2018 Nisqually Watershed Planning Sub-Basins

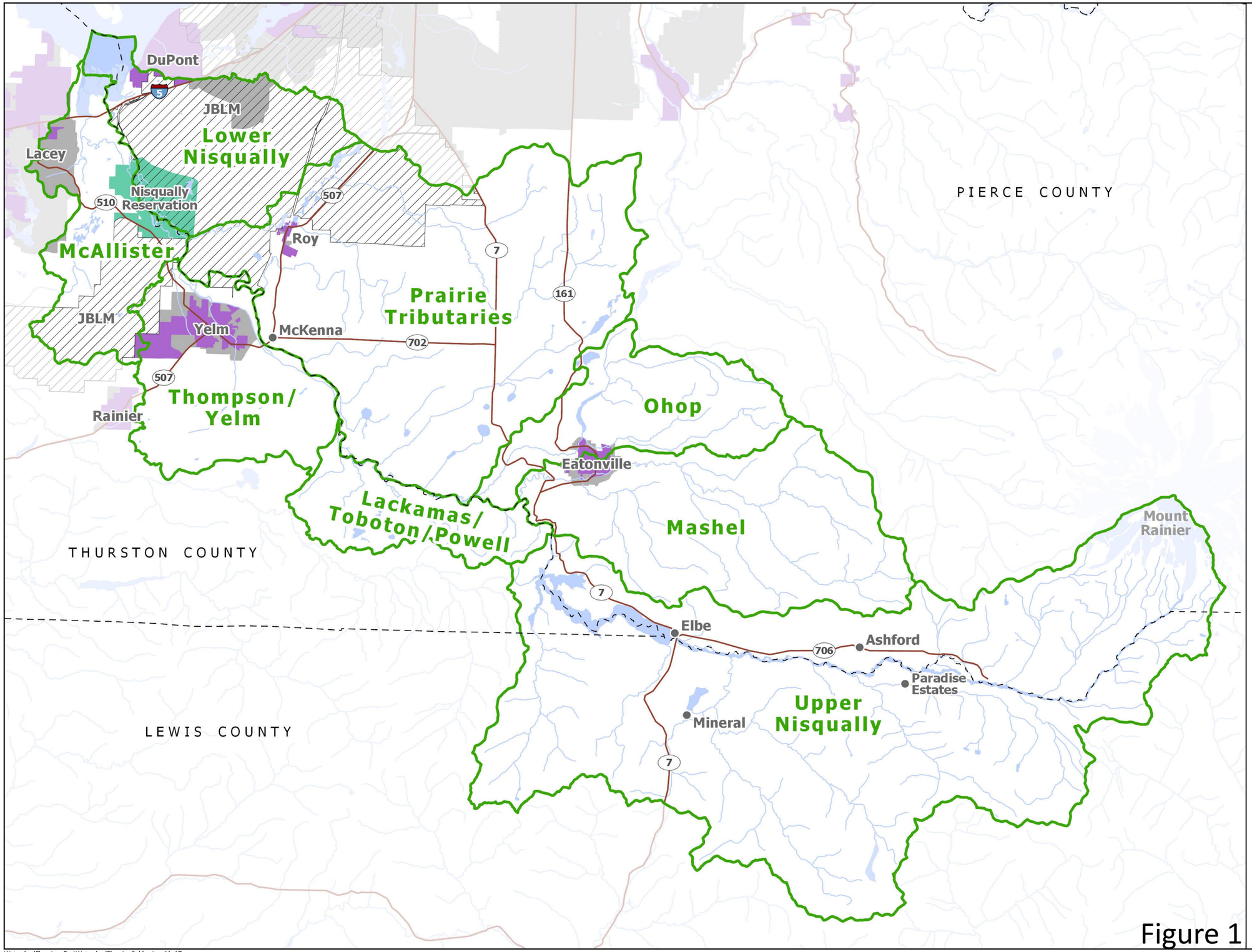

Figure 1

- County Boundaries
- Watershed Planning Sub-Basins
- Incorporated UGA
- Unincorporated UGA
- Nisqually Reservation and Adjacent Trust Land
- Joint Base Lewis-McChord

N
W E
S

Miles
0 2 4 8

Data derived from: City Urban Growth Areas - WSDOT; County Boundaries - WADNR; Joint Base Lewis-McChord Installation Area - JBLM; Sub-basins - Nisqually Indian Tribe;

Note: Sub-basin boundaries originated from WADNR's Watershed Administrative Units which were clipped to WADOE's Nisqually Water Resource Inventory Area and then manually modified using lidar and other terrain data as a guide. These sub-basins were then combined into logical groupings by the Nisqually Water Planning Unit for the purposes of this project.

