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Nitrogen Inventory in the Nooksack-Fraser Transboundary Watershed

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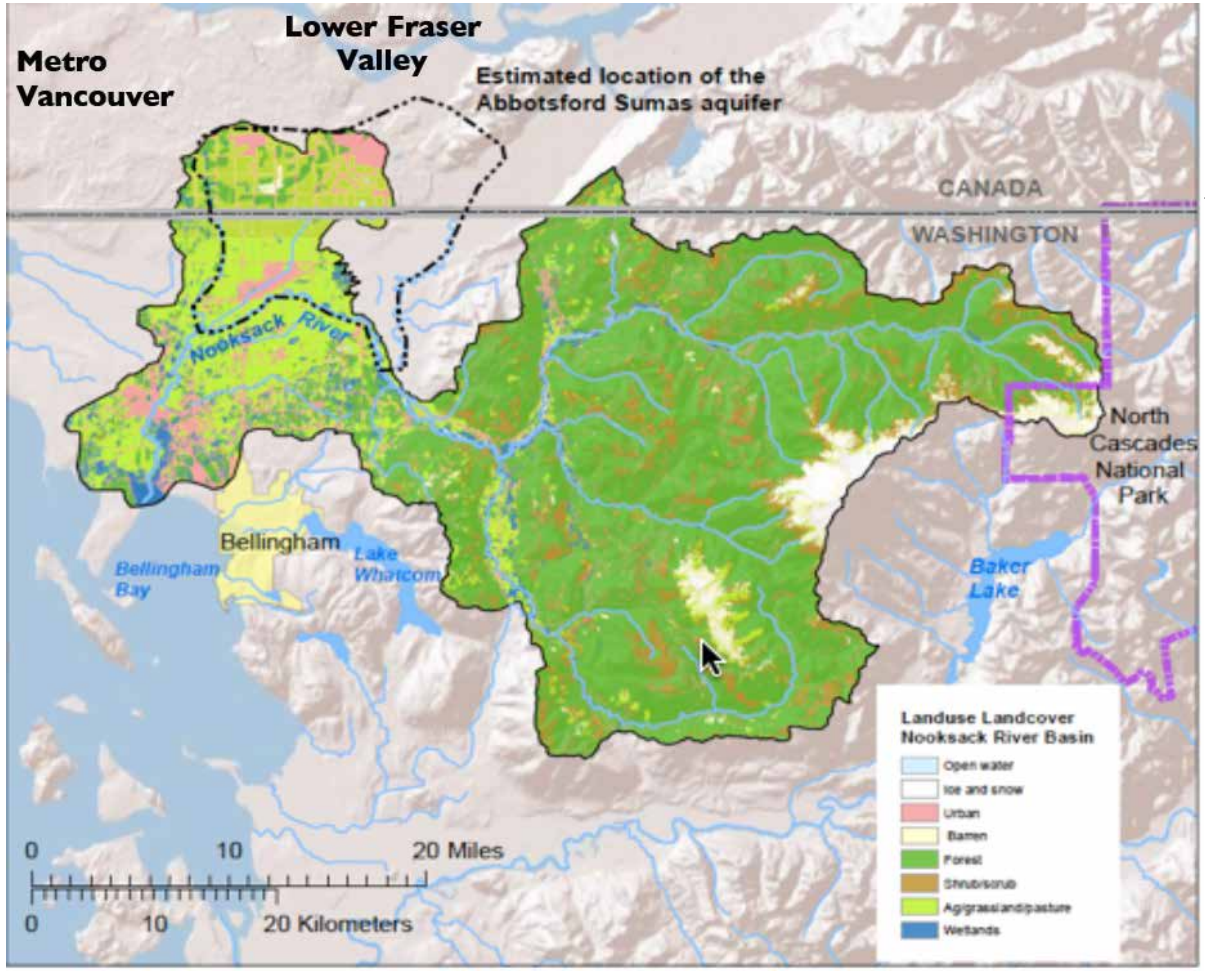
SSEC, Seattle, April 6, 2018

Outline

- Nooksack-Fraser Transboundary nitrogen study (NFT-N)
  - Project and our goals
- Nitrogen budget
  - Method and data sources
  - Preliminary results
- Future work
  - Link to International Nitrogen Management System

Nooksack-Fraser Transboundary Watershed



- Cities, farms, dairies, shellfish operations in BC and WA watershed
- Surface water, groundwater, and air quality issues related to nutrients

Surface water quality issue

- Nooksack River drains to the bay
- Algal bloom
- Biotoxin—shellfish closure
- Hypoxia
- Nutrient enhanced ocean acidification

