



May 13, 2019

To: Members of the Seismic Monitoring Advisory Committee,
Southeast Geysers Effluent Pipeline Project (SEGEP)

Fm: Northern California Power Agency

Re: SEGEP Operation and Seismicity Report for October 1, 2018 through April 30, 2019

A. Pipeline Operations

The Southeast Geysers Effluent Pipeline (“SEGEP”) has been in operation for 22 years and has delivered 59.02 billion gallons of water at an average rate of 5,216 gpm to the South East Geysers steam field for injection. **Figure 1** illustrates the daily delivery rates since the beginning of the project.

During the six-month period from October 1, 2018 through April 30, 2019, the SEGEP Pipeline was in operation 90.7% of the time (**Figure 2**). Pipeline delivery rates have averaged 7.35 million gallons per day (MGD) or 5,101 gpm. There were several curtailments and shutdowns for maintenance work. Most notably NCPA replaced a transformer and some pump start equipment in October and December 2018 at the Bear Canyon #1 pump station. Injection activities returned to normal following this maintenance activity.

B. Observed Seismicity

Seismic Activity in the Southeast Geysers

The USGS recorded 82 seismic events of magnitude 1.5 and greater within the SE Geysers area from October 1, 2018 through April 30, 2019. This is a 24% increase over the previous six month period (May 1 through September 30, 2018) which recorded 66 seismic events greater than magnitude 3.0. Historical trends and locations of the recent events are shown respectively in **Figures 3 and 4**. There was one magnitude 3.08 seismic event in the Southeast Geysers during this reporting period.

In combination with the seismic activity, steam production for the Southeast Geysers area was 17.67 billion pounds mass for the past six months. This value is down 3% from the previous six

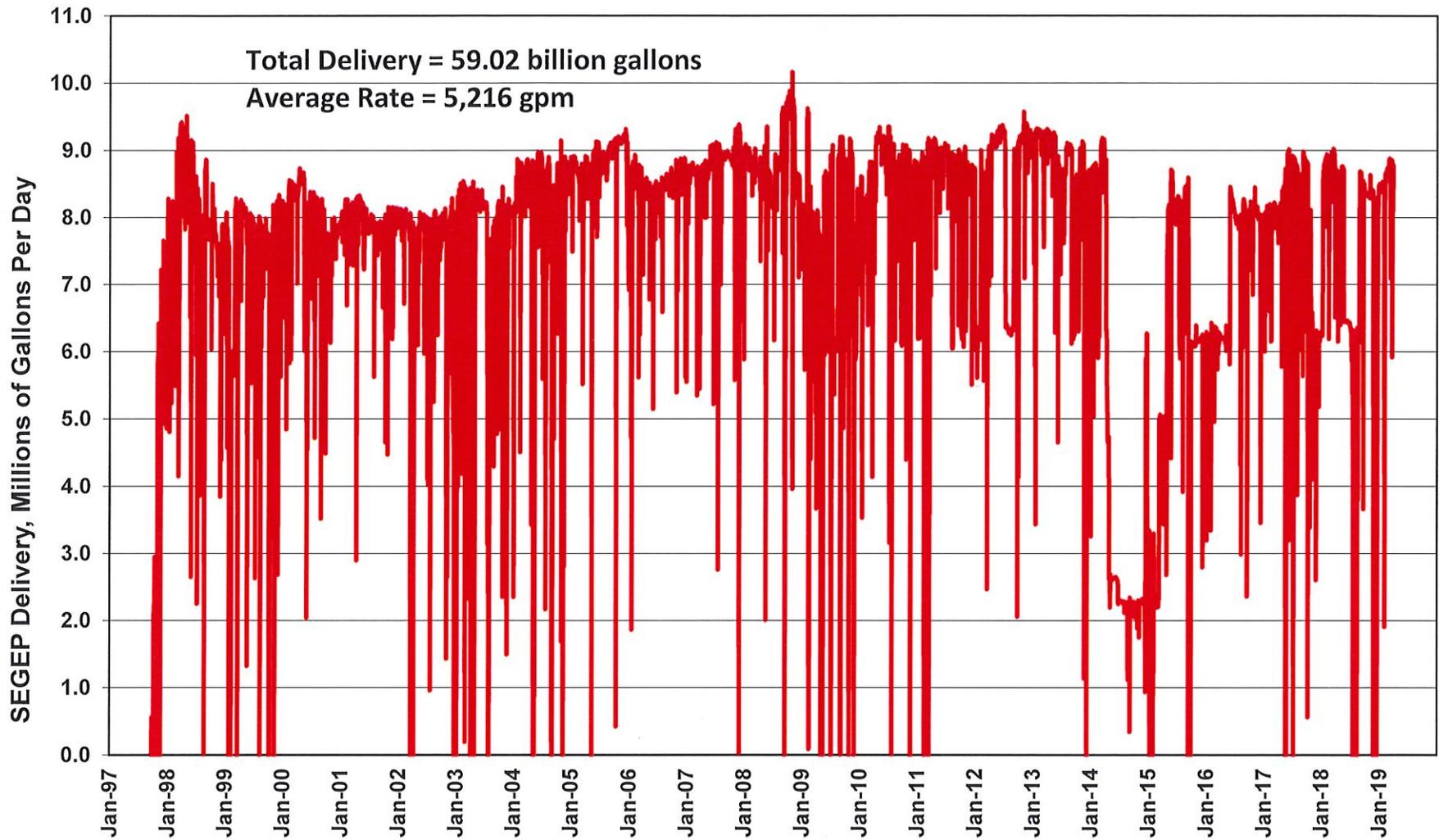
month period where 18.23 billion pounds was produced. The amount of water injected into the Southeast Geysers reservoir was 13.23 billion pounds. This compares with the 9.15 billion pounds of water injected from April 1 through September 30, 2018. The increase in injection likely caused the significant increase in seismic activity. **Figure 5** shows the historical changes in steam production, water injection and recorded seismicity within the Southeast Geysers area.

