

RE SMITHS FALLS 2 SOLAR PROJECT

Design and Operations Report

April 15, 2011

RECURRENT
ENERGY





Report to:

RE SMITHS FALLS 2 ULC

Design and Operations Report

**DEVELOPED WITH TECHNICAL SUPPORT
PROVIDED BY WARDROP ENGINEERING**

RE Smiths Falls 2 Solar Project

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1.0 INTRODUCTION

RE Smiths Falls 2 (the “Project”) is made by RE Smiths Falls 2 ULC. The RE Smiths Falls 2 site consists of approximately 35 hectares of agricultural land located about 8 km northwest of Smiths Falls, in the Township of Drummond/North Elmsley, County of Lanark, Province of Ontario (as shown on Figure 1.1).

The Project will consist of solar photovoltaic panels that generate direct current (DC) electricity when exposed to sunlight. This project will use 230W – 280W crystalline photovoltaic modules to form the solar panel arrays. The panels will be stationary, arranged in rows mounted off the ground with a fixed tilt angle to the south to catch the sun’s rays. Electricity generated by the rows of panels is collected through underground cabling by inverter/transformer pairs which convert the DC electricity to alternating current (AC) at a specified voltage. The AC current then continues from the inverters through underground cabling to a single main facility substation. At this substation, the main power transformer increases the voltage to the level of voltage of the electricity distribution grid. The power passes through protective relays (SEL - 351) and fault - breaking switches before being delivered to Hydro One’s electrical network.

In addition to the PV panels, the facility will consist of a substation with a power transformer, control house, and internal access roadways. In general, the development will follow the existing topography of the site to the greatest extent possible in order to minimize the extent of re-grading required and to maintain existing drainage patterns. A system of swales, ditches and culverts will be constructed to collect and transport stormwater runoff through the site to existing drainage outlets. These swales and ditches will generally be installed adjacent to the proposed internal roadways and will be lined with vegetation to minimize the potential for erosion.

This Design and Operations Plan has been prepared in accordance with the March 1, 2010 draft of *Technical bulletin two: Guidance for preparing the Design and Operations Report as part of an application under O.Reg.359/09 PIBS 7437e*.

Figure 1.1 Site Location Map



2.0 SITE PLAN

The overall site plan for the facility is shown in Figure 2.1. The layout as shown in the figure is subject to change and will depend on the final design of the facility. The facility will be contained within the total constructible area as shown in the figure.

2.1 FACILITY COMPONENTS

2.1.1 *BUILDINGS AND STRUCTURES*

Building and structures include the control house, substation area including containment area and the laydown/parking area. The prefabricated control house building is approximately 6m x 9 m, which will be built within the substation area. The substation, which will occupy an area measuring approximately 20 m by 20 m, will be located within the 30 m by 50 m parking lot/laydown area. The surface of the parking/laydown area will be constructed of granular materials.

A 2.7 m (9') chain link security fence will be erected around the perimeter of the solar facility. The perimeter fence will be designed to accommodate a 3-strand barbed wire top, where required. A 2.7 m (9') chain link security fence topped with 3-strand barbed wire will be erected around the substation area and the inverter clusters.

Motion sensitive, directional security lights will be installed to provide adequate illumination around the substation area, and each inverter cluster.

2.1.2 *TRANSPORTATION SYSTEM*

The internal road system will consist of approximately 1,425 m of granular roadways with widths varying from 3.5 to 5.0 m and varying depths of granular pavement structure depending on the type of subsoils encountered on the site.

2.1.3 *ROADS, UTILITY CORRIDORS AND RIGHTS OF WAY*

One access point from a municipal roadway to the site will be created from Russell Road. The entrance will be 8 m wide and will include a 12 m long culvert within the roadside ditch.

2.1.4 *GROUNDWATER AND SURFACE WATER*

Surface water drainage on the project is generally towards the valley in the northern mid-portion of the site and the valley at the eastern end of the site.

Surface water drainage is generally in a south-easterly direction towards Black Creek, a tributary of the Rideau River, which crosses the site approximately 250 metres from the Buttermilk Hill Road entrance.

2.1.5 SEWAGE COLLECTION AND TREATMENT

A collection system will be in place for an oil/water separator to collect any oil from transformers. During monthly inspections, the oil/water separator system will be checked for proper usage and repaired as needed.

2.1.6 PROJECT LOCATION BOUNDARY

The site is bound by Buttermilk Hill Road to the south and the east, north and west boundaries are divided by property parcel ownership. The location boundaries are shown on Figure 2.1.

2.1.7 ASSOCIATED TRANSFORMERS

The proposed power transformer is specified as follows: 7.5/10 MVA, 44kV /13.8 kV, ONAN/ONAF with surge arresters on both sides and neutral bushing CT and rapid pressure rise relay and winding and oil temperature gauges. Typical details of the power transformer are in Appendix A.

Intermediate outdoor padmount transformers will be installed at the inverter locations on the site plan. These transformers are proposed to be 2MVA, 13.8 kV/265 VAC with a visible open load break switch.

Additionally, a station service transformer will be located within the substation area rated as follows: 100 kVA three phase, 120-208 VAC.

2.1.8 STORMWATER FACILITIES

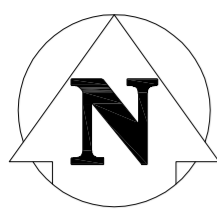
In general, the development will follow the existing topography of the site to the greatest extent possible in order to minimize the extent of re-grading required and to maintain existing drainage patterns. A system of swales, ditches and culverts will be constructed to collect and transport stormwater runoff through the site to existing valleys within the limits of the site or at existing valleys within the limits of the site or at existing outlets to adjacent municipal ditches or agricultural lands. These swales and ditches will generally be installed adjacent to the proposed internal roadways and will be lined with vegetation to minimize the potential for erosion.

2.2 CULTURAL FEATURES/NATURAL FEATURES AND WATERBODIES

Cultural features, natural features and water bodies are discussed in the respective natural heritage reports. Figures from those reports showing the location of features including archaeological resources, waterbodies and significant and provincially significant natural features are provided in Appendix B.

2.3 NOISE RECEPTORS

Noise receptors are identified in the noise assessment report. Sensitive receptors in the area are shown in the figure from the Noise Assessment Report that has been reproduced here, in Appendix B.



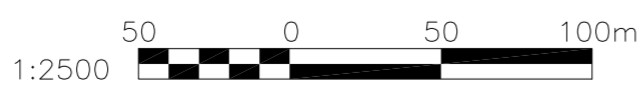
NOTES:

- AERIAL IMAGERY OBTAINED FROM GOOGLE EARTH PRO, IMAGERY DATE 2006
- ROAD CONSTRUCTION PROCEDURES
 - CLEAR & GRUB ALL AREAS PROPOSED FOR ROAD AND PARKING LOT CONSTRUCTION.
 - STRIP & REMOVE ALL TOPSOIL.
 - SHAPE & PROOF-ROLL SUBGRADE.
 - SHAPE & GRADE DITCHES & SWALES.
 - PLACE, SHAPE AND COMPACT GRANULAR SUBBASE AND BASE MATERIALS AS FOLLOW:
 - TYPE 1 - 300mm GRANULAR "B" SUBBASE, 150mm GRANULAR "A" BASE.
 - TYPE 2 - 200mm GRANULAR "B" SUBBASE, 150mm GRANULAR "A" BASE.
 - TYPE 3 - 150mm TO 200mm GRANULAR "A".
 - RE-VEGETATE DITCHES AND SWALES.

CULVERTS:

- CULVERT SHALL BE CORRUGATED STEEL PIPE OR RIBBED PVC PIPE INSTALLED IN ACCORDANCE WITH OPSD.
- MINIMUM CULVERT DIAMETER:
 - 300mm Min. Dia. FOR MINOR CULVERTS
 - 600mm Min. Dia. FOR MAIN CULVERTSREFER TO PLANS FOR CULVERT LOCATIONS.

APP. SCALE:



LEGEND:

- INVERTER / XFMR EQUIPMENT PAD
- SOLAR ARRAY
- LEASE BOUNDARY
- ACCESS ROAD
- PROPOSED FENCE
- ADDITIONAL CONSTRUCTIBLE AREA THAT MAY BE USED FOR THE FACILITY

REFERENCE NO. 1088760100-DWG-E0005-05

REV.	DATE	DESCRIPTION	APPROVED BY
05	10.12.22	ISSUED FOR REVIEW	ENERGY
04	10.10.18	ISSUED FOR REVIEW	ENVIRO.
03	10.08.16	ISSUED FOR REVIEW	INFRA.
02	10.06.21	ISSUED FOR REVIEW	STRUCT.
01	10.05.21	ISSUED FOR REVIEW	

RECURRENT ENERGY – SMITHS FALLS 2
10MW AC

SOLAR GENERATION FACILITY – SITE LAYOUT

WARDROP | A TETRA TECH COMPANY

3.0 FACILITY DESIGN PLAN

3.1 ELECTRICAL GENERATION EQUIPMENT

3.1.1 *SOLAR MODULES*

As of the date of this report, Suntech Model STP280-24/Vd solar modules are proposed for this project. Drawings of the solar modules are located in Appendix A.

3.1.2 *MOUNTING SYSTEM*

The PV modules will be assembled and mounted on a fixed tilt, ground mounted, and modular racking system. Typical details for the mounting system are shown in Appendix A. The system will be selected based on the array foundation type appropriate for the geotechnical conditions of the site (see Section 3.2.2).

3.1.3 *SUN TRACKING*

The panels are static; no sun tracking mechanism is specified.

3.1.4 *SOIL PERMEABILITY AND LAND TREATMENT*

See section 4.2, Stormwater Management.

3.1.5 *POWER CONVERSION*

Power will be converted from the DC collection system to AC using inverters. As of the date of this report, Satcon PowerGate Plus 1 MW Inverter 420- 850 VDC input, suitable for outdoor installations are proposed for the facility (Appendix A).

3.2 STRUCTURAL COMPONENTS

3.2.1 *SUBSTATION AREA*

Structural components in the substation area will include:

- Footings and oil containment system for the power transformer;
- Footings for the control house; and
- A pre-fabricated control house to enclose the protection and control equipment.

3.2.2 *ARRAY FOUNDATION*

Array foundations will consist of structural footings of the appropriate design, placed into the soil to an appropriate depth depending on the geotechnical conditions. Typical footings may include steel piles, screw piles, concrete piers or a foundation on bedrock. Typical detail drawings of these foundation options are provided in Appendix A.

3.2.3 *INVERTER LOCATIONS*

Inverters and their associated transformers will be mounted on concrete pads in the locations shown in Figure 2.1.

3.3 TRANSMISSION EQUIPMENT

Proposed transmission equipment for the facility is composed of the following:

- Walk-in metal clad switchgear with 15kV cells;
- Revenue metering with a Main Class IESO & Hydro One approved meter and an Alternate IESO & Hydro One approved meter; and
- 44kV Riser Pole framed for 44kV, 250 kV BIL, 600 A disconnecting switch, 55 kV MCOV arresters and three fuses.

3.4 TRANSFORMERS

Transformers have been discussed in 2.1.7.

3.5 STORMWATER MANAGEMENT

3.5.1 *PROPOSED FACILITIES*

The swales and ditches conveying stormwater runoff through the site will be constructed as triangular shaped open channels with a minimum depth of 600 mm below the elevation of the adjacent roadway and 3:1 vegetated sideslopes. The depth and longitudinal slope of the swales and ditches will vary depending on the topography of the surrounding ground surface and the anticipated peak flow expected to be carried by the ditch or swale.

Corrugated steel pipe culverts will be installed in each location where a swale or ditch intercepts an internal roadway. The culverts will be sized to accommodate the anticipated peak flow produced during the design storm event with a minimum 300 mm freeboard between the maximum water level at the culvert inlet and the elevation of the roadway to minimize the potential for overtopping of the roadway during relatively frequent storm events.

Where topographic and subsurface conditions allow, selected downstream sections of the swales and ditches will be constructed as enhanced vegetated swales to provide stormwater detention to reduce peak runoff flow rates and volumes and to promote the deposition of any water borne sediment. These enhanced swales, where provided, will be constructed as trapezoidal channels with 1 to 3 m bottom widths designed to convey design flows at velocities not exceeding 0.50 m/s.

Vegetated filter strips, densely planted area of vegetation with flat slopes, will also be employed to provide additional filtering of sediment and infiltration of runoff in areas where runoff from the site will enter watercourses, protected areas surrounding the watercourses or on adjacent private properties. Flow dissipation devices such as rock check dams and splitter ditches will also be utilized to diffuse runoff.



Typical Enhanced Swale



Typical Vegetated Buffer Strip

3.5.2 *DESIGN CRITERIA*

Drainage ditches, swales and culverts handling internal site drainage will be designed to accommodate runoff produced from a five year design storm event. Culverts placed within the municipal road allowance at the site entrances will be designed to carry runoff from a ten year design storm event.

4.0 FACILITY OPERATIONAL PLAN

4.1 MAINTENANCE SCHEDULE

Maintenance will include panel repairs, panel washing, maintenance to transformers, inverters and other electrical equipment as needed, maintenance to the oil/water separator system and road and fence repairs. Inspections will occur monthly and all items will be documented and repairs will take place accordingly, as required.

The facility electrical operations will be monitored remotely with a SCADA system. The facility will be monitored by security cameras installed around the facility.

4.1.1 *VEGETATION CONTROL*

As part of maintenance to the property, vegetation onsite will be managed appropriately. Control of the vegetation will be satisfied to allow access to all areas of the site, as well as maintaining good aesthetics.

4.1.2 *PANEL WASHING*

Panel washing will be completed approximately three times per year, as required, to ensure the optimal generation capability from the PV panels. Water will be obtained from the on-site water well and off-loaded to small maintenance vehicles to allow spray-washing to the panels. It is anticipated that two crews will take approximately 4 to 5 days to wash the panels in the facility for each maintenance period. It is expected that a total 25,700 L of water are required for each maintenance period. A flow meter will be installed on the well in order to monitor the amount of drawn for maintenance. The daily use of groundwater for all purposes will be limited to a performance criterion less than 45,000 L per day. If adequate cleaning cannot be achieved with the performance criterion, water from an off-site source will be considered (see Appendix C).

4.1.3 *TRANSFORMERS*

Visual inspections must be completed monthly. A record of the inspection must be kept at the site. A log book will be located within the transformer mechanism box.

The visual inspection will include, but is not limited to, a thorough check around the transformer for signs of oil leaks and inspection of the oil/water separator.

General procedures:

- Check the containment system to ensure the liner is attached and has no signs of perforations or other damage;
- Check the concrete walls for signs of cracks or frost heaving;
- Check the sump for evidence of water or oil. There should be no oily film or sheen on the water in the oil separator sump; and
- Inspect the transformer for signs of leaks. If any are observed, they should be noted and reported to supervision for an immediate assessment.

Any leaks detected on the transformer must be repaired as soon as possible. Any oil absorbing material should be placed under the leak to prevent oil from entering the containment area. Once the leak has been repaired, the absorbing material should be disposed of appropriately.

4.2 STORMWATER

4.2.1 *ESTIMATED FLOW RATES AND RUNOFF VOLUMES*

Minimal changes to the post development hydrology of the site are anticipated as the development of the solar generation facility will involve minimal alteration to the underlying native soils, the topography of the site or ground surface cover.

While the solar panels are impervious surfaces, their design and placement promotes the dispersal of rainwater to the ground surface beneath and surrounding the panels. These areas will be planted with native grasses and other groundcover to replicate pre-development hydrologic conditions.

The construction of granular access roads, transformer pads and parking areas represent the most significant change to the level of imperviousness of the site, however, the total area of these land uses, approximately 0.84 ha represents only 3% of the total development site. During the design storm event, this small increase in impervious area will result in an estimated increase in total peak flows generated from the site of approximately 4.5% and an increase in total volume of stormwater runoff produced of approximately less than 3.6%.

4.2.2 *MAINTENANCE*

A detailed plan of the erosion and sediment control work planned for the site will be prepared and submitted as a part of the detailed engineering design for the project to ensure that adjacent properties and downstream sections of drainage courses and waterways receiving runoff from the site are not adversely impacted by development of the site. The detailed design plans will include recommended implementation,

inspection and maintenance schedules and will include the following general requirements for erosion and sediment control during construction:

- Removal and/or disturbance of existing vegetative ground cover will be restricted to areas of proposed construction and re-grading;
- Final grading and re-vegetation of all disturbed areas will be completed as soon as possible after the grading or construction activities in the area are completed. Restoration should be carried out in phases as each area is complete rather than on a site wide basis on completion of all works;
- All erosion and sediment control works should be installed and fully functional prior to the start of any construction activities on the site except those activities required to implement the erosion and sediment control works; and
- Regular inspections and maintenance of the erosion and sediment control works will be conducted. These inspections and maintenance activities will be documented in regular status reports.

4.2.3 CHEMICAL INPUTS

There will be no chemical waste introduced or generated.

4.2.4 RESIDUAL WASTES

No residual wastes are anticipated from the stormwater management facilities.

4.3 WATER WELL

A water well will be installed during the construction phase of the project. The water will be used for panel washing and dust control (when required).

4.3.1 QUANTITIES

Water will be taken from the well in order to wash the solar panels.

To complete power washing, it is anticipated that two crews will take approximately 4 to 5 days to wash the panels in the facility for each maintenance cycle. It is expected that a total 25,700 L of water are required for each maintenance period, equal to approximately 5,100 to 6,400 L of water per day for each maintenance cycle.

Water needed for dust control on the internal roadways during maintenance would be minimal since it would be limited to the internal road system.

4.3.2 FLOW RATES

Flow rate for panel washing described in section 4.3.1.

4.3.3 MAINTENANCE

The well will be properly maintained including a protective steel casing at ground level.

4.3.4 *CHEMICAL INPUTS*

There will be no chemical waste introduced or generated.

4.3.5 *RESIDUAL WASTES*

There will be no residual waste introduced or generated.

5.0 COMMUNICATION AND EMERGENCY RESPONSE PLAN

5.1 GENERAL

During construction, operation and decommission activities at the facility, a sign with emergency instructions will be posted at the site including contact information.

- Emergency Instructions
 - Dial 911 for all emergencies
 - Dial RE Smiths Falls 2 ULC contact
- Medical Aid Facilities
 - Perth and Smiths Falls District Hospital, 60 Cornelia Street West, Smiths Falls, ON K7A 2H9, Administrative telephone number (613) 283-2330
- Fire Services
 - Drummond/North Elmsley Tay Valley Fire Rescue, 14 Sherbrooke St. E., Perth, ON, Administrative telephone number (613) 267-2596
- Police Services
 - Ontario Provincial Police (OPP), 361 Queen St., Smiths Falls, ON, Administrative telephone number (613) 284-4500

5.2 GENERAL INQUIRIES

The public and other organizations will be able to contact RE Smiths Falls 2 ULC regarding general non-emergency issues. A contact number and website will be posted at the site. All inquiries will be directed to a company official who can respond to the questions or comments. Inquiries may be addressed by discussion internally and where required, local authorities may be contacted. A written and/or verbal response will be communicated to the concerned individual or party. All correspondence will be recorded and saved electronically in a database and will include name, address and telephone number of individual; time and date of contact and proposed actions to be taken to resolve any issues and possibly prevent reoccurrence.

5.3 EMERGENCIES: GENERAL

A detailed Emergency Response Plan will be prepared in consultation with local municipal authorities and emergency response agencies prior to the start of any

construction activity being performed at the site. The plan will be communicated and available to all site personnel. The plan will include:

- Communication procedures including the identification of a primary and secondary crisis manager to serve as the company spokesperson in the event of an emergency;
- Listing of site personnel trained in first aid/CPR;
- Emergency & evacuation procedures for each type of emergency (fire, personal injury, spill);
- Emergency phone numbers (as detailed below); and
- Name and directions to nearest hospital or medical aid facility.

All emergencies will be documented by the Primary Emergency Contact and saved in an electronic file.

5.4 EMERGENCY SCENARIO: FIRE

Prior to the commencement of construction, a fire response plan will be implemented. This will include the notification of appropriate emergency personnel, including the Drummond/North Elmsley Tay Valley Fire Rescue, will be contacted if a fire occurs at the site.

5.5 EMERGENCY SCENARIO: SPILLS

Spills of operating fluids (gasoline, diesel fuel, lubricants) are possible from construction equipment and maintenance equipment and vehicles.

Spills of transformer insulating oils are possible. The main tanks of the power transformers at the station facility will be filled with insulating oil. Oil levels in the transformers are remotely monitored. Monthly maintenance routines include a check of the level of transformer oil in each transformer, and an inspection of the transformer for leaks.

5.5.1 REPORTABLE SPILLS

Spills are defined as a discharge of a pollutant into the natural environment, from out of a structure, vehicle or other container, and which is abnormal in quantity or quality in light of all the circumstances of the discharge and which may cause an adverse effect resulting directly or indirectly from human activities (Environmental Protection Act, R.S.O. 1990 Part X).

Reportable spills include:

1. Discharge of a pollutant into the natural environment.

2. Discharge likely to cause adverse effects.
3. Discharge not contained by secondary containment.
4. Discharge >100 litres of vehicle operation fluids.
5. Discharge >100 litres of mineral oil from electrical equipment
6. Any discharge (including those exempted in d and e) that enter water or drainage structures (ditches, maintenance holes, etc.).
7. Any discharges that contain more than 1.0 gram of PCBs (>50ppm) or any discharge with unknown but potential PCB content.
8. Spills of airborne pollutants or emissions of smoke including gases, vapours, particulate, uncontained dust emissions from blasting, etc.

5.5.2 *INTERNAL NOTIFICATIONS*

The Primary Crisis Manager will record all the pertinent information regarding the spill in a Spill Incident Report. The Secondary Crisis manager will be informed of the spill, and be given a copy of the Spill Incident Report.

5.5.3 *EXTERNAL NOTIFICATIONS*

The Response Supervisor or designate must notify the following responders:

Agency	Contact Numbers
Ministry of the Environment	
Spills Action Centre (SAC)	1-800-268-6060 (24 hours)
Drummond/North Elmsley Tay Valley Fire Rescue	911
Ontario Provincial Police	911

Where readily ascertainable, also contact third party of or person having control of the pollutant (if applicable). For spills that enter the storm and/or sanitary sewer system, or that occur within the boundaries of the municipal authority, contact the local municipality/township.

Agency	Contact Numbers
Township of Drummond/North Elmsley	(613) 267-6500
County of Lanark	(613) 267-4200

The nearest hospital or medical aid facility to the Smiths Falls 2 site is the Perth and Smiths Falls District Hospital in Smiths Falls, which is approximately 8 km to the southeast of the site.

5.5.4 *SPILL INCIDENT REPORT*

When reporting a spill to any government agency, the following information should be given:

- What was spilled?
- How much was spilled?
- Where is the spill?
- What was done to contain and clean up the spill?
- Who (i.e. what company) do you represent?
- Where are you?

The following Spill Incident Report will be used to record spills.

Spill Incident Report			
Location: _____	Date: _____	<div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"> Year Month Day </div> <div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> a.m. <input type="checkbox"/> p.m. </div>	
Reported by Whom: _____	Reported Internally to: _____	<div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"> Year Month Day </div> <div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> a.m. <input type="checkbox"/> p.m. </div>	
Incident description _____ _____ _____ _____			
Material Spilled/Released: _____		Duration: _____	
Estimated Quantity _____			
Immediate Cause _____			

Additional Equipment or Agency Employed: _____			
Immediate Actions: _____			

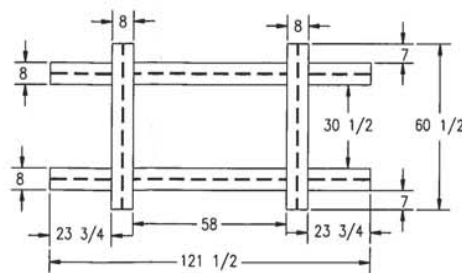
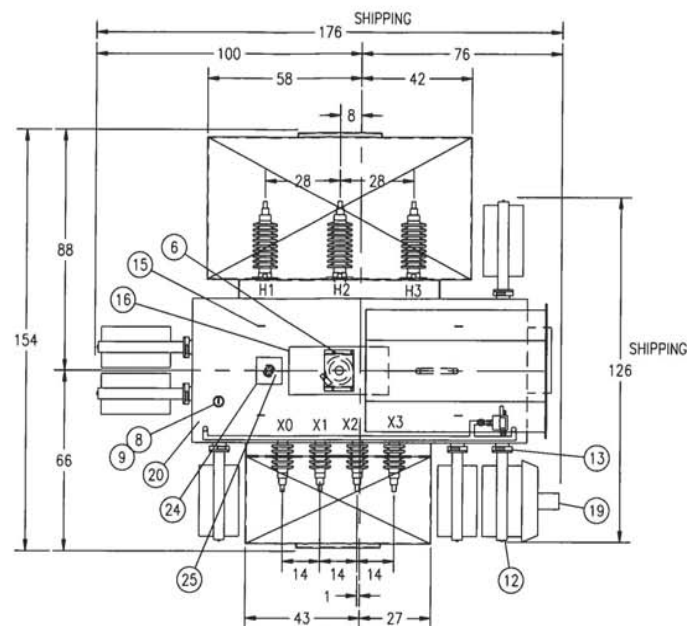
Weather Conditions: _____			
Time Normal Conditions Restored: _____		Date: _____	
<input type="checkbox"/> a.m. <input type="checkbox"/> p.m.		<div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"> Year Month Day </div>	
Reported to (MOE, etc.): _____		Date: _____	
Time _____		<div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"> Year Month Day </div>	
<input type="checkbox"/> a.m. <input type="checkbox"/> p.m.		<input type="checkbox"/> a.m. <input type="checkbox"/> p.m.	

6.0 ENVIRONMENTAL EFFECTS MONITORING PLAN

See Appendix C for the environmental effects monitoring plan.

APPENDIX A

TYPICAL EQUIPMENT DETAILS

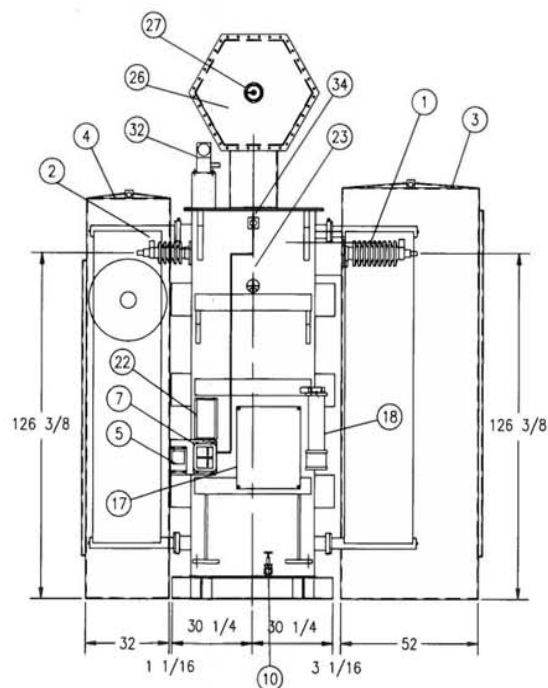
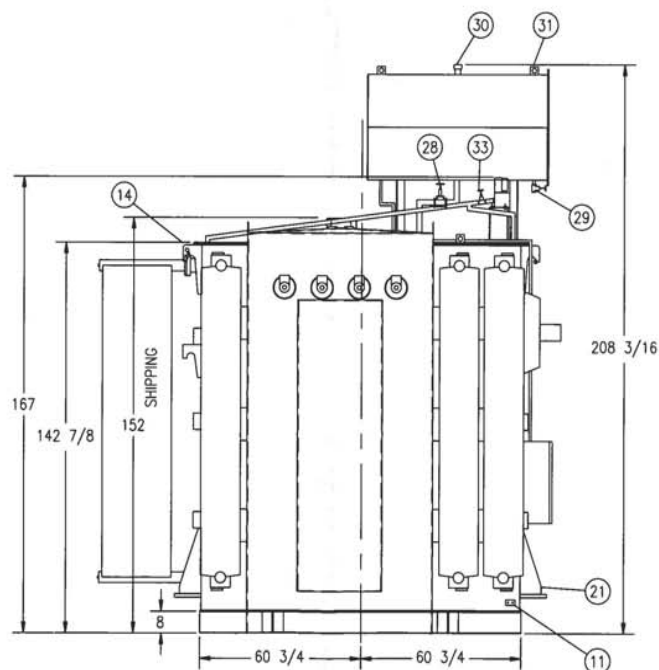


SHIPPING WEIGHTS	LB	KG
PARTS REMOVED	7750	3515
ASSEMBLED UNIT	75250	34135
TOTAL	83000	37650

CONSERVATOR OIL @ 25°C = 155 GAL. 7046 L.

PARTS REMOVED FOR SHIPPING
CONSERVATOR AND PIPING
GAS DETECTOR RELAY AND PIPING
HV AND LV BOX

- 1 HV BUSHINGS 46 KV 400 A.
PCORE #B-89401-40-70 c/w 1 1/8-12 TH'D STUD 2 1/2 LG
- 2 LV BUSHINGS 25 KV 400 A.
PCORE #B-89201-40-70 c/w 1 1/8-12 TH'D STUD 2 1/2 LG
- 3 HV BOX C/W HINGED FRONT DOOR & OPEN BOTTOM
- 4 LV BOX C/W HINGED FRONT DOOR & OPEN BOTTOM
- 5 REMOTE READING LIQUID LEVEL MONITOR FOR CONS. OIL LEVEL GAUGE
- 6 PRESSURE RELIEF DEVICE C/W SHROUD & CONTACT
QUALITROL #213-001-03
- 7 THERMOMETER QUALITROL #111-200-14
- 8 SHIPPING PRESSURE-VACUUM GAUGE
QUALITROL #50-35E
- 9 1/2" PRESSURE VACUUM GAUGE SHUT OFF GLOBE BRASS VALVE
- 10 2" DRAIN GLOBE BRASS VALVE C/W 3/8" SAMPLER
- 11 S.S. GROUND PADS C/W 1/2" UNC TAPPED HOLES @ 1-3/4" CTRS.
- 12 COOLING RADIATORS
- 13 COOLING RADIATORS SHUT OFF VALVES
- 14 TRANSFORMER LIFTING LUGS
- 15 COVER LIFTING LUGS
- 16 HANDHOLE C/W BOLTED COVER
- 17 CONTROL BOX (30 X 24 X 8) SEE DWG 2029-0300
- 18 SILICA GEL BREATHER
- 19 FANS 120 V 1/6 HP 1 PH
- 20 BOLTED COVER
- 21 JACKSTEPS
- 22 RATING PLATE SEE DWG 2029-020B
- 23 TAP CHANGER HANDLE c/w PADLOCKING PROVISION
- 24 C. T. OUTLET BOX
- 25 CORE GROUND LOCATED IN BOX
- 26 CONSERVATOR C/W REMOVABLE END
- 27 CONSERVATOR OIL LEVEL GAUGE
QUALITROL #039-008-01
- 28 CONSERVATOR SHUT OFF VALVE 2" IPS GLOBE BRASS
- 29 CONSERVATOR DRAIN VALVE 1" IPS GLOBE BRASS
- 30 CONSERVATOR TOP FILTER CAP 1" IPS
- 31 CONSERVATOR LIFTING LUGS
- 32 GAS DETECTOR RELAY ABB MODEL 11
- 33 GAS DETECTOR RELAY SHUT OFF VALVE 3/4 IPS BALL BRASS
- 34 TEMPERATURE MONITOR RTD QUALITROL #103-044-01



APPROXIMATE WEIGHT	LB	KG
CORE & COILS	33525	15207
TANK & FITTINGS	25617	11623
OIL 2774 GALS. 12612 L.	23858	10822
TOTAL	83000	37650

TANK SIZE 120 X 46 X 138 H.

FINISH ASA 70 GREY

06-2029 MS#7 LESLIE ST.
06-2030 MS#8 WELLINGTON ST.

REV.	REMARKS	BY:	DATE:
Northern Transformer INCORPORATED			
PLOT	DRAWN BY:	DATE:	REV. 0
JOB:	CHECKED BY:	DATE:	S.D. NO.
TITLE: 7500/10000 KVA Oil Insulated Transformer			
DRAWING NO.			

Prism MVP 1

Two-piece, pre-packaged MV system for grounded 900 VDC arrays:

2 x PVS-500 kW NEMA 1 inverters

Prefabricated weather-tight outdoor enclosure with dual entrances houses inverters

Corresponding 1000 kVA transformer with dual low voltage-side windings and integral MV disconnect switch

Transformer configurable to meet any voltage up to 43.8 kV

Two-piece installation allows for separation of the inverter and transformer to suit site requirements

Prism MVP 2

One piece, factory integrated MV system for grounded 900 VDC arrays:

2 x PVS-500 kW NEMA 1 inverters

Prefabricated weather-tight outdoor enclosure with dual entrances houses inverters

Corresponding 1000 kVA transformer with dual low voltage-side windings and integral MV disconnect switch

Transformer configurable to meet any voltage up to 43.8 kV

One piece design with inverter and transformer on same transportable chassis allows for "ship and drop" installation with minimal site preparation

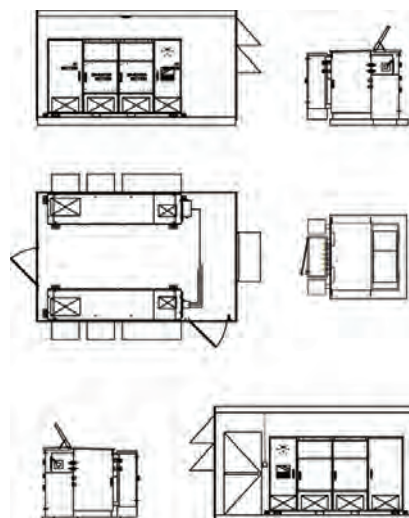
Satcon Prism 1 MW Medium Voltage Solution



Satcon Prism a fully integrated one megawatt medium voltage (MV) solution optimized for utility scale solar PV installations. Leveraging Satcon's industry standard setting PowerGate® Plus 500kW solar PV inverters, Prism is a utility grade one megawatt platform, complete with factory integrated step-up transformers, MV disconnect switches, and power conversion electronics.

