Memorandum

June 28, 2013

From: Richard R. Luckey, High Plains Hydrology, LLC

To: Thad Kuntz, Adaptive Resources, Inc.

CC: Jesse Bradley, Nebraska Department of Natural Resources; Rod Horn, South Platte Natural Resources District; Ron Cacek, North Platte Natural Resources District

Subject: Simulated flow to Lodgepole Creek

Introduction

Lodgepole Creek in Nebraska generally flows east in Kimball County and passes south of Bushnell, north of Kimball, and north of Dix. In Cheyenne County, it continues eastward south of Potter where it turns east-southeast and passes south of Sidney and then turns east and passes south of Lodgepole. In Deuel County, Lodgepole Creek turns southeastward, passes south of Chappell, and turns south toward the Colorado state line. It is about 100 mi long (excluding meanders) in Nebraska and changes in elevation from about 5000 ft to about 3570 ft.

Lodgepole Creek is difficult to characterize in Nebraska because its baseflow (low flow due to ground-water discharge from the High Plains aquifer) changes abruptly from place to place. The aquifer in Lodgepole valley frequently consists of fractured Brule Formation overlain by a thin veneer of alluvium. Where the fractures are pervasive, the water from Lodgepole Creek can partially or completely flow underground and flow of the creek is decreased. Where the fractures are sparse or non-existent, water is forced to the surface and the flow of the creek increases.

This memorandum summarizes simulated flow to Lodgepole Creek from the ground-water flow model recently completed for the area (Ground Water Flow Model for the Southern Half of the Nebraska Panhandle, June 2013). The information in this memorandum is more detailed to aid in the understanding of Lodgepole Creek. No comparison is made to actual flow of Lodgepole Creek, although the model is thought to represent the general flow conditions of the creek.

Data

Simulated flow to Lodgepole Creek was examined for three dates: April 30, 1953; April 30, 1973; and April 30, 1993. These dates are thought to represent conditions before large-scale ground-water development in Lodgepole Valley, after substantial development had occurred, and after development had been substantially completed. April 30 represents the end of the non-irrigation season and is the time of the year when the ground-water system is most nearly in equilibrium.

Two graphs are shown for each period. The first graph shows the simulated flow to Lodgepole Creek at the indicated date. At each date, the input flow at the western limit of the model, about 0.7 mi west of

the Wyoming state line, was 10 ft^3/s. If the actual flow was different, the graphs need to be adjusted up or down. The second graph shows the simulated gain (positive) or loss (negative) of Lodgepole Creek. The simulated gain is shown as zero when the creek is dry, and the point at which the creek goes dry is somewhat dependent on the input flow at the western limit of the model.

The graphs show the segment and reach number used in the model. Streams in the model are represented as 40-acre cells, although the actual width and length of the stream in a cell is represented using a streambed conductance factor. Lodgepole Creek in the model is divided into segments and the segments are then divided into reaches, with each reach representing one cell. Lodgepole Creek begins with segment 154, reach 1 and ends with segment 176, reach 6. The graphs show various places along the creek to better indicate the location.

Results

Figure 1 shows the simulated flow of Lodgepole Creek on April 30, 1953. Input flow at the western edge of the model was 10 ft^3/s. The flow increased slightly to Bushnell and then decreased to west of Kimball. Simulated flow at Kimball on April 30, 1953 was 7.3 ft^3/s. Flow was fairly steady to east of Dix, where it started to decrease. Simulated flow reached a minimum at about Potter, where it was 5.7 ft^3/s. Simulated flow increased rapidly between Potter and west of Brownson, and then increased more slowly to Ralton. Simulated flow on April 30, 1953 was 21.2 ft^3/s at Sidney, 25.8 ft^3/s at Lodgepole, and 30.8 ft^3/s at Ralton. Downstream of Ralton, simulated flow did not change a lot.

