

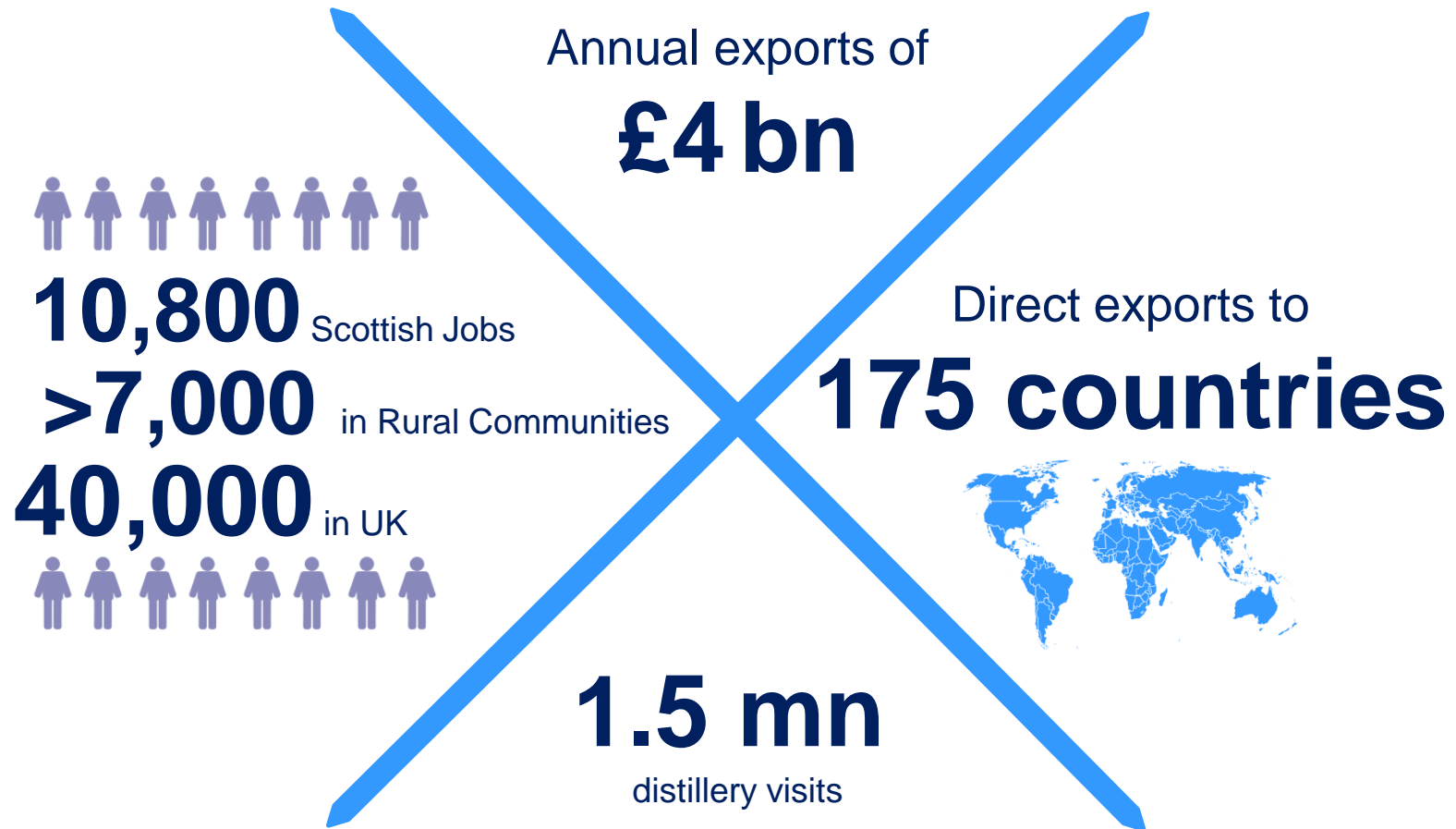
Managing production in water dependent industries: a Scotch Whisky example

