DESIGN TECHNOLOGY MANUAL

APPLICABILITY OF REVISION 3

Supersedes Revision 2

For projects that have not yet commenced Preliminary Engineering as of December 20, 2022.

East Link Extension

East Link I-90 Segment

Contract No.	Title	DTM Revision	Design Status
E110	Central Link Interface and Turn Back Track at IDS	0	CO
E120	Gravity and Seismic Retrofits of WSDOT Structures – WSDOT BDM	N/A Will use WSDOT manual	CO
E130	Seattle to South Bellevue	(WSDOT for WSDOT Structures Retrofit)	CO
E135	Mercer Island Transit Interchange	0	CO
E140	Mechanical/Electrical Work in WSDOT Tunnel Facilities –	0	N/A (see E130)
E160	I-90 Track Bridge System and Prototype Project	0	CO

East Link Bel-Red

Contract No.	Title	DTM Revision	Design Status
E320	I-90 to East Main Station (South Bellevue)	0	CO
E330	Downtown Bellevue Tunnel	0	Completed
E335	East Main Station to 124th (DBT to Spring District)	0	CO
E340	124th to NE 20th (Bel-Red)	0	CO
E360	NE 20th to Overlake Transit Center Station	0	DB

Eastlink - Systems

Contract No.	Title	DTM Revision	Design Status
E750	Systems	0	CO

Lynnwood Link Extension

Contract No.	Title	DTM Revision	Design Status
L115	Early Demolition	1	Completed
L200	Civil – Northgate to S 200th	1	CO
L300	Civil – S 200th to Lynnwood	1	CO

Lynnwood Link - Systems

Contract No.	Title	DTM Revision	Design Status
L800	Systems	1	CO

Downtown Redmon Link Extension

Contract No.	Title	DTM Revision	Design Status
R200	Downtown Redmond Link Extension	1-2	DB

Federal Way Transit Expansion

Contract No.	Title	DTM Revision	Design Status
F100	Advanced Demolition	2	Complete
F200	Design Build Guideway and Station	2	DB
F210	Traffic Mitigation	2	DB

Central Corridor Projects

Contract No.	Title	DTM Revision	Design Status
N/A	Ballard to Downtown Link Extension	2-3	CE/PE-FD/DB
N/A	West Seattle to Downtown Link Extension	2-3	CE/PE-FD/DB

South Corridor Projects

Contract No.	Title	DTM Revision	Design Status
N/A	Tacoma Dome Link Extension	1-2	CE/PE-FD/DB
N/A	Operations & Maintenance Facility South (OMFS)	2-3	PE-FD
T100	Hilltop Tacoma Link Extension	1	CO

Sounder Projects

Contract No.	Title	DTM Revision	Design Status
N/A	Sounder Maintenance Base	0	CE
N/A	Kent Station Parking & Access Improvements	3	FD
N/A	Sumner Station Parking & Access Improvements	2*	FD
N/A	Puyallup Station Parking & Access Improvements	2	DB
N/A	Lakewood Station Parking & Access Improvements	1	CE/PE
N/A	Sounder South Capacity Expansion	1	CE/PE

Bus Rapid Transit Projects

Contract No.	Title	DTM Revision	Design Status
N/A	I-405 Stride	2	FD
N/A	SR522 / NE 145th Stride	2	FD
N/A	North Sammamish Park & Ride	2	CE
N/A	Bus Base North	2	CE/PE

* Sumner Access Project will be on DTM Rev 2 with addendum to include sections under DTM Rev 3

CE - Conceptual Engineering
CO - Construction
DB - Design-Build
PE - Preliminary Engineering
FD - Final Design

DISCLAIMER FOR
Design and Engineering Design Standards Documents

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APPLICABILITY FOR
Design and Engineering Design Standards Documents

Project teams shall refer to their executed project contracts for applicable document versions/revisions.

SOUNDTRANSIT

DESIGN TECHNOLOGY MANUAL

December 20, 2022

Revision 3

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Table of Contents

1. General

1.1 About this Manual

This manual defines the requirements provided by all projects for drawings, models, asset data, supporting electronic data, and documentation to maintain, operate, and upgrade our infrastructure and systems.

This revision supersedes previous ST Design Technology Manuals for all new projects and internal work.

The graphical examples in this document were created with Autodesk 2020 and may not match newer versions.

1.2 Additions and Deviations to ST Requirements

Additions and deviations, discovered during the project, are documented in the BIMf and BIMc Project Execution Plan (PXP).

Requesting a deviation to this manual: Complete the ***DTM Deviation Form*** in section ***13*** and submit the form to the Design Technology Manager for approval prior to documenting in the PXP and implementing.

Only additions or deviations meeting the following guidelines are considered:

- Follows the intent of the requirements
- Provides a clear and detailed description of the changes in the BIM PXPs
- All project team members adhere to the same defined requirements
- Maintains all project documentation and related data in a consistent structure and appearance, even between contributing firms and disciplines
- All project data is usable by ST in the approved software and version

2. Definitions & Abbreviations

2.1 Definitions

The following are terms to Sound Transit's Design Technology and the related drawings, models, and data provided to ST.

Requirements for creating new abbreviations are in ***2.2***

3rd Party Modeling Software, add-in applications - Software that is not available in the default installations of Autodesk Civil 3D, Revit, and Navisworks Manage.

As-Built Drawings (Prepared by the Contractor) - They reflect the site's final condition by recording necessary changes to the conformed contract drawings with colored markups and referenced Field Sketches.

Building Information Modeling Facilities (BIMf) - A design process, which uses 3D geometric models tied to parametrically modifiable databases, for planning, design, construction, and management of facilities including Stations, Parking Structures, Operations and Maintenance Facilities, and other Buildings through asset management. Provides REVIT software.

Building Information Modeling Civil Infrastructure (BIMc) – A design process, which uses 3D geometric models and associated data of items outside of facility structures, for planning, design, construction, and management of ST infrastructure. Provides Civil 3D software.

Computer Aided Drafting (CAD) – The use of software for drafting and design efforts. Provides AutoCAD software.

Design Technology (DT) – The group within Sound Transit that defines the requirements for drawings, models, asset data and other information used to design, build, and maintain ST's infrastructure and systems. Includes the related software and systems used to author, maintain, and consume the information. For example: AutoCAD, Civil 3d, Revit, and Navisworks.

Design Technology Manager – Sound Transit's designated authority on all design technology related issues for work being completed for Sound Transit by consultants, contractors, partnering agencies, and Sound Transit staff.

Design Technology Resources – Files and tools created and maintained by Sound Transit to support the creation of data and documentation that meets the established requirements.

Electronic Document/Data Management System (EDMS) - An electronic organizational system for maintaining and sharing project data between team members. For this manual, it is where all the CAD/BIM files are maintained and shared. For example: ProjectWise or BIM360.

External Reference (Xref) – A common term to identify a CAD file that is overlaid to another CAD file. Typically, they contain source "reference" elements that are compiled with other elements to produce a complete Drawing. Contains existing conditions or design elements in real space, scale, and orientation in the project's defined coordinate system.

Field Sketches - Prepared by the Contractor, CMC, or DSDC. They are a separate drawing that supplements the Change Drawings and mark-ups in the As-Built Drawings to improve the clarity of large or complex changes. They are provided to DSDC along with the As-Built drawings.

File Management Plan – Contains, at a minimum; an outline of the file names, structure, and content for all BIM and CAD related files provided to Sound Transit and other AHJ.

Joint Aquatic Resource Permit Application (JARPA) – An application for multiple permits, through multiple regulatory agencies, at the same time. Refer to the WSDOT Environmental Services Office for the permit application drawing guidance document.

Level of Development (LOD) – Describes developed graphical and parametric details of an element or category within a BIM Model. Sound Transit bases its LOD descriptions on the LOD specification version 2021 published by www.bimforum.org

Orthographic Projection (OP) Base Maps (xref) – Files that contain attached aerial images of existing topography. Use on Preliminary Engineering projects ONLY. Not on Final Design projects.

Record Drawings – Prepared by DSDC. They reflect the site's final condition in a final drawing presentation without markups, sketch references, or irrelevant information by drafting/modeling necessary changes to the conformed contract drawings in the supporting electronic data.

Record Shop Drawings - Prepared by the contractor or their sub-contractors. They reflect the final condition of the sub-contractors installed work in a final drawing presentation without markups, sketch references, or irrelevant information.

As-Built Shop Drawings - Prepared by the sub-contractors to show the intended installation. They show more detailed information about the work performed and products installed on site than the contract drawings.

Supporting Electronic Data – A file that contains information used to produce the documents, drawings, models, and asset data. This includes, but not limited to: CAD, Civil 3D, REVIT, Excel, Word, and PDF. All data is fully editable in the approved authoring software without the use of any custom tools, resources, or processes, beyond what Sound Transit provides or approves for acceptance.

2.2 Abbreviations

2.2.1 General Conditions

Include all abbreviations used in the package

Keep abbreviations to a minimum

Consistently apply abbreviations throughout all drawings in the project

Post abbreviations in the package in either of two ways:

- Include all abbreviations used on the general discipline drawing
- Include abbreviations related to each discipline on a discipline specific notation drawing

2.2.2 Creating New Abbreviations

Capitalize all abbreviations

Use letter symbols for mathematical operations, such as Equal (=) or Divide (/)

Use the same abbreviation for all tenses and cases ("BM" for beam and beams)

Combine individual abbreviations as needed ("AVG" and "TEMP" into "AVG TEMP")

Do Not add spaces

3. BIM and CAD Management

All contractors and consultants that develop or update drawings, models, and the supporting BIM or CAD data on a Sound Transit project to provide a full-time position meeting the following responsibilities:

- Act as single point of contact to the Sound Transit Design Technology Manager, or designated representative
- Coordinate all BIM and CAD related issues between Sound Transit, other Authorities Having Jurisdiction (AHJ), and related design or construction teams
- Coordinate the transfer of data between Project team, Sound Transit, other AHJ, and those designated by Sound Transit
- Schedule, attend, and facilitate BIM and CAD meetings. Coordinate necessary preparations with other project participants
- BIM and CAD Meetings, prepare and distribute agenda 2 days prior to meeting
- Provide minutes for BIM and CAD meeting to attendees within 24 hours after meeting.
- Provide Sound Transit Staff Direct support accessing BIM and CAD data

4. Software and File Types

4.1 General

Sound Transit requires that all drawings and models are developed and delivered in Autodesk CAD and BIM software products.

Sound Transit's Design Technology Manager approves:

- Use of any other software, add-on, or plug-in that is not included in the default installation packages
- The specific software version allowed at the beginning of each project
- The timing of when a project updates to the next software version

Translated files from other software used to produce the design data or resulting drawings or models files to meet these conditions:

- Fully compliant with all the defined requirements
- Have no loss of drawing file entities or project data
- Submitted in the approved file formats and versions
- Manipulated using the approved software with standard CAD/BIM methods

4.1.1 AutoCAD

Authoring software used to produce 2D drawing files for general discipline and drawing files that do not require BIM model elements.

4.1.2 Civil 3D

BIMc authoring software for 3D models and design drawings for civil, geotechnical trackwork, structural, utilities, systems, and survey.

Used to produce BIM, pdf drawings, and drawings for elements such as survey coordinates, surface features, trackway, bridge, and wall structures, and utility networks.

3D model data includes:

- Data shortcut definitions
- Documented workflow that is maintainable by ST without any needed changes.
- Fully intact usable 3D elements
- All customized Pipe Network parts

4.1.3 Revit

BIMf authoring software for architecture, structural, MEP and systems disciplines

Used to produce BIM, pdf drawings, and renderings for facilities, such as stations and maintenance buildings

Prior to use, The ST Design Technology Manager approves:

- In-Place modeling
- Revit families containing any imported or exported, model or parametric elements created from third party authoring tools

4.1.4 NavisWorks Manage

BIM federation and review software

Used to incorporate various models for visualization, design coordination review, clash detection disposition and resolution reports.

4.1.5 Bluebeam

PDF submittal review software for comment documentation and resolution.

4.1.5.1 Review Session Hosting and Administration

Sound Transit administers the Bluebeam Studio server and provides membership and administration access to internal staff.

Provides access to ST project teams for conducting reviews, as requested by the project's ST leadership.

The project's prime consultant or contractor is generally responsible for the session administration. Refer to specific project requirements.

Refer to ***Sound Transit Bluebeam Session Setup Guide*** documentation of Bluebeam review setup session guidance.

4.1.5.2 Session Profiles and Guides

Use ST provided Bluebeam profiles for reviews

Use ST provided guides for review sessions

Contact the project's Bluebeam Studio Administrator for Bluebeam profiles, guides, or training

4.2 File Types

4.2.1 External Reference (xref)

Usage requirements:

- Do not attach, bind, or insert xrefs
- Use the OVERLAY method for linking only
- Do not use hard pathing of xrefs
- Place all xrefs on layer 0
- Nesting xref is only allowed on abutting property files with no connection to ST infrastructure.

4.2.2 Existing Conditions Base Map (xref)

Individual files containing specific discipline features that make up a project area

Usage requirements:

- Use the ST provided ***C3D Existing DWT xref.dwt*** to start all existing xrefs
- Maintain the intelligence of all collected 3D data, Do not flatten to 2D
- Use only the best data collected (e.g., use FIELD data over AERIAL data)
- Place all collected 2D data at elevation zero
- Place all collected 3D data at true elevations

- Define content limits by city limits, county limits and state boundaries

Create and maintain these types of files:

- VSF - surveyed elements features are separate files
- OP (Ortho image files)
- RX (Right of Way)
- SE (Spot Elevations)
- SF (Surface Features, less utilities)
- UT (Utilities above/at and below grade)
- VG (Vegetation)
- VCN - containing Digital Terrain Model contour lines with contour labels
- Civil 3D surface file containing a completed Digital Terrain Model with Triangular Irregular Network contain the 3D objects (3D polylines, points, etc) used to define a surface.

4.2.3 Orthographic Projection (OP) Base Maps (xref)

Usage requirements:

- Refer to ***ST Requirements Manual SET 905*** for survey datum information
- Replace record data with field located information in key areas as the project is developed
- Overlay aerial images to the corresponding OP file and orient to the established project datum and then xref the OP file to other CAD/BIM files without the re-orienting the image

4.2.4 Drawing Files

Use a combination of Autodesk Drawing and Revit files to create Record Drawings with the following:

- Printable from PAPER SPACE
- Viewports to present xref items maintained in model space
- Maintain the title block as an xref in paper space at coordinates 0,0
- Maintain the title block's text attributes as a block in paper space at coordinates 0,0
- Maintain title block attributes through Sheet Set Manager or provide alternative method to ST Design Technology Manager for approval PRIOR to use
- Do not explode or rename ST provided attributed text blocks
- Use similar file configuration to figure below

4.2.5 BIMc Civil 3D Models

Used to produce construction drawings for stations, roadways, trackways, bridges, structural walls, columns, and other ancillary structures, Refer to section ***7***

4.2.6 BIMf REVIT Models

Used to produce construction drawings for stations, parking garages and other ancillary structures, Refer to section ***8***

4.2.7 BIMf NAVISWORKS Models

Used for design reviews and clash detection analysis and documentation

4.3 File Submission Format

4.3.1 Electronically Signed Drawings

Submit electronically signed drawings in PDF format

Refer to ***EP-12*** for electronic signature requirements

4.3.2 Submittals to other Regulatory Entities

Projects may require review submittals and final deliverables to ST partnering. Authorities Having Jurisdiction (AHJ) in their own requirements

AHJ standards and requirements are defined by the AHJ and project team.

Any requirement to meet AHJ standards does not change or limit Sound Transit's requirements.

4.3.3 PDFs

Refer to ***EP-12*** for PDF requirements

All PDF submittals to include:

- All drawings are 22"x34"" in size
- Contain page labels per section ***4.3.6***
- Contain hyperlinks per section ***4.3.7***
- Contain bookmarks per section ***4.3.8***
- Information is provided correctly (no missing or obscured information).
- Does Not contain embedded layers, fonts, watermarks, or protections
- Page numbers are populated on PDFs prior to IFC.
- At IFC and beyond, Page numbers are generated in original Revit, CAD, or Civil 3D files.

4.3.4 Single page PDFs

File names of All PDFs made as single page drawings to include:

- Drawing Number
- Contract Package Number
- Location or Facility ID
- Drawing Number
- Dash (-) between each string

For example: 00125-E320-L12-KAP101.pdf

4.3.5 Multi-page PDFs

Compile all drawings in the correct order

Books = 500 mb MAX PDF file size

Create multiple "Books" and label the title pages

Adjust the page limits to keep disciplines together as needed

File names of All multi-paged PDFs to include:

- Project/Contract Name
- Phase
- Drawings
- Volume #
- Book X of X

For example: E320 60% L12-KAP101 Volume 1 Book 2 of 5.pdf

4.3.6 PDF Page Labels

Each PDF page to have a page label

Format Sheet Number followed by Drawing Number, as stated in section *10.4*

4.3.7 Hyperlink PDF Pages

Hyperlinks are to work in both directions, between all cross-referenced views including sections, elevations, details, and partial plans.

Hyperlinks are compatible within the current version of Bluebeam.

Hyperlinks are not highlighted.

4.3.8 Bookmark PDF Pages

Group bookmarks by drawing discipline

Show each subsequent drawing

5. File Naming

This section defines the naming convention for BIM and CAD files.

5.1 General

All files, models and drawings within a project are uniquely named while relating to their parent group, this includes all contract packages within the project.

This is accomplished by making changes to the core structure, as shown below.

Abutting property CAD files provided to the design team for adjacent non-Sound Transit projects are left as named and documented in the PXP.

5.2 Previous Phase File Names

Consultant to rename all previous phase files to reflect the current project phase name

5.3 Core File Naming Structure

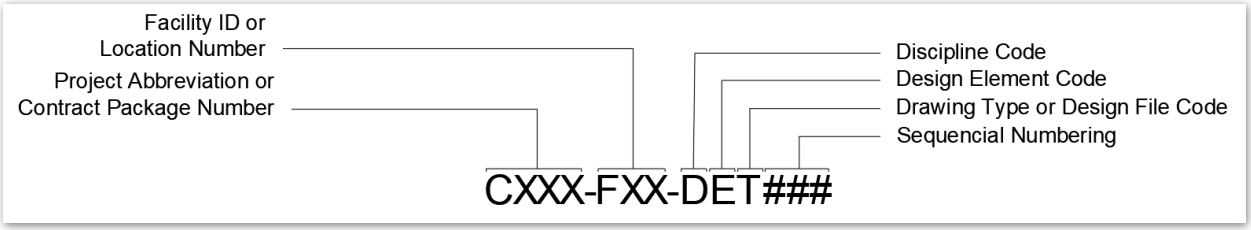
The core naming structure is comprised of 4 parts to define:

- Project abbreviation (in PE phase) or Contract package number (in FD Phase)
- Facility ID or Location ID
- Specific discipline code, design element code, and drawing type/design file code
- Two types of numbering within a drawing file series

Uniquely name all drawing files, supporting BIMc and CAD files

Place dashes (-) between the key parts as shown

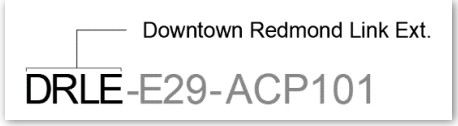
Submit drawing file list of the project to the ST Design Technology Manager for approval prior to implementing



5.4 Project Abbreviation or Contract Package Number

5.4.1 Project Abbreviation (Expansion Projects - Preliminary Engineering)

ST Project Manager or Design Manager of the expansion project provides this abbreviation in Preliminary Engineering phase.



5.4.2 Contract Package Number (Expansion Projects - Post PE)

The ST Project Manager or Design Manager of the expansion project provides this number near the beginning of the Final Design phase.

5.5 Facility, Location, or Drawing ID

The facility's ID, location ID," STD" or "GEN" is used within the file name and drawing number to help drawing navigation on large drawing sets.

These IDs keep each drawing file unique in packages.

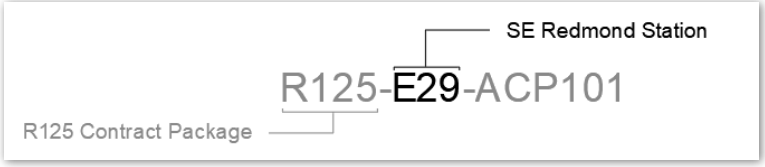
Does not have duplicate discipline drawing files with the last 6 characters

5.5.1 Facility ID

Alternative analysis and conceptual design files do not use facility IDs

Facility IDs are required on all related information starting at Preliminary Engineering thru Record Drawings delivery and maintenance.

Facility IDs to identify drawings containing elements related to and/or immediately around a building such as stations, parking garages, and maintenance facilities. For example, a station and the adjacent assess road.

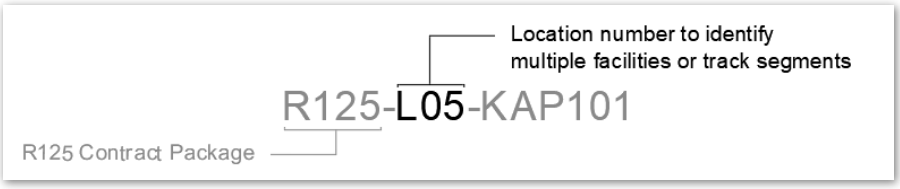


Facility IDs are defined in the ***Sound Transit Equipment and Facilities Numbering Standard*** manual. Coordinate with project's ST Senior Design Manager to define a new Facility ID, if needed.

5.5.2 Location ID

Location IDs are required on all related information starting at Preliminary Engineering.

Location IDs identify drawings containing multiple facilities and/or linear elements. For example, a trackwork plan that spans large distances and may include a section of track and a station.

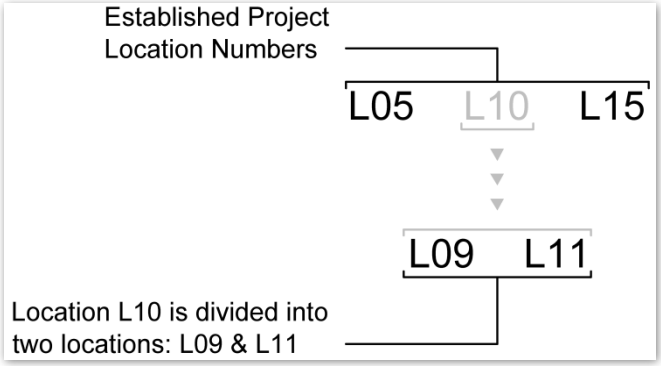


Create Location IDs for project based on the scheme outlined below.

Start numbering Location IDs with “05” at the project’s agreed upon start location, such as the beginning of a track segment, and increase by increments of five (5) for each new segment.

Use numbers in between 0-5 to divide an area already established with a Location Number.

Coordinate Location IDs with the project’s Design Technology Coordinator at the project’s BIM and CAD kick-off meeting.



5.5.3 General Drawings

GEN is for the General drawings that apply contract-wide not to a specific location.

Example: Title drawing, Index(es), package wide general notes, legend, and abbreviations drawing (s).

5.5.4 Standard Drawings

STD is for the Standard drawings that apply consistently across the entire project limits area.

Example: details, sections, and notes related to design elements.

5.6 Discipline, Design Element, and Drawing Type

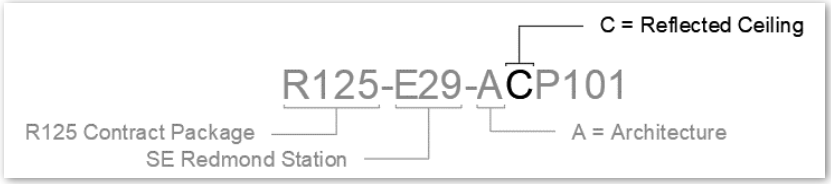
5.6.1 Discipline Codes

Group items by ***MAJOR DISCIPLINE***.

Code	Definition
A	Architectural
B	Geotechnical
C	Civil
E	Electrical
F	Fuel
G	General
J	Systems
K	Trackwork
L	Landscaping
M	Mechanical
R	Right-of-Way
S	Structural
T	Traffic
U	Utilities
V	Survey / Base Mapping

5.6.2 Design Element Codes

Group items by their ***PURPOSE*** and ***CONTENT*** within the ***MAJOR*** discipline group



A - Architectural

Code	Description
A	Area
C	Reflected Ceiling
D	Door, Window, Glazing
E	Exterior
F	Finish
H	Hardscape
I	Interior
L	Escalator
N	Signage
P	Floor
R	Roof
S	Site
T	Stair, Ramp
V	Elevator
W	Artwork
Z	General (Legends, Abbreviations, Notes)

B -Geotechnical

Code	Description
G	Grading
N	Ground Treatment Permeation, Jet Grouting/Ground Freezing
S	Site Preparations
Z	General (Legends, Abbreviations, Notes)

F -Fuel

Code	Description
D	Distribution

C - Civil

Code	Description
A	Alignment
B	Exploration Sites (Boring Location)
C	Construction Staging
D	Drainage
E	Existing Conditions
F	Emergency Fire Access
G	Grading
H	Truck Haul Routes
L	Lighting & Illumination
M	Pavement Marking (Channelization) and Signage
N	Non-Motorized
P	Paving (Surface treatments)
R	Roadway/Site
S	Site Preparation/Restoration
T	Temp Erosion & Sediment Control
X	Demolition and Removal
Z	General (Legends, Abbreviations Notes)

E - Electrical

Code	Description
F	Fire Alarm
G	Grounding
L	Lighting & Illumination
M	Motor Control
N	Corrosion Control
P	Power
Z	General (Legends, Abbreviations Notes)

G - General

Code	Description
Z	Title Drawing, Cover Page, Project wide Notes, Legends, Key Plans, Index and Abbreviations

J - Systems

Code	Description
A	Public Address (PA) System
B	Controls - Building Management, Emergency Ventilation
C	Communications, Train Signal,
E	Systems Conduits
F	Single Line Diagram
G	Grounding
N	Corrosion Control
O	Overhead Catenary Distribution
P	26 kv
R	Radio
S	Signal
T	Traction Control
Z	General (Legends, Abbreviations, Notes)

K - Trackwork

Code	Description
A	Alignment
TC	Track Charts
W	Walls (Ballast and other nonstructural track types)
Z	General (Legends, Abbreviations, Notes)

L - Landscaping

Code	Description
H	Hardscape
I	Impacts, Permitting
M	Mitigation
P	Planting
R	Irrigation
T	Tree/Plant Protection
X	Tree/Plant Removal
Z	General (Legends, Abbreviations, Notes)

M - Mechanical

Code	Description
F	Fire Protection
H	HVAC
P	Plumbing
V	Emergency Ventilation
Z	General Discipline (Legends, Abbreviations, Notes)

R - Right-of-Way

Code	Description
H	Hatching
M	ROW Monuments
P	Proposed
Z	General (Legends, Abbreviations, Notes)

S – Structural (BIMc & BIMf)

Code	Description
B	Bridge Bents (BIMc)
C	Cross Passage (BIMc)
D	Drainage (BIMc)
E	Elevated Guideway, Deck Slabs (BIMc)
F	Foundation (BIMc & BIMf)
G	Framing – Girder, Beam, Barrier, Canopy, Concrete Framing Details, Steel Framing Details (BIMc & BIMf)
H	Cross Heads, Columns (BIMc & BIMf)
J	Expansion Joint Segment (BIMc & BIMf)
M	Structural Performance & Settlement Monitoring (BIMf)
N	Ground Treatment Permeation, Jet Grouting/Ground Freezing (BIMf)
O	CIP on False work Segment/Bulkhead (BIMc & BIMf)
P	Pier Segment (BIMc)
Q	Waterproofing (BIMc & BIMf)
R	Reinforcement, Rebar, Cable Barrier (BIMc & BIMf)
S	Construction Sequencing (BIMc)
T	Tunnel (BIMc & BIMf)
V	Drilled Vertical Shafts, Escalator, Elevator (BIMf)
W	Walls – Retaining, Sound, Shear, CMU etc (BIMc)
X	Excavation Support Drilled or Driven piling, Tie-backs, Lagging, Soil nails, Shotcrete, Slurry Walls, Final Lining Lattice Girders, Wire Mesh, CIP Concrete (BIMc & BIMf)
Z	General (Legends, Abbreviations, Notes)

T - Traffic

Code	Description
D	Detours
I	Intelligent Traffic System (ITS)
M	Maintenance of Traffic (Traffic Control)
N	Signage
S	Signalization
W	Signal Wiring
Z	General (Legends, Abbrevs, Notes)

U - Utilities

Code	Description
C	Composite Utilities
D	Drainage
F	Fiber Optic
G	Gas
H	Potholes
L	Lighting & Illumination
P	Power
R	Relocation
S	Sanitary Sewer
T	Telephone, Communication
U	Underground Ducts, Ductbanks
W	Water
Z	General (Legends, Abbrevs, Notes)

V - Survey / Base Map (xrefs only)

Code	Description
CN[1]	Contours
GR[1]	Grid Ticks
OP[1]	Orthographic Projection (Aerial Image)
RX[1]	Right-of-Way
SE[1]	Field Survey Points
SF[1]	Surface Features
UT[1]	Utilities
VG[1]	Vegetation

[1]Special paired codes, don't add Drawing Type

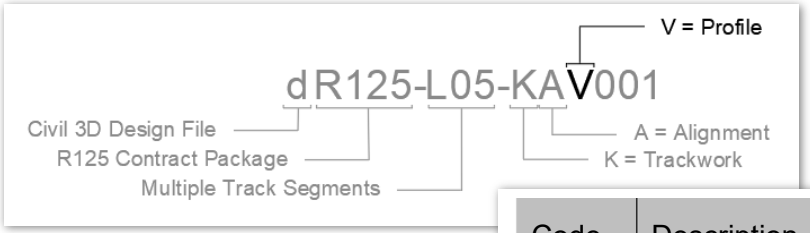
5.6.3 Drawing Type Codes

Group drawing and xref files by ***DRAWING TYPE*** within a design element code

Code	Description
D	Details
E	Elevations
I	Index
K	Key Plans
N	General Notes, Legends, Abbrev's
P	Full Drawing Plans &Plan and Profile
S	Schedules, Schematics, Diagrams
T	Title & Cover
V	Full Drawing & Xref Profiles
X	Sections
Y	Typical Sections

5.6.4 Design File Codes

Group design files by the ***DESIGN OBJECT*** within a design element code



Code	Description
A	Alignments
C	Corridors
N	Pipe Networks
V	Profiles
S	Surfaces

5.7 Numbering

All drawing files are numbered in either a sequential-based or a level-based scheme. It is applied to all drawing files with the same extents (vertically or horizontally), disciplines, and packages.

The project team determines:

- Numbering scheme to use
- Submit to the ST Design Technology Coordinator's approval before implementing

5.7.1 Level Based Numbering

Organize files by the level (floor) or location within a structure

Apply to drawings and xrefs created in AutoCAD and Civil 3D or exported .dwg files from Revit

5.7.2 Sequential Numbering

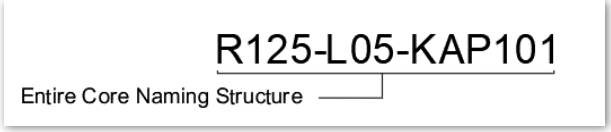
Organize files sequentially within a series or package

Required for contract drawing and xref Files

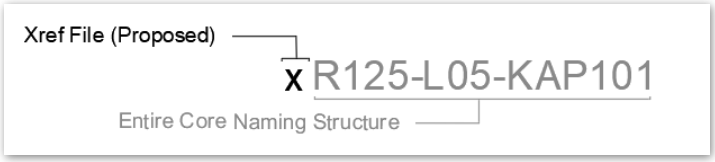
5.8 File Names (by File Type)

Use ST File naming convention to create the various types of files to complete Record Drawings on ST projects

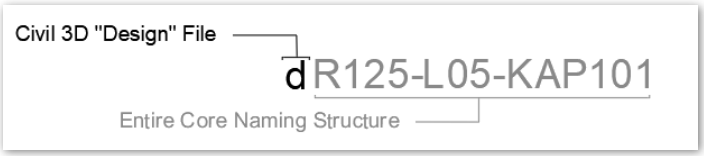
5.8.1 Drawing Files



5.8.2 Xref Files

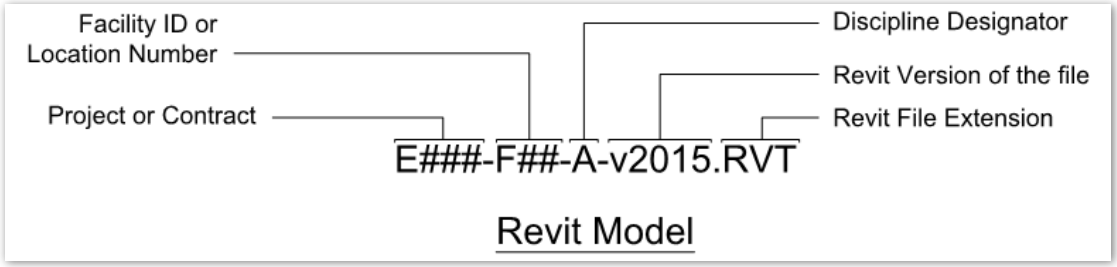


5.8.3 Civil 3D Design Files

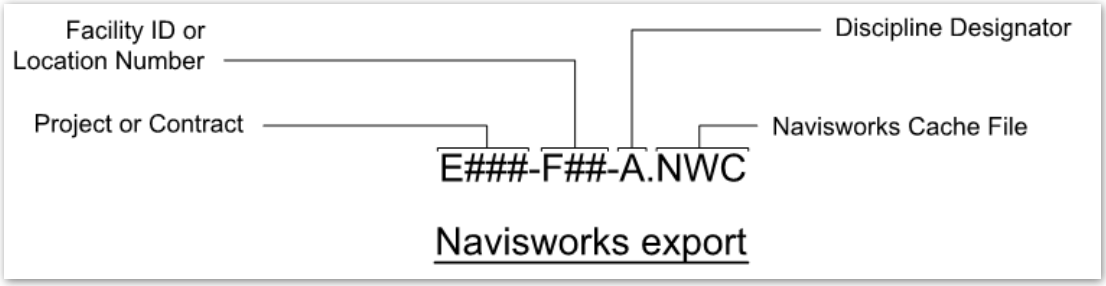


5.8.4 BIMf Model Files

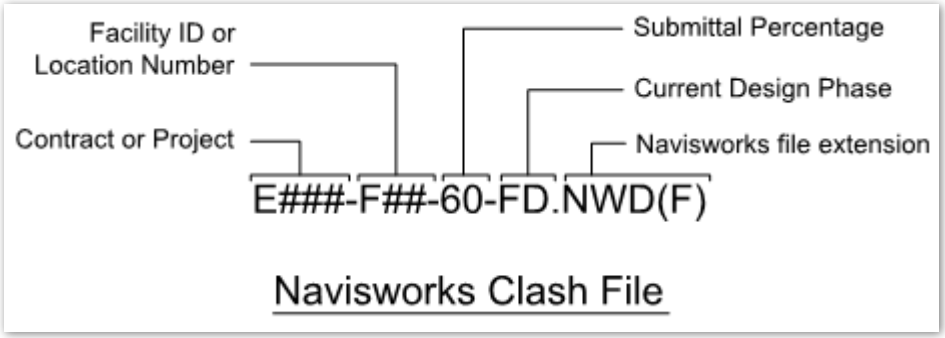
Files created in Revit to include the Revit software version in the title



NWC files exported from the Revit model not to include the Revit software version in the title



Navisworks clash detection file to include the submittal percentage and current phase of the project



5.9 Drawing Numbers

Match the drawing number to the file name. Eliminate the leading "Project Abbreviation or Contract Package Number" and the dash (-). For example: ***E09-ACP101***

5.10 Single Paper Space Tabbed Drawing File

5.10.1 Layout Tab Name

Name each tab with the last 6 characters of the drawing number

See section ***5.3*** for the naming convention

5.11 Multiple Paper Space Layout Tabbed Drawing File

Maximum of 20 tabs in a single DWG file

5.11.1 Layout Tab Name

Name each tab with the last 6 characters of the drawing number

See section ***5.3*** for the naming convention

5.11.2 File Name

Begin with the Core File Name as defined in section ***5.3*** which includes the first paper space tab's name

Add a dash (-) and the last 3 digits of the last paper space layout tab's name, as shown below

1st File name in a series: ***T100-L10-CGP101-105.dwg***

Continue naming any subsequent multi-tabbed files in the series of drawings using the first and last paper space layout tabs, as shown below

2nd file name in a series ***T100-L10-CGP106-110.dwg***

6. CAD

6.1 Paper Space vs Model Space

Consistently apply the following items in model or paper space in all drawing files

6.1.1 Paper Space

All necessary model space views and paper space items in their final arrangement to print the final drawing form

Listed below are items placed in Paper Space:

- Drawing borders
- Border Attributed block
- Titles
- Notes
- North arrow
- Bar scale
- Tables
- Schedules
- Engineering Seals
- Plot Stamp

6.1.2 Model Space

Existing features and design elements in two-dimensional graphics or three-dimensional models

Everything in model space is drawn at True Size and orientation to the project's coordinate system.

Images are not used in place of drafted or modelled elements.

Listed below are items placed in Model Space:

- Existing features
- Design elements including annotation
- Control elements (alignment, grids)
- Non-printable items for coordination (clouds, notes, alternatives, etc.)

6.2 Drawing Units

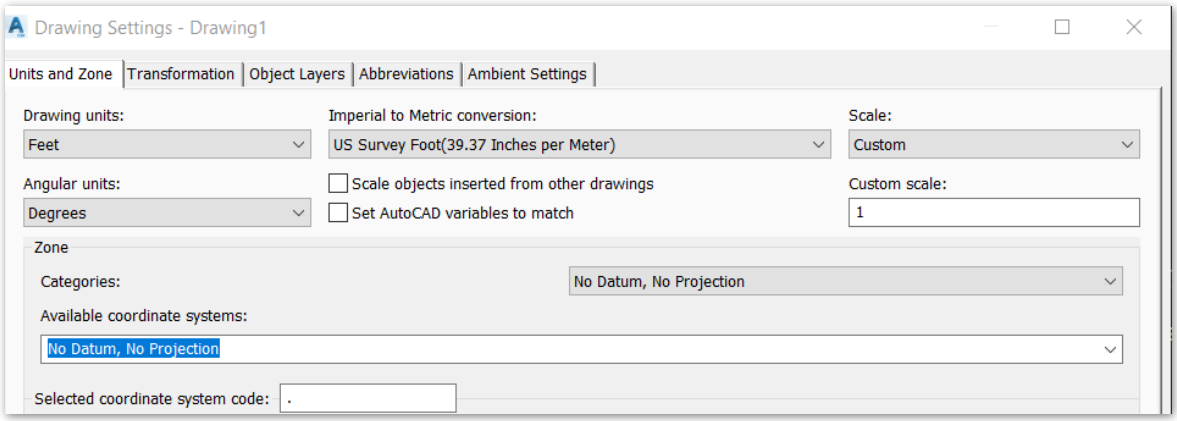
Length: Decimal, precision 0.00

Angle: Deg/min/sec, precision 0°00'00"

Insertion scale: Unitless or feet (assumed 1 unit = 1 U.S. Survey Foot)

Toolspace > Settings > Drawing name > Edit Drawing Settings > Unit and Zone:

- Drawing units: U.S. survey feet (not International Feet)
- Imperial to metric conversion: US survey foot (39.37 Inches per Meter)
- Scale: Custom
- Angular units: Degrees
- Categories: No datum, no projection



6.3 Tables

Used ***ST-Table*** style to create ALL tables.

TABLE TITLE		
COLUMN HEADER	**COLUMN HEADER**	**COLUMN HEADER**
TEXT	TEXT	TEXT

6.4 Legends

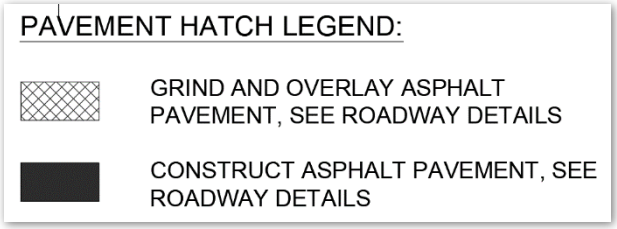
Present consistently across all disciplines and packages in one of the following ways:

- The main package's general drawings
- Each discipline's general drawings
- On each drawing within a discipline's series

Add a general note referring to the legend's location if not shown on individual discipline drawings

Add legends directly to specific drawings with the following conditions:

- Legend structure and content are applied consistently in all drawings in the series.
- All relevant items are presented in the drawing's legend.
- Legend items match the scale and presentation of the item within the drawing
- Does not conflict with other Legends in the package



6.5 Symbology

Use ST provided blocks and linetypes located in ***ST Existing Blocks and Linetypes.dwg*** and ***ST Proposed Blocks and Linetypes.dwg***.

- Additional blocks are added only if the appropriate block is not available from ST.
- Do not use the same symbol to represent more than 1 item in a single discipline
- Include all symbols used in the drawing files in the appropriate legend(s)

6.5.1 Linetypes

Use ST provided linetypes located in ***ST-Linetypes.lin*** prior to use of acad.lin or creating new linetypes.

Document any line types in BIMc PXP not found in these sources

When using line types:

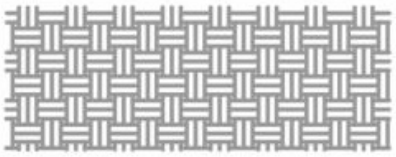
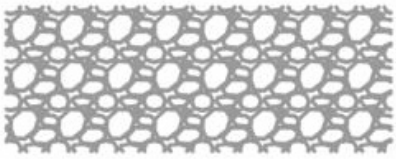
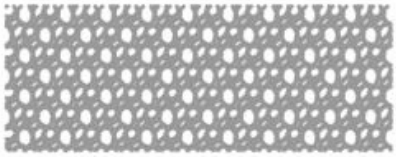
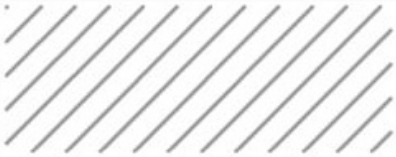
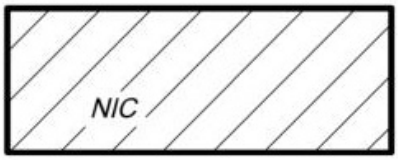
- Do not use the same linetype for different items within the same series of drawing files.
- Do not modify the internal definitions of either ST or Autodesk linetype files.
- Document all used line types in legends.
- Set the linetype property are BYLAYER for all entities

6.5.2 Existing Elements

Existing Elements = ST Existing Blocks and Linetypes.dwg

6.5.2.1 Hatch Patterns

These hatch patterns can be found in the "ST Existing Blocks and Linetypes.dwg"

Hatch Name	Example	Description
Embankment		*Pattern : EARTH* *Rotation: 0* *Color: Exist: THIN (8)* *Scale: 0.50 x VP Scale*
Ballast		*Pattern : GRAVEL* *Rotation: 0* *Color: Exist: THIN* *Scale: 0.25 x VP Scale*
Concrete		*Pattern : AR-CONC* *Rotation: 0* *Color: Exist: THIN* *Scale: 0.05 x VP Scale*
Subballast		*Pattern : GRAVEL* *Rotation: 45* *Color: Exist: THIN* *Scale: 0.15 x VP Scale*
Asphalt Concrete		*Pattern : ANSI131* *Rotation: 0* *Color: EXist: THIN* *Scale: 1.0 x VP Scale*
Wetland		*Pattern : GRASS* *Rotation: 0* *Color: Exist: THIN* *Scale: 0.50 x VP Scale*
Not in Contract *Text Style:* *ST-Arial* *Text Ht.: 0.2 x VP Scale*		*Pattern : ANSI131* *Rotation: 0* *Color: EXTRA WIDE* *Scale: 1.50 x VP Scale* *Frame Color: EXTRA Wide* *Frame Linetype: Hidden*

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

6.5.2.2 Linetypes

These items can be found in the "ST-LINETYPES.LIN"

Name	Description	Sample
C-Fence	Chain Link Fence	X X
C-Fence_Wood	Wooden Fence	O O
C-FilterFence	Filter Fabric Fence	*
C-Handrail	Handrail	o o
C-HighVisibilityFence	High Visibility Fence	HVF
C-SiltFence	Silt Fence	SF
R-Easement-E	Existing Easement	
R-Easement-P	Existing Permanent Easement	
R-Easement-U	Existing Utility Easement	
R-Lot	Lot or Parcel Lines	
R-Plat	Plat Limits	
R-ROWCenterline	Right of Way Centerline	
R-ROW-E	Right of Way Lines	
R-Section	Section Limits	
R-Section_Qtr	Quarter Section Limits	
R-Section_16th	16th Section Limits	
R-WSDOTLimitAccess	WSDOT Limited Access Boundary	
S-BallastWall	Ballast Wall	
SL	Survey Traverse Line	
S-NoiseWall	Noise Wall	NW
S-NoiseWall_AccPanel	Noise Wall with Acoustical Panel	AP
S-NoiseWall_Hidden	Hidden Noise Wall	NW NW NW
T-Barrier	Concrete Traffic Barrier (Uses Dbl Line - 0.04" offset)	
T-Guardrail	Guardrail	
T-RoadwayStripe	Street Channelization Dahhed Line	
Tracks	Track	
U-AbandonUtility	Abandon Utility	
U-Anchor	Anchor	
U-BuriedCable-E	Buried Cable	B B
U-BuriedCTV-E	Buried Cable TV	C C
U-BuriedCTV&FO-E	Buried CTV & Fiber Optic	CFO

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

These items can be found in the "ST-LINETYPES.LIN"

Name	Description	Sample
U-BuriedElec-E	Buried Electrical	E
U-BuriedElec&CTV-E	Buried Electric and CTV	EC
U-BuriedElec&FO-E	Buried Electric and Fiber Optic	EFO
U-BuriedElec&Tele-E	Buried Electric & Telephone	ET
U-BuriedFO-E	Buried Fiber Optic	FO
U-BuriedITS-E	Buried Intelligent Traffic System	ITS
U-BuriedTele-E	Buried Telephone	T
U-BuriedTele&CTV-E	Buried Telephone & CTV	TC
U-BuriedTele&CTV&FO-E	Buried Telephone, CTV & Fiber Optic	TCFO
U-BuriedTele&FA-E	Buried Telephone & Fire Alarm	TFA
U-BuriedTele&FO-E	Buried Telephone & Fiber Optic	TFO
U-BuriedWater-E	Buried Water	W
U-CombinedSewer-E	Combined Storm and Sanitary Sewer	CS
U-DrainageForceMain	Drainage Force Main	DFM
U-Gas-E	Buried Gas	G
U-OverheadCTV-E	Overhead CCTV and Cable TV	OC
U-OverheadElec-E	Overhead Electrical	OE
U-OverheadElec&CTV-E	Overhead Electric & CTV	OEC
U-OvereheadElec&FO-E	Overhead Electric & Fiber Optic	OEFO
U-OverheadElec&Tele&CTV-E	Overhead Electric, Telephone & CTV	OETC
U-OverheadElec&Tele&FO-E	Overhead Electric, Telephone & Fiber Optic	OETFO
U-OverheadElec&Tele-E	Overhead Electric & Telephone	OET
U-OverheadFO-E	Overhead Fiber Optic	OFO
U-OverheadTele-E	Overhead Telephone	OT
U-OverheadWater-E	Overhead Water	OW
U-SanitarySewer-E	Buried Sanitary Sewer	SS
U-Steam-E	Buried Steam	STE
U-StormDrain-E	Storm Sewer	SD
U-Underdrain-E	Underdrain	UD
V-Building	Building Edge	
V-Contour-E	Existing Contours	
V-Floodplain	Floodplain Limits	
V-FlowDirection	Flow Direction	< <

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

These items can be found in the "ST-LINETYPES.LIN"

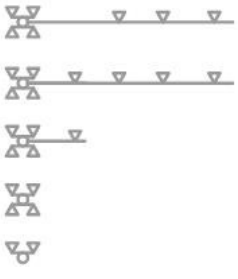
Name	Description	Sample
V-FlowDirection2	Ditch or Stream	
V-StreamBuffer	Stream Buffer	STMB
V-OHWM	Ordinary High Water Mark	OHWM
V-Wetland-E	Wetland Boundry, Body of Water, River	
V-Wetland-M	Wetland Mitigated	

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

6.5.2.3 Blocks

Civil

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
C-Bench-Dynamic-E	NTS 	Benches
C-Bollard-E		Bollard
C-HandHole-E		Hand Hole (various utilties)
C-Mailbox-E		Mail box
C-MonitoringWell-E		Monitoring Well
C-Outfall-E	NTS 	Storm Outfall Rip Rap
C-ParkingMeter-E		Parking Meter
C-Rock-E		Large Rock
C-Rock Wall-E		Rock Wall
C-StLightJBox-E		Street Light J-Box
C-StSign-E		Street Sign
C-TeleBooth-E		Telephone Booth
C-TrackGateDynamic		Track Crossing Single Gate Track Crossing Double Gate Track Crossing Pedestrian Gate Track Crossing Pedestrian Flasher 4 Track Crossing Pedestrian Flasher 2
C-Trash Bins-Dynamic-E	NTS 	Recycling or Landfill Trash Bins

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
C-Tree-C		Coniferous Tree
C-Tree-D		Deciduous Tree
C-WaterSurfaceLevel-E		Water Surface Level
C-WetlandFlag-E		Wetland Flag
L-Schrub-E		Shrubs
L-Stump-E		Stump
L-Tree Grate-E	NTS 	Tree Grate

Storm, Sewer, and Misc. Utility

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

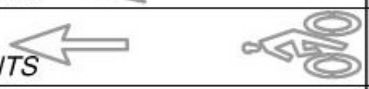
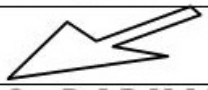
Block Name	Example (NTS = all blocks are Not To Scale)	Description
C-Beehive-E	NTS 	Beehive Grate
C-StormdrainCatchBasin-E		Storm Drain Catch Basin
C-StormdrainCulvert-E		Storm Drain Culvert
C-StormdrainManhole-E		Storm Drain Manhole
U-CableTVManhole-E		Cable TV Manhole
U-CableTVVault-E		Cable TV Vault
U-Electrical Meter-E		Electrical Meter
U-ElectricalManhole-E		Electric Manhole
U-ElectricalVault-E		Electric Vault
U-FiberOpticManhole-E		Fiber Optic Manhole
U-FiberOpticVault-E		Fiber Optic Vault
U-PadMountedTransformer-E		Pad Mounted Transformer
U-TrackDrain-E		Track Drain
U-SanitaryCleanout-E		Sanitary Sewer Cleanout
U-SanitaryManhole-E		Sanitary Sewer Manhole

