1. **Data Set Title**: Binary Output, 2010-2099, for Willamette Water 2100 Modeling Scenarios, Output Version 3.0

2. **Abstract**: Binary output from nine modeling scenarios developed by the Willamette Water 2100 project. The output was generated by Willamette Envision, a computer model developed to explore future water supply and demand under different trajectories of climate change, demographic change and water management (http://inr.oregonstate.edu/ww2100). This output is called WW2100 3.0 and was generated by Willamette Envision code version 330 and 331 as archived in the WW2100svn repository (https://freshwater.ceoas.oregonstate.edu:8443/svn/WW2100svn). Binary output data are grouped into zip files that specify modeling scenario name (e.g. Ref_binaryData.zip, Extreme_binaryData.zip). Refer to the scenario table (PDF) and Willamette Water 2100 web page (http://inr.oregonstate.edu/ww2100/model-overview/scenarios) for a description of each scenario. The binary data are available for eight WW2100 scenarios including: Ref, HighClim, LowClim, FireSuppress, HighPop, UrbExpand, EconExtreme, Extreme, and Managed. The binary data include values for each map polygon (called an Integrated Decision Unit, IDU) and each day (January 1, 2010-December 31, 2099). There are 164,892 polygons covering the spatial extent of the Willamette River Basin in Western Oregon, USA.

3. **Recommended data citation**: Willamette Water 2100 Project Team. 2016. Binary Output, 2010-2099, for Willamette Water 2100 Modeling Scenarios, Output Version 3.0. Oregon Hydrologic Information Server.

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5. **Related publications***:* http://inr.oregonstate.edu/ww2100/publications

6. **Methods**: Willamette Envision is a whole watershed model, i.e. it attempts to represent all the significant processes related to the supply and fate of water in the entire basin. These processes are both natural (e.g. precip, snow dynamics, infiltration, runoff, evapotranspiration) and human (e.g. reservoir operations, irrigation, municipal water use, crop choice). The model takes exogenous projections of climate, population, and income as its drivers. It operates by simulating the processes across the entire basin for one time step, recording the effects on the landscape, and then advancing to the next timestep. Some processes are modeled at a daily timestep, for example streamflow and evapotranspiration, while others are modeled at an annual timestep, such as population growth and urban expansion. Refer to the Willamette Water 2100 website for more details about Willamette Envision (http://inr.oregonstate.edu/ww2100). Refer to the IDU

metadata description for details about how IDU polygons were created. Refer to the scenario table (PDF) and Willamette Water 2100 web page.

7. (http://inr.oregonstate.edu/ww2100/model-overview/scenarios) for a description of each scenario. The binary data include values for IDU and each day (January 1, 2010-December 31, 2099). Every modeled year has exactly 365 days. Input daily climate data, was resampled for leap years to reduce 366 days to 365 days. The first resampled day represented all of the original January 1 plus 1/365 of the original January 2. The second resampled day represented 364/365 of the original January 2 plus 2/365 of the original January 3, and so on.

List of binary files output for each scenario:

filename	Description	Units
LULC_A.flw	Coarse land cover (see documentation for classification)	-
LULC_B.flw	Finer land cover (see documentation for classification)	-
MAX_ET_yr.flw	Maximum ET for each year	mm
Q.flw	Daily discharge	cms
SWE_April1.flw	Snow Water Equivalent (SWE) on April 1	mm
SWE_Max	Maximum SWE value during the year of the liquid water equivalent volume, in cubic meters, of all the snow in the HRU where the IDU is located. To get the value in units of mm SWE, divide by the area of the HRU. The code determines which day of the year has the most snow for the WRB as a whole, and then stores that day's snow for each HRU as SWE_Max. As a result, SWE_MAX is specific to the HRU in which the IDU is located, but is not necessarily the maximum SWE for that particular HRU, since the actual day of max snow may vary from HRU to HRU.	m^3
age.flw	Forest stand age	years
et_yr.flw	Total annual actual evapotranspiration	mm/year
irrig_yr.flw	Total annual irrigation	mm/year
lai.flw	Leaf area index (only calculated for forested areas)	-
precip_yr.flw	Total annual precipitation (January-January)	mm/year

runoff_yr.flw	Total annual runoff to the stream network	mm/year
storage_yr.flw	Total annual storage	mm/year

Description of Stream Discharge File (Q.flw)

The stream discharge file includes a short header. Following the header, the main file contents are comprised of simulated stream discharge for each reach, for each day, for each year.