Nisqually Indian Tribe

Cartography by: J.Cutler, 12/18/2018

WatershedPlanning_Pro\WatershedPlanningSubbasins_11x17

Control Station Number/Stream Management Unit Name	Affected Stream Reach
*New Gage Nisqually River	From influence of mean annual high tide at low base flow levels to the outlet of the Centralia City Light Power Plant
12-0895-00 Nisqually River (closed June-October)	From outlet of the Centralia City Light Power Plant at RM 12.6 to Centralia City Light Power canal diversion at River Mile 26.2, including all tributaries
12-0884-00 Nisqually River (closed June-October)	From the Centralia City Light Power canal diversion at RM 26.2 to gage 12-0865-00 near the La Grande Power Plant, including all tributaries except the Mashel River
Nisqually River Above La Grande	From gage 12-0865-00 near the La Grande Power Plant to the headwaters, including all tributaries.
12-0870-00 Mashel River (closed June-October)	From mouth upstream to the headwaters including all tributaries

2018 Nisqually Watershed Planning

Nisqually River Reaches, Instream Flow Control Points, and Administrative Actions

- Instream Flow Control Points
- Other Gages

Administrative Actions - Streams
- Closure
- Low Flow

Mainstem Nisqually Reaches
- Lower Reach
- Middle Reach
- Upper Reach

Administrative Actions - Lakes
- Closure
- Low Flow

- Watershed Planning Sub-Basins
- County Boundaries
- Nisqually Reservation and Adjacent Trust Land

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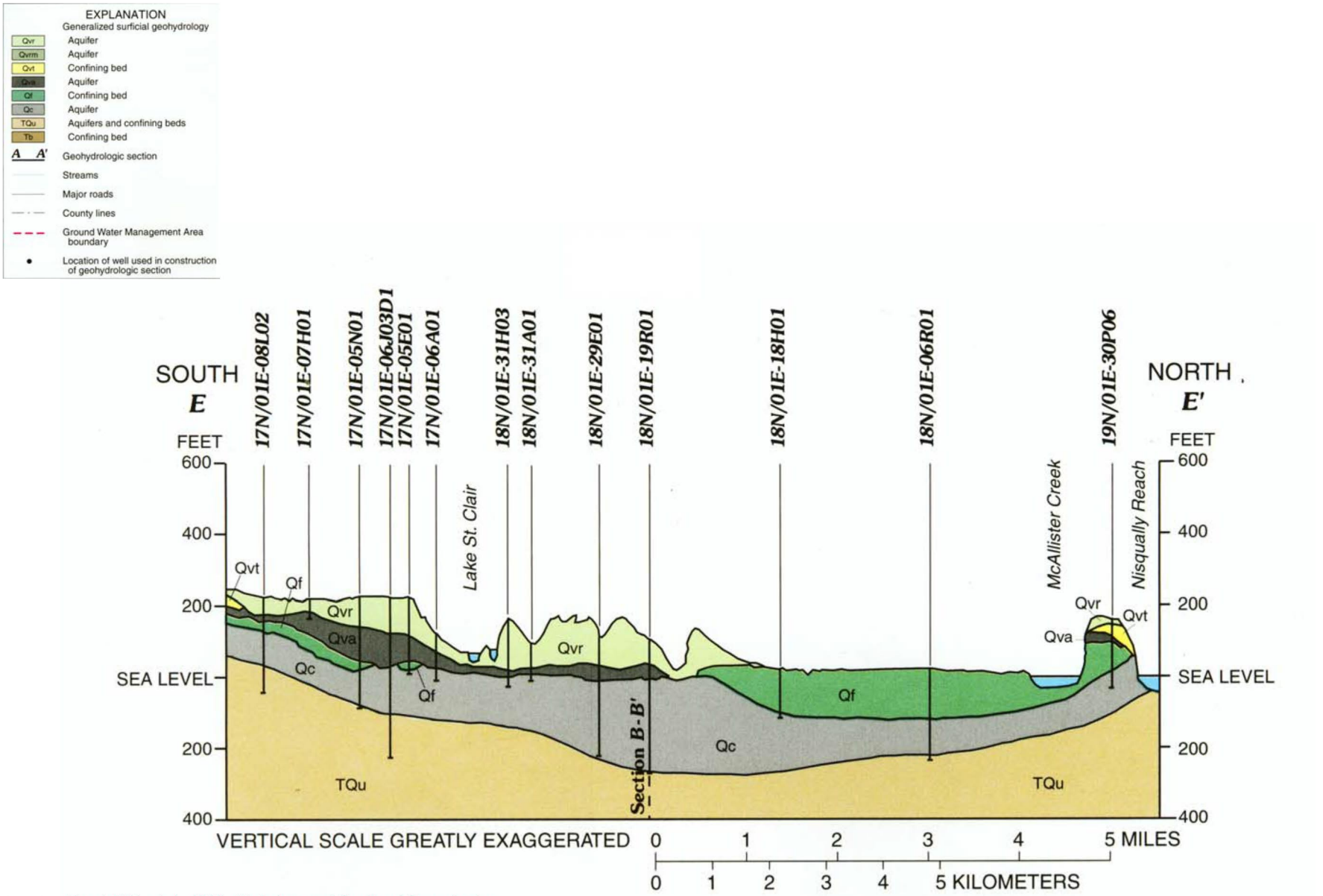
Data derived from: Administrative Actions, Instream Flow Control Points, Mainstem Reaches - Nisqually Watershed Management Plan, 2003; Basedata - ESRI World Ocean Basemap Service, USGS, WADOE, WSDOT