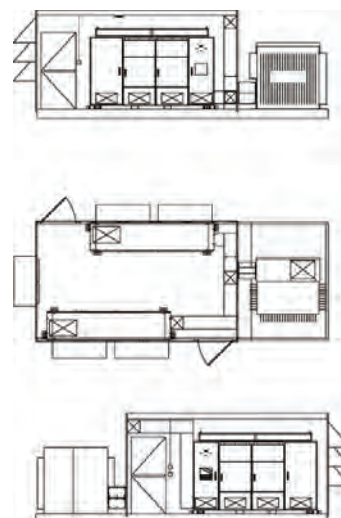
The solution is delivered in two configurations; both complete with an all-weather outdoor enclosure and ready to connect to the PV array and utility grid, enabling rapid installation through a modular prepackaged design.

Satcon Prism MVP 1



Two-Piece, pre-packaged MV system for grounded 900 VDC array systems

Satcon Prism MVP 2



Pre-packaged, 1MW, integrated, one – piece MV solution for grounded, 900 VDC PV array systems



Edge MPPT

Provides rapid and accurate control that boosts PV plant kilowatt yield

Provides a wide range of operation across all photovoltaic cell technologies

Printed Circuit Board Durability

Wide thermal operating range: -40° C (-40° F) to 85° C (185° F)

Conformal coated to withstand extreme humidity and air-pollution levels

Proven Reliability

Rugged and reliable, PowerGate Plus PV inverters are engineered from the ground up to meet the demands of large-scale installations.

Low Maintenance

Modular components make service efficient

Dual cooling fans

Safety

Seismic Zone Compliant (IBC, ASCE 7, ICC ES AC156 seismic acceptance criteria)

Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance

Isolation provided by MV transformer

Protective covers over exposed power connections

Prism - 1,000 kW MV System Electrical Specifications			UL/CSA
Input Parameters			
PV Array Configuration		Positive Ground	○
		Negative Ground	●
Maximum Array Input Voltage		900 VDC	●
Input Voltage Range (MPPT; Full Power)		420 VDC to 850 VDC	●
Maximum Input Current		1,228A (per 500 kW power block)	●
		2,456A Total	
Combiner Option		15 inputs @ 200 A per 500 kW power block (30 inputs total per 1 MW)	○
Output Parameters			
Inverter Output Voltage Range	265 VAC	233 VAC - 292 VAC	●
Transformer - High Voltage Side (nominal)		To be specified by Customer	
Output Frequency Range		59.3Hz - 60.5Hz	●
Maximum Output Current per Phase	265 VAC	1,090 A per 500 kW power block (2,180 A total)	●
		Typical @ 12.47 kV = 46.32 A per 1 MW power block	
		46.32 A total	
CEC-Weighted Efficiency		96%	●
Maximum Continuous Output Power		1,000 kW	●
Power Factor at Full Load		>0.99	●
Harmonic Distortion		<3% THD	●
Temperature			
Operating Ambient Temperature Range (Full Power)		-20° C to +50° C	●
Cooling		Forced Air	●
Heater			○
Auxiliary Transformers			
480V, 120V			○
Warranty			
Five Years			●
Extended Warranty (Up to 10, 15 or 20 Years)			○
Extended Service Agreement			○
Uptime Guarantee			○
Intelligent Monitoring			
Satcon PV View® Plus			○
Satcon PV Zone			○
Third-Party Compatibility			●

- Standard
- Optional

Note: Specifications are subject to change.



Streamlined Design

With all components encased in a single, space-saving enclosure, PowerGate Plus PV inverters are easy to install, operate, and maintain.

Single Cabinet with Small Footprint

Convenient access to all components

Large in-floor cable glands make access to DC and AC cables easy

Rugged Construction

Engineered for outdoor environments

Medium Voltage Transformer

Provides galvanic isolation

Steps up output voltage of the PV inverter to the grid

Quiet Operation

65 dB(A) standard

E-House Enclosure Specifications:

Satcon Prism is housed in a NEMA 3R outdoor rated enclosure which is designed and constructed to ensure a robust package capable of maintaining weather-tightness over a wide range of environmental conditions in addition to security for the power conditioning system.

Baseframe:

Base frame is constructed of structural steel, shop welded, and in full conformance with ASTM A 36 standards. It is designed to handle uniform and concentrated loads during shipping, handling, and rigging, with strategically located lifting lugs.

Flooring:

The flooring is made up of tightly fitting, non-conducting, of ¾" Fire Rated plywood covered with a non-skid surface

Walls:

Wall posts are 14 gauge galvanized (minimum), shop welded to both the structural steel base frame and roof z-bracket to form a rigid framework which is capable of transmitting full roof load into the base frame. All walls are insulated with CertainTeed Fiber Glass Duct Board System for an R value 4.3.

Steel Doors and Hardware:

The two steel doors are 20 gauge with R 2.4 insulation. They each have an interior panic bar and door closer as standard.

Siding:

Siding panels are tight fitting, full length, panels that provide a continuous weathertight, waterproof exterior. The panels are made of 22 gauge Factory Painted Stucco Aluminum, fastened to the vertical wall posts with zinc plated fasteners that resist galvanic reaction. The siding is designed to exceed a wind load of 90mph.

Roof:

The enclosure roof is comprised of tight fitting, robust, weathertight, waterproof, EPDM membrane. The roof has a minimum pitch of 1" across the enclosure width for best water run-off. The roof is insulated to an R value of 4.3.

Lighting:

Standard interior fluorescent lighting is 4'T8 High Output light fixtures.

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Satcon Corporate
27 Drydock Avenue
Boston, MA 02210
P: 617.897.2400
F: 617.897.2401
E: sales@satcon.com

Satcon West
2925 Bayview Drive
Fremont, CA 94538
P: 510.226.3800
F: 510.226.3801
E: sales@satcon.com

Satcon Canada
835 Harrington Court
Burlington, ON L7N 3P3
Canada
P: 905.639.4692
F: 905.639.0961
E: sales@satcon.com

Satcon Greece
Athanasίου Diakou 2 &
Marathonas Ave
Gerakas 15344
Greece
P: 30 210 6654424
F: 30 210 6654425
E: sales@satcon.com

Satcon Czech Republic
Classic 7 Business Park
Jankovcova 1037/49
170 00 Praha 7
Czech Republic
P: 420 255 729 610
F: 420 255 729 611
E: sales@satcon.com

Satcon Shenzhen China
Room 1112, 11/F, International
Chamber of Commerce,
No. 168 FuHua San Road,
FuTian District, Shenzhen, P.R.C.
518048
P: +86 755 61682588
F: +86 755 61682599
E: sales@satcon.com

Satcon Shanghai China
Room 2308, 23/F, New
HongQiao Center Building,
No. 83 LouGuanShan Road,
Changning District,
Shanghai, P.R.C.
P: 139.1811.2818
E: sales@satcon.com

PVS-500 (MVT)

PVS-500 (480 V)

PVS-500 (265 V) CE

Peak Efficiency 97.6%

Power Efficiency

Power Level	Output Power ¹	Efficiency ²
10%	50 kW	92.2%
20%	100 kW	95.6%
30%	150 kW	96.2%
50%	250 kW	96.5%
75%	375 kW	96.4%
100%	500 kW	96.0%

¹ 320V minimum ² 480V model

Power Efficiency without Transformer

Power Level	Output Power ¹	Efficiency
10%	50 kW	97.08%
20%	100 kW	97.52%
30%	150 kW	97.58%
50%	250 kW	97.46%
75%	375 kW	97.09%
100%	500 kW	96.52%

¹ 310V minimum

Unparalleled Performance

With their advanced system intelligence, next-generation Edge™ MPPT technology, and industrial-grade engineering, PowerGate Plus inverters maximize system uptime and power production, even in cloudy conditions.

Edge MPPT

Provides rapid and accurate control that boosts PV plant kilowatt yield

Provides a wide range of operation across all photovoltaic cell technologies

Printed Circuit Board Durability

Wide thermal operating range: -40° C (-40° F) to 85° C (185° F)

Conformal coated to withstand extreme humidity and air-pollution levels

PV Inverters | PowerGate® Plus 500 kW



Profitable PV Power

The Satcon® PowerGate® Plus 500 kW PV inverter has a significant impact on the profitability dynamic of large-scale solar PV systems. With its unparalleled system intelligence, next-generation Edge™ MPPT technology, and industrial-grade engineering, the PowerGate Plus 500 kW inverter maximizes system uptime and power production, even in the harshest environments.

Commercial and Utility Scale

The world's largest solar power installations depend on Satcon PowerGate Plus PV inverters to provide efficient and stable power—even in the harshest climates.

Advanced, Rugged, and Reliable

Engineered from the ground up to meet the demands of large-scale installations, Satcon PV inverters feature an outdoor-rated enclosure, advanced monitoring and control capabilities, and Edge,™ Satcon's next-generation MPPT solution.

Proven Performance

The proven leader in solar PV inverter solutions for commercial installations, Satcon sets the standards for efficient large-scale power conversion.

Increased PV Plant Yield

At the heart of PowerGate Plus is Edge, Satcon's next-generation power optimization solution. With rapid and accurate MPPT control, Edge increases PV plant kilowatt yield by extending the production window of arrays, enabling them to operate at optimal voltage and current levels for longer periods of time—even in varied sun conditions. To maximize efficiency, Edge improves the performance of all PV technologies, including fixed and tracking solar arrays, enabling you to get the most from your investment.

Proven Reliability

Rugged and reliable, PowerGate Plus PV inverters are engineered from the ground up to meet the demands of large-scale installations.

Low Maintenance

Modular components make service efficient

Dual cooling fans

Safety

UBC Seismic Zone 4 compliant

Built-in DC and AC disconnect switches

Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance

Protective covers over exposed power connections

PowerGate Plus 500 kW Specifications

UL/CSA

CE

Input Parameters

Maximum Array Input Voltage	600 VDC		•	
	900 VDC			•
PV Array Configuration	Positive Ground		◦	◦
	Negative Ground		•	◦
	Floating			•
Input Voltage Range (MPPT; Full Power)	320/333–600 VDC	200/208 VAC ¹	•	
	420–850 VDC	265 VAC ¹		•
	320–600 VDC	480 VAC	•	
Maximum Input Current	1,628 ADC/ 1,565 ADC	200/208 VAC ¹	•	
	1,228 ADC	265 VAC ¹		•
	1,628 ADC	480 VAC	•	

Output Parameters

Output Voltage Range (L-L)	176–220 VAC/ 183–229 VAC	200/208 VAC ¹	•	
	233–292 VAC	265 VAC ¹		•
	422–528 VAC	480 VAC	•	
Nominal Output Voltage	200/208 VAC ¹		•	
	265 VAC ¹			•
	480 VAC		•	
Output Frequency Range	59.3–60.5 Hz		•	
	49.3–50.5 Hz			•
AC Voltage Range (Standard)	-12%/+10%		•	•
Nominal Output Frequency	60 Hz		•	
	50 Hz			•
Number of Phases	3		•	•
Maximum Output Current per Phase	1,443/1,388 A	200/208 VAC ¹	•	
	1090 A	265 VAC ¹		•
	602 A	480 VAC	•	

◻ Standard ◦ Optional



The integrated external transformer is standard on the 480 VAC models only; custom transformer solutions are also available.

Streamlined Design

With all components encased in a single, space-saving enclosure, PowerGate Plus PV inverters are easy to install, operate, and maintain.

Single Cabinet with Small Footprint

Convenient access to all components

Large in-floor cable glands make access to DC and AC cables easy

Rugged Construction

Engineered for outdoor environments

Output Transformer

Provides galvanic isolation

Matches the output voltage of the PV inverter to the grid

Quiet Operation

65 dB(A) standard

PowerGate Plus 500 kW Specifications

UL/CSA

CE

Peak Efficiency

97.6%

CEC-Weighted Efficiency³

97%

200/208 VAC¹

•

97%

265 VAC¹

•

96%

480 VAC

•

Maximum Continuous Output Power

500 kW (500 kVA)

•

•

Tare Losses

138.12 W

200/208 VAC¹

•

170 W

265 VAC¹

•

138.12 W

480 VAC

•

Power Factor at Full Load

>0.99

•

•

Harmonic Distortion

<3% THD

•

•

Temperature

Operating Ambient Temperature Range (Full Power)

-20° C to +50° C

•

•

Storage Temperature Range

-30° C to +70° C

•

•

Cooling

Forced Air

•

•

Noise

Noise Level

<65 dB(A)

•

•

Combiner

Number of Inputs and Fuse Rating
(2 fuses/input for floating)

20 (160 ADC)

◦

30 (100 ADC)

◦

20 (160 ADC)

◦

20 (125 ADC)

◦

Transformer

Integrated External Transformer

480 VAC

•

Low Tap Voltage²

20%

•

External Transformer²

◦

◦

Inverter and Integrated External Transformer Cabinets

Enclosure Rating

NEMA 3R

•

IP54

•

Enclosure Finish

(11 Gauge CRS, painted, base zinc coated)

RAL-7032

•

•

Stainless Steel Finish

◦

◦

Cabinet Dimensions
(Height x Width x Depth)

Inverter

92.6" x
138.8" x
43.1"
(235 cm x
352 cm x
109 cm)

92.6" x
153.8" x
43.1"
(235 cm x
391 cm x
109 cm)

Transformer

480 VAC

77" x 49" x 30.5"
(195.58 cm x 124.46 cm
x 77.47 cm)

Cabinet Weight

Inverter

5,900 lbs.

2,676 kg

Transformer

480 VAC

3,200 lbs.

1,451 kg

◦ Standard ◦ Optional



Output Options

PowerGate Plus 500 kW

UL/CSA	208 VAC ¹ Output
	480 VAC Output
CE	265 VAC ¹ Output

¹ External transformer

PowerGate Plus 500 kW Specifications

Testing and Certification

UL1741, CSA 107.1-01, IEEE 1547, IEEE C62.41.2, IEEE C62.45, IEEE C37.90.1, IEEE C37.90.2

CE Certification (EN 50178, EN 61000-6-2, EN 61000-6-4)

UBC Zone 4 Seismic Rating

Warranty

Five Years

Extended Warranty (up to 10, 15, or 20 years)

Extended Service Agreement

Uptime Guarantee

Intelligent Monitoring

Satcon PV View® Plus

Satcon PV Zone

Third-Party Compatibility

- Standard
- Optional

¹ Options designed to be used with external transformer.

² The 20% boost tap on the isolation transformer increases the AC voltage output range for applications where the solar array DC operating voltage is at or near the lower end of the DC input range. This boost allows for continued inverter operation at lower DC voltage input levels.

³ For 265 VAC and 200/208 VAC models efficiency is listed as "Inverter Only" efficiency.

Note: Specifications are subject to change.

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Satcon Corporate
27 Drydock Avenue
Boston, MA 02210
P: 617.897.2400
F: 617.897.2401
E: sales@satcon.com

Satcon West
2925 Bayview Drive
Fremont, CA 94538
P: 510.226.3800
F: 510.226.3801
E: sales@satcon.com

Satcon Canada
835 Harrington Court
Burlington, ON L7N 3P3
Canada
P: 905.639.4692
F: 905.639.0961
E: sales@satcon.com

Satcon Greece
Athanasiou Diakou 2 &
Marathonas Ave
Gerakas 15344
Greece
P: 30 210 6654424
F: 30 210 6654425
E: sales@satcon.com

Satcon Czech Republic
Classic 7 Business Park
Jankovcova 1037/49
170 00 Praha 7
Czech Republic
P: 420 255 729 610
F: 420 255 729 611
E: sales@satcon.com

Satcon Shenzhen China
Room 1112, 11/F, International
Chamber of Commerce,
No. 168 FuHua San Road,
FuTian District, Shenzhen, P.R.C.
518048
P: +86 755 61682588
F: +86 755 61682599
E: sales@satcon.com

Satcon Shanghai China
Room 2308, 23/F, New
HongQiao Center Building,
No. 83 LouGuanShan Road,
Changning District,
Shanghai, P.R.C.
P: 139.1811.2818
E: sales@satcon.com

STP280 - 24/Vd STP275 - 24/Vd

SUNTECH
Solar powering a green future™

280 Watt

POLYCRYSTALLINE SOLAR MODULE

Features



High module conversion efficiency (up to 14.4%), through superior manufacturing technology



Guaranteed 0-5W positive power output tolerance ensures high reliability



Three bus-bar design enhances cell reliability and reduces series resistance for large fill factor



Excellent performance under low light environments (mornings, evenings and cloudy days)



Entire module certified to withstand high wind loads (2400 Pascal) and snow loads (5400 Pascal) *



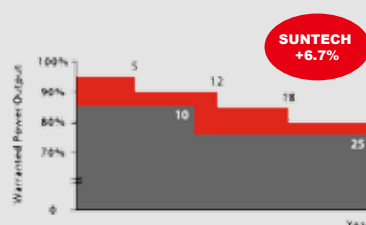
4.0mm thick tempered glass improves module durability



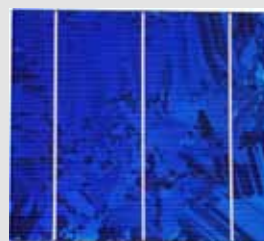
Trust Suntech to Deliver Reliable Performance Over Time

- World's leading manufacturer of crystalline silicon photovoltaic modules
- Unrivaled manufacturing capacity and world-class technology
- Rigorous quality control meeting the highest international standards : ISO 9001: 2008 and ISO 14001: 2004
- Certification and standards: IEC 61215, IEC 61730, conformity to CE

Industry-leading warranty



- 25 year transferrable power output warranty: 5 year/95%, 12 year/90%, 18 year/85%, 25 year/80% **
- Based on nominal power
- Warrants 6.7% more power than the market standard over 25 years
- 5 year material and workmanship warranty

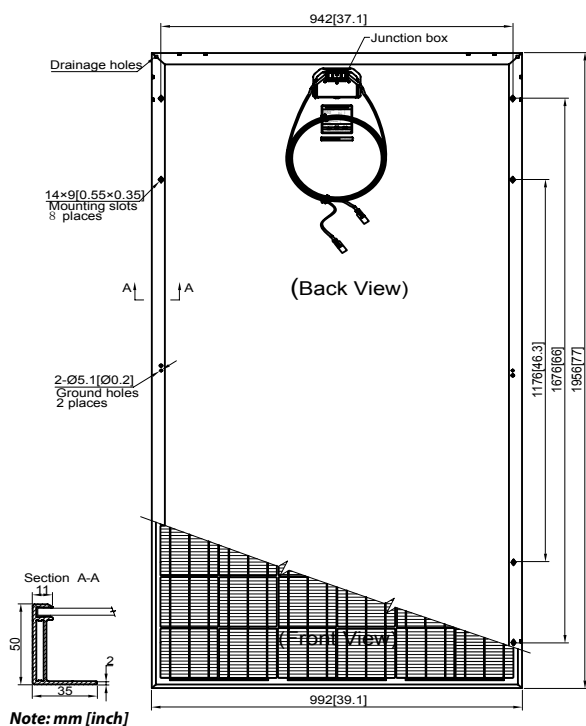


Textured surface and silicon nitride anti-reflection coating improves light absorption for more current production

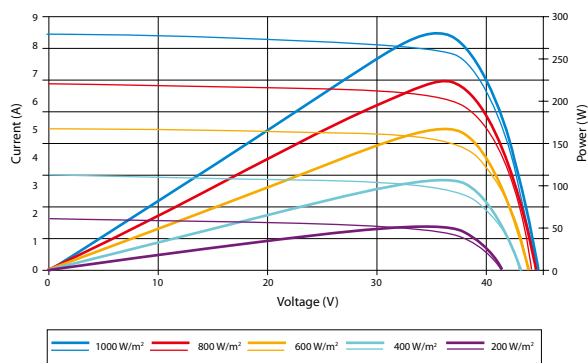


Suntech's reputation is founded on more than 1.5 gigawatts of high-performing solar modules installed around the world

* Please refer to Suntech Standard Module Installation Manual for details.
** Please refer to Suntech Product Warranty for details.



Current-Voltage & Power-Voltage Curve (280-24)



Temperature Characteristics

Nominal Operating Cell Temperature (NOCT)	45±2°C
Temperature Coefficient of Pmax	-0.47 %/°C
Temperature Coefficient of Voc	-0.34 %/°C
Temperature Coefficient of Isc	0.045 %/°C

Dealer information box

Specifications are subject to change without further notification

Electrical Characteristics

STC	STP280-24/Vd	STP275-24/Vd
Optimum Operating Voltage (Vmp)	35.2 V	35.1 V
Optimum Operating Current (Imp)	7.95 A	7.84 A
Open - Circuit Voltage (Voc)	44.8 V	44.7 V
Short - Circuit Current (Isc)	8.33 A	8.26 A
Maximum Power at STC (Pmax)	280 W	275 W
Module Efficiency	14.4%	14.2%
Operating Temperature	-40 °C to +85 °C	-40 °C to +85 °C
Maximum System Voltage	600 V DC	600 V DC
Maximum Series Fuse Rating	20 A	20 A
Power Tolerance	0/+5 W	0/+5 W

STC: Irradiance 1000 W/m², module temperature 25 °C, AM=1.5

NOCT	STP280-24/Vd	STP275-24/Vd
Maximum Power (W)	204 W	201 W
Maximum Power Voltage (V)	32.0 V	31.9 V
Maximum Power Current (A)	6.39 A	6.29 A
Open Circuit Voltage (Voc)	40.8 V	40.7 V
Short Circuit Current (Isc)	6.74 A	6.68 A
Efficiency Reduction (from 1000 W/m ² to 200 W/m ²)	<4.5%	<4.5%

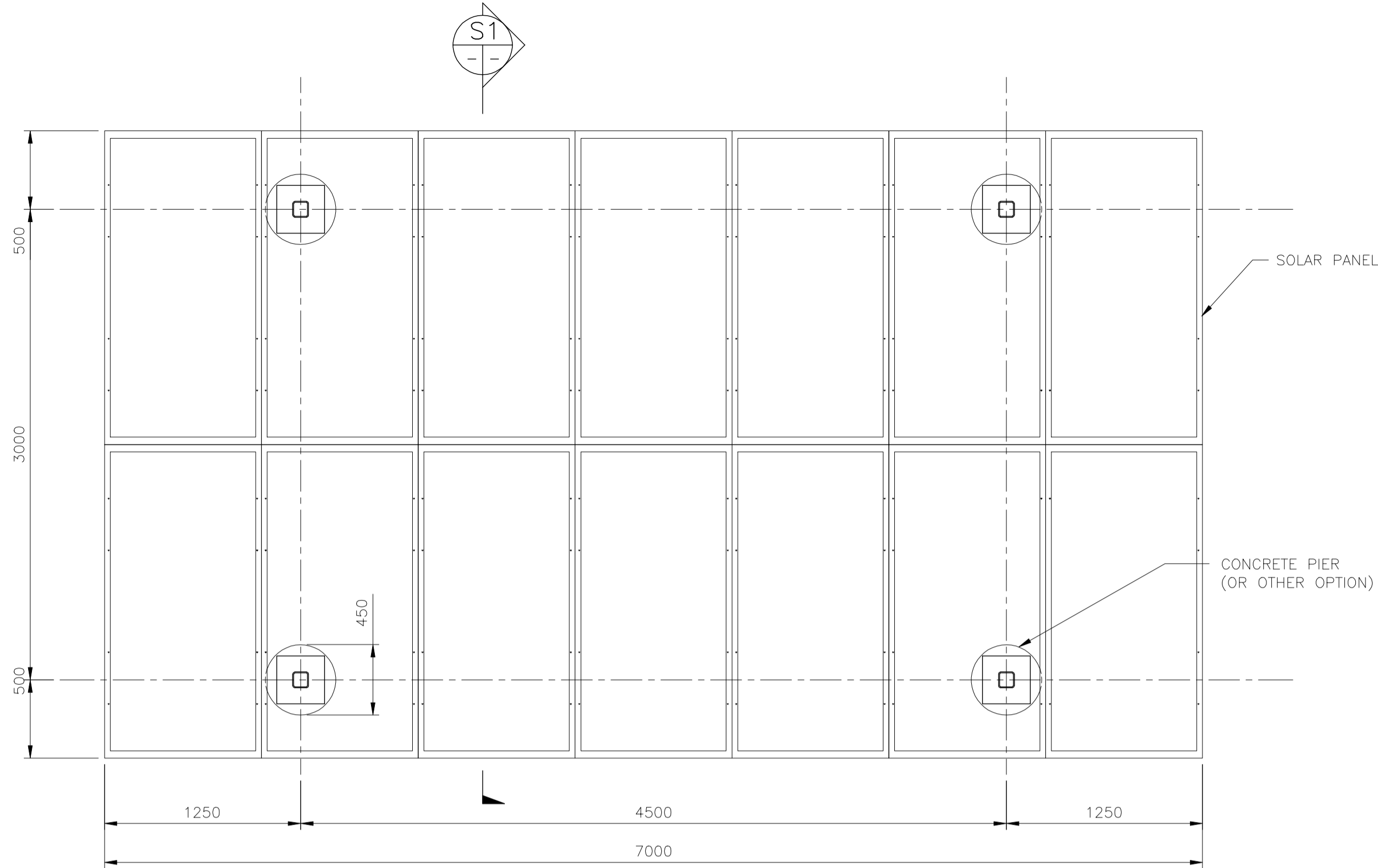
NOCT: Irradiance 800 W/m², ambient temperature 20 °C, wind speed 1 m/s

Mechanical Characteristics

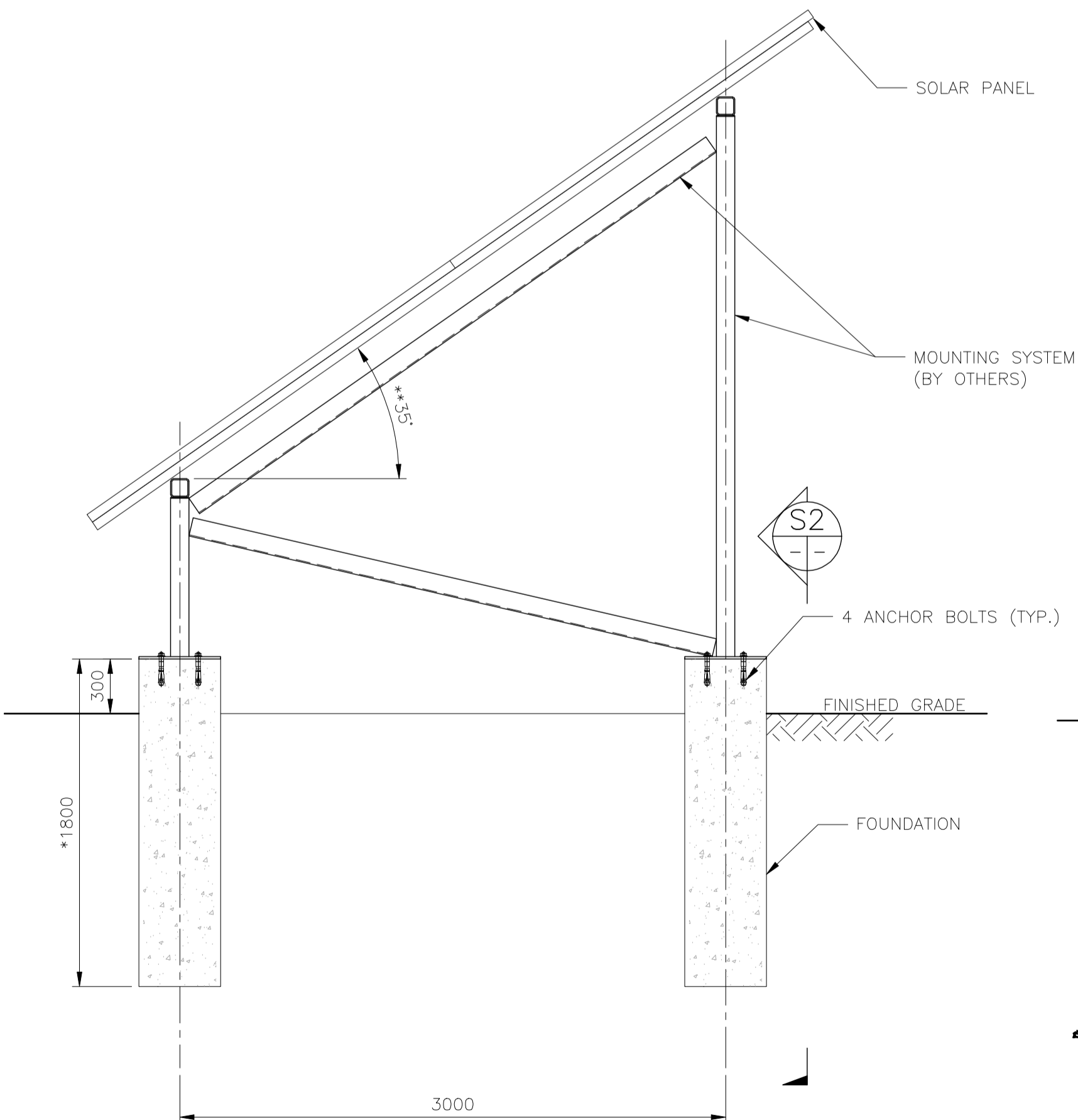
Solar Cell	Polycrystalline 156 × 156 mm (6 inches)
No. of Cells	72 (6 × 12)
Dimensions	1956 × 992 × 50 mm (77.0 × 39.1 × 2.0 inches)
Weight	27 kgs (59.5 lbs.)
Front Glass	4.0 mm (0.16 inches) tempered glass
Frame	Anodized aluminium alloy
Junction Box	IP67 rated
Output Cables	H+S RADOX® SMART cable 4.0 mm ² (0.006 inches ²), symmetrical lengths (-) 1100 mm (43.3 inches) and (+) 1100 mm (43.3 inches), H4 connectors (MC4 compatible)

Packing Configuration

Container	20' GP	40' GP	40' HC
Pieces per pallet	21	21	21
Pallets per container	6	12	24
Pieces per container	126	252	504

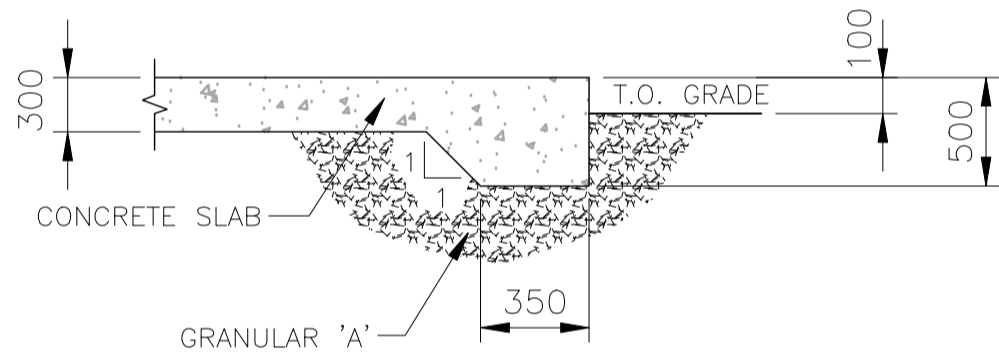


1 PLAN VIEW
1:25

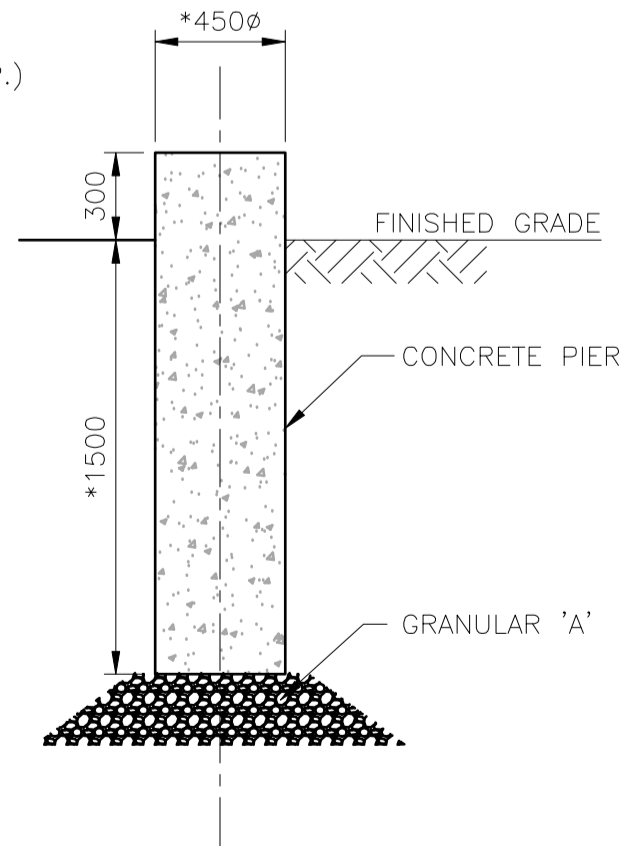


S1 SECTION
1:25

* EXACT DIMENSION DEPENDS ON SITE CONDITIONS
** EXACT ANGLE DEPENDS ON ELECTRICAL REQUIREMENTS

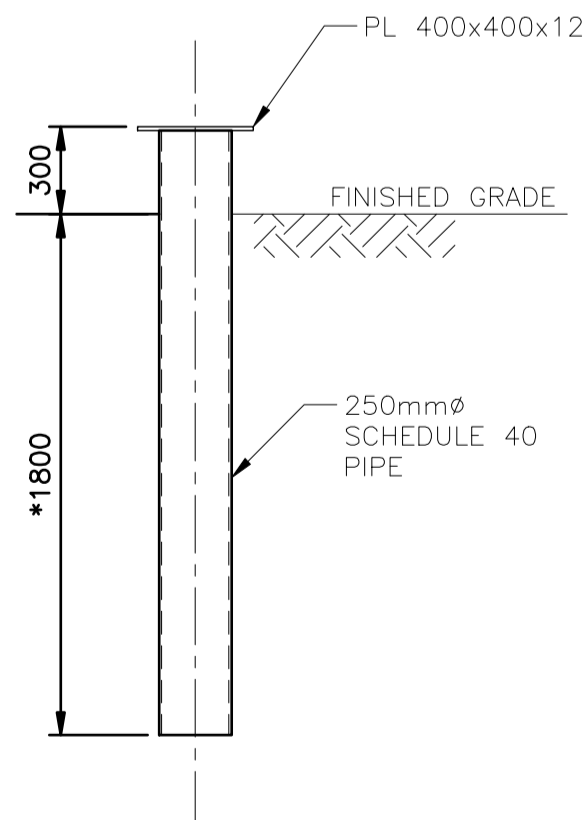


S3 FLOATING SLAB FOUNDATION SECTION
N.T.S.



