

This is a guidance document with sample specification language intended to be inserted into project specifications on this subject as appropriate to the agency's environmental goals. Certain provisions, where indicated, are required for U.S. federal agency projects. Sample specification language is numbered to clearly distinguish it from advisory or discussion material. Each sample is preceded by identification of the typical location in a specification section where it would appear using the SectionFormat™ of the Construction Specifications Institute; the six digit section number cited is per CSI Masterformat™ 2004 and the five digit section number cited parenthetically is per CSI Masterformat™ 1995.

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Section 33 16 20 (SECTION 11201) – RAINWATER HARVESTING

SPECIFIER NOTE:

resource management: Rainwater harvesting systems are available for irrigation and potable water. The system can be as simple as a barrel under a downspout or as complex as a system with filters, settling tanks, pumps, UV radiation and water purification treatment. Rainwater harvesting keeps rainwater on site. It lessens the burden to municipal water facilities and decreases erosion and flooding caused by runoff from impervious surfaces. Refer to Section 32 71 00 (02670) - Constructed Wetlands for information regarding natural treatment of water.

toxicity/IEQ: Chlorine is routinely added to municipal water supplies and may be a required additive for water collected/treated in situ and destined for potable use. Where such additives are necessary, iodine is considered to be a less toxic alternative. Ozonation may also be effective. Ozone oxidizes bacteria, viruses, and other contaminants without undesirable odors or by-products. Ozone is ph neutral. Ozone reduces chemical usage up to 95%. Ozone oxidizes contaminants up to 3,000 times faster than chlorine. Rainwater is generally of better quality than well and municipal tap water. The exception is near industrial sites where rainwater may be extremely acid. Also, rainwater may wash many types of bacterial, molds, algae, protozoa, particulates and other contaminants from the collection area into storage. If you plan to use rainwater for drinking water, have it tested by a laboratory certified by the State; for a list of State Certification Officers for drinking water laboratories, refer to <http://www.epa.gov/safewater/labs/index.html>

performance: Performance is comparable for green methods and standard methods. In many instances, rainwater and water treated via constructed wetlands have tested better than the available municipal water. Rainwater is soft (hardness of zero) and can significantly reduce the quantity of detergents and soaps needed for cleaning.

Ozonation reduces chemical costs, chemical storage requirements, and labor expenses. It requires weekly, rather than daily, chemical check. And, it prolongs life of equipment by reducing calcium and scale buildup.

The American Water Works Association (AWWA) is an international nonprofit scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, AWWA is the largest organization of water supply professionals in the world. AWWA also runs Water Wiser web site, which provides comprehensive information on water efficiency to consumers and utilities. For information related to rainwater harvesting studies and related links, refer to <http://www.awwa.org/waterwiser/>

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes engineering, fabricating, furnishing, and installing:
 - 1. Rainwater Harvesting System[s].
 - [a. Roof collection system.]
 - [b. Site collection system.]

- B. Related Sections:
1. Divisions 31 – 33 (2) – landscaping and irrigation sections.
 2. Division 07 (7) – roofing section(s).
 3. Division 22 (15) – plumbing.

1.2 DEFINITIONS

- A. Rainwater Harvesting System: An assembly that collects, stores, and distributes rain water for use in situ; including water treatment as appropriate to intended use.

1.3 SUBMITTALS

- A. Product Data: Submit product data on all components of the rainwater harvesting system[s]. Unless otherwise indicated, include the following for each type of product provided under work of this Section:
1. Manufacturer's brochure indicating equipment model(s).

SPECIFIER NOTE:

Green building rating systems often include credit for materials of recycled content. USGBC-LEED™ v3, for example, includes credit for materials with recycled content, calculated on the basis of pre-consumer and post-consumer percentage content, and it includes credit for use of salvaged/recovered materials. Green Globes US also provides points for reused building materials and components and for building materials with recycled content.

2. Recycled Content:
 - a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

SPECIFIER NOTE:

Specifying local materials may help minimize transportation impacts; however it may not have a significant impact on reducing the overall embodied energy of a building material because of efficiencies of scale in some modes of transportation.

Green building rating systems frequently include credit for local materials. Transportation impacts include: fossil fuel consumption, air pollution, and labor.

USGBC-LEED™ v3 includes credits for materials extracted/harvested and manufactured within a 500 mile radius from the project site. Green Globes US also provides points for materials that are locally manufactured.

