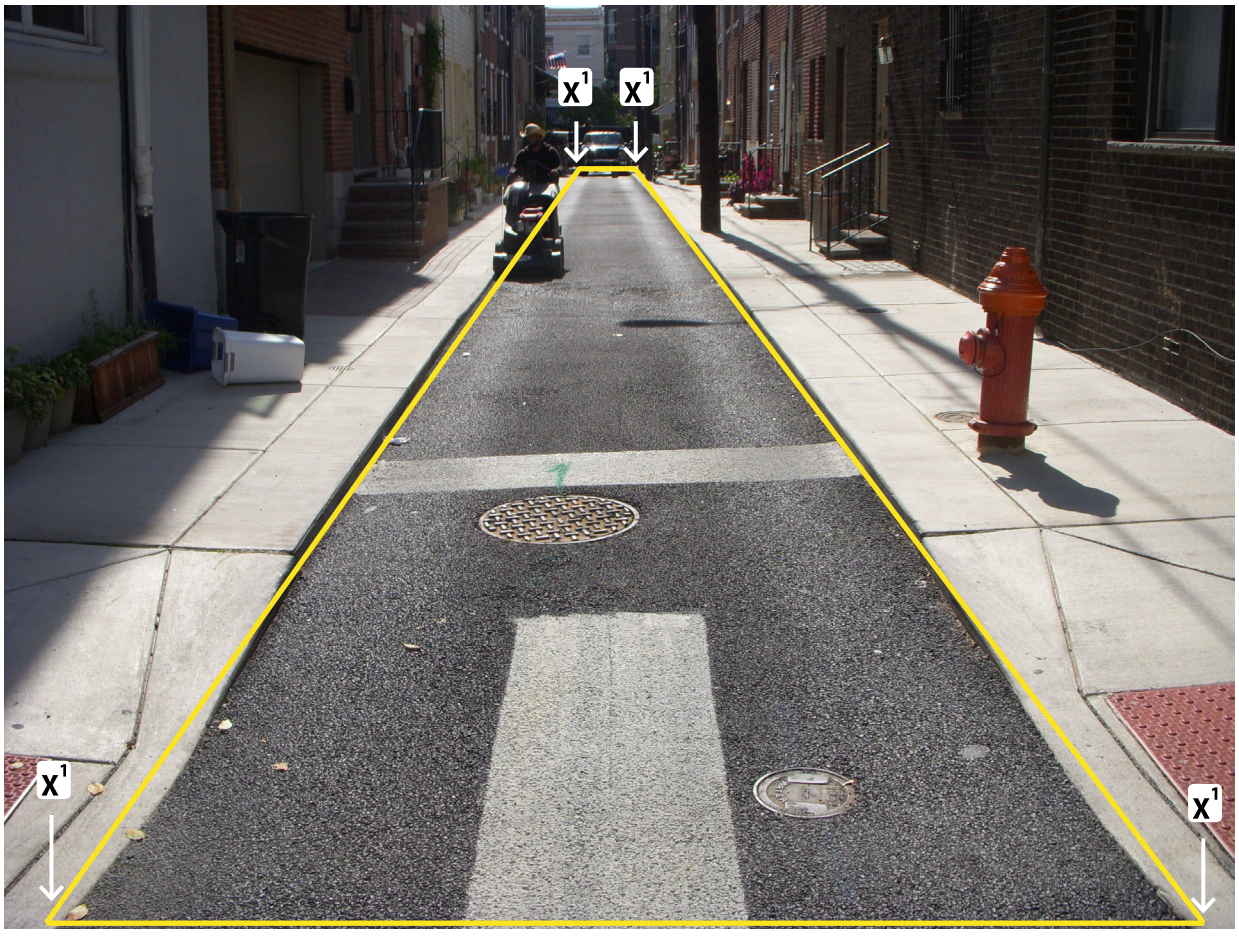
Feature	Required Survey Point	Description of Survey Point
Permeable Pavement	X[1] Surface Perimeter Points	Only survey the four corner points of the permeable pavement or extents of the pavement for rectilinear installations. Additional corner points may be needed for irregular shapes.

All survey points documented must include **both** horizontal and vertical points.

DOCUMENT

- ✓ Material (e.g., porous asphalt, permeable concrete, permeable pavers, etc.)

Permeable pavement surface



Perimeter points: survey at the extents of the permeable pavement.

POST CONSTRUCTION SURVEY

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AS-BUILT DRAWING STANDARD OPERATING PROCEDURES

HOW TO USE THIS SECTION

The As-Built Drawing section of this manual provides a three step procedure for creating GSI as-built drawings using survey data collected as per the As-Built Survey section of this manual. These three steps consist of: Drawing Setup, Drawing Creation, and Drawing Completion.

MATERIALS PROVIDED BY PWD

- ✓ Hard copies of construction documents and specifications
- ✓ AutoCAD GSI As-Built standard template file (*.dwg) supplying layer standards, title blocks, block references, linestyles, legend, and a plot style table
- ✓ AutoCAD PWD standard plot style file (pwd_plot_style.ctb)

REQUIRED SUBMITTALS TO PWD

(Reference page 3 for detailed requirements)

- ✓ One *.dwg file for each GSI system (in general, one *.dwg plan shows one city block) in DWG 2000 file format
- ✓ A *.pdf file of red-lined contractor mark-ups
- ✓ A *.txt file with raw survey points (digital)

1. DRAWING SETUP

The Drawing Setup section provides easy-to-follow steps for: File Creation and Naming, Importing Existing Curblines and Right-of-Way Lines, and Importing Survey Points.

2. DRAWING CREATION

The drawing creation section contains of guidance and standards which consist of: Drafting Instructions, Drawing Standards, Typical Annotation Values, and Example Drawings with Annotations. During this step, survey data is used to create an organized representation of as-built design features within this section. Standard headers, as shown below, call-out key instructions and guidance for drawing each GSI feature.

DRAFTING INSTRUCTIONS

✓ Look to this section for guidance constructing CAD linework from the survey data points.

DRAFTING STANDARDS

✓ Look to this section for CAD drawing standards for: linetype, lineweight, color, layer, and annotations.

TYPICAL ANNOTATION VALUES

✓ Look to these tables for acceptable annotation.

3. DRAWING COMPLETION

The drawing completion section consists of guidance and standards for: Finishing Touches, Borders and Title Blocks, and Viewport Creation.

DRAWING SETUP

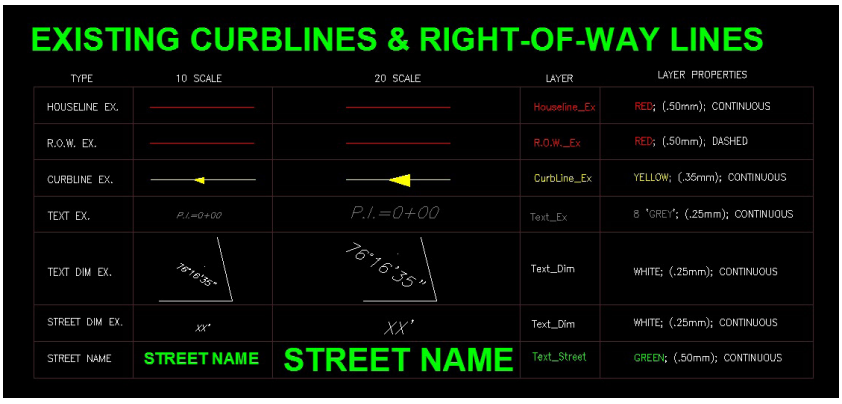
File Creation & Naming

1. Open the GSI As-Built CAD Template (GSI_AS-BUILT_CAD_TEMPLATE_V1.0.dwg) using AutoCAD 2010 software or a more recent version.
2. Save this file using PWD work number (X-XXXXX-X), contractor name (no spaces), and date of drawing completion (YearMonthDay - no spaces):
   PWDWorkNumber_ContractorName_DrawingCompletionDate.dwg
   For example: S-50026-G_JaneDoeConstruction_20140829
3. Utilize 10 scale linework and block templates, as appropriate, to draft existing and new (as-built) features. 20 scale linework and block templates are allowed upon request and approval.
4. Choose sheet border size and layout by following the guidance provided in the Drawing Completion section (page 93).

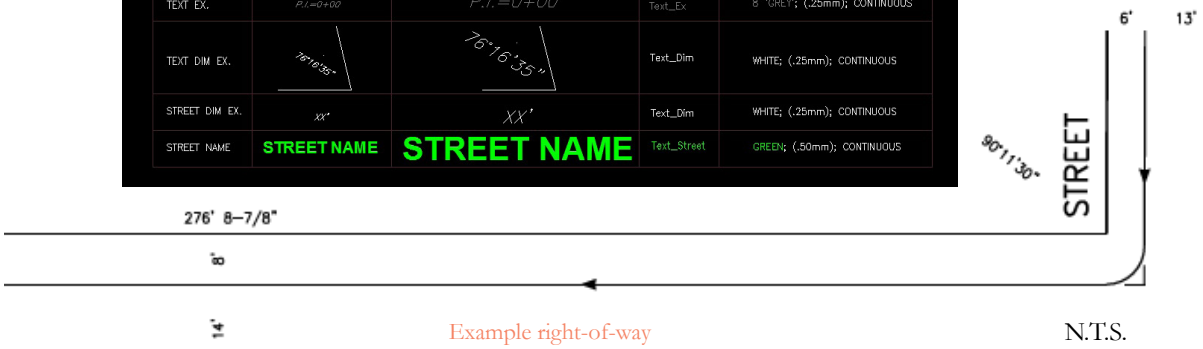
Drawing Existing Curblines & Right-of-Way Lines

Draw geo-referenced existing curblines and right-of-way lines to include: right-of-way line distance and angles, street and right-of-way widths, name of street and legislative route number (if state highway), and projected point of intersections (P.I.s) for all curblines (2 foot tick marks). The following sources may be utilized for this information:

1. City plan information (supplied by the Streets Department in paper or digital formats).
2. City of Philadelphia GIS data.
3. GSI design plans.
4. As-built survey points (if complete street survey is conducted).



Note: utilize existing curblines & right-of-way lines table in CAD templates.



Example right-of-way N.T.S.

Importing Survey Points

1. Import the GSI as-built survey points (collected as per the GSI As-Built Survey specifications) into the working CAD drawing on the Survey Points_NEWLAYER.
2. Verify that survey points (including the controlling benchmark) are geo-referenced to the correct horizontal and vertical datums.