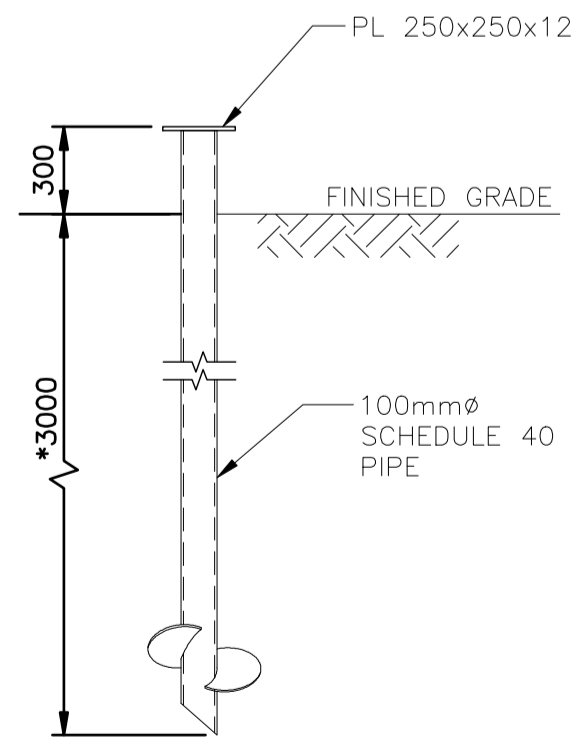
S2a CONCRETE PIER SECTION - OPTION 1
1:25

* EXACT DIMENSION DEPENDS ON SITE CONDITIONS



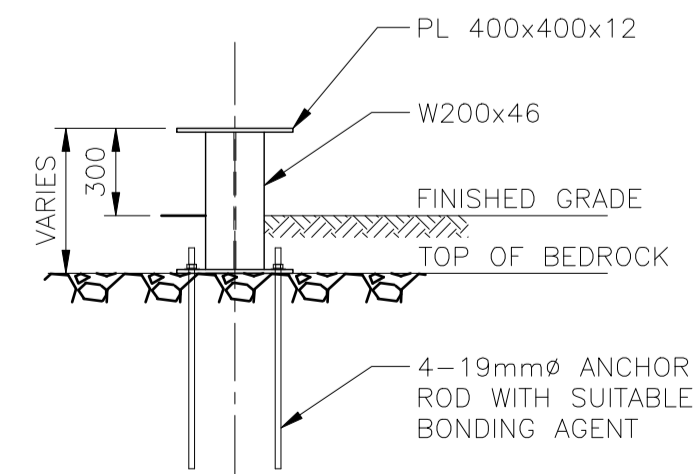
S2b STEEL PILE SECTION - OPTION 2
1:25

* EXACT DIMENSION DEPENDS ON SITE CONDITIONS



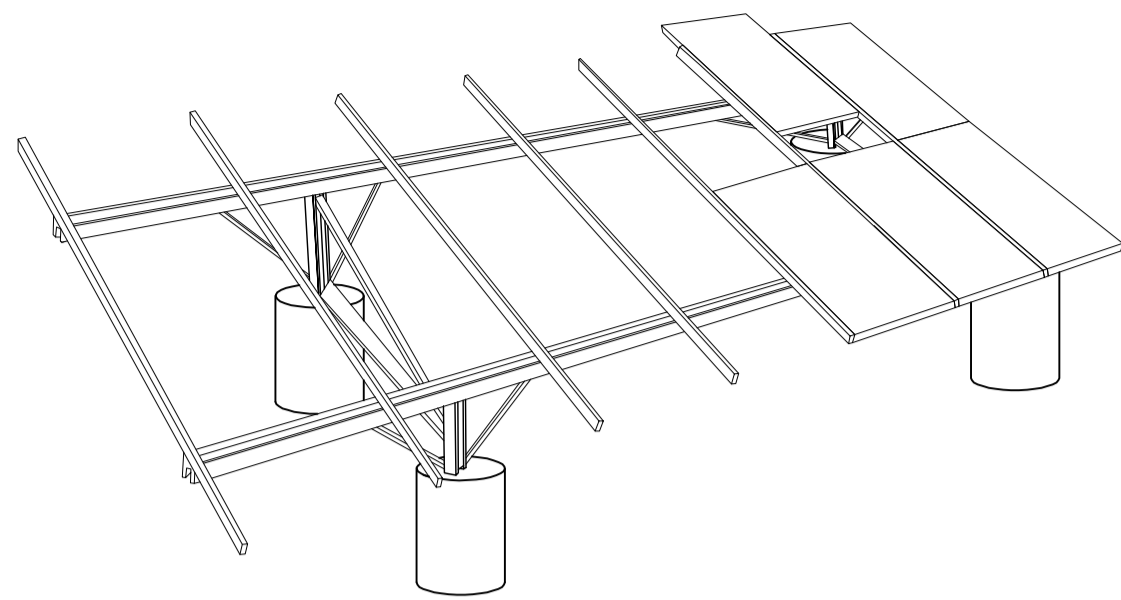
S2c STEEL SCREW PILE SECTION - OPTION 3
1:25

* EXACT DIMENSION DEPENDS ON SITE CONDITIONS

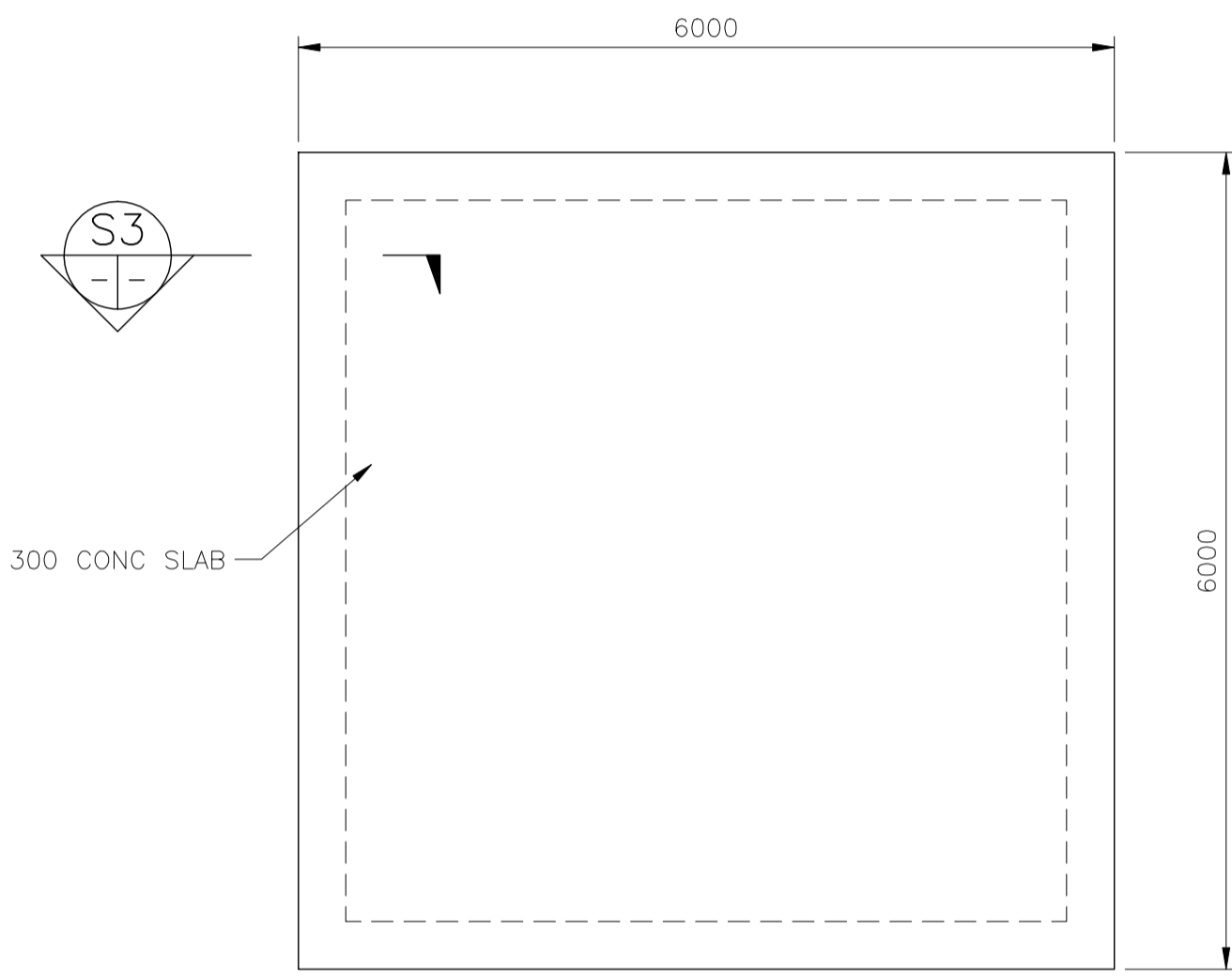


S2d FOUNDATION ON BEDROCK SECTION - OPTION 4
1:25

* EXACT DIMENSION DEPENDS ON SITE CONDITIONS



2 ISOMETRIC VIEW
N.T.S.



3 2 INVERTERS AND 1 TRANSFORMER CONCRETE PAD
1:50

DRAWING NOTES:

GENERAL

- DO NOT SCALE THIS DRAWING.
- THE DIMENSIONS SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. THEY WILL BE FINALIZED WHEN THE FINAL EOTECHNICAL REPORT IS RECEIVED.

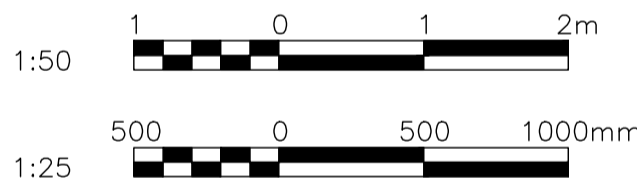
CAST-IN-PLACE CONCRETE

- CONCRETE WORK TO BE DONE IN ACCORDANCE WITH CAN3-A23.1 AND A23.2 INCLUDING COLD WEATHER REQUIREMENTS WHEN THE MEAN TEMPERATURE FALLS BELOW +5 DEGREES CELSIUS.
- CONCRETE MIXES SHALL BE PROPORTIONED IN ACCORDANCE WITH CAN3-A23.1, ALTERNATIVE 1 TO GIVE THE FOLLOWING PROPERTIES:
 - 28 DAY STRENGTH..... 4350 psi (30 MPa)
 - CEMENT..... TYPE 10
 - MINIMUM CEMENT CONTENT..... 20 lb/ft3 (320kg/m3)
 - NOMINAL SIZE AGGREGATE..... 3/4" (20 mm)
 - SLUMP..... 4"+3/4" (100+20mm)
 - AIR CONTENT..... 5% TO 8%
- PROVIDE TROWEL FINISH TO TOP OF ALL CONCRETE SLABS.
- BEFORE CONCRETE IS PLACED, EXAMINE REVIEWED SHOP DRAWINGS FOR PROVISION OF REINFORCING, ANCHOR BOLTS, INSERTS, ETC.
- AIR ENTRAINING ADMIXTURES TO CONFORM TO CSA A266.4.
- SUBMIT REINFORCING SHOP DRAWINGS TO THE CONSULTANT FOR REVIEW PRIOR TO FABRICATION.

REINFORCING STEEL (NOT SHOWN)

- REINFORCING STEEL TO BE CSA G30.18-M 400 MPa DEFORMED BARS, EXCEPT 10M TIES, WHICH MAY BE 300 MPa GRADE STEEL.
- STEEL TO BE DETAILED IN ACCORDANCE WITH THE MANUAL OF STANDARD PRACTICE BY THE REINFORCING INSTITUTE OF CANADA, CSA A23.1 AND A23.3.
- REINFORCING STEEL COVER FOR FOOTINGS TO CONFORM TO CSA A23.3 AND AS FOLLOWS:
 - BOTTOM/CONCRETE CAST AGAINST EARTH, 3" (75 mm)
 - TOP & SIDES..... 2" (50 mm)
- REINFORCING TO BE HELD IN PLACE AND TIED WITH PROPER ACCESSORIES, SUCH AS HI-CHAIRS AND SPACERS.
- REINFORCING STEEL TO BE CLEANED OF ALL DIRT, GREASE AND OTHER DELETERIOUS MATERIALS PRIOR TO PLACING.
- DO NOT WELD OR HEAT REINFORCING STEEL WITHOUT PRIOR APPROVAL OF THE CONSULTANT.

ISSUED FOR
INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION



01	ISSUED FOR INFORMATION ONLY	10.09.22	AM
00	ISSUED FOR INFORMATION ONLY	10.08.17	AM
NO.	DESCRIPTION	DATE	ISSUED BY

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CLIENT

RECURRENT ENERGY

WARDROP | Engineering Inc.

PROJECT NAME
RECURRENT ENERGY SOLAR PROJECT

DRAWING DESCRIPTION

MOUNTING SYSTEM FOUNDATION
FOR SOLAR PANELS

PRELIMINARY
DRAWING

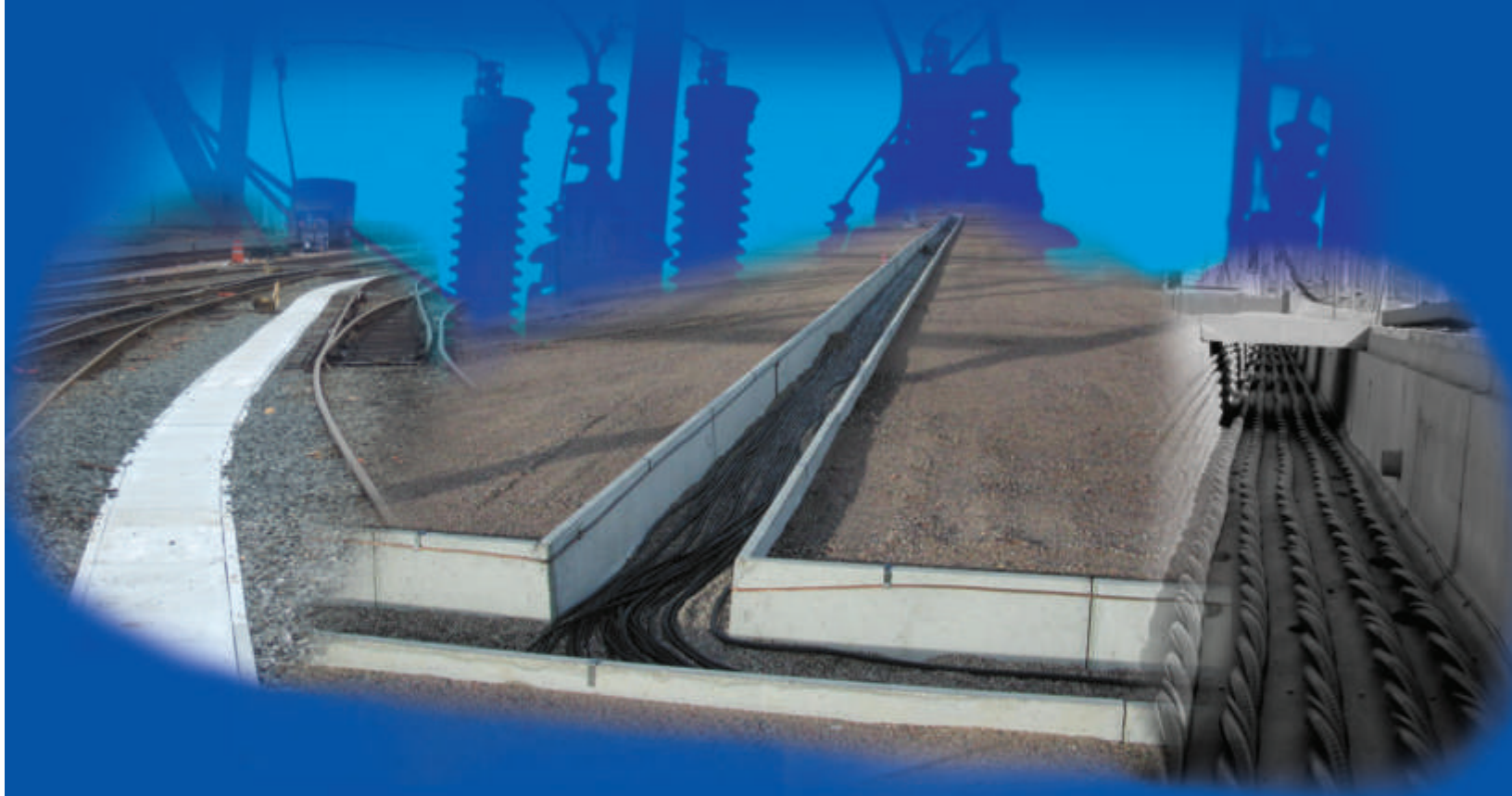
NOT TO BE
USED FOR
CONSTRUCTION

DESIGNED BY: HJL	DRAWN BY: JF	CHECKED BY: AM
APPROVED BY: IA		
SCALE: AS NOTED	DATE: 10.07.20	
DRAWING NO. 1088205300-SKT-C0001	REV. 01	

TRENWA

Trench Products Catalog

2010



Access

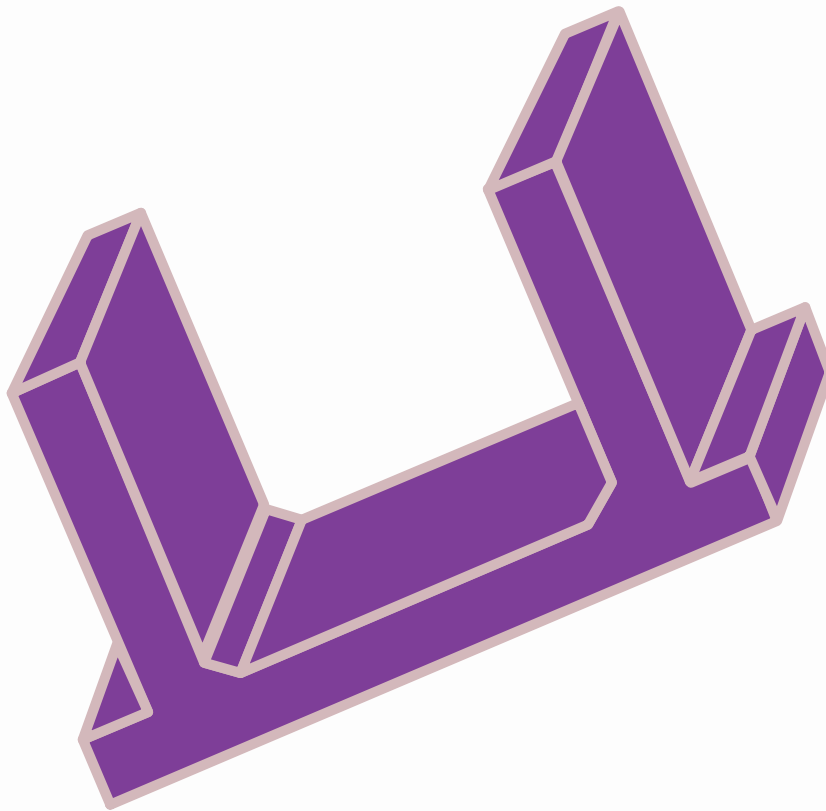
Flexibility

Protection



Table of Contents

- Introduction - 4
- One Piece trench - 7
- Road Crossing trench - 18
 - Component trench - 31
 - XL trench - 39
 - C trench - 41
- Accessories - 43
- Specs & Installation - 49



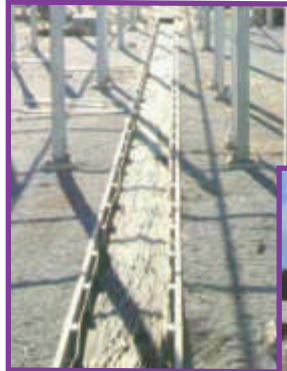
1419 Alexandria Pike
Ft. Thomas, KY 41075

www.trenwa.com

phone: 859-781-0831
fax: 859-781-1085
e-mail: info@trenwa.com

BACKGROUND

Trenwa manufactures a variety of precast concrete trench systems for the distribution of electrical control cables, power cables and mechanical piping. Sales and engineering support are provided from offices in Fort Thomas, Kentucky, a suburb of Cincinnati. With production plants across the United States, Trenwa can service the entire North American continent. In fact, Trenwa has shipped material to all 50 states and nine Canadian provinces.



Trenwa's original **Component** trench design was developed by Cincinnati Gas & Electric Company engineers in the mid 1950's to provide a means of locating and protecting control cables in substations, especially those stations where future growth was anticipated.

The design was so innovative that it was granted a U.S. patent and its unique "U"-shaped bracket continues to be the company's logo today. Trenwa later introduced additional trench designs including the **One Piece** trench, **Road Crossing** trench, and **XL-Trench** (formerly **Pipe Trench**).

BENEFITS

Trenwa trenches offer a variety of benefits including the following:

ECONOMY - Trenwa trenches are often more economical than poured-in-place trench with its expensive forming costs or duct banks with their costly cable pulling.

ACCESSIBILITY - Unlike duct bank or direct buried systems, Trenwa trenches provide accessibility for future maintenance or expansion.

DURABILITY - Trenwa trench systems are proven trench systems which are more durable than lighter-weight alternatives.

FLEXIBILITY - With a wide range of sizes, Trenwa trenches can meet the capacity needs of almost any customer. In addition, a limitless number of layout configurations can be created using tees, crosses, horizontal and vertical angles, side by side trenches, and cross-unders.

LEAK CONTAINMENT - Trenwa solid bottom trenches with sealants and damp-proof coatings provide leak containment for piping.

OPTIONS & ACCESSORIES - • Design loads ranging from 200 psf (pedestrian loading) to HS-20 (highway loading) or greater • Embedded Unistrut or Weld Plates • Cable Support Blocks • Ground Cable Clips • Cable Risers • Barriers • Steel Ventilator Lids • Guard Posts



WHICH TRENCH TO USE

The following factors should be considered when deciding which Trenwa trench to use.

1. DESIGN LOAD

Trenwa offers trenches to meet three basic design loads:

- **200 psf** (pounds per square foot) for pedestrian loading.
- **Medium Vehicle -9,000# GVW** (gross vehicle weight) for 3/4 ton pickups and light utility vehicles.
- **HS20, 32,000# axle load** for typical highway rating.

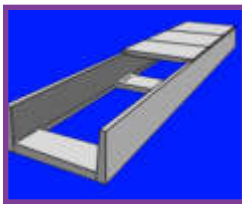
Available design loads for Trenwa's various trenches are summarized in the following table. Designs for loads heavier than HS20 can also be provided, if desired.

Standard Design Load Chart

Trench Type	Pedestrian	Medium Vehicle	HS20
One Piece	✓	✓	✓
Component	✓		
XL		✓	✓
C-Trench	✓		

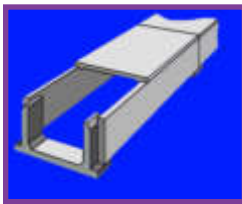
2. ONE PIECE VS COMPONENT:

There are unique advantages for both the **One Piece** and **Component** trenches. Their respective features include the following:



One Piece Trench

- 10'-0" Standard Lengths
- Depths of 12", 15" and 24"
- Faster Installation -- Fewer Pieces to Handle
- Requires Machine Installation
- Available Open or Solid Bottom
- Below or Above Grade Installation
- Design loads for pedestrian, light vehicle, and HS20 heavy vehicle.



Component Trench

- 5'-0" Standard Lengths
- Depths of 12", 16" and 24"
- Manual Installation
- More Flexible for Complex Layouts
- Easy Field Modification
- Pedestrian rated only

3. LARGER SIZES

Any size not listed in our standard sizes will require either multiple trenches or one of Trenwa's **XL-Trenches**.

4. PIPE APPLICATIONS

Component trench should not be used for piping. All of our other trenches are suitable for piping applications.

5. RECESSED COVERS

Trenwa's **Road Crossing** trench and some **XL-Trench** sizes have recesses in the trench walls to hold the covers. This feature, which is not available on our other trenches, permits the trench covers to be flush with the top of grade and helps prevent backfill material from entering the trench when lids are removed.



HOW TO WORK WITH TRENWA

Although you can use this catalog to design and develop a bill of materials and place an order consisting of quantities and part numbers, in most cases it is better to let us design the project. Working with us from the quoting stage through the design and delivery of the project is a simple process.

Design Assistance-we will be glad to discuss your requirements and help you with design ideas and recommend the optimum trench for your project.

Budgetary pricing- if you have a simple project in mind and need budgetary pricing for engineering estimates give us a call or email us and we can get you a budget price rather quickly. All we need to know is the type of trench, linear footage involved, sizes and load rating of trenches, and the number of turns and tees.

Quotation- to get a firm price on a project out for bid we would prefer to get a bid package consisting of written specs and site plan drawings. These can be sent to us via email, with attachments, at sales@trenwa.com.

Or you can mail them to:

Trenwa, Inc.
1419 Alexandria Pike
Fort Thomas, KY 41075

File formats we support
• drawings; AutoCAD-dwg, dxf, pdf, tif
• documents; Word, rtf, txt, pdf.
• other; any MS Office format.

If you prefer you can fax the information to us at 859-781-1085.

If you don't have an official bid package then send us a site plan drawing that shows the basics of the project. A simple line drawing will suffice. Note the sizes and rating of the trench.

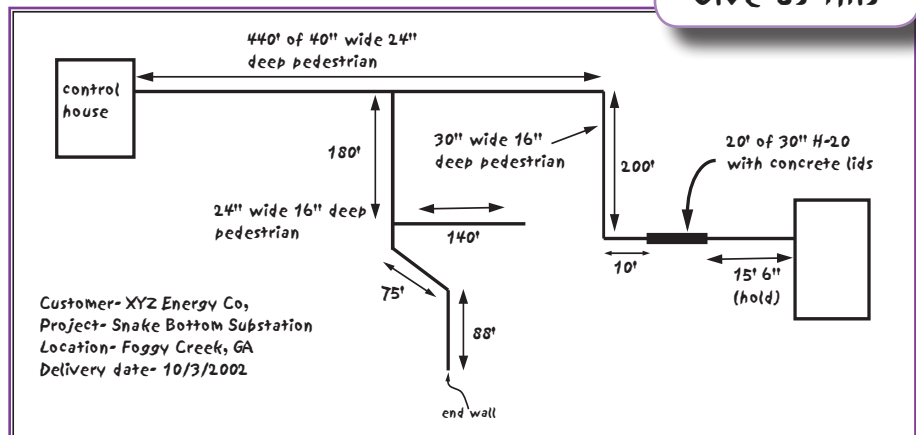
We also need to know job specific information like:

- ship to city
- project name
- end user/customer
- delivery schedule

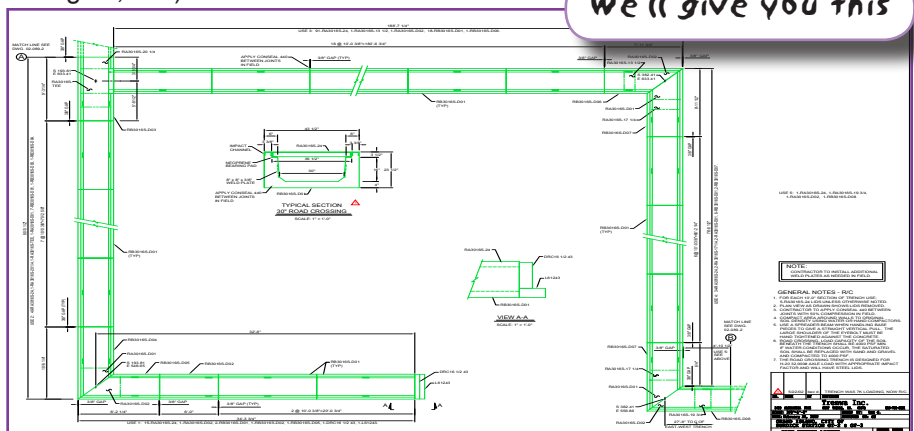
Order- upon receipt of an order we will design and draw the project in AutoCAD. The drawings will show all dimensions, bill of materials, weight of each piece, installation notes etc. The drawings will be sent to you for approval. Approval is required before any special pieces (miters, tees, short lengths, etc.) can be fabricated. A final set of drawings will be sent for field use and archival purposes.

Delivery- most orders will be delivered via flat bed truck. Small orders may be shipped LTL (less than truck load). The site contact will be called 24-48 hours prior to shipping so they can be prepared to off load the truck when it arrives.

Give us this

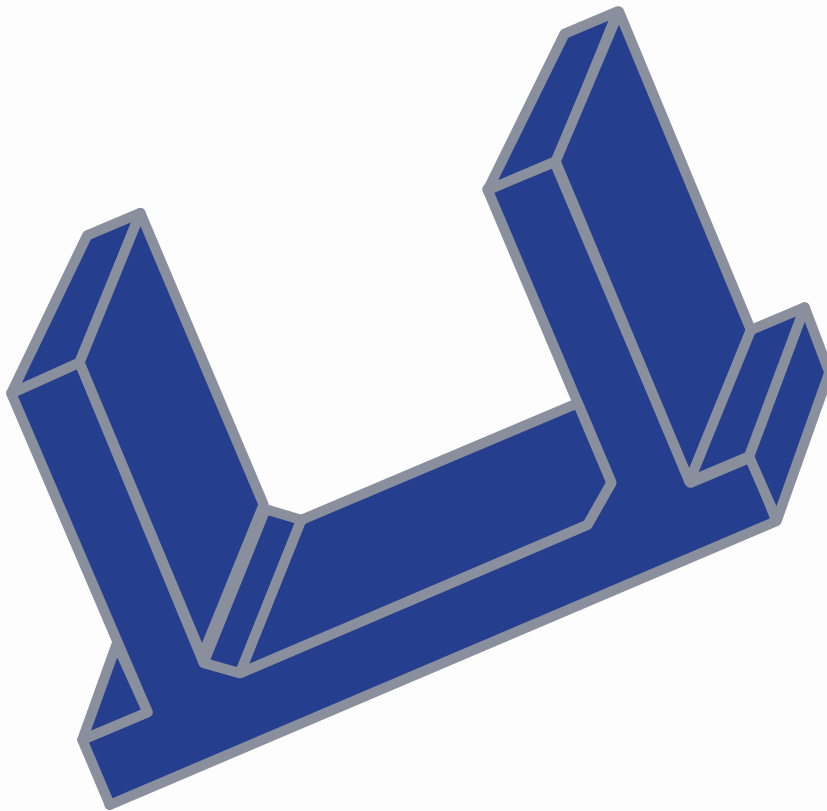


We'll give you this



One Piece Trench

- Overview - 8
- Pedestrian Base & Lids - 9
- Medium Vehicle Base & Lids - 14
- HS20 Road Crossing Base & Lids - 18
- Slopes & Crossunders - 26
- Ventilator Lids - 27



www.trenwa.com

1419 Alexandria Pike
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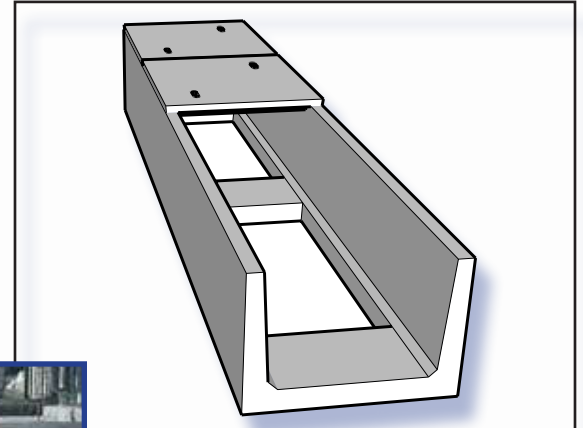
OVERVIEW

Trenwa's **One Piece** trench is available in three designs: **200 psf pedestrian loading**, **Medium Vehicle (9,000# GVW) loading** for pickup trucks or light utility vehicles, and **HS20 Road Crossing** for 32,000# per axle rated vehicles. See the size charts in each section for standard widths and depths

The base pieces in the **One Piece** system are available in standard lengths of 10 feet with two openings, 42" long, in the bottom for cable exits. The base can be cast in shorter lengths or with solid bottoms, if required.

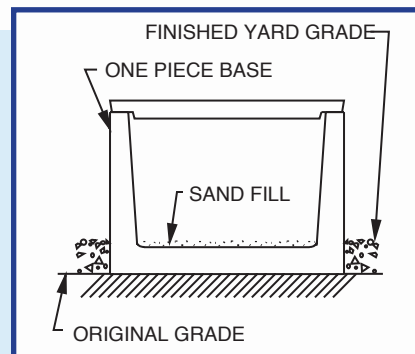


Since the base piece provides both the bottom and the side walls for the trench, the addition of the trench lids on top of the base completes the **One Piece** trench system. Note that the HS20 Road Crossing is solid bottom but can have selected openings cast in as needed.



ABOVE GRADE TRENCH

Because the **One Piece** base is *free-standing*, the **One Piece** trench can be easily used as an above grade trench system in situations where it is not possible or desirable to place a trench in the ground.

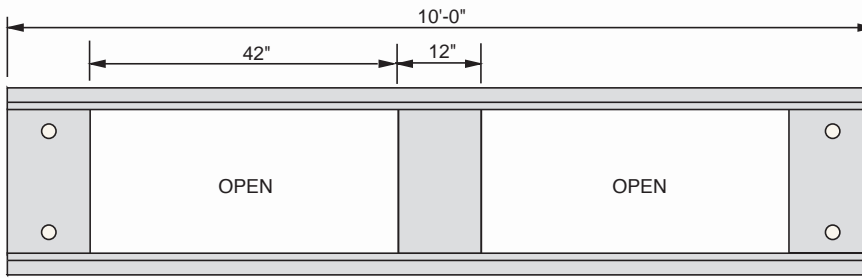


PART NUMBERING

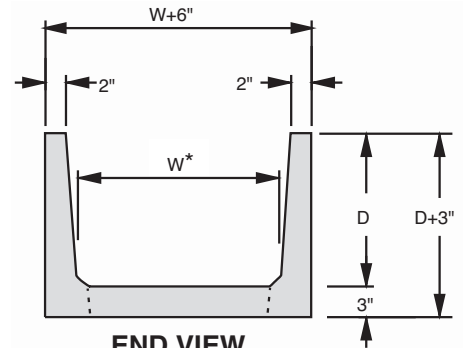
Most of the parts in the **One Piece** system are identified by leading letters which identify the type of part (e.g. lid, base section, end wall, etc.) and trailing numbers which identify the size of the part. The first letter designates the type of part, **B**ase, **L**id, **W**all etc. The second letter designates the rating, **P**edestrian, **M**edium Vehicle, **H**S20. The remaining numbers designate width and depth (inside clear) and the last set of numbers after the dash is the length of the piece. Below is a chart which summarizes this part numbering scheme.