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
U-TeleManhole-E		Telephone Manhole
U-TeleMarker-E		Telephone Marker (Buried)
U-TeleRiser-E		Telephone Riser
U-TeleVault-E		Telephone Vault
U-UtilityBox-E		Utility Box

Pavement Marking

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-BUS-E	NTS 	Bus Marking
T-ONLY-E	NTS 	Only Marking
T-Sym2wayArrow-E	NTS 	2 Way Arrow (WSDOT T4S)
T-Sym3wayArrow-E	NTS 	3 Way Arrow (WSDOT T7S)
T-SymADA-E	NTS 	ADA Marking
T-SymArrowLeft-E	NTS 	Left Turn Arrow
T-SymArrowRight-E	NTS 	Right Turn Arrow
T-SymArrowThru-E	NTS 	Thru Arrow
T-SymArrowThruRight-E	NTS 	Thru Right Turn Arrow
T-SymBikeLane-E	NTS 	Bike Lane Marking
T-SymBusOnly-E	NTS 	Bus Only Marking
T-SymDblSharrow-E	NTS 	Bi-directional Bike Lane
T-SymHOV-E	NTS 	HOV Lane Marking
T-SymLeftArrow-E	NTS 	Left Shift Arrow (WSDOT T6SL)
T-SymNoParking-E	NTS 	No Parking Marking
T-SymPed-E	NTS 	Pedestrian Lane Marking
T-SymRightArrow-E	NTS 	Right Shift Arrow (WSDOT T6SR)
T-SymSharrow-E	NTS 	Bike Sharrow

Traffic Signals

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-SignalEVP-E		EVP Sensor
T-SignalHead-E		Vehicle Signal Head
T-SignalHeadTurnArrow-E		Vehicle Signal Head with Turn Arrow
T-SignalLuminaire-E		Luminaire
T-SignalPedHead-E		Pedestrian Signal Head
T-SignalPedPole-E		Pedestrian Push Button Pole
T-SignalPedPushButton-E		Pedestrian Push Button
T-SignalVideoCamera-E		Video Detection Camera
T-SymSignSignal-E		Mast Arm Mounted Sign
T-TrafficControlCabinet-E		Traffic Control Cabinet
T-TrafficJbox-E		Hand Hole
T-TrafficJbox1-E		Junction Box
T-TrafficPoleLuminaire-E		Traffic Signal Pole with Luminaire
T-TrafficSignalPole-E		Traffic Signal Pole (Dynamic)
T-TrafficVault-E		Traffic Vault

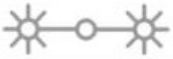
ITS

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-ITS-ADVWARN-E		Advanced Warning Sign
T-ITS-CCTVCAB-E		CCTV Cabinet
T-ITS-Cable Vault-E		Cable Vault ITS
T-ITS-ClosedCircutTV-E		CCTV Camera
T-ITS-DataStationCabinet-E		Monument In Case
T-ITS-PernTrfRec-E		Permanent Traffic Recorder Cabinet
T-ITS-PullBox-E		Pull Box
T-ITS-RampMeter-E		Remote Traffic
T-ITS-RemoteTrfMicroSensor-E		Remote Traffic Microwave Sensor
T-ITS-ServiceCabinet-E		Service Cabinet
T-ITS-TransformerCabinet-E		Transformer Cabinet

Miscellaneous Utilities

These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
U-ButterflyValve-E		Butterfly Valve, M.J.
U-DoubleLuminaire-E		Double Luminaire
U-Firedeptconnection-E		Fire Department Connection
U-GasValve-E		Gas Valve
U-GateValve-E		Gate Valve
U-IrrigationControlValve-E		Irrigation Control Valve
U-SingleLuminaire-E		Single Luminaire
U-SteamVault-E		Steam Vault
U-Tee-E		Tee
U-ThrustBlock-E		Water Thrust Block
U-UtilityPoleAnchor-E		Utility Pole Anchor (dynamic)
U-UtilityPole-E		Utility Pole
U-UtilityPoleLuminaire-E		Utility Pole with Light
U-WaterFireHydrant-E		Fire Hydrant
U-WaterManhole-E		Water Manhole
U-WaterMeter-E		Water Meter
U-WaterPipeHoseValve-E		Standpipe with Hose Valve

Survey Control

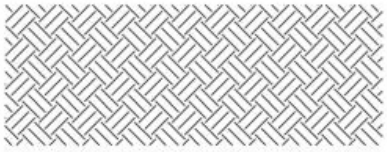
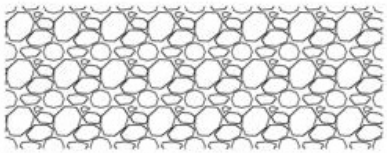
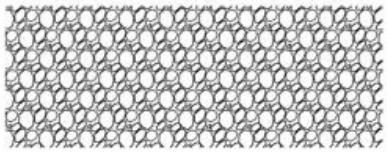
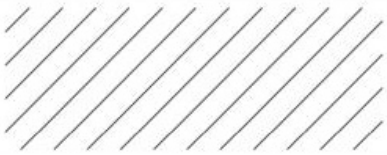
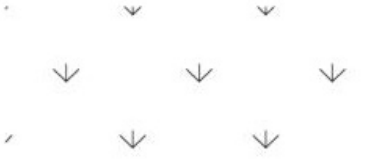
These blocks can be found in the "ST Existing Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
V-FaststaticPoint-E		Fast-static Point
V-HVPTMonument-E		Monument (HVPT)
V-IPMonument-E		Monument (Iron Pin)
V-Monument-E		Monument
V-MonumentInCase-E		Monument In Case
V-MonumentSurface-E		Surface Monument
V-RebarMonument-E		Monument (Rebar)
V-ROWMonument-E		Monument (Right of Way)
V-SectionQuarterCornerPoint-E		Section Quarter Corne rPoint
V-SurveyControlMonument-E		Survey Control Monument
V-TraversePoint-E		Ground Transverse Point
WSDOT-CNTRLPNT		WSDOT Control Point

6.5.3 Proposed Elements

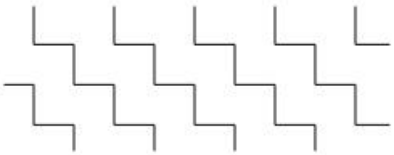
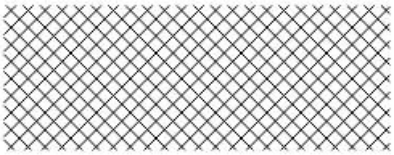
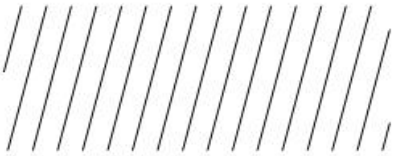
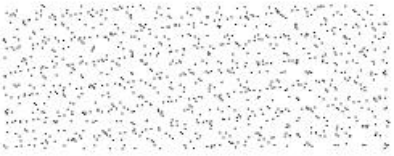
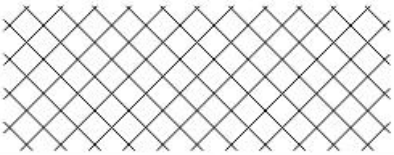
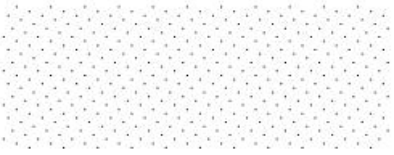
6.5.3.1 Hatch Patterns

These hatch patterns can be found in the "ST Propsed Blocks and Linetypes.dwg"

Hatch Name	Example	Description
Embankment		Pattern: EARTH Rotation: 45 Color: THIN (1) Scale: 0.50 x VP Scale
Ballast		Pattern: GRAVEL Rotation: 0 Color: THIN (1) Scale: 0.25 x VP Scale
Concrete		Pattern: AR-CONC Rotation: 0 Color: THIN (1) Scale: 0.05 x VP Scale
Porous Concrete		Pattern: AR-CONC Rotation: 0 Color: THIN (1) Scale: 0.10 x VP Scale
Subballast		Pattern: GRAVEL Rotation: 45 Color: EXTRA FINE (10) Scale: 0.15 x VP Scale
Asphalt Concrete		Pattern: ANSI31 Rotation: 0 Color: THIN (1) Scale: 1.0 x Scale
Wetland		Pattern: GRASS Rotation: 0 Color: THIN (1) Scale: 0.50 x VP Scale
Gravel Surfacing		Pattern: AR-SAND Rotation: 0 Color: THIN (1) Scale: 0.20 x VP Scale

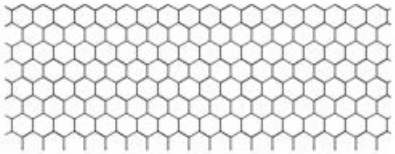
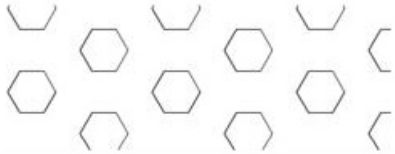
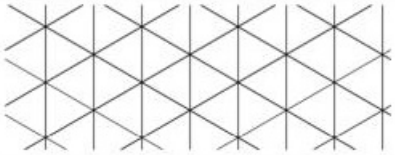
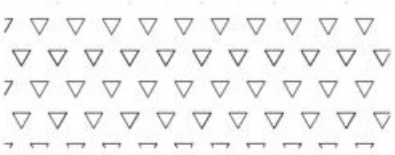
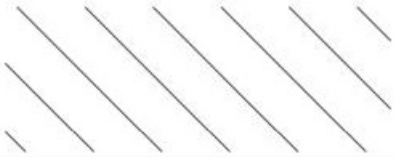
Refer to ST-Mono.ctb for detailed information on colors and pen weights.

These hatch patterns can be found in the "ST Propsed Blocks and Linetypes.dwg"

Hatch Name	Example	Description
Area Impacted by Existing Excavation Support Systesm		Pattern: ZIGZAG Rotation: 90 Color: EXTRA FINE (10) Scale: 1.67 x VP Scale
Existing Pavement to be Removed		Pattern : ANSI37 Rotation: 0 Color: EXTRA FINE (10) Scale: 0.50 x VP Scale
Area to be Ddemolished by Others		Pattern : Dots Rotation: 45 Color: THIN (1) Scale: 1.25 x VP Scale
Existing Structure to be Removed		Pattern : ANSI31 Rotation: 30 Color: EXTRA FINE (10) Scale: 1.00 x VP Scale
Existing Concrete to be Removed		Pattern : AR-SAND Rotation: 0 Color: THIN (1) Scale: 0.05 x VP Scale
Fee Acquisition		Pattern : ANSI37 Rotation: 0 Color: EXTRA FINE (10) Scale: 1.00 x VP Scale
Permanent and Slope Easement		Pattern : Dots Rotation: 45 Color: THIN (1) Scale: 1.00 x VP Scale
Conservation Easement		Pattern : ANSI32 Rotation: 0 Color: THIN (1) Scale: 1.50 x VP Scale

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

These hatch patterns can be found in the "ST Propsed Blocks and Linetypes.dwg"

Hatch Name	Example	Description
Aerial/Guideway Easement		Pattern : Honey Rotation: 30 Color: THIN (1) Scale: 0.50 x VP Scale
Temporary Construction Easement		Pattern : Dash Rotation: 30 Color: THIN (1) Scale: 1.00 x VP Scale
Access Easement		Pattern : ANSI36 Rotation: 30 Color: THIN (1) Scale: 1.00 x VP Scale
Tieback Soil Nail Easement		Pattern : CROSS Rotation: 165 Color: THIN (1) Scale: 1.00 x VP Scale
Temporary Enviromental Monitorinrg Easement		Pattern : HEX Rotation: 0 Color: THIN (1) Scale: 1.00 x VP Scale
Permanent WSDOT Airspace Lease		Pattern : NET3 Rotation: 30 Color: THIN (1) Scale: 2.00 x VP Scale
Temporary Crane Swing Easement		Pattern : TRIANG Rotation: 0 Color: THIN (1) Scale: 0.50 x VP Scale
Resource Conservation Easement		Pattern : ANSI31 Rotation: 90 Color: THIN (1) Scale: 2.00 x VP Scale

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

These hatch patterns can be found in the "ST Propsed Blocks and Linetypes.dwg"

Hatch Name	Example	Description
Not in Contract Text Style: ST-Arial Text Ht.: 0.2 x VP Scale		Pattern : ANSI131 Rotation: 0 Color: THIN (1) Scale: 1.50 x VP Scale Frame Color: EXTRA Wide Frame Linetype: Hidden

Refer to ST-Mono.ctb for detailed information on colors and pen weights.

6.5.3.2 Linetypes

These items can be found in the "ST-LINETYPES.LIN"

Name	Description	Sample
C-Cut	Cut Limits	C
C-Excavation	Excavation Limits	
C-Fence	Chain Link Fence	X X
C-Fence_Wood	Wood Fence	
C-Fill	Fill Limits	F
C-FilterFence	Filter Fabric Fence	*
C-Handrail	Handrail	
C-HighVisibilityFence	High Visibility Fence	HVF
C-SiltFence	Silt Fence	SF
C-SIP	Surface Improvement Permit Limits	SIP
C-StrawBale	Straw Bale	STB
J-BMS	Building Managment System	BMS
K-TrackWall	Track Wall	TW TW
	Clearance Check Line	
R-Construction	Construction Limits	
R-Easement-P	Permanent Easement	
R-Easement-T	Temporary Easement	
R-Easement-U	Utility Easement	
R-Lot	Lot Limits	
R-Plat	Plat Limits	
R-ROWCenterline	Right of Way Centerline	
R-ROW-E	Existing ROW Limits	
R-ROW-P	Proposed ROW Limits/Transit Way	
R-WSDOTLimitAccess	WSDOT ROW Limited Access	
R-Section	Section Line	
R-Section_Qtr	Quarter Section Line	
R-Section_16th	16th Section Line	

These items can be found in the "ST-LINETYPES.LIN"

Name	Description	Sample
S-BallastWall	Ballast Wall	
S-CutWall	Cut Wall	CW
S-CutWall_Hidden	Hidden Cut Wall	CW CW CW
S-Fill Wall	Fill Wall	FW
S-FillWall_Hidden	Hidden Fill Wall	FW FW FW
S-NoiseWall	Noise Wall	NW
S-NoiseWall_AccPanel	Acoustical Panel Noise Wall	AP
S-NoiseWall_Hidden	Hidden Noise Wall	NW NW NW
T-Barrier	Concrete Barrier (Uses Dbl Line - offsetted)	
T-Guardrail	Guardrail	
T-RoadwayDottedStripe	Wide Dotted Lane Line	
T-RoadwayStripe	Dashed Roadway Stripe	
U-AbandonUtility	Abandon Utility	
U-Anchor	Anchor	
U-BuriedCable-P	Buried Cable	B
U-BuriedCTV&FO-P	Buried CTV & Fiber Optic	CFO
U-BuriedCTV-P	Buried Cable Television (CTV)	C
U-BuriedElec-P	Buried Electric	E
U-BuriedElec&CTV-P	Buried Electric & CTV	EC
U-BuriedElec&FO-P	Buried Electric & Fiber Optic	EFO
U-BuriedElec&Tele-P	Buried Electric & Telephone	ET
U-BuriedFO-P	Buried Fiber Optic	FO
U-BuriedTele-P	Buried Telephone	T
U-BuriedTele&CTV&FO-P	Buried Telephone, CTV & Fiber optic	TCFO
U-BuriedTele&CTV-P	Buried Telephone & CTV	TC
U-BuriedTele&FA-P	Buried Telephone & Fire Alarm	TFA
U-BuriedTele&FO-P	Buried Telephone & Fiber Optic	TFO
U-BuriedWater-P	Buried Water	W
U-CombinedSewer-P	Combined Sewer	CS
U-Conduit	Conduit	

These items can be found in the "ST-LINETYPES.LIN"

Name	Description	Sample
U-DrainageForceMain	Drainage Force Main	DFM
U-Gas-P	Gas	G
U-GuyAnchor	Guy Anchor	)( )(
U-ITS-P	Intelligent Traffic System	ITS
U-OverheadCTV-P	Overhead CTV	OC
U-OverheadElec-P	Overhead Electric	OE
U-OverheadElec&CTV-P	Overhead Electric & CTV	OEC
U-OverheadElec&FO-P	Overhead Electric & Fiber Optic	OEFO
U-OverheadElec&Tele&CTV-P	Overhead Electric, Telephone & CTV	OETC
U-OverheadElec&Tele&FO-P	Overhead Electric, Telephone & Fiber Optic	OETFO
U-OverheadElec&Tele-P	Overhead Electric & Telephone	OET
U-OverheadFO-P	Overhead Fiber Optic	OFO
U-OverheadTele-P	Overhead Telephone	OT
U-RemoveUtility	Remove Utility	
U-OverheadWater-P	Overhead Water	OW
U-SanitarySewer-P	Sanitary Sewer	SS
U-Steam-P	Steam	STE
U-StormDrain-P	Proposed Storm Drain	SD
U-Underdrain-P	Underdrain	UD
V-Building	Building Limits	
V-Clear&Grub	Clear & Grub Limits	
V-Floodplain	Floodplain	
V-Floodway	Floodway	
V-FlowDirection	Flow Direction	
V-FlowDirection2	Flow Direction	
V-OHWM	Ordinary High Water Mark	OHWM
V-StreamBuffer	Stream Buffer Limits	STMB

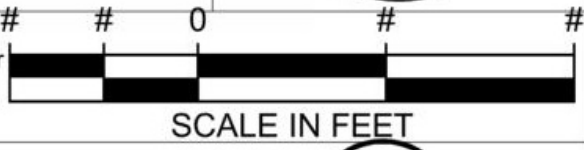
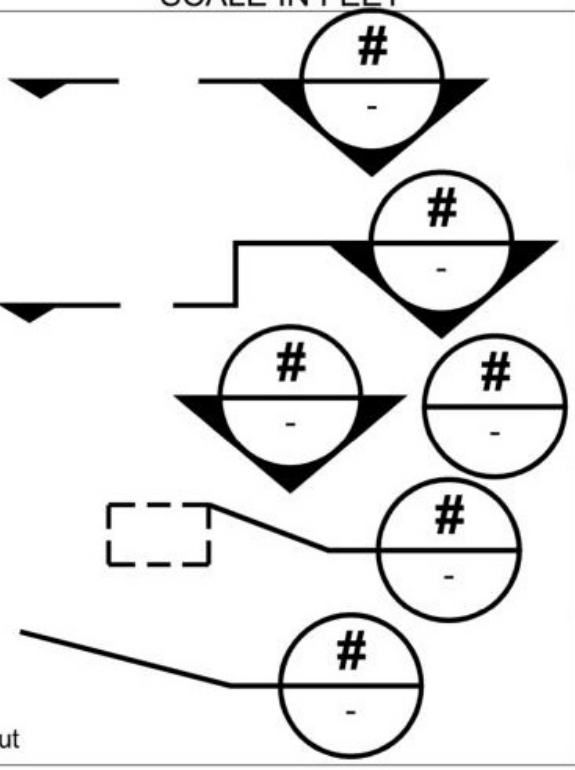
6.5.3.3 Blocks

General

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
GA-BasicNote	**NOTE:** XXX.	Single Note (Multi-Text) For notes that apply to a specific detail or item
GA-GeneralNote	**GENERAL NOTES:** 1. XXX. A. XXX.	General Notes (Multi-Text) For notes that apply to entire sheet or plan set.
GA-KeyNote	**KEY NOTES:** 1 XXX.	Key Notes (Multi-Text with Multi-Leader as tag)
GA-ConstructionNote	**CONSTRUCTION NOTES:** 1 XXX.	Construction Notes (Multi-Text with Multi-Leader as tag)
GB-Logo-ST-Horiz	SOUNDTRANSIT	ST Logo
GB-Logo-ST-Vert	NTS SOUNDTRANSIT	ST Logo
GR-RevCloud-All	REVISIONS TO ENTIRE DRAWING 1 REVISIONS TO ENTIRE DRAWING A NTS	Revision Cloud - All Dwg
GR-RevCloud-New	NEW DRAWING 0 NEW DRAWING A NTS	Revision Cloud- New Dwg
GR-RevTag	1 A	Revision Tag

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

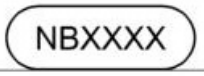
Dynamic Block Name	Example (NTS = all blocks are Not To Scale)	Description - View State
GS-NorthArrow		North Arrow - Supports Rotate by Grip
GS-ScaleBar		Scale Bar - Custom & Preset Scales
GS-ViewCallout		Section Cut - Rotate, Flip, Stretch
		Section Jog - Rotate, Flip, Stretch
		Elevation - Rotate Bubble Only
		Detail Box - Rotate, Flip, Stretch
		Detail Leader - Rotate, Flip, Stretch
G-MTCH	**MATCHLINE: STA 00+00 SEE DWG X00-XXX000**	Match Line

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Dynamic Block Name	Example (NTS = all blocks are Not To Scale)	Description - View State
GS-ViewTitle	TITLE SCALE: CUSTOM # / -	Title Bar - Stretch, Custom & Preset Scales
GS-ViewTitleCtr	TITLE SCALE: CUSTOM	Centered Title - Stretch, Custom & Preset Scales
	SUBTITLE	Subtitle - Stretch
GS-NFC	NOT FOR CONSTRUCTION	Not For Construction

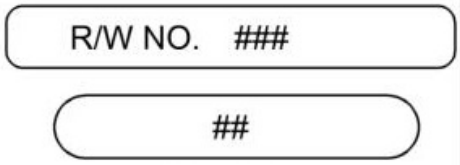
Civil and Track

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
	NTS 	Bench - Dual
	NTS	Bench - Lean
C-Bench-Dynamic-P	NTS 	Bench - Single
C-Bollard-P	NTS	Bollard
C-CurveNumber-P		Track Curve Number
C-Mailbox-P		Mailbox
C-MonitoringWell-E	NTS 	Monitoring Well
C-Rock-P		Large Rock
C-Rock Wall-P		Rock Wall
C-StationEquation-P		Track Station Equation
	NTS 	Recycling Trash Bin
C-Trash Bins-Dynamic-P	NTS 	Landfill Trach Bin
C-WaterSurfaceLevel-P		Water Surface Level
K-PGLMARK	NTS 	Track Profile Grade Line Maker
K-RAILLUBRICATOR		Track Rail Lubricator
R-TRANSITWAYPOINT	NTS 	Transit Way Angle Point
V-SpotElev		Spot Elevation

ITS and ROW

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

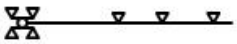
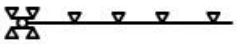
Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-ITS-ADVWARN-P		Advanced Warning Sign
T-ITS-CCTVCAB-P		CCTV Cabinet
T-ITS-DataStationCabinet-P		Data Station Cabinet
T-ITS-RemoteTrfMicroSensor-P		Remote Traffic Microwave Sensor
T-ITS-PullBox-P		Pull Box
T-ITS-PermTrfRec-P		Permanent Traffic Recorder Cabinet
T-ITS-RampMeter-P		Description
T-ITS-ServiceCabinet-P		Service Cabinet
T-ITS-TransformerCabinet-P		Transformer Cabinet
R-ParcelInfo		Parcel Information
R-ParcelID		Parcel Tax ID Number
R-ROWNumber		Sound Transit R/W Number

Traffic Signals

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

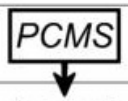
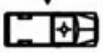
Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-SignalEVP-P		EVP Sensor
T-SignalHead-P		Vehicle Signal Head
T-SignalHeadTurnArrow-P		Vehicle Signal Head with Turn Arrow
T-SignalLuminaire-P		Luminaire
T-SignalMastArmDynamic-P		Traffic Signal Pole - 20ft
		Traffic Signal Pole - 35ft
		Traffic Signal Pole - 40ft
		Traffic Signal Pole - 65ft
		Traffic Signal Pole with Luminaire
T-SignalPedHead-P		Pedestrian Signal Head
T-SignalPedPole-P		Pedestrian Push Button Pole
T-SignalPedPushButton-P		Pedestrian Push Button
T-SignalVideoCamera-P		Traffic Camera
T-SymSignSignal-P		Mast Arm Mounted Sign
T-TrainAprchDir-P		Train Approach Direction
T-Sign Post-P		Sign with Post
T-TrafficControlCabinet-P		Traffic Control Cabinet
T-TrafficControllerCabinet2-P		Controller Cabinet

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-TrafficJbox-Dynamic-P		Junction Box Type 1
		Junction Box Type 2
		Junction Box Type 3
		Junction Box Type 4
		Junction Box Type 5
		Junction Box Type 6
T-TrackGateDynamic		Track Crossing Single Gate
		Track Crossing Double Gate
		Track Crossing Pedestrian Gate
		Track Crossing Pedestrian Flasher 2
		Track Crossing Pedestrian Flasher 4
T-TrackSignal-Dynamic-P		Pole Mounted Track Signal Large Scale
		Pole Mounted Track Signal Small Scale
		Wall Mounted Track Signal Large Scale
		Wall Mounted Track Signal Small Scale

Maintenance of Traffic (MOT)

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

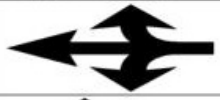
Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-Barricade_Type3		Type 3 Barricade
T-ConstSign_CLassB		Class B Construction Sign
T-ConstSign_ClassA		Class A Construction Sign
T-Flagger		Flagger Station
T-LawOfficer		Uniformed Police Officer Location
T-PortableChangeMessageSign-P		Portable Changeable Message Sign
T-ProtectiveVehicle		Protective Vehicle
T-SafetyDrum		Traffic Safety Drum
T-SequentialArrowSign		Sequential Arrow Sign
T-TempImpactAttenuator		Temporary Impact Attenuator
T-TransAttenuator		Transportable Attenuator
T-I405-I5-I90-Dynamic		Interstate 5
		Interstate 405
		Interstate 90
T-SequentialArrowSign		Sequential Arrow Sign

Pavement Markings

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

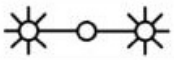
Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-Ladder-Dynamic-P	NTS 	Crosswalk Marking
T-SymADA-P	NTS 	ADA Marking
T-SymArrowLeft-P	NTS 	Left Turn Arrow
T-SymArrowRight-P	NTS 	Right Turn Arrow
T-SymArrowThru-P	NTS 	Thru Arrow
T-SymArrowThruRight-P	NTS 	Thru/ Right Turn Arrow
T-SymBikeLane-P	NTS 	Bike Lane Marking
T-SymBusOnly-P	NTS 	Bus Only Marking
T-SymDblSharrow-P	NTS 	Bi-directional Bike Lane
T-SymHOV-P	NTS 	HOV Lane Marking

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
T-SymNoParking-P	NTS 	No Parking Marking
T-SymPed-P	NTS 	Pedestrian Lane Marking
T-SymSharrow-P	NTS 	Bike Sharrow
T-Sym3wayArrow-P	NTS 	3 Way Arrow (WSDOT T7S)
T-Sym2wayArrow-P	NTS 	2 Way Arrow (WSDOT T4S)
T-SymLeftArrow-P	NTS 	Left Shift Arrow (WSDOT T6SL)
T-SymRightArrow-P	NTS 	Right Shift Arrow (WSDOT T6SR)
T-BUS-P		Bus Marking
T-ONLY-P		Only Marking

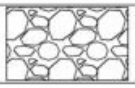
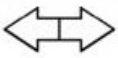
Electrical and Lighting

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
U-DoubleLuminaire-P		Double Luminaire
U-ElectricalManHole-P		Electrical Manhole
U-ElectricalMeter-P		Electrical Meter
U-ElectricalVault-P		Electrical Vault
U-HandHole-P		Hand Hole
U-Manhole-P		Manhole
U-OffsetManHole-P		Offset Manhole
U-PadMountTransformer-P		Pad Mounted Transformer
U-PotHole-P		Pot Hole (Test Boring)
U-SingleLuminaire-P		Single Luminaire
U-SurfaceSettlePoint		Surface Settlement Point
U-UtilitySettlePoint		Utility Settlement Point
U-UtilityBox-P		Utility Box
U-UtilityPole-P		Utility Pole
U-UtilityPoleAnchor-P		Utility Pole Anchor
U-UtilityPoleLight-P		Utility Pole with Luminaire

Storm and Sanitary

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
C-Beehive-P		Beehive Grate
C-CatchBasin-Dynamic-P		Catch Basin
		Catch Basin Type 242A
		Catch Basin Type 242B
		Catch Basin Type 240C
		Catch Basin Type 241
		Catch Basin Type 240A
		Catch Basin Type 240B
C-Outfall-P	NTS 	Storm Outfall Rip Rap
C-StormCleanout-P		Storm Drain Cleanout
C-StormDrainCulvert-P		Storm Drain Culvert
C-StormDrainManhole-P		Storm Drain Manhole
U-GuidwayAreaDrain-P		Aireal Guideway Storm Drain
U-SanitaryCleanout-P		Sanitary Sewer Cleanout
U-SanitarySewerManhole-P		Sanitary Sewer Manhole
U-TrackDrain-P	NTS 	Track Drain
U-TrackDrainCenter-P	NTS	Track Center Drain
U-HighPoint-P		High Point
U-LowPoint-P		Low Point

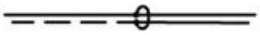
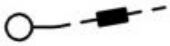
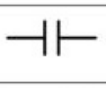
Miscellaneous Utilities

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

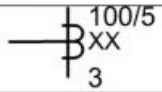
Block Name	Example (NTS = all blocks are Not To Scale)	Description
U-GasValve-P		Gas Valve
U-GateValve-P		Gate Valve
U-FireDeptConnection-P		Fire Department Connection
U-FireHydrant-P		Fire Hydrant
U-IrrigationControlValve-P	ICV	Irrigation Control Valve
U-Tee-P		Tee
U-ThrustBlock-P		Thrust Block
U-WaterBflyValve-P		Butterfly Valve, M.J.
U-WaterManhole-P	W	Water Manhole
U-WaterMeter-P		Water Meter
U-WaterPipeHoseValve-P		Standpipe with Hose Valve
U-CableTVManhole-P	C	Cable TV Manhole
U-CableTVVault-P	C	Cable TV Vault
U-FiberOpticManhole-P	FO	Fiber Optic Manhole
U-FiberOpticVault-P	FO	Fiber Optic Vault
U-TeleManhole-P	T	Telephone Manhole
U-TelephoneRiser-P		Telephone Riser
U-TeleVault-P	T	Telephone Vault

Systems

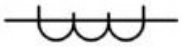
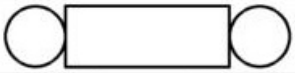
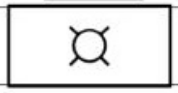
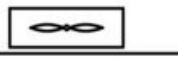
These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-OCS2Cant-P		OCS Twin Cantilever
J-OCSBack2Back-P		OCS Back To Back Cantilever
J-OCSCantilever-P		OCS Cantilever
J-OCSContBridge-P		Continuous Bridge
J-OCSFeederCblTap-P		Feeder Cable Tap
J-OCSFerruleAttach-P		Ferrule Attachment
J-OCSFixed-SpringAssy-P		Fixed Termination \W Spring Assembly
J-OCSHeadSpanSprt-P		Head-Span Support
J-OCSInstall-P		OCS Installation
J-OCSINOutPotEqlJmpr-P		In Running Or Out of Running Potential Equalizing Jumper
J-OCSJumper-Dynamic-P		Full Feeding / Continuity Jumper
		Potential Equalizing Jumper
J-OCSPoleDCFeeder-P		Pole With OCS DC Feeder
J-OCSPoleMidAnchor-P		Pole With Midpoint Anchor
J-OCSPullOff-P		OCS Pull-Off
J-OCSSectnInsulator-Dynamic-P		OCS Section Insulator (Traction Pwr) OCS Section Insulator
J-OCSX-SpanSprt-P		Cross-Span Support

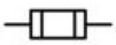
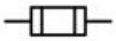
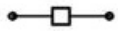
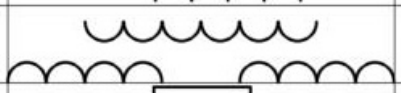
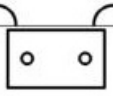
These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-OCSSupportRegistration-P		Support Registration
J-OCSPoleMtSwch-P		Pole Mounted Switch
J-SWECableBondConnection-P		Cable Bond Connection
J-SWECoiledPigtailFuture-P		Coiled Pigtail Future
J-SWECoiledPigtail-P		Coiled Pigtail
J-SWEGroundCableToPlate-P		Ground Cable To Plate
J-SWEPowerSwtichMachine-P		Power Swtich Machine
J-SWESwitchHeater-P1		Switch Heater
J-SWETWCLoop-P		TWC Loop
J-SWEPedXingSignl-P		Pedestrian Crossing Signal
J-IJ-Dynamic-P		Insulated Bond
		Insultated Joint
J-Box-Dynamic-P		Square JBox
		Wall Mounted JBox
		Non Mounted JBox
		Recess Mounted JBox
J-TPCurrentXfrmr-P		TP Current Transformer
J-SWESwtchHtrCase-P		Switch Heater Case or TWC Case

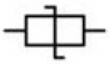
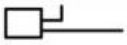
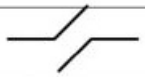
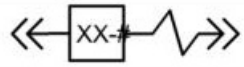
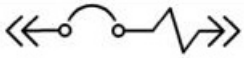
These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-SWEOCSPoleFoundation-P		OCS Pole Foundation
J-SWEOCSPoleGuyFoundation-P		OCS Pole Guy Foundation
		Dual Port Audio Frequency Overlay Track Circuit
J-SWEAudioFreqOverly-Dynamic-P		Single Port Audio Frequency Overlay Track Circuit
J-SWEBmprPostSignl-P		Bumper Post Signal
J-SWEDualCntlElecMachine-P		Dual Control Electrical Machine
J-TPEquipenclose-P	NTS 	Equipment Enclosure
J-TPCircleTag-P		Tag for Ammeter, Volt Meter, etc
J-TPContactor-P		Contactor
J-TPCurrentTransformer1-P		Current Transformer type 1
J-TPCurrentTransformer2-P		Current Transformer type 2
J-TPDiode-P		Diode
J-TPDisconnectSwtich-P		Disconnect Swtich
J-TPEmergencyExitLight-P		Emergency Exit Light
J-TPEmergencyLight-P		EmergencyLight
J-TPEmergencyTripStation-P		Emergency Trip Station
J-TPExteriorLight-P		Exterior Light
J-TPFan-P		Fan

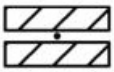
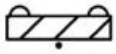
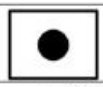
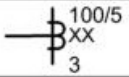
These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-TPFusedDisconnectSwitch-P		Fused Disconnect Switch
J-TPFuse-Dynamic-P		TP Fuse-Removable
		Fuse
J-TPGround-P		Ground
J-TPHandHole-P1		Hand Hole
J-TPInteriorLight-P	NTS 	Interior Light
J-TPInterphaseTransformer-P		Interphase Transformer
J-TPLowVoltageCircutBreaker-P		Low Voltage Circut Breaker
J-TPS ETS SSS Pushbutton-P		ETS, SSS Pushbutton
J-TPImpdnceBnd-Dyn-P		Impedance Bond
J-Pull Box-P	NTS 	Systems Pull Box
J-TPOCSSectionInsulator-P		OCS Section Insulator
J-TPPotentialTransformer-P		Potential Transformer
J-TPReceptacle-P		Receptacle
J-TPRectifierTransformer6-P		Rectifier Transformer 6
J-TPRectifierTransformer12-P		Rectifier Transformer 12
J-TPShunt-P		Shunt
J-TPSquareTag-P1		Tag for SCADA, Current, Voltage, etc

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-TPStub-P		Stub
J-TPSubstationSystemShutdown-P		Substation System Shutdown
J-TPSurgeArrester-P		Surge Arrester
J-TPTestSwitch-P		Test Switch
J-TPTransformerConnection-P		Delta, Transformer Connection
J-TPUtilityGroundConnection-P		Utility Ground Connection
J-TPWyeTransformerConnection-P		Wye Transformer Connection
J-TPInterlock-P		Interlock
J-TPSNonfusedDiscSwtch-P		Non-Fused Disconnect Switch
J-TPOCSInsulatedOverlap-P		Insulated Overlap
J-TPPwrSubstn-P		Traction Power Substation-P
J-TPRailVoltMonGrndgSys-P		Rail Voltage Monitoring and Grounding System
J-TPSSmokeDetect-P		Smoke Detector
J-TPDiode-Dynamic-P		TPSS
		Traction Rectifier
J-TPWithdrwbleDCBrkr-Dynamic-P		Withdrawable DC Breaker
		Withdrawable DC Breaker /W Circuit

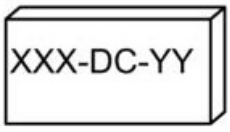
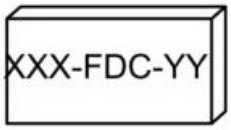
These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
		MV AC Breaker
J-TPWithdrwbleMVBrkr-Dynamic-P		MV AC Breaker with Circut
		Reader/Network IP Door Controller
		Door Magnetic Door Contacts Only
J-Security-Dynamic-P		Bike Access
		VMS Sign
		VMS Flat Pnl TV, 2 Fixed Cameras
		VMS Sign Single R
		VMS, 2 TV's Back-2-Back, 2 Fixed Cam
J-VMS-Dynamic-P		VMS, 2 TV's Back-2-Back, 2 Fixed Cam
	NTS 	System Manhole Type I
J-Manhole-Dynamic-P	NTS 	System Manhole Type II
J-TPCurrentXfrmr-P	NTS 	Current Transformer
J-Buzzer-P		Buzzer
J-Transformer-Audio-P		Audio Transformer
J-SZbond-P		Z Bond
		Microphone Push to Talk
J-Microphone-Dynamic-P		Ceiling Mounted ANS Microphone

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
		Traction Electrification Connection
		Ground Rod
		Cross Connection
J-Ground-Dynamic-P		Tee Connection
		Ceiling Mounted Box Speaker
		Surface Flush Mounted Box Speaker
		Surface Mounted Box Speaker HI-Q
		Elevator Speaker
J-Speakers-Dynamic-P		Speaker Schematic
J-FOPTC-1Mode-P		Single Mode Fiber Optic Cable
J-Pull Box-Dynamic-P		Systems Pull Box
J-Terminalstrip-P		Terminal Strip for Hardwired Conn's
J-Lightswitch-OS-P		Lightswitch / Ocupancy Sensor
		Pan Tilt Zoom Camera
		Pan Tilt Zoom Camera Elevation
J-Camera-Dynamic-P		CCTV Camera
J-CivilCondID-P		Conduit Number/Schedule Identifier
J-Antenna-Dist-P		Distribution Antenna System

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-AmbNoise-P		Ambient Noise Sensor
J-AudioCable-Dynamic-P		Audio Cable
		Audio Network Bus
		Speaker Cable
C-CommCables-Dynamic-P		MULTI-CONDUCTOR
		SERIAL
		CAT6
		COAXIAL CABLE
C-CommPnlCallout-Dynamic-P		FIBER DISTRIBUTION PANEL
		FIBER PATCH PANEL
		DISTRIBUTION CABINET
		FIBER DISTRIBUTION CABINET
J-COMMRmTag-DynamicP		Comm Room
		Signal Room

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-RadioDivAntenna-Dynamic-P		Radio Divider
		Distribution Antenna System
		Antenna
J-SigPwr-Dynamic-P	NTS 	Uplink Noise Power in 12.6 KHZ ENBW Channel
	NTS 	Downlink Signal Power
	NTS 	Lowest Power Uplink Signal Distributed Antenna System
	NTS 	Nominal Tunnel Radiating Cable Signal Power
J-Phone-Dynamic-P		Phone - Type Etel
		Phone - Type Pet
		Phone - Type PBX
		Phone - Type PBX Wall
		Phone - Type Data
J-FCAnalogSignal-P		Analog Signal
J-FCBuzzer-P		Buzzer
J-FCCardReader-P		Card Reader
J-FCDirArrow-Dynamic-P		Direction Arrow (Heading Left or Right)
J-FCDryContact-Dynamic-P		Normally Open
		Normally Closed

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
J-FCFOptc-1Mode-P		Single Mode Fiber Optic Cable
J-FCInst-P		Instrument
J-FCInteger-P		Integer
J-FCLight-P		Light
J-FCPushbutton-Dynamic-P		Normally Open
		Normally Closed
J-FCSolenoid-P		Solenoid

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
		Ammeter
		Voltmeter
	NTS 	Kilowatt Hour Meter
	NTS 	Kilovar Meter
		Kilowatt Meter
		LCMS Annunciator (PLC Monitor Screen) and SCADA
		SCADA and LCMS
		DCAM Interface
		Emergency Trip Station
		Substation Shutdown Station
		Current Transducer
		Voltage Transducer
		Electrical Interlock
J-TrctnPwrCallout-Dynamic-P		Mechanical Key Interlock

Landscape

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

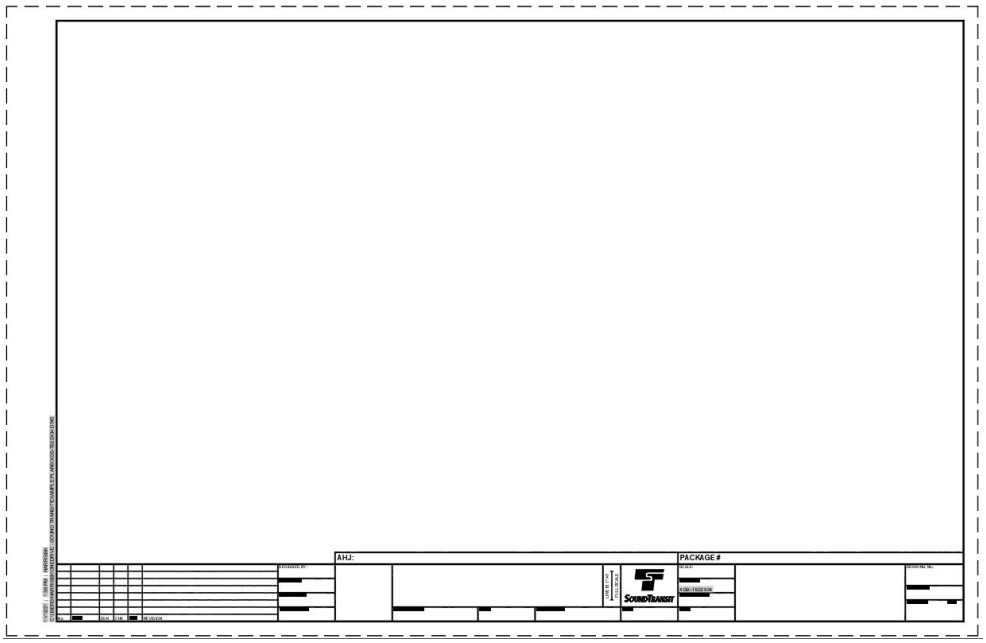
Block Name	Example (NTS = all blocks are Not To Scale)	Description
L-Schrub-P		Shrub
L-Stump-P		Stump
L-Tree Grate-P	NTS 	Tree Grate
L-Deciduous Trees-P	NTS 	Deciduous Tree 1
	NTS 	Deciduous Tree 2
	NTS 	Deciduous Tree 3
	NTS 	Deciduous Tree 4
	NTS 	Deciduous Tree 5
	NTS 	Deciduous Tree 6
	NTS 	Deciduous Tree 7
	NTS 	Deciduous Tree 8
	NTS 	Deciduous Tree 9
	NTS 	Deciduous Tree 10
	NTS 	Deciduous Tree 11
	NTS 	Deciduous Tree 12
	NTS 	Deciduous Tree 13

These blocks can be found in the "ST Propsed Blocks and Linetypes.dwg"

Block Name	Example (NTS = all blocks are Not To Scale)	Description
L-Conifer Trees-P	NTS 	Conifer Tree 1
	NTS 	Conifer Tree 2
	NTS 	Conifer Tree 3

6.5.4 Title Blocks

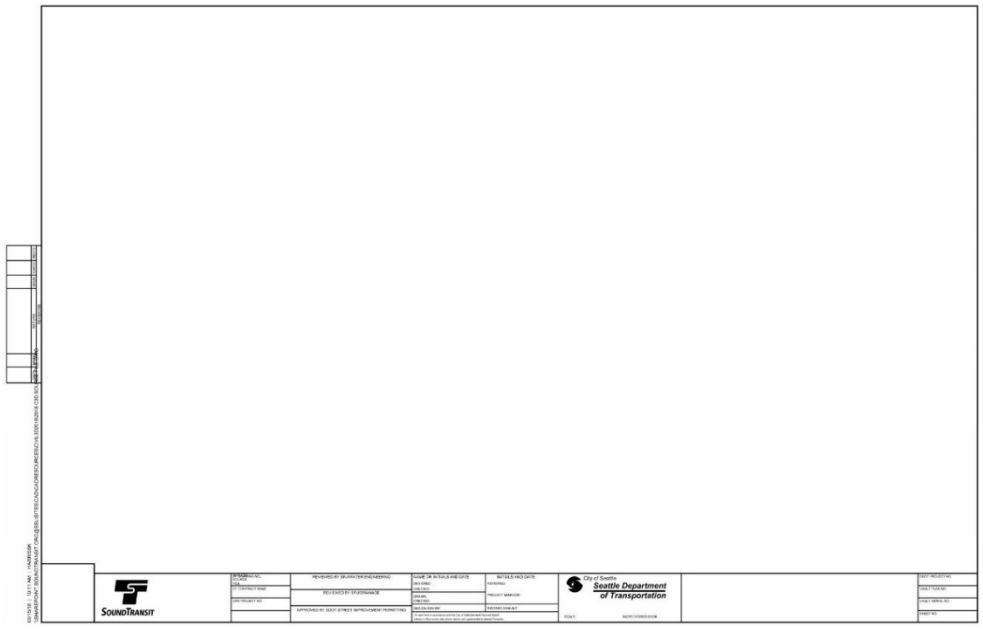
6.5.4.1 All ST Contract drawings



Block name = GB-TB22x34

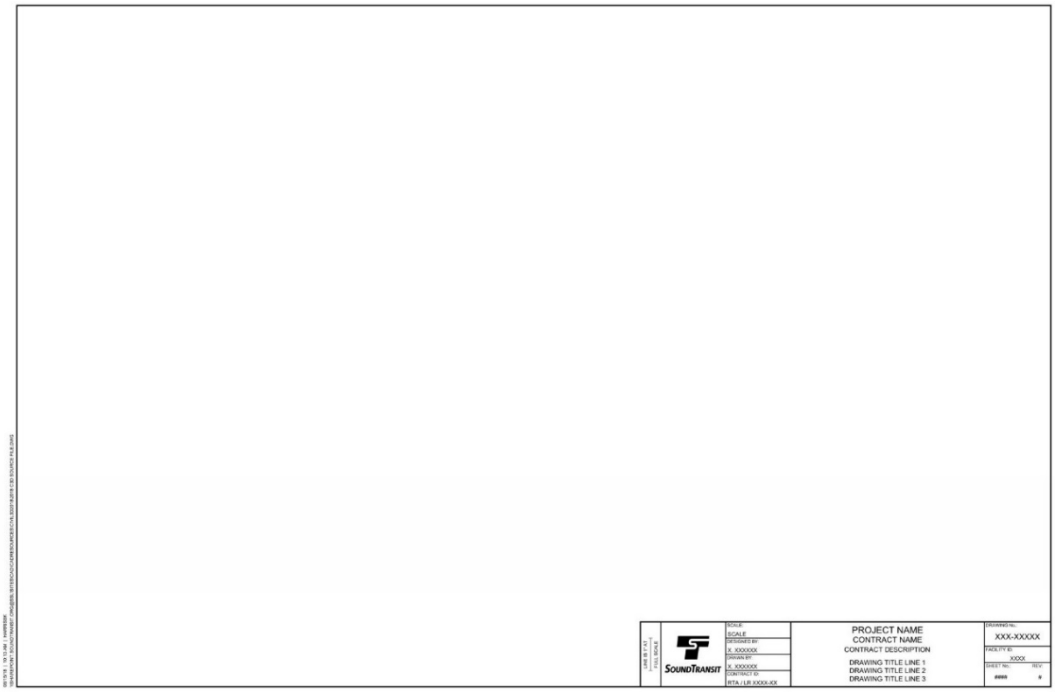
6.5.4.2 City of Seattle's Street Improvement Permit

Block name = GB-TB22x34-SIP



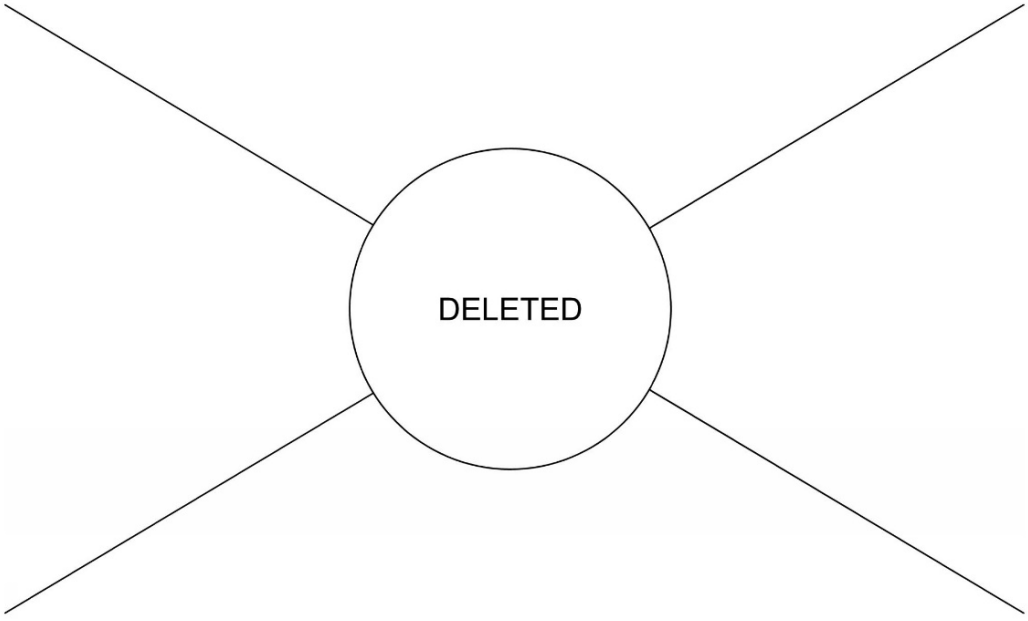
6.5.4.3 Roll Plots

Block name = GB-TBRollPlot. A dynamic block to plot various lengths



6.5.4.4 Deleting a drawing within a Contract Package

Block name = ZG-DEL. Place in the Title Block stretched corner to corner



6.6 Screened Lines

Screened (grey) lines are to show all existing features, regardless of project construction phase or primary discipline of the drawing.

