

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

PUMPING PLANT

(No.)
CODE 533

DEFINITION

A pumping facility installed to transfer water for a conservation need.

PURPOSE

Provide a dependable water source or disposal facility for water management.

CONDITIONS WHERE PRACTICE APPLIES

Wherever water must be pumped to accomplish a conservation objective, which may include but is not limited to one of the following:

- To provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.
- To maintain critical water levels in swamps, marshes, open water, or for newly constructed wetlands and ponds.
- To transfer wastewater for utilization as part of a waste management system.
- To provide drainage by the removal of surface runoff water or groundwater.

CRITERIA

Design, installation, and operation of a pumping plant shall comply with all federal, state, and local laws, rules and regulations.

The efficiency of units, type of power, quality of building, automation features, and other accessories installed shall be in keeping with the economic and environmental value of the system to accomplish the conservation objectives.

Criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering

principles.

Pump requirements. Capabilities, range of operating heads, and general class and efficiency of equipment shall be determined by appropriate technical means. Size and number of pumps and their performance shall be determined on the basis of system conservation requirements in order to meet the intended purpose. Total head shall be determined for critical operating conditions, taking into account all hydraulic losses. Automatic controls shall be included as required.

Pumps utilized for the transfer of wastewater or manure shall be sized to transfer material at the required system head and flow rate determined by the waste management plan. The pump type shall be based on the consistency of material being pumped and manufacturer's recommendations.

Power units. Power units shall be selected on the basis of availability of fuel or power costs, operating conditions, conservation needs, and objectives, including the need for automation. The power unit shall be matched to the pump and be capable of operating the pump efficiently and effectively within the range of operating conditions. The horsepower requirements, pump efficiency and total head on the pump shall be computed.

Suction and discharge pipes. The size of suction and discharge pipes shall be based on a hydraulic analysis, operating cost, and compatibility with other system components. The arrangement and length of discharge pipe shall be based on the need for recovery of head through siphoning action, and for delivery of water in keeping with conservation and environmental objectives. Gates, valves, pipe connections, discharge bays, and other protective devices shall be installed, as needed, for satisfactory pumping plant operation.

Federal, State, and local laws and regulations concerning back flow prevention shall be followed when pumping from wells or when chemigating.

Building and accessories. The design of the pumping plant and associated housing, if required, shall consider accessibility for equipment maintenance and repairs, and the need for protecting equipment from the elements, vandalism, and fire. The housing design shall also include ventilation and shade for the motor or engine and the pump. The appearance of the plant shall be compatible with the surrounding environment, as applicable.

Foundations shall be designed to safely support the loads imposed. Sheet piling or other measures shall be used, as required, to prevent piping beneath the foundation.

Pumps may be mounted in the open, on piling or concrete foundations, in a well or pit, or by other appropriate means.

Suction bays (or sumps) shall be designed to conform to the hydraulic characteristics established by the pump manufacturer.

The discharge bay or connection with the distribution system shall meet hydraulic and structural requirements. Provisions for repair or removal of pumps and engines shall be provided. Trash racks shall be provided, as needed, to exclude debris and trash from the pump.

All structural features and equipment shall provide adequate safety features to protect workers and the public from injury.

Photovoltaic (PV) Powered Systems

An acceptable PV powered pumping plant shall include the following components:

- Photovoltaic array and mounting structure
- Pump, including intake and outlet piping
- Electrical System
- Protective structures
- Provisions for water storage

Float switches, timers or other monitoring devices shall be included to minimize the waste of water to the extent possible.

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Solar Insulation Data. Site specific data, such as energy received per unit area day, are preferable for system design. Where site specific data is not available, solar insulation values may be estimated.

The solar insulation values for the period where the ratio of daily water requirement to average daily solar insulation is largest shall be used to size the PV array.

PV System Components. Electrical components must be designed and installed in accordance with all applicable provisions of the National Electrical Code (NEC). All components shall be warranted against material and workmanship defects for a period of no less than one year from installation.