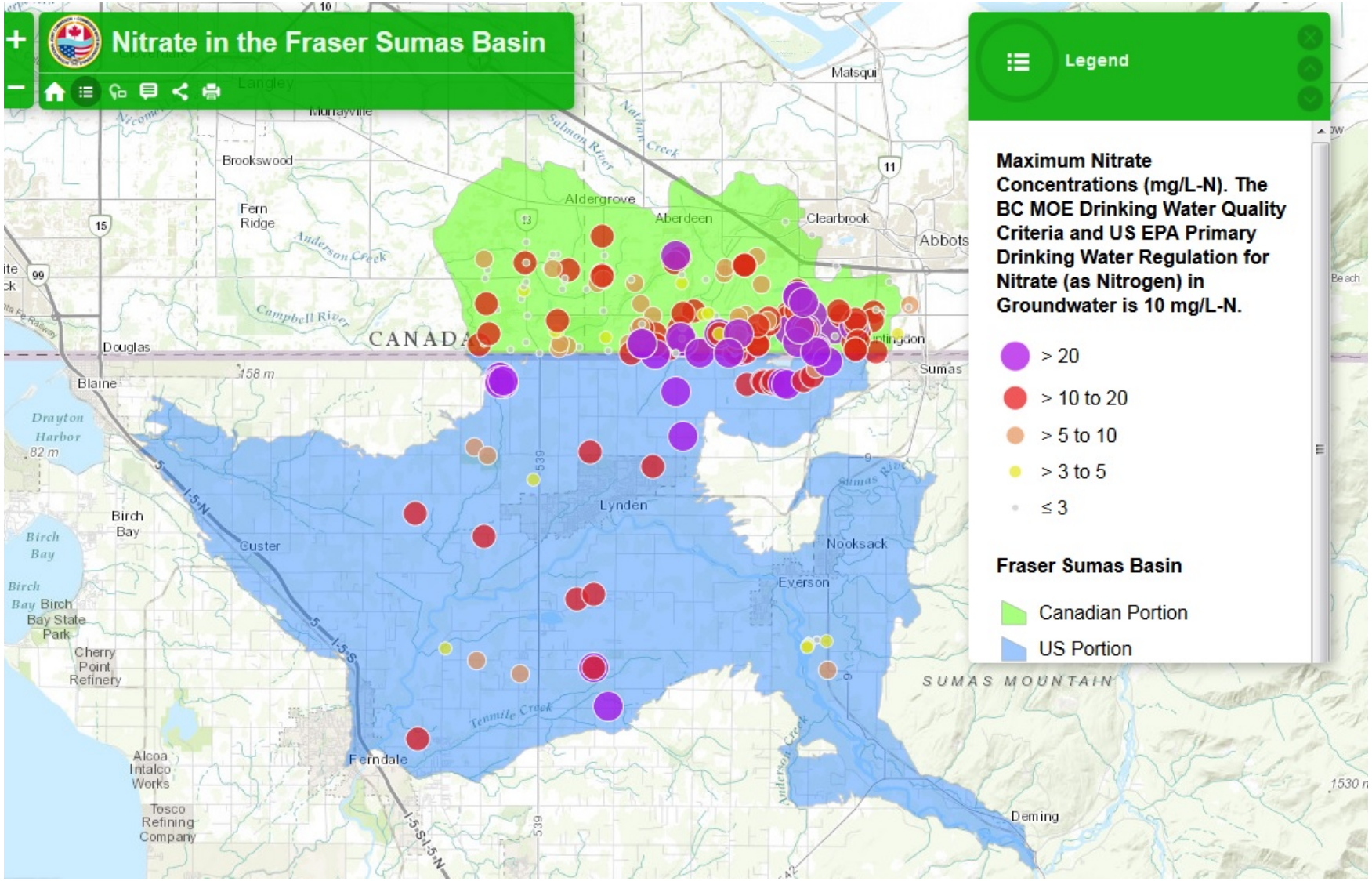
(Photo by Miriam Godfrey)

(Photo credit: University of Washington)

(Photo credit: EPA)

Groundwater/drinking water issue

- 29% ≥10 mg/L
- 44% ≥ 5 mg/L
- 14% ≥ 20 mg/L
- 73 mg/L max nitrate-N in private well



IJC Cross-Border Characterization

Air quality issue

- Visibility
- Connected airshed
- Requires attention to NOX, ammonia, SO2, organic carbon sources

Vancouver, British Columbia, Canada

(Photo credit: http://www.ens-newswire.com/ens/oct2004/2004-10-01-04.html)