3. Local/Regional Materials:
 - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
 - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
 - d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

- B. Shop Drawings: **[For each system,] [For roof collection system,] [For site collection system,]** include plans, sections, details, and attachments to other work, for the following:
1. Pumps.
 2. Storage.
 3. Connection to roofing system.
 4. Connection to irrigation system.
 5. Connection to plumbing system.
- C. Calculations: **[For each system,] [For roof collection system,] [For site collection system,]** submit the following:
1. Maximum water capacity.
 2. Collection data: Include the following:
 - a. average rainfall rate (inches annually)
 - b. total collection area (s.f.)
 - c. potential collection (s.f.= gallons)
 - d. peak gallons @ 5"/hour
 - e. peak gallons @ 5 min. duration
 - f. available gallons
 3. Water Demand: Include the following:
 - a. Landscaping:
 - total estimated planted area (acres)
 - application rate / week (high) gallons
 - application rate /week (low) gallons
 - gallons required
 - b. Fixture Demand:

SPECIFIER NOTE:

Typical usage is likely to include:

- # toilets/1.6 gallons flush/ # flush per day
- faucets - 10 gallons/day
- dishwasher 10/galls/load/1 load/day

Fixtures by type, water use per person/day
Gallons potable water required
Gallons non-potable water required

- D. Designer/Installer Qualifications.
- E. Regulatory Requirements Documentation:

SPECIFIER NOTE:

Guidance and regulation specific to rainwater harvesting are limited. In some regions, the Owner does not own the rainwater that falls on his/her property. Some regions do provide guidance. In Texas, for example, contact the Texas Water Development Board http://www.twdb.state.tx.us/assistance/conservation/Alternative_Technologies/Rainwater_Harvesting/rain.asp

Regulations related to potable water stem primarily from the Safe Drinking Water Act (SDWA). The SDWA authorizes the EPA to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and ground water wells. For additional information, refer to the EPA Office of Ground Water and Drinking Water <http://www.epa.gov/safewater/index.html> Also, to verify local requirements, contact the Local/State Health Department.

- F. Operation and Maintenance Manuals Submittals: Provide the following:

1. Operation and maintenance procedures, including variations of procedures appropriate for normal climatic conditions anticipated throughout an annual cycle of operations.
 2. Water testing laboratory contact information.
 3. Water testing requirements, schedule, kits, and equipment.
- G. Reports for Field Quality Control: Submit test reports and inspection reports to **[Owner]** **[Architect]**.
1. System Inspections.
 2. Water Quality Tests.
- H. Closeout Submittals:
1. Warranty.

1.4 QUALITY ASSURANCE

- A. Designer/Installer Qualifications: For work of this Section, engage an experienced rainwater consultant who has specialized in systems similar to those required for this Project and with a record of successful in-service performance. Consultant shall:

SPECIFIER NOTE:

The American Rainwater Catchment Systems Association (ARCSA) was founded in Austin, Texas in 1994 to promote rainwater catchment systems in the United States. Membership consists of professionals working in city, state, and federal government, academia, manufacturers and suppliers of rainwater harvesting equipment, consultants, and other interested individuals <http://www.arcsa-usa.org/default.aspx>

1. be a member in good standing of The American Rainwater Catchment Systems Association.
2. have a minimum **[3] [5] [xxxx]** years experience designing and constructing rainwater catchment systems similar to requirements for this Project.

SPECIFIER NOTE:

State law may include requirements for designers/installers of potable water equipment. For example, Texas Water Code Chapter 37, Texas Health & Safety Code Chapter 341, and Title 30 Texas Administrative Code, Chapter 30, Subchapter H, any individual who installs and services fixed or portable equipment in public or private systems in the State of Texas for the analysis and treatment of potable water to alter or purify the water or to add or remove a mineral, chemical, or bacterial content must be a Licensed Water Treatment Specialist. Refer to http://www.tnrcc.state.tx.us/subject_water.html

3. for potable systems, **[comply with agencies having jurisdiction] [have a current Class III Water Treatment Specialist license] [xxxx]**.
- B. Single-Source Responsibility: To the greatest extent possible, obtain the system components from one source and from a single manufacturer.
- C. Pre-Construction Meeting: After award of Contract and prior to the commencement of the Work of this Section, schedule and conduct meeting to discuss the Work of this Section and to coordinate with related Work. Convene pre-construction meeting to comply with requirements of Division 01 (1) and as follows:
1. Notify all attendees at least two weeks prior to the conference.
 2. Require attendance of parties directly affecting Work of this Section, including, but not limited to:
 - a. Owner,
 - b. Contractor,
 - c. Architect,
 - d. Civil Engineer

- e. System Designer/Installer,
 - f. Landscape Architect and Irrigation Installer,
 - g. Roofing Membrane Provider/Installer,
 - h. Owner's insurer, and if applicable; testing and inspecting agency representative.
3. Review methods and procedures related to installation and operation of Work of this Section, including coordination with related Work.
 4. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the Work with installation of associated roofing, waterproofing, flashings, and roof accessories specified under other sections as the Work of this Section proceeds.
- B. Coordinate the Work with installation of associated irrigation and plumbing systems specified under other sections as the Work of this Section proceeds.

