



TIMBER USE, PROCESSING CAPACITY AND CAPABILITY BY DIAMETER SIZE CLASS IN THE BLACK HILLS NATIONAL FOREST TIMBER-PROCESSING AREA

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Introduction

Insect and disease outbreaks in the central Rocky Mountains and Black Hills region reached epidemic levels in the past two decades resulting in vast stands of dead trees across parts of Wyoming, Colorado and South Dakota. An estimated half a million acres have been impacted since the epidemic started in the Black Hills region (USFS BHNF 2017). Both the states and the U.S. Forest Service have increased investments in forest health, hazardous fuels mitigation and safety protection on private and public lands (Wyoming State Forestry Division 2017). These and other treatments designed to restore ecological condition and function and reduce fire hazard require the removal of a mix of timber valuable enough to offset some of the costs along with smaller trees with limited value and markets (Wagner et al. 2000). The loss of milling infrastructure throughout the West, combined with changing management objectives on federal lands, raise questions about the industry's ability to purchase timber of varying sizes and quality at a rate that is adequate for the forest and sustainable for the industry (Keegan et al. 2005; Keegan et al. 2006).

This report was prepared as a forest planning support document for the Black Hills National Forest to:

1. Examine the harvest of timber from the counties containing non-reserved timberland for the Black Hills National Forest;
2. Analyze the flow of and identify the location of mills receiving timber harvested from the above counties; and
3. Describe the kinds of mills, their capacity to process timber and their capability to use timber of various sizes.