Screened colors in contract drawings with the following conditions:

- Apply consistently across all drawings in the package
- Readable, recognizable, and discernable from other elements in printed and electronic (PDF) form

6.7 Line Weights

The following table provides the (8) line weights used on ST projects:

0.005” – Extra Fine	0.030” – Extra Wide
0.010” – Thin	0.040” – XX Wide
0.015” – Medium	0.055” – XXX Wide
0.020” – Wide	0.080” – XXXX Wide

Weight definition’s name (not value) is referenced in the requirements.

User may select several colors for a specific weight. For example, the “Wide” line is produced by using color numbers 4, 13, 17, 19, 23, etc.

Set the color & line weight for all elements to ***BY LAYER***.

Maintain xref line types in all plan drawing viewports

Requirement defines basic element properties. Consultant to choose a specific color provided in color tables, and linetype to clearly depicts the design intent and necessary detail within a drawing file.

6.8 Hatch Patterns

Use the Autodesk pattern file ***acad.pat, ST Existing Blocks and Linetypes.dwg*** and ***ST Proposed Blocks and Linetypes.dwg*** to produce all hatch patterns

Do not use custom hatch pattern definitions

Use the ST provided hatch patterns as noted in section ***6.5***

Use of the same pattern to define different items only when:

- Each pattern only represents 1 item within the same discipline series of drawings
- Each disciplines’ legend identifies all patterns used

Add new patterns only if not already used in the same discipline series

6.9 Layers

ST CAD layers are based on the National CAD Standards and adjusted to meet the needs of ST multi-faceted infrastructure.

Use the layers provided in ***C3D Existing DWT xref*** and ***C3D Proposed DWT xref – drawing*** template files

6.10 New Layers

Add new layers only when a layer is not available in the ST DWT files

Requirements to adding a new layer:

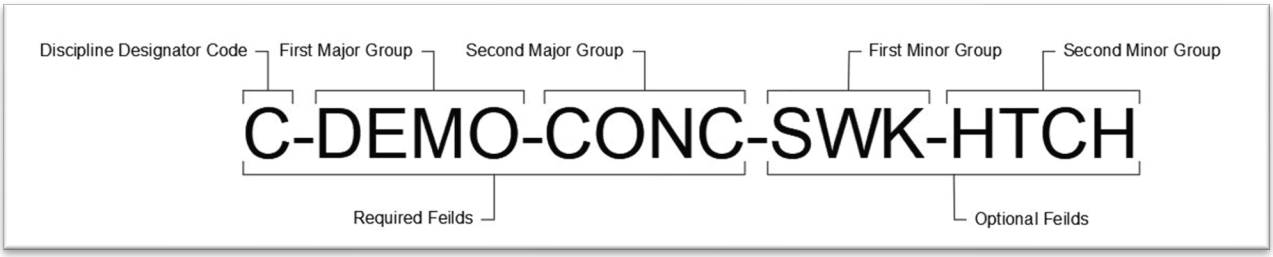
- Follow the naming structure outlined in this manual
- Capitalize the whole layer name
- Do not include spaces or special characters
- Include a detailed description in the layer manager
- Consistently apply codes across all layers (same word or abbreviation)

6.10.1 Proposed Layer Names

Use the Discipline Codes in section ***5.6.1***

Use a maximum of 4 characters in each of the 4 remaining groups

Example of a Proposed Layer Name



6.10.2 Existing Layer Names

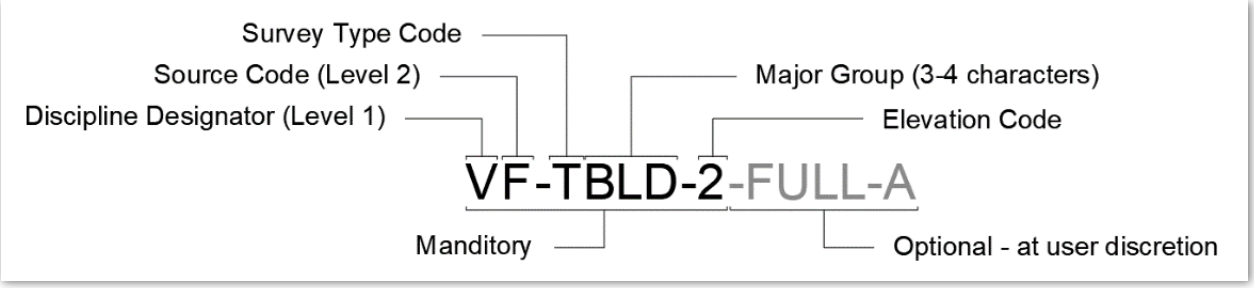
Discipline Designator - Always “V” for base map and survey layers

Source Code - Where it came from (Arial Photos, As-Builts, GIS, etc.)

Survey Type Code - What it is (Topo, Contours, Utilities, etc.)

Elevation Code - Below grade, at grade, or above grade

Example of an Existing Layer Name



Source Code

Code	Definition
A	Aerial Photo
F	Field Survey
G	GIS
R	Record As-built

Survey Type Codes

Code	Definition
C	Contours
S	Survey
T	Topographic
U	Utility

Elevation Codes

Code	Definition
0	Below Grade
1	At Grade
2	Above Grade

6.11 Annotation

The convention to build and apply annotation elements

CAD file examples of the items below are found in ***Proposed Blocks and Linetypes.dwg***

6.11.1 Text Styles

Text is controlled by pre-defined Text Styles, as noted below.

- All have an oblique angle of zero degrees
- All text has a width of 1
- STANDARD text style to use ARIAL as the embedded font to avoid errors when loading custom ST linetype definitions
- Do not use the STANDARD text style for anything other than for text within linetypes
- Do not use SHX fonts
- Capitalize all text
- Do not modify pre-defined Text Styles

6.11.2 Annotation Objects (with Style and Size)

Annotation Object	Text Style	Size (inch)
General Annotation	ST-Arial	0.125
Legend & Notes (General, View, and Key Notes)		
Note Header	ST-ArialBold	0.150
Note Body	ST-Arial	0.125
Headers		
Column Header	ST-ArialBold	0.200
Note Header	ST-ArialBold	0.150
Township / Range Header	ST-ArialBold	0.250
Primary Table Header	ST-ArialBold	0.175
Secondary Table Header	ST-ArialBold	0.150
Cover Page Titles	ST-ArialBold	Varies
View Titles		
Main Title	ST-ArialBold	0.200
Sub-titles	ST-Arial	0.150
Scale	ST-Arial	0.125
Dimensions	ST-Arial	0.125
Callouts (Labels)		
General / Proposed Items	ST-Arial	0.125
Existing Features - Base Map	ST-ArialItalic	0.100
Existing Features - Large Scale Plans	ST-ArialItalic	0.125
Match Lines	ST-ArialBold	0.175
Roadway/Street Names	ST-ArialBoldItalic	0.175
All City, County, and other AJH Names	ST-ArialBoldItalic	0.150
Significant Points of Interest (Civic Centers, Colleges, Parks, etc.)	ST-ArialBoldItalic	0.150

6.11.3 General Annotation

Includes dimensions, callouts, general notes, and notes for proposed and existing features (not in base maps)

6.11.4 Headers

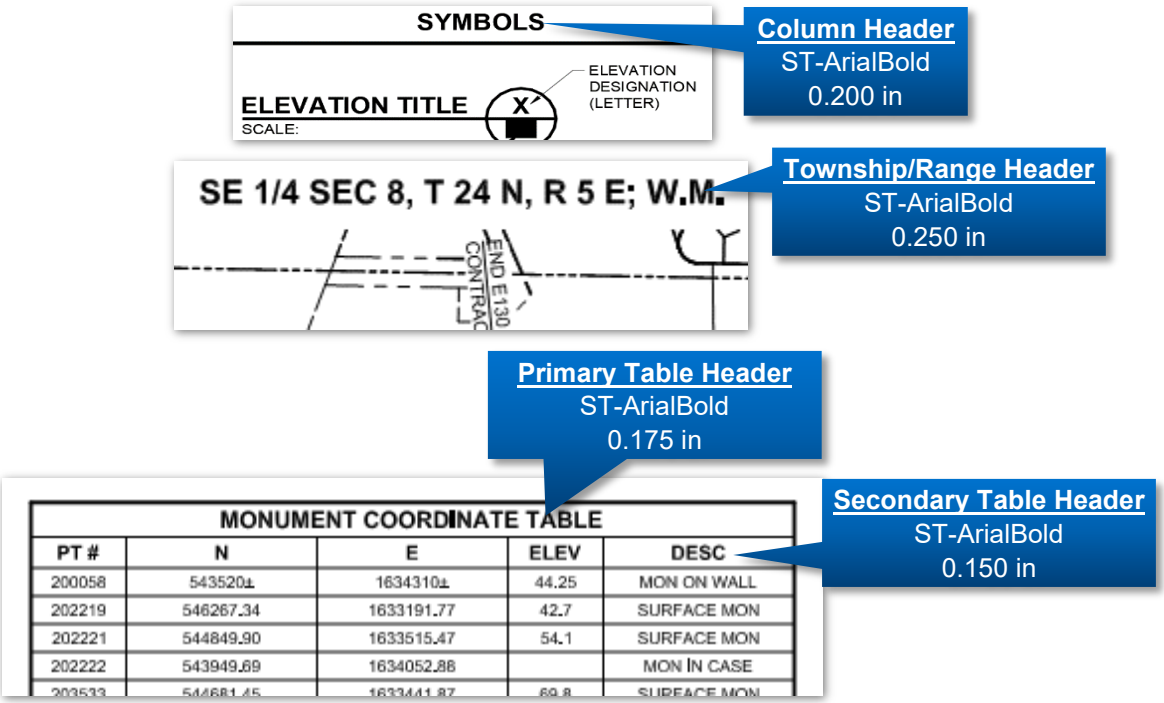
6.11.4.1 CAD and BIMc Files

Blocks provided in ***Proposed Blocks and Linetypes.dwg*** file

GA-BasicNote	**NOTE:** XXX.	Single Note (Multi-Text) For notes that apply to a specific detail or item
GA-GeneralNote	**GENERAL NOTES:** 1. XXX. A. XXX.	General Notes (Multi-Text) For notes that apply to entire sheet or plan set.
GA-KeyNote	**KEY NOTES:** 1 XXX.	Key Notes (Multi-Text with Multi-Leader as tag)
GA-ConstructionNote	**CONSTRUCTION NOTES:** 1 XXX.	Construction Notes (Multi-Text with Multi-Leader as tag)

6.11.4.2 BIMf Files

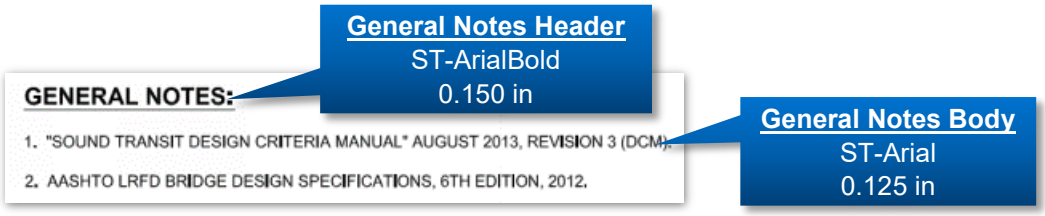
Use families provided in ST Revit template or match the properties in the examples shown below:



6.11.5 Drawing Notes

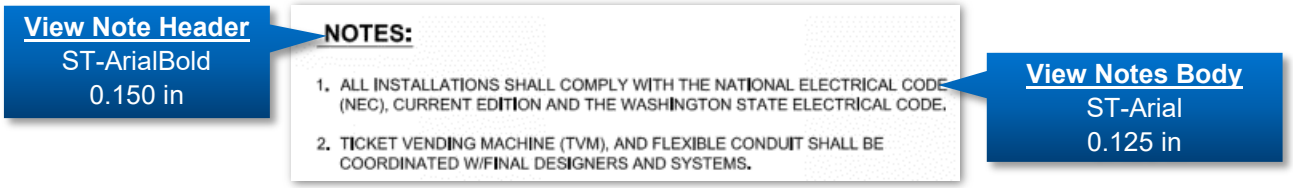
6.11.5.1 General Notes

- Used for addressing the whole drawing.
- Place in the upper-right corner of the drawing, when possible.
- Place a header of **GENERAL NOTES:** above the note body.
- Sequentially number the notes in body.
- Notes referring to other drawings to include full drawing number for individual drawing or drawing series range for multiple drawings.



6.11.5.2 View Notes

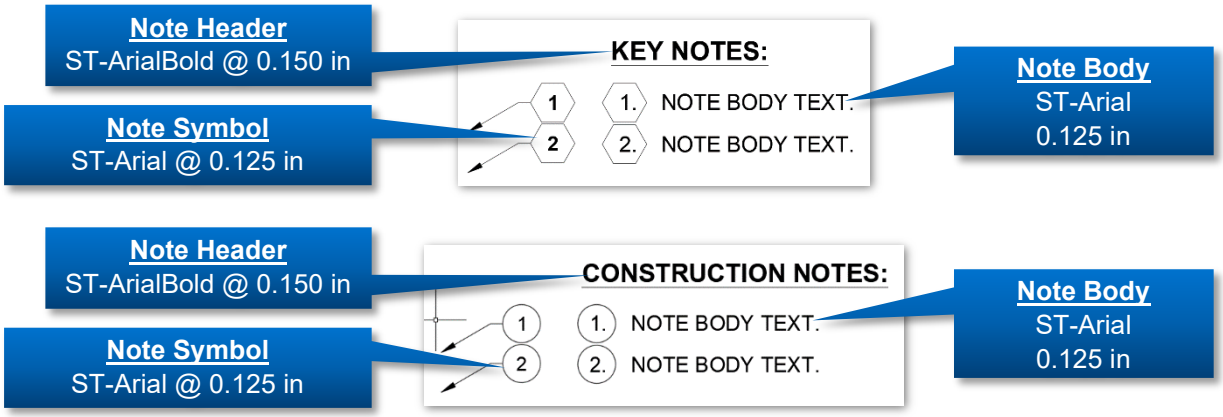
- Used to address a specific view or item in a drawing.
- Place close to the related view or item.
- Sequentially number the notes in body



6.11.5.3 Key Notes and Construction Notes

KEY NOTES describe specific aspects related to installation or removal of items. Always use Hexagons.

CONSTRUCTION NOTES are specific instructions describing HOW items are installed. Always use Circles.



- Do not cross leaders or obscure text.
- Consistently format, justify, and arrange callouts to avoid obscuring text, dimensions, or other relevant objects.
- Use Autodesk authoring tools (multi-leader or quick leader) to place all callouts.

- Do not explode or create fragmented note structures.
- Do not use as a substitute for general notes.
- Repeat the same note and number on each drawing that shows the related item.
- Turn the leader type to NONE to show the correct symbol with the list
- Place a header of KEY NOTES: or CONSTRUCTION NOTES: above the note body.
- Omit notes that do not relate to an item on the drawing. Example: Drawing one contains notes 1-6, drawing two contains notes 1-3 and 6, with 4 & 5 omitted.
- All numbers remain sequential and assigned to the original item.

6.11.6 Callouts

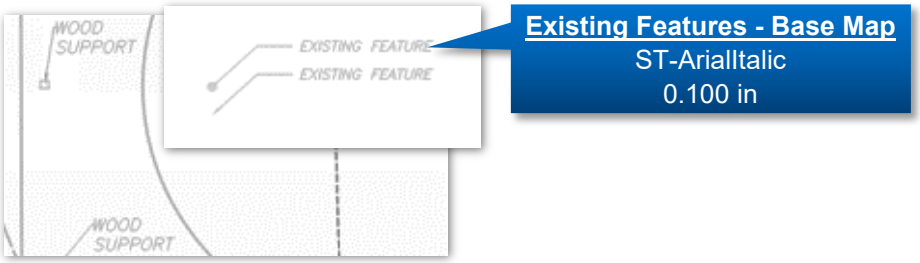
- Include the whole note and do not reference or rely on Key notes or Construction notes.
- Do not cross or obscure text, dimensions, leaders, or other relevant objects.
- Use Autodesk authoring tools (multi-leader or quick leader) to place all callouts.
- Do not explode or create fragmented notes.
- Orient text to read horizontally (default orientation) or from the right side of the drawing when placed vertically.

6.11.6.1 Proposed/General Callouts

- Use a Dot leader when pointing to an area.
- Use an Arrowhead leader when pointing to a specific object. Leader to touch the object.

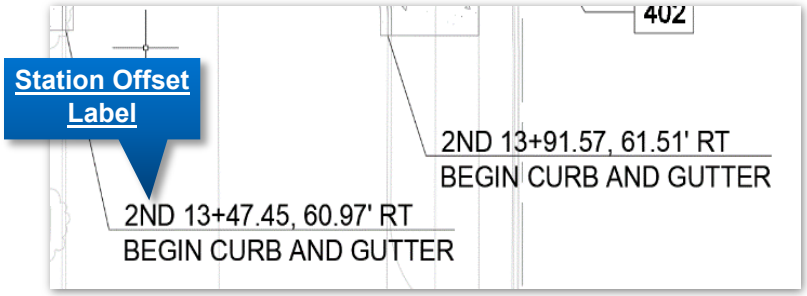
6.11.6.2 Existing Feature Callouts

- Base map annotation is aligned along trackway corridor and plan readable.



6.11.6.3 Station/Offset Callouts

- Orient callout text horizontally to the drawing.
- Avoid overlaps of text/leaders and other items that obscure the text.
- Place leaders perpendicular to the alignment.
- CIVIL 3D Data Labels are utilized and maintained until RECORD DRAWINGS acceptance in drawing files for Civil 3d elements.



6.11.6.4 Package Cross Reference Callouts

When a reference to another drawing that is in a different package is made, the notation must include which package the reference drawing is found in.

2. FOR TRACK ALIGNMENT DATA, SEE PLAN AND PROFILE DRAWINGS L05-KAP100 SERIES AND L10-KAP200 SERIES INCLUDED IN PACKAGE CW.01.

6.11.6.5 Multi-Leader Styles:

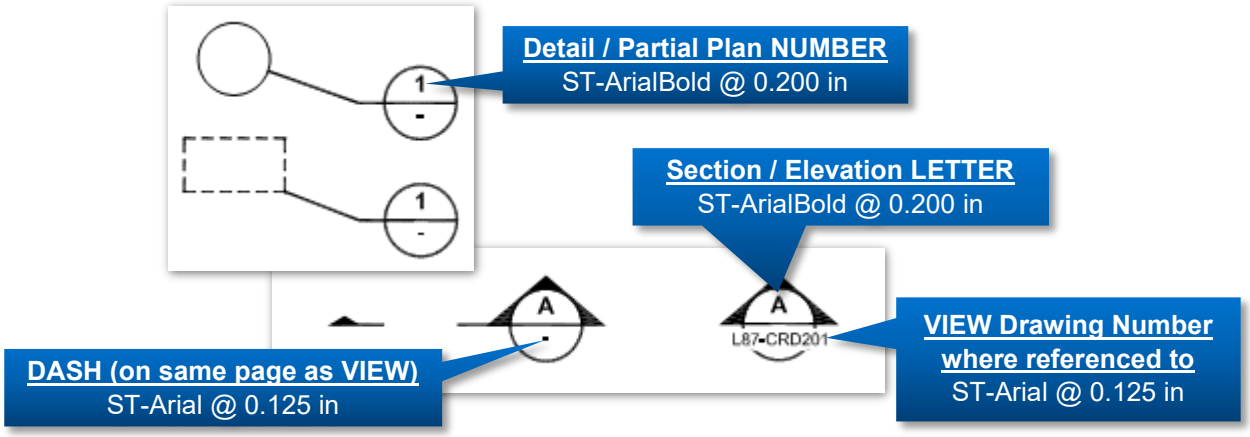
- ***ST-Basemap -*** Existing features in the base maps.
- ***ST-Standard -*** Remaining leaders.
- ***ST-KeyNote and ST-ConstructionNote -*** for specific notation callouts.
- Select ***NONE*** as the arrowhead property to omit the arrowhead as needed.
- Do not explode.

6.11.7 Titles

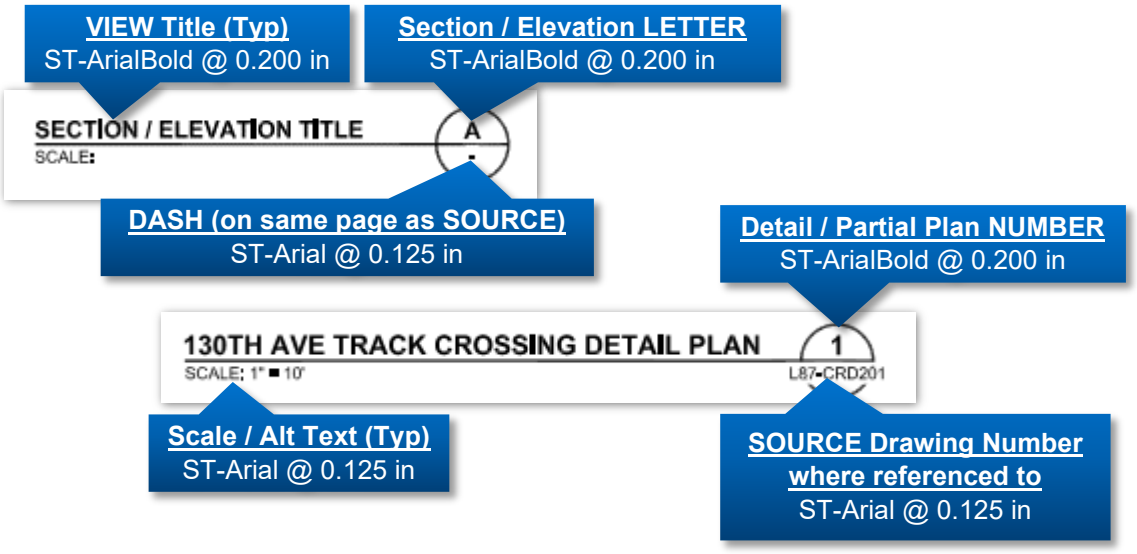
6.11.7.1 View Titles (Sections, Details, Elevations, and Partial Plans)

- Arrange views in ascending alphabetical or numerical order, from left to right and from top to bottom of the drawing.
- List additional source cross-references below the original reference shown.
- Use ST provided blocks and properties.

6.11.7.2 View Cut Symbols



6.11.7.3 View Title Symbols

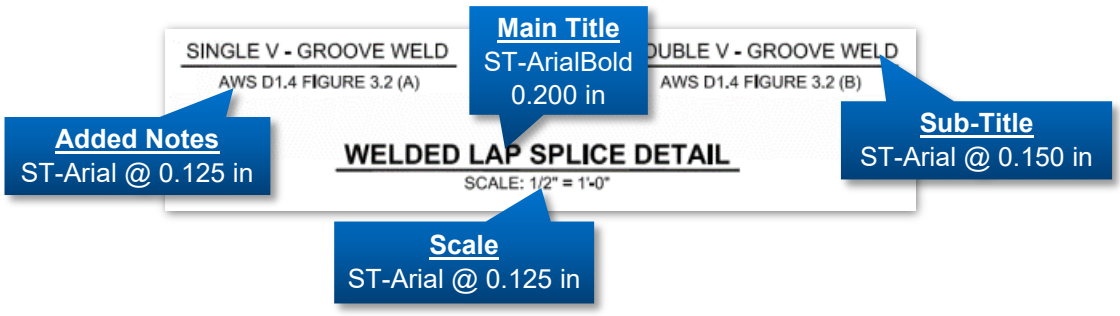


6.11.7.4 Enlarged Plans/Details

A plan, profile or elevation requiring greater detailed information and is referenced to another drawing.

6.11.7.5 Stand-alone Views

- Combined views for a complex structure with a main title and sub-titles.
- A single view that is not referenced from other drawings via cut symbols.
- Use when referenced from notes, tables, schedules.
- Do not place under full plan drawings



6.11.8 Dimensions

- Place dimension text above and centered to the dimension line or use a leader to avoid obstructing relevant objects.
- Add a break-line along the dimension line and include the correct dimension if not drawn to scale.
- Use abbreviations in notes, such as (TYP) and (SIM) to avoid dimension repetition on the same drawing or part of the drawing.
- Apply consistently throughout the drawing package.
- Arrowheads are FILLED.

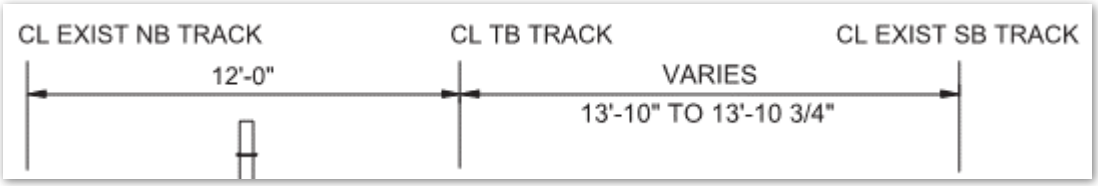
- Arrowheads are the same size as the text.
- Always use dimension styles.
- Maintain dimension's associations and structure.
- Do not explode or manually override dimensions

6.11.8.1 Dimension Styles

Use the ST provided styles listed below

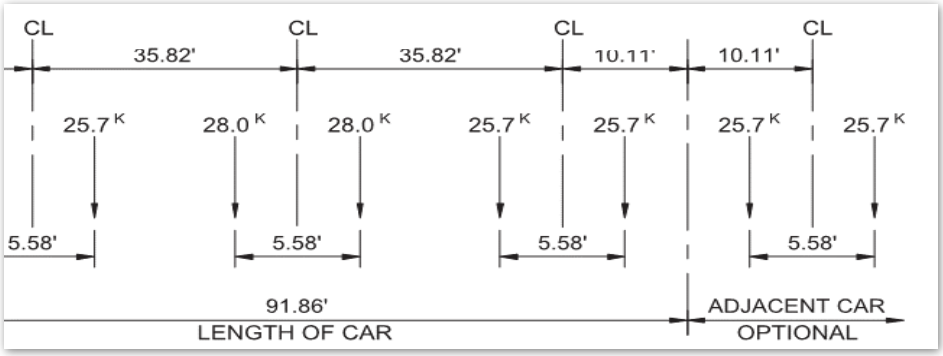
6.11.8.2 ST-Architectural

(1 unit = 1 inch) FRACTIONAL format.



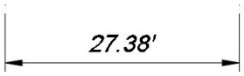
6.11.8.3 ST-Decimal Feet

(1 unit = 1 foot) DECIMAL format.



6.11.8.4 ST-Basemap

(1 unit = 1 foot) DECIMAL format.



6.11.8.5 AutoCAD Drawing Units

- Define as ENGLISH units in all contract drawing files.
- Not the same as CIVIL 3D Toolspace unit setting.
- Define as either "Decimal Feet" or "Feet and Inches".
- All aligned disciplines (e.g. architectural vs civil) within a project must use to the same unit definitions.

6.11.8.6 Decimal

- Linear dimension accuracy at (2) two decimal places.
- Include a "0" in front of the decimal point on a dimension less than one foot.

6.11.8.7 Feet and Inches

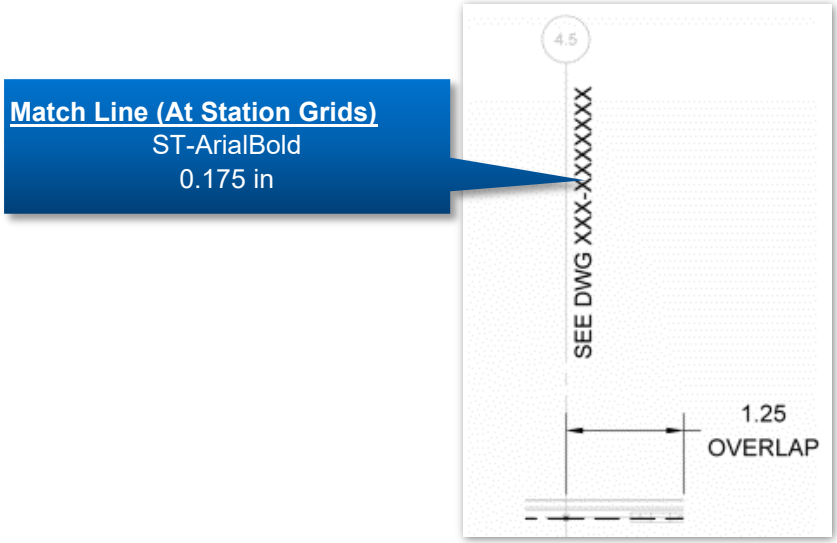
- Separate feet and inches with a short dash (example: 12’-10").
- Include a zero (0) in the inches placeholder if the dimension is in whole feet (example: 9’-0").
- Show fractions on the same horizontal line and separate with a space (example: 2 1/4").

6.11.9 Match Lines

Apply 1 of 2 types of control to show where a view ends in one drawing and continues in another.

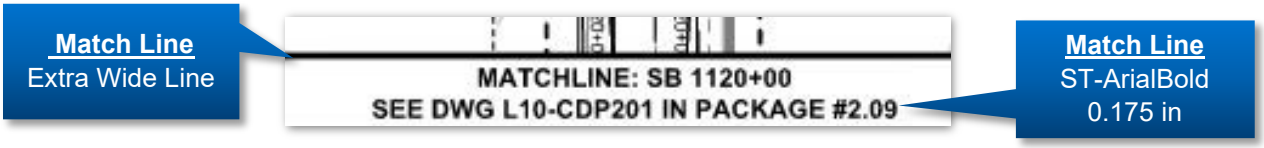
6.11.9.1 Station Structural Grids

- Architectural/structural plans spanning two or more drawings.
- Place at a grid line and extend the view 1.25” beyond the gridline.
- Add a grid line to denote the location of the match if no grid line exists.
- Adjust position along the grid line or use MASKED TEXT to avoid conflict with objects.



6.11.9.2 Viewport Limits

- Place perpendicular to the related alignment.
- Label with text outside limits
- Do not create an overlapping or gap between the match lines viewports.



- DB Projects must follow the same criteria as noted above with additional text denoting which package to find the connecting drawing.

- Remove stationing text from a matchline that has no alignment stationing to reference.

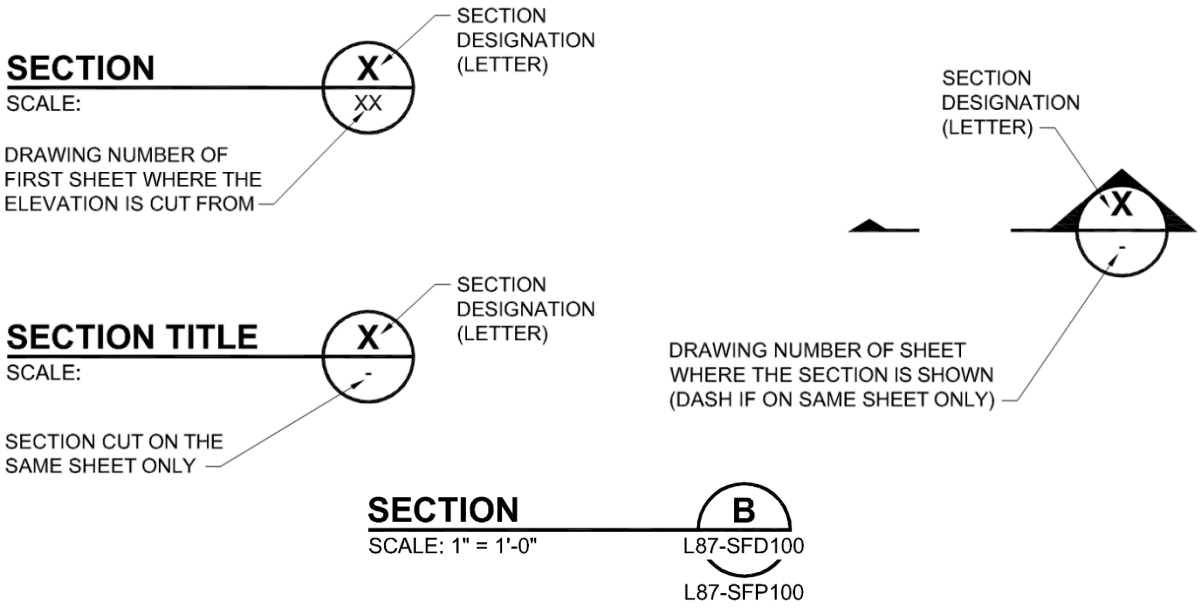
6.11.10 Cross Referencing

Cross-reference symbols for SECTIONS, DETAILS, and ELEVATIONS.

Use ST provided blocks for the cross-reference symbols.

All cross-references to adhere to the following conditions:

- Maintained as a block, not exploded elements.
- ***DETAILS*** use ***NUMBER*** designations.
- ***SECTIONS*** and ***ELEVATIONS*** use ***LETTER*** designations.
- When the origin of the Section, Elevation, or Detail is in more than one location, stack text with reference.
- Apply the referencing convention outlined below.



6.12 Printing

6.12.1 Layouts and Plotting Limits

This section refers to plotting Contract Drawings with any Autodesk AutoCAD or Civil 3D software.

Refer to section 8.8 for printing with Revit.

Full Size Contract Drawings - 22”x34”

Half Size Contract Drawings - 11”x17”

All contract drawings:

- Ensure it is printable from paper space.
- Place plot limits at base coordinates 0,0 – 34,22 for a “full size” drawing (22x34 inches).

6.12.2 Element Printing Properties

Default properties are assigned to the elements in the ST Civil 3D Template files.

Adjust layers colors within the drawing file to produce the alternative weights for distinction and clarity in conjunction with ST-Mono.ctb. (Black or Grey, Thin, Medium, or Wide).

BIM models require different properties to look the same in the drawings.

6.12.2.1 Existing Features (Grey Linework)

Linetype: = Varies

Printed color = SCREENED 40%

Text = ST-Arial Italic @ 0.125 in. or 0.10 in.

Line weight = THIN to WIDE

6.12.2.2 Primary Relevant Design Elements (Black Linework)

Linetype: = SOLID/CONTINUOUS

Printed color = BLACK

Text = ST-Arial @ 0.125 in.

Line weight = MEDIUM to XXX WIDE

6.12.2.3 Secondary Relevant Design Elements (Black Linework)

Linetype: = SOLID/CONTINUOUS

Printed color = BLACK

Text = ST-Arial @ 0.125 in.

Line weight = THIN to WIDE

6.12.2.4 Non-Relevant Design Elements (Black Linework)

Linetype: = SOLID/CONTINUOUS

Printed color = BLACK

Text = ST-Arial @ 0.125 in.

Line weight – THIN to MEDIUM

6.12.2.5 Dimension, Leaders, and Text (Black Linework)

Linetype: = SOLID/CONTINUOUS

Printed color = BLACK

Text = ST-Arial @ 0.125 in.

Line weight = THIN

6.12.2.6 Patterns (Grey or Black Linework)

Linetype: = Varies

Printed color = Grey or BLACK

Text = ST-Arial @ 0.125 in.

Line weight = EXTRA FINE

6.12.3 Color Tables

ST provides two color tables for printing contract drawings and related exhibits.

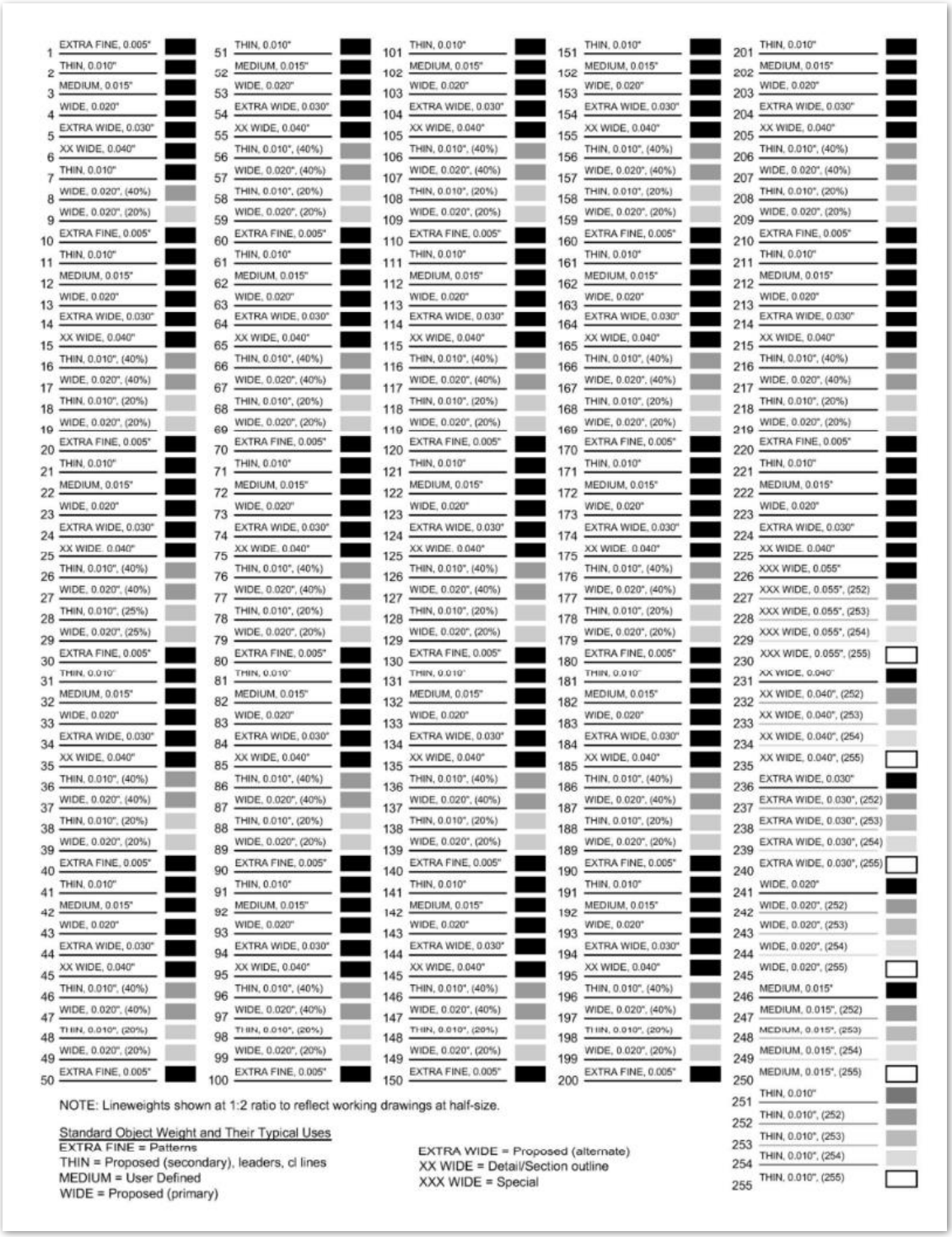
Do not change the color table (CTB) settings or use another CTB to manage ST contract drawing files without prior approval from the Design Technology Manager.

Select “Scale Line Weights” within the print dialog settings to produce the correct weights on non-full size drawings

6.12.3.1 ST-Mono.ctb (Contract Drawings)

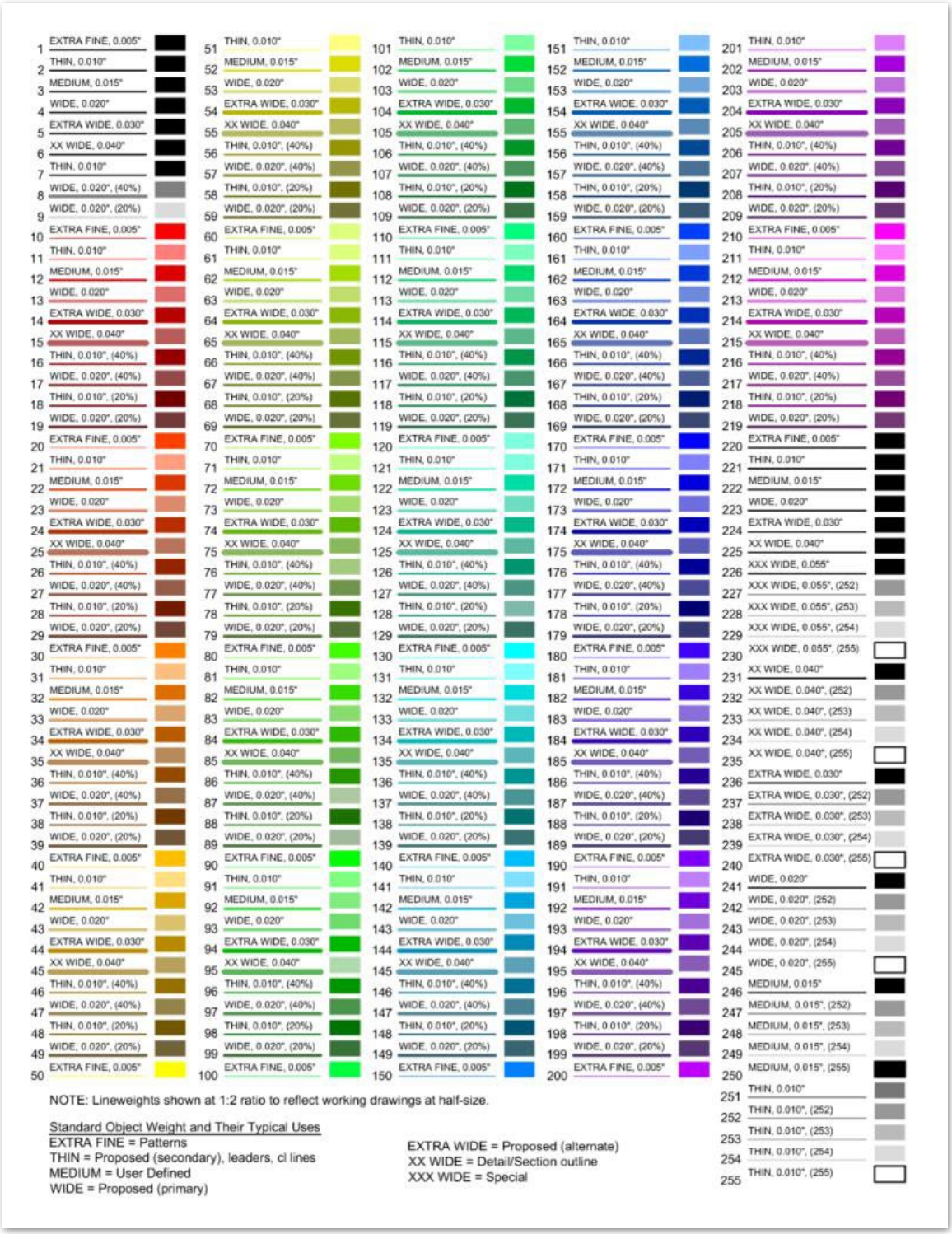
Used to produce all ST contract drawing files. It contains multiple “screen colors” to produce lines at various weights.

Do not modify the settings within the ST color tables.



6.12.3.2 ST-Color.ctb

Used to produce ST exhibits, presentations, figures, and roll plots). Prints elements in their "screen colors" at various weights.



6.13 CAD Deliverables

6.13.1 Supporting Electronic Data

6.13.2 File Management Plan

6.13.3 PDF Plan Set

Plan set per section *4.3*

6.13.4 CAD Drawings

- All drawing files.
- All ctb files.
- All Sheet Set Manager files.
- All font files.
- All shx files.

6.13.5 CAD PxP

- Submit first version for approval no later than 30 days after Notice To Proceed (NTP).
- Submit all subsequent changes for approval 30 days prior to implementation. PXP templates are provided by Sound Transit.
- Record any approved deviations to the project scope of work, project requirements, Design Technology Manual requirements in the BIM PXP.
- Submit all CAD PXP updates to SharePoint and send a notification to the discipline/trade CAD Leads as well as the ST Design Technology Manager.

6.13.6 BIMc and CAD Kick-off Meeting

- One BIMc and CAD kick-off meeting is held within 30 days of NTP. The BIM and CAD Managers coordinate the schedule, meeting agenda, and preparations of Kick-off meeting for BIM and CAD efforts with the Sound Transit Design Technology Manager and distribute it to attendees two days prior to meetings. Meeting minutes are recorded and submitted to the project folder no later than two business days after meeting.

6.13.7 Autodesk Batch Standards Checker Report

- Submit a Batch Standards Checker report of all drawing files for each milestone. The report must add all xrefs regardless of nesting level. This report is a HTML image file and must contain:
- A list of drawings checked
- All Standards violations for layers, dimension styles, linetype, text styles for each file.

6.13.8 Autodesk Reference Manager Report

- Submit a Reference Manager report of all drawing files for each milestone. The report is run with the “all xrefs automatically loaded regardless of nesting level” option. This report is a CSV file and must contain:
    - Host Drawing
    - Type
    - Status
    - File Name
    - Reference Name
    - Saved Path
    - Found Path
    - Host Version

6.13.9 CAD Essential Requirements Checklist

- ST provides a CAD Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

6.13.10 PDF Essential Requirements Checklist

- ST provides a PDF Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

7. BIMc

The following requirements are based on the use of Autodesk Civil 3D.

7.1 BIMc Requirements

The BIM manager to lead design and construction teams and sub-contractors to utilize BIM platforms in design and construction processes. This includes creating all objects, geometries, physical characteristics, data, annotations, styles, and drafted contents necessary to produce complete sets of design and construction BIMc models and drawings to ST Design Technology requirements.

BIMc models to include all components within the project site and immediate vicinity, up to connection points specified in the BIMf requirements. Surface features and grades are modeled in Civil 3D. Utilities and services are modeled in Civil 3D to BIMf connection points. If the surface structures and utility services and systems have minor extensions that exceed the project site area, or actual connection points are placed outside the project site and immediate vicinity of 5-feet, these extensions are modeled in Civil3D as appropriate.

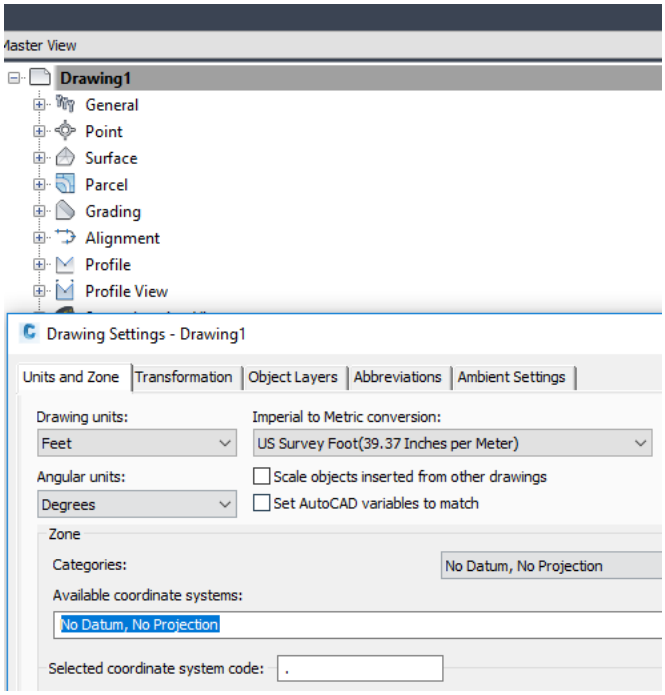
The BIMc model content is a minimum 300 Level of development model as defined by the 2021 LOD specification developed by BIMForum.

BIMForum LOD 300 interpretation: The quantity, size, shape, location, and orientation of the element as designed are measured directly from the model without referring to non-modeled information such as notes or dimension callouts. The project origin is defined, and element is located accurately with respect to project origin.

Below is the modeling requirements that outline the intended BIMc uses within ST:

- Model all 3D elements at their true elevation, size, location, and orientation.
- Model and maintain all gravity utilities in Pipe Networks, including their structures and pipes/conduits 6” and larger.
- Do not include any additional items not intended for construction or modification by the project.
- Do not promote any 3D elements from one design file into another design file, xref file, or contract drawing file.
- Resolve all conflicts between design elements, such as
- Alignments, profiles, pipe networks, and corridors.
- Retain the automatic update functions between drawings and design xrefs in all Civil 3D labels.
- All projects to utilize BIM 3D technology and practices to design, build, and maintain ST infrastructure.
- Create separate files for different design element groups and/or disciplines.
- Do not duplicate any base map information in any other file.
- Do not create surface files that require software to create memory map surface files (*.MMS) files.

- Set units to US feet for all xrefs (Toolspace Setting under Units and Zone tab, not international feet).



Create the following design items as Civil 3D objects:

- Points, Surfaces
- Alignments
- Profiles, Sections
- Corridors
- Pipe Networks
- Utilities:
    - Wet
    - Dry
    - Pumped
    - Gravity Fed
    - Pressurized Conduit

7.1.1 Surveyed Surface Files

- DWG points file with an existing surface to contain the following:
- All recorded 3d points
- All break/fault/feature lines as 3d polylines
- 3d Points to include Point Number (P), Northing (N), Easting (E), Elevation (Z), Description (D)
- 3d Point Code list (if applicable)
- Multiple Surveyed surfaces are combined into 1 Existing surface file for each Facility ID

- Surface design DWG file size not to exceed 100 mb. Break up Surface files into 1 or more Facility ID locations, as needed

7.1.2 As-Built Surface Files

- All break/fault/feature lines as 3d polylines
- DWG file with all objects utilized to create or modify the surface are identifiable and visible.
- Direct modification of the TIN through edge swapping, edge deletion and point deletion is minimized
- Multiple AS Built surfaces are combined into 1 As Built surface file for each Facility ID
- Surface design DWG file size not to exceed 100 mb. Break up Surface files into 1 or more Facility ID locations, as needed

7.1.3 Alignments Files

All Roadway, Track, Curb, Drainage Flow line, Structural and any other centerline used to generate the construction of horizontal and vertical information.

7.1.4 Pipe Networks Files

All pressurized and gravity based utility structures are modelled.

All pressurized and gravity based utility pipes of 6" and larger are modelled.

Alternate uses of Pipe Networks – bent, columns, etc are supplied to ST.