Description	Part Number Format	Example	Dimension for Example
Lid-Pedestrian	LPXX-YY	LP30-30	Fits 30" width trench x 30"long
Lid-Medium Vehicle	LMXX-YY	LM20-60	Fits 20" width trench x 60" long
Base-Pedestrian	BPWWXX-YYY	BP4015-120	40" inside width,15" depth x 120" long
Base-Medium Vehicle	BMWWXX-YYY	BM2024-072	20" inside width,24" depth x 72" long
Endwall Ped/Medium	WMWWDD-YYY	WM2619-03	26" x 19" x 3"
Endwall HS20	WHWWDD-YYY	WH5323-06	53" x 23" x 6"
Base HS20	BHZWWDD-YYY	BHC4016-120	40" x16" x 120" for concrete lid

BASES



PLAN VIEW



END VIEW

D= Depth
W=Width

Specify length by last 3 digits i.e.
BP2015-xxx
BP2015-062

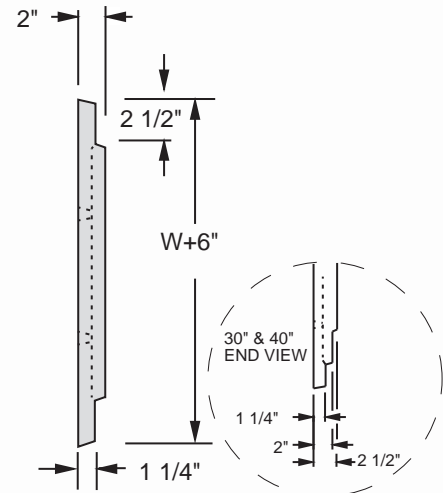
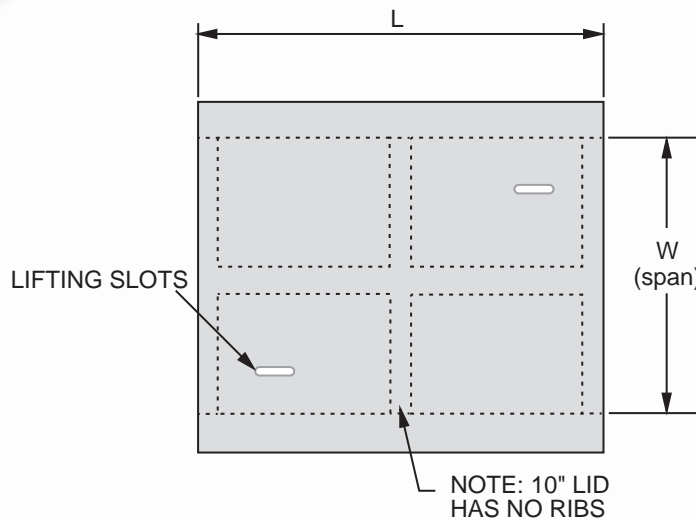
Example: BP3024-096 1/2

Notes: W for 24" deep base is 2" narrower.
12" width not typically a stock item

Open Bottom					Solid Bottom			
W*	Part Number	D=12"	D=15"	D=24"	Part Number	D=12"	D=15"	D=24"
10"	BP10D-120	1,060#	1,190#	1,945#	BPS10D-120	1,180#	1,300#	2,010#
20"	BP20D-120	1,180#	1,300#	2,045#	BPS20D-120	1,500#	1,620#	2,320#
24"	BP24D-120	1,220#	1,340#	2,095#	BPS24D-120	1,610#	1,740#	2,450#
30"	BP30D-120	1,290#	1,410#	2,160#	BPS30D-120	1,810#	1,930#	2,640#
40"	BP40D-120	1,400#	1,520#	2,260#	BPS40D-120	2,130#	2,250#	2,950#
48"	BP48D-120	1,470#	1,590#	2,355#	BPS48D-120	2,370#	2,490#	3,190#

New! 12" Depth

LIDS



W	Part Number	L	Weight
10"	LP10-30	30"	70#
20"	LP20-30	30"	65#
24"	LP24-30	30"	80#
30"	LP30-30	30"	95#
40"	LP40-20	20"	85#
48"	LP48-20	20"	98#

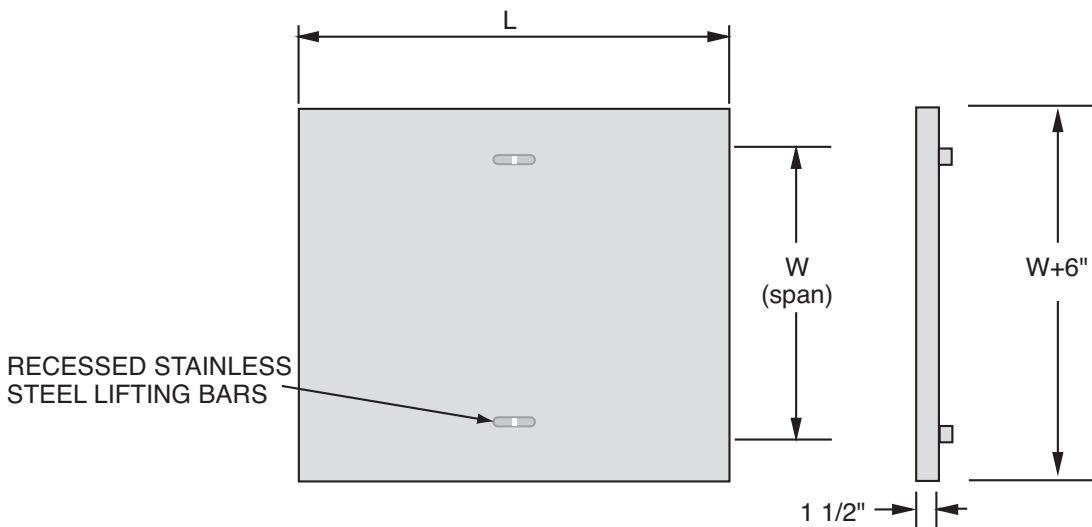
New Product !

Polymer Concrete Lids

Our pedestrian Polymer Concrete lids are a great alternative to traditional Portland Cement concrete lids. Manufactured from resins, aggregate and fiber, these lids are strong, durable and crack resistant.

- Higher compressive strength than traditional concrete
- Better resistance to freeze/thaw cycles
- More cost effective than steel or aluminum plate.
- Will not absorb water
- Resists salt and chemical attack.

These are the same width and length as our concrete LP lids and make great replacement lids for existing installations.



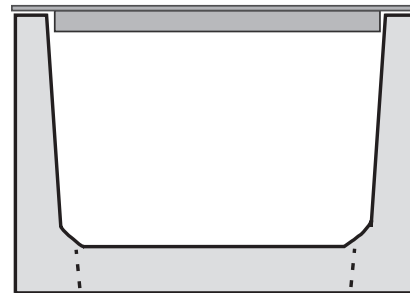
W	Part Number	L	Weight
10"	LPP10-30	30"	50#
20"	LPP20-30	30"	60#
24"	LPP24-30	30"	65#
30"	LPP30-30	30"	80#
40"	LPP40-20	20"	90#

Note: these lids are 1/4" thicker than our LP concrete lids and may pose a trip hazard when intermixed.

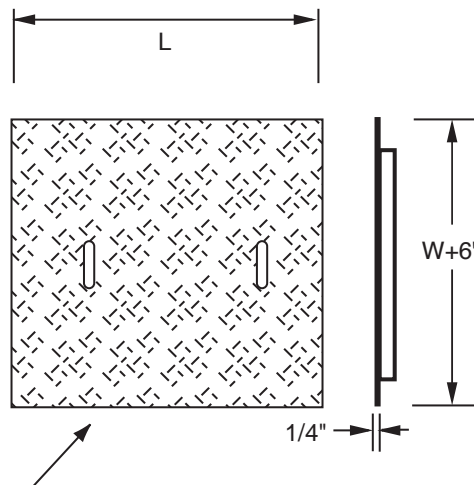
Steel & Aluminum Lids

Trenwa now offers both galvanized steel and aluminum lids for our pedestrian rated trench. The steel lids are made of 1/4" hot dip galvanized checker plate. The aluminum lids are made of 1/4" aluminum checker plate and are very light weight. They have stiffener and locator bars on the bottom surface.

These lids are designed to set on top of the trench walls just like our concrete lids. Due to the thinner construction they can not be mixed with concrete or vent lids.



ALONG LENGTH OF TRENCH



1/4" checker plate

Steel Lids			
W	L	Part Number	Weight
10"	40"	LPS10-40	70#
20"	30"	LPS20-30	75#
24"	30"	LPS24-30	105#
30"	30"	LPS30-30	130#
40"	20"	LPS40-20	130#

Aluminum Lids			
W	L	Part Number	Weight
10"	60"	LPA10-60	30#
20"	60"	LPA20-60	40#
24"	60"	LPA24-60	55#
30"	60"	LPA30-60	68#
40"	60"	LPA40-60	90#



Layouts of almost any shape can be created from our standard Miters, T's, Crosses and Ends. These pieces can be specified in a wide range of lengths and configurations which makes it easy to create a complex layout.

Standard Pedestrian Mitered Bases

Standard Pedestrian Mitered base sections are specified by the width, depth, length of the long side and turn direction.

Example 1

BPWWDDRAA-LLL

Base Pedestrian

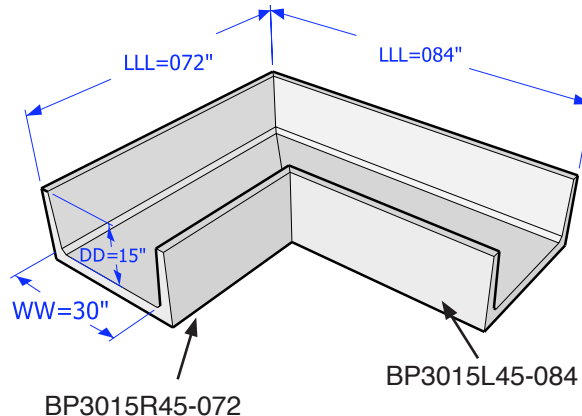
Width (WW) = 30"

Depth (DD) = 15"

Right Angle (AA) = 45°

Length (LLL) = 072"

BP3015R45-072



Example 2:

BPWWDDLAA-LLL

Base Pedestrian

Width (WW) = 30"

Depth (DD) = 15"

Left Angle (AA) = 45°

Length (LLL) = 084"

BP3015L45-084

Standard Pedestrian Mitered Lids

Standard Pedestrian Mitered lids are specified by the length of the long side, turn direction and angle.

Mitered lids are solid.

Example

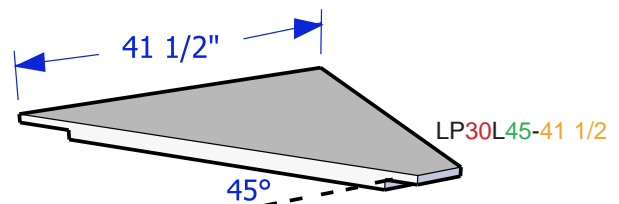
LPWVRAA-LL

Pedestrian Lid

Width (WW) = for 30" trench

Left Angle (AA) = 45°

Length (LL) = 41 1/2"



Standard Pedestrian T sections

Standard Pedestrian T sections are specified by the width, depth, length and size of the T opening. Any length less than 67" will be solid bottom.

Example: BPWWDDTOO-LLL

Base Pedestrian

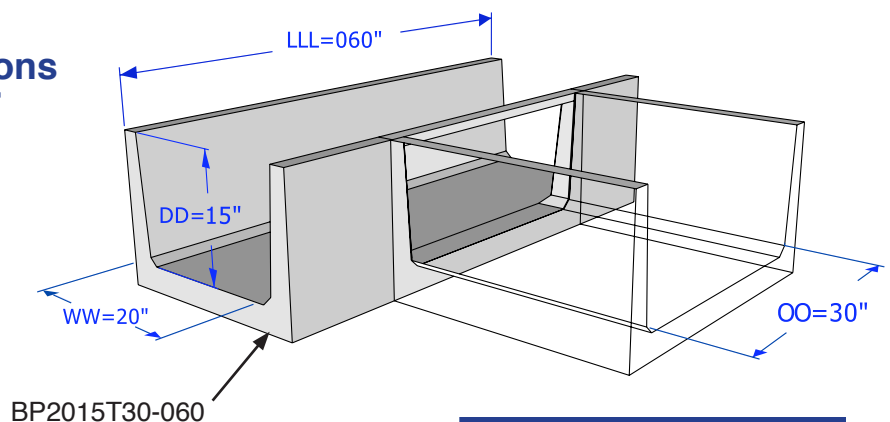
Width (WW) = 20"

Depth (DD) = 15"

T opening (OO) = 30"

Length (LLL) = 060"

BP2015T30-060





Standard Pedestrian Cross sections

Standard Cross sections are specified by the width, depth, length and size of the X opening.

Example: BPWWDDXOO-LLL

Base Pedestrian

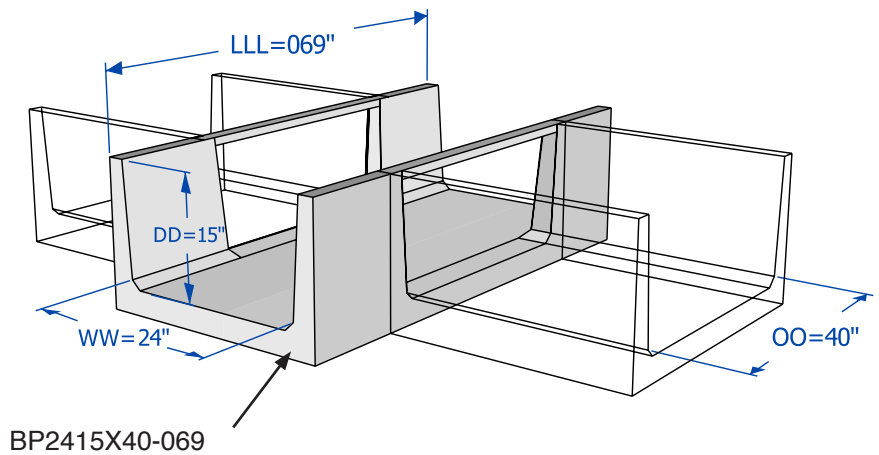
Width (WW) = 24"

Depth (DD) = 15"

X opening (OO) = 40"

Length (LLL) = 069"

BP2415X40-069



Contact us for crosses with different width openings.

End Walls & Reducers

Standard End Walls are specified by the width, depth & length of the wall (03").

Example 1: WMWWDD-LL

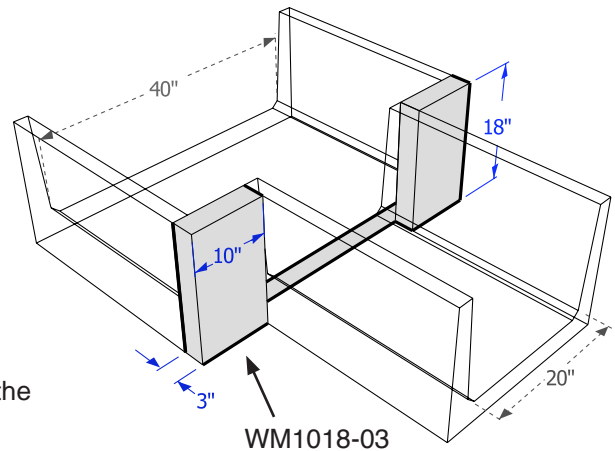
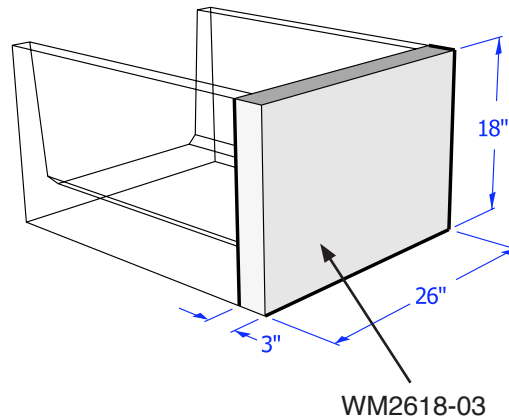
Pedestrian Wall

Width (WW) = 26"

Depth (DD) = 18"

Length (LL) = 03"

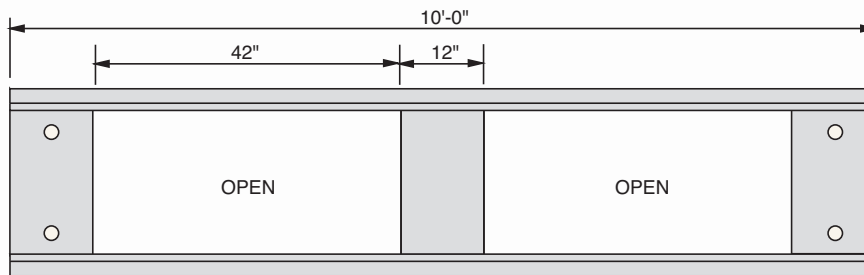
WM2618-03



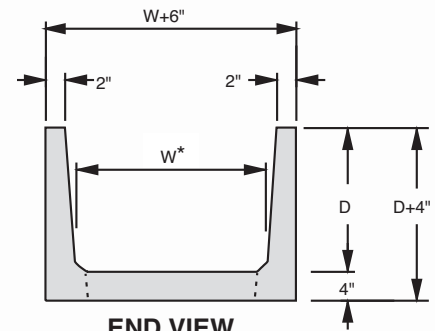
Reducers are created just by specifying 2 small end walls to block off the opening of the wider trench.



BASES



PLAN VIEW



END VIEW

Medium Vehicle

Our Medium Vehicle rated one piece trench is designed for 9,000# GVW (gross vehicle weight) traffic; cars, pickup trucks, small forklifts and other light utility vehicles.

Open Bottom					Solid Bottom			
W*	Part Number	D=12"	D=15"	D=24"	Part Number	D=12"	D=15"	D=24"
10"	BM10D-120	1,260#	1,380#	2,080#	BMS10D-120	1,350#	1,470#	2,170#
20"	BM20D-120	1,395#	1,515#	2,225#	BMS20D-120	1,760#	1,880#	2,590#
24"	BM24D-120	1,455#	1,575#	2,270#	BMS24D-120	1,930#	2,050#	2,750#
30"	BM30D-120	1,540#	1,660#	2,355#	BMS30D-120	2,280#	2,300#	3,000#
40"	BM40D-120	1,670#	1,790#	2,500#	BMS40D-120	2,590#	2,710#	3,420#
48"	BM48D-120	1,765#	1,885#	2,595#	BMS48D-120	2,945#	3,065#	3,800#

Example: BM3024-096

Notes: W for 24" deep base is 2" narrower.
12" depth is typically not at stock item

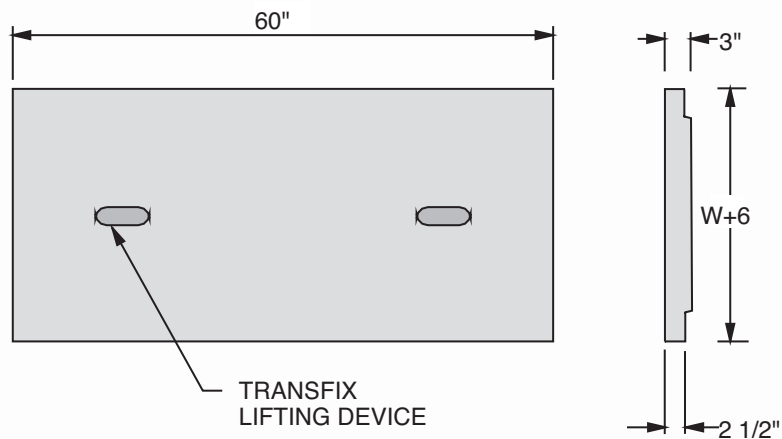
LIDS

New! 12" Depth

The lids are 5ft. long and come with transfix lifting devices and protective covers.

Lid length is specified by the last 2 digits.

Example: LM30-48 for a 48" long lid.

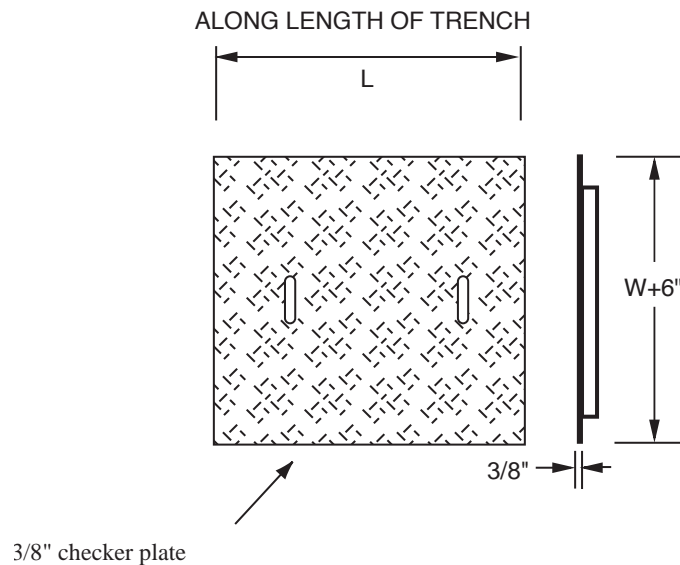
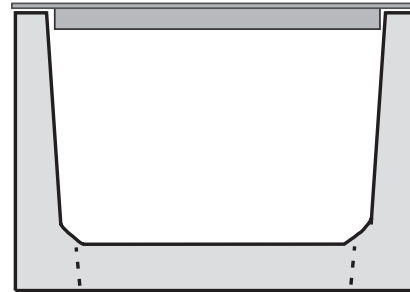


W	Part Number	Weight
10"	LM10-60	260#
20"	LM20-60	420#
24"	LM24-60	480#
30"	LM30-60	580#
40"	LM40-60	730#
48"	LM48-60	830#

Steel & Aluminum Lids

Trenwa now offers both galvanized steel and aluminum lids for our 9,000 lb GVW rated Medium Vehicle trench. The steel lids are made of 3/8" hot dip galvanized checker plate. The aluminum lids are made of 3/8" aluminum checker plate and are very light weight. They have stiffener and locator bars on the bottom surface.

These lids are designed to set on top of the trench walls just like our concrete lids. Due to the thinner construction they can not be mixed with concrete or vent lids.



Steel Lids			
W	L	Part Number	Weight
10"	40"	LMS10-40	90#
20"	30"	LMS20-30	110#
24"	30"	LMS24-30	135#
30"	30"	LMS30-30	170#
40"	20"	LMS40-20	170#

Aluminum Lids			
W	L	Part Number	Weight
10"	60"	LMA10-60	48#
20"	60"	LMA20-60	85#
24"	60"	LMA24-60	95#
30"	40"	LMA30-40	75#
40"	40"	LMA40-40	105#

Layouts of almost any shape can be created from our Standard Medium Vehicle Miters, T's, Crosses and Ends. These pieces can be specified in a wide range of lengths and configurations which makes it easy to create complex layouts.

Standard MV Mitered Bases

Standard Medium Vehicle Miter sections are specified by the width, depth, length of the long side and turn direction.

Example 1

BMWWDDRAA-LLL

Base Medium Vehicle

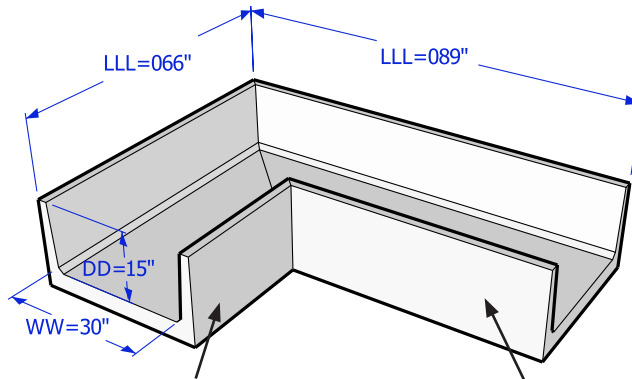
Width (WW) = 30"

Depth (DD) = 15"

Right Angle (AA) = 45°

Length (LLL) = 066"

BM3015R45-066



BM3015R45-066

BM3015L45-089

Example 2:

BMWWDDLAA-LLL

Base Pedestrian

Width (WW) = 30"

Depth (DD) = 15"

Left Angle (AA) = 45°

Length (LLL) = 089"

BM3015L45-089

Standard MV Mitered Lids

Standard Medium Vehicle Mitered lids are specified by the length of the long side, turn direction and angle.

Example

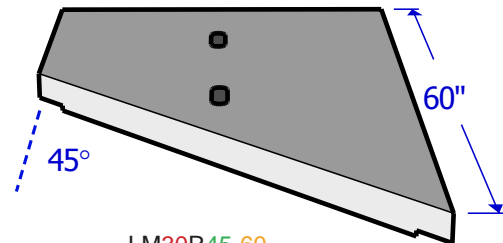
LMWWRAA-LL

Pedestrian Lid

Width (WW) = for 30" trench

Right Angle (AA) = 45°

Length (LL) = 60"



LM30R45-60

Standard MV T sections

Standard Medium Vehicle T sections are specified by the width, depth, length and size of the T opening. Any length less than 67" will be solid bottom.

Example: BMWWDDTOO-LLL

Base Medium vehicle

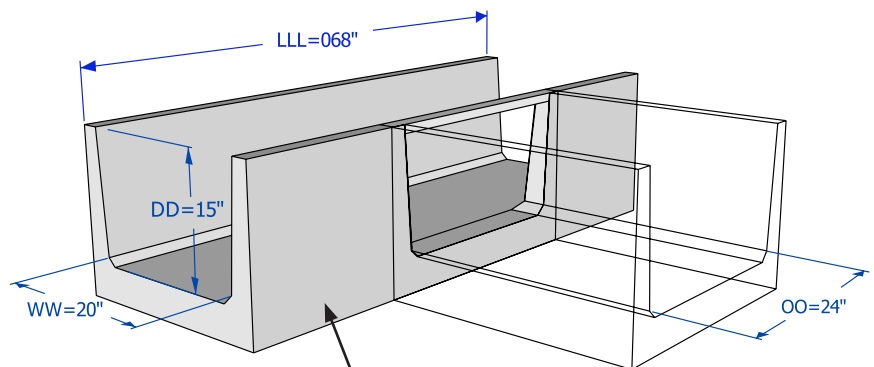
Width (WW) = 20"

Depth (DD) = 15"

T opening (OO) = 24"

Length (LLL) = 068"

BM2015T24-068



BM2015T24-068

Standard MV Cross sections

Standard Medium Vehicle Cross sections are specified by the width, depth, length and size of the X opening.

Example: BMWWDDXOO-LLL

Base Medium Vehicle

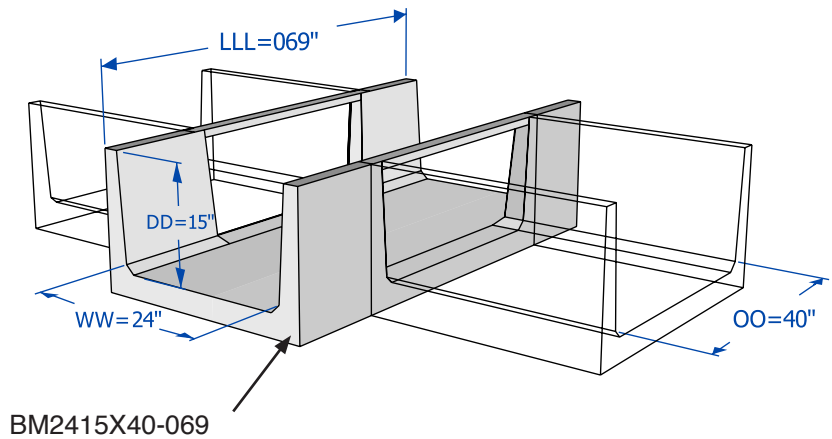
Width (WW) = 24"

Depth (DD) = 15"

X opening (OO) = 40"

Length (LLL) = 069"

BM2415X40-069



Contact us for crosses with different width openings.

End Walls & Reducers

Standard End Walls are specified by the width, depth & length of the wall (03").

Example 1: WMWWDD-LL

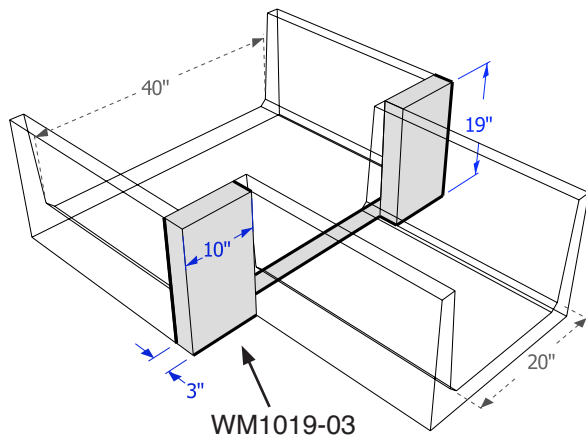
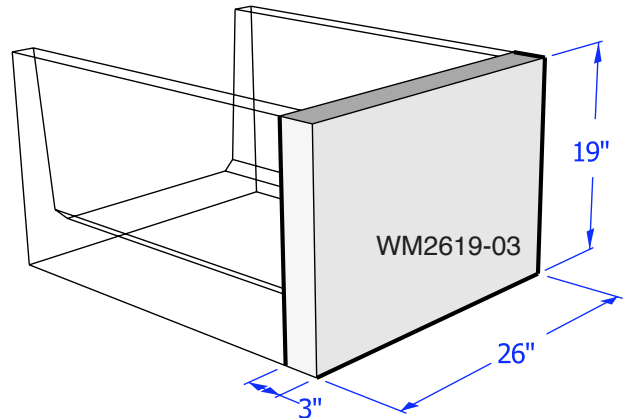
Pedestrian Wall

Width (WW) = 26"

Depth (DD) = 19"

Length (LL) = 03"

WM2619-03



Reducers are created just by specifying 2 small end walls to block off the opening of the wider trench.

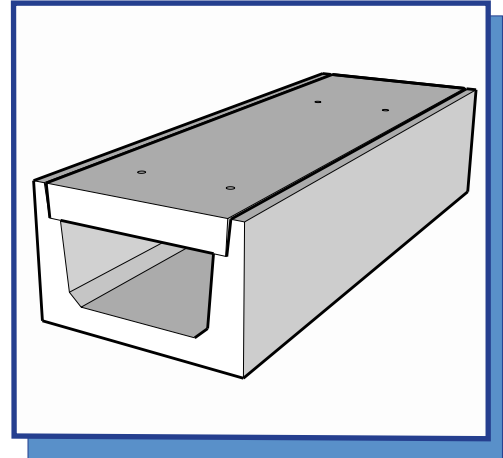
OVERVIEW

Trenwa offers a road crossing design that may be used with either the **Component** or **One Piece** pedestrian trench systems. It is now available in 12", 16", 24", 36", and 48" depths and is designed in accordance with ASHTO requirements for HS20, 32,000# axle loading, with 30% impact resistance.

Either **steel reinforced concrete lids** or **galvanized steel lids** are available, both recessed within the walls of the base unit. The base units and concrete lids are manufactured in standard 10'-0" lengths with shorter lengths available to suit your layout. The minimum length for both base and concrete lid is 5'-0". **The base units have galvanized impact angles imbedded along the top edges for durability.**

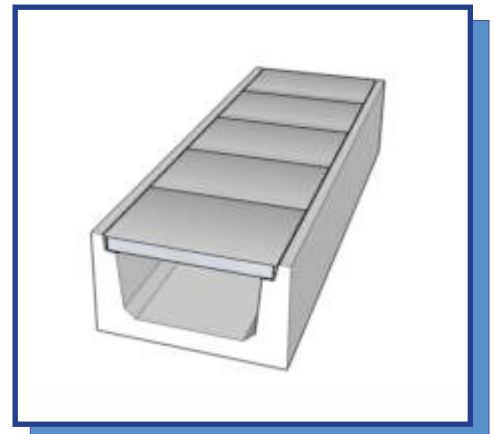
Concrete Lids

Concrete lids are 6-1/2" -8" thick by 10'-0" long and must be machine set because of their heavy weight. The lids have a broom finish to prevent slipping when wet. With concrete lids, a 24" deep transition section of pedestrian trench is placed on each side of the road crossing to feed cables from the shallower pedestrian trench into the deeper road crossing trench.

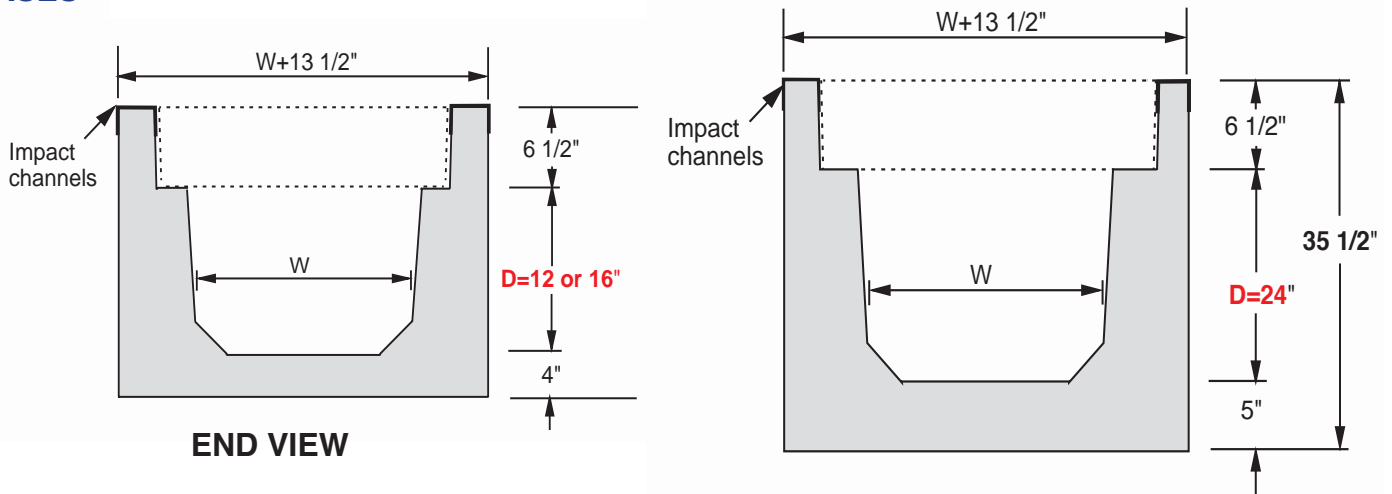


Steel Lids

Although the steel lids are more expensive than concrete lids, they are only 3 1/2" thick which permits a shallower recess in the base section. In addition, the steel lids are much lighter and can be handled manually for quick installation and removal. They range from 15" to 40" long. The steel lids are fabricated using structural steel components with checker plate cover and are hot dipped galvanized.



