



This document will guide CDOT staff including Design Engineers, Project Engineers, Hydraulic Engineers, and Environmental and Maintenance staff in evaluating the full life cycle cost of permanent water quality control measures (PWQ CMs) that may be used on a site. When considering which types of PWQ CMs may be used, cost is often considered, but it is frequently only the cost of construction that is considered. The full cost of each PWQ CM, including the expected life span of the CM and the replacement cost, is seldom considered. This document is intended only to serve as a qualitative guide to evaluating the full life cycle cost of a PWQ CM until specific cost data is available from CDOT for the contributing cost factors. Once that data is available, this document may be modified. While the goal of this document is to help CDOT choose the PWQ CM with the lowest life cycle cost, every PWQ CM must meet its water quality treatment objectives.

Life cycle costs refers to all costs that occur over the economic life of a project. These costs include design and permitting, construction, land acquisition, operation and maintenance, and major rehabilitation or replacement costs. How these costs are distributed can be skewed, with PWQ CMs that are less expensive to design and construct often having greater long-term costs, and vice versa. While each of these costs may be the responsibility of different groups within CDOT, ultimately all these costs are typically borne by CDOT. Full life cycle cost estimating provides a better way to determine the true expected cost of a PWQ CM.

There are several guidance documents available from other regulatory agencies that discuss life cycle costs of PWQ CMs. This document includes information gathered from the National Cooperative Highway Research Program's (NCHRP) Report 792, *The Long-Term Performance and Life-Cycle Cost of Stormwater Best Management Practices* and from Urban Drainage and Flood Control District's (UDFCD) *Urban Storm Drainage Criteria Manual* (USDCM), Volume 3. Each of these references can be consulted and used to develop more detailed full life cycle cost estimates.

The NCHRP has a Life-Cycle Cost Estimation spreadsheet tool that includes operation and maintenance costs, required equipment, optional design parameters, and expected service life by PWQ CM type. It also includes expected pollutant removal capabilities. The NCHRP's spreadsheet tool can be downloaded as part of the NCHRP Report 792, found at <http://www.trb.org/Publications/Blurbs/171471.aspx> and clicking on the hyperlink that reads "Download the .ISO CD-ROM Image" or via an internet search for NCHRP Report 792. There is a spreadsheet for each type of PWQ CM that reports full life cycle costs in terms of net present value, which is an effective method for comparing alternatives.

The UDFCD has a spreadsheet tool called BMP-REALCOST that provides planning-level full life cycle cost evaluations. It can be found at <https://udfcd.org/software> by using a link at the bottom of the page for "BMP Life Cycle Cost Analysis Tool - BMP-REALCOST" or via an internet search for UDFCD BMP-REALCOST. A narrative that includes an overview of the general concepts used by the spreadsheet is included in Volume 3 of the USDCM. Like the NCHRP tool, the UDFCD tool includes a spreadsheet for each type of PWQ CM and reports full life cycle costs in terms of net present value.

Regardless of whether the NCHRP methodology, the UDFCD methodology, or some other methodology is used, every project site that is required to construct PWQ CMs should evaluate the full life cycle costs of all alternatives. If one of the spreadsheet tools is not used, following must be accounted for at a minimum:





Design and Construction

Design and construction costs for each PWQ CM alternative should be evaluated. At the time of the PWQ CM alternatives analysis, the design budget may already be established. In this case, construction costs should be evaluated including estimates of major costs including, but not limited to, excavation with haul offsite; manufacture, delivery, and installation costs of proprietary measures; specific filter materials required; and large cast-in-place or precast concrete structures.

Land

The cost of purchasing required property and/or right-of-way for a PWQ CM can be estimated with input from the CDOT Right-of-Way Section.

Maintenance

Maintenance costs must include estimates for required maintenance and maintenance frequency, including man hours, equipment hours, debris disposal or reuse, and the frequency of items to be replaced such as filter material and proprietary CM elements such as filter cartridges.

Major Rehabilitation or Replacement

PWQ CMs, just like all construction, have a design life and will eventually need to be replaced or require major rehabilitation. The design life and costs associated with replacement must be accounted for in the full life cycle costs.

An evaluation of full life cycle costs of at least two alternative PWQ CMs for each CM site should be included in the drainage report submitted as part of the overall project.