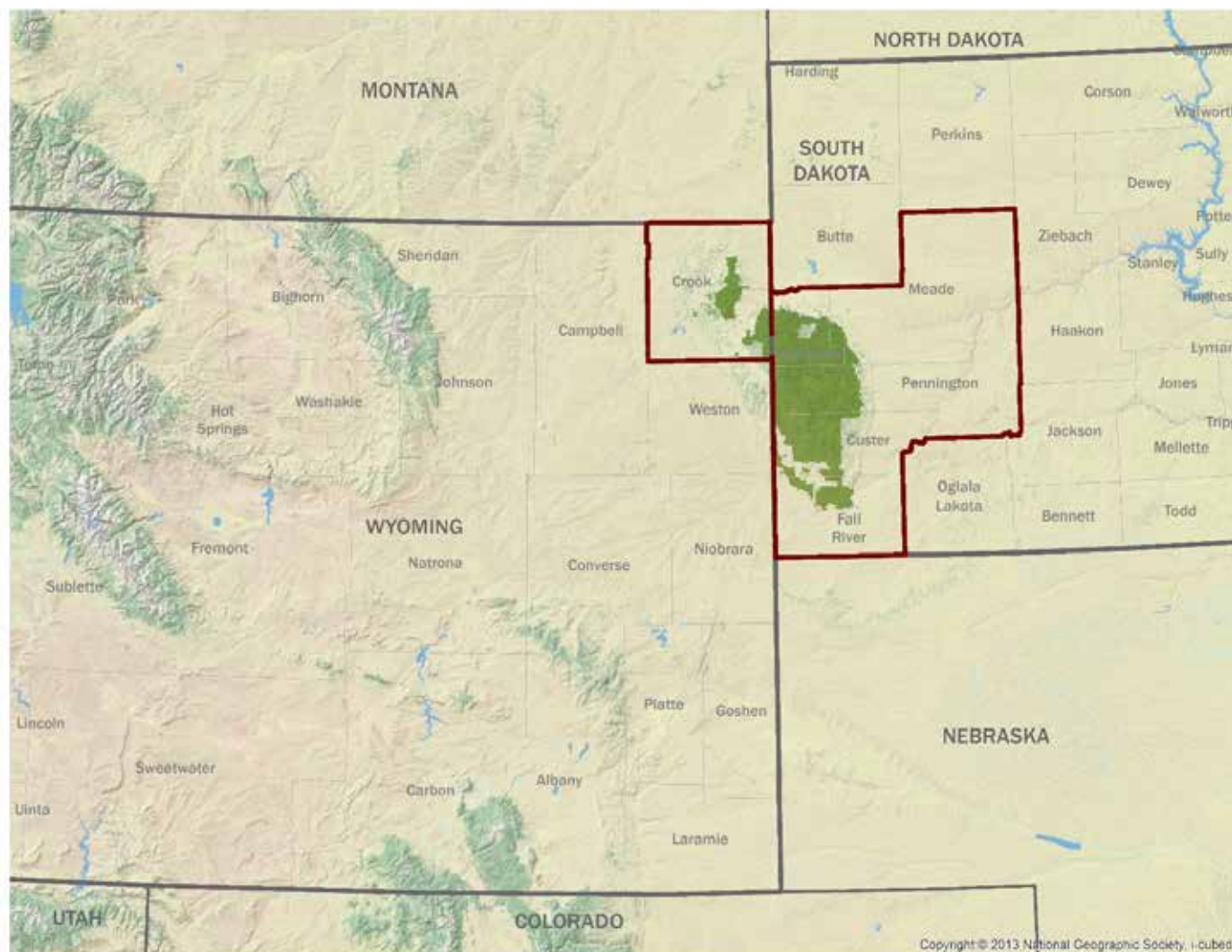
Definitions and Methods

In this report, “capacity” refers to the total volume of timber that existing timber processors could utilize annually. Also known as “timber-processing capacity,” it is a measure of input capacity and generally expressed in board feet, Scribner or cubic feet. Input capacity is a useful measure when attempting to express the capacity of multiple types of mills in a common unit because finished products (output and output capacity) are measured in a variety of units: board feet lumber tally (lumber), thousand square feet (plywood, veneer), lineal feet (house logs) and pieces (posts, small poles and log furniture). Input capacity is a measure of the volume of raw logs that a mill can process in a given year, given firm market demand and sufficient raw material. Estimates in this report include the capacity of active facilities that exclusively use timber in round form; this includes sawmills and facilities processing timber into house logs/log homes, posts and small poles, and log furniture.

In contrast, “capability” refers to the volume of trees of a certain size class (measured as diameter at breast height or dbh) that existing timber processors can *efficiently and economically* process annually. Most facilities are designed to operate using trees of a given size class (e.g., log home plants typically use trees ≥ 10 inches dbh and post manufacturers primarily use trees < 8 inches dbh). Capability at these facilities is readily classified in just one of the size classes. This is true for some sawmills, but sawmills vary greatly in equipment, product output and ability to process timber of various sizes.

Timber harvest and flow from all ownerships within the study area counties were analyzed using 2014 data for Wyoming and South Dakota mills (McIver et al. 2017; Piva 2017) and

Figure 1. Black Hills National Forest and study area.



U.S. Forest Service cut and sold data (USFS 2016). Conversations with mill owners were used to make 2016 estimates of total timber use, total capacity and capability by size class.

To determine the timber-processing area (TPA) for the Black Hills National Forest, counties containing mills receiving timber from the study area were identified. Contiguous counties that received timber from the study area were automatically included. If historic (2010) data indicated a substantial flow of timber into a contiguous county, the county would be included in the TPA even if recent (2014, 2016) flows were relatively small or non-existent. Finally, all other counties receiving timber from the study area were included if the volume represented more than 10 percent of the total timber received in that county.

For each mill in the TPA, an estimation of the mill's capability to process timber of a given size was made based on conversations with mill owners and the most recent census data, taking into consideration the financial feasibility and physical charac-