Any customized structures or pipes created by the project.

7.1.5 Corridor Files

All dedicated alignments, cross sections and vertical profiles with identifying labels located in an area of model space.

7.2 Model and Project Datum

All BIMc files must share a common project datum consistent with the project location data or assigned monument defined by the project survey data.

Refer to ***ST Requirements Manual SET 905*** for survey datum information.

All discipline leads must ensure the datum is consistently applied.

The BIMc project datum provide consistent and accurate:

- Data exchange, seamlessly between disciplines using BIM workflows.
- Location of all design models linked via shared project coordinates.

All BIM files delivered to ST must have full functionality and oriented accurately without any relinking/re-positioning regardless of its previous version or format.

7.3 BIMc LOD Matrix

Sound Transit uses the definition of LODs (version 2021) developed by BIM Forum (www.bimforum.org/lod).

7.4 BIMc File Management

7.4.1 Project Resources

Contact the project's Design Technology Coordinator for ST provided Civil 3D resources, including templates.

The project's lead must develop and maintain a library of resources is consistently applied by the project team.

7.4.1.1 Consultant EDMS

Define the locations, document in the project's BIMc PXP and submit to ST along with all resources.

7.4.1.2 Design Ref Files

Civil 3D files used to develop preferred design alternatives analysis.

They are organized by discipline and location.

Not used in contract drawing plans.

7.4.1.3 Xref Files

Civil 3D files containing data shortcuts of the preferred design alternatives in the Design Refs files and are presented in the contract drawing plans.

7.4.1.4 Civil 3D Templates

ST provides Civil 3D template files containing a broad foundation of styles for all disciplines.

C3D Proposed xref – drawing.dwt - Use to create all proposed design, xrefs and drawing files.

C3D Existing DWT xref.dwt - Use to create all existing xref files.

New styles or changes to the provided ST styles must:

Adhere to the defined requirement core visual appearance.

Are documented in the BIMc PXP.

Approved by the project's Design Technology Coordinator prior to use.

7.4.1.5 Archiving

Consultants are responsible for archiving the project data at each milestone deliverable and maintaining until project completion.

7.5 CIVIL 3D Data Shortcuts Naming

This naming convention closely follows the file naming format outlined in section ***5***, utilizing the Facility IDs in section ***5.5*** and the Discipline Codes in section ***5.6.1***.

Description fields within CIVIL 3D Data Shortcut Element properties dialogue are filled out in detail.

Do not use abbreviations, acronyms, initials, or other forms of shorthand.

Alignment descriptions are NOT required. The description field is used in the alignment labels.

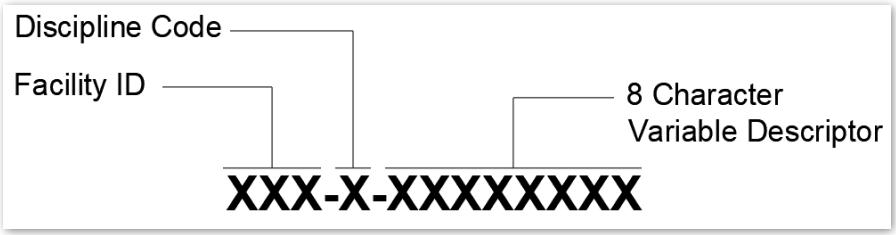
Do not submit As-Built files with information that is not part of the final condition, including all Civil 3D elements, data shortcuts, and data references.

7.5.1 Core Element Naming Structure

- Facility ID
- Discipline Code
- Eight-character variable descriptor

Always place dashes (-) between the key parts as shown.

Submit a File Naming Plan in the first PXP submittal for approval prior to use. Provide all the proposed names are used on the project following this convention.



7.5.1.1 Facility ID

Refer to the ***ST Facilities and Equipment Naming and Numbering Guide*** for Facility IDs.

Use a single Facility ID for all elements at a station or garage locations.

Use two (beginning and ending) Facility IDs for elements that span more than one location. Starting with location closest to downtown Seattle followed by farthest location from downtown Seattle.

Are used on all CIVIL 3D data shortcut elements, even off trackway items.

7.5.1.2 Discipline Code

Refer to section ***5.6.1*** for discipline codes for alignments and pipe network element names

Points & Surfaces to use the following discipline codes:

- A = As-Built
- E = Existing
- F = Final
- S = Subsurface
- G = Guideway (Aerial only)
- T = Tunnel (Tunnels or cut/cover below grade)

7.5.1.3 Eight Character Variable Descriptor

The Descriptor must adhere to the following:

- Between 3 and 8 characters.

- Specific and relatable to the item such as a nearby street, track station.
- Unique from other similar items such as detention ponds or roads.
- Not numbered sequentially (A, B, C, 1, 2, 3) with other similar items.

Easy to decode without referencing another document.

Provide all the descriptors used on the project in the first CIVIL3D PXP submittal for ST approval prior to use.

Provide any added or changed descriptors in all subsequent PXP submittals for approval.

7.5.1.4 Points, Point Groups & Surfaces

Example names and descriptions:

- S01S09-E-AL to KDM = Existing Ground for Angle Lake to Kent Des Moines Transit Centers
- S04-F-216th = Final Surface for 216th St in facility S04

Other example descriptors:

- POND 216 = Drainage Pond at 216th
- SLTC = Star Lake Transit Center
- GDR TOP = Top of Girder
- TOP RAIL = Top of Rail
- ACC RD = Access Road

7.5.1.5 Alignments

Example names and descriptions:

- S09-S-BW L123 = Bottom of Structural Wall L123
- S01S09-K –XOVER212 = Track crossover at station 212+00
- S03S04-U-WTR 320 = Water Line on 320th St.

7.5.1.6 Pipe and Pressure Pipe Networks

Example names and descriptions:

- S09-U-DRN FWTC = Drainage at Federal Way Transit Center
- S01S03-S-GDWYCOL = Structural Guideway Columns from 204th to 216th
- S07-U-FO PSE 272 = PSE Fiber Optic Line on 272nd St

Sites, Site Groups, Catchments, Assemblies, Intersections, Survey

Submit a list of intended names for these elements to the project's Design Technology Coordinator for approval prior to use.

7.6 BIMc Deliverables

7.6.1 Supporting Electronic Data

7.6.2 BIMc Drawings

- All drawing files.
- All ctb files.

- All Sheet Set Manager files.
- All font files.
- All shx files.

7.6.3 PDF Plan Set

- Plan Set per section *4.3*

7.6.4 BIMc PxP

- Submit first version for approval no later than 30 days after Notice To Proceed (NTP).
- Submit all subsequent changes for approval 30 days prior to implementation. PXP templates are provided by Sound Transit.
- Record any approved deviations to the project scope of work, project requirements, Design Technology Manual requirements in the BIMc PXP.
- Submit all BIMc PXP updates to SharePoint and send a notification to the discipline/trade CAD Leads as well as the ST Design Technology Manager.
- **For the BIM PXP**, ST provides templates for the LOD & BIM Roles responsibility matrix. Both matrices are required sections of the BIMc PXP.

7.6.5 BIMc LOD Matrix

- Developed by Sound Transit the LOD Matrix template is used and modified in accord with project requirements.
- The LOD Matrix clarifies the LOD of model components at different project milestones. The forecasted LOD for each major milestone is reviewed and committed to by the project participants within 30 days of NTP for each submittal phase and submitted for approval by Sound Transit.
- All submittals and selected LODs for them must conform to minimum requirements outlined in Sound Transit Engineering Procedures Manual EP-03 matrix and additional modeling requirements listed in this task.

7.6.6 PE Models

The design models used to create the Preliminary Engineering drawing set. All models must have a minimum LOD levels outlined in the BIMc LOD matrix.

7.6.7 IFB/IFC Models

- The design models used to create the IFB/IFC drawing set. All IFB/IFC models must have a minimum LOD of 300.

7.6.8 Record Models

- The IFB/IFC models that produce the Record drawings are updated to reflect the as-built (final installation) condition and installed works once in-place All Record models must have a minimum LOD of 300.

7.6.9 Contractor/Sub-Contractor Record Models

- The Contractor/Sub-contractor model(s) which reflects the final condition, it is submitted to Sound Transit. These Contractor/Sub-Contractor models is used

for supplemental details to the Record model. All models must have a minimum LOD of 300. The models are submitted in their native format.

- The contractor must supply a Federated Model combining all Contractor/Sub-Contractor models via Navisworks .NWD format. All Contractor/Sub-Contractor models are shared with the project coordinates established in the IFC models.

7.6.10 BIMc Kick-off Meeting

- BIMc and CAD kick-off meeting is held within 30 days of NTP. The BIM and CAD Managers coordinate the schedule, meeting agenda, and preparations of Kick-off meeting for BIM and CAD efforts with the Sound Transit Design Technology Manager and distribute it to attendees two days prior to meetings. Meeting minutes are recorded and submitted to the project folder no later than two business days after meeting.

7.6.11 BIMc Model Walkthrough

- The Consultant BIMc Lead to show the integrated model, walking through the environment narrating areas of interest. Answering questions from Sound Transit Engineering, Construction Management, Operations, and Maintenance to efficiently review and contribute to the design.
- Sound Transit comments received during the presentations are documented and resolved in writing and are incorporated prior to the next milestone submittal
- A single Consolidated model of all discipline models of the location.
- All files used to create Model walkthrough.
- Presentation Comment log with resolutions.
- Scheduled prior to All milestone and final deliverables

7.6.12 Autodesk Batch Standards Checker Report

- Submit a Batch Standards Checker report of all drawing files for each milestone. The report must add all xrefs regardless of nesting level. This report is a HTML image file and must contain:
    - A list of drawings checked
    - All Standards violations for layers, dimension styles, linetype, text styles for each file.

7.6.13 Autodesk Reference Manager Report

- Submit a Reference Manager report of all drawing files for each milestone. The report is run with the “all xrefs automatically loaded regardless of nesting level” option. This report is a CSV file and must contain:
    - Host Drawing
    - Type
    - Status
    - File Name
    - Reference Name
    - Saved Path
    - Found Path

- Host Version

7.6.14 BIMc CAD Essential Requirements Checklist

- ST provides a BIMc Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

7.6.15 PDF Essential Requirements Checklist

- ST provides a PDF Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements

8. BIMf

This section describes Sound Transit's requirements related to:

- Building Information Modeling (BIM) (Facilities) deliverable data
- BIMf generated contract drawings
- Default settings of ST developed content used to create models and documents.

The project team must communicate and coordinate their efforts and ensure the requirements are consistently applied across all trades and disciplines.

The following requirements and workflows are based on the use of Autodesk Revit, and NavisWorks Manage.

8.1 Discipline/Trade Modeling Leads

When working on projects with multiple discipline BIMs, it is recommended that the team assign discipline/trade BIM Leads within their discipline or trade (architectural, structural, mechanical, fire protection, etc.).

The Discipline/Trade BIM Lead can help ensure:

- Coordination of all technical discipline and trade specific BIM activity with the BIM manager
- Coordinate BIM efforts within their discipline
- Consistent modeling application and execution within their trade or discipline

8.2 General BIMf Modeling

Below are the modeling guidelines that assist the intended BIM uses within ST.

- Name levels and use them to define major horizontal datum planes intended as plans.
- Name model groups used on the project to identify the collection or group's intent.
- Do not include any datum objects (levels and grids) in your groups.
- Avoid attached relationships in groups.
- Resolve all Revit warnings affecting accurate quantification processes, or room boundary identification.
- Do not use model lines as a replacement for modeling elements.
- Separate walls and columns per level. Attach top of wall/column to bottom of slab/floor above. Attach base of wall to top of slab/floor at base.
- Bind all spaces by walls and floors.
- Include a name and room number for every space, including shafts and stairs.

Define all mechanical spaces floor to floor unless there is a plenum. If a plenum is present, include the extents of the plenum in the definition of a mechanical space.

8.3 BIMf Requirements

The BIM manager must lead design and construction teams and sub-contractors to utilize Building Information Modeling (BIM) platforms (or trade specific software upon approval by Sound Transit) in design and construction processes. This includes creating all objects, geometries, physical characteristics, data, and annotations and drafted contents necessary to produce complete sets of IFB/IFC and Final As-Built BIMf models and drawings to ST Design Technology Requirements.

BIMf models must include all components within the footprint and immediate vicinity of 5-feet of the facility. If the building services and systems have minor extensions sites, or actual connection points that are placed outside the footprint and immediate vicinity of 5-feet, these extensions are modeled in BIM.

The BIMf model content is a minimum 300 Level of development model as defined by the 2021 LOD specification developed by BIMForum.

BIMForum LOD 300 interpretation: The quantity, size, shape, location, and orientation of the element as designed are measured directly from the model without referring to non-modeled information such as notes or dimension callouts. The project origin is defined, and element is located accurately with respect to project origin.

Additionally, all conduit 1-1/2" and smaller are shown if connecting to equipment (Listed in the Equipment Matrix). Identify size and routing and the interface between these pieces of equipment as they connect to power or signal conduit. Model individual conduits and block out cross sectional area and continuous pathways through facilities to account for cumulative area of chases required.

From Final Design through As-Builts after construction, the uses and goals for the BIM models include the following:

- Visualizations and Renderings
- Design/Constructability Reviews
- 3D Coordination/Clash Detection
- Construction documents
- Quantity Take Off
- Export of family and component information
- Record Final As-Built Conditions

8.4 BIMf LOD Matrix

Sound Transit uses the definition of LODs (version 2021) developed by BIM Forum (www.bimforum.org/lod).

8.5 Model and Project Datum

All BIMs must share a common project datum consistent with the project location data or assigned monument defined by the project survey data.

The BIMf manager must determine the location and synchronization method for the project and record the team's approach in the BIMf PXP.

All discipline model leads must ensure the method is consistently applied and coordinated between all discipline members.

The BIMf project datum must provide consistent and accurate:

- Data exchange, seamlessly between disciplines using BIM workflows.
- Location of all models when linked via shared project coordinates.
- Location of all plan xrefs when linked via shared project coordinates.
- Location of plan views exported for use in CAD applications or xref creation.
- Accurate sun study modeling, according to the actual geolocation of the project.

All BIM files delivered to ST must have full functionality and oriented accurately without any relinking/re-positioning regardless of its previous version or format.

When files are re-linked, ST must not have to do any relinking/re-positioning based on discrepancies between CAD file formats, and true or project north *(verify exact wording from Revit) formats.

8.6 BIMf File Management

8.6.1 Project Resources

ST provides Revit templates for use on projects with preloaded system and loadable families.

Contact the project's Design Technology Coordinator for the most current resources available.

The project's BIMf manager must develop and maintain a library of resources consistently applied by the project team.

8.6.2 Consultant EDMS

Define the locations, document in the project's BIMf PXP and submit to ST along with all resources.

8.6.2.1 Central vs. Local Files

Only submit ***Synchronized Central*** Revit project files to ST.

Before submitting central files to ST:

- Purge and compress.
- Relinquish ownership of all worksets and model components.

Refer to your project's BIM PXP for specific project protocols regarding shared and local file workflow and synchronization.

8.6.3 Work Sharing and Workset Creation

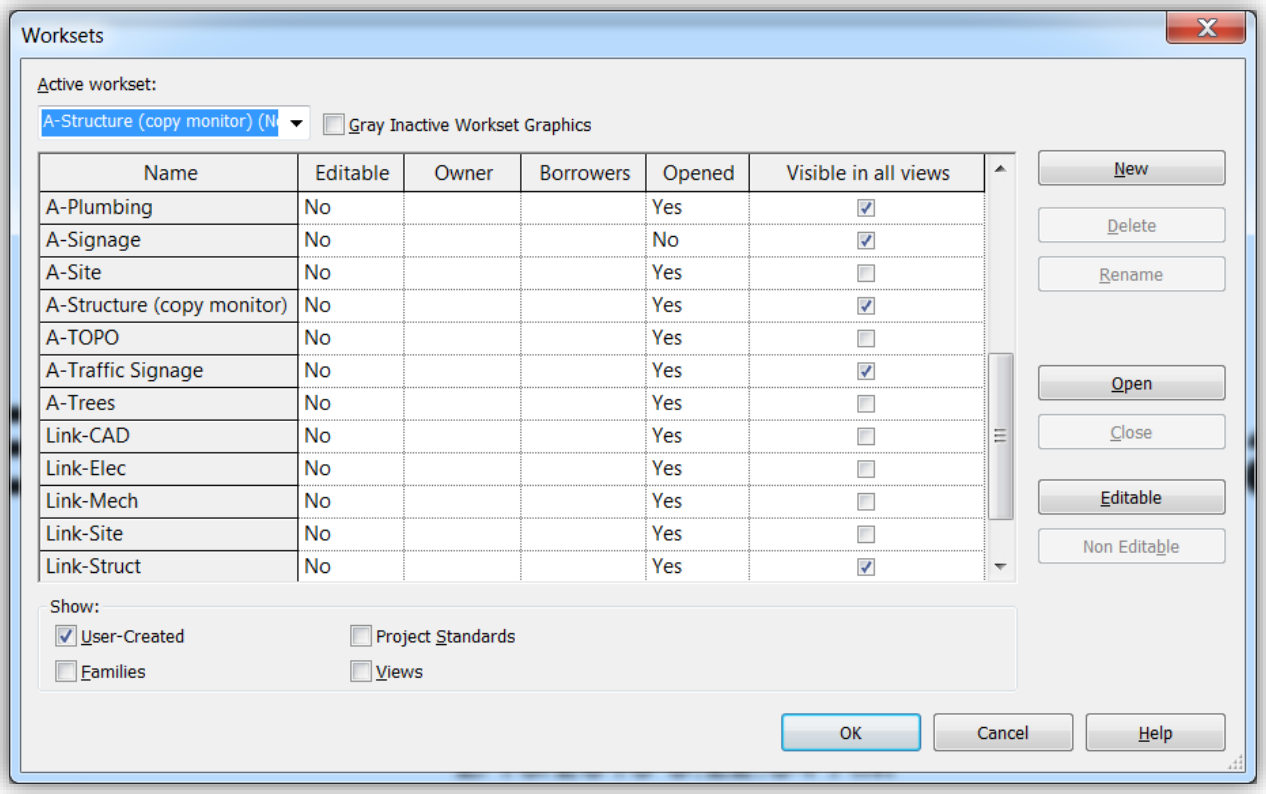
Work sharing allows multiple members to work on the project model at the same time.

To accommodate work sharing, the BIM manager must:

- Define all work sharing practices and record in the BIM PXP.
- Execute all work sharing consistently among the project team.
- Name worksets in the Revit models to clearly describe the objects within the workset, or the specific use of the workset. For example, "Link-CAD", or "A-Curtain Wall"
- List all workset names and a description of their content in the project's BIM PXP.
- Do not use non-descript workset names such as, workset 1, or username reference.
- Assign separate worksets to linked models, defining the discipline and components within them. For example: arch facade, arch station sculptures, etc.
- Name the workset the same as the model if the linked model is a specific discipline or trade model.
- Unload all unused links prior to upload or submittal.

- For assigned independent worksets to linked models used as a reference:
- Name per the discipline or component.
- Set the default value to non-visible.

Acceptable Workset Naming



8.6.4 Linking, Importing, or Exporting Drawings and Models

8.6.4.1 Linking and importing external files

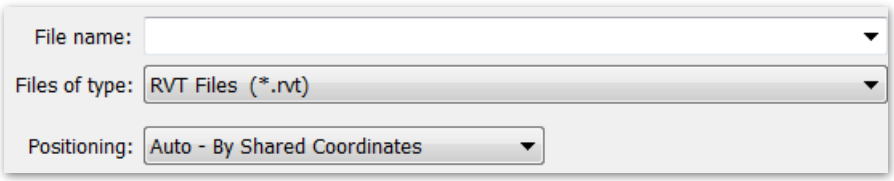
DO NOT import CAD/BIMc, PDF, raster, etc. files into the Revit models without ST approval.

Submit approval request via deviation form.

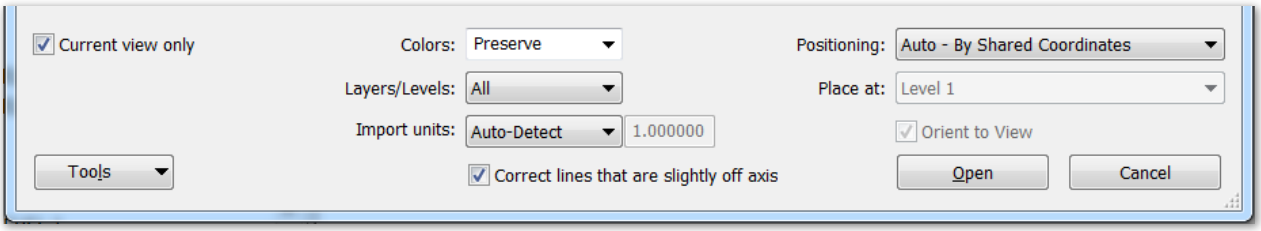
When you LINK a file:

- Assign linked drawing files to a specific workset.
- When linking models, use – By shared coordinates.

Positioning Example (Linking Models)



Positioning Example (Linking Drawings)



8.6.4.2 Export Settings from Revit to AutoCAD

Use as referenced backgrounds.

Make all exported plans or sections available to other disciplines for use as xrefs.

The project CAD and BIM managers determine the appropriate settings for the xrefs exported from Revit and record them in the BIM PXP.

The exports must meet the following criteria:

- In .dwg format
- Objects on separate object layers
- Object layer mapping and naming is consistent with project requirements
- Fonts, linetypes, and hatches can be matched via AutoCAD's "match" command
- Correct project datum location

8.6.4.3 Converting Models to BIMc and CAD files

Some team members may need Revit views exported to CAD and BIMc for use as a reference during the project.

All exported views must adhere the following:

- Translated into the approved CAD software.
- Conforms to all the established and approved requirements for the project.
- Fully functional by ST with the approved BIMc and CAD authoring software.

8.6.5 File Maintenance

Perform a ***PURGE UNUSED*** and ***COMPRESS*** before submitting the central model file(s) to Sound Transit.

Record all file maintenance procedures in the project's BIM PXP.

8.6.6 Archiving

Consultants are responsible for archiving the project data at each milestone deliverable and maintaining until project completion.

8.6.7 Project Templates and Related Settings

Sound Transit provides non discipline specific project templates that are based on presentation needs to match the requirements outlined in this document.

Use the template as a starting point for browser organization and basic ST Presentation requirements.

Add content needed to develop the models and documents based on project scope or requirements, then coordinate with the project's BIM manager and document in the BIM PXP.

The sections below outline general settings and content within ST project templates.

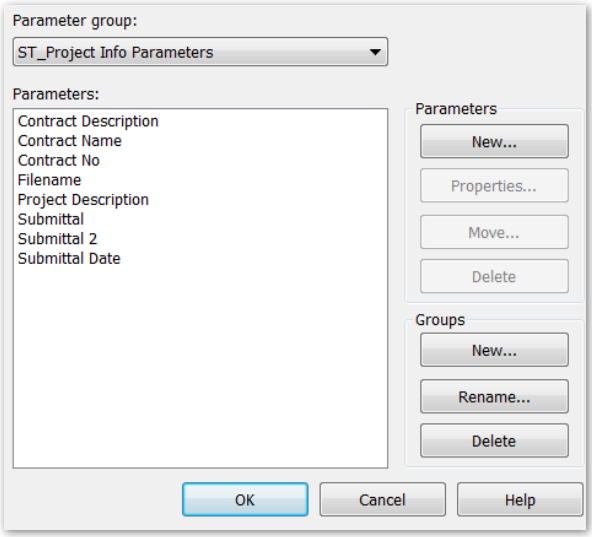
8.6.7.1 Project information and Shared Parameters

ST provides a shared parameters file for the project that contains default parameters aligned with ST requirements.

Coordinate any addition of shared parameters during the project's life cycle with the BIM manager.

The BIM manager must acquire approval from ST and record in the BIM PXP.

Refer to the project's shared parameter file for the complete project category and parameter list.



ST Shared parameter file – Project information group

8.6.8 Grid Control

Develop and maintain an architectural or structural grid, in lieu of alignment stationing and offsets, to establish and control the design layout of building elements.

For example:

Station structures

Parking garages

Maintenance facilities

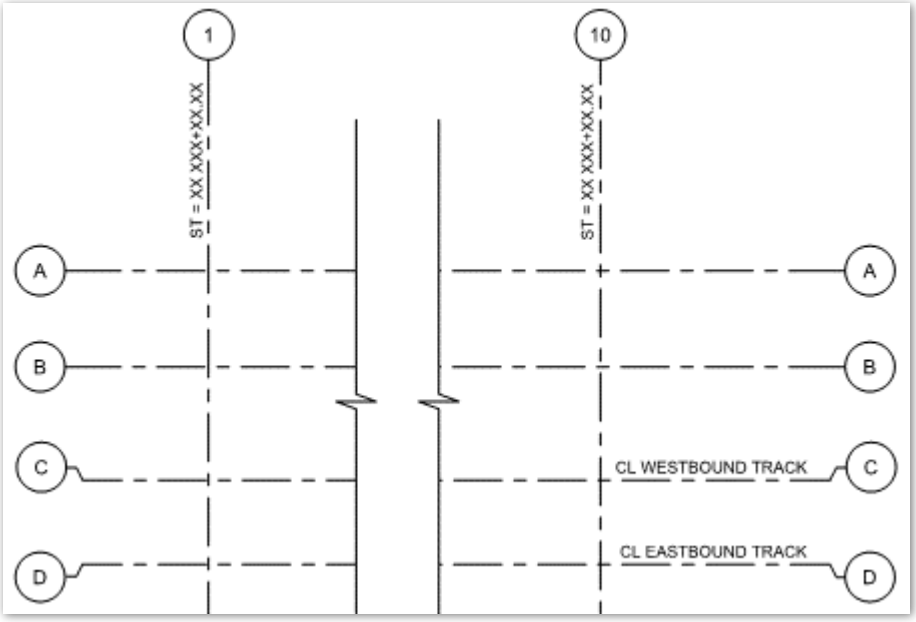
Other ancillary structures

At a minimum:

Tie two of the grid lines into the alignment geometry at two alignment points

Label by station and offset

- Tie one grid line to the centerline of track unless no alignment geometry exists within the project limits.

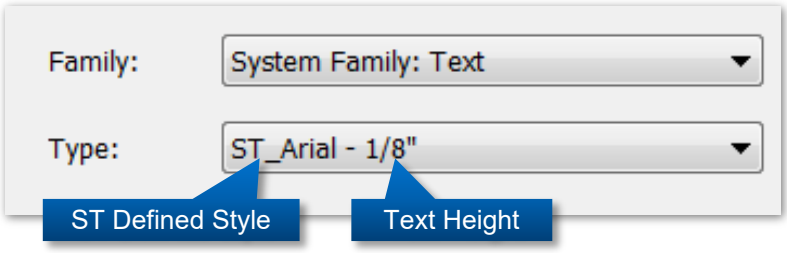


8.6.9 Annotation styles (Text, Dimensions)

Default text and dimension styles are provided in the ST templates.

Refer to section *6.11* for general annotation requirements and examples.

Annotation Style Naming



Dimension Style Naming

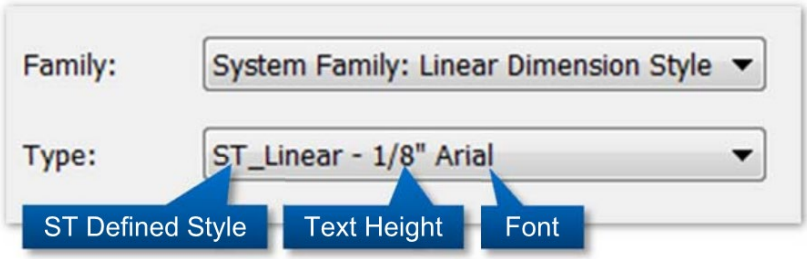
8.6.10 Annotation Tags

Annotation tags are used in the project to populate schedule data.

Create new tags following the naming conventions in section *5*.

8.6.11 Line styles and Object styles

Refer to your project template for current line and object styles.



The object styles provided in the template are used as a starting point.

The consultant may edit or add line and object styles to meet the project needs.

Use view templates and project settings to apply styles within the model.

Avoid visual style overrides specific only to a particular view.

8.6.12 Filled Regions

Refer to your project template for current drafting and model filled region settings.

Name all patterns added to the template to identify their material, area, or object.

New patterns must also function as intended with the “modify/match type” command.

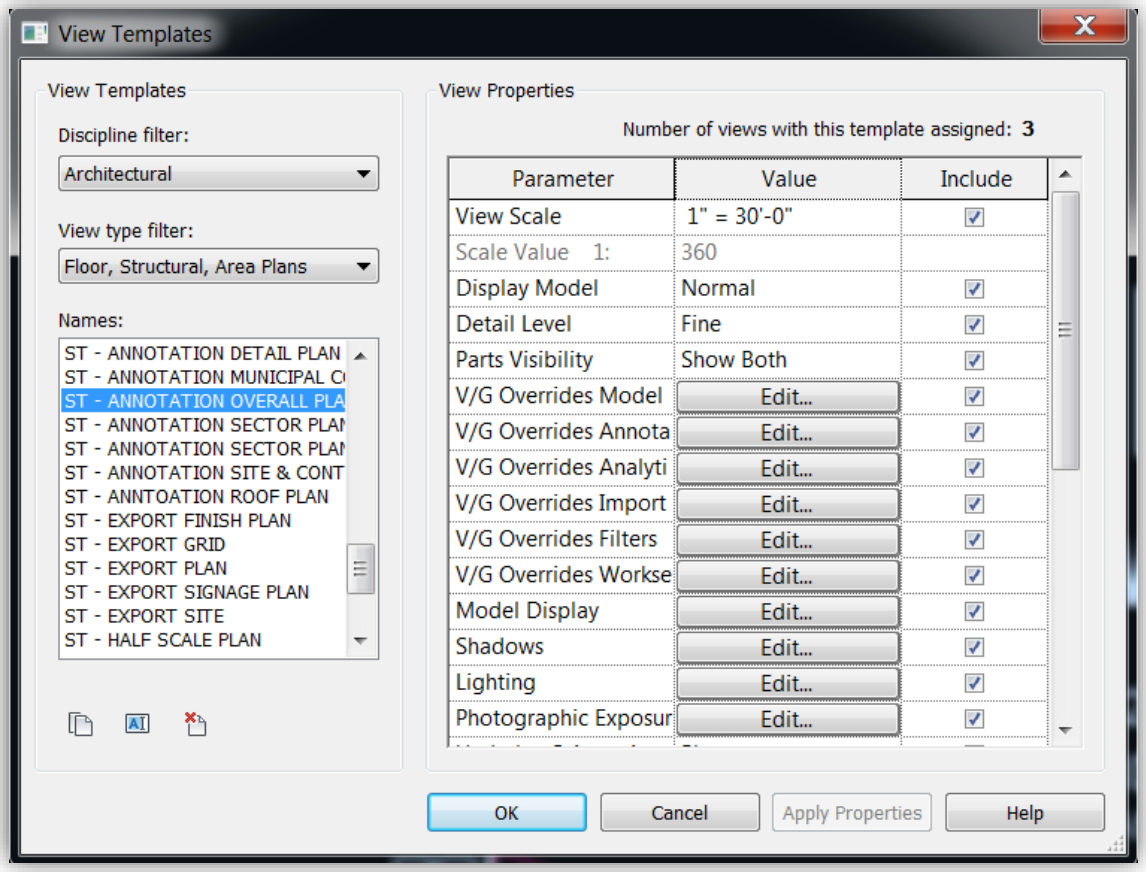
8.6.13 View Templates

Refer to your project template for current Sound Transit View templates.

The view templates provided are used as a starting point.

The consultant may edit or add view templates to meet project needs.

View Template Example



8.6.14 Schedules

Refer to your project template for current Sound Transit schedule view templates.

The schedule view templates provided are used as a starting point.

The consultant may edit or add schedule view templates to meet project needs.

Clearly identify any added schedule view templates and match the naming convention of the other view templates.

8.6.15 Families

The sections below describe Sound Transit's system families, system and project settings, loadable and in-place families.

8.6.15.1 System Families, System and Project Settings

System families create basic elements that you would assemble on a construction site. For example, walls, roofs, floors, ducts, and pipes.

They are predefined in Revit.

Do not load them into your projects from external files

Do not save them in locations external to the project.

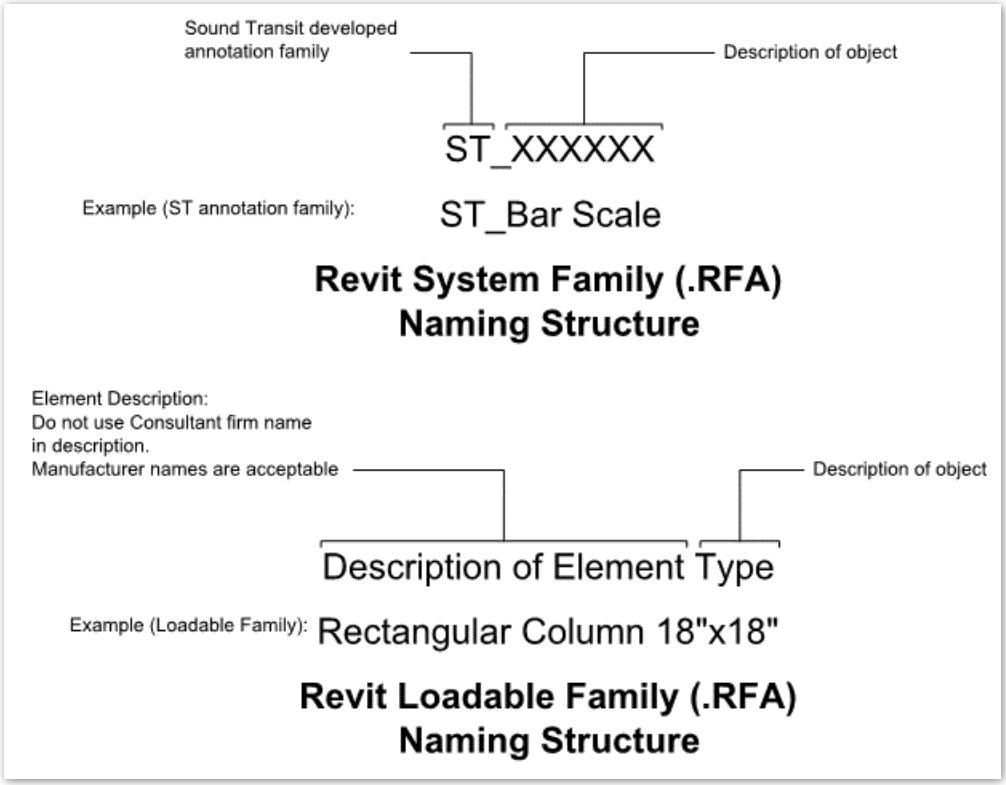
The ST project templates contain generic system families.

During the project, new system family types are created for the specific design of the building or system.

Follow the naming system shown in the examples below for new families.

Family Naming Convention

8.6.15.2 System and Project Settings



System and project settings associated with project environment elements are set in the ST Revit project template.

For example:

- Levels
- Grids
- Drawings
- Viewports

Refer to your project template for the latest settings.

8.6.15.3 Loadable Families

Create and use type catalogs for loadable families that contain many types.

ST BIM Families are provided at the beginning of the project when BIM is used.

NEW Loadable Family Types that are created for the specific design of the building or system. Use the naming system in this manual.

Maintain new families created by the project team in a local project resource folder.

8.6.15.4 In-Place Families

Unique elements are created when a unique component that is specific to the current project is needed.

When approved, create in-place geometry so that it references other project geometry. Resize or adjust accordingly if the referenced geometry changes.

Do not use in-place modeling unless approved by the ST Design Technology Manager.

Approved in-place modeling must categorize the family in the appropriate discipline model category and named according to size, component configuration, or function, similar to loadable family.

8.7 BIMf Model Organization

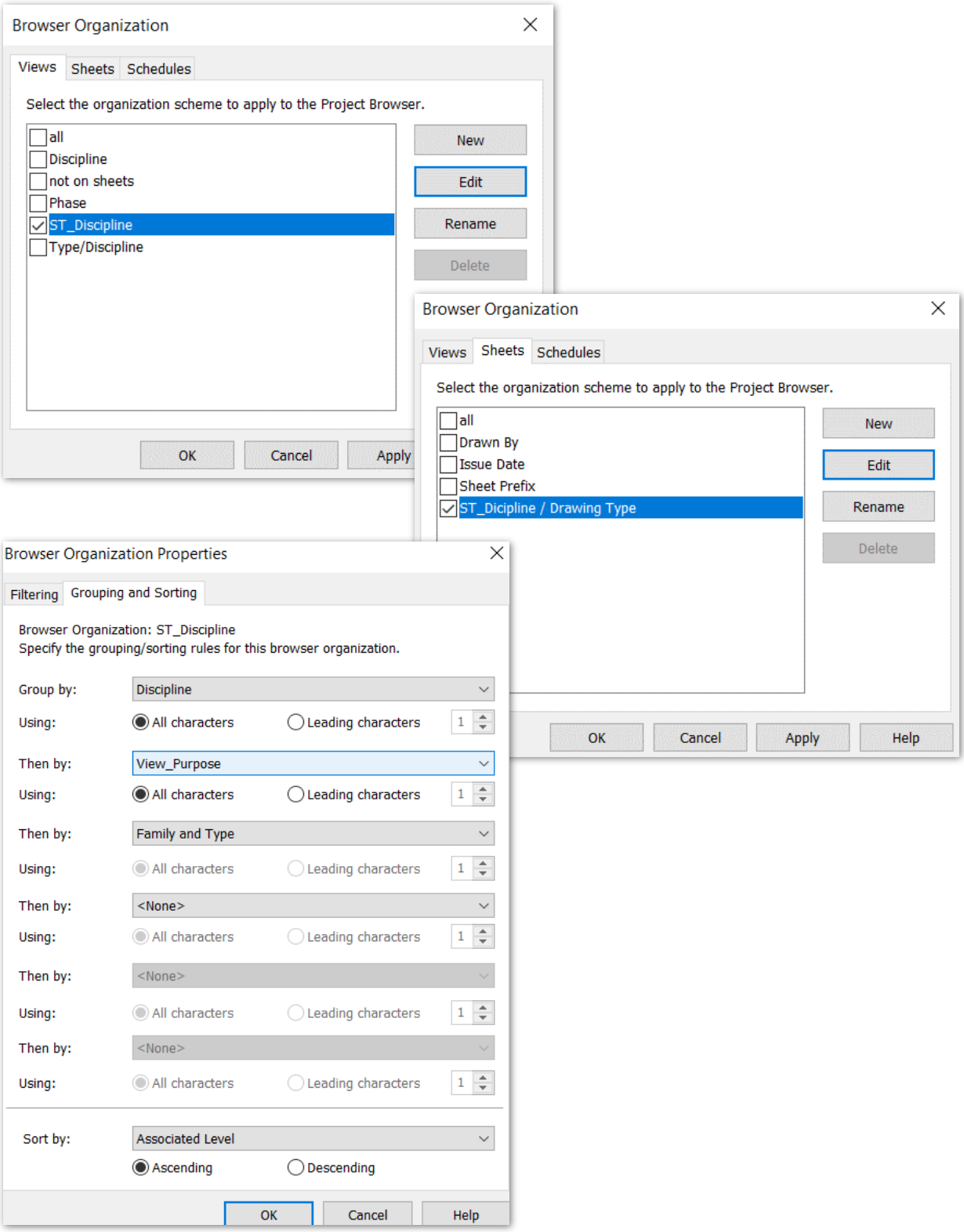
8.7.1 Project Browser

ST_Discipline is the default browser view type setting in the ST provided template.

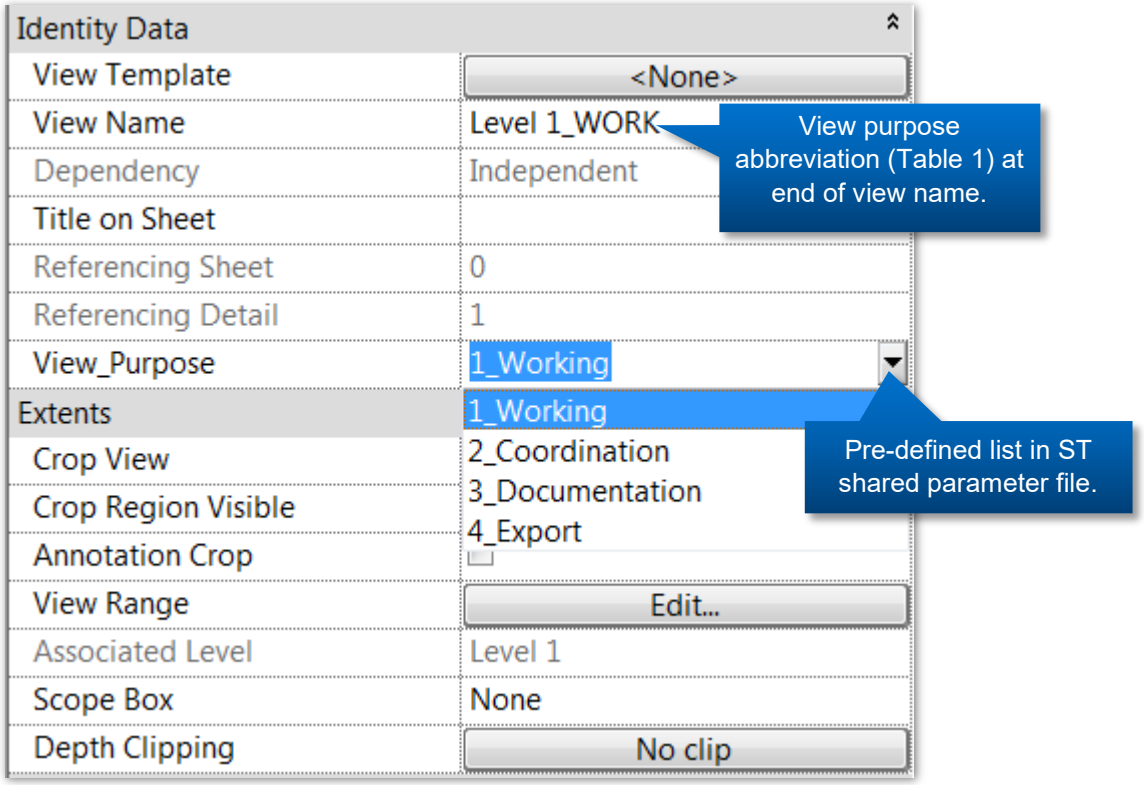
Group model views within the project, including legends and schedules, are based on the view's purpose within the project browser.

Manually associate views to their corresponding category by selecting the category name as shown below.

Browser Organization scheme settings for views and Drawings



View Purpose Parameter



Define view purpose as a project parameter and append the uppercase abbreviation to the end of the view names for user recognition of the views.

See the table below for a list of pre-defined view purposes available in the ST Revit templates and a brief description for each.

Pre-defined View Purposes

1_Working (WORK)	Working views, not placed on drawings
2_Coordination (CORD)	Coordination views not placed on drawings
3_Documentation (DOC)	Views placed on drawings and issued as drawings
4_Export (EXP)	Views set as export to .dwg, nwc, etc.

8.7.2 Drawing Views

Use drawing views to produce the drawings originating from Revit models.

Refer to the Plan Preparation in section ***14*** for content and layout requirements.

The ST Revit project templates are pre-loaded with the ST title block.

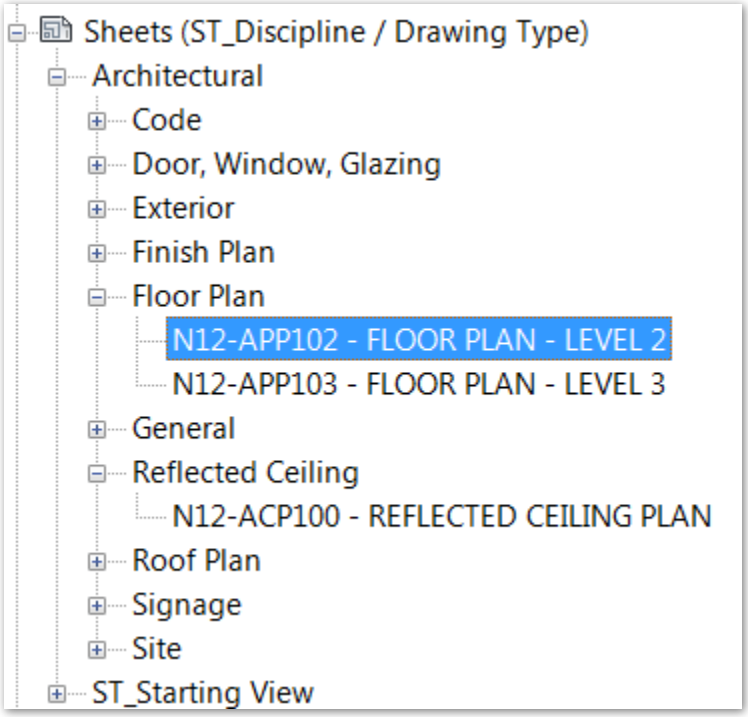
Organize drawing views in the Revit file by ST_discipline/drawing type.

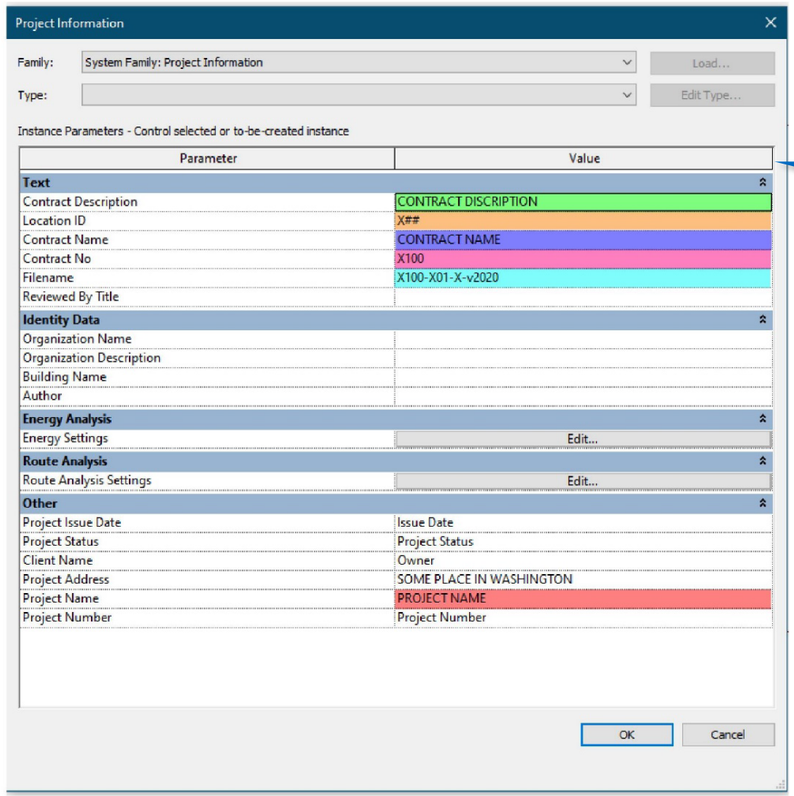
Refer to your project specific template for the current title block.

Populate all Revit title block information with project shared parameters and instance parameters.

See below for project shared parameters vs. instance parameters on the title block.

