RSET CLARIFICATION PAPER 12-01 – Grain Size Analysis for Dredged Material Physical Characterization under the 2009 *Sediment Evaluation Framework for the Pacific Northwest* (SEF)

This clarification paper prescribes the use of the Udden-Wentworth grain size classification system under the SEF guidance.

ISSUE: Some SEF users are unclear about differentiation between the three major grain size divisions: 1) fines (silts and clay), 2) sands, and 3) gravels and coarser material. The particle size break between fine-grained material and sands (and coarser materials) is defined in the SEF as those materials retained in an ASTM No. 230 sieve. However, the preferred grain size classification system for dredged material characterization is not referenced. Confusion is possible because three different particle size classification systems are used in the United States, and each system has specific applications.

CLARIFICATION:

1. Under the SEF, the Udden-Wentworth grain size distribution scale is used for particle size analysis of dredged material.

2. The 2009 *Sediment Evaluation Framework for the Pacific Northwest* (SEF) identifies two testing methods for grain size distribution analysis for the purposes of dredged material characterization:
   - The 1986 Puget Sound Estuary Program method
   - ASTM test method D-422 (mod)

3. For the purposes of SEF particle size analysis, the break between fines (silts and clay) and very fine sand is 63 µm (ASTM no. 230 sieve), and the break between very coarse sand and gravels (and coarser material) is 2 mm (ASTM no. 10 sieve).

BACKGROUND AND DISCUSSION:

1. There are three major grain size classifications systems in use in the United States:
   - The Udden-Wentworth scale, after Udden (1914) and Wentworth (1922) [adapted by Krumbein and Sloss (1963) in the phi (φ) scale]: Fines are differentiated from sands at 63 µm (ASTM no. 230 sieve); sands are differentiated from gravels and coarser materials at 2 mm (ASTM no. 10 sieve). The Udden-Wentworth scale is primarily used by geologists for the purposes of grading consolidated and unconsolidated materials. Regionally and nationally, the aggregate mining and dredging industries use these scales to characterize particle size distribution for mined/dredged materials. Use of the Udden-Wentworth scale in the SEF is implicit through references to the use of the 63 µm-mesh (ASTM no. 230) sieve for grain size analysis.
   - The Unified Soil Classification System (USCS): Fines are differentiated from sands at 75 µm (ASTM no. 200 sieve); sands are differentiated from gravels and coarser materials at 4.75 mm (ASTM no. 4 sieve). The USCS is typically used by geotechnical engineers to assess building site substrate properties (e.g., texture, plasticity, and compressibility).
   - The US Department of Agriculture (USDA) Soil Classification System: Fines are differentiated from sands at 50 µm (ASTM no. 270 sieve [opening actually 53 µm]); sands are differentiated from gravels and coarser materials at 2 mm (ASTM no. 10 sieve). The USDA Soil Classification System is used by the USDA Natural Resources Conservation Service for soil textural analysis used in soil mapping and soil taxonomic classification. The USDA system is also used by the US Army Corps of Engineers (USACE) Regulatory and Civil Works programs in wetland delineations.

2. The differentiation (dividing line) between fine-grained materials; and sands and other coarser materials, is particularly relevant for dredged material evaluations. In the sections of the Code of Federal Regulations (CFR) governing testing of dredged materials, chemical testing may not be necessary if the following conditions are met:

- Dredged material is composed predominantly of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and
- Dredged material is found in areas of high current or wave energy, and
- The dredged material is far removed from known existing and historical sources of pollution so as to provide reasonable assurance that such material has not been contaminated by such pollution. [*from:* Clean Water Act (CWA) regulations, 40 CFR §230.60(a); Marine Protection, Research and Sanctuaries Act (MPRSA) regulations, 40 CFR §227.13(b)1&2]

3. Consistent with CWA and MPRSA regulations, under the SEF, chemical testing is typically not required in projects with the following characteristics:

- Dredged material is found in highly active or erosional (i.e., energetic) systems, and
- The dredge area is removed from potential sources of contamination, and
- Dredged material consists of coarse-grained sediment with at least 80 percent sand or coarser material (≥ 63 μm No. 230 sieve), and
- Dredged material has a total organic carbon content of less than 0.5 percent [*from:* Table 4-2,USACE et al, 2009].

REFERENCES:

Clean Water Act, 40 CFR §230.60(a)

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