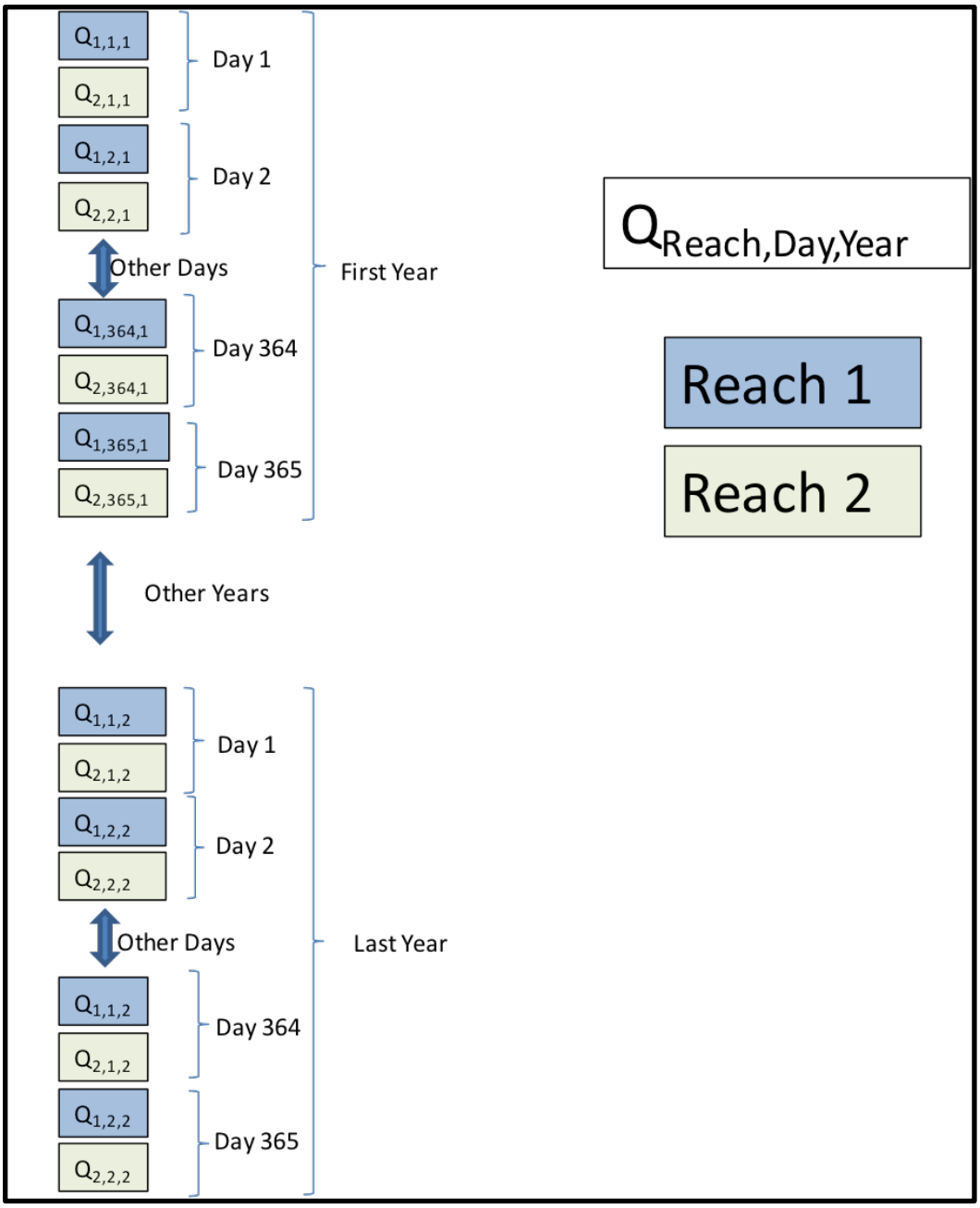
Header:

Start Position	Field	# elements	Units	Type
Byte 0	Version of file	1	-	Integer(4)
Byte 4	Name of element	64		Char(1)
Byte 8	Number of years	1	-	Integer(4)
Byte 72	Number of HRUs	1	-	Integer(4)
Byte 76	Number of layers	1	-	Integer(4)
Byte 80	Number of polys	1	-	Integer(4)
Byte 84	Number of reaches	1	-	Integer(4)
Byte 88	Number of data elements (1)	1	-	Integer(4)
Byte 92	zero-based offset of each polygon in the shapefile	# reaches	-	Integer(4)

Main File Contents:

Start Position	Field	# of elements	Units	Type
Byte 92+#Reaches*4	Stream discharge for each reach, day, and year	#Reaches*#years*365	m^3/s	Float(4)

An example of the main file contents, representing a stream with two reaches, is depicted below.



