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Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States

Katherine E. Curtis and Robert W. Lichvar

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Cover: Moenkopi Wash at Moenkopi, Arizona, September 2009. This is an example of an ephemeral stream channel.

Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States

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Abstract: The Ordinary High Water Mark (OHWM) is a method used to identify the lateral limits of non-wetland waters. Lichvar and McColley (2008) developed an OHW delineation manual for ephemeral and intermittent streams in the Arid West. Their approach identified key hydrologic, geomorphic, and vegetation indicators useful in OHW delineation. This technical note provides an updated datasheet to the manual. The datasheet has been simplified but still includes the overall field signatures and preliminary methods used to determine the OHWM. The datasheet now focuses on identifying the characteristics of each individual hydrogeomorphic floodplain unit and uses the differences between the floodplain units to identify the OHWM.

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Preface

The work was performed by Katherine E. Curtis and Robert W. Lichvar, both of the Remote Sensing/Geographic Information Systems (RS/GIS) and Water Resources Branch, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory (ERDC-CRREL). Support and funding for this report was provided by Headquarters, U.S. Army Corps of Engineers (HQ USACE), through the Wetland Regulatory Assistance Program (WRAP). Technical support was provided by Lindsey Dixon of the RS/GIS and Water Resources Branch. At the time of publication, Timothy Pangburn was Chief, RS/GIS and Water Resources Branch. The Deputy Director of ERDC-CRREL was Dr. Lance Hansen and the Director was Dr. Robert Davis.

COL Gary E. Johnston was the Commander and Executive Director of ERDC, and Dr. Jeffery Holland was the Director.

1 Background

1.1 Summary of the OHWM manual

The Ordinary High Water Mark (OHWM) is a method for determining the lateral limits of non-wetland waters. Non-wetland waters are regulated under "Waters of the United States" (WoUS) in Section 404 of the Clean Water Act (33 U.S.C. 1344) and are defined by a line on the shore established by fluctuations of water. This OHW line is indicated by shelving, changes in sediment texture, and changes in vegetation. Effective discharge events that are capable of moving the greatest proportion of sediment over time establish the OHWM. In the Arid West region, these ordinary high flows are low- to moderate-discharge events (Lichvar et al. 2006). Identifying the lateral extent of this boundary on the landscape in Arid West ephemeral and intermittent streams is often challenging because the storm systems are flashy and the channel morphology shifts frequently. The OHWM manual was developed to address these complications by creating a reliable and repeatable methodology for identifying the lateral extent of the OHWM in ephemeral and intermittent streams in the Arid West.

The OHWM manual (Lichvar and McColley 2008) incorporates years of fieldwork collecting data and modeling flows in ephemeral and intermittent channels to develop a methodology for identifying the OHWM. This methodology uses hydrology, vegetation, and geomorphology indicators to identify the boundary between the active floodplain and the low terrace. (For a complete description of the indicators and their positions within the channel, see Section 2, pages 20–28 of the OHWM manual.) Because each indicator is distributed randomly within the channel and is not associated with any specific event levels, an individual indicator cannot be used to delineate the OHWM. However, understanding the positions of all indicators in relation to each other and a hydrogeomorphic surface provides critical insight into identifying the OHWM.

The three distinctive hydrogeomorphic surfaces in many ephemeral and intermittent channels are the low-flow channel, the active floodplain, and the low terrace (Figure 1). The distinguishing feature of the low-flow channel is the frequent absence of vegetation cover. Common indicators signifying a recent discharge, such as ripples or mudcracks, may also be present on the streambed. During low-discharge events in many streams, the low-flow channel often fills with sediment and migrates within the active floodplain, incising a new low-flow channel. Conversely, the extent of the active floodplain is a consistent and reliable feature within the channel. It is formed by the geomorphically effective discharge—a low- to moderate-discharge event in the Arid West—and is frequently identified by a break in slope indicating the outer extent of ordinary high discharges. Depending on the time that has passed since the last ordinary high event, the active floodplain often has early to mid-community successional stage vegetation. The sediment texture is generally coarser grained than that in the surrounding floodplain units. The low terrace is inundated less frequently than the active channel. It is characterized by well-established, late-stage vegetation, and the surface may show indications of desert pavement or surface relief.

