# VALDEZ GLACIER ICE-DAMMED LAKE: JUNE 2018 GLACIAL LAKE OUTBURST FLOOD

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**Preliminary Interpretive Report 2019-4**

Valdez Glacier ice-dammed lake. Photo by Gabriel Wolken.

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# VALDEZ GLACIER ICE-DAMMED LAKE: JUNE 2018 GLACIAL LAKE OUTBURST FLOOD

Katreen Wikstrom Jones[1] and Gabriel J. Wolken[1]

The report is one of a series to present brief technical analyses of data collected prior to and after the annually recurring glacial lake outburst floods (GLOFs) at Valdez Glacier. The goal is to describe this year's event and how it compares to previously observed events, with sufficient information for the City of Valdez to better understand the complex nature of these phenomena.

Ice-dammed lakes (IDLs) can form wherever glacier ice impedes the natural drainage of water. Such lakes are common in the mountainous, glacierized terrain of Alaska where complex ice fields, large outlet glaciers, and smaller tributary glaciers interact. Many of these lakes can drain catastrophically and threaten downstream communities and infrastructure. Such a drainage event is referred to as a glacial lake outburst flood (GLOF) and results from the rapid release of water from a glacial lake due to sudden failure of an ice- or moraine-dam, or water overtopping the dam as a result of displacement waves, (e.g., a mass wasting event from a nearby slope).

The Valdez Glacier ice-dammed lake is located northeast of Valdez, 7.2 km (4.5 mi) up-glacier from the current glacier terminus at an elevation of approximately 280 m (722 ft) above sea level (fig. 1). This ice-dammed lake forms adjacent to the eastern margin of the glacier and is the largest among many meltwater lakes that form seasonally along Valdez Glacier on an annual to bi-annual basis. The basin in which the lake forms was previously occupied by the unnamed tributary glacier that has retreated to the east, and the basin is repeatedly filled with water from glacier melt, snow, and rain runoff, and is blocked to the west by Valdez Glacier, which occupies the trunk valley (fig. 1).

The Valdez Glacier ice-dammed lake produces annual to bi-annual outburst floods of varying magnitude. Currently, one outburst event regularly occurs in June following spring snowmelt and a second outburst event can occur in September–October in association with heavy rain from fall storms.

The exact dynamics of each drainage and outburst event are currently unknown, but the triggering mechanism is likely related to increasing hydrostatic pressure as lake volume increases, and the interaction of englacial and subglacial processes, such as hydraulic jacking and the sudden expansion of drainage conduits in Valdez Glacier near the lake margin. Once the ice-dammed lake starts draining and water enters Valdez Glacier's subglacial and englacial network of conduits, it is efficiently transported down-glacier and exits Valdez Glacier at its mouth into the pro-glacial Valdez Glacier Lake. These sudden drainage events cause a rapid rise in water level, which commonly results in flooding of Valdez Glacier Stream (fig. 1).

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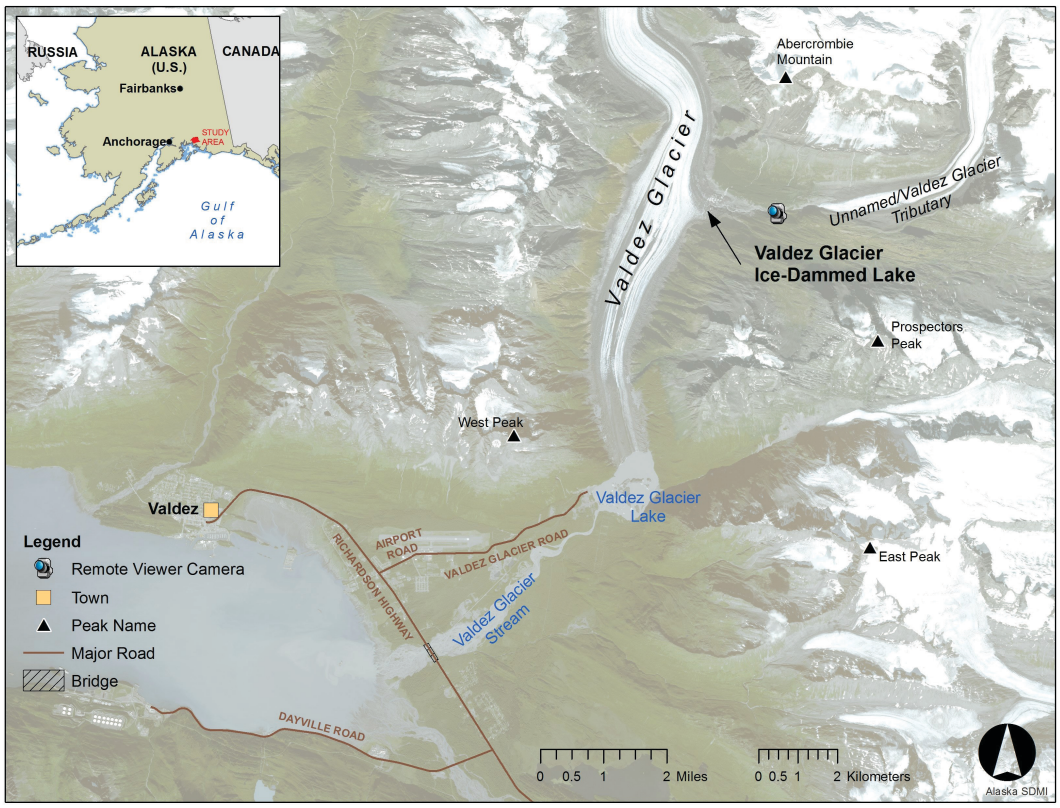