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World Water Day
Resilience to Drought and Low Flow Conditions in Scotland
Edinburgh, 22nd March 2019

The Scotch Whisky Industry



Scotch Whisky Operations

- 117 malt distilleries, 250 mola (14 CBL)
- 7 grain distilleries, 300 mola (1 CBL)
- Warehouses (20m+ casks)
- 15 major bottling plants (2 CBL)
- Maltings, offices, research/technical centres
- By-products/dark grains processing
- Energy facilities
- Long-term business



Many other products are whisky, but Scotch can only be made in Scotland and by definition must be distilled and matured - in Scotland - for a minimum of 3 years. Scotch Whisky has been made for more than 500 years and uses just a few natural raw materials - water, cereals, and yeast.

Scotland is home to over 100 malt and grain distilleries, making it the greatest concentration in the world. Many of the Scotch Whisky distilleries featured on this map bottle some of their production for sale as Single Malt (ie, the product of one distillery) or Single Grain Whisky.

However, the majority of all Scotch Whisky is consumed as Blended Scotch Whisky. This means as many as 50 of the different Single Malt and Single Grain Whiskies are blended together, ensuring that the individual Scotch Whiskies harmonise with one another and the quality and flavour of each individual blend remains consistent down the years.

Malt whisky is usually classified to one of the main categories - Highland, Lowland, Speyside, Islay and Campbeltown - according to the geographical location of the distillery in which it is made. In many ways, the geography and climate of each region influences the character of the whisky produced there.