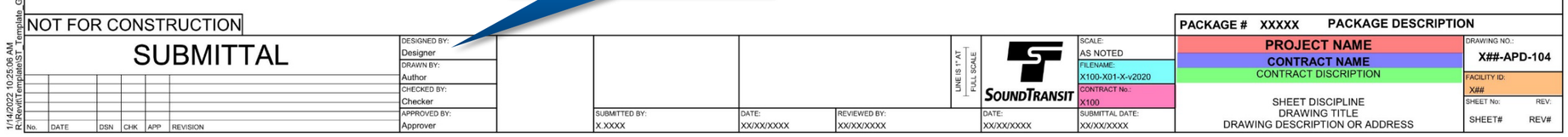
Drawing Organization Example

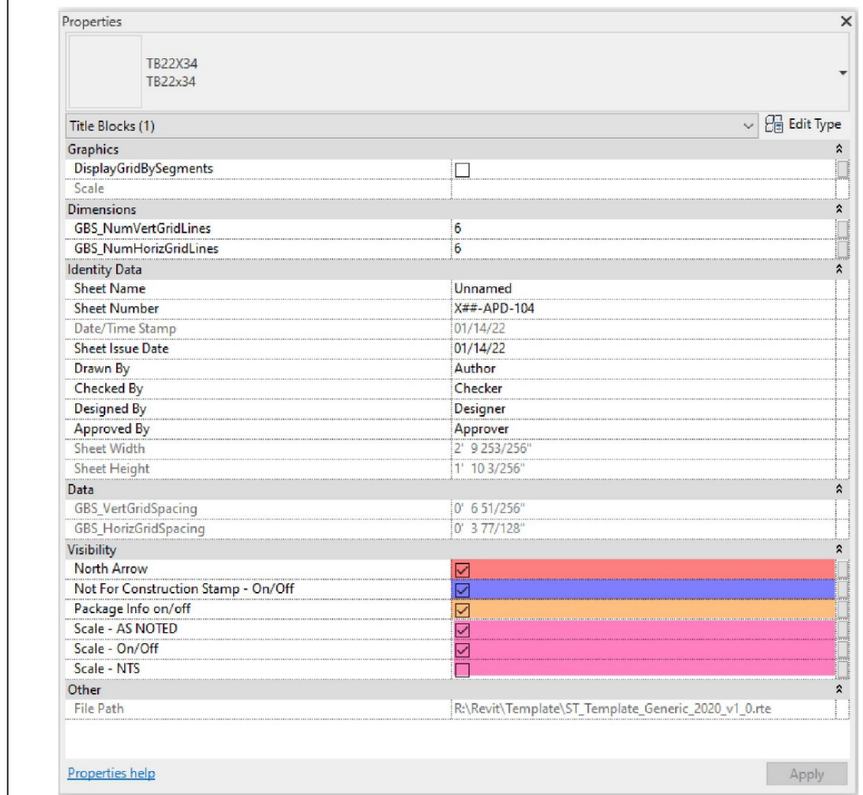


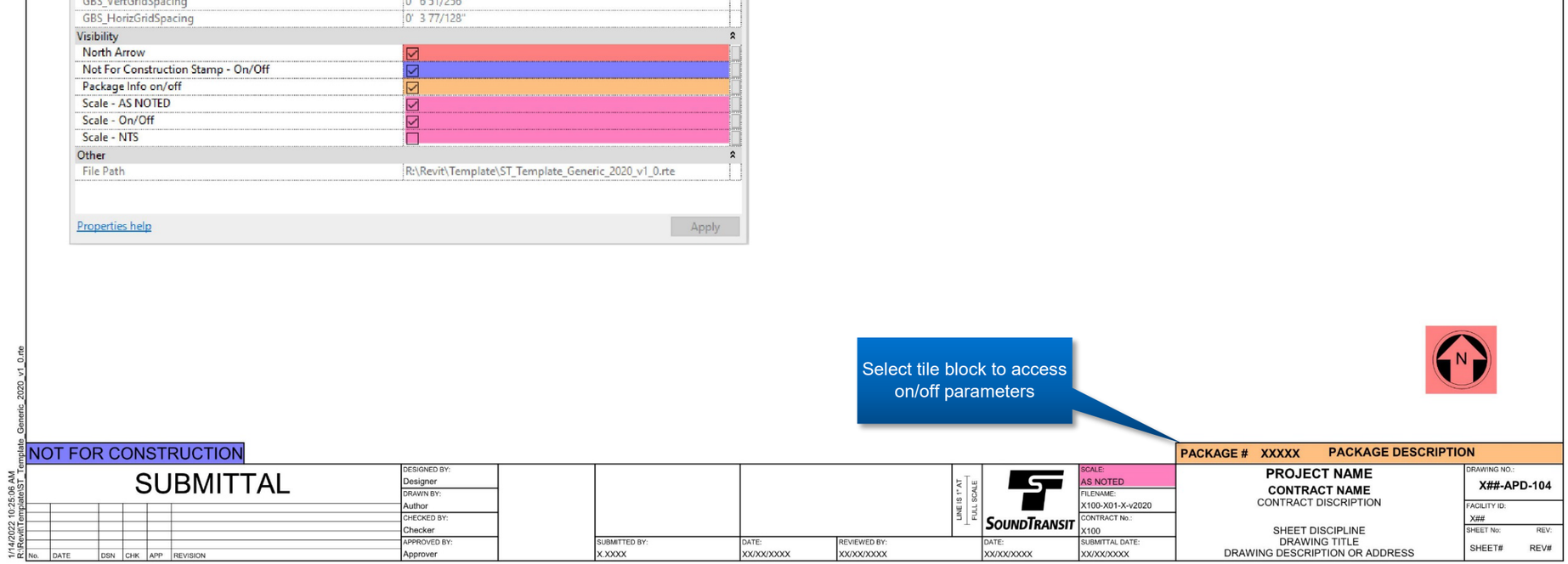


Title block Parameters
Color shaded boxed = Shared Parameters

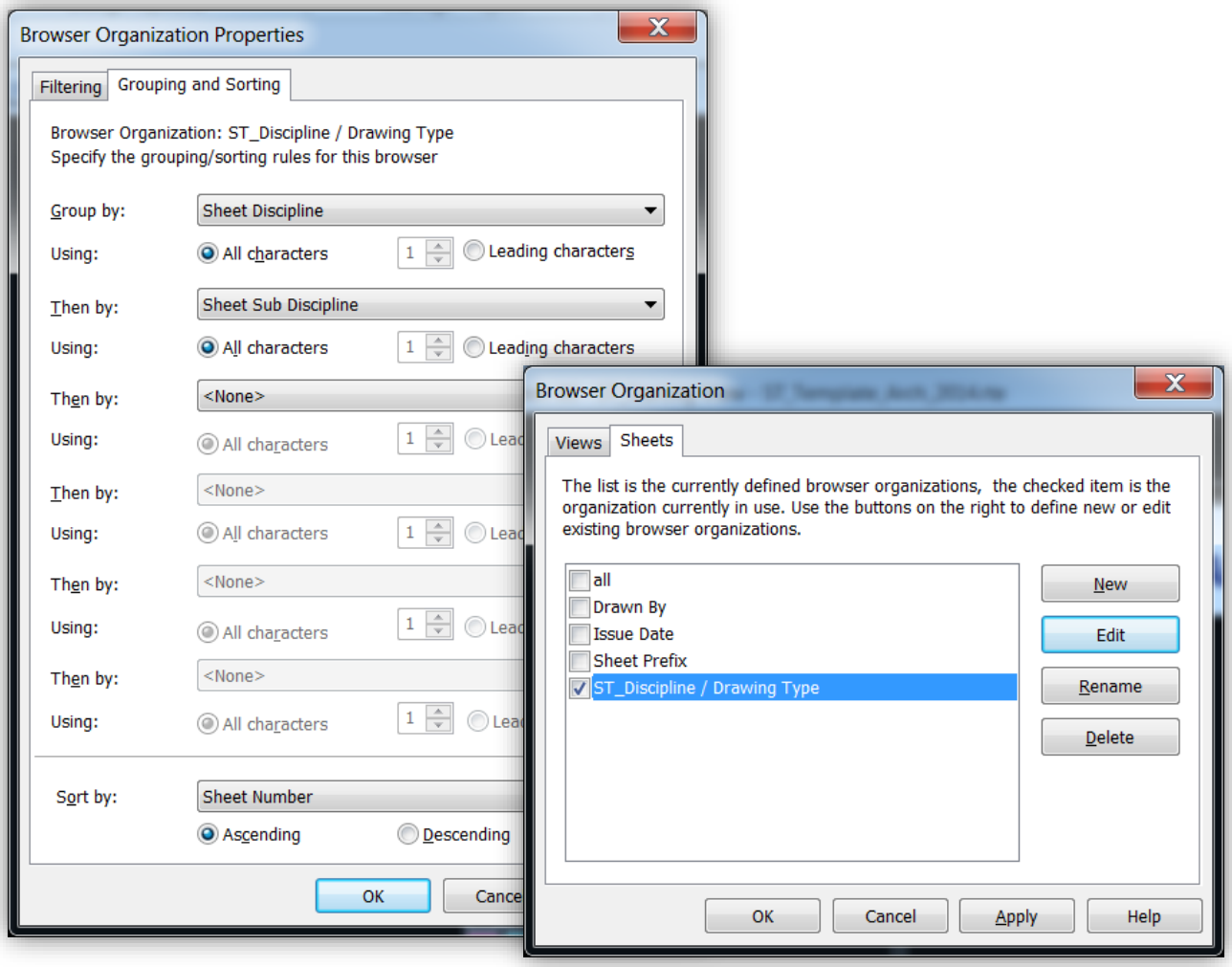
All other title block information is filled via instance parameters on the drawing .







Browser Organization – Drawings Tab Settings & Drawing Tab Grouping and Sorting



Settings

8.7.3 Starting View

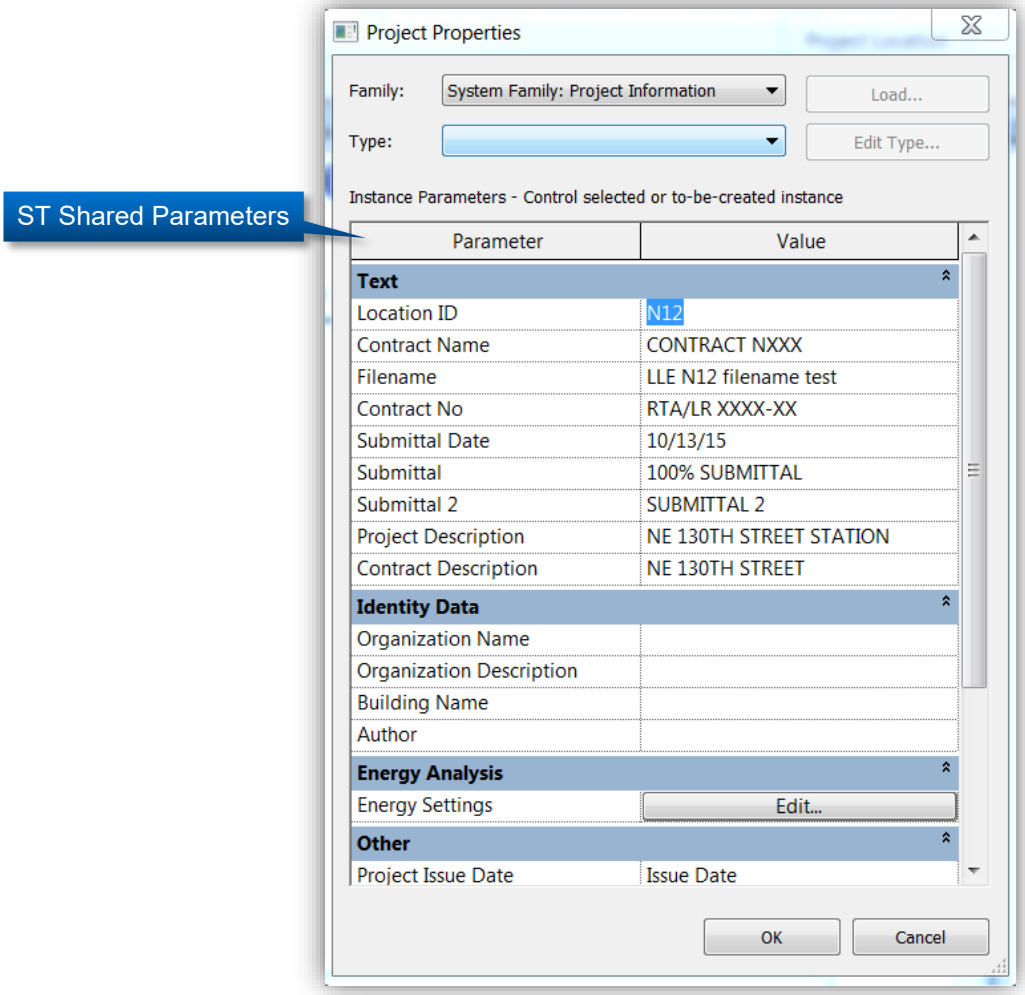
The starting view of the ST Revit template is set up to assist the user in filling out the project information and provides a place to add project specific notifications, messages, or production notes.

The Project Information section on the starting view is linked to the ST Project info parameters.

Input the information in the “Project Properties” dialogue box by accessing the manage tab.

All information that is entered must automatically populate the drawings.

Project Information



8.7.4 Phases

The use of phases vary depending on several factors unique to the project, such as existing structures or sequence of construction.

The phases set in the default ST project template are generic and used as a starting point.

Apply consistent phase organization between all discipline models.

Submit all proposed phases and their names to the ST Design Technology BIM Coordinator for approval prior to use if additional phases are needed in the Revit model.

Record all amended phasing in the BIM PXP.

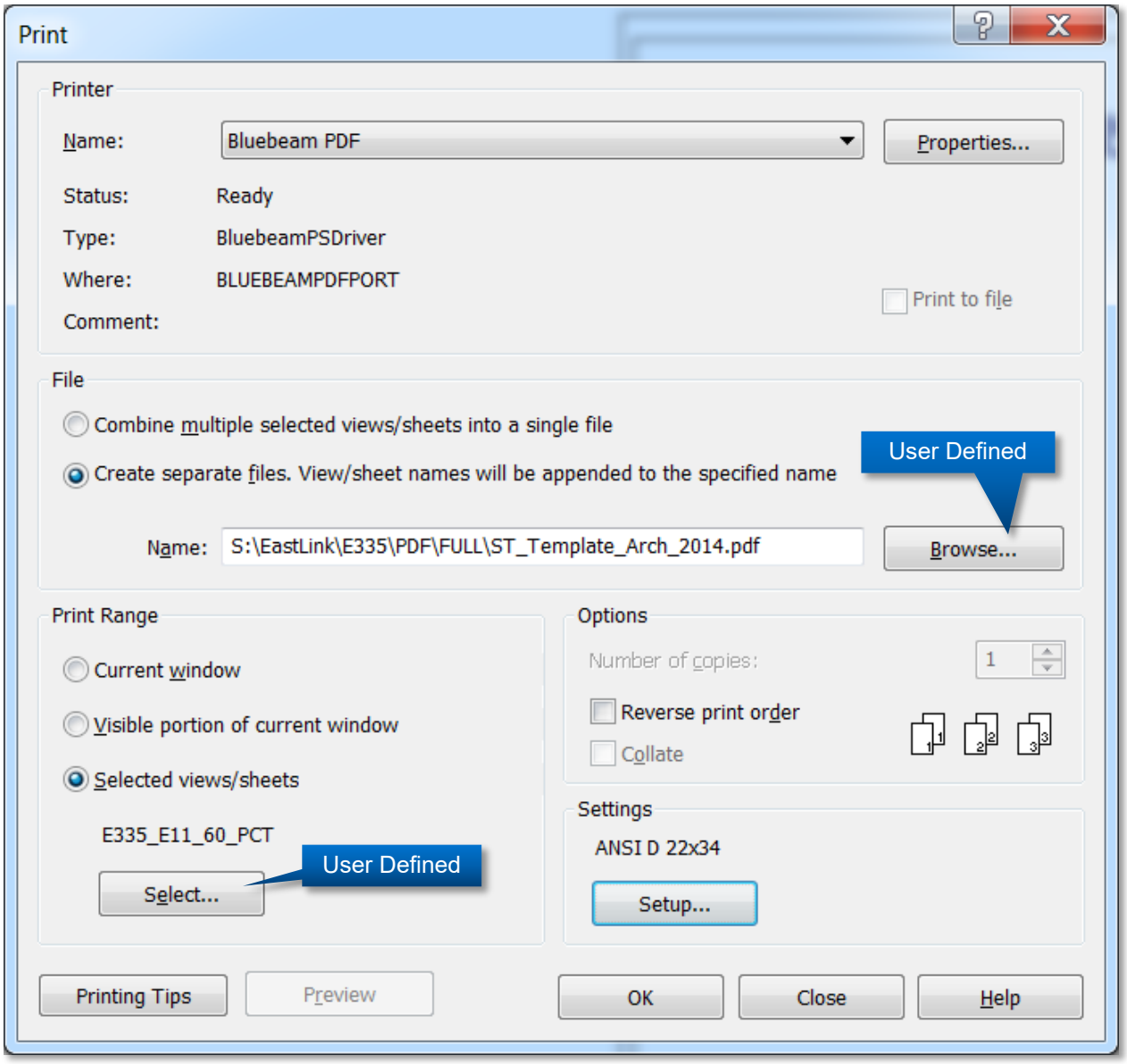
8.8 Printing

Ensure all delivered PDFs are Optical Character Recognition (OCR) ready.

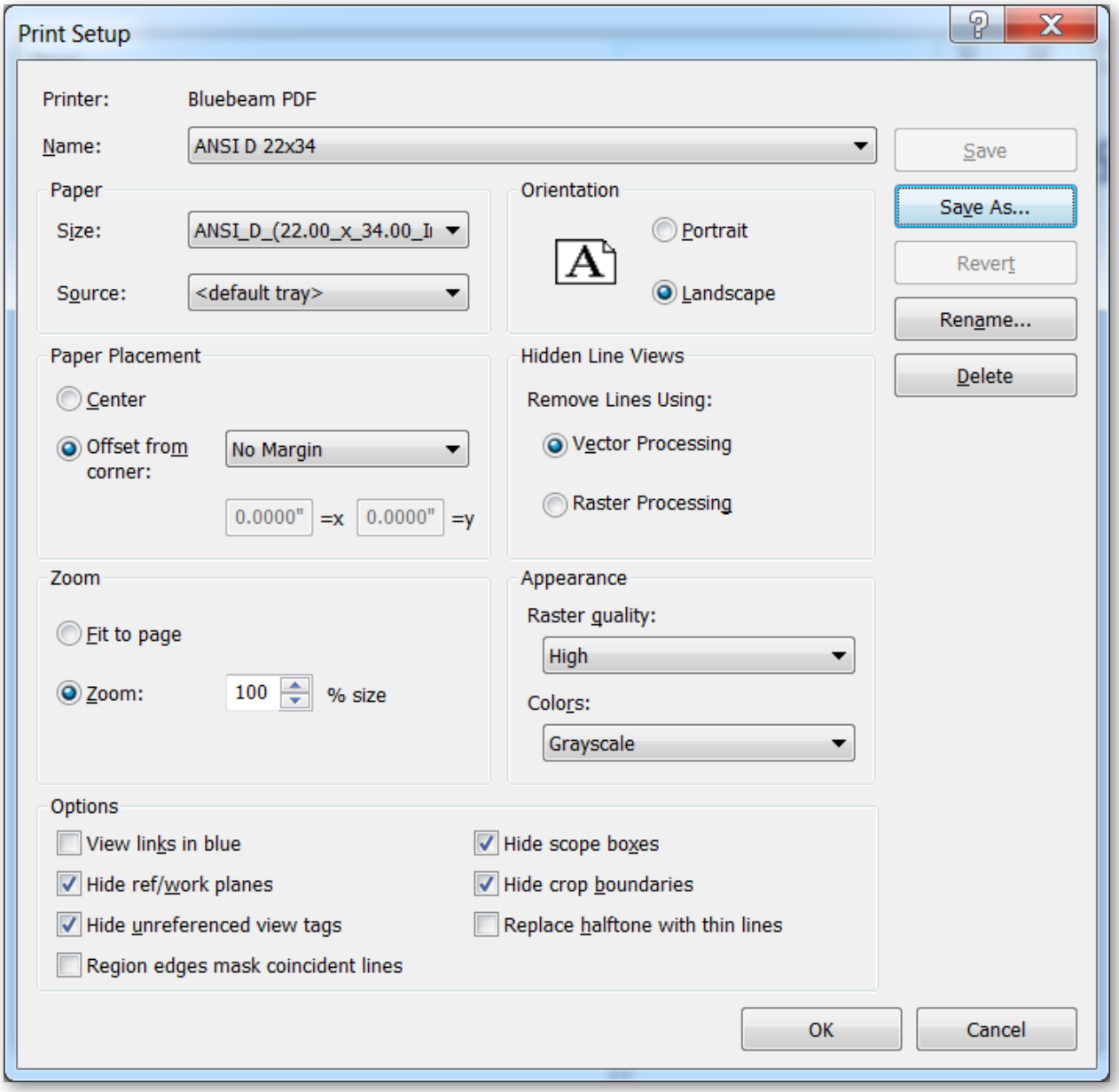
In the Bluebeam driver, select “True Type as TEXT” to produce OCR based PDFs.

Refer to the following examples for the default settings in the ST Revit template to produce hardcopy prints and PDFs.

PDF Settings – Full size.



Print (ANSI D) Settings – Full Size



8.9 BIMf Clash Detection

Clash detection is performed between all discipline models in the project.

Refer to your project's scope of work, or project requirements for contract specific deliverables.

8.9.1 Export of .nwc from Revit to Navisworks

In each Revit model, prepare a 3D view for the purpose of .nwc export, and place it in the "4_Export" category within the project browser.

The view must accomplish the following:

- Includes only the discipline, or specific items noted in the scope of work, to be clashed (consultant may apply filters to accomplish).
- Includes graphic LOD as defined in the BIMf PXP LOD Matrix.

8.9.2 Clash Detection Rules and workflow

The project's BIM manager and discipline/trade model leads must:

- Establish the clash detective rules and workflow.
- Gain approval from the ST Design Technology Manager.
- Document the approved clash detective rules in the BIM PXP.

The workflow must accomplish all clash detection criteria as defined in the project's requirements and as described in the Clash Detection deliverables.

8.10 BIMf Deliverables

8.10.1 Supporting Electronic Data

8.10.2 PDF Plan Set

- Plan set per section *4.3*

8.10.3 BIMf PxP

- Submit first version for approval no later than 30 days after Notice To Proceed (NTP).
- Submit all subsequent changes for approval 30 days prior to implementation. PXP templates are provided by Sound Transit.
- Record any approved deviations to the project scope of work, project requirements, Design Technology Manual requirements in the BIMf PXP.
- Submit all BIMf PXP updates to SharePoint and send a notification to the discipline/trade CAD Leads as well as the ST Design Technology Manager.
- **For the BIM PXP**, ST provides templates for the LOD & BIM Roles responsibility matrix. Both matrices are required sections of the BIMf PXP.

8.10.4 BIMf LOD Matrix

- Developed by Sound Transit the LOD Matrix template is used and modified in accord with project requirements.
- The LOD Matrix clarifies the LOD of model components at different project milestones. The forecasted LOD for each major milestone is reviewed and committed to by the project participants within 30 days of NTP for each submittal phase and submitted for approval by Sound Transit.
- All submittals and selected LODs for them must conform to minimum requirements outlined in Sound Transit Engineering Procedures Manual EP-03 matrix and additional modeling requirements listed in this task

8.10.5 PE Models

- The design models used to create the Preliminary Engineering drawing set. All models must have a minimum LOD of 200.

8.10.6 IFB/IFC Models

- The design models used to create the IFB/IFC drawing set. All IFB/IFC models must have minimum LOD of 300.

8.10.7 Record Model(s)

- The IFB/IFC models that produce the Record drawings are updated to reflect the as-built (final installation) condition and installed works once in-place All Record models must have a minimum LOD of 300.

8.10.8 Contractor/Sub-Contractor Record Model(s)

- The Contractor/Sub-contractor model(s) which reflects the final condition, it is submitted to Sound Transit. These Contractor/Sub-Contractor models is used for supplemental details to the Record model. All models must have a minimum LOD of 300. The models are submitted in their native format.
- The contractor must supply a Federated Model combining all Contractor/Sub-Contractor models via Navisworks .NWD format. All Contractor/Sub-Contractor models are shared with the project coordinates established in the IFC models.

8.10.9 BIMf Kick-off Meeting

- One BIMf meeting is held within 30 days of NTP. The BIM and CAD Managers coordinate the schedule, meeting agenda, and preparations of Kick-off meeting for BIM and CAD efforts with the Sound Transit Design Technology Manager and distribute it to attendees two days prior to meetings. Meeting minutes are recorded and submitted to the project folder no later than two business days after meeting.

8.10.10 Gap Analysis Meeting

- Gap Analysis Meetings will be scheduled and coordinated with ST Design Technology Manger and ST Systems Design Leads. The contractor will walk ST representatives through the design models showing locations and configuration all model elements listed in the equipment matrix. Contractor will Confirm model elements to be reviewed with ST Systems Design Leads prior to meeting.

8.10.11 BIMf Walkthrough

- The Consultant BIMf Lead to show the integrated model, walking through the environment narrating areas of interest. Answering questions from Sound Transit Engineering, Construction Management, Operations, and Maintenance to efficiently review and contribute to the design.
- Sound Transit comments received during the presentations are documented and resolved in writing and are incorporated prior to the next milestone submittal
- A single Consolidated model of all discipline models of the facility.
- All files used to create Model walkthrough.
- Presentation Comment log with resolutions.
- Scheduled prior to All milestone and final deliverables

8.10.12 Shared Parameter files

- All project shared parameter files.

8.10.13 BIMf Clash Detection Analysis

The Clash Detection Analysis includes the following:

- Summary of Clash Detection Analysis in PDF
- NavisWorks clashes detection models
- Clash Resolution Log:
  - Integrating solutions for each clash/issue into models and drawings prior to submittal.
- Regardless of conduit size the equipment (Listed in the Equipment Matrix) shows connections to BMS and power.
- Sound Transit is invited to attend all Clash Detection/3d coordination meetings. The frequency of meetings are recorded in the BIM PxP.

8.10.14 Gap Analysis Report

- The project team to submit a Gap-Analysis report for each MEP discipline. The gap analysis consists of strict correlation with, and accounting of, model features with PIIP products as shown in the block diagrams, schematics, and equipment lists. Format and content of report to be approved by ST Systems Engineering & Integration.

8.10.15 BIMf Essential Requirements Checklists

- ST provides a BIMf Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

8.10.16 PDF Essential Requirements Checklist

- ST provides a PDF Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements

9. JARPA Requirements

9.1 General

Joint Aquatic Resource Permit Application (JARPA) drawings are used to streamline the environmental permitting process.

Multiple regulatory agencies joined forces to create one application that people can use to apply for more than one permit at a time.

The drawings must accompany all JARPA permit forms submitted by Sound Transit.

The JARPA form are found at:
https://www.epermitting.wa.gov/site/alias__resourcecenter/9978/default.aspx.

All drawings must adhere to the ST Design Technology Requirements for the presentation.

Use the hatch patterns defined at the end of this section for permit elements.

Sound Transit can provide an AutoCAD drawing template and example drawings to help with the correct visual provide of the JARPA permit drawings.

Consultant to follow all requirements and checklists supplied by the US Army Corps of Engineers for drawing data requirements.

Use the Army Corp of Engineer's Drawing Checklist (on the next two pages) for items to appear on the JARPA permit drawings.

9.2 Army Corp of Engineers' Drawing Checklist

US Army Corps of Engineers
Seattle District

Drawing Checklist

The ultimate objective of a set of drawings is to allow someone who is unfamiliar with the project to quickly obtain a clear understanding of what is proposed and how the impacted waterbody and/or wetlands will be affected. Drawings should be originals and not reduced copies of large-scale plans. Engineering drawings are not required. Existing and proposed site conditions (manmade and landscape features) should be drawn to scale.

Page 1 should be a vicinity map, Page 2 should provide a top-down plan view, Page 3 should show a cross-sectional view; additional pages should be used if needed. Every drawing should have a Title Block. Additional information can be found on our website: http://www.nws.usace.army.mil/ (click on "Regulatory/Permits")

1. GENERAL GUIDELINES AND USEFUL INFORMATION TO INCLUDE ON DRAWINGS

( ) Use clear black lettering and the fewest number of pages necessary; use 8 ½- by 11-inch paper
( ) Even if drawings are created by hand please use a graphic scale
( ) Vertical and horizontal scales should use the same units of measure
( ) Vicinity maps and plan drawings must include an accurate North Arrow
( ) Descriptions/types of substrate can be included on drawings along with photographs
( ) Critical habitat and/or known essential fish habitat can be indicated on drawings along with surveys
( ) A drawing with the existing water features overlaid with the proposed project would be helpful

2. TITLE BLOCK EXAMPLES

( ) A completed title block (first example) should be on the first page; for subsequent sheets you can use the smaller abbreviated form (second example)

REFERENCE: *(USACE will provide)*	LOCATION: _____ *(address/intersection/ parcel number)*	PROPOSED PROJECT: *(short description)*
APPLICANT:	LAT/LONG: _____	IN: *(waterbody)*
ADJACENT PROPERTY OWNERS:		NEAR/AT: *(closest city or town)*
1. *(include name/parcel on plan view)*		COUNTY: *(county)*
2. *(include name/parcel on plan view)*	PAGE # OF # DATE: *(last revised)*	STATE: WA

Reference Number:
Applicant Name:
Proposed Project:
Location:
Sheet # of # Date:

3. VICINITY MAP

( ) Show and label location of each ***project area*** (e.g. circle the perimeter, use an arrow, etc.)
( ) Show and label location of each ***mitigation site***, if applicable
( ) List latitude, longitude, section, township, and range and parcel numbers – a parcel map can be helpful
( ) Show and label all waterways (e.g. ditches, wetlands, ponds, streams, rivers, lakes, inlets, oceans, etc.)
( ) Show roads, streets, and/or mileage to nearest town or city limits
( ) The map should be zoomed out enough to show the area but detailed enough to see landmarks for context

4. PLAN VIEWS

( ) ***Marine/tidal waters:*** Harbor Lines, Mean high water (MHW)/Mean higher high water (MHHW)
( ) ***Freshwater wetlands, bogs, fens, lakes, streams, etc:*** Ordinary high water (OHW)/Wetland boundaries
( ) Waters, including wetlands and other features extending across property boundaries
( ) Show dimensions of proposed and existing structures
( ) Indicate location, quantity, and type of fill and excavation (area and volume)
( ) Direction of currents, if known (e.g. tidal ebb, drift cells, creek flow, etc.)

5. ELEVATION AND/OR SECTION VIEWS

( ) Label shorelines with the MHW line, MHHW line, OHW line, and/or wetland boundary, as appropriate
( ) Show original and proposed elevations, water depths, dimensions of proposed structures or fills, and pertinent vertical dimensions to top and base of structure/fill; use the same vertical and horizontal scale

6. DRAWINGS INVOLVING DREDGING AND/OR THE DISPOSAL OF DREDGED MATERIAL

If proposing to discharge dredged material in one of the Dredged Material Management Program Disposal (DMMP) sites, another in-water disposal site, or as beach nourishment the information below should be submitted:

( ) Include pages with all applicable items in Sections 1-5 of this document
( ) In-water disposal site name (if applicable) with coordinates and boundaries *(see Note)*
( ) Upland/beach "beneficial use" disposal site coordinates and boundaries
( ) If using an in-water disposal site specify the type (non-dispersive or dispersive)
( ) Identify the barge positioning method (either the U.S. Coast Guard Vessel Traffic Service and/or a differential GPS used in conjunction with the National Dredging Quality Management Program automated monitoring system)

Note: The Dredged Material Management Office has printable maps of open-water disposal sites in Washington State. For maps and dredging project assistance go to the Seattle District website: http://www.nws.usace.army.mil/index.cfm

6. MITIGATION AND/OR PLANTING PLAN DRAWINGS

( ) Include pages with all applicable items in Sections 1-5 of this document
( ) Reference the title and date of the approved mitigation/planting plan *(See Note)*
( ) Planting areas with key identifying specific species and plant spacing
( ) Buffer areas and staging or construction access areas
( ) Amounts and locations of temporary fill or excavation work (area and volume)
( ) Structures, piers, piling, over-water floats, etc. to be removed for the purpose of mitigation

Note: See also 33 CFR Part 332.4(c) regarding the contents of a mitigation plan

8. DRAWINGS FOR AQUACULTURE PROJECTS

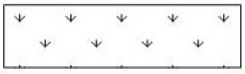
( ) Include pages with all applicable items in Sections 1-5 of this document
( ) Include the county parcel numbers; a parcel map is helpful
( ) Show and label the current project area including fallow areas *(see Note)*
( ) Show and label areas proposed for expansion or new aquaculture activities
( ) Specify species, methodologies using a key (e.g, long-line Pacific oysters, tube culture of geoduck, etc.)
( ) Identify areas with canopy predator nets
( ) Identify the latitude and longitude for each corner of the project area
( ) Show and label areas with eelgrass, kelp, or mudflats

Note: For the purposes of Nationwide Permit 48, *Commercial Shellfish Aquaculture Activities*, the project area is the area in which the operator is currently authorized to conduct commercial shellfish aquaculture activities, as identified through a lease or permit issued by an appropriate state or local government agency, a treaty, or any other easement, lease, deed, or contract which establishes an enforceable property interest for the operator.

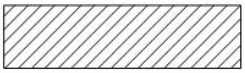
9.3 JARPA Hatch Patterns

The following patterns are used in the JARPA drawings to reflect noted elements.

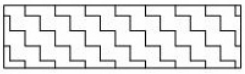
WETLAND



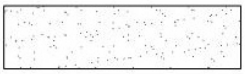
PERMANENT WETLAND IMPACT



INDIRECT WETLAND IMPACT

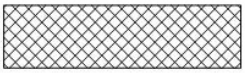


WETLAND VEGETATION CONVERSION



WETLAND TO STREAM CONVERSION

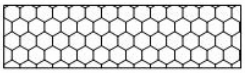
TEMPORARY WETLAND IMPACT (SHORT TERM)



TEMPORARY WETLAND IMPACT (LONG TERM)

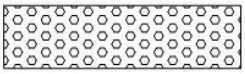
PERMANENT STREAM IMPACT

PERMANENT BED GRADING



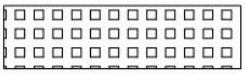
TEMPORARY BED GRADING

PERMANENT RIFFLE/POOL COMPLEX

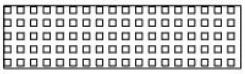


TEMPORARY RIFFLE/POOL COMPLEX

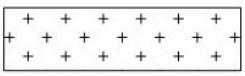
PERMANENT MUDFLAT IMPACT



TEMPORARY MUDFLAT IMPACT



PERMANENT STREAM BUFFER IMPACT



TEMPORARY STREAM BUFFER IMPACT

10. Title Blocks

ST provides BIM and CAD templates with pre-defined Title Blocks (TB) for use on contract drawings, exhibits and permits.

10.1 Title Blocks (Exhibits and Roll Plots)

Consultants may use the ST provided title block templates or provide their own.

Consultant provided title blocks must meet the following conditions:

- All elements and settings meet established requirements.
- Appearance matches the rest of the project drawing files (No firm specific looking TBs).
- At a minimum, include in the title block:
  - Project title or segment name
  - Location of drawing contents
  - Drawing scale
  - Contributing consultant or team name/logo
  - A plot stamp including the print date, file name/path and user

10.2 Title Blocks (Contract Drawings)

ST provides title block templates in AutoCAD/Civil 3D and Revit format.

Printable at full size (22”x34”) and half size (11”x17”).

Maintain title block:

- Embed them as an xref (not as a block).
- Insert into paper space at 0,0 and at FULL size (22”x34”).
- Maintain the fidelity of the title block as provided.
- Do not explode the title block or redefine layers or colors.
- Do not replace the title block or change its structure without ST approval.

10.3 Title Attributes Block

ST DST template file (ST STD SSM.dst) has 72 fields in the Attributed block.

Use for ALL AutoCAD and Civil 3D based drawings

One ST STD SSM.DST file PER discipline of drawings in the entire contracted document.

Embed as a BLOCK (not an xref).

DO NOT EXPLODE THE BLOCK, OR REDEFINE IN ANY WAY

Consultant may provide an alternate, automated, and repeatable method for approval. Maintainable and modifiable with Autodesk tools already owned by ST.

10.4 Title Block Information

The section outlines the content and purpose of each field in the title block.

10.4.1 Drawing Number

Drawing numbers to cross-reference other drawing files.

All drawing numbers are unique.

Refer to section *5* for drawing file naming convention.

10.4.2 Facility/Location ID

Includes all facilities/components shown in each drawing file.

For example:

- A drawing file of Shoreline Station = N15.
- A drawing file of the station and trackwork on both sides = N14/N15/N16.
- A drawing file that includes most or all a corridor segment = N01-N28.

See Sound Transit's 'Light Rail Equipment and Facilities Numbering Standards' manual for the facility IDs.

Leave the facility/location ID box empty until the appropriate value is defined by ST.

10.4.3 Sheet Number

Begin numbering with "1" on the Title Drawing and continue without interruption or duplication throughout the set.

PRIOR to IFB/IFC drawing numbering is done in PDF files. At each IFB/IFC and post IFB/IFC submittals, drawing numbering is done in the native cad/rvt files.

POST IFB/IFC Add "A, B, C, etc." to the new drawing number. Use a 2nd alpha character to insert additional new drawings between 2 previously added drawings. For example: 101A, 101AA, 101B.

ST may opt to renumber all the drawings to reset the package at their discretion.

Do not use number 00.

Do not use sheet numbers to cross-reference drawing files.

10.4.4 Revision Number

Reflects the latest revision of the drawing.

Always match to the current revision number in the revision information history.

10.4.5 Drawing Title Box

Project level information is defined by Sound Transit and includes:

- Project Name
- Contract Package Number
- Contract Description

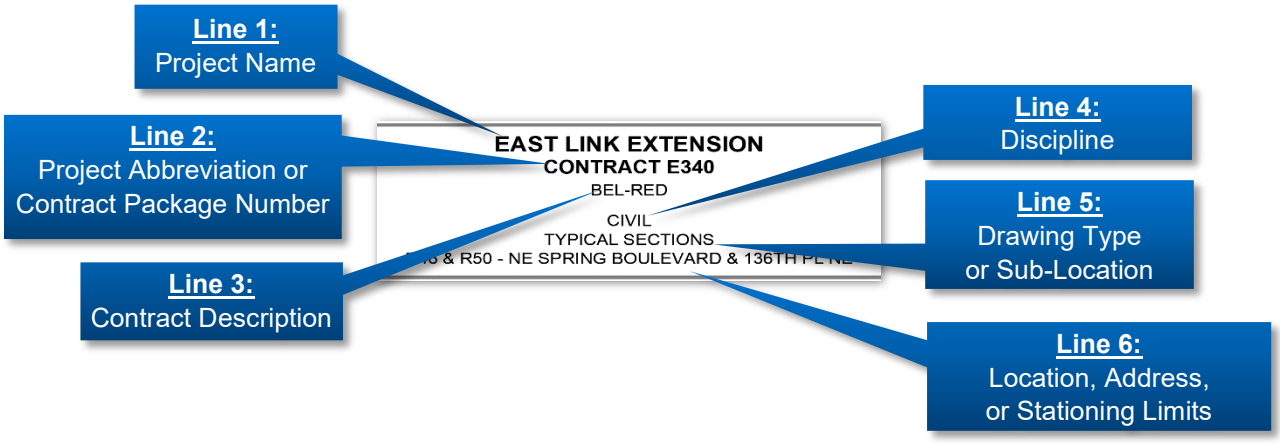
Drawing Level Information is defined by the consultant and includes:

- Discipline
- Drawing File Type
- Location, Address or Stationing Limits

Apply information available to all drawing files prior to the first submittal to ST. Update at each subsequent submittal.

Apply title structure consistently throughout the package.

Match the titles in these fields to titles in the drawing index and any references within other documents. This includes specifications and other contract drawing files.



10.4.6 Drawing Scale

Add one of the following:

- When all items are drawn at the same scale use specific scale (e.g. 1” = 100’, 1/4” = 1’-0”).
- When items are drawn at multiple scales use “AS NOTED”.
- When all items are drawn Not to scale use “NTS”.

10.4.7 File Name

Contains an automated field showing the CAD file name without the extension.

10.4.8 Contract Number

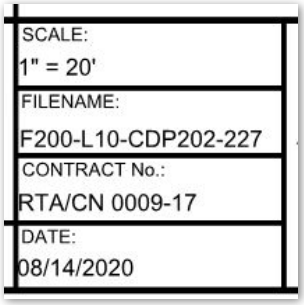
Keep field as “RTA/LR XXXX-XX” during the design phases.

Replace with the intended construction contract number when provided by ST, just prior to the IFB submittal.

10.4.9 Submittal Date

The date of the current submittal. This is a milestone submittal (30%, 60%, etc.), a change made during construction, or the Record Drawings submittal.

This is the date it was submitted, not the date it was printed.



10.4.10 ST and Consultant Logos

The ST logo and related text is provided in the ST title block file.

Insert all consultant logos with the following conditions:

- Into the package’s controlling title block file (not in each drawing file).
- Define and follow a consistent method of applying blocks and/or layers to control the logo’s appearance in the drawings.

10.4.11 ST and Consultant Manager Names and Dates

“Submitted By” = Primary design consultant’s project manager.

Design-Bid-Build, or General Engineering Contract = “Reviewed By” = ST SDM, PM or other as provided by ST.

Design-Build = “Reviewed By” = GC Project PM.

Both include dates for the submittal/review of the final submittal that is presented to the construction contractor at IFB or earlier at ST discretion. Dates do not change.

10.4.12 Professional Seal

Provide the professional seal for the drawing’s Engineer of Record is required at all submittals.

Seals to print clearly and legibly with ST color table file. (CTB).

Consultant to create and maintain seals for anyone signing a project drawing or specification.

10.4.13 Contributors

Shows the names of the four (4) key contributors to the drawing with first initial and last name.

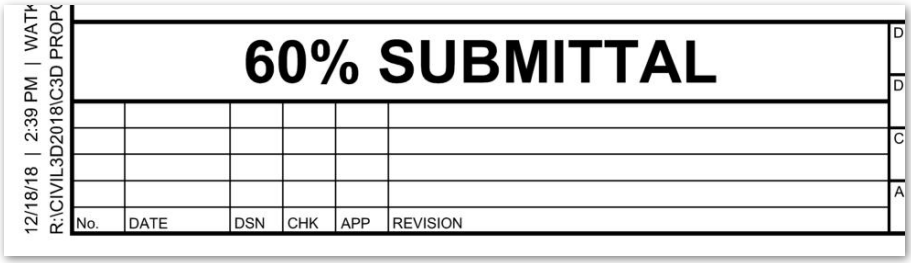
For example:

- DESIGNED BY: J. SMITH
- DRAWN BY: J. DOE
- CHECKED BY: J. ADAMS
- APPROVED BY: J. JONES

10.4.14 Revision Information History

Use the ST provided stamp provided in the title block template for the current milestone submittal on all contract drawings submitted to ST.

Refer to section 11 for more details about recording various revision types during design and construction.



10.4.15 AHJ and Package Name

DB Project to utilize these additional fields in the title block.

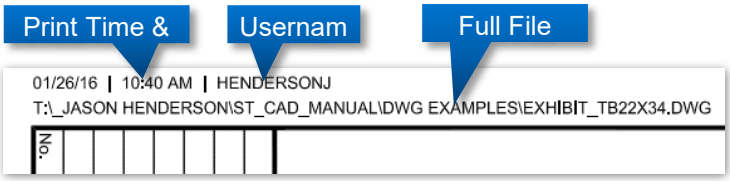
DBB projects to turn off the layers for these areas and NOT put any information into the attributed title block fields.

All AHJ are listed

Package Name, Number is listed, without acronyms

10.4.16 Plot Stamp

An automated plot stamp is provided in the lower/left corner of the ST title block.



11. Revisions

This chapter defines how to track and document changes to the drawings, models, and supporting electronic data.

11.1 General

11.1.1 Baseline

Baseline the drawings by resetting all revisions back to zero at the start of a new phase. For example, Issue for BID (IFB) and Issue for CONSTRUCTION (IFC).

Remove all previous revision clouds, symbols, and revision box information if present.

Add the bottom line in the Revision Block:

- Revision Number (No.) Column = 0
- Middle Columns (date, designer, checker, and approver).
- Revision Column = current submittal

11.1.2 First revision

Fill-in the revision block above the baseline information.

Label with the next sequential number/letter.

Draw a cloud around the revised item(s).

Place the diamond/triangle symbol and number/letter contacting each cloud.

11.1.3 Each Successive Revision

Remove all previous revision clouds and related symbols.

Add the latest revision information to the line above the previous revision.

Label latest revision with next consecutive number/letter available.

Fill-in the revision block above the baseline information.

Draw clouds around the revised item(s).

Place the diamond/triangle symbol and number/letter contacting each cloud.

11.2 Revisions per Submittal Type

11.2.1 Issued for Bid (IFB)

Baseline drawings per section ***11.1.1***.

11.2.2 IFB plus Addenda

Revise per sections ***11.1.2*** to***11.1.3***

Add a ***Diamond*** symbol and include the next available sequential ***Number.***

11.2.3 Issued for Construction (IFC)

Baseline drawings per section ***11.1.1***

11.2.4 Changes After IFC

Revise per sections ***11.1.2*** to***11.1.3***

Add a ***Triangle*** symbol and include the next available sequential ***Letter.***

11.3 Change Document Types & Examples

This section notes various change documents used with examples.

Refer to:

- PCPP- 08 Changer Orders/Notices
- PCPP-15 CM Process & all other change documents
- EP-05 – DSDC Process

11.3.1 Pre-Construction

Addendum (ADD)

Enter information into revision box per section ***11.4***

For example: ADD #001

11.3.2 During Construction

Change Notice Request for Proposal (CNRFP), Example: CNRFP #001

Change Notice Work Directive (CNWD), Example: CNWD #001

Change Order (CO), Example: CO #001

Field Clarification (FC), Example: FC #00001

Request for Information (RFI), Example: RFI #00001

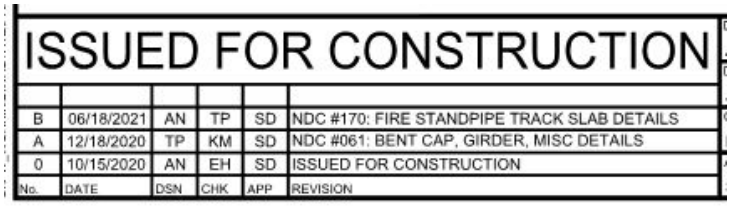
11.4 Revision Information Box

Record all changes to contract drawings in the revision block.

Include for each revision entry:

- Revision number
- Revision date
- Designer – drafter – approver
- Summary of changes

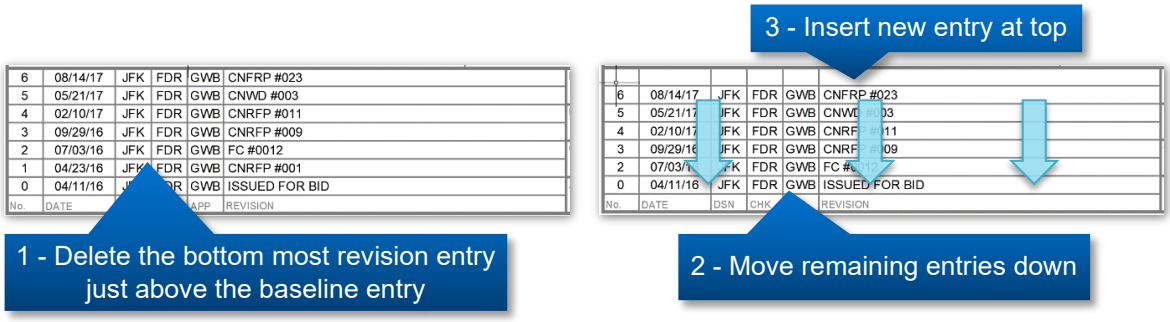
Add revision entries from the bottom-up, starting with the baseline entry, labeling each with sequential numbers.



ISSUED FOR CONSTRUCTION					
B	06/18/2021	AN	TP	SD	NDC #170: FIRE STANDPIPE TRACK SLAB DETAILS
A	12/18/2020	TP	KM	SD	NDC #061: BENT CAP, GIRDER, MISC DETAILS
0	10/15/2020	AN	EH	SD	ISSUED FOR CONSTRUCTION
No.	DATE	DSN	CHK	APP	REVISION

If all lines are full:

- Leave baseline entry (IFB, IFC)
- Delete first revision entry (just above baseline entry)
- Move all others down
- Add latest entry in top line



11.5 Drawing Information Box

Match the ***Rev.*** (revision) field to the current revision number/letter in the revision block.

11.6 Revision Clouds

Add a cloud around the entire change in the drawings and include either a Diamond & Number or a Triangle & Letter with the shape toughing the cloud.

11.7 Revision Tags

11.7.1 Pre IFC

Add a Diamond with a Number for Addenda.

11.7.2 Post IFC

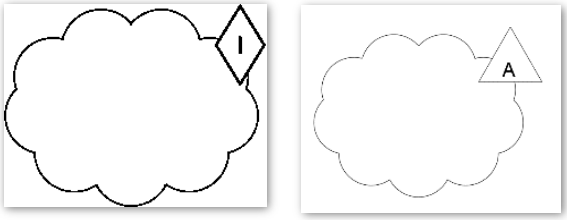
Add Triangles with Letters for Construction phase with letters.

11.7.3 Revising Part of a Drawing

Add a diamond/triangle revision tag, contacting and trimmed out of each cloud.

Diamonds for Addenda phase with numbers. Triangles for Construction phase with letters.

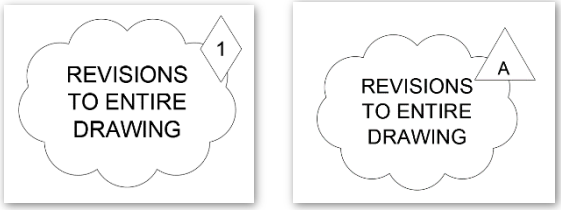
Remove all clouds from previous changes, making only the current revision clouds visible in the drawing.



11.7.4 Revising the Whole Drawing

Used to show changes to the entire drawing.

Show clouds in the lower/right corner, matching the example below.



11.7.5 Creating a New Drawing

When a drawing is added into the contract package after issued to the contractor.

Add revision entry and label as “0” to note it as the baseline version. See section ***11.1.1***.

11.8 Creating Field Sketches

Field sketches must have sufficient details and dimensions to accurately locate all objects within the As-Built drawing files

Field sketches must use consistent project symbology with all sketches across all disciplines.

Use the following color scheme for applying markups to a drawing or sketch:

- Red – Add the item.
- Green – Remove the item.
- Blue - Note to drafter or staff, not added.

Do not use Red, Green, or Blue to communicate any other purpose than defined above.

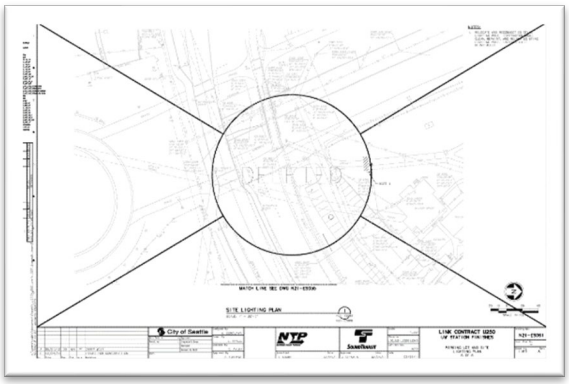
Add colors for other purposes as needed and provide a legend of additional colors and their purpose.

Refer to PCPP- 08, 15 and EP-05 for additional field sketch requirements.

11.9 Removing a Drawing

This section applies to all contract drawings post IFB.

- Remove all previous clouds and tags.
- Remove any professional seals and signatures.
- Add a revision entry for the deletion.
- Add a marking across the drawing using the provided block noted in section ***6.5.4.4***.
- Edit the drawing index(s) to reflect the deleted drawing.



52	L00-JCP005	0	C09 - INTERNATIONAL DISTRICT STATION COMM ROOM - ENLARGED PLAN EQUIPMENT LAYOUT
53	L00-JCD002	0	DELETED 1
54	L00-JCD009	0	DELETED
55	L00-JCD010	0	C09 - INTERNATIONAL DISTRICT STATION FIBER DISTRIBUTION PANEL DETAILS
56	L81-JCP201	0	E00-TPSS-01 - RAINIER WEST - COMMUNICATIONS COMM DEVICE LAYOUT
57	L81-JCP202	0	E00-SIG-01 - RAINIER WEST - COMMUNICATIONS COMM DEVICE LAYOUT
58	L81-JCP203	0	E01-SIG-01 - RAINIER WEST - COMMUNICATIONS COMM DEVICE LAYOUT

11.10 Managing Xref Files During Revisions

The Design Consultant must define a system to maintain and track all xrefs as part of the proposed revision process and provide for ST approval prior to use.

Provide an accurate and complete record of the final condition, the most important factor is keeping the accuracy of the design in a non-chronological process, not in the order created.