Nisqually Indian Tribe

Cartography by: J.Cutler, 12/20/2018

Figure 2

WatershedPlanning_Pro\WatershedPlanningClosures_11x17



SOURCE: Drost, BW., et.al., 1998. *Hydrology and Quality of Groundwater in Thurston County, Washington*. USGS Water Resources Investigations Report 92-4109. Figure reproduced from: Well Locations, Surficial & Geohydrology, and Geohydrologic Sections - PLATE 1.

GEOHYDRAULIC CROSS SECTION: LAKE ST. CLAIR TO NISQUALLY REACH

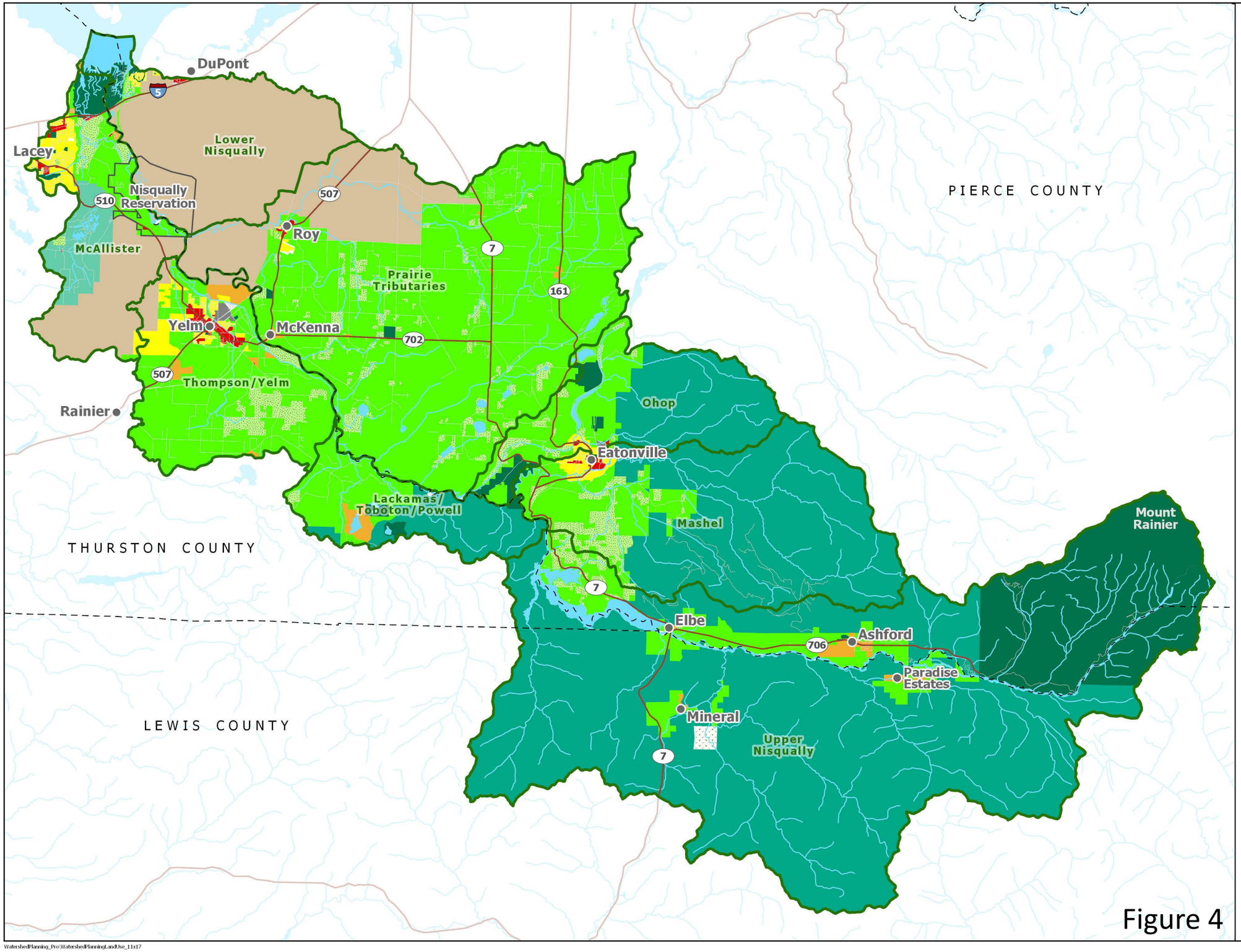
NISQUALLY TRIBE/WATERSHED PLAN/WA

DRAWING NO. 0231248208fg02.fh11 DATE 09/25/03 DRAWN BY EFS

Golder Associates

Figure 3

2018 Nisqually Watershed Planning General Land Use



County Boundaries
Watershed Planning Sub-Basins
Nisqually Reservation and Adjacent Trust Land

General Land Use

- Active Open Space and Recreation
- Forest Lands
- Natural Preservation and Conservation
- Agricultural Area
- Rural Character Residential
- Intensive Rural
- Urban Character Residential
- Intensive Urban
- Military
- Mineral Resource Area
- Industrial
- Undesignated
- Right of Way
- Water

N W E S

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Data derived from: General Land Use - WA Department of Commerce (Puget Sound Mapping Project - Pierce and Thurston Counties), Lewis County, Nisqually Watershed Planning Unit; Sub-basins - Nisqually Indian Tribe

Note: WA Department of Commerce General Land Use categories and symbology were used on this map except for the Intensive Rural category which was added by the Nisqually Watershed Planning Unit. Areas identified as Intensive Rural are Limited Areas of More Intensive Rural Development (LAMIRDs) consistent with the Washington State Growth Management Act.

