9.0 - WASTEWATER PUMP STATIONS AND FORCE MAINS

9.1 GENERAL
One (1) copy of the pump station structural design plans, geotechnical investigation and supporting calculations, all stamped by a registered civil engineer and electrical engineer, shall be submitted to Public Works for approval. Construction shall not start on the pump station prior to Public Works approval of the submittal. Design calculations should include a hydraulic analysis and a map of the tributary area. NDEP approval is required prior to Public Works approval.

Operation and maintenance information shall be provided for all equipment and material and shall consist of the names and addresses of the manufacturer, the nearest representative of the manufacturer, the nearest parts supplier, as well as lubrication information, control diagrams, start-up procedures, operating procedures, preventative maintenance, overhaul instructions, parts list, and a spare parts list.

9.2 WET WELL
Wastewater pump stations shall have a wet well with submersible pump configuration unless waived by Public Works. Wastewater pump stations with a wet well/dry well configuration may be considered only by Public Works. Due consideration shall be given to the selection of materials because of the presence of hydrogen sulfide and other corrosive gases, greases, oils, and other components present in sewage.

Wet wells shall be equipped with submersible pumps installed on vertical guide bars, which are installed and removed through the use of chains and/or cables. The wet well layout shall allow for removal of the wastewater pumps through a hatch at the ground level over each pump. All facility telemetry equipment shall be installed within weather-proof control panels.

Small packaged lift stations for single users may be considered by Public Works for special circumstances. Currently E-One grinder pumps are used and approved by Public Works (see Section 9.13).

The wet well size and control setting shall be such that each pump cycles within a range of six to ten times in one hour under any condition. Septic conditions due to excessive detention times shall be avoided. The wet well shall be constructed of concrete.

Wet well design calculations shall account for high groundwater level during construction and during normal operating conditions. A soil report, including well logs and soil bearing calculations, shall be provided.

9.3 PUMPS
At least two pumps shall be provided for each pump station. The Engineer-of-Record and/or Public Works shall determine a minimum number of pumps based on the Average Daily Flow. All pumps shall have the same capacity. Pumping capacity will be such that the station can handle peak sewage flows, as determined per Section 8.2, with one pump out of service. All pumps shall have premium efficiency motors unless otherwise approved by Public Works.

The pumps shall be placed so that they will operate under a positive suction head during normal operation unless waived by Public Works. A shutoff valve shall be located on the suction line of the pump. A check valve and shutoff valve shall be located on the discharge line of the pump. One set of manufacturer recommended spare parts shall be supplied to Public Works upon dedication.

Pumps shall be of the non-clog centrifugal type and shall have pump suction and discharge openings at least four-inches (4”) in diameter, be designed to handle sewage, and shall not operate in excess of 1750 revolutions per minute (RPM), unless otherwise approved by Public Works. Pumps shall be capable of passing spheres of at least 3 inches in diameter, unless
otherwise approved by Public Works. Pumps shall be equipped with mechanical seals, inspection and clean out ports on the suction piping immediately prior to the front head of the pump and on the discharge portion of the volute, and a bleed valve assembly to the highest portion of the volute or seal housing. One extra set of all mechanical seals shall be provided to Public Works upon completion of the project and prior to acceptance by the City. Pneumatic ejectors will not be permitted. Suction line velocities shall not exceed 5 fps and discharge piping velocities shall not exceed 8 fps.

The pump station improvement plans shall identify the following operating conditions and performance criteria:

- Operating System Functional Description
- Depth of Wet Well
- Pumping Level
- Pump Manufacturer and Model
- Pump Materials of Construction
- Certified Pump Curve from Manufacturer
- Pump Intake Setting
- Required Pump Discharge
- Total Dynamic Head at Required Discharge
- Available Net Positive Suction Head Determination
- Maximum Pump Speed (RPM)
- Minimum Motor Horsepower
- Minimum Efficiency
- Motor Protection Features
- Motor Starters and/or VFD
- Meter Sizing Determination
- Air-Vacuum Valve Sizing Determination
- Discharge Piping Sizing Determination

9.4 PIPING
Piping shall be ductile iron with grooved or flanged joints. All fasteners used for joining pipes shall be stainless steel. Pump isolation valves shall be eccentric or full port plug valves. Swing check valves with external levers shall be provided on each pump discharge. The individual pump discharge shall connect into the main header horizontally to prevent grit buildup in the check valve.