This is coordinated with other changes to ensure proper chronological order of when changes are issued.

Issues to address for defining the process. Include but not limited to:

- Not showing changes in the right chronological order to the issued Change Document.
- Consistent tracking process of the changes in xref files through completion of Record Drawings.
- Parallel change efforts is tracked to eliminate confusion with issuing sequence.
- Tracking and reverting a “Voided Change” back to previous state.

11.11 Drawing/Model Change Log

Post IFC, the maintainers of the Record Models must document all drawing/model changes in the Drawing/Model Change Log. Format for Post IFC Drawing/Model change log is approved by ST Design Technology Manager. The Drawing/Model change log must record the following:

- A summarized list of model elements changed or updated, including a description of what was changed/updated.
- Date of Revision
- Name of drafter or modeler (who made the revision).
- List of drawing numbers affected by the revision.
- Individual the performs verification Model changes were incorporated and date.

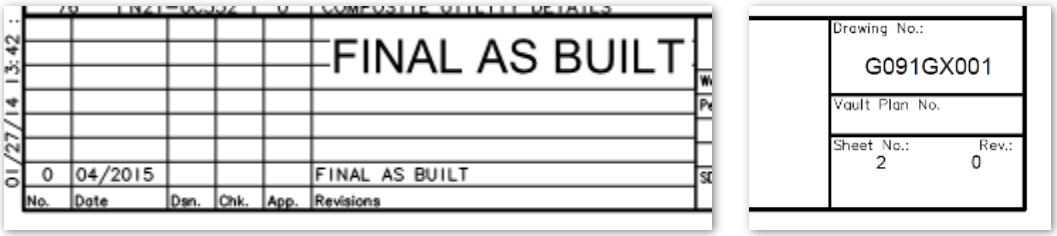
12. Record Drawings

12.1 Baseline All Drawings

See section *11.1*

- Remove all revision clouds, symbols, and revision block information.
- Change drawing revision number (lower right corner) to “0”.
- Add a new, version “0”, revision line with appropriate data, staff, and “Record Drawings” in the bottom description field.
- Remove all attached professional seals.
- Leave contributing firm logos intact.
    - Add stamp or update field at the top of the revision block to read “RECORD DRAWINGS”.
    - Update Record Drawings milestone globally.
    - Date is end of construction. CMC/DBPM to provide.

Example of Revision Entries at Baseline



12.2 Deliverables

Prepare and deliver the Record Drawings and supporting electronic data with the following:

Only one comprehensive set of Record Drawings that represent the final site condition. Drawing files are provided to Sound Transit (separate Record Drawings packages for the different design packages is not acceptable). Record Drawing files are provided as a unified coordinated document set without duplications, unrelated information, or numerous versions residual from the Contractor’s chosen packaging strategy.

Update all Record Drawings in the package and their supporting electronic data to accurately reflect the final condition of all objects and impacts in all views and across all disciplines.

12.2.1 Completion of Record Drawings

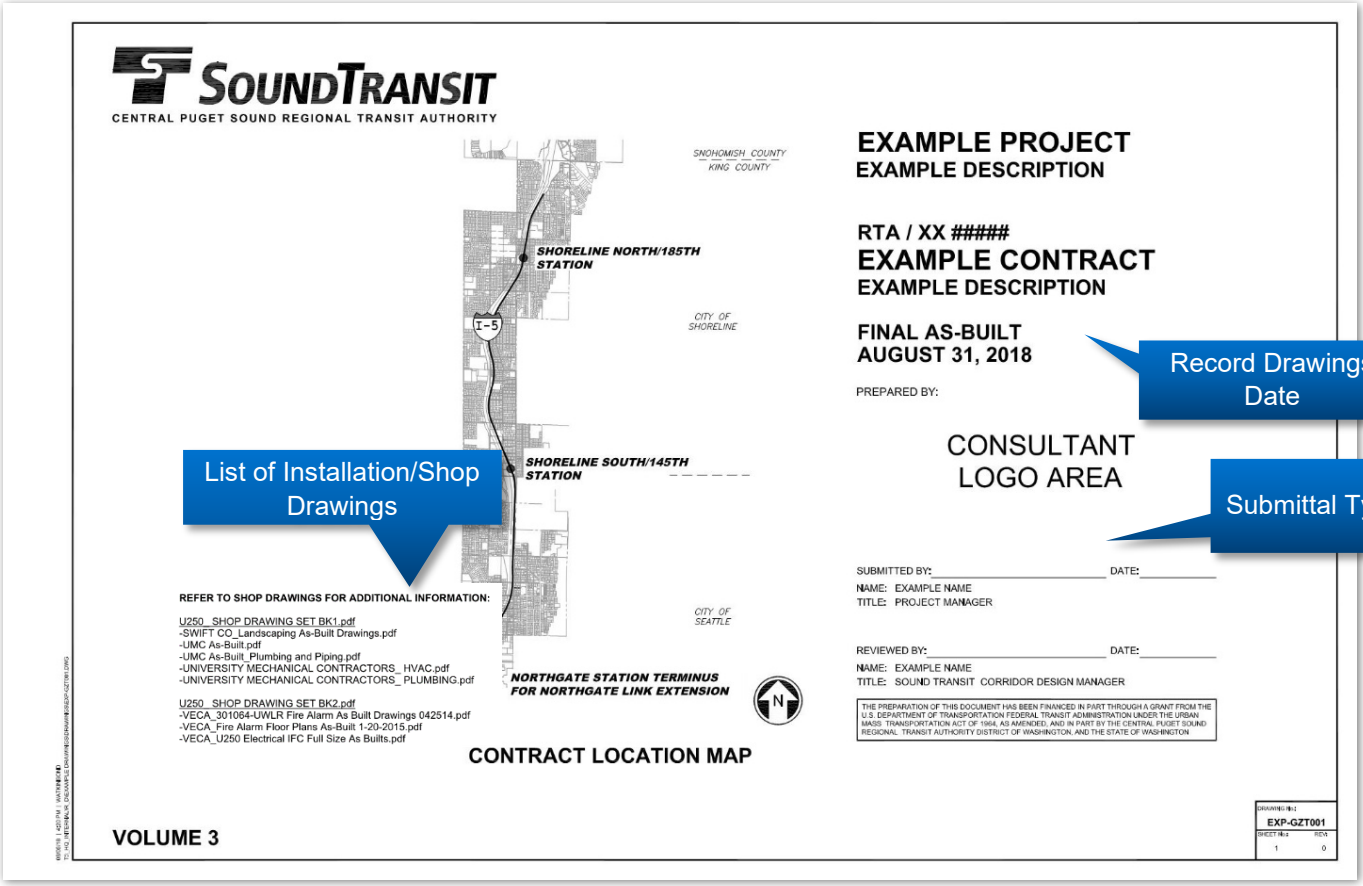
- Milestone is correct on Title Blocks & Cover Drawings.
- Removed, clouds, deltas, stamps.
- Page size is consistent.
- Shop drawing index list on Cover Drawing of all books.
- “AutoCAD SHX Text” is removed from pdf files

- Bookmarks and page labels, confirm linked to correct drawing and fit to page is set.
- Sheet numbers were done in CAD.
- Compare pdf drawings to the index; Sheet numbers, drawing numbers and titles are correct.
- Drawings are in the index order.
- Mark-ups are incorporated into the Record Drawings drawing files.
- No marks-ups in drawings. No flattened marks in sets, CAD elements only. Black/Gray scale only drawings.
- Submit QC plan for ST approval.
- BIM check lists are submitted with review sets.

12.2.2 Update Cover Drawing/Title Page

- Change submittal type (IFB/IFC text) on the Cover sheet to “Record Drawings”.
- Change the date to reflect construction completion (not when the as-builts were completed).

Example of Title Page with changes



12.2.3 PDF Plan Set

- Plan set per section *4.3*

12.2.4 PDF Essential Requirements Checklist

ST provides a PDF Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements

12.2.5 Shop Drawing Index

- Add an index of the included Installation/Shop drawings to Title/Cover drawing. Create a new sheet behind the cover if full index will not fit on the Title/Cover drawing.
- The design consultant will obtain and format an index of the shop drawings from a list provided by the Construction Management Consultant.

12.2.6 BIMf and BIMc PxP

- Submit first version for approval no later than 30 days after the start of construction phase.
- Submit all subsequent changes for approval 30 days prior to implementation. PXP templates are provided by Sound Transit.
- Record any approved deviations to the project scope of work, project requirements, Design Technology Manual requirements in the BIMc and BIMf PXP.
- Submit all BIMc and BIMf PXP updates to SharePoint and send a notification to the discipline/trade CAD Leads as well as the ST Design Technology Manager.
- ST provides templates for the LOD & BIM Roles responsibility matrix. Both matrices are required sections of the BIMc and BIMf PXP.

12.2.7 BIMc and BIMf LOD Matrix

- Developed by Sound Transit the LOD Matrix template is used and modified in accord with project requirements.
- The LOD Matrix clarifies the LOD of model components at different project milestones. The forecasted LOD for each major milestone is reviewed and committed to by the project participants within 30 days of NTP for each submittal phase and submitted for approval by Sound Transit.
- All submittals and selected LODs for them must conform to minimum requirements outlined in Sound Transit Engineering Procedures Manual EP-03 matrix and additional modeling requirements listed in this task

12.2.8 BIMc Essential Requirements Checklists

- ST provides a BIMc Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

12.2.9 Autodesk Batch Standards Checker Report

- Submit a Batch Standards Checker report of all drawing files for each milestone. The report must add all xrefs regardless of nesting level. This report is a HTML image file and must contain:
  - A list of drawings checked
  - All Standards violations for layers, dimension styles, linetype, text styles for each file.

12.2.10 Autodesk Reference Manager Report

- Submit a Reference Manager report of all drawing files for each milestone. The report is run with the "all xrefs automatically loaded regardless of nesting level" option. This report is a CSV file and must contain:
  - Host Drawing
  - Type
  - Status
  - File Name
  - Reference Name
  - Saved Path
  - Found Path
  - Host Version

12.2.11 BIMf Clash Detection Analysis

- The Clash Detection Analysis includes the following:
  - Summary of Clash Detection Analysis in PDF
  - NavisWorks clashes detection models
  - Clash Resolution Log
  - Integrating solutions for each clash/issue into models and drawings prior to submittal.
  - Regardless of conduit size the equipment (Listed in the Equipment Matrix) shows connections to BMS and power.
  - Sound Transit is invited to attend all Clash Detection/3d coordination meetings. The frequency of meetings are recorded in the BIM PxP.

12.2.12 BIMf Gap Analysis Report

- The project team to submit a Gap-Analysis report for each MEP discipline. The gap analysis consists of strict correlation with, and accounting of, model features with PIIP products as shown in the block diagrams, schematics, and equipment lists. Format and content of report to be approved by ST Systems Engineering & Integration.

12.2.13 BIMf Essential Requirements Checklists

- ST provides a BIMf Essential Requirements checklist. The project team uses the checklist to ensure all project files regardless of firm or discipline adhere to the Design Technology Manual requirements and project scope. Meeting all checklist items does not eliminate the need to adhere to all prescribed requirements.

12.2.14 Shared Parameter files

- All project shared parameter files.

12.2.15 Record Drawing Kick-off Meeting

- One Record Drawing Kick-off meeting is held prior to commencement of Final As-Built BIM and CAD work. The BIM and CAD Managers coordinate the schedule, meeting agenda, and preparations of Final As-Built kick-off meeting for BIM and CAD efforts with the Sound Transit Design Technology Manager and distribute it to attendees five business days prior to Final As-Built Kick-off Meeting.

12.2.16 Record Models

- The IFB/IFC models that produce the Record drawings are updated to reflect the as-built (final installation) condition and installed works once in-place All Record models must have a minimum LOD of 300.

12.2.17 Contractor/Sub-Contractor Record Models

- The Contractor/Sub-contractor model(s) which reflects the final condition, it is submitted to Sound Transit. These Contractor/Sub-Contractor models is used for supplemental details to the Record model. All models must have a minimum LOD of 300. The models are submitted in their native format.
- The contractor must supply a Federated Model combining all Contractor/Sub-Contractor models via Navisworks .NWD format. All Contractor/Sub-Contractor models are shared with the project coordinates established in the IFC models.
-

13. DTM Deviation Form

SOUNDTRANSIT

DESIGN TECHNOLOGY MANUAL

REQUEST FOR DEVIATION

1. Department:	2. Contract Unit No.:	3. DTM Version:	4. Deviation No.:
5. Date of Request:	6. Project/Contract Name:		
7. DTM Chapter(s):			
8. Requested By (CAD/BIMc/BIMf Manager):	9. Reference Documentation/Drawings (attach):		
10. DTM Requirement:			
11. Purpose and Description of Deviation:			

SOUNDTRANSIT

DESIGN TECHNOLOGY MANUAL

REQUEST FOR DEVIATION

12. Explanation and Justification for Deviation (Justification shall include why the Design Technology Manual requirement cannot be met and how the original intent of the criteria will be achieved. Provide measures that will be employed to mitigate impacts to operations, safety, and performance):

13. Requested

Consultant CAD/BIMc/BIMf Manager Signature | Date

(Print name and Title / Company)

14. Approved

ST Design Technology Manager Signature | Date

(Print name)

14. Plan Preparation

14.1 Introduction

14.1.1 Purpose of Plan Preparation Guidelines and Their Expected Use

These guidelines provide uniform guidance to be used by designers when preparing design contract drawings. They do not address all potential project, contract, and/or site-specific conditions.

These guidelines do not supersede sound engineering judgment and drafting practices used when working on Sound Transit projects.

The designer is fully responsible for preparing contract drawings that are clear, concise, complete, accurate, and functional in identifying all items of work.

The designer is also responsible for and expected to collaborate closely with Sound Transit staff to resolve all issues during the plan preparation process.

14.1.2 Package Organization & Extents

Follow the order of Transit Elements, Discipline Series, and Drawings as outlined in the following as closely as possible.

Gain approval for any deviations from the project's Senior Design Manager or Project Manager prior to use.

14.1.3 Order of Transit Elements

The order of transit elements when including multiple elements:

- Transit line segment
- Transit station
- Park and ride
- Parking garages
- Appurtenant facilities such as guideway access stairs and ancillary off-site elements.

14.1.4 Order of Discipline Series

The order of disciplines:

- General
- Right-of-Way
- Trackwork
- Civil
- Utility
- Traffic
- Structural
- Architectural
- Landscaping
- Mechanical
- Electrical
- Systems Wide Electrical

- Traction Power System
- Overhead Contact System
- Signal
- Communication

14.1.5 Drawing Extents

View limits are defined by a controlling alignment (track and roadway), grid control (stations), or irregular boundaries (site work).

All drawings similar scaled viewports of and location must use the same view limits across all disciplines drawing series.

14.2 General Series

The series contains key information related to the overall project and is included in each contract package, or book within a multi-book set, for all projects regardless of the disciplines involved.

ST provides templates to create the General Drawings.

DBB, DB, Smaller projects that are contained to a single location must contain a single set of general drawings for the entire project's plan.

DB Larger projects (Corridors and Major Systems) must contain a project wide drawing or group of drawings for the types of plans at RECORD DRAWINGS. Each DB package during design phases must provide the same group of drawings tailored to that specific package

14.2.1 Drawing Order

- Title Page
- Index of Drawings
- General Legend and Notes
- Project Facility/Location ID Plan
- Contract Package Key Plan

14.2.2 Title Page

Typical drawing discipline, design element and type code GZT per section ***5.6***.

Use the ST provided template file ***GZ-TitlePage.DWT***

Include:

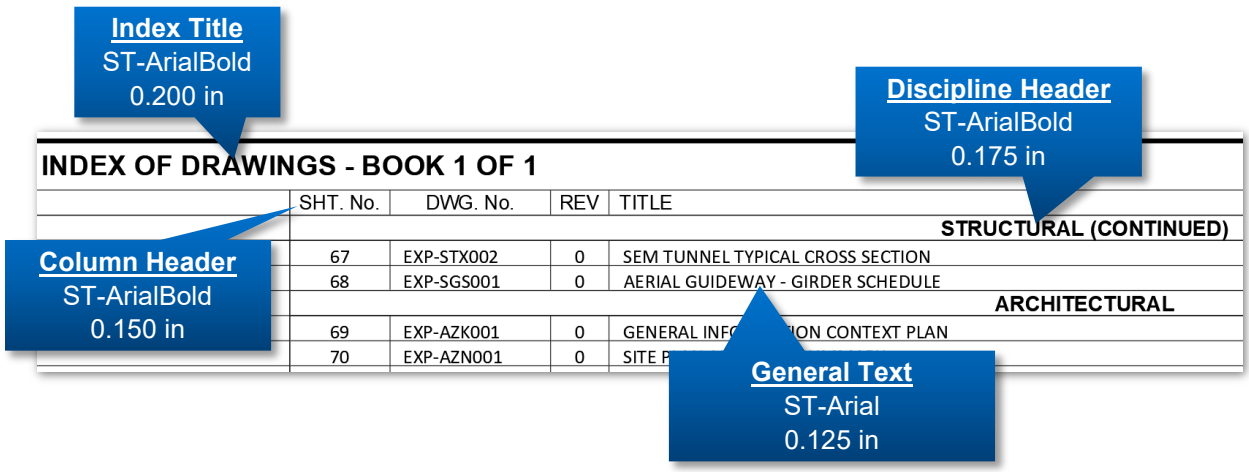
- Signature block for the prime consultant project manager
- Signature block for the Sound Transit SDM or PM.
- Project vicinity map with north arrow and scale.
- List of all consultants and sub-consultants.
- Project name
- Project description
- Contract number
- Contract name
- Contract description
- Submittal phase
- Submittal date
- List of Disciplines in book
- Volume number
- Book number
- Logos of all participating companies
- Label drawing number 1.

14.2.3 Index of Drawings

Lists the drawings included in the drawing package by Transit element and design discipline.

When developing:

- Use the ST provided template ***GI-DrawingIndex.dwt***
- Match titles listed in the drawing index and the titles used in each drawing file.
- Include header between sections.
- Divide the body of the Index into two equal sides.
- Include four columns in each side with the following headings from left to right.
- Autodesk Drawing Set Manager is use and in accordance with section ***10.3***.



INDEX OF DRAWINGS - BOOK 1 OF 1

	SHT. No.	DWG. No.	REV	TITLE
				STRUCTURAL (CONTINUED)
	67	EXP-STX002	0	SEM TUNNEL TYPICAL CROSS SECTION
	68	EXP-SGS001	0	AERIAL GUIDEWAY - GIRDER SCHEDULE
				ARCHITECTURAL
	69	EXP-AZK001	0	GENERAL INFO ON CONTEXT PLAN
	70	EXP-AZN001	0	SITE P

14.2.4 General Legend and Notes

Include in each contract package, or book within a multi-book set, for all projects regardless of the disciplines involved.

Use the ST provided template ***GZ-GenLegned1.DWT*** as a starting point and adjust to the specific project.

Equally space columns of text, starting in the upper left-hand corner.

Use single line spacing and include a blank space between each note.

Include a listing of all Authorities Having Jurisdiction (AHJ) related to the project.

14.2.5 Horizontal and Vertical Control

Include the location of all primary control survey monuments within the project area required for field layout.

Include:

- Mapped locations of all primary and secondary horizontal and vertical control survey monuments.
- Monument ties to reference points (where given), including coordinates, elevations, and descriptions.
- Secondary control monuments as applicable.

- Political subdivision indicated at the top of the drawing (Section, Township, Range, County, and State).
- Tabulated list of control point numbers/names with coordinate values, elevations, and descriptions. Coordinates shown to 0.01 feet.
- Surveyor's notes and list of referenced record(s) of survey used to establish control for project.
- North arrow and scale.
- Statement of local project datum indicating:
- Coordinate system used on the project.
- How to translate project coordinates to WA SPCS using the appropriate zone (North or South), if applicable.

Clearly label:

- Nearest streets.
- Intersecting streets.
- Large identifiable landmarks such as parks, lakes, or large commercial properties.

Refer to ST Requirements Manual SET 905.

14.2.6 Project Facility and Location ID Plan

Include in all contract packages related to a new ST facility or infrastructure.

Include the pre-defined Facility IDs in the ***Facilities Equipment Naming and Numbering Standard.*** Request a new Facility ID(s) to include from the project's SDM.

Use the ST provided template ***GZ-FacilityIDs.dwt***

Include existing facilities and infrastructure in grey (screened).

Include new facilities in black.

14.2.7 Contract Package Key Plans

Use the ST provide template ***GZ-KeylayoutIndex.dwt*** as a starting point and adjust to the specific project

Scale: 1" = 500'. Adjust as needed.

Include a key plan(s) for the overall package in all contract packages.

Use different key plans for linear and architectural based drawings as noted below.

14.2.7.1 Linear Key Plan

Show the location, orientation, and extents of the areas covered in various linear related drawings.

Create 1 or more key plans as needed per Plan View port scale.

All 1"=20' plan series shown on 1 key plan drawing.

All 1"=40' plan series shown on 1 key plan drawing.

Do not combine plan drawing series of different scales in a single Key Plan series.

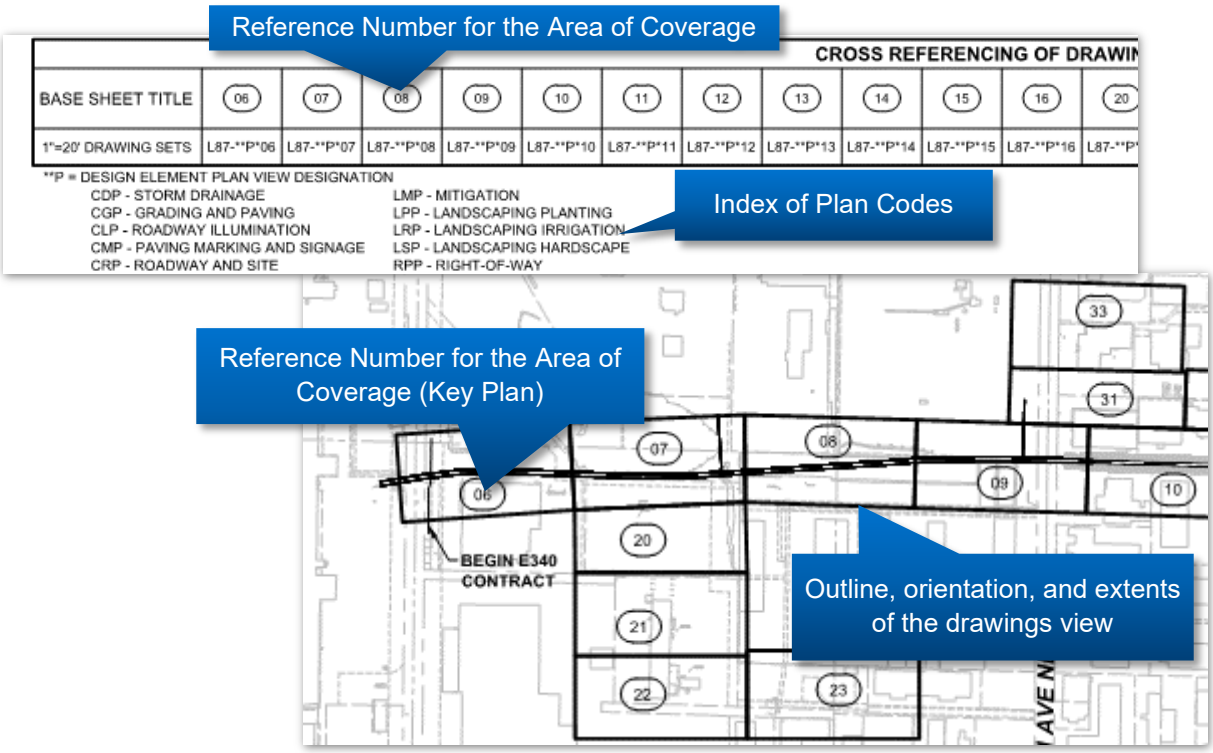
DBB projects create a set of Key Plans for entire project area.

DB projects to create 1 set of key plans PER DB package and at RECORD DRAWINGS a single conformed set of Key Plans is required.

Include an Index of all plan code types, for example: ***KAP***.

Define plan numbering of the areas across all disciplines along the alignment consistently, for example: ****05***.

Show in the correct orientation and extents of individual plan areas.



14.2.7.2 Architectural Key Plan

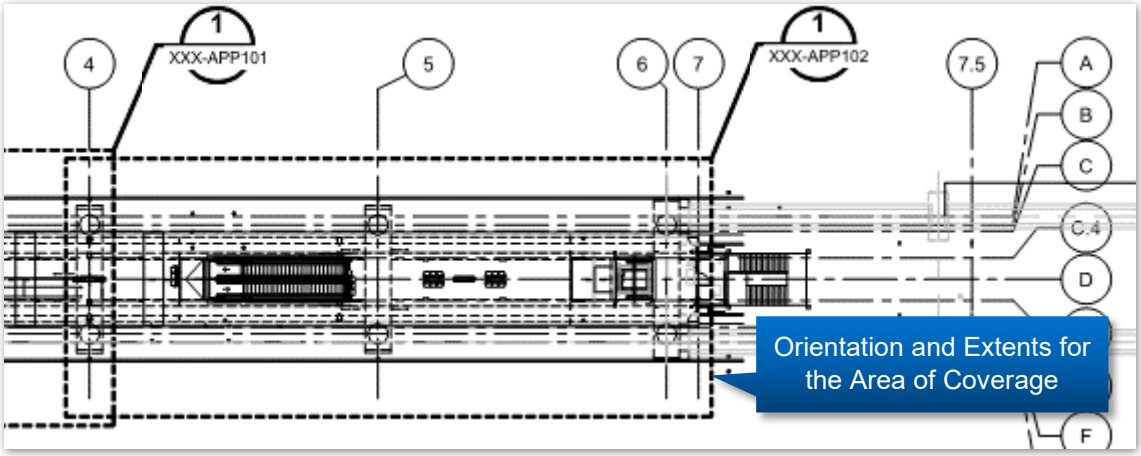
Include on all Architectural, Structural, and MEP discipline plans.

Show the overall view of the facility or structure and the area callout symbols in the correct extents and orientation of each area plan.

Include the overlap of soft match areas.

Apply drawing numbering related to the callout area consistently.

Architectural key plans are made for each plan type. For example, platform plans and reflected ceiling plans.



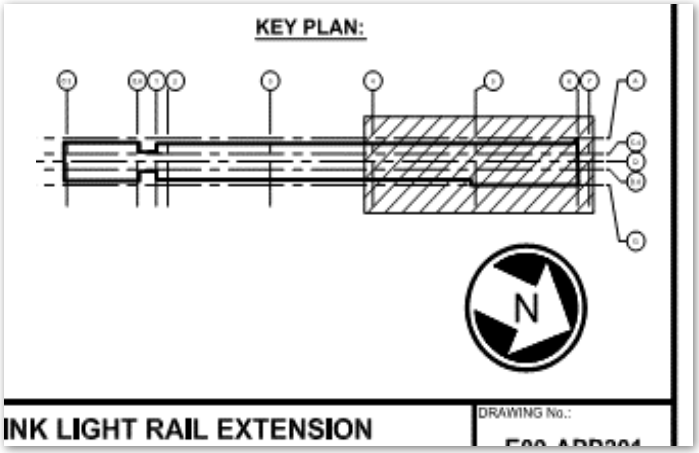
14.2.7.3 Drawing Key Plan

Add a small version of the discipline's key plan in each drawing with a plan view for site locations (Transit Centers, Stations, and Garages).

Locate in the bottom-right corner of an area plan drawing.

Minimize background data to clearly show limits and key details.

Create a consistent presentation (scale, hatch, line types) across all disciplines on the project.



14.3 Right-of-Way Series

The series shows the total of all real property interests and uses required to construct, maintain, protect, and operate the transit system as well as the controlling survey monuments.

14.3.1 Drawing Order

- ROW Monumentation Plans
- ROW Notes, Abbreviations, and Legend
- ROW Plans
- ROW Details

14.3.2 ROW Monumentation Plans

Show the location of all primary ROW monuments within the project area that were used to determine existing ROW and/or property lines or are in the vicinity of the construction zone and therefore in danger of being destroyed.

Include:

- Track alignment and stationing
- WSDOT alignment and stationing (if applicable)
- Tabulated list of ROW monument control point numbers/names with coordinate values, elevations, and descriptions. Coordinates shown to 0.01 feet. Elevations shown to 0.1 feet.
- Surveyor's notes identifying the Basis of Bearing
- North arrow and scale.
- Statement of local project datum indicating:
- Coordinate system used on the project.
- How to translate project coordinates to WA SPCS using the appropriate zone (North or South).

Clearly label:

- Nearest streets.
- Intersecting streets.
- Quarter section lines and Section/Township/Range information
- Large identifiable landmarks such as parks, lakes, or large commercial properties.

14.3.3 ROW Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.3.4 ROW Plans

Include EXISTING items:

- All ROW lines (Street, County, Railroad, etc.)
- Existing ST transit way lines, if any
- WSDOT ROW with limited access and beautification areas
- ROW centerlines with bearings and distances
- Curve data for ROW centerlines

- Existing ST property limits, if any
- Existing easements
- WSDOT airspace leases and/or temporary and permanent easements
- Pertinent structures including pads and fences
- Significant surface features including buildings, walls, paving, walkways, and roadways
- Adjacent streets including centerlines.
- Quarter of the Quarter section, Township and Range call-out at top of every drawing
- All cities, counties, 1/16 and 1/4 section, section, township and range lines, and other government jurisdictional lines as appropriate
- Basis of bearing and reference to horizontal & vertical control drawing
- ROW monuments with northing and easting coordinates
- Existing Sound Transit lease/license agreements, if any
- Unlicensed encroachments into RR/ST ROW
- All adjacent property lines with:
- County Parcel numbers.
- Owner names.
- ST assigned ROW ID numbers.
- ST lease/license agreements (if any) for use of ST land by adjacent property owners.
- ST licenses issued to utilities with facilities on ST property (if any)
- Unlicensed encroachments into ST ROW

Include PROPOSED items:

- Proposed transit way limits including one northing and easting coordinate for at least one angle point per drawing along the transit way line, and all information needed to re-calculate the transit way (e.g.- bearings, distances, curve information, and any other labels needed.)
- Curve data for Transit Way lines.
- Property required for permanent or temporary use, established and located.
- Reference in the centerline of track alignment and stationing
- Identify proposed ST lease/license agreements, if any.
- Fee take areas
- Proposed easements both permanent and temporary with ownership labels (e.g. - SCL, PSE, Century Link, City of Bellevue, WSDOT, King County)
- Call-outs for parcels dedicated by ST to Others (specify City, Agency, etc.)

Include with table listing parcels certified for acquisition:

- Sound Transit ROW ID number(s)
- Parcel number
- Parcel owner name(s)
- Parcel area
- Fee take area
- Remainder square footage
- Temporary and Permanent Easement area

14.3.5 ROW Parcel Maps

Aids in the parcel certification process required for acquisition.

All parcel legal descriptions and maps must follow:

- Governing municipalities' recording requirements for borders and layout.
- Similar drafting requirements as required for plan drawings regarding text, layering and general layout.

Include:

- Two locational markers (e.g. adjacent streets), if possible
- Key monuments
- Proposed center of track and Transit Way limits
- Surface feature line work (e.g. nearby buildings, wall, curbs, edge of pavement)
- Existing utilities if visible
- Existing easements
- Proposed acquisitions including types and areas (Subsurface easements show vertical elevation limits.)
- Metes and bounds linework and labels that matches descriptions used for acquisition
- North arrow
- Legend
- Scale
- ST parcel map title block
- Sound Transit ROW limits
- ST ROW number
- Parcel Number (Tax Account No.)
- Name of owner
- Square foot areas of:
- Full parcel
- Fee takes
- Remainder
- Permanent easement
- Temporary construction easement.

14.4 Trackwork Series

This series shows the total of all trackway interests and uses required to construct, maintain, protect, and operate the transit system.

14.4.1 Drawing Order

- Track General Notes, Abbreviations, and Legend
- Key Plans
- Track Alignment Data Tables
- Track Plan and Profiles
- Track Typical Sections
- Track Supplemental Sections
- Special Trackwork Details
- Track Charts

14.4.2 Track General Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.4.3 Key Plan

Include per section ***14.2.7***

14.4.4 Track Alignment Data Tables

Include:

- All horizontal alignment data
- All curve data including all circular and spiral curve elements to nearest 0.01 feet of linear dimensions 0.01 second of angular values
- Coordinates to nearest 0.0001 feet
- Curve number
- Alignment point designations
- Stationing to nearest 0.01 feet
- Design Speed noted as the maximum train control speed attainable within each curve segment in miles per hour (mph)
- Super elevation to nearest 0.25 inch
- Unbalance to nearest 0.01 inch
- Remarks

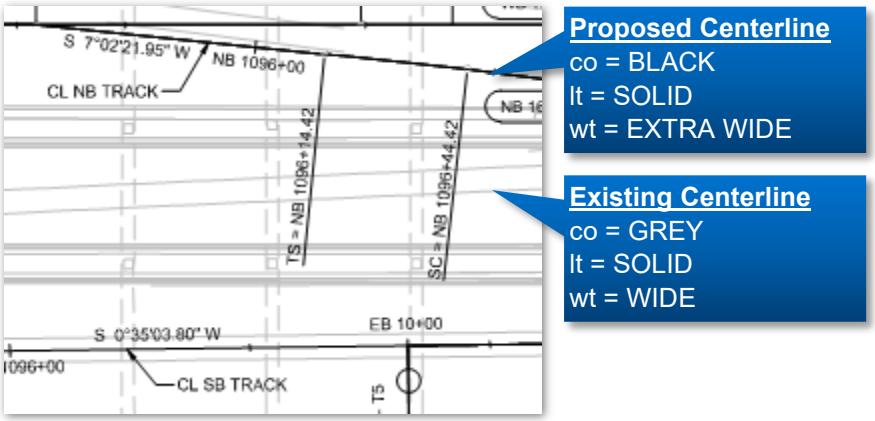
14.4.5 Track Plan

Place the Track Plan in the upper half of the drawing at 1”= 40’ scale.

Place Track Yard Areas Plan in the upper half of drawing at 1”=20’ scale.

Include:

- All existing and proposed right-of-way and easement lines.
- Streets and Roadways (including frontage roads, access roads).
- Railroads and Street Railway lines
- Street and Place Names
- All City, County, and other AHJ names
- Significant Points of Interest (Civic Centers, Colleges, Parks, etc.)
- Alignments:
- Proposed track centerlines
- Existing track centerlines



- All Points of Curvature
- All Point of Intersection Turnout (PITO)
- All Points of Switch (POS)
- All alignment tangent bearings
- Beginning stationing of platform
- Ending stationing of platform

Include for Stationing:

- All Stationing Text with alignment designation
- Full station number (e.g. 140+00).
- On 1" = 20' scale drawings:
- Station Labels @ 200'
- Station Tics @ 50'
- On 1" = 40' scale drawings:
- Station Labels @ 500’
- Station Tics @ 100'
- Label stationing every 500'.

Include for station footprints:

- Outline of each transit station

- Labels once per plan.

14.4.6 Track Profile

Profile Band

Set Profile View Band Styles at each major and minor station line to label existing ground elevation on the left and proposed grade elevation on the right.

Set vertical scale 1/4th the horizontal scale.

For example:

- If H is 1”=40”, then V is 10’.
- If H is 1" = 20', then V is 5’.

Include for Station Labels, along the bottom of the profile grid:

- 1" = 20' scale profiles @ 100'
- 1" = 40' scale profiles @ 200'

Label Grade Elevations at:

- Beginning and end of the project
- Both sides of the profile grid
- All breaks
- Even 100-feet horizontal intervals
- Each end of vertical curves

Include for Track Profile Line:

- Top of low rail on right track profile
- Significant points defining changes in grade, including a vertical line drawn to the circle
- Profile tangent intersections = Open triangles
- Vertical line to the triangle and label with the station, elevation, length of curve and abbreviation "PVI, PVC, PVT”

Include for Track Profile Notes:

- Profile label with "PGL (T/LR)" once per drawing.
- Percent grade label on top of all vertical tangents.

- Length of vertical curve above the profile and as near to the PVI label as practical.
- Beginning stationing of platform
- Ending stationing of platform
- Station and elevation of all low points

Include for Ground Line:

- Right track profile at existing ground along track
- Water surface elevation and profile of bottom where the transit line crosses a body of water.
- Profile label with "EGL" once per drawing

Include for Structure Type:

- ***Track is on elevated structure or bridge*** - show low member of spanning structure and abutments.
- ***Transit line is in a tunnel*** - show top and bottom of structure, inside and outside, and portals.

Include for Transit Stations:

- Elevation view of each station platform schematically.
- Station Name

Include for Overpasses and Underpasses:

- Street, highway, or railroad names along centerline
- Existing structures with identifying label
- Station equation of centerline intersections

Include at street, highway, and rail crossings:

- Centerline intersection
- Section of the structure.
- Station equation of centerline intersections

Include for Utilities:

- All existing and proposed utilities, drainage pipe and structures.

14.4.7 Typical Track Sections

Include:

- Improvements through the full proposed or existing right-of-way section.
- Vertical and horizontal dimensions.
- All Items installed or constructed in other contracts.
- All trackway drainage elements and systemwide facilities, including:
    - Trackwork
    - Traction power
    - Train control
    - Communications
    - Any other LLR facilities

14.4.8 Track Supplemental Sections

Applies to only one specific location.

14.4.9 Special Trackwork Details

Include:

- Special trackwork plans and details.
- Details for installation of various track components.

14.4.10 Track Charts

Include:

Type of Rail

- Contract Limits
- Limits of different types of rails and including special track work rail types
- Limits of restraining rail
- Limits of emergency guard rail
- Insulated joint location

Horizontal Alignment

- Contract Limits
- Station limits
- Horizontal Curve details
    - Curve Basic Info Table, includes
    - Curve No.
    - PI Sta.
    - Radius
    - Length of Circular Curve
    - Lengths of Spiral Curves, Lc1, Lc2
    - Actual Superelevation Ea
    - Unbalanced Superelevation Eu
    - Operational Speed V
- Curve control points location, such as TS, SC, CS, ST, and PT, PC
- Stationing equations
- Track Center Spacing for parallel track
- Special Trackwork
    - Limits
    - Turnout Number with Locations of controlled points, such as PS, PITO
    - Special Trackwork Curve Info Table (for closure curve)
- Hi-rail access Limits
- Grade crossing panel limits
- MOW/emergency egress crossing width and location

Track Type

- Limits of type of Trackwork such as Ballasted, Direct Fixation, Embedded, floating slab,

- Limits for using different types of different fastener types
- Drawing reference to track construction detail for each type of construction.

Vertical Alignment Control (Track Only)

- Contract Limits
- Existing Grade Line
- Station limits
- Station equations
- Vertical Profile:
    - Tangent grades
    - For Vertical Tangent, including
    - Vertical PVC, PVI and PVT points
    - Vertical curve length
- Tunneling limits
- Elevated guideway and columns
- Special Trackwork Turnout number, Point of Switch location and Elevation

14.5 Civil Series

The series shows the total of all civil interests and uses required to construct, maintain, protect, and operate the transit system.

14.5.1 Drawing Order

- Civil General Notes, Abbreviations, and Legend
- Key Plan
- Alignment Plan and Data
- Construction Staging
- Truck Haul Routes
- Typical Roadway Sections
- Existing Conditions and Restoration Plans
- Removal and Demolition Plans
- Erosion and Sediment Control Plans
- Site Plans
- Roadway Plan and Profile Plans
- Grading Plans
- Drainage Plans and Profiles

14.5.2 Civil General Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.5.3 Key Plan

Include per section ***14.2.7***

14.5.4 Alignment Plan and Data

Include:

- All street or site alignments in relation to existing right-of-way.
- Curve Data table with all horizontal tangent and curve data with station references to establish the alignment.

14.5.5 Construction Staging

Include:

- Footprint of facilities being built.
- Lay-down areas.
- Site access and site constraints for major construction stages.

14.5.6 Truck Haul routes

Include 2 sets of drawings:

Haul Route drawings at 1000' scale - showing construction truck routing between the construction site and the nearest freeway access point.

Access Point drawings at 1"=100' scale - showing site access points for trucks and internal site circulation.

14.5.7 Typical Roadway Sections

Show perpendicular to the alignment or layout line.

Include:

- All improvements through the full proposed or existing right-of-way section.
- Vertical and horizontal dimensions.

14.5.8 Existing Conditions and Restoration Plans

Scale: 1'=20'

Include EXISTING items:

- Topography and conditions of the project site prior to construction
- Buildings
- Right-of-Way
- Miscellaneous structures
- Trees
- Roadways and other pavements
- Various facilities restored

Included PROPOSED items:

- LLRT track centerlines
- Right-of-Way
- Additional items shown are:
- Street names
- City lines
- County lines
- Other related jurisdictional lines

14.5.9 Removal and Demolition Plans

Scale: 1'=20'-0"

Include EXISTING items:

- Topography
- Right-of-Way
- Miscellaneous structures
- Roadways and other pavements
- Various facilities restored
- Street names
- City and County lines
- Other related jurisdictional lines
- Trees protected with fencing
- Trees removed
- Limits of Tree protection

Include PROPOSED items:

- LLR track centerlines
- Right-of-Way

14.5.10 Erosion and Sediment Control Plans

Scale: 1'=20'-0"

Include GENERAL items:

- Temporary and permanent erosion control methods.
- All impacts to environmentally sensitive resources.
- Differences between permanent and temporary impacts for each environmentally sensitive resource.

Include PROPOSED items:

- Drainage
- Surface improvements
- Erosion control methods.

Include EXISTING items:

- Topography
- Utility structures
- Trees
- Contours
- Environmentally sensitive resources

Develop erosion control methods, plans, details, and notes in accordance with the Best Management Practice established by Washington State Department of Ecology and local jurisdictions.

14.5.11 Site Plans

Scale: 1" = 20'

Include GENERAL items:

- Horizontal alignment controls and dimensions required to construct park and ride, stations, and other facilities.
- All elevations of street surfaces matched.
- The "pay limits" of areas constructed or restored.
- A reasonable area outside the limits for excavation and areas damaged by relocation of utilities.

Include PROPOSED item(s):

- Structure outlines
- Street lines
- Walls
- Temporary & permanent easement lines
- Sidewalks
- Curbs & Gutter
- Streets & Alleys
- Catch basins
- Manholes
- Fences
- Guard rails

- Trees

Include EXISTING items or reference to other plans:

- Typical sections
- Existing elevations
- Proposed Elevations
- Cross-sections or cross-section information
- Type(s) of pavement
- Curbs, pole, signs, and other surface items
- Details for areas paved, repaved, or restored

14.5.11.1 Drainage

Include:

- A layout of new and relocated storm sewer facilities.
- Sizes and materials of pipes, types of channels, and gutters.
- Cross-reference to profiles and details on other drawings.

14.5.11.2 Sections

Include labels of finished pavement elevations at:

- 25-feet or 50-feet intervals along centerline
- Edges of pavement
- Changes in slopes, gutter lines, faces of curbs, or backs of sidewalks.

Include labels in areas graded:

- Elevations at all breaks in uniform slopes.
- Areas warped.
- Edges of restoration.
- Centerlines of ditches and channels.
- Depressions and high points required to define finished graded surfaces and limits of restoration.

14.5.11.3 Curbs

Include if not shown in the profile:

- New curb centerline elevations and elevations at each face of curb line.
- Flow line or top of curb line.

14.5.11.4 Adjoining Drainage

Include if restoration includes adjoining sidewalk:

- Areaways
- Window walls
- Doorways
- Gratings
- Existing and proposed elevations
- Other pertinent surface features in sufficient detail to clearly show slope and warping of sidewalk to assure that areas are properly drained

14.5.11.5 Control Elevations

Include labels at:

- Tangent points of the street corners or fillets
- Points matched
- Various points as required for construction

14.5.11.6 Existing Trees and Landscaping

Label trees and landscaping saved unless already on landscaping plans.

14.5.11.7 Contours

Include:

- Contours of finished grades, finished pavement elevations
- Major contours at 5’ or 10’ intervals.
- Do not exceed 2’ minor contour intervals
- Label each index contour at least once per

14.5.11.8 Right-of-Way and Easement Lines

Include all:

- Right-of-way lines
- Easement lines
- Monuments
- Subdivision lines.

14.5.11.9 Typical Details

Clearly indicate specific elements of construction.

They may include track way, roadway, station site, and other civil details.

14.5.11.10 Typical Cross-Sections

Include to ST as a reference drawings in a clear, organized, and readable manner.

Prepare cross-sections perpendicular or radial to the centerline at 50-feet intervals and sharp breaks in the terrain, to determine earthwork quantities.

14.5.12 Roadway Plan and Profile Plans

Indicate elevations of street surfaces matched.

Define the “pay limits” of areas constructed or restored. Include a reasonable area outside the limits for excavation and areas damaged by relocation of utilities.

Include PROPOSED item(s) affected by construction:

- Structure outlines
- Street lines
- Walls
- Temporary easements
- Permanent easements
- Sidewalks
- Fences
- Guard rails

- Curbs
- Alleys
- Catch basins
- Manholes

Include EXISTING items or reference to other plans:

- Typical sections
- Existing and new elevations
- Other details for areas paved, repaved, or restored

14.5.12.1 Plan View

Scale = 1”=20’-0”

Include for Alignment:

- Alignment line
- Curves labeled with station & abbreviations.
- Points of curvature and intersection on the alignment as an open circle 1/16-inch in diameter with a leader line to the circle.
- Station tick marks at every 50’.
- Stationing at every 200’ Station labels

Include for Curbs:

- Curb improvements (face, back of curb, lip & gutter) and sidewalks
- Proposed concrete and asphalt surfaces, filled with a hatch pattern.

Include for Utilities:

- Proposed utilities that are constructed under separate plans
- Existing utilities that are not relocated
- Include for Subdivisions:
- All city, county, and other government jurisdictional lines.

Include for Street and Place Names:

- Street, Highway, & Railroad Names
- City and County Names
- Significant Points of Interest Labels to include:
  - Civic and Community Centers
  - Educational Facilities
  - Military establishments
  - First Responder Facilities
  - Religious Centers
  - Parks
  - Race tracks

14.5.12.2 Profile

Horizontal scale at 1” = 20’

Vertical scale at 1” = 5’.

Include for Profile Grid:

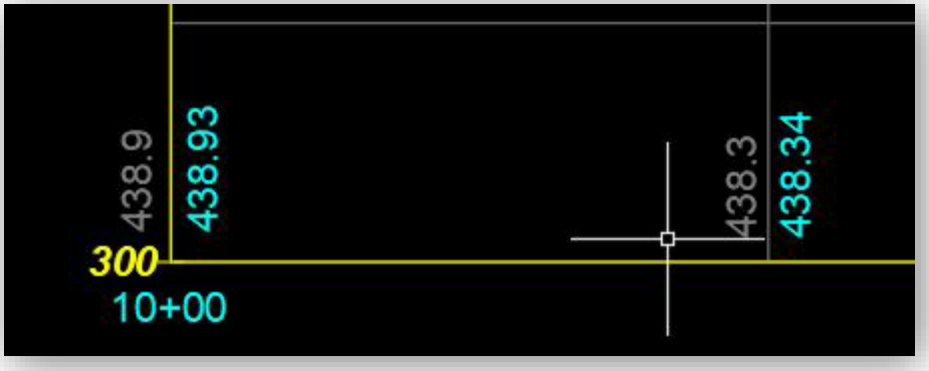
- Elevations on the left and right side of each profile grid and at breaks.

- Stationing labels at the bottom of the profile grid every 100 feet.

Place the grid behind objects in the view.

Profile Band:

At each major and minor station line Profile View Band Styles are set to label existing ground elevation on the left and proposed grade elevation on the right.



Include for Profile Grade:

- Control line profile
- Significant points defining changes in grade
- Label all Points of Vertical Change.
- Profile tangent intersections
- Station labeled with the abbreviation “PVI” and elevation of the PVI.
- Show profile grade elevations at:
  - Even fifty feet horizontal intervals
  - Each end of vertical curves
  - The beginning and end of the project

Include for Profile Labels:

- All Labels.
- Profile grade line with “PGL” at least once on each drawing.
- Profile Ground Line with “EGL” at least once per drawing.
- Grade in % on top of all vertical tangents using sign convention, + 2.54%.
- Length of vertical curve above the PVI label.

Include for Utilities:

- All crossing utility lines.

14.5.13 Grading Plans

Scale: same as existing conditions

Include:

- All right-of-way and easement lines.

- Labels of trees and landscaping saved, unless already on landscaping plans.
- Parking lots, city and county streets, and highways:
- Existing ground
- Proposed finish grading
- Erosion control measures

Include for Contours:

- Contours defining finished grades and finished pavement elevations
- Major contours at 5 feet or 10 feet intervals
- Minor contours at 1 foot or 2 feet intervals
- Label at each index contour a minimum of once on each drawing.
- Spot elevations for ramps

Do not exceed 2' minor contour intervals.

Include for Elevations:

- Finished graded surfaces
- Limits of restoration in areas graded.

14.5.14 Drainage Plan and Profiles

The construction of new or relocation of existing drainage facilities.

Use the same criteria as the Site Plans outlined in section ***14.5.11*** as well as the following.

Adhere to additional requirements by local jurisdictions

Use ST CIVIL 3D Styles included for all elements and labels in plan and profile.

Create enlarged detail plans when clarity is needed per section ***14.6.8***.

Include:

- Labels of existing contours and drainage elevations, unless adequately represented on other drawings.
- Labels of the type, size, material, and owner of each structure, pipe facility types of channels, and gutters.
- Cross-references to proposed utilities work in other plan or profile drawings.
- All right-of-way and easement lines.
- Layout of new and relocated:
- Storm sewer facilities
- Pipes
- Manholes
- Catch basins
- Vaults
- Other appurtenances
- Existing and proposed:
- Sidewalks
- Curbs
- Ramps
- Driveways
- Other surface features constructed or affected by construction including:

- Water course
- Closed storm drainage systems
- Other facilities.

14.5.14.1 Drainage Plans

Scale = 1’=20’

Include for Contours:

- Contours of finished grades and finished pavement elevations
- Major contours at 5’ or 10’ intervals.
- Minor contours at 1’ or 2’ intervals
- At least one label at each index contour on each drawing.
- Do not exceed 2’ minor contour intervals.

Include for Adjoining Drainage:

- Areaways
- Window walls
- Doorways
- Other pertinent surface features
- Existing and proposed elevations

Include for Existing Utilities:

- Existing Utility line
- Existing Utility Labels

Set line types of scales to show utility line types at correct scale for plan viewport.