DRAWING CREATION

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SUBSURFACE STORAGE SMPs

SUBSURFACE STORAGE SMPs

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Subsurface Storage SMP Footprint*	1. Connect all perimeter points with a closed polyline to create SMP bottom footprint. 2. Select polyline to ensure a closed shape has been created. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

*Assumes excavated subsurface storage has 1:1 vertical side slopes

DRAFTING STANDARDS

Tree Trench

CAD Legend Description	New Tree Trench
CAD LineType/ Block Image	
Layer	GSI_SubsurfaceFeature_New
Color	11 'SALMON'
Line Weight	0.40mm
LineType	Continuous
Callout	STORMWATER TREE TRENCH <STORAGE TYPE> STORAGE BOTTOM EL. = +XX.XX TOP EL. = +XX.XX WITH GEOMEMBRANE*

*If applicable

Trench

CAD Legend Description	New Trench
CAD LineType/ Block Image	
Layer	GSI_SubsurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous
Callout	STORMWATER TRENCH <STORAGE TYPE> STORAGE BOTTOM EL. = +XX.XX TOP EL. = +XX.XX WITH GEOMEMBRANE*

*If applicable

Cistern

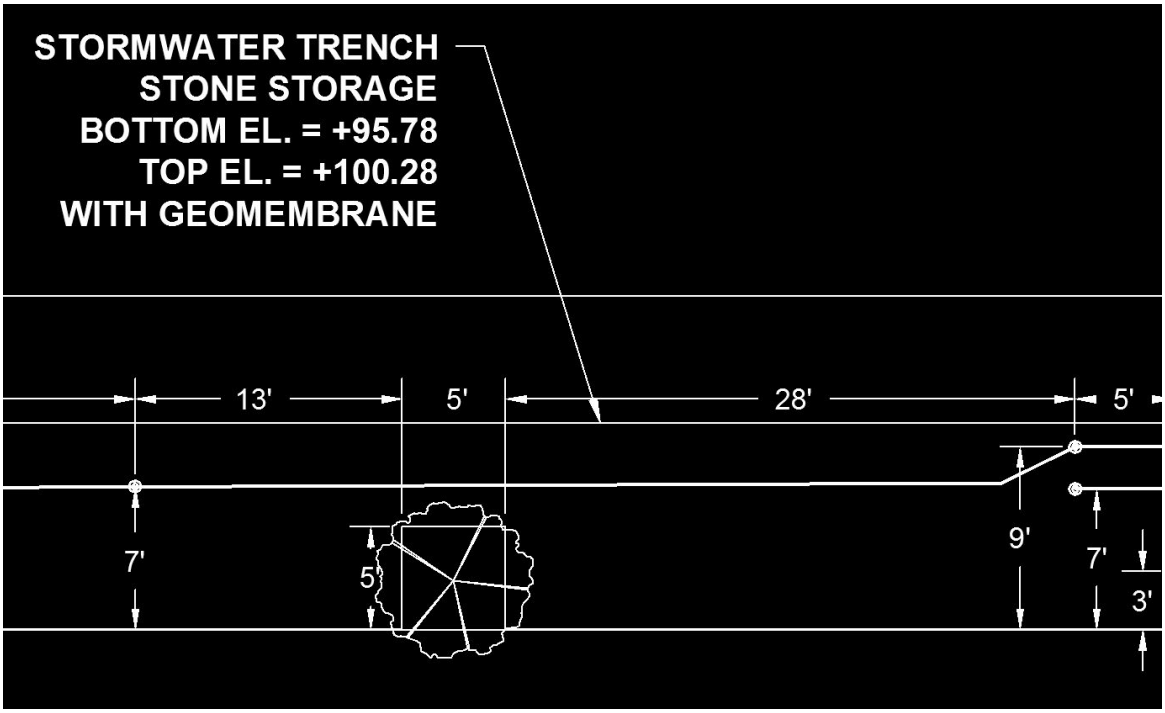
CAD Legend Description	New Cistern
CAD LineType/ Block Image	
Layer	GSI_SubsurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous
Callout	<DIMS/SIZE> <MATERIAL> CISTERN BOTTOM EL. = +XX.XX TOP EL. = +XX.XX

SUBSURFACE STORAGE SMPs

TYPICAL ANNOTATION VALUES

MATERIAL
H.D.P.E.
R.C.
PRECAST CONCRETE
CORR. METAL
STEEL

STORAGE TYPE
STONE
VAULT
<NUM> x X.XX DIA. ARCH
CRATE



CAD screenshot of as-built drawing annotations and dimensions for subsurface SMP.

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PIPES & FITTINGS

PIPES & FITTINGS

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Pipes & Fittings	1. Connect upslope and downslope points with a single polyline (PL command). 2. Polylines terminate at every invert, fitting, change in pipe material or diameter. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

DRAFTING STANDARDS

Conveyance Pipes

CAD Legend Description	New Conveyance Pipe
CAD LineType/ Block Image	
Layer	GSI_Conveyance_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	XX.XX L.F. <DIA.>" <MATERIAL> @ X' PER XXX' <PIPE FUNCTION>*

*Underdrain pipes typically have no slope (0' per 100')

***THE ELEVATION OF ALL NEW CONNECTIONS TO EXISTING SEWERS SHALL BE CALLED OUT AS GREEN RETURN ELEVATIONS (G.R.E.)*

Fittings

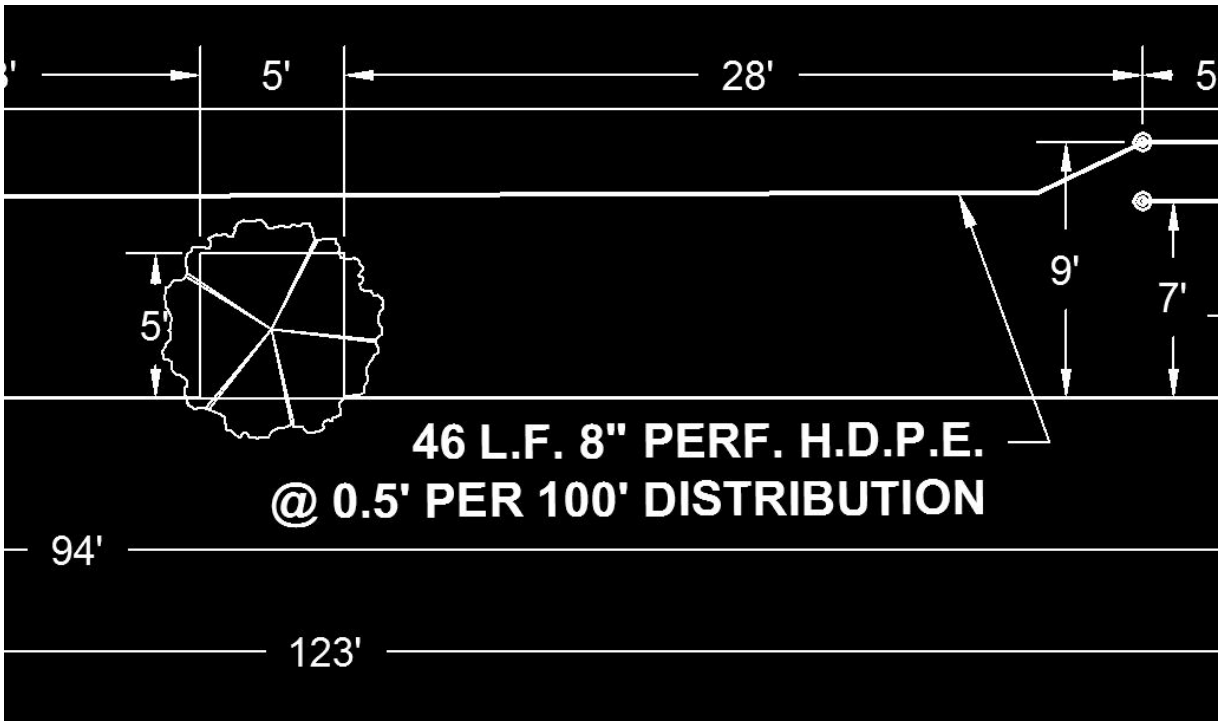
CAD Legend Description	New Fitting
CAD LineType/ Block Image	
Layer	GSI_Fitting_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	<FITTING TYPE>

TYPICAL ANNOTATION VALUES

MATERIAL
D.I.P.
PERF. D.I.P.
H.D.P.E.
PERF. H.D.P.E.
P.V.C.
PERF. P.V.C.
R.C.P.
V.C.P.

FITTING TYPE
VENT
WYE
PLUG
COLLAR
ATTRIBUTE CHANGE
TEE
VALVE
ELBOW
SLEEVE

PIPE FUNCTION
DISTRIBUTION MAIN
GRAVITY MAIN
TRENCH DRAIN
UNDERDRAIN
LATERAL



CAD screenshot of as-built drawing annotations and dimensions for pipes and fittings.

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INLETS & OUTLETS

INLETS & OUTLETS

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
City Inlet, Highway Grate Inlet, OMG Inlet, Non-Standard Inlet, Control Structures, Domed Riser, Curb Openings, Endwalls	1. Copy appropriate block (from provided CAD template file) using the COPYBASE command and select the center of the block as the base point (or in the same location as the survey point). 2. Paste block onto the designated survey point. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**
Spillways & Weir Walls, Swales, Trench Drains, Splash Pads	1. Connect corner or perimeter points with a closed polyline (PL command). 2. Select polyline to ensure a closed shape has been created. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

DRAFTING STANDARDS

LINEWORK & BLOCKS: City Inlets

City Inlet

CAD Legend Description	New 4' City Inlet	Existing 4' City Inlet	New 6' City Inlet	Existing 6' City Inlet
CAD LineType/Block Image				
Layer	GSI_Inlet_New	Inlet_Ex	GSI_Inlet_New	Inlet_Ex
Color, Line-Weight, Line-Type	Block	Block	Block	Block

LINEWORK & BLOCKS: Highway Grate, OMG, Non-Standard (Bottomless, Park, Special)

Highway Grate Inlet

CAD Legend Description	New 4' Highway Grate Inlet	Existing 4' Highway Grate Inlet	New 6' Highway Grate Inlet	Existing 6' Highway Grate Inlet
CAD LineType/ Block Image				
Layer	GSI_Inlet_New	Inlet_Ex	GSI_Inlet_New	Inlet_Ex
Color, Line-Weight, Line-Type	Block	Block	Block	Block