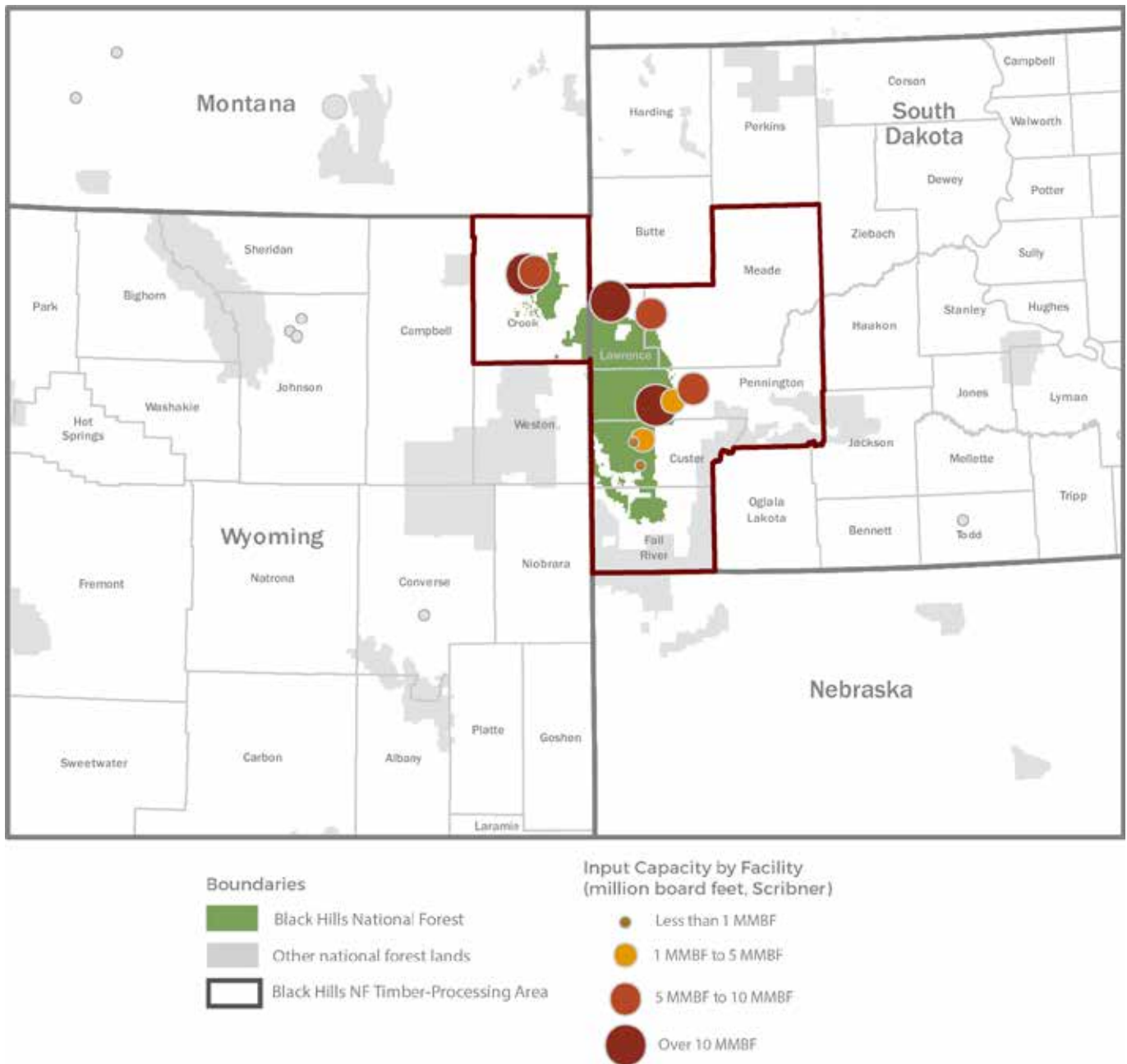
teristics of the mill. For this report, three tree size classes were used: <7 inches dbh, 7-9.9 inches dbh and ≥ 10 inches dbh. BBER researchers first assigned capability to efficiently process timber <10 inches dbh; capability to process trees ≥ 10 inches dbh is then calculated as the proportion of total capacity *not* capable of efficiently using trees <10 inches dbh.

Finally, because data are collected in board feet Scribner, each mill was also assigned a board foot to cubic foot conversion factor based on their mill type and characteristics of their raw log inputs from the most recent census year (Keegan et al. 2010).

Harvest from Counties Containing Black Hills National Forest Non-Reserved Timberland

The Black Hills National Forest is spread over six counties and two states: Crook County in Wyoming and Custer, Fall River, Lawrence, Meade and Pennington counties in South

Figure 2. Black Hills National Forest timber-processing area.



Dakota (Figure 1). Within this area lies 1.8 million acres of non-reserved timberland, of which 63 percent is owned and managed by the U.S. Forest Service (Miles 2017). The estimated total volume of timber harvested and utilized from all ownerships in the study area during 2016 was 22.5 million cubic feet (MMCF) (99 million board feet, Scribner) (BBER 2017, McIver et al. 2017, WWPA 2017). Timber harvested from the Black Hills National Forest was estimated to account for 77 percent (17.3 MMCF) (USFS 2016). The species composition of the

timber harvested in the study area was estimated to consist of primarily ponderosa pine.

Black Hills National Forest Timber-Processing Area

A national forests' timber-processing area (TPA) establishes the geographic region potentially influenced by timber harvested from that forest by analyzing the flow of timber harvested from all ownerships in counties containing non-reserved national forest lands. The analysis also describes the area and extent to

Table 1. Active timber processing facilities in the Black Hills National Forest timber-processing area, 2016. Sources: McIver and others 2017; BBER, 2017; USFS NRS 2017.

Type	2016
Sawmills	7
Log home	1
Log furniture	1
Post and pole	2
Total	11

which timber processors are dependent upon the timber harvested in these counties, and federal timber more specifically.