14.5.14.2 Drainage Profiles

Horizontal scale: 1"=20'

Vertical scale: 1"=5'

Include:

- Profile grade line labeled with “PGL” at least once per drawing.
- Profile Ground Line labeled with “Existing G/L” at least once per drawing.
- Elevation of grades and manhole covers.

Include the type and location of:

- Manholes
- Catch basins
- Inlets

Include for pipes:

- Material
- Diameter
- Bedding
- Slope
- Length
- Invert elevations at drainage structures

Label all pipe slopes with the percent symbol (%).

14.6 Utilities Series

Include all utility interests and uses required to construct, maintain, protect, and operate the transit system.

14.6.1 Omitted Information

Omit certain information from the drawings to increase clarity and overall presentation if they are highly congested.

Include a note in the drawing listing the missing information and include a reference to the drawing(s) containing it.

14.6.2 Drawing Order

- General Utility Notes, Abbreviations, and Legend
- Key Plan
- Existing Utility Plans
- Composite Utility Plans
- Utility Specific Relocation Plans and Profiles
- Enlarged Utility Detail Plans

14.6.3 General Utility Notes, Abbreviations, and Legend

Larger projects (Corridor and Major Systems) include this drawing at the beginning of the series.

Smaller projects (Renovations and JOC) include this along with other discipline specific information in the General drawings.

14.6.4 Key Plan

Include per section 14.2.7

14.6.5 Existing Utility Plans

Scale: Same as the Roadway

The plans depict the available survey and mapping concerning existing utilities.

Create this set of drawings if the Composite Utility Plans are illegible. Gain approval from the ST Utility coordinator prior to creating.

Include:

Any utility pothole data in the plan drawing and/or in a drawing schedule.

Overhead vertical clearance of an overhead utility

Depth of an underground utility

Identify for guy wires, strain poles, and related appurtenances:

- Size or diameter
- Pipe class
- Voltage

- Location

Identify for manholes:

- Size
- Configuration
- Rim, Inlet, and Outlet Elevations

Identify for all utility objects:

- Owner
- Type
- Size
- Material
- Overhead or Underground

14.6.5.1 Added Information for Major Utilities

Include:

- Large diameter pipelines of 24-inches or higher. Show as two lines representing each side of the utility.
- Labels for 110kV or higher electrical utilities.
- Gravity utilities parallel to proposed light rail.

14.6.5.2 Projects using Subsurface Utility Engineering methods

Designate the definitions of quality levels A through D.

Designate the quality level of specific information shown on the drawings.

Refer to ***ASCE 38-02***

14.6.6 Composite Utility Plans

Scale: Same as the Roadway Plans.

The plans show all existing and proposed utilities included in the project to:

- Demonstrate resolution of conflicts between existing and proposed utilities.
- Identify utility relocation work by others that are included in the project.
- Include reference to other drawings where proposed utilities work is presented.

Use enlarged plans, or equivalent, to include clarity in areas of high congestion.

Create enlarged detail plans for clarity is needed per section ***14.6.8***.

Include:

- Relationship of existing facilities to temporary and permanent utility relocations.
- Additional AHJ requirements.
- All storm drainage and utility facilities included in the project.
- Type, size, and material of each utility.
- These utilities and their ancillary facilities:
- Electric Power
- Water/ Fire mains
- Telephone

- Sanitary, storm, combined sewers
- Cable TV
- Fiber Optics
- Telegraph
- Railroad comm. and signal cables
- Other utilities as necessary
- Streetlight and traffic signals

14.6.6.1 Clarifications and Exclusions

Include a note stating the intent and extent of the Composite Utility Plans. For example, when the drawing does not include all existing utilities or easements in the area.

14.6.7 Utility Specific Relocation Plans and Profiles

Shows construction of new utilities, relocation of existing, or work by the utility owners.

When developing:

- Base them on coordinated agreements with utility owners with ST Utility lead authorization.
- Include utility relocation work performed by others.
- Indicate for each utility:
- Type
- Size
- Material
- Owner

Include:

- Storm drains
- Water/Fire mains
- Gas mains
- Electrical facilities
- Telephone facilities
- Telegraph facilities
- Sanitary and combined sewers
- Other utilities as necessary
- Street lighting
- Cable TV facilities

14.6.7.1 Plan

Scale: 1"=20' or match to the scale of the composite plans of existing utilities.

14.6.7.2 Profile

Horizontal scale: 1”=20’

Vertical scale: 1”=5’

Adjust scales as needed to include all necessary information.

14.6.8 Enlarged Utility Detail Plans

These drawings

Horizontal scale: 1"=20'

Vertical scale: 1"=5'

Criteria information in ***14.5.14, 14.6*** and the subsections are followed

14.7 Traffic Series

The series shows the total of all traffic interests and uses required to construct, maintain, protect, and operate the transit system.

14.7.1 Drawing Order

- General Traffic Notes, Abbreviations, and Legend
- Key Plan
- Pavement Marking
- Illumination
- Traffic Signal
- Wiring Schedules and Details
- Signing
- Construction Staging
- Maintenance of Traffic

14.7.2 General Traffic Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series

14.7.3 Key Plan

Include per section 14.2.7

14.7.4 Pavement Marking

Shows the following existing and proposed items:

- Light poles
- Manholes
- Catch basins
- Curbs
- Sidewalks
- Driveways
- ROW

Do not include

- Existing or Proposed underground utilities
- Existing base map labels
- Contours

Show with sufficient detail and dimensions to enable the contractor to prepare templates for fabrication and installation.

14.7.5 Illumination

Include existing and proposed items:

- Light poles
- Handholes
- Conduit systems and other features.
- Surface features

Do not Include:

- Existing base map labels not related to Illumination
- Existing or proposed contours

Show with sufficient detail and dimensions to enable the contractor to prepare for fabrication and installation.

14.7.6 Traffic Signal

Include ***Temporary*** and ***Permanent*** items:

- Traffic signals
- Equipment layouts
- Vehicle detection
- Pole Schedule
- Wiring diagrams
- Construction details
- Interconnected conduit and wiring
- Existing and Proposed Surface features

Do not Include:

- Existing base map labels not related to Traffic Signals
- Proposed or Existing Contours

Show with sufficient detail and dimensions to enable the contractor to prepare for fabrication and installation.

Adhere to requirements from the Washington State Department of Transportation (WSDOT) and the Manual on Uniform Traffic Control Devices (MUTCD) or the governing municipality.

14.7.7 Wiring Schedules and Details

Include in tabular form:

- Conduit size
- Conductor number and size
- Circuit designations for each element of the power distribution system

Include in tabular or graphic form:

- Type and size of handholes
- Other construction details.

Include the following ***Pole Details*** in tabular form for each luminaire:

- Fixture type
- Wattage
- Mounting height

14.7.8 Signing

Include:

- Sign summary in tabular form

- Existing and proposed Surface features
- All street and highway signs:
- Installed
- Removed
- Modified
- Detail drawings showing:
- Sign colors
- Legends
- Size
- MUTCD designations

Do not include

- Existing or Proposed underground utilities, existing base map labels
- Proposed or Existing Contours

Show with sufficient detail and dimensions to enable the contractor to prepare templates for fabrication and installation.

14.7.9 Construction Staging

Includes the contractor with a possible method of completing contract work.

Include footprint of:

- Facilities being built
- Lay-down areas
- Site access
- Site constraints for major construction stages

14.7.10 Traffic Control

Include:

- Traffic staging
- Traffic detours
- Highway, street, and sidewalk areas closed for some duration
- Other requirements for vehicles, pedestrians, and bicycles

14.8 Structural Series

The series shows the total of all structural interests and uses required to construct, maintain, protect, and operate the transit system.

14.8.1 Categories

Structural drawings are organized into three primary categories:

- Transit
- Non-Transit
- Station

14.8.1.1 Transit Structural Drawings

Include line structures that carry transit train loading:

- Cut-and-cover structures
- Tunnel structures
- Aerial structures
- Retaining structures for cut or fill

Include relevant facilities near transit operations:

- Ventilation structures
- Substations
- Pump stations
- Retaining walls
- Drainage structures
- Buildings

Include typical transit line structures:

- Aerial Structures
- Grade Separations
- Subway Structures
- Retained Cuts
- Retained Fill

Show with sufficient detail and dimensions to enable the contractor to prepare for fabrication and installation.

14.8.1.2 Non-Transit Structural Drawings

Show grade separation structures that carry highway or railroad loadings.

Include other non-transit related structures:

- Utilities
- Drainage structures
- Retaining walls

Include typical non-transit (grade – separation) structures:

- Highway bridges
- Railroad bridges

Show with sufficient detail and dimensions to enable the contractor to prepare for fabrication and installation.

14.8.1.3 Station Structural Drawings

Shows transit passenger stations.

14.8.2 Organization

14.8.2.1 Transit Structures

Line Structures:

- Aerial structures
- Grade separations
- Subway structures
- Retained cuts
- Retained fill

14.8.2.2 Non-Transit Structures

Grade-Separation Structures:

- Highway bridges
- Railroad bridges

14.8.3 Drawing Order

14.8.3.1 Aerial and grade separated structures

- General Plan and Elevation
- General Structural Notes and Abbreviations, and Legend
- Key Plan
- Foundation Plan
- Foundation Details
- End Bent Plan
- End Bent Elevations
- End Bent Sections and Details
- Intermediate Bent Plans
- Intermediate Elevations
- Intermediate Sections and Details
- Superstructure Plans
- Superstructure Elevations
- Superstructure Sections
- Superstructure Details
- Miscellaneous Details
- Standard Details (if applicable)

14.8.3.2 All Other Structures

- General Structural Notes, Abbreviations and Legend
- Key Plan
- Structural Plans
- Foundation Plans
- Plans and Framing Plans

- Elevations
- Sections
- Details
- Schedule
- Standard Details (if applicable)

Show with sufficient detail and dimensions to enable the contractor to prepare for fabrication and installation.

14.8.4 General Structural Notes, Abbreviations, and Legend

Contains a summary of considerations needed for the design and installation of the permanent structure.

For example:

- Basis for the design
- Precautions for construction
- Design requirements for temporary structures

Include this drawing at the beginning of the series

14.8.5 Key Plan

Include per section *14.2.7*

14.8.6 Structural Plans

Scale: varies from 1" = 10' to 1" = 50'.

Shows the overview of the structure in plan.

Include:

- General arrangement and features of the structure
- Significance of the interface areas with adjacent structures
- Existing trees or facilities protected

14.8.7 Foundation Plan

Scale: varies from 1/16" = 1’-0” to 1/4" = 1'-0".

Contains plans, sections, and details of the structure’s foundation.

Include:

- Excavation
- Backfill
- Footing
- Piles
- Caissons
- Underpinning
- Footing drainage
- Other permanent protective structures

14.8.8 Plan and Framing Plans

Scales may vary from 1/16" = 1’-0” to 1/2" = 1'-0".

Include:

- Plan view of the structure
- Arrangement of structural components at designated elevation or floor level.
- Concrete beam depth, including depth of slab and beam.
- All column sizes.

14.8.9 Elevations

Scale: varies from 1/16" = 1’-0” to 1/2" = 1'-0".

Include:

- Vertical view of the structure
- Arrangement of structural components

14.8.10 Sections

Scales may vary from 1/4" = 1’-0” to 3" = 1'-0”.

14.8.11 Details

Scales may vary from 1/4" to 1"= 1'.

14.8.12 Schedules

Contains structural components, summarizing their individual physical properties and applications in tabular format.

Include:

- Component designation
- Locations
- Dimensions

14.9 Architectural Series

The series shows the total of all architectural interests and uses required to construct, maintain, protect, and operate the transit system.

14.9.1 Drawing Order

- General Architectural Notes, Abbreviations, and Legend
- Key plan
- Site plans
- Floor plans
- Roof plans
- Reflected ceiling plans
- Longitudinal and transverse sections
- Wall sections
- Exterior and interior elevations
- Sections and elevations and partial plans
- Exterior and interior details
- Door schedules
- Finish schedules
- Elevators
- Escalators

14.9.2 General Architectural Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series .

14.9.3 Key Plan

Include per section ***14.2.7***

14.9.4 Site Plans

Scale: 1”=100’ for station site and adjacent structures.

Scale: 1”=20’ for station site only.

Include the location and boundaries of:

- Station sites
- Parking layout
- Landscaped areas

14.9.5 Floor Plans

Scale: 1/8"=1'-0"

Use enlarged plans to define more detailed dimensioning and layouts at 1/4” = 1’-0” or larger.

Include:

- Each station level
- Layout of all ancillary rooms
- All spaces dimensioned

- All room names and numbers
- All door numbers
- All partition types

Follow the naming and numbering definitions in the ST maintained ***Light Rail Equipment and Facilities Numbering Standard manual.***

If names and numbers are not defined at the beginning of the project, leave blank and include when defined by ST.

14.9.6 Roof Plans

Scale: 1/8”=1’-0”

Include:

- Direction of slope
- Roof penetrations
- Material callouts
- Relevant dimensions
- Fall protection equipment
- Walk mats

14.9.7 Reflected Ceiling Plans

Scale: 1/8"=1'-0", or 1/4”=1'-0", or the same as the architectural floor plans.

Include:

- All items in the ceiling located by dimensions.
- All exposed ceiling grids in each room for layout purposes.

14.9.8 Longitudinal and Transverse Sections

Scale: 1/8"=1'-0"

Include all relevant:

- Vertical dimensions
- Callouts
- Other information to depict the overall facility design

14.9.9 Wall Sections

Scale: 1/4” = 1’-0”

Include detailed materials and their assemblage and fire resistance rating.

14.9.10 Exterior Elevations

Scale: 1/8"=1'-0" or 1/4"=1'-0".

Include all exterior views of the facility with:

- Relevant vertical dimensions
- Material callouts

14.9.11 Interior Elevations

Scale: 1/8"=1'-0" or 1/4"=1'-0".

Include relevant dimensions and callouts if not clearly shown in the plan view.

14.9.12 Sections, Elevations, and Partial Plans

Scale: 1/4"=1'-0" or 1/2"=1'-0".

Include all relevant:

- Dimensions
- Callouts
- Other information needed

14.9.13 Details Exterior and Interior

Scale: 1/2"=1'-0", 3/4"=1'-0", 1"=1'-0", 1 1/2"=1'-0" or 3"=1'-0".

Include all relevant:

- Dimensions
- Callouts
- Other information needed

14.9.14 Door Schedule

Include:

- Door Number
- Size
- Fire resistance rating
- Door type
- Finished hardware type
- Detail references
- Security designation and access control

14.9.15 Finish Schedule

Include for all floors, walls, and ceilings:

- Room height
- Material
- Finish

14.9.16 Elevators / Escalators

Vertical transportation machinery drawings.

Include:

- Vertical conveyance machinery
- Vertical transportation equipment rooms
- Hoist ways
- Other areas related to their operation and maintenance

14.10 Landscaping Series

The series shows the total of all landscape interests and uses required to construct, maintain, protect, and operate the transit system.

14.10.1 Drawing Order

- General Landscaping Notes, Abbreviations, and Legend
- Key Plan
- Hardscapes Plans and Details
- Planting Plans, Details, and Schedules
- Irrigation plans
- Tree locations
- Tree & Plant Location Protection Plans. Details and Schedules
- Miscellaneous Plans and Details

14.10.2 General Landscaping Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.10.3 Key Plan

Include per section ***14.2.7***

14.10.4 Hardscape Plans and Details

Plan scale: same as the civil drawings or 1’=100' for an overall plan

Detail scales: 3/4"=1'-0", 1 1/2"=1'-0", 3"=1'-0".

Include:

- Urban design
- Special walking finishes
- Bollards
- Bicycle racks, lockers
- Tree grates
- Benches
- Lighting
- Fencing
- Retaining walls
- Ramps
- Stairs
- Shade structures
- Site furnishings
- Artwork infrastructure
- Bus and transit shelters

Do not Include:

- Underground utilities
- Base map labels
- Contours.

Show with sufficient detail and dimensions to enable the contractor to prepare for installation.

14.10.5 Planting Plans, Details, and Schedules

14.10.5.1 Plans

Scale: same as the civil drawings or at 1’=100' for overall plan.

Include:

- Tree locations
- Shrub and ground cover spacing
- Lawn areas

Do not Include:

- Underground utilities
- Base map labels
- Contours

14.10.6 Detail

Scales: 3/4"=1'-0", 1 1/2"=1'-0", 3"=1'-0".

Show the construction and installation requirements

14.10.6.1 Schedule

Include for each type:

- Botanical name
- Quantity
- Size

Show with sufficient detail and dimensions to enable the contractor to prepare for installation.

14.10.7 Irrigation Plans

Include with the different zones:

- Head types
- Controller location
- Vacuum breakers
- Electrical connections
- Main connection to the water source
- Meters
- Backflow preventer
- Pressure-reducing
- Detail drawings to show the construction and installation requirements.

Do not Include:

- Underground utilities
- Base map labels
- Contours.

Show with sufficient detail and dimensions to enable the contractor to prepare for installation.

14.10.8 Tree & Plant Location Protection Plans, Details, and Schedules

14.10.8.1 Plans

Scale: same as civil drawings or at 1’=100' for an overall plan.

Include:

- Locations
- Saved and Protected trees and plants
- Removed trees and plants
- Limits of tree protection
- Fencing
- Plywood walls
- Details of mulch
- Notes to include maintenance during construction:
- Watering
- Fertilizing
- Pruning
- Roots

Do not Include

- Existing or Proposed underground utilities
- Base map labels
- Contours

14.10.8.2 Details

Scales: 3/4"=1'-0", 1 1/2"=1'-0", 3"=1'-0".

Show with sufficient detail and dimensions to enable the contractor to prepare for installation.

14.10.9 Miscellaneous Plans and Details

14.10.9.1 Plans

Scale: same as civil drawings or at 1’=100' if an overall plan is needed.

Include applicable areas to locate these special requirements.

Add drawings as required to show the extent of special requirements.

14.10.9.2 Details

Scales: 3/4"=1'-0", 1 1/2"=1'-0", 3"=1'-0".

Include construction and installation requirements.

14.11 Mechanical Series

The series shows the total of all mechanical interests and uses required to construct, maintain, protect, and operate the transit system.

Organize into categories:

- Transit station
- Transit line
- Tunnel emergency ventilation
- Maintenance facilities
- Garages

Items included in mechanical series to reflect previous process of Equipment Clearance Diagram review, per PIIP requirements.

14.11.1 Drawing Order

- General Plumbing Notes, Abbreviations, and Legend
- Key plan
- Plumbing and Drainage Plans
- Plumbing and Drainage Equipment Room Layouts
- Plumbing and Drainage Riser Diagrams
- Plumbing and Drainage Sequence of Operations (if applicable)
- Miscellaneous Piping Systems
- Plumbing and Drainage Schedules
- Standard Plumbing Details (if applicable)
- General Fire Protection Notes, Abbreviations, and Legend
- Fire Protection Plans
- Fire Protection Valve Room Layout (Enlarged Plans and Details)
- Fire Protection Schedules
- Standard Fire Protection Details (if applicable)
- General HVAC Notes, Abbreviations, and Legend
- HVAC Plans
- HVAC Equipment Room Layout
- HVAC Plan and/or Equipment Room Sections (if applicable)
- HVAC Control Systems and Instrumentation Diagrams including Sequence of Operations
- HVAC Air Flow Diagrams
- HVAC Schedules
- Standard HVAC Details (if applicable)

14.11.2 General Plumbing Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.11.3 Key Plan

Include per section ***14.2.7***

Also include the structures and applicable portions of the parking lot(s) and show:

- Utility connection points
- Equipment room locations
- Areas that are sprinkled including temperature conditions

14.11.4 Plumbing and Drainage Plans

These drawings show the general arrangement of plumbing and drainage piping.

Scale: 1/8”=1’-0”

Include the architectural floor plan with room names and numbers as a grey background.

Do not show non-applicable architectural information, such as room finishes and door schedules.

14.11.5 Plumbing and Drainage Equipment Room Layouts

Scale: 1/4”=1’-0”

These drawings show the general arrangement of plumbing and drainage equipment.

Include:

- Water heaters
- Circulating pumps
- Sump pumps
- Sewage ejectors
- Oil/Water separators

14.11.6 Plumbing and Drainage Riser Diagrams

These drawings show a schematic diagram of plumbing and drainage piping systems.

Include sequential arrangement of fixtures and devices to show the intent of the design.

14.11.7 Plumbing and Drainage Sequence of Operations (if applicable)

These drawings show the sequence of operations establishing functional intent and serves as basis for necessary controls and elements needed to manage functionality.

14.11.8 Miscellaneous Piping Systems

These drawings show the general arrangement of miscellaneous piping systems, for example, a compressed air system.

Include flow diagram of each system riser diagram for complex systems and equipment installation details.

Include the architectural plan with room names and numbers as a grey background.

Do not show non-applicable architectural information, such as room finishes and door schedules.

14.11.9 Plumbing and Drainage Schedules

These drawings show lists of plumbing and drainage fixtures and devices.

Include with other pertinent information used for the design:

- Trap sizes
- Supply sizes
- Vent sizes
- Lavatories
- Drain fixtures
- Hose bibs
- Water closets

14.11.10 Standard Plumbing Details (if applicable)

Scale: VARIES

Detailed drawings and enlarged plans for clarity.

Include with other pertinent information used for the design:

- Methods of plumbing installation
- Equipment configuration
- Fixture mounting
- Control diagrams

14.11.11 General Fire Protection Notes, Abbreviations and Legend

Include this drawing at the beginning of the series.

14.11.12 Fire Protection Plans

These drawings show the fire department connection and associated fire hydrants.

Include:

- Point of service connection.
- General arrangement of wet and dry standpipe piping.
- General layout and occupancy of sprinkler system arrangement.
- Typical sprinkler head location.
- Drainage supply main, cross mains, and pitch.
- Clearly distinguishable protected and non-protected areas.
- Location and arrangement of Clean Agent protection, including the releasing panel location.

Include the architectural plan with room names and numbers as a grey background.

Do not show non-applicable architectural information, such as room finishes and door schedules.

14.11.13 Fire Protection Valve Room Layout (Enlarged Plans and Details)

These drawings show the general arrangement of fire protection supply piping and devices,

Scale: 1/4”=1’-0”

Include:

- Backflow preventers
- Check valves
- Fire Pumps
- Risers
- Test drains

14.11.14 Fire Protection Schedules

Include:

- Fire hose valves
- Air release vent valves
- Fire Department Connections
- Pumps and jockey pumps
- Valves:
- Control
- Dry
- Wet
- Pre-action
- Deluge
- Check
- Double check
- Sectional
- Isolation
- Low point drain
- Test connection

14.11.15 Standard Fire Protection Details (if applicable)

Scale: VARIES

Include:

- Methods of fire protection installation
- Equipment configuration
- Fixture mounting
- Freeze protection
- Minimum head clearances
- Drains
- Bracing
- Structural design of guideway standpipe and other unique systems

14.11.16 General HVAC Notes, Abbreviations and Legend

Include this drawing at the beginning of the series.

14.11.17 HVAC Plans

These drawings show the general arrangement of duct routing.

Include:

- Louver/penetration identification
- Refrigeration and chilled water lines

Include the architectural plan with room names and numbers as a grey background.

Do not show non-applicable architectural information, such as room finishes and door schedules.

14.11.18 HVAC Equipment Room Layout

These drawings show the general arrangement of air-handling equipment.

Scale: 1/4”=1’-0”

Include space allocations for component replacement and equipment maintenance.

14.11.19 HVAC Plan and/or Equipment Room Sections (if applicable)

These drawings show the mechanical and ancillary rooms that house Air Conditioning Units and fans.

Scale: 1/4”=1’-0”

Include rooms above the HVAC equipment or areas where the equipment and duct work are congested (stacked).

14.11.20 HVAC Control Systems and Instrumentation Diagram including Sequence of Operations

These Drawings show the schematic diagram of the control system, instrumentation devices, and their interconnecting piping and tubing.

Scale: Show the intent of the design.

Include the sequence of operations for all HVAC equipment.

14.11.21 HVAC Air Flow Diagram

These drawings show the schematic portrayal of air movement from air-handling equipment to conditioned space and its return or dispersal.

If room is positive to adjacent rooms add “+” symbol with “(positive pressure)” note for that room.

Include make-up air and component arrangement at an adequate size to show the intent of the design.

14.11.22 HVAC Schedules

Listing of HVAC equipment and devices.

- Air Conditioning Unit Condensers,

- Emergency fans/dampers (smoke control, other)
- Barometric relief dampers
- Emergency/standby power connections
- Damper fail-safe positions
- Sensors

Include pertinent information used for the design or minimum requirements including fan capacity and filter efficiency.

14.11.23 Standard HVAC Details (if applicable)

These drawings show details of HVAC ductwork and piping, including their fittings, accessories, and installation.

Scale: VARIES

14.12 Electrical Series

The series shows the total of all electrical interests and uses required to construct, maintain, protect, and operate the transit system.

Items included in electrical series to reflect previous process of Equipment Clearance Diagram review, per PIIP requirements.

14.12.1 Definition:

Busway – A raceway consisting of a metal enclosure containing factory-mounted, bare, or insulated conductors, which are usually copper, or aluminum bars, rods, or tubes.

Cablebus – An assembly of units or sections with insulated conductors having associated fittings forming a structural system used to securely fasten or support conductors and conductor terminations in a completely enclosed, ventilated, protective metal housing. This assembly is designed to carry fault current and to withstand the magnetic forces of such current.

Cable Tray System – A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways.

Conduit – A type of Raceway

Direct-Buried Cables – Underground direct-buried cables that are not encased or protected by concrete and buried 750 mm (30 in.) or more below grade must have their location identified by a warning ribbon that is placed in the trench at least 300 mm (12 in.) above the cables.

Ductbank – Ductbanks are groups of conduits designed to protect and consolidate cabling to and from building. In a ductbank, data and electrical cables are laid out within PVC conduits that are bundled together; these groupings of conduit are protected by concrete and metal casings. NOTE: ***See ST Requirements Manual SET 1007.***

Handhole Enclosure – An enclosure for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both.

Innerduct – A nonmetallic raceway placed within a larger raceway.

Metal Wireways – Drawing metal troughs with hinged or removable covers for housing and protecting electrical wires and cable and in which conductors are laid in place after the raceway has been installed as a complete system.

Nonmetallic Wireways – Flame-retardant, nonmetallic troughs with removable covers for housing and protecting electrical wires and cables in which conductors are laid in place after the raceway has been installed as a complete system.

Raceway – An enclosed channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in NFPA 70.

Raceway, Communications – An enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables; optical fiber

cables; data cables associated with information technology and communications equipment; Class 2, Class 3, and Type PLTC cables, and power-limited fire alarm cables in plenum, riser, and general-purpose application.

Strut-Type Channel Raceway – A metal raceway that is intended for mounting to the surface of or suspended from a structure, with associated accessories for the installation of electrical conductors and cables.

Surface Metal Raceway – A metal raceway that is intended for mounting to the surface of a structure, with associated couplings, connectors, boxes, and fittings for the installation of electrical conductors.

Underfloor Raceway – A raceway and associated components designed and intended for installation beneath or flush with the surface of a floor for the installation of cables and electrical conductors.

14.12.2 Organization

Show the following areas:

- Station area
- Ancillary rooms
- Auxiliary electrical room
- Other relevant areas

Include:

- Embedded raceways
- Recesses
- Opening sleeves
- Panel boards, switchboards, and switchgear (if applicable)
- Junction boxes
- Cable raceways
- Duct bank schedules and details
- Light fixtures: normal lights, emergency lights and emergency exit light sign (if applicable with arrow direction)
- Signs
- Switches
- Receptacles
- Transformers
- Control and disconnect switch equipment
- Grounding
- Utility transformer and utility meter (if applicable)
- Engine generator and automatic transfer switch (if applicable)
- Generator plug and manual transfer switch (if applicable)
- UPS / lighting inverter
- Lighting control panel
- Energy code requirements
- NEC (NFPA 70) requirements (if applicable)
- NFPA 130 requirements (if applicable)
- EVS / BMS / TCS
- Fire alarm

- Communications

14.12.3 Drawing Order

Note: This section's drawing order varies, expected to have combination of Power, Lighting, Fire Alarm, BMS / EVS, Communication, and Signal.

- General Electrical Notes, Abbreviations, and Legend
- Power Single-Line Diagram
- Panel Schedules
- Key Plan
- Power Riser Diagram
- Power Plans
- Grounding Riser Diagram
- Grounding Plans
- Exterior Lighting Plans
- Interior Lighting Plans
- Lighting Fixture Schedule
- Power & Lighting Raceway Wire Schedules
- Lighting Control Schedules
- Power & Lighting Enlarge Plans, Details Sections, and Elevation
- Fire Alarm System Diagram
- Fire Alarm Plans
- Fire Alarm Riser Diagram with Conduits, Sub Panels, and Terminal Cabinets
- Fire Alarm Equipment Schedule
- Fire Alarm Raceway Wire Schedules
- Fire Alarm Panel Enlarge Plans, Details, Sections, and Elevation
- Fire Alarm Response Matrix
- EVS Riser Diagrams (Stations Only)
- BMS Riser Diagrams (Stations Only)
- TCS Riser Diagrams
- EVS, BMS, TCS Control Diagrams
- EVS, BMS, TCS Plans
- EVS, BMS, TCS Equipment I/O List
- EVS, BMS, TCS Conduit and Wire Schedules
- EVS, BMS, TCS Enlarge Plans, Details, Sections, and Elevations
- Control Panel Enclosure Layout
- Communication Riser Diagrams
- Communication Plans
- Communication Raceway Wire Schedule
- Communication Enlarge Plans, Details, Sections, and Elevations

14.12.4 General Electrical Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.12.5 Power Single-Line Diagram

Depict both normal and standby power to the panelboard level.

Include all major elements:

- Switchboards/switchgear
- Panels
- Circuit breakers
- Fused-disconnects
- Switches
- Sub-metering
- Transformers
- Motors
- Conductors

Include if a backup system is employed:

- Generator(s)
- Transfer equipment
- UPS
- Bypass equipment

Include for each element, at a minimum:

- Sequence of Operation description for automatic source transfer (if applicable).
- Incoming utility:
- Transformer
- Meter
- Switchboards/Switchgear/Panels:
- Amp and voltage ratings
- System classification, for example 3-phase or 4-wire
- AIC rating for service entrance equipment
- Circuit breakers and fuses:
- Trip-amps
- Applicable poles
- Switches:
- Amp rating
- Applicable poles
- Transformers:
- Winding
- Rating
- Primary and secondary voltages
- Motors:
- Horsepower
- Full-load amp rating
- Generators:
- Rating
- Voltage
- System classification
- Conductors:
- Material
- Insulation
- Size
- UPS:
- Rating

- Input/output voltages
- Bypass and battery circuiting for larger units

14.12.6 Panel Schedules

Include for all panels:

- Location including room numbers (if applicable)
- Panel Number
- Voltage noted as 480Y/277V, 120/208, or 120/240V
- Phase noted as 2 or 3
- Wires notes as 3 or 4
- Panelboard AIC ratings
- Main breaker amps
- Panel bus size

Include for all circuits:

- Circuit number
- Description
- Connected load in KVA and in the correct phase assignment
- Amp's value of the connected load in KVA, if applicable, and in the correct phase assignment.
- Phase
- Circuit breaker size
- Circuit breaker pole
- Description including the load type and equipment number
    - Example: M, N150-EFAN-01
- Description codes:
- M (Motor)
- N150 (Location Code)
- EFAN (Exhaust Fan)
- 01 (Instance number)
- Load Type, Room Number
    - Example: R, M05107, M05108, M05109
- R (Receptacle)
- M05107, M05108, M05109 (room numbers in MOW Bldg.)
- Load Type, Equipment Number (see ST Equipment and Facilities Numbering Standard Manual)
    - Example: LM, E19EL01
- LM (Large Motor)
- E19EL01
- Load Type in the Description are calculated based on NEC (NFPA 70) Demand Factor. Include % factor for each Load Type.
- Include the Total Demand Load in KVA.
- Include the Total Connected Load in KVA.
- Each phase, calculate the Total Amps and Total KVA.

Use the ST Equipment and Facilities Numbering Standard Manual

14.12.7 Key Plan

Include per section *14.2.7*

Also include the general electrical components within the contract limits and shown:

- All electrical utility connection points.
- All major rooms and structures for electrical equipment.
- An overall layout diagraming the electrical systems of power and emergency power.

14.12.8 Power Riser Diagram

The electrical riser diagram indicates system connections travelling vertically through a building or facility. Only major components are depicted.

The following information is included:

- Utility transformer, meter, and incoming service voltage
- Transformer ratings and voltages
- Switchboards, panelboards, disconnects and all major electrical distribution equipment at each level
- Backup power equipment including generators, transfer switches and UPS/Inverters.
- Larger motors, starters and VFD's if applicable
- Conduit connections between each component

14.12.9 Power Plans

Show all electrical equipment and devices.

14.12.9.1 Site Plans

Match site plans as shown in Civil Drawings (if applicable) Make site plans as background layers and all electrical entity are heavy line type.

Include location of incoming service, Utility Transformer, Utility Meter.

Show all equipment with equipment tag. See Mechanical, Plumbing, Architecture, Landscape, BMS/EVS, Lighting, Communication and Fire Alarm drawings for additional information. Check Power Single-Line Diagram (if applicable).

14.12.9.2 Raceways

Include all conduit routes and conduit tags listed in Conduit and Wire Schedules (if applicable).

Show all conduit routes for all conduit sizes. No exemption.

Raceway routes should distinguish above ground, underground, concealed, and exposed.

Design team to reference Sound Transit Requirements for ductbank.

Raceway for Communication and Power must not run in the same ductbank.

Include information from Landscape such as irrigation, backflow preventers and any equipment that needs power requirement. Include equipment tags or equipment call out (if applicable).

When a conduit runs needs to continue inside the building from a site plan, include a cross reference between the site plan and building floor plans.

Include appropriate reference such as matchline, or continuation call out.

14.12.9.3 Floor Plans

Match floor plans as shown in Architect Drawings (if applicable)

Include all electrical equipment shown in Power Single-Line Diagram including the conduit tag.

Show all rooms and furniture (if applicable) including escalators, elevators, and bike lockers with room numbers or as shown on Architectural Series. Make these items in background layer. All electrical entity are heavy line type.

Show all equipment for each floor levels that needs power. See Mechanical, Plumbing, Architecture, BMS/EVS, Lighting (for LCP), Communication and Fire Alarm drawings for additional information. If applicable distinguish devices located on the floor against the ceiling.

14.12.9.4 Raceways

Include all conduit routes and conduit tag listed in Conduit and Wire Schedules.

Show all conduit routes for all conduit sizes.

Distinguish between above ground, underground, concealed, and exposed conduits.

Homerun is only applicable if the device or equipment and the electrical panel feeding power to the device or equipment are in the same room or space.

Include for cable trays:

- Location
- Width
- Mounting height from above finish floor (if applicable).
- A divider, per NEC (NFPA 70) requirements if the communication and power cable are using the same cable tray.
- Equipment served by multiple circuit breakers and feeder routing.

Power requirements must meet the ***ST Requirements Manual SET 1005***.

14.12.10 Grounding Riser Diagram

See NEC (NFPA 70) requirement for Equipment Grounding Conductor (EGC), Grounding Electrode Conductor (GEC), Main Bonding Jumper, Supply-side bonding jumper

Include all electrical equipment including transformers

Include grounding conductor size per requirements.

14.12.11 Grounding Plans

Site Plans – Match Civil Plan viewport limits

Floor Plans – Match Architectural Floor limits

Include grounding routing between equipment rooms.

Include location of grounding equipment such as:

- Grounding bar
- Grounding exothermic connection
- Ground rod
- Ground test

Grounding requirements to meet ***ST Requirements Manual SET 1005***.

14.12.12 Exterior Lighting Plans

Site Plans – include the related Civil Plan view as a grey background.

Exterior Lighting Plans of the building – include the related Architectural Floor Plan view as a grey background.

Parking Garage / Stations – include the related Architectural Floor Plan view as a grey background.

Fixture designation, branch circuit wiring, and other requirements must meet ***ST Requirements Manual SET 1007.***

If applicable, include Type according to the Light Fixture Schedule. Otherwise, locate and label with the following:

- Light poles with mounting height (if applicable)
- Fixture Types
- Illuminated signage
- Panelboard and branch circuit wiring
- Lighting Control Panel (LCP) and relay number (if applicable)
- Handhole for light pole (if applicable)

Include location of photocell (if applicable)

Show location of panelboard and LCP (if applicable)

14.12.13 Interior Lighting Plans

Floor Plans – match floor plan as shown in Architect Drawings. Make The plans background layer. All electrical entities are heavy line type.

Include location of the Lighting Control Panel (LCP) inside the Electrical Room or Electrical Closet (if applicable)

Include branch circuit wiring if not shown in Power Plans.

Locate and designate all fixtures, illuminated graphics and emergency exit sign, and Include the following:

- Type – See ***ST Requirements Manual SET 1007*** for more information.
- Panelboard and branch circuit wiring – ***See ST Requirements Manual SET 1007***.
- Lighting Control Panel (LPC) and relay number (if applicable)

Include conduit routes from light fixture to another light fixture (if applicable)

Show location of all sensors: daylight sensors, motion or occupancy sensors, photocell according to the ***ST Requirements Manual SET 1007***.

Include location of light switch and include if light switch needs weatherproof (WP).

Include Emergency light locations.

14.12.14 Lighting Fixture Schedule

Include separate Light Fixture Schedule for the following:

- Exterior
- Interior
- Tunnel (if applicable)
- Roadway (if applicable)

Lighting Fixture Schedule must consist of the following columns:

- Symbol – Light fixture symbol
- Type – ***See ST Requirements Manual SET 1007***, Luminaire's Types
- Description – manufacturer's light fixture description such as:
- Light fixture's length or dimension (if applicable)
- UL Listing such damp or wet rated – See ***ST Requirements Manual SET 1007***
- Lens or diffuser information – See ***ST Requirements Manual SET 1007***
- Housing or material made (if applicable)
- Minimum Luminaire Lumens output
- Sensor such motion sensor or daylighting sensor integral to the light fixture
- Other crucial information.
- Lamp / LED information
- Type – if linear light such LED or fluorescent lamp, include length (if applicable)
- QTY – include number of lamps per light fixture
- CCT (Kelvin) – See ***ST Requirements Manual SET 1007***
- CRI – See ***ST Requirements Manual SET 1007***
- Manufacturer / Basis of Design
- Ballast / Driver Information
- Ballast / Driver
- Dimming capability (if dimming is integral to the light fixture – include % percentage (if applicable)
- Input Watts
- Voltage
- Mounting – include height information (if applicable)
- Remarks

14.12.15 Power & Lighting Raceway Wire Schedules

Include Raceway Tag for all conduits shown in Power Single-Line Diagram, Panel Schedules, Power Riser Diagram, Power Plans, Exterior Lighting Plans, Interior Lighting Plans, and Lighting Matrix Schedule (if applicable).

The Raceway / Wire schedules must consist of the following columns:

- Raceway Tag (Ex: LXX-N4-01)
- Equipment with (2) sub-column “FROM” and “TO”
- Raceway Size (in inches): (Ex: 2)
- Conductors with information quantity and size (Ex: 3#12)
- Grounding with quantity and size (Ex: 1#12 EGC)

See NEC (NFPA 70) requirement for Equipment Grounding Conductor (EGC), Grounding Electrode Conductor (GEC), Main Bonding Jumper, Supply-side bonding jumper

Comments – this column is for the Designer to add additional information (if applicable).

NOTE: Raceway and Conductor types are as specified in the applicable Spec Section.

Example of Power / Lighting Raceway and Wire Schedules

POWER / LIGHTING RACEWAY AND WIRE SCHEDULES(LOCATION PREFIX LXX)						
RACEWAY TAG	EQUIPMENT		RACEWAY SIZE (IN INCHES)	CONDUCTORS SIZE	GROUNDING SIZE	COMMENTS
	FROM	TO				
N4-01	PB4-01	PB4-02	1.5	3#1	1#1 EGC	

14.12.16 Lighting Control Schedules

Include Lighting Control Diagram

Include Lighting Control Matrix

Include Sequence of Operation

14.12.17 Power & Lighting Enlarge Plans, Details, Sections, and Elevations

14.12.17.1 Enlarge Plans

Equipment Room Layout Scale: 1/4”=1’-0” (if applicable)

Enlarge plan is to clearly to illustrate small area that is hard to shown in the plan view

Enlarge plan must follows the information describe in Power Plans / Exterior / Interior Lighting Plan.

14.12.17.2 Details

Scale: VARIES

Show methods of installation, equipment configuration, and fixture mounting.

Include all relevant dimensions, callout, and other applicable information.

14.12.17.3 Sections

Scale: VARIES

Enlarged scale Sections to clearly illustrate conduit arrangement and to define details necessary for installation.

Include all relevant dimensions, callout, and other applicable information.

14.12.17.4 Elevations

Scale: VARIES

Include all relevant dimensions, callout and other applicable information if not clearly shown in the plan view.

Elevation of electrical equipment such as Motor Control Center (MCC) or Switchgear to include arrangement of the MCC or Switchgear's section.

14.12.18 Fire Alarm System Diagram

Match the symbols used to the Legend and Symbol drawing

Include diagrams for all fire alarm components and devices.

Include power requirements for all components and devices.

Include diagram notes or system operation

14.12.19 Fire Alarm Plans

Site Plans – if applicable match Civil Drawings

Floor Plans – match floor plan as shown in Architectural Drawings

Show the fire alarm field devices throughout the facility.

14.12.20 Fire Alarm Riser Diagram with Conduits, Sub Panels, and Terminal Cabinets

Show fire alarm control panel elevation view that indicates the number and size of cabinets with nipples and square wire way either above or below the panels.

Include:

- Central station communicator
- Remote battery box (if included) and AC power connection.
- An estimate of the wall space included.

- Main conduits diagrammatically extending from the FACP to terminal cabinets, sub panels, remote annunciator indicate the level, floor, and location of each.

14.12.21 Fire Alarm Equipment Schedule

Fire Alarm Matrix

Fire Alarm System Interface Schedule

14.12.22 Fire Alarm Raceway Wire Schedules

Include Raceway Tag for all raceways shown in Fire Alarm Plans

The Raceway / Wire schedules must consist of the following columns:

- Raceway Tag (Ex: LXX-F4-01)
- Equipment with (2) sub-column “FROM” and “TO”
- Raceway Size (in inches): (Ex: 1)
- Conductors with information quantity and size (Ex: xxx)
- Comments – this column is for the Designer to add additional information (if applicable).

NOTE: Raceway and Conductor types are as specified in applicable Spec Section.

Example of Fire Alarm Raceway and Wire Schedules

FIRE ALARM RACEWAY AND WIRE SCHEDULES (LOCATION PREFIX LXX)						
RACEWAY TAG	EQUIPMENT		RACEWAY SIZE (IN INCHES)	CONDUCTORS SIZE	GROUNDING SIZE	COMMENTS
	FROM	TO				

14.12.23 Fire Alarm Enlarge Plans, Details, Sections, and Elevations

14.12.23.1 Enlarge Plans

Equipment Room Layout Scale: 1/4”=1’-0” (if applicable)

Enlarge plan is to clearly to illustrate small area that is hard to shown in the plan view.

14.12.23.2 Details

Scale: VARIES

Show methods of installation, equipment configuration, and fixture mounting.

Include all relevant dimensions, callout, and other applicable information.

14.12.23.3 Sections

Scale: VARIES

Enlarged scale Sections to clearly illustrate conduit arrangement and to define details necessary for installation.

Include all relevant dimensions, callout, and other applicable information.

14.12.23.4 Elevations

Scale: VARIES

Include all relevant dimensions, callout and other applicable information if not clearly shown in the plan view.

Include position of equipment or components within a limited area.

14.12.24 Fire Alarm Response Matrix

Include rows of INPUTS and columns of OUTPUTS.

Inputs are organized as alarm, supervisory and trouble from fire alarm devices and clean agent panels (where applicable) and other equipment.

Outputs must list notification devises, controlled equipment (doors, dampers) and outputs to other equipment such as BMS.

Outputs organized in a logical manner.

Matrix should align closely with the ST control drawing on this topic. Clean agent and pre-action releasing panels must their own response matrix (where included).

Do not merge them into a single matrix.

14.12.25 EVS Riser Diagrams (Stations Only)

The emergency ventilation system riser diagram indicates system connections travelling vertically through a building or facility.

Only major components are depicted, including:

- Distribution Cabinets and Interface Cabinets
- Emergency Fans
- Emergency Fan Dampers
- Emergency Track Dampers
- Emergency Station Dampers
- Emergency Bypass Dampers
- Emergency Fan Sound Attenuators
- Interfaces to Fire Alarm and other Fire-Life Safety systems

14.12.26 BMS Riser Diagrams (Stations Only)

The building management system riser diagram indicates system connections travelling vertically through a building or facility. All components are depicted and often grouped by similar equipment types.

The following equipment is included:

- PLC / DDC Cabinets and I/O Network Equipment
- Access Control and Security Equipment
- HVAC Equipment
- Conveying Equipment
- Power/Lighting Equipment

14.12.27 TCS Riser Diagrams

The train control system riser diagram indicates system connections. All components are depicted and grouped by similar equipment types.

The following equipment is included:

- PLC and I/O Network Equipment
- Wayside Equipment
- TPSS Equipment
- Signaling

14.12.28 EVS, BMS, TCS Control Diagrams

Schematic diagrams of control system, instrumentation, and interconnecting equipment.

Include sequence of operations for all equipment. This sequence should describe controls during normal and abnormal operations with consideration to start-up, shutdown, and emergency operation of the equipment.

Show at an adequate size to show the intent of the design.

14.12.29 EVS, BMS, TCS Plans

Show the ordinate location of tag-marked control components on plan drawings of the facility.

Site Plans – if applicable match Civil Drawings

Floor Plans – match floor plan as shown in Architectural Drawings

14.12.30 EVS, BMS, TCS Equipment I/O List

The BMS, EVS, and TCS Equipment I/O Lists contains control system input/output information for all equipment interfaces.

The following are included:

- System (Ex: HVAC, Electrical)
- Equipment Type (Ex: Access Card Reader, Air Handling Unit)
- Equipment ID (Ex: ACR, AHU)
- PLC I/O Description
- Point Type (Ex: AI, AO, DI, DO, Networked)
- PLC Tag Name
- Local Indication and/or Control required checkbox
- Remote Indication and/or Control required checkbox

14.12.31 EVS, BMS, TCS Conduit and Wire Schedule

Include Conduit Tag for all conduits shown in Riser Diagrams, Control Diagrams, and Plans.

The Raceway & Wire schedules must consist of the following columns:

- Raceway Tag (Ex: LXX-B4-01)
- Equipment with (2) sub-column “FROM” and “TO”

- Raceway Size (in inches): (Ex: 2)
- Conductors with information quantity and size (Ex: Cat6)
- Comments – this column is for the Designer to add additional information (if applicable).

NOTE: Raceway and Conductor types are as specified in the applicable Spec Section.

Example of EVS / BMS / TCS Raceway and Wire Schedules

EVS / BMS RACEWAY AND WIRE SCHEDULES(LOCATION PREFIX LXX)						
RACEWAY TAG	EQUIPMENT		RACEWAY SIZE (IN INCHES)	CONDUCTORS SIZE	GROUNDING SIZE	COMMENTS
	FROM	TO				

14.12.32 EVS, BMS, and TCS Enlarge Plans, Details, Sections, and Elevations

14.12.32.1 Enlarge Plans

Equipment Room Layout Scale: 1/4”=1’-0” (if applicable)

Enlarge plan is to clearly to illustrate small area that is hard to shown in the plan view

14.12.32.2 Details

Scale: VARIES

Show methods of installation, equipment configuration, and fixture mounting.

Include all relevant dimensions, callout, and other applicable information.

Typical wiring panel wiring for power, I/O, and interconnections.

14.12.32.3 Sections

Scale: VARIES

Enlarged scale Sections to clearly illustrate conduit arrangement and to define details necessary for installation.

Include all relevant dimensions, callout, and other applicable information.

14.12.32.4 Elevation: (if applicable)

Scale: VARIES

Include all relevant dimensions, callout, and other applicable information if not clearly shown in the plan view.

Equipment Elevation

14.12.33 Control Panel Enclosure Layout

Scale: VARIES

Include all dimensions and clearances.

Bill of Material

Electrical loads.

Equipment space allocation within panels.

14.12.34 Communication Riser Diagrams

Describe in the Riser Diagram:

- Supervisory
- Control
- IT Networks
- IOT Networks
- Public Address
- Variable Messaging Signs
- Radio
- Closed Circuit TV
- Telephone Systems
- Fire and Intrusion
- Access Control
- Fare Vending
- Parking Management
- Misc. Systems
- Power Monitoring

14.12.35 Communications Plans

Site Plans – if applicable match Civil Drawings

Floor Plans – match floor plan as shown in Architectural Drawings

Show all end devices of systems called out in ***14.12.31***.

14.12.36 Communication Raceway Wire Schedule

Include Raceway Tag for all raceways shown Communication Plans

The Raceway / Wire schedules must consist of the following columns:

- Raceway Tag (Ex: LXX-XX-01)
- Equipment with (2) sub-column “FROM” and “TO”
- Raceway Size (in inches): (Ex: 2)
- Conductors with information quantity and size (Ex: xxx)
- Grounding with quantity and size (Ex: xxxx)
- Comments – this column is for the Designer to add additional information (if applicable).

NOTE: Raceway and Conductor types are as specified in the applicable Spec Section.

Example of Communication Conduit and Wire Schedules

COMMUNICATION RACEWAY AND WIRE SCHEDULES (LOCATION PREFIX LXX)						
RACEWAY TAG	EQUIPMENT		RACEWAY SIZE (IN INCHES)	CONDUCTORS SIZE	GROUNDING SIZE	COMMENTS
	FROM	TO				

14.12.37 Communication Enlarge Plans, Details, Sections, and Elevations

14.12.37.1 Enlarge Plans

Equipment Room Layout Scale: 1/4”=1’-0” (if applicable)

Enlarge plan is to clearly to illustrate small area that is hard to shown in the plan view

14.12.37.2 Details

Scale: VARIES

Show methods of installation, equipment configuration, and fixture mounting.

Include all relevant dimensions, callout, and other applicable information

14.12.37.3 Section

Scale: VARIES

Enlarged scale Sections to clearly illustrate conduit arrangement and to define details necessary for installation.

