Loveland Water and Power

Requirements for Electric Service

Effective date: February 6, 2024

City of Loveland
Water and Power
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Electronic version of RFES: www.lovgov.org/res

Rates, Charges & Fees: www.lovewp.org/rates

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Requirements for Electric Service

Foreword:

Loveland Water and Power's vision is to provide best-in-class utility services for our community. To meet this vision, certain rules and regulations are needed to govern the customers' wiring and installations that are connected to the City of Loveland's (City) electric distribution system. **These Requirements for Electric Service (Requirements) will serve to expedite service connections by establishing uniform standards for electric service, and ensure the protection of public health, safety, and welfare.**

Therefore, customers' electrical wiring and installations intended for connection to the City's electric distribution system must comply with all relevant provisions of these Requirements, the Loveland Municipal Code, the National Electrical Code, National Electrical Safety Code, and any other codes or regulations in effect in the area served. **While these requirements are not intended to conflict with other codes or regulations, where there is a conflict between other authorities and this document, these requirements shall govern.** Any perceived conflicts should be resolved with the City before construction begins.

This document has been prepared to assist customers, architects, engineers, contractors, electricians, and inspectors in planning, constructing, operating, and maintaining electrical installations. It is not intended to ensure the adequacy or safety of the customers' wiring or equipment. Such responsibility remains with the customer.

Distribution Design (970-962-3535) and Electric Metering (970-962-3582) should be contacted in advance of construction or the purchase of equipment to resolve possible issues while the project is still in the planning stage. The specification sheets for all equipment should be sent to the Electric Metering Supervisor and approved prior to purchase to ensure that costly changes will not need to be made in order to comply with the City's specifications. This will resolve issues and minimize the necessity for expensive changes required during the construction stage of the project.

Intent:

This document provides information to Loveland Power customers concerning conditions for service and regulations governing the construction, connection, and electrification of electric service for every customer served by the City. These regulations are approved by a public process and are consistent with the NESC, NEC, and applicable provisions of the Loveland Municipal Code and must be strictly followed.

Customers must demonstrate compliance with all applicable provisions within these Requirements for Electric Services before receiving electrical service from the City, unless exempted in writing by the Director of Water and Power or their designee under the process described in these Requirements. Existing installations which fail to meet requirements for clearance and/or access to City equipment may be subject to additional fees and/or disconnection of electric service. Requirements contained herein are for reference and guideline purposes and are not intended to cover all installation practices. Please contact the appropriate City representative for any questions regarding installations or modifications.

Exemptions:

No set of rules or instructions will cover all conditions. The Director of Water and Power, or their designee, will consider requests for variances from these requirements and may grant such exemption requests on a case-by-case basis in a timely manner. An **Exemption/Revision Form** must be completely filled out, signed and submitted via email to PowerDevelopment@cityofloveland.org and must be approved by staff as a condition of service. If the request is approved, it is a one-time only exemption for the specific project and any future exemption requests will require submittal of another form.

Revisions and Updated Requirements:

Revisions to these Requirements shall be made in accordance with LCUASS 1.6.2.

Requesting Revisions: Members of the public may submit proposed revisions to these requirements by completing an **Exemption/Revision Form** and submitting via email to PowerDevelopment@cityofloveland.org along with documented evidence of the benefits of the proposed revision. Staff will review all proposals to assess the potential impacts to the City's electric distribution system; revisions will be considered for inclusion in the following update period if the assessment of the proposal results in a benefit to both the electric distribution system and the customers requesting service. Revisions are required for continued application of a work practice, as opposed to an exemption which is reviewed on a case-by-case basis.

The City will maintain the current version of the Requirements on the City's Internet site. It shall be the responsibility of each customer or contractor to verify their installation is consistent with the Requirements in effect at the time of such installation.

Areas highlighted in grey indicate a change or addition of information in this version. Changes to this version of the *Requirements for Electric Service* are detailed in the *Current Version Revision Log* at the end of this document.

This edition of *Requirements for Electric Service* is effective February 6, 2024 and replaces all previous editions of the *Requirements for Electric Service* or *Contractor Construction Standards*. All previous editions should be destroyed.

The *Requirements for Electric Service* document applies to all new installations and additions to, or modifications of, existing installations. Visit http://www.lovgov.org/RES to access this document electronically.

Important Documents

The documents below are separate from the Requirements for Electric Service document; however, there are references made to these throughout this document.

City of Loveland Documents

- Contractor License Application
- Electric Service Worksheet (Commercial)
- Electric Service Worksheet (Residential)
- Exemption/Revision Form
- Grant of Easement Form
- Grant of Easement Instructions
- Interconnection Agreement
- Municipal Code Title 13 Utilities Chapter 13.12 Electricity
- KYZ Metering Request Form
- Schedule of Rates, Charges, and Fees
- DER Interconnection Checklist

DEFINITIONS & ACRONYMS

Accessory Dwelling Unit (ADU) – An accessory dwelling unit, usually just called an ADU, is a secondary housing unit on a single-family residential lot.

Advanced Inverter – A Generating Facility's Inverter that performs functions that when activated, can autonomously contribute to grid support by providing: dynamic reactive/real power support, voltage and frequency Ride-Through, ramp rate controls, communication systems with ability to accept external commands, and other functions.

ANSI – **American National Standards Institute**

Anti-Islanding – A control scheme installed as part of the Generating or Interconnection Facility that senses and prevents the formation of an Unintended Island.

Applicant – A person or entity that has filed an application to interconnect a Generating Facility to an Electric Delivery System. For a Generating Facility that will offset part or all of the load of a City customer, the applicant is that customer, regardless of whether the customer owns the Generating Facility or a third party owns the Generating Facility.

ASTM – **American Society for Testing and Materials** is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

Automatic Sectionalizing Device – Any autonomous circuit-opening device, which can detect fault current and remove the faulted section of the circuit from the upstream circuit and allow restoration of service to the upstream sections of the circuit.

Available Capacity – The Total Capacity less the sum of Installed Capacity and Queued Capacity.

Bi-directional Meter – A meter having two separate metering registers, one to record electricity delivered to the customer and the other to record electricity received from the customer.

Business Day – Monday through Friday, excluding Federal and State Holidays.

Certified – Proof of certification from IEEE or UL regarding standards applicable to Generating Facility components.

Certified Equipment – Equipment which has been submitted by a manufacturer to an OSHA-approved nationally recognized testing laboratory and has been tested and listed by the laboratory for continuous interactive operation with an electric distribution system in compliance with the applicable codes and standards listed in the IEEE 1547 and UL 1741 Standards.

Cable in Conduit (CIC) – Cable and conduit assembly manufactured by loosely extruding High Density Polyethylene conduit around cable assembly.

City – Unless otherwise specified, means the City of Loveland Water and Power.

Current Transformer (CT) – A device which transforms the primary load current to a secondary current level which is a precise ratio of the primary load current. These are used for transformer rated services. (This does not include primary metered services 600 volt and above.)

Customer – The party making application for service, or any contractor, electrician, or any other authorized agent representing the party. Contractors employed by the City are required to meet these Requirements.

Customer Space – A single customer address/location or contiguous addresses/locations not separated by a permanent demising wall.

Dedicated Feeder – An Electric Distribution System feeder placed into service with the sole purpose of serving a single customer. Note that a non-Dedicated Feeder (sometimes referred to as a "Shared Feeder") serves multiple customers.

Demarcation Point – The dividing point on the service which marks who is responsible for maintenance and repairs.

Demising – Boundary that separates one tenant's space from that of the other and from the common corridor. Also called demising partition or party wall.

Distributed Energy Resource (DER) – Any non-utility owned generation resource that is capable of exporting active power to the City's Electric Distribution System through generation or energy storage technology and is not otherwise included in the formal NERC definition of the Bulk Electric System.

Disconnect Switch – A visible open disconnect device that the customer is required to install and maintain in accordance with the requirements set forth in this book. The Disconnect Switch will completely isolate the customer's facility from the City's electric power system, including the Utility metering equipment located at the service entrance.

Distribution Service – The service of delivering energy over the Electric Delivery System pursuant to the approved tariffs of the City other than services directly related to the interconnection of a Generating Facility under these Interconnection Procedures.

Direct Transfer Trip (DTT) – The immediate separation of all sources of generation at a DG customer's location initiated upon the operation of an automatic upstream protection device (substation breaker or line recloser) by means of a dedicated communication channel between the upstream device and the DG location.

Dry Utilities – Includes the installation of the following utilities: electricity, natural gas, telecommunication, and fiber optic.

Electric Delivery System – The equipment operated and maintained by the City to deliver electric service to end-users, including without limitation transmission and distribution lines, substations, and transformers.

Electric Distribution System (EDS) – A network of power cables, poles, transformers, underground vaults, switches, and substations that allow power to be transmitted from a source to a destination. This system also steps the voltage down from transmission levels to customer use levels.

Emergency – An event that is threatening life or property or otherwise determined by the Director of Water and Power or their designee.

Emergency (Backup) Generator – An independent power generation source or sources located at a customer's facility installed for the sole purpose of supplying on site generated power to selected loads upon failure or outage of the normal Utility source. An Emergency (Backup) Generator shall be understood to include a Standby Power System and an Emergency Power System as defined in IEEE STD 446.

ESW – **Electrical Service Worksheet**

Fault Current – The level of current that can flow if a short-circuit is applied to a voltage source.

FERC – Federal Energy Regulatory Commission.

Flicker – A variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity.

Generating Capacity – The rated capacity of a Generating Facility in alternating current (AC). For an inverter-based Generating Facility, the Generating Capacity is the rated capacity of the inverter.

Generating Facility – All or part of the electrical generator(s) or inverter(s) together with all protective, safety, and associated equipment and improvements associated with the interconnection to the City's electric power system.

Generator – A Rotating Machine or Static Inverter used to produce electrical power.

Harmonic Distortion – Continuous distortion of the normal sine wave; typically caused by nonlinear loads or by inverters.

House Meter – Meters for multiple tenant buildings that measure electrical usage in common areas.

IEEE – **The Institute of Electrical and Electronic Engineers**

Installed Capacity – Existing aggregate Generating Capacity in megawatts (MW) interconnected to a substation/area bus, bank, or circuit (i.e., amount of generation online).

Interconnection – A point of connection between a customer, power provider, and other utility with Water and Power. Usually accompanied by a meter panel.

Interconnection Agreement – A standard form agreement between an Interconnection Customer and a City governing the interconnection of a Generating Facility to a City's Electric Delivery System, as well as the ongoing operation of the Generating Facility after it is interconnected.

Interconnection Customer – An Applicant that has entered into an Interconnection Agreement with a City to interconnect a Generating Facility and has interconnected that Generating Facility.

Interconnection Equipment Package – A group of components connecting an electric generator with an Electric Delivery System, and includes all interface equipment including switchgear, inverters, or other interface devices. An Interconnection Equipment Package may include an integrated generator or electric source.

Interconnection Facilities – The electrical wires, switches, and related equipment that are required in addition to the facilities required to provide electric Distribution Service to a customer to allow Interconnection. Interconnection Facilities may be located on either side of the Point of Common Coupling as appropriate to their purpose and design. Interconnection Facilities may be integral to a Generating Facility or provided separately. Interconnection Facilities may be owned by either the Interconnection Customer or the City.

Inverter – A device or system that changes direct current power to alternating current power. Inverters that are self-commutating can be configured for stand-alone service. Inverters that are line-commutated cannot be configured for stand-alone service.

Island or Islanding – A condition on the City's Electric Delivery System in which one or more Generating Facilities deliver power to customers using a portion of the City's Electric Delivery System that is electrically isolated from the remainder of the City's Electric Delivery System.

Kilovolt Amperes (kVA) – A measure of energy which is a unit of apparent power in an electric circuit equal to 1000 volt-amperes.

KYZ Metering – KYZ metering is the act of measuring energy usage with a watt-hour meter, then converting the measured quantity into electronic increments of a constant known value, known as "pulses".

Line Section – That portion of the City's Electric Delivery System connected to a customer bounded by automatic sectionalizing devices or the end of the distribution line.

Material Modification – A modification that has a material impact on the cost or timing of processing the Application or an Interconnection Request with a later queue priority date.

Metering – The function related to measuring the transfer of electric power and energy.

Minor System Modifications – Modifications to the City's Electric Delivery System, including activities such as changing the fuse in a fuse holder cut-out, changing the settings on a circuit recloser, and other activities that usually entail less than four (4) hours of work and less than $1000 in materials.

Nationally Recognized Testing Laboratory (NRTL) – Shall mean a qualified private organization that meets the requirements of OSHA regulations. NRTLs perform independent safety testing and product certification. Each NRTL must meet the requirements as set forth by OSHA in the NRTL program.

NEC – **National Electrical Code**

NESC – **National Electrical Safety Code**

NEMA – **National Electrical Manufacturers Association**

NFPA – **National Fire Protection Association**

Non-Parallel Connection Agreement – An agreement, together with appendices, signed between the City of Loveland and the customer, covering the terms and conditions governing the non-parallel connection and operation of the Generating Facility with the City of Loveland.

OSHA – **Occupational Safety and Health Administration**

Parallel – A Generating Facility that electrically parallels with the City's Electric Power System for more than 15 seconds.

Permanent Structure – Anything built or constructed that is fixed to the ground by any method allowed by building code including but not limited to foundations, piers, slabs, posts, or poles.

Permission to Operate (PTO) – Permission to Operate or "PTO" means the letter executed by the Utility evidencing that the DER System, under the terms of the Interconnection Agreement, is permitted to operate in parallel with the EDS.

Point of Common Coupling (PCC) – The point at which the generator facility is connected to the shared portion, or potentially shared portion of the City's electrical power system. The IEEE STD 1547 Standard establishes this point as the location where voltage and harmonic limits are measured and applied.

Potential Transformer (PT) – A device that transforms the primary load voltage to a secondary voltage, which is a precise ratio of the primary load voltage. These are used for transformer rated meters where service voltages are above 240 volts. Also referred to as a voltage transformer (VT).

Photovoltaic (PV) – Devices that absorb energy from sunlight and convert it into electrical energy through semiconducting materials.

Queued Capacity – The aggregate generation capacity in MW of the Applicant's Generating Facilities intending to interconnect to a substation/area bus, bank, or circuit but not yet functional.

Reclosing – The act of automatically re-energizing a utility line in an attempt to restore power.

Relay – An electric device that is designed to interpret input conditions in a prescribed manner and after specified conditions are met to respond to cause contact operation or similar abrupt change in associated electric control circuits.

Resale – Charging more for electric service than the amount billed by the utility or including unauthorized charges in the amount passed on to end-users.

Ride-Through – Ability to withstand voltage or frequency disturbances inside defined limits and continue operating as specified.

Self-Contained Metering – An installation where the service voltage and/or current flows directly through the meter. These installations are used on services with a 320 amp continuous load rating or less for single-phase 120/240 volt three-wire, three-phase 120/208 volt four-wire services, and 277/480 volt four-wire services.

Single Phasing Condition – Occurs when one or two phases of the three-phase supply line are disconnected.

System Impact Study (SIS) – A study or studies that may be undertaken by the City's Power Division (or a designated third party) in response to its receipt of a completed application for Interconnection and parallel operation with the City's electric power system. Interconnection studies may include, but are not limited to, Interconnection Feasibility Studies, System Impact Studies, and Facilities Studies.

Static Inverter – An electronic device used to convert direct current (DC) power into alternating current (AC) power.

Substructure – Underground power distribution material such as transformer boxpads, conduit, vaults, handholes, pedestals, streetlight foundations, or sectionalizing cabinets.

Supply Side Source Connection – An electric power production source which is connected on the supply side of the service disconnecting means.

Transformer Rated Meter – Required for installations where the service voltage and/or current cannot safely travel directly through the meter. These installations require the use of potential transformers and/or current transformers which are typically installed in a separate enclosure.

UFER Grounding – An electrical earth grounding method using concrete-encased electrodes to improve grounding in dry areas.

UL – **Underwriters Laboratories Inc.**

UL Listed – Equipment identified herein that has been tested and certified to an applicable UL Standard and is listed and labeled according to Section 110.3 of the NEC.

Unintended Island – The continued delivery of power from a Generating Facility in an Island situation usually following a loss of a portion of the City's Electric Delivery System.

Volt-Amperes Reactive (VAR) – A unit of measurement of reactive power. VARs occur when AC electric currents and voltage are not in phase. Current and voltage become out-of-phase due to certain loads that require reactive power, or VARs. Reactive power creates an additional load on the cables, wires, and electrical equipment itself, and causes losses on AC distribution lines.

Wet Utilities – Utilities associated with water including water lines, wastewater lines, and storm water lines and structures.

Wireways – A wireway, also known as a "trough" or "gutter", is typically a metallic or non-metallic enclosure with hinged or removable covers so that the cables contained inside are protected but still accessible.

Section 1 - General Information

1.1 General Requirements

a. ***Call for Locates***
CALL 811 BEFORE YOU DIG at least three (3) working days in advance.

Digging into buried electrical installations can be very dangerous, expensive, and can create hardships for people and businesses should there be an interruption of service. In addition to the cost of repair, the State of Colorado imposes severe penalties on parties who dig up electrical facilities without calling 811 at least three (3) working days in advance (weekends and holidays are not considered working days). The City will locate existing City underground electric facilities.

b. ***Illegal Modifications & Tampering***
The customer shall not modify or tamper with any City-owned electric facility under any circumstance.

Modification or tampering with the color of City owned electrical equipment is prohibited. All City equipment must be maintained in the color listed in the Material Specification for that equipment except if the piece of equipment has been selected by the Visual Arts Commission's Transformations Project or other public approval for an alteration has been obtained.

Cutting/removing City installed seals on any meter, socket, box or cabinet is prohibited and constitutes a violation of the Municipal Code, subject to prosecution including fines or imprisonment.

c. ***Metered Electrical Power***
All electrical power supplied to customers must be metered with the exception of those customers approved by the City for flat-rate service. Flat-rate services will be limited to a 5 amp in-line fuse. The City shall not approve any new flat-rate services unless exempted in writing by the Director of Water and Power or their designee.

d. ***Mounting Customer-Owned Equipment***
Customer-owned metering equipment, switching devices, conduits, conductors, luminaires, etc., shall not be mounted on a City owned facility.

e. ***Unmetered Yard Lights/Free Porch Light Program***
Unmetered yard lights are no longer available. Street lighting is provided in the subdivision design plan. For subdivisions with electrical designs approved prior to August 1997, the City will continue to furnish unmetered power to one (1) forty-watt lamp at each residential unit and two (2) forty-watt lamps on corner lots of any residential unit, when requested by the customer. Repairs to unmetered yard light circuits are the responsibility of the customer. However, the City will maintain the 1amp fuse supplying the circuit and photocell if applicable. When a customer upgrades an existing service that includes an unmetered light, the customer will be responsible for relocating that lighting circuit to a breaker in the customer's electrical panel.

f. ***Disconnect Timeframe***
Requests for disconnects must be submitted to the City a minimum of two (2) working days prior to the time needed for disconnect.

g. ***Permits & Meter Inspections***
Permits and inspections for electrical panel and meter socket installation are issued and scheduled by the City's Building Division or state electrical inspector, whichever has jurisdiction. Residential building permits will not be released until a subdivision project has been energized by the City.

h. ***Warehouse Hours***
Materials may be picked up or returned to the Warehouse, Monday through Friday between 8:00 a.m. and 3:00 p.m.

i. ***Ownership of Electrical Distribution System***
The City owns, operates, and maintains all its overhead and underground electrical distribution facilities in accordance with Sections 13.12.050 and 13.12.060 and 13.12.070 of the Loveland Municipal Code, as well as all electric meters and associated equipment. Once installed pursuant to these Requirements, the customer shall own and be responsible for all electrical service components on the customer side of the demarcation point.

1.2 Electric Services

a. ***Service Upgrades***
Work that would require a service upgrade includes, but is not limited to:

- Any changes in the meter socket or CT cabinet including wiring (line and/or load side), terminations, and meter block.
- Relocation of service entrance equipment and/or metering equipment.
- Any change that increases the capacity (amperage) of the service entrance equipment or overcurrent protection device.

Exemptions may be granted to accommodate repairs to damaged metering or customer-owned equipment.

b. ***New Services Underground***
All new electric utility facilities and services on all residential, commercial, and industrial developments shall be installed underground and meet all current standards unless exempted in writing by the Director of Water and Power or their designee.

c. ***Convert Overhead Services to Underground***
In an existing overhead area, customers may request underground service in accordance with *Municipal Code section 13.12.110 Undergrounding of Existing Overhead Electrical Systems*, and costs for underground service conversions shall be as described in that section.

d. ***Special Cases***
At the City's sole discretion, the City may need to conduct a study and may require additional equipment and/or information prior to approval of any installation of services.

1.3 Electrical Service Voltage Standards

a. ***Standard Services***
Standard electric service provided by the City is single-phase or three-phase 60-hertz alternating current.

b. ***Standard Voltage Classification***
The standard voltage classification provided by the City is 120/240 single-phase and 120/208 three-phase.

c. ***Nominal Secondary Voltages***
The City offers the following nominal secondary voltages to customers subject to review and acceptance of application for service.

- Single-phase, three-wire 120/240, grounded
- Single-phase, three-wire 120/208, grounded
- Three-phase, four-wire 120/208 WYE, grounded
- Three-phase, four-wire 277/480 WYE, grounded

1.4 Service Quality

a. ***Voltage Level***
The voltage level at the customer's service entrance varies depending on customer load, length of service conductor, and other factors. The nominal voltage variation will be in accordance with the latest version of ANSI C84.1.

b. ***Power Irregularities & Interruptions***
Consistent with section 13.12.010 of the Loveland Municipal Code, the City will make every effort to provide a continuous reliable source of power to its customers. **However, the City does not guarantee against irregularities or interruption.** The City shall not be liable for injury to persons, damage to property, monetary loss, or loss of business related to interruptions of electric service or delays in furnishing electric service to a customer, whether planned or unplanned, and/or are due to causes or contingencies beyond the control of the City, including but not necessarily limited to: accidents, breakdown of equipment, inadequate supply of equipment, acts of God, floods, disease outbreak or epidemic, storms, fires, strikes, riots, war, or orders of government. Customers with equipment sensitive to service interruptions, voltage irregularities, single phasing, etc. are responsible for taking the necessary precautions to prevent damage from such events.

Customer-owned equipment shall not create disturbances or produce harmonic distortion on the system. The City shall require that the customer take corrective action to prevent a piece of equipment from causing disturbances or harmonic distortion, including disconnection of such equipment at the customer's expense. Compliance of this requirement is assessed by the City's measurement at the demarcation point. In the event the customer fails to take corrective action, the City may discontinue electrical service until corrective action is taken.

1.5 Motors & Three-Phase Equipment

a. ***Air Conditioners & Heat Pumps Requiring Soft Starts***
Air conditioners or heat pumps larger than five (5) tons shall be required to have a soft start device installed.

b. ***Motors Requiring Soft Starts***
Motor starts may cause unacceptable voltage dips and flicker events for adjacent customers or on the customer's service. The following motors require a motor start analysis by the City's electrical engineering group to determine whether the equipment requires a soft start device:

- Single-phase motors 3hp or larger within the service territory
- Three-phase motors 35hp and larger within the City limits
- Three-phase motors in the Big Thompson Canyon

c. ***Motor Start Analysis Requirements***
The following information shall be provided to the electrical engineering group for the motor start analysis:
- Horsepower rating
- Nameplate full-load amps
- Nameplate locked rotor amps
- Nameplate voltage
- NEMA code letters
- Frequency of starts per time unit

d. ***Motor Protection Responsibility***
The customer is responsible for motor protection. The motor protection shall meet all NEC requirements for motor protection, including, but not limited to, current overload, voltage surges/spikes, short-circuits, ground faults, low voltage, and single-phasing of three-phase motors.

1.6 Transformer & Service Entrance Sizes

a. **Equipment Sizing**
The City electrical engineering group is responsible for the final determination of the appropriate size for all City owned and operated equipment including transformers and residential services. All transformers are the property of the City, with the customer responsible for costs and installation. The City shall procure the necessary transformers based on the requirements for the customer's service and shall determine the costs of such transformers based on the City's actual costs to supply certain sizes of transformers for development within the City.

b. ***Available Transformer Sizes***
The City offers the following standard pad-mounted transformer sizes.

1 ϕ Transformers – Pad-Mounted
kVA
25
50
75
100
167
3 ϕ Transformers – Pad-Mounted
kVA
45
75
112.5
150
225
300

500
750
1000
1500*
2500*

*1500 kVA & 2500 kVA transformers available with three-phase, four-wire 277/480 volt WYE, grounded secondary only

c. ***Maximum Allowable Service Entrance Sizes***

- Single-phase, three-wire 120/240 volt, grounded: **800A**
- Three-phase, four-wire 120/208 volt WYE, grounded: **4000A**
- Three-phase, four-wire 277/480 volt WYE, grounded: **4000A**

1.7 Infinite Bus Fault Current

The fault current information provided below is based upon an infinite bus calculation using standard transformer data.

Fault current data based upon the current distribution system configuration and project specific equipment can be requested from the electrical engineering group through your Electric Distribution Design contact. This information is subject to change at any time without notice.

Material				Nominal	Secondary Voltage	Infinite Bus Fault Current	
Number	Type	Phase	kVA	Impedance (% Z)	Line to Line (Volts)	Line to Line (Amps)	Line to Ground (Amps)
LV25-120	PAD	1 ϕ	25	1.95	240	5,342	8,013
LV50-120	PAD	1 ϕ	50	1.95	240	10,684	16,026
LV75-120	PAD	1 ϕ	75	1.95	240	16,026	24,038
LV100-120	PAD	1 ϕ	100	2.15	240	19,380	29,070
LV167-120	PAD	1 ϕ	167	2.55	240	27,288	40,931

Material				Nominal	Secondary Voltage	Infinite Bus Fault Current
Number	Type	Phase	kVA	Impedance (% Z)	Line to Line (Volts)	3 ϕ (Amps)
LV45-208	PAD	3 ϕ	45	2.70	208	4,626
LV75-208	PAD	3 ϕ	75	2.70	208	7,710
LV112.5-208	PAD	3 ϕ	112.5	3.10	208	10,073
LV150-208	PAD	3 ϕ	150	3.10	208	13,431
LV225-208	PAD	3 ϕ	225	3.10	208	20,146
LV300-208	PAD	3 ϕ	300	3.10	208	26,862
LV500-208	PAD	3 ϕ	500	4.35	208	31,905

LV750-208	PAD	3 ϕ	750	5.75	208	36,205
LV1000-208	PAD	3 ϕ	1000	5.75	208	48,273
LV45-480	PAD	3 ϕ	45	2.70	480	2,005
LV75-480	PAD	3 ϕ	75	2.70	480	3,341
LV112.5-480	PAD	3 ϕ	112.5	3.10	480	4,365
LV150-480	PAD	3 ϕ	150	3.10	480	5,820
LV225-480	PAD	3 ϕ	225	3.10	480	8,730
LV300-480	PAD	3 ϕ	300	3.10	480	11,640
LV500-480	PAD	3 ϕ	500	4.35	480	13,825
LV750-480	PAD	3 ϕ	750	5.75	480	15,689
LV1000-480	PAD	3 ϕ	1000	5.75	480	20,918
LV1500-480	PAD	3 ϕ	1500	5.75	480	31,378
LV2500-480	PAD	3 ϕ	2500	5.75	480	52,296

1.8 Contractor Installation of Utility Substructure

a. ***Contractor Qualification for Substructure Installation***

- As required by Loveland Municipal Code section 13.12.060 and 13.12.070, the customer is responsible for all costs of hiring a contractor to install all new substructure, relocate existing substructure, if necessary, and preparation for transformer.
- The contractor's onsite project manager will be required to attend a qualification meeting conducted by the Power Distribution Designer assigned to the project prior to scheduling a pre-construction meeting.

b. ***Pre-Construction Meeting***

No substructure, including street crossings, shall be installed prior to a pre-construction meeting held by the Electric Distribution Designer with the qualified contractor, city inspector(s), and Pulse Fiber Designer.

c. ***Substructure Material***

All material, including materials for street crossings, must be supplied by the City's Power Division, with the costs borne by the customer as described in Loveland Municipal Code section 13.12.100. Failure to use City supplied material may result in the substructure not being accepted. Replacement will be at the customer's cost.

d. ***Permit Requirements***

The contractor and/or customer shall be responsible for the acquisition and cost of all necessary permits for the project including, but not limited to, building permits, ditch crossing permits, easements, or special crossing permits (i.e. railroad crossing).

1.9 Guarantee

The contractor shall guarantee that the utility substructure shall be installed according to these Requirements and free from defects for a period of two (2) years after the date of final inspection. In addition, the equipment furnished by the contractor shall be guaranteed to be free from defects.

a. ***Contractor Repairs during the Guarantee Period***

Upon notification, the contractor shall promptly make all adjustments, repairs, or replacements which, in the opinion of the City, arose out of defects and became necessary during the guarantee period.

b. ***Paid by Contractor***

The cost of all materials, parts, labor, transportation, supervision, special tools, and supplies required for replacement or repair of parts and for correction of defects shall be paid by the contractor.

c. ***Guarantee Coverage***

This guarantee shall be extended to cover all repairs and replacements furnished under the guarantee, and the period of the guarantee for each such repair or replacement shall be one (1) year after installation or completion. The contractor's guarantee shall not be construed as a waiver by the City of the relevant statute of limitations and statute of repose periods.

d. ***Repairs and Adjustments Deadline***

If within 10 days after the City has notified the contractor of a defect, failure, or abnormality in the work and the contractor has not started to make the necessary repairs or adjustments, the City is hereby authorized to make the repairs or adjustments or to order the work to be done by a third party, with the cost of such work to be paid by the contractor.

e. ***Emergency Repairs***

In the event of an emergency where, in the sole judgment of the City, delay would cause serious loss or damage for the customer or the City, repairs or adjustments may be made by the City or a third party chosen by the City without advance notice to the contractor, with the cost of such work to be paid by the contractor.

1.10 Easement Requirements

Utility Easements are required for transformers, conduit, and any required electrical facilities. A clear drivable path shall be provided from a roadway or parking area to the access point of the equipment (typically located at the front of the lot except in the case of unique lot sizes, alley access, or other approved alignment). Any obstructions to the access point shall be removed at the owner's expense. If the below easement requirements cannot be met due to non-typical circumstances (i.e. small lot developments) the City and customer shall agree on a customized solution and unique terms and conditions that provides the City with necessary utility easements to operate, maintain, repair, and replace its electrical facilities at minimal long term cost to the City.

a. ***Typical Easement Widths***

- Residential Lot
  - Front – 14 feet
- Commercial Lot
  - Front and sides – 14 feet
  - Conduit route to transformer – 10 feet
- Transformer site
  - 15 feet by 15 feet centered on the transformer location

- Roadways adjacent to and within property
  - Adjacent to Right-of-Way or adjacent to back of sidewalk – 14 feet to 25 feet

b. ***Additional Required Utility Easements***

The customer shall grant any additional required utility easements as determined in the sole discretion of the City. These easements may be dedicated by separate instrument. The easement documents must be recorded before the service is energized.

c. ***Customer Responsibility for Utility Coordination***

The customer shall be responsible for the coordination of all utilities located within the provided easements concerning the required utility clearance requirements and eliminating conflicts between each residing entity. Between differing utility clearance standards or requirements, the more stringent requirements shall control.

d. ***Agreement to Dedicate Easement***

All easements shall be granted to the City of Loveland and certified in writing by a Colorado licensed Professional Engineer or Professional Land Surveyor. By submitting an Electric Service Worksheet (ESW), the customer agrees to grant or arrange for a documented easement on the customer's property for the installation, operation, and maintenance of electric lines and/or equipment necessary to provide service to the customer.

e. ***Construction/Installation Requirements***

Prior to construction and installation of the utilities, the land surface of the easement area shall be within six (6) inches of final grade. Curb and gutter must be installed before installation of the utilities. The easement must be staked including property pins. The slope or grade of the land for the easement area shall not exceed seven percent (7%). For example, the slope shall not exceed a one-foot vertical drop across a fourteen (14) foot wide easement. All obstacles, such as construction materials, shall be removed before infrastructure can be installed. Easements must provide a level working surface around electric equipment to be compliant with the clearance requirements in Section 8.

f. ***Terms and Conditions of Utility Easements***

All easements granted to the City of Loveland shall include the following terms and conditions:

- If the easement is dedicated by plat, the owner of the property shall agree by separate agreement, or development agreement, to these terms and conditions prior to installation and operation of the utilities.
- The owner and/or their successors and assigns are prohibited from constructing or placing on any part of the Easement Area without prior written approval from the City, any fence or gate, building, above or below ground utility systems or appurtenances not owned or maintained by the City, or any other permanent or substantial structure.
- The owner and/or their successors and assigns are prohibited from making or permitting any use of the Easement Area that would impair, impede, or interfere with the City's access to or along the easement, or the City's full free use and exercise of the easement. The City shall be permitted to immediately remove without liability for damages any obstruction prohibited by this easement that interferes with the City's access to the City-owned utility systems or impairs the City's full free use and exercise of the easement.

- The owner and/or their successors and assigns owns the trees and other vegetation on the Easement Area, and acknowledges, for itself and for all successors and assigns, that this easement provides the City with the authority to cut and remove trees and other vegetation that encroaches upon the Easement Area if, in the sole discretion of the City, such trees or vegetation interferes with the City's use and enjoyment of this easement.

Section 2 - Temporary Overhead & Underground

2.1 Temporary Construction Services

a. ***Temporary Construction Power***
The City provides temporary construction power where electrical service is required **for a period of 12 months or less**. After the 12-month period, the customer can request a 12-month extension if needed. See *Sections 2.2a and 2.3a*. Additional extension after 24 months will be subject to review and approval by the Electric Metering Supervisor. No temporary services are to be utilized as a permanent power source.

b. ***Address Posting Requirements***
The customer shall post the address on or near the temporary power service. The posting shall be weatherproof and large enough to be seen from the road.

c. ***Location Requirements***
The customer shall install the temporary power facility (typically a meter pedestal) within 2 to 3 feet of an underground electric source. If a transformer will be the power source, the temporary power facility shall not be located in front of the transformer and shall maintain a minimum clearance of 5 feet. For overhead services, the customer shall install an overhead temporary pole a minimum of 10 feet from an existing pole. The temporary facility must meet the requirements of *Drawings No. 2.1 and 2.2*. The temporary pole height for overhead installations must allow for the service wire to meet minimum service drop clearance requirements. See *Table 8-1 in Section 8 - Clearances.*

d. ***Conductor Requirements for Underground Temporary Power***
The customer shall provide a minimum of 36 inches up to a maximum of 48 inches of conductor length exposed at the end of the flex-conduit, with the neutral conductor clearly indicated and a total length sufficient for termination at the electric source.

e. ***Temporary Pole & Meter Equipment Requirements***
The temporary pole and metering equipment must conform to all current regulations of the City, NEC, and NESC, including ground fault protection.

f. ***NEC Requirements***
ALL requirements for permanent wiring found in the most recent version of NEC adopted by the City Council apply to temporary installations.

2.2 Residential Development Construction Power

a. ***Applying for Residential Development Construction Temporary Power***
Prior to applying for a permit from the Building Division, the customer must completely fill out, sign, and submit an Electrical Service Worksheet (ESW) to PowerDevelopment@cityofloveland.org. A Distribution Designer will conduct a site visit and then follow up with the customer on the scope of work that needs to be completed, and any fees that need to be paid to the Power Department for services rendered by the City on the ESW form. New construction temporary power will not require an ESW. An ESW is required for any demolishing and rebuilding project.

The City will collect fees or distribution design deposits required on the form prior to design or construction. The customer must pay the total estimated cost of the project prior to release of

materials or installation. When the final cost is determined, the customer will be billed or refunded the difference between the estimated cost and the actual cost. Frequently, the costs of temporary construction power can be included in the cost of the permanent power.

The Distribution Designer will email a copy of the completed and signed ESW to the customer so they can apply for a permit.

b. ***Building Permits & Fees***
The customer must apply for a building permit through the Building Division who will collect all permit fees and issue the permit to the customer. All permits shall be obtained before proceeding with construction.

c. ***Inspection & Energizing***
The City's building inspector or state electrical inspector will inspect the installation. Upon inspection approval, the City will set the meter, make the final termination, and energize the installation.

d. ***Utility Locates***
See *Section 1.1.a – Call for Locates*.

e. ***Temporary Meter Poles***
The developer, contractor or electrical contractor shall furnish and install the temporary meter pole in close proximity to power service (power pole, handhole, etc.). The temporary meter pole must meet City and NEC requirements. For a multi-family dwelling, one (1) temporary meter is required per building. See *Drawings No. 2.1 and 2.2*.

f. ***Standard Service Voltage***
The standard service voltage of single-phase 120/240 three-wire service is available for temporary residential construction power applications.

g. ***Service Connection Timeframe***
The City will make the temporary power connection within three (3) working days from the notification date of inspection from the Building Division unless a line extension of the system is required to provide the power.

h. ***Contractor Installed Equipment***
Contractors shall install all metering equipment except the meter.

i. ***Approved Meter Sockets***
All service installations must have an approved meter socket with a sealing mechanism. All meters shall have lever-operated bypass. See *Section 6 – Meters and Meter Connections.*

j. ***Accessible Meter Locations***
All meter equipment must be installed in readily accessible locations. Interior installations are prohibited, as are installations behind or within locked fences, walls, and enclosures.

k. ***Meter Ground Rods***
Each meter installation shall meet current NEC requirements for grounding and bonding.

2.3 Commercial Development Construction Power

a. ***Applying for Commercial Development Construction Temporary Power***
The customer must apply for a building permit and pay all associated fees to the Building Division prior to issuance of the building permit. All permits shall be obtained before proceeding with construction. Prior to applying for a permit from the Building Division, the customer must complete and submit the following:

- An electric design deposit made payable to the City of Loveland
- Electrical Service Worksheet
- Electrical one-line diagram, panel schedules, load calculations
  - All three-phase services or single-phase services that are larger than 200 amps require a stamped one-line diagram
- Plat and current site improvement/utility plans
- Cut sheets of meter gear/service entrance equipment

All required items must be submitted to the City's Power Division prior to issuing a temporary construction meter and prior to receiving approval for the site work permit. Please E-mail items to powerdevelopment@cityofloveland.org.

Electric design deposit check may be made out and sent to:
Loveland Water and Power
200 N. Wilson Avenue
Loveland, CO 80537
(**Please reference project name and PZ/Building Permit number**)

Distribution Designers will design the installation and provide an estimated cost. The customer must pay the total estimated cost of the project prior to release of materials or installation. When the final cost is determined, the customer will be billed or refunded the difference between the estimated cost and the actual cost. Frequently, the costs of temporary construction power can be included in the cost of the permanent power.

b. ***Inspection & Energizing***
The City's building inspector or state electrical inspector will inspect the installation. Upon inspection approval, the City will set the meter, make the final termination, and energize the installation.

c. ***Utility Locates***
See *Section 1.1.a – Call for Locates*.

d. ***Standard Services***
The standard services for temporary construction power applications are single-phase three-wire 120/240 volt, single-phase three-wire network 120/208 volts or three-phase four-wire 120/208 wye, grounded volts. This includes services up to 400 amps or less, excluding 120/208 three-wire network services. Temporary 277/480 volt transformers will not typically be installed. Contact the City at 970-962-3582 for special applications.

e. ***Meter Socket Requirements***
The self-contained meter socket must include a lever-operated bypass. Any single-phase three-wire 120/240 volt and single-phase three-wire 120/208 volt service shall have a five-jaw meter socket installed. The fifth jaw shall be installed in the 9 o'clock position and connected to the neutral. All three-phase, four-wire, 120/208 volt services up to 400 amps and 277/480 volt self-contained services up to 400 amps or less shall have a seven-jaw meter socket installed. See *Section 6 – Meters and Meter Connections.*
(No K-Base metering installations allowed)

f. ***No Meters on Utility Poles***
The City prohibits meter installation on any of its utility poles.

g. ***Service Connection Timeframe***
The City will make the temporary power connection within three (3) working days from notification date of inspection from the Building Division, unless a line extension of the system is required to provide the power.

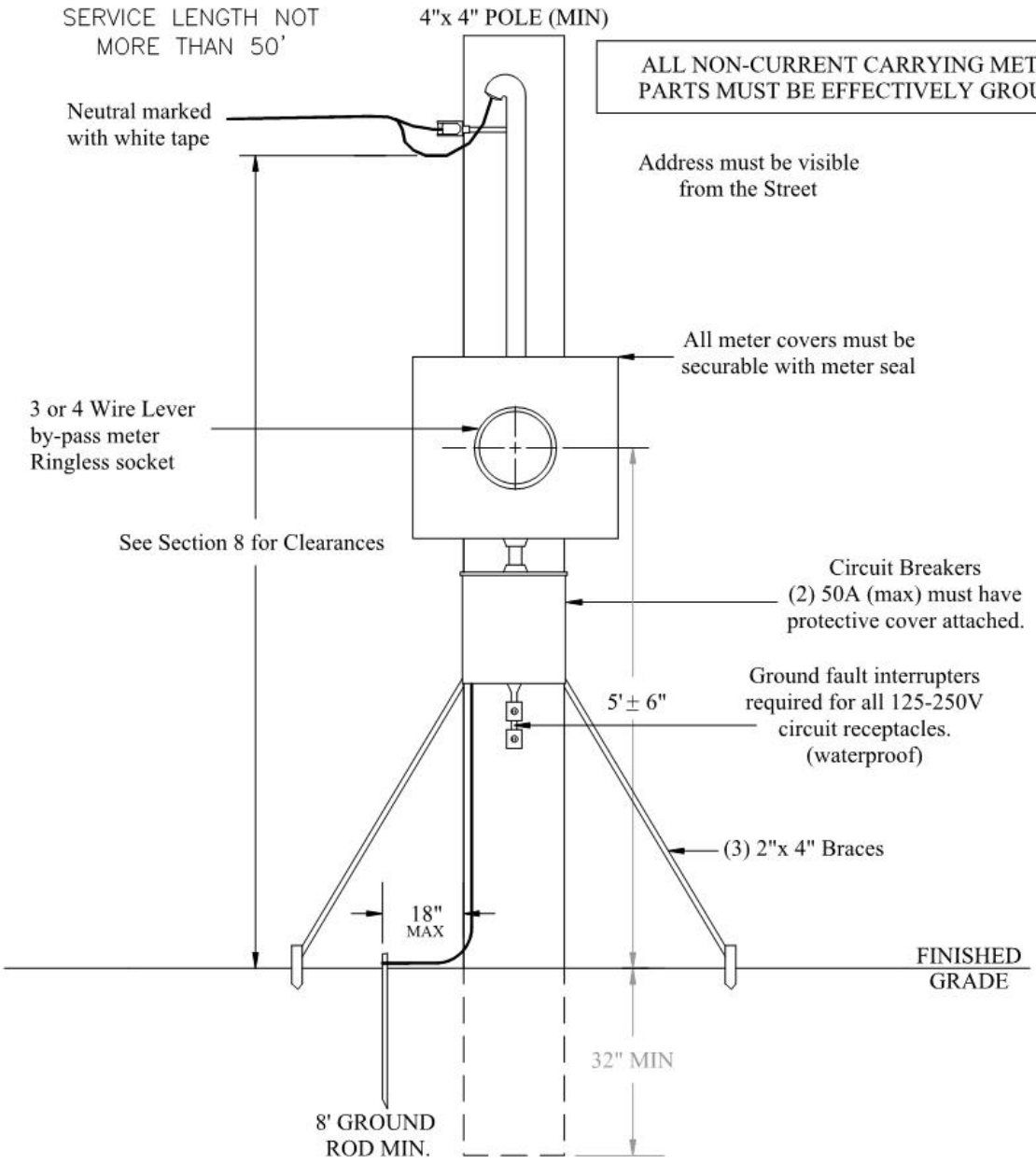
h. ***Developer/Contractor Installed Equipment***
The developer, contractor, or electrical contractor shall furnish and install all metering equipment and temporary pole except the meter. See *Drawings No. 2.1 and 2.2.* For service greater than 200 amps or three-phase, contact the Distribution Design Supervisor at 970-962-3561.

i. ***Approved Meter Sockets***
All service installations must have an approved meter socket with sealing mechanism. All self-contained meter sockets shall have lever-operated bypass. See *Section 6 - Meters and Meter Connections.*

j. ***Meter Location Approvals***
All meter locations shall be approved by the City prior to construction. Please contact the Electric Metering Supervisor at 970-962-3582.

k. ***Accessible Meter Locations***
All meter equipment must be installed in readily accessible locations. Interior installations are prohibited, as are installations behind or within locked fences, walls, and enclosures.

l. ***Meter Ground Rods***
Each meter installation shall meet current NEC requirements for grounding and bonding.



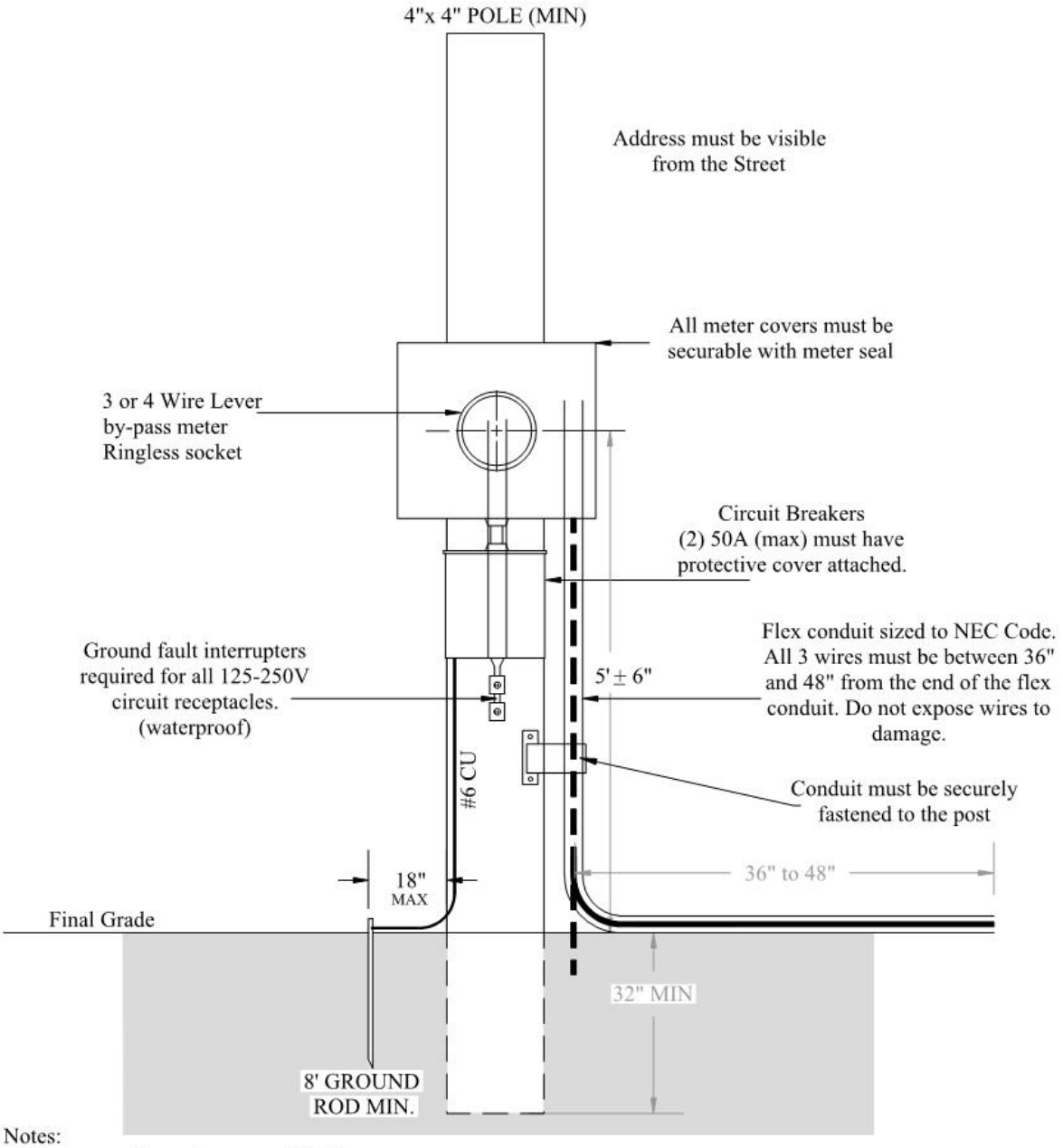
NOTES:

1. MUST MEET ALL REQUIREMENTS OF NEC.
2. ALL 15– AND 20–AMPERE, 125– AND 250–VOLT RECEPTACLES TO HAVE IN–USE COVERS.
3. CLEARANCES BETWEEN METALLIC EQUIPMENT, NON–METALLIC EQUIPMENT AND POLES SHALL BE SPECIFIED IN SECTION 8.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2019	2.1	TEMPORARY METER INSTALLATION - OVERHEAD

ALL NON-CURRENT CARRYING METALLIC PARTS MUST BE EFFECTIVELY GROUNDED.



Notes:
1. Must meet all requirements of NEC.
2. All 15- and 20-ampere, 125- and 250-volt receptacles to have in-use covers.
3. Clearances between metallic equipment, non-metallic equipment and poles shall be specified in section 8.
4. City to terminate in transformer or handhole.