PHILADELPHIA WATER

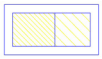
OMG Inlet

CAD Legend Description	New 4' OMG Inlet	Existing 4' OMG Inlet	New 6' OMG Inlet	Existing 6' OMG Inlet
CAD LineType/ Block Image				
Layer	GSI_Inlet_New	Inlet_Ex	GSI_Inlet_New	Inlet_Ex
Color, Line-Weight, Line-Type	Block	Block	Block	Block

Non-Standard

CAD Legend Description	New Bottomless Inlet	Existing Bottomless Inlet	New Park Grate Inlet	Existing Park Grate Inlet
CAD LineType/ Block Image				
Layer	GSI_Inlet_New	Inlet_Ex	GSI_Inlet_New	Inlet_Ex
Color, Line-Weight, Line-Type	Block	Block	Block	Block

Non-Standard

CAD Legend Description	New Special Inlet	Existing Special Inlet	Dual Trap Inlet
CAD LineType/ Block Image			
Layer	GSI_Inlet_New	Inlet_Ex	GSI_Inlet_New
Color, Line-Weight, Line-Type	Block	Block	Block

ANNOTATIONS FOR ALL INLET TYPES: City Inlets, Highway Grate, OMG, Non-Standard

Callout	<INLET TYPE> INLET WITH INLET INSERT <TOP> EL. = +XX.XX INV. IN EL. = +XX.XX INV. OUT EL. = +XX.XX BOTTOM OF BOX EL. = +XX.XX WITH X" DIA. ORIFICE @ INV. EL. = +XX.XX* WITH TRAP* WITH <CREST LENGTH/DIMS> <WEIR SHAPE> <WEIR MATERIAL> WEIR* WITH <APRON LENGTH IN FEET> BY <APRON WIDTH IN FEET> BY <APRON DEPTH IN INCHES> CONCRETE APRON*

*If applicable

INLETS & OUTLETS

DRAWING CREATION

Control Structure

CAD Legend Description	New Control Structure
CAD LineType/Block Image	
Layer	GSI_ControlStructure_New
Color, LineWeight, LineType	Block
Callout	<DIMS/SIZE> CONTROL STRUCTURE WITH INLET INSERT <TOP> EL. = +XX.XX INV. IN EL. = +XX.XX INV. OUT EL. = +XX.XX BOTTOM OF BOX EL. = +XX.XX WITH X" DIA. ORIFICE @ INV. EL. = +XX.XX* WITH TRAP* WITH <CREST LENGTH/DIMS> <WEIR SHAPE> <WEIR MATERIAL> WEIR*

*If applicable

Spillways & Weir Walls

CAD Legend Description	New Spillways and Weir Walls
CAD LineType/Block Image	
Layer	GSI_Structure_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	<CREST LENGTH/DIMS><WEIR SHAPE><WEIR MATERIAL> WEIR INV. EL. = +XX.XX

Domed Riser

CAD Legend Description	New Domed Riser
CAD LineType/ Block Image	
Layer	GSI_Inlet_New
Color, LineWeight, LineType	Block
Callout	X.XX" <MATERIAL> DOMED RISER RIM. EL. = +XX.XX WITH <GRATE MATERIAL> GRATE

Swales

CAD Legend Description	New Swale
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous
Callout	XX.XX L.F. STORMWATER SWALE XX.XX' BOTTOM WIDTH* @ X' PER XXX'

*If applicable

Trench Drains

CAD Legend Description	New Trench Drain
CAD LineType/ Block Image	
Layer	GSI_Conveyance_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	<DIMS> TRENCH DRAIN INV. IN EL. = +XX.XX WITH CAST IRON GRATE COVER* WITH <APRON LENGTH IN FEET> BY <APRON WIDTH IN FEET> BY <APRON DEPTH IN INCHES> CONCRETE APRON*

*If applicable

Curb Openings

CAD Legend Description	New Curb Opening
CAD LineType/ Block Image	
Layer	GSI_Structure_New
Color, LineWeight, LineType	Block
Callout	XX.XX L.F. CURB OPENING WITH WHEEL STOP* INV. EL. = +XX.XX

*If applicable

PHILADELPHIA WATER

INLETS & OUTLETS

Splash Pads

CAD Legend Description	New Splash Pads
CAD LineType/ Block Image	
Layer	GSI_Structure_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	<DIMS> <SP MATERIAL> SPLASH PAD

Endwalls

CAD Legend Description	New Endwall
CAD LineType/ Block Image	
Layer	GSI_Structure_New
Color, LineWeight, LineType	Block
Callout	<DIMS> <ENDWALL MATERIAL> ENDWALL

TYPICAL ANNOTATION VALUES

GRATE MATERIAL
METAL
PLASTIC

ENDWALL MATERIAL
CONC.
H.D.P.E.
PLASTIC

INLET TYPE
4' CITY
6' CITY
4' HWY GRATE
6' HWY GRATE
4' OMG
6' OMG

WEIR MATERIAL
METAL
CONC.
EARTHEN
PLASTIC
STONE

MATERIAL
D.I.P.
PERF. D.I.P.
H.D.P.E.
PERF. H.D.P.E.
P.V.C.
PERF. P.V.C.
R.C.P.
V.C.P.

SP MATERIAL
STONE
CONCRETE
BRICK

TOP
GRATE
BC INV.
RIM

WEIR SHAPE
RECT.
V-NOTCH
TRAP.

CAD screenshot of as-built drawing annotations and dimensions for inlets and outlets.

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ACCESS STRUCTURES

ACCESS STRUCTURES

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Access Structures	1. Copy appropriate block (from provided CAD template file) using the COPYBASE command and select the center of the block as the base point (or in the same location as the survey point). 2. Paste block onto the designated survey point. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

DRAFTING STANDARDS

Cleanouts

CAD Legend Description	New Cleanout
CAD LineType/ Block Image	
Layer	GSI_Cleanout_New
Color, LineWeight, LineType	Block
Callout	XX.XX" <MATERIAL> CLEANOUT RIM EL. = +XX.XX X" <MATERIAL COVER> COVER <DIRECTION OF SWEEP> SWEEP

Maintenance Ports

CAD Legend Description	New Maintenance Port
CAD LineType/ Block Image	
Layer	GSI_Cleanout_New
Color, LineWeight, LineType	Block
Callout	XX.XX" <MATERIAL> CLEANOUT

Green Manholes

CAD Legend Description	New Green Manhole
CAD LineType/ Block Image	
Layer	GSI_Manhole_New
Color, LineWeight, LineType	Block
Callout	XX.XX' MH RIM EL. = +XX.XX INV. IN EL. = +XX.XX INV. OUT EL. = +XX.XX WITH X" DIA. ORIFICE @ INV. EL. = +XX.XX* WITH <CREST LENGTH/DIMS> <WEIR SHAPE> <WEIR MATERIAL> WEIR*

*If applicable

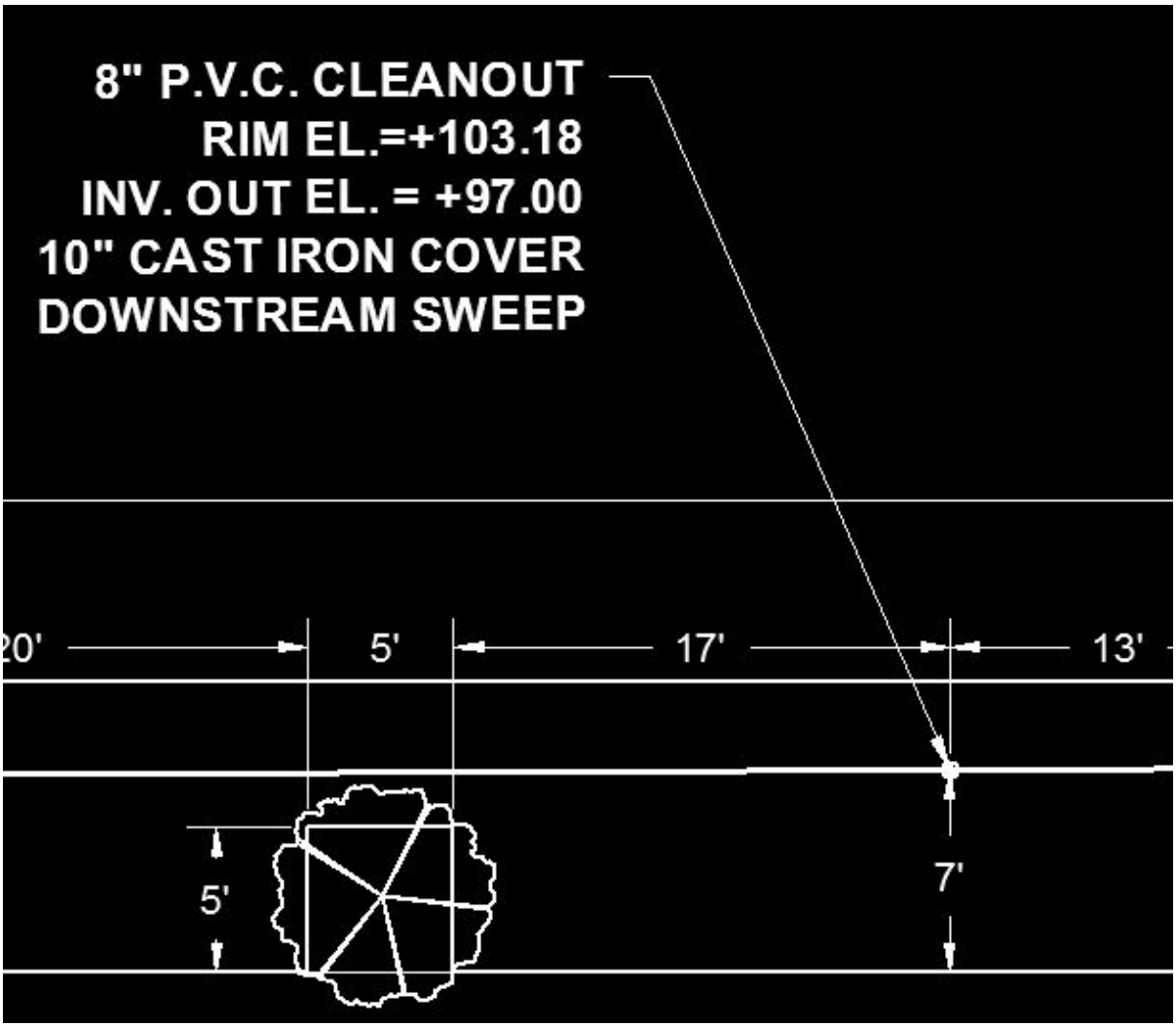
TYPICAL ANNOTATION VALUES

MATERIAL
H.D.P.E.
P.V.C.
CONC.