Nisqually Indian Tribe

Cartography by: J.Cutler, 12/18/2018

Figure 4

WatershedPlanning_Pro\WatershedPlanningLandUse_11x17

Table 7-2: Summary of WRIA 11 Watershed Mitigation Options

	Mitigation Strategy	Description	Sub-Basin(s)	Timing of Benefits	Project Assumptions	Annual AF Benefit (AF) MIN	Annual AF Benefit (AF) MAX	Streamflow Benefit (cfs) MIN	Streamflow Benefit (cfs) MAX	Ecological Benefits	Uncertainties	Reference
Demand Reduction	**Yelm Offset Action 1**	Connect new development in Yelm UGA to City water service using deep well	Thompson/Yelm	Year-Round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	240.5	240.5	0.33	0.33	Streamflow increases equal to the amount of consumptive water saved.	Water right permitting	Section 5.1.1 Appendix L
	Upper Nisqually Sub-basin regulatory status	Mitigation not required because sub-basin is not closed and ISFs are normally met	Upper Nisqually	Year-Round	49 Acre-Feet	49	49	0.067	0.067		Drought conditions could result in ISFs not being met	Section 3.3.8 Appendix B
Micro Mitigation Sub-Basin Strategies	**Deep Groundwater Option 1**	Complete new P-E wells only in deeper aquifers	All Sub Basins	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).					Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits	Section 5.1.1
	Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).					Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits	Section 5.1.1
	Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).					Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions	Section 5.1.1
	Water Right Acquisition	Purchase and retire water rights	Prairie Tributaries	Irrigation season	Water right specific - Tier 1 only	0	673	0	0.93	Streamflow increases equal to the amount of consumptive water saved.	Funding for analyses and purchases, consumptive use volumes, water right owner willingness to sell.	Section 5.1.2 Appendix K
	Yelm Offset Action 2	Connecting existing Permit-Exempt uses to Yelm's water service	Thompson/Yelm	Year-round	10% of existing wells replaced, consumptive use portion is credited (0.249 AF per connection).	10.4	10.4	0.014	0.014	Streamflow increases equal to the amount of consumptive water saved.	Assume 10 % of existing wells in service area, funding permitting	Section 5.1.1
	Yelm Offset Action 3	Infiltration of reclaimed Class A water to provide mitigation	Thompson/Yelm	Year-round	Additional recharge of reclaimed water	87	400	0.12	0.552	Streamflow increases equal to the amount of reclaimed water discharged to the shallow aquifer.	Funding, permitting, reclaimed water volume, site-specific factors	Section 5.1.1
	Pierce County Stream Restoration	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Prairie Tributaries	Year-round	Assume 0.0096 cfs/mile of linear channel and 6-60 miles	41.7	417	0.0576	0.576	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Thurston County Stream Restoration - Thompson/Yelm	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Thompson/Yelm	Year-round	Assume 0.0096 cfs/mile of linear channel and 1.6-16 miles	11.12	111.2	0.01536	0.1536	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Thurston County Stream Restoration - Lackamas/Toboton/ Powell	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Lackamas/Toboton/Powell	Year-round	Assume 0.0096 cfs/mile of linear channel and .23-2.3 miles	1.6	15.9	0.002208	0.02208	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Mashel, Ohop, Prairie Tribs, Upper Nisqually, Lower Nisqually	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit	0	1000	0	2.7626	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors	Secton 5.1.3 Appendix M