**Figure 1.** Location of Valdez Glacier ice-dammed lake (after Wolken and Wikstrom Jones, 2017).

The volume of the ice-dammed lake prior to each outburst event varies. We estimate volumes by identifying water level position with respect to reference markers on telemetered images from an automatic remote viewer camera (see location of remove viewer camera in fig. 1). To calculate lake volume, we define an elevation plane based on highest IDL level achieved prior to outburst and integrate the elevation values of each cell between that plane and the empty lake basin surface as defined by a recent (10/15/2014) photogrammetry-derived high-resolution digital surface model (DSM; Wikstrom Jones and Wolken, in press). This year we observed the highest IDL level on June 18 (fig. 2), and an empty IDL basin on June 19 following very rapid release of water during the evening hours (fig. 3).

Based on the highest lake level on 18 June 2018, we estimated a lake volume of 19,700,000 $m^3$ (approx. 25,800,000 cubic yards = 7,880 Olympic-size swimming pools), 9.4 percent larger than the 2017 IDL volume, but smaller than the 2015 pre-outburst lake volume estimated at 32,500,000 $m^3$ (approx. 42,500,000 cubic yards) (see fig. 4; Wolken and Wikstrom Jones, 2017). While IDL volumes were similar in 2017 and 2018, there was a marked difference in the draining and discharge rates. In 2017, the slow outburst lasted for almost four days with peak discharge rates of approximately 425 $m^3/s$ (15,000 $ft^3/s$) and maximum gage height of approximately 2.2 m (6.7 ft). In 2018, the IDL was completely emptied within 6–12 hours, with peak discharge rates of approximately 963 $m^3/s$ (34,000 $ft^3/s$; fig. 5) and a maximum Valdez Glacier Lake gage height of approximately 2.7 m (8.2 ft) (fig. 5). Flooding was reported along Valdez Glacier Stream, but no injuries were reported and infrastructure and property damage were minimal (figs. 6–7).


**Figure 2.** Water level of Valdez Glacier Ice-Dammed Lake before outburst, observed on 06/18/2018. Looking west toward Valdez Glacier.