1.6 WARRANTY

- A. Warranty: Warrant the system against defects including equipment failure and leakage, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period.
 1. Warranty Period: One year after date of Substantial Completion,

PART 2 PRODUCTS

SPECIFIER NOTE:

EO 13423 includes requirements for Federal Agencies to use "sustainable environmental practices, including acquisition of biobased, environmentally preferable, energy-efficient, water-efficient, and recycled-content products"

Specifically, under the Sustainable Building requirements per Guiding Principle #5 Reduce Environmental Impact of Materials, EO13423 directs Federal agencies to "use products meeting or exceeding EPA's recycled content recommendations" for EPA-designated products and for other products to "use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project."

EO 13423 directs Federal Agencies "... beginning in FY 2008, reduce water consumption intensity, relative to the baseline of ... year 2007 ... by 2 percent annually through the end of fiscal year 2015 or 16 percent by the end of fiscal year 2015"

Specifically, under the Sustainable Building requirements per Guiding Principle #3 Protect and Conserve Water, EO 13423 directs Federal agencies to "Employ strategies that in aggregate use a minimum of 20 percent less potable water than the indoor water use baseline calculated for the building, after meeting the Energy Policy Act of 1992 fixture performance requirements." And, to "Use water efficient landscape and irrigation strategies, including water reuse and recycling, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities)."

Executive Order 13514; *Federal Leadership in Environmental, Energy, and Economic Performance*; was signed on October 5, 2009. <http://www.ofee.gov/execorders.asp> It expands upon the environmental performance requirements of EO 13423.

http://www1.eere.energy.gov/femp/regulations/printable_versions/eo13423.html

EO 13514 sets numerous federal requirements in several areas, including sustainable buildings and communities. Federal agencies must implement high performance sustainable federal building design, construction, operation and management, maintenance, and deconstruction, including:

- Ensuring all new Federal buildings, entering the design phase in 2020 or later, are designed to achieve zero net energy by 2030.
- Ensuring all new construction, major renovations, or repair or alteration of Federal buildings comply with the Guiding Principles of Federal Leadership in High Performance and Sustainable Buildings <http://www1.eere.energy.gov/femp/pdfs/mouhighperfsustainfedfacs.pdf>
- Ensuring at least 15% of existing agency buildings and leases (above 5,000 gross square feet) meet the Guiding Principles by fiscal year 2015 and that the agency makes annual progress towards 100% compliance across its building inventory.

Additionally, EO 13514 Federal requirements for water stewardship, including:

- Reducing potable water consumption intensity 2% annually through fiscal year 2020, or 26% by the end of fiscal year 2020, relative to a fiscal year 2007 baseline.
- Reducing agency industrial, landscaping, and agricultural water consumption 2% annually, or 20% by the end of fiscal year 2020, relative to a fiscal year 2010 baseline.
- Identifying, promoting, and implementing water reuse strategies consistent with state law that reduce potable water consumption.

2.1 SYSTEM COMPONENTS

SPECIFIER NOTE:

Rainwater harvest systems should be designed with consideration for the project location, climate, and regulatory requirements. Following is an example.

- A. Catchment Area:
 - 1. Roofing as indicated.
- B. Conveyance:
 - 1. Pump(s), sized as appropriate to water demands of facility.
 - a. Roof collection system: **[Electric] [Wind powered] [xxxx].**
 - b. Site collection system: **[Electric] [Wind powered] [xxxx].**
 - 2. Piping. Overflow pipe shall empty into a non-flooding area. Include separate inlet for intermittent treatment as is deemed necessary on basis of regular inspection/testing.
- C. Storage:
 - 1. Tank(s), sized as appropriate to water demands of facility. Above ground design. System design shall indicate load requirements for tank foundation. Tanks shall be accessible for routine maintenance.
 - a. Potable systems: **[Tank shall be fabricated from FDA-approved materials.] [Tank shall be state-approved as a vessel for potable water storage.]**

SPECIFIER NOTE:

For current designations under the Federal Biobased Products Preferred Procurement Program (FB4P), refer to www.biobased.oce.usda.gov. As of January 4, 2010, the Federal Register includes designations for approximately 60 product types. The requirements for purchasing biobased items apply to those items directly purchased by the federal agency. Under a construction contract, the contractor's use of hydraulic fluid in its bulldozers and backhoes is incidental to the purpose of its contract, so the contractor is not required to use biobased hydraulic fluids. The Office of the Federal Environmental Executive (OFEE) recommends that agencies encourage the use of these items, however.