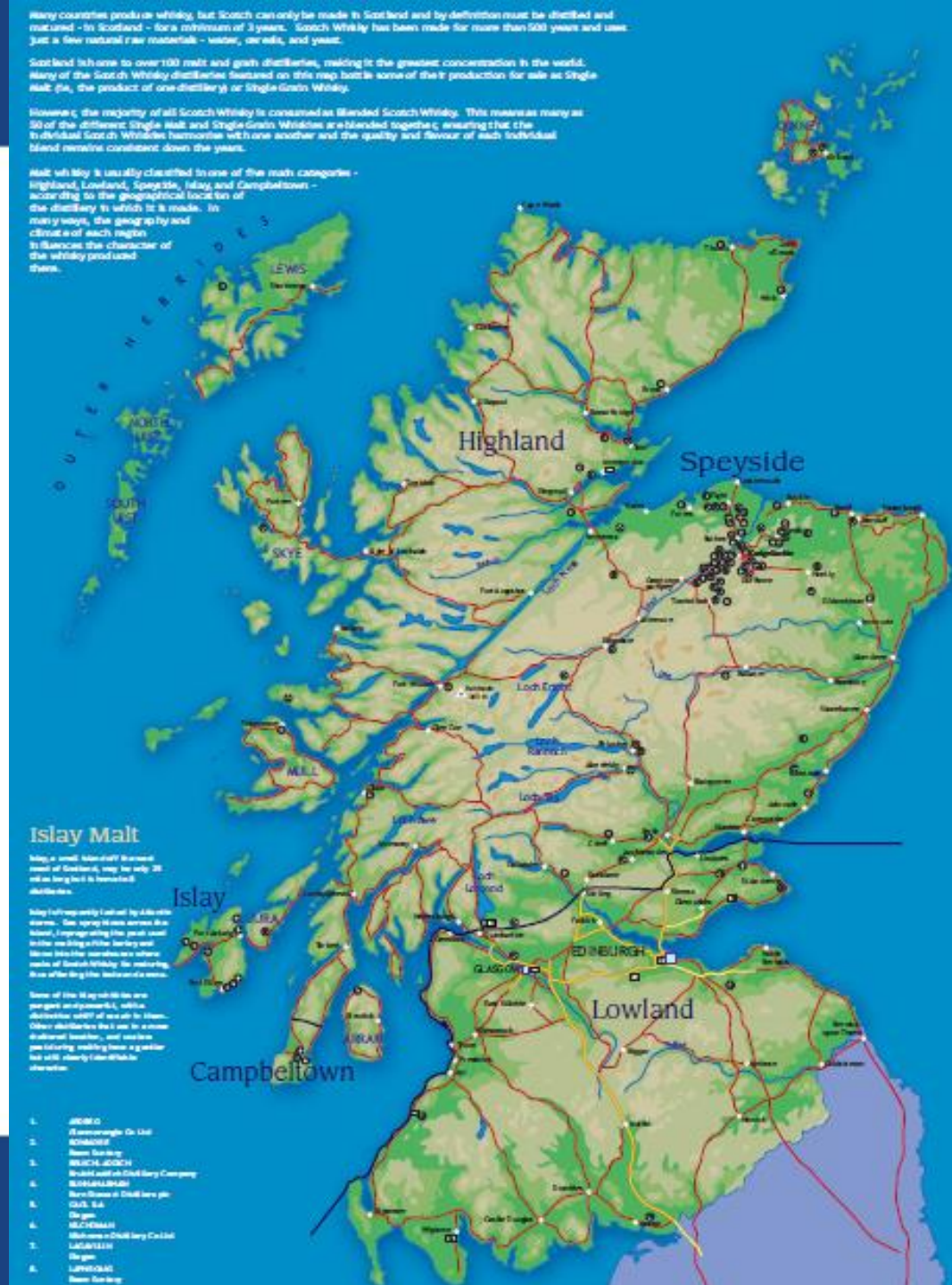
Islay Malt

Islay is small, isolated off the west coast of Scotland, yet its only 28 distilleries are famous for their whisky.

Islay's whisky is made from barley malted on the island. The spring water comes from the island's springs, giving the whisky a unique character. The whisky is then matured in the island's warehouses, where the whisky is stored for several years before being bottled.

Some of the 18 distilleries on Islay are: Ardbeg, Bunnahabhain, Caol Iarra, Glengormly, Laphroaig, Lagavulin, Port Charlotte, and Tighnabharra. These distilleries are famous for their whisky, which is made from barley malted on the island.

1. ARDBEG
Ardbeg Distillery Co Ltd
Ardbeg
Bunnahabhain
2. BUNNAHABHAIN
Bunnahabhain Distillery Co Ltd
Bunnahabhain
3. CAOL IARRA
Caol Iarra Distillery Co Ltd
Caol Iarra
4. GLENORMLY
Glenormly Distillery Co Ltd
Glenormly
5. LAPHROAIG
Laphroaig Distillery Co Ltd
Laphroaig
6. LAGAVULIN
Lagavulin Distillery Co Ltd
Lagavulin