Figure 2 shows the simulated gain or loss of Lodgepole Creek on April 30, 1953. This figure shows the same information as the previous figure, although in more detail. This figure represents the slope of the line in the previous figure. As can be seen in this figure, there was considerable variation in flow from cell to cell. For example, although there was an overall gain from the western edge of the model to Bushnell, some cells lost water. There was an overall loss from Bushnell to Kimball and there was nearly no gain or loss to Potter. There was considerable gain between Potter and Brownson, and the greatest gain occurred about midway between these places. East of Brownson, there was an overall gain in flow, although there were losing sections.

Figure 3 shows the simulated flow of Lodgepole Creek on April 30, 1973. Input flow at the western boundary of the model was 10 ft^3/s. The flow increased slightly to about Bushnell and then decreased to east of Dix. Simulated flow at Kimball on April 30, 1973 was 4.7 ft^3/s. Lodgepole Creek was dry from east of Dix to east of Potter. Simulated flow increased rapidly between east of Potter and west of Brownson, and then decreased slowly to east of Sidney. Simulated flow was 9.7 ft^3/s at Sidney. Simulated flow increased slightly from east of Sidney to about Ralton. Simulated flow at Lodgepole was 8.4 ft^3/s and simulated flow at Ralton was 9.9 ft^3/s. Downstream of Ralton, simulated flow increased.

Figure 4 shows the simulated gain or loss of Lodgepole Creek on April 30, 1973. There was a small gain from the western model boundary to Bushnell and then a loss from Bushnell to east of Dix. From east of Dix to east of Potter, Lodgepole Creek was dry. There was considerable gain between Potter and Brownson, and the greatest gain occurred about midway between these places. This is the same section

that showed a gain in 1953. Between Brownson and Chappell, there were sections of both gains and losses. East of Chappell, there was a gain in flow.

Figure 5 shows the simulated flow of Lodgepole Creek on April 30, 1993. As with the other dates, the input flow at the western boundary of the model was 10 ft^3/s. The flow increased slightly to about Bushnell and then decreased to west of Dix. Simulated flow at Kimball on April 30, 1993 was 3.3 ft^3/s. The creek was simulated as dry from west of Dix to east of Potter, and then it began to gain water. The flow reached a maximum west of Brownson and then decreased to east of Sidney, where the creek again went dry. Simulated flow at Sidney was 2.5 ft^3/s. The creek was dry or had very little flow from east of Sidney until west of Ralton, where it again began to gain water. Simulated flow at Ralton was 0.7 ft^3/s. The flow increased and reached a maximum at the southern boundary of the model.

Figure 6 shows the simulated gain or loss of Lodgepole Creek on April 30, 1993. There was a small gain from the western model boundary to Bushnell and then a loss from Bushnell to west of Dix. Lodgepole Creek was dry from west of Dix to east of Potter. There was considerable gain between Potter and Brownson, and the greatest gain occurred about midway between these places. This is the same section that showed a gain in 1973, but the length of the gaining section is shorter than in previous years. From west of Brownson to east of Sidney, Lodgepole Creek lost water and eventually west dry east of Sidney. From there to Ralton, there were sections of both gains and losses, but the creek was mostly dry. South of Ralton, there was a gain in flow.

References Cited

Luckey, R.R., 2013, Ground water flow model for the southern half of the Nebraska Panhandle: Western Water Use Model Study, 103 p.