Seismic Activity in The Geysers (KGRA)

Within the Geysers geothermal field, there have been 503 events of magnitude 1.5 and greater recorded from October 1, 2018 through April 30, 2019. This amount is up from 355 events recorded from the previous six month period. There were 3 events of magnitude 3.0 or greater. The largest event was magnitude 3.35, which occurred on October 10, 2018. **Figure 6** shows the trends of seismic events for the Geysers since 2010 while **Figure 7** shows the location of the events for the last six months.

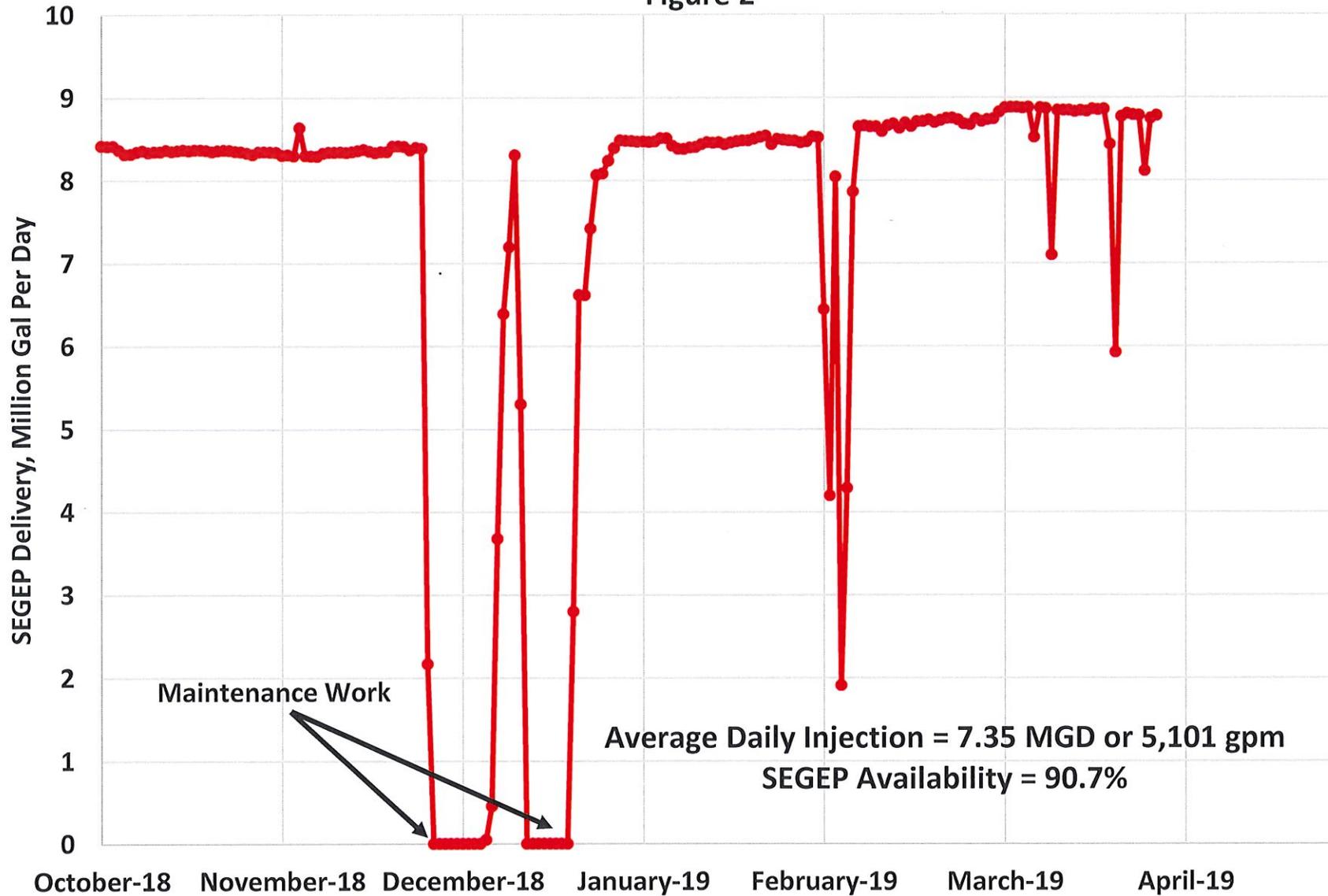
Ed Voge
Reservoir Engineer
NCPA Geothermal Facility

Historical SE Geysers Effluent Pipeline Deliveries to The Geysers
Figure 1



Southeast Geysers Effluent Pipeline Delivery October 1, 2018 through April 30, 2019

Figure 2



Southeast Geysers - Historical Seismic Activity

Magnitude > 1.5

Figure 3

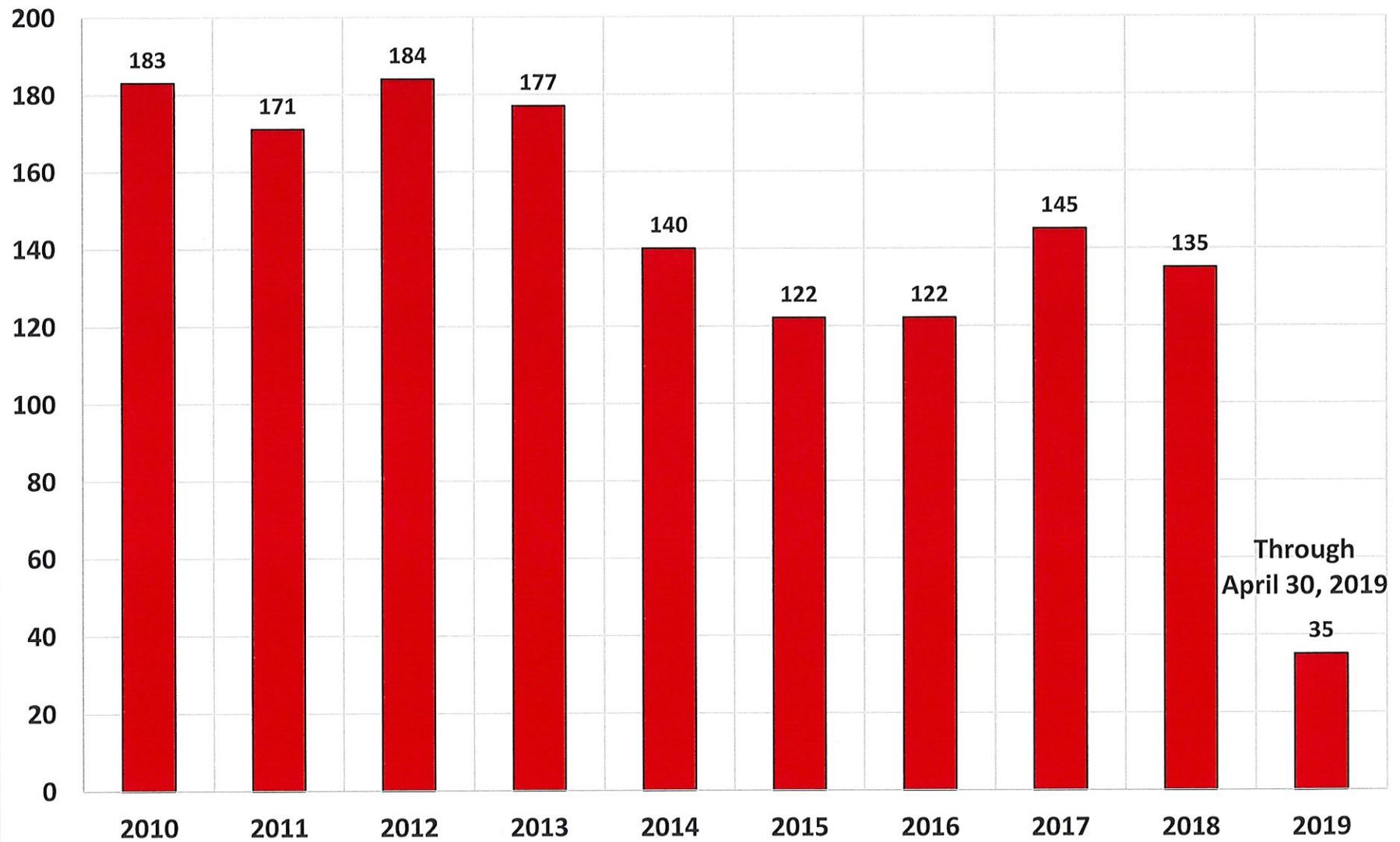
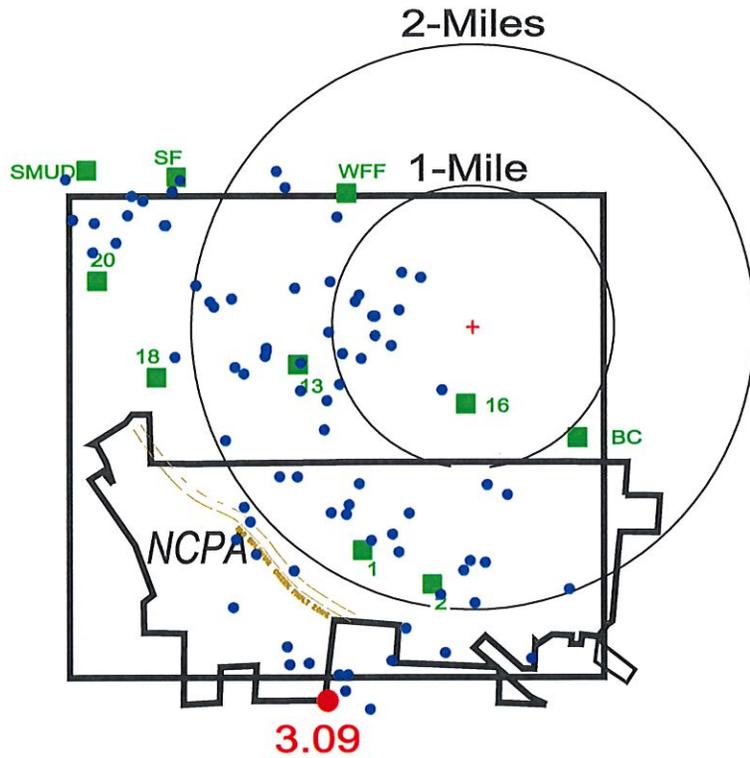


Figure 4



Radial distances are from Anderson Springs Strong Motion Instrument

October 1, 2018 - April 30, 2019

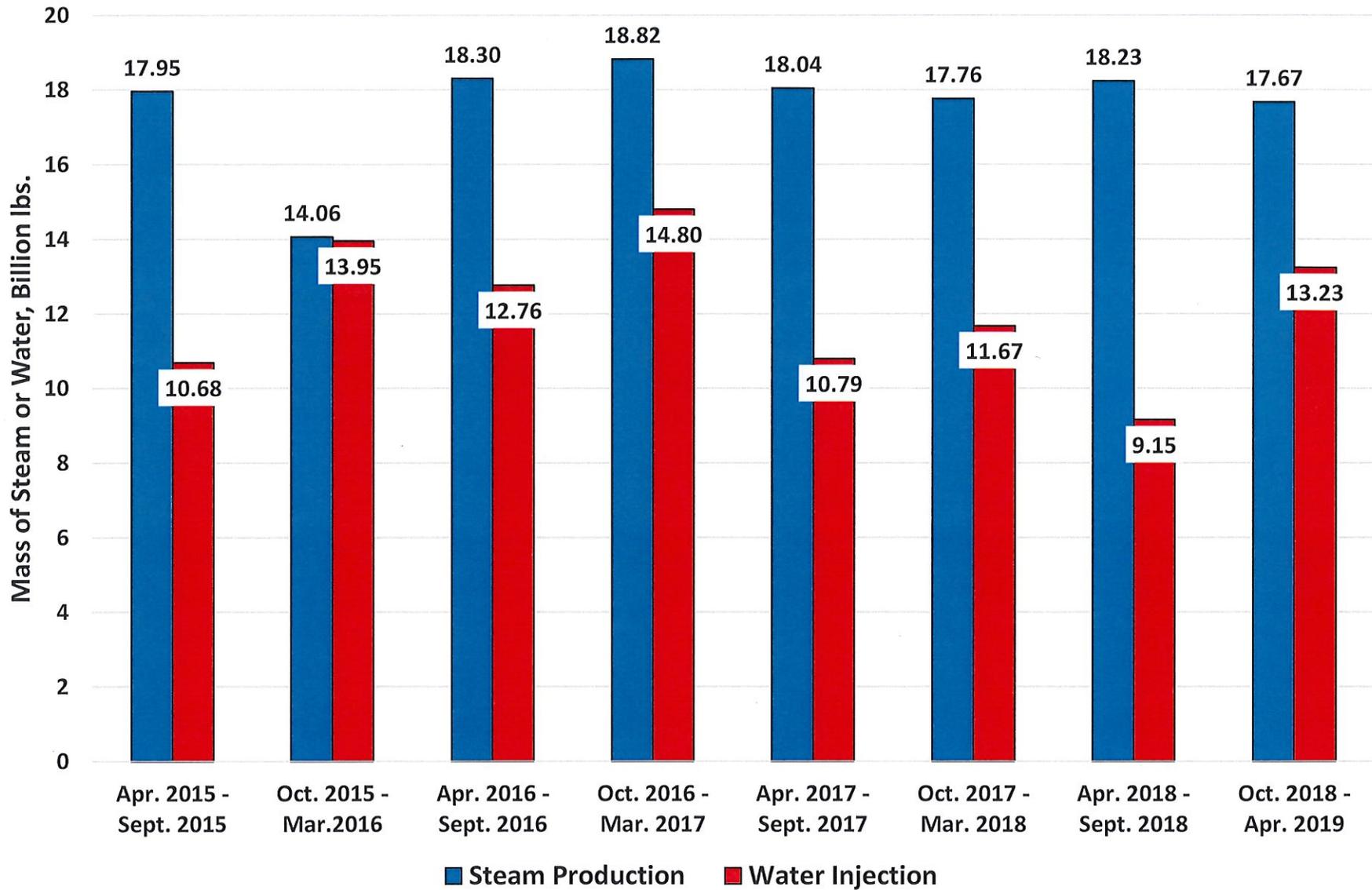
- **Magnitude > 1.5 - 82 Events**
- **Magnitude > 3.0 - 1 Event**

SOUTH EAST
GEYSERS
SEISMIC STUDY
AREA

SEISMIC EVENTS
REPORTED BY THE USGS
(from U.C. Berkeley Catalog)

SE Geysers Production and Injection

Figure 5



The Geysers - Historical Seismic Activity Magnitude > 1.5 Figure 6