Environmental Sustainability Strategy



Biodiversity & Agriculture



Environmental Governance





Water & Wastewater



Byproducts & Waste



Packaging & Materials



Energy & Carbon





Distillery Water Use

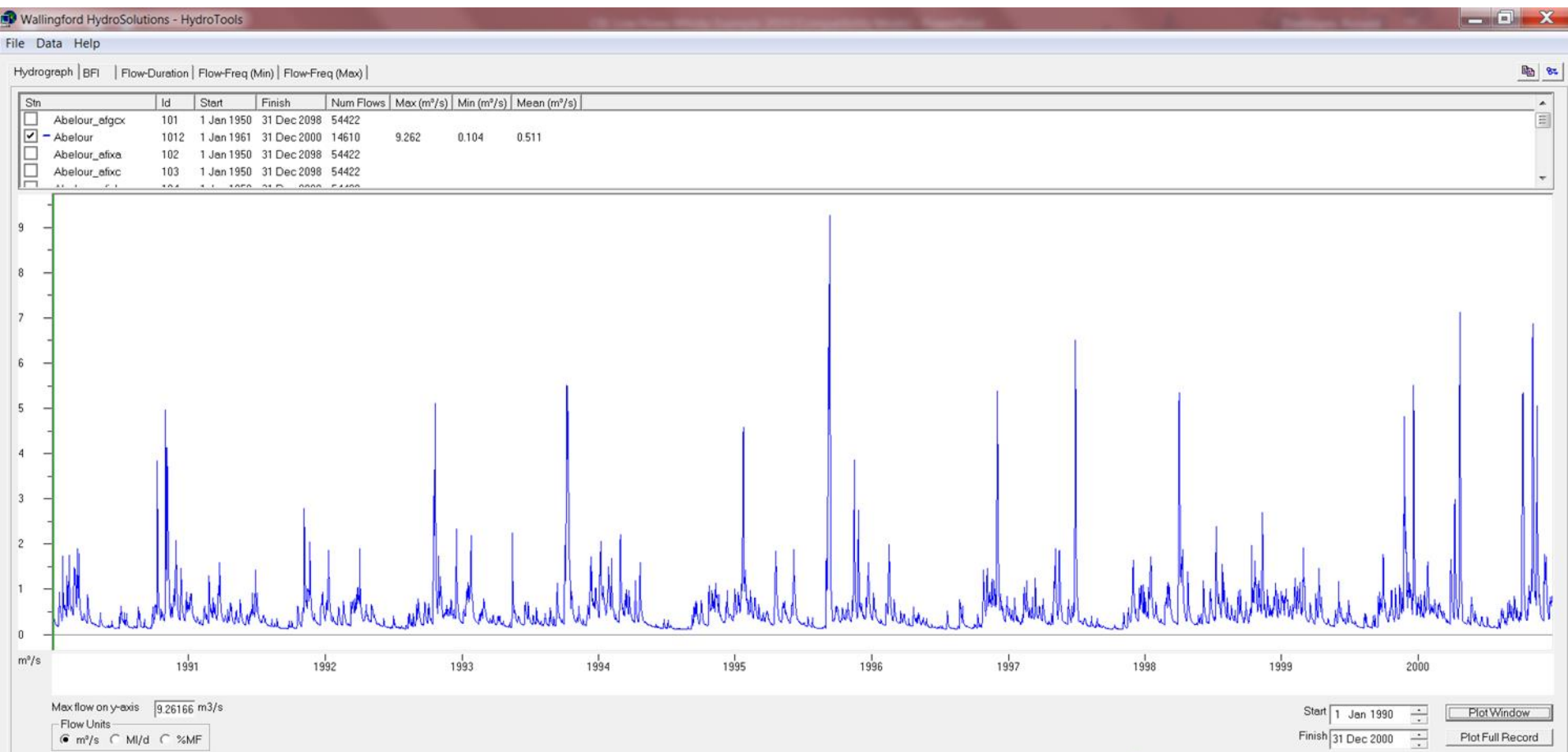
- Process Water
 - Mainly springs, some borehole, few surface
 - High quality
 - Steady temperature
 - Fixed consumption with over flows
- Cooling Water
 - Generally from rivers & burns
 - Lades, cooling ponds, intake pipes, pumped
 - Once-through vs Cooling Towers
 - Range of return distances (metres to miles)
 - Fixed, variable or on-demand
- Location, location, location
 - Remote upland tributaries
 - Major rivers (e.g. Spey)
 - Lowland agricultural
 - Single site to multi-user cascade