Sewage air relief valves shall be provided at high points in the sewer force main and approved for use by Public Works.

9.5 OVERFLOW PREVENTION
Satisfactory means shall be provided to prevent overflows due to wet weather or power failures. As a minimum both of the following shall be incorporated:
Storage – The Engineer-of-Record shall submit a calculation of the maximum storage in the collection system at peak flow, before sewage reaches the top of the lowest manhole in the system for review by Public Works.

Stand-by Generator – A stand-by engine generator shall be provided with automatic starting and load transfer equipment to operate the entire pump station load during power failure, unless automatic overflow into a gravity sewer line can be provided at an elevation that insures no back-ups. Consideration shall be given to control of odors and noise. The generator shall be located in a weather-protective, sound-proof, and lockable housing with access to all engine and generator components for servicing and maintenance. The generator shall be fueled by diesel with an above-ground tamper-proof storage tank and concrete pad for secondary containment, or by natural gas as approved by Public Works. The storage tank shall have capacity to provide a 24-hour continuous run time. The generator engine block shall be equipped with a block heater and thermostat that will allow for instantaneous start-up at temperatures as lows as -10 degrees F. The engine shall be protected with shutdown safeguards, gauges and indicator lamps for over-temperature, low oil pressure, over speed and over crank. The engine shall be equipped with an automatic battery trickle charger, installed on the hot side of the transfer switch enabling the battery to maintain its charge when idle.

Alternative pumping ability utilizing an alternate fuel-driven pump can be used in lieu of a stand-by generator. The alternative fuel-driven pump must meet the same pumping capacity requirements for the lift station.

9.6 ELECTRICAL

Electrical systems and components (motors, lights, cables, conduits, switch boxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code Requirements for Class I, Group D, Division I locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions.

Each flexible cable shall be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment.

A Nevada registered electrical engineer shall stamp drawings, which involve electrical and control systems.

9.7 CONTROLS AND ALARMS

Sewage monitoring and control systems shall consist of a complete radio telemetry system to monitor the status of the pumping facilities. All telemetry equipment shall be installed within weather-proof control panels. Control systems shall have a pressure transducer for level measurement with float switches for backup, or as directed by Public Works. Control systems shall be configured to allow inspection, service, repair or replacement from the ground surface through the wet well hatch or lid, without confined space or wet well entry. The controls shall be located away from the turbulence of incoming flow and pump suction. In all stations, provisions shall be made to automatically alternate the pumps in use. Control panels shall be equipped with start counters and hour meters for all pumps. Alarm systems shall be provided for pumping stations. The alarm shall be activated to indicate high and low wet well level. The alarm shall be telemetered by radio to a receiver located at Public Works control panel and shall activate an auto dialer. Backup power shall be supplied to the control system.

The discharge and suction side of the pump shall have direct read pressure gauges located at the same height with the ability to transmit a 4 - 20 mA signal to the telemetry system. Pressure gauges shall be installed in accordance with the manufacturer’s recommendations.

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Typical functions to be monitored include:

1) Pump Status
2) Pump Alarms
3) High Motor Temperature
4) Successive Starts
5) Over-Voltage or Over-Amp draw
6) Suction and Discharge Pressure
7) Wet Well Levels
8) Intrusion alarms
9) Sewage Flow Rate
10) Operating Voltage (for each phase leg)
11) Operating Amp Draw (for each phase leg)

9.8 FORCE MAINS

A minimum flow velocity of three (3) feet per second shall be maintained in the force main during pump operation. A dual automatic air relief valve assembly designed for operations in sanitary sewage systems shall be placed at high points in the force main to prevent air locking. Provisions for odor control at the air relief valve may be required in applications where the force-main empties as part of normal operation sequence. Vacuum relief valves shall be provided as necessary to relieve negative pressures on force mains. The force main configuration and head conditions shall be evaluated to determine the need for and placement of vacuum relief valves.

