



**CITY OF BOTHELL
MODEL TO ESTIMATE ENVIRONMENTAL IMPACT
FROM HOME CAR WASHING**

BACKGROUND

The City of Bothell is interested in estimating the environmental impacts and type of interventions the City may choose to undertake -- including The model below is based on similar research undertaken by other jurisdictions, as well as possible stream loading. Assumptions, implications: spreadsheet.

MODEL

METRIC	DATA	NOTES
Households in Bothell	17,035	1
Percent of homes with home car washers	47%	2
Frequency of washes per year	5	3
Cars per household	1.89	9
Percent on paved area	57%	4
Washes per year at home on pavement	43,127	5
Gallons of fresh water per car wash	50	6
Gallons per minute	2.5	7
Minutes per car wash	20	7
Gallons of detergent per car wash (16 ml)	0.004	10
Gallons of water to mix detergent per car wash	4	
Gallons of total effluent per car wash	54.004	
Gallons of effluent/ year on pavement & streets	2,329,017	8

This is the equivalent of over 46,000 full bathtubs per year, or over 1.1

Note that Source 2 and Source 4 indicate that at likely real world, at-stre

significant mortality and other health impacts on fish and aquatic life in summer months when car washing activity is high and stream volumes

NOTES

- 1 Households are used here, rather than population, to best match the state data (see "Stormwater Runoff..." under Sources). We also assume that all impervious surfaces contribute to runoff.
- 2 The Elway Research Poll's number of washers at home did not include washers at work. This data input is conservatively low.
- 3 According to the "*Stormwater Runoff*" survey, 20% of car washers was used in the calculation, this would be six times per year. Other sources consulted include "*Washwater...*", both referenced below. The first study utilizes a water quality survey (see "Water Quality Survey; Water & Land Resources Div., King County, 1997") that estimates car wash frequency in the Puget Sound Region as once every two weeks. It does not give a sense of whether this is year-round or not. This would be 26 washes per year, which seems extraordinarily high. The latter study also does not provide clarity on whether the car wash frequency is year-round or not; it estimates that 73% of car washers wash their cars year-round. We have chosen to use the conservative figure of five washes per year so that our maximum estimate. In this instance, and throughout this model, we have chosen the most conservative outcome is as verifiable and replicable as possible. We have also made the model conservative for summer months, so the "5 washes per year" figure we are using likely represents the highest impact is highest due to concentrations of harmful chemicals. (See also note 4.)
- 4 This number can be tracked over time through subsequent Elway Research Polls as behaviors are changing over time.

5 This figure is calculated by multiplying the above five variables. Another
The 2014 estimated statewide passenger vehicle registrations per capita:
WA Office of Financial Management: (<http://www.ofm.wa.gov/budget/ir>)
This allows the following alternative calculation, similar to the Federal Way
* 54.004 gal's/wash * 47% home washers * 57% pavement washers =
This figure is somewhat comparable to this model's determination.

Note that Federal Way has used a calculation relying on vehicle registra
below in this spreadsheet based on Source 4. The results for Bothell are
This is primarily due to Federal Way's much higher estimate of the frequ

6 This metric is calculated by multiplying the two variables below it.

7 These two variables are open for interpretation. Though based on the S
exist, and these are clearly important variables that have considerable i
model based on their scale. The City may choose to perform a sensitivity
brackets of higher and lower estimates for these variables.

Variations can include the rate of water flow in the hose, and whether th
It is also important to note that this metric will have an impact on soap
estimates for stream impacts.

Note that the Federal Way and Kitsap High School sources both use an e
assuming a low flow nozzle [p.8 and p.6, respectively]. The Kitsap Coun
The Puget Sound Car Wash Association fact sheet estimates between 80
The average, unrestricted garden hose delivers approximately 5 gpm, a
continuously running, that would result in 100 gallons of water per car v
compromise between an restricted and unrestricted hose. While that est
for Bothell's purposes.

8 This model does not account for evaporation of run-off during car washi
by other conservative assumptions in this model, but soap and petroche
washed to stream during subsequent rain events.

9 This is a rough estimate based on the average of two approaches. First,
(<http://www.energy.gov/eere/vehicles/fact-573-june-1-2009-vehicles-c>)
(<http://www.wsdot.wa.gov/planning/wtp/datalibrary/population/number>)
Second, household vehicle ownership (Oak Ridge National Laboratory Tr
<http://cta.ornl.gov/data/chapter8.shtml>) applied to Bothell's population
The average then is 1.89 cars/ HH. $[(.87*2.4)+(1.7)]/2$

This is the ratio per the product instruction sheet.