Scale of Water Use

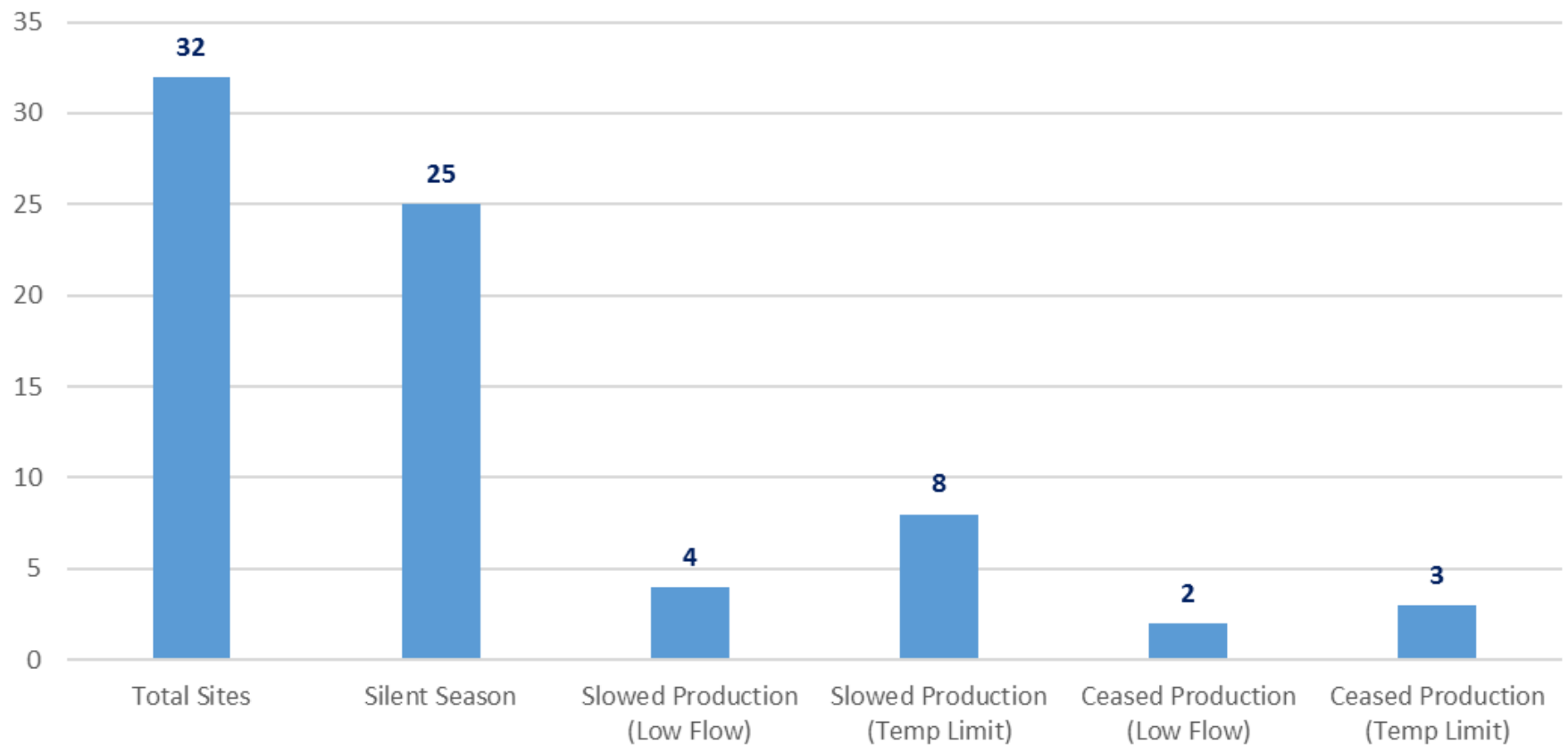
Aberlour Distillery (Lour Burn)

- Water Demand: Process = $0.006 \text{ m}^3/\text{s}$, Cooling = $0.043 \text{ m}^3/\text{s}$
- Available Flow: $0.021 \text{ m}^3/\text{s}$
- Low Flow @ Q98: $0.12 \text{ m}^3/\text{s}$
- Low Flow @ Q99.9: $0.11 \text{ m}^3/\text{s}$



Sector Impacts

Operational Impacts on Malt Distilling - Summer 2018



Planning - Risk Assessment

Water Resilience Assessment

Site	Water Use		Regulatory Risk			Water Efficiency		Water Availability			Expansion	Temp
	Type	Source	RBMP	Q95	Design	Reasonable	Planned	Current HR	Future HR	Return	Sources	Return
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Process	River	●	●	●	●	●	●	●	●	●	●
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Process	Springs	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●
	Cooling	River	●	●	●	●	●	●	●	●	●	●