DIRECTION OF SWEEP
UPSTREAM
DOWNSTREAM
TRAP.

WEIR MATERIAL
METAL
CONC.
EARTHEN
PLASTIC
STONE

WEIR SHAPE
RECT.
V-NOTCH
TRAP.



CAD screenshot of as-built drawing annotations and dimensions for access structures.

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MONITORING STRUCTURES

MONITORING STRUCTURES

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Monitoring Structures	1. Copy appropriate block (from provided CAD template file) using the COPYBASE command and select the center of the block as the base point (or in the same location as the survey point). 2. Paste block onto the designated survey point. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

DRAFTING STANDARDS

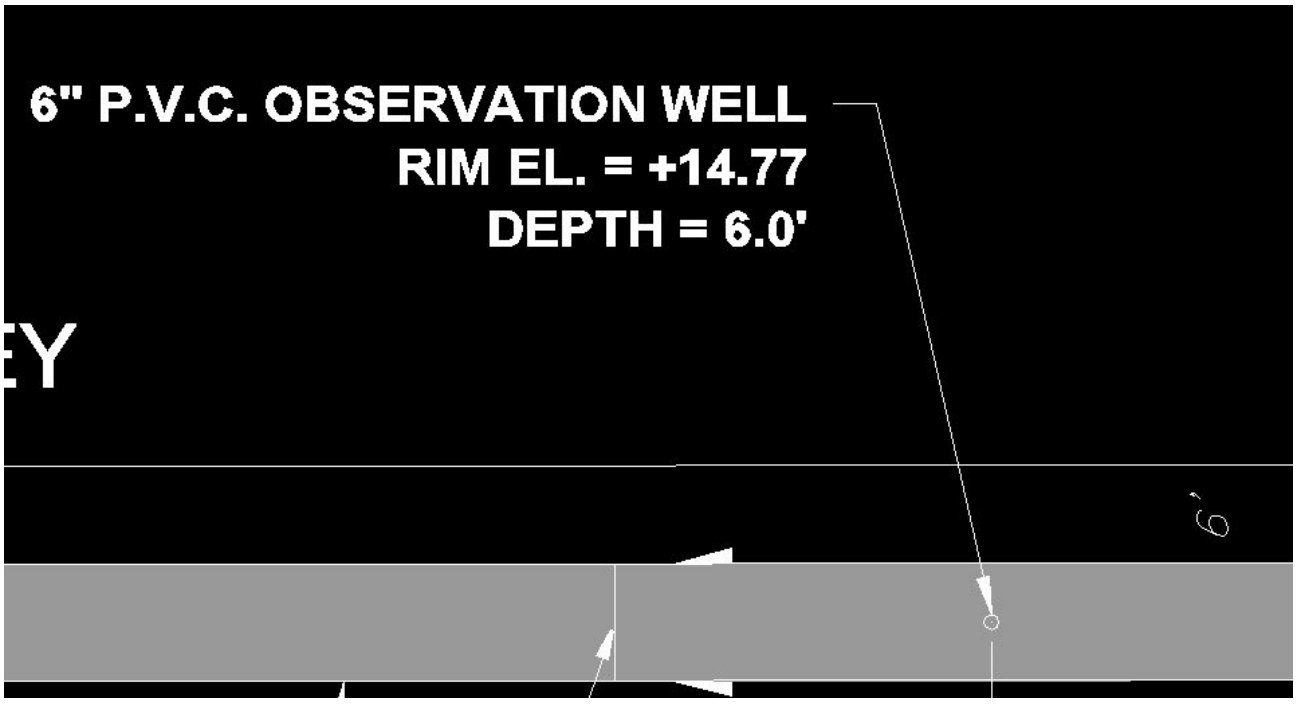
Observation Wells

CAD Legend Description	New Observation Well
CAD LineType/ Block Image	
Layer	GSI_ObservationWell_New
Color, LineWeight, LineType	Block
Callout	XX.XX" <MATERIAL> OBSERVATION WELL RIM EL. = +XX.XX DEPTH = X'

TYPICAL ANNOTATION VALUES

MATERIAL
D.I.P.
PERF. D.I.P.
H.D.P.E.
PERF. H.D.P.E.
P.V.C.
PERF. P.V.C.
R.C.P.
V.C.P.

MONITORING STRUCTURES



CAD screenshot of as-built drawing annotations and dimensions for monitoring structures.

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SURFACE STORAGE SMPs

SURFACE STORAGE SMPs

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Surface Storage SMPs	1. Connect all perimeter points with a closed polyline (PL command) to create the lowest contour elevation of the surface storage[1]. 2. Select polyline to ensure a closed shape has been created. 3. Create 1' contours using survey points where applicable (utilize layer CONTOURS_NEW in CAD template. 4. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 5. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

[1]If subsurface storage is present below surface storage, refer to subsurface storage drafting section for drafting instructions and standards.

DRAFTING STANDARDS

Basin

CAD Legend Description	New Basin
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Blue Roof

CAD Legend Description	New Blue Roof
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Bumpout

CAD Legend Description	New Bumpout
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Green Roof

CAD Legend Description	New Green Roof
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Planter

CAD Legend Description	New Planter
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Rain Garden

CAD Legend Description	New Rain Garden
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

Wetland

CAD Legend Description	New Wetland
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous

ANNOTATIONS FOR ALL SURFACE STORAGE SMPS: Basin, Blue Roof, Bumpout, Green Roof, Planter, Rain Garden, Wetland

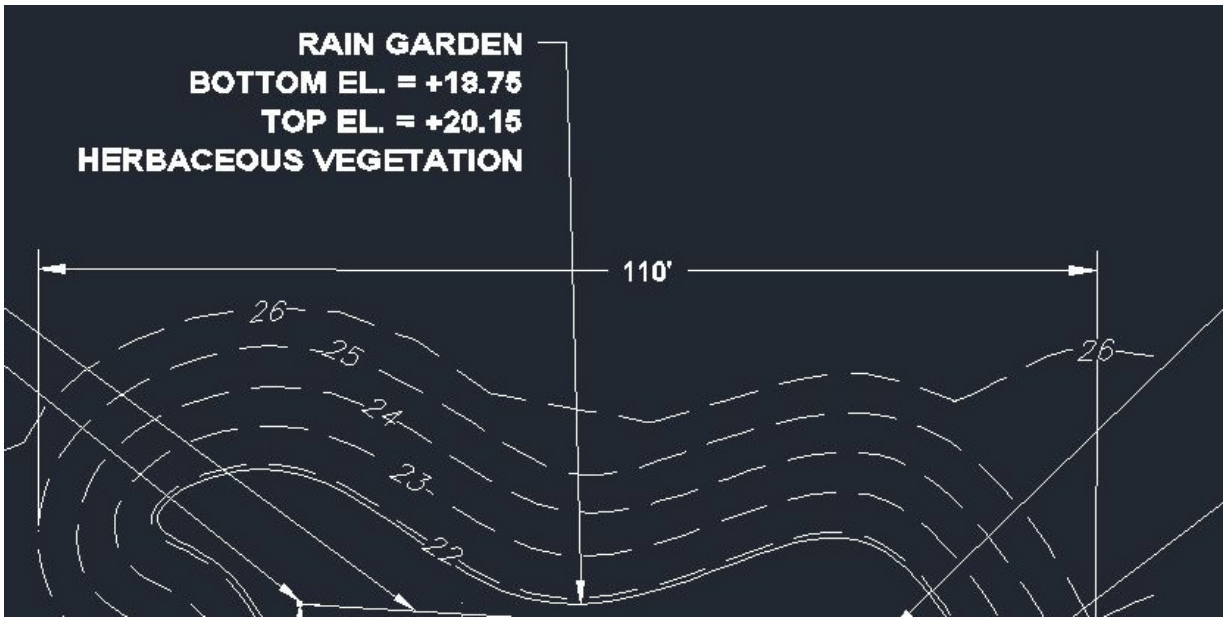
Callout	<SURFACE STORAGE SMP TYPE> BOTTOM EL. = +XX.XX TOP EL. = +XX.XX <VEGETATION TYPE> VEGETATION*

*If applicable
**Surface Storage SMPs may be underlain with subsurface storage SMPs which must be labeled as such. Refer to page 61.

TYPICAL ANNOTATION VALUES

VEGETATION TYPE
HERBACEOUS
TURF
TREE
WOODY
MIXED
UNKNOWN

SURFACE STORAGE SMP TYPE
STORMWATER BASIN
BLUE ROOF
STORMWATER BUMPOUT
GREEN ROOF
STORMWATER PLANTER
RAIN GARDEN
STORMWATER WETLAND



CAD screenshot of as-built drawing annotations for surface storage.

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STORMWATER TREES

STORMWATER TREES

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Stormwater Trees	1. Copy appropriate block (from provided CAD template file) using the COPYBASE command and select the center of the block as the base point (or in the same location as the survey point). 2. Paste block onto the designated survey point. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

[1]If subsurface storage is present below stormwater tree, refer to subsurface storage drafting section for drafting instructions and standards.

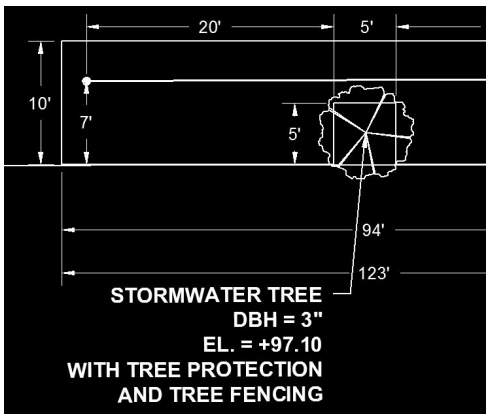
DRAFTING STANDARDS

Stormwater Trees

CAD Legend Description	New Stormwater Tree
CAD LineType/ Block Image	
Layer	GSI_Tree_New
Color, LineWeight, Linetype	Block
Callout	STORMWATER TREE DBH = X” EL. = +XX.XX WITH TREE PROTECTION* WITH TREE FENCING*

*If applicable

TYPICAL ANNOTATION VALUES



CAD screenshot of as-built drawing annotations and dimensions for stormwater trees.

