Guidance for Determining Equalization Water Storage for Public Water Systems

Idaho Department of Environmental Quality
Drinking Water Program
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Table of Contents

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Summary

Idaho Department of Environmental Quality (DEQ) guidance does not have the force of law or regulation, nor does it replace best professional judgment; it provides a starting point and assistance in the design of drinking water facilities.

This guidance provides additional direction for determining sufficient equalization storage, as defined in the *Components of Finished Water Storage* presented in section 003 of the *Idaho Rules for Public Drinking Water Systems* (IDAPA 58.01.08 2012):

> **16. Components of Finished Water Storage**. Storage is available to serve the system if the storage structure or facility is elevated sufficiently or is equipped with sufficient booster pumping capability to pressurize the system. Components of finished water storage are further defined as:
>
> a. Dead Storage. Storage that is either not available for use in the system or can provide only substandard flows and pressures.
>
> b. Effective Storage. Effective storage is all storage other than dead storage and is made up of the additive components described in Paragraphs c. through f. of this Subsection.
>
> c. Operational Storage. Operational storage supplies water when, under normal conditions, the sources are off. This component is the larger of;
>
> i. The volume required to prevent excess pump cycling and ensure that the following volume components are full and ready for use when needed; or
>
> ii. The volume needed to compensate for the sensitivity of the water level sensors.
>
> **d. Equalization Storage**. Storage of finished water in sufficient quantity to compensate for the difference between a water system's maximum pumping capacity and peak hour demand.
>
> e. Fire Suppression Storage. The water needed to support fire flow in those systems that provide it.
>
> f. Standby Storage. Standby storage provides a measure of reliability or safety factor should sources fail or when unusual conditions impose higher than anticipated demands. Normally used for emergency operation, if standby power is not provided, to provide water for eight (8) hours of operation at average day demand.

The methods for estimating equalization storage presented in this guidance are not the only methods acceptable. Other methods, such as using a computer model, are equally acceptable provided they are based upon sound engineering analysis.

Authority

The Idaho Legislature has given the Idaho Board of Environmental Quality the authority to promulgate rules governing quality and safety of drinking water, pursuant to Title 37, Chapter 21 and Title 39, Chapter 1, Idaho Code. The Idaho Department of Environmental Quality (DEQ) promulgated IDAPA 58.01.08 for the purpose of controlling and regulating the design, construction, operation, maintenance, and quality control of public drinking water systems, to provide a degree of assurance that such systems are protected from contamination and maintained free from contaminants that may injure the health of the consumer.

Recommended Methods for Estimating Equalization Storage

When analysis of equalization storage using a computer model is not feasible, the following methods of estimating minimum equalization storage volume could be considered acceptable:

- The first method assumes a constant rate of pumping to provide inflow to the reservoir and outflow based upon a typical diurnal demand curve.
- The second method assumes pumping follows demand, typical of a system using variable frequency drive (VFD) pumps.

Recommended Equalization Storage Volume for Constant Rate Inflow

When the inflow to the system is constant, outflow can be based on Maximum Day Demand (Qmxdy) and distributed according a typical diurnal curve presented in *Design Standards for Public Water Supplies* (WSDSHS 1973). To estimate equalization volume, divide the source capacity of the system (Qs, gallons per day, GPD) by Qmxdy (GPD) and use the ratio in Table 1 to select the appropriate equalization storage (Es) in gallons.

Table 1. Reservoir Capacity as a Function of Source Capacity/Qmxdy

Qs/Qmxdy	Equalization (Es) (gallons)
1.00	(5.4) x Qmxdy/24
1.05	(4.7) x Qmxdy/24
1.10	(4.0) x Qmxdy/24
1.15	(3.3) x Qmxdy/24
1.20	(2.6) x Qmxdy/24
1.25	(2.0) x Qmxdy/24
1.30	(1.5) x Qmxdy/24
1.35	(1.2) x Qmxdy/24
1.40	(1.0) x Qmxdy/24
1.45	(0.8) x Qmxdy/24
1.50	(0.6) x Qmxdy/24
1.55	(0.4) x Qmxdy/24
1.60	(0.3) x Qmxdy/24
1.65	(0.1) x Qmxdy/24
1.70	(0.1) x Qmxdy/24
1.75	(0.0) x Qmxdy/24

Example A

System A has a source capacity of 500 gpm (720,000 GPD) and a Qmxdy of 500 gpm (720,000 GPD)

Qs/Qmxdy = 1.0

Es = (5.4)(720,000)/24 = 162,000 gallons

Example B

System B has a source capacity of 200 gpm (288,000 GPD) and a Qmxdy of 167 gpm (240,480 GPD)

Qs/Qmxdy = 288,000/240,480 = 1.2

Es = (2.6)(240,480)/24 = 26,052 gallons

Recommended Equalization Storage Volume for Pumping With Demand

For systems in which pumping matches demand, *Water System Design Manual* (WSDOH 2009) suggests calculating Es based on peak hour demand (Qpkhr in GPM, note shift in units from Table 1) and Qs (GPM, note shift in units from Table 1) as shown in Equation 1.

Es = (Qpkhr – Qs)(150 minutes) **Equation 1**

Example A

System A has a source capacity of 500 gpm and a Qpkhr of 1,000 gpm

Es = (1,000 – 500)(150) = 75,000 gallons

Example B

System B has a source capacity of 200 gpm and a Qpkhr of 334 gpm

Es = (334-200)(150) = 20,100 gallons

Design Assumptions and Use

This guidance provides simplified methods for estimating equalization storage in a single pressure zone system. Fire flow, landscape irrigation and other components of storage should be calculated separately and then added to the equalization storage to determine total storage needed. These recommended equalization storage volume estimation methods may not be suitable for very small public water systems such as campgrounds that have storage tanks. Ultimately, the method used to estimate equalization storage needs to be chosen by the project engineer; the methods offered by the guidance simply serve as acceptable starting points when more sophisticated means of analysis are not feasible.

References

IDAPA 58.01.08. 2013. *Idaho Rules for Public Drinking Water Systems*. Accessed 3/21/2013 at http://adminrules.idaho.gov/rules/current/58/0108.pdf.

WSDSHS (Washington State Department of Social and Health Services). 1973. *Design Standards for Public Water Supplies*. Olympia, WA.

WSDOH (Washington State Department of Health). 2009. *Water System Design Manual*. Accessed 3/21/2013 at http://www.doh.wa.gov/Portals/1/Documents/Pubs/331-123.pdf.