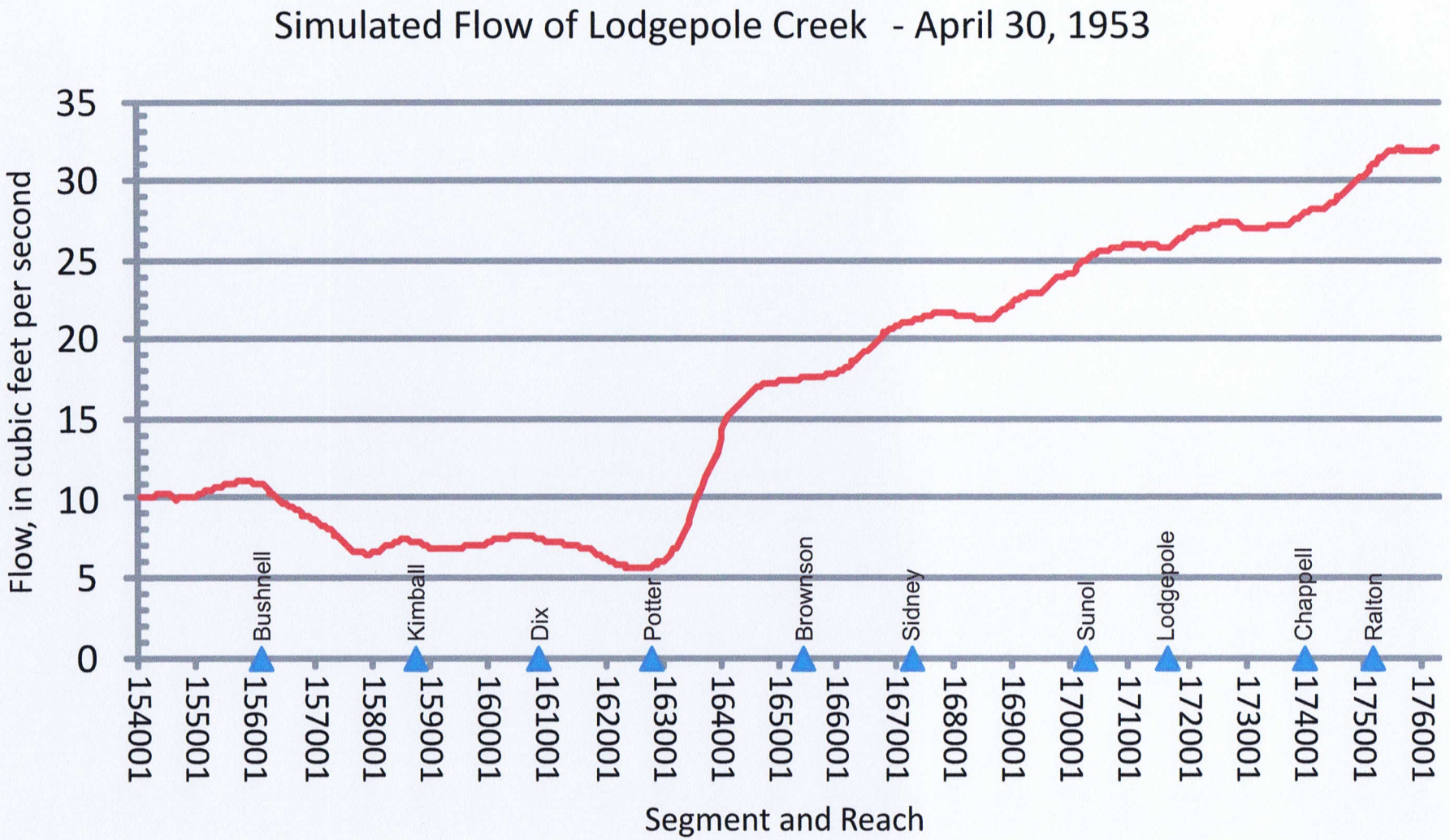

Figure 1. Simulated flow of Lodgepole Creek, April 30, 1953.