BASES



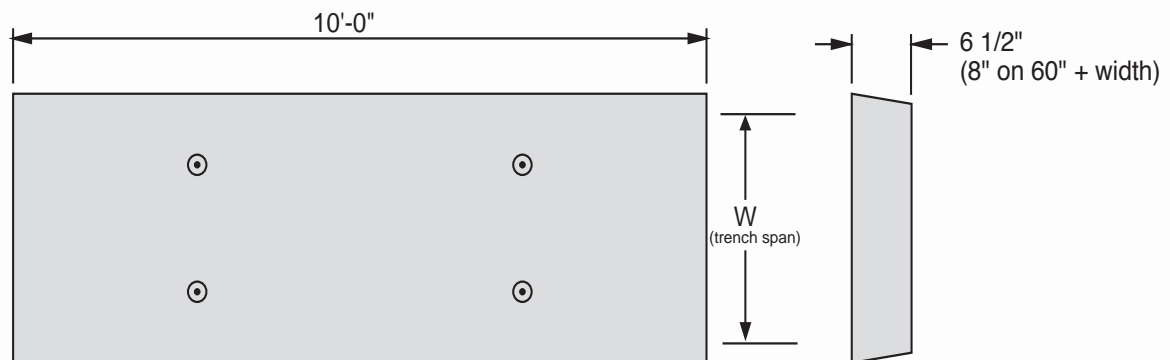
Substitute "**D**" in the part number for the desired depth.

W	Part Number	Weight		
		D=12"	D=16"	D=24"
10"	BHC10D-120	3,140#	3,620#	4,830#
20"	BHC20D-120	3,550#	4,030#	5,350#
24"	BHC24D-120	3,720#	4,200#	5,550#
30"	BHC30D-120	3,970#	4,450#	5,450#
40"	BHC40D-120	4,380#	4,860#	6,390#
48"	BHC48D-120	4,720#	5,200#	6,790#

10'-0" STANDARD LENGTH
5'-0" MINIMUM LENGTH

Note: 12" depth not a stock item.

New! 12" Depth



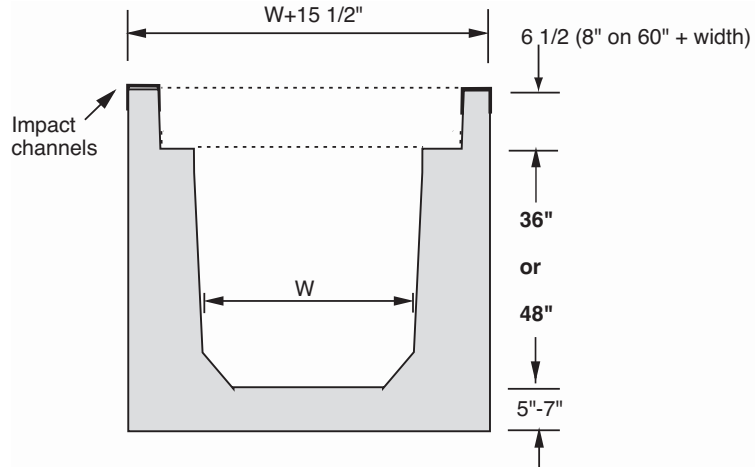
5'-0" MINIMUM LENGTH

W	Part Number	Weight
10"	LHC10-120	1,160#
20"	LHC20-120	1,840#
24"	LHC24-120	2,110#
30"	LHC30-120	2,520#
40"	LHC40-120	3,190#
48"	LHC48-120	3,730#

CONCRETE LIDS

Extra Deep

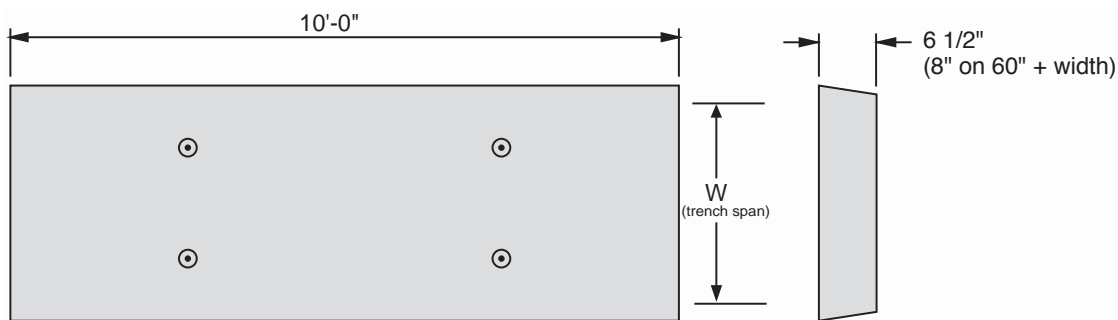
Extra deep road bases are now available in 36" & 48" depths and widths from 24" to 96" for those high capacity jobs!



10'-0" STANDARD LENGTH
5'-0" MINIMUM LENGTH

Note: 96" wide bases may be manufactured as 8' long sections to avoid oversized shipping.

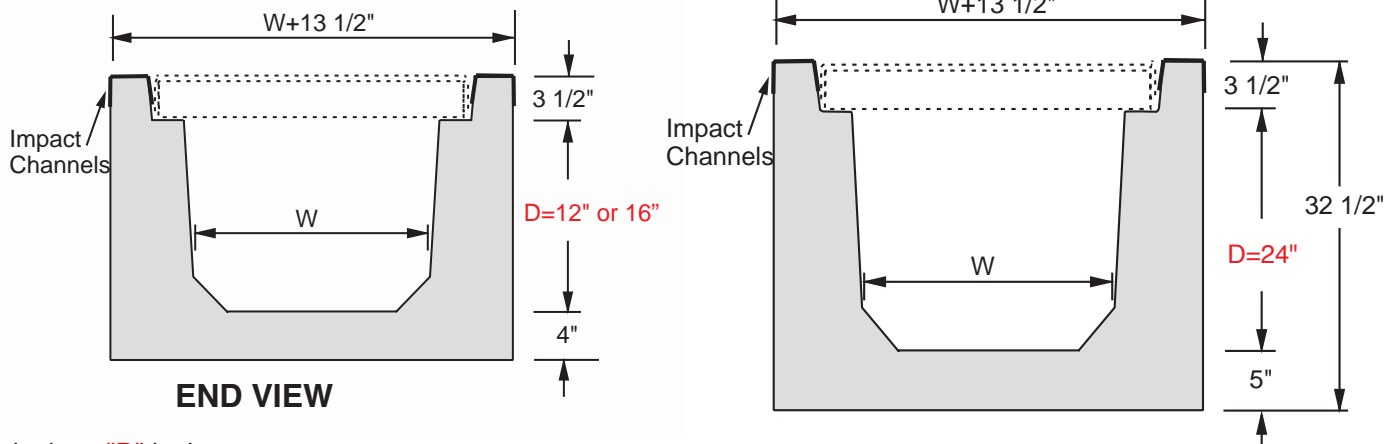
36" Deep Base			48" Deep Base	
W	Part Number	Weight	Part Number	Weight
24"	BHC2436-120	7,705#		
30"	BHC3036-120	8,010#		
36"	BHC3636-120	8,315#		
40"	BHC4036-120	8,520#		
48"	BHC4836-120	8,925#	BHC4848-120	10,815#
60"	BHC6036-120	10,395#	BHC6048-120	11,640#
72"	BHC7236-120	11,615#	BHC7248-120	13,245#
84"	BHC8436-120	12,470#	BHC8448-120	14,100#
96"	BHC9636-120	14,440#	BHC9648-120	16,075#



W	Part Number	Weight	Part Number	Weight
24"	LHC2436-120	2,182#		
30"	LHC3036-120	2,579#		
36"	LHC3636-120	2,975#		
40"	LHC4036-120	3,240#		
48"	LHC4836-120	3,770#	LHC4848-120	3,770#
60"	LHC6036-120	5,620#	LHC6048-120	5,620#
72"	LHC7236-120	6,600#	LHC7248-120	6,600#
84"	LHC8436-120	7,570#	LHC8448-120	7,570#
96"	LHC9636-120	8,550#	LHC9648-120	8,550#

CONCRETE LIDS FOR EXTRA DEEP BASES

BASES



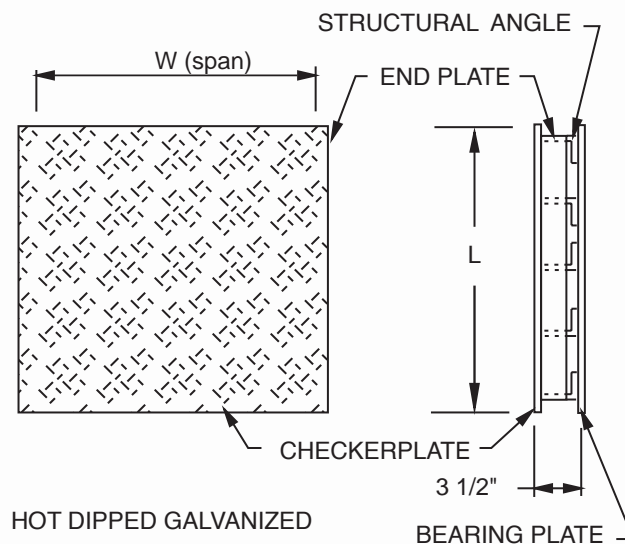
Substitute "D" in the part number for the desired depth.

W	Part Number	Weight		
		D=12"	D=16"	D=24"
10"	BHS10D-120	2,920#	3,400#	4,620#
20"	BHS20D-120	3,330#	3,810#	5,130#
24"	BHS24D-120	3,500#	3,980#	5,340#
30"	BHS30D-120	3,750#	4,230#	5,680#
40"	BHS40D-120	4,160#	4,640#	6,200#
48"	BHS48D-120	4,490#	4,970#	6,620#

Notes: 10' standard lengths
5' minimum length
12" depth not a stock item.

New! 12" Depth

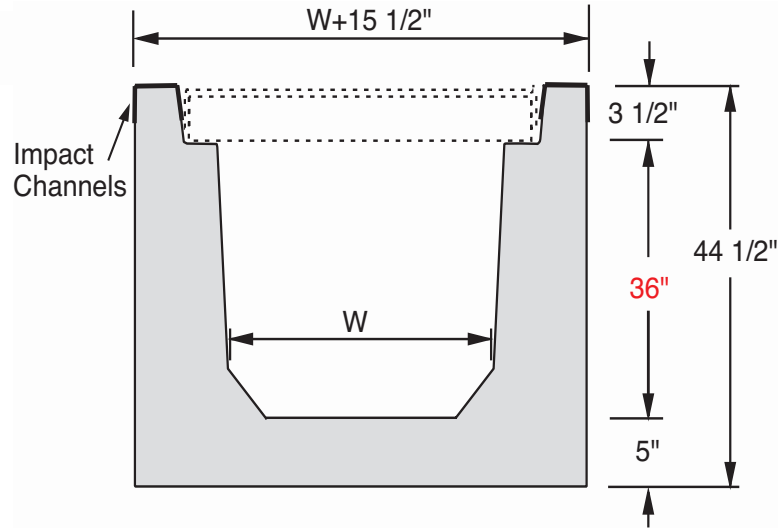
STEEL LIDS



W	L	Part Number	Weight
10"	40"	LHS10-40	113#
20"	24"	LHS20-24	110#
24"	24"	LHS24-24	125#
30"	24"	LHS30-24	145#
40"	15"	LHS40-15	125#
48"	15"	LHS48-15	150#



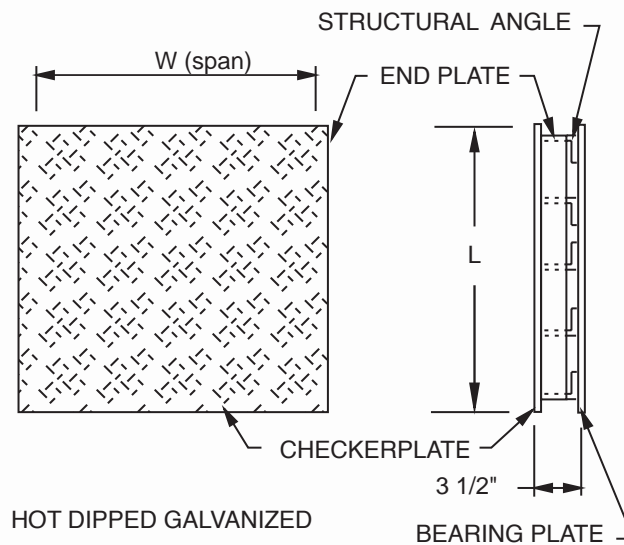
Extra Deep



36" DEEP BASES

W	Part Number	Weight
24"	BHS2436-120	7,786#
30"	BHS3036-120	7,920#
36"	BHS3636-120	8,233#
40"	BHS4036-120	8,441#
48"	BHS4836-120	8,858#

STEEL LIDS FOR 36" DEEP BASES



W	L	Part Number	Weight
24"	24"	LHS2436-24	128#
30"	24"	LHS3036-24	151#
36"	20"	LHS3636-20	157#
40"	15"	LHS4036-15	131#
48"	15"	LHS4836-15	198#

Layouts of almost any shape can be created from our Standard Medium Vehicle Miters, T's, Crosses and Ends. These pieces can be specified in a wide range of lengths and configurations which makes it easy to configure a complex layout.

Standard HS20 Mitered Bases

Standard HS20 Miter sections are specified by the width, depth, length of the long side and turn direction.

Example 1

BHCWWDDRAA-LLL

Base HS20

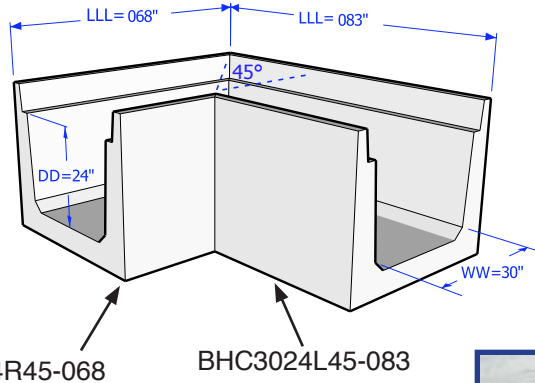
Width (WW) = 30"

Depth (DD) = 24"

Right Angle (AA) = 45°

Length (LLL) = 068"

BHC3024R45-068



Example 2:

BHCWWDDLAA-LLL

Base HS20

Width (WW) = 30"

Depth (DD) = 24"

Left Angle (AA) = 45°

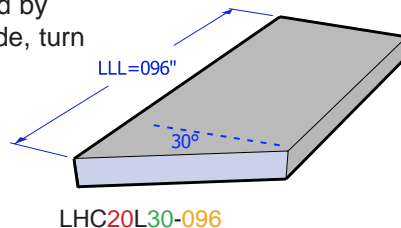
Length (LLL) = 083"

BHC3024L45-083



Standard HS20 Mitered Lids

Standard HS20 Concrete Mitered lids are specified by the length of the long side, turn direction and angle.



Example

LHCWWRAA-LL

HS20 Lid

Width (WW) = for 20" trench

Right Angle (AA) = 30°

Length (LL) = 096"

LHC20L30-096

Standard HS20 T sections

Standard HS20 T sections are specified by the width, depth, length and size of the T opening.

Example: BHCWWDDT00-LLL

Base HS20 road crossing

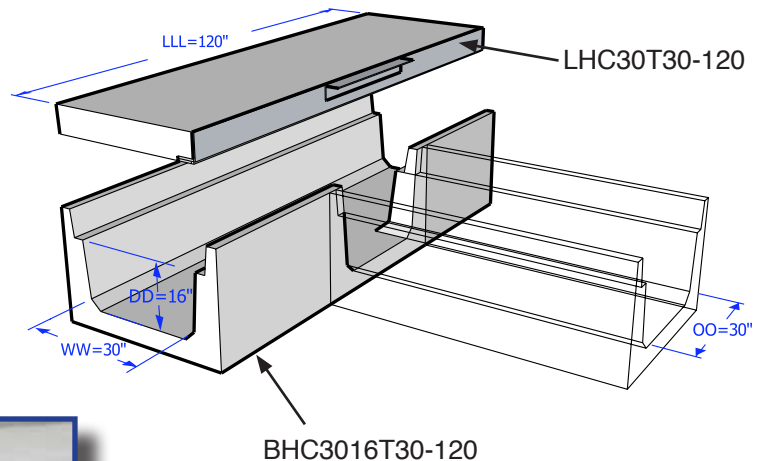
Width (WW) = 30"

Depth (DD) = 16"

T opening (00) = 30"

Length (LLL) = 120"

BHC3016T30-120



Standard HS20 Cross sections

Standard HS20 road crossing Cross sections are specified by the width, depth, length and size of the X opening.

Example: BHC**WW****DD**X**OO**-**LLL**

Base HS20 road crossing

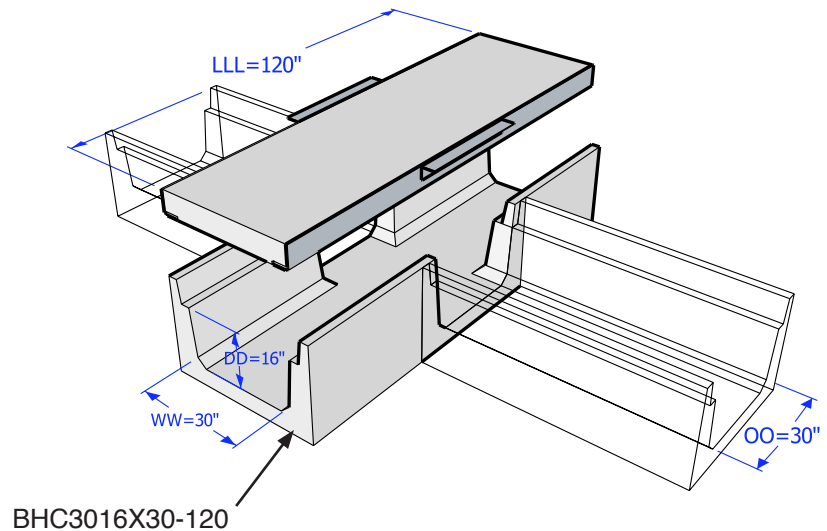
Width (**WW**) = 30"

Depth (**DD**)= 16"

X opening (**OO**) = 30"

Length (**LLL**) = 120"

BHC**30****16**X**30**-**120**



Contact us for crosses with different width openings.

HS20 End Walls & Reducers

Standard End Walls are specified by the width, depth & length of the wall (06").

Example 1: WM**WW****DD**-**LL**

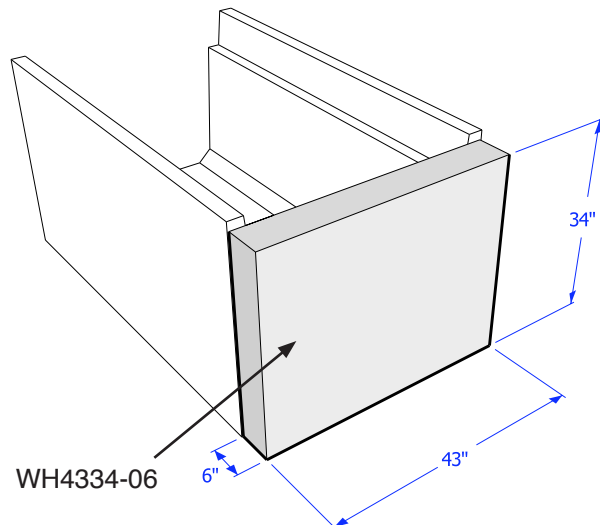
Pedestrian Wall

Width (**WW**) = 43"

Depth (**DD**)= 34"

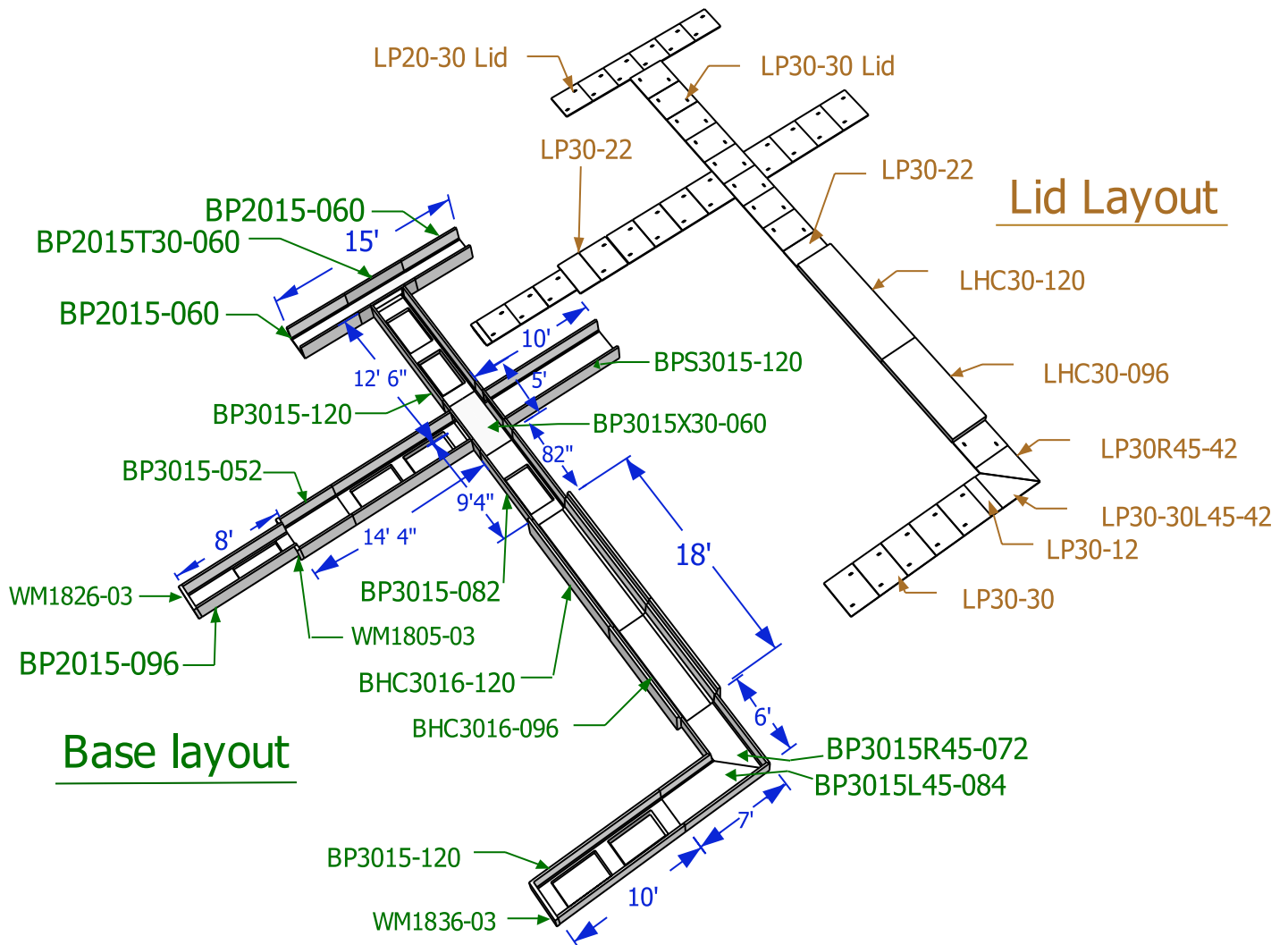
Length (**LL**) = 06"

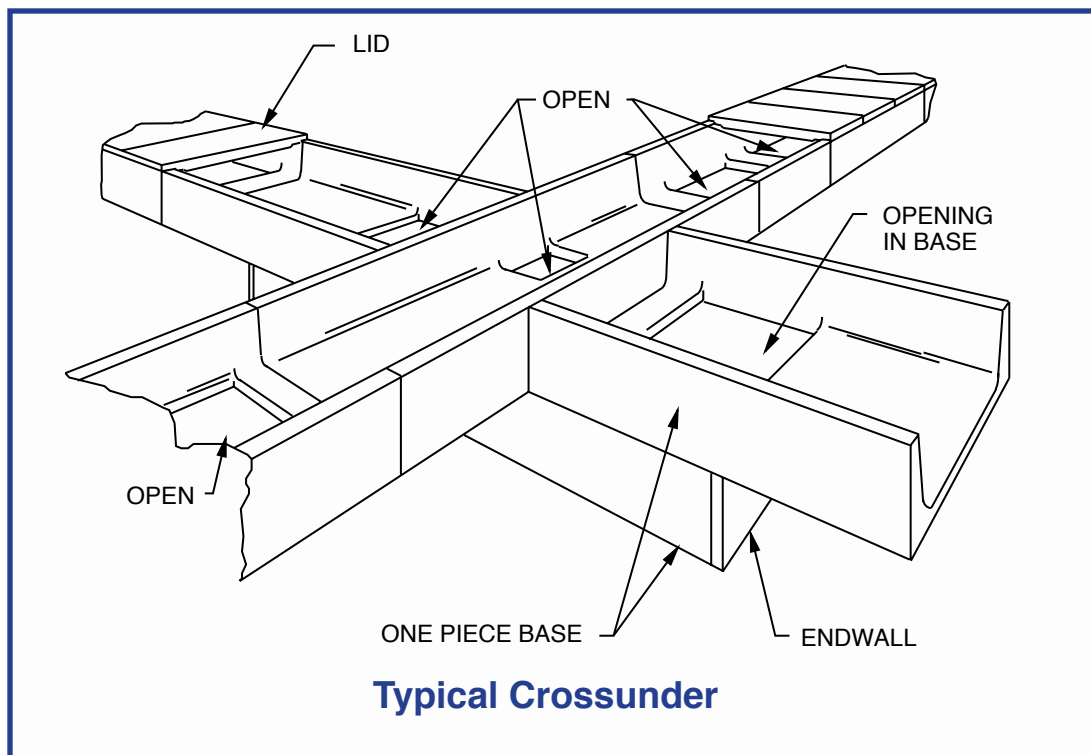
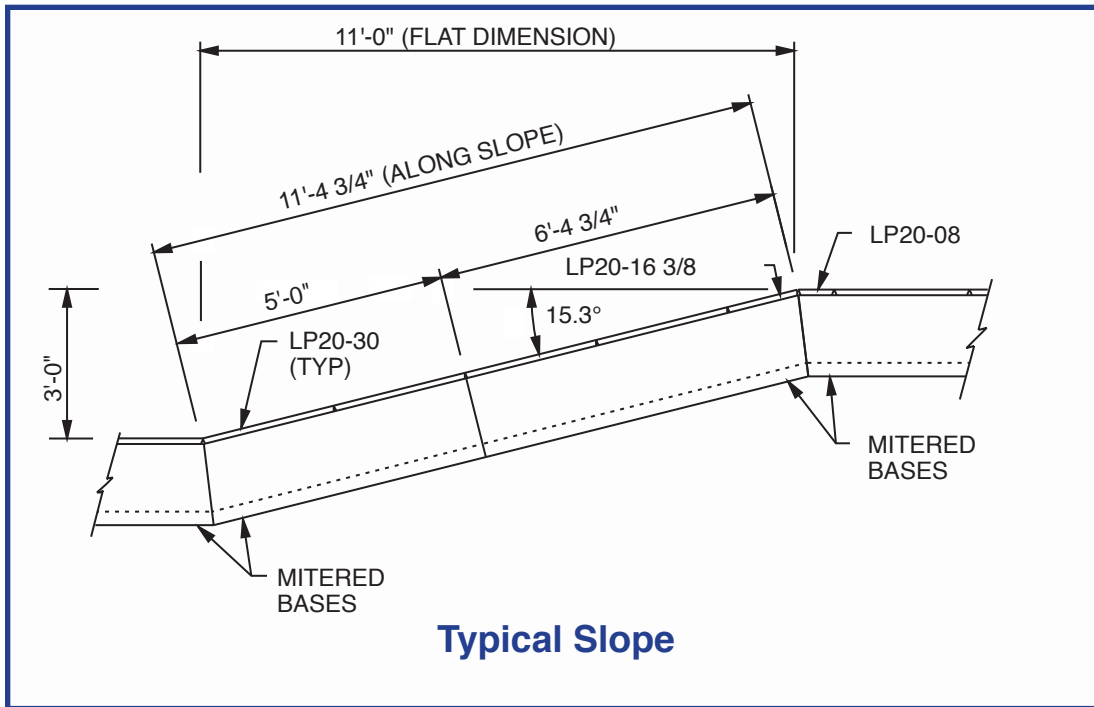
WH4334-06



Layout Example using Standards

This is one example of combining BP (Base Pedestrian) trench and BHC (Base HS20 Concrete lids) with standard geometric pieces to create a complex layout. Many, many other combinations are possible.





**TRENWA RECOMMENDS USING THE ONE PIECE TRENCH
FOR ALL SLOPES AND CROSSUNDERS**

OVERVIEW

Steel ventilation lids are available for our One Piece trench in Pedestrian, Medium Vehicle and Road Crossing rated designs. These ventilator lids allow heat to rise and dissipate from the trench. They are typically used when power cables are installed in the trench.

Standard sizes allow lids to be alternated with concrete lids or to be 100% vent lids. They can be used with over the top lid styles like our Pedestrian and Medium Vehicle trench or with recessed lids like our Road Crossing trench.

Vent lids for Pedestrian and Medium Vehicle are over the top designs and have locator angles on the underside.

Road Crossing lids set in a recess and do not require locators. When alternated with concrete HS20 lids the vent lids have steel riser tubes to match the height of the concrete lids.

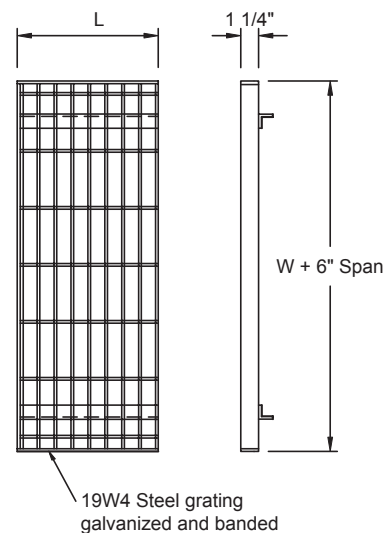
All lids are made with 19W4 bar grating and are hot dip galvanized for long, rust resistant usage.



Pedestrian Vent Lids

Pedestrian Vent lids are rated for 200psf and are available in 10", 24" and 30" nominal lengths. Contact us for custom sizes.

W	Part Number	L=10"	L=24"	L=30"
10"	VP10- L	12#	26#	32#
20"	VP20- L	18#	40#	50#
24"	VP24- L	21#	48#	58#
30"	VP30- L	25#	55#	70#
40"	VP40- L	30#	70#	90#

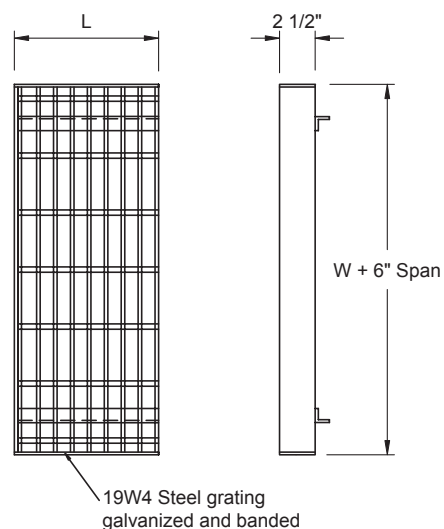


W is the inside nominal width of the trench the lid is designed to span. L is the length of the vent lid.

Medium Vehicle Vent Lids

Medium Vehicle Vent lids are rated at 9,000# G.V.W. and are available in 10", 24" and 30" nominal lengths. These can be used on our BM series trenches wholly or mixed with concrete lids. Contact us for custom sizes.

W	Part Number	L=10"	L=24"	L=30"
10"	VM10- L	28#	65#	80#
20"	VM20- L	45#	100#	125#
24"	VM24- L	50#	120#	150#
30"	VM30- L	75#	NA	220#
40"	VM40- L	110#	NA	325#

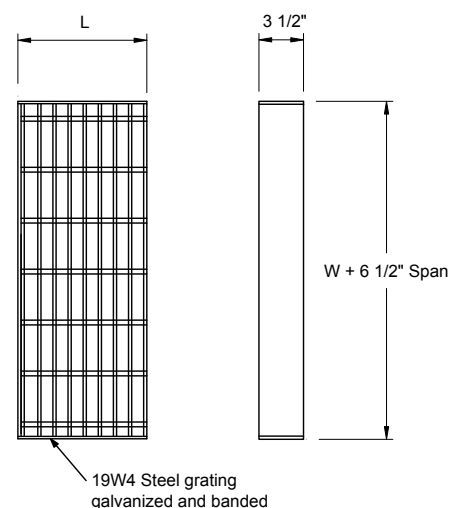


HS20 Road Crossing Vent Lids

HS20 Vent lids are rated at 32,000#/axle and are available in 10", 24" and 30" nominal lengths. These can be used on our BHS and BHC series trenches wholly or mixed with concrete lids. Contact us for custom sizes

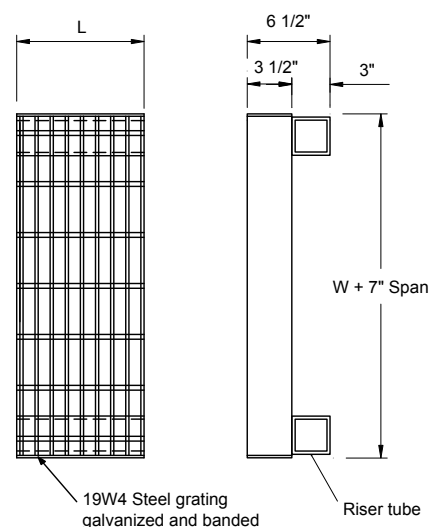
The following vent lid models are designed for a 3 1/2" recess and will fit our BHS series road bases. They should be used where 100% vent lid coverage is desired or mixed with steel lids.