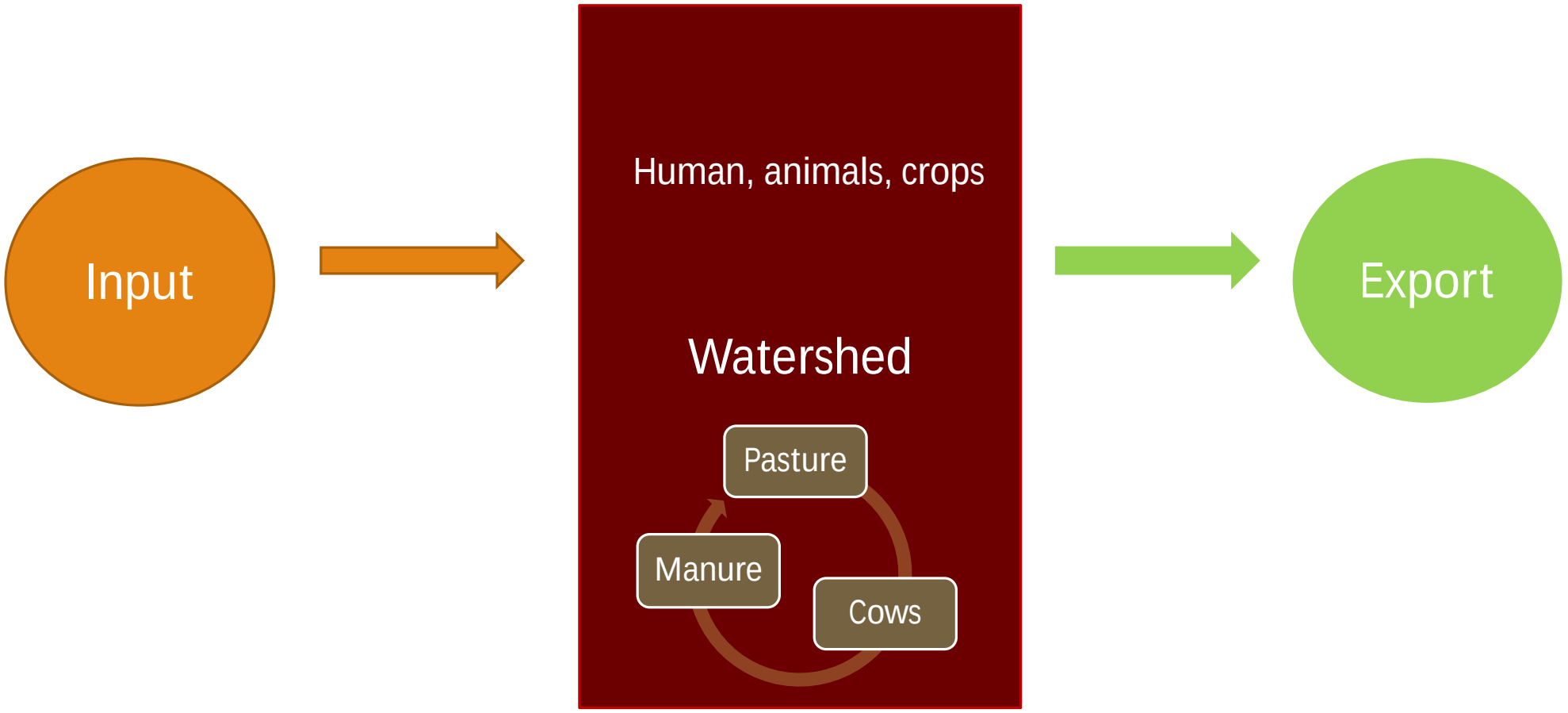
Why a nitrogen budget?

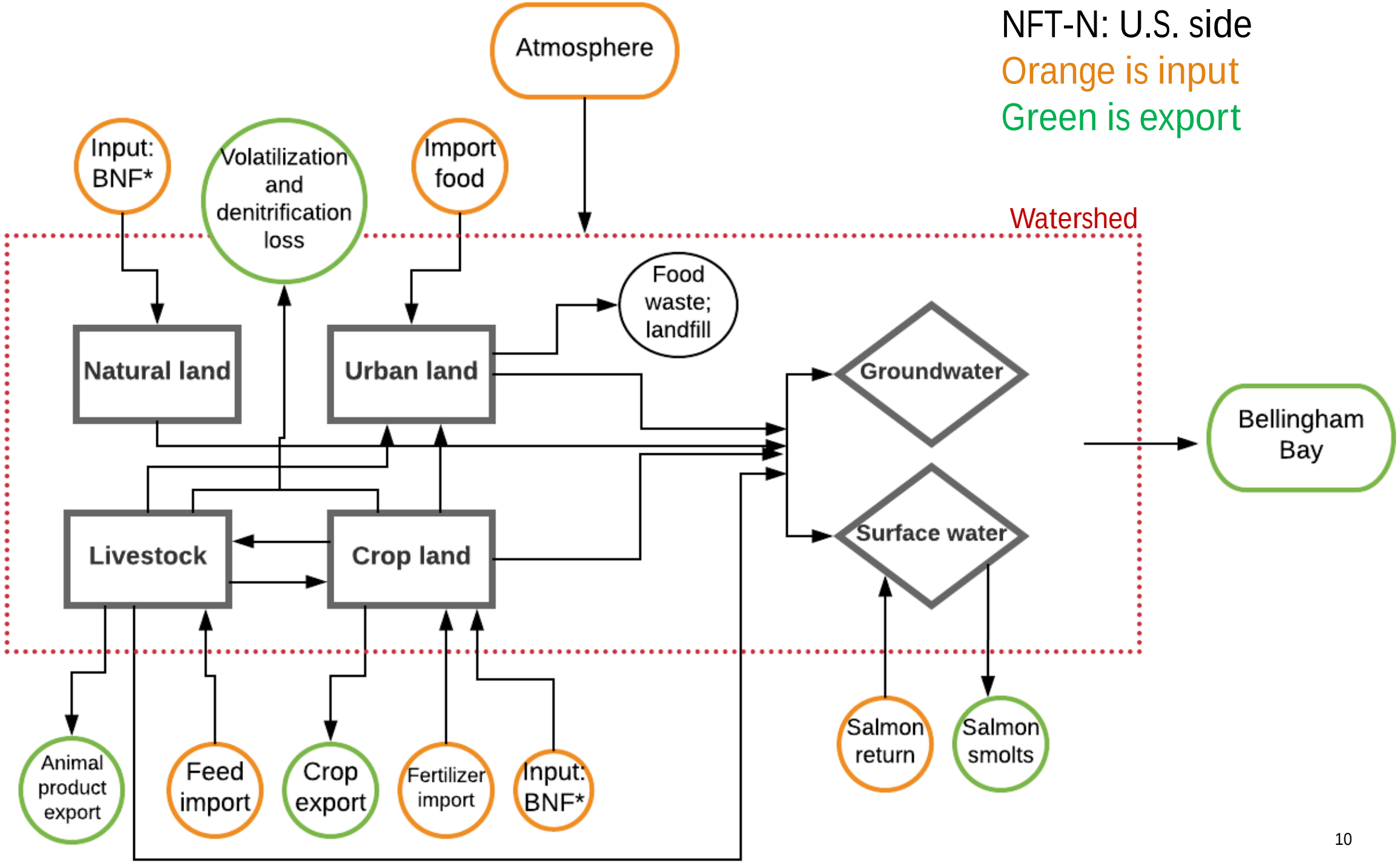
- Quantitative information on N fluxes
- Examine N fates and transport
- Link sources to contamination: where and how to reduce N fluxes
- Ongoing project
- Cross boundary issues