The plans shall call for a water pressure test at a pressure of 150 psi in accordance with the requirements for testing water lines. The plans shall also call for a magnetic locating tape printed with “SANITARY SEWER FORCE MAIN” to be installed in the trench one (1) foot above the pipe.

The force main shall be constructed of either cement-lined Ductile Iron Pipe in accordance with AWWA C150 and C151 or PVC Pipe in conformance with AWWA C900. If PVC pipe is used, is shall be green in color. Trenching and installation of the force main shall be as required for water mains including thrust blocks and tracer wire.

Force mains shall enter the gravity sewer at a point not more than 2 feet above the flow line of the receiving manhole.

All force main cleanouts shall utilize threaded connections and caps. In-line valve spacing shall be similar to potable water mains, unless otherwise determined to be necessary at a different spacing.

9.9 FLOW METERING

The pump station shall have one magnetic flow meter with a 4-20 milli-amp (mA) output (remote readout) installed on the force main in a water-tight vault. The flow meter shall include a submergibility kit, and shall be capable of operating in continuously submerged conditions. The vault shall be equipped with a sump pump and flood alarms (remote readout).

9.10 FLOOD PROTECTION

Pumping station structures, access to all spaces, electrical panels, mechanical equipment, and motors shall be at an elevation of at least 1 foot above the 100 year base flood elevation.
9.11 START-UP AND OPERATION

Prior to approval or acceptance by Public Works, the developer or owner shall commission all systems including pumps, controls, and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate the system in operating order in accordance with the approved plans and specifications. To insure that the work is ready for full-time operation, the developer shall include procedures for the verification, balancing, calibration, witness testing, documentation, and inspection by equipment manufacturers. The developer shall also provide training of Public Works operators.

The developer shall include the following items in the start-up activities, and other items that are necessary to operate and maintain the system:

1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide maintenance, lubrication and personnel as required for test operation until Public Works accepts the project.
2. Perform testing of electrical work prior to energizing electrical systems.
3. Calibrate all instruments.
4. Test-operate all equipment.
5. Public Works shall be notified in writing 10 days before complete facility operation is to occur. Under the supervision of Public Works, the developer shall start-up and operate the facility on a complete full time basis beginning on the acceptance date. At no time during this initial operation shall the developer operate any Public infrastructure without Public Works approval. The developer shall provide the Engineer-of-Record, a mechanic, electrician, instrument engineer, representatives of manufacturers of equipment, and other personnel to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 10 days. The developer shall also furnish all mechanical and electrical personnel as required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 10-day initial operation period. Maintenance of equipment shall include lubrication, adjustments, replacements, and modifications as required.
6. Following completion and approval of the 10-day initial operation period, Public Works will take over operation and maintenance duties. If continuous operation is interrupted for a period of four consecutive hours or more due to a failure of equipment or work, the 10-day initial operation period shall be restarted at day one. At the end of one year from the date of acceptance, another test will be performed by Public Works to verify efficiency and operating condition of all pertinent facilities. Any deficiencies as evidenced by the test will be corrected by the developer under warranty.
7. Submit documentation of test reports and calibration results to Public Works during the 10-day initial start-up period within 10 days of completion.
8. Prior to the 10-day initial start-up period, the developer shall submit to Public Works affidavits from the manufacturers stating that the equipment has been properly installed, tested, and adjusted. The affidavit shall contain the following wording: “The (Name of Equipment) has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation. The installation has been inspected and been found to be in accordance with our (the manufacturer’s) standards and requirements.”
9. The developer shall provide training to Public Works operators which shall include a demonstration of the operation, maintenance, and safety procedures for all facilities. Training of Public Works operators shall be performed separate from facility start-up and commissioning.