Currently designated items that affect construction include:

- Roof Coatings

- Water Tank Coatings
- Adhesive and Mastic Removers
- Composite Panels
- Fertilizers
- Plastic Insulating Foam
- Carpet and Upholstery Cleaners
- Carpets
- Dust Suppressants
- Packaging Films
- Glass Cleaners
- Hydraulic Fluids – Stationary Equipment
- Wood and Concrete Sealers
- Cleaners

The USDA currently has identified about 150 items for which it is collecting test data needed for the additional designations of items that will extend preferred procurement status to include all qualifying biobased products.

- b. Biobased content:
 - 1) Water Tank Coatings: Coatings formulated for use in potable water storage systems. Provide minimum 59% biobased content.
- 2. Cisterns. Below ground design; accessible for cleaning and maintenance. Provide screens for all openings.
- 3. Ponds. Provide soil liner or synthetic liner.

SPECIFIER NOTE:

Soils that contain more than 15% clay are generally suitable.

Bentonite, as well as other clays, provide adsorption/ reaction sites and contribute alkalinity.

- a. Where on-site soils or clay provide an adequate seal, compaction of these materials may be sufficient to line the pond.
 - 1) On-site soils may be used if they can be compacted to permeability of <108 ft/sec (<10⁻⁶ cm/sec).
 - b. Synthetic liners: Asphalt liners are not permitted. Synthetic liners may be fabricated from synthetic butyl rubber or 0.5 to 10.0 mil high density polyethylene.
 - 1) If the site soils contain angular stones, place sand bedding or geotextile cushions under the liner to prevent punctures.
 - 2) Cover the liner with 3 - 4 inches of soil to prevent the roots of the vegetation from penetrating the liner.
- D. Water Treatment:
- 1. Filtration. Include automatic catchment tank/pump system to prefilter water prior to entry to storage tank. Carbon is not permitted.
 - 2. Disinfection: Provide disinfection acceptable to agencies having jurisdiction. Provide disinfection necessary to attain **[Advanced Secondary Wastewater] [Advanced Tertiary Wastewater] [Potable Water]** quality.
 - [a. Chlorine: Where acceptable to agencies having jurisdiction, prohibit use of chlorine treatment. Verify acceptability of iodine.]**
 - [b. Potable system shall include automatic ozonation treatment.]**
- E. Accessories:
- 1. Joint Sealants: Non-toxic and as specified in Division 07 (7).
 - 2. Fasteners: non-corrosive and compatible with materials being fastened.
- F. Lead components are not permitted.

2.2 FABRICATION

- A. Design prefabricated components and necessary field connections required for installation to permit easy assembly, repair and maintenance, and disassembly.
- B. Design and construct to comply with applicable regulatory requirements.
 - 1. Potable system(s): Provide piping and accessories necessary to operate as a potable water system capable of utilizing municipal water as a supplementary source.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which system will be installed, with Designer/Installer present, for compliance with requirements.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, approved shop drawings, and applicable regulatory requirements.

3.3 FIELD QUALITY CONTROL

- A. General: Comply with requirements of agencies having jurisdiction and as specified herein.
- B. System Inspection: System Designer/Installer shall inspect system installation and submit reports to Architect. Notify **[Architect] [Owner]** 48 hours in advance of the date and time of inspection.
 - 1. Provide site inspection of system **[at Substantial Completion] [two weeks prior to Occupancy]**.
 - 2. Provide site inspection of system immediately after storm event that may be severe enough to affect the system; provide inspection services for minimum **[12] [xxxx]** months after Final Completion.
 - 3. Provide site inspection of system seasonally, and not less than once every three months; provide inspection services for minimum **[12] [xxxx]** months after Final Completion.

SPECIFIER NOTE:

ASTM D4840 specifies chain of custody documentation for laboratory samples.
ASTM D3864 provides guidance for the selection, establishment, application, and validation and verification of monitoring systems for determining water characteristics by continual sampling, automatic analysis, and recording or otherwise signaling of output data. If on-line monitoring equipment is utilized for water testing, reference ASTM D3864.

- C. Water Quality tests: Comply with requirements of agencies having jurisdiction and as specified herein. Comply with ASTM D4840 for chain of custody of water samples. **[Provide on-line monitoring consistent with ASTM D3864.]**
 - 1. Provide data on the following immediately after plants are established and **[weekly] [monthly] [xxxx]** thereafter for minimum **[6] [12] [xxxx]** months:
 - a. Biochemical oxygen demand (BOD₅).
 - b. Total Suspended Solids (TSS).

- c. Fecal coliform.
- d. **[xxxx]**.
- 2. Establish baseline water quality for rainwater harvesting systems for both influent and effluent.
- 3. Provide comparison of test results with municipal water quality, and maintenance of system.
- 4. Water testing shall be performed by a laboratory in compliance with agencies having jurisdiction.

END OF SECTION