Project Goals

- Develop a nitrogen inventory using local data
- Share among stakeholders
  - Anyone affected by nitrogen in some way is a stakeholder, who is welcome to participate, adding your information, knowledge, and perspective
- Identify and evaluate solutions that can be used by local stakeholders to meet community goals
  - Improve air quality and drinking water quality
  - Economic goals

NFT-N
Nooksack-Fraser Transboundary Nitrogen budget



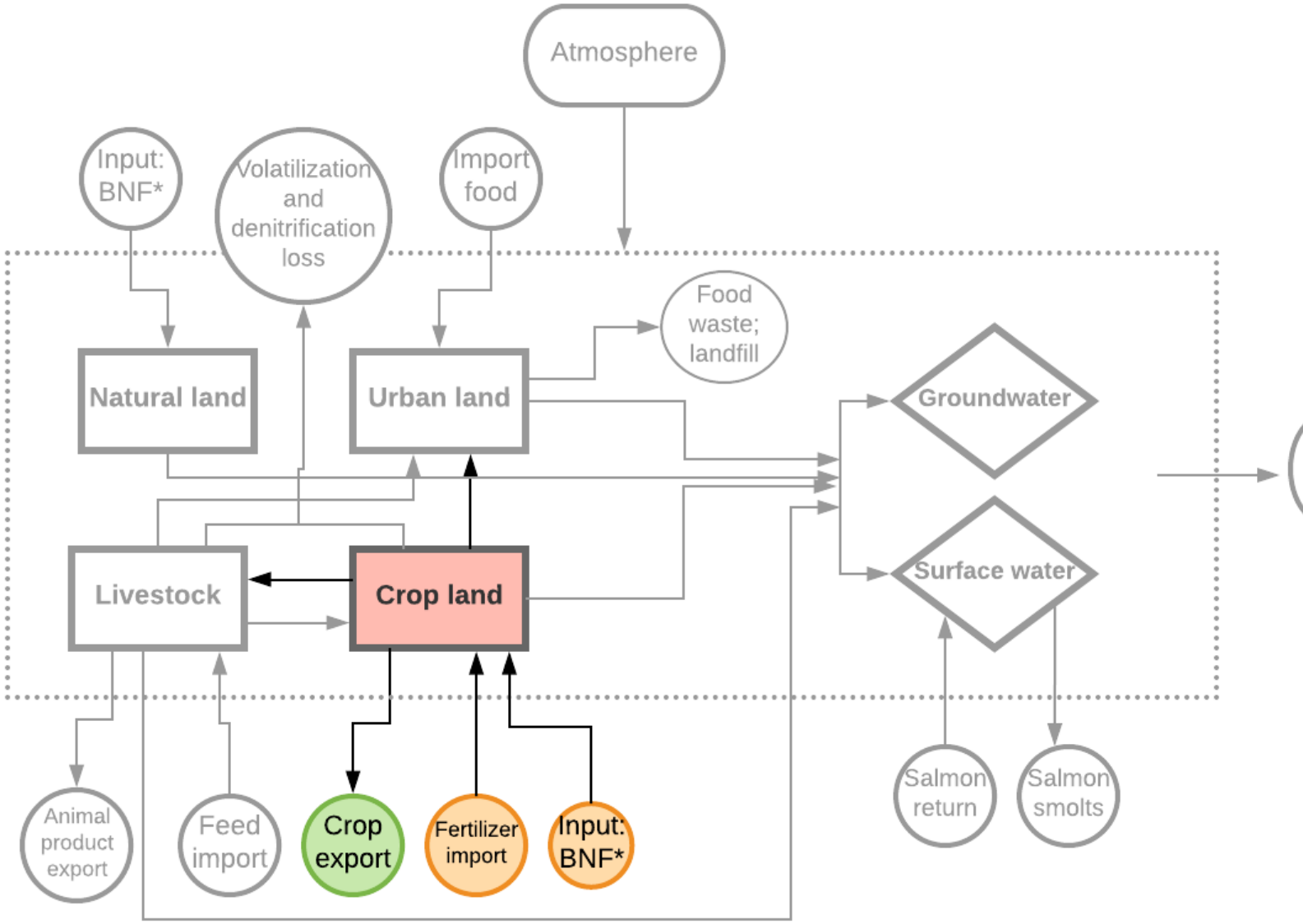

NFT-N: U.S. side
Orange is input
Green is export
Atmosphere
Input: BNF*
Volatilization and denitrification loss
Import food
Watershed
Food waste; landfill
Natural land
Urban land
Groundwater
Bellingham Bay
Livestock
Crop land
Surface water
Animal product export
Feed import
Crop export
Fertilizer import
Input: BNF*
Salmon return
Salmon smolts