Planning - Responsible Consumption (Process Water)

- **In vs Out**

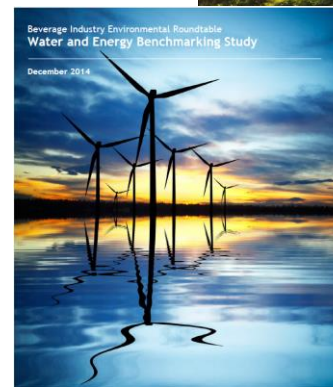
- All material flows containing water, plus external factors (e.g. rainfall) & meter error
- Investigate significant differences

- **Actual vs Theoretical**

- Design basis for water use per activity
- Investigate omissions & cross-overs

- **Benchmarking**

- Context Important
- Whisky Average = 27m³/kl
- CBL Average = 21m³/kl
- CBL Best = 13m³/kl
- Sector reports
- Identify local buddies

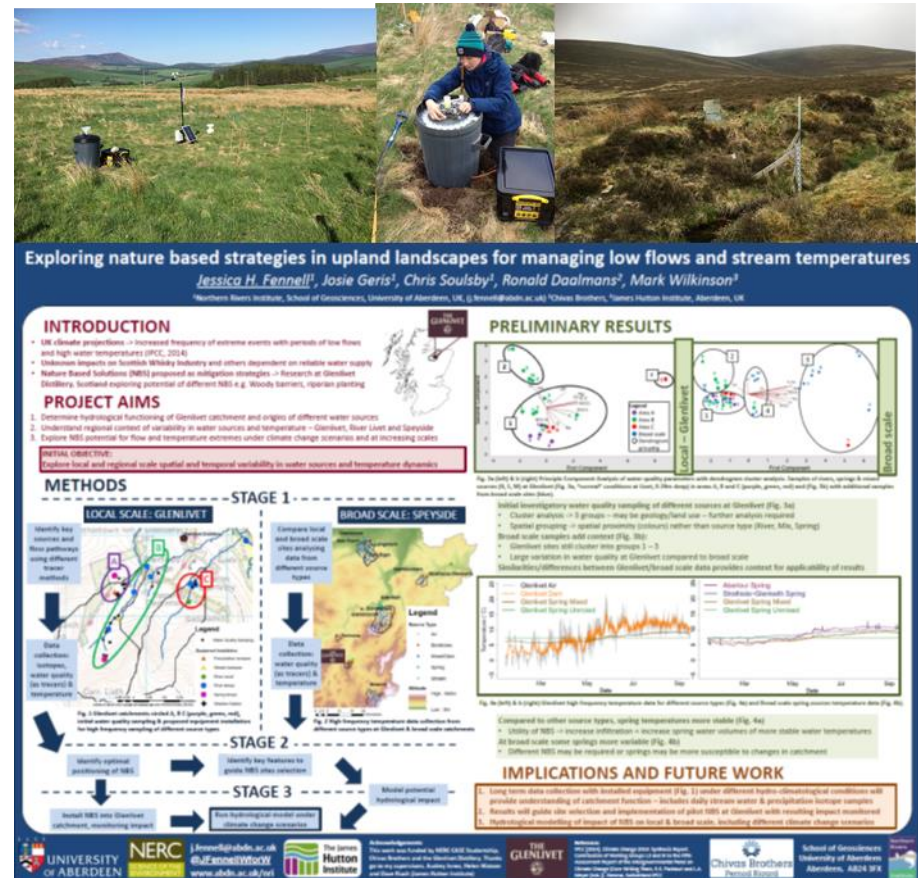


Distillery	Priority	Site Balance	Process Theoretical
GA	Y	In = Out	Act > The
GK-SI	N	In = Out	Act > The
BV	Y	In < Out	Act > The
LM	