CITY OF LOVELAND - DEPARTMENT OF WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2019	2.2	Temporary Meter Installation Underground

Section 3 - Residential

3.1 Residential Service – General

This section covers residential single-family homes and duplexes with service sizes up to 400 amps. Buildings with three or more units and/or services larger than 400 amps are considered commercial installations and are covered in *Section 4 – Commercial and Industrial*. For any solar and DER related installations, please refer to *Section 9 - Interconnection Requirements for Distributed Energy Resources*.

a. ***All New Residential and Upgraded Underground Services***

The service entrance cable shall be installed in conduit. See *Section 1.2 and reference Municipal Code 13.12.060*.

b. ***Applying for Service***

Prior to applying for a permit from the Building Division, the customer must completely fill out, sign, and submit an Electrical Service Worksheet (ESW) to PowerDevelopment@cityofloveland.org. A Distribution Designer will conduct a site visit and then follow up with the customer on the scope of work that needs to be completed and any fees that need to be paid to the Power Department for services rendered by the City on the ESW form.

The City will collect fees or distribution design deposits required on the form prior to design or construction. The customer must pay the total estimated cost of the project prior to release of materials or installation. When the final cost is determined, the customer will be billed or refunded the difference between the estimated cost and the actual cost. The costs of temporary construction power can be included in the cost of the permanent power.

The Distribution Designer will email a copy of the completed and signed ESW to the customer so they can apply for a permit. The customer must apply for a building permit through the Building Division who will collect all permit fees and issue the permit to the customer. All permits shall be obtained before proceeding with construction.

c. ***Additional Requirements***

Residential services may be required to provide a one-line diagram, panel schedules and load calculations at the discretion of the City on a case-by-case basis.

d. ***Service De-energization Procedure***

After a building permit has been issued, the service shall be de-energized prior to any service upgrade or work on any of the service equipment. Notify Dispatch at 970-962-3581 at least two business days in advance to schedule a disconnect. Standard operating hours are Monday through Friday 7:30am-3:30pm (excluding City observed holidays); work done outside of these hours may incur additional fees. Disconnection shall only be performed by the City. The meter socket/disconnect shall be brought up to current meter standards at the customer's cost.

e. ***Inspection & Energizing***

The City's building inspector or state electrical inspector will inspect the installation. Upon inspection approval, notify Dispatch at 970-962-3581 to schedule a reconnect after which the City will set the meter, make the final termination, and energize the installation. Standard operating hours are Monday through Friday 7:30 am - 3:30 pm (excluding City observed holidays); work done outside of these hours may incur additional fees.

f. ***Demarcation Point***

The point of demarcation for underground residential service is the line side jaws of the meter socket. The customer owns and is responsible for the maintenance of all electrical equipment on the customer side of the demarcation point including the meter socket. The service entrance conductor from the City transformer, handhole or pedestal to the meter base and the meter remains the property of the City. The City maintains this portion of the service. Any damage incurred to the City's property will be billed at actual cost to the responsible party. The customer-owned electric equipment shall be maintained in a manner that is safe and consistent with City standards. If the customer's installation is deemed unsafe by City personnel, the customer will be notified of the unsafe condition and the customer must correct the unsafe installation in a manner approved by the City at the City's sole discretion. If not repaired within the timeframe ordered by the City at the cost of the customer, the City reserves the right to temporarily terminate service to the customer until the unsafe condition is corrected and approved by the City.

g. ***Additional Fees May Apply***

The installation fees paid prior to issuance of the building permit covers only standard service installations of 100 feet or less in length and 200 amps or less. Installations exceeding this standard will be charged to the customer at actual cost for the City's time and material.

h. ***Utility Locates***

See *Section 1.1.a – Call for Locates*.

i. ***Mark Lot Corners***

Lot corners must be accurately located and marked with pins and stakes except for services with existing power at the lot line. The lot corners must be marked with lot numbers corresponding to the plat map.

j. ***Additional Meters on a Single Residential Lot***

Multiple services and/or meters to separate buildings on one residential lot are not allowed except on Accessory Dwelling Units (ADU) if all applicable uses, codes, and regulations are met. See *Section 3.6 – Additional Service Added*

k. ***Meter Socket Requirements***

The customer is responsible for furnishing and installing an approved meter socket. Refer to *Section 6 - Meters and Meter Connections* for complete metering requirements. The customer will be responsible for the load side terminations in the meter socket. The City will make line side terminations.

l. ***Accessible Meter & Service Entrance***

The service entrance and meter must be outside of the building in an easily accessible location approved by the City's representative. Contact the City at 970-962-3570 prior to construction. Access to the meter shall not be blocked. If the customer is found to be negligent of said action, removal of the obstruction or relocation of the meter shall be at the customer's expense. Refer to *Drawing No. 8.2 in Section 8 - Clearances.*

m. ***Construction Standards***

All customer-owned facilities must meet the most recent version of the NEC adopted by the City Council and all applicable portions of the NESC.

n. ***Service Entrance Standards***
The service entrance must meet the current City Standards, the most recent version of the NEC adopted by the City Council, and all applicable portions of the NESC. The City will install the permanent meter upon satisfactory inspection by the electrical inspector.

o. ***Keep Area around Service Clear***
The service conduit shall not pass under or into any permanent structure or landscaping features. The meter shall not be enclosed by building materials or any other permanent structure.

p. ***Violations***
Any additional costs created by violating these requirements will be borne by the customer.

q. ***Grounding Method***
Grounding per NEC is required.

r. ***Customer Installed Service Entrance Conduit***
The customer is responsible for all costs associated with the installation of the underground service conduit and conductor from the conduit stub adjacent to the handhole (junction box) or transformer pad to the permanent meter location. The conduit stubs are marked by a red colored stake. (If the stake has been removed, contact the City or Distribution Designer to locate the stub.) See *Section 5* for example drawings. The installation must comply with the City of Loveland's Standards and must be inspected by the City's Power Division at 970-962-3570. After the service is energized the City is responsible for maintaining the underground service conductor and conduit. The slip sleeve riser remains the responsibility of the customer.

s. ***Access Restrictions to City Equipment***
At no time is the customer allowed to open or enter the City's handhole (junction box) or any other City owned electrical equipment. The customer shall contact the City if access is needed.

t. ***600V or Less Trench Requirements***
- The trench bottom shall be smooth, continuous, and free of any large rocks or other sharp objects.
- The top of the conduit shall be a minimum of 24 inches deep below final grade. The depth shall not exceed 36 inches.
- For joint service trench detail, refer to *Drawing No. 5.1* in *Section 5 – Equipment & Substructure Installation.*
- The trench shall remain open until the conduit is inspected by the City Power Inspector.

u. ***Conduit Requirements***
- The conduit size shall be 2-½ inch PVC SCH 40 conduit. Sweeps must be a minimum 24-inch radius
- The customer shall keep conduit free of dirt and debris during installation.
- All conduit (sweeps and straight sections) shall be fully seated within the bell ends and glued to prevent infiltration of water into electrical equipment.
- The path between the conduit stub and the meter shall be as straight as possible. The number of conduit bends shall not exceed a maximum of 270 degrees (including the riser sweep).

v. ***Slip Coupling Riser Requirements***
A slip coupling riser is required below the meter. The thread size shall be 2-½ inches to match the meter canister opening. The inside diameter of the slip riser shall be large enough to fit over the 2-½ inch SCH 40 PVC. The 2-½ inch PVC shall extend the complete length into the slip coupling riser and be fully seated. The slip coupling riser must be securely attached to the structure.

w. ***Warning Tape***
Red electric warning tape shall be installed 12 inches below final grade directly above the conduit.

x. ***Backfill Requirements***
Backfill within four (4) inches of the conduit, on all sides, shall be free of any materials that may damage the conduit system.

y. ***Damage Prevention***
Care shall be taken during installation and during backfill around the conduit to ensure that the conduit is undamaged, crushed, or deformed. There shall be no internal burrs or sharp edges that will obstruct the cable installation.

3.2 New Residential Service with Power at the Lot Line
To determine if power is available at the lot line, contact the Distribution Design department at 970-962-3535.

a. ***Applying for New Residential Service with Power at the Lot Line***
The customer must apply for a building permit and pay any associated fees to the Building Division prior to issuance of the building permit. All permits shall be obtained before proceeding with construction. All fees for this new service will be collected by the Building Division.

b. ***Inspection & Energizing***
See Section 3.1.e.

c. ***General Requirements***
See *Section 3.1* for General Requirements.

3.3 New Residential Service without Power at the Lot Line
To determine if power is available at the lot line, contact the Distribution Design department at 970-962-3535.

a. ***Applying for New Residential Service without Power to the Lot Line***
See *Section 3.1.b, c, & e*.

b. ***General Requirements***
See *Section 3.1* for General Requirements.

3.4 Residential Underground Service Upgrade
Any service upgrade will require that the applicant bring the service entrance up to the current code. See *Section 1.2.a* for what constitutes a service upgrade.

a. ***Applying for Residential Service Upgrade***
See *Section 3.1.b-e*.

Work required with an upgrade includes but is not limited to the installation of:

- Lever bypass meter socket.
- Slip coupling riser.
- External disconnect with adequate overcurrent protection

(Refer to *Drawing 3.2* for examples of the above items)

b. ***General Requirements***
See *Section 3.1* for General Requirements

3.5 Residential Overhead Service Upgrade

Upgrades to existing overhead services are not required to be installed underground. Overhead service upgrades include, but are not limited to, replacement of the mast or weatherhead, updating the meter housing, or changes to the service ampacity.

a. ***Applying for Residential Overhead Service Upgrade***
See *Section 3.1.b-e*.

b. ***Demarcation Point***
The point of demarcation for overhead services is the connection at the customer's weatherhead. The City provides, owns, and installs the service wire up to that point. The customer owns and is responsible for maintenance of all wire and equipment past that point, with the exception of the City's metering equipment.

c. ***Attachment Point Requirements***
The point of attachment height for the service drop conductor on the customer's structure must adequately provide vertical clearances between the service drop and the ground. All clearances must meet the requirements of *Drawing No. 3.1* and *Table 8-1 located in Section 8 - Clearances*.

d. ***Connection Point Requirements***
The Contractor must provide a suitable connection point for the service drop. The connection point must have adequate strength to safely withstand the strain of the service drop.

e. ***Attachment Requirements***
The attachment must safely withstand the strain imposed by the riser. Exercise particular care when installing vertical risers on brick, concrete block, or similar building walls. When attaching the service drop support to a wooden building, attach the service entrance wire holders to the building studs or other structural support. The attachment point is the sole responsibility of the customer.

f. ***General Requirements***
See *Section 3.1* for General Requirements

3.6 Additional Service Added

When submitting a building permit, the customer shall clearly indicate the application includes an additional electric service for an Accessory Dwelling Unit (ADU). Each metered service will require an address to be assigned through the building permit process.

a. ***Applying for Additional Service***
See *Section 3.1.b, c, & e*.

b. ***Additional Meters on a Single Residential Lot***
Additional electric meters are only allowed on Accessory Dwelling Units (ADU) if all applicable uses, codes, and regulations are met. All meters must be accessible and meet all clearance requirements in Section 8 - Clearances. This excludes the conversion of a single-family dwelling to a multifamily dwelling requiring three or more meters. Refer to multiple metering requirements in *Section 6.8 – Multiple Metering.*

c. ***General Requirements***
See *Section 3.1* for General Requirements.

3.7 Mobile, Cottage, or Tiny Home Communities

a. ***General***
For the purpose of this section, one lot with multiple dwelling units shall comply with the commercial requirements in Section 4, and one lot with a single dwelling unit shall comply with the residential requirements in Section 3.

b. ***Lots Owned by Mobile Home Parks - Upgrades***
If a mobile home park owner requests an upgrade, the owner will pay all associated costs. See *Section 4.1* concerning commercial requirements.

c. ***Lots Owned Individually - Upgrades***
If the mobile home park lots are sold to an individual owner, that owner shall pay for all associated costs required from any requested upgrades on their lots, including, but not limited to, secondary upgrades and new transformer installations. See *Sections 3.2 and 3.3* concerning residential requirements.

3.8 Electrical Substructure in New Subdivisions

Electrical infrastructure in new subdivisions is designed to accommodate single-phase electric service connections up to 200 amps per dwelling unit. Subdivision developments that seek to differ from this design standard must clearly communicate their proposed power requirements on the project documents at the time of Civil Construction Plans (CCP) and/or Site Development Plans (SDP) submittal.

a. ***Requirements for Electrical Design & Fees for Residential Subdivisions***
- The Distribution Design deposit
- Plat and current site improvement/utility plans
- AutoCAD base drawing file (dwg) that shows all existing and proposed utilities, easements, and property lines. All X-ref's must be bound to the base drawing.

All required items must be submitted to the Loveland Power Division prior to issuing a temporary construction meter and prior to receiving approval for the site work permit. Please E-mail items to powerdevelopment@cityofloveland.org.

Electric design deposit check may be made out and sent to:
Loveland Water and Power

200 N. Wilson Avenue
Loveland, CO 80537
(**Please reference project name and PZ/Building Permit number**)

Distribution Designers will design the electrical system upon the receipt of the items mentioned above and provide an estimated cost. The customer must pay the total estimated cost of the project prior to release of materials or installation. After installation the City shall determine the final cost and the customer will be billed or refunded the difference between the estimated costs paid and the actual cost. Typically, the costs of temporary construction power can be included in the cost of the permanent power.

b. ***Eliminating Conflicts with Power Equipment***

- The proposed lot or building layout must be submitted to Power Development at PowerDevelopment@cityofloveland.org for a power equipment design prior to submitting the Civil Construction Plans (CCP) and/or Site Development Plans (SDP).
- Loveland Power will provide the location of the required power infrastructure on the proposed layout and return the layout to the customer.
- The customer's design team must update the drawings to show the proposed power infrastructure and design wet utility infrastructure to avoid conflicts between the power equipment and wet utility equipment (i.e. meter pits and fire hydrants).
- The CCP & SDP must show the designated power equipment locations with a square containing either a "T" for a transformer, an "H" for a handhole, a "V" for an electric vault, as well as the electric primary power lines and conduits.

c. ***Residential Building Permit Approval***

Residential building permits will not be approved until all power infrastructure is installed and energized and the lot has been released by the Distribution Designer.

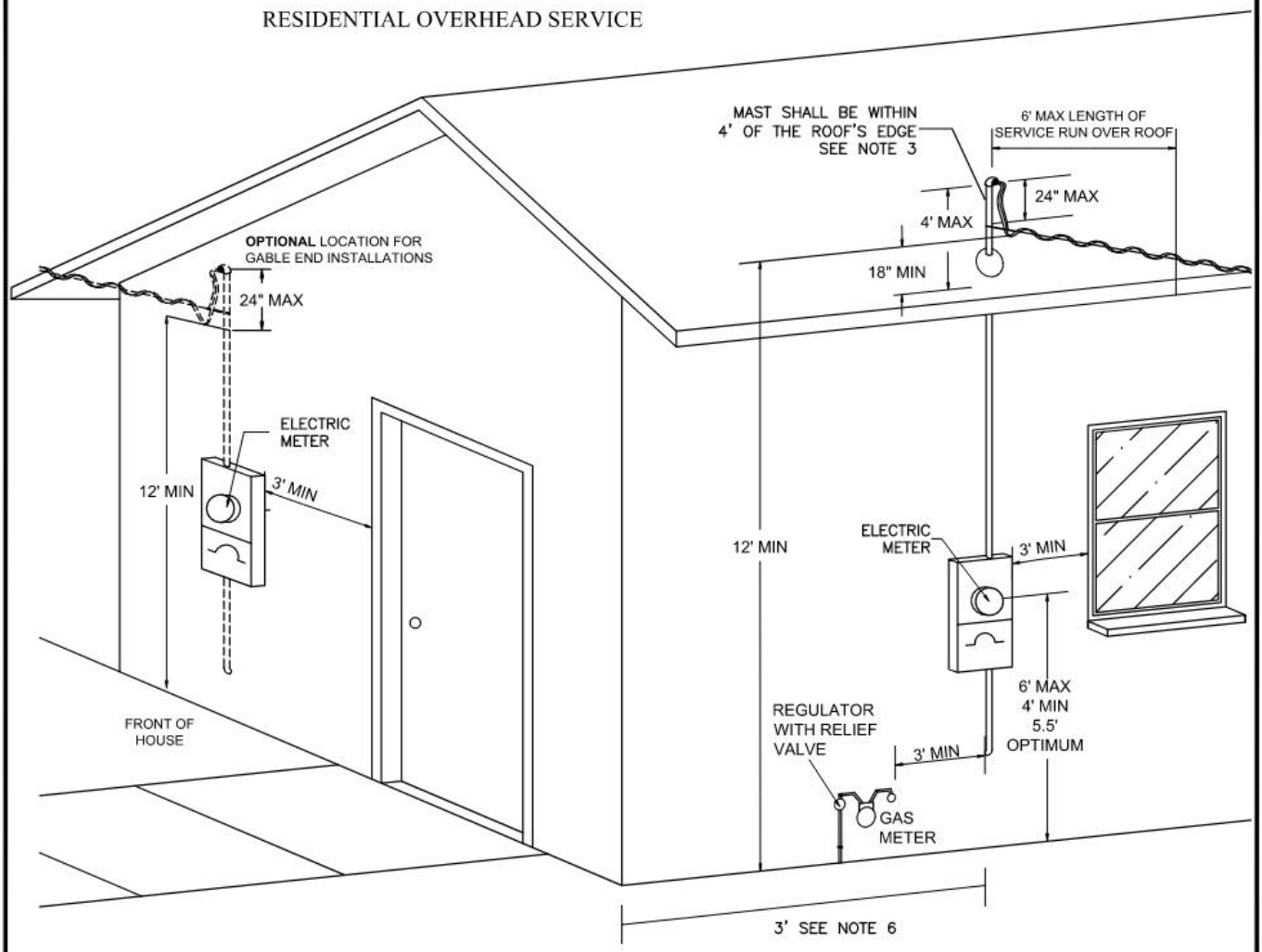
d. ***Pre-Construction Meeting***

An on-site pre-construction meeting must be held with the Electric Distribution Designer, the qualified contractor, city inspector(s), and Pulse Fiber Designer to determine the start time and construction schedule for substructure installation. All other utility providers shall be notified of the date and time of this meeting by the developer.

e. ***Trenching & Foundation Requirements***

All trenching and foundations shall meet the requirements of *Section 5 – Equipment & Substructure Installation*.

RESIDENTIAL OVERHEAD SERVICE

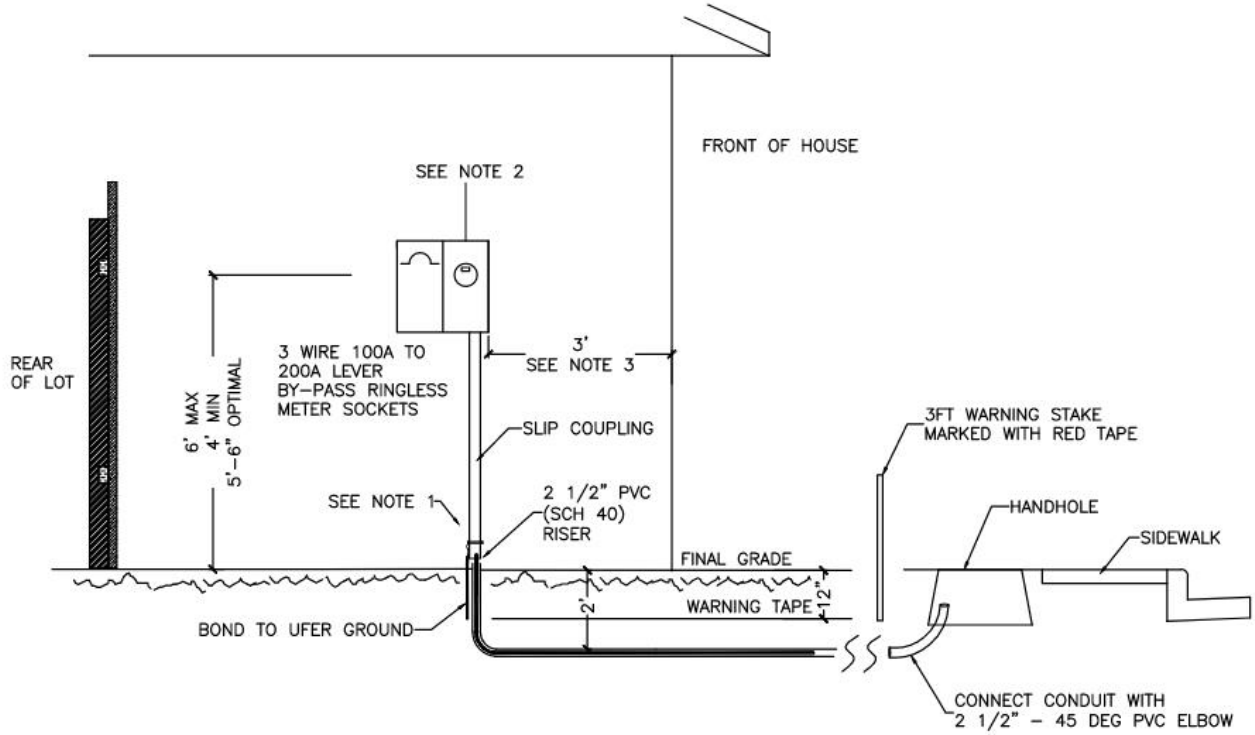


NOTES:
1. RISERS MUST BE 2" GRC MINIMUM
2. ALL METER SOCKETS SHALL BE RINGLESS AND HAVE LEVER–PASS HANDLE
3. MAST SHALL BE WITHIN 4' OF EAVE. GUYING OF THE MAST MAY BE REQUIRED
4. UNDER EAVE–ATTACHMENT CLEVIS MUST BE SECURED TO A STUD
5. ALL NON–CURRENT CARRYING METALLIC PARTS MUST BE EFFECTIVELY GROUNDED
6. METER LOCATIONS SHALL BE AT LEAST 3' FROM FRONT CORNER OF HOUSE. FENCES SHALL NOT ENCLOSE METER
7. NO METERS SHALL BE LOCATED ABOVE OR BELOW OBSTRUCTIONS (INCLUDING WINDOW WELLS, STAIRS, PLATFORMS ETC.)
8. SEE SECTION 8 FOR ADDITIONAL CLEARANCE REQUIREMENTS
9. PROVIDE MAIN BREAKER FOR EACH METER, ACCESSIBLE ON OUTSIDE < 10' FROM METER. NO COLD SEQUENCING.
10. METER LOCATION SHALL BE AT LEAST 3' FROM ANY GAS METER, PIPE, OR REGULATOR

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	3.1	RESIDENTIAL OVERHEAD SERVICE

RESIDENTIAL UNDERGROUND SERVICE



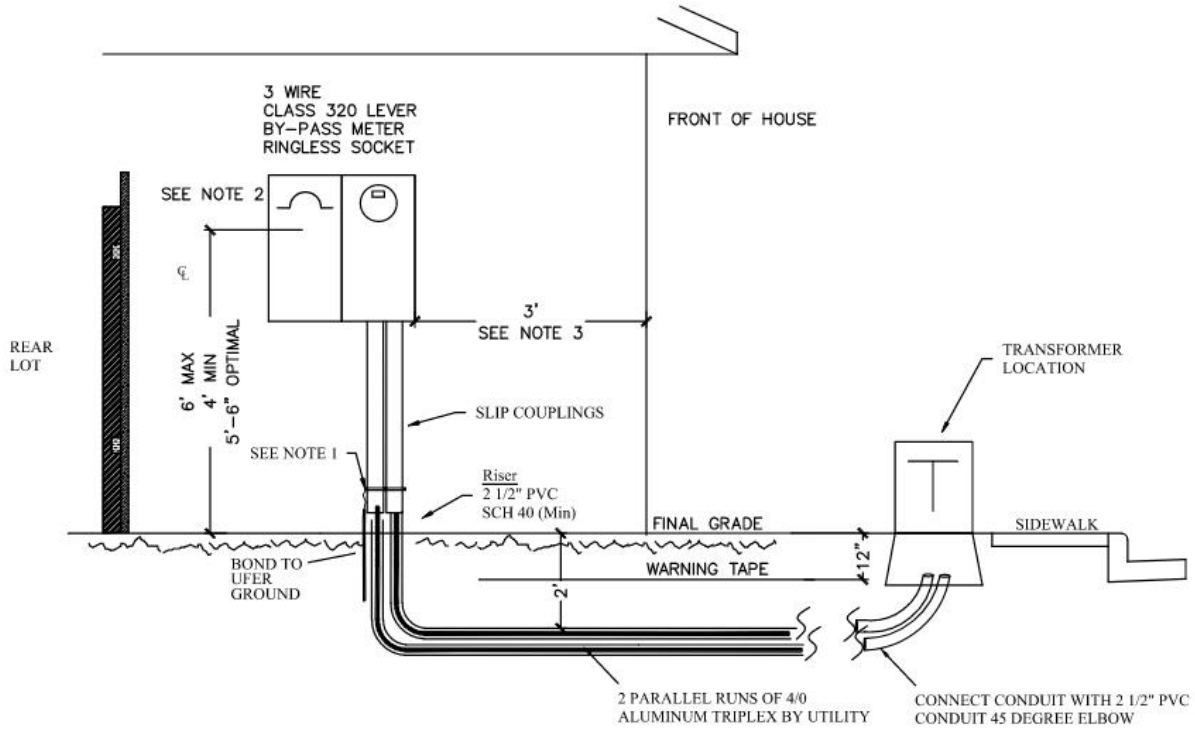
NOTES:

1. FASTEN SECURELY TO WALL PLATE ABOVE FOUNDATION.
2. SINGLE MAIN METER COMBINATION IS REQUIRED IN CASE OF REMOTE METER LOCATION
3. METER LOCATIONS SHALL BE AT LEAST 3' FROM FRONT CORNER OF HOUSE. FENCES SHALL NOT ENCLOSE METER
4. SERVICE ENTRANCE TO BE LOCATED ON THE SIDE OF THE BUILDING CLOSEST TO CITY CONNECTION POINT.
5. NO METERS SHALL BE ABOVE OR BELOW OBSTRUCTIONS INCLUDING WINDOW WELLS, STAIRS AND PLATFORMS.
6. MAIN BREAKER PROVIDED FOR EACH METER, ACCESSIBLE ON OUTSIDE < 10' FROM METER. NO COLD SEQUENCING.
7. PERMANENT LABELS MUST BE FASTENED. SEE METER SECTION 6.
8. ALL NON-CURRENT CARRYING METALLIC PARTS TO BE EFFECTIVELY GROUNDED.
9. METER SOCKET MUST HAVE A LEVER BY-PASS HANDLE.
10. SEE SECTION 6 "METERS AND METER CONNECTIONS"FOR ALL OTHER REFERENCES.
11. CONNECT THE SERVICE CONDUIT TO THE 2 1/2" PVC ELBOW ADJACENT TO THE SECONDARY HANDHOLE. THE PVC ELBOW IS 45 DEGREE - 24" RADIUS CONDUIT AND THE LOCATION WILL BE DESIGNATED WITH A WARNING STAKE MARKED WITH RED TAPE.
12. DO NOT OPEN THE UTILITY HANDHOLE TO ACCESS THE CONDUIT.
13. METER LOCATION SHALL BE AT LEAST 3' FROM ANY GAS METER, PIPE, OR REGULATOR
14. 6' OF CLEARANCE SHALL BE MAINTAINED BETWEEN ELECTRIC SERVICE CONDUIT AND ANY WATER OR SEWER UTILITIES
15. SEE SECTION 8 FOR ADDITIONAL CLEARANCE REQUIREMENTS.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	3.2	RESIDENTIAL UNDERGROUND SERVICE

RESIDENTIAL
400 AMP SERVICES

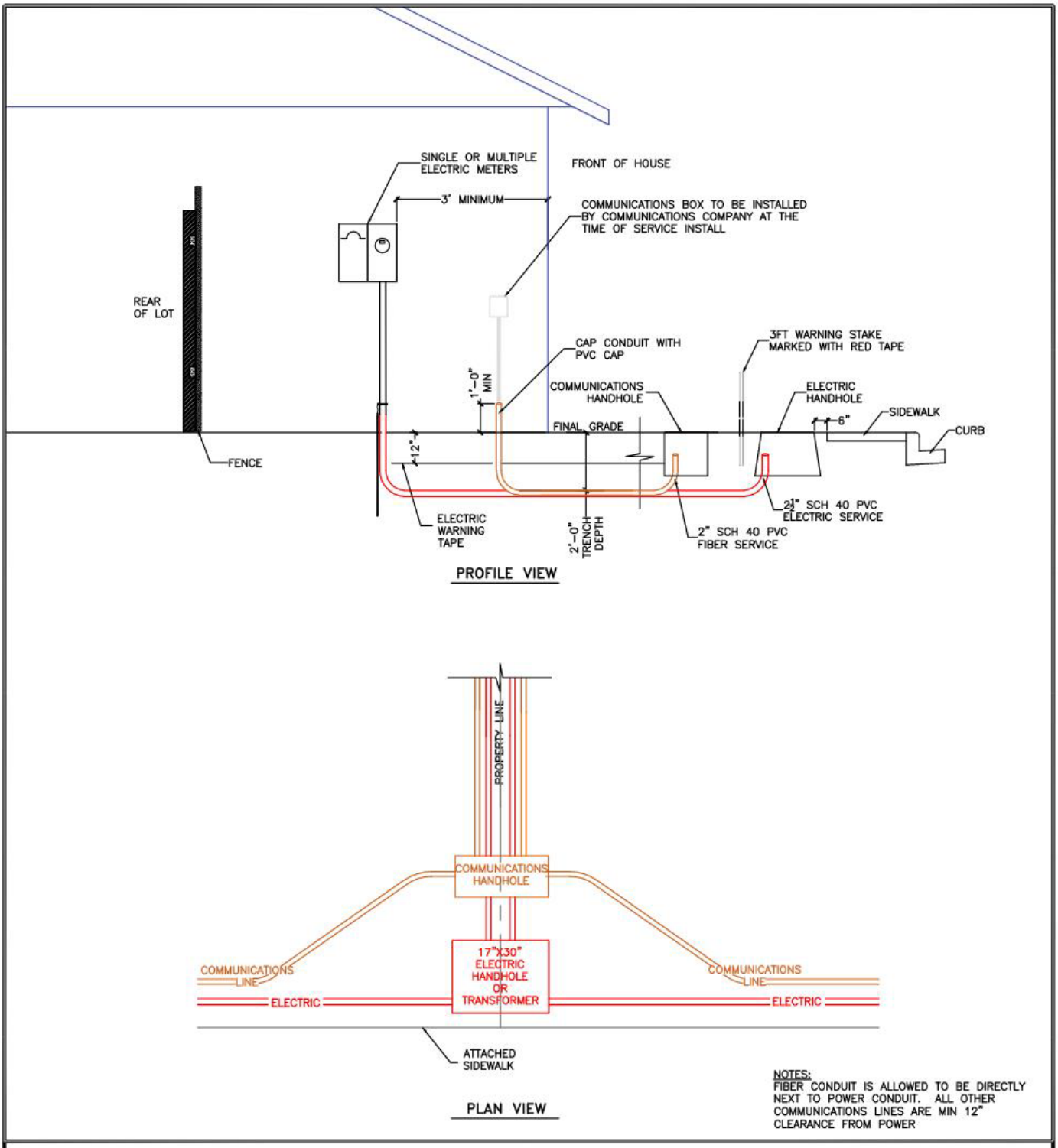


NOTES:

1. FASTEN SECURELY TO WALL PLATE ABOVE FOUNDATION.
2. SINGLE MAIN METER COMBINATION IS REQUIRED IN CASE OF REMOTE METER LOCATION
3. METER LOCATIONS SHALL BE AT LEAST 3' FROM FRONT CORNER OF HOUSE. FENCES SHALL NOT ENCLOSE METER
4. SERVICE ENTRANCE TO BE LOCATED ON THE SIDE OF THE BUILDING CLOSEST TO CITY CONNECTION POINT.
5. NO METERS SHALL BE ABOVE OR BELOW OBSTRUCTIONS INCLUDING WINDOW WELLS, STAIRS AND PLATFORMS.
6. MAIN BREAKER PROVIDED FOR EACH METER, ACCESSIBLE ON OUTSIDE < 10' FROM METER. NO COLD SEQUENCING.
7. PERMANENT LABELS MUST BE FASTENED. SEE METER SECTION 6.
8. ALL NON–CURRENT CARRYING METALLIC PARTS TO BE EFFECTIVELY GROUNDED.
9. METER SOCKET MUST HAVE A LEVER BY–PASS HANDLE AND TWO LINE–SIDE LUGS FOR TERMINATING SERVICE CONDUCTORS.
10. SEE SECTION 6 "METERS AND METER CONNECTIONS"FOR ALL OTHER REFERENCES.
11. CONNECT THE SERVICE CONDUIT TO THE 2 1/2" PVC ELBOWS ADJACENT TO THE TRANSFORMER. THE PVC ELBOW IS 45 DEGREE – 24" RADIUS CONDUIT.
12. DO NOT OPEN THE UTILITY TRANSFORMER TO ACCESS THE CONDUIT.
13. METER LOCATION SHALL BE AT LEAST 3' FROM ANY GAS METER, PIPE, OR REGULATOR
14. 6' OF CLEARANCE SHALL BE MAINTAINED BETWEEN ELECTRIC SERVICE CONDUIT AND ANY WATER OR SEWER UTILITIES
15. SEE SECTION 8 FOR ADDITIONAL CLEARANCE REQUIREMENTS.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	3.3	RESIDENTIAL 400AMP SERVICE



CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	3.4	RESIDENTIAL UNDERGROUND JOINT TRENCH ELECTRIC AND COMMUNICATIONS

Section 4 - Commercial & Industrial

4.1 New or Upgraded Commercial & Industrial Service - General

All non-residential installations as well as residential buildings with three (3) or more units and/or services larger than 400 amps are considered commercial installations and must comply with the requirements of this section. For any solar and DER related installations, please refer to *Section 9 - Interconnection Requirements for Distributed Energy Resources*.

a. ***Underground Commercial Service Requirements***

All new commercial services shall be installed underground. Existing overhead three-phase commercial services being upgraded shall be installed underground. Existing overhead commercial services being upgraded that share a point of service with other customers will be evaluated on a case-by-case basis and may be required to install the service underground. See *Section 1.2.*

b. ***Service Entrance Cable***

Service Entrance Cable shall be installed in conduit.

c. ***Multiple Service Entrances on One Building***

A building shall have only one (1) service entrance per voltage class per building. Multiple service entrances of the same voltage are not allowed.

d. ***Applying for New or Upgraded Commercial & Industrial Service***

The customer must apply for a building permit and pay all associated fees to the Building Division prior to issuance of the building permit. All permits shall be obtained before proceeding with construction. The customer must complete and submit the following items when applying for a permit from the Building Division:

- The Distribution Designer deposit.
  - Please refer to the "Rates, Charges and Fees" for more information regarding the Distribution Designer Deposits.
- Electrical Service Worksheet
- Electrical one-line diagram, panel schedules, and load calculations.
  - All three-phase services or single-phase services that are 100 amps or larger require a stamped, one-line diagram.
- Elevation drawing detailing location of service entrance equipment on building with horizontal and vertical clearances shown from ground level, windows, doors, other utilities, etc.
- Plat and current site improvement/utility plans.
- AutoCAD base drawing file (dwg) that shows all existing and proposed utilities, easements, and property lines. All X-ref's must be bound to the base drawing.
- Cut sheets of meter gear/service entrance equipment for all transformer-rated metering. See section 6.9 – Transformer Rated Metering (CTs & PTs), for CT/PT metering requirements.
- Documentation of exemption approval/denial if an exemption request was previously submitted.

All required items must be submitted to the Loveland Power Division prior to issuing a temporary construction meter and prior to receiving approval for the site work permit. Please E-mail items to powerdevelopment@cityofloveland.org.

Distribution design deposit check may be made out and sent to:

Loveland Water and Power
200 N. Wilson Avenue

Loveland, CO 80537
(**Please reference project name and PZ/Building Permit number**)

Distribution Designers will design the installation and provide an estimated cost. The customer must pay the total estimated cost of the project prior to release of materials or installation. After installation the City shall determine the final cost and the customer will be billed or refunded the difference between the customer's initial deposit for the estimated cost and the actual cost. Typically, the costs of temporary construction power can be included in the cost of the permanent power.

e. ***Utility Locates***
See *Section 1.1.a – Call for Locates*.

f. ***City Furnished Materials & Installation Standards***
For services less than 600 volts and greater than 400 amps, except single-phase and three-phase class 320, the City furnishes the meter socket, current transformers (CT) and potential transformers (PT), where required. The electrical contractor must install the above in accordance with all City standards. CTs/PTs shall not be installed in any transformer but rather in an approved CT (PT – if above 240 volts) enclosure, within 10 feet of the meter on the exterior wall of the building. See *Section 6 - Meters and Meter Connections*, for CT/PT metering requirements.

g. ***Wireways***
Wireways, also known as troughs, gutters, or multiple tap enclosures which are located on the line side of the meter are not allowed. This includes all self-contained and transformer rated metering applications.

h. ***Wiring Standards***
All wiring on the customer side must meet the City's most recently adopted version of the NEC requirements.

i. ***Final Inspection Prior to Meter Installation***
The City will install the meter and instrument wiring, if applicable, upon satisfactory final inspection by the inspecting authority. The installation must conform to all metering requirements before the meter is set. The installation area shall be at final grade and meet all acceptable clearances and guidelines.

j. ***Pre-Construction Meeting***
An on-site pre-construction meeting with the Distribution Designer and the City's construction inspector shall be arranged to determine the start time and construction schedule. All other utility companies shall be notified of the date and time of this meeting by the developer.

k. ***Meter Pedestal Installations***
For meter pedestal installations, see *Drawing No. 6.3* in *Section 6 – Meters and Meter Connections*.

4.2 Commercial & Industrial Services – Underground

c. ***City Work Paid by Customer***
The City shall design, furnish, and energize all primary underground system extensions necessary to provide the desired service including the transformer. The customer bears all costs involved of

such installation including, but not limited to, materials, labor, vehicles, inspection, and engineering. See *Section 6.1 – Metering Requirements* for primary metering.

b. ***City Supplied Subsurface Structures***
The customer or contractor shall install all City supplied subsurface structures required for the primary conductor including conduits and vaults. Refer to *Section 5 – Equipment & Substructure Installation.*

c. ***Customer Supplied Items***
The customer supplies and installs all service cable and conduits from the transformer to the premises in accordance with the NEC and this document.

d. ***Slip Coupling Riser Requirements***
A slip coupling riser is required below the meter. The thread size shall match the meter canister opening. The inside diameter of the slip riser shall be large enough to fit over the conduit. The conduit shall extend the complete length into the slip coupling riser and be fully seated. The slip coupling riser must be securely attached to the structure.

e. ***Demarcation Point***
The demarcation point for underground commercial service is the secondary terminals of the power transformer or secondary connection cabinet. Note that a secondary connection cabinet is allowed only by special approval from the Power Division. The customer owns, installs, and maintains at their expense all wire and equipment past that point, with the exception of the City's metering equipment.

f. ***Underground Service Installations***
For details on installing underground services, refer to *Section 5 – Equipment & Substructure Installation* and *Section 8 - Clearances*.

4.3 Existing Commercial & Industrial Services – Overhead

New overhead services or service upgrades on overhead services are not allowed.

a. ***Demarcation Point***
The point of demarcation for overhead services is the connection at the customer's weatherhead. The City provides, owns, and installs the service wire up to that point. The customer owns, installs, and maintains at their expense all wire and equipment past that point, with the exception of the City's metering equipment.

b. ***Attachment Point Requirements***
The point of attachment height for the service drop conductor on the customer's structure must adequately provide vertical clearances between the service drop and the ground. All clearances must meet the requirements of *Table 8-1* in *Section 8 - Clearances*.

The Contractor must provide a suitable point of attachment for the service drop. The point of attachment must have adequate strength to safely withstand the strain of the service drop.

c. ***Attachment Requirements***
Exercise care when installing vertical risers on brick, concrete block, or similar building walls. The point of attachment must safely withstand the strain imposed by the riser.

When attaching the service drop support to a wooden building, attach the service entrance wire holders to the building studs or other structural support.

Maintaining the attachment point is the responsibility of the owner.

d. ***Keep Area around Service Clear***
No structure or object shall be placed underneath the service without permission from the City.

4.4 Electrical Substructure in New Commercial Subdivisions

Commercial lots with two (2) or more buildings are covered in this section.

a. ***Requirements for Electrical Design & Fees for Commercial Lots with Two (2) or More Buildings***
See *Section 4.1.d* for requirements.

b. ***Eliminating Conflicts with Power Equipment***

- The proposed lot or building layout must be submitted to Power Development at PowerDevelopment@cityofloveland.org for a power equipment design prior to submitting the Civil Construction Plans (CCP) and/or Site Development Plans (SDP).
- Loveland Power will provide the location of the required power infrastructure on the proposed layout and return the layout to the customer.
- The customer's design team must update the drawings to show the proposed power infrastructure and design the wet utility infrastructure to avoid conflicts between the power equipment and wet utility equipment (i.e. meter pits and fire hydrants).
- The CCP & SDP must show the designated power equipment locations with a square containing either a "T" for a transformer, an "H" for a handhole, a "V" for an electric vault, as well as the electric primary power lines and conduits.

Section 5 – Equipment & Substructure Installation

5.1 Trenching - General

a. ***Minimum Separation from Other Utilities***
Refer to *Section 8 – Clearances* for minimum separation between utilities.

b. ***Minimum Separation for Multiple Conduits***
Multiple conduits shall have a minimum separation of three (3) inches (outside wall to outside wall) from the trench wall and to other conduits. Spacers shall be used and supplied by the City. Four or more 6-inch conduits require City specified concrete duct encasement.

c. ***Trench Specifications***
For Trench Specifications see *Drawing No. 5.1.*

d. ***Excavation Requirements***
- All excavation work shall conform to standards and codes set forth in the OSHA, Colorado 811, and City regulations. No more trench shall be opened in advance of conduit installation than is necessary to expedite the work.
- Per Colorado 811's Procedures Guide, "Damage Notification Ticket is processed when any underground facility has been damaged or any unknown and/or unmarked facility has been exposed." The Contractor shall note any unknown and/or unmarked facilities on field drawings.

e. ***Trench Variances***
Trenching shall not vary more than six inches from the centerline designated on the plans. The City will not accept trenching outside of the right-of-way or easement lines.

f. ***Trench Width***
See *Drawing No. 5.1.*

g. ***Trench Bottoms***
Trench bottoms should be level and smooth with well-tamped earth, with no sharp rises or drops in elevation. Trenches shall be free of sharp rocks, other sharp objects, and foreign material.

h. ***Trench Cover***
See *Drawing No. 5.1.*

i. ***Backfill Materials***
Backfill material shall be finely divided and free from debris and organic material. Backfill material shall be placed in uniform layers not exceeding 12 inches in un-compacted thickness. The first lift shall contain no rocks larger than one inch in the greatest dimension. Subsequent lifts shall contain no rocks larger than three inches in the greatest dimension.

j. ***Conduit Bends***
All bends shall be constructed using pre-formed elbows. The contractor shall not heat conduit to create bends.

k. ***Trench Backfill Compaction***
Trench backfill at all depths shall be compacted to 90% of maximum density at a moisture content of +/- 2% of optimum moisture content as determined by ASTM D698 or to that of the surrounding undisturbed earth, whichever is less.

Backfill for trenches traversing sub-grades of roads, parking areas, underground piping, street crossings, and other facilities subject to damage by settlement shall be compacted to 95% of maximum density at a moisture content of +/- 2% of optimum moisture content as determined by ASTM D698.

See *Section 5.3* for areas requiring flowable fill.

l. ***Transformer Pad Location Compaction***
All transformer pad locations, including those for temporary power, shall be constructed per the details provided in Sections 3 and 4. Backfill materials at all depths shall be compacted to 95% of maximum density at a moisture content of +/- 2% of optimum moisture content as determined by ASTM D698 or to that of the surrounding soil.

m. ***Compaction Methods***
The first lift of backfill material shall be mechanically compacted using platform type tampers. Compaction by rolling is allowed for the second lift provided the first lift has been adequately consolidated. Water inundation is not allowed as a method of compaction; however, soil may be dampened prior to backfilling to ensure uniform moisture content and adequate compaction.

n. ***Compaction Tests***
Compaction tests are the responsibility of the developer for substructure installation. The location and depth of all compaction tests will be designated by the inspector and performed in the presence of the inspector unless excused by the inspector. These tests must be conducted by a certified laboratory and signed by a professional engineer registered in the State of Colorado. Test results must be supplied to the Inspector and Distribution Designer prior to final acceptance. Inspectors can designate additional tests at their discretion.

The frequency of the tests is as follows:
- At least one test for every 150 feet of trench or minimum of one test if trench is less than 150 feet (location at inspector's discretion)
- At least three tests at each permanent transformer location – front, back, and one side (location at inspector's discretion)
- At least one test at each temporary transformer location

o. ***Underground Equipment Inspection***
Pull tape must be passed through each empty duct at the time of installation. The pull tape shall be left in each conduit.

p. ***Tracer Wire***
One tracer wire (#12 Red Solid CU THHN) shall be installed with any number of conduits four inches and larger. Tracer wire shall be installed on top of conduit and secured to conduit using duct tape at five-foot intervals. Tracer wire splice shall be in a gel splice kit suitable for underground installation. No tracer wire is needed for CIC installations. Tracer wire must be terminated at test boxes. Test boxes must be grounded at a single side.

5.2 Boring – General

a. ***Description***
The work specified in this section consists of furnishing and installing underground utilities using the directional boring (horizontal directional drilling, HDD) method. The standard material used for boring installations is 4" PVC Bore-Gard conduit which is supplied by the City in 20 ft lengths.

b. ***Boring Fluid (Mud) System***
Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source. No hazardous additives may be used. Boring fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall. Used boring fluid and boring fluid spilled during boring operations shall be contained and properly disposed of. A berm, minimum of 12 inches high, shall be maintained around boring equipment, boring fluid mixing system, entry and exit pits and boring fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess boring fluid from containment areas to storage facilities.

A self-contained, closed, boring fluid mixing system shall be of sufficient size to mix and deliver boring fluid composed of bentonite clay, potable water, and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. Mixing system shall continually agitate the boring fluid during boring operations.

c. ***Equipment***
Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe. Hydraulic or pneumatic pipe rammers or pullers may only be used if necessary and with prior written authorization of the Electrical Engineering group.

d. ***Record Keeping: As-Builts***
Contractor shall maintain a daily project log of boring operations and a guidance system log with a copy given to the Designer at completion of the project. As-built drawings shall be certified as to accuracy by contractor. As-built records shall be provided to the City upon completion of the bore installation.

Third-party verification of as-built drawings may be done at the owner's expense.

e. ***Bore Inspection***
Pull tape must be passed through each empty duct at the time of installation. The pull tape shall be left in each conduit.

5.3 Structural Fill, Flowable Fill, and Concrete Duct Encasement

a. ***Structural Fill***
Structural fill will be used for backfill at all single-phase and three-phase transformer pad installations. See construction details provided at the end of this section and compaction information in *Section 5.1* for additional information. Material shall meet Class 1 Structure backfill, conforming to the latest version of CDOT Standard Specifications.

Class 1 Structure Backfill Material	
Size	Percent Passing
2” (50 mm)	100
#4 (4.75 mm)	30-100
#50 (300 µm)	10-60
#200 (75 µm)	5-20
In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T 89 and T 90 respectively.	

b. ***Areas Requiring Flowable Fill***

Flowable fill shall be required under all streets, parking lots and alleyways. Flow fill to within 12 inches from top of subgrade and from right-of-way to right-of-way.

c. ***Flow Fill***

Flow fill shall have a slump of nine (9) inches when tested in accordance with ASTM C143. Material shall conform to the latest version of CDOT Standard Specification.

Mix Proportions (Per Cubic Yard of Concrete)	
Cement .50 sack	0.15 Ft.^{3}
Flyash – 50% Replacement	0.12 Ft.^{3}
3/8" Aggregate, ASTM C 33 Size No. 67	3.97 Ft.^{3}
3/4" Aggregate, ASTM C 33 size No. 67	6.22 Ft.^{3}
Sand - ASTM C 33	10.69 Ft.^{3}
Water 35 gals	4.68 Ft.^{3}
Air 3%	1.35 Ft.^{3}
Total	27.18 Ft.^{3}
Slump	9”
State Spec Flow Fill Minimum 28-Day Compressive Strength - 60 PSI Maximum Aggregate Size - 3/4" – ASTM/AASHTO Size No. 67 Blend Type I - II Portland Cement GCC ASTM C 150	

d. ***Concrete Duct Encasement***

Concrete duct encasement shall be designed to provide mechanical protection of the duct banks, to provide a controlled soil resistivity, and to thermally conduct heat away from the power cables. The concrete shall flow in and around the conduit leaving no gaps or air spaces.

Mix Design and Performance Requirements	
Application	Duct Bank Encasement Concrete
7 day Strength	Min; 2,000 psi
28 day Strength	Min: 3,000 psi
Max Aggregate Size	3/8”

Slump-at point of placement	Min: 7” Max: 9”
Cement	Min cement content: 4 sacks/cu. yd.

e. ***Crushed Rock***

Crush rock shall be a well-graded crushed stone or gravel, conforming to CDOT Table 703-1 No. 67.