Virtually all of the timber harvested in the six county study area was processed in just five of the study area counties: Crook County in Wyoming and Custer, Lawrence, Meade and Pennington counties in South Dakota. Thus, the timber-processing area for the Black Hills National Forest is identical to the study area (Figure 2).

Within the Black Hills National Forest TPA there were 11 facilities currently operating in 2016: Seven sawmills, one log furniture, one house log/log home and Two post and small pole facilities; one facility had both sawmill and post and pole capacity (Table 1). The Black Hills National Forest supplied roughly 60 percent of the timber utilized in 2016 and the majority of mills in the TPA reported depending upon USFS timber for half or more of their annual raw material requirements.

Timber Flow

Of the 36 MMCF of timber harvested in the six-county study area, 99 percent was processed in three counties: Crook County in Wyoming and Lawrence and Pennington counties in South Dakota. Each of these counties processed more than half of the timber harvested within their borders (Table 2).

Current Conditions

Timber Use

Capacity to process timber in the Black Hills National Forest TPA during 2016 was 37.5 MMCF. Mills processed 31.6 MMCF that year, indicating that they were operating at approximately 85 percent of capacity (Table 3). Nearly 74 percent of the volume processed in the TPA was composed of trees with a diameter at breast height (dbh) greater than 10 inches. Another 24 percent came from trees 7 – 9.9 dbh, while the remaining 2 percent was made up of trees less than 7 inches dbh.

Processing Capacity and Capability

Most facilities are designed to operate using trees of a given size class (for example, post and rail manufacturers generally use trees less than 7 inches dbh while house log manufacturers typically only use trees greater than 10 inches dbh). Capacity at these facilities is readily classified as being capable of processing timber in just one size class. While this is also true for some sawmills, sawmills can vary greatly in equipment, products produced and ability to process timber of various sizes.

In addition, sawmills often process trees that are larger than the smallest tree size they are capable of processing due to higher recovery rates, and thus greater profitability. However, some mills that process larger trees are not capable of processing smaller-diameter trees. For this reason, capability to process

Table 2. Timber flow from the Black Hills National Forest six-county study area to county of processing facility, 2016.

County of harvest	Processed within the county of harvest	Processed within TPA	Processed outside TPA
	----- Percentage of harvest by county -----		
Crook County, WY	52%	48%	0%
Custer County, SD	1%	98%	1%
Fall River County, SD	0%	100%	0%
Lawrence County, SD	66%	34%	0%
Meade County, SD	0%	100%	0%
Pennington County, SD	59%	41%	0%

Table 3. Annual volume of timber processed by tree size class (excluding pulpwood) for the Black Hills National Forest timber-processing area, 2016.

Thousand cubic feet		Thousand board feet, Scribner	
Tree dbh	Volume used	Tree dbh	Volume used
<7 in.	610	<7 in.	1,201
7 - 9.9 in.	7,712	7 - 9.9 in.	25,699
>10 in.	23,358	>10 in.	108,016
Total	31,680	Total	129,928

trees greater than 10 inches dbh is calculated as the proportion of total capacity *not capable* of processing trees less than 10 inches dbh. Conversely, capability to process trees less than 7 inches dbh is presented as a maximum volume that could be processed efficiently (Wagner et al. 2000 and Stewart et al. 2004). Thus, for those mills with a great deal of flexibility in the size of material utilized (e.g. whole log chipping or grinding), all of their capacity was assigned to the smallest size class since this is where the greatest limitations in the industry exist.

The authors estimate that 74 percent of existing capacity in the Black Hills National Forest TPA is not capable of efficiently utilizing trees less than 10 inches dbh (Table 4). However, as much as 18 percent of total capacity is capable of utilizing trees between 7 and 10 inches dbh and another 8 percent is capable of processing trees less than 7 inches dbh.

Approximately 86 percent of the stated capability to process trees < 10 inches dbh was used in 2016. Mills processed 8,322 MCF of the estimated 9,699 MCF capable of processing trees <10 inches dbh, although most of this volume was in the 7-9.9 inch dbh class. Only 20 percent of capability was utilized in the <7 inch dbh class, indicating that as much as 2,395 MCF in <7 inch dbh capability was substituted with trees in the next larger size class.

Discussion

As documented by Stewart et al. (2004) and others, the profitability of processing timber diminishes as the average diameter of the timber decreases. When markets are poor it

becomes more difficult to profitably produce lumber from small and low quality logs. This was evident across the western United States during the Great Recession, which reduced mill demand for small diameter logs used to make studs.