PAVEMENT & CURBS

PAVEMENT & CURBS

DRAFTING INSTRUCTIONS

GSI As-Built Feature	Drafting Instructions
Pavement & Curbs	1. Connect all perimeter points with a closed polyline (PL command) to create the lowest contour elevation of the surface storage[1]. 2. Select polyline to ensure a closed shape has been created. 3. Create annotation using MLEADER command, placing annotations on TEXT_NEW Layer. 4. Create dimensions using DIMLINEAR command, placing dimensions on TEXT_DIM Layer. **All features must have dimensions that include the horizontal distance (perpendicular) to nearest curbline and longitudinal distance parallel to curbline where applicable.**

[1]If subsurface storage is present below surface storage, refer to subsurface storage drafting section for drafting instructions and standards.

DRAFTING STANDARDS

Curbs

CAD Legend Description	New Curbline
CAD LineType/ Block Image	
Layer	Curbline_New
Color	BLUE
LineWeight	0.70mm
LineType	Continuous
Callout	TC +XX.XX BC +XX.XX

Permeable Pavement

CAD Legend Description	New Permeable Pavement
CAD LineType/ Block Image	
Layer	GSI_SurfaceFeature_New
Color	11 'SALMON'
LineWeight	0.40mm
LineType	Continuous
Callout	<PERMEABLE PAVEMENT MATERIAL>* AREA = XX S.F.

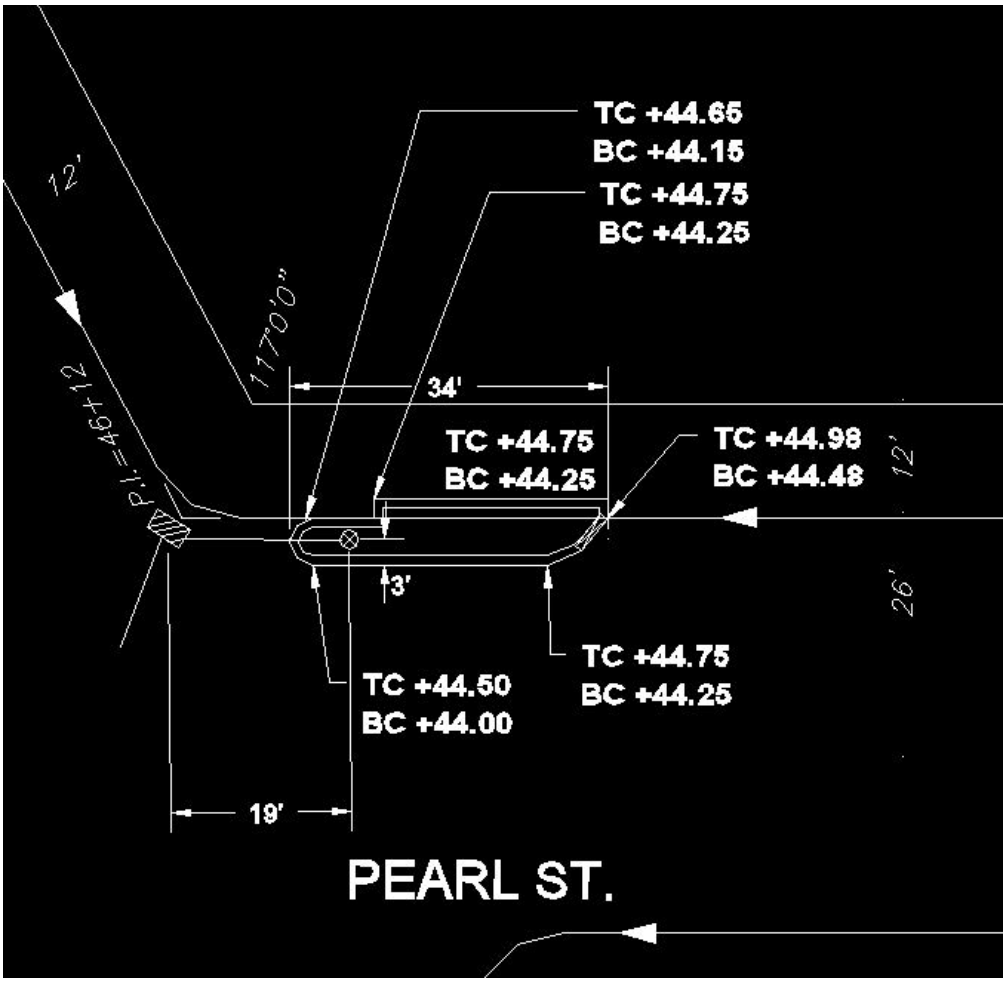
*Permeable pavement may be underlain with subsurface storage SMPs which must be labeled as such. Refer to page 61.

**Permeable pavement should be shown with a solid hatch with color '253' on the "GSI_SurfaceFeature_New" layer.

PHILADELPHIA WATER

TYPICAL ANNOTATION VALUES

PERMEABLE PAVEMENT MATERIAL
POROUS ASPHALT
POROUS CONCRETE
POROUS PAVERS
POROUS PLAY SURFACE



CAD screenshot of as-built drawing annotations for curbs.

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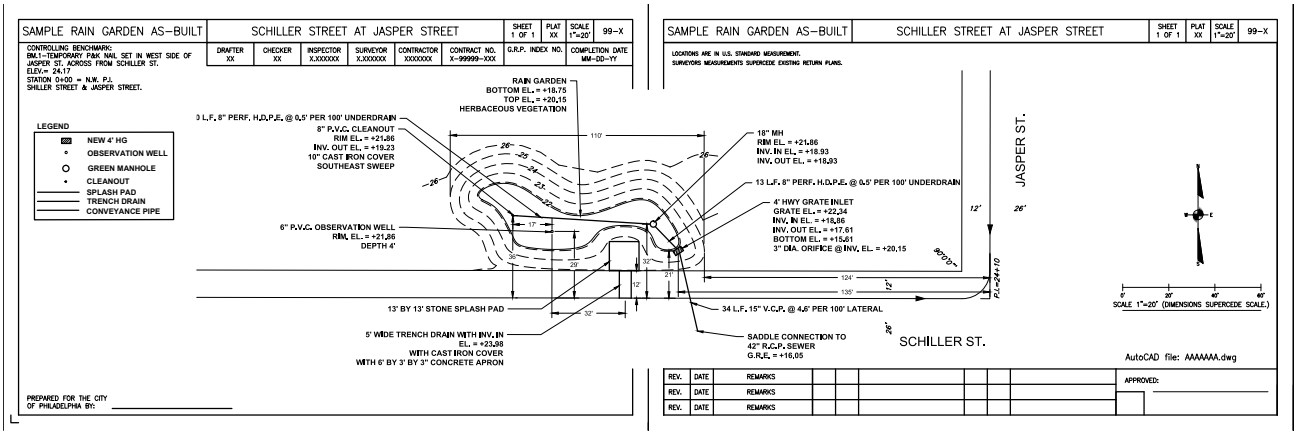
DRAWING COMPLETION

BORDERS & TITLE BLOCKS



ALLOWABLE SCALES:

- ✓ 1" = 10'
- ✓ 1" = 20'

BORDER SIZES (AS-PLOTTED):

- ✓ 9.25" x 14" -- 1L Sheet
- ✓ 9.25" x 28" -- 2L Sheets
- ✓ 9.25" x 42" -- 3L Sheets
- ✓ 18.50" x 28" -- 2L x 2H Sheets
- ✓ 27.75" x 28" -- 3L x 2H Sheets
- ✓ 27.75" x 42" -- 3L x 3H Sheets

Note: If larger border sizes are needed, consult with PWD.

10 SCALE (H' x W')

- ✓ 60' x 270' -- 2L Sheets
- ✓ 60' x 410' -- 3L Sheets
- ✓ 150' x 270' -- 4L Sheets
- ✓ 330' x 190' -- 4H Sheets
- ✓ 150' x 410' -- 6L Sheets

20 SCALE (H' x W')

- ✓ 120' x 540' -- 2L Sheets
- ✓ 120' x 820' -- 3L Sheets
- ✓ 300' x 540' -- 4L Sheets

Note: Dimensions represent the outer perimeter of drawing in model-space.

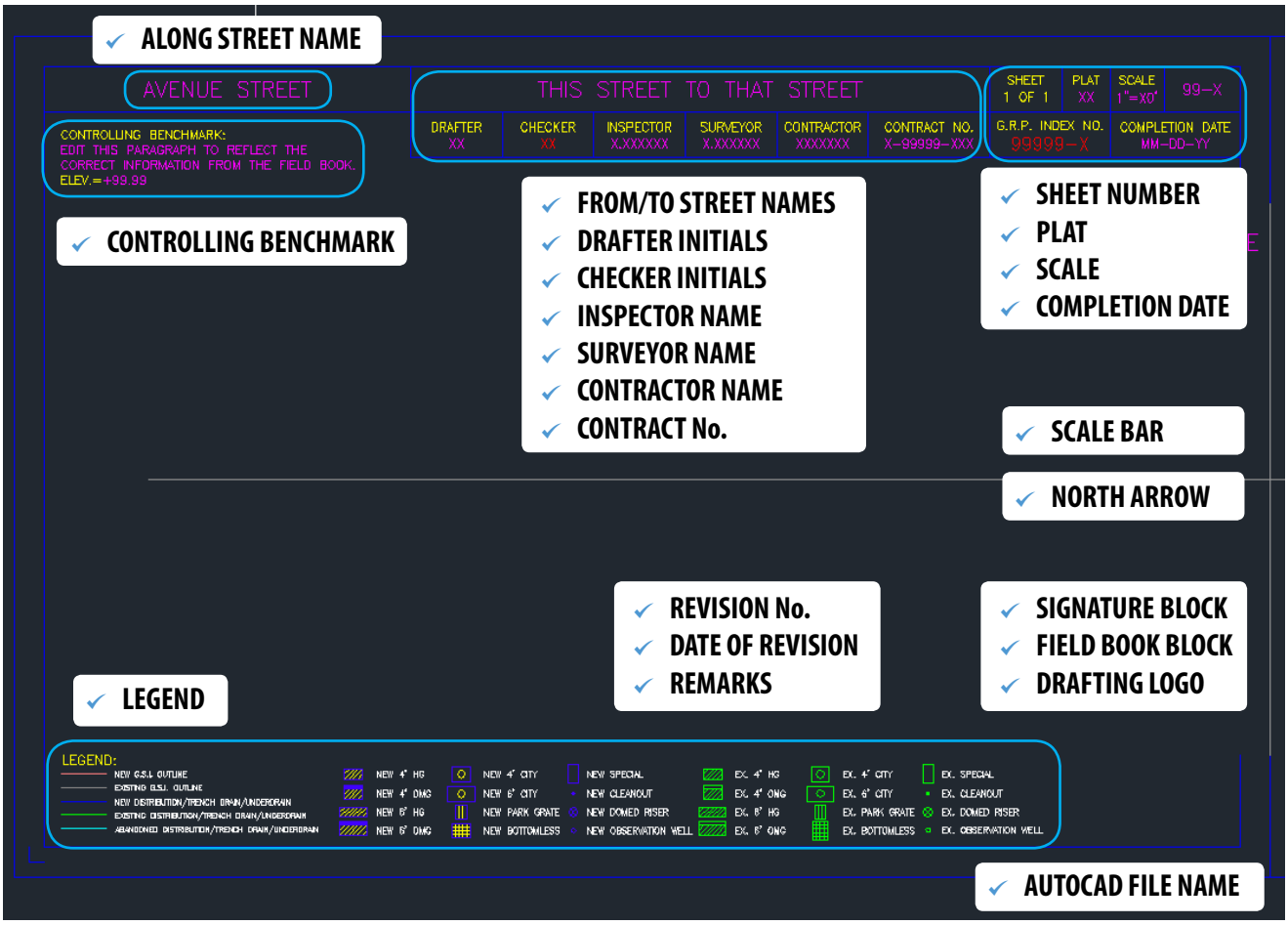
FITTING PROCEDURE:

1. Measure the outer perimeter of the drawing in model-space. Include a 40' offset of curblines or if construction is limited to one side of the right-of-way, cut perimeter at center line.
2. Locate the appropriate title block layout using the available scales *(Note: Borders are fit at the largest scale possible. For example: if a site can fit on a 20 scale 2L sheet OR a 10 scale 4L sheet, the correct option is the 10 scale 4L sheet).*
3. Using the appropriate layout within paper space, change the viewport scale to match and center the drawing within the viewport (using the ZOOMEXTENTS command).

PHILADELPHIA WATER

TITLE BLOCK CHECKLIST

- ✓ Complete all title block fields except G.R.P. Index No.
- ✓ Include controlling benchmark in upper left hand corner of drawing.
- ✓ Create legend that consists of all linework and blocks represented in drawing (utilize CAD template).



GENERAL BEST PRACTICES

Before submitting the final drawing (*.dwg) file to PWD, follow these steps to ensure a clean, approval-ready as-built drawing submission:

1. Flatten drawings using the FLATTEN command to ensure all linework is on the same plane (set Z values to 0).
2. Make sure dimensions and annotation texts are not obscuring objects or lines.
3. Check that there are no extraneous lines or objects.
4. Place north arrow within viewport extents.
5. Insert proper scale bar in layout space.
6. Purge CAD file to reduce file size using PURGE command (select purge all).
7. Check for errors using the AUDIT command.
8. Type "zoom extents" into the CAD command line before saving and submitting the final CAD file.
9. Save file.

FINISHING TOUCHES

PLOTTING PROCEDURES

1. Open plot style manager and copy the pwd_plot_style.ctb file provided into the plot styles folder.
2. Plot drawings from layout space from using the pwd_plot_style.ctb plot style table.
3. Set plot area to layout, match plotting paper size to correct layout paper size, and ensure plot scale is set to 1:1.
4. Plot drawing from DWG to PDF for *.pdf file.
5. Open *.pdf file and SAVE AS: *.tiff and *.jpeg.

GSI AS-BUILT DRAWING FINAL REVIEW CHECKLIST

1. Plans drafted using PWD templates and standards. ☐
2. Plans drawn to an appropriate scale (1"=10' or 20'). ☐
3. All linework and/or blocks internal to the submitted *.dwg (i.e., no external reference files). ☐
4. All linework assigned to the appropriate layers. ☐
5. Each *.dwg plan shows only one GSI system or one city block. ☐
6. Plans are geo-referenced. ☐
7. Plans are saved as *.dwg 2010 file format. ☐
8. All files are appropriately named. ☐
9. A *.dwg of all as-built GSI systems and *.pdf files of red-lined contractor mark-ups are included with the CD submission. ☐
10. Raw survey points submitted in a tab-delimited *.txt file format or an approved format with the CD or DVD submission. ☐
11. Professional Land Surveyor verified as-built drawing represents surveyed conditions and signed drawings. ☐

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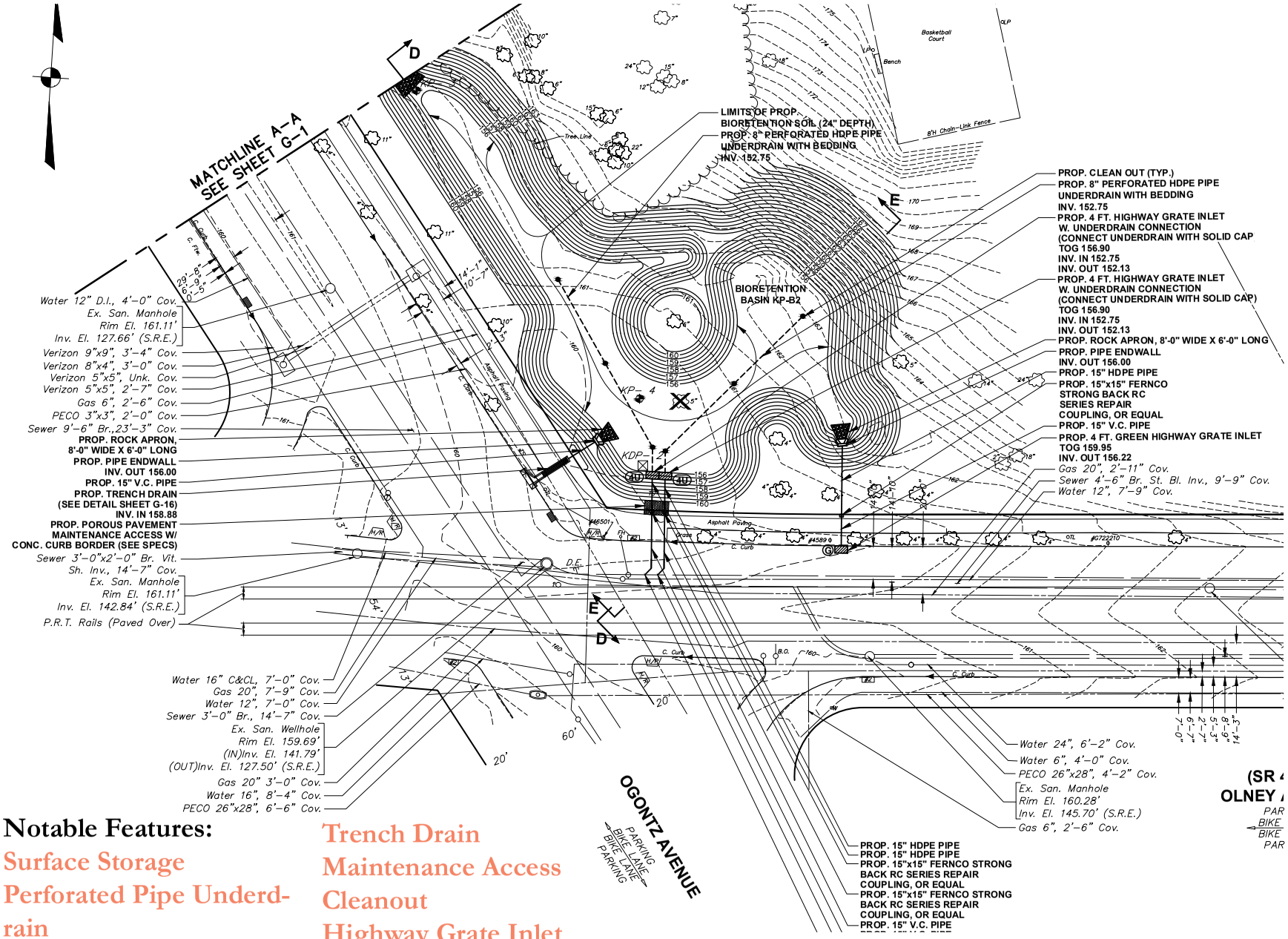
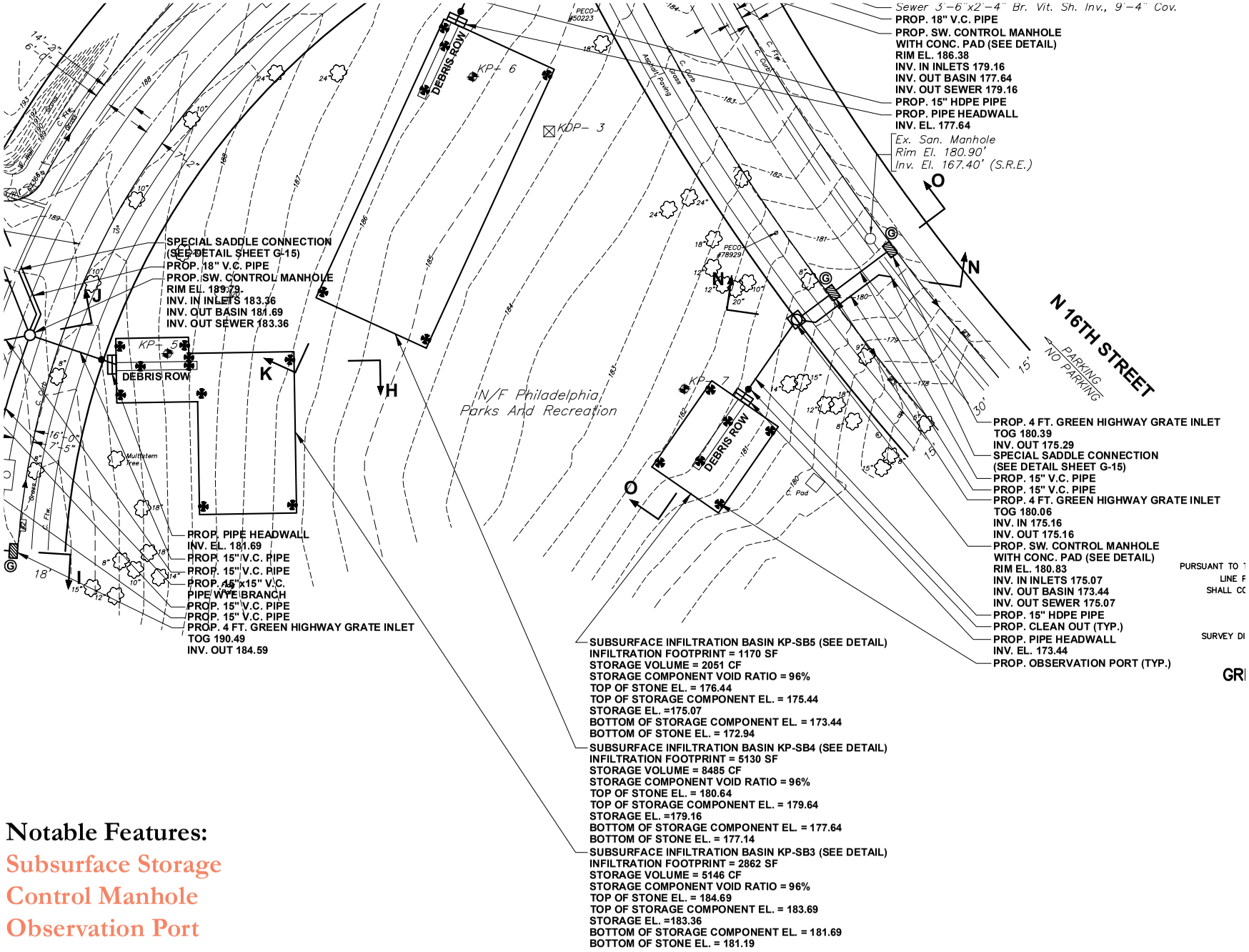
APPENDIX A
SAMPLE GSI DESIGN DRAWINGS