Crushed Rock	
Size	Percent Passing
1” (25 mm)	100
3/4” (19 mm)	90-100
3/8” (9.5 mm)	20-55
#4 (4.75 mm)	0-10
#8 (2.36 mm)	0-5

5.4 Cable Handling

a. ***Unloading Cable Requirements***

Unloading of cable shall be accomplished without contacting the cable or outer covering or supporting the weight of the reel on the cable or covering. This precludes the use of a web sling or inappropriate use of a forklift or crane.

b. ***No Dropping Cable Reels***

Under no circumstances shall reels be dropped from the delivering vehicle to the ground.

c. ***Cable Reel Storage Requirements***

- Reels shall be stored on a hard surface in the upright position. Do not allow the flanges of the reel to sink into a soft surface allowing the weight to be supported on the cable.
- Cable must not come in contact with chemicals or petroleum products.
- Cable shall be stored where it cannot be damaged by construction equipment and flying debris.

d. ***Rolling Cable Reel Requirements***

When rolling reels, clear the path of any objects that could come in contact with the cable.

e. ***Seal Cable Ends***

Exposed cable ends shall be sealed with an appropriately sized cold shrink end cap to prevent environmental and mechanical damage to the cable.

f. ***Cable-in-Conduit Length for Vaults***

Leave a minimum of 25 feet of cable only, not conduit (see *Drawing No. 5.14*), past the inside face of the vault.

g. ***Cable-in-Conduit Handling Guidelines***

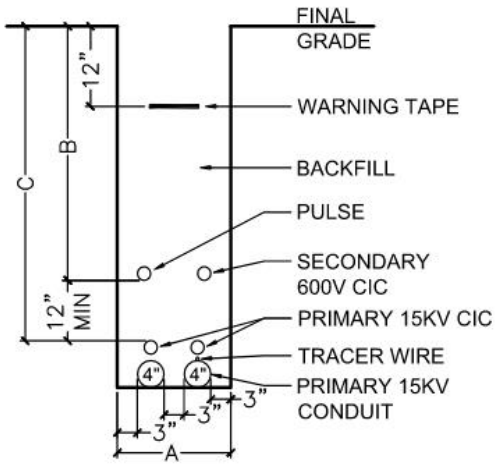
Reference *Drawings 5.2, 5.3, 5.4*, and *5.5* for proper handling of cable-in-conduit. Also see below table for bend radius requirements:

CIC Bending Radius Table

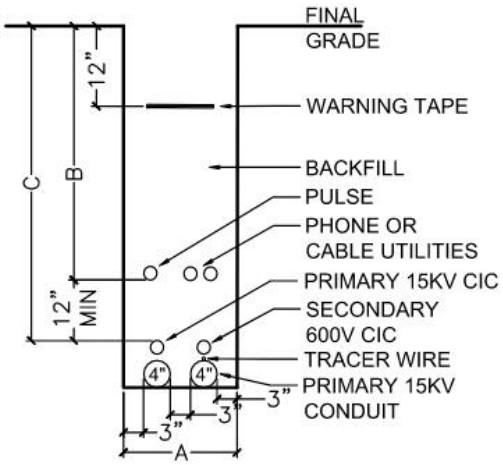
Cable Type	HDPE Conduit Diameter (inches)	Bending Radius Supported (inches)	Bending Radius Unsupported (inches)	Sidewall Pressure (lbs.)
1/0 15kV Full Neutral Primary	1.5	19	38	1507
6 duplex secondary	0.75	10	20	570
1/0 triplex secondary	1.5	19	38	1867
4/0 triplex secondary	2	24	48	2917
350 kcmil triplex secondary	2	24	48	2917

TRENCH DETAILS

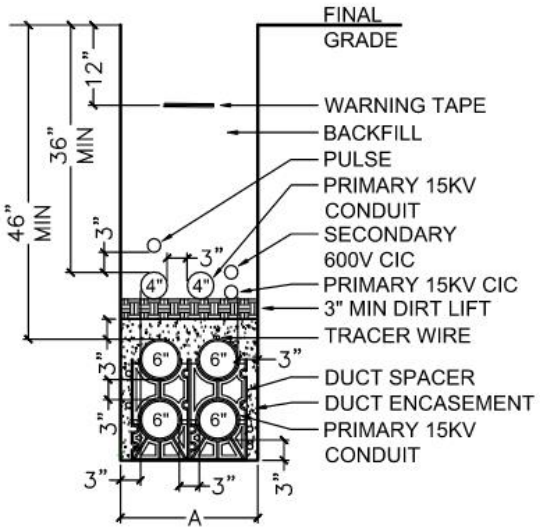
STANDARD TRENCH



JOINT TRENCH WITH OTHER UTILITIES



DUCT ENCASEMENT



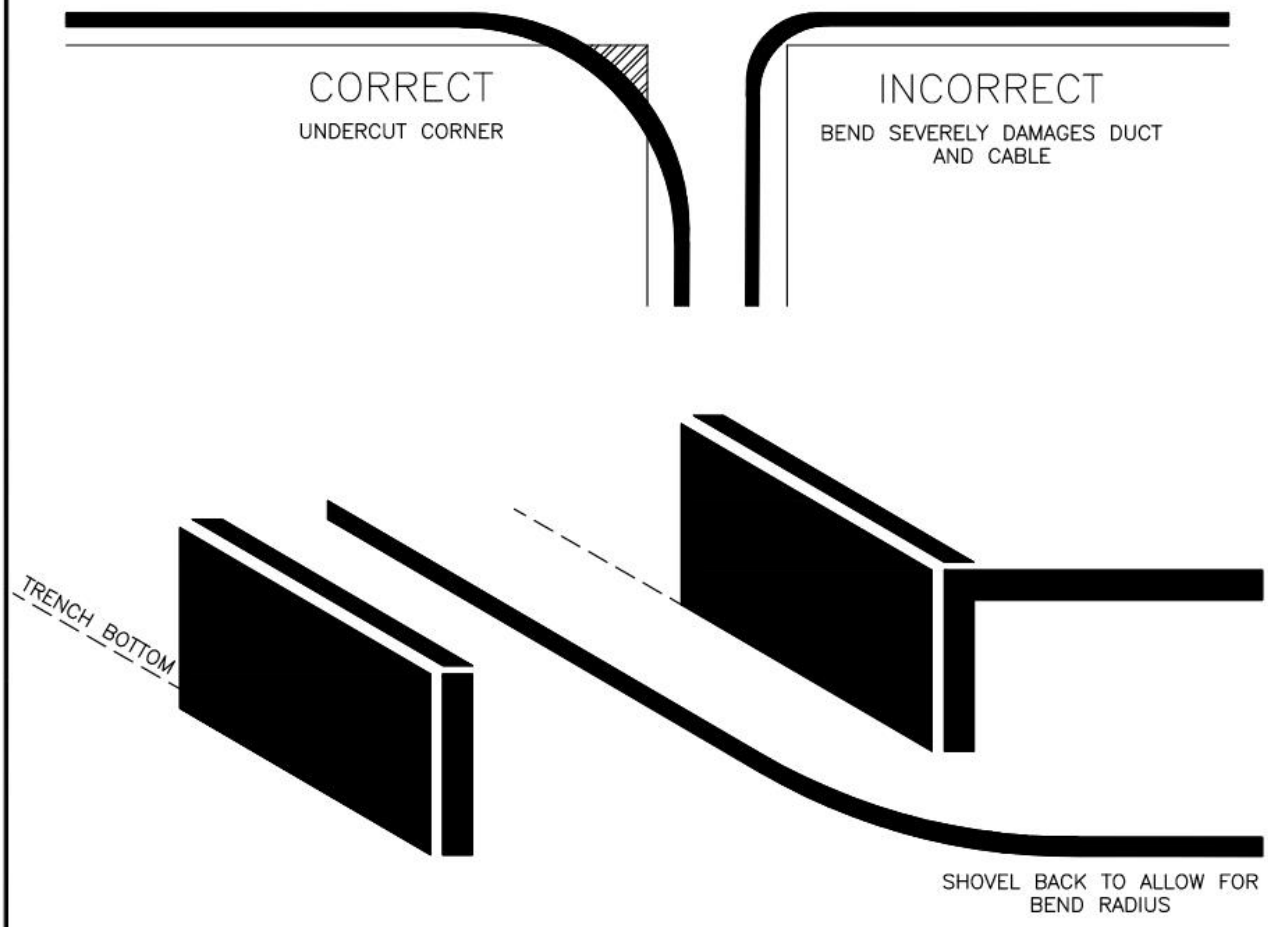
	MIN	MAX
A	8"	24"
B	30"	36"
C	42"	48"

NOTES:
1. JOINT TRENCH NOT PERMITTED IN 3 PHASE RESIDENTIAL TRENCHES AND DUCT ENCASEMENT INSTALLATIONS
2. SEE SECTION 5.1 FOR TRENCH BACKFILL COMPACTION REQUIREMENTS.
3. SEE SECTION 5.3 FOR AREAS REQUIRING FLOWABLE FILL.
4. DUCT ENCASEMENT IS REQUIRED WHEN THERE ARE FOUR OR MORE 6" CONDUITS.
5. DUCT SPACERS ARE REQUIRED EVERY 5' WITH ALL 6" CONDUIT.
6. REFER TO SECTION 8 FOR UTILITY CROSSING DETAILS.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.1	TRENCH DETAILS

TRENCH INSTALLATION: CABLE - IN - CONDUIT



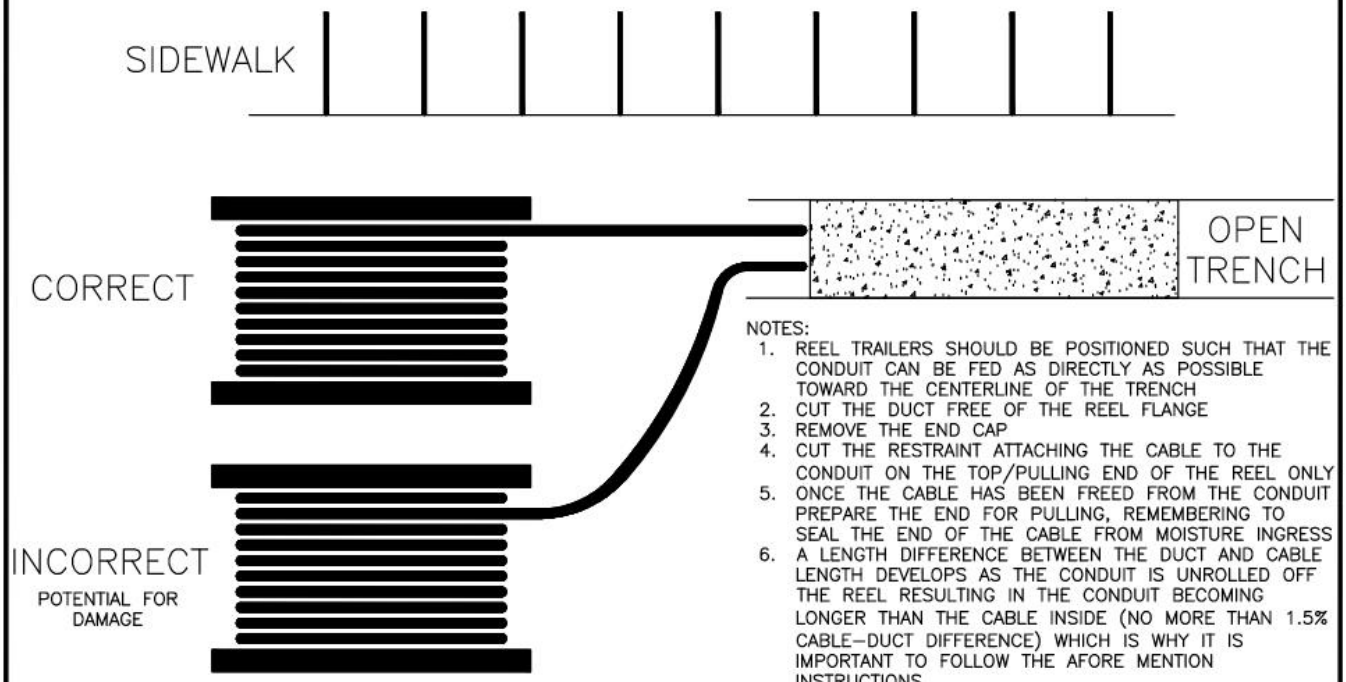
NOTES:

1. EVERY DEVIATION IN ELEVATION OR DIRECTION WILL HAVE A NEGATIVE IMPACT ON CABLE REPLACEMENT TENSION
2. PROPER TRENCH PREPARATION ASSURES THE LEAST RESISTANCE TO CABLE PULLING
3. THE NUMBER OF 90° BENDS SHOULD BE LIMITED TO A MAXIMUM OF 4
4. IN GENERAL CABLE–IN–CONDUIT SHOULD BE INSTALLED IN THE TRENCH AS STRAIGHT AS POSSIBLE WITH AS FEW BENDS AS POSSIBLE
5. MINIMIZE THE SEVERITY OF A BEND WHEN A CHANGE IN DEPTH IS NECESSARY
6. PROVIDE A GRADUAL TRANSITION FROM BORE PITS TO DESIRED TRENCH DEPTH AND WHEN FORCED TO DEVIATE AROUND OBSTACLES
7. WHEN RAPID GRADE CHANGES EXIST, USE SHADING OR BACKFILL TO MAKE THE CHANGE AS GRADUAL AS POSSIBLE
8. INTERSECTIONS OF TRENCH LINES WHERE THE CABLE–IN–CONDUIT IS TO TAKE A CORNER NEED TO BE UNDERCUT AT A BURIAL DEPTH TO PROVIDE FOR THE MINIMUM BENDING RADIUS OF THE CONDUIT

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.2	TRENCH INSTALLATION: CABLE - IN - CONDUIT

REEL TRAILER POSITION: CABLE - IN - CONDUIT



NOTES:

1. REEL TRAILERS SHOULD BE POSITIONED SUCH THAT THE CONDUIT CAN BE FED AS DIRECTLY AS POSSIBLE TOWARD THE CENTERLINE OF THE TRENCH
2. CUT THE DUCT FREE OF THE REEL FLANGE
3. REMOVE THE END CAP
4. CUT THE RESTRAINT ATTACHING THE CABLE TO THE CONDUIT ON THE TOP/PULLING END OF THE REEL ONLY
5. ONCE THE CABLE HAS BEEN FREED FROM THE CONDUIT PREPARE THE END FOR PULLING, REMEMBERING TO SEAL THE END OF THE CABLE FROM MOISTURE INGRESS
6. A LENGTH DIFFERENCE BETWEEN THE DUCT AND CABLE LENGTH DEVELOPS AS THE CONDUIT IS UNROLLED OFF THE REEL RESULTING IN THE CONDUIT BECOMING LONGER THAN THE CABLE INSIDE (NO MORE THAN 1.5% CABLE–DUCT DIFFERENCE) WHICH IS WHY IT IS IMPORTANT TO FOLLOW THE AFORE MENTION INSTRUCTIONS

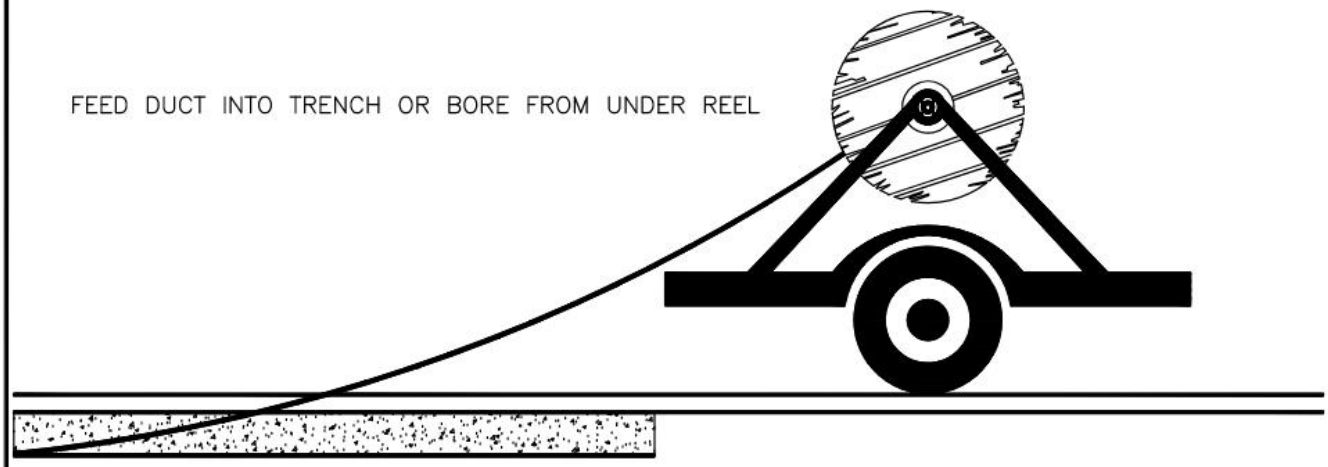
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.3	REEL TRAILER POSITION: CABLE - IN - CONDUIT

REEL PAYOFF: CABLE-IN-CONDUIT

GENERAL NOTES

1. THE PAYOFF OF THE CONDUIT FROM THE REEL NEEDS TO BE DETERMINED PRIOR TO THE REEL BEING PLACED ON THE REEL TRAILER
2. REVERSE BENDING OF THE CONDUIT NEEDS TO BE AVOIDED
3. IN OPEN TRENCH CONSTRUCTIONS OR DIRECTIONAL BORING APPLICATIONS FEED THE CONDUIT FROM BELOW THE REEL DRUM INTO THE TRENCH OR BORE OPENING (SEE FIGURE BELOW)
4. WHEN FEEDING INTO A HANDHOLE OR VAULT FEED THE CONDUIT FROM OVER THE TOP OF THE DRUM INTO A GUIDE



CITY OF LOVELAND WATER & POWER

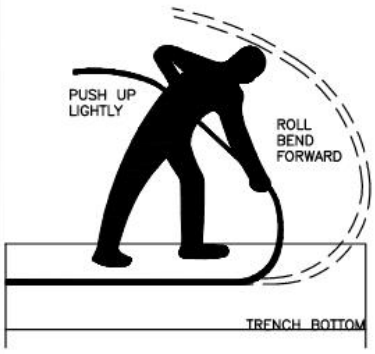
Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.4	REEL PAYOFF: CABLE-IN-CONDUIT

BENDING CABLE-IN-CONDUIT

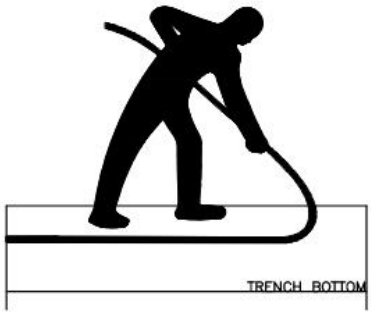
GENERAL NOTES

1. CABLE–IN–CONDUIT DOES NOT REQUIRE PREFORMED BENDS OR SWEEPS
2. BENDS REQUIRED TO SWEEP UP INTO PEDESTALS OR TRANSFORMER PADS CAN BE FORMED WITHOUT THE USE OF A HEAT SOURCE OR ADDITIONAL TOOLS
3. FORM THE SWEEP BY BENDING THE CONDUIT BACK OVER ITSELF FORMING A HORIZONTAL 'U' BEYOND THE DESIRED ANGLE. BE CAREFUL NOT TO BE LESS THAN THE MINIMUM BENDING RADIUS FOR THE CONDUIT AND THEN RETURN TO THE VERTICAL POSITION IN THE DESIRED LOCATION
4. BACKFILL UNDER THE BEND TO SUPPORT THE CONDUIT
5. FOR ALL 90° TURNS OR SEVERE BENDS IN THE TRENCH, THE BOTTOM CORNER OF THE TRENCH MUST BE UNDERCUT SUCH THAT THE MINIMUM BENDING RADIUS OF THE CONDUIT IS NOT VIOLATED (SEE DRAWING 5.16 FOR TRENCH DETAIL AND SECTION 5.4G FOR BENDING RADIUS TABLE)

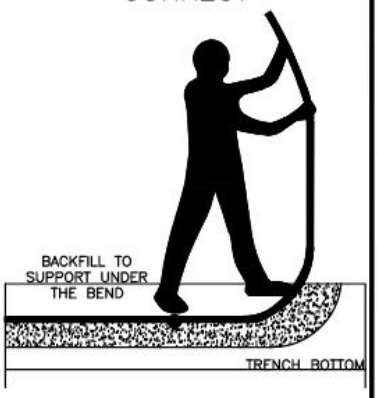
CORRECT



INCORRECT



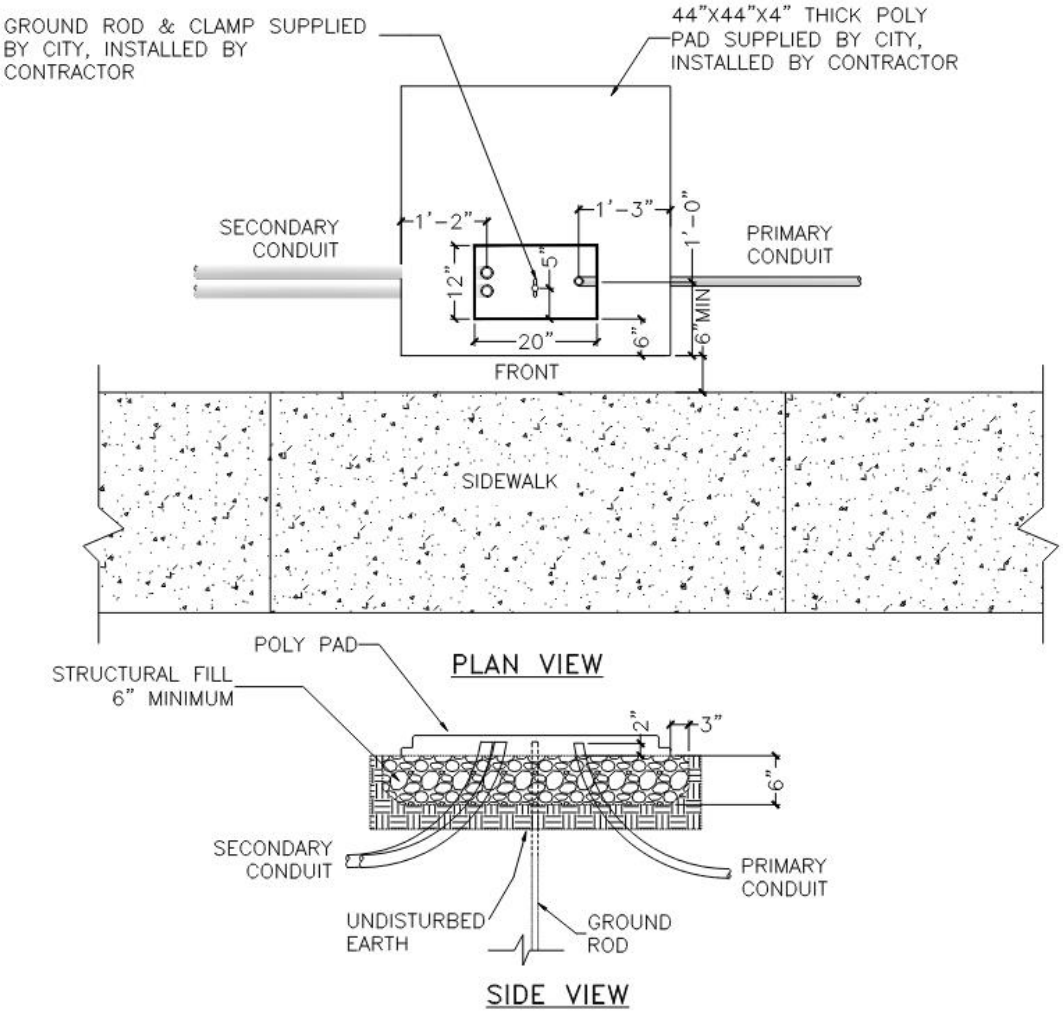
CORRECT



CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.5	BENDING CABLE-IN-CONDUIT

SINGLE PHASE TRANSFORMER FOR TEMPORARY SERVICE

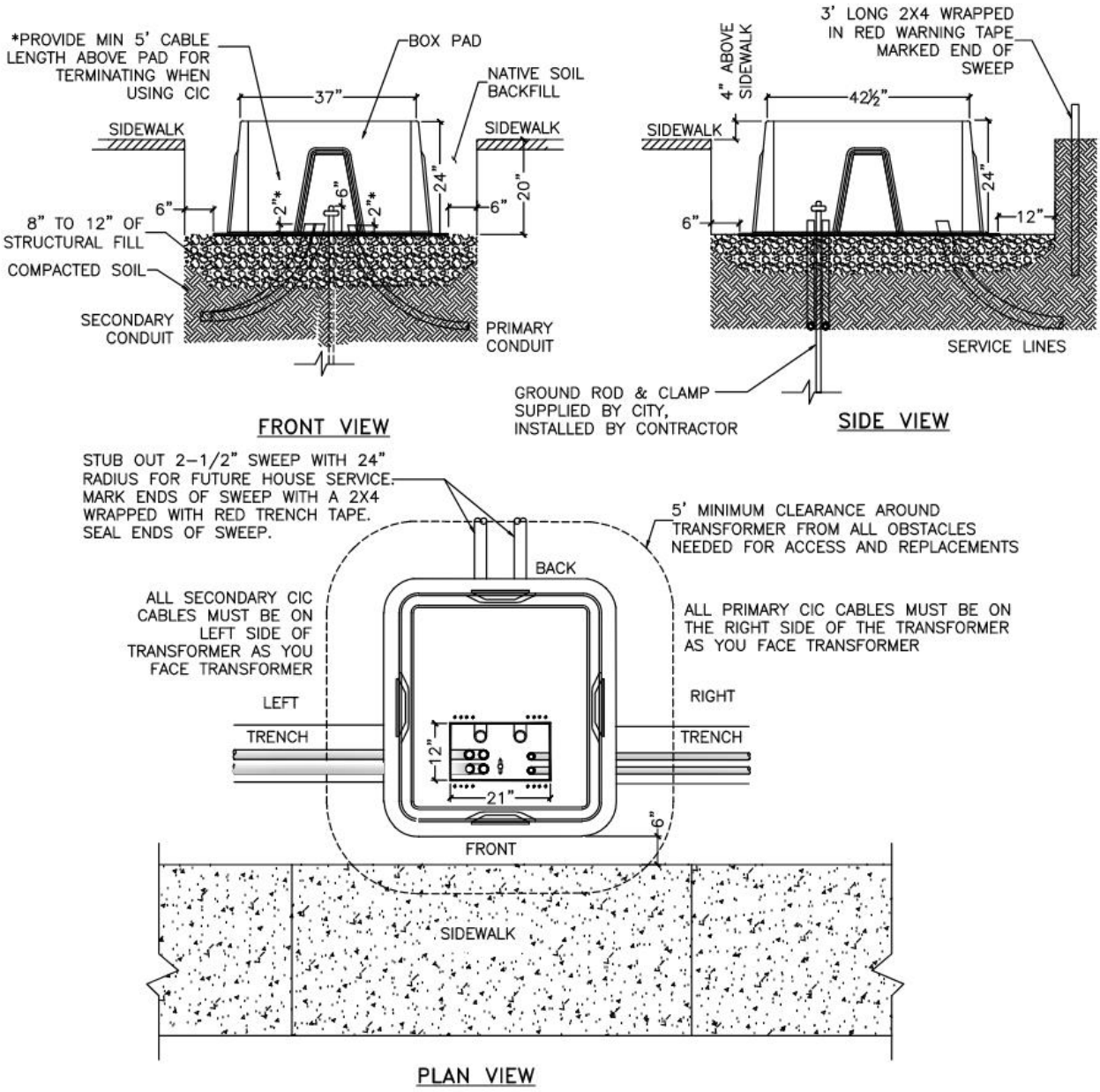


NOTES:
1. PROVIDE MIN 5' CABLE LENGTH ABOVE PAD FOR TERMINATING WHEN USING CIC.
2. 6" MINIMUM DISTANCE FROM SIDE WALKS.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.6	SINGLE PHASE TRANSFORMER FOR TEMP SERVICE

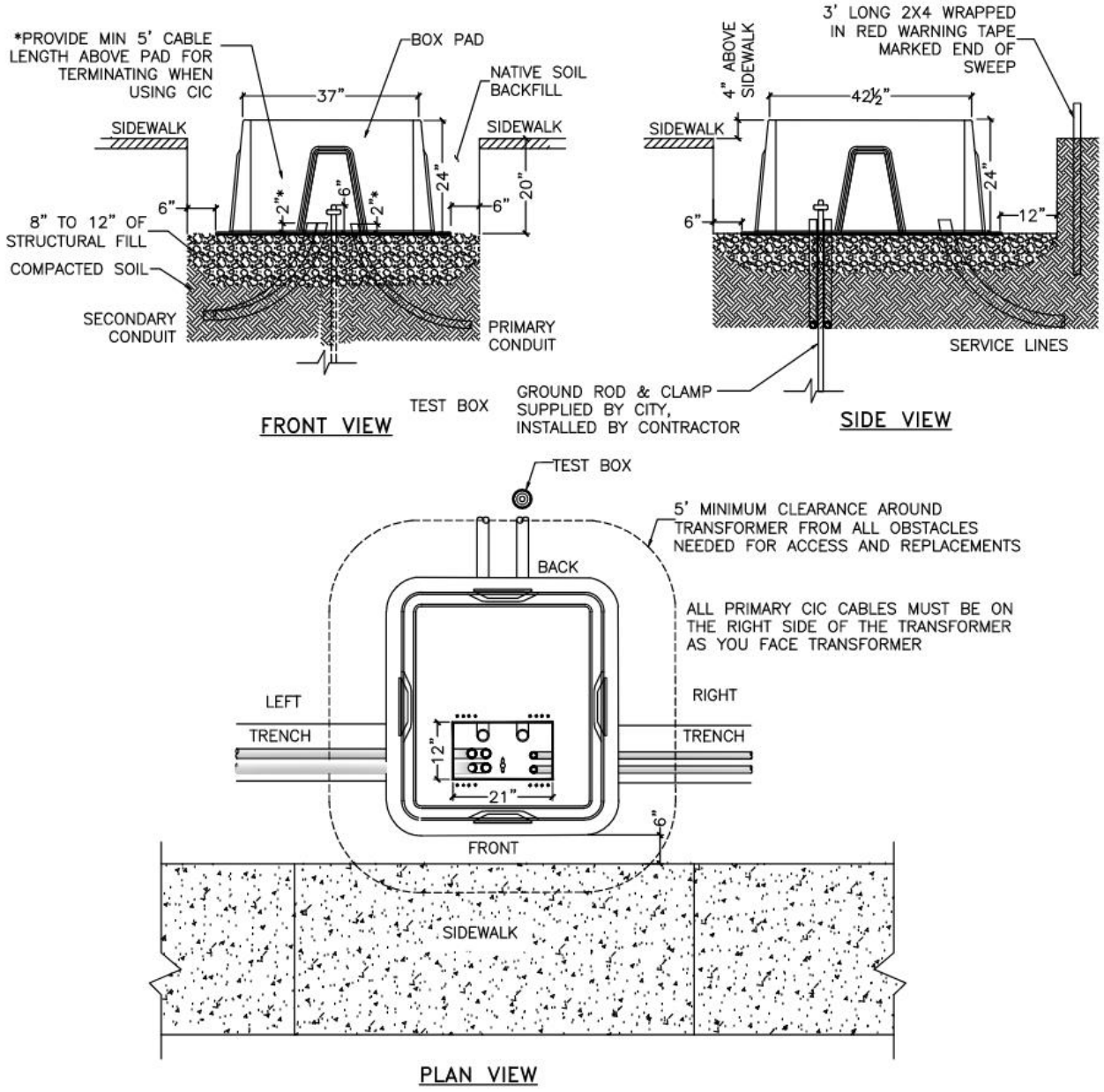
RESIDENTIAL SINGLE PHASE TRANSFORMER WITH BOX PAD



CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.7	RESIDENTIAL SINGLE PHASE TRANSFORMER BOX PAD

COMMERCIAL SINGLE PHASE TRANSFORMER WITH BOX PAD

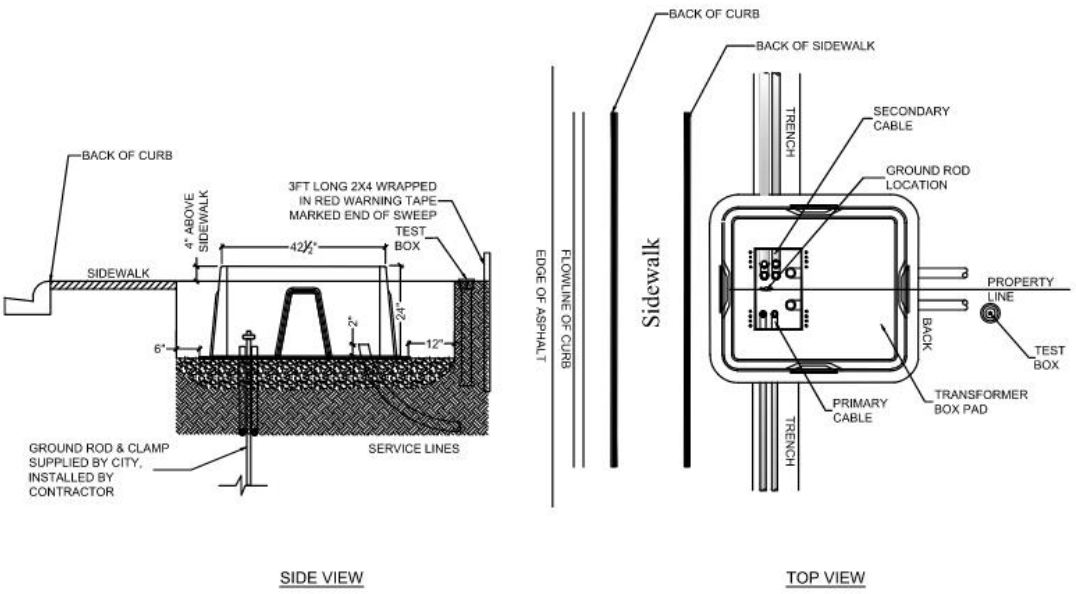


CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.8	COMMERCIAL SINGLE PHASE TRANSFORMER BOX PAD

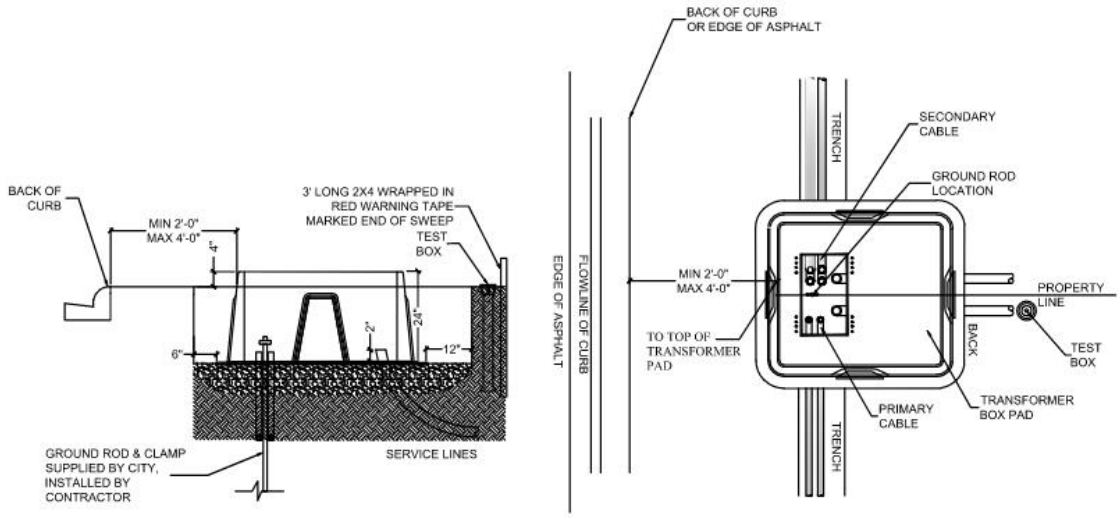
TRANSFORMER BOX PAD LOCATION

WITH SIDEWALK



SIDE VIEW TOP VIEW

WITHOUT SIDEWALK OR DETACHED SIDEWALK



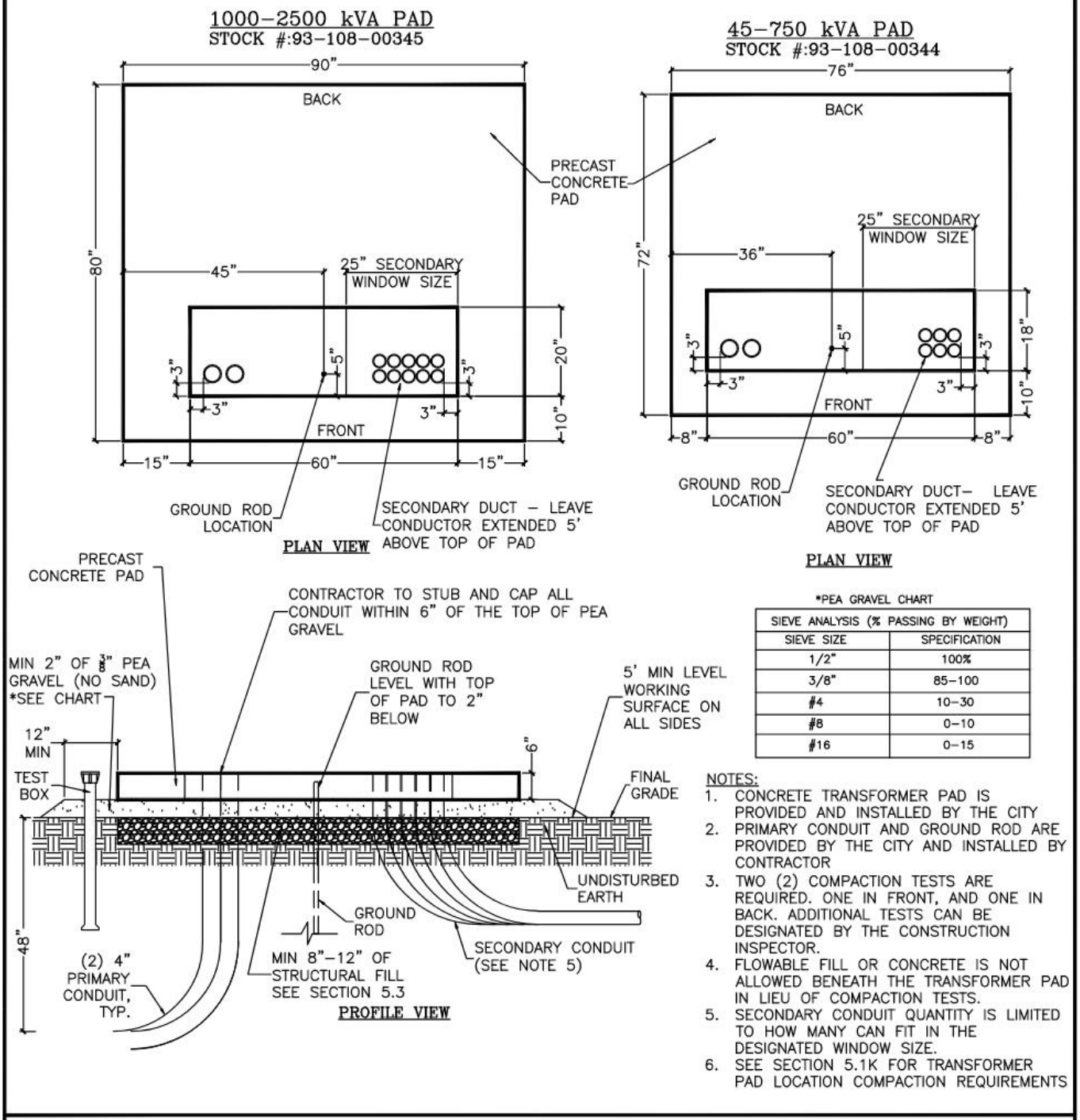
NOTES:
1. STREETLIGHT POLES ARE NOT ALLOWED AT TRANSFORMER LOCATIONS IN RESIDENTIAL AREAS

SIDE VIEW TOP VIEW

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.9	TRANSFORMER BOX PAD LOCATION

THREE PHASE TRANSFORMER INSTALLATION



*PEA GRAVEL CHART

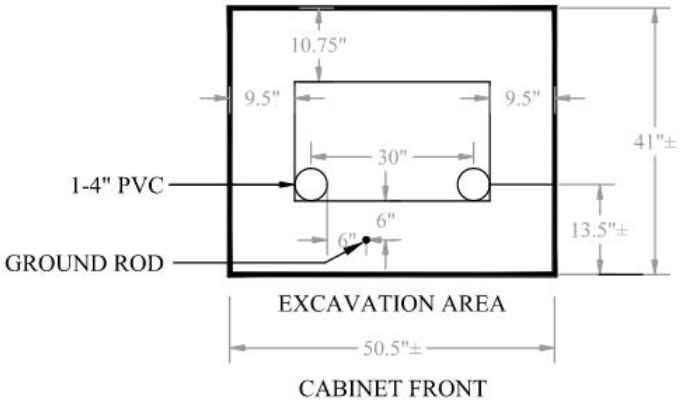
SIEVE ANALYSIS (% PASSING BY WEIGHT)	
SIEVE SIZE	SPECIFICATION
1/2"	100%
3/8"	85–100
#4	10–30
#8	0–10
#16	0–15

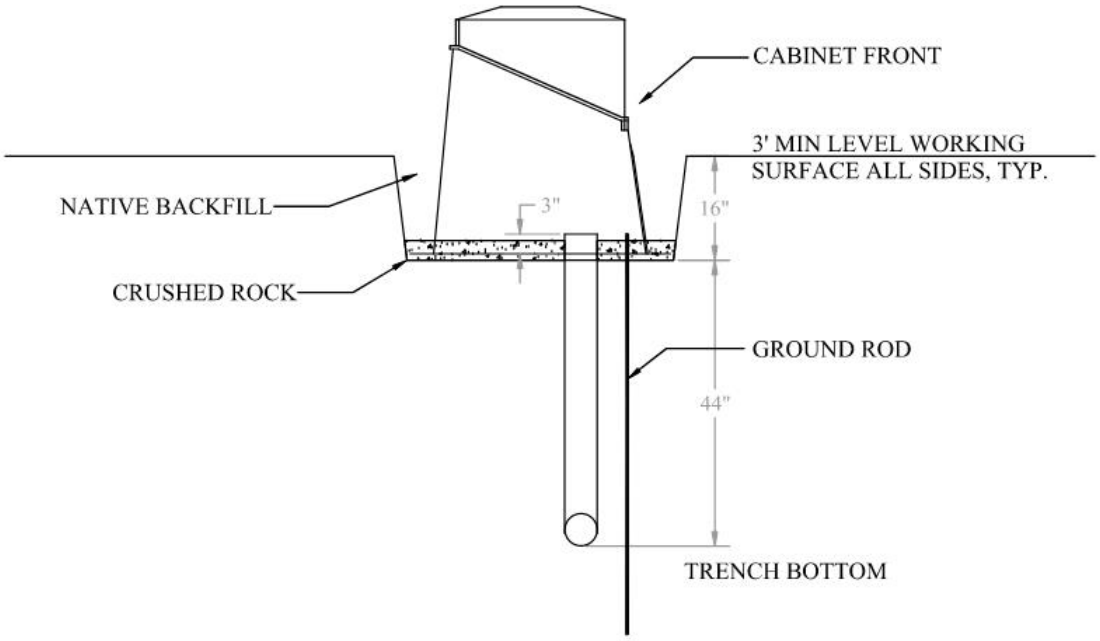
NOTES:
1. CONCRETE TRANSFORMER PAD IS PROVIDED AND INSTALLED BY THE CITY
2. PRIMARY CONDUIT AND GROUND ROD ARE PROVIDED BY THE CITY AND INSTALLED BY CONTRACTOR
3. TWO (2) COMPACTION TESTS ARE REQUIRED. ONE IN FRONT, AND ONE IN BACK. ADDITIONAL TESTS CAN BE DESIGNATED BY THE CONSTRUCTION INSPECTOR.
4. FLOWABLE FILL OR CONCRETE IS NOT ALLOWED BENEATH THE TRANSFORMER PAD IN LIEU OF COMPACTION TESTS.
5. SECONDARY CONDUIT QUANTITY IS LIMITED TO HOW MANY CAN FIT IN THE DESIGNATED WINDOW SIZE.
6. SEE SECTION 5.1K FOR TRANSFORMER PAD LOCATION COMPACTION REQUIREMENTS

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.10	THREE PHASE TRANSFORMER INSTALLATION

SINGLE PHASE SECTIONALIZING CABINET





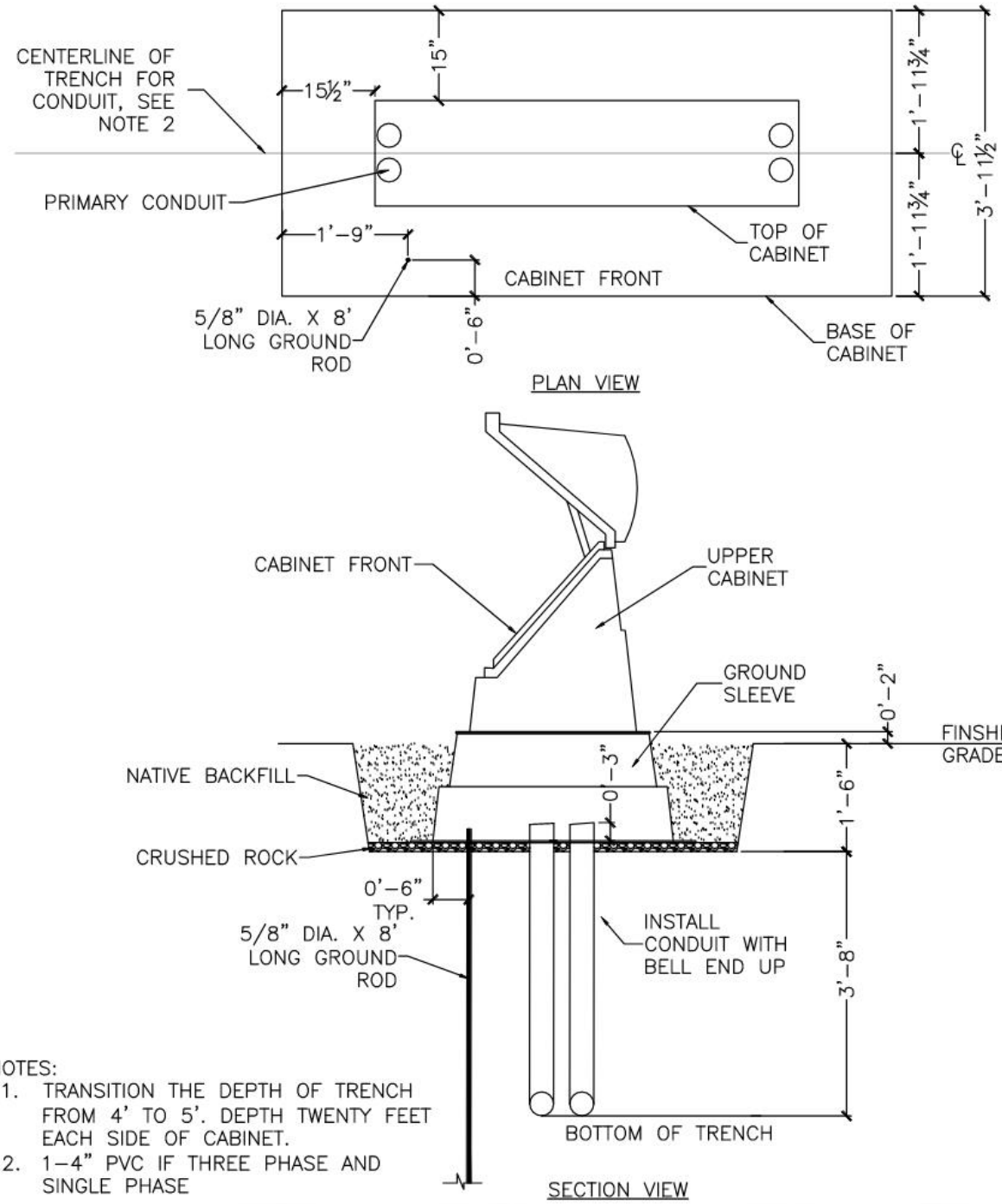
NOTES:

1. TRANSITION THE TRENCH DEPTH FROM 4' TO 5' STARTING AT 20' FROM EACH SIDE OF THE CABINET

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.11	SINGLE PHASE SECTIONALIZING CABINET