In the event that the facility does not meet the approved plans and specifications, the owner/developer will come up with a design to meet the original approved plans and
specifications. Public Works will not submit a design by review. The costs of any additional designs, equipment and implementation will be paid by the developer.

9.12 OPERATIONS AND MAINTENANCE MANUAL

Four (4) copies of an operations and maintenance manual shall be submitted to Public Works upon completion of construction and prior to acceptance of facilities or improvements, pump stations, and force mains. The operations and maintenance manual shall contain the following as a minimum:

1) Listing of emergency telephone numbers for Public Works
2) Priority calling list
3) List of abbreviations
4) General narrative of the facility
   a) Introduction
   b) Objectives of the facility
   c) Facility design criteria
5) Operating instructions
   a) Facility description
   b) Emergency operation (discussion of potential facility failures and procedures for responding to emergency operations)
6) Operating records
7) Monitoring and treatment processes
8) Stand-by power operations
9) Maintenance instructions
   a) General instructions
   b) Maintenance records
   c) Maintenance of motors and drives
   d) Maintenance of pumps
   e) Maintenance of treatment/process equipment
   f) Maintenance of valves
   g) Maintenance of instrumentation and meters
   h) Maintenance of Stand-by power
10) Facility safety
    a) General
    b) Confined spaces
    c) Electrical safety
    d) Explosion hazards
    e) Process facilities
    f) Pump rooms
    g) Collecting samples
    h) Equipment set-up and performance tests
    i) General safety considerations
11) Appendices and required
    a) Permits
    b) Figures and drawings
9.13 APPROVED ALTERNATIVE SEWER SYSTEMS

9.13.1 E-ONE GRINDER PUMP SYSTEM

Use of E-One alternative sewer systems must first be requested by the Engineer-of-Record and approved by Public Works prior to submitting improvement plans to Public Works for review. Public Works requires gravity systems at any and all locations if at all possible. E-One systems will only be considered by Public Works if the Engineer-of-Record has exhausted all possibilities of incorporating a gravity system. If an E-One system is to be used, they should be selected based on the following:

### Table 1: Recommended Grinder Pump Selection

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Use Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>GP 2010</td>
</tr>
<tr>
<td>Multi-Family/Multiple Homes</td>
<td>GP 2012</td>
</tr>
<tr>
<td>2 Units</td>
<td>GP 2014</td>
</tr>
<tr>
<td>3 to 6 Units</td>
<td>GP 2015</td>
</tr>
<tr>
<td>10 Units</td>
<td>GP 2016</td>
</tr>
<tr>
<td>12 Units</td>
<td></td>
</tr>
<tr>
<td>Mobile Homes</td>
<td>GP 2010</td>
</tr>
<tr>
<td>1 to 2</td>
<td>GP 2012</td>
</tr>
<tr>
<td>3</td>
<td>GP 2014</td>
</tr>
<tr>
<td>4 to 6</td>
<td></td>
</tr>
<tr>
<td>Motel/Hotel</td>
<td>GP 2010</td>
</tr>
<tr>
<td>Resident</td>
<td>GP 2012</td>
</tr>
<tr>
<td>1 to 4 Rooms</td>
<td>GP 2014</td>
</tr>
<tr>
<td>5 to 6 Rooms</td>
<td></td>
</tr>
<tr>
<td>7 to 8 Rooms</td>
<td></td>
</tr>
<tr>
<td>Transient</td>
<td>GP 2010</td>
</tr>
<tr>
<td>1 to 12 Rooms</td>
<td>GP 2012</td>
</tr>
<tr>
<td>13 to 18 Rooms</td>
<td>GP 2014</td>
</tr>
<tr>
<td>19 to 24 Rooms</td>
<td></td>
</tr>
<tr>
<td>Large Restaurants, Strip Malls</td>
<td>GP 2015</td>
</tr>
<tr>
<td>Laundry, Business with Constant Flows</td>
<td></td>
</tr>
<tr>
<td>Campers and Recreation Vehicles</td>
<td>*</td>
</tr>
</tbody>
</table>