PV modules must have as a minimum, a manufacturers warranty against power degradation in excess of 10% of the rated power for no less than ten years after installation. PV modules shall be individually labeled and shall be listed by Underwriters Laboratories (UL) or another nationally recognized testing laboratory.

The array mounting structure may be fixed or portable. It must be designed with adequate anchors to maintain alignment under the normally expected loads and to support the array under extreme conditions.

A pump controller, inverter, fuses, surge protection, and other electronic components shall be provided as recommended by the pump and PV module manufacturers, or as necessary to meet NEC requirements. Provisions shall be included to protect the pump from common pump faults, overload, electrical short circuits, and low water (dry running), as recommended by the pump manufacturer. A circuit breaker shall be provided as a means for disconnecting the array from the system. All electronic components shall be housed in a weather resistant enclosure (National Electrical Manufacturers Association (NEMA) 3R or equivalent). The system components shall be grounded in accordance with NEC.

Wiring materials and methods shall be in accordance with NEC. The length of wiring shall be minimized to the extent possible. All wiring shall be sized for a minimum of 125% of

the maximum expected currents, and when feasible maintain the total distance voltage drop to less than 2.5%.

Pumps. The pump must be capable of delivering the design water requirements at the estimated total dynamic pumping head when solar power is available. Where the source of water is a well, depth, yield, static water level and draw down level at the design pumping rate must be determined.

The pump and fittings must be constructed from materials appropriate for the quality of water expected. Stainless steel, brass, or plastic material shall be specified when total dissolved solids (TDS) in water are greater than 500 ppm. The pump intake must be adequately screened to prevent entrance of sand or other objectionable material. Pumps and required appurtenances must be installed in accordance with the current state and local regulations.

A minimum water storage volume equal to 3 days design water requirement shall be provided for all PV powered pumping systems.

All components of the system shall be protected from damage by livestock and wildlife with fencing or other appropriate measures.

CONSIDERATIONS

- When planning this practice the following items should be considered, as applicable:
- Effects on downstream flows or aquifer recharge volumes.
- Effects on existing wetland hydrology.
- Effects on surface and ground water by leaked or spilled fuels and lubricants.
- Secondary containment of spilled fuel for water quality as may be required by federal and state laws or regulations.
- Protection of system components from "natural" events such as floods.
- Use of Variable Frequency Drive Control systems to protect the pump and conserve energy.

- Properly maintained PV modules should have a service life in excess of twenty years. When feasible, other components of the pumping system, as well as the installation methods, should be of sufficient quality to maintain performance comparable to the modules.
- Solar trackers or storage battery units may be included as components of a PV powered pumping plant. When necessary, the batteries, battery enclosure, charge controller, and wiring design should be in accordance with the manufacturer recommendations and NEC.
- In lighting prone areas consideration should be given to locating the system away from high points in the topography, installing lightning rods adjacent to the system, and including lightning surge protection in the system specifications

PLANS AND SPECIFICATIONS

Plans and specifications for constructing pumping plants shall be in compliance with this standard and describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the facilities installed shall be prepared for use by the landowner or responsible operator. The plan shall provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions properly. The plan shall include provisions to address the following, as a minimum:

- Inspection or testing of all pumping plant components and appurtenances, as applicable.
- Proper start-up procedures for the operation of the pumping plant.
- Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.
- When applicable, the power unit, fuel storage facilities and fuel lines should be frequently checked for fuel or lubricant leaks and repaired as needed.

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- Periodic checks and removal of debris as necessary from trash racks and structures to assure adequate capacity reaches the pumping plant.
- Periodic removal of sediment in suction bays to maintain design capacity and efficiency.
- Inspect and maintain anti-siphon devices, if applicable.
- Routinely test and inspect all automation components of the pumping plant to assure they are functioning as designed.
- Inspect and maintain secondary containment facilities, if applicable.
- Periodic inspection of all safety features to ensure they are in place and functional.
- Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

REFERENCES

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