THREE PHASE SECTIONALIZING CABINET

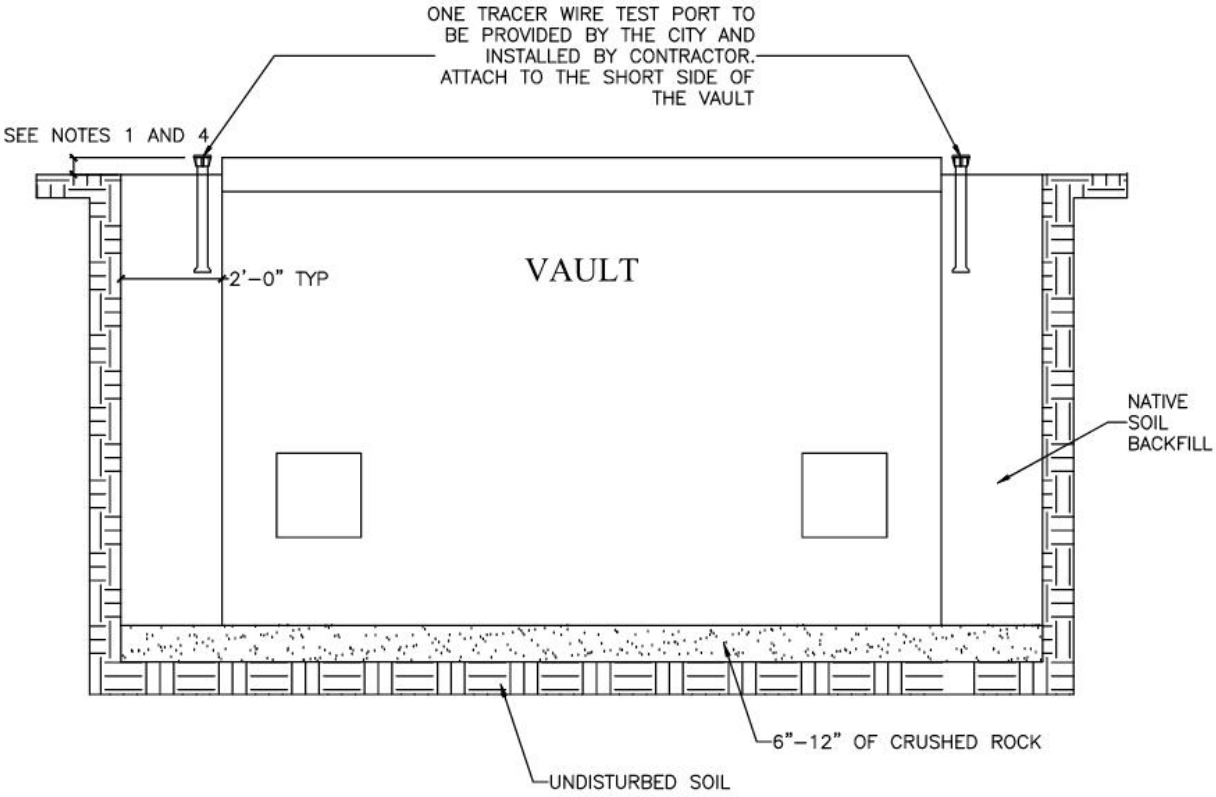


NOTES:
1. TRANSITION THE DEPTH OF TRENCH FROM 4' TO 5'. DEPTH TWENTY FEET EACH SIDE OF CABINET.
2. 1–4" PVC IF THREE PHASE AND SINGLE PHASE

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.12	THREE PHASE SECTIONALIZING CABINET

VAULT DETAILS

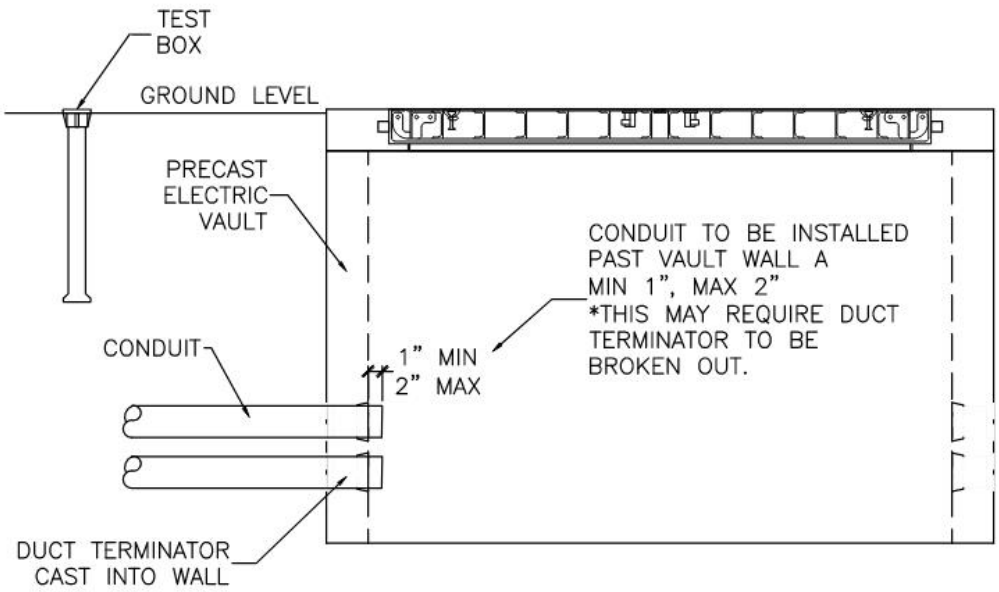


NOTES:
1. IF VAULT IS TO BE PLACED NEAR A SIDEWALK, ALONG CURB OR OTHER PAVED AREAS, KEEP TOP OF LID LEVEL WITH TOP OF CURB, WALK OR ASPHALT.
2. EXCAVATIONS SHALL EXCEED THE OUTSIDE VAULT WALL DIMENSIONS BY TWO (2) FEET ON ALL SIDES TO PROVIDE FOR TAMPING.
3. EXCAVATION BACKFILL AT ALL DEPTHS SHALL BE COMPACTED TO NOT LESS THAN 90% OF MAXIMUM DENSITY AS DEFINED BY ASTM D698 STANDARD PROCTOR.
4. TOP OF LID SHALL BE 6" ABOVE FINAL GRADE WHEN INSTALLED IN NON-PAVED LOCATIONS.
5. SEE SECTION 8.1 FOR LANDSCAPING CLEARANCE.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.13	VAULT DETAILS

CONDUIT DETAIL



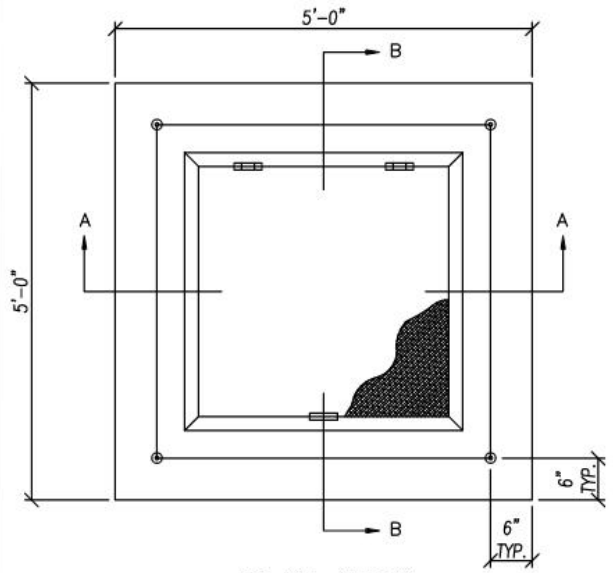
SECTION VIEW

NOTES:
1. THE ENDS OF THE CONDUIT INSIDE THE VAULT SHALL BE DEBURRED, CUT SQUARE, AND SECURED WITH SPRAY FOAM.
2. THE CONDUCTOR SHALL BE EXTENDED PAST THE CONDUIT INTO THE VAULT BY A MIN OF 25FT.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.14	Vault Details - Conduit Detail

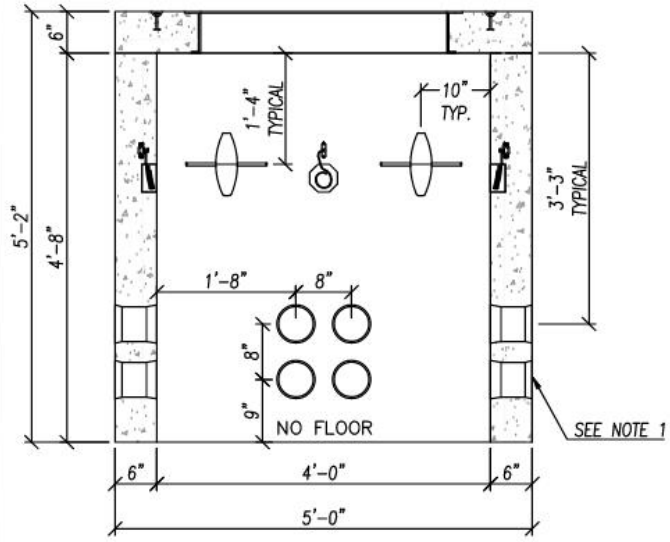
5'X5' VAULT



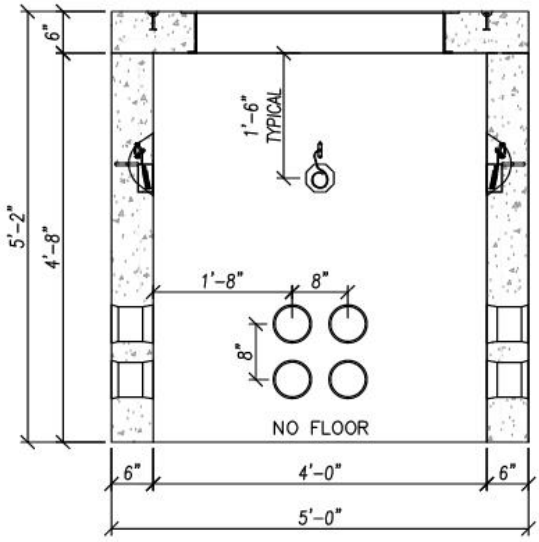
PLAN VIEW

NOTES:

1. 5" DUCT TERMINATORS TO ACCOMMODATE 5" SCH 40 PVC
1. LID WEIGHS APPROXIMATELY 1,200 LBS
   WALLS WEIGH APPROXIMATELY 6,100 LBS



SECTION A–A



SECTION B–B

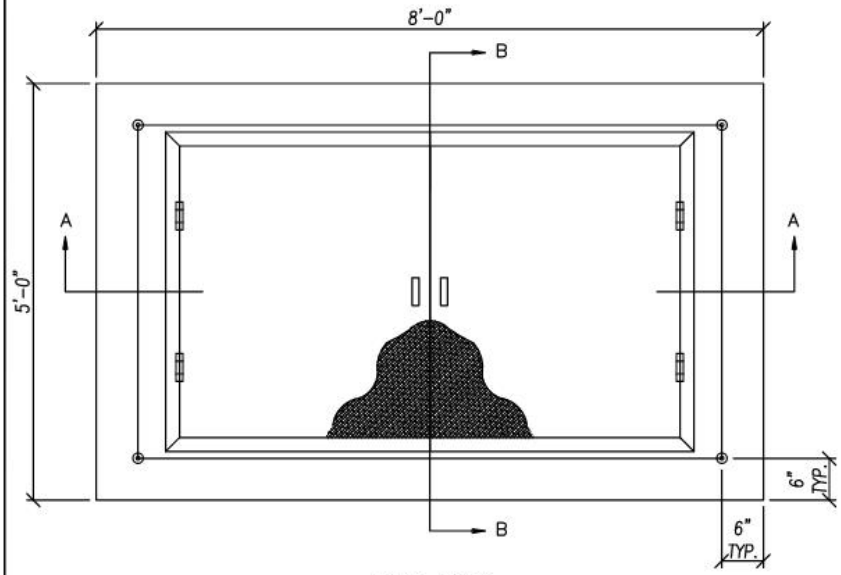
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.15	5'X5' VAULT

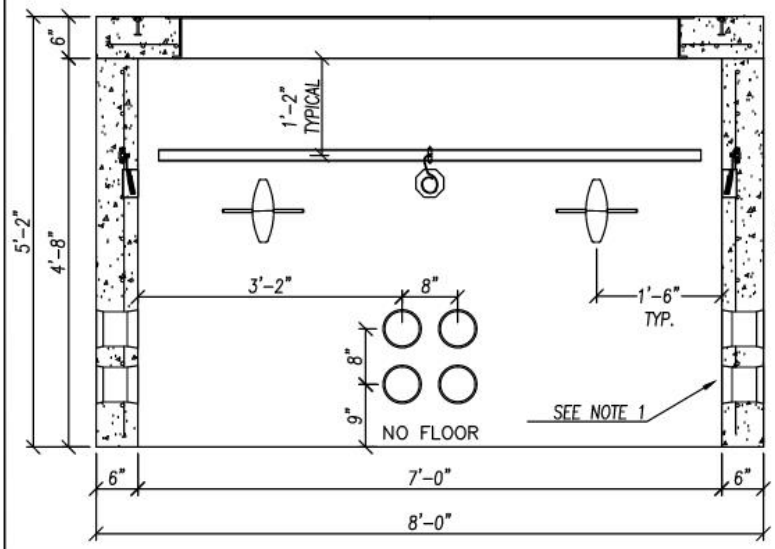
5'X8' VAULT

NOTES:

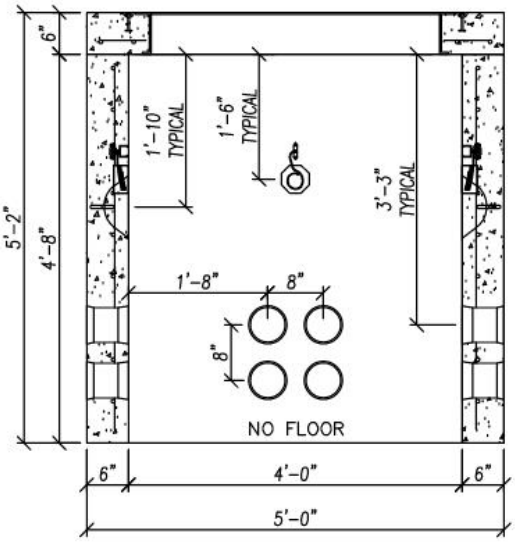
1. 5" DUCT TERMINATORS TO ACCOMMODATE 5" SCH 40 PVC
2. LID WEIGHS APPROXIMATELY 1,300 LBS
   WALLS WEIGH APPROXIMATELY 8,200 LBS



PLAN VIEW



SECTION A–A



SECTION B–B

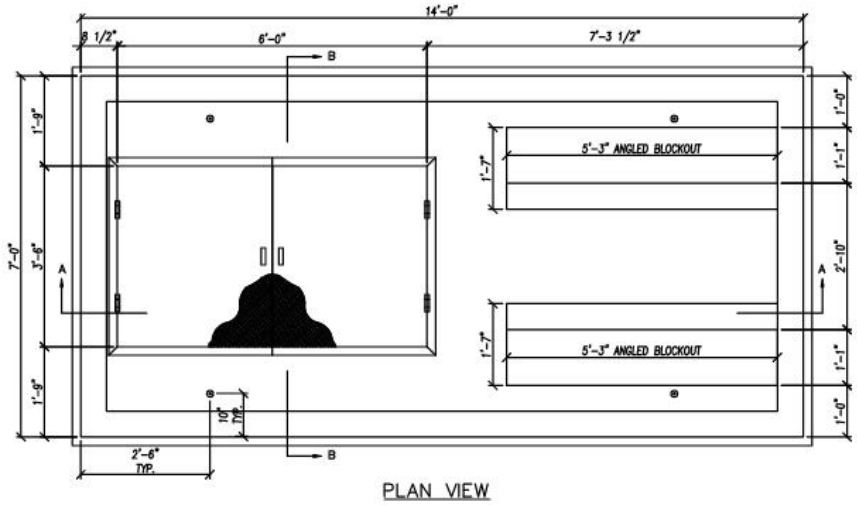
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.16	5'X8' VAULT

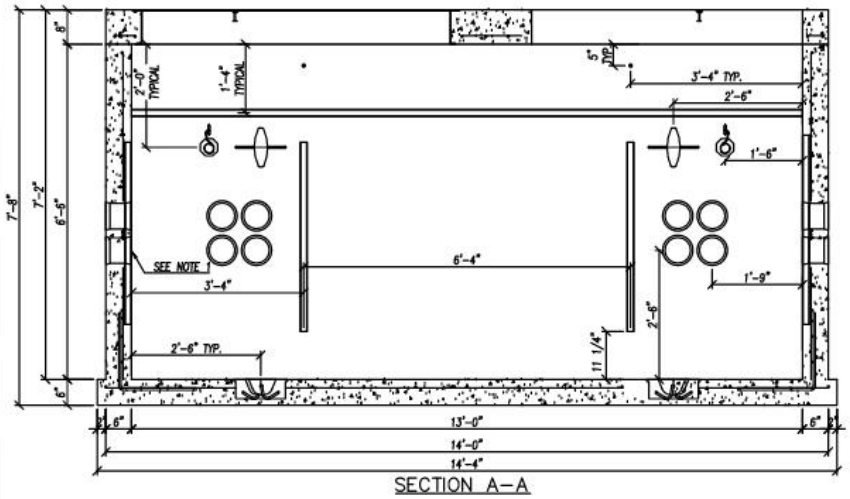
7'X14' SWG VAULT

NOTES:

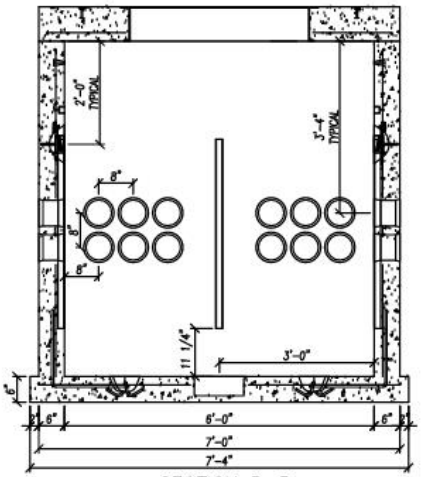
1. 5" DUCT TERMINATORS TO ACCOMMODATE 5" SCH 40 PVC
2. LID WEIGHS APPROXIMATELY 7,000 LBS
   WALLS WEIGH APPROXIMATELY 26,200 LBS



PLAN VIEW



SECTION A–A



SECTION B–B

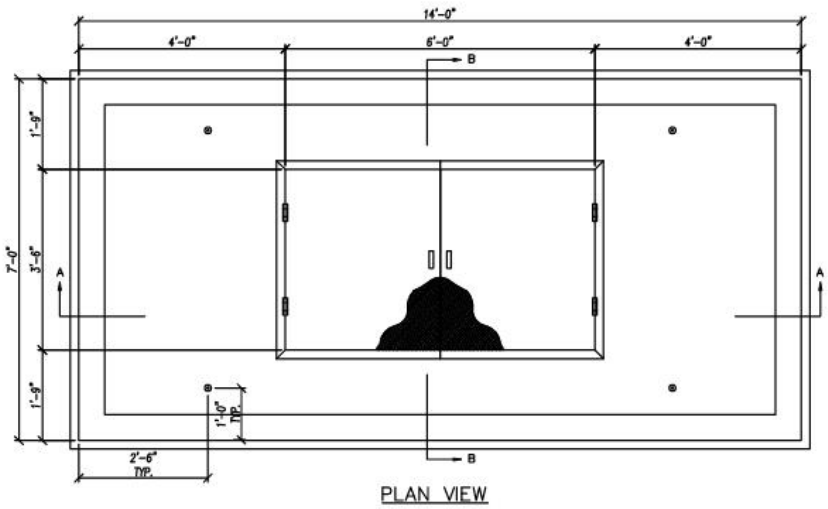
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.17	7'X14' SWG VAULT

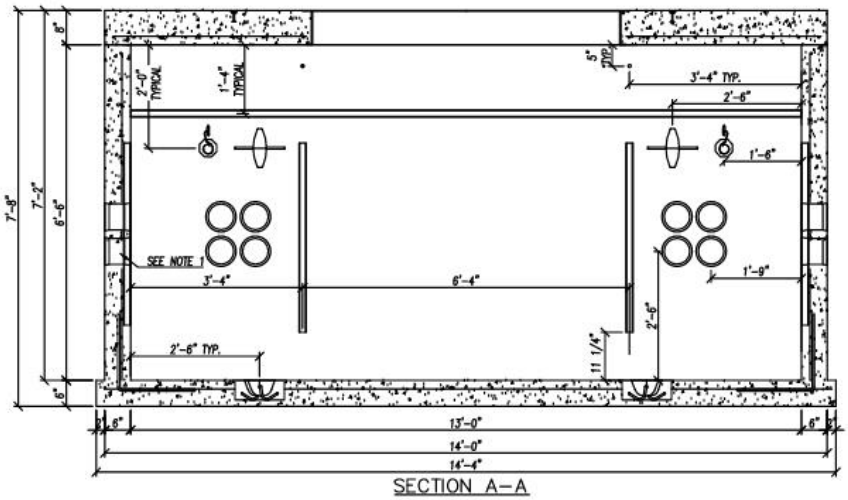
7'X14' HATCH ONLY VAULT

NOTES:

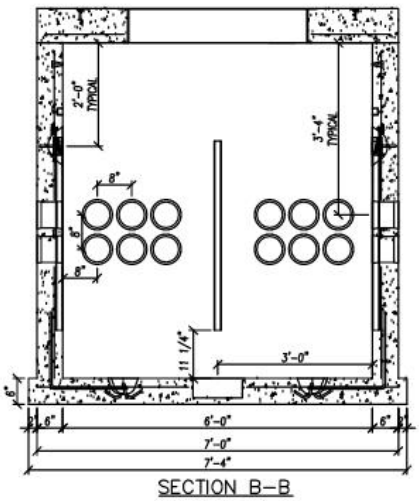
1. 5" DUCT TERMINATORS TO ACCOMMODATE 5" SCH 40 PVC
2. LID WEIGHS APPROXIMATELY 8,100 LBS
   WALLS WEIGH APPROXIMATELY 26,200 LBS



PLAN VIEW



SECTION A–A



SECTION B–B

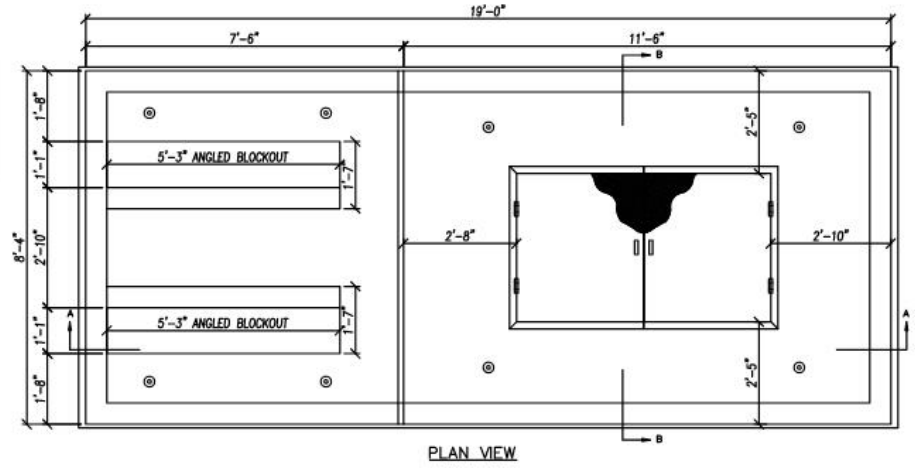
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.18	7'X14' HATCH ONLY VAULT

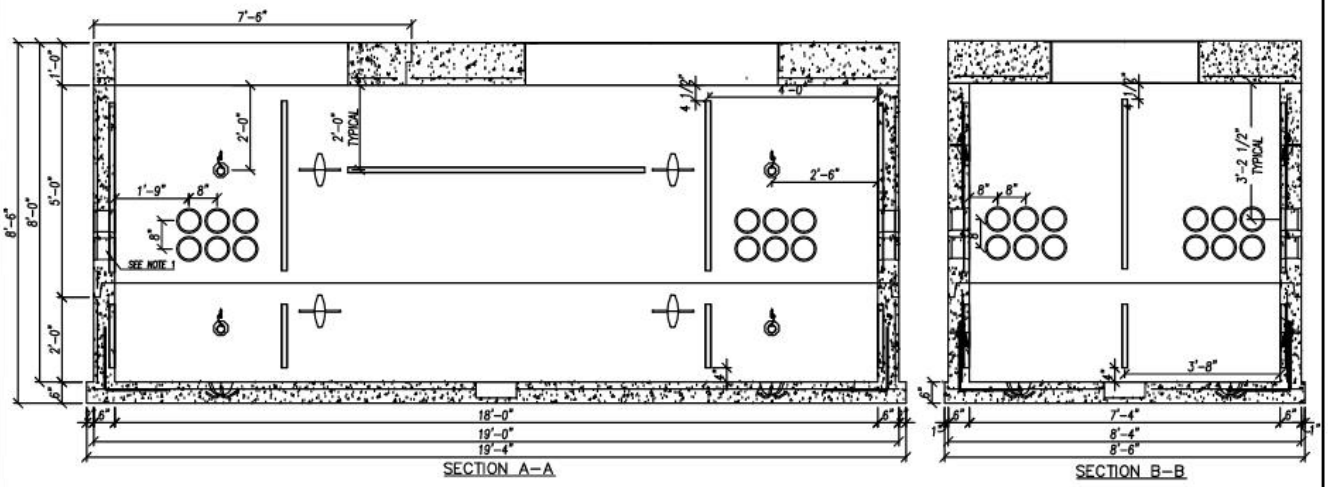
NOTES:

1. 5" DUCT TERMINATORS TO ACCOMMODATE 5" SCH 40 PVC
2. LID WEIGHS APPROXIMATELY 19,000 LBS
   RISER WEIGHS APPROXIMATELY 20,000 LBS
   BASE SECTION WEIGHS APPROXIMATELY 21,000 LBS

8'X19' SINGLE SWG VAULT



PLAN VIEW



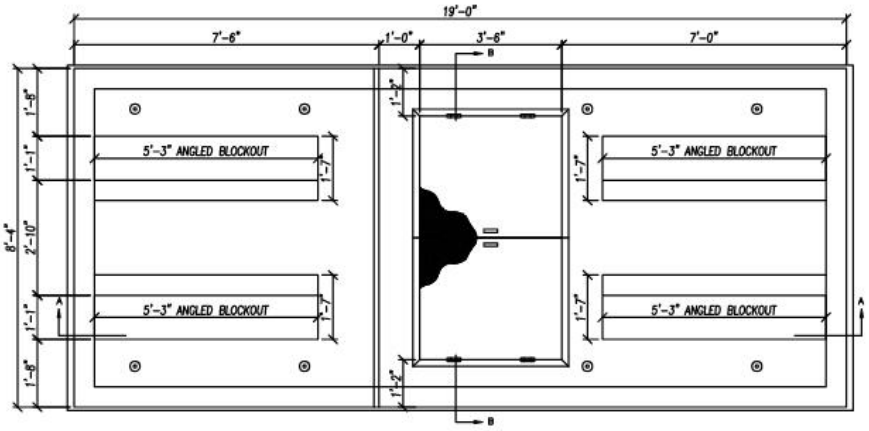
SECTION A–A

SECTION B–B

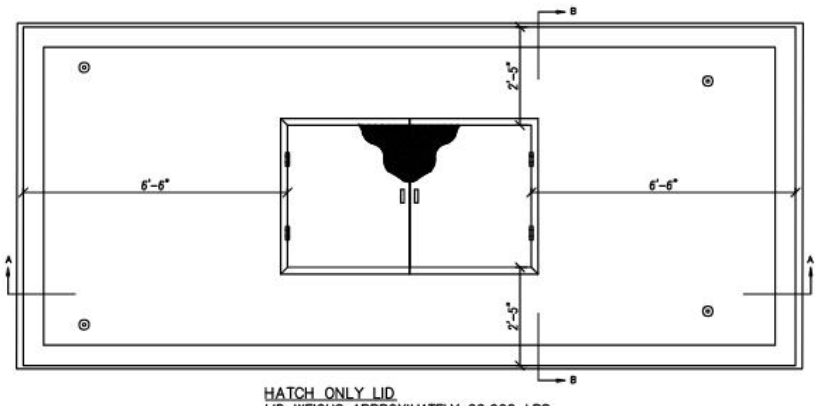
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.19	8'X19' SINGLE SWG VAULT

ADDITIONAL 8'X19' LID CONFIGURATIONS



DOUBLE SWG LID
LID WEIGHS APPROXIMATELY 18,200 LBS



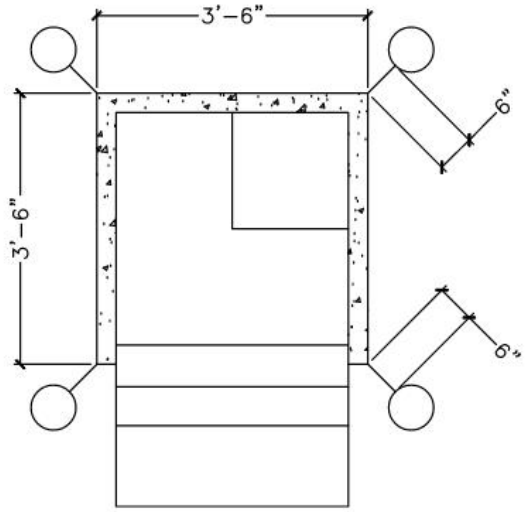
HATCH ONLY LID
LID WEIGHS APPROXIMATELY 20,000 LBS

CITY OF LOVELAND WATER & POWER

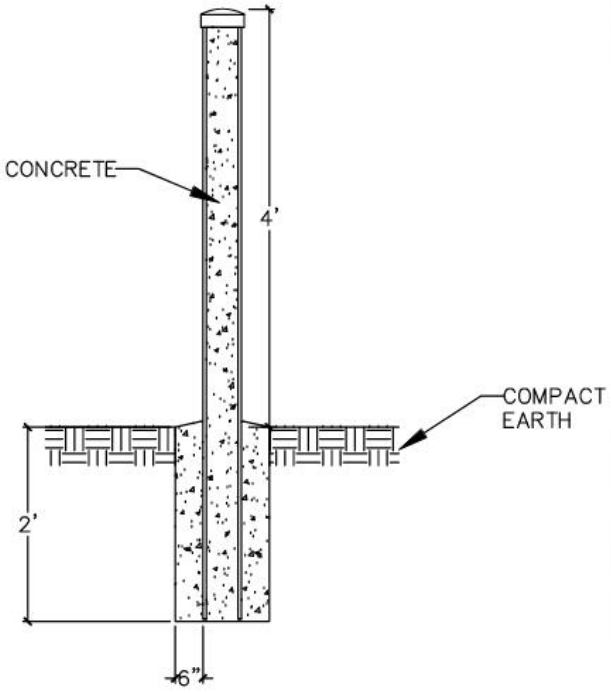
Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.20	ADDITIONAL 8'X19' LID CONFIGURATIONS

SINGLE PHASE BOLLARD STANDARD

SINGLE PHASE PAD
25–167 KVA



BOLLARD CROSS
SECTION



NOTES:

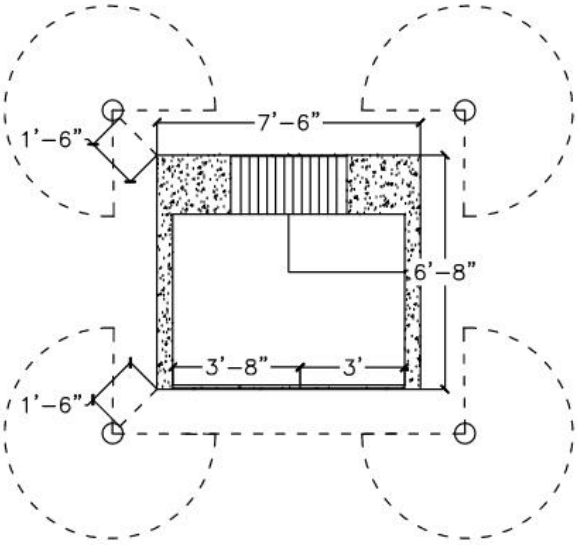
1. BOLLARDS ARE REQUIRED TO HAVE A MINIMUM DIAMETER OF 4"
2. BOLLARDS MUST BE PAINTED "SAFETY YELLOW" IN ACCORDANCE WITH OSHA STANDARD 1910.144

CITY OF LOVELAND WATER & POWER

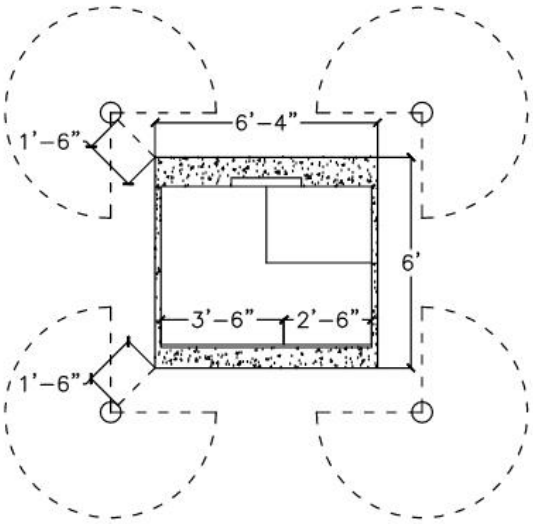
Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.21	SINGLE PHASE BOLLARD STANDARD

THREE PHASE BOLLARD STANDARD

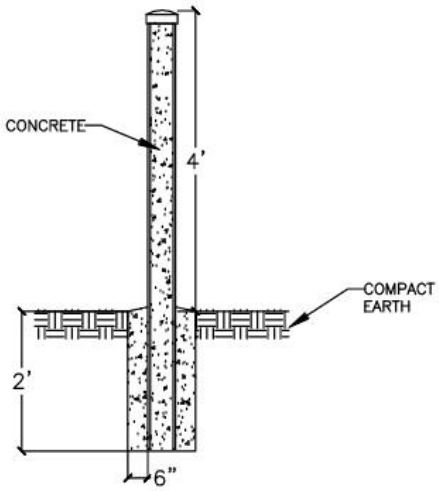
THREE PHASE PAD
1000–2500 KVA



THREE PHASE PAD
45–750 KVA



BOLLARD CROSS SECTION

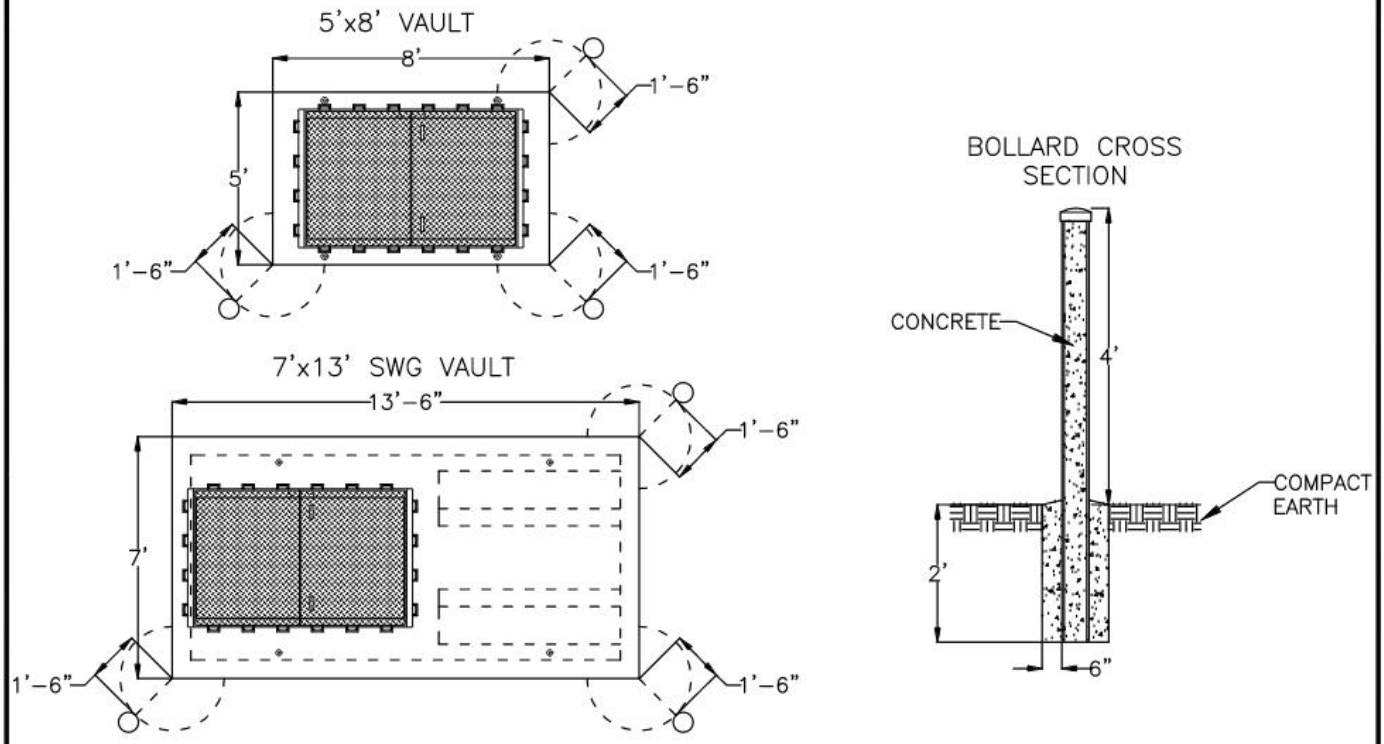


NOTES:
1. BOLLARDS ARE REQUIRED TO HAVE A MINIMUM DIAMETER OF 4"
2. BOLLARDS MUST BE PAINTED "SAFETY YELLOW" IN ACCORDANCE WITH OSHA STANDARD 1910.144

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.22	THREE PHASE BOLLARD STANDARD

VAULT/SWITCHGEAR BOLLARD STANDARD



NOTES:

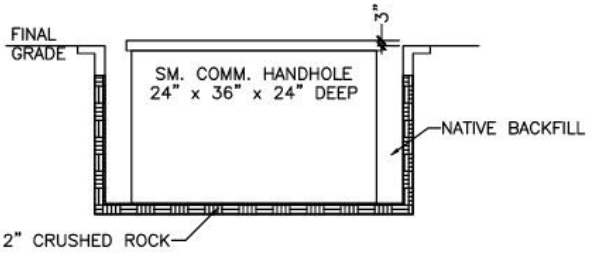
1. BOLLARDS ARE REQUIRED TO HAVE A MINIMUM DIAMETER OF 4"
2. BOLLARDS MUST BE PAINTED "SAFETY YELLOW" IN ACCORDANCE WITH OSHA STANDARD 1910.144

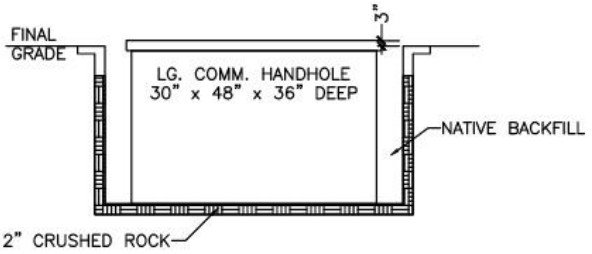
CITY OF LOVELAND WATER & POWER

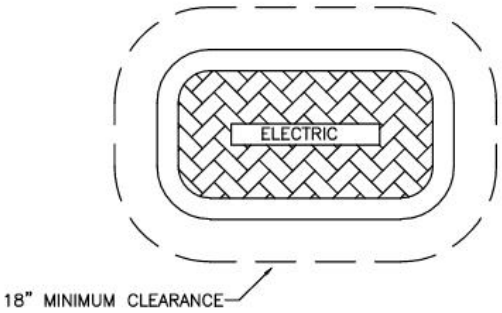
Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.23	VAULT/SWITCHGEAR BOLLARD STANDARD

SECONDARY HANDHOLES

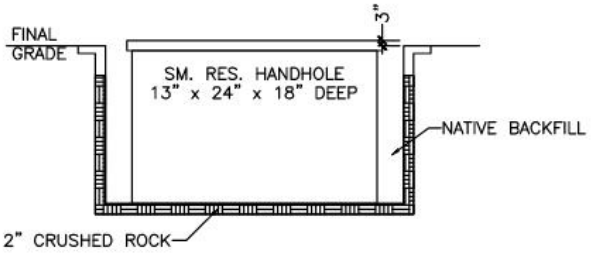
COMMERCIAL HANDHOLE

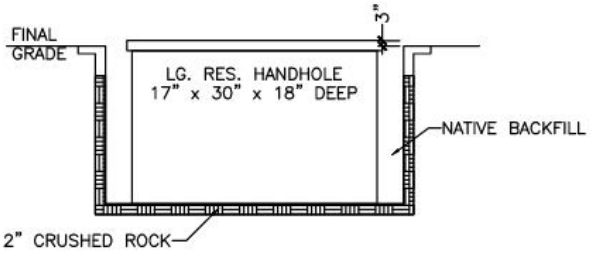


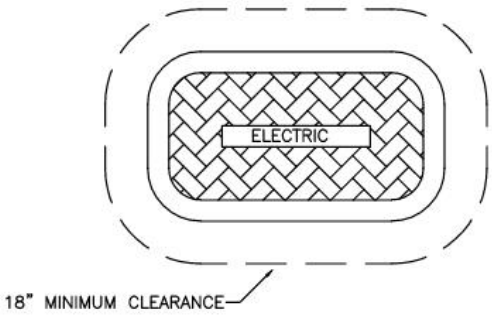




RESIDENTIAL HANDHOLE







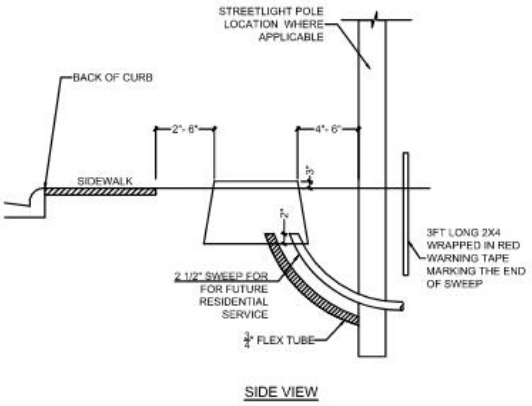
NOTES:
1. IF LOCATED IN GRASSY AREA – HEIGHT 3" ABOVE GRADE.
2. IF LOCATED IN ALLEYWAY OR SIDEWALK, THE HANDHOLE SHALL BE FLUSH WITH FINAL GRADE.
3. PROVIDE 5 FEET OF EXTRA CABLE COILED WITHIN THE HANDHOLE
4. CRUSHED ROCK SHALL BE A WELL–GRADED CRUSHED STONE OR GRAVEL CONFORMING TO CDOT TABLE 703–1 #67

CITY OF LOVELAND WATER & POWER

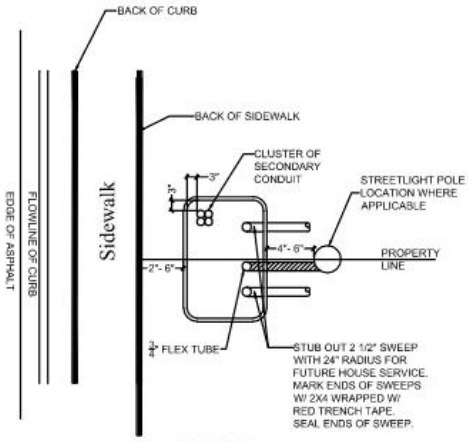
Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.24	SECONDARY HANDHOLES

HANDHOLE LOCATION

ATTACHED SIDEWALK

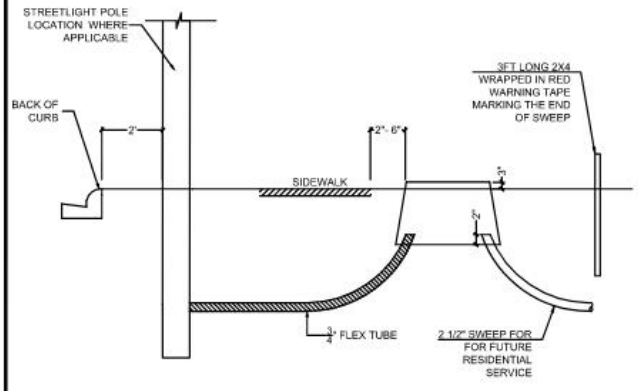


SIDE VIEW

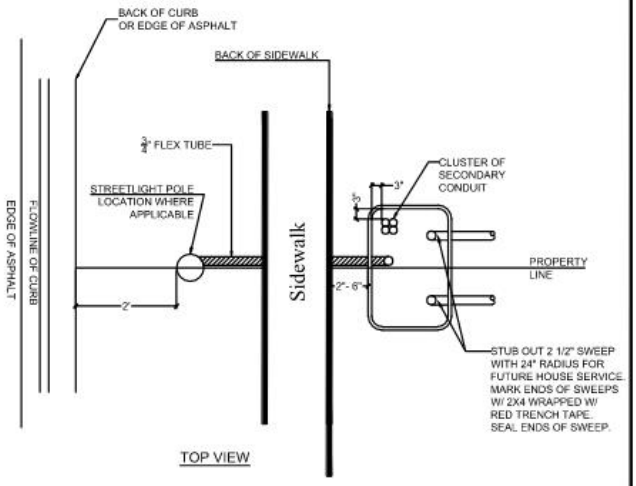


TOP VIEW

DETACHED SIDEWALK



SIDE VIEW



TOP VIEW

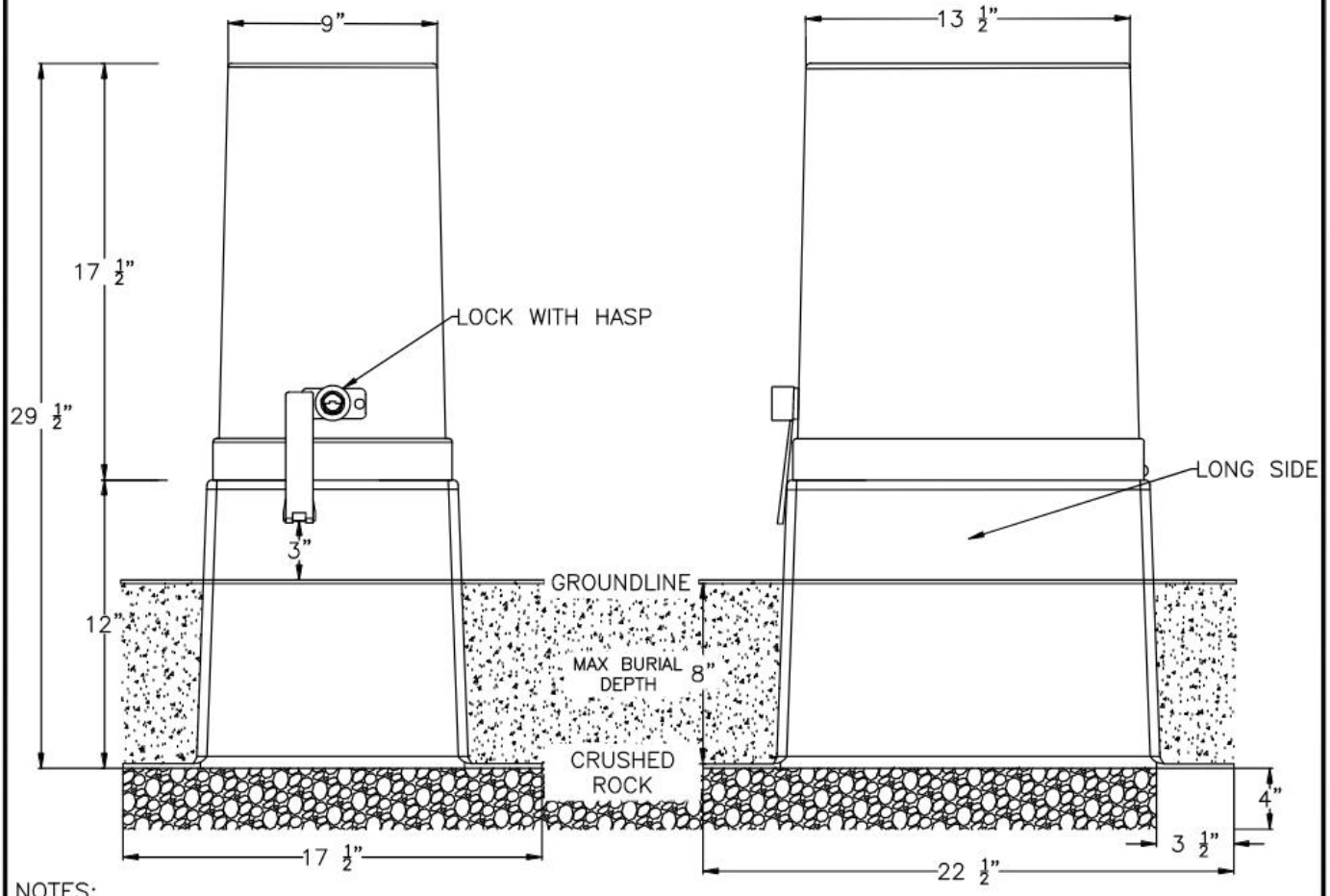
NOTES:

1. ALL STREETLIGHTS SHALL INCLUDE A BUTT PLATE FOR GROUNDING.
2. 18" MINIMUM CLEARANCE AROUND HANDHOLE FROM ANY OBSTRUCTION INCLUDING BUT NOT LIMITED TO SHRUBS, BOULDERS, ETC.
3. ALL CONDUIT/FLEX TUBE TO BE CUT 2" ABOVE THE BOTTOM OF THE HANDHOLE
4. PROVIDE 5 FEET OF EXTRA CABLE COILED WITHIN THE HANDHOLE

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.25	HANDHOLE LOCATION

PEDESTAL INSTALLATION DETAIL



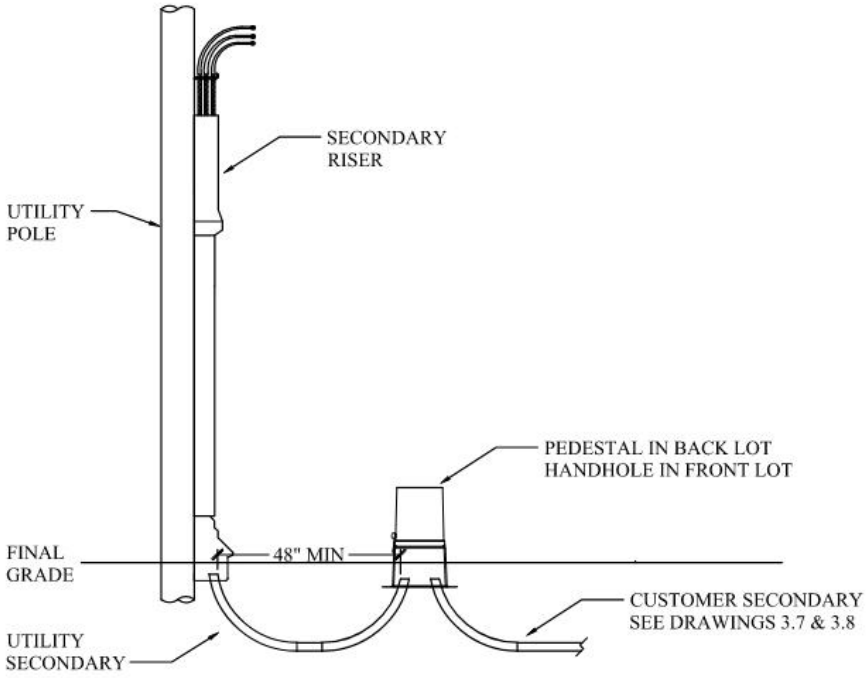
NOTES:

1. LONG SIDE OF PEDESTAL MUST BE PARALLEL TO SIDEWALK
2. MEASURE THE BOTTOM WIDTH AND DEPTH OF THE PEDESTAL'S FLANGES
3. MEASURE 3" DOWN FROM THE BOTTOM OF THE LOCKING SYSTEM, MARK THAT SPOT
4. THEN MEASURE FROM THAT SPOT TO THE BOTTOM OF THE PEDESTAL, THAT'S THE MAXIMUM BURIAL DEPTH
5. DIG A HOLE APPROXIMATELY 4" DEEPER THAN THE MAXIMUM BURIAL DEPTH AND 6" WIDER THAN THE BOTTOM FLANGE DIMENSIONS OF THE PEDESTAL
6. ADD 4" OF CRUSHED ROCK TO THE BOTTOM OF THE HOLE, MACHINE TAMP AND LEVEL IT. CRUSHED ROCK SHALL BE A WELL–GRADED CRUSHED STONE OR GRAVEL CONFORMING TO CDOT TABLE 703–1 #67
7. MAKE SURE THE LID IS FASTENED AND TIGHTEN THE PENTA–HEAD BOLT(S)
8. LOWER THE PEDESTAL INTO THE HOLE
9. USING A LEVEL, ENSURE THAT THE PEDESTAL IS LEVEL AND PLUMB. IF NOT LEVEL, ADD OR REMOVE CRUSHED ROCK, RE–TAMP AND LEVEL AGAIN
10. BACKFILL WITH LOOSE DIRT, NO CHUNKS OF DIRT OR ROCKS, NO MACHINE TAMPING

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.26	PEDESTAL INSTALLATION DETAIL

PEDESTAL/HANDHOLE INSTALLATION WITH SECONDARY RISERS WHEN UNDERGROUNDING SERVICES

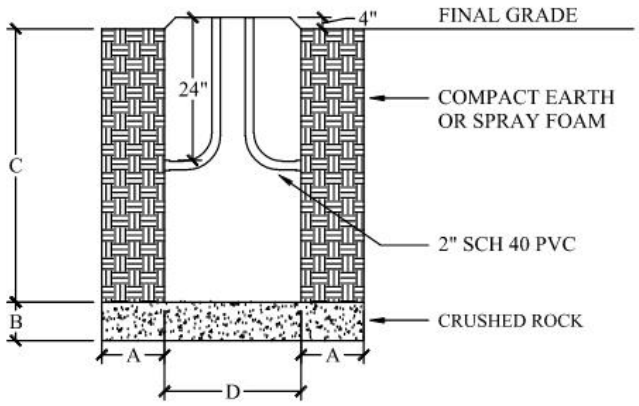


NOTES:
1. 2.5" 90° CONDUIT ELBOW WITH A RADIUS OF 24".
2. ADD ADDITIONAL CONDUIT FOR INCREASED LENGTH AS NEEDED.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.27	PEDESTAL / HANDHOLE AND RISER INSTALLATION

STREET LIGHT FOUNDATION



A	11"	
B	6 "	
C	4'	7'
D	1.5'	2'

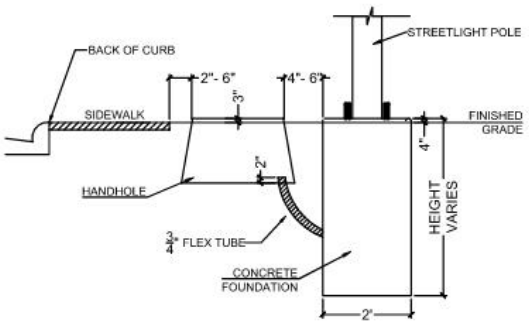
NOTES:
1. INSTALL STREET LIGHT FOUNDATION 4" ABOVE FINAL GRADE.
2. SEE SECTION 5.1 FOR TRENCH BACKFILL COMPACTION REQUIREMENTS
3. CRUSHED ROCK SHALL BE A WELL-GRADED CRUSHED STONE OR GRAVEL CONFORMING TO CDOT TABLE 703-1 #67

CITY OF LOVELAND WATER & POWER

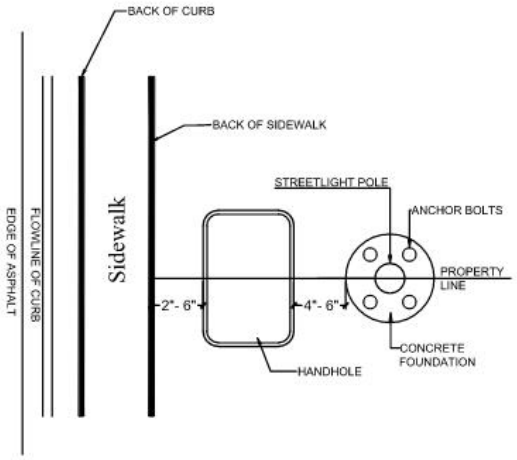
Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	5.28	STREET LIGHT FOUNDATION

CONCRETE BASE FOR STREETLIGHT

STREETLIGHT: ATTACHED SIDEWALK

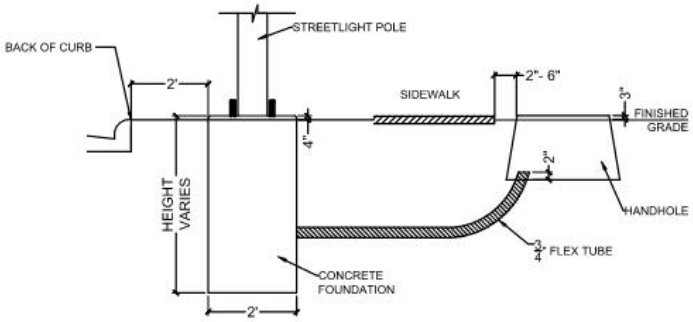


SIDE VIEW

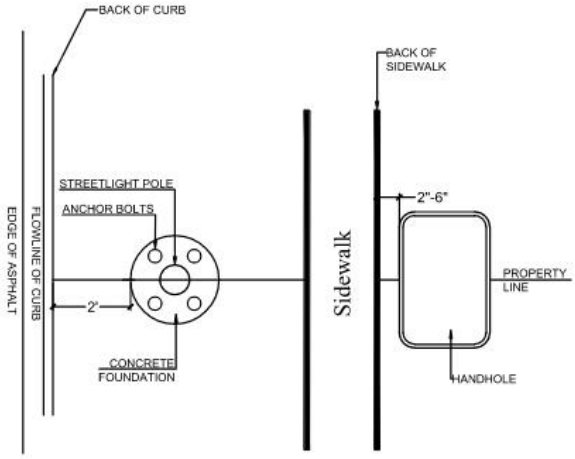


TOP VIEW

STREETLIGHT: DETACHED SIDEWALK



SIDE VIEW



TOP VIEW

NOTES:

1. CONCRETE BASES SHALL HAVE A UFER GROUND OR GROUND ROD.
2. BASE SHALL BE INSTALLED WITH ANCHOR BOLTS SQUARE TO THE CURB / SIDEWALK.
3. 2' MINIMUM DISTANCE FROM BACK OF CURB OR BACK OF SIDEWALK
4. FOR RESIDENTIAL SERVICE ELBOW SWEEP INSTALLATION, SEE DRAWING NUMBER 5.25

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	5.29	CONCRETE BASE FOR STREETLIGHT

Section 6 - Meters & Meter Connections

6.1 Metering Requirements – General

a. ***Meter Installation Requirements***

Metering installations must meet all City requirements in effect at the time a new meter is requested. This includes requests to install a new meter in existing equipment not currently being used. Meters will not be set if all requirements are not met. All metering equipment installed must match what's shown on the one-line diagrams and/or cut sheets submitted with the permit application documents. Contact the Electric Metering Supervisor at 970-962-3582 with any questions you might have regarding metering requirements.

b. ***Electric Service Delivered to a Single Point***

All electric service to a dwelling/customer space shall be delivered at a single point and measured with a single electric meter.

- Residential and Multi-dwelling units – Residential dwelling units are required to be individually metered with one meter per address. Multi-dwelling units with three or more dwelling spaces may also require a house meter for common electrical usage. Refer to *Section 6.8 – Multiple Metering* for further information.
- Commercial and Industrial with multiple buildings –Facilities with multiple buildings that will not be served by a primary metering point shall have each building served by individual metering points and shall comply with all other requirements within this publication.
- Multi-Tenant Occupancy Buildings.
  - Multi-tenant occupancy buildings that are designed with static customer spaces shall be individually metered with one meter per address. Space shall be separated by partition/demarcation walls with no other access from adjoining spaces and shall be considered a separate address. House meters for common electrical usage are required. Refer to *Section 6.8 – Multiple Metering* for further information.
  - Multi-tenant occupancy buildings that are designed as Core & Shell buildings with flexible demising walls between customer spaces should be designed with individual metering points for each tenant space. When tenants occupy more than one customer space, spaces require consolidation of corresponding electric meters to ensure the space is metered at a single point with one meter per address. Consolidation of metering can be accomplished by physical reconfiguration of metering equipment or through virtual consolidation through the City's aggregated metering process. When tenants vacate multiple spaces, metering equipment must be separated with individual metering points for each tenant space with one meter per address. The building owner is responsible for ensuring that mis-wiring does not occur between the tenant spaces. House meters for common electrical usage are required. Refer to *Section 6.8 – Multiple Metering* for information on mis-wiring liability and House meters. Contact the Electric Metering Supervisor with questions regarding metering requirements on multi-tenant buildings.

c. ***Upgrading Equipment/Service to an Existing Building***

If upgrading equipment/service to an existing building, the site must meet current standards and guidelines set forth by the City and other national codes. Customers may not add or combine an additional meter to accommodate increased load. The existing meter/service and meter equipment must be upgraded to the appropriate size to handle the new load. The cost of upgrading and/or relocating electric metering is the responsibility of the customer.

d. ***Building Use Changes***
Any building use other than original plans, including altering original space, may require re-designed metering to accommodate a change in load characteristics at the building owner's expense. For information, please contact the Electric Metering Supervisor.

e. ***Compromised or Unauthorized Changes to Meter/Meter Equipment***
If any meter/metering equipment or City requirement is found to be compromised by changes to an existing building installation without the documented approval of the City, the building owner may be subject to citation and fines and must pay the cost to correct the deficiencies.

f. ***Electronic Load Data Collection***
The City reserves the right to install and collect various electronic load data from its customers. Such data remains the sole property of the City of Loveland. Names and addresses of utility users shall at all times remain confidential and will not be disclosed to the public as required by the Colorado Open Records Act (CORA), section 24-72-204(3)(a)(IX), C.R.S.

g. ***Installation of Emergency or Back-up Generation***
- This section only applies to emergency or back-up generation that is not an interconnected facility. For interconnected facilities, refer to *Section 9 - Interconnection Requirements for Distributed Energy Resources Less Than 1.0 MVA.*
- The City requires an external and easily accessible main disconnect, which is in addition to the disconnect that is required by NEC 230.70. The building disconnect or a remote control device used to actuate the main distribution panel shall be immediately adjacent to the utility disconnect and meter.
- The customer shall install a permanently attached sign or placard on the main disconnect between the utility meter and building distribution panel stating "Utility Disconnect: Back-up Generation Exists".

h. ***Fire Pumps***
Fire pumps that are directly fed from the utility transformer will be metered using transformer rated metering provisions.

i. ***City to Install Locks & Seals***
Only City of Loveland locks and seals shall be installed from the City transformer to the metering equipment. Customers may not install their own locks on any metering equipment. The City has the authority to remove any unauthorized locks. The City reserves the right to install locking devices on customer-owned equipment, as necessary to ensure safety and eliminate diversion (theft of electricity).

j. ***City to Cut Locks & Seals or Remove Meters***
Only authorized and qualified City of Loveland electric utility personnel shall cut seals/locking mechanisms on any gear ahead of and including the metering equipment. All metering equipment belongs to the City of Loveland and shall not be removed or taken. Tampering or interfering with the City's metering equipment is a violation of the Loveland Municipal Code and will be prosecuted.

k. ***No Jumpered Sockets***
Under no circumstances shall an electric meter socket be jumpered to provide temporary power. This includes jumpering the permanent meter socket out while the temporary power pole is

providing power. If the socket is found to be jumpered, the socket shall be replaced at the customer's expense before a meter will be installed.

l. ***Replace Damaged Meter Socket Lids***
If the meter socket lid is damaged or will not provide the safety and protection that was originally intended, the cover/meter socket shall be replaced at the customer's expense before the meter will be re-installed. A disconnect/reconnect may be required; contact the Electric Metering Supervisor at 970-962-3582 for fees that may apply.

m. ***No Paint & No Obstructions of Meter Covers***
No painting or obstruction on any part of the meter cover is allowed. Altered meter covers will be replaced at the customer's expense.

n. ***Approved Meter Sockets***
All meter sockets shall be approved for applied voltage, current, and number of wires.

o. ***Self-Contained Meter/Main Breaker Enclosures***
All self-contained meter/main breaker enclosures shall have a permanent divider between the meter and the customer's breaker and a separate cover over each section to prevent access of the meter from the customer's side of the enclosure.

p. ***Meter Socket Material Specifications***
All single-phase 120/240 volt three-wire self-contained meter sockets rated for up to 400 amps or 320 amps (continuous duty) and three-phase 120/208 volt, 277/480 volt four-wire WYE self-contained meter sockets rated for up to 400 amps or 320 amps (continuous duty) shall have a jaw-clamping, lever-operated bypass mechanism that can operate as a continuous duty bypass device.

- Meter sockets shall have ringless style covers with latch capable of accommodating City seal and lock mechanism.
- Two-piece lids are not allowed unless combination meter main equipment is being used.
- Recommended dimensions for individual meter sockets used in underground installations shall be:
  - Up to 200-amp – 19 inches height by 13 inches width
  - 320-amp – 26.5 inches height by 13 inches width
- Meter sockets must be constructed of galvanized steel, 16-gauge minimum. Non-metallic or aluminum enclosures are not allowed.
- Meter sockets shall be suitable for outdoor installation, i.e., weatherproof (NEMA 3R, IP, 14, or equivalent).
- Meter socket bypass lever shall be constructed of metal.
- Meter socket shall have a non-tracking polycarbonate safety shield to prevent accidental contact with energized parts.
- All three-wire sockets, both single-phase and network, shall have a fifth terminal installed at the 9 o'clock position.
- 320 amp meter sockets shall be equipped with anti-inversion clips that prevent normal width terminal blades from being installed in a 320 amp socket.
- All meter socket configurations shall be approved by the Electric Metering Supervisor at 970-962-3582 prior to purchase and installation.

6.2 Meter & Associated Equipment Locations

a. ***Meter Location Approval***
Meter location is subject to City approval. All meters and equipment, including service disconnects, must be outside of the building and continuously accessible at a location approved by the City. An exception is allowed for internal mounting of disconnects for fire pumps as required by *NFPA 20, Appendix A.3*.

b. ***Prohibited Meter Locations***
Meters shall not be installed over window wells, in stairwells, under stairways, platforms, and in parking garages or alcoves. For location questions, please see *Section 8 – Clearances* or contact the Electric Metering Supervisor at 970-962-3582.

c. ***Access to Meter Equipment Required by the City***
The City requires the right to enter the customer's premises and to access metering equipment at any time for the purposes of meter reading, maintenance, and emergencies.

d. ***Keep Meter Access Clear***
The customer shall keep the meter access clear of fences, building additions, vehicles, shrubbery, or other blockages. The meter access area must have clearance after full maturity of plantings. A minimum 5-foot-wide access path to all metering equipment must also be maintained by the customer. If any blockage is present, the City will notify the customer to permanently remove the blockage. Failure to clear any blockage may result in disconnection of service. The City is not responsible for damage to trees, shrubs, grass, fences and/or other landscaping due to inadequate access. See *Section 8 - Clearances*.

e. ***Sloped/Uneven Final Grades around Meter***
When the final grade around the meter is sloping or uneven, a level area with a 5-foot radius is required in front of the meter or meter equipment.

f. ***Parking Bollards (Posts)***
When metering equipment is located in an area with a risk of vehicular damage, the City may require additional protection such as parking bollards (posts) at the customer's expense.

g. ***Protective Enclosures***
Where damage to metering equipment occurs or is anticipated, the City may require the customer to install fencing or a protective metal enclosure with City locking provisions to protect the equipment. The City will determine when protective enclosures are required.

h. ***Repeated Damage to Metering Equipment***
In cases of repeated damage to metering equipment, the customer will be charged for repair or replacement of equipment and all associated costs. Failure to provide adequate protection to metering equipment and/or the service entrance may result in disconnection of service.

6.3 Meter Equipment Mounting

a. ***Who Installs & Supplies Metering Equipment***
Contractors install all metering equipment, except the meter, in most situations. Overhead primary metering and some special metering applications will be purchased and built by qualified City

personnel. Underground primary metering equipment will be specified by City of Loveland Electric Metering, purchased by the customer, and maintained by the City. The City supplies and owns all 600 volt current transformers (CTs), potential transformers (PTs), transformer rated meter sockets, and meters. The City does not supply or maintain self-contained meter sockets.

b. ***Meter Mounting***

Metering equipment must be mounted securely on a rigid surface. When there is a permanent building structure, metering equipment must be mounted to the building it is serving. If there is no permanent building structure, the metering equipment may be installed on:

- A freestanding concrete wall, or similar.
- An approved metering pedestal or H-Frame meter stand. See *Drawings No. 6.3 and 6.4.*
- The side of a pad-mounted CT cabinet, switchgear, or equipment cabinet, provided the proper clearances and mounting heights are maintained.

c. ***Prohibited Meter Mounting Locations***

Meters shall not be mounted on the inside or outside of pad-mounted transformers or on City utility poles.

d. ***Mounting Heights***

- Individual or Horizontally Adjacent Meters - Individual meter sockets or meters adjacent to each other horizontally shall be mounted so that the centerline is between 6 feet and 4 feet of finished grade. See drawings at the end of this section and *Section 8 - Clearances*.
- Vertically Stacked Meters - Vertically stacked multiple metering shall be mounted so that the bottom of the lowest meter is at least 3 feet above final grade and the top of the highest meter is no more than 6 feet. See drawings at the end of this section and *Section 8 - Clearances*.

e. ***CT Mounting Requirements***

Wall-mounted CT cabinets shall be installed so that the bottom of the cabinet is at least 3 feet above final grade. Potential transformers (if used) shall be installed within the CT compartment at a maximum mounting height of 6 feet. Refer to *Section 6.9 – Transformer Rated Metering (CTs & PTs)* for detailed requirements. The CT cabinet and meter socket shall be installed so that the meter socket is not obstructed with the cabinet door in the full open position. Mount the meter socket on the latch side of the metering cabinet. See drawings at the end of this section and *Section 8 - Clearances*.

f. ***Service Conduit Requirements***

Service conduit shall have no access or cover point of access between the metering equipment and the power transformer with no more than two 90 degree sweeps in less than three feet for transformer rated sockets. Conduit shall be a minimum of 1-inch diameter. The bonding collar is to be installed on either a CT or meter socket with #6 copper ground solid or insulated. Install threaded plastic ring on both sides of conduit. Conduit shall not pass through the customer side of the equipment or customer walls or structures. Conduit from the CT cabinet to the meter shall not be buried.

g. ***Metering Clearances***

Metering clearances must comply with *Section 8 – Clearances* of this book.

6.4 Sequence of Meter, Service Entrance, and Customer Equipment Connections

a. ***Cold Sequencing***
No cold sequencing allowed, except as required by NEC's six handle rule or multi-family applications.

b. ***No Customer Equipment Ahead of Electric Metering***
No customer equipment shall be connected ahead of the electric metering. Any customer-owned equipment must be connected after the CT compartment or meter socket.

c. ***No Separately Derived Power Source Ahead of City Metering***
No separately derived power source shall be connected ahead of the City metering string. For any self-generation, please refer to *Section 9 – Interconnection Requirements for Distributed Energy Resources Less Than 1 MVA* for specifications and approval procedure, prior to purchase or installation of equipment.

d. ***No Junction Boxes at Meter Sockets or CT Cabinets***
Meter sockets or CT cabinets shall not be used as a junction box under any circumstance.

6.5 **Residential** (Single-Family Homes or Duplexes)

a. ***Approved Meter Sockets***
For all residential, self-contained service installations, the customer will be responsible for the cost to furnish and install an approved lever-operated bypass meter socket with a sealing mechanism. Neither ring-type meter sockets nor A-base sockets are allowed. Two-piece lids are not allowed unless combination meter-main equipment is being used. A customer main disconnect with adequate overcurrent protection is required. The disconnect must be either combination meter-main or immediately adjacent to the meter socket on the outside of the building. Contact the Electric Metering Supervisor with any questions you might have at 970-962-3582.

Any metering equipment issues found during inspection will require replacement with equipment meeting current standards. Examples of issues include but are not limited to:

- Faulty or Damaged meter housings, including meter block, termination lugs, etc.
- Broken or damaged conduit due to ground settling.
- The meter jaws failed the tension test.
- Damaged conductor or insulation failure on the conductor.

b. ***Demarcation Point***
Underground and overhead services –Refer to *Section 3 – Residential.*

c. ***Replacing Meter Pedestals***
Existing meter pedestals will be replaced with a meter installed on the house or structure whenever repairs (at City expense) or upgrading (at customer expense) are required.

d. ***Multi-Family Dwellings with Three (3) or More Meters***
Multi-family dwellings with three (3) or more meters are considered commercial services by the Loveland Water & Power Department and are covered in *Section 6.7 – Commercial and Industrial* and *Section 6.8 – Multiple Metering*.

e. ***Residential Services Greater than 400 Amps***
Residential services greater than 400 amps (class 320 meter) shall be considered commercial services and are covered in *Section 6.7 – Commercial and Industrial*.

6.6 Mobile Home Parks

a. ***Demarcation Point & Ownership***
In most cases, the demarcation point is the meter itself. The City owns and is responsible for the service conductor from the power transformer to the line side connections of the meter socket. The conductor will be specified and installed by the City.

b. ***Terminations***
The City shall complete the terminations from the load side of the power transformer to the line side of the meter socket. The load side wire connections and wire leading to each mobile home will be the owner's responsibility. This includes both overhead and underground services.

c. ***Meter Pedestal Approvals & Ownership***
Metering pedestals must be approved by the Electric Metering Supervisor before purchase and installation. Ownership and maintenance of these pedestals is the customer's sole responsibility. See *Drawing No. 6.3.*

6.7 Commercial and Industrial

(Includes Multi-Family Housing with Three (3) or More Dwellings & Residential Services Greater than 400 Amps)

a. ***277/480 Volts up to 400 Amp Services***
277/480 volt services up to 400 amps will be metered with self-contained metering. When the load is greater than 400 amps, PTs with CTs are required.

b. ***Self-Contained Meters***
All commercial self-contained metering shall have manual bypass meter sockets. The bypass lever must supply clamping action on meter spades and must operate continuous duty bypass device. This includes both single-phase and three-phase applications.

c. ***Single-Phase Three-Wire, 240 Volts, 400 Amp Services***
Single-phase three-wire 240 volts, 400 amp services utilize a class 320 meter and require the installation of an approved CL320 meter socket purchased by the customer. The CL320 meter socket must include a jaw-clamping lever bypass that can operate as a 320 amp continuous duty bypass device.

d. ***Three-Phase 120/208 Volt Four-Wire Services Greater than 400 Amps & Single-Phase Services Greater than 400 Amps***
All three-phase 120/208 and 277/480 volt four-wire services greater than 400 amps and single-phase services greater than 400 amps will utilize CTs. PTs are required when service voltage is greater than 240 volts and the load is greater than 400 amps. See *Section 6.9 – Transformer Rated Metering (CTs & PTs)* for complete requirements.

e. ***Address Posting at Entrance Doors & Meter Sockets***
All commercial locations shall have the City-assigned address permanently displayed on or above the entrance door. The same address shall be imprinted on a brass or mylar tag permanently attached to the customer access panel beside the meter using pop-rivets or self-tapping screws, or below the customer's main disconnect beside the meter. Meters will not be installed until addresses are correctly displayed. For a single meter installation (for a building with one (1) address), the address tag may be placed on the meter cover. See drawings at the end of this section.

f. ***Address Labeling of Meters***
Address labeling of meters shall correspond to the building permit scheme. These addresses are given by Larimer County Land Records Management or the Building Division and shall not be changed by the customer. If changes are required, contact the City Building Division. If improper address labeling is found, the responsible electrician/customer shall bear all costs to correct the installation.

g. ***Temporary Meter Design for Services Greater than 200 Amps***
Temporary metering designed for any loads over 200 amps shall be approved by electric metering prior to installation.

h. ***Sub-Metering***
Sub-metering for the purposes of resale of electricity is prohibited. Sub-metering is not allowed as a substitute for City owned revenue metering.

Sub-metering is allowed beyond the City of Loveland metering point and may be used by the customer for informational purposes only to determine how the electricity is being distributed. The customer will provide all equipment, including electric meter(s), and such metering will be installed and maintained by the customer.

i. ***Demarcation Point***
- Underground and overhead services – refer to *Section 4 – Commercial & Industrial*.
- Primary Metering – See drawings at the end of this section.

j. ***Site/Parking Lot Lighting***
Site/parking lot lighting shall be connected to the house panel, unless it is being fed from a separate service. If more than one meter is installed on a single building with multiple addresses, a house meter is required.

k. ***Commercial Fire Pump Metering***
Refer to *Section 6.9.n – Metering Fire Pumps* for requirements pertaining to commercial stand-alone fire pump applications.

6.8 Multiple Metering

a. ***Address Posting at Entrance Doors & Meter Sockets***
All commercial locations shall have the City-assigned address permanently displayed on or above the entrance door. The same address shall be imprinted on a brass or mylar tag permanently attached to the customer access panel beside the meter using pop-rivets or self-tapping screws, or below the customer's main disconnect beside the meter. Meters will not be installed until

addresses are correctly displayed. For a single meter installation (for a building with one address), the address tag may be placed on the meter cover. See drawings at the end of this section.

b. ***Address Labeling of Meters***
Address labeling of meters shall correspond to the building permit scheme. Addresses that are given by Larimer County Land Records Management or the Building Division are not to be changed by the customer. If changes are required, contact the Building Division. If improper address labeling is found, the responsible electrician/customer shall bear all costs to correct the installation.

c. ***Liability for Mis-Wiring or Incorrect Labeling***
The electrician will be held liable for any mis-wiring or labeling at multiple dwellings resulting in billing inaccuracies. Any costs for the City to correct labeling and/or billing errors will be charged to the customer.

d. ***House Meter for Multiple Tenant Buildings***
All multiple tenant buildings shall have a meter to measure common electrical usage that is not billable to a single tenant or entity. The meter shall be labeled "house meter". This meter shall not be used for any tenant space.

e. ***Multi-Occupancy Buildings with Individual Tenant Meters***
Individual tenant meters in multi-occupancy buildings will not be installed until such time that the individual units are being finished and permanent demising walls are constructed. Core & Shell buildings will only be issued the meter once individual tenant finishes are permitted.

f. ***Meter Equipment Approval***
Any pre-manufactured multiple metering equipment must be approved by the electric metering group. Multiple metering equipment must be bus-type construction. Cable-connected multi-metering will not be accepted. Submit cut sheets to the Electric Metering Supervisor for approval prior to purchasing.

g. ***120/208 Volts Single-Phase Multiple Metering Equipment***
All 120/208 volts single-phase multiple metering equipment fed by 120/208 three-phase requires factory balanced phases.

6.9 Transformer Rated Metering (CTs & PTs)

a. ***All Single-Phase and Three-Phase Services 400 Amps and Greater***
Unless de-rated for continuous load of 320 amps, services rated 400 amps and greater for single-phase 120/240 volt three-wire, three-phase 120/208 volt four-wire, and three-phase 277/480 volt four-wire will utilize CTs.

b. ***277/480 Volt Services PT Requirements For 400 Amps and Greater***
277/480 volts services 400 amps and greater require Potential Transformers (PTs). The CT cabinet shall have integral PT mounting provisions (See *Table 6-3* for minimum dimensions). Electrical conductors shall not be placed in front of PTs. Refer to *Drawing No. 6.6*.

c. ***Approved CT Cabinets***

CTs and PTs shall only be installed in approved NEMA Type 3R CT cabinets with a hinged door, lockable hasp, and fasteners that cannot be removed from the exterior of the cabinet. The cabinet shall be of sufficient size for load and voltage conditions. See *Tables 6-1 through 6-3* for minimum dimensions. Keyed door locks are not allowed. The CT cabinet and meter socket shall be installed so that the meter socket is not obstructed with the cabinet door in the full open position. The meter shall be installed on the latch side of the cabinet.

d. ***Main Disconnect Required***

All new CT rated utility metering service installations will require that a single main disconnect with adequate overcurrent protection be installed after the metering on the outside of the building and within 10 feet of the CT rated service. This disconnect shall always be readily accessible.

e. ***Prohibited Installation Locations***

Under no circumstances shall CTs or PTs be installed on secondary overhead lines, in pad-mount transformers, or inside wireways, gutters, or raceways.

f. ***CT-Rated Metering Request Submittals***

All CT-rated metering requests require that a one-line diagram be submitted to the Electric Metering Supervisor for approval prior to installation. The diagram shall include the main disconnect or main distribution panel bus rating and service voltage. Submit cut-sheets to the Electric Metering Supervisor for CT rated metering equipment for approval prior to purchasing.

g. ***Switchgear CT Compartment Requirements***

Whenever switchgear metering is desired, cut sheets must be submitted to the Electric Metering Supervisor for approval prior to purchase. Unapproved switchgear is not allowed.

Switchgear CT compartments must have barriers on all four sides of the compartment and hinged sealable doors. The compartment shall have no customer installed equipment behind hinged sealable doors. All panels providing access to unmetered conductors shall have fasteners that cannot be removed from either the exterior or the customer compartment. No conductors, other than those serving the CT compartment and the ground bus, shall be installed in or routed through the compartment. 277/480 volts switchgear shall be manufactured with provisions for unobstructed mounting of PTs inside the same compartment as CTs. If switchgear is to have door fronts, there shall be no other customer equipment inside the metering section.

NOTE: CT Type = Bar (B) or Window (W). When ordering a cabinet for window-type CTs, the customer is required to supply bars and mounting brackets.

h. ***Wall-Mounted Cabinet Requirements***

Wall-mounted CT cabinets shall be installed so that the bottom of the cabinet is at least three feet above final grade. Potential transformers (if used) shall be installed within the CT compartment. CTs and/or PTs shall be installed at a maximum mounting height of six (6) feet.

i. ***Pad-Mounted Cabinet Approvals***

Pad-mounted CT cabinets may be used with approval from the Electric Metering Supervisor.

j. ***No Pull Boxes/Junction Boxes at Meter Sockets or CT Cabinets***
CT cabinets and meter sockets shall not be used as a pull-box or junction box. No connections shall be made in the CT compartment or meter socket to supply another meter, more than one load circuit, or customer equipment. For multiple loads, a switchboard or combination CT/multi-main equipment shall be used. Gutters, raceways, and conduit *after* the metering point is allowed.

k. ***Conduit Requirements***
The conduit from the CT cabinet to the meter box shall be of a single piece, minimum 1.5-inch diameter, and no greater than 10 feet in length. No 90-degree hard corners or LB conduit with plate covers are allowed. The total bends of conduit shall not exceed 180 degrees. All conduit shall remain visible for inspection at all times. Conduit shall not pass through the customer side of equipment or customer walls or structures. Conduit from the CT cabinet to the meter shall not be buried. (See *Drawings No. 6.5 and 6.6.)*

l. ***Ground Bonds***
Ground bonds shall be made from the CT can to the meter box by means of continuous #6 solid or stranded copper, bonded with a double lug to the system neutral within the CT compartment. No mechanical bonds are to be solely relied upon. At least one (1) grounding bushing shall be installed on the conduit between the meter box and the CT can. Plastic end caps shall be installed on each end of the conduit. Grounding provisions shall be available in the CT/PT can and meter box.

m. ***City Furnished Materials & City Installations***
The City will furnish the necessary CTs, PTs, and meter socket for all CT rated metering installations under 600 V. The City will provide and install the wiring between CTs/PTs, meter, and associated equipment.

n. ***Metering Fire Pumps***
All commercial stand-alone fire pump applications that are 1200 locked rotor amps and below will be required to have a 400 amp CT-PT rated service installed by the customer for metering purposes. Self-Contained metering applications are not acceptable.

Tables of Minimum Dimensions for CT Cabinets

- All dimensions are in inches -

Table 6-1: Single-Phase 120/240V

Amps	Height	Width	Depth	CT Type
400[1]	N/A	N/A	N/A	N/A
600	40	24	8 ¼	B
800	48	30	11	B

[1] Class 320 socket used for 400A single-phase

Table 6-2: 3-Phase 4-Wire 120/208V (or 240V)

Amps	Height	Width	Depth	CT Type
400	30	30	8¼	B
600	40	30	8 ¼	B
800	48	30	11	B
1200	48	33	11	B
1600	60	33	11	B
2000	60	39	15	W*
3000	75	39	24	W*
4000	75	39	24	W*

*See Note in Section 6.9.g

Table 6-3: 3-Phase 4-Wire 277/480V
with dedicated PT mounting provisions

Amps	Height	Width	Depth	CT Type
400	48	36	15	B
600	48	36	15	B
800	48	36	15	B
1200	60	51	24	B
1600	75	63	24	B
2000	75	63	24	W*
3000	75	63	24	W*
4000	75	63	24	W*

*See Note in Section 6.9.g

6.10 Primary Metering

a. ***Primary Metering Installations***
To qualify for primary metering, customers have to meet the minimum kW threshold stated in the Rates, Charges & Fees. The City will specify the cabinet and install all primary metering instrument transformers, cabinet, and switches. The customer shall purchase and have the cabinet delivered to the City, which will be owned, operated, and maintained by the City. Contact the Electric Metering Supervisor for specifications and approval prior to purchasing. All primary metering installations will be built by the City and billed on actuals at the customer's expense. The customer must contact the Electric Metering Supervisor at 970-962-3582 for access to the metering cabinet. (See *Drawings No. 6.8 and 6.9.)*

b. ***Vaults Under Primary Metering Cabinets***
Any underground primary metering shall have a vault underneath the primary metering cabinet. An Electrical Engineering review is required. Contact the Electric Metering Supervisor at 970-962-3582 for specifications. The City will install the vault and primary metering cabinet. The customer will be billed actual costs for labor and material. The customer must contact the Electric Metering Supervisor at 970-962-3582 for access to the vault.

c. ***Meter Sockets & Meter Installations***
The City will provide and install the meter socket. The Electric Metering group will wire the metering circuit and install a meter.

d. ***Overhead Primary Metering***
Overhead primary metering is not allowed.

e. ***Primary Meter Testing & Certification***
The City will test and verify the primary meter installation upon energizing the service.

f. ***Replacing Primary Metering Equipment***
Any replacement of the primary metering equipment enclosure including, but not limited to, mechanical failure or acts of nature will be coordinated by the City. If, during routine testing, the primary CTs and PTs are determined to require replacement, then replacement of items shall be performed by the City. The customer will be responsible for the enclosure excluding City owned equipment. The customer is responsible for all costs of replacement, including labor and materials.

6.11 KYZ Metering

a. ***KYZ Outputs***
KYZ metering is measuring energy usage with a watt-hour meter, then converting the measured quantity into electronic increments of a constant known value, known as "pulses". KYZ metering provides a common standard of exchanging energy use information between systems and is often used with customer energy management or building management systems. KYZ metering can be used to signal the beginning and end of "peak" demand by the City.

- Two general purposes of KYZ pulses:
  - Interval Data Pulses - for counting and recording usage
  - Real-Time Power Use - for transmitting instantaneous, real- time energy usage information to other devices without any direct electrical contact
- Often used with customer energy management / building management systems
- Can be used to signal 'peak' – beginning and end of peak signal from utility

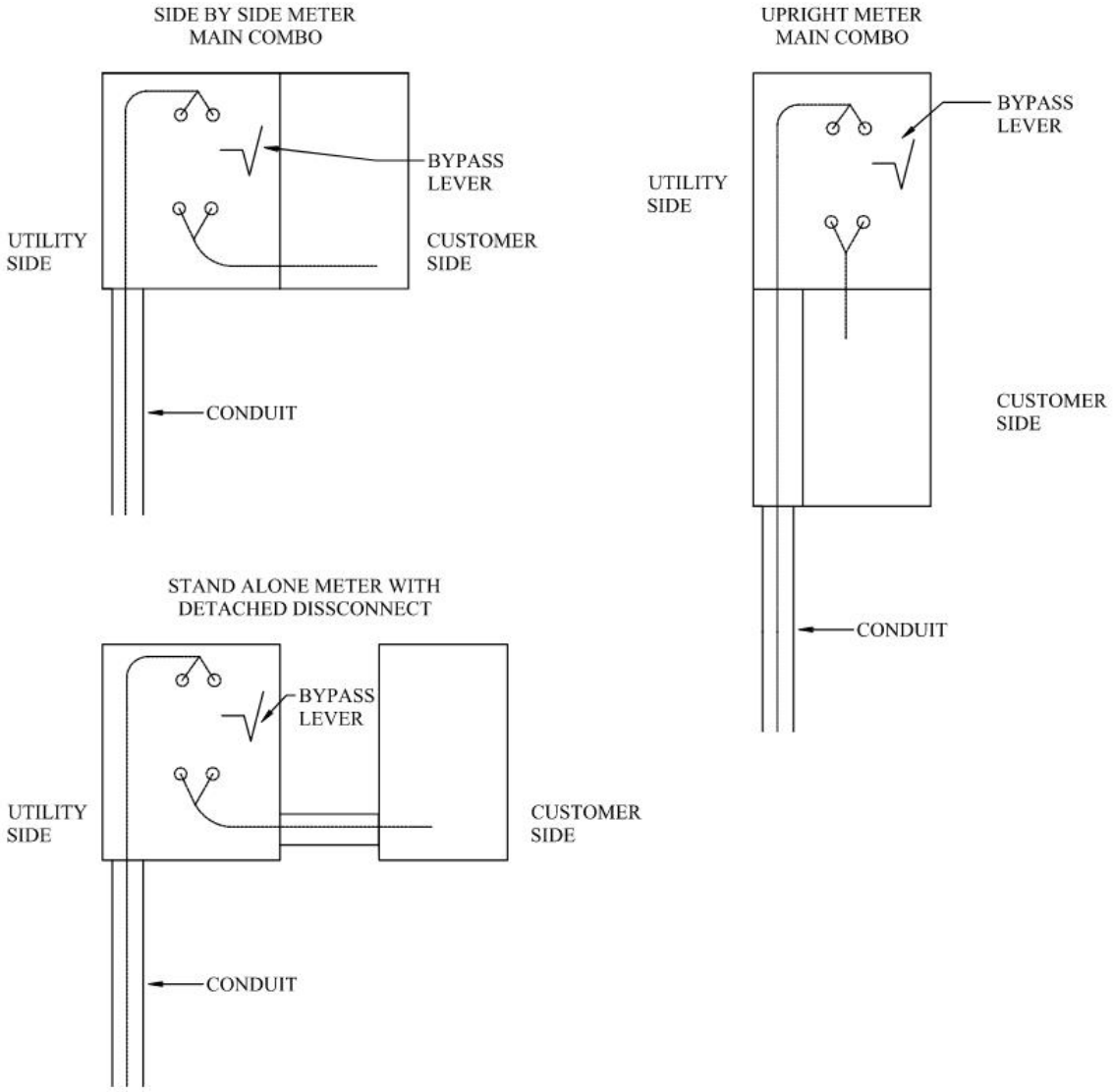
Electric load pulse outputs will be provided after a customer submits a completed KYZ Metering Request Form and payment of applicable fees. This form can be found on the Requirements for Electric services website.

b. ***KYZ Meters***
The City will supply all necessary equipment including weatherproof enclosure, relays, and conduit from meter to weatherproof enclosure. Customer will be responsible for installing and maintaining the weatherproof enclosure and conduit from the enclosure to the internal Energy Management System (EMS) location. The city will install and maintain the isolation relay, conduit and conductor between the meter and the relay. See *Drawing No. 6.7*.

c. ***Energizing Requirements***
The City will energize and seal the relay and perform relay pulse verification after the customer has completed the connection between the relay output and the EMS. Contact the Electric Metering Supervisor at 970-962-3582 to schedule energization.

d. ***Energy Management System Configuration***
The City will provide the customer with the pulse value based on the standard pulse rate of the meter. It will be the customer's responsibility to configure their EMS to utilize the pulse value, as provided. All pulse outputs from the meter to the relay will be three-wire, form-C contacts.

UTILITY vs CUSTOMER CONDUCTORS IN COORDINATION WITH LEVER BYPASS HANDLE

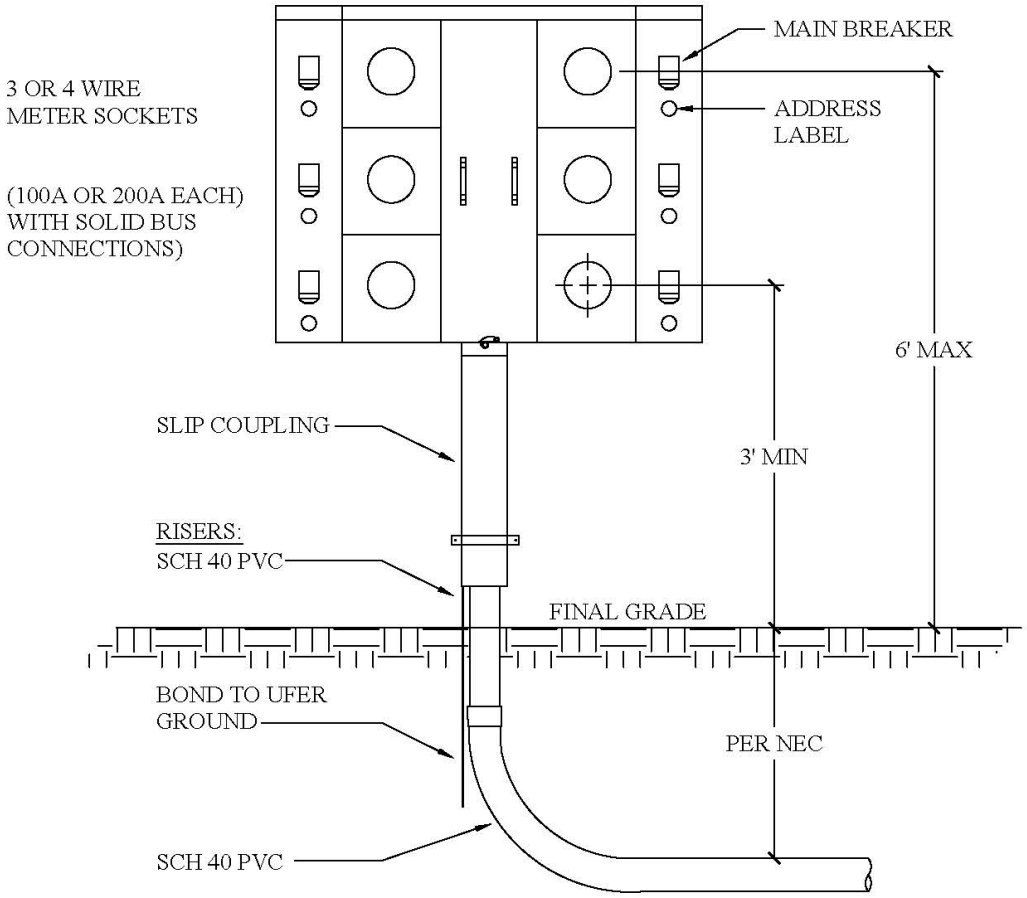


NOTES:
1. THE UTILITY SIDE AND THE CUSTOMER SIDE CONDUCTORS SHOULD NEVER CROSS.
2. NO CONDUCTORS SHALL BE LOCATED ON LEVER BYPASS HANDLE SIDE OF METER HOUSING.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	6.1	CONDUCTORS IN COORDINATION WITH LEVER BYPASS

UNDERGROUND MULTIPLE METER



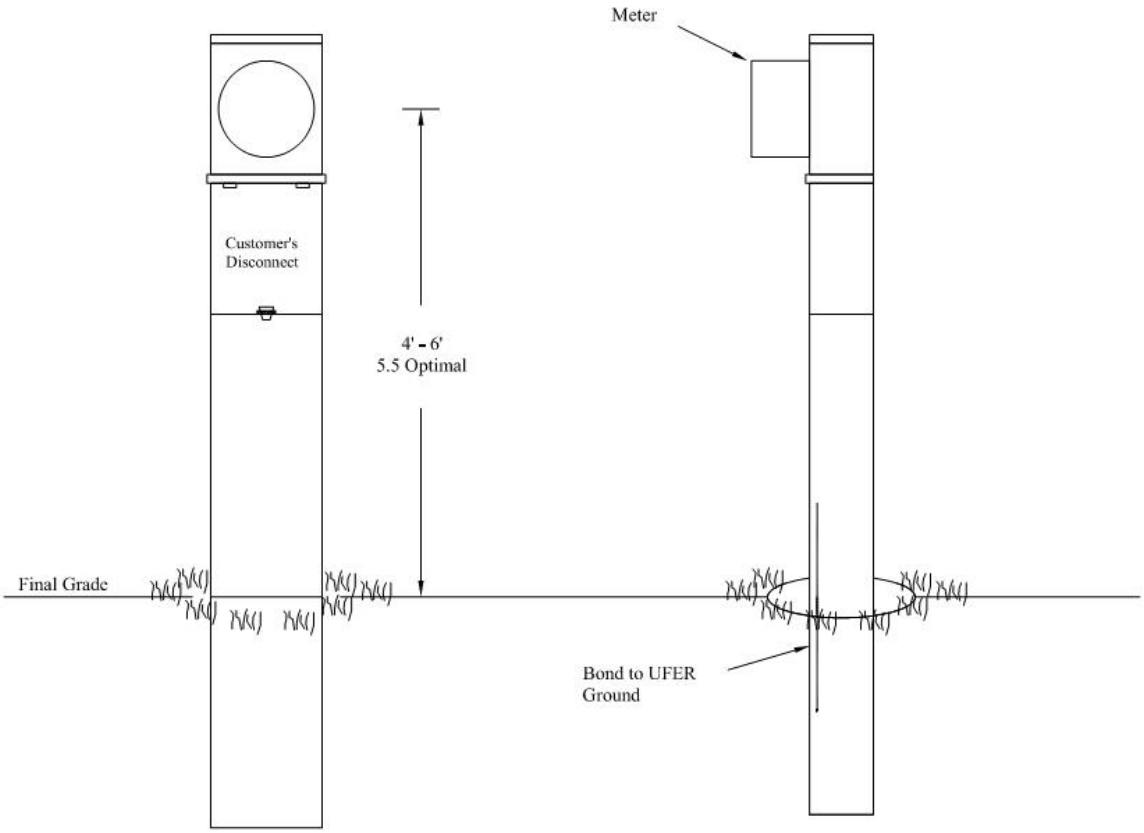
NOTES:

1. THE MULTIPLE METER PACKAGE FURNISHED SHOULD HAVE SOLID BUS BAR CONNECTIONS.
2. ALL NON-CURRENT CARRYING METALLIC PARTS MUST BE EFFECTIVELY GROUNDED.
3. INCLUDE GROUNDING LUG FOR COMMUNICATIONS GROUND.
4. ALL SELF-CONTAINED METERING SHALL HAVE MANUAL BYPASS LEVER METER SOCKETS.
5. SEE SECTION 6 FOR ALL OTHER METERING REQUIREMENTS
6. SEE SECTION 8 FOR ADDITIONAL CLEARANCE REQUIREMENTS

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2021	6.2	UNDERGROUND MULTIPLE METER