**Figure 3.** Empty ice-dammed lake basin, observed on 06/19/2018. View west toward Valdez Glacier.

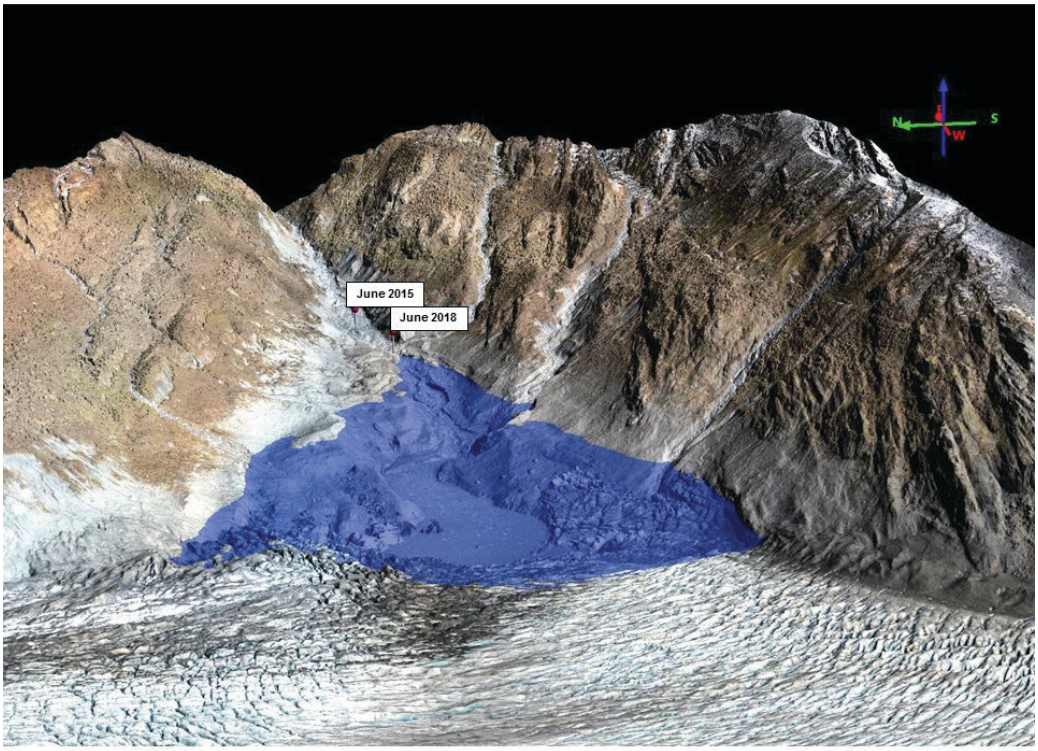


**Figure 4.** Blue polygon showing estimated lake volume on 06/18/2018 (before the outburst) and points showing estimated level of Valdez Glacier ice-dammed lake on 06/18/2018 and 06/15/2015, projected on orthoimage and DEM data acquired 10/15/2014. This perspective view is toward the east.

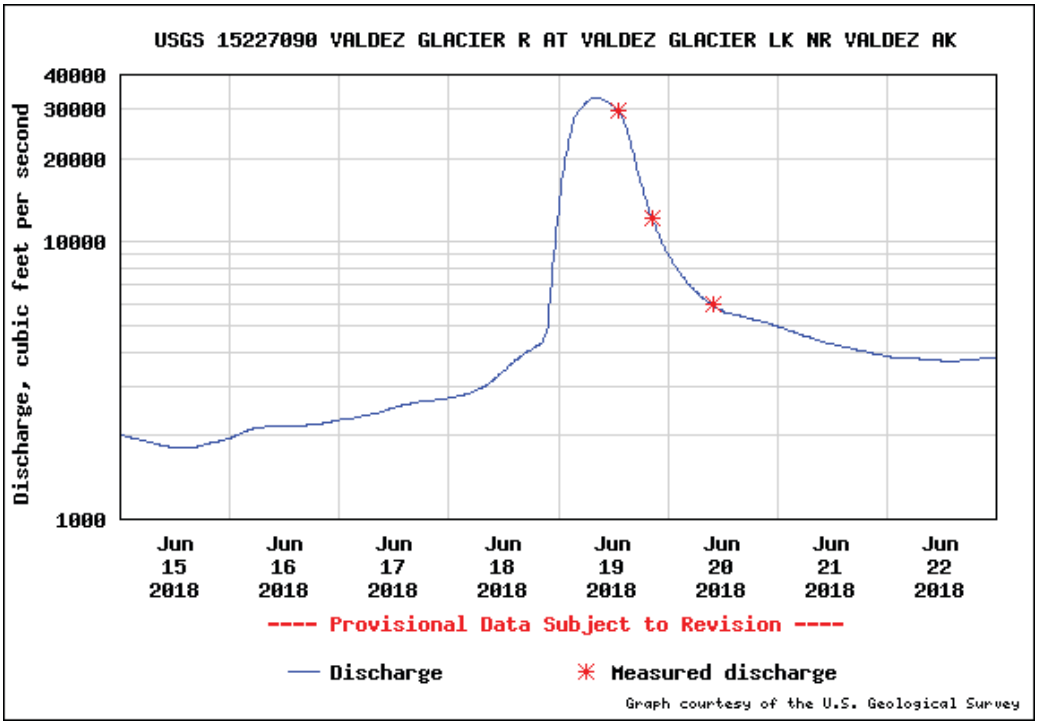


**Figure 5.** Discharge (cubic feet per second) of Valdez Glacier Stream, June 14–21, 2018 (USGS Water Resources, 2018).

**Figure 6.** Flooding near the Richardson Highway bridge at Valdez Glacier Stream. Arrow indicates the path of floodwaters from the river bank toward town (City of Valdez, written commun., June 2018).

**Figure 7.** Flooded area near 9th Street in Valdez (City of Valdez, written commun., June 2018).

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