Sawmill owners also spoke to the impact that the condition of timber, namely live versus dead, has on their ability to recover economic value from the material. Mills reported on their capability to process primarily dead timber, citing their capability to process timber <10 inches dbh would be greater if they were processing green trees due to the associated higher grade recovery. Similar relationships among log size, live versus dead trees and value have been documented by Fahey et al. (1986).

When considering the economic feasibility of removing trees from the landscape, land managers should balance their need to remove small and/or dead trees with the local industry's ability to profitably use that material. Offering larger quantities of small and/or dead trees than the industry can profitably use will likely lead to unsold sales and fewer acres being treated.

References

BBER, 2017. Bureau of Business and Economic Research. Forest Industries Data Collection System (FIDACS). Missoula, MT: Bureau of Business and Economic Research, Forest Industry Research Program. Unpublished dataset. Data obtained August, 2017.

Fahey, Thomas D.; Snellgrove, Thomas A.; Plank, Marlin E. 1986. "Changes in Product Recovery Between Live and Dead

Table 4. Annual capacity and capability of mills to process trees by size class for the Black Hills National Forest timber-processing area, 2016.

Thousand cubic feet		Thousand board feet, Scribner	
Tree dbh	Capability	Tree dbh	Capability
<7 in.	3,005	<7 in.	6,463
7 - 9.9 in.	6,694	7 - 9.9 in.	25,126
>10 in.	27,765	>10 in.	128,568
Total	37,464	Total	160,157

Lodgepole Pine: A Compendium.” Research Paper PNW-RP-353. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Rangeland Experiment Station. 32 p.

Keegan, Charles E.; Morgan, Todd A.; Wagner, Francis G.; Cohn, Patricia J.; Blatner, Keith A.; Spoelma, Timothy P.; Shook, Steven R. 2005. “Capacity for Utilization of USDA Forest Service, Region 1 Small-Diameter Timber.” *Forest Products Journal* 55(12): 143-147.

Keegan, Charles E.; Morgan, Todd A.; Gebert, Krista M.; Brandt, Jason P.; Blatner, Keith A.; Spoelma, Timothy P. 2006. “Timber-Processing Capacity and Capabilities in the Western United States.” *Journal of Forestry* 104(5): 262-268.

Keegan, Charles E.; Morgan, Todd A.; Blatner, Keith A. 2010. “Trends in Lumber Processing in the Western United States. Part I: Board Foot Scribner Volume Per Cubic Foot of Timber.” *Forest Products Journal* 60(2): 133-139.

McIver, Chelsea P.; Sorenson, Colin B.; Morgan, Todd A. 2017. “Wyoming’s Forest Products Industry and Timber Harvest, Part I: Timber Harvest, Products and Flow.” Forest Industry Brief BBER-FIB-01. Missoula, MT: University of Montana, Bureau of Business and Economic Research. 6 p.

Miles, P.D. 2017. Forest Inventory EVALIDator web-application version 1.6.0.03a. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. Accessed August 23, 2017.

Stewart, Hayden G.; Blatner, Keith A.; Wagner, Francis G.; Keegan, Charles E. 2004. “Risk and Feasibility of Processing Small-Diameter Material in the U.S. West, Part I: Structural Lumber.” *Forest Products Journal* 54(12): 97-103.

U.S. Forest Service (USFS). 2016. “Forest Products Cut and Sold from the National Forests and Grasslands.” U.S. Department of Agriculture. Accessed December 7. <https://www.fs.fed.us/forestmanagement/products/cut-sold/index.shtml>

U.S. Forest Service, Black Hills National Forest (USFS BHNF). 2017. “Forestry Officials Release 2016 Forest Health Report.” <https://www.fs.usda.gov/detail/blackhills/news-events/?cid=F-SEPRD537499>. Accessed September 29, 2017.

Wagner, Francis G.; Fiedler, Carl E.; Keegan, Charles E. 2000. “Processing Value of Small-Diameter Sawtimber at Conventional Stud Sawmills and Modern High-Speed, Small-Log Sawmills in the Western United States – A Comparison.” *Western Journal of Applied Forestry* 15(4): 208-212.

Western Wood Products Association (WWPA). 2017. “2016 Statistical Yearbook of the Western Lumber Industry.” Portland, OR: Western Wood Products Association. 22 p.

Wyoming State Forestry Division. 2017. “State and Private Forestry Fact Sheet: Wyoming 2017.” National Association of State Foresters. Accessed September 19, 2017. <http://stateforesters.org/sites/default/files/publication-documents/WYFY2017Standard%20%281%29.pdf>

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