Include all relevant dimensions, callout, and other applicable information

14.12.37.4 Elevations

Scale: VARIES

Include all relevant dimensions, callout and other applicable information if not clearly shown in the plan view.

Equipment Elevation

Panel/Rack elevation

14.13 Systems Wide Electrical Series

The series shows the total of all systemwide electrical interests and uses required to construct, maintain, protect, and operate the transit system.

See section *14.12.1* for definitions.

14.13.1 Drawing Order

- General Systemwide Electrical Notes, Abbreviations, and Legend
- Key Plans
- Systems Ductbank/Raceway Layout Plans
- Systems Ductbank/Raceway Layout Plan Grade Level
- Systems Ductbank/Raceway Layout Enlarged Plans (for TPSSs)
- Systems Ductbank/Raceway Layout Enlarged Plans (Crossovers)
- Systems Ductbank/Raceway Track Approach Slab Details and Sections
- Systems Aerial Guideway Sections at Grade Communications Device Locations
- Systems Aerial Guideway Section at Bents
- Systems Typical Superstructure Section Typical Dual Track
- Systems Typical Superstructure Section Typical Single Track
- Systems Typical Superstructure Section Overcrossing
- Systems Typical Superstructure Section Span
- Systems TPSS Site Sections and Details
- Systems Precast Vault Details
- Systems Precast Vault Installation Details
- Systems Signal Handhole Installation Details
- Systems Electrical Service Cabinet Details
- Systems Typical at Grade Ductbank Details
- Systems Typical Ductbank/Raceway at Arial Structure Details
- Systems OCS Pole Mounted DC Disconnect Switch Raceway Layout Plans
- Systems TPSS DC Disconnect Switch Pad and Penetration Details
- Systems Handhole Details
- Systems Ductbank/Raceway Details
- Systems Raceway Transition Details
- Systems Aerial Guideway Ductbank/Raceway Details
- Systems TPSSs Basement Details
- Systems Manhole & Pullbox Handhole Schedules
- Systems Handhole Schedules
- Systems TE, MV, & LV Ductbank/Raceway Schedules
- Systems SC Ductbank Schedules
- Systems SC Raceway Schedules

- Systems Traction Power Raceway Schedules
- Systems Communication Cable Schedules
- Systems Elements at Guideway Column Schedules
- Systems Surge Arrestor Schedules
- Systems TPSS Ground Grid Layouts
- Systems Typical Grounding Details
- Systems Typical Aerial Guideway Emergency Guardrail Grounding Details
- Systems Typical Aerial Guideway OCS Pole Mounted Grounding Details
- Systems OCS Surge Arrestor Grounding Details
- Systems Elevated Guideway Grounding Details
- Systems Corrosion Control Details
- Systems Bonding and Stray Current Details
- Systems OCS Foundation Layout Plans
- Systems OCS Foundation Schedules
- Systems OCS Typical Tapered Tubular Pole Foundation Assembly Details
- Systems OCS Typical Tapered Tubular Feeder Pole Foundation Assembly Details
- Systems OCS Pole Typical Down Guy Anchor Pole Foundation Assembly Details
- Systems OCS Typical Wide Flange Pole Foundation Assembly Details
- Systems Square Tubular Pole Foundation Assembly Details

14.13.2 General Systemwide Electrical Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.13.3 Key Plan

Include per section ***14.2.7***

14.13.4 Systems Ductbank/Raceway Layout Plans

Show all segments of Systems Ductbank/Raceway from the start of the alignment to the end of the alignment. Include matchlines or references between drawings so that the entire segment can traced from end to end.

The plans must include:

- Manholes
- Handholes
- Pullboxes.

The Layout plan must show Ductbank/Raceway ID numbers on each drawing depicting the segment. Include for each Manhole, Handhole, and Pullboxes labels in accordance with ST naming standards including the number of Raceways running. The Ductbank/Raceway layouts must include the Center Lines of track (NB/SB, or EB/WB)

14.13.5 Systems Ductbank/Raceway Layout Plan Grade Level

Show Systems Ductbank/Raceway routes to and from the TPSS, Signal Houses, Comm. Rooms, and Utility Services including routing to the Elevated Guideway. Include matchlines or references between drawings so that the entire segment can traced from end to end.

Include:

- Manholes
- Handholes
- Pullboxes

The Layout plan must show Ductbank/Raceway ID numbers on each drawing depicting the segment. Include for each Manhole, Handhole, and Pullboxes labels in accordance with ST naming standard including the number of Raceways running.

14.13.6 Systems Ductbank/Raceway Layout Enlarged Plans (for TPSSs)

Show the entire (Detail) Systems Ductbank/Raceway running to and from inside every TPSS. Include matchlines or references between drawings so that the entire segment can traced from end to end.

Include:

- Manholes
- Handholes
- Pull boxes

14.13.7 Systems Ductbank/Raceway Layout Enlarged Plans (Crossovers)

Show enlarged plan of Ductbank/Raceway routes in a crossover area including Manholes, Handholes, and Pullboxes.

Scale: 1”=10’

14.13.8 Systems Ductbank/Raceway Track Approach Slab Details and Sections

Show detail of the Track approach Slab, and Section of Track Approach Slab.

14.13.9 Systems Aerial Guideway Section at Grade Communications Device Locations

Show a section of dual track at Comm. device location of a guideway with Ductbank/Raceway runs from the top of the guide way to the underground ductbank. Show Manholes and Handholes including conduit supports.

14.13.10 Systems Aerial Guideway Section at Bents

Show Systems Ductbank/Raceway route section plan from aerial guideway to the underground Ductbanks.

Include:

- Pullboxes
- Handholes

- Raceway supports on a different Bent arrangement.

14.13.11 Systems Typical Superstructure Section Typical Dual Track

Show a section view of Systems Ductbank/Raceway on a superstructure aerial guideway in dual track arrangement.

14.13.12 Systems Typical Superstructure Section Typical Single Track

Show section views of Systems Ductbank/Raceway on a superstructure aerial guideway in a single-track arrangement.

14.13.13 Systems Typical Superstructure Section Overcrossing

Show section views of Systems Ductbank/Raceway on a superstructure aerial guideway at a crossover location.

14.13.14 Systems Typical Superstructure Section Span

Show a Systems Ductbank/Raceway on a typical section view of a superstructure Span.

14.13.15 Systems TPSS Site Sections and Details

Show section details of TPSS TE Ductbank/Raceways and TPSS signal/Communication Ductbank/Raceways also showing Pullboxes/Manholes, Raceway supports, & typical conduit expansion fittings.

14.13.16 Systems Precast Vault Details

Show a Precast Vault detail plan and sections for the different types of Vaults used on the project. The plan must include a tabulated Vault dimension schedule.

14.13.17 Systems Precast Vault Installation Details

Show a Typical Vault installation detail including installation of the Vault Lid.

14.13.18 Systems Signal Handhole Installation Details

Show installation details for each type of Signal handholes including their Lids.

14.13.19 Systems Electrical Service Cabinet Details

Show details of a typical electrical service cabinet.

include:

- Electrical service cabinet elevations (Sides and front)
- Electrical service cabinet foundation
- Electrical service cabinet schematic diagram

14.13.20 Systems Typical at Grade Ductbank Details

Show details of Ductbanks at Grade.

include:

- Typical underground Ductbank detail
- Typical Ballasted bridge ductbank and installation at street crossing
- Flush conduit stub details
- Conduit stub-out details

14.13.21 Systems Typical Ductbank/Raceway at Arial Structure Details

Show details of Ductbank/Raceway at Arial Structure:

- Plan at guideway deck which shows Typical Pullbox, Ductbank and wireway running from Pullbox to the other side of the track between the track plinths.
- Section at guideway deck which shows section details of Pullbox, grounding stud, and wireway running from pull box to the other side of the track between the track plinths.

14.13.22 Systems OCS Pole Mounted DC Disconnect Switch Raceway Layout Plans

Show Pole mounted DC Disconnect Switch raceway layout details for the power cable and indication control cable runs.

14.13.23 Systems TPSS DC Disconnect Switch Pad and Penetration Details

Show the following for all TPSS:

- TPSS Disconnect Switch Pad detail
- Elevation details at the walls where the Raceway penetrates though.

14.13.24 Systems Handhole Details

Show TE/SC Type 5 Handhole details.

Include:

- Typical Handhole and lid dimensions
- Cable Rack Details
- Typical Section
- Typical Handhole installation detail

14.13.25 Systems Ductbank/Raceway Details

Show the details of Ductbank for:

- Surface mounted SC Ductbank with detail shows the required dimensions of the Ductbank, spacing, Raceway type, Supporting anchor, and framing support
- Surface mounted TE Ductbank shows conduit type, Raceway Spacing, supporting anchor, and framing support
- SC Pullbox Type 6 shows the clearance from the track plinths, Supporting anchor, and framing support
- Typical SC Type 5 or TE Type 2 Pullbox shows detail of the Pullbox showing support, anchor dimension and cover type (hinged)
- Systems Pullbox Type 10 shows detail of the Pullbox showing support, anchor dimension and cover type (hinged)
- Pullbox Barrier Details for straight through barrier side exit and straight through barrier exit

- Exposed Fiberglass expansion Slip collar detail
- Exposed Ductbank detail

14.13.26 Systems Raceway Transition Details

Show details of:

- Track approach Slab
- Track approach Slab section
- Conduit Transition

14.13.27 Systems Aerial Guideway Ductbank/Raceway Details

Show details of the TE and SC Ductbanks coordination details on the Aerial Guideway.

Scale: ½"=1-0' for the TE detail and ¼" = 1-0' for the combined TE/SE detail

14.13.28 Systems TPSSs Basement Details

Show details of the systems Ductbank/Raceway routes for each basement of TPSSs in the alignment.

14.13.29 Systems Manhole and Pullbox Handhole Schedules

Include separate Manhole Pullbox, and Handhole schedules listing all Manholes and Pullboxes shown on the Traction Electrification, Signal, and communication drawings.

These tabulated Manhole and Pullbox schedules must consist of the following columns showing information for each Manhole and Pullbox:

- Manhole Number (ID) (Example: NXX-MHSC-01 for signal and communication, NXX-MHTE-01 for Traction Electrification.
- Manhole Type
- Manhole Location: with a station number (Example: NB1751+76 LT 6.6')
- Top Elevation: the minimum elevation above finished ground (Example: Min2 2'' AFG)
- Drawing Number: where the manhole is shown. List multiple drawing numbers if applicable.
- Remarks: Includes information on if the Manhole/Pullbox/Handhole is referenced in other drawings or purpose of the manhole

Example of SC/TE Manhole and Pullbox Schedule:

SC/TE MANHOLE SCHEDULE					
MANHOLE ID.	TYPE	LOCATION	TOP ELEVATION	DRAWING	REMARKS
NXX-MHSC-01	1	NB1751+76 LT 6.6’	MIN 2’’ AFG	LXX-JEPXXX	SEE LXX-JEDXXX
NXX-MHTE-01	2	NB1751+76 LT 6.6’	MIN 2’’ AFG	LXX-JEPXXX	SEE LXX-JEDXXX

Example of SC/TE Pullbox schedule:

SC/TE PULLBOX SCHEDULE					
PULLBOX ID.	TYPE	LOCATION	TOP ELEVATION	DRAWING	REMARKS
NXX-PBSC-01		NB1751+76 LT 6.6’	MIN 2’’ AFG	LXX-JEPXXX	SC MAINLINE
NXX-PBTE-01		SB178+76 LT 6.6’	GRADE	LXX-JEPXXX	TE

Example of SC Handhole Schedule:

SC HANDHOLE SCHEDULE					
HANDHOLE ID.	TYPE	LOCATION	TOP ELEVATION	DRAWING	REMARKS
NXX-HHSC-01	1	NB1751+76 LT 6.6’	GRADE	LXX-JEP103	NXX-ETEL-08

14.13.30 Systems TE, MV, & LV Ductbank/Raceway Schedules

Tabulate the Ductbank and Raceway runs on standard drawings and identify the routing of each Raceway.

This tabulated Ductbank schedule must consist of the following columns:

- Ductbank/Raceway ID
- Type
- From
- To
- Drawing: List all drawings on which the run appears
- Raceway ID
- Remarks

Example of TE Ductbank/Raceway Schedule

TE DUCTBANK/RACEWAY SCHEDULE						
DUCKBANK ID	TYPE	FROM	TO	DRAWING	RACEWAY ID	REMARKS
NXX-TE-01	2-4PVCC	TPSS FOUNDATION	DS DISC SW PAD	LXX-JEPXX		POS FDR
NXX-TE-02	8-4PVCC	NXX-TPSS	NXX-MHTE-XX	LXX-JEPXXX		NEG RETURN

Example of MV/LV Ductbank/Raceway Schedule:

MV/LV DUCTBANK SCHEDULE						
DUCTBANK ID	TYPE	FROM	TO	DRAWING	RACEWAY ID	REMARKS
NXX-MV-01	2-5 PVCC	NXX TPSS	PSE	LXX-JEPXXX		PSE
NXX-LV-01	2-3PVCC	NXX-SIG-01	UTILITY	LXX-JEPXXX		UTILITY

14.13.31 Systems SC Ductbank Schedule

Tabulate the Ductbank and Raceway runs on standard drawings and identify the routing of each conduit.

This tabulated Ductbank schedule must consist of the following columns:

- Ductbank
- Type
- From
- To
- Drawing
- Raceway ID
- Remarks

Example of SC Ductbank Schedule:

SC DUCTBANK SCHEDULE						
DUCTBANK ID	TYPE	FROM	TO	DRAWING	RACEWAY ID	REMARKS
NXX-SC-XX	6-4 XW FBRGLC	NXX-PBSC-XX	NXX-PBSC-XX	LXX-JEPXXX		SC MAINLINE

14.13.32 Systems SC Raceway Schedule

Tabulate the Raceway runs on standard drawings and identify the routing of each conduit.

This tabulated Raceway schedule must consist of the following columns:

- Raceway ID
- Type
- From
- To
- Drawing
- Conductors ID
- Remarks

Example of SC Raceway Schedule:

SIGNAL/COMMUNICATION RACEWAY SCHEDULE						
RACEWAY ID	TYPE	FROM	TO	DRAWING	CONDUCTOR ID	REMARKS
NXX-SC-XXX.01				LXX-JEPXXX	NCC-AF-XXX	

14.13.33 Systems Traction Power Raceway Schedule

Tabulate the Raceway runs on standard drawings and identify the routing of each conduit.

This tabulated Raceway schedule must consist of the following columns:

- Raceway ID
- Type
- From
- To
- Drawing
- Conductor IDs
- Remarks

Example of TE Conduit Schedule:

SIGNAL/COMMUNICATION RACEWAY SCHEDULE						
RACEWAY ID	TYPE	FROM	TO	DRAWINGS	CONDUCTOR ID	REMARKS
NXX-TE-XXX.01	4'' PVC 40	NXX-TPSS	NXX-MHTE-XXX	LXX-JEDXXX, etc.	NXX-TENF-XX, etc.	SEE LXX-JTSXXX

14.13.34 Systems Communications Cable Schedule

Tabulated Communication cable runs on a standard drawing and identify the routing of each cable.

The tabulated Communication cable schedule must consist of the following columns:

- Cable ID
- Type
- From
- To
- VIA
- Remarks

Example of Communications Cable Schedule:

COMMUNICATIONS CABLE SCHEDULE					
CABLE ID	TYPE	FROM	TO	VIA	REMARKS
XXXF-CXX-NXX-XXA	144SMFO	NXX-MHSC-XX	NXX-MHSCXXX	NXX-SC-XXX	BACKBONE FIBER

14.13.35 Systems Elements at Guideway Column Schedules

Tabulate the Systems Elements at guideway Columns on standard drawings and identify the Systems Elements (Grounding, CCTB, Conduit risers, OCS Surge Arresters) of each Column.

This tabulated Systems Element schedule must consist of the following columns:

- Column ID
- Grounding
- Expansion Fittings
- CCTB
- Raceway Riser
- OCS Arrester with sub columns of OCS Structure Stationing & Drawing Number

Example of Systems Elements at Guideway Column Schedule:

SYSTEMS ELEMENTS AT GUIDEWAY COLUMN						
COLUMN ID	GROUNDING	EXPANSION FITTINGS	CCTB	RACEWAY RISER	OCS SURGE ARRESTER	
					OCS STRUCTURE STATIONING	DRAWING NUMBER
XX	YES	4'' EXP JT	NXX-CCTB-XX		NB1710+97, SB1710+87	LXX-JOPXXX

14.13.36 Systems Surge Arrestor Schedules

Tabulate the surge arrestor on the Aerial Guideway alignment on standard drawings and identify locations where those arrestors are placed.

The tabulated Systems Surge Arrestor Schedule must consist of the following columns:

- Civil Segment
- Track
- Station
- Location

Example of Surge Arrestor Schedule:

SURGE ARRESTOR SCHEDULE				
CIVIL SEGMENT	TRACK	STATION	OCS POLE ID	LOCATION
N160	NB	1437+83		AERIAL GUIDEWAY

14.13.37 Systems TPSS Ground Grid Layouts

Show detailed ground grid layouts for the Alignment.

include:

- Dimensions
- Structural materials
- Site specific details

14.13.38 Systems Typical Grounding Details

Show typical details of each type of grounding connection used system-wide.

14.13.39 Systems Typical Aerial Guideway Emergency Guardrail Grounding Details

Show typical details of the guideway emergency guardrail grounding system including a section detail.

14.13.40 Systems Typical Aerial Guideway OCS Pole Mounted Grounding Details

Show Typical OCS Pole grounding arrangements for Poles mounted between Tracks and Poles mounted on the side of track.

14.13.41 Systems OCS Surge Arrestor Grounding Details

Show OCS surge arrestor grounding arrangement information for Ballast Mat Slabs and Slabs on Grade.

14.13.42 Systems Elevated Guideway Grounding Details

Show grounding information for drilled shaft foundations and guideway columns including size of bare grounding cable, a Tabulated schedule showing Column bents, and a tabulated schedule of surge arrestor cable sizes with the routings (From –To)

14.13.43 Systems Corrosion Control Details

Show corrosion control information including the following:

- Typical track slab bonding schematic
- Bridge stray current mitigation schematic
- Galvanic cathodic protection schematic
- Track reference Electrode installation detail
- Foreign structure isolation detail
- Casing installation and test station detail
- Track slab embedded component installation detail
- Reinforcement test station detail for Track Slab
- Cathodic protection/Stray current test station detail
- Insulating joint test station detail
- Longitudinal reinforcement weld detail
- Transverse bonding bar reinforcement weld detail
- Pipe joint bonding detail
- Galvanic anode installation detail
- Pipeline insulation joint detail
- Thermite welding detail
- Galvanic anode splice detail
- Insulating joint and galvanic anode test station detail

14.13.44 Systems Bonding and Stray Current Details

Show details of the systems bonding.

Include:

- Detail of bond cable to bonded rebar
- Detail of wiring at Test Box location
- Detail of expansion joint cable jumper

14.13.45 OCS Pole Foundation Layout Plans

Show views of the alignment with pole locations along the entire alignment.

14.13.46 Systems OCS Pole Foundation Schedules

This schedule tabulates OCS foundation information. It must consist of the following columns:

- Layout Drawing Number
- Structure Number
- Reference Track
- Stationing
- Offset (ft.)
- Direction
- Foundation reference
- Foundation Depth (ft.)
- Foundation Elevation above TOR (ft.)
- Conduit Quantity
- Conduit Size (in.)
- Notes

Example of OCS Foundation Schedule:

OCS POLE FOUNDATION SCHEDULE											
DRAWING	STRUCTURE #	REFERENCE TRACK	STATION	OFFSET (ft.)	DIRECTION	FND REFERENCE	FND DEPTH (ft.)	FND ELEVATION ABOVE TOR	CONDUIT QUANTITY	CONDUIT SIZE	NOTES
LXX-JCPXXX	NXX-XXX	NB	1662+54	7.29	RIGHT	ATT					

14.13.47 Systems OCS Typical Tapered Tubular Pole Foundation Assembly Details

Show typical OCS Tapered Tubular Pole Foundation assembly details on standard drawings including tabulated Bill of Material and foundation schedules for Type FD-XT.

The assembly details must consist of the following details:

- Pole Foundation Elevation
- Anchor bolt detail
- Anchor Plate Detail
- Bolt Pattern Template Detail
- Foundation section view detail

The OCS Foundation Schedule must include:

- Foundation with sub columns of Type and Foundation Diameter
- Reinforcement with sub columns of “Vertical (VR)’’ and “Transverse (T)”

- Anchor Bolts with sub column of Bolt Circle “BC”, Bolt dia., Total Bolt length L , and Bolt Projection “P”
- Maximum Allowable Moment

Example of OCS Pole Foundation Schedule:

OCS FOUNDATION SCHEDULE								
FOUNDATION		REINFORCEMENT		ANCHOR BOLTS				MAX. ALLOWABLE MOMENT
TYPE	“FD” (DIA)	VR	T	BC	BOLT DIA.	L	P	KIP-FT

14.13.48 Systems OCS Typical Tapered Tubular Feeder Pole Foundation Assembly Details

Show typical OCS Tapered Tubular Feeder Pole Foundation assembly details on standard drawings including tabulated Bill of Material and foundation schedules for Type FD-XFT.

The assembly details must consist of the following details:

- Pole Foundation Elevation
- Anchor bolt detail
- Anchor Plate Detail
- Bolt Pattern Template Detail
- Foundation section view detail

The OCS Foundation Schedule must include:

- Foundation with sub columns of Type and Foundation Diameter
- Reinforcement with sub columns of “Vertical (VR)’’ and “Transverse (T)”
- Anchor Bolts with sub column of Bolt Circle “BC”, Bolt dia., Total Bolt length L, and Bolt Projection “P”
- Maximum Allowable Moment

Example of OCS Feeder Pole Foundation Schedule:

OCS FEEDER FOUNDATION SCHEDULE								
FOUNDATION		REINFORCEMENT		ANCHOR BOLTS				MAX. ALLOWABLE MOMENT
TYPE	“FD” (DIA)	VR	T	BC	BOLT DIA.	L	P	KIP-FT

14.13.49 Systems OCS Pole Typical Down Guy Anchor Foundation Assembly Details

Show OCS typical Down Guy Anchor Foundation assembly information on standard drawings including a tabulated Bill of Material and a Foundation Schedule for the type of foundation used on the project.

The assembly details must consist of:

- Foundation detail
- Anchor Rod detail
- Foundation Section view (From top)
- Bar section detail

Example of Foundation Schedule:

OCS DOWN GUY SCHEDULE-TYPE FD-3A							
FOUNDATION		REINFORCEMNT		25' DGA SPACING		17' DGA SPACING	
TYPE	'FD' (DIA)	"VR"	'T"	Mx	Fz	Mx	Fz

14.13.50 Systems OCS Typical Wide Flange Pole Foundation Assembly Details

Show OCS typical Tapered Tubular Pole Foundation assembly information on standard drawings including a tabulated Bill of Material and foundation schedules for this type of foundation.

The foundation assembly details must consist of the following details:

- Pole Foundation Elevation
- Anchor bolt detail
- Anchor Plate Detail
- Bolt Pattern Template Detail
- Foundation section view detail (Top)

The tabulated Foundation Schedule must include:

- Foundation with sub columns of Type and Foundation Diameter
- Reinforcement with sub columns of "Vertical (VR)'' and "Transverse (T)"
- Anchor Bolts with sub column of Bolt Circle "BC", Bolt dia., Total Bolt length "L" , and Bolt Projection "P"
- Maximum Allowable Moment

Example of OCS Wide Flange Pole Foundation Schedule:

OCS POLE FOUNDATION SCHEDULE-TYPE FD-XXW								
FOUNDATION		REINFORCEMENT		ANCHOR BOLTS				MAX. ALLOWABLE MOMENT
TYPE	"FD" (DIA)	"VR"	"T"	"BC"	BOLT DIA	"L"	"P"	KIP-FT

14.14 Traction Power System Series

The series shows the total of all traction power system interests and uses required to construct, maintain, protect, and operate the transit system.

Items included in traction power system series to reflect previous process of Equipment Clearance Diagram review, per PIIP requirements.

14.14.1 Drawing Order

- General TPSS Notes, Abbreviations, and Legend
- Key Plan
- System Single-Line Diagrams
- TPSS One-Line Diagrams (12.5kV/26kV)
- Transfer Trip Schematic Diagrams
- Emergency Trip Station (ETS) Control Schematic Diagrams
- Typical Control Power Schematic & AC/DC Panel Schedules
- DC Disconnect Switch Pad-mounted One-Line Diagram & Controls Wiring Schematic
- Typical TPSS LCMS Configuration Diagram
- Typical TPSS LCMS HMI Views
- Typical TPSS LCMS SCADA Points List
- Typical Prefabricated TPSS Equipment Layout
- Typical Prefabricated TPSS Interior Elevation Details
- Typical Prefabricated TPSS Exterior Elevation Details
- Typical Prefabricated TPSS Basement Equipment Layout & Elevation
- Typical Prefabricated TPSS Platform and Stair Details
- DC Disconnect Switch Pad-Mounted Cabinet Assembly Details
- Typical TPSS LCMS Cabinet Assembly Details
- Typical TPSS Rail to Ground Device Assembly Details
- Typical Fire Control Room ETS Cabinet Assembly Details (if applicable)
- Typical Fire Control Room ETS Installation and Signage Details (if applicable)
- TPSS Site plan and Cable Layout
- TPSS Cable Schedule (AC, DC positive & negative, Control)

14.14.2 General TPSS Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

Include all alpha, numeric, and alphanumeric numbers used to identify traction power equipment and devices use on the plans.

14.14.3 Key Plan

Include per section 14.2.7

14.14.4 System Single-Line Diagrams

Show the power distribution from Utility to DC 1500Vdc through the Traction power system and OCS system. It represents the power sectionalization.

Include:

- Double fed mainline OCS system supplied by each Traction power substation including Tie Station
- Negative return path
- Transfer trip with associated breakers
- OCS electrical section (e.g. Insulated overlap, Cross-over, Pocket track)
- OCS electrical section number
- All disconnect switches
- Passenger stations

14.14.5 TPSS One-Line Diagram (12.5kV/26kV)

Show the electrical elements on each substation

Include:

- AC/ DC Breakers
- Transformer and Rectifier (TRU)
- Protection Relays and associated alarms
- Rail voltage monitoring and grounding systems
- All control power system elements

14.14.6 Transfer Trip Schematic Diagrams

Show the transfer trip scheme under normal (tie-switch(es) open) and contingency (tie-switch(es) closed) conditions, with dedicated breakers shown at each TPSS

14.14.7 Emergency Trip Station (ETS) Control Schematic Diagrams

Show the ETS including FCC ETS trip schedule with associated OCS electrical section number per track direction (NB, SB, EB, WB)

14.14.8 Traction Power Facility Layout

Include separate drawings as below

- TPSS equipment layout (Scale 3/8” = 1’-0”)
- TPSS exterior/interior elevation details (Scale 3/8” = 1’-0”)
- Prefabricated TPSS basement equipment layout & elevations (Scale 1/4” = 1’-0”)
- Prefabricated TPSS platform and stairs
- TPSS Electrical Layout (e.g. Lighting, Receptacle, HVAC, Sump Pump, AC/DC Panel etc.)

Show the following facilities along each line extension:

- Substations
- Tie-Stations (if applicable)

14.14.9 Traction Power System Assembly Diagrams

Include separate drawings as below, but not limited.

- DC Disconnect Switch Pad-Mounted Cabinet Assembly details (Scale 1 ½”=1’-0”)

- TPSS LCMS Cabinet Assembly details (Scale 1 ½”=1’-0”)
- TPSS Rail to Ground Device Assembly details (Scale 1 ½”=1’-0”)
- Fire Control Room ETS Cabinet Assembly details if applicable
- Fire Control Room ETS Installation and Signage details if applicable

14.14.10 Traction Electrification Cable Layout and Schedules

Assign unique ID to all Raceway and cables shown on Traction Power Systems Site Plan and Cable Layout drawings.

Tabulate the Traction Electrification Cables with Ductbank/Raceway ID, conduit ID to identify the routing of each cable.

List in the Raceway, cable and ductbank, as applicable, in the schedules:

- Assigned cable, conduit, and duct-bank ID
- Quantity, Type, Size, Voltage rating and Routing of conduit and cable contents.
- Approximate conduit and cable lengths*
- Reference Drawing number

* Approximate information is given for design information but is verified by the responsible contractor prior to installation.

14.15 Overhead Contact System (OCS) Series

The series shows the total of all overhead contact system interests and uses required to construct, maintain, protect, and operate the transit system.

14.15.1 Drawing Order

- General OCS Notes, Abbreviations, and Legend
- Key Plan
- Master Overlap Charts
- Layout Plans and Schedules
- Tie-In Plans
- Technical Drawings
- General Arrangements
- Poles Assemblies
- Wire Support Assemblies
- Miscellaneous Assemblies
- Terminations and Downguy Assemblies
- Site Specific Cross Section Assemblies (if applicable)

14.15.2 General OCS Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.15.3 Key Plan

Include per section ***14.2.7***

14.15.4 Master Overlap Charts

Include:

- Wire runs and numbers
- Tension lengths in feet
- Termination types and downguys
- Stationing of terminations
- Insulated overlaps, uninsulated overlaps, section insulators
- Passenger stations
- Layout plan and schedule reference line
- Cross streets, pedestrian crossings, and hi-rail access points
- Traction power substations and signal bungalows
- Track profile with operational maximum speed

14.15.5 Layout Plans and Schedules

Scale: 1” = 20’.

Include in plan views:

- Poles, downguys, and overhead guys
- Pole/structure numbers

- Cantilevers and headspans
- Wire runs and numbers labeled at terminations
- Terminations
- Span lengths in tenths of a foot
- Insulated overlaps and uninsulated overlaps with labels
- Section insulators
- Splices and in-line insulators
- Disconnect switch numbers and feeder taps
- Jumpers
- Surge Arrestors
- Contact wire bridges
- Centerline of track references
- Versine and mid-span offsets
- Crossover labels
- Stationing references and station equations
- Passenger stations
- Cross streets, over and under crossings, pedestrian crossings, and hi-rail access points. Include minimum elevation above top of rail for elevated crossings over the tracks.
- Traction power substation locations
- Scale in feet and north arrow
- Overhead utility crossings including Utility, line type and voltage, and minimum elevation above top of rail in feet at worst case sag.
- Notes (as applicable)

Include in separate schedules for each track with the below information in each row:

- Stationing
- Structure number
- Wire run number
- Messenger wire height (ft-in)
- Contact wire height (ft-in)
- Stagger (in)
- Termination Height (ft-in)
- Attachment/Pole reference
- Attachment/Pole offset (ft-in)
- Pole rake (in)
- Foundation reference
- Foundation depth (ft-in)
- Foundation elevation above top of rail (ft-in)
- OCS assemblies
- Notes

14.15.6 Tie-In Plans

When tying in the OCS to an existing system, include plans and instructions explaining the sequence of work including any temporary configurations and power outages required that may affect revenue service. Include plans showing existing, interim, and final conditions.

14.15.7 Technical Drawings

Include:

- Conductor characteristics (each OCS style)
- Blow off and midspan offsets (each track type)
- Conductor temperature/tension charts (contact wire and messenger wire)
- Vertical loads and wind loads
- Along track movement
- Structure clearance envelope
- Pantograph interface
- Pantograph clearance envelope
- Steady arm clearance
- Pantograph clearance to live fittings
- Clearance from overhead conductors

14.15.8 General Arrangements

Include the following general arrangements where applicable:

- Single crossover
- Universal crossover
- Diamond crossover
- Pocket track
- Insulated overlap center poles
- Uninsulated overlap center poles
- Insulated overlap in tunnel
- Uninsulated overlap in tunnel
- Midpoint anchor on center poles
- Midpoint anchor on side poles
- Center pole cantilever
- Side pole cantilever
- Two track headspan
- Three track headspan
- Turnout headspan
- Typical anchor
- Standard spans
- Overlap spans
- Crossover spans
- Termination spans
- Tangent span in tunnel
- Curve span in tunnel
- Wide flange feeder pole and surge arrester
- Tapered tubular feeder pole and surge arrester

14.15.9 Poles Assemblies

Include the following assembly drawings where applicable:

- Wide flange poles
- Wide flange feeder poles

- Tapered tubular poles
- Tapered tubular poles
- Tubular balance weight anchor poles
- Square tubular poles
- Square tubular feeder poles
- Downguy anchor plates
- Tunnel and aerial supports
- Building eyebolts
- Brackets
- Framing insert brackets
- Wide flange pole brackets
- Anchor brackets
- Pole and warning signs
- Slab on grade OCS pole and downguy anchor support details

14.15.10 Wire Support Assemblies

Include the following assembly drawings where applicable:

- Cantilever pull-offs
- Cantilever push-offs
- Single wire cantilevers
- Out-of-running cantilevers
- Over-reach cantilevers
- Reduced system height cantilevers
- Reduced system height long reach cantilevers
- Increased system height cantilevers
- Long reach cantilevers
- Under bridge/tunnel supports
- Two track cantilevers
- Span wires
- Cross span registrations
- Headspan registrations
- Contact wire pull-offs
- Messenger wire pull-offs
- Bridle wires
- Tunnel supports
- Low profile tunnel supports

14.15.11 Miscellaneous Assemblies

Include the following assembly drawings where applicable:

- Hangers
- In-span assemblies
- Jumpers
- In-span insulators and splices
- Pole mounted disconnect switches (each type, e.g. feeder, bypass, sectionalizing, tie, etc.)
- Feeder cables

- Surge arrestors
- Section insulators

14.15.12 Terminations and Downguy Assemblies

Include the following assembly drawings where applicable:

- Balance weight anchors
- Constant-tension spring terminations
- Fixed termination anchors
- Fixed Y-termination anchors
- Midpoint termination span guys
- Wide flange pole downguys/head guys
- Tapered tubular pole downguys/head guys

14.15.13 Site Specific Cross Section Assemblies

Include site-specific cross-section assemblies in unique or complex site conditions with additional orientation, clearance, or construction details. These are included for, at minimum, complex headspan arrangements, portal structures, anchorage to bridges and buildings, low clearance environments and station environments.

14.16 Signal Series

The series shows the total of all signal interests and uses required to construct, maintain, protect, and operate the transit system.

See *14.12.1* for Definition.

14.16.1 Drawing Order

- General Signals Notes, Abbreviations, and Legend
- Signals System Single Line Track Diagram
- Signals System Control Line Diagram
- Signals System Track Layout and Cable Plan
- Signals System Route and Aspect Chart
- Signals System Typical Local Control Panel
- Signals System Typical Control and Indication Chart
- Signals System Subsystem Block Diagrams
- Signals System Equipment Arrangement Plans
- Signals System Facility Layout Plans
- Signals System Installation Details
- Signals System Standard Details (if applicable)

14.16.2 General Signals Notes, Abbreviations, and Legend

Include this drawing at the beginning of the series.

14.16.3 Signals System Single Line Track Diagram

Include horizontal scale drawings showing the track configuration including the maximum authorized speed (MAS), grade and curve profile and the stationing of pertinent items of signal system facilities including, at minimum, Signals, Insulated Joints, Switches, Signal houses, Highway-rail grade & pedestrian crossings, Hi-rail crossings, Bridges, Station Platforms, Signs, etc. Show type of track construction (embedded, direct fixation, elevated, at-grade, ballasted etc.) and illustrate street running and cabinet signing sections. These drawings must accompany any set of plans in which the project requires a change.

14.16.4 Signal System Control Line Diagram

Drawings showing control lines for track circuits. Include stationing of signal wayside equipment, speed restrictions, the respective stationing and grade percentages.

Include:

- Normal and reverse directions.
- Diverging normal and reverse directions.
- Control lines for crossings approaches (If applicable).

14.16.5 Signal System Track Layout and Cable Plan

Track layout plans include double line horizontal drawings showing track configuration including stationing and designations of items such as Train to Wayside Communication (TWC) loops, signal equipment rooms, signal and grade crossing houses, cases, switch heater cases, switch machines, signals, track circuits (transmit and feed ends) and bonding, station platforms, and insulated joints that are pertinent to the area for that signal location. Cable plan drawings show point-to-point cable runs and identify cable make ups and conductor wire size. Include cables, wire, and equipment to which cables run that are pertinent to the area for that signal location. Include drawings that document the location to location fiber optical cable utilized by the signal system.

14.16.6 Signals System Route and Aspect Chart

Show layout of interlocking or vent zone with wayside signals and all approach track locking circuits.

Include:

- Entrance signal
- Exit signal
- Signal aspect
- Automatic operation track circuits
- TWC loop operation
- Signal slotting track
- Track circuit in route vent zone
- Switches locked
- Traffic
- Opposing/ conflicting signals
- Approach locking track circuits and comments.

Example of Route and Aspect Chart

ROUTE AND ASPECT CHART												
ENT. SIG.	EXIT SIG.	SIG. ASPECT	APP. CLEAR	TWC LOOP OPERATION	TWC CALL	SIG. SLOTTING TRK.	TRK. CIRCUITS IN RTE.	SW. LOCKED	TRAFFIC	PREVENTS CLEARING OF SIGNALS	APPROACH LOCKING TRACK CIRCUITS	NOTES
XX-2N	XX-2S	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX

14.16.7 Signals System Typical Local Control Panel

Include typical LCP layout with wayside equipment controls and indications.

Include station platform and wayside equipment locations.

14.16.8 Signals System Typical Control and Indication Chart

Include Table showing the indication and control bits of Office and SVP interface. Include a legend showing the nomenclature of bits.

14.16.9 Signals System Subsystem Block Diagrams

ST includes Subsystem Block Diagrams of existing locations as typical diagrams to show the system configuration. Modify the block diagram as needed to reflect current conditions. Identify only the major components at each location. Do not show Interconnection details.

14.16.10 Signals System Equipment Arrangement Plans

ST includes Equipment Arrangement Drawings of existing locations to show the physical location of signals and related equipment.

Include:

- Signal equipment layout plan. Show track and equipment layout. Include stationing location of wayside equipment. Method of installation of wayside equipment referenced. Also include location of station platform and signal house and traction power substation.
- Signal equipment layout plan (Enlargement plan). Enlarged view of signal equipment layout, include track and equipment layout, stationing location of wayside equipment, grade crossing layout, method of installation of wayside equipment referenced. Also include location of station platform, switch heater case, signal house and traction power substation.
- OS Track and Cab Loop Arrangement. Include wayside equipment layout of interlocking.

14.16.11 Signal System Facility Layout Plans

The designer of the train control and communications room(s) must prepare the Signal System Facility Layouts, which are distinct from the Key Plans used for other disciplines.

Scale: The scale must match the electrical drawings unless specified.

Include:

- Signal house site specific plans.
- Typical signal house concrete pier installation details. Scale: ½" – 1'-0". Show prefab concrete pier foundation. Scale: NTS.
- Typical signal house concrete pad installation details. Scale: ½" – 1'-0".
- Typical grade crossing house details. Include grounding grid, elevation detail integrated house foundation and prefab concrete pier foundation. Prefab concrete pier foundation and integrated house foundation are NTS, all other details are scale 1" – 1'-0".
- Typical signal equipment case detail. Include front and side view details. Scale: NTS.
- Typical signal house signal power distribution plan. Include signal location electrical power source/voltage schedule. Include distribution for vital and non-vital panels. Scale: NTS.

- Typical signal house communication interface diagram. Include connections between signal system equipment rack and communications equipment rack and interface with PBX phone, fire alarm control panel, door contact switches and intrusion detection disarm switch. Also include signal system terminal strip detail and wire/cable table. Scale: NTS.
- Signal house equipment layout. Show 10'x22', 10'x26' and 10'x30' plans. Scale: ¾" – 1'-0". Include rack layout, UPS, manual transfer switch and HVAC locations.

Include locations of the following equipment in signal equipment rooms:

- Train control cabinets
- Communications cabinets and racks
- Cable trays
- Termination and interface cabinets
- Batteries
- Dedicated power distribution

Layout plans to include the following for each signal location

- Grounding
- Raceways
- Lighting

14.16.12 Signal System Installation Details

Include:

- Typical switch machine layout (direct fixation, embedded and ballasted tracks). Scale: NTS
- Typical signal layout details (side aerial guideway mount, direct fixation track, ballasted track, wall and bore mount and mast mount on ductbank). Show Bumper post, 2, 3 and 4 aspects signals. Scale: 1" – 1'-0".
- TWC loop placement and signal relationship detail. Show TWC location for 2 car and 4 cars consist of. Show TWC location relative to wayside signal and IJ. Scale: NTS.
- Typical TWC loop installation layout (direct fixation, ballasted track, embedded track, and direct fixation with guardrail). Scale: NTS
- Typical prefabricated narrow TWC loop details. Scale: NTS
- Typical impedance bond installation layout (for direct fixation with negative return, direct fixation with guardrail, full concrete tie in ballasted rack, wall mount walkway platform and floating slab track). Include rail bond detail Scale: NTS.
- Typical impedance bond cover details. Scale 1 ½" – 1'-0".
- Typical track box and conduit details. Include rail base bond detail (NTS). Remainder of drawing Scale: ¼" – 1'-0".
- Typical B-Point installation layout. Show Ballasted and Concrete Plinth plan views. Scale NTS.
- Signals system single gate details. Show foundation and flasher schedule, single gate detail, bolt pattern detail and gate mech. base detail Scale: NTS.
- Two and Four quadrant gate double track configuration with embedded inductive loops. Scale: NTS.

- Signals system red flasher details. Include stanchion base detail, bolt pattern detail and foundation and flasher schedule. Scale: NTS.
- Signals system Grade Crossing Electronic Bell Only details. Include stanchion detail, bolt pattern detail and foundation schedule. Scale: NTS.
- Another train coming warning and other activated blank out sign's details. Use notes to describe sign's functionality. Scale: NTS
- Typical turnout traction electrification signal bonding and switch heating elements. Include bonding for typical double crossover and diamond crossover. Scale NTS.
- Rail heater installation. Show location of switch machine JB, heater (rail/crib) elements, rail temperature JB and switch machine. Scale: NTS.
- Rail expansion joint with emergency guard rail traction electrification and signal bonding. Show rail bond detail. Scale: ¾" – 1'-0".
- Typical switch heater control panel installation layout (direct fixation and ballasted track). Show front and side views. Also show foundation plan view. Scale: NTS.
- Typical track circuit and speed command installation layout. Scale: NTS.
- Typical audio frequency overlay tuned coupler installation. Scale: NTS.

Include on all drawings:

- Equipment mounting height
- Equipment configuration
- Method of fastening and details
- Dimensions of each equipment and material used.
- Signal house grounding layout
- Other pertinent information that would prove useful to the project but was not covered in this document, including train control features that may be unique to a particular project.
- A bill of materials

14.17 Book of Plans (BOP) Drawing Order

- Cover Drawing
- Index Drawing
- Abbreviations
- Single Line Drawing
- Track Layout and Cable Plan
- OS Track and CAB Loop Arrangement
- Circuits Drawings
- Power Distribution Circuits
- Signal House Detail
- Local Control Panel Layout
- Control and Indication Chart
- Route and Aspect Chart
- Control Lines Diagrams
- Equivalent Circuits

14.17.1 Cover Drawing

Drawing to show name of location and other pertinent contractual items.

14.17.2 Index Drawing

Index to list each drawing and drawing number in the plan book. For small locations, this is combined with the cover drawing. See section ***14.2.3***.

14.17.3 Abbreviations

List typical abbreviations and their meanings.

14.17.4 Single Line Drawing

See section ***14.16.3***.

14.17.5 Track Layout and Cable Plans

See section ***14.16.5***.

14.17.6 OS Track and CAB Loop Arrangement

Show detailed layout of interlocking arrangement. Include TWC and CAB loops arrangement, switches, wayside signals, impedance bonds, insulated joints, track circuit, depiction of signal and negative return rails.

14.17.7 Circuits Drawings

Show various types of control, operating, indication circuits, track circuits and line circuits required.

List title and unit number of particular function(s) performed by circuits illustrated.

Show complete circuit when it leaves the room, including termination points and locations.

Draw circuits to show actual wiring of circuit, not as schematics.

Use a uniform method such as angled lines to indicate actual locations of double wired terminations if it is not desirable to shown both wires terminating on the same point.

Show complete circuit on a single drawing to the maximum extent possible. Circuits that are incomplete on one drawing must include a reference to drawing circuit is continued on.

Show provisions for future equipment.

Include:

- Track Circuits
- Slow Order Switch Circuits
- Highway Grade Crossing Interface Circuits (include: Signal and Gate flashers, another train coming signs, Hi-rail access gates and Pedestrian crossings)
- Switch Control and Indication Circuits
- Rail Heater Circuits
- Signal Control and Lighting Circuits
- TWC Circuits
- Ground Detector Circuits
- Traffic Magnetic Stick Circuits
- System and CAB Transfer Circuits
- Communication Block Diagram and Circuits (VHLC architecture, VHLC Master/Slave & Data recorder, Remote links, SCADA & LCP)
- I/O Circuits

14.17.8 Power Distribution Circuits

Show AC/DC energy distribution systems or subsystems including wire sizes. Show grounding on a separate drawing, or on energy distribution drawing.

Include:

- House power load center
- UPS
- Signal power load center
- Power supplies
- 100/120 AC Rack feeds
- DC Rack feeds
- RBO/RNO/TBO/TNO Rack feeds
- VHLC modules power supplies

14.17.9 Signal House Detail

Show arrangement of equipment, facilities, or components in a room, rack, or module. Detail arrangement drawings must show contacts and terminals. Show spare contacts, terminals, and wires.

Include:

- Signal house foundation layout.
- Wall detail
- Signal house rack layout

- Grounding arrangement
- Security and fire alarm circuits
- Main terminal board layout
- Equipment layout of racks. Include row detail.
- Junction box
- HVAC alarm circuits, security alarm circuits, radio health alarm and device servers.
- WAGO terminal and Fiber modems rows.
- Microprocessor, TWC interrogator and AF track transmitter/receiver chassis configuration. Include microprocessor plug connector diagram, RS232 module details and modules details.
- Relay tabulation
- Local control panel and legend. Include LCP circuits.
- Slow order switch panel faceplate layout.
- Front and rear view of UPS and EBM.
- Conduit and cable schedules. Tabulate the signal cables routed between facilities. Identify the routing of each cable via conduit and wire-way. Plans as specified in Common Work Results for Systems Conductors and Cable.

14.17.10 Local Control Panel Layout

Show the layout of each signal location. Include location of wayside controls and indication. Also include a legend that illustrates the meaning of each indication seen on the LCP.

14.17.11 Control and Indication Chart

Include Table of control and indication bits.

Include a legend that shows the nomenclature of bits.

14.17.12 Route and Aspect Chart

Refer to section ***14.16.6***.

14.17.13 Control Lines Diagrams

Refer to section ***14.16.4***.

14.17.14 Equivalent Circuits

Include:

- Translated application logic, both vital and non-vital, into standard size circuit drawings using standard Signal System drop line symbols for relays, and contacts. Show contacts in normal position.
- Include any timing characteristics associated with a software relay.
- CRC and CHECKSUM for vital and non-vital processors.
- Commentary on each equation.
- All new locations and all existing locations that are modified, update the logic equation books including variable nomenclature description, equations, equation variable index, identification where each variable is used, timer

settings (min, max, default, current value), and serial interfaces to other locations.

14.18 Communication Series

The series shows the total of all communications interests and uses required to construct, maintain, protect, and operate the transit system.

See *14.12.1* for Definitions.

Use ST Systems Directive Drawings as a standard for expected detail and style.

14.18.1 Drawing Order

- General Communication Notes, Abbreviations, and Legend
- System Riser Diagrams
- System Block Diagrams
- Equipment Arrangement Plans
- Equipment Elevations
- Equipment Lists
- Facility Layout Plans
- Installation Details
- Raceway and Cable Schedules
- Network Schedules
- Standard Details (if applicable)

14.18.2 General Communication Notes, Abbreviations, and Legend

Include this drawing at the beginning of this series .

14.18.3 System Riser Diagrams

Riser diagrams are prepared for each of the communications subsystems showing the system configuration.

Riser diagrams must show how major components of each system interfaces with each other and the IT network at a specific location. May reference integration points of the system but detail likely to cover in a block diagram. Interconnection detail typically not shown here.

Risers are required for each system at each location. See section *14.12.34*.

14.18.4 System Block Diagrams

Functional block diagrams showing the relationship of the functions for a system installation within a facility.

System Block Diagrams show detailed interconnection of a system and integration requirements with other systems and is not limited to showing network, wiring, and logical connections required to understand the flow an information throughout a system. As a result, they also show relationships of local system to remote or headend systems.

IT networks include Fiber Single Line Diagrams. Network topologies for WAN (integration into existing infrastructure) and LAN (station/location level).

Define all cable types and label all interfaces

14.18.5 Equipment Arrangement Plans

Equipment arrangement drawings must show the physical location of communications and related equipment, as well as:

- Communications cabinets and racks
- Signal cabinets cable trays
- Termination and interface cabinets
- Batteries
- Dedicated power distribution equipment in train control and communications rooms
- System end devices

14.18.6 Equipment Elevations

Equipment elevations must show vertical spatial requirements not shown in plan drawings. These drawings must include all communications cabinets and racks elevations with detailed layout planning of all enclosed equipment.

14.18.7 Equipment Lists

Include list of all major equipment for each system. Also include reference to related drawings like plans and details as need. Follow examples included in ST System Directive Drawings.

14.18.8 Facility Layout Plans

Scale: Match Electrical Drawings

Layouts are prepared by the section designer for all communications related spaces including communications rooms, closets, and spaces where systems are installed.

Layouts must include for each specific site:

- Grounding
- Raceways
- Power systems
- Lighting

Place over screened backgrounds.

Include Radio coverage maps (include legend for color/RSSI (or BER)).

14.18.9 Installation Details

Show:

- Mounting details for installing the communications equipment
- Mounting heights
- Method of fastening
- Dimensions
- Interconnection details (networked or wired)
- Radio details must include Link Budget Calculations, donor site link budget with noise calculations.

Include a bill of materials upon ST request.

14.18.10 Raceway and Cable Schedules

Tabulate the communications cables routed between facilities and identify the routing of each cable via raceway, interduct, and wireway. Use examples from electrical sections, ***14.12*** and ***14.13***.

14.18.11 Network Schedules

Tabulate the communications cables interfaces for fiber and structured cabling and identify all patch and splice interfaces. Schedules should follow examples included in ST Systems Directive Drawings