CURVILINEAR RAIN GARDEN



Notable Features:

Surface Storage
Perforated Pipe Underdrain
Rock Apron
Trench Drain
Maintenance Access
Cleanout
Highway Grate Inlet
Pipe Endwall



INFILTRATION BASIN

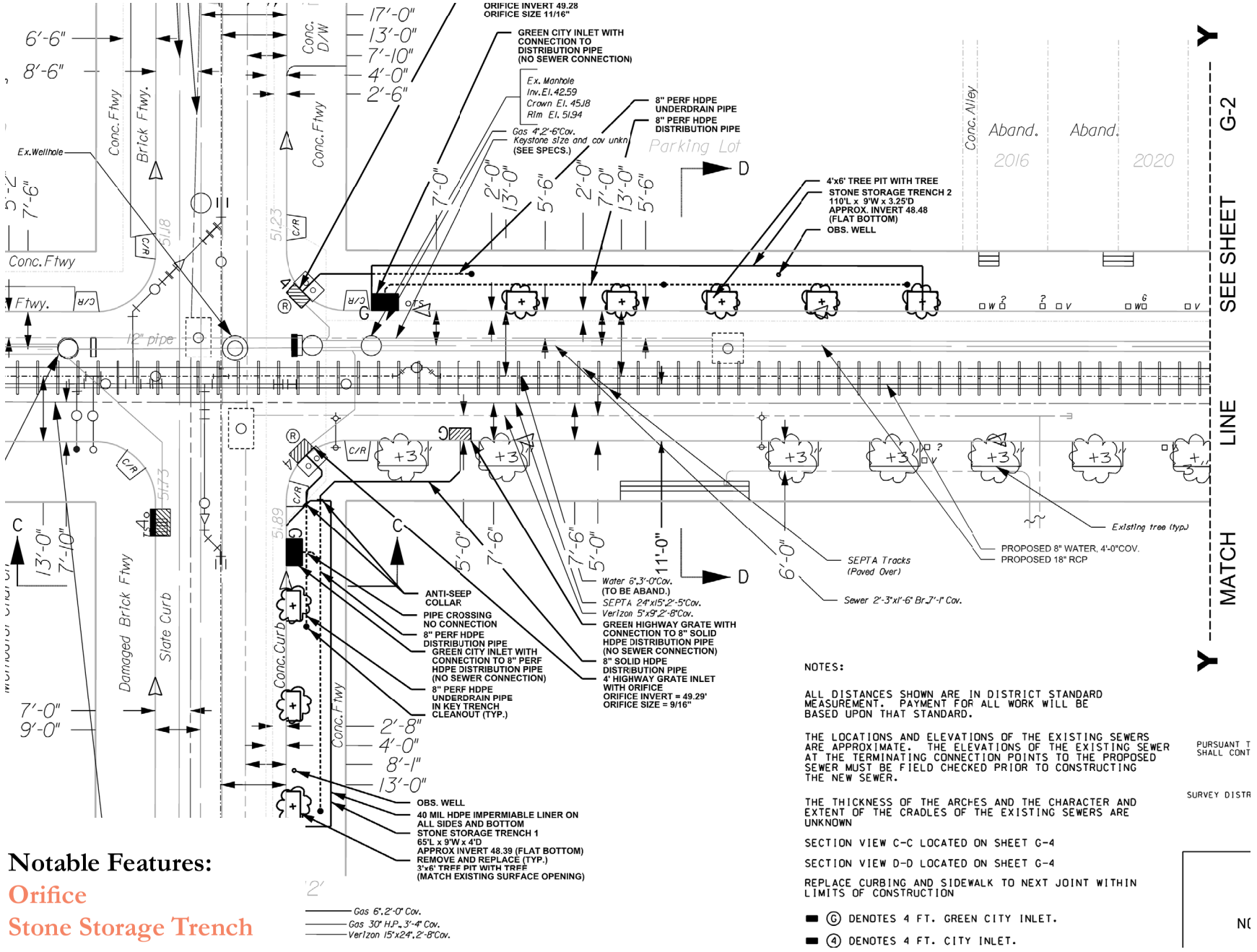
Notable Features:

Subsurface Storage

Control Manhole

Observation Port

TREE TRENCH



Notable Features:

Orifice

Stone Storage Trench

APPENDIX B
SAMPLE GSI AS-BUILT DRAWINGS

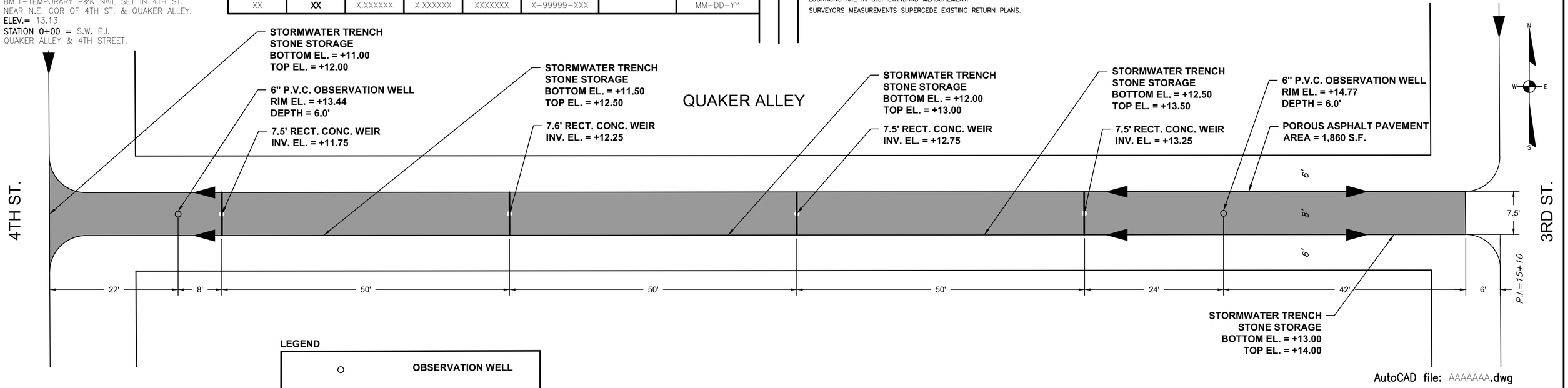
- Permeable Pavement
- Rain Garden
- Tree Trench
- Stormwater Bumpout

SAMPLE PERMEABLE PAVEMENT	QUAKER ALLEY BETWEEN 3RD ST. & 4TH ST.	SHEET 1 OF 1	PLAT XX	SCALE 1"=10'	99-X

DRAFTER	CHECKER	INSPECTOR	SURVEYOR	CONTRACTOR	CONTRACT NO.	G.R.P. INDEX NO.	COMPLETION DATE
XX	XX	X.XXXXXX	X.XXXXXX	XXXXXXX	X-99999-XXX		MM-DD-YY

CONTROLLING BENCHMARK:
BM.1-TEMPORARY P&K NAIL SET IN 4TH ST.
NEAR N.E. COR OF 4TH ST. & QUAKER ALLEY.
ELEV.= 13.13
STATION 0+00 = S.W. P.I.
QUAKER ALLEY & 4TH STREET.

LOCATIONS ARE IN U.S. STANDARD MEASUREMENT.
SURVEYORS MEASUREMENTS SUPERCEDE EXISTING RETURN PLANS.



AutoCAD file: AAAAAAA.dwg

LEGEND

- OBSERVATION WELL
- WEIR WALL
- PERMEABLE PAVEMENT

0' 10' 20' 30'
SCALE 1"=10' (DIMENSIONS SUPERCEDE SCALE.)