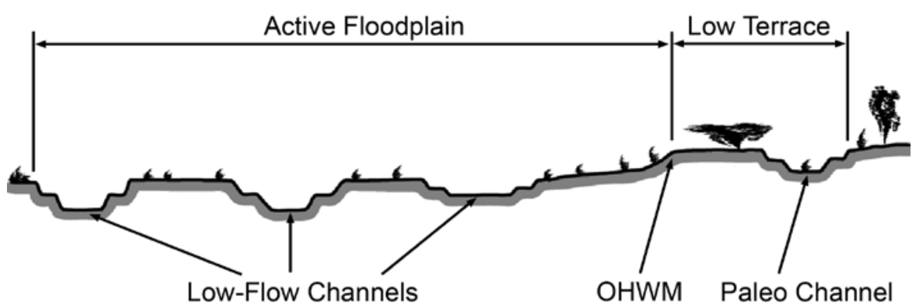

Figure 1. Example of a representative cross section identifying the hydrogeomorphic floodplain units in intermittent and ephemeral channels.

It is the consistent position of the boundary between the active floodplain and low terrace that is important to regulators. The low-flow channel, which migrates frequently and may be dry most of the time, is too undefined to be consistently delineated. However, characterizing each of these floodplain units helps develop an understanding of the channel dynamics that is crucial to identifying the OHWM.

1.2 Purpose

This technical note is designed to supplement the OHWM delineation manual for ephemeral and intermittent streams in the Arid West by providing a refined datasheet with a clearer and more concise procedure for identifying the OHWM. The procedure outlined on the original datasheet entailed significant time walking around the site and recording specific observations of the hydrogeomorphic surfaces, the boundaries between floodplain units, and the similarities or differences of the surrounding hydrogeomorphic units. Recording these entities separately can lead to confusion about the overall channel morphology, as the focus is on characterizing individual parts of a floodplain unit rather than viewing the floodplain unit as a complete hydrogeomorphic surface. Focusing on the components rather than the whole signature can make it more challenging to identify consistent trends within floodplain units and to recognize the key features that characterize the OHWM between the active floodplain and the low terrace.

This revised datasheet combines and simplifies many of the elements of the original version. It emphasizes identifying the dominant characteristics for each hydrogeomorphic floodplain unit and using these characteristics to develop a comprehensive image of the channel and to identify the OHWM. Combining steps for identifying each hydrogeomorphic surface from the original procedure and looking at the floodplain units on a broad scale makes it clearer to see the differences between the hydrogeomorphic surfaces and to identify their boundaries.

2 Identification Method

The general themes in the OHWM manual for identifying the boundary between the active floodplain and the low terrace in alluvial ephemeral and intermittent streams are still included in this update. However, the datasheets are now more focused on succinctly describing the characteristics that represent a particular hydrogeomorphic floodplain unit. The primary change in the updated datasheet is that several steps for identifying features of the individual floodplain units have been combined into one step. In this method, a representative cross section is chosen, and points on each hydrogeomorphic surface that reflect the characteristics of each unit will be used. The observations of the surrounding floodplain unit are recorded at these reference positions. For large study areas where channel morphology may change, numerous cross sections are required to adequately describe the OHWM.

2.1 Preliminary delineation

The procedure for completing a preliminary delineation is described in the OHWM manual in Section 3, pages 35–43, and includes instructions for analyzing aerial photography, topographic maps, geologic maps, vegetation maps, soils maps, rainfall/precipitation maps, and stream gage data. Prior to the site visit, users should ideally gather and interpret these resources, as well as existing delineation(s) for the site, global positioning system (GPS) data, and any additional studies. These resources will be very briefly summarized here, but users should refer to the manual for a complete description.

Aerial photographs can provide the most beneficial preliminary insight into OHWM delineation. Hydrogeomorphic surfaces may be interpreted from the photographs by observing changes in vegetation characteristics and changes in pixel color within the channel that may represent different sediment textures. Topographic maps assist in understanding the local topography and any possible anthropogenic influences around the site; geologic maps assist in understanding the alluvial sediments available for transport in flows; vegetation maps provide insight into plant communities; and soils maps provide information on the distribution of soil types. Additionally, vegetation and soils maps can be useful in understanding bank stability and sediment storage along a channel.