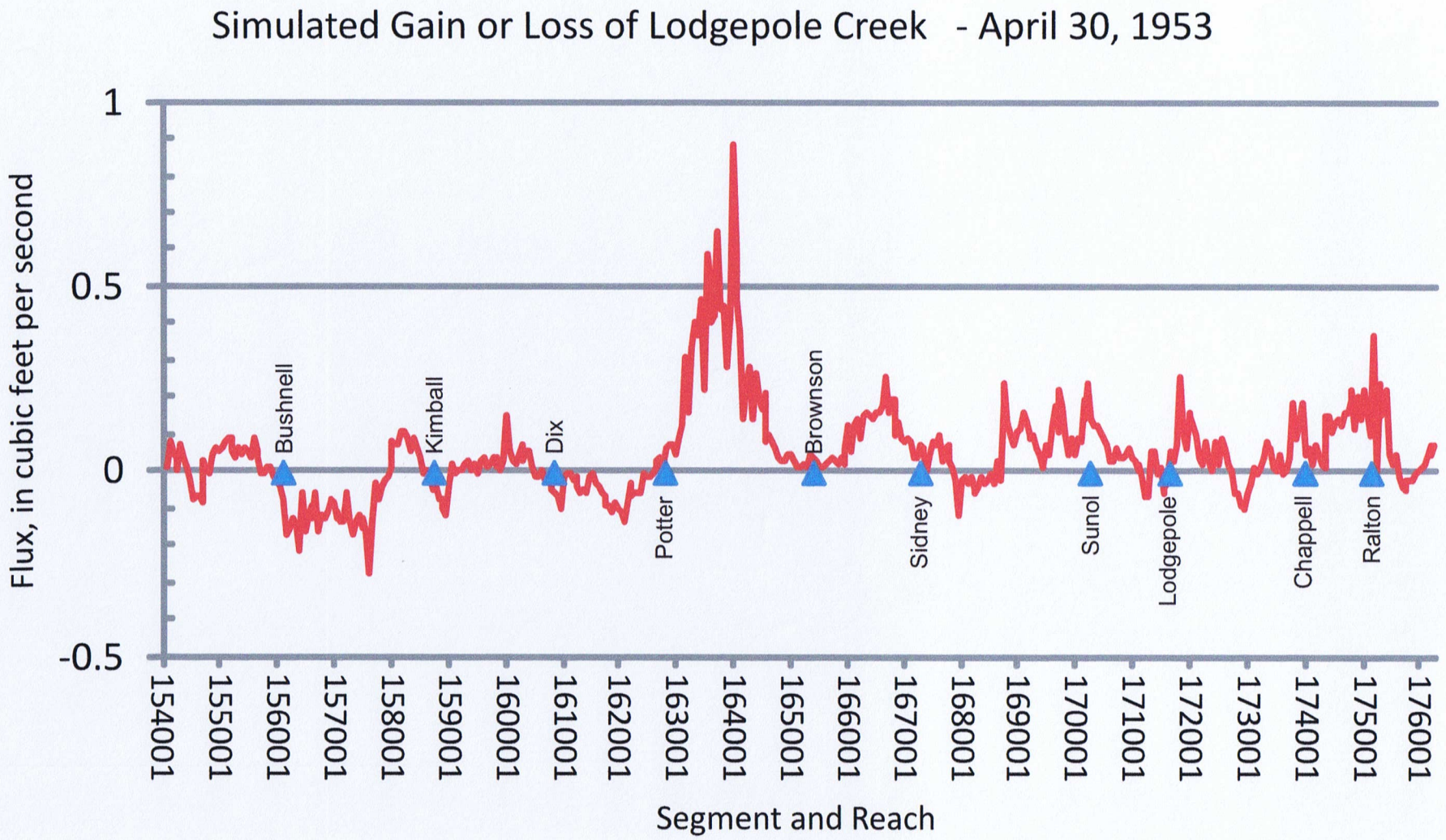

Figure 2. Simulated gain or loss of Lodgepole Creek, April 30, 1953.