W	Part Number	L=10"	L=24"	L=30"
10"	VHS10- L	40#	90#	113#
20"	VHS20- L	60#	145#	180#
24"	VHS24- L	70#	168#	208#
30"	VHS30- L	85#	200#	250#
40"	VHS40- L	105#	253#	315#



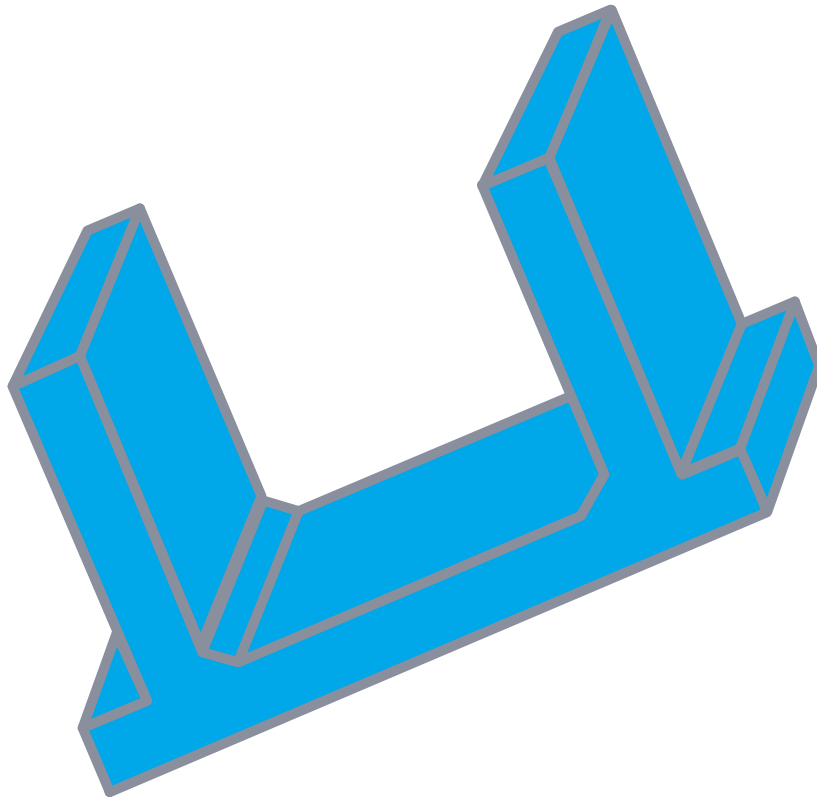
The following vent lid models are designed for a 6 1/2" recess and will fit our BHC series road bases. They should be used when mixed with concrete lids.

W	Part Number	L=10"	L=24"	L=30"
10"	VHC10- L	46#	100#	125#
20"	VHC20- L	70#	165#	208#
24"	VHC24- L	80#	185#	235#
30"	VHC30- L	92#	220#	275#
40"	VHC40- L	115#	275#	345#



Component Trench

- Overview - 32
- Lids & Brackets - 33
- Walls - 34
- Tees, Crosses, Reducers - 36
- 90° & Mitered Turns - 37



1419 Alexandria Pike
Ft. Thomas, KY 41075

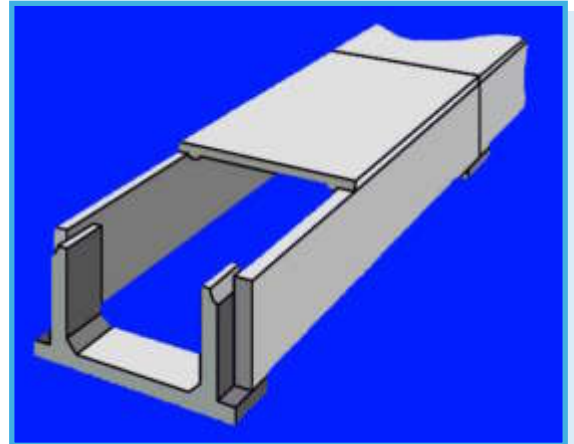
www.trenwa.com

phone: 859-781-0831
fax: 859-781-1085
e-mail: info@trenwa.com

OVERVIEW

Unlike the **One Piece** trench, Trenwa's **Component** trench is available only in **200 psf pedestrian loading**. It is available in six standard sizes: 20", 30", and 40" inside widths by 16" or 24" inside depth.

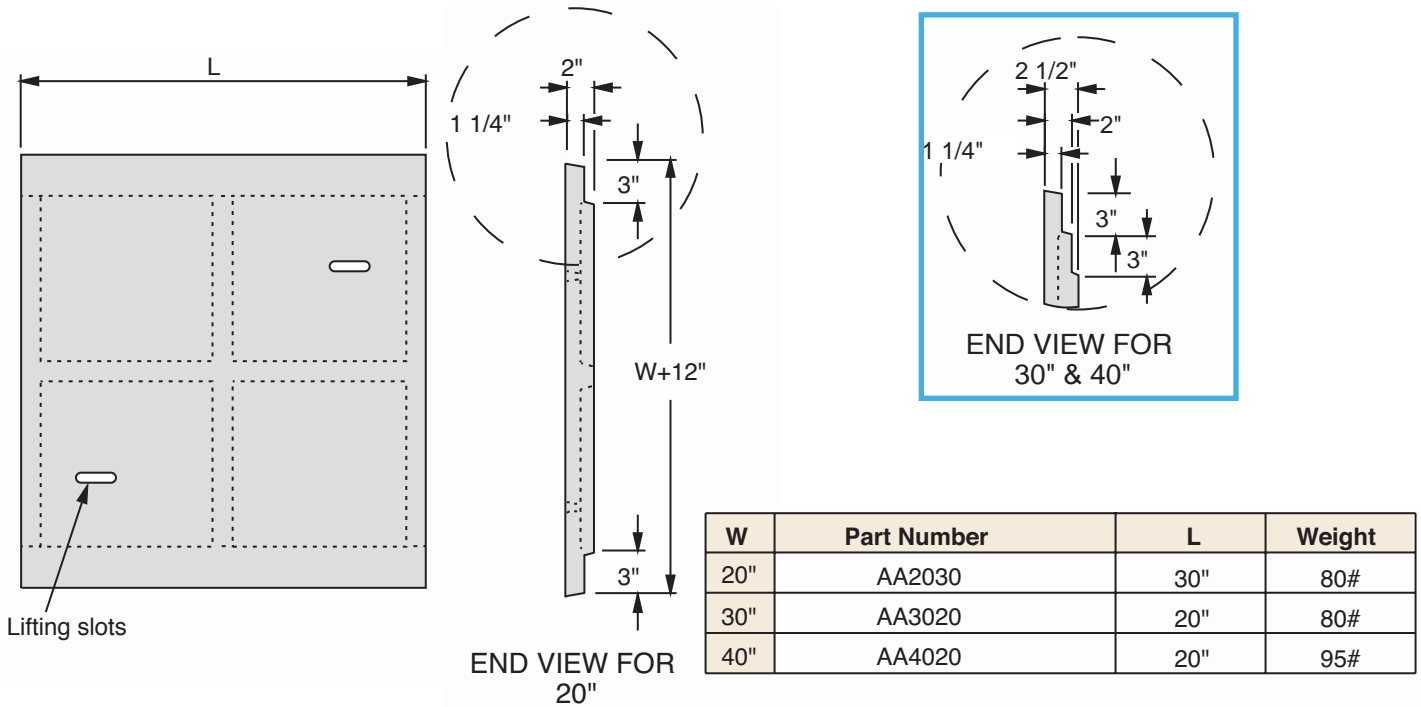
Trenwa's **Component** system is very simple. The key element is the **support bracket**, which supports the **sidewalls**, which in turn carry the **lids**. **Endwalls** terminate straight trench runs while **bulkheads** are used at ninety degree turns to close the run and provide a bearing for **lintels**, which in turn support lids over openings created by the turns; a **radius corner** is also required to support the far side of the lintel. Both right and left hand radius corners are used to support the lintel at a tee. **Dividers** segregate trenches into separate sections.



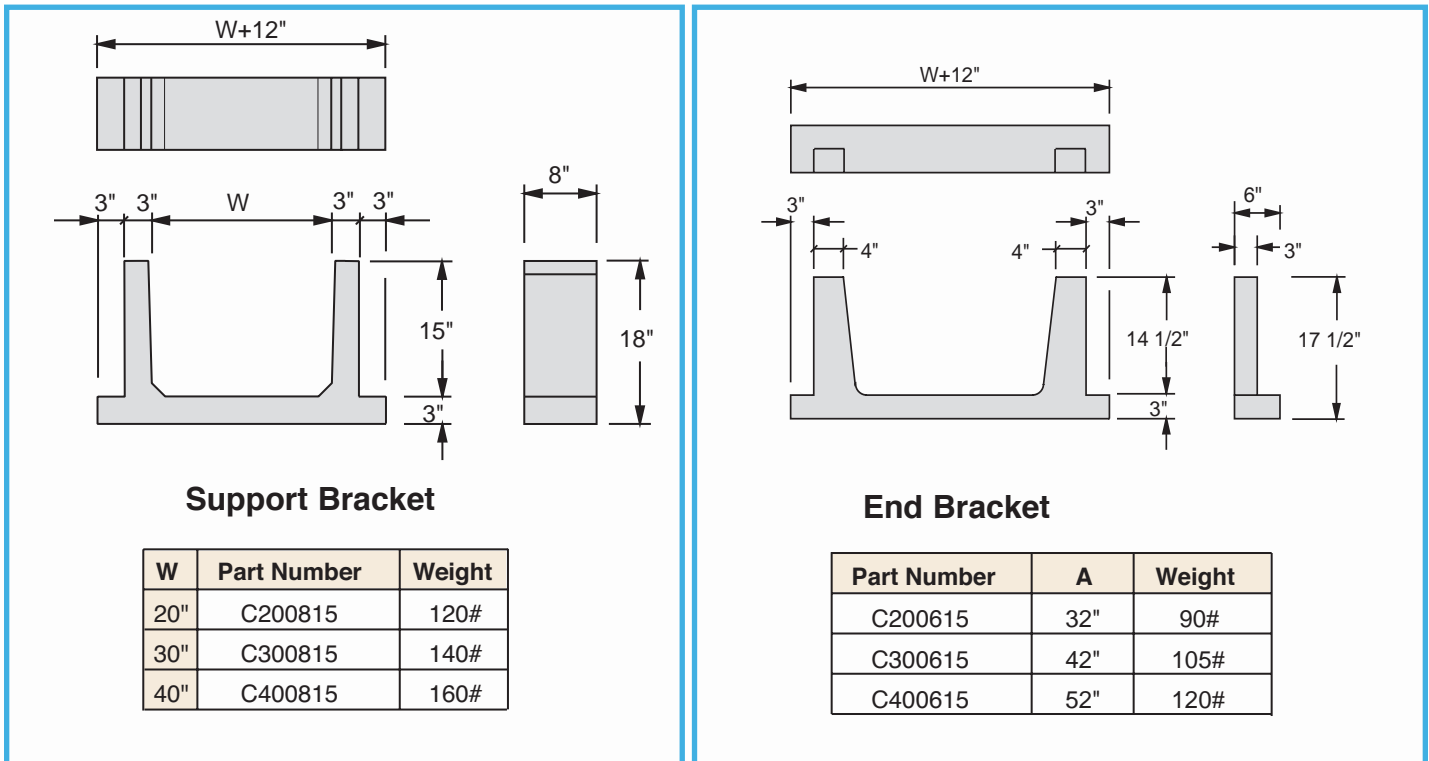
PART NUMBERING

Like the **One Piece** trench, most of the parts for the **Component** trench are identified by leading letters which identify the type of part (e.g. lid, base section, end wall, etc.) and trailing numbers which identify the size of the part.

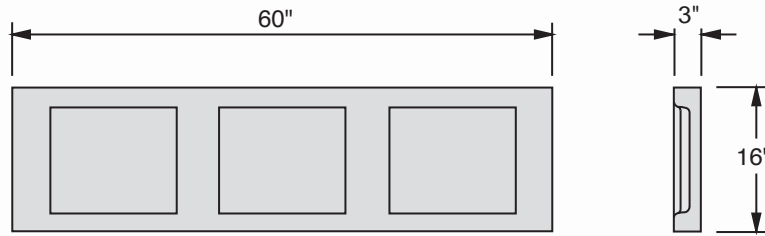
Description	Part Number Format	Example	Dimensions for Example
Lid – Pedestrian	AAxxxx	AA3020	30" inside width x 20" long
Support Bracket	Cxx08xx	C400815	40" inside width x 15" tall leg
End Bracket	Cxx06xx	C300615	30" inside width x 15" tall leg
Sidewall	Bxxxx	B1632	3" thick x 16" tall x 32" long
Endwall	Dxxxx	D1536	3" thick x 15" tall x 36" long
Bulkhead	DxxxxR or L	D1529L	3" thick x 15" tall x 29" long (left hand turn)
Lintel	Lxxxx	L3340	3" x 3" x 40" long
Radius Corner	RCRxx or RCLxx	RCR16	Right Hand Radius x 16" tall



PEDESTRIAN LIDS



BRACKETS

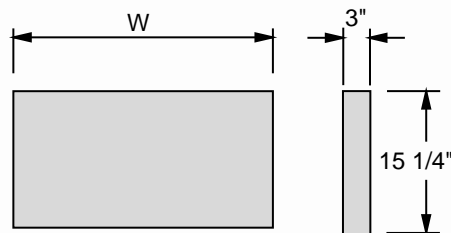


Sidewall B1660

(Wt. = 150#)

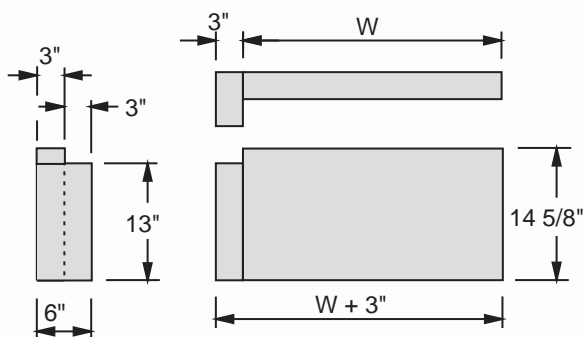
NOTE: Sidewall is also available in a 24" (B2460) depth with End wall and Bulkhead to match

WALLS



Endwall

Part Number	W	Weight
D1526	26"	95#
D1536	36"	130#
D1546	46"	165#



Bulkhead

Part Number	W	Weight
D1529L or R	26"	110#
D1539L or R	36"	145#
D1549L or R	46"	180#

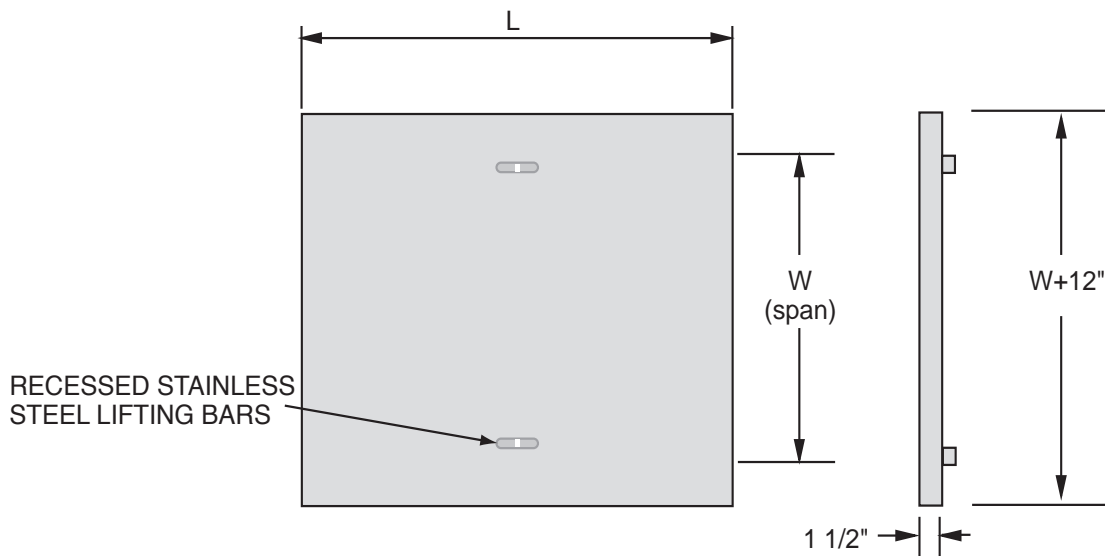
New Product !

POLYMER CONCRETE PEDESTRIAN LIDS

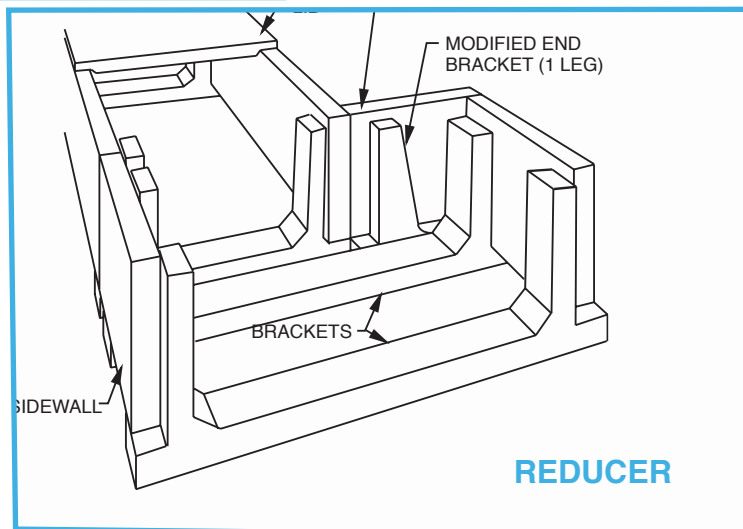
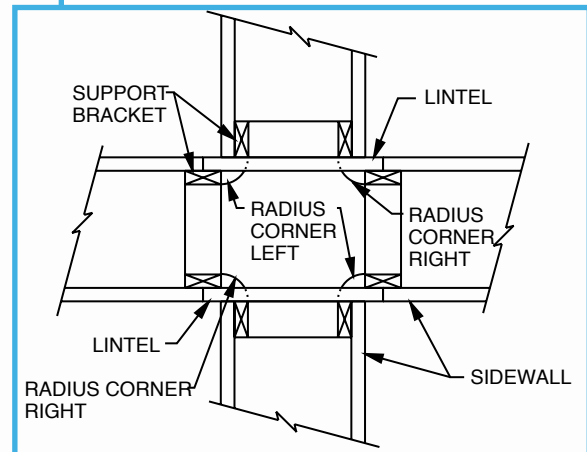
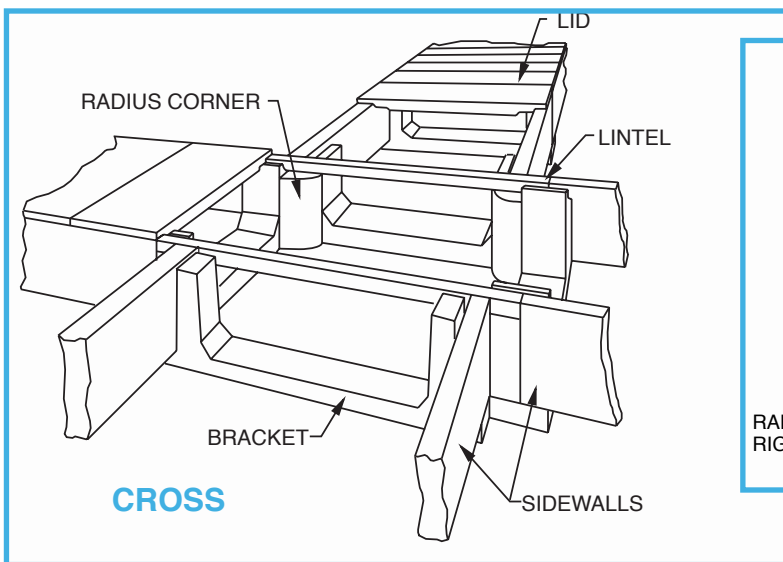
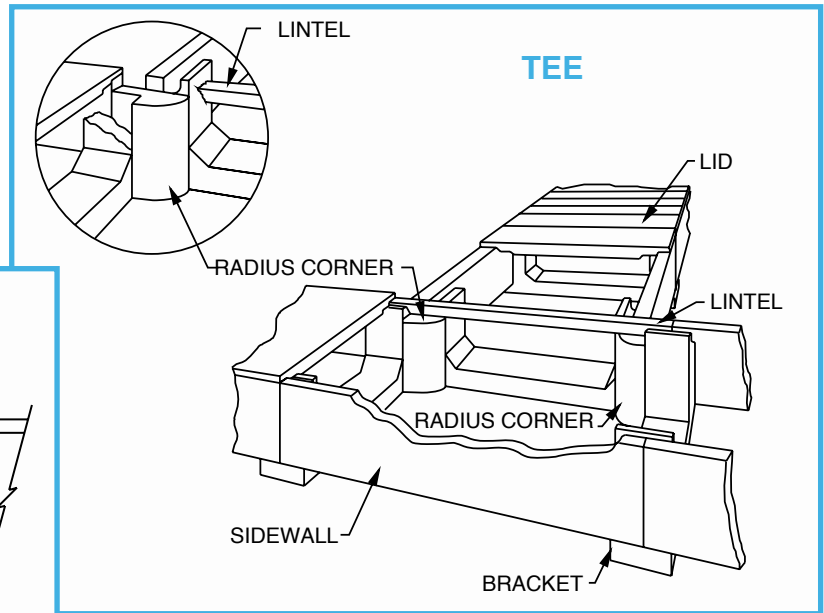
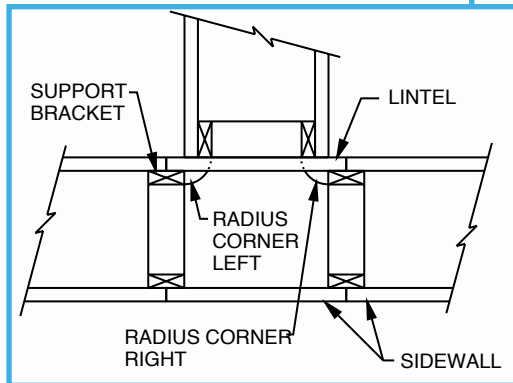
Designed specifically for our Component Trench these Polymer Concrete lids are a great alternative to traditional Portland Cement concrete lids. Manufactured from resins, aggregate and fiber, these lids are strong, durable and crack resistant.

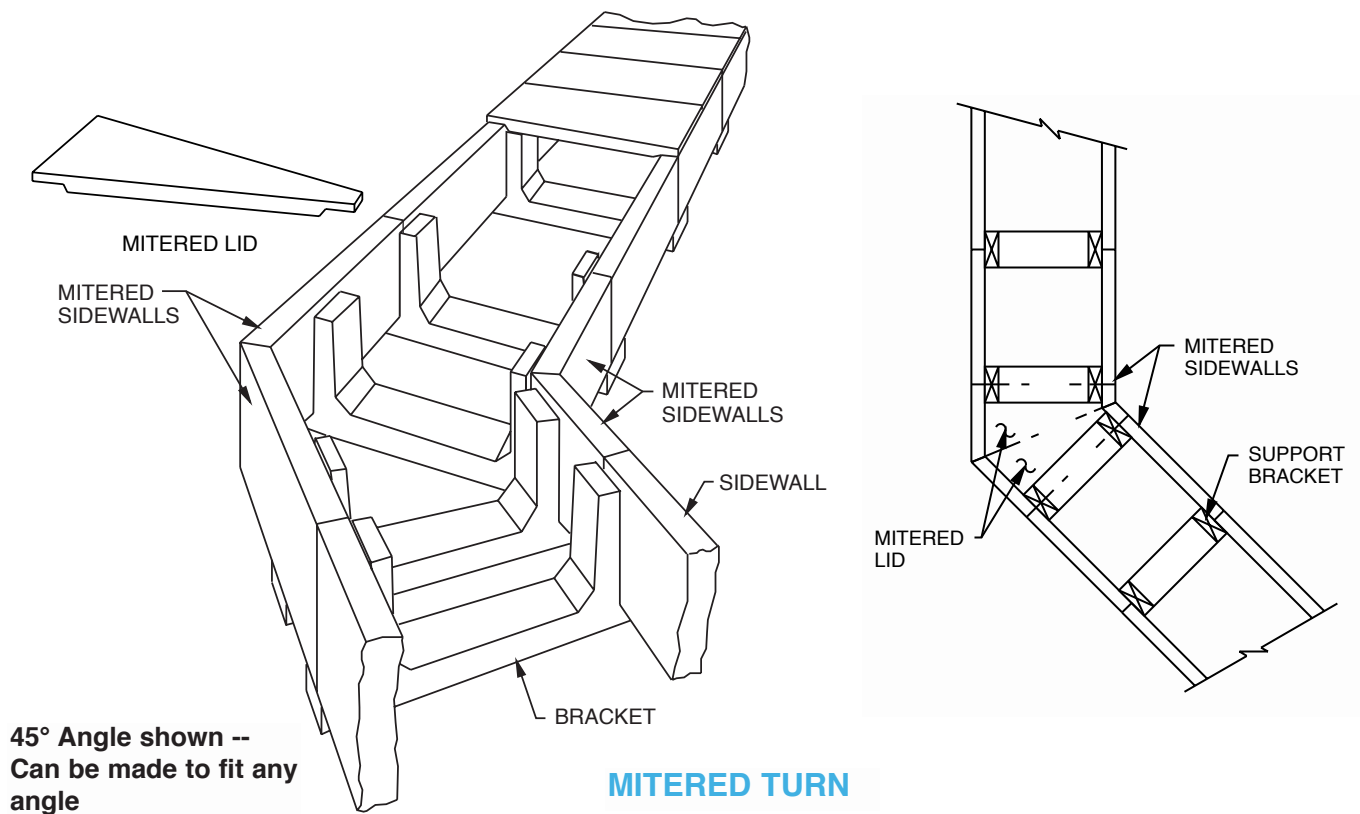
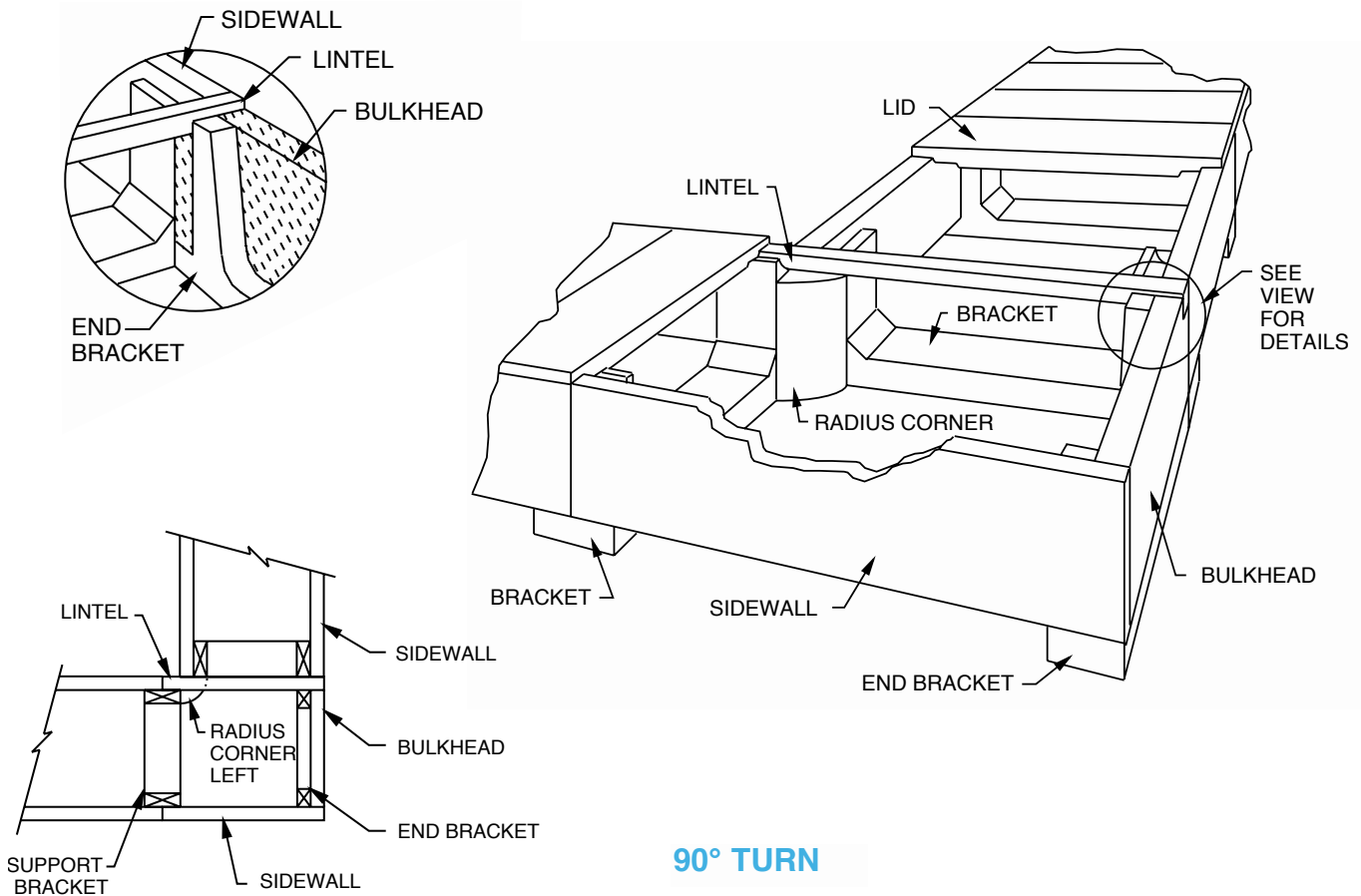
- Higher compressive strength than traditional concrete
- Better resistance to freeze/thaw cycles
- More cost effective than steel or aluminum plate.
- Will not absorb water
- Resists salt and chemical attack.

These are the same width and length as our concrete AA lids and make great replacement lids for existing installations.



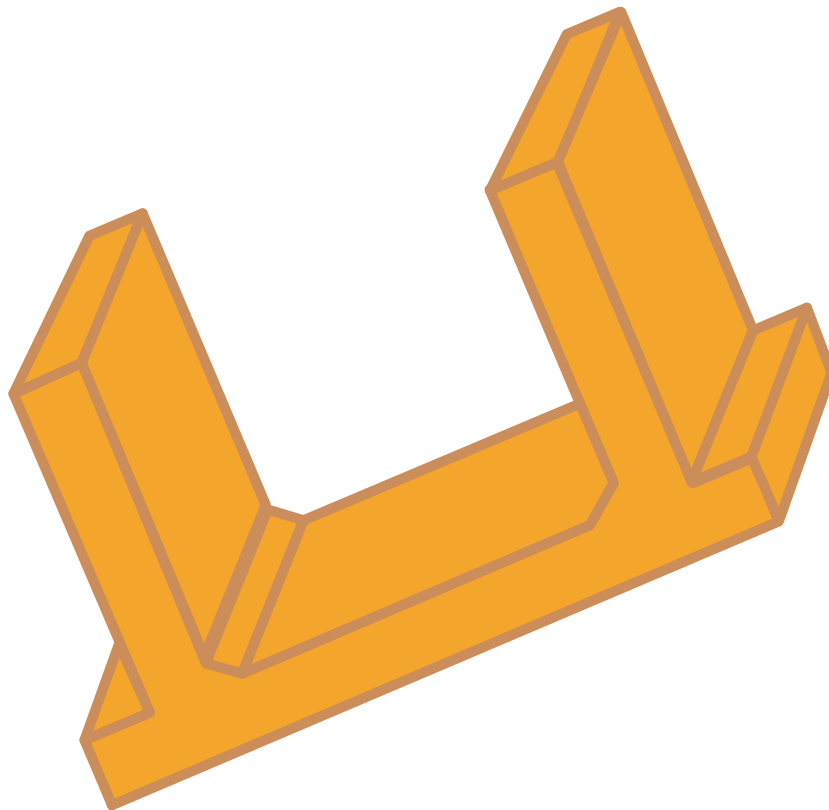
W	Part Number	L	Weight
10"	AAP10-30	30"	80#
20"	AAP20-30	30"	85#
30"	AAP30-20	20"	86#
40"	AAP40-20	20"	106#





XL Trench

- XL Trench Overview - 40
- XL Trench Information - 40



1419 Alexandria Pike
Ft. Thomas, KY 41075

www.trenwa.com

phone: 859-781-0831
fax: 859-781-1085
e-mail: info@trenwa.com

OVERVIEW

Trenwa offers a number of larger trench sizes for both electrical and mechanical applications. These **XL-Trenches** are typically produced in standard 10 foot lengths. Shorter lengths are also available and Trenwa can cast pieces with miters or blockouts to meet any trench layout.

These **XL-Trenches** are available in 12" standard increments for inside widths from 48" up to 96" and any inside depth up to 72". Custom widths between 48" and 96" can be made but may incur a mold setup cost.

With their larger sizes, the **XL-Trenches** are appropriate for electrical applications with large numbers of cables or where additional height is required to support multiple levels of cable tray. They are also well-suited for most piping applications as explained below.