Understanding the recent flow regime is critical to OHWM delineation. The timing for low to moderate ordinary high events can be determined from rainfall maps that show recent precipitation patterns and stream gage data. Stream gage data are also directly related to the volume of water that may be responsible for creating the OHWM signature. If a large flood event has occurred in the past few years, it is likely the channel has not recovered from this event and there will not be a well-established OHWM. Similarly, if all flows in the past decade have been low-discharge events, it is possible that the vegetation in the active channel has become as well established as that on the low terrace, so identifying the OHWM is more challenging. Understanding the flow conditions prior to a visit makes it possible to picture how discharges of different magnitudes affect the channel morphology. The manual provides a detailed step-by-step procedure for using the software package HEC-SSP to perform an annual peak flood frequency analysis (FFA), accessing U.S. Geological Survey (USGS) gage data, and relating discharge to stage (Section 3.2, pages 43–49).

2.2 Field verification

Appendix A contains an updated datasheet that is designed to replace the original datasheet in the manual. It includes a checklist of available resources for the preliminary delineation and a procedure for how to verify the position of the OHWM in the field. This datasheet is more succinct than originally published and focuses on emphasizing the characteristics and key indicators of the floodplain unit.

1. Walk the channel and floodplain within the study area to develop a general understanding of the overall site characteristics. Note any anthropogenic influences on the channel system and record a brief description of the site. Develop a general understanding of the geomorphology and vegetation at the site and observe their differences across the hydrogeomorphic floodplain units.
2. Within the area of interest, select a cross section of the channel perpendicular to flow that reflects the overall characteristics of the site (Figure 2). Sketch the cross section and label the hydrogeomorphic floodplain units.

Figure 2. Step 2 of the field verification process: aerial view of a selected cross section (red line).

3. Walk to one of the hydrogeomorphic floodplain units on the cross section.

   a. On the datasheet, record the floodplain unit and the GPS point of your position.

   b. Describe the characteristics of the floodplain unit. The average sediment texture size is the dominant particle size of the floodplain unit and is described by Wentworth size classes. A table describing the Wentworth size classes and a scale for reference are included on the datasheet. Describe the vegetation at the site. Record the percent vegetation coverage by strata and approximate the stand age (early successional to mature) based on general size, growth form, and height or thickness of stems or trunks.

   c. Identify any indicators present at the site. A complete description of indicators may be found in Section 2, pages 20–28, in the OHWM manual. Confirm that most of the indicators identified are associated with the floodplain unit selected. If not, walk the channel again and reassess the position of the floodplain unit identified. Note any additional site characteristics or defining features in the Comments section.

4. Walk to the next hydrogeomorphic floodplain unit along the cross section. Repeat Step 3, recording the GPS position, average sediment

texture, vegetation characteristics, and indicators of this floodplain unit.

5. Once the hydrogeomorphic floodplain characteristics are identified, find the OHWM boundary. This transition line between the active floodplain and the low terrace is often characterized by changes in vegetation and changes in sediment texture between the two floodplain units. A change in slope or the presence or absence of indicators as described in the OHWM manual (pages 20–28) may also assist in identifying this boundary. Record the characteristics of the boundary on the datasheet. Record the location of the OHWM boundary with a GPS. If the resources are available, map the boundary on an aerial photograph and digitize the boundary on a computer.
6. For large areas, repeat Steps 2-5 to adequately characterize the hydrogeomorphic floodplain surfaces and the OHW signature.

If the site is located at a stream gage, gage data may assist in confirming the boundary of the OHWM. The procedure for using gage data, described on pages 56–60 in the manual, involves aligning a clinometer with the stage height of the most recent discharge and projecting the height onto the landscape within 50 yards upstream from the gage. However, a current study suggests using caution when determining the OHWM from gage data (Curtis and Lichvar, in prep). Preliminary results indicate that it is necessary to shoot the clinometer directly across the stream perpendicular to flow from the gage. The channel slope alters the relationship between stage and discharge upstream from the gage and can provide results that may be misleading for determining the OHWM boundary. Although gage data can be helpful in identifying the boundary, it should not be relied on exclusively. The field signature is the strongest, most reliable method for OHWM delineation.

References

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Lichvar, R. W., D. Finnegan, M. Ericsson, and W. Ochs. 2006. *Distribution of Ordinary High Water Mark (OHWM) indicators and their reliability in identifying the limits of "Waters of the United States" in arid southwestern channels.* ERDC/CRREL TR-06-5. Hanover, NH: U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory. (http://www.crrel.usace.army.mil/techpub/CRREL_Reports/reports/TR06-5.pdf).