PREPARED FOR THE CITY
OF PHILADELPHIA BY: _____

REV.	DATE	REMARKS
REV.	DATE	REMARKS
REV.	DATE	REMARKS

APPROVED: _____

SAMPLE RAIN GARDEN AS-BUILT	SCHILLER STREET AT JASPER STREET	SHEET 1 OF 1	PLAT XX	SCALE 1"=20'	99-X

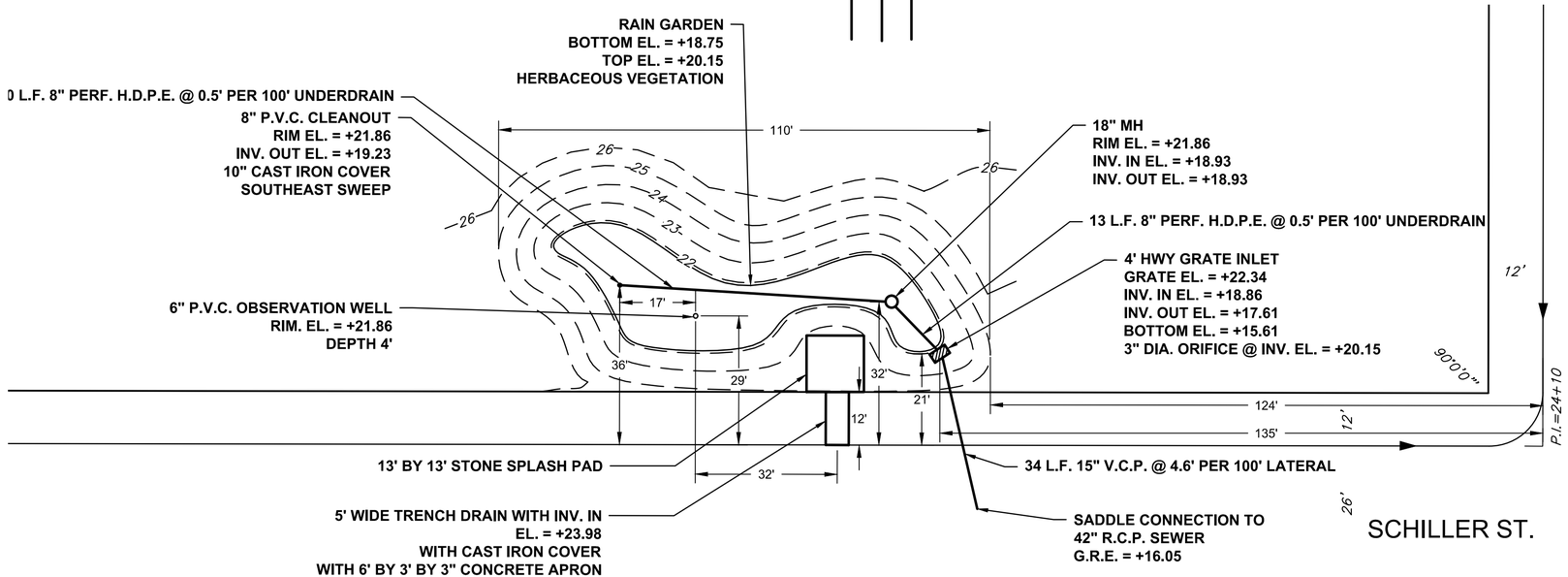
DRAFTER	CHECKER	INSPECTOR	SURVEYOR	CONTRACTOR	CONTRACT NO.	G.R.P. INDEX NO.	COMPLETION DATE
XX	XX	X.XXXXXX	X.XXXXXX	XXXXXXX	X-99999-XXX		MM-DD-YY

CONTROLLING BENCHMARK:
BM.1-TEMPORARY P&K NAIL SET IN WEST SIDE OF JASPER ST. ACROSS FROM SCHILLER ST.
ELEV.= 24.17
STATION 0+00 = N.W. P.I.
SHILLER STREET & JASPER STREET.

LOCATIONS ARE IN U.S. STANDARD MEASUREMENT.
SURVEYORS MEASUREMENTS SUPERCEDE EXISTING RETURN PLANS.

LEGEND

- NEW 4' HG
- OBSERVATION WELL
- GREEN MANHOLE
- CLEANOUT
- SPLASH PAD
- TRENCH DRAIN
- CONVEYANCE PIPE



0' 20' 40' 60'
SCALE 1"=20' (DIMENSIONS SUPERCEDE SCALE.)

AutoCAD file: AAAAAAA.dwg

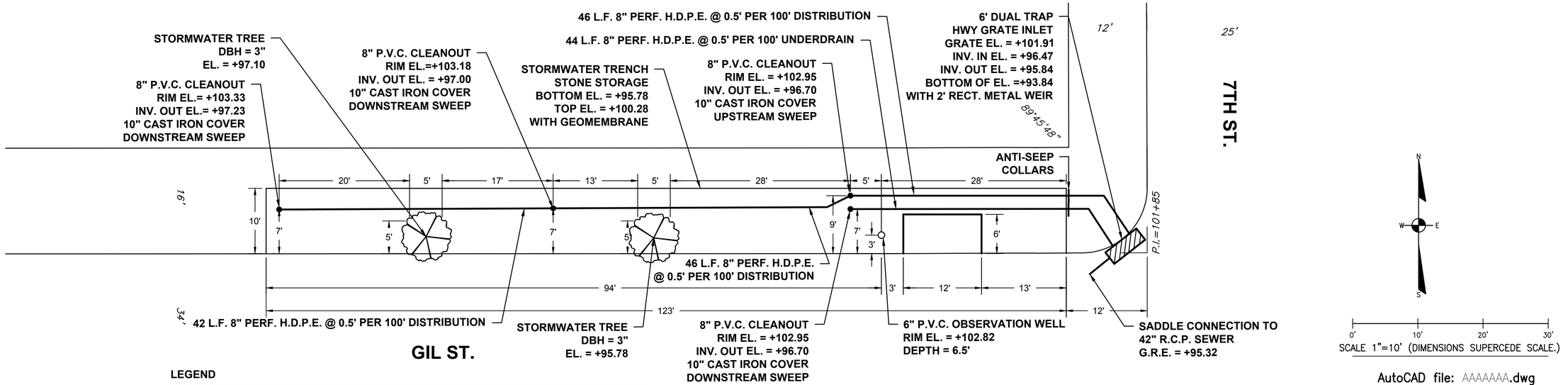
PREPARED FOR THE CITY
OF PHILADELPHIA BY: _____

REV.	DATE	REMARKS							APPROVED:
REV.	DATE	REMARKS							
REV.	DATE	REMARKS							

SAMPLE TREE TRENCH AS-BUILT	GIL STREET AT 7TH STREET					SHEET 1 OF 1	PLAT XX	SCALE 1"=X0'	99-X
CONTROLLING BENCHMARK: EDIT THIS PARAGRAPH TO REFLECT THE CORRECT INFORMATION FROM THE FIELD BOOK. ELEV.=+99.99 STATION 0+00 = N.E. P.I. GIL STREET AT 7TH STREET.	DRAFTER XX	CHECKER XX	INSPECTOR X.XXXXXX	SURVEYOR X.XXXXXX	CONTRACTOR XXXXXXX	CONTRACT NO. X-99999-XXX	G.R.P. INDEX NO.		COMPLETION DATE MM-DD-YY

SAMPLE TREE TRENCH AS-BUILT | GIL STREET AT 7TH STREET | SHEET 1 OF 1 | PLAT XX | SCALE 1"=X0' | 99-X

LOCATIONS ARE IN U.S. STANDARD MEASUREMENT.
SURVEYORS MEASUREMENTS SUPERCEDE EXISTING RETURN PLANS.



LEGEND

NEW 6' HG	TREE TRENCH
CLEANOUT	CONVEYANCE PIPES
OBSERVATION WELLS	

AutoCAD file: AAAAAAA.dwg

PREPARED FOR THE CITY OF PHILADELPHIA BY: _____

REV.	DATE	REMARKS							APPROVED:
REV.	DATE	REMARKS							
REV.	DATE	REMARKS							

SAMPLE BUMPOUT AS-BUILT

PEARL STREET AT MAIN STREET

SHEET	PLAT	SCALE	
1 OF 1	XX	1"=10'	99-X

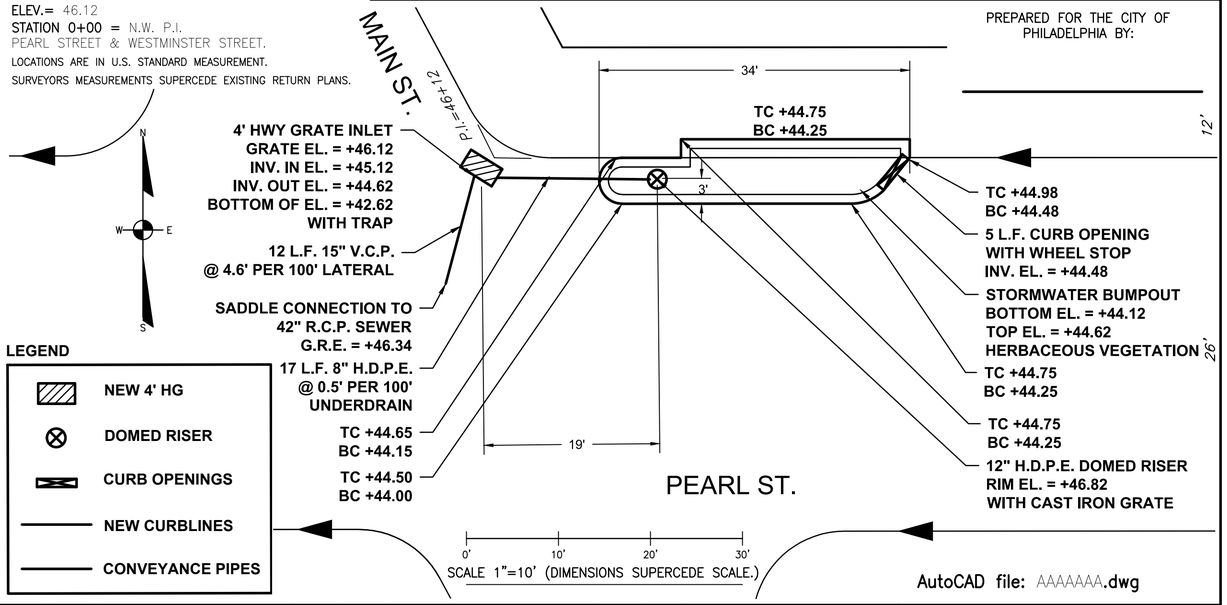
DRAFTER	CHECKER	INSPECTOR	SURVEYOR	CONTRACTOR	CONTRACT NO.	G.R.P. INDEX NO.	COMPLETION DATE
XX	**XX**	X.XXXXXX	X.XXXXXX	XXXXXXX	X-99999-XXX		MM-DD-YY

CONTROLLING BENCHMARK:
BM.1-TEMPORARY P&K NAIL SET IN WEST SIDE OF PEARL ST. ACROSS FROM WESTMINSTER ST.
ELEV.= 46.12
STATION 0+00 = N.W. P.I.
PEARL STREET & WESTMINSTER STREET.

LOCATIONS ARE IN U.S. STANDARD MEASUREMENT.

SURVEYORS MEASUREMENTS SUPERCEDE EXISTING RETURN PLANS.

PREPARED FOR THE CITY OF PHILADELPHIA BY:



LEGEND

- NEW 4' HG
- DOMED RISER
- CURB OPENINGS
- NEW CURBLINES
- CONVEYANCE PIPES

0' 10' 20' 30'
SCALE 1"=10' (DIMENSIONS SUPERCEDE SCALE.)

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