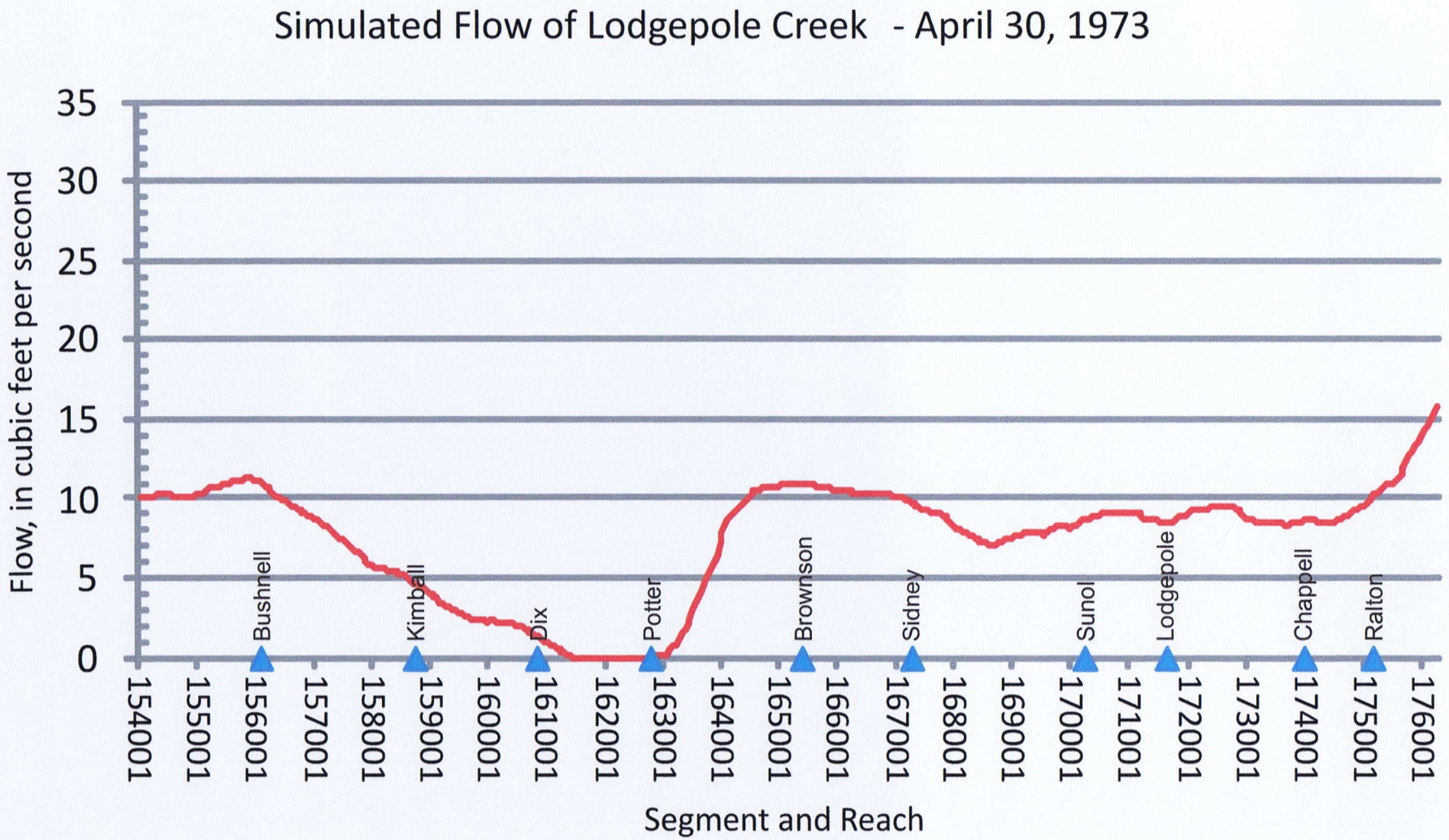

Figure 3. Simulated flow of Lodgepole Creek, April 30, 1973.

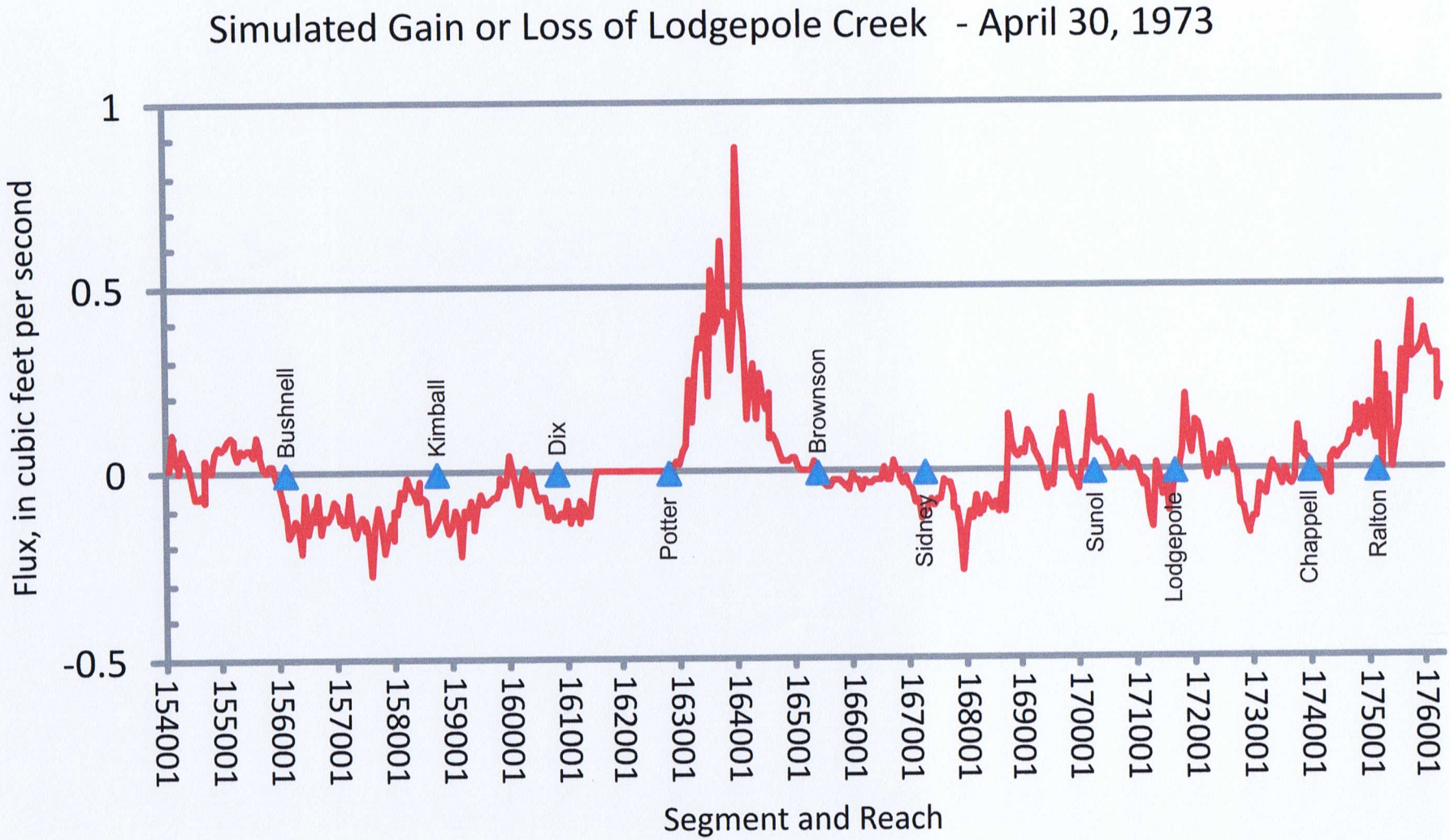

Figure 4. Simulated gain or loss of Lodgepole Creek, April 30, 1973.

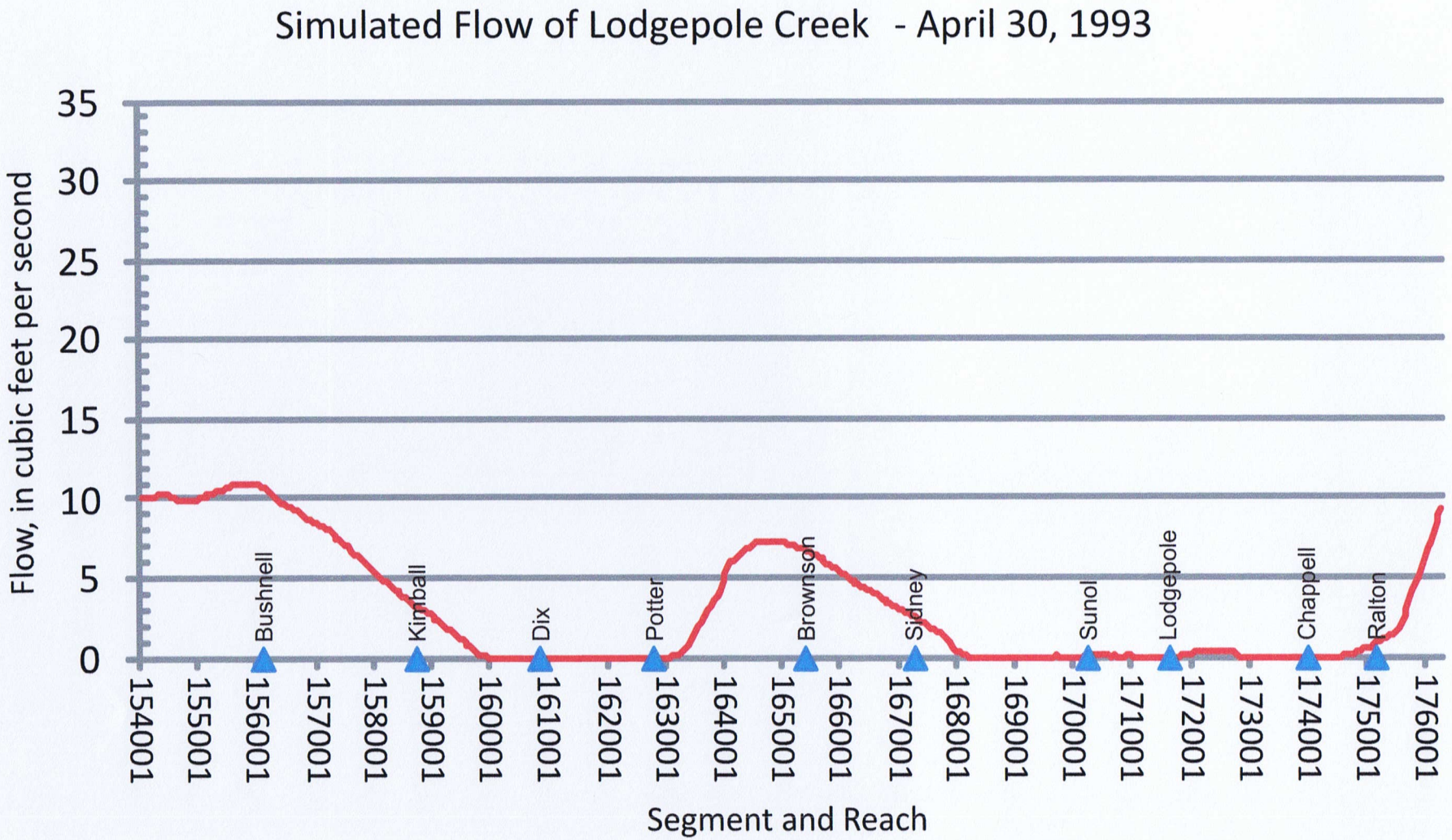

Figure 5. Simulated flow of Lodgepole Creek, April 30, 1993.

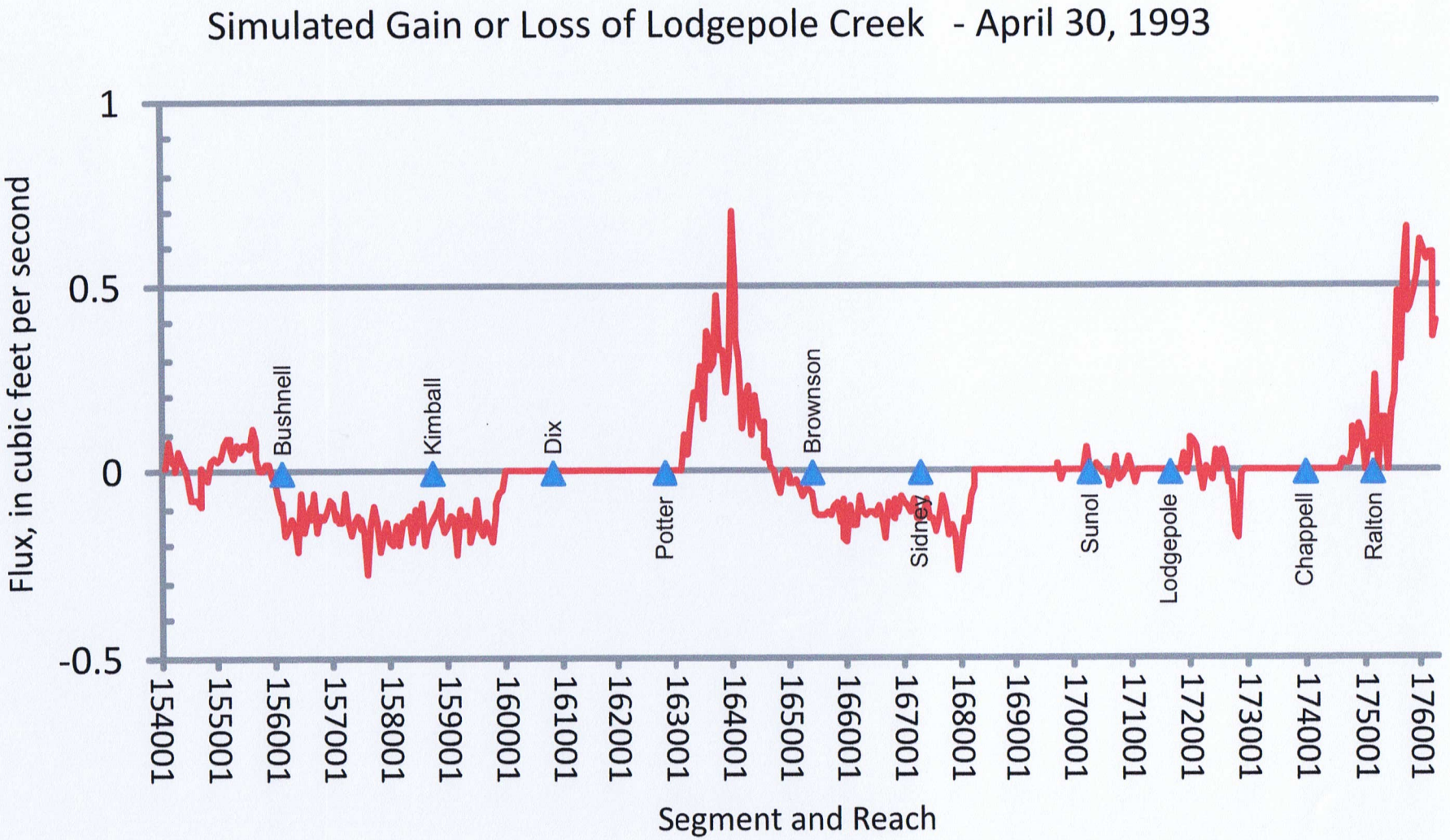

Figure 6. Simulated gain or loss of Lodgepole Creek, April 30, 1993.