Lichvar, R. W., and S. M. McColley. 2008. *A field guide to the identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the western United States.* ERDC/CRREL TR-08-12. Hanover, NH: U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory. (http://www.crrel.usace.army.mil/library/technicalreports/ERDC-CRREL-TR-08-12.pdf).

Appendix A: Datasheet

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: | **Date:** | **Time:**
Project Number: | **Town:** | **State:**
Stream: | **Photo begin file#:** | **Photo end file#:**
Investigator(s):

Y ☐ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☐ Is the site significantly disturbed?

Location Details:

Projection: **Datum:**
Coordinates:

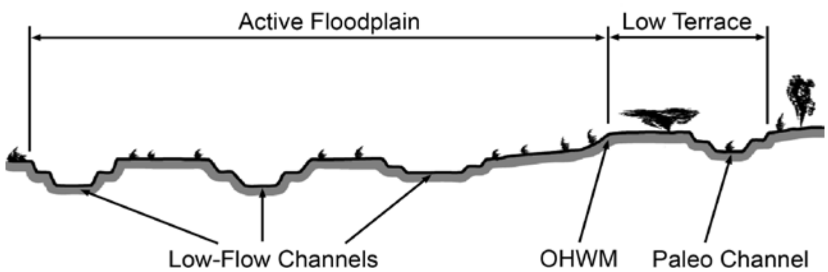
Potential anthropogenic influences on the channel system:

Brief site description:

Checklist of resources (if available):

- ☐ Aerial photography
  Dates:
- ☐ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☐ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event



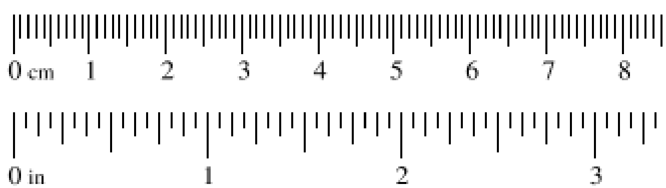
Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:

   ☐ Mapping on aerial photograph ☐ GPS
   ☐ Digitized on computer ☐ Other:

Wentworth Size Classes

Inches (in)		Millimeters (mm)	Wentworth size class	
			Boulder	Gravel
	10.08	256		
			Cobble	
	2.56	64		
			Pebble	
	0.157	4		
			Granule	
	0.079	2.00		
			Very coarse sand	Sand
	0.039	1.00		
			Coarse sand	
	0.020	0.50		
			Medium sand	
1/2	0.0098	0.25		
			Fine sand	
1/4	0.005	0.125		
			Very fine sand	
1/8	0.0025	0.0625		
			Coarse silt	Silt
1/16	0.0012	0.031		
			Medium silt	
1/32	0.00061	0.0156		
			Fine silt	
1/64	0.00031	0.0078		
			Very fine silt	
1/128	0.00015	0.0039		
			Clay	Mud



Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:

OHWM

GPS point: ____________________________

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☐ Other: ____________________
- ☐ Other: ____________________

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: ____________________________

Characteristics of the floodplain unit:

Average sediment texture: ___________________

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: ____________________
- ☐ Other: ____________________
- ☐ Other: ____________________

Comments:

Project ID: **Cross section ID:** **Date:** **Time:**

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: ____________________________

Characteristics of the floodplain unit:

Average sediment texture: __________________

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

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- ☐ Surface relief
- ☐ Other: ____________________
- ☐ Other: ____________________
- ☐ Other: ____________________

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: ____________________________

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- ☐ Soil development
- ☐ Surface relief
- ☐ Other: ____________________
- ☐ Other: ____________________
- ☐ Other: ____________________

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14. ABSTRACT

The Ordinary High Water Mark (OHWM) is a method used to identify the lateral limits of non-wetland waters. Lichvar and McColley (2008) developed an OHWM delineation manual for ephemeral and intermittent streams in the Arid West. Their approach identified key hydrologic, geomorphic, and vegetation indicators useful in OHWM delineation. This technical note provides an updated datasheet to the manual. The datasheet has been simplified but still includes the overall field signatures and preliminary methods used to determine the OHWM. The datasheet now focuses on identifying the characteristics of each individual hydrogeomorphic floodplain unit and uses the differences between the floodplain units to identify the OHWM.

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