NFT-N: Data sources

- Plus extensive local knowledge
  - WCD

	Component	Parameter	Data source
Input	**Atmospheric deposition**	Total N deposition	EPA-CMAQ
	Food and feed import	Nutritional requirement	USDA, literature
		Population, human, pets and livestock	USDA census
	Fertilizer import	Crop land	WSDA land use map
		Fertilization rate	Local ag. Expert
	Biological N fixation	Alder density	OSU-LEMMA
		N fixing crop	WSDA land use map
	Salmon import	Salmon population and size	NOAA, Lummi Nation
Export	**Food and feed export**	Animal population	USDA census
		Animal product and production rate	USDA, WA extension
		N content	USDA Livestock & Meat Domestic Data
		Crop land	WSDA land use map
		Crop N content	USDA nutrient tool
	Smolt export	Smolt population and size	NOAA, Lummi Nation
	Groundwater	Flow and N concentration	USGS, Ecology, ECCC
	Surface water	Flow and N concentration	Ecology, USGS, EPA
Internal	**Human waste**	Sewage	WTPs
	Animal and food waste	Animal population	USDA, WSDA
		Animal excretion rate	USDA waste characteristics
		Animal product and production rate	USDA, WA extension
		Nutritional requirement	USDA, literature

NFT-N
- crops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Crop land
Animal product export
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Fertilizer import
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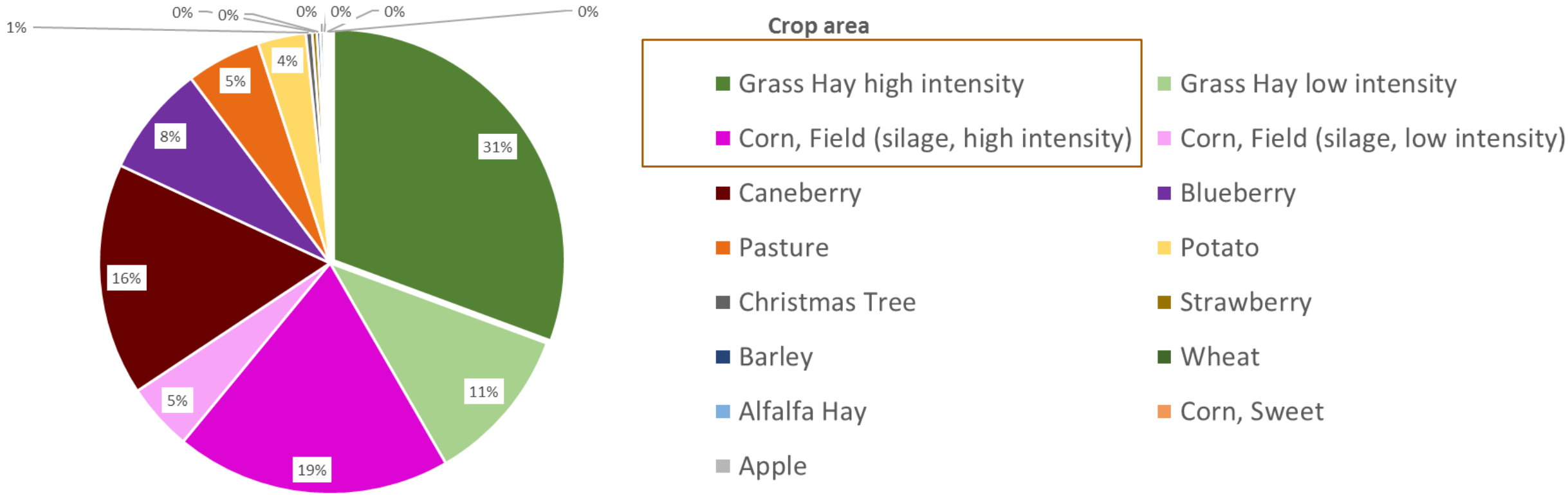