	Barrier Removal Projects	Culvert Replacement	Lackamas/Toboton/Powell	Year-round	Peissner Road Project 3.03 Acre-Feet (0.0023 cfs)	1.67	1.67	0.0023	0.0023	Re-open stream reaches & habitat, increase low flows	Funding, analyses, permitting	Section 5.1.4 Table 5-6
Salmon Recovery Strategies	**Mashel Watershed Community Forest**	Forest Management, protection, acquisition, restoration	Mashel	Year-round	rate of purchase is linear and begins in year 1 - and compounds	1699	3798	2.347	5.246	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Eatonville Capital Improvement Projects	Implementation of highest priority stormwater comprehensive plan projects	Mashel/Ohop(1)	Summer - Fall	0.659 - 1.843 AFY[2]	38.7	38.7	0.128	0.128	Increased streamflow, improved water quality	Funding, modeling uncertainties	Section 4.2.2 Table 4-4 Appendix H
	Eatonville Water System Conservation	Leak detection and repair	Mashel	Year-round	N/A	69.35	69.35	0.096	0.096	Increased streamflow	Funding, unauthorized water uses	Section 4.2.2 Table 4-4 Appendix I
	Eatonville ASR	Capture high winter flows, recharge and store in the volcanic aquifer for recovery during high-demand season	Mashel	Summer - Fall	20 - 80 Acre-Feet [2]	20	80	0.11	0.45	Increased streamflow	Funding, aquifer hydraulic properties, groundwater quality, ability to store water, impacts during recovery	Section 4.2.2 Table 4-4 Appendix H
	Eatonville Alternative Water Supply	Relocate Eatonville's water intake from Mashel River near town to mouth of Mashel River or Alder Lake	Mashel	Summer	95 Acre-Feet (0.8 cfs)	95	95	0.8	0.8	Increased streamflow	Funding, property ownership, right-of-way access, water quality	Section 4.2.2 Table 4-4 (Golder, 2010)
	Ohop Phase IV Floodplain Restoration & Protection	Floodplain reconnection and stream meandering, engineered log jams, re-vegetation	Ohop	Year-round	24.4 Acre-Feet/yr	24.4	24.4	0.0173	0.0173	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow season.	Project funding and land secured - low uncertainty	Section 4.2.3 Table 4-5 Appendix E
	Ohop Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Ohop	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	0	1112	0	1.5356	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Bald Hills Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Toboton/Lackamas/Powell	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	80.9	487	0.1117	0.6727	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Upper Nisqually Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Upper Nisqually	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	0		0		Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
TOTAL						**2470**	**8623**	**4.22**	**14.36**			

[1]All Eatonville CIP Projects are accounted for in Mashel Sub-basin (In actuality CIP 1&2 are in Mashel; 3&4 are in Ohop; 5&6 are on the divide between the two sub-basins)

[2] Seasonal flow benefit only. CFS shows maximum seasonal benefit; Annual AF shows total benefit averaged over one year. See Chapter 4 and Appendices for assumptions.

Figure 5