*Since these vehicles vary widely in size and accommodations, design flow must be based on a specific type. Loading can then be selected on the basis of peak flow handling capacity of anticipated overhaul period, whichever is limiting.*

### Table 2: Maximum Number of Grinder Pump Cores Operating Daily

<table>
<thead>
<tr>
<th>Number of Grinder Pump Cores Connected</th>
<th>Daily Number of Grinder Pump Cores Operating Simultaneously</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2 - 3</td>
<td>2</td>
</tr>
<tr>
<td>4 - 9</td>
<td>3</td>
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<tr>
<td>10 - 13</td>
<td>4</td>
</tr>
<tr>
<td>14 - 18</td>
<td>6</td>
</tr>
<tr>
<td>19 - 25</td>
<td>6</td>
</tr>
<tr>
<td>26 - 34</td>
<td>7</td>
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<tr>
<td>35 - 50</td>
<td>8</td>
</tr>
<tr>
<td>51 - 74</td>
<td>8</td>
</tr>
<tr>
<td>75 - 100</td>
<td>8</td>
</tr>
<tr>
<td>101 - 150</td>
<td>10</td>
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<tr>
<td>151 - 200</td>
<td>10</td>
</tr>
<tr>
<td>201 - 250</td>
<td>10</td>
</tr>
<tr>
<td>251 - 300</td>
<td>10</td>
</tr>
<tr>
<td>301 - 350</td>
<td>10</td>
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<tr>
<td>351 - 400</td>
<td>10</td>
</tr>
<tr>
<td>401 - 450</td>
<td>10</td>
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<tr>
<td>451 - 500</td>
<td>10</td>
</tr>
<tr>
<td>501 - 550</td>
<td>10</td>
</tr>
<tr>
<td>551 - 600</td>
<td>10</td>
</tr>
<tr>
<td>601 - 650</td>
<td>10</td>
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<tr>
<td>651 - 700</td>
<td>10</td>
</tr>
<tr>
<td>701 - 750</td>
<td>10</td>
</tr>
<tr>
<td>751 - 800</td>
<td>10</td>
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<td>801 - 850</td>
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<tr>
<td>851 - 900</td>
<td>10</td>
</tr>
<tr>
<td>901 - 950</td>
<td>10</td>
</tr>
<tr>
<td>951 - 1000</td>
<td>10</td>
</tr>
</tbody>
</table>

9.13.2 E-ONE CALCULATIONS

The engineer of record is required to submit stamped engineering calculations of the E-One system intended with the improvement plans for approval by Public Works. The calculations must include proposed sewer flows and number of units requiring E-One
stations. The calculations must include the brand name, rating, size and type of E-One system to be used on each residence. The calculations must also include sizing of the small diameter force main.

9.13.2.1 E-ONE PERFORMANCE CRITERIA
The following figures display the pump performance of the E-One Grinder Pumps.
### Table 1

<table>
<thead>
<tr>
<th>N</th>
<th>V</th>
<th>Hh</th>
<th>Hm</th>
<th>Hn</th>
<th>N1</th>
<th>V1</th>
<th>Hh1</th>
<th>Hm1</th>
<th>Hn1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.26</td>
<td>1.14</td>
<td>0.85</td>
<td>0.85</td>
<td>0.35</td>
<td>0.52</td>
<td>1.25</td>
<td>1.50</td>
<td>1.15</td>
</tr>
<tr>
<td>2</td>
<td>4.72</td>
<td>2.38</td>
<td>1.81</td>
<td>1.81</td>
<td>0.52</td>
<td>0.65</td>
<td>2.50</td>
<td>2.81</td>
<td>1.81</td>
</tr>
<tr>
<td>3</td>
<td>7.28</td>
<td>3.71</td>
<td>2.83</td>
<td>2.83</td>
<td>0.68</td>
<td>0.78</td>
<td>3.75</td>
<td>3.90</td>
<td>2.83</td>
</tr>
<tr>
<td>4</td>
<td>9.84</td>
<td>4.89</td>
<td>3.46</td>
<td>3.46</td>
<td>0.84</td>
<td>1.00</td>
<td>4.90</td>
<td>4.90</td>
<td>3.46</td>
</tr>
<tr>
<td>5</td>
<td>12.40</td>
<td>6.05</td>
<td>4.00</td>
<td>4.00</td>
<td>1.00</td>
<td>1.12</td>
<td>5.95</td>
<td>5.95</td>
<td>4.00</td>
</tr>
</tbody>
</table>