NFT-N - crops

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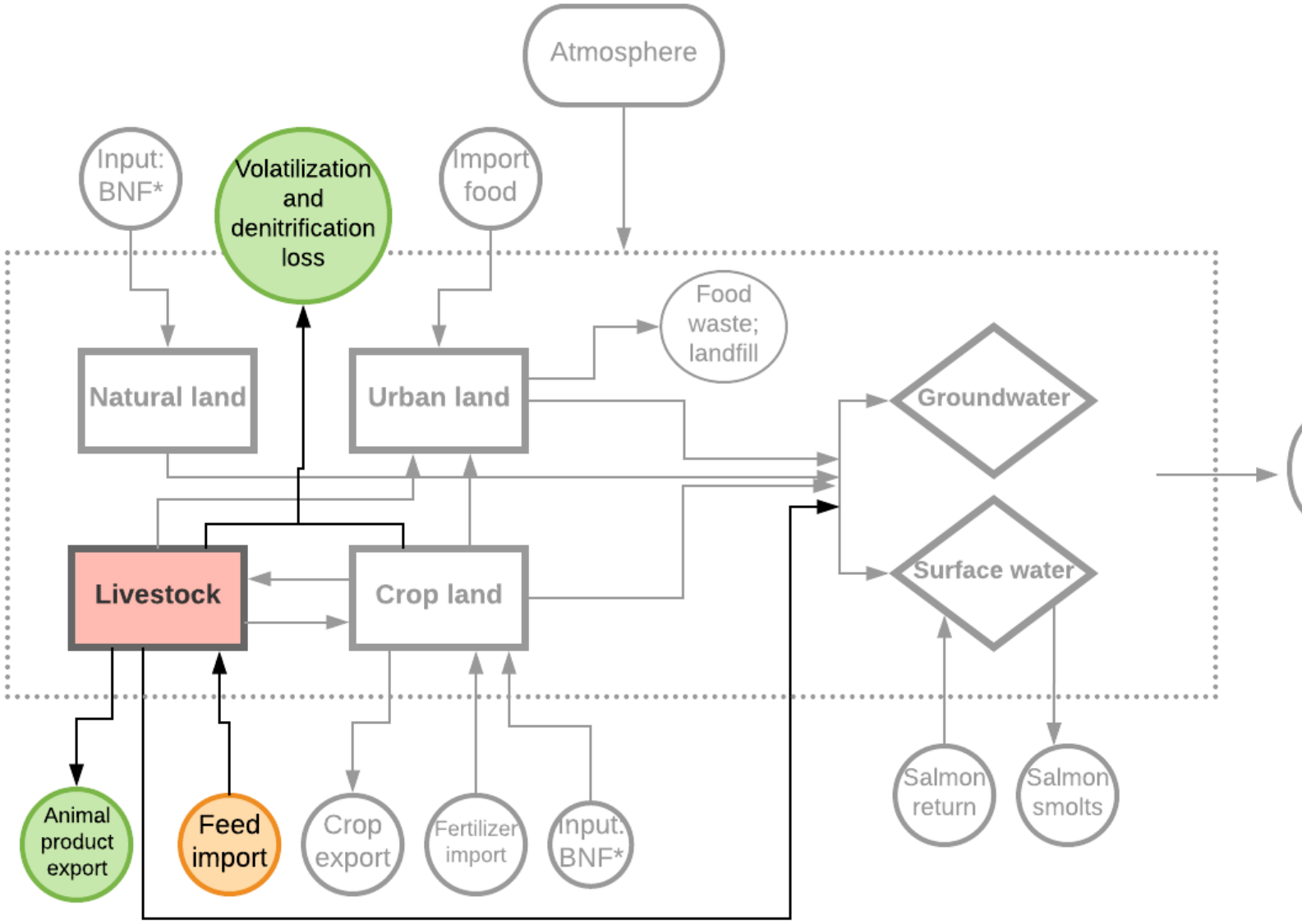
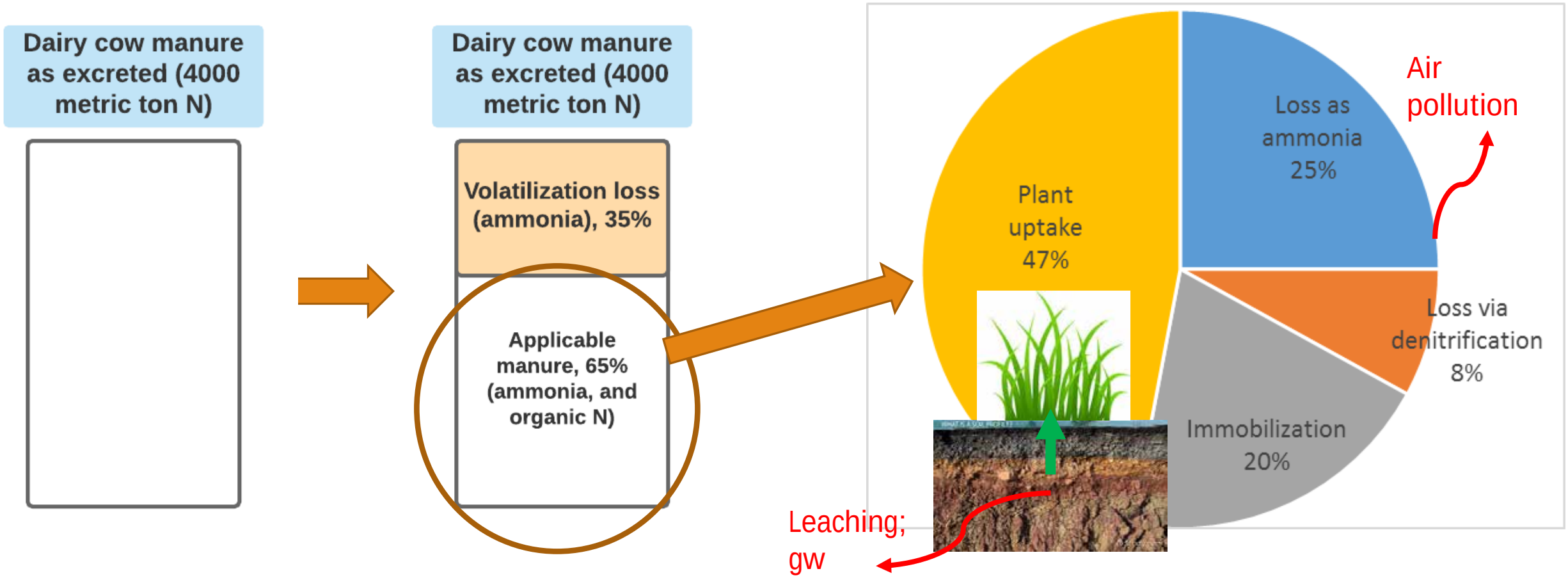
NFT-N – dairy animals and other livestock