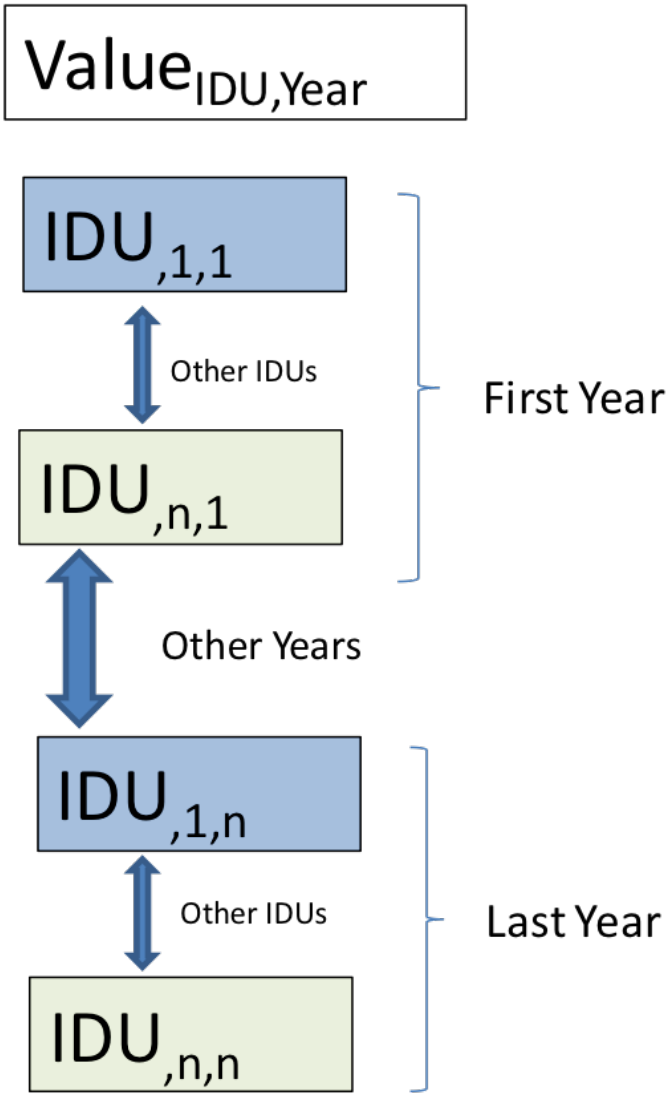
Polygon Output File:
There is a separate polygon output file for each output element. The format of each of these files is the same, with the only difference between each of them being the simulated data that are included. Each file includes a header that is very similar to that for the stream output file. The complete definition is below. The majority of the file is comprised of a single value for each polygon and for each year. These files together describe a number of components of the land cover projections and of the hydrologic cycle. The hydrologic cycle is characterized as a set of rates that are all presented as annual totals.

Header:

Start Position	Field	# elements	Units	Type
Byte 0	Version of file	1	-	Integer(4)
Byte 4	Name of element	64		Char(1)
Byte 68	Number of years	1	-	Integer(4)
Byte 72	Number of HRUs	1	-	Integer(4)
Byte 76	Number of layers	1	-	Integer(4)
Byte 80	Number of polys	1	-	Integer(4)
Byte 84	Number of reaches	1	-	Integer(4)
Byte 88	Number of data elements (1)	1	-	Integer(4)
Byte 92	Area of each polygon	# polys	m^2	Float(4)
Byte 92+#polys*4	Zero-based offset of each polygon in the shapefile	# polys	-	Float(4)

Main File Contents:

Start Position	Field	# elements	Units	Type
Byte 92+(#polys*4)+ (#polys*4)	Output values for each IDU and year	#polys * #years	vary	Float(4)



8. **Location:** Hydrologic Unit Code: 170900

9. **File format:** binary

10. **Related Documentation**:
    WW2100_ScenarioTable.pdf
    Notes.pdf - notes on how this version of code differs from previous versions
    Scenario_Comparison.xlsx - comparison of how model output differs from output from earlier code versions
    Binary processing scripts and instructions.zip - this contains instructions plus Matlab and Python code for converting SWE and ET binary data to csv files. The csv files were used to create the interactive maps on the website.

11. **Sponsorship**: Generation of this data set was supported by the National Science Foundation under Grants No. 1039192 (OSU), 1038925 (PSU) and 1038899 (UO).

12. **Overview of project and disclaimer**: The Willamette Water 2100 project was a six year collaborative research effort by Oregon State University, Portland State University and the University of Oregon to evaluate how climate change, population growth, and economic growth will alter the availability and the use of water in the Willamette River Basin on a decadal to centennial timescale. The project team developed a computer model, called Willamette Envision, that integrates aspects of hydrology, ecology, and human systems, and allows scientists and stakeholders to explore the interaction between land and water management policies, economics, climate, and ecology. The project was supported by grants from the National Science Foundation and was carried out between 2010 and 2016. Any opinions, findings, and conclusions or recommendations expressed by this work are those of the authors and do not necessarily reflect the views of the National Science Foundation.

13. **Keywords**: Envision, Water Sustainability and Climate, water scarcity, Willamette River Basin

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