

Background

Landau Associates and The Boeing Company have been investigating, monitoring, and performing cleanup actions on groundwater impacted with trichloroethene (TCE) since the mid-2000s:

- TCE impacts groundwater beneath ~3,000-ft of a wooded ravine.
- Area of TCE-impacted groundwater has historically had stable boundaries.
- Boeing has performed source treatment and implemented a groundwater extraction and treatment system that is containing TCE-impacted groundwater; concentrations are steadily declining as a result of these interim actions.
- Boundaries of the leading edge of the TCE-impacted groundwater area are controlled by a gaining stream.
- Influence of the stream and natural recharge along a groundwater divide has historically prevented potential migration toward another gaining stream to the west.



Groundwater Elevation Contours and Flow Direction – April 2010

Effects of Land Development on TCE-Impacted Groundwater Boundaries

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Apparent Shift of Formerly Stable TCE-Impacted Area

- In January 2016, monitoring of sentry wells along the leading (northwest) edge of the impacted area detected TCE for the first time.
- Groundwater contours identified a subtle shift in flow direction to the northnorthwest in this area.
- Indicated never-before-seen shift of the TCE-impacted area boundary to the northwest.
- In October 2017, monitoring of a new well along the western boundary identified an anomalous TCE detection where TCE has not been historically present.
- Another corresponding shift in groundwater contours/flow directions was also identified in this area.







Groundwater Contours – July 2015



Groundwater Contours – January 2018

Explanation: Land Development

In mid-2014 to 2015 a large commercial development was constructed on the ridge located between the two streams:

- Approximately 25 acres of previously wooded land was developed and covered with impervious surfaces (buildings and parking lots).
- Stormwater was collected and routed to a detention/infiltration pond in the northeast corner of the development.

In 2017, construction of a second large commercial development began (still ongoing) to the south of the first:

- Approximately 11 acres of previously wooded land was developed and covered buildings and parking lots.
- Stormwater was collected and routed offsite via storm sewer.

Nearly all groundwater recharge that previously infiltrated in the area between the two streams was modified or eliminated. This appears to have modified the hydrology between the streams causing the TCE-impacted area boundary to shift northwest.

The infiltration pond on the northern development could mitigate some of the shift. Boeing is still evaluating site hydrology as a result of the second development and seasonal effects, and post development data will be used to determine whether the TCEimpacted area has restabilized. Boeing continues to monitor site conditions, and if future data warrants further action, **Boeing will work with the Department of Ecology to develop an** appropriate plan.

Important Factors to Consider

Development activities have the potential to significantly alter groundwater hydrology:

- Construction of impervious surface can significantly reduce groundwater recharge.
- Focused stormwater infiltration can cause localized groundwater mounding.
- Hydrologic impacts may result in destabilization of contaminated groundwater areas.

Boeing continues to operate the groundwater extraction system and TCE concentrations continue to decline site-wide. Boeing is also carefully monitoring site conditions and the impacts of the apparent change in hydrologic conditions.







May 2013 Aerial Photo (October data)



July 2014 Aerial Photo (October data)



April 2015 Aerial Photo (October data)



May 2017 Aerial Photo (October data)

36 acres of land development may reduce groundwater recharge by up to 34.9M-gal/yr (equivalent to a 66 gpm extraction well)