Inside Widths	48"	60"	72"	84"	96"
Inside Depths	12" to 72"				

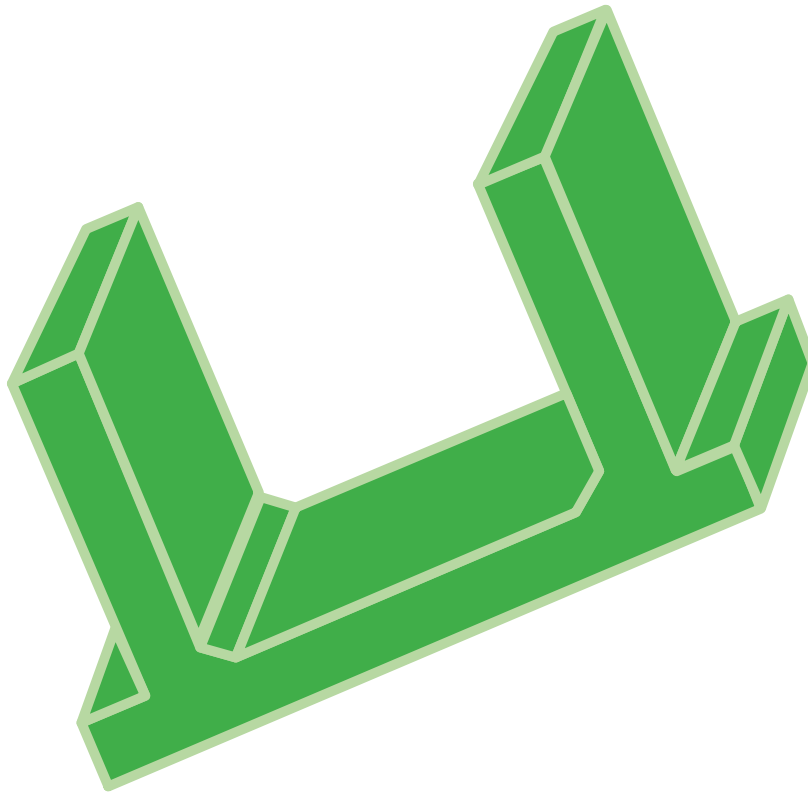
PIPE APPLICATIONS With their larger cross-sections, Trenwa's **XL-Trenches** are excellent candidates to carry piping. As in electrical applications, they provide accessibility for future maintenance or expansion. Also, the use of sealants and/or damp-proofing help provide both corrosion protection for the pipes as well as leak containment. Weld plates can be embedded in the trench walls or bases to anchor pipe supports, tie plates can also be imbedded to provide a rigid connection between adjacent trench bases.

One final note on the use of Trenwa trenches for piping: our **One Piece** trench and **Road Crossing** trench can also be used for smaller pipe applications with all of the features listed above.



C Trench

- C trench overview - 42
- C trench information - 42



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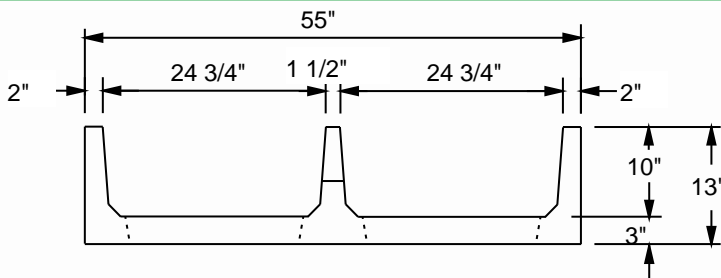
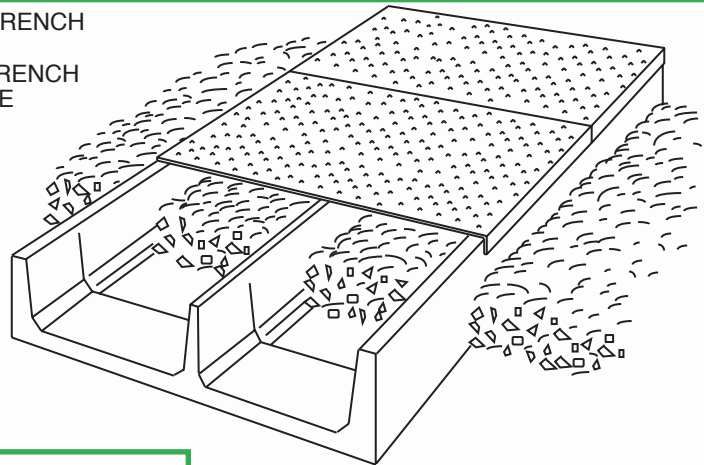
phone: 859-781-0831
fax: 859-781-1085
e-mail: info@trenwa.com

OVERVIEW

Around the same time Trenwa obtained its original patent, engineers with the Bureau of Reclamation in Denver developed a trench system with a 24" width, and aluminum lids to protect against ground faults. This trench was called **C-Trench**.

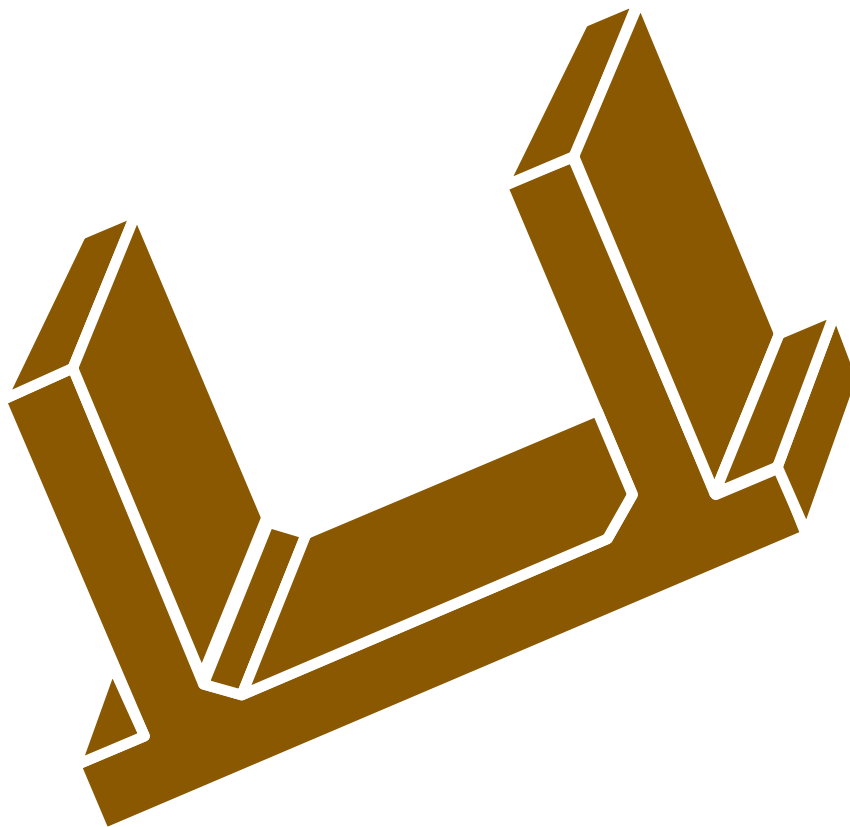
In the early 1990's, Trenwa developed a One Piece version of **C-Trench**. Significant installation economies can be realized during installation because this **C-Trench** comes in 10 foot lengths and can be provided in either single or double trench widths. The design offers great flexibility and can be buried or placed above ground. **C-Trench** is available only from our plant in **Denver, Colorado**.

DOUBLE WIDE TRENCH
SHOWN
SINGLE WIDE TRENCH
AVAILABLE



Accessories

- Dividers, Unistrut, Weld Plates - 44
- Cable Clips, Guard Posts, Cable Risers - 45
 - Power - 46
- Tie Plates, Sealant - 47
 - Corner Guards - 48



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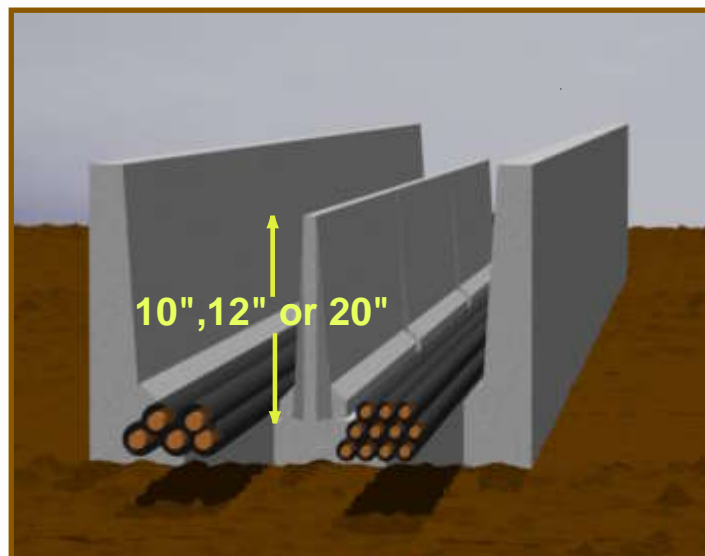
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Ft. Thomas, KY 41075

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fax: 859-781-1085
e-mail: info@trenwa.com

Dividers

Our improved free-standing divider can be used to separate a trench for cable isolation. This divider has an inverted tee-shaped cross-section and is made from 5,000 psi steel reinforced concrete. A full length 4" wide foot provides stability and permits the divider to stand up if field cutting is required to accomodate unforeseen layout changes.

The standard divider is 5'-0" long and comes in three heights. The **D10-60** is 10" tall, the **D12-60** is 12" tall and the **D20-60** is 20" tall.

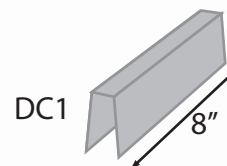


Shorter length dividers can be provided by changing 60 to the number of inches desired.

Examples: D12-42
D20-49

Pregalvanized steel clips are available to tie the D12 & D20 dividers together for improved stability.

Recommended for the D20 dividers.



Weld Plates

Weld plates can be cast into the trench walls or bases to attach supports for pipes.



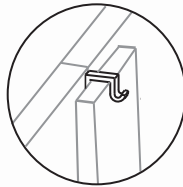
Unistrut

Trenwa can embed unistrut channels in the walls or bases of its trenches so that cable trays or other supports can be mounted in the trench.



Cable Clips

Stainless steel clips can be provided to hold grounding cables at the top of the trench wall for any of our trench systems. GC1's are used on Component trench, GC5's are used on One Piece Pedestrian & Medium Vehicle, and GC3's are used on HS20 trench. All cable clips are shipped separately and are field installed.



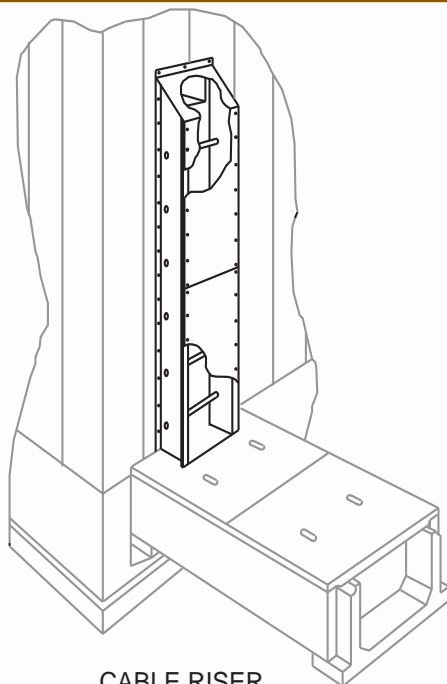
GROUND CABLE
SUPPORT CLIP



Guard Posts & Chain

To ensure that traffic does not drive over pedestrian rated trench, we can optionally provide guard posts and chain. The posts are yellow HDPE with a cap and screw eye for the chain; part number GPE-78, 78" length standard.

Other length posts are available by changing the last two numbers to the length desired. Chain is yellow and can be easily unhooked for passage; part number YC-LLL (specify length in feet). For a guard post without eyebolt to be used without chain as a stand alone barrier use part number GP-78.



CABLE RISER

Cable Risers

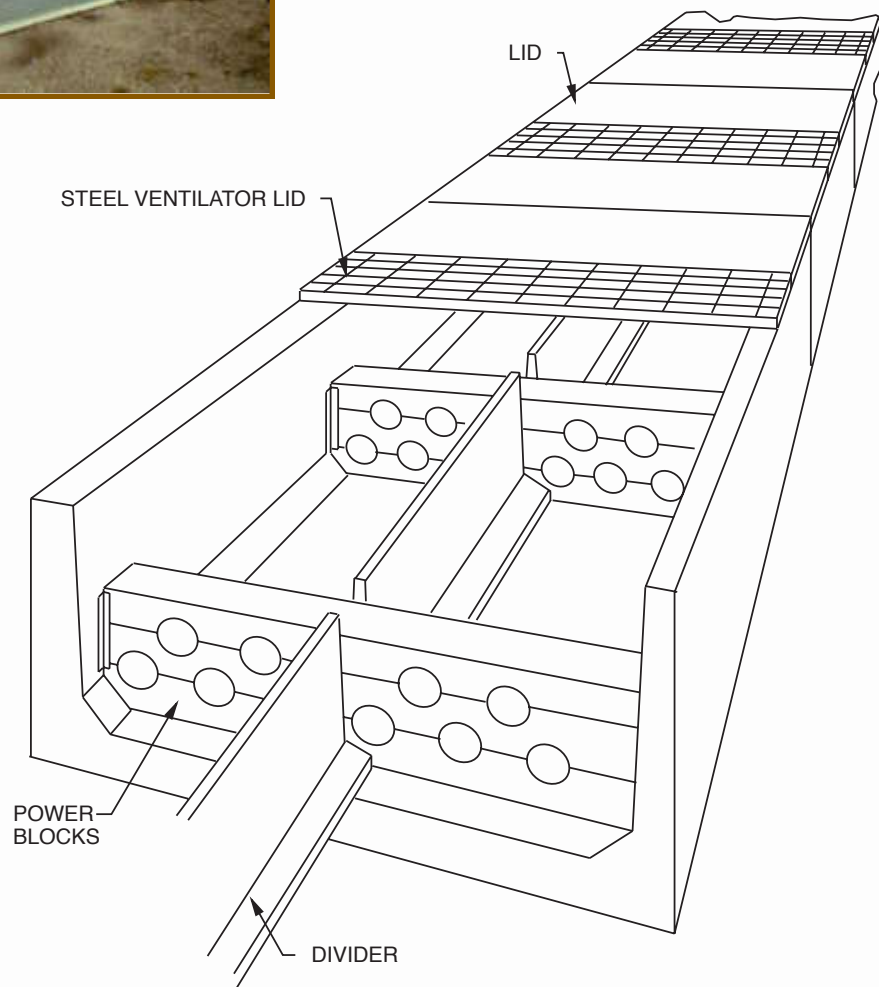
Aluminum cable risers are available in a variety of sizes to carry cables out of a Trenwa trench into a control building. Standard riser depths are 6", 8", 10", and 12" with widths ranging from 12" to 42", typically in 6" increments. Lengths can also vary from a few feet to over 120".

Use part number CR wwdd-ll where ww is width, dd is depth and ll is length. Example CR3208-096. Add a 'B' for back cover; CRB1606-080.



Power Accessories

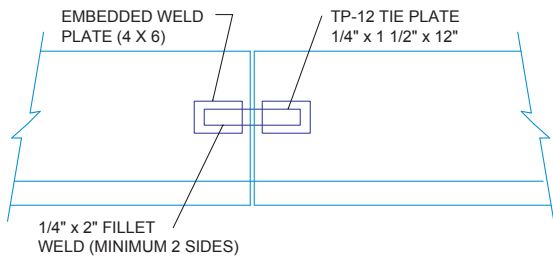
Several accessories are available for use with power cables to aid in heat dissipation. **Unistrut channels** can be embedded in the trench walls or bases to support cable trays or light-weight high density polyethylene (HDPE) **cable support blocks** can be provided to match any cable arrangement. When used with galvanized steel **ventilator lids**, heat is dissipated more effectively from the cables, often allowing the use of smaller cables which can result in significant cost savings.



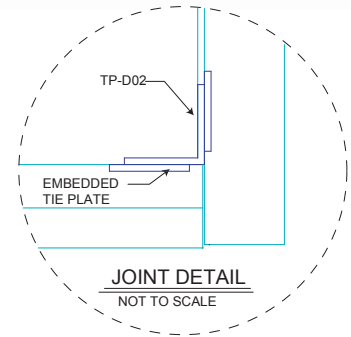


Tie Plates

In some applications it is desirable to lock the trench bases together to minimize shifting or differential settlement in poor soil conditions or when there is localized, repeated heavy loading. Trenwa can embed weld plates in the sides and/or bottoms of the trench walls which can then be held together by welding tie plates between them. Expansion joints are recommended every 30 to 50 ft.



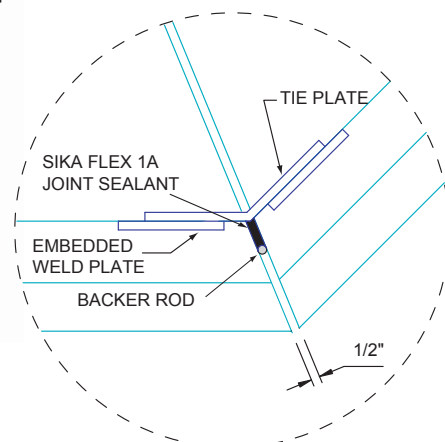
MECHANICAL CONNECTION



EXPANSION JOINT

Sealant

Joint sealants can be applied between the trench bases and lids to provide water resistance if required. This can be done in conjunction with our tie plate system for stability of the bases. A flexible sealant compound is typically applied on a backer rod in any joint with a 1/2" gap or more after the bases have been set in place.



Corner Guards

For cable applications we will supply our Corner Guards on T's, Crosses, and 90 degree turns to protect cables from abrasion. They typically come partially installed with drive nail anchors to complete the other side.

They are available in the following sizes:

CG-09 for trenches 10-12 inches deep

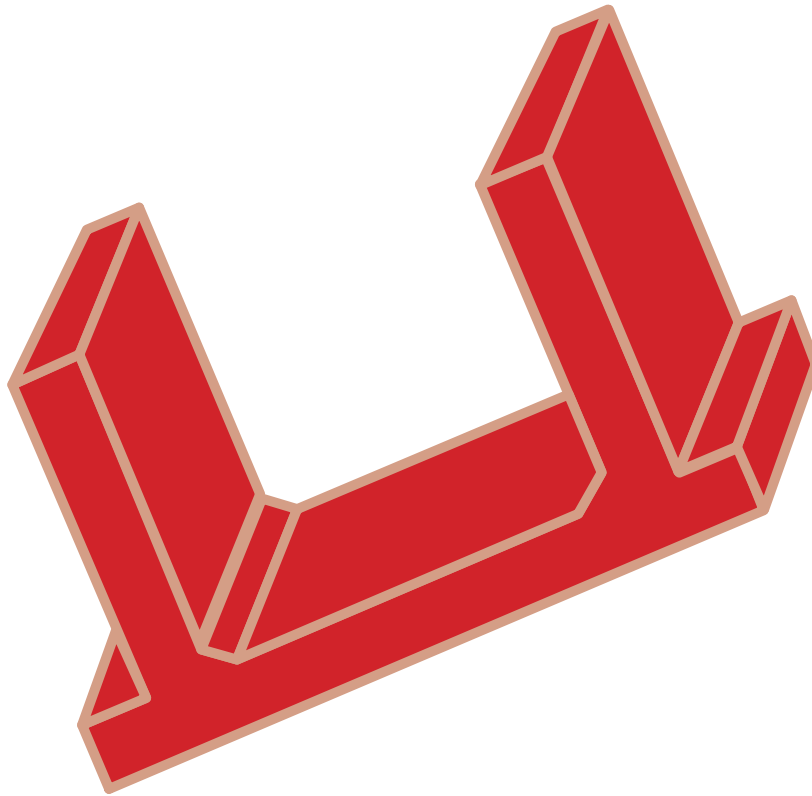
CG-12 for trenches 15-16 inches deep

CG-20 for trenches 24 inches deep



Installation, Specifications

- One Piece, XL, C trench - 50
- Component trench- 52
- Specifications - 53



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Ft. Thomas, KY 41075

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e-mail: info@trenwa.com

Unloading & Storage

To reduce the risk of damage, care should be taken in unloading and storing trench material. All material should be stored on level ground. Dunnage should be placed under all bases and road crossing covers. In addition, the dunnage should be placed vertically in-line with underlying dunnage as additional pieces are placed on each stack of material.

Preparation & Excavation

1. The contractor should review the drawings and installation instructions before attempting to install the trench. Establish a starting location, typically at one end of the trench or at a fixed point such as a building or manhole.

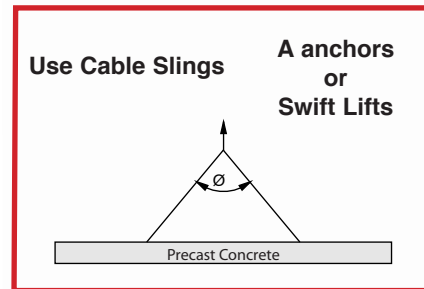
2. Excavate trench to a minimum width for the specified size of trench and to a sub-grade elevation 2"-3" below the bottom of the trench (8"-12" if a drain tile will be placed under the trench). Cut walls as vertical as possible. Deep excavations may require shoring or protection from cave-ins.

3. If a drain tile is used, backfill with crushed stone or pea gravel around the drain tile to within 3" of the trench bottom. A fine, clean backfill material such as sand should then be placed, leveled and compacted to the bottom of trench elevation. For HS20 loading, material should be compacted to 4,000 psf.

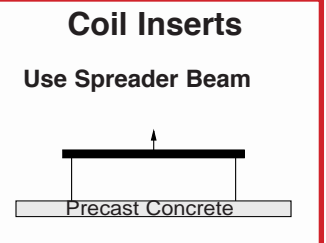


Setting Trench Bases

4. All trench bases and lids should be lifted with the coil, A anchors, or swift lift inserts cast into them. If coil inserts are provided, use a spreader beam lifting device (user provided) so that a vertical



pull is applied to the coil eye-bolts. If A anchors or swift lift inserts are provided, use cable slings that are long enough to maintain a 30°-60° angle between the cables at the hook point.



5. A transit or string line should be used to maintain horizontal alignment of the base units. The bases may follow any natural, gentle grade of the area. The first base unit should be set at a fixed point such as a building wall or manhole and subsequent base units placed in sequence so that gapping is minimal. If desired, roofing paper, Con-Wrap sealant, or similar materials may be placed over vertical joints between bases to minimize future silt infiltration.

6. With large trench bases, a chain winch or come-a-long can be attached to the lifting devices to pull the base units together while the crane supports the full weight of one base.

Sealants and Mechanical Connections

7. When installing a trench system that requires water-resistant joints, follow the manufacturers directions for applying the sealant. If sealant is included as part of our design follow the application instructions on the project drawings.

Some installations require a joint sealant material that is applied to the exterior of the base units overlapping the joint. Apply this type sealant material after the base units have been securely set.

8. If a mechanical connection is specified to join the base units, weld the Trenwa supplied steel tie-plate to the weld plates which are embedded in the end of the walls of adjacent bases. Do this after the bases have been securely set and pulled together. Weld the tie-plates prior to removing the chain winch or come-a-long. All exposed weld plates should be treated with a rust inhibitor coating after welding is completed and the trench is securely in place.

9. Any damp proof coating on the base units (if provided) may require touch up after handling.

Backfilling

10. Backfilling should be done with sand or gravel and firmly compacted to the compaction specified in **Step 3**. The backfill can be topped off with excavated soils.

11. With Medium Vehicle and HS20 road crossing trenches, a flowable grout may be placed in the trench excavation after all bases are set so that the grout fills any voids between the bases and the backfill material.

Setting Lids

12. Trench lids can be installed after all cable, piping, insulation, testing, etc. has been completed. Inserts are cast in the Medium Vehicle and HS20 road crossing lids so that lifting devices can be attached. Care must be exercised to maintain an even strain on each lifting insert during lifting and setting of the lids. [Review the instructions for handling the base units in **Step 5**].

13. The lid installation sequence should start at a fixed point (e.g. building, end of trench, manhole, etc.). The lids should match the joint spacing in the base units. Overlapping the joints can create an uneven bearing surface that could cause damage to the lids.

14. For HS20 trenches with concrete lids, Trenwa can provide a neoprene gasket for the lids to bear on to minimize movement that may chip the lids. If provided, place the neoprene strips the full length of the horizontal lid bearing surface on each side of the base.

15. Connect a chain winch or come-a-long to the lifting hardware of the lid being installed and the previous lid. While the crane is supporting the full weight of the lid, pull the lids together, then release the crane support. Pulling the lid with its full weight on the trench may damage the joint sealant on the top of the walls.

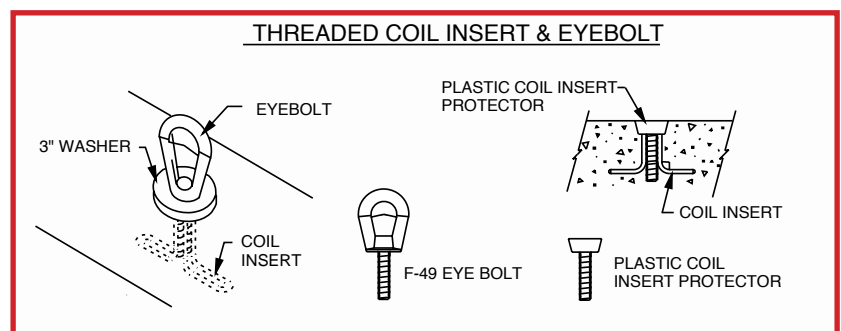
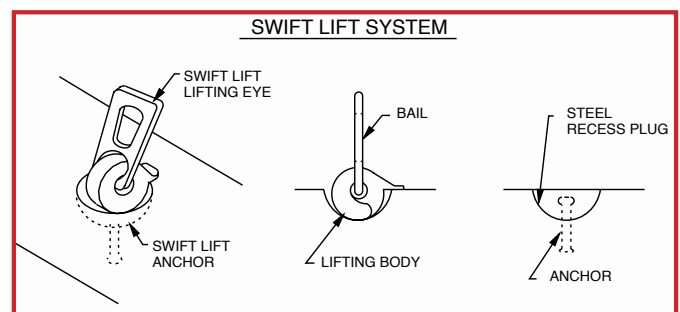
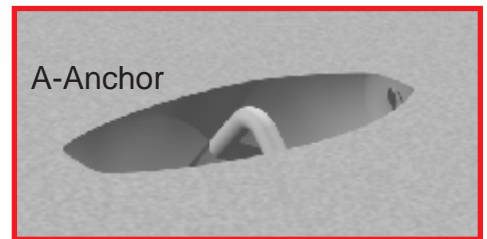
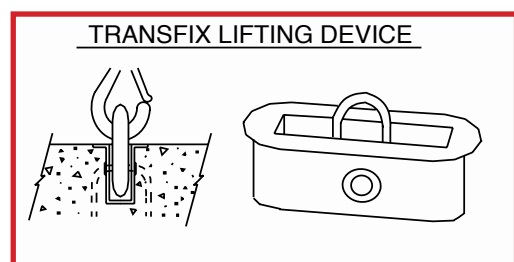
16. Chipping of HS20 Concrete lids can occur when stones and other hard debris are in the area, particularly during periods of construction. Tires can cause this debris to impact the lid and chip the edge or surface of the concrete lid. Care should be exercised to keep the area clean or protect the lids during these periods. Snowplows can also cause damage to the lids or impact channels. The area should be marked and snowplow operators should be made aware and use caution when clearing the trench. The use of salts and other corrosive de-icers is not recommended since they can cause the impact channels to rust prematurely and damage the surface of the concrete.

LIFTING DEVICES

Trenwa uses different lifting devices, depending on the project size and type of trench piece.

	Coil inserts	Transfix	A-anchors	Swift lifts
Pedestrian bases			x	
MV bases			x	o
MV lids		x		
HS20 bases			x	o
HS20 lids	x			o

Swift lifts are optional, cost extra and require a special lifting tool.



Unloading & Storage

To reduce the risk of damage, care should be taken in unloading and storing pallets of trench material. If a forklift is not available for unloading, use a spreader bar to separate lifting cables or chains so material is not pinched. Pallets should be stored on level ground. Dunnage should be placed under road crossing bases and covers. In addition, the dunnage should be placed vertically in-line with underlying dunnage as additional pieces are placed on each stack of material.

Preparation & Excavation

1. The contractor should review the drawings and installation instructions before attempting to install the trench. Establish a starting location, typically at one end of the trench or at a fixed point such as a building or manhole.
2. Excavate trench to a minimum width for the specified size of trench and to a sub-grade elevation 2"-3" below the bottom of the trench (8"-12" if a drain tile will be placed under the trench). Cut walls as vertical as possible. Deep excavations may require shoring or protection from cave-ins.
3. If a drain tile is used, backfill with crushed stone or pea gravel around the drain tile to within 3" of the trench bottom. A fine, clean backfill material such as sand should then be placed, leveled and compacted to the bottom of trench elevation.



Setting Trench Brackets & Sidewalls

4. Support brackets should be set on maximum 5'-0" centers (or less, as required by the layout). After setting each bracket to the required spacing, the bracket should be checked for level and alignment. A transit or string line should be used to maintain horizontal alignment of the brackets. At entrances to hand holes or buildings set trench support brackets on footings provided in foundation construction.

5. After setting the support brackets, place sidewalls on both sides of the support brackets (with the smooth side of the sidewall facing outside) so that they span from the center of one bracket leg to the center of the next bracket leg. Backfill should be placed against the sidewalls as soon as is reasonably possible to hold the sidewalls in place.

6. A minimum 4" bedding of sand should then be placed in the trench to form a level bottom, just covering the support brackets. If required, trench dividers or cable support blocks should be placed in the trench at this time.



Backfilling

7. Backfilling should be done with sand in layers and firmly compacted. Be careful not to over-compact as this can damage the sidewalls. The backfill can be topped off with excavated soils.

Setting Lids

8. Trench lids can be installed after all cable has been placed in trench. **Use care in handling and placing pedestrian covers. Impact from dropping a cover can exceed the pedestrian design load and damage the cover.**
9. **The lid installation sequence should start at a fixed point (e.g. building, end of trench, manhole, etc.). The lids should match the joint spacing in the base units. Overlapping the joints can create an uneven bearing surface that could damage the lids.**

GENERAL SPECIFICATIONS

1. SCOPE

- 1.1 Provide a precast concrete underground utility trench system (for electrical cabling or mechanical piping) as manufactured by Trenwa, Inc. (Patent #2862367); 1419 Alexandria Pike; Fort Thomas, KY 41075. The manufacturer must have experience in design and fabrication of similar products and with facilities for fabricating them with the quality specified herein and without delay to the specified schedule.

2. DESIGN

- 2.1 The precast components shall be designed to conform to requirements stated in ASTM C857-07 "Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures, ASTM C858-07 "Specifications for Underground Precast Concrete Utility Structures" and ACI-318 "Building Code Requirements for Reinforced Concrete".

3. MATERIALS

- 3.1 Cement shall conform to ASTM C150-07, "Specification for Portland Cement".
- 3.2 Fine and coarse aggregates shall conform to ASTM C33, "Specification for Concrete Aggregates".
- 3.3 Chemical Admixtures shall conform to ASTM C260 "Air-Entraining Admixtures for Concrete and ASTM C494 "Chemical Admixtures for Concrete".
- 3.4 Steel reinforcing bars shall conform to ASTM A615 "Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement".
- 3.5 Steel reinforcing wires shall conform to ASTM A496 "Specification for Steel Wire, Deformed, for Concrete Reinforcement".
- 3.6 Steel reinforcing welded wire mats shall conform to ASTM A497 "Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement".
- 3.7 Embedded steel shapes and plates shall conform to ASTM A36 "Specification for Structural Steel".

4. CONCRETE

- 4.1 Batching, mixing and placing of concrete shall conform to ASTM A94 "Specification for Ready-Mix Concrete" and ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete". All materials shall be pre-weighed prior to mixing.
- 4.2 Concrete shall obtain a minimum compressive strength of 5,000 psi at 28 days of age.
- 4.3 Concrete shall contain 6% entrained air by volume (plus or minus 1%).

5. REINFORCEMENT

- 5.1 Fabrication and placement shall conform to ACI-318 "Building Code Requirements for Reinforced Concrete".

6. SUBMITTALS

- 6.1 Engineering layout drawings will be provided for approval and to assist field installation. The drawings will include dimensions, identification and location of each trench part in the trench layout along with a bill of material.

ONE PIECE TRENCH SPECIFICATIONS

1. GENERAL

- 1.1 The trench system will consist of precast concrete U-shaped bases and removable covers equivalent to Trenwa's One Piece trench system to be installed in earth trenches with covers extending above the surrounding crushed rock surface.
- 1.2 The trench system will be designed to support at least 200 pounds per square foot live load for pedestrian traffic or 9,000# G.V.W. for pickup trucks and light duty utility vehicles.
- 1.3 The trench shall have an interior clear cross sectional area of (10")(20")(24")(30")(40")(48") wide x (12") (15") (24") deep. The trench will be approximately (16")(26")(30")(36")(46")(54") wide x (19-1/4")(28 1/4") deep overall including cover
- 1.4 The precast U-shaped bases for the trench will be furnished in standard 10 foot lengths, except that special lengths will be furnished where required by the layout on the drawings. The U-shaped bases will (have openings in the bottom) (be solid bottom). The trench shall not require cross braces to support the walls during backfilling.
- 1.5 The precast trench covers will be furnished in lightweight sections, sized to permit removal by a single person. The covers will have slots for lifting tools and will be made of (fiber and steel reinforced concrete) (polymer concrete)(galvanize checker plate).
- 1.6 The precast trench system shall be designed and constructed so that neither the covers, nor temporary side-to-sides braces need to be installed to facilitate installation or subsequent machine backfilling and tamping.

ROAD CROSSING TRENCH SPECIFICATIONS

1. GENERAL

- 1.1 All sections of trench designated for road crossing use will be designed to carry HS20, 32,000 pound axle loading and will be furnished in standard 10 foot lengths, except that special lengths will be furnished where required by the layout on the drawings.
- 1.2 The lids for the road crossing trench will be made of (steel reinforced concrete) (hot-dipped galvanized steel) designed to carry HS20, 32,000 pound axle loading.
- 1.3 The interior clear cross sectional area for the road crossing bases will be at least (10")(20")(24")(30")(36")(40") (48")(60")(72")(84")(96") wide x (12")(16")(24")(36")(48") deep.