**Notes:**
- V: Flow in gpm
- Hh, Hm, Hn: Loss in feet
- N1, V1: Flow at 100 gpm

**Formulas:**
- H = 2063(V^2) + 852X
- C = 2000
- d = ID of pipe in inches
- Q = Flow in gpm
- N = Number of pumps operating at 11 gpm
- F = Flow friction loss in m

**Head Loss Calculations:**
- Modified Hazen-Williams Formula

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9.13.3 E-ONE IMPROVEMENT PLANS
The improvement plans must include the depth of bury and horizontal location of the force main in relation to other existing utilities and/or proposed utilities, primarily, potable water. The plans must also show the proposed location of the E-One units, which will be field verified, and sizes of all force mains. The force mains shall include sewage air-vacuum valves at all high points and isolation valves every 1000 feet. Check valves must be included where necessary.
Cleanouts must be installed at all isolation valves for access to the low-pressure force main for cleaning, if necessary. Cleanouts shall incorporate threaded caps to preclude force main pressure removal of the caps. The E-One control/alarm panel is to be placed to ensure serviceability. Never should the control/alarm panel be placed within the backyard of the residence. All E-One’s supply and discharge lines shall be green in color and installed with tracer wire.

9.13.4 E-ONE START UPS
At the time the developer purchases the E-One unit (core, pump, etc.) the pump is delivered to Public Works for storage. The Engineer-of-Record must provide a letter of acceptance to Public Works after successful start-up indicating the time, date, residence address, and specifics of the start-up. The specifics must include pump operation in relation to the level controls. The level controls and proper operation of alarms must also be indicated in the start-up report prior to acceptance by Public Works. Public Works requires a representative from Public Works and the E-One Company for start-up certification and acceptance of the installations.

9.13.5 E-ONE RECORD DRAWING
The Record Drawings must include location of E-One units in relation to the residence or commercial building being served and the adjacent street(s) on 8 ½ X 11 sketches. The Record Drawings must also include any fencing, sidewalks, landscaping, or other structures preventing or hindering access by Public Works to the unit. Public Works will only issue acceptance of the E-One system upon acceptance of the Record Drawing and certification from an E-One Representative.

9.13.6 E-ONE WARRANTY
The E-One Units and force main piping installation and equipment will remain on warranty for a period of two (2) years from the date of installation or twenty-seven (27) months from the date of shipment, with the manufacturer(s) and developer. The E-One Manufacturer representative can be reached at (925)-485-9720 ext. 15, Don Reppond of Shape Incorporated, 7020 Knoll Center Pkwy, Pleasanton, CA, 94566. Warranty and E-One usage information must be provided to the Public Works Department.

9.13.7 E-ONE SERVICE
Public Works responds to service calls and reinstalls pumps for the homeowner. Public Works maintains E-One units and force mains. Fernley Electric responds to electrical repairs.
9.13.8 HOMEOWNER NOTIFICATION AND RESPONSIBILITY

The Homeowner must be provided all warranty information, operations and maintenance information, and contract information with the CCR's. The homeowner is required to provide complete and absolute access to all E-One Units and service panels at all times by signing an affidavit. Public Works will not be responsible for any damage to private property during service calls. "Homeowner Agreements" are available at the office of Public Works.