

4. Groundwater Water Levels

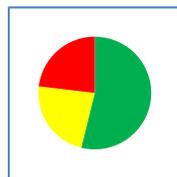
Target: Water table levels are maintained or improved with time

About this indicator: Water levels are measured at numerous locations across the island within several different water bearing zones. The frequency of this dataset varies from monthly to annual to longer periods of time between measurements.

Influencing factors: Amount of precipitation for a given year. Changes to recharge areas from land use changes. Changes in water use patterns for a given year.

2010 Target: 2010 data within one standard deviation of baseline average.

2010 Finding: 13 sites; 3 sites higher, 6 sites lower, 4 no change



2010 Status: Sixty sites have water level data during 2001-2010. The majority of these sites are not being actively monitored or monitored on an infrequent (once a year) basis. Thirteen sites have 2010 water level data along with an averaged baseline (2001-2008), Figure 1 and Table 1. Three sites have higher water table elevations in 2010 compared to their baseline average value shown in Figure 1 with bold green color. Six sites have lower 2010 values compared to baseline: yellow for values between 1 & 2 standard deviations; red for values past 2 standard deviations, Table 1 and Figure 1. The remaining four sites have 2010 values within their standard deviation also reported as green color in Table 1.

Vashon-Maury Island has multiple water bearing zones, aquifers, that are being monitored with the help of volunteers and monitoring wells, Table 1 and Table 2. Consistent regular data allows for the assessment of conditions. Volunteer monitoring began in 2001 while monitoring wells were installed in 2005 and 2007.

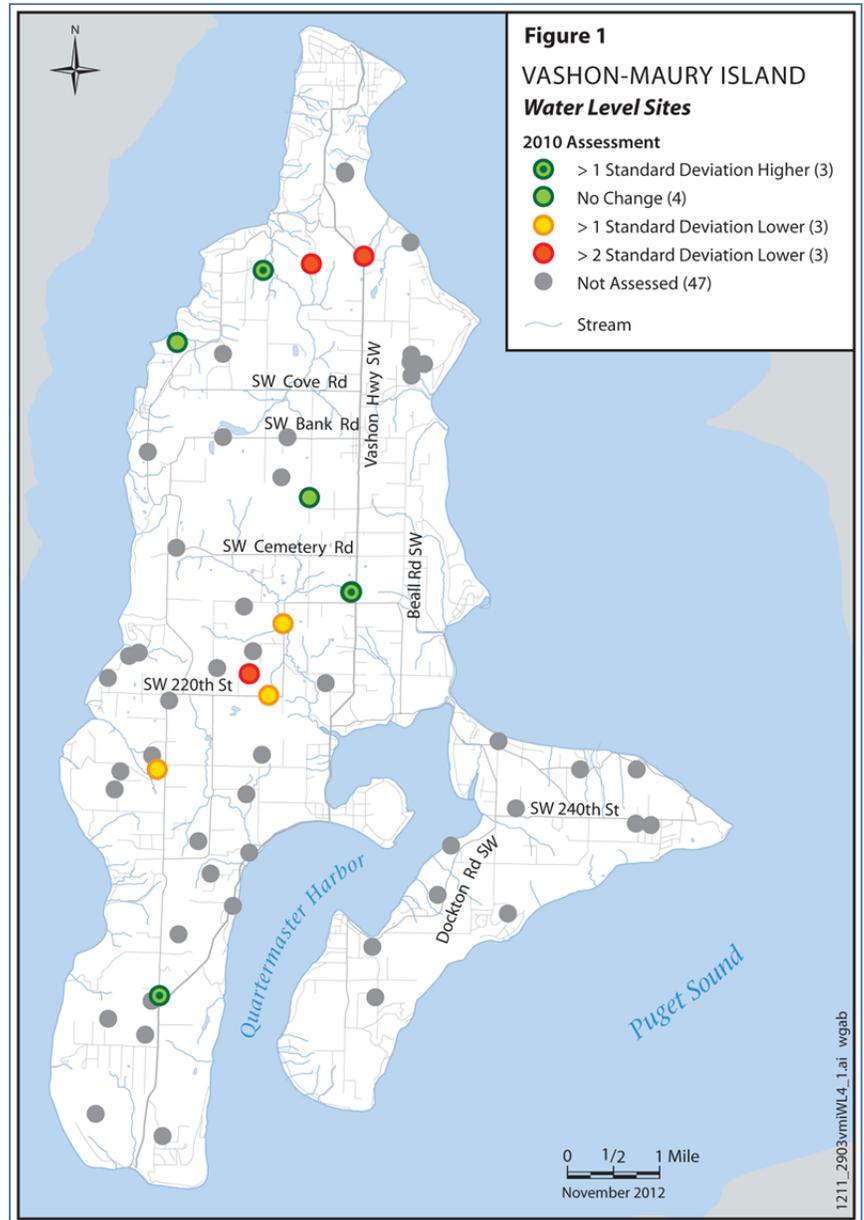


Figure 1. Water level locations used in this indicator. Data shown represent 2010 assessment compared to baseline average. Three sites have higher water table elevations in 2010 compared to their baseline average value: green w/ dot. Six sites have lower 2010 values compared to baseline: yellow for values between 1 & 2 standard deviations; red for values past 2 standard deviations. The remaining four sites have 2010 values within their standard deviation also reported as green color. The remaining 47 sites have too few data points to assess baseline.

Table 1. 2010 Water Table elevations for baseline sites and King County Monitoring wells. An average of the data collected in 2010 was compared to the baseline average (see Table 2) to assess any change. Colors represent change: green (with bold) for sites with higher 2010 values compared to baseline; Yellow for sites with lower (> 1 st dev) values; Red for sites with lower (>2 st dev) values; Green also represent sites with no change (data within the standard deviation)

Site Id	2010 Assessment				Aquifer
	Count	Avg-WT elev	difference	st-dev_ft	
vol_w-06	12	197.0	-0.6	0.2	Qva - Main
vol_w-13	12	158.7	-1.4	1.3	Qpfc - Deep
w-21	11	184.1	0.4	0.3	Qva - Main
vol_w-02	6	25.8	-0.5	2.0	Qpo - Deep
KC Wells	w-60	9	178.2	-1.7	Qva - Main
	w-61	12	240.6	0.2	Qva - Main
	w-63	9	180.1	-0.2	Qva/Qpfc
	w-64	3	199.7	1.0	Qva - Main
	w-65	12	240.4	0.1	Qva - Main
	w-70	12	178.3	0.0	Qpo- Deep
	w-71	10	282.8	0.3	Qva - Main
	w-72	12	260.6	-0.8	Qva - Main
	w-73	3	134.7	-1.0	Qvr - Shallow

Count = Number of data points – volunteers typically report monthly – continuous recorder data are also shown as monthly.

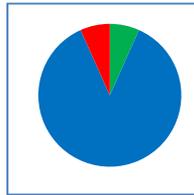
Avg-WT elev = Average water table elevation in feet above sea level.

St-dev_ft = Standard deviation of the average of all the water table elevation data for each site – units are feet.

2001-2010 Target: No long term declines in water table levels over baseline.

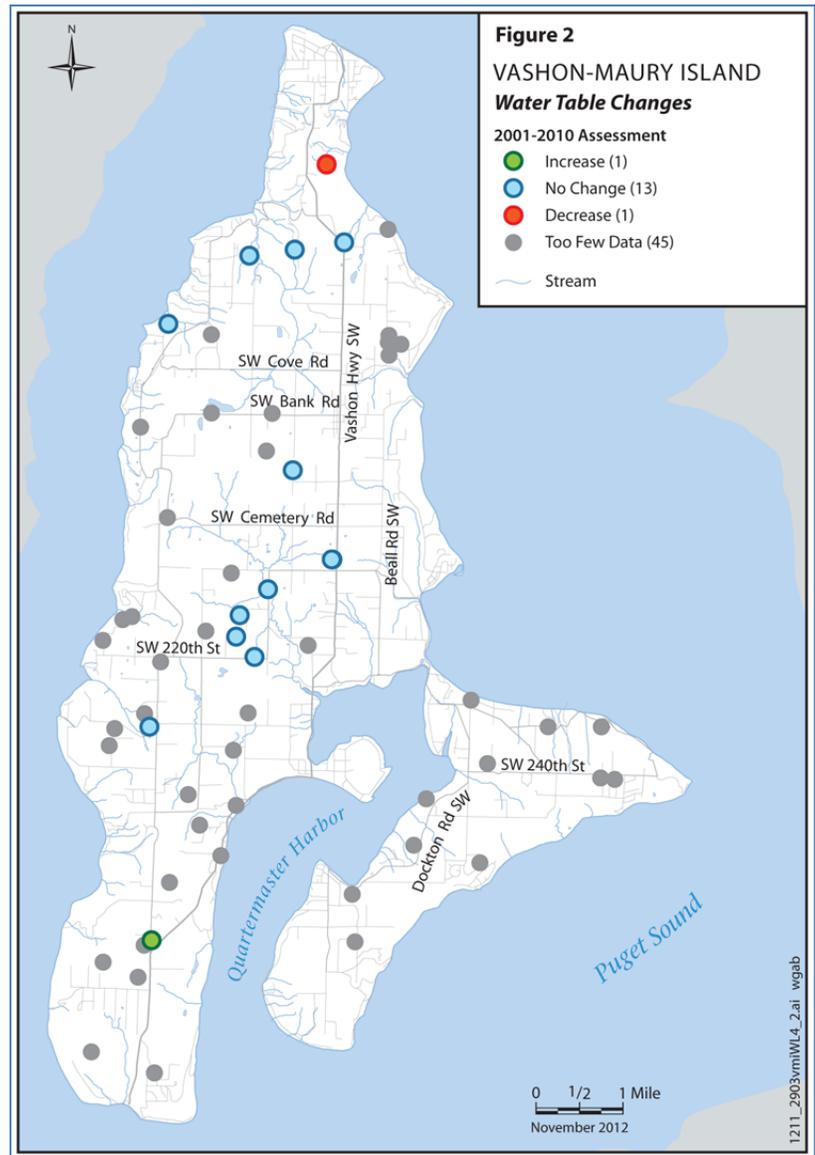
2001-2010 Assessment:

15 sites; 1 site - lower levels, 1 site - higher levels, 13 sites - no change 2001 to 2010



2001-2010 Status: One site has a decrease in the water table elevation greater than 1 standard deviation when comparing recent (2009-2010) averaged water table levels to an averaged baseline (2001-2008), Table 2. One site has a greater than 1 standard deviation increase in their recent averaged water table levels as compared to baseline. The remaining 13 sites in Table 2 have difference within 1 standard deviation of data. Another 45 sites have too few data points to assess change through time. King County has 10 monitoring wells which have a limited dataset of water levels data from 2006-2010.

Figure 2. Water level locations used in this indicator. Data shown represent recent status conditions with 1 site having lower recent water table elevation data compared to their baseline while one site has an increase in their recent water table data, Table 2. Thirteen sites have no change in the water table levels when comparing baseline (2001-2008) data to recent (2009-2010) data based on their standard deviation. The remaining 45 sites have too few data points to assess baseline.



Technical Notes Water Levels on Vashon-Maury Island

Data source: The data for this indicator comes from multiple sources including volunteers, VMI water purveyors and King County WLRD Groundwater Protection Program. Vashon-Maury Island has over 1000 wells including public water sources and individuals.

Collection frequency: A volunteering program was started in 2001 for well owner to self monitor their water levels. Four sites are currently active that started in 2001. Water purveyors monitor their sources on a regular basis and have report their data to King County upon request. The groundwater program collects water level data at 10 monitoring well locations which began in 2006. The KC wells typically have continuous data loggers recording daily water level information. Additional water level data is collected during annual water quality sampling if possible.

Methods for analysis: Total count of water level measurements per site done over 2001 to 2010. For those sites with more than 30 measurements, a baseline average was calculated. This baseline average was compared to a recent (2009-2010) average of water level measurements to assess any change greater than 1 standard deviation. One site has a decline more than 1 standard deviation when comparing recent averaged water level data to baseline. Another site shows an increase over the same time period yet has a limited dataset, Table 2. The remaining 13 sites have no change (within the standard deviation) when comparing baseline to recent data. All other sites (45) have too few data to assess changes through time. The KC well data is reported as monthly data for similar count periods as other datasets.

Data Reliability and Quality: The data quality of this indicator is high based on the KC SOP/training of data collection. The reliability is fair to good. Data reliability from the sources varies. A direct solicitation of data from the water purveyors began in 2011. Vashon-Maury Island has over 1000 wells including public water sources and individuals. King County monitors water levels in 10 monitoring wells.

Data Reference:

King County - Water Resources Evaluation Project – Data Report 2005-2009.

<http://www.kingcounty.gov/environment/waterandland/groundwater/management-areas/vashon-maury-island-gwma/vashon-island.aspx>

Table 2. Water Table elevations for baseline sites and King County Monitoring wells. For those sites with more than 30 measurements, a baseline average was calculated*. This baseline average was compared to a recent (2009-2010) average of water level measurements to assess any change greater than 1 stand deviation highlighted in color – red for sites with lower recent compared to baseline and green for sites with higher recent compared to baseline.

Site Id	Baseline (2001-08)		Recent (2009-10)		Assessment		Aquifer	
	Count	Avg-WT elev	Count	Avg-WT elev	difference	st-dev_ft		
vol_w-06	91	197.5	24	197.1	-0.5	0.5	Qva - Main	
vol_w-13	85	160.2	24	158.0	-2.2	2.2	Qpfc - Deep	
w-21	77	183.7	23	184.1	0.3	0.9	Qva - Main	
vol_w-09	77	159.7	11	160.8	1.1	3.9	Qpo - Deep	
vol_w-02	52	26.3	12	24.4	-2.0	2.9	Qpo - Deep	
w-02a	35	113.8	2	107.3	-6.4	1.5	Qva - Main	
K C W e l l s	w-60	26	179.9	15	178.2	-1.7	2.1	Qva - Main
	w-61	33	240.4	24	240.5	0.1	0.4	Qva - Main
	w-63	31	180.2	15	180.1	-0.1	0.7	Qva/Qpfc
	w-64	8	198.8	4	200.3	1.4	0.9	Qva - Main
	w-65	33	240.3	24	240.1	-0.2	0.6	Qva - Main
	w-70	1	178.4	20	178.3	-0.1	0.3	Qpo- Deep
	w-71	1	282.5	18	282.4	-0.1	0.9	Qva - Main
	w-72	1	261.4	14	260.5	-0.9	1.0	Qva - Main
w-73	1	135.7	5	134.6	-1.1	1.1	Qvr - Shallow	

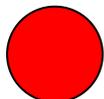
Sites w-60 thru w-73 are King County monitoring wells. Wells 60-65 were installed late 2005 and wells 70-73 were installed late 2007.

*All monitoring wells have continuous water level probes except w-73. This well data is reported as monthly data for similar count periods as other datasets. Sites w-60 and w-64 had multiple rounds of well development which affected the water level data and have lower count values as a result. Site w-62 is "dry" – no water in the screen zone. The continuous data supports the depth to water data noted above.

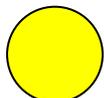
A collaboration of Vashon-Maury Island Groundwater Protection Committee and King County

Legend

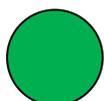
2010 Finding



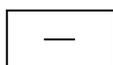
Poor Conditions: Reported data are above Maximum Contaminant Level (MCL) and/or fails to meet the state standard or criteria for a given indicator; needs improvement.



Fair Conditions: On average, data fell between the standard or criteria for “poor” and “good” and may be variable.

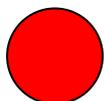


Good Conditions: Reported data are below MCL and/or meet the state standard or criteria for a given indicator.



No Annual Assessment

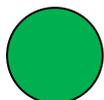
2001-2010 Status



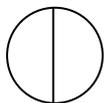
Downward Trajectory: 2001-2010 data shows decreasing or worsening conditions



No Change: 2001-2010 data shows no change with time.



Upward Trajectory: 2001-2010 data indicate increasing or improving conditions



Insufficient Data: reported data has too few data points and/or too short a period