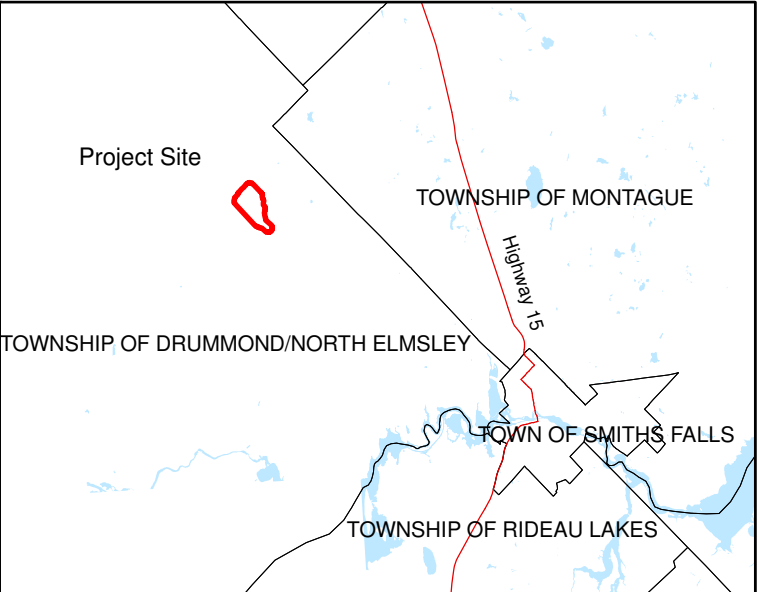
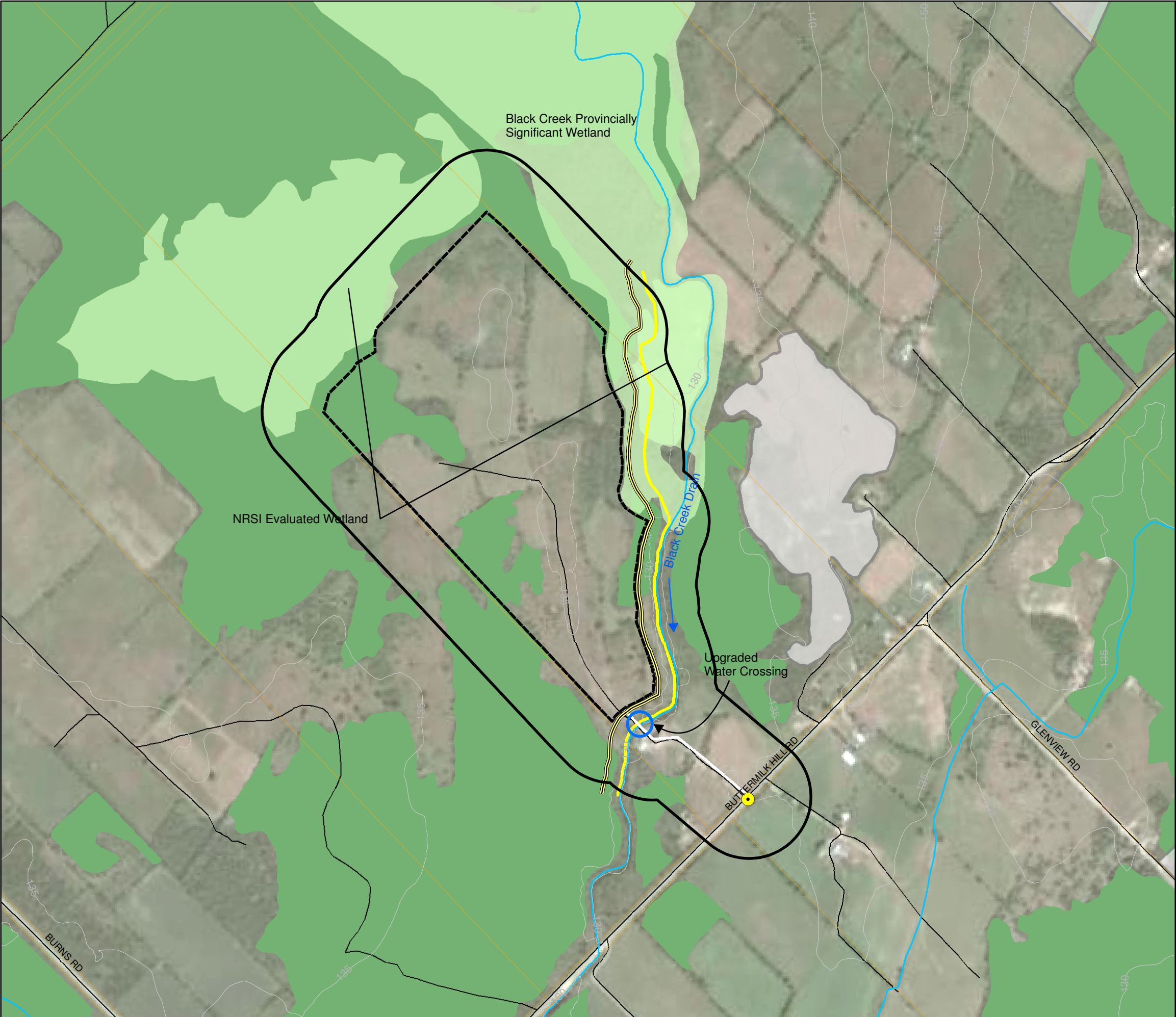
COMPONENT SPECIFICATIONS

1. GENERAL

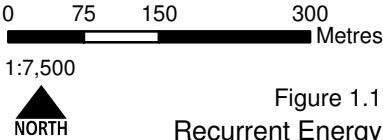
- 1.1 The trench system shall consist of precast concrete support brackets, sidewalls and removable covers assembled to form a completely enclosed trench, except with open earth bottom having a 4" bedding of sand.
- 1.2 The trench system will be designed to support at least 200 pounds per square foot live load for pedestrian traffic.
- 1.3 The trench shall have an interior clear cross sectional area of (20")(30")(40") wide by (16")(24") deep. The outside dimensions shall be approximately (32")(42")(52") wide x (20")(28") deep overall (including cover).
- 1.4 The precast sides of the trench system shall be furnished in standard 5 foot lengths, except that special lengths shall be furnished where required by the layout on the drawings. The trench design is such that the sidewalls are held in place by the pressure of the external earth backfill.
Provide U shaped support brackets at a maximum spacing of 5 feet center to center with rectangular sidewall panels spanning the brackets .
- 1.5 The precast trench covers will be furnished in lightweight sections, sized to permit removal by a single person. The covers will have slots for lifting tools and will be made of (fiber and steel reinforced concrete)(polymer concrete).

APPENDIX B

NOISE RECEPTORS, CULTURAL AND NATURAL FEATURES MAPS



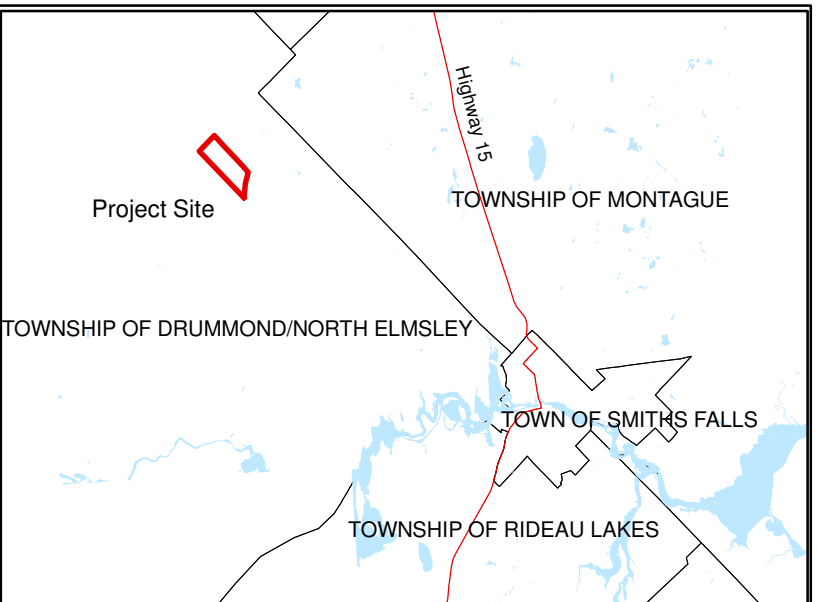
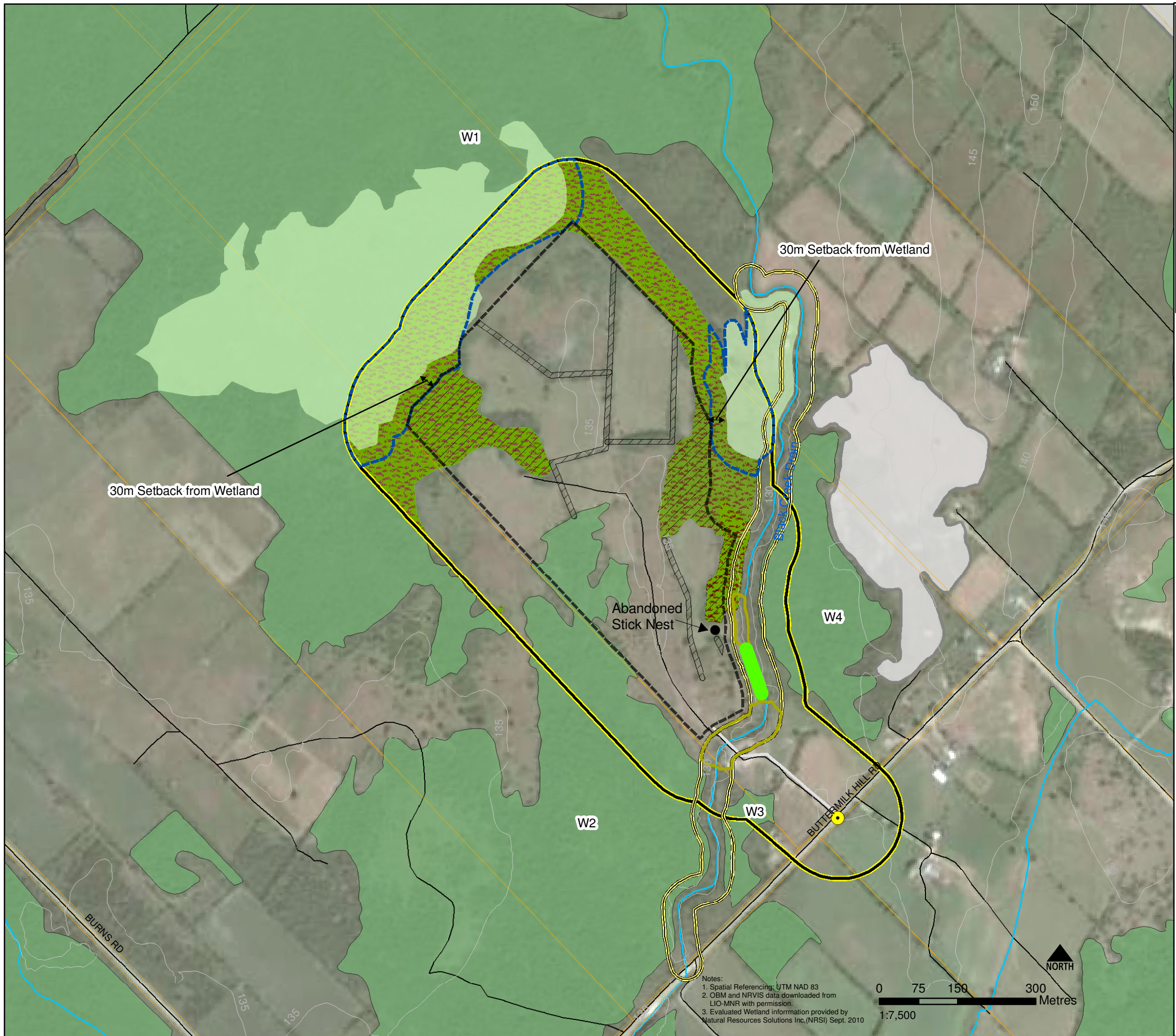
- Legend**
- Roads
 - Topographic Contour (5m Interval)
 - Watercourse
 - Average Annual High Water Mark
 - 30 m Setback from High Water Mark
 - 120 m from Project Location
 - Parcels
 - Pit/Quarry
 - Wetland
 - Evaluated Wetland
- Project Components**
- Connection Point With Existing Distribution Line
 - New Distribution Line From Project
 - Project Location



Notes:
1. Spatial Referencing: UTM NAD 83
2. OBM and NRVIS data downloaded from LIO-MNR with permission.
3. RVCA data provided by NVCA, March 2010

Figure 1.1
Recurrent Energy
RE Smiths Falls 2
Water Body and
Project Boundaries





Legend

- Roads
- +— Railway
- Topographic Contour (5m Interval)
- Watercourse
- ▭ Parcels
- ▭ Pit/Quarry
- Candidate Significant Natural Heritage Features**
 - ▭ Wetland
 - ▭ Woodland - Animal Movement Corridor (Terrestrial)
- Wildlife Habitat**
 - ▭ Woodlands Supporting Amphibian Breeding Ponds
 - ▭ Forest Providing a High Density of Habitats
 - ▭ Milksnake Habitat
 - ▭ Reptile Hibernacula
 - ▭ 30m Setback from Watercourse - Eastern Ribbonsnake Habitat/Animal Movement Corridor (Semi-aquatic)
- Project Components**
 - Connection Point with Distribution Line
 - Distribution Line
 - ▭ Project Location
 - ▭ 120m from Project Location
 - ▨ Tree/Hedgerow Removal (construction)
 - ▭ Annual Vegetation Management Zone (Operations)

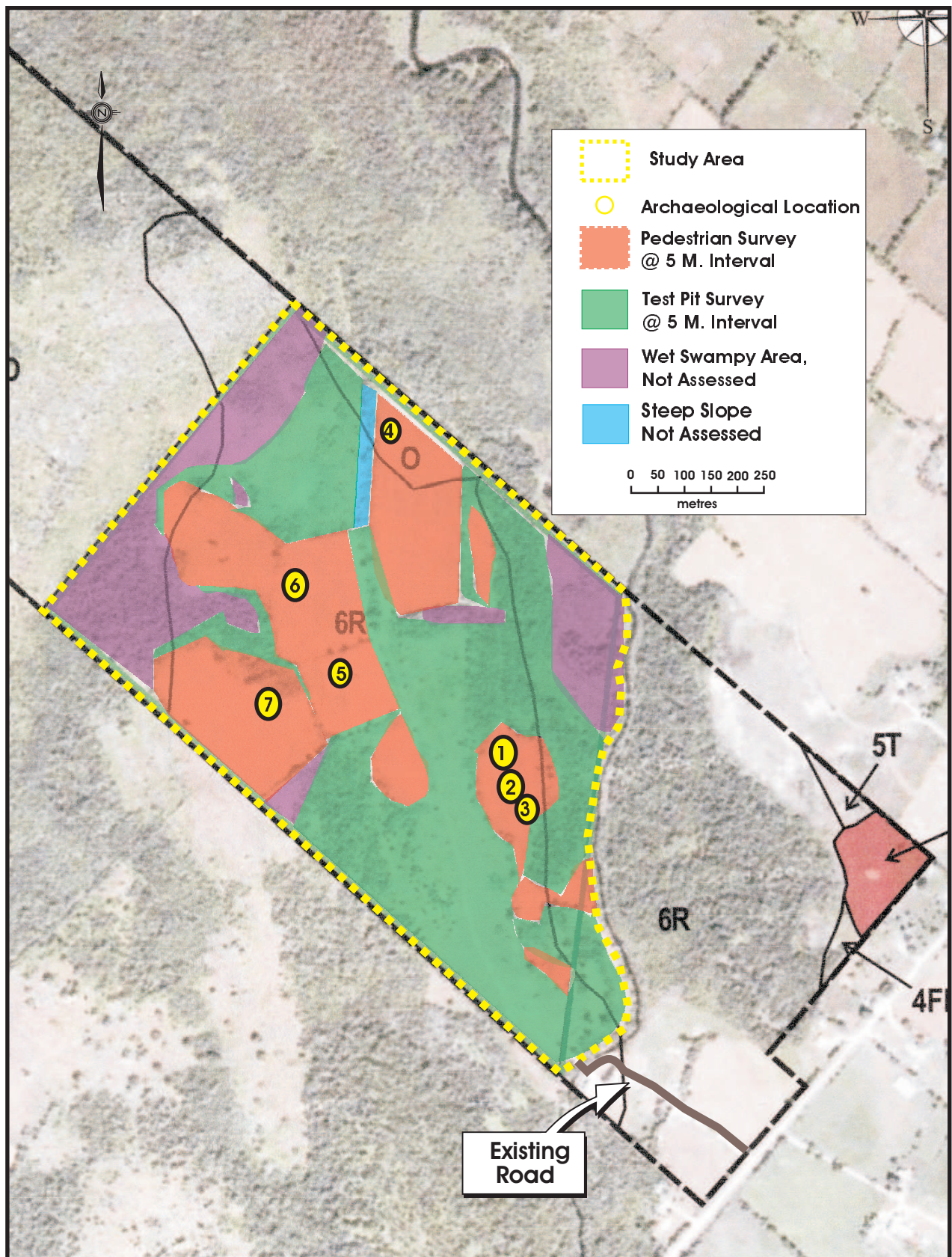
Notes:
1. Spatial Referencing: UTM NAD 83
2. OBM and NRVIS data downloaded from LIO-MNR with permission.
3. Evaluated Wetland information provided by Natural Resources Solutions Inc.(NRSI) Sept. 2010

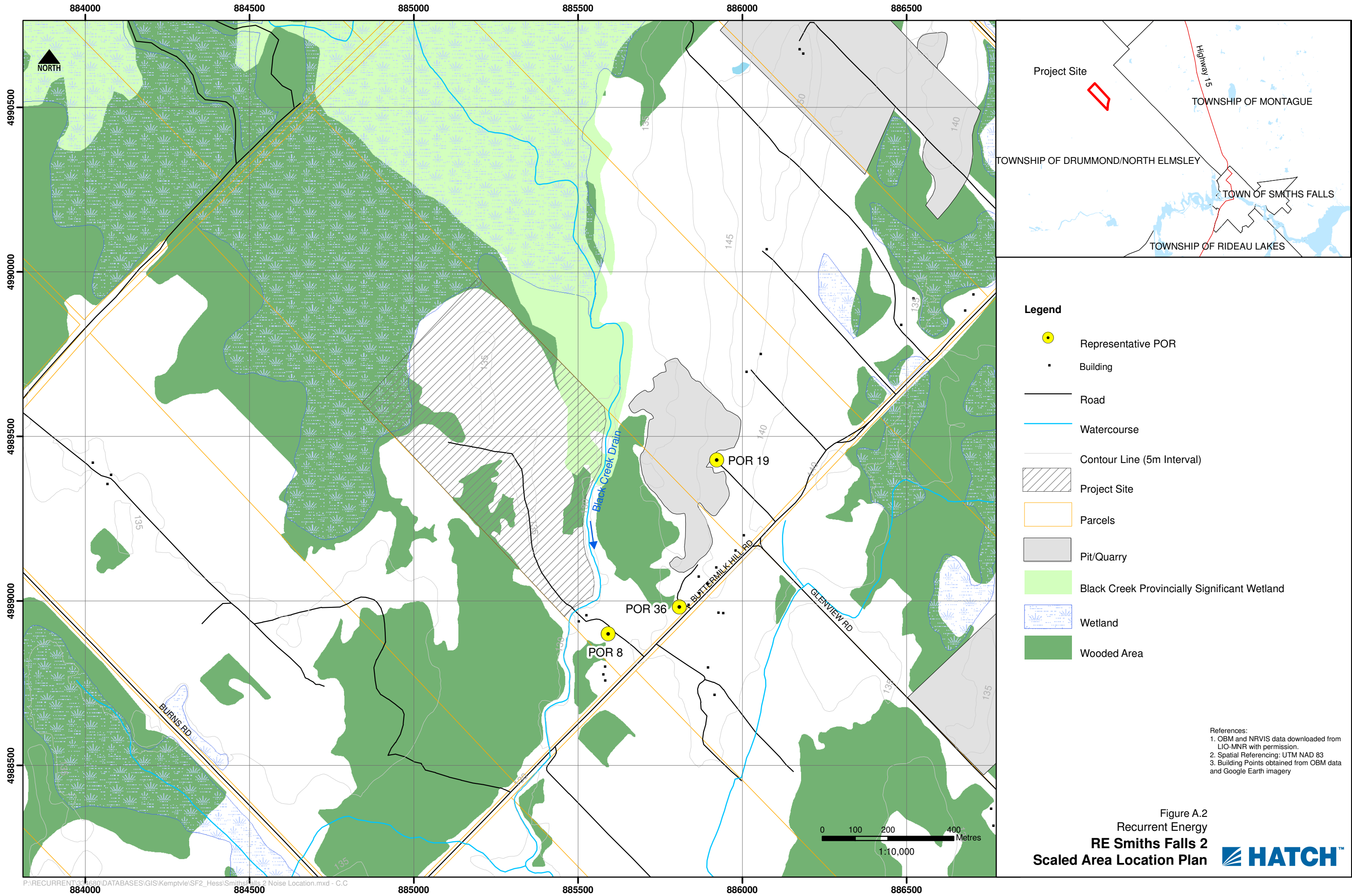


Figure 1.1
Recurrent Energy
RE Smiths Falls 2
Project Components and
Significant Natural
Heritage Features



Figure 5: Site Map Showing Stage 2 Results





APPENDIX C

ENVIRONMENTAL EFFECTS

MONITORING PLAN

RE SMITHS FALLS 2 SOLAR PROJECT

Design and Operations Report -
Environmental Effects Monitoring Plan

April 15, 2011

RECURRENT
ENERGY





RE Smiths Falls 2 ULC

Design and Operations Report -
Environmental Effects Monitoring Plan

RE Smith Falls 2 Solar Project

H334680-0000-07-124-0156

Rev. 1

April 15, 2011

Disclaimer

This report has been prepared by or on behalf of RE Smiths Falls 2 ULC for submission to the Ontario Ministry of the Environment as part of the Renewable Energy Approval process. The content of this report is not intended for the use of, nor is it intended to be relied upon by, any other person. Neither RE Smiths Falls 2 ULC nor any of its directors, officers, employees, agents or consultants has any liability whatsoever for any loss, damage or injury suffered by any third party arising out of, or in connection with, their use of this report.

Project Report

April 15, 2011

RE Smiths Falls 2 ULC

RE Smiths Falls 2 Solar Project

Design and Operations Report - Environmental Effects Monitoring Plan

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1. Introduction

RE Smiths Falls 2 ULC is proposing to develop and operate a 10-megawatt (MW) solar photovoltaic (Solar PV) facility, on an approximately 35-hectare (ha) parcel of land located approximately 8 km northwest of Smiths Falls in the Township of Drummond/North Elmsley in the County of Lanark; herein referred to as “RE Smiths Falls 2” or the “Project”.

Ontario Regulation (O. Reg.) 359/09 – *Renewable Energy Approvals Under Part V.0.1 of the Act*, (herein referred to as the REA Regulation) made under the *Environmental Protection Act* identifies the Renewable Energy Approval (REA) requirements for renewable energy projects in Ontario. As per Section 13 of the REA Regulation, several reports, including a Design and Operations Report, are required. Table 1 of the REA outlines the requirements for the Design and Operations Report. In addition, MOE has released a draft Technical Bulletin for Preparing the Design and Operations Report. The Technical Bulletin requires that the environmental effects monitoring plan be prepared to show how the negative environmental effects will be mitigated and monitored to comply with O. Reg. 359/09. The following is the environmental effects monitoring plan for the Project.

2. Environmental Effects Monitoring Plan

As per the Technical Bulletin, the environmental effects monitoring plan for the design and operations phase of the Project is required in which summary tables, text descriptions and references to other reports can be used. More specifically, the following are required:

1. A summary of all potential negative environmental effects caused by the project as given in the description of negative environmental effects in the Project Description Report.
2. Performance objectives in respect of each potential negative effect in which each performance objective should be defined such that in achieving the objective the negative effect will be mitigated.
3. A description of all mitigation strategies planned to achieve performance objectives.
4. If there is an ongoing risk of potential negative environmental effects, a description of how the project will be monitored to ensure that mitigation strategies are meeting performance objectives.
5. Contingency measures will be provided should monitoring reveal that negative effects are continuing to occur.

With respect to requirement 1 above, several Project reports have determined and documented the potential negative environmental effects. These reports and the context of the potential negative environmental effects are as follows:

- Project Description Report – preliminary potential negative environmental effects for features within 300 m of the Project.

- Construction Plan Report – potential negative environmental effects caused by construction activities for features within 300 m of the Project.
- Noise Report – potential negative environmental effects caused by operational noise emissions from the transformer and inverters.
- Stage 1 and 2 Archaeological Assessment – potential negative effects to archaeological resources from construction activities.
- Natural Heritage Environmental Impact Study – potential negative effects to natural heritage features within 120 m of the Project for construction, operation and decommissioning phases.
- Waterbodies Environmental Impact Study – potential negative effects to waterbodies within 120 m of the Project for construction, operation and decommissioning phases.

Table 2.1 summarizes the potential negative environmental effects due to operational activities, the mitigation measures to address those effects and the resulting residual negative effects.

With respect to requirements 2 to 5 above, several Project reports have specified environmental effects monitoring plans related to the operations phase of the Project. These reports and the context of the monitoring plans are as follows:

- Natural Heritage Environmental Impact Study – monitoring requirements for natural features within 120 m of the Project for construction, operation and decommissioning phases.
- Waterbodies Environmental Impact Study – monitoring requirements for waterbodies within 120 m of the Project for construction, operation and decommissioning phases.

Table 2.2 identifies i) the potential negative effects that have an ongoing risk of occurrence throughout the operational period, ii) the performance objectives and mitigation strategies to address those effects, iii) monitoring protocols to confirm that performance objectives are being met and iv) contingency measures in the event that objectives are not being met, as identified in the reports listed above. Table 2.2 also provides the monitoring plan for those environmental effects that were not included in the reports above, as per the definition of “environmental effects”. These include potential effects to the social and economic environments.

Table 2.1 Summary of Potential Negative Environmental Effects and Proposed Mitigation Occurring During Operations Phase

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
Vegetation Communities/Wildlife Habitat	Changes in site topography, placement of Project components, access roads, ditches and other less pervious areas.	Increase in surface water runoff.	Ground cover planted around Project components to maintain the stormwater management function of the existing pasture fields. Ditches and drainage conveyance features installed during construction activities will remain in place.	Mitigation will minimize changes to stormwater runoff from the Project site.
	Accidental spills from transformer.	Adverse effects on vegetation and soil due to contamination.	Oil-water separator at main transformer pad. Spill control kits on site. Spill response procedure implemented in the event of an accident.	None – oil water separator at main transformer will prevent releases to the environment in the event of a spill. No adverse effect anticipated.
Wildlife Communities	Maintenance activities.	Disturbance of wildlife due to noise and human presence resulting in wildlife avoidance of Project location.	Ground cover will be selected to be suitable for use by wildlife. Mowing will not be conducted during the breeding bird season.	None – Disturbance to wildlife due to maintenance activities less than existing disturbance due to agricultural activities.
Groundwater	Potential use of groundwater for periodic, relatively low frequency maintenance purposes (e.g., panel washing, dust control) activities.	Minor local decrease in groundwater table during periods when groundwater is being withdrawn for maintenance purposes.	Amount of water used for all maintenance purposes combines (e.g. panel washing, dust control) limited to 45,000 L/d to minimize changes in groundwater table. Expected groundwater usage anticipated to be considerably less (see expected panel washing usage below).	Negligible – Low volumes and frequency groundwater withdrawals will have minimal short-term effects on local groundwater table.
	Accidental spills from transformer.	Adverse effects on groundwater quality due to contamination.	Oil-water separator at main transformer pad. Spill control kits on site. Spill response procedure implemented in the event of an accident.	None – oil water separator at main transformer will prevent releases to the environment in the event of a spill. No adverse effect anticipated.
Surface Water, Aquatic Habitat and Biota	Accidental spills from transformer.	Adverse effects on surface water quality due to contamination.	Oil-water separator at main transformer pad. Spill control kits on site. Spill response procedure implemented in the event of an accident.	None – oil water separator at main transformer will prevent releases to the environment in the event of a spill. No adverse effect anticipated.
	Erosion due to surface water runoff from the Project area.	Adverse effects on water quality and aquatic habitat in receiving water body.	Dense vegetation cover beneath solar panels and in ditches on the Project site.	None – provided mitigation is effective in preventing erosion and sedimentation.
	Washing of solar panels during maintenance activities.	Increase in surface water runoff and impact to surface water quality.	Amount of water used for cleaning will be approximately 25,700 L over a period of 4 to 5 days per maintenance cycle (approximately 3 times per year). No cleaning solutions will be used.	None – mitigation anticipated to be effective in preventing residual negative effects.
	Changes to surface water quality and surface water runoff rate as a result of the Project.	Indirect effect to the aquatic biota and habitat in receiving water body.	Proposed mitigation for surface water quality and surface water runoff is anticipated to be sufficient to prevent adverse effects on aquatic biota and habitat.	None – mitigation anticipated to be effective in preventing residual negative effects.
Sound Levels	Noise emissions from transformer and Inverters.	Disturbances to nearby receptors due to noise emissions.	Installation of noise barrier around transformer if required to meet performance objectives.	Noise emissions will meet provincial requirements at nearest sensitive receptors.
Public and Facility Safety	Installation of the facility.	Installation of the facility will result in a potential risk to the public and facility, should trespassing on site occur.	Public access to the facility will be prevented through the use of fences, gates, and any other necessary security procedures.	Elimination or reduction in risk to public and facility safety.
Change in Visual Landscape	Installation of the facility.	Installation of the facility will result in a change to the local landscape. This may be perceived as a negative environmental effect.	Visual barriers will be considered, if necessary, and will be reviewed based on viability and effectiveness.	Elimination or reduction in visual disturbance of the facility if visual barriers implemented.
Property Values	Installation of the facility.	Installation of the facility has the potential, though unproven, to result in a change in the value of nearby properties based on aesthetic preference of potential landowners. Though subjective, the potential reduction in property values for the purpose of this assessment is considered a potential negative effect.	No mitigation measures are proposed.	Potential reduction in property value.

Table 2.2 Environmental Effects Monitoring Plan – Design and Operations

Negative Effect	Mitigation Strategy	Performance Objective	Monitoring Plan					Contingency Measures
			Methodology	Monitoring Locations	Frequency	Rationale	Reporting Requirements	
Increases in surface water runoff from Project site	Stormwater management measures including enhanced vegetated swales, ditch flow controls and filter strips.	Minimize changes to surface water runoff conditions to receiving water body.	Visual assessment of structural stability of mitigation measures and identification of unintended impacts.	Throughout Project site.	Twice per year during site inspections.	Visual monitoring will confirm that stormwater management measures remain as designed and allow identification of deficiencies.	Reported in annual operational environmental monitoring report.	Stormwater management measures will be remediated as necessary to ensure that they are functioning as designed.
Erosion and sedimentation resulting in increased turbidity in site runoff	Vegetation to prevent erosion due to stormwater runoff.	No long-term erosion from site over and above existing conditions.	Visual monitoring of Project area to identify areas of erosion (e.g., rills, gullies).	Throughout Project site.	Twice per year during site inspections.	Visual monitoring of erosion would identify potential areas of concern.	Reported in annual operational environmental monitoring report.	Erosion remediated as necessary to ensure no long-term erosion issues.
Decrease in groundwater table should groundwater be used for maintenance purpose.	Limit the daily use of groundwater for maintenance purposes to 45,000 L or less.	Less than 45,000 L/d groundwater used for maintenance purposes.	A flow meter will be installed on the pump to monitor the amount of groundwater withdrawn during pumping activities.	At the groundwater well.	During periods when groundwater is withdrawn for maintenance purposes.	Monitoring of amount of groundwater taken will ensure that performance objective is met.	Reported in annual operational environmental monitoring report.	If maintenance cannot be achieved with the amount of water specified in the performance objective, RE Smiths Falls 2 ULC will consider bringing in water from an off-site source, or applying for an amendment to the REA to allow more water to be withdrawn from the well. This latter option may require additional study on local groundwater resources and identification of additional mitigation and monitoring measures.
Potential for adverse surface water, groundwater and soil quality due to accidental spills	Standard mitigation to prevent spills and minimize magnitude of spills that do occur. Installation of secondary containment around transformer.	No long-term environmental effects due to spills.	Visual monitoring of spill prevention/mitigation measures during maintenance activities.	Throughout Project site where maintenance occurs and at transformer location.	Twice per year during site inspections.	Spill prevent and control measures to be monitored to ensure they are functioning as designed and protocols are being implemented as specified in plans to meet performance objectives.	Reported in annual operational environmental monitoring report.	Spill contingency measures implemented as necessary in the event of a spill. Following spill event, response will be reviewed to determine if additional or altered response protocols are necessary to meet performance objectives.
Noise levels disturbing nearby noise receptors	Noise mitigation strategies including installation of a noise barrier around transformer and separate inverter and transformer locations to minimize cumulative noise emissions.	To minimize noise emissions at nearby noise receptors to the provincial guideline values.	Sound level monitoring as per any requirement documented in the REA issued for the Project.	At the closest sensitive receptors.	As per the frequency documented in the REA issued for the Project.	Auditory monitoring will confirm that noise emissions from the Project meet performance objectives.	Reported in annual operational environmental monitoring report.	If Project components are not meeting performance objectives with respect to noise emissions, noise barriers will be installed as necessary.

Negative Effect	Mitigation Strategy	Performance Objective	Monitoring Plan					Contingency Measures
			Methodology	Monitoring Locations	Frequency	Rationale	Reporting Requirements	
Installation of the facility will result in a potential risk to the public and facility, should trespassing on site occur	Public access to the facility will be prevented through the use of fences, gates, and any other necessary security procedures.	Elimination of risk to public safety.	Site security monitoring will be ongoing to confirm adequacy of security measures.	Throughout the Project location and facility perimeter.	Ongoing.	Site security monitoring will identify any breach in facility security.	Incidents of trespassing or vandalism will be reported to local authorities. Internal reporting to be determined by RE Smiths Falls 2 ULC.	Additional security measures will be implemented as required.
Installation of the Project will result in a change to the local landscape. This may be perceived as a negative environmental effect	Visual barriers will be considered, if necessary, and will be reviewed based on viability and effectiveness.	Elimination/reduction in visual disturbance.	Concerns and complaints regarding visual disturbance and adequacy of visual barriers will be documented by the proponent.	To be determined.	As required.	Documentation of visual disturbance and adequacy of visual barriers by local residents will result in evaluation of visual barrier necessity or effectiveness.	Internal reporting to be determined by RE Smiths Falls 2 ULC.	Visual barriers will be considered, if necessary, and will be reviewed based on viability and effectiveness.