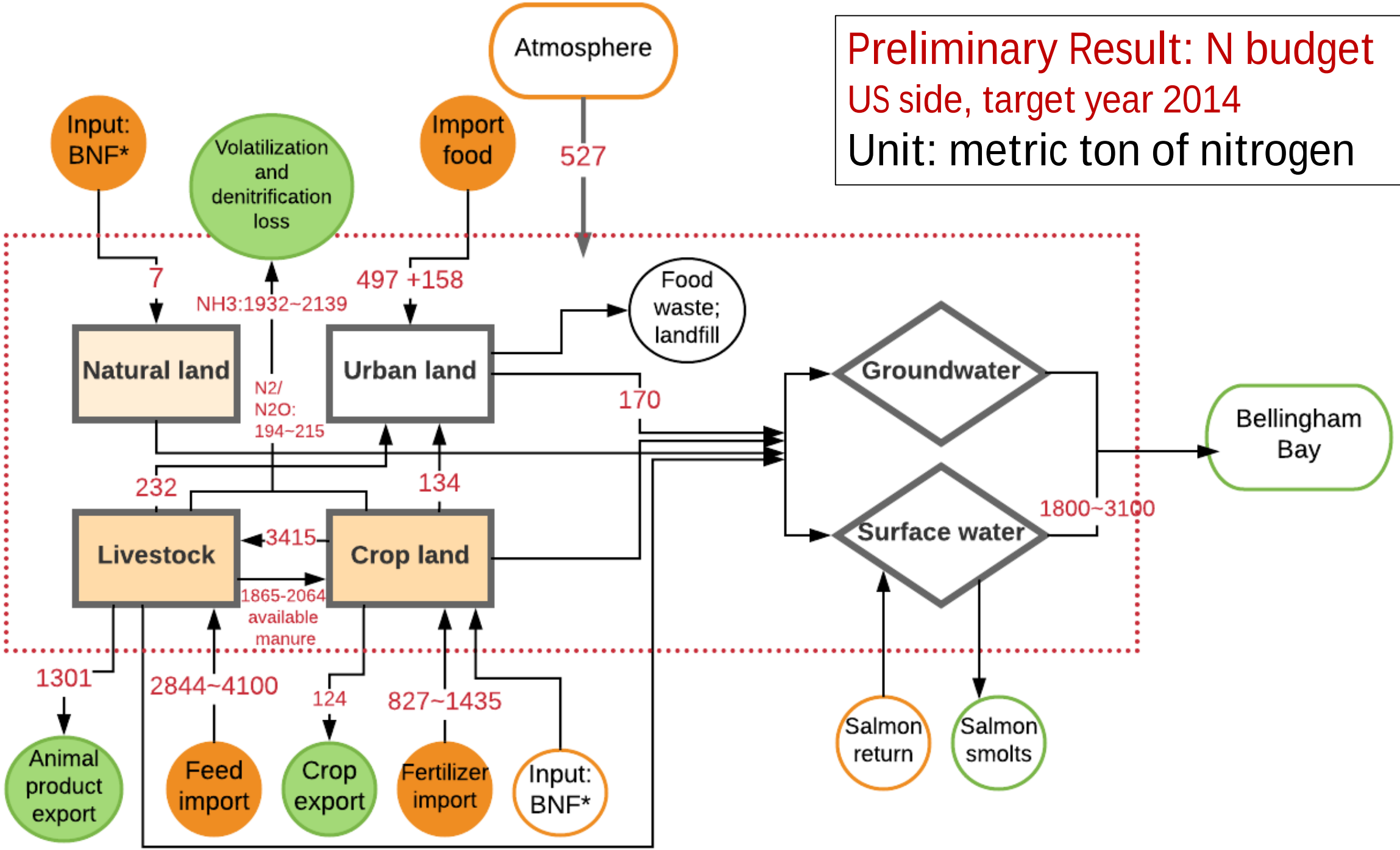
NFT-N – dairy manure losses



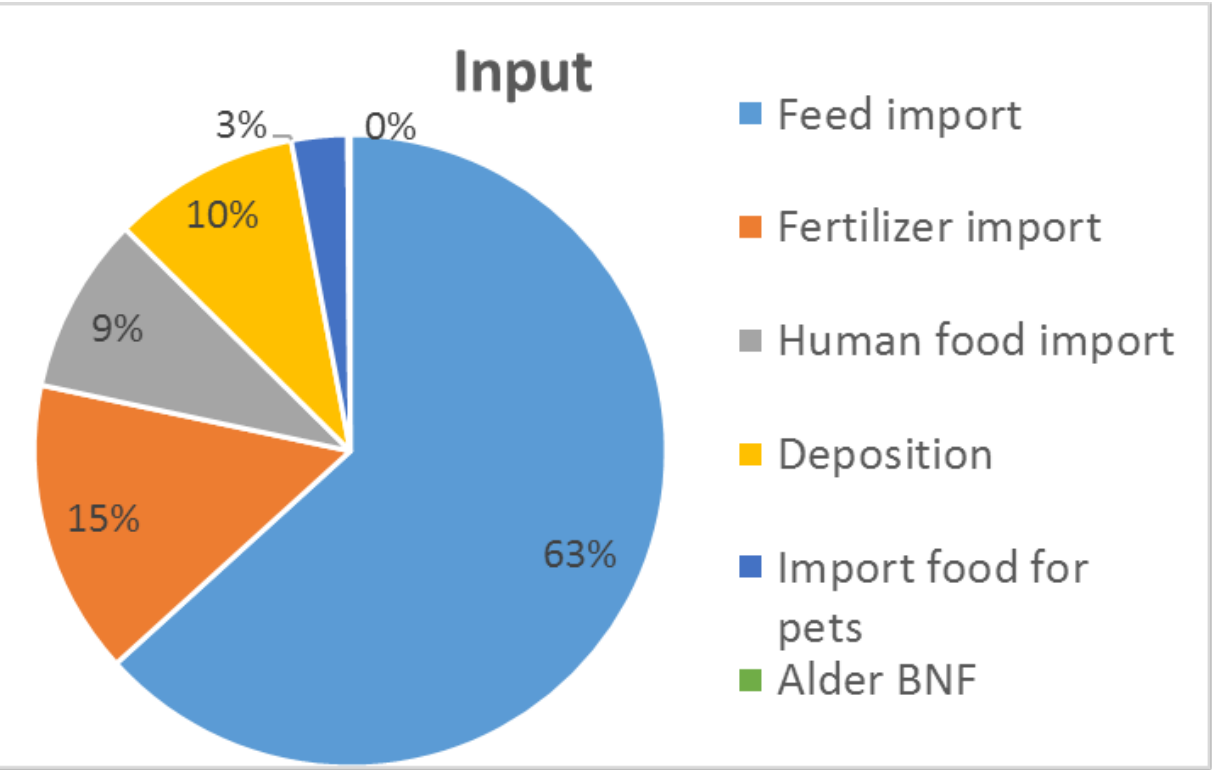
Preliminary Result: N budget

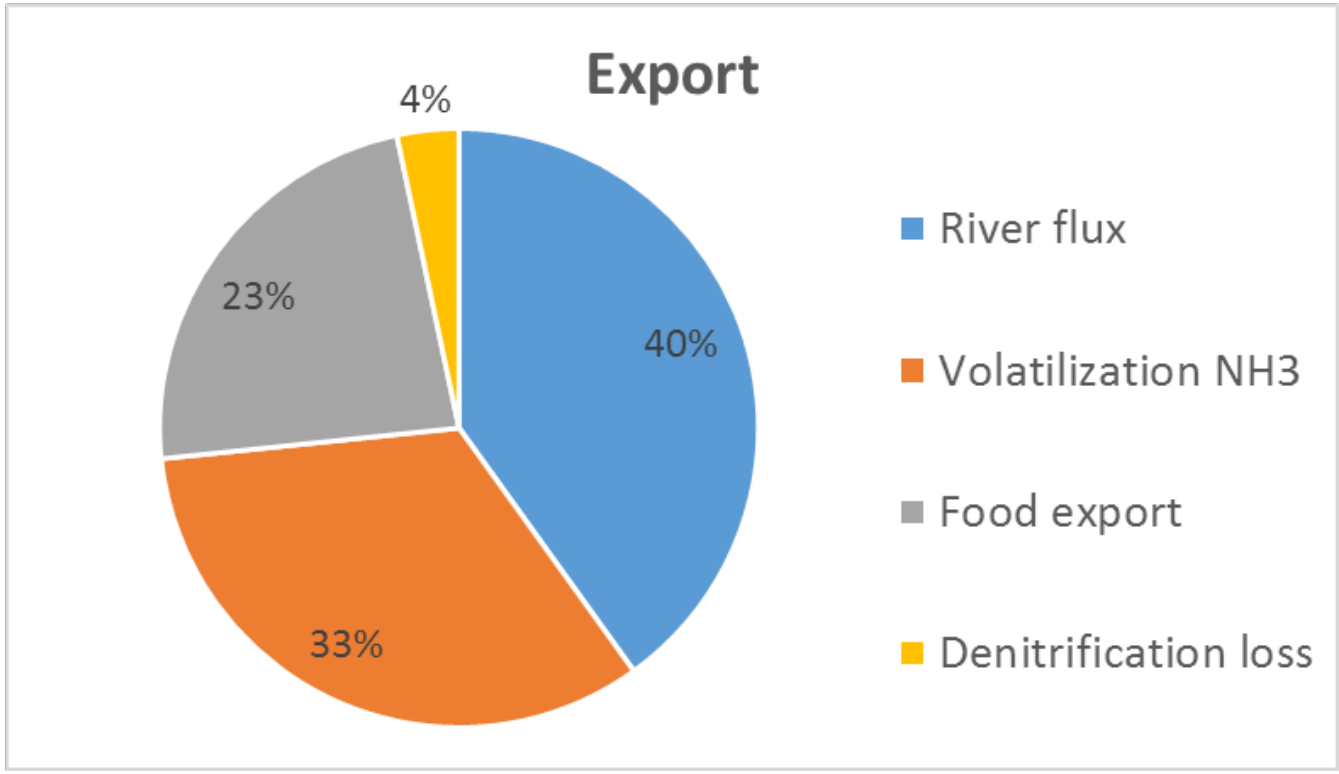
US side, target year 2014

Unit: metric ton of nitrogen



Draft N inputs and output proportions, US side





Missing: Canadian inputs, Wildlife, Lawn fertilizer

Missing: Wildlife, groundwater/leaching, non-manure gas losses (?)

Total Inputs = 5488 mt N

Total output = 6114 mt N

River flux includes Canada; 2014 high streamflow year

Future work

- Refine results
- Combine with Canadian budget
- Share with local stakeholders to build trust and accuracy
- Identify implications for management
- Develop a modeling structure and scenarios of N use in the future using stakeholder input

International Nitrogen Management System (INMS)

- Bring together the science community, the private sector and civil society to synthesize evidence that can support international policy development to improve global nitrogen management.
- Implemented by the UN Environment with funding through the Global Environment Facility (GEF)
- There are over 70 global project partners, conducting eight regional demonstrations

Towards the INMS
International Nitrogen Management System
www.inms.international

Countries that have a Crop NUE_N below 70% (2008, for details see Appendix).

Sutton et al. 2013

Thank you!

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