MANUFACTURED METER PEDESTAL

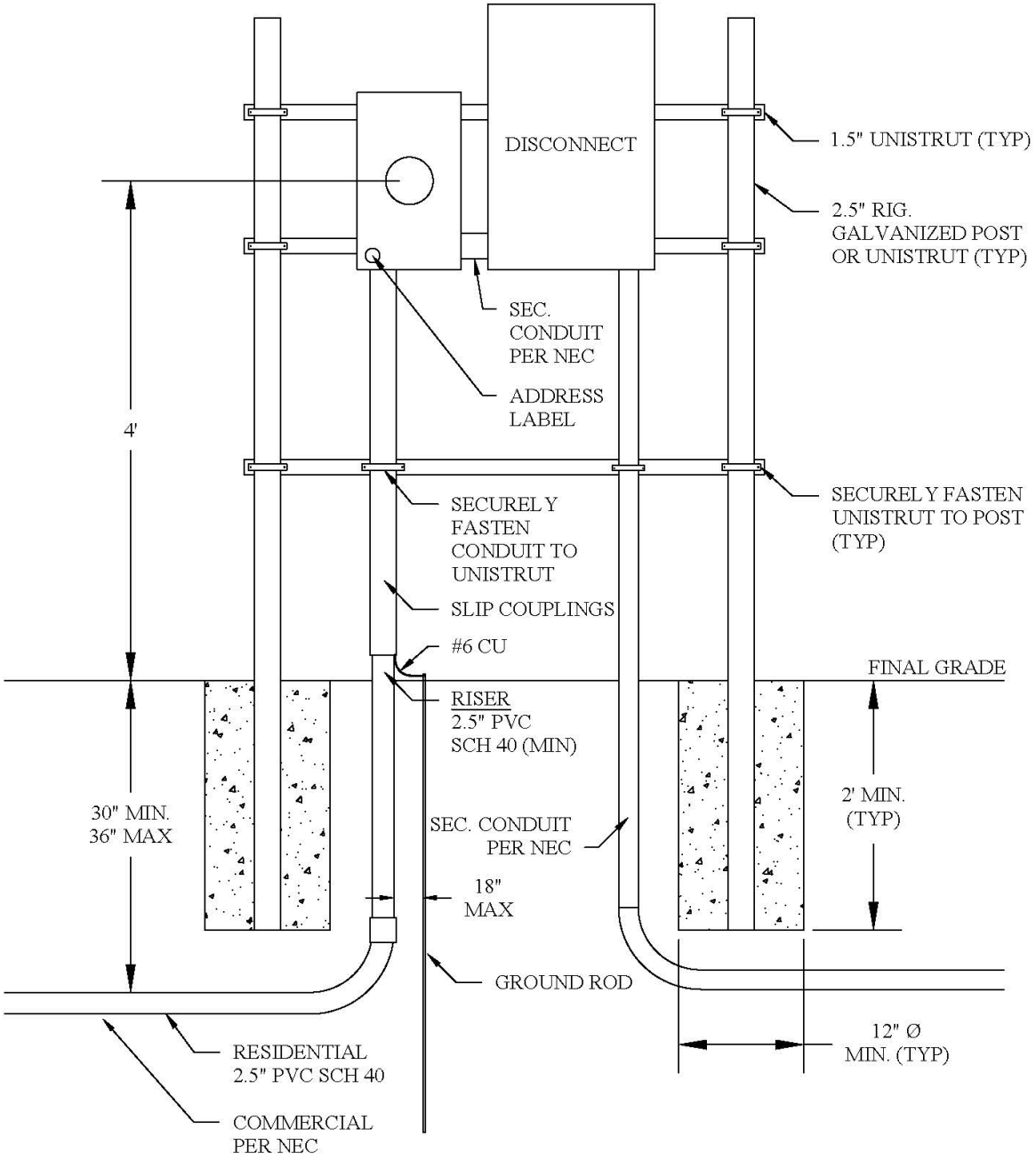


NOTES:
1. Must meet all requirements of NEC.
2. Footing - 30" Min. set in concrete from base of hole to finished grade.
   Concrete must also completely surround the pedestal.
3. Install pedestal per manufacturer recommendation.
4. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2017	6.3	Manufactured Meter Pedestal

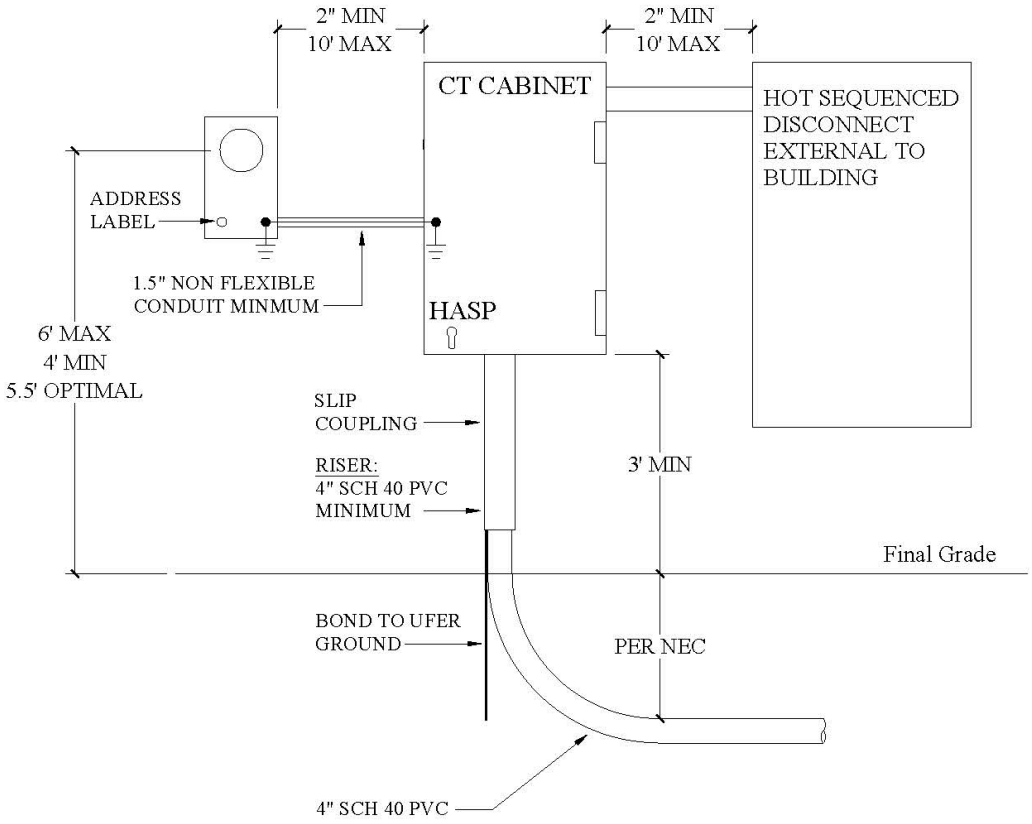
METER STAND



CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2021	6.4	METER STAND

CT RATED METERING



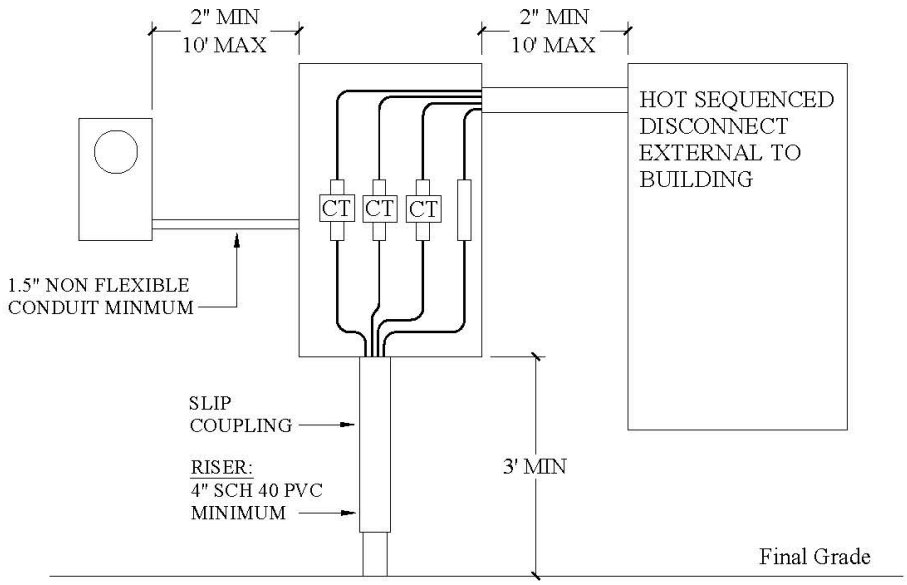
NOTES:

1. BOND METER BOX GROUND TO CT CABINET WITH APPROVED COPPER WIRE. INSTALL BONDING BUSHING ON EITHER END OF CONDUIT. MECHANICAL BONDS ARE NOT ALLOWED.
2. CT's & PT's SHALL BE 6' MAX ABOVE FINISHED GRADE.
3. SEE SECTION 6 "METERS AND METER CONNECTIONS" FOR ALL OTHER REFERENCES
4. GRADE TO BE LEVEL WITHIN 5' WORKING RADIUS IN FRONT OF THE METER.
5. FOR CT CABINET SIZING SEE TABLES 6-1 THROUGH 6-3.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
AUGUST 2020	6.5	CT METERING

120/208V CT RATED METERING
STANDARD CABINET INTERIOR VIEW



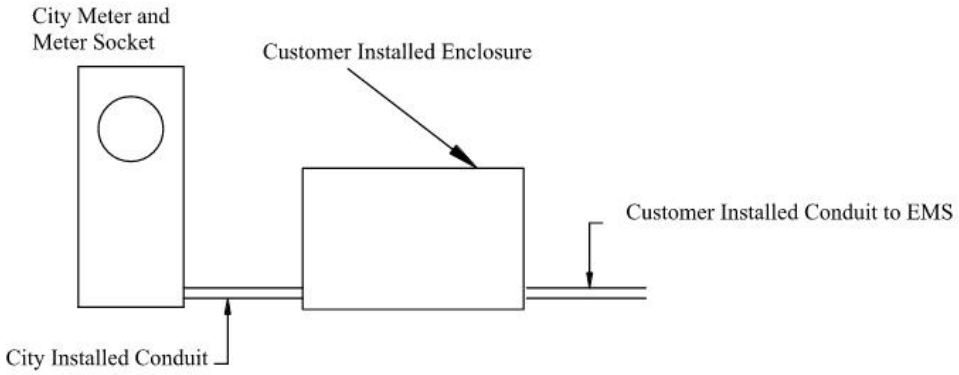
NOTES:

1. BOND METER BOX GROUND TO CT CABINET WITH APPROVED COPPER WIRE. INSTALL BONDING BUSHINGS ON EITHER END OF CONDUIT. MECHANICAL BONDS ARE NOT ALLOWED.
2. INCLUDE GROUNDING LUG FOR COMMUNICATIONS.
3. LINE SIDE CAN BE ON TOP OR BOTTOM OF CT CABINET.
4. METER SOCKETS OR CT CABINETS SHALL NOT BE USED AS A JUNCTION BOX UNDER ANY CIRCUMSTANCE.
5. CT's SHALL BE 6' MAX ABOVE FINISHED GRADE.
6. PT's ARE TO BE INSTALLED ON SERVICES GREATER THAN 240 VOLTS. PLEASE CONTACT ELECTRIC METERING SUPERVISOR FOR GEAR SPECIFICATIONS.
7. SEE SECTION 6 "METERS AND METER CONNECTIONS" FOR ALL OTHER REFERENCES.

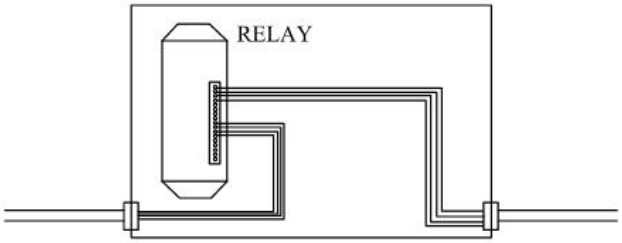
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
AUGUST 2020	6.6	CT METERING CABINET

LOAD CONTROL KYZ OUTPUT



RELAY ENCLOSURE INTERIOR (TYPICAL)



NOTES:

1. The customer will determine the location and perform the mounting of the relay enclosure, typically within 18" of the meter socket.
2. Customer installed conduit is required from relay enclosure to customer equipment.
3. No additional customer equipment is allowed inside relay enclosure.
4. The power feed to the relay will be fused inside the meter socket. The city will energize the relay after the customer's wiring is completed. The relay feed shall not be used to power any other equipment.
5. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	6.7	LOAD CONTROL KYZ OUTPUT

PRIMARY METER INSTALLATION

TABLE OF RESPONSIBILITY

ITEM, MATERIAL OR WORK DESCRIPTION	PARTY TO FURNISH AND OWN	PARTY TO INSTALL AND MAINTAIN
PERMITS AND INSPECTIONS	CUSTOMER	N/A
PRIMARY METERING CABINET	CUSTOMER PURCHASE/CITY SPECIFIED & OWNED	CITY
CONCRETE PRECAST VAULT	CITY	CITY
LINE SIDE CONDUIT AND CONDUCTOR	CITY	CITY
LINE SIDE TERMINATIONS	CITY	CITY
INSTRUMENT TRANSFORMERS CTs & PTs	CITY	CITY
METER SOCKET	CITY	CITY
METERING CIRCUIT CONDUCTORS	CITY	CITY
BILLING METER	CITY	CITY
LOAD SIDE CONDUIT AND CONDUCTORS	CUSTOMER	CUSTOMER
LOAD SIDE TERMINATIONS	CITY	CITY
GROUND RODS (S), CONDUCTOR OR GRID	CITY	CITY

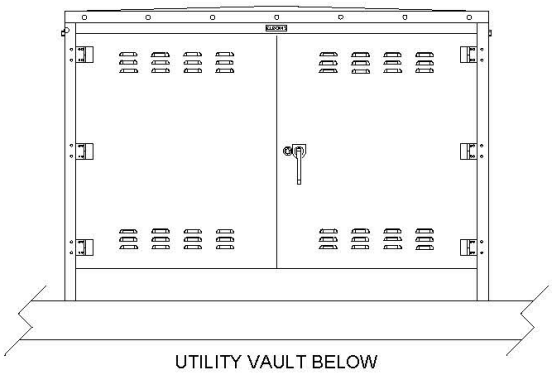
NOTES:

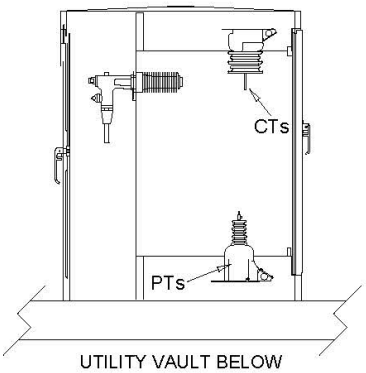
1. DEMARCATION POINT - LOAD SIDE TERMINATIONS
2. SEE SECTION 6.10 FOR PRIMARY METERING REQUIREMENTS

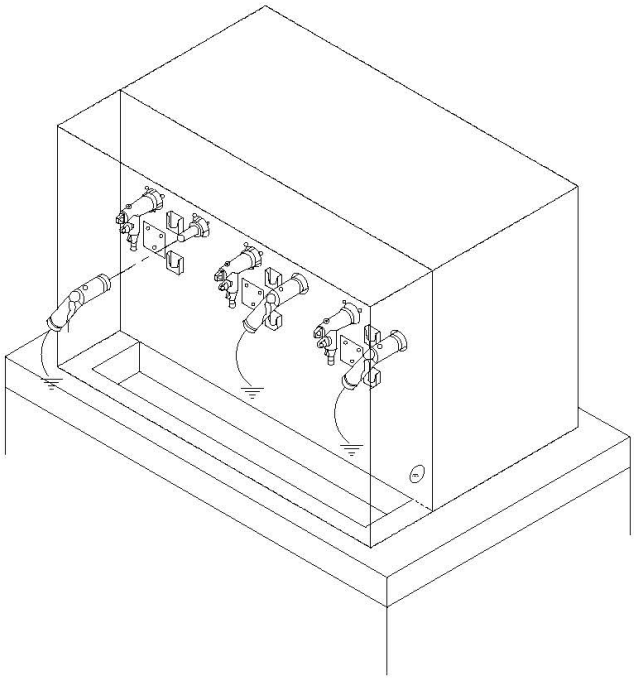
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	6.8	PRIMARY METER RESPONSIBILITY

PRIMARY METER INSTALLATION







NOTES:

1. CUSTOMER OWNED CONDUCTORS MUST FIT CITY SUPPLIED LOAD SIDE TERMINATIONS. CONTACT POWER ENGINEERING AT 970-962-3000

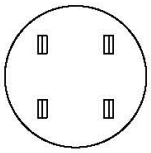
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
AUGUST 2020	6.9	PRIMARY METER INSTALLATION

Section 7 – Meter Socket Connections

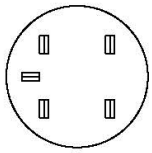
METER SOCKET TERMINAL ARRANGEMENT		
TYPE OF SERVICE	SELF CONTAINED	WITH CURRENT TRANSFORMER
SINGLE-PHASE 120/240V, 3-WIRE	FIGURE 1	FIGURE 3
SINGLE-PHASE 120/208V, 3-WIRE	FIGURE 2	
THREE-PHASE 120/208V, 4-WIRE	FIGURE 5	FIGURE 4
THREE-PHASE 120/240V, 4-WIRE	FIGURE 5	FIGURE 4
THREE-PHASE 277/480V, 4-WIRE	FIGURE 5	FIGURE 4

FIG. 1



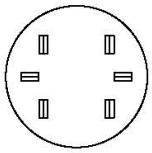
2S

FIG. 2



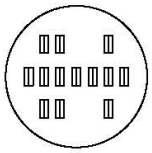
12S

FIG. 3



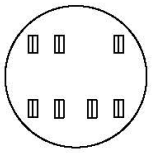
4S

FIG. 4



9S

FIG. 5



15S/16S

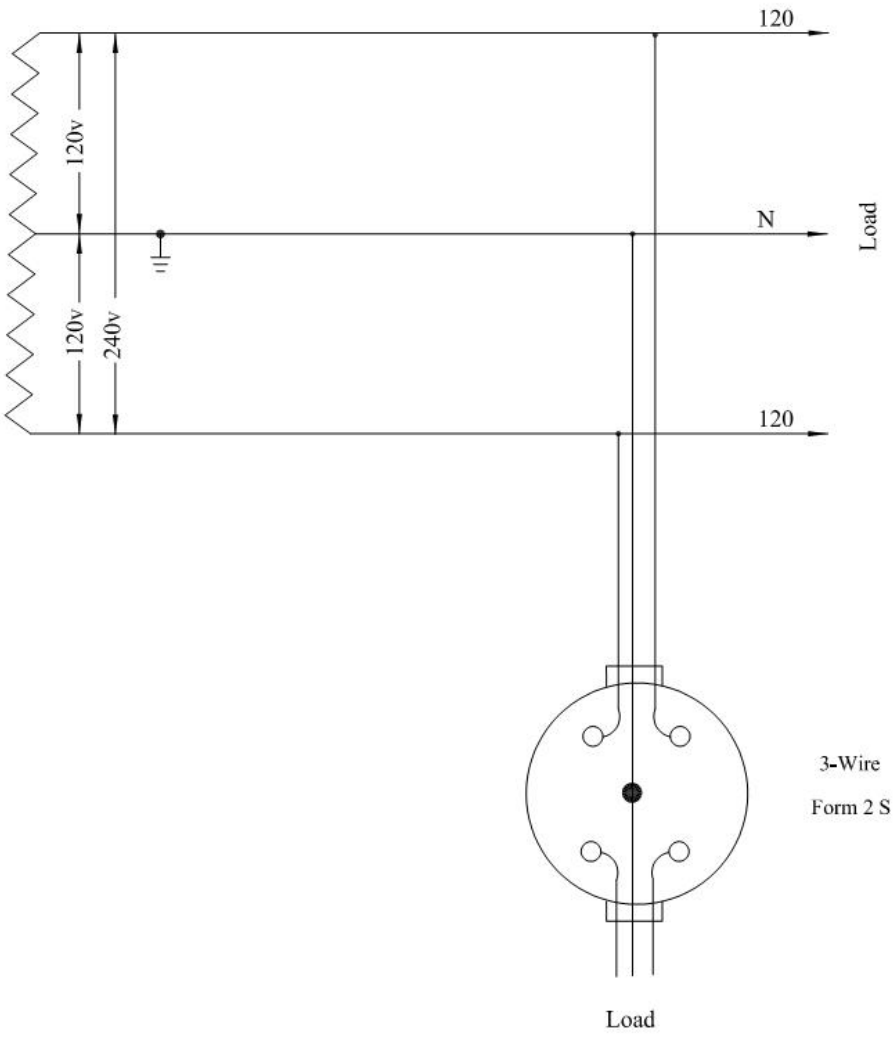
NOTES:

1. FIG.2 SHALL ALWAYS HAVE THE 5TH TERMINAL IN THE 9:00 POSITION
2. ALL SELF CONTAINED METER SOCKETS SHALL HAVE A LEVER BY-PASS HANDLE

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2021	7.1	METER SOCKET TERMINAL ARRANGEMENT

SINGLE PHASE 120/240 VOLTS
THREE WIRE



Socket Viewed From the Front

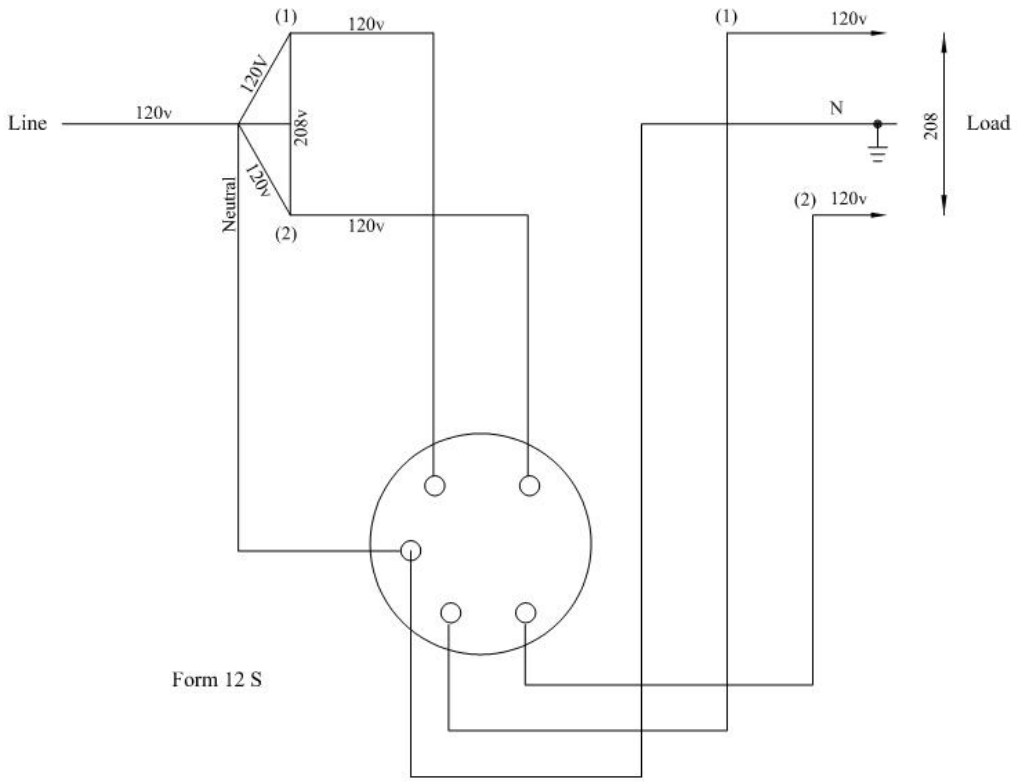
Notes:

1. Must have a lever by-pass handle.
2. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2017	7.2	Meter Connections

THREE WIRE 120/208 VOLTS WYE
TWO STATOR METER AND FIVE TERMINAL SOCKET



Form 12 S

Socket Viewed From the Front

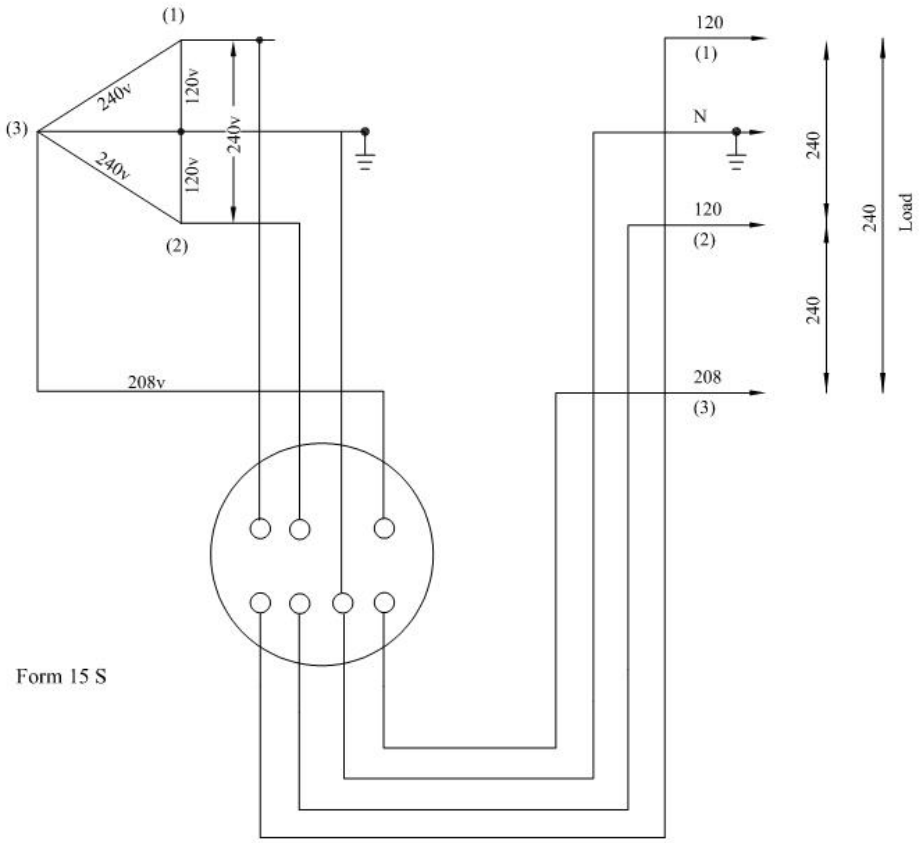
Notes:

1. Must have lever by-pass handle.
2. Neutral lug to be installed on the 9:00 position.
3. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2017	7.3	Meter Connections

THREE PHASE FOUR WIRE 120/240 VOLTS DELTA
SELF CONTAINED 2-STATOR METER



Form 15 S

Socket Viewed From the Front

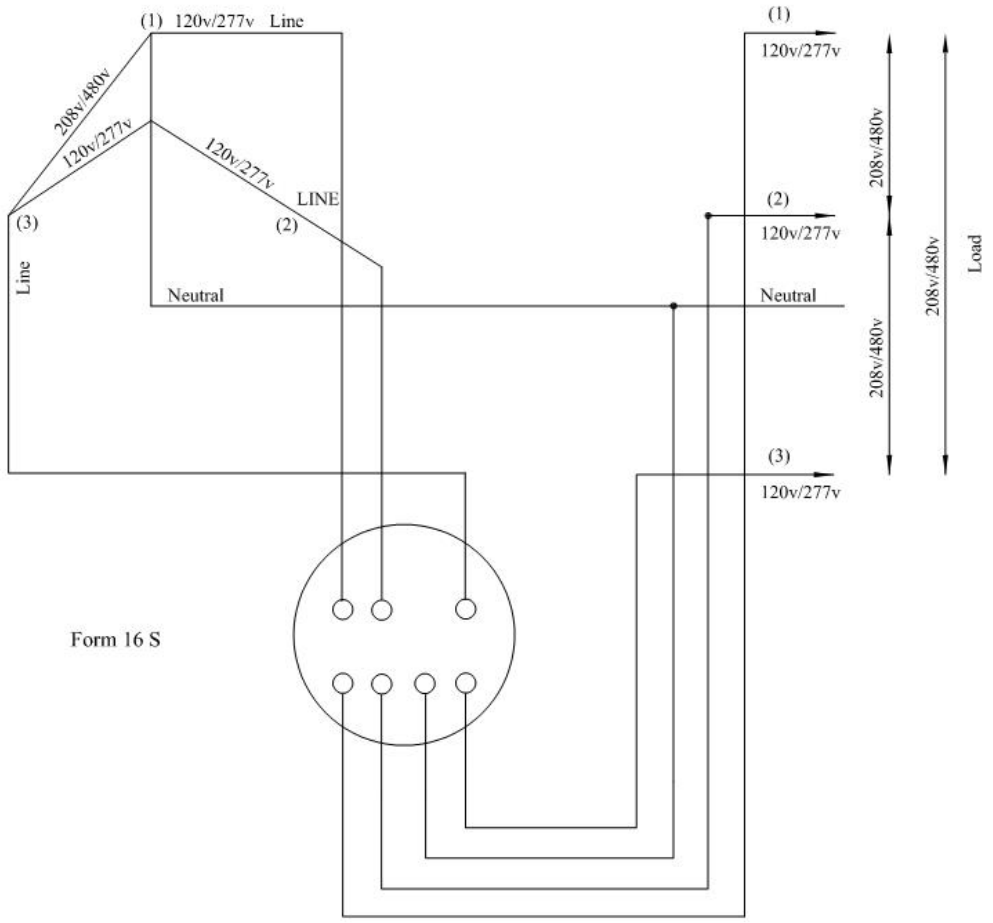
Notes:

1. Must have a lever by-pass handle.
2. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2017	7.4	Meter Connections

THREE PHASE FOUR WIRE WYE
THREE STATOR - 120/208, 277/480 VOLT METER



Socket Viewed From the Front

Notes:

1. Must have a lever by-pass handle.
2. See Section 6 "Meters and Meter Connections" for all other references.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2017	7.5	Meter Connections

Section 8 – Clearances

8.1 General Clearances

a. ***Clearance to Electric Lines***

Minimum clearance to underground power lines, overhead power lines, and service drops, as required by these Requirements, NESC, NEC or other code, must be maintained at all times – both during and after construction. The customer is responsible for all costs associated with the temporary or permanent reconfiguration of power lines impacted by their project.

b. ***Landscape Clearances to Electrical Infrastructure***

No bushes, shrubs, or trees shall be planted where mature growth may interfere with electrical infrastructure. Clearances are outlined below and shown in Detail Drawings within this section.

- *Vault Clearances:* 10 feet from all sides of vaults with no covering on or over the vault lid
- *Switchgear Clearances:* 10 feet from the sides of the switchgear
- *Transformer Clearances:* 10 feet from the doors, 5 feet from all other sides of the transformer
- *Metering Equipment:* 5 feet from face of metering equipment and 3 ft to either side
- *Primary Metering Equipment:* 10 feet from the front and back, 5 feet from the sides of metering equipment
- *Handholes:* No trees within 5 feet; no bushes or shrubs on street side; no bushes or shrubs within 18 inches of sides or back
- *Electric Lines:* No trees within 5 feet of existing or proposed underground electric lines (from center of tree to center of trench or electric line). No trees may be planted directly under existing or proposed overhead electric lines.

Clearances for bushes, shrubs, and trees must be based on full growth diameters of the plantings. A clear path shall be provided from a roadway or parking area to the access point of the equipment. The customer shall remove any obstruction at the owner's expense.

Refer to *Section 1.10* for non-typical situations where easement requirements and/or landscape clearances can't be met.

c. ***Damage Due to Inadequate Access***

The City is not responsible for damage to or replacement of trees, shrubs, and/or grass if such vegetation is interfering with the access or operation of any of the City's equipment or facilities.

d. ***Parking Bollards (Posts)***

When City-owned equipment is at risk of damage or vandalism, the City may require the customer to install at the customer's expense additional protection such as parking bollards (posts), protective enclosures, or fencing. Locations of parking bollards and posts will be determined by the City to ensure access and operation of City owned equipment.

e. ***Clearances from Windows & Doors***

Refer to Drawings in this section for clearances from walls, openings, and overhangs.

8.2 Overhead Clearances

a. ***Overhead Clearance Table***

Refer to *Table 8-1* for clearances for service drops and drip loops.

8.3 Underground Clearances

a. ***Underground Clearances Drawing***
Refer to *Drawing No. 8.7* for residential underground service clearances. Refer to *Drawing Nos. 8.8 & 8.9* for commercial underground multiple meter and CT metering clearances.

b. ***Pad-Mounted Equipment Clearances***
For all pad-mounted equipment, the City requires a minimum of 10 feet of clear space in front of all access doors to allow for hot-stick operation, and must have 24-hour unobstructed access. Refer to *Drawing No. 8.1*.

c. ***Permanent Structures Not Permitted Above Underground Conductors***
No permanent structure shall be constructed over any existing underground conductor. Permanent structures (sheds, mailbox kiosks, monument signs, fences, etc.) shall have 5-feet horizontal clearance from any existing underground conductor. Temporary structures may be required to be relocated at the owner's expense if requested by the City.

d. ***Minimum Horizontal Separation for Parallel Utilities***
For utilities running parallel, the following minimum horizontal separation is required between each utility and the primary power conduit, measured from outside conduit wall to outside conduit wall:

- Wet Utilities - 6 feet
- Dry Utilities - 3 feet

e. ***Minimum Vertical Separation for Perpendicular Utilities***
For utilities running perpendicular, the following minimum vertical separation is required between each utility and the primary power conduit, measured from outside conduit wall to outside conduit wall. :

- Wet Utilities - 18 inches
- Dry Utilities - 12 inches

Refer to *Drawing No. 8.13* in this section.

8.4 Swimming Pools or Hot Tubs/Spas

a. ***Swimming Pool or Hot Tubs/Spas Clearances***
Refer to *Drawing No. 8.3* for clearances from swimming pools or hot tubs/spas.

8.5 Flammable Gases or Liquids

a. ***Tanks of Flammable Gases or Liquids Clearances***
Refer to *Drawing No. 8.5* for clearances from tanks containing flammable gases or liquids.

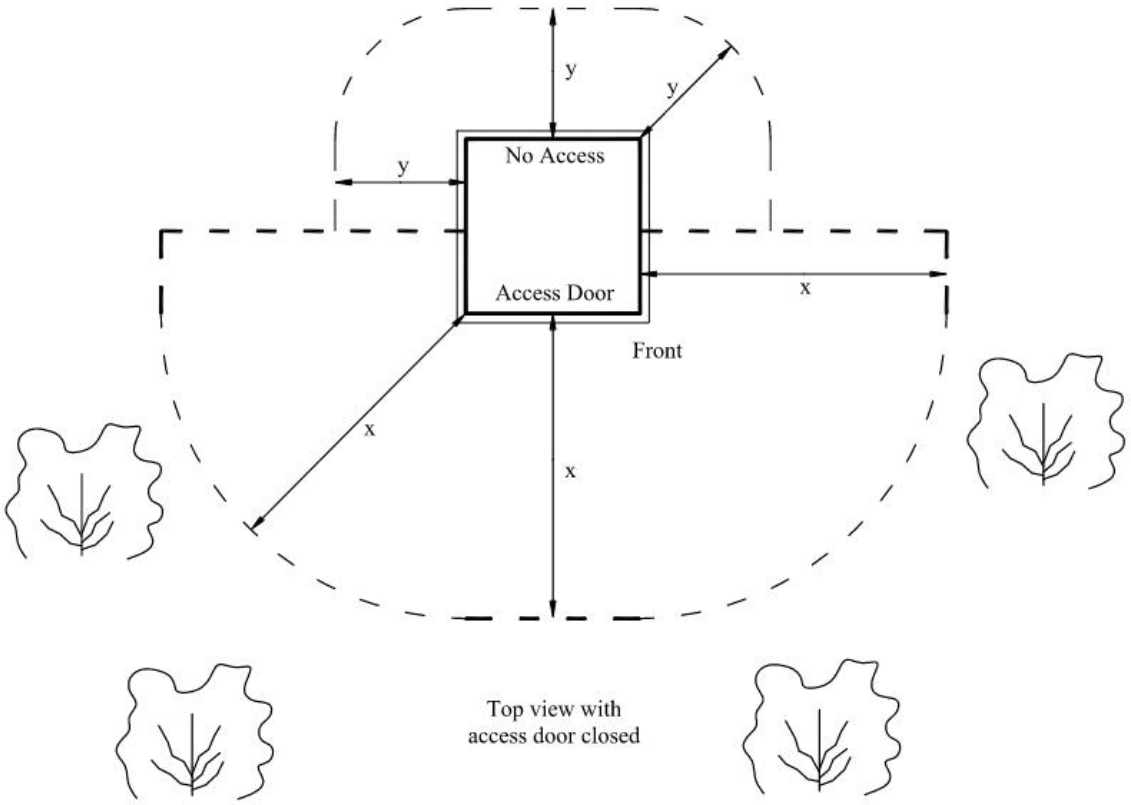
Table 8.1 – Clearances for Service Drops and Drip Loops

750 Volts and Below (Distances in Feet)

The customer shall provide a point of attachment which allows NESC minimum clearances to be met in all conditions. A two-foot addition to certain NESC values is required by the City to ensure minimum clearances are met in extreme conditions and after conductor sag. These required heights are noted as "clearance required at time of construction" in the table below. Long services or other special cases (i.e. services crossing uneven or sloped terrain) may require clearance additions greater than two (2) feet. References to applicable codes (NEC, NESC) are *italicized*.

	NESC Minimum Clearance	Clearance Required at Time of Construction
Service drop clearance (*NESC Table 232-1, NEC clearance for this section is 18' – Art.230.24(B)(4)*)		
Over roads, streets, and other areas subject to truck traffic	16'	18'
Over or along alleys, parking lots, and nonresidential driveways	16'	18'
Over land travelled by vehicles	16'	18'
Clearances over residential driveways (*NESC Table 232-1*)		
If height of building or installation will permit	16'	18'
If height of building or installation will not permit and is not subject to truck traffic:		
-For service drops 120/240 & 208Y/120 volts	12'	14'
-For drip loops of service drops 120/240 & 208Y/120 volts	10'	12'
Clearances over spaces and ways subject to pedestrians/restricted travel only (*NESC Table 232-1*)		
If height of building or installation will permit	12'	14'
If height of building or installation will not permit, drip loop clearances may be reduced:		
-For 480Y/277 volts (*Note 8-b of NESC Table 232-1*)	10.5'	10.5'
-For 120/240 & 208Y/120 volts (*Note 8-d of NESC Table 232-1*)	10'	10'
Clearances from buildings for service drops not attached to the building (*NESC Table 234-1*)		
Vertical clearance over or under balconies and roofs:		
-Accessible to pedestrians, if cabled with a grounded bare neutral	10'	12'
-Accessible to pedestrians, if open wire or cabled with an insulated neutral	10.5'	12.5'
-Not accessible to pedestrians, if cabled with a grounded bare neutral	3.5'	5.5'
-Not accessible to pedestrians, if open wire or cabled with an insulated neutral	10.5'	12.5'
Horizontal clearance to walls, projections, windows, balconies and areas accessible to pedestrians:		
-If cable with grounded bare neutral	5'	5'
-If open wire or cabled with an insulated neutral	5.5'	5.5'
Clearances for service drops attached to a building or other installation (over or along the installation to which they are attached; service cable with an effectively grounded bare neutral, *NESC 230.C*)		
From the highest point of roofs, decks or balconies over which they pass:		
-If readily accessible (*NESC 234.C.3.d.1, NEC 230.24(A), Exception No. 1*)	10'	12'
-If not readily accessible (*NESC 234.C.3.d.1.a, NEC 230.24(A), Exception No. 2*)	3'	5'
-Above a not-readily accessible roof and terminating at a (through-the-roof) service conduit or approved support, the service and its drip loops set no less than eighteen (18) inches above the roof. No more than six (6) feet of the service cable passes over the roof or within four (4) feet of the roof edge (*NESC 234.C.3.d.1.b, NEC 230.24(A), Exception No. 3*)	1.5'	1.5'
-In any direction from windows designed to open (does not apply to service cable above the top level of a window; *NESC 234.C.3.d.2, NEC 230.9(A)*)	3'	3'
- For vertical clearance from doors, porches, fire escapes, etc. (*NESC 234.C.3.d.5, NEC 230.9(A)*)	3'	3'
- For horizontal clearance from doors, porches, fire escapes, etc. (*NESC 234.C.3.d.4, NEC 230.9(A)*)	5'	5'

PADMOUNT EQUIPMENT CLEARANCES



Top view with
access door closed

MINIMUM DISTANCE REQUIRED FROM PAD

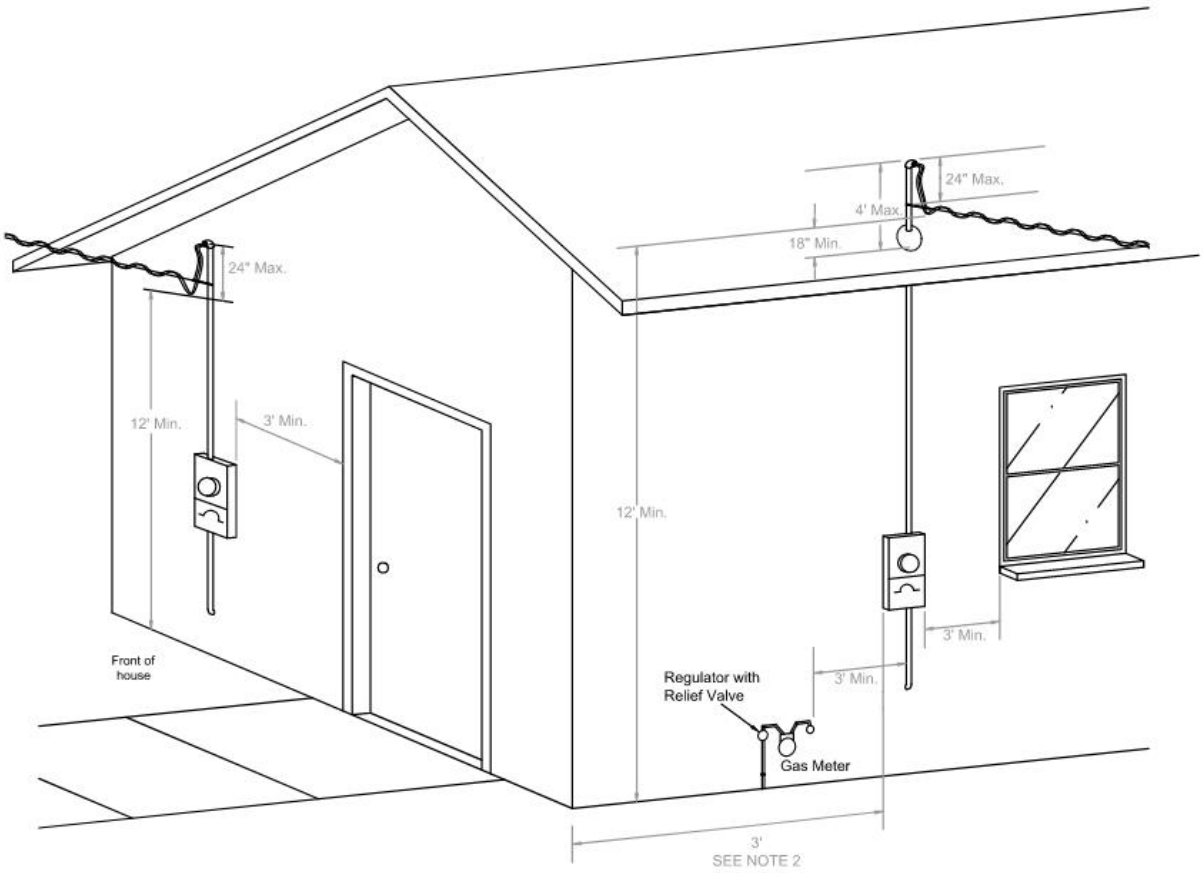
x = 10' clear area in front of any equipment access door or opening to allow the use of hot sticks

y = 10' for short side of vaults and sides of padmounted switchgear and padmounted metering equipment
5' for padmounted transformers
These clearances are also listed in section 8.1

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	8.1	PADMOUNT EQUIPMENT CLEARANCES

MINIMUM CLEARANCE REQUIREMENTS
FOR RESIDENTIAL OVERHEAD SERVICES



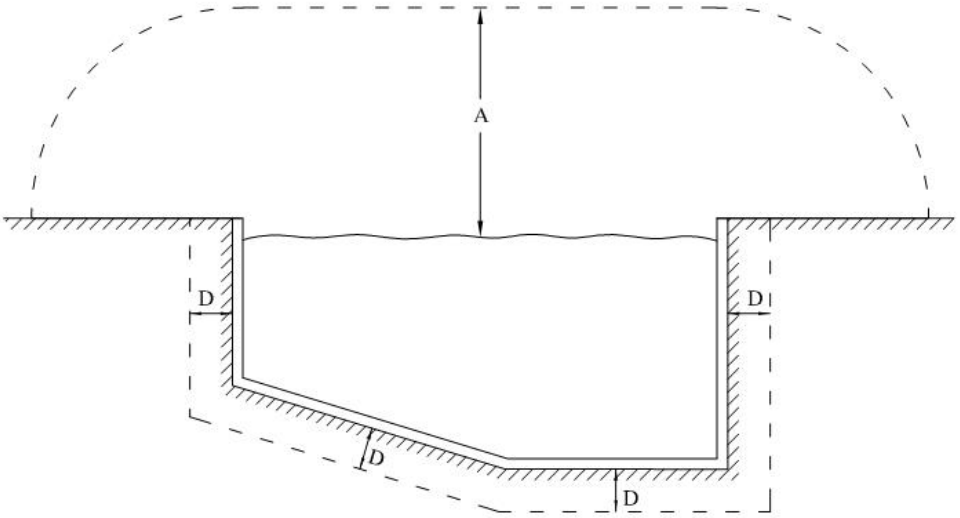
NOTES:

1. THE THREE-FOOT DISTANCE BETWEEN WINDOWS OR DOORS IS INTENDED TO GIVE THE HOMEOWNER SOME PRIVACY.
2. THE METER LOCATION SHALL BE AT LEAST 3' FROM THE FRONT OF THE HOUSE. FENCES SHALL NOT ENCLOSE METER.
3. METER LOCATION SHALL BE AT LEAST 3' FROM ANY GAS METER, PIPE, OR REGULATOR
4. NO METERS SHALL BE LOCATED ABOVE OR BELOW OBSTRUCTIONS (INCLUDING WINDOW WELLS, STAIRS, PLATFORMS, ETC.).

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	8.2	RESIDENTIAL OVERHEAD SERVICE CLEARANCES

CLEARANCE FROM SWIMMING POOLS



D = Five (5) Feet Minimum
A = Twenty Two and A Half (22.5') Feet Minimum.

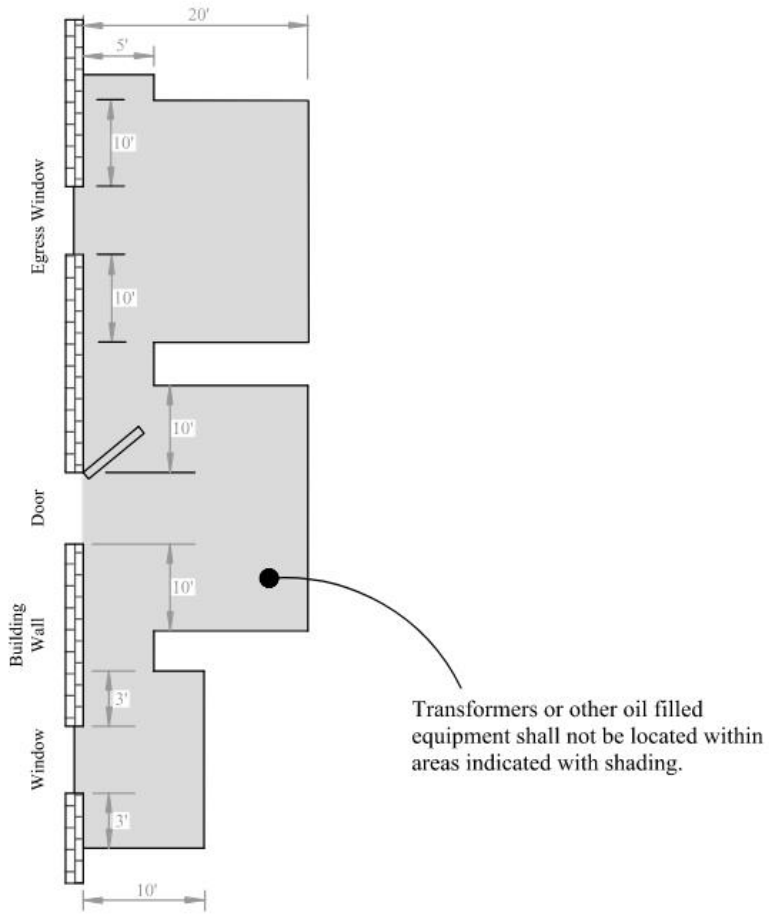
NOTES:

1. No underground conductors shall be installed within five (5) feet of a swimming pool or its auxiliary equipment.
2. If five (5) feet is not attainable, supplemental mechanical protection shall be provided.
3. Clearance of overhead services in any direction from swimming pools or its auxiliary equipment shall be 22.5'.
4. It is highly recommended to not put an overhead conductor directly over any swimming pool, or hot tub.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
June 2013	8.3	Swimming Pool Clearances

MINIMUM CLEARANCES FROM WALLS, OPENINGS AND OVERHANGS

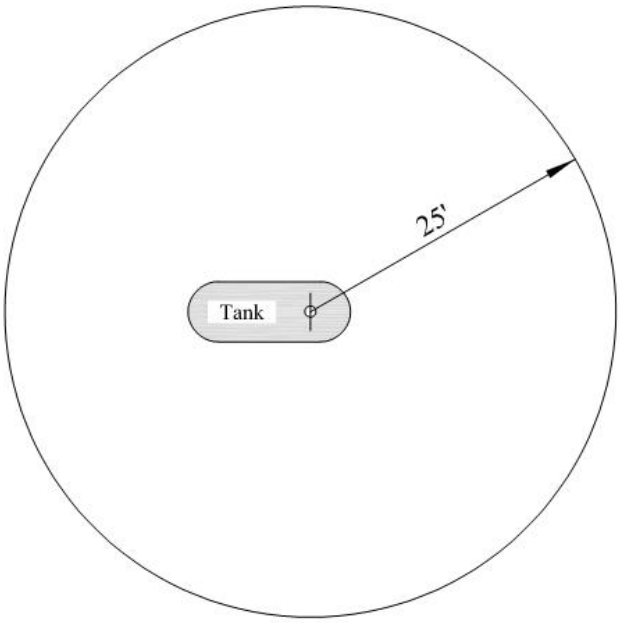


NOTES:

1. All padmounted equipments must have a minimum of ten (10) feet clear area on the door(s) side for hot stick operation.
2. Doors shall face away from building walls, fences, etc.
3. Mechanical protection shall be provided.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
March 2023	8.4	Clearances for Building Openings



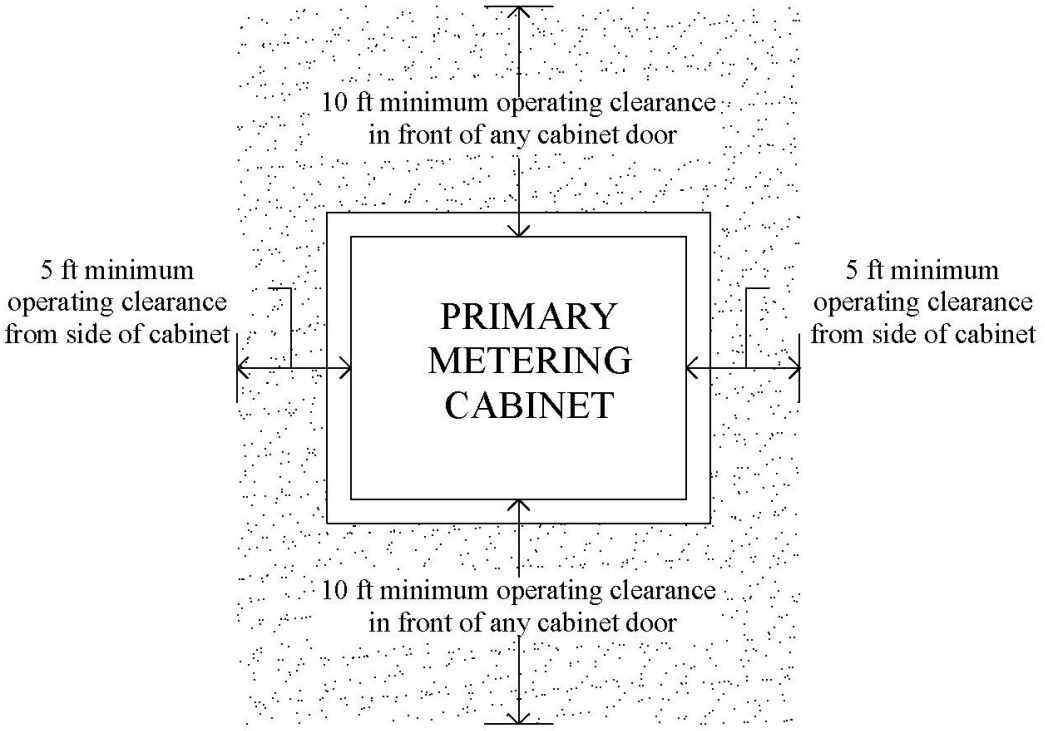
NOTES:

1. No padmounted equipment shall be installed within twenty-five (25) feet of the refill valve of a tank containing flammable gas or liquid.

CITY OF LOVELAND - DEPARTMENT OF WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
June, 2013	8.5	Clearances from Flammable Gas or Liquid

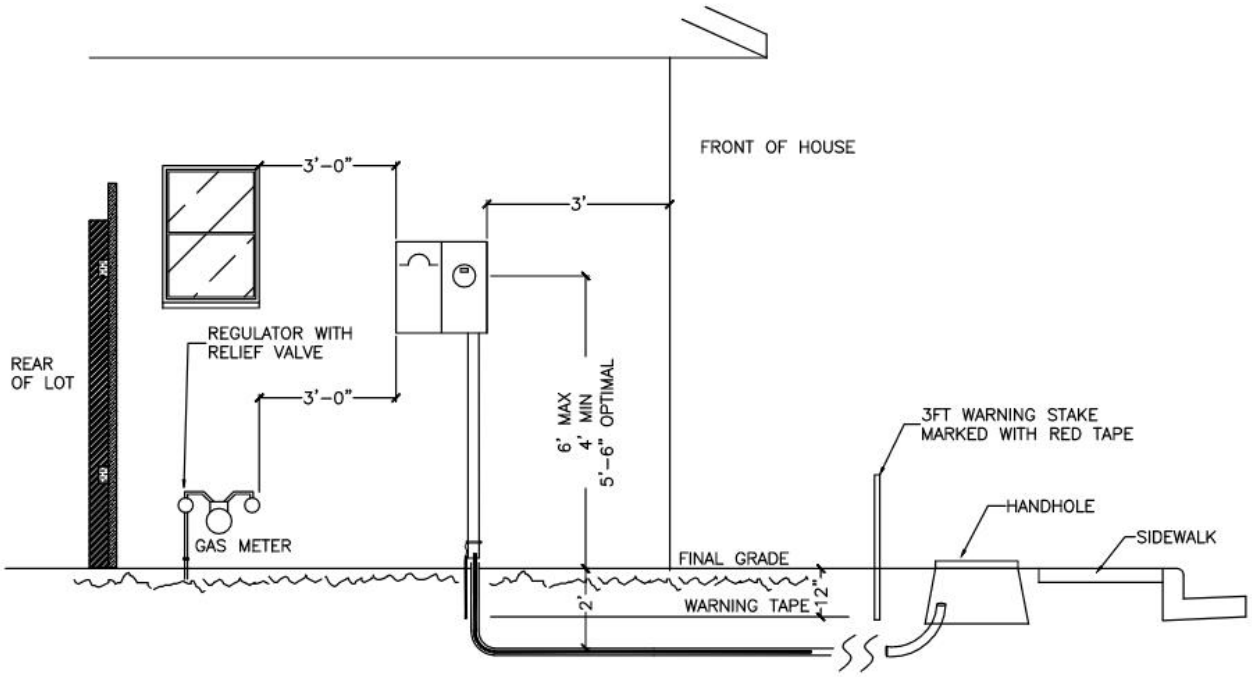
PRIMARY METERING CLEARANCE REQUIREMENTS



CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
AUGUST 2020	8.6	PRIMARY METERING CLEARANCE REQUIREMENTS

MINIMUM CLEARANCE REQUIREMENTS
FOR RESIDENTIAL UNDERGROUND SERVICES



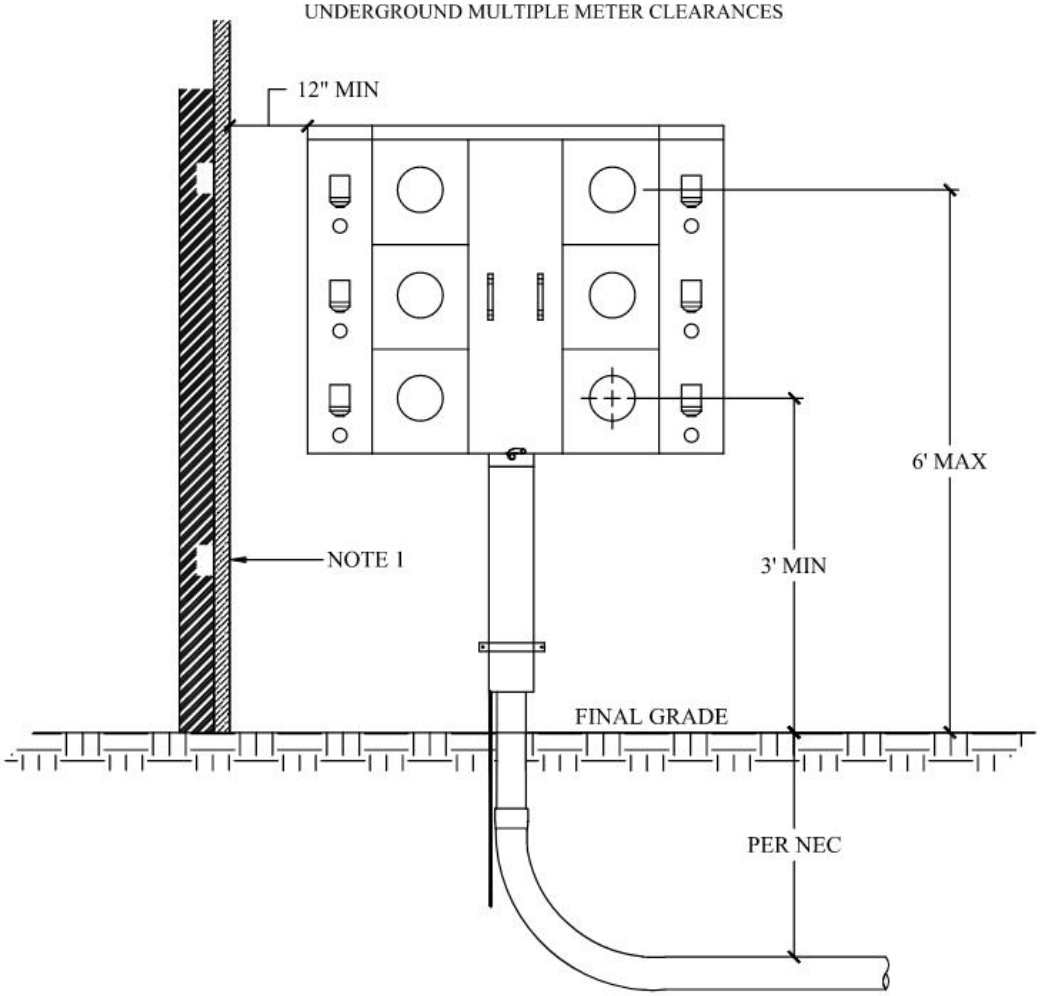
NOTES:

1. THE THREE-FOOT DISTANCE BETWEEN WINDOWS OR DOORS IS INTENDED TO GIVE THE HOMEOWNER SOME PRIVACY.
2. THE METER LOCATION SHALL BE AT LEAST 3' FROM THE FRONT OF THE HOUSE. FENCES SHALL NOT ENCLOSE METER.
3. METER LOCATION SHALL BE AT LEAST 3' FROM ANY GAS METER, PIPE, OR REGULATOR.
4. NO METERS SHALL BE LOCATED ABOVE OR BELOW OBSTRUCTIONS (INCLUDING WINDOW WELLS, STAIRS, PLATFORMS, ETC.).
5. 6' OF CLEARANCE SHALL BE MAINTAINED BETWEEN ELECTRIC SERVICE CONDUIT AND ANY WATER OR SEWER UTILITIES
6. SEE SECTION 8 FOR ADDITIONAL CLEARANCE REQUIREMENTS.

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	8.7	RESIDENTIAL UNDERGROUND SERVICE CLEARANCES

UNDERGROUND MULTIPLE METER CLEARANCES

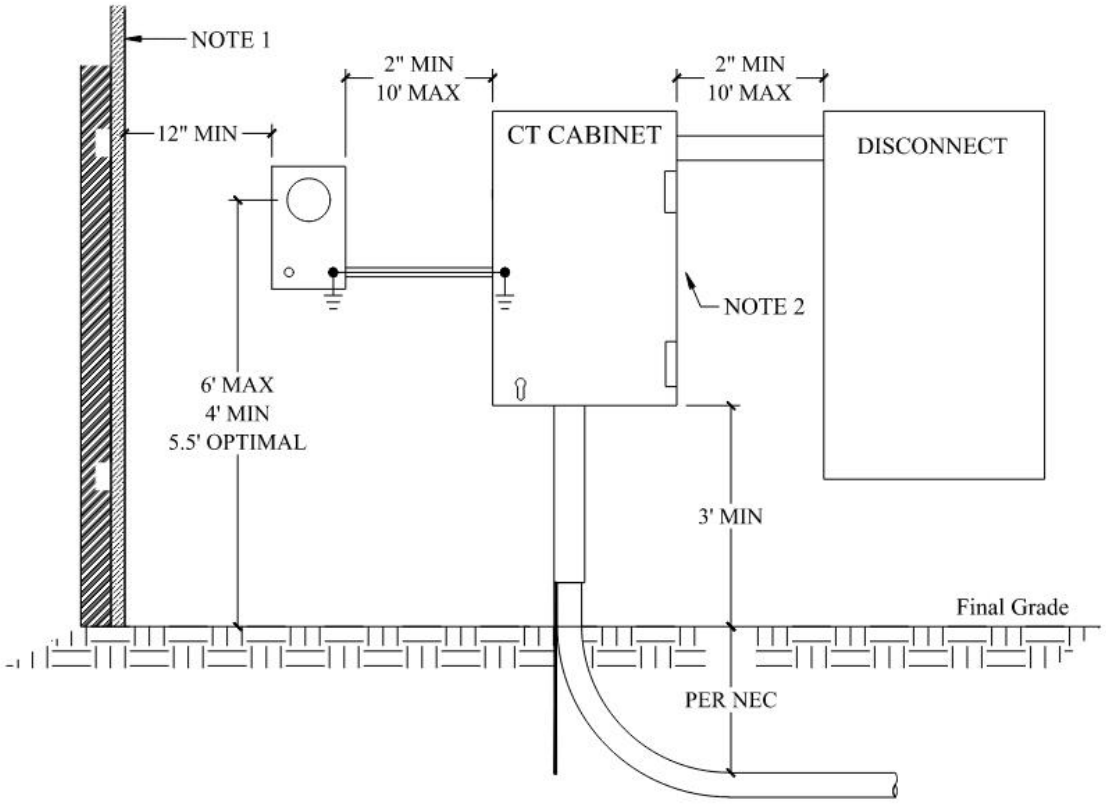


NOTES:
1. ALL METERING EQUIPMENT SHALL BE INSTALLED AT LEAST 12" FROM ANY DOOR, WINDOW, WALL OR OBSTRUCTION. DOORS SHALL OPEN AWAY FROM METERING EQUIPMENT OR MAINTAIN 12" MIN CLEARANCE WHEN OPENED.
2. GRADE TO BE LEVEL WITHIN 5' WORKING RADIUS IN FRONT OF THE METER.
3. SEE SECTION 6 FOR ALL OTHER METERING REQUIREMENTS

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2023	8.8	UNDERGROUND MULTIPLE METER CLEARANCES

CT METERING CLEARANCES



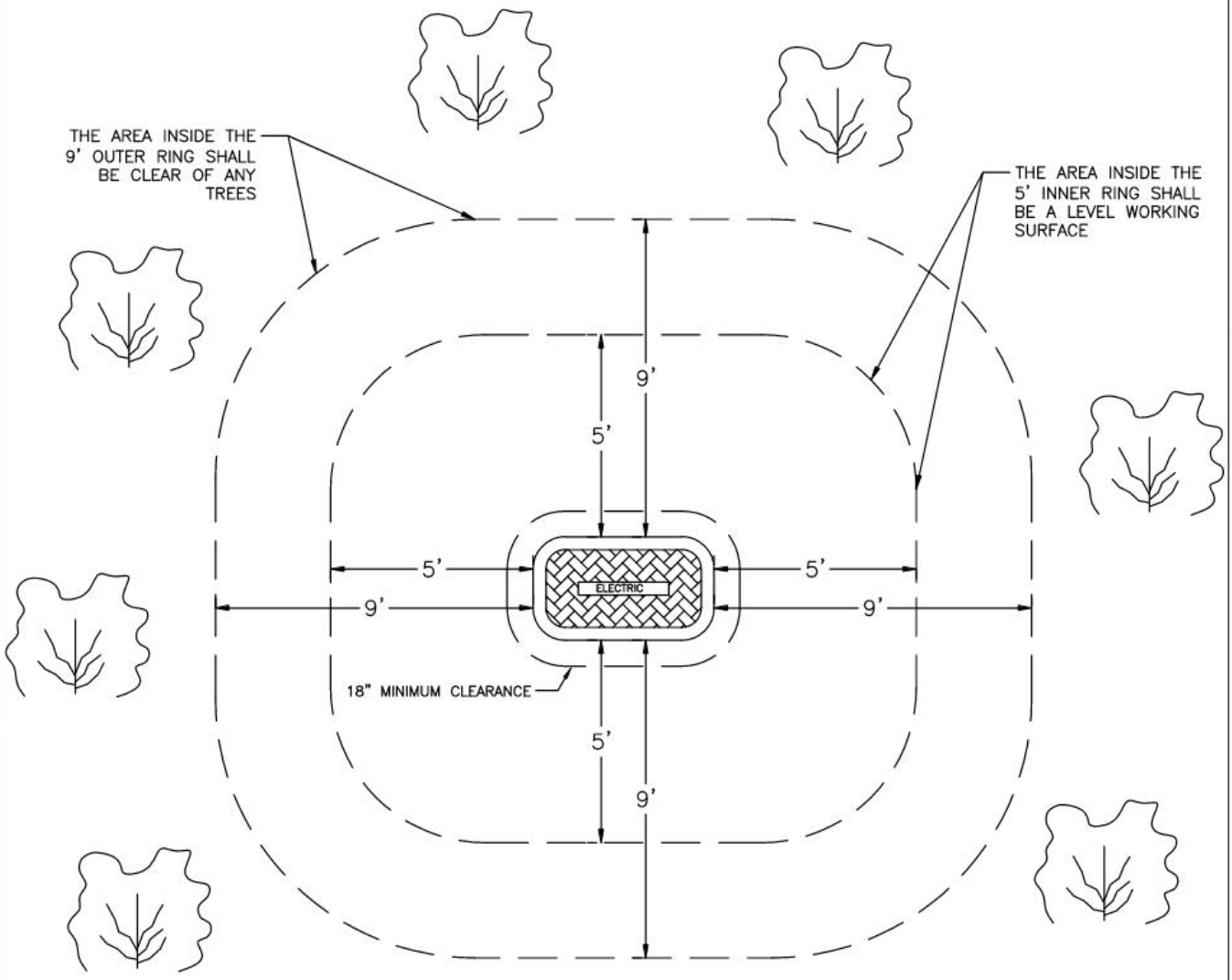
NOTES:

1. ALL CT METERING EQUIPMENT SHALL BE INSTALLED AT LEAST 12" FROM ANY DOOR, WINDOW, WALL OR OBSTRUCTION. DOORS SHALL OPEN AWAY FROM METERING EQUIPMENT OR MAINTAIN 12" MIN CLEARANCE WHEN OPENED.
2. CT CABINET DOOR SHALL OPEN AWAY FROM METER SOCKET
3. CT's & PT's SHALL BE 6' MAX ABOVE FINISHED GRADE.
4. GRADE TO BE LEVEL WITHIN 5' WORKING RADIUS IN FRONT OF THE METER.
5. SEE SECTION 6 FOR ALL OTHER METERING REQUIREMENTS

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
MARCH 2021	8.9	CT METERING CLEARANCES

HANDHOLE/PEDESTAL EQUIPMENT CLEARANCES



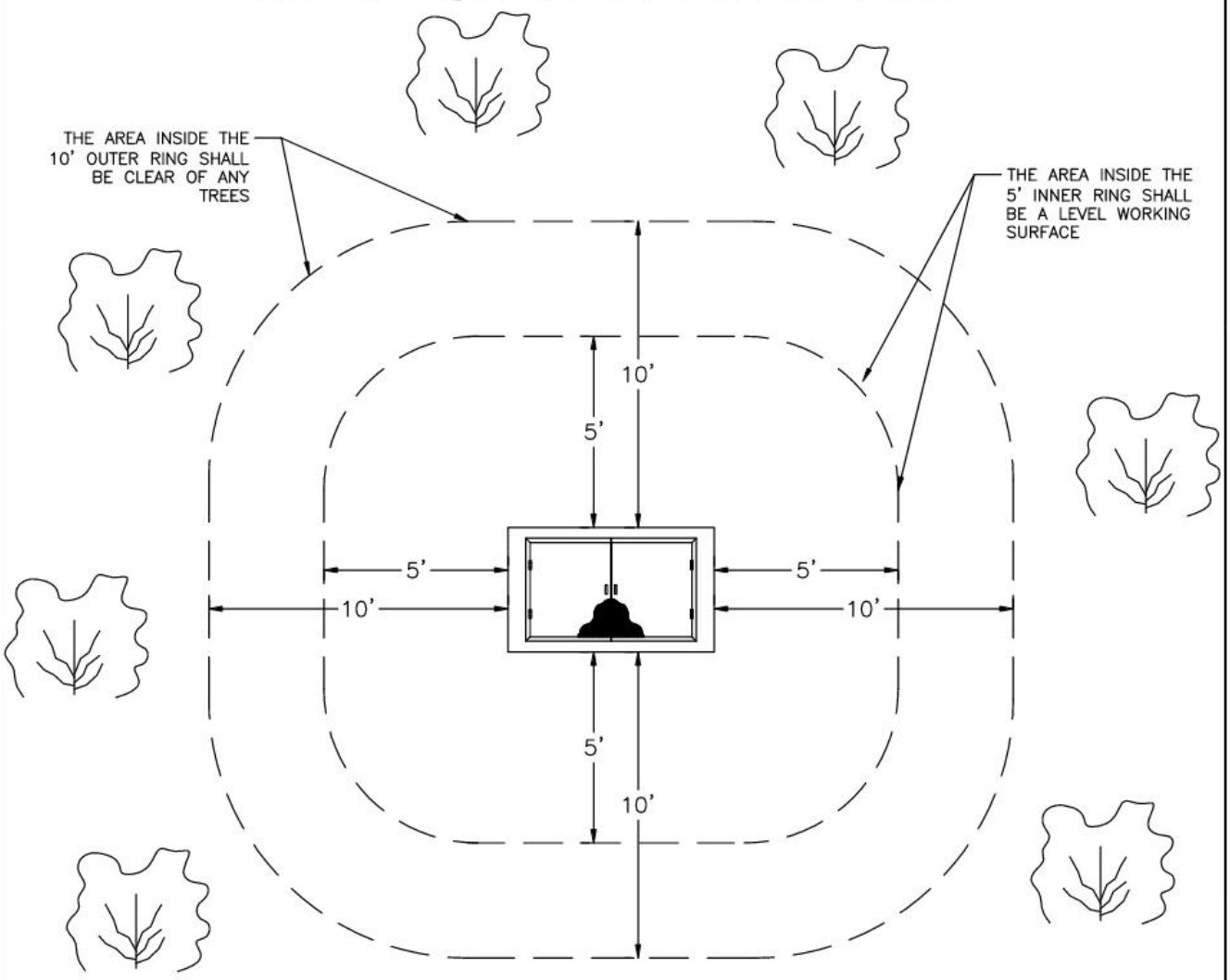
NOTES:

1. IF LOCATED IN GRASSY AREA – HEIGHT 2" ABOVE GRADE.
2. IF LOCATED IN ALLEYWAY OR SIDEWALK, THE HANDHOLE SHALL BE FLUSH WITH FINAL GRADE
3. 18" MINIMUM DISTANCE FROM ANY OBSTRUCTION INCLUDING BUT NOT LIMITED TO SHRUBS, BOULDERS, ETC.
4. 9' MINIMUM DISTANCE FROM TREES
5. NO TREES, BUSHES, OR SHRUBS SHALL BE LOCATED ON THE STREET SIDE
6. THE ABOVE CLEARANCES ARE LISTED IN SECTION 8

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
JANUARY 2023	8.10	HANDHOLE/PEDESTAL EQUIPMENT CLEARANCES

VAULT EQUIPMENT CLEARANCES

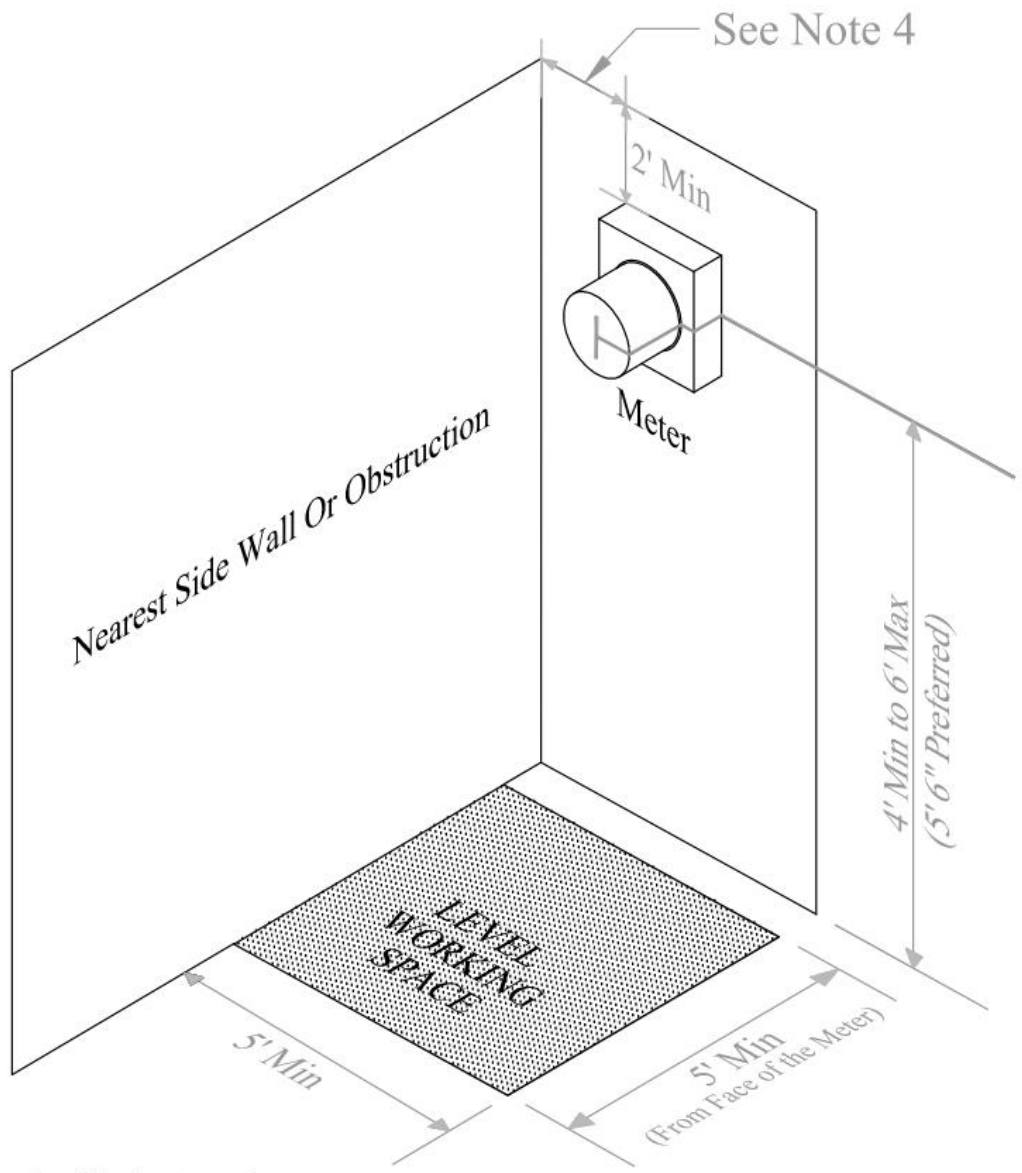


NOTES:
1. IF VAULT IS TO BE PLACED NEAR A SIDEWALK, ALONG CURB OR OTHER PAVED AREAS, KEEP TOP OF LID LEVEL WITH TOP OF CURB, WALK OR ASPHALT
2. IF LOCATED IN ALLEYWAY THE VAULT SHALL BE FLUSH WITH FINAL GRADE
3. TOP OF LID SHALL BE 6" ABOVE THE FINAL GRADE WHEN INSTALLED IN NON–PAVED LOCATIONS
4. 10' MINIMUM DISTANCE FROM TREES
5. NO TREES, BUSHES, OR SHRUBS SHALL BE LOCATED ON THE STREET SIDE
6. THE ABOVE CLEARANCES ARE LISTED IN SECTION 8

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
JANUARY 2023	8.11	VAULT EQUIPMENT CLEARANCES

METER CLEARANCES



Notes:

1. See section 6 for all meter requirements
2. See section 8 for all clearances
3. No meters shall be located above or below obstructions (including window wells, stairs, platforms, etc.)
4. Minimum of 12" for commercial, multimeter, and CT rated applications. Minimum of 3' for residential applications

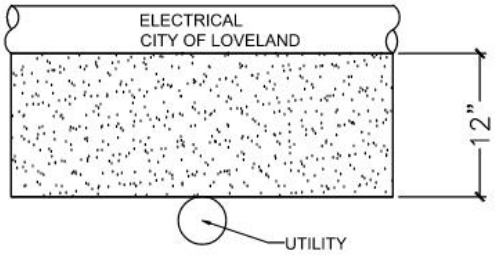
CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
February 2023	8.12	Meter Clearances

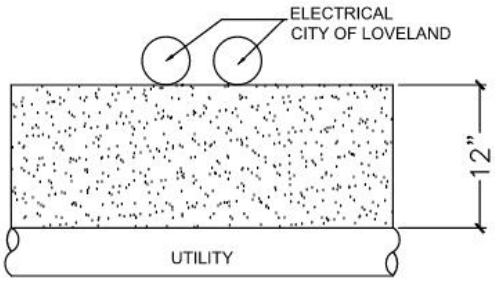
UTILITY CROSSING DETAIL

SEPARATION FROM DRY UTILITIES

FACING VIEW

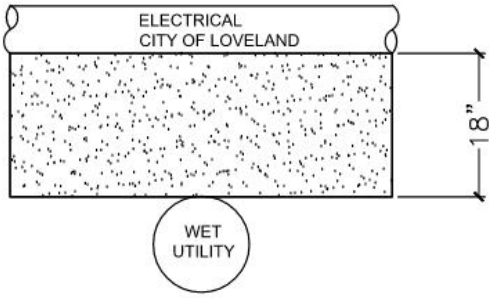


SIDE VIEW

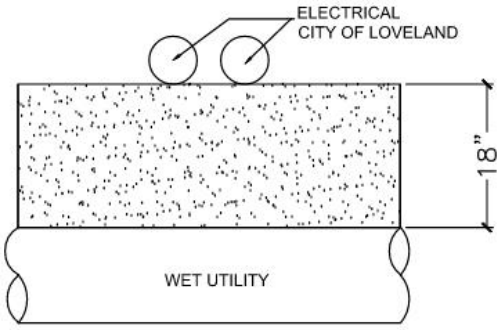


SEPARATION FROM WET UTILITIES

FACING VIEW



SIDE VIEW



NOTES:

1. THERE WILL BE A MINIMUM VERTICAL DISTANCE OF 12" FROM THE EDGE OF LOVELAND'S ELECTRICAL CONDUIT TO OTHER DRY UTILITIES
2. THERE WILL BE A MINIMUM VERTICAL DISTANCE OF 18" FROM THE EDGE OF LOVELAND'S ELECTRICAL CONDUIT TO OTHER WET UTILITIES

CITY OF LOVELAND WATER & POWER

Date:	Drawing No.	Requirements for Electric Service
FEBRUARY 2023	8.13	UTILITY CROSSING DETAIL

Section 9 – Interconnection Requirements for Distributed Energy Resources

9.1 Introduction

This section describes standards for interconnection of customer-owned, non-utility generation distributed energy resources (DER) intended to operate while electrically connected to the City's electric distribution system (EDS). The criteria and requirements in this section are relevant to the installation, operation, and safety considerations of the interconnection and are applicable to all DER technologies interconnected to the EDS.

No system will interconnect with the EDS without prior approval from the City of Loveland Power Division. Any source not covered herein will need to be further evaluated and may require a formal System Impact Study performed by the City of Loveland. Similarly, any system that exceeds the sizing limitations as described in Section 9.4 Sizing and System Capacity Limitations will need further evaluation and may require a System Impact Study.

For purposes of this document, a Distributed Energy Resource (DER) is any non-utility owned generation resource that is capable of exporting active power to the EDS through generation and is not otherwise included in the formal NERC definition of the Bulk Electric System.

The customer is responsible for conforming to the rules and regulations that are in effect at the time of the installation. The customer seeking to interconnect a DER under these rules must fill out and submit a signed application form to the City. Information must be accurate, complete, and approved by the City. Please note that approval of the application as complete does not constitute approval to interconnect.

9.2 Scope

This section applies to all customer-owned DER systems designed to operate in parallel with the EDS. Legally required emergency systems or systems not designed to operate in parallel with the EDS are exempt from these requirements. (Refer to applicable National Fire Protection Association (NFPA) 70, National Electrical Code (NEC) codes for more information.)

Requirements in this revision shall apply to all projects with a building permit application date and/or interconnection application date after the revision date of this document.

9.3 Improper Operation of the DER

DER systems shall not adversely impact the operation of the City EDS in any way. Adverse impacts to the City EDS include but are not limited to the following:

a) Unbalanced currents or voltages
b) Voltages outside of acceptable ranges as described in *Section 1.4.a Voltage Level* in this document
c) Impact to bulk electric system frequency deviating from the normal 60 Hz
d) Injection of Direct Current (DC) or harmonics into the system beyond what is allowed by this document
e) Any operation that causes excessive operations of system voltage regulating devices such as load tap changers and voltage regulators
f) Any operation that affects system grounding or ground fault protection

The City will not normally interfere with the operation of any DER. However, when requested by the City by telephone, in person, or in writing, the Operator must immediately stop operation and not resume operation until cleared by the City to do so. If the Operator begins to operate the DER out of the ranges or conditions listed herein, the Operator must agree to cease operation until such a time as

the DER Operator can demonstrate to the City that it has remedied the problem and can once again operate the DER in compliance with these requirements.

If usage of the DER causes unusual fluctuations or disturbances on, or interference with the City's EDS or other City customers, the City shall have the right to require the DER Operator to install supplemental DER devices to reasonably correct or limit such fluctuation, disturbance, or interference at no expense to the City or other customers.

9.4 Sizing and System Capacity Limitations

In general, behind the meter residential installations are limited to two hundred percent (200%) of the previous years' energy usage (kWh) up to 15kW. For single-phase commercial installations, a maximum of 25kW is allowed with the same 200% previous usage cap. For three-phase installations, maximum sizing is 200% of previous usage. Any installation over 250 kW will require system monitoring as defined by the City and a distribution system analysis. All interconnected DER systems shall be behind-the-meter.

Whenever one or more of the following limitations are exceeded, additional analysis is required. In the City's sole discretion, the City may require additional study, equipment, and/or modifications to the DER system prior to approval.

a) After the addition of the proposed DER, the total rated DER kVA interconnected via the distribution transformer equals or exceeds 100% of the transformer's rating
b) After the addition of the proposed single-phase, non-inverter connected DER, the total rated non-inverter connected DER kVA interconnected via the single-phase transformer equals or exceeds 20kVA
c) After the addition of the proposed DER, the total rated DER kVA on the feeder or portion of the feeder equals or exceeds 100% of the previous year's minimum daytime (7am – 7pm) load on that feeder or feeder section
d) After the addition of the proposed non-photovoltaic DER, the total rated DER kVA on the feeder or portion of the feeder equals or exceeds 100% of the previous year's minimum load on that feeder or feeder section
e) After the addition of the proposed single-phase DER, an imbalance greater than 90kVA of single-phase DER export capacity exists between two phases of the feeder or portion of the feeder
f) The proposed DER includes an induction machine 300 kVA or greater, or an aggregate of 300 kVA of induction generators

9.5 System Reclosing

In the cases and locations where automatic reclosing is used, the DER shall be designed to ensure that the DER will disconnect from the distribution system in the event an automatic reclose occurs. Normally the DER shall not interfere with automatic reclosing where it exists; however, industry standards require that a DER must automatically disconnect from an islanded system within two seconds. If the existing reclosing interval is faster than two seconds, the City will reset it to ensure that the DER does not interfere with City operations.

9.6 Synchronizing

Synchronization of the DER with the City's EDS shall be done automatically. Any proposal to allow manual synchronization is subject to review and approval by the City. All DER must use protective devices that prevent electrically closing a DER that is out of synchronization with the distribution system. The City will under no circumstances be responsible or liable for any damage done due to an

out of synchronization closure of a DER onto the system. The Operator is responsible and liable for any damage done to the City's EDS by any type of improper closing onto the system.

9.7 Pre-Application Requirements

Prior to applying for the DER building permit, the installation contractor must contact the Power Division at PowerDevelopment@cityofloveland.org to schedule a site walk with a Distribution Designer. The subject line of the E-mail submission must include the address and DER Site Walk, and an Electric Service Worksheet (ESW) should be attached. The site walk will be conducted to assess the meter gear.

A service upgrade is required if:

1) The design/size of the PV system requires an increase to the service size of the residence.,
2) The meter gear does not comply with *Section 6.5.a Approved Meter Sockets* or there is damage to the meter socket requiring replacement.

If the City determines a service upgrade is required (see *Section 3.4 Residential Underground Service Upgrade* and *3.5 Residential Overhead Service Upgrade*), the upgrade must be completed on a separate building permit before continuing with a DER building permit application submittal.

9.8 General Installation Requirements

a. ***Standards***

The technical requirements for DER installation and operation are described in the Codes and Standards referenced here except as amended in this document. The customer is responsible for ensuring that the installation meets the requirements as referenced here; Permission to Operate (PTO) will not be issued until all requirements are met.

Articles applicable to the most recent addition of National Fire Protection Association (NFPA) NATIONAL ELECTRICAL CODE NFPA-70 include, but are not limited to:

- 480: Storage Batteries
- 625: Electric Vehicle Power Transfer System
- 690: Solar Photovoltaic (PV) Systems
- 692: Fuel Cell Systems
- 694: Wind Electric Systems
- 705: Interconnected Electric Power Production Sources
- 706: Energy Storage Systems

Also applicable is the Institute of Electrical and Electronic Engineers (IEEE) STANDARD 1547-2018 "IEEE STANDARD FOR INTERCONNECTION AND INTEROPERABILITY OF DISTRIBUTED ENERGY RESOURCES WITH ASSOCIATED ELECTRIC POWER SYSTEMS INTERFACES", including all referenced Codes and Standards. Also included from IEEE:

- 18 IEEE Standard for Shunt Capacitors
- 32 IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices
- 141: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
- 142: IEEE Recommended Practice for Grounding of Industrial and Commercial
- 242: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

- 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
- 665: IEEE Standard for Generation Station Grounding
- 1015: IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
- 1036: IEEE Standard for Application of Shunt Power Capacitors
- 1547 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power System Interfaces
- 1547.1 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems
- 1547.2 IEEE Application Guide for IEEE Std. 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
- 1547.7 IEEE Guide for Conducting Distribution Impact Studies for Distributed Resource Interconnection
- C2: National Electrical Safety Code
- C37.06: IEEE Standard for AC High-Voltage Circuit Breakers rated on a Symmetrical Current Basis-Preferred Ratings and Required Capabilities.
- C37.012: IEEE Application Guide for Capacitor Current Switching for AC High-Voltage Circuit Breakers
- C37.66: IEEE Standard Requirements for Capacitor Switches for AC Systems (1kV thru 38kV).
- C37.90 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- C37.90.1 IEEE Standard for Surge Withstand capability (SWC) Tests for Relay and Relay
- Systems Associated with Electric Power Apparatus.
- C37.90.2 IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic
- Interference from Transceivers
- C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays
- C37.95 IEEE Guide for Protective Relaying of Utility-Consumer Interconnections
- C37.102 IEEE Guide for AC Generator Protection
- C62.41: IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

Other applicable requirements:

- NERC PRC-024-1: Generator Frequency and Voltage Protective Relays
- NFPA 70: National Electrical Code
- UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources

b. ***Technical Information Requirements***

1) For PV systems:
See DER SYSTEMS CHECKLIST, latest revision.

2) For Rotating systems:
   i. Prime mover type
   ii. Fuel (if applicable)
   iii. Generator nameplate
   iv. Excitation system (if applicable)
   v. Capability curves on all synchronous and doubly-fed induction generators
   vi. All specification sheets
   vii. Short circuit calculation

3) All other systems:

i. Description of system
ii. Make and model if a commercial manufacturer
iii. Specification sheets

c. ***Type of Connection***

All DER must be connected to the load side of the customer's service disconnecting means; supply-side source connections are not permitted.

d. ***Insurance Requirements***

All customers must provide proof of general liability insurance. For facilities of less than 100 kW, either homeowner's or building owner's insurance is an acceptable form of insurance without any specific minimum amount of coverage.

For larger systems the customer, at their own expense, shall secure and maintain liability insurance in effect during connection of any of its DER facilities to the City's electrical distribution system according to the following requirements:

- **System size 100kW and above, and less than 500kW** - A combined single limit for bodily injury and property damage of not less than $300,000 (three hundred thousand dollars) for each occurrence.
- **System size is 500kW or greater** - A combined single limit for bodily injury and property damage of not less than $2,000,000 (two million dollars) for each occurrence.

Such liability insurance shall not exclude coverage for any incident related to the subject DER facility or its operation. Customer agrees that the City of Loveland shall be named as an additional insured under the liability policy.

Any insurance policy required herein shall include that written notice be given to the City at least 30 days prior to any cancellation or reduction of any coverage. Such liability insurance shall provide, by endorsement to the policy, that the City shall not by reason of its inclusion as an additional insured incur liability to the insurance carrier for the payment of premium of such insurance. Customer agrees to provide a copy of the liability insurance certificate, so it is received by the City prior to interconnection of or operation of the DER. The City shall be permitted to periodically obtain proof of current insurance coverage from the customer to verify proper liability insurance coverage. The customer will not be allowed to commence or continue interconnected operations unless evidence is provided that satisfactory insurance coverage is always in effect.

e. ***Interruption Devices***

Circuit breakers or other interrupting devices located at the Point of Common Coupling (PCC) must be certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. The DER system and associated interconnection equipment must be designed so that the failure of any single device will not potentially compromise the safety and reliability of City's EDS.

f. ***Grounding***

DER installations shall be effectively (solidly) grounded on the EDS side of the interconnection. The DER grounding system must not adversely impact the City's grounding or ground fault protective relaying. The DER grounding shall not cause high voltages to occur under any condition, either during normal operating conditions or during a system fault (e.g. single-line-to-ground fault).

1) *Equipment Bonding Conductor*

The Operator shall install an equipment-grounding conductor in addition to the ungrounded conductors and grounded conductor (neutral) between the DER and the distribution system. The grounding conductor shall be permanent, electrically continuous, and capable of safely carrying the maximum fault current that could be imposed on it by the systems to which it is connected. Additionally, the equipment-grounding conductor must be of sufficiently low impedance to facilitate the operation of overcurrent protection devices under fault conditions. All conductors shall comply with the National Electrical Code (NEC). The DER shall not be designed or implemented such that the earth becomes the sole fault current path.

2) *Surge Protection*

The DER Operator is responsible for providing surge or transient protection of the DER equipment.

3) *System Grounding*

The City maintains an effectively grounded distribution system and requires that all DER be designed to contribute to an effectively grounded system. Effective grounding prevents the occurrence of excessively high voltages during ground faults and protects existing City equipment. Effective grounding of the DER may desensitize existing City ground fault protection, which could require City ground fault relay settings changes or modifications in the design of the DER.

The transformer supplied to interconnect three-phase DER to the City system will normally be a grounded-wye to grounded-wye transformer. This connection will not provide a grounding source by itself and will not provide an effectively grounded system from the DER side of the interconnection unless effective grounding of DER is implemented. When designing the grounding system for the DER, the designer should consider the condition that will result when a ground fault occurs on the line serving the DER. This ground fault would be cleared on the City side of the line by opening a substation breaker or a downstream interrupter or fuse. This will result in momentarily islanding the line on the DER until it trips. Under this condition, where the line is islanded and being supplied by the DER, the system must remain effectively grounded.

Effective grounding shall be defined by IEEE 142 which states that to be considered effectively grounded both of the following two conditions must be met:

a) The ratio of zero-sequence reactance to positive-sequence reactance (X0/X1) must be positive and three or less.
b) The ratio of zero-sequence resistance to positive-sequence reactance (R0/X1) must be positive and less than 1.

The DER system equivalent (Thevenin equivalent) impedance shall meet the criteria for effective grounding stated above. The networks used in determining this impedance, and other fault current calculations for the plant, will include the positive, negative, and zero sequence networks of the step-up transformer connected to the City's system, all other transformers between the DER and the point of common coupling, the DER subtransient, positive, negative and zero sequence values, the neutral grounding device for the DER, the grounding transformer and neutral grounding device (if used) and any significant cable runs. The DER shall maintain an effectively grounded system under normal operating conditions while operating connected to the City system.

The short circuit contribution ratio (SCCR) of the DER is defined as the ratio of the DER short circuit contribution to the City's contribution to a short circuit (IscDER/IscCity) for either a three-phase or single-line-to-ground fault measured at the high voltage side of the transformer stepping up from the generation voltage to the City voltage.

The DER shall be grounded in such a way that the SCCR for a line-ground fault calculated at the high voltage side of the transformer connecting the DER to the City is less than 3% while still achieving effective grounding as defined above. If this SCCR ratio is greater than 3% City must do a study to determine if re-setting ground fault relays on the existing City system is required. In rare cases connecting a certain DER to a particular feeder may not be practical due to protection issues or special protection techniques may be needed to make the connection safe.

Proper grounding of the DER can be achieved in a number of ways. The City may at its discretion accept any of the following methods:

a) Solidly grounding the DER or installing a solidly grounded grounding transformer (zig-zag or grounded wye-delta transformer). While a solidly grounded DER is acceptable to the City if all other requirements are met, it must be used with care. ANSI standards generally require that for a synchronous generator the ground fault current must be limited to the three-phase fault current. This usually requires a resistance or reactance be used for grounding the DER neutral. Also, a solidly grounded DER may conduct large amounts of harmonic currents. There may be some unbalanced voltage at the terminals of the DER. This can cause circulating current through the DER system if it is solidly grounded which may make de-rating of the DER necessary. If a solidly grounded system is used the designer must consider and plan for all issues that may result.
b) Resistance grounding. A resistance grounded DER or grounding transformer with a resistance placed between neutral and ground may be used if it meets the requirements of effective grounding.
c) Reactance grounding. A reactance grounded DER or grounding transformer with a reactor between the transformer neutral and ground may be used if it meets the requirements of effective grounding.
d) Other methods may be suggested for consideration by the City.

If the Operator desires to generate at the City's primary voltage and to connect the DER directly to the City system without the use of an interconnecting transformer, a study of the connection is required. The study will determine the grounding and other requirements necessary for this type of connection.

g. ***Disconnecting Means***

1) All DER systems that have the ability to energize electrical lines to the EDS must be equipped with a UL Listed, lockable in the open position, visible break disconnect switch located between the customer's meter and the DER system.
2) The disconnect switch shall be rated to interrupt the maximum output of the DER, shall be rated for the voltage and fault current requirements of the DER, and shall meet all applicable NEMA, UL, ANSI, IEEE, and NEC standards as well as local and state electrical codes.
3) The switch must be located within 10 feet of the meter.
4) The switch must be readily accessible to City personnel and first responders.

5) The switch must be clearly labeled according to NFPA-70 as to its function.
6) The disconnect switch shall be permanently labeled with text indicating that the switch is for the DER. The labeling shall also clearly indicate the open and closed position of the switch. The disconnect switch must be located on the output or load side of the DER such that the entire DER can be isolated from the City's EDS.
7) If the site contains more than one DER unit or system (e.g. PV and battery), a single disconnect switch may be used if its rating is sufficient for all DER and opening it produces a visible open point between all DER and the City's EDS system. If more than one disconnects are used, each must meet the requirements in this section, be located near the City's electric meter, and be labeled to clearly indicate multiple disconnects are used to isolate the DER system(s) at the site.

h. ***DER System Protective Functions***

The protective functions and requirements contained in this document are designed to protect the City's EDS and not specifically the DER. The Customer is solely responsible for providing adequate protection for the DER and all associated equipment. The Customer's protective devices must not impact the operation of other protective devices utilized on the City's EDS in a manner that would affect the City's ability to provide reliable service to its customers. The DER's protective functions must sense abnormal conditions and disconnect the DER from the City's EDS when those abnormal conditions occur. All DER must be capable of sensing line-line-line, line-line, and line-ground faults, and loss of source voltage on any one or all three phases of the City's feeder supplying the DER. In any of the above abnormal conditions, the DER must disconnect from the utility system to protect both the line and the DER from damage due to excessive currents or unusual voltages.

The minimum protective functions and other requirements for system protection for various categories of DER are shown below. Unless otherwise specified, each DER shall be protected by an electronic relay and shall coordinate protection with the City's upstream protective devices; documentation (i.e. TCC curve) demonstrating coordination of devices shall be submitted to the City for review. All relay settings and test reports shall be submitted to the City for review and the City will determine whether an on-site inspection is required to observe calibration and testing of the relay and/or inverter functions.

Category A1

1) Over and under voltage functions (27/59)
2) Overcurrent trip functions
    a. If less than 100kVA, overcurrent trip function (50/51) which may be included in a breaker trip-unit or a fuse
    b. If 100kVA or greater, voltage restrained overcurrent trip function (50/51V)
3) Ground fault protection (50/51G)
4) Over and under frequency functions (81O/U)
5) Sync Check (25)
6) Phase-sequence or negative sequence voltage (47)
7) Anti-Island
    a. A function to prevent the DER from contributing to the formation of an unintended island and to prevent the DER from reconnecting with the distribution system under abnormal conditions is required.
8) If 100kVA or greater:
    a. Interrupting devices shall be 3-phase circuit breakers with electrical operation.

b. All relays shall be utility grade (must meet IEEE Std. C37.90, C37.91, C37.92, and C37.93) and shall be independent from the generator control devices.
c. Reverse power (32)

9) If 1MVA or greater:
a. Negative sequence current (46)
b. Loss of field (40)

Category B2

1) Inverter-connected systems
a. Inverters must be tested to meet IEEE 1547, IEEE 1547.1, and UL1741 including UL1741-SA. If the inverter does not carry a UL sticker, the City must be supplied with certification from a Nationally Recognized Testing Laboratory (NRTL) stating the inverter has been tested to and meets the above IEEE and UL standards.
b. Overcurrent trip function (50/51)
i. Overcurrent trip function may be included in a breaker trip-unit or a fuse. This device shall be separate from the inverter control system and internal disconnect device.
c. If total system capacity is 1MVA or greater:
i. Ground fault protection (50/51G) which may be included in a breaker trip-unit. This device shall be separate from the inverter control system and internal disconnect device.
ii. Over/ frequency (81O/U). This device shall be separate from the inverter control system and internal disconnect device.
iii. Over/Under voltage (27/59). This device shall be separate from the inverter control system and internal disconnect device.

2) Non-inverter systems
a. Over and under voltage functions (27/59)
b. Overcurrent trip functions (50/51) which may be included in a breaker trip-unit or a fuse
c. Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
d. Automatic speed matching to within 5% (15) prior to closing associated breaker
e. Phase-sequence/negative sequence voltage (47)
f. If the generator is capable of self-excitation, the DER shall include a function to prevent the DER from contributing to the formation of an unintended island and to prevent the DER from reconnecting with the distribution system under abnormal conditions. If the generator is incapable of self-excitation, evidence must be provided to the City proving that this is the case and anti-islanding protection is not required. If such evidence does not meet the City's approval, anti-islanding protection is required.
g. If 100kVA or greater:
i. Interrupting devices shall be 3-phase circuit breakers with electrical operation
ii. All relays shall be utility grade (must meet IEEE Std. C37.90, C37.91, C37.92, and C37.93) and shall be independent from the generator control devices.
iii. Negative sequence current (46)
iv. Over and under frequency (81O/U)
v. Reverse power (32)

i. ***Voltage Regulation***

The DER shall not actively regulate the voltage at the point of common coupling (PCC) unless the effects of this are first reviewed and approved by the City. If the City determines it is advantageous

for a DER to actively control its voltage, the City will inform the Operator and the Operator will be required to control the DER's terminal voltage.

j. ***System Voltage***

The voltage operating range limits for DER shall be used as a protection function that responds to abnormal conditions on the City's EDS. The City voltage operating range is normally 95% to 105% of the nominal voltage at the PCC, and 90% to 105% of nominal voltage at the utilization point, as required by ANSI C84.1 Range A. Occasional excursions outside this range may occur, and the DER shall respond as required in this section.

k. ***Shall Trip Voltage Limits***

When the voltage at the PCC is above the Over Voltage (OV) limits or below the Under Voltage (UV) limits in this section, the DER shall cease to energize and trip within the clearing time indicated.

Category A1

Table 9.8.k.1: A1 Shall Trip Voltage Settings (Reproduced from IEEE 1547-2018)

Shall trip function	Voltage at PCC (p.u. of nominal voltage)	Clearing Time (s)
OV2	1.20	0.16
OV1	1.10	2.00
UV1	0.70	2.00
UV2	0.45	0.16

Category B2

Table 9.8.k.2: B2 Shall Trip Voltage Settings (Reproduced from IEEE 1547-2018)

Shall trip function	Voltage at PCC (p.u. of nominal voltage)	Clearing Time (s)
OV2	1.20	0.16
OV1	1.10	2.00
UV1	0.70	10.00
UV2	0.45	0.16

l. ***Ride Through Voltage Requirements***

Voltage ride through requirements are not applicable if frequency is greater than 62Hz or less than 57Hz. Ride-through requirements in Category A1, Table 9.8.l.3 and Category B2, Table 9.8.l.4 are not applicable if either of the following conditions is satisfied:

1) The net active power exported across the PCC into the Area EPS is continuously maintained at a value less than 10% of the aggregate rating of the DER connected to the Local EPS prior to any voltage disturbance, and the Local EPS disconnects from the Area EPS, along with the Local EPS load to intentionally form a Local EPS island.
2) An active power demand of the Local EPS load equal or greater than 90% of the pre-disturbance aggregate DER active power output is shed within 0.1s of when the DER ceases to energize the Area EPS and trips.

Category A1

Table 9.8.l.3: A1 Ride Through Voltage Settings (Reproduced from IEEE 1547-2018)

Voltage range (p.u.)	Operating Mode / Response	Minimum ride-through time (s)	Maximum Response Time (s)
V > 1.20	Cease to Energize	N/A	0.16
1.175 < V ≤ 1.20	Permissive Operation	0.2	N/A
1.15 < V ≤ 1.175	Permissive Operation	0.5	N/A
1.10 < V ≤ 1.15	Permissive Operation	1	N/A
0.88 ≤ V ≤ 1.10	Continuous Operation	Infinite	N/A
0.70 ≤ V < 0.88	Mandatory Operation	Linear slope of 4 s/1 p.u. voltage starting at 0.7 s @ 0.7 p.u.	N/A
0.50 ≤ V < 0.70	Permissive Operation	0.16	N/A
V < 0.50	Cease to Energize	N/A	0.16

Category B2

Table 9.8.l.4: B2 Ride Through Voltage Settings (Reproduced from IEEE 1547-2018)

Voltage range (p.u.)	Operating Mode / Response	Minimum ride-through time (s)	Maximum Response Time (s)
V > 1.20	Cease to Energize	N/A	0.16
1.175 < V ≤ 1.20	Permissive Operation	0.2	N/A
1.15 < V ≤ 1.175	Permissive Operation	0.5	N/A
1.10 < V ≤ 1.15	Permissive Operation	1	N/A
0.88 ≤ V ≤ 1.10	Continuous Operation	Infinite	N/A
0.65 ≤ V < 0.88	Mandatory Operation	Linear slope of 8.7 s/1 p.u. voltage starting at 3 s @ 0.65 p.u.	N/A
0.45 ≤ V < 0.65	Permissive Operation	0.32	N/A
0.30 ≤ V < 0.45		0.16	N/A
V < 0.30	Cease to Energize	N/A	0.16

m. ***System Frequency***

The DER shall operate in synchronism with the City's EDS. Whenever the City's EDS frequency at the PCC varies from nominal (60 Hertz) by the amounts as set forth in the table below, the DER system's protective functions shall disconnect the DER from the City's EDS with delay times no longer than those shown.

Unless some other anti-islanding scheme is employed, the DER shall disconnect due to low frequency resulting from islanding the feeder load on the DER. The frequency settings must be adjusted to ensure that, during the lowest loading level on the feeder, the resulting frequency change of the DER when it is islanded with those feeder loads, should cause the under frequency protection to disconnect the DER within two seconds.

Shall Trip Frequency Limits

When the frequency at the PCC is above the Over Frequency (OF) limits or below the Under Frequency (UF) limits in this section, the DER shall cease to energize and trip within the clearing time indicated.

Category A1 and B2

Table 9.8.m.1.a: Shall Trip Frequency Settings (Reproduced from IEEE 1547-2018)

Shall trip function	Frequency (Hz)	Clearing Time (s)
OF2	62.0	0.16
OF1	61.2	300.00
UF1	58.5	300.00
UF2	56.5	0.16

n. ***Ride Through Frequency Requirements***

Frequency ride-through requirements are not applicable if voltage is outside of voltage ride-through ranges specified in Category A1, Table 9.8.l.3 and Category B2, Table 9.8.l.4.

Ride-through requirements in Category A1 and B2, Table 9.8.n.2.a are not applicable if either of the following conditions is satisfied:

1) The net active power exported across the PCC into the Area EPS is continuously maintained at a value less than 10% of the aggregate rating of DER connected to the Local EPS prior to any frequency disturbance, and the Local EPS disconnects from the Area EPS, along with Local EPS load to intentionally form a Local EPS island.
2) An active power demand of the Local EPS load equal or greater than 90% of the pre-disturbance aggregate DER active power output is shed within 0.1s of when the DER ceases to energize the Area EPS and trips.

Category A1 and B2

Table 9.8.n.2.a: Ride Through Frequency Settings (Reproduced from IEEE 1547-2018)

Frequency range (Hz)	Operating Mode	Minimum ride-through time (s)
f > 62.0	No ride-through requirements apply to this range	
61.2 < f ≤ 61.8	Mandatory Operation	299
58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite
57.0 ≤ f < 58.8	Mandatory Operation	299
f < 57.0	No ride-through requirements apply to this range	

o. ***Synchronization***

Synchronous machine automatic synchronizers and sync-check relays shall be set as shown in following table.

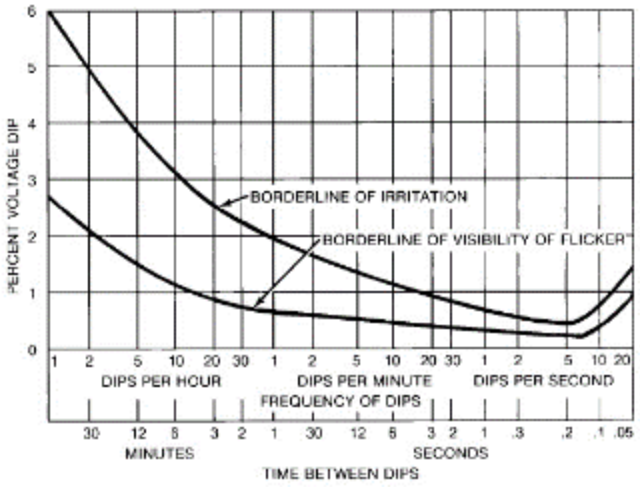
Table 9.8.o: Synchronization/Sync Check Relay Settings (Reproduced from IEEE 1547-2018)

Aggregate rating of DER units (kVA)	Maximum Frequency Difference (Hz)	Maximum Voltage Difference (%V)	Maximum Phase Angle Difference (deg.)
0-500	0.3	10	20
>500-1,500	0.2	5	15
>1,500	0.1	3	10

p. ***Flicker***

Any voltage flicker at the PCC caused by the DER shall not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519, IEEE 141, and IEEE 1453. This limit is shown in figure below. This requirement is necessary to minimize the adverse voltage effects which may be experienced by other customers on the City EDS due to the operation of the DER. Induction generators may only be connected to the system and brought up to synchronous speed (as an induction motor) if these flicker limits are not exceeded.

Figure 9.8.p: Allowable Voltage Flicker vs. Time (Reproduced from IEEE 1547-2018)



q. ***Harmonics***

Harmonic distortion measured at the PCC must be in compliance with IEEE 519 and IEEE 1547. Harmonic current injection limits are shown in the following tables.

Table 9.8.q.1: Maximum odd harmonic current distortion in percent of rated current at the PCC (Reproduced from IEEE 1547-2018)

	Individual Harmonic Order h (Odd Harmonics Only)					
	h<11	11≤h<	17≤h<	23≤h<	35≤h<	TRD
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

Table 9.8.q.2: Maximum even harmonic current distortion in percent of rated current at the PCC (Reproduced from IEEE 1547-2018)

	Individual Harmonic Order h (Even Harmonics Only)			
	h=2	h=4	h=6	8≤h<50
Percent (%)	1.0	2.0	3.0	Associated rage specified in Table 5-8

DER shall not inject direct current greater than 0.5% of the full rated output current into the City's EDS.

r. ***Power Factor***

The power factor at the PCC shall always remain within 0.95 lagging (VARs consumed by the site) to 0.95 leading (VARs supplied by the site), unless otherwise approved by the City.

Inverter-connected DER systems shall be set to operate in a constant power factor mode with a power factor of 1. The City may require modifications to the power factor settings described in this section if it is determined to be beneficial to the City EDS.

Synchronous generators shall be capable of operating at any point within a power factor range of 0.95 leading (i.e. VARs absorbed by generator, capacitive, -0.95) to 0.95 lagging (i.e. VARs supplied by the generator, inductive, +0.95). Synchronous generators should automatically control power factor and should be set to deliver VARs to the system as needed to keep the power factor at the PCC within the range required by this section.

For non-inverter generators other than synchronous generators, operation outside this power factor range is acceptable provided the cumulative power factor of the customer's entire facility, measured at the PCC, is kept within the range noted. This may be done using capacitor banks, adding static VAR compensators (SVC) or synchronous condensers, or other means agreeable to both the DER and the City. If capacitor banks are used, they shall be sized and installed per IEEE Stds. 18, 1036, C37.012, C37.06, C37.66, and 1015. Capacitors may need to be stepped and switched to meet the power factor requirements above. Before the addition of capacitors, the Operator should completely study the effects of the capacitor additions on the resonance conditions and harmonic values that will result. If the addition of capacitors causes adverse resonance or harmonics effects on the City's system, the Operator shall be required to pay for any modifications needed to mitigate the problem.

s. ***Disconnect Switch Operation***

City operational procedures require line crews to create a visible break in the circuit between themselves and all potential sources of generation when working on deenergized equipment. The visible break disconnect switch will be used for this purpose during both planned outage work and unplanned outage restoration.

Under no circumstances shall the Operator tamper with or attempt to close a disconnect switch that has been open and locked out/tagged out by City personnel.

t. ***Monitoring Control Requirements***

The following monitoring and metering requirements must be met by any Operator connecting a DER to the City's EDS.

Each non-inverter connected DER with a generation capacity of 100 kVA AC or larger and each inverter-connected DER with a capacity of 250kVA AC or larger aggregated at the PCC shall be required, at the discretion of the City, to have City-supplied equipment that will be used for monitoring and control of the facility.

The Operator shall be responsible for all hardware, software, and any installation costs of City-provided equipment associated with the DER installation. The City will provide a remote monitoring and control equipment enclosure containing the following or similar equipment as approved by the City at the Operator's expense:

- 900 MHZ spread spectrum radio or optical network terminal
- SEL 351 relay
- Terminal blocks as required
- Various control switches, CT blocks, etc. as required
- UPS battery backup

The Operator shall be responsible for mounting the equipment enclosure.

The monitoring and control system shall be designed to allow the City to perform the following:

- Trip the DER system breaker for unstable system conditions such as frequency, voltage, and fault conditions
- Place a hotline tag on the DER breaker relay that would block the breaker's closing circuit to prevent operation
- Allow for future power dispatching by the City through SCADA, provided an agreement to do so exists between the City and DER Operator

- Real time monitoring of the following data points:
    - Active (Real) power
    - Reactive power
    - Current on each phase
    - Neutral current
    - Voltage
    - Frequency
    - Operational state
    - Connection status
    - Alarm status
    - Operational state of charge for storage systems
    - Solar irradiance for PV systems (W/m2)
    - System breaker or operation status to determine if the system is on or offline
    - Others as required by the City

The Operator shall provide all the necessary interface design to accomplish the functions listed above. The Operator must submit drawings of the proposed design to the City for review and approval.

u. ***Momentary Paralleling Power System***

Some backup power systems only operate parallel to the City's system momentarily (normally less than 0.1 seconds). With the City's approval, the transfer switch or system used to transfer the Operator's loads between the City's distribution system to the Operator's DER may be used in lieu of the protective functions required for parallel operation. In this scenario, all transfer schemes and electrical drawings shall be provided to the City for review and the City will determine if an on-site inspection is required to observe the functionality of the transfer switch or system.

v. ***Metering***

The City will install, own, and maintain a kilowatt-hour meter, or meters, as the City may determine, capable of registering the bi-directional flow of electricity at the PCC in the interconnection of the DER and the City's EDS.

The City may require separate metering for production. This meter will record all generation produced and may be billed separately from any bi-directional metering or customer usage metering. All costs associated with the installation of production metering will be paid by the customer.

The City does not allow currently available meter collars.

w. ***Meter Installations***

Meter installations shall comply with City requirements as detailed in the Section 6 Meters and Meter Connections. Meter(s) may measure such parameters as time of delivery, power factor, voltage, and such other parameters as the City will reasonably require.

x. ***Transformer***

The transformer supplied (whether supplied by the City or the Operator) to interconnect a three-phase DER to the City's EDS is required to be a grounded-wye to grounded-wye transformer. Any three-phase step-up or step-down transformer connected in the DER installation shall be a grounded-wye to grounded-wye connection.

DER shall not be permitted to interconnect through transformer banks made up of two or more single phase transformers.

y. ***Phased Projects***

If a project is to be installed in a phased manner, the Customer may submit an application for approval of the final project size or may submit applications at each stage of the project. Each application will be evaluated based on the nameplate rating stated on the application.

All projects must be completed within 12 calendar months unless prior approval is requested and granted in writing. Any project not completed within 12 months will require further review, further permitting requirements, and delayed schedule. System capacity will need to be further evaluated.

z. ***Non-Discrimination***

All DER interconnection applications pursuant to this Section will be scheduled by the City in a non-discriminatory manner consistent with other service requests and in a manner that does not delay other service requests.

9.9 Solar DER

All behind-the-meter PV installations are required to limit their size to comply with Section 9.4 Sizing and System Capacity Limitations. Requirements in this Section do not apply to:

- Energy resources that are not interconnected (i.e. isolated) from the City's Distribution System.
- Energy resources that are connected via an ATS and will not operate in parallel with the City's Distribution System (back-up only). Some backup power systems only operate parallel to the EDS momentarily (normally less than 0.1 seconds). With the City's approval, the transfer switch or system used to transfer the Customer's loads between the City's EDS to the Customer's DER may be used in lieu of the protective functions required for parallel operation. In this scenario, all transfer schemes and electrical drawings shall be provided to the City for review and the City will determine if an on-site inspection is required to observe the functionality of the transfer switch or system.

Technical Information Requirements

In general, if the DER equipment is a commercially available product with proof of performance by the manufacturer and is being installed by a licensed professional, only the technical information listed within the Checklist is required. If the equipment or installation is of a non-commercial or custom-designed nature, a more detailed system description including the information listed here shall be accompanied by drawings and specifications. All drawings shall be stamped by a licensed Professional Engineer.

- **DER Systems Checklist:** A standard application form for DER installations can be found on the DER Systems Checklist located on the City's website.
- **Service Upgrade Required:** A Service Upgrade will be required for all DER systems that request an increase in service ampacity. (see *Section 3.4 Residential Underground Service Upgrade* and *3.5 Residential Overhead Service Upgrade*)
- **No Service Upgrade Required:** If the design for the PV system only requires the addition of a PV backfeed breaker to be added to the main electrical panel, no service upgrade will be required unless the site walk reveals an issue with the meter gear (see *Section 6.5 Residential Metering*).

Any safety concerns will remain at the discretion of the City to require a meter gear upgrade due to site-specific circumstances.

All other requirements of Sections 3 and 4 will apply in accordance with the type of installation.

9.10 Installation Limitations

The City reserves the right to limit the amount of, or exclude altogether, DER that can be installed on any one distribution circuit.
No DER equipment used in the DER system shall be manufactured by any company on the United States Bureau of Industry and Security's Entity List (Supplement No 4 to Part 744).

a) Sizing

i. Energy: The DER shall be generally sized in compliance with Section 9.4 Sizing and System Capacity Limitations. In the event there is no history to draw from, a suitable justification for sizing shall be submitted to the City for approval.

b) Load Balancing

i. Single-phase DER connections with the City are permitted at power levels up to 25 kVA AC (25kW DC for solar). For power levels exceeding 25 kVA AC (25kW DC for solar), a three-phase balanced interconnection will be required unless otherwise agreed in writing by the City through the submission of an Exemption/Revision Form.

ii. A single-phase DER interconnected on a transformer center tap neutral of a 240-volt service shall not create an imbalance between the two sides of the 240-volt service of more than three percent (3%) of the nameplate rating of the service transformer.

9.11 Operational Restrictions

The City reserves the right to refuse to accept electric power or disconnect a DER from the City System due to:

a) Emergencies and/or maintenance requirements. The City will make reasonable efforts to notify the customer when such conditions exist or are anticipated. In the event the DER is disconnected from the City System, it will be reconnected after the conditions giving rise to the disconnection no longer exist.
b) Hazardous conditions existing on, or as the result of, the DER operation.
c) Any breach of regulation, rules, orders, or decisions of any governmental or regulatory entity having jurisdiction over the City's System.
d) Islanding: For an unintentional island in which the DER energizes a portion of the distribution system through the PCC, the DER shall detect the island. DER shall be equipped with protective devices and controls designed to prevent the DER from being connected to a de-energized distribution system. Islanding is not permitted on the City's EDS.
e) Excessive operation of EDS voltage regulating devices.
f) Fuel source for DER that conflicts with PRPA's 2030 goal of 100% non-carbon fuel sources.

9.12 Monitoring/Control Requirements

DER installations 100kVA AC and larger will be required to include an interface capable of monitoring/control by the City.

9.13 Evaluation Review by the City

Based on the information provided by the customer, the City will evaluate the system impact of the proposed DER and its interconnection system. If studies reveal that more than minor modifications to the EDS are required to accommodate the DER, the City will notify the customer. If the customer

decides to go forward with interconnection, the City will prepare a good-faith estimate of the cost of the improvements for the customer's review and arrangements will be made to complete the required modifications, upgrades, or changes. Typical modifications may include, but are not limited to, the following:

- Changes to existing circuit breaker controls to include voltage check reclosing
- Addition of reclosers or sectionalizers to control reclosing
- Installation of direct transfer-trip to limit unintended islanding
- Installation of a SCADA interface to provide real-time data and control of the DER facility
- Modifications to relay settings
- An alternate location for the PCC

All DER interconnection requests will be reviewed by the City to verify that the design meets the interconnection and interoperability requirements of this standard. The City's review is for general conformance to the technical requirements described herein and is not intended to be interpreted as an approval of the quality or methods used by the equipment installer.

Electrical equipment on the customer's side of the meter must be installed in accordance with the version of the National Electrical Code in effect at the time of initial commercial operation of the equipment. The customer is responsible for the proper installation and safe operation of the DER equipment.

9.14 Inspection

The City shall have the right to inspect the DER interconnection prior to and after approval is granted. Such inspections will normally occur during standard City business hours with a minimum of three (3) business days prior notice provided to the customer. The customer may request an inspection be performed at their convenience; however, a fee may be required by the City for non-standard inspection times, short notice, or excessive requests. If the City discovers a DER installation is not in compliance with the requirements of this document or has been altered from the approved design documents, operation of the equipment must cease until the situation can be corrected and an inspection occurs to verify correction.

9.15 Testing

In addition to any commissioning tests required by the Operator or manufacturer of equipment installed, some or all of the following inspections and tests are required by the City before operation of the DER:

- Visual inspection of distribution transformer
- Visual inspection of the DER
- Visual inspection of the disconnect switches
- Visual inspection of the breaker
- Visual inspection of the fuses
- Operation test of the disconnect switch
- Phasing test
- Sync test
- Phase loss test
- Phase absent test
- Anti-islanding test
- Power quality test

The Operator must notify the City two weeks in advance of the time of the testing so that City representatives may observe the tests required by the City. If the phase loss or phase absent testing is required, the City will schedule a line crew to perform the switching on the City EDS. Prior to performing the commissioning tests, the installation is required to be inspected and approved by City of Loveland's Building Department.

9.16 Periodic Maintenance Tests and Inspections

The City reserves the right to inspect any DER equipment interconnected to the City EDS.

An Operator must maintain the DER equipment in good order and in compliance with all manufacturer's suggested periodic maintenance. If it is discovered that an Operator is not properly maintaining the equipment, the City may disconnect the DER until such time that the Operator can prove that they have provided all required maintenance needed to allow the DER to operate properly and safely.

Functional testing must be performed every year to prove the proper operation of the isolation device and all breakers and relays. For all DER consisting of synchronous machines with aggregate ratings of larger than 1000kVA, no less than once every three years all protective functions must be re-tested and calibrated to prove their operation complies with the requirements contained in this document. The Operator must maintain written records of these tests and these records shall be made available to the City on request.

Battery systems used for DER control or protective relaying must be maintained and periodically tested as suggested by the battery manufacturer.

9.17 DER System Modifications

After the DER begins operation any design changes, such as the addition of more generation capacity, must be submitted to the City for review. Protective devices or any other requirements listed in this document must not be modified or their settings changed without approval of the City.

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Current Version Revision Log

Section	Revision
Cover Sheet	Updated cover sheet design. Added link to website, RFES electronic version, and Rates & Charges.
Requirements for Electric Service Section	•Removed the "*Foreword*" section that was originally after the definitions and integrated it into this section. •Reworded the section clarifying that these requirements will govern when any conflict exists with other codes or regulations. •Updated and clarified language regarding the process for requesting a revision or exemption to the RFES.
Important Contacts Section	Removed "*Important Contacts"* section as the information is found other places in the document and is redundant.
Important Documents Section	•Changed "*Pulse Metering Request Form*" to "*KYZ Metering Request Form*" •Changed "*Solar Photovoltaic Systems Checklist*" to "*DER Interconnection Checklist*"
Definitions Section	•Added "*Accessory Dwelling Unit (ADU)*" definition •Updated "*Current Transformer (CT)*" definition to remove "above 400 amps" •Updated "*Distributed Energy Resources (DER)*" definition to remove "renewably" and clarify •Removed "*Distributed Generation (DG)*" definition •Removed "*Distributed Resource (DR)*" definition •Added "*Dry Utilities*" definition •Added "*Kilovolt Amperes (kVA)*" definition •Added "*KYZ Metering*" definition •Added "*Permanent Struture*" definition •Added "*Permission to Operate (PTO)*" definition •Added "*Photovoltaic (PV)*" definition •Added "*Ride-Through*" definition •Updated "*Self-Contained Metering*" definition •Removed "*Service Upgrade*" definition and added it to Section 1.2.a •Removed "*Spot Network*" definition •Removed "*System Size*" definition •Added "*Transformer Rated Meter"* definition •Updated "*UL Listed*" definition •Added "*Volt-Amperes Reactive (VAR)*" definition •Added "*Wet Utilities*" definition •Added "*Wireways*" definition
Section 1.1	Combined sections 1.1.a and 1.1.b together into 1.1.a to streamline. Rest of section was renumbered accordingly.
Section 1.1.i	Updated section to include reference to municipal code and to clarify ownership of certain parts of distribution system.
Section 1.2	Changed title "*Overhead & Underground Facilities*" to "*Electric Services*"
New Section 1.2.a	Added "*Service Upgrades*" as Section 1.2.a to clarify what constitutes a service upgrade renumbered following sections accordingly.

Section 1.2.b	Updated wording of section to remove "upgraded services" since not all upgraded services will be required to be installed underground anymore.
Section 1.2.c	Removed redundant language and clarified reference to Municipal Code.
New Section 1.2.d	Added "*Special Cases*" as Section 1.2.d with language covering non-standard installations that require further information and review.
Section 1.4.b	Added a reference to Loveland Municipal Code 13.12.010 and additional clarifying language from the code stating the City does not guarantee uninterrupted service and is not liable for power irregularities & interruptions caused by factors beyond the control of the City.
New Section 1.6.a	Added a new section "*Equipment Sizing*" as Section 1.6.a with clarifying language on our existing process to appropriately size electrical equipment owned by the city, and how costs are determined. Following sections numbering updated accordingly.
Section 1.8.b	Added language to clarify who is present at pre-construction meetings.
New Section 1.8.d	Added "*Permit Requirements*" as Section 1.8.d with the following clarifying language: "*Contractor shall be responsible for the acquisition and cost of all necessary permits for the project including, but not limited to, building permits, ditch crossings or special crossing permits (i.e. railroad crossing).*"
Section 1.10	Added clarifying language under "*Easement Requirements*" section about needing a clear drivable path free of obstructions, and to cover non-typical circumstances where easement requirements can't be met.
Section 1.10.a	Removed "*Side - 7 feet*" under "*Typical Easement Widths*" for a Residential Lot.
Section 1.10.c	Clarified language about customer responsibility for utility coordination and clearances within easement.
New Section 1.10.d	Added Section 1.10.d "*Agreement to Dedicate Easement*" for existing language about granting of easements
New Section 1.10.e	Added Section 1.10.e "*Construction/Installation Requirements*" for existing language about final grade requirements for easements. Also added language about curb and gutter needing to be installed, staking with property pins, and the acceptable slope/grade of the easement.
New Section 1.10.f	Added Section 1.10.f "*Terms and Conditions of Utility Easements*" with language about easements dedicated by plat, as well as obstruction or landscaping encroachment within easements.
Section 2.1.f	Clarified language about the application of the most recent NEC version approved by City Council.
Section 2.2.a	Reworded section to clarify process for submitting an ESW and scheduling a site visit with a distribution designer.
Section 2.2.b	Reworded section to clarify how permit fees are paid.
Section 2.2.d	Removed redundant wording about utility locates and instead referenced Section 1.1.a "*Call for Locates*".
Section 2.2.g	Added the words "*temporary power*" to clarify sentence.
Section 2.2.k	Updated wording for meter grounding requirements to refer customer to current NEC requirements.
Section 2.3.a	Changed requirement for stamped one-line diagram for temporary power from "200 amps or larger" to "larger than 200 amps".
Section 2.3.c	Removed redundant wording about utility locates and instead referenced Section 1.1.a "*Call for Locates*".
Section 3.1	•Added language to clarify distinction between residential and commercial installations. •Also added a reference to Section 9 for any solar and DER related installations.

Section 3.1.a	•Changed title "*All New Residential and Upgraded Services Shall Be Underground*" to "*All New Residential and Upgraded Underground Services*". •Added sentence "*The service entrance cable shall be installed in conduit*" from previous Section 3.1.b "*Service Entrance Cable*" . •Added reference to Municipal Code 13.12.060.
New Section 3.1.b	•Changed title "*Service Entrance Cable*" to "*Applying for Service*". •Added language that was found in multiple places later in Section 3 to guide the customer through applying for a new or upgraded service, and clarify process for submitting an ESW and scheduling a site visit with a Distribution Designer.
New Section 3.1.c	•The previous section 3.1.c "*Demarcation Point*" was moved to section 3.1.f and this section was renamed "*Additional Requirements*". Added language to allow the City flexibility to request one-line diagrams, panel schedules, and/or load calculations in non-typical situations.
New Section 3.1.d	•The previous section 3.1.d "*Additional Fees May Apply*" was moved to section 3.1.g and this section was renamed "*Service De-energization Procedures*" with language that was found in multiple places later in Section 3.
New Section 3.1.e	•The previous section 3.1.e "*Utility Locates*" was moved to section 3.1.h and this section was renamed "*Inspection & Energizing*" with language that was found in multiple places later in Section 3.
Section 3.1.f	Added extra language to clarify the demarcation point.
Section 3.1.h	Removed redundant wording about utility locates and instead referenced Section 1.1.a "*Call for Locates*".
Section 3.1.j	Reworded for clarity and added the more familiar and commonly used term "Accessory Dwelling Unit (ADU)".
Section 3.1.r	•Reworded and clarified the first sentence regarding service entrance conduit and conductor installation costs being the customer's responsibility. •Changed reference to drawings that had been moved, and instead referred to Section 5 for installation drawings. •Added a sentence to clarify the City is responsible for maintaining the service conductor and conduit after being energized. The customer remains responsible for the slip sleeve riser.
Section 3.2	•Removed language "*This section covers single-family homes and duplexes with service sizes up to 400 amps with existing power at the lot line*" and "*Multiple unit buildings and services larger than 400 amps are considered commercial installations and are covered in Section 4 – Commercial and Industrial*" since this was added to section 3.1. •Changed instructions for determining if power is at the lot line to contact the Distribution Design department main line instead of the supervisor.
Section 3.2.b	Replaced redundant language with reference to new Section 3.1.e to help streamline section.
Section 3.3	•Removed language "*This section covers single-family homes and duplexes with service sizes up to 400 amps without existing power at the lot line*" and "*Multiple unit buildings and services larger than 400 amps are considered commercial installations and are covered in Section 4 – Commercial and Industrial*" since this was added to section 3.1. •Changed instructions for determining if power is at the lot line to contact the Distribution Design department main line instead of the supervisor.
Section 3.3.a	Replaced redundant language with reference to new Sections 3.1.b,c, & e to help streamline section.

Removed Sections 3.3.b & c	•After referencing in Section 3.3.a above, redundant sections 3.3.b "*Building Permits & Fees"*, 3.3.c "*Inspection & Energizing*" were removed, and previous Section 3.3.d "*General Requirements*" was moved up to replace them and help streamline Section 3.
Section 3.4	Added language to clarify service upgrade requirement and define what constitutes a service upgrade.
Section 3.4.a	•Replaced redundant language with a reference to Section 3.1.b-e to help streamline section. •Added a list of work required with an upgrade and a reference to Drawing 3.2.
Removed Sections 3.4.b, c, & d	•After referencing in Section 3.4.a above, redundant sections 3.4.b "*Building Permits & Fees"*, 3.4.c "*Service Disconnects*", & 3.4.d "*Inspection & Energizing*" were removed, and previous Section 3.4.e "*General Requirements*" was moved up to replace them and help streamline Section 3.
Section 3.5	Changed the language for this section to reflect the policy change that upgraded overhead residential services will no longer be required to be installed underground. Added clarifying language of what constitutes an overhead service upgrade.
Section 3.5.a	•Replaced redundant language with a reference to Section 3.1.b-e to help streamline section.
Removed Sections 3.5.b, c, & d	•After referencing in Section 3.5.a above, redundant sections 3.5.b "*Building Permits & Fees"*, 3.5.c "*Service Disconnects*", & 3.5.d "*Inspection & Energizing*" were removed, and Sections 3.5.e through i were moved up to replace them and help streamline Section 3.
Section 3.6	Reworded for clarity and added the more familiar and commonly used term "Accessory Dwelling Unit (ADU)".
Section 3.6.a	Replaced redundant language with reference to new Sections 3.1.b,c, & e to help streamline section.
Removed Sections 3.6.b & c	•After referencing in Section 3.6.a above, redundant sections 3.6.b "*Building Permits & Fees"*, 3.6.c "*Inspection & Energizing*" were removed, and previous Section 3.6.d "*Additional Meters on a Single Residential Lot*" and Section 3.6.e "*General Requirements*" were moved up to replace them and help streamline Section 3.
New Section 3.6.b	Added the more familiar and commonly used term "Accessory Dwelling Unit (ADU)" and a reference to meter clearances in Section 8.
Section 3.7.a	Added clarifying language for the distinction between what qualifies as residential and commercial.
Section 3.8	Added clarifying language for new residential subdivision power requirements.
Section 3.8.b	Updated the wording regarding power coordination layouts to provide more clarity.
Section 3.8.d	Added language to clarify who is present at pre-construction meetings.
Section 3.8.f	Removed section 3.8.f "*Installation Requirements"* since it is redundant and covered by the rest of the section.
Drawing 3.1	Added Note 10 with updated language for clearance between electric meter and gas
Moved Drawing 3.2 to 5.25	Moved Drawing 3.2 "*Handhole Location*" to Section 5 and re-numbered as Drawing 5.25. Updated note regarding minimum clearances to obstructions. Updated handhole location for detached sidewalks to align with field installation process. Changed height above final grade from 2" to 3". Added note #4 about coiled cable in handhole.
Moved Drawing 3.3 to 5.9	Moved Drawing 3.3 "*Transformer Box Pad Location"* to Section 5 and re-numbered as Drawing 5.9.
Moved Drawing 3.4 to 5.6	Moved Drawing 3.4 "*Single Phase Transformer for Temporary Service"* to Section 5 and re-numbered as Drawing 5.6.

Moved Drawing 3.5 to 5.7	Moved Drawing 3.5 "*Single Phase Transformer Transformer With Box Pad*" to Section 5 and re-numbered as Drawing 5.7. Updated title by adding the word "Residential" and updated the minimum clearance around transformer from 36" to 5' to be consistent with other drawings and section 8 clearance requirements.
Moved Drawing 3.6 to 5.11	Moved Drawing 3.6 "*Single Phase Sectionalizing Cabinet*" to Section 5 and re-numbered as Drawing 5.11. Added labels for crushed rock and native backfill.
Moved Drawing 3.7 to 3.2	Moved Drawing 3.7 "*Residential Underground Service*" and re-numbered as Drawing 3.2. Added notes 13 and 14 with clearances from meter to gas meter and for wet utilities separation.
Moved Drawing 3.8 to 3.3	Moved Drawing 3.8 "*Residential 400AMP Service*" and re-numbered as Drawing 3.3. Added notes 13 and 14 with clearances from meter to gas meter and for wet utilities separation.
Moved Drawing 3.9 to 5.27	Moved Drawing 3.9 "*Pedestal/Handhole and Riser Installation"* to Section 5 and re-numbered as Drawing 5.27.
Moved Drawing 3.10 to 3.4	Moved Drawing 3.10 "*Residential Underground Joint Trench Electric and Pulse Fiber*" and re-numbered as Drawing 3.4. Changed title to "*Residential Underground Joint Trench Electric and Communications*" and updated the note clarifying minimum distance from meter to corner of house. Also revised the notes to encompass communications in general and not specific to Pulse.
Section 4.1	•Added language to clarify distinction between residential and commercial installations. •Also added a reference to Section 9 for any solar and DER related installations.
Section 4.1.a	•Updated title from "*All New or Upgraded Commercial and Industrial Services Shall Be Underground"* to "*Underground Commercial Service Requirements".* •Added language to clarify overhead to underground requirements which allows flexibility for commercial customers who share a point of service with other customers.
Section 4.1.d	•Reworded sentence to provide clarity on list of documents needed for commercial permit submittal and timing. •Updated language referring to Distribution Designer deposit, and added reference to Rates, Charges and Fees. •Added clarification on required cut sheets of meter gear/service entrance equipment for all transformer-rated metering. •Added item requesting documentation of exemption response.
Section 4.1.e	Removed redundant wording about utility locates and instead referenced Section 1.1.a "*Call for Locates*".
Section 4.1.g	Changed title of section from "*Cable Tray*" to "*Wireways*" and added further clarifying language of what is meant by wireways.
New Section 4.4	Added new Section 4.4 to cover new commercial subdivisions power requirements.
Section 4.4.a	Replaced redundant language with reference to Section 4.1.d to help streamline section.
Moved Drawing 4.1 to 5.10	Moved Drawing 4.1 "*Three Phase Transformer Installation*" to Section 5 and re-numbered as Drawing 5.10. Updated the minimum clearance around transformer from 36" to 5' to be consistent with other drawings and section 8 clearance requirements. Added test box to primary side of transformer. Changed pea gravel from 4" to 2". Changed structural fill from 6" to 8"-12".
Moved Drawing 4.2 to 5.24	Moved Drawing 4.2 "*Secondary Handholes*" and re-numbered as Drawing 5.24. Added labels for crushed rock. Changed height above final grade from 2" to 3". Added note #3 about coiled cable in handhole. Added note #4 to specify crushed rock requirements.
Section 5	Changed section title from "*Trenching & Boring*" to "*Equipment & Substructure Installation*"

Section 5.1.a	Replaced specific separation info with a reference to Section 8 Clearances to ensure consistency with clearance information.
Section 5.1.n	Adjusted compaction test frequency requirements and added clarifying language for trenching (from 300 ft to 150 ft) and transformer pads (from 2 tests to 3 tests).
Section 5.1.p	Added guidelines for installation of tracer wire with conduit.
Section 5.2.a	Added clarifying language for type of conduit used in directional boring applications to reduce confusion.
Section 5.2.c	Updated title of engineering group based on current titles that authorizes equipment described in section.
Section 5.3.d	Removed the sentence "The complete specification can be furnished upon request" as there is not currently a complete specification available and a reference to CDOT standards will be provided in a future revision.
New Section 5.3.e	•Added new section for "*Crushed Rock*" which provides definition for size of crushed rock used in handholes, pedestals, and other applications referenced in various detail drawings. •Added new table for crushed rock size specifications.
New Section 5.4.g	•Added new section for "*Cable-in-Conduit Handling Guidelines*" which refers to newly added Drawings 5.2, 5.3, 5.4, and 5.5. •Added the "*CIC Bending Radius Table*"
Drawing 5.1	Added additional language to Note #1 not allowing joint trenching in duct encasement installations.
Moved Drawing 5.2 to 5.12	Moved Drawing 5.2 "*Three Phase Sectionalizing Cabinet*" and re-numbered as Drawing 5.12. Added labels for crushed rock and native backfill.
New Drawing 5.2	Added new Drawing 5.2 "*Trench Installation: Cable-In-Conduit*" with proper handling techniques and bending guidelines for cable-in-conduit installed in a trench.
Moved Drawing 5.3 to 5.13	Moved Drawing 5.3 "*Vault Details*" and re-numbered as Drawing 5.13.
New Drawing 5.3	Added new Drawing 5.3 "*Reel Trailer Position: Cable-In-Conduit*" with proper handling techniques for cable-in-conduit fed from a trailer reel into a trench.
Moved Drawing 5.4 to 5.14	Moved Drawing 5.4 "*Vault Details - Conduit Detail*" and re-numbered as Drawing 5.14.
New Drawing 5.4	Added new Drawing 5.4 "*Reel Payoff: Cable-In-Conduit*" with proper handling techniques for cable-in-conduit fed from a trailer reel.
Moved Drawing 5.5 to 5.15	Moved Drawing 5.5 "*5'X5' Vault*" and re-numbered as Drawing 5.15.
New Drawing 5.5	Added new Drawing 5.5 "*Bending Cable-In-Conduit*" with proper handling techniques and bending guidelines for cable-in-conduit.
Moved Drawing 5.6 to 5.16	Moved Drawing 5.6 "*5'X8' Vault*" and re-numbered as Drawing 5.16.
Moved Drawing 5.7 to 5.17	Moved Drawing 5.7 "*7'X14' SWG Vault*" and re-numbered as Drawing 5.17.
Moved Drawing 5.8 to 5.18	Moved Drawing 5.8 "*7'X14' Hatch Only Vault*" and re-numbered as Drawing 5.18.
New Drawing 5.8	Added new Drawing 5.8 "*Commercial Single Phase Transformer Box Pad*" giving instruction on how to install single phase transformer pads in a commercial application.
Moved Drawing 5.9 to 5.19	Moved Drawing 5.9 "*8'X19' Single SWG Vault*" and re-numbered as Drawing 5.19.

Moved Drawing 5.10 to 5.20	Moved Drawing 5.10 "*Additional 8'X19' Lid Configurations*" and re-numbered as Drawing 5.20.
Moved Drawing 5.11 to 5.29	Moved Drawing 5.11 "*Concrete Base for Street Light*" and re-numbered as Drawing 5.29. Updated handhole location for detached sidewalks to align with field installation process. Changed streetlight base height above final grade from 2" to 4". Changed handhole height above final grade from 2" to 3".
Moved Drawing 5.12 to 8.13	Drawing 5.12 "*Utility Crossing Detail*" moved from Section 5 to Section 8 and was re-numbered as Drawing 8.13.
Moved Drawing 5.13 to 5.28	Moved Drawing 5.13 "*Street Light Foundation*" and re-numbered as Drawing 5.28. Changed height above final grade from 2" to 4". Added note #3 to specify crushed rock requirements.
New Drawing 5.21	Added new Drawing 5.21 "*Single Phase Bollard Standard*".
New Drawing 5.22	Added new Drawing 5.22 "*Three Phase Bollard Standard*".
New Drawing 5.23	Added new Drawing 5.23 "*Vault/Switchgear Bollard Standard*".
New Drawing 5.26	Added new Drawing 5.26 "*Pedestal Installation Detail*" giving instruction on how to install pedestals.
Section 6.1.a	Added sentence that metering equipment installed must match one-line diagrams and cut sheets submitted.
Section 6.1.e	Added language "may be subject to citation and fines" for unauthorized changes to metering equipment.
Section 6.1.f	Added reference to Colorado Open Records Act (CORA) in the Colorado Revised Statutes to assure customers that their contact information will remain confidential.
Section 6.1.i	Replaced "revenue losses" with "diversion (theft of electricity)".
Section 6.1.j	Added sentence to reinforce seriousness of meter tampering.
Section 6.2.d	Updated clearance around meter to be consistent with Drawing 8.12
Section 6.2.e	Updated clearance around meter to be consistent with Drawing 8.12
Section 6.4.a	Updated section to allow cold sequencing metering on multi-family applications.
Section 6.5.a	•Updated language about what types of meter sockets are not allowed. •Added clarifying language about a main disconnect needing adequate overcurrent protection. •Add bulleted list of inspection issues that require replacement and bringing equipment to current standards.
Section 6.5.d	Added language to clarify what Loveland Water & Power considers a commercial service.
Section 6.6.a	Updated section title from "*Service Wire Source & Ownership"* to "*Demarcation Point & Ownership"* and added the info from section 6.6.c to 6.6.a to make the section more clear about the ownership, maintenance responsibility, and demarcation point. Also made minor wording changes for readability, and removed the words "or wire gutter" since gutters are not allowed in our requirements.
Old Section 6.6.c	Removed section 6.6.c "*Demarcation Point"* since it was added to section 6.6.a.
New Section 6.6.c	Section 6.6.d "*Meter Pedestal Approvals & Ownership"* was moved up to 6.6.c and minor wording change was made in the second sentence for clarification on ownership and maintenance responsibility. Words "…will not be the responsibility of the City of Loveland" was replaced by "...is the customer's sole responsibility."
Section 6.7	Changed section title to be shorter and added extra info under heading.
Section 6.7.f	Specified Larimer County as the Land Records Management entity.
Section 6.7.h	Removed language at the end of sub-metering section that created confusion for developers in regards to reimbursements and allocations in sub-metered situations.

Section 6.7.j	Removed redundant first sentence.
New Section 6.7.k	Added section to reference item "*Section 6.9.n - Metering Fire Pumps*".
Section 6.8.b	Specified Larimer County as the Land Records Management entity.
Section 6.9	Added the "*Tables of Minimum Dimensions for CT Cabinets*" to the end of Section 6.9 which was previously after Section 6.11 as they are more applicable to and referenced in Section 6.9.
Section 6.9.a	•Updated title to be consistent with 400 Amp threshold in other areas of the section. •Included CT requirement clarification for de-rated 320 amp continuous load services.
Section 6.9.b	Updated title and section wording to be consistent with 400 Amp threshold in other areas of the section.
Section 6.9.d	Added clarifying language about a main disconnect needing adequate overcurrent protection.
Section 6.9.g	Integrated the content from the "*Switchgear Metering Notes*" which was previously after Section 6.11 to Section 6.9.g as some of it was redundant and more applicable to this section.
New Section 6.9.n	Added "*Section 6.9.n – Metering Fire Pumps*" to address requirements pertaining to commercial stand-alone fire pump applications.
Section 6.10.a	Added sentence: "*To qualify for primary metering, customers have to meet the minimum kW threshold stated in the Rates, Charges & Fees.*"
Section 6.10.d	Removed language about allowing overhead primary metering as it is no longer applicable/allowable.
Section 6.11	Changed title from "*Load Pulse Outputs*" to "*KYZ Metering*".
Section 6.11.a	•Changed title from "*Load Pulse Outputs*" to "*KYZ Outputs*". •Added additional details on what KYZ metering is used for.
Section 6.11.b	•Changed title from "*Pulse Output Meters*" to "*KYZ Meters*". •Reworded the section to align with Drawing 6.7 and provide clarification on the responsibilities of the City and customer regarding providing equipment, installation, and maintenance. Also removed reference to fee payment which is not enforced and no longer required.
Drawing 6.7	Changed title from "*Load Control Pulse Output*" to "*Load Control KYZ Output*".
Drawing 6.8	Updated the Table of Responsibility for the Primary Metering Cabinet under the Party to Furnish and Own column to clarify that the customer furnishes but city owns. Also added Note #2 referring to "*Section 6.10 - Primary Metering"*.
Section 8.1.a	Changed title of section from "*Electrical Equipment Clearances"* to "*Clearance to Electric Lines".*
Section 8.1.b	•Added clarifying language for landscape clearances to Metering Equipment. •Added reference to Section 1.10 regarding non-typical situations.
Section 8.3.c	Added examples of permanent structures.
New Section 8.3.d	Added new Section 8.3.d called "*Minimum Horizontal Separation for Parallel Utilities*" to outline separation requirements for wet and dry utilities running parallel to power lines.
New Section 8.3.e	Added new Section 8.3.e called "*Minimum Vertical Separation for Perpendicular Utilities*" to outline separation requirements for wet and dry utilities running perpendicular to power lines.
Table 8.1	•Under "*Clearances from buildings for service drops not attached to the building*" and subsection "*Vertical clearance over or under balconies and roofs*" which are "*Accessible to pedestrians…*", both distances were lowered by 1 ft to align with NEC. •Under "*Clearances for service drops attached to the building or other installation*" the wording "*In any direction...*" was changed to "*For vertical clearance...*". •Under "*Clearances for service drops attached to the building or other installation*" another item was added to cover horizontal clearances and distance of 5 ft to align with NESC.

Drawing 8.2	Updated distance from gas equipment to electrical conduit to be consistent with other drawings and clarified Note 3 about distance to gas equipment
Drawing 8.4	Updated outdated clearance for oil-filled equipment to walls from 4' to 5' to be consistent with other drawings and clearance requirements.
Drawing 8.7	Added Note 5 with clearances for wet utilities separation, and Note 6 referencing Section 8 clearance requirements.
Drawing 8.8	Updated minimum clearance for multiple meters to door, window, wall or obstruction from 6" to 12" to be consistent and align with Drawing 8.9 and Drawing 8.12.
Drawing 8.9	Updated minimum clearance for multiple meters to door, window, wall or obstruction from 2' to 12" to be consistent and align with Drawing 8.8 and Drawing 8.12.
New Drawing 8.10	Added new Drawing 8.10 "*Handhole/Pedestal Equipment Clearances*" showing clearance requirements around handholes and pedestals.
New Drawing 8.11	Added new Drawing 8.11 "*Vault Equipment Clearances*" showing clearance requirements around vaults.
New Drawing 8.12	Added new Drawing 8.12 "*Meter Clearances*" showing clearance requirements around meters.
New Drawing 8.13	Drawing 5.12 "*Utility Crossing Detail*" moved from Section 5 to Section 8 and was re-numbered as Drawing 8.13.
Section 9	The entire Section 9 was revised so it is highlighted in grey in its entirety. Implementation of rule 21 is enforced through the Solar Checklist.