SOURCES

- 1 Characterization of Runoff from Charity Carwashes in the Dyes Inlet Watershed; Kitsap High School
- 2 Practical Fish Toxicity Test Report; Environmental Partners, Inc.; March, 2007
- 3 Puget Sound Car Wash Association, 10 Facts About Professional Car Washing and Water Consumption
- 4 Residential Car Washwater Monitoring Study; City of Federal Way Public Works Department, Survey
- 5 Runoff from Fundraiser Car Washing: A Situational Analysis; Kitsap County Public Works Surface Water
- 6 Stormwater Runoff: Awareness, Attitudes and Behavior; April 2012; Prepared for Cities of Bellevue
- 7 United States Census: <http://quickfacts.census.gov/qfd/states/53/5307380.html> plus annexation

FEDERAL WAY MODEL

Bothell car washes/ year draining to stream 43,462 Based on:

Car Wash Frequency	Percent of Home Car Washers	Number of Bothell Driveway Washes
Once per week	11%	4,781
2 or 3 times per month	27%	11,735
Once per month	32%	13,908
Every other month	14%	6,085
2 or 3 times per year	13%	5,650
Once per year	3%	1,304
Total Annual car washes draining to stream		43,462

Updated 5-31-14

FACTS

s from home car washing. This information will inform
ig policy, programmatic, enforcement and educationa
isdictions, and provides estimates for the volume of c
s and caveats are presented in the footnotes below th

SOURCES

Source #7:

Source #6: P. 10.

Source #6: P. 5.

See note 9

Source #6: P. 10.

Calculation w/in Model

Calculation w/in Model

Source #1 & Source #5

Source #1 & Source #5

Source #2:

Source #2:

Calculation w/in Model

Calculation w/in Model

bathtubs of water per Bothell resident per year.

ream dilutions, the run-off from home car washes will

streams reached by the run-off. This is particularly true for streams with low flow rates, resulting in higher contaminant concentrations.

Statistically significant survey data from Elway Research shows that 70% of residential surfaces near homes drain to streams.

Car washers that wash both at home and at a car wash. The

study shows that car washers wash their car at least every other month. At its most significant, the study includes "Characterization of Runoff..." and "Residential Car Washes: A Field-based Study (Hardwick, Lake Sammamish Watershed)". The study estimates the frequency of residential car washing in the area, whether this is a year-round figure or just during high season.

The frequency reported was between 6 and 36 times per year. For this Model we will use a conservative estimate rather than a maximum estimate. We have erred on the side of conservative assumptions so that the assumption that most car washes happen during high season will all happen when stream volumes are lowest, and environmental impacts will be minimized. (Note 5. re. the Federal Way estimate of car washes)

Additional monitoring and water quality data, which can help demonstrate whether target

· approach would be to rely upon vehicle registrations
a figure is: .92 based on
ifo/Feb12transpovol3.pdf).
/ay Model: .92 reg's./ capita * 41,440 pop. * 6 washe
3,309,463 total gallons effluent/ year on pavement {

tions [See below]. That model has been run
e 17 times higher than this model would predict.
ency of car washing at 21 washes/ person/ year.

ources listed, other estimates for these variables
mpact on the overall outcome of the
ty analysis on these variable by running the analysis

re hose has an auto shut-off handle.
and petrochemical dilution, and will therefore effect t

estimate of 20 gallons of water used per vehicle wash
ity Public Works study uses a figure of 5 to 30 gallons
and 140 gallons of water are used for a home car wa
nd if we assume a 20 minute car wash with the hose
wash. We will use a figure of 2.5 gallons per minute a
timate may be on the high side, we feel it is most acc

ng. Not only is evaporation likely minimal, and made
ymical residue would remain on the impervious surfac

light vehicles per person, .87
:apita-state) multiplied by 2.4 people per household
rofhouseholds.htm).
ransportation Energy Data Book Chapter 8, Table 8.5:
n, resulting in 1.7 cars per HH.

chool Science Department; Bill Wilson, Science Teacher.

nption

rface Water Management Division, September 2009.

Water & Stormwater Management Program; Kirschbaum and Fohh; S
vue, Bothell, Kenmore, Kirkland, Redmond & Shoreline by Elway Resea
on figures from J. Geer, City of Bothell.

Bothell Registered Vehicles * 38% "driveway car washers"

Annual Bothell Driveway Car Washes	Car washes per year per segment of 100 people	
248,604	572	
422,453	972	
166,895	384	
36,508	84	
16,950	39	
1,304	3	
892,715	2,054	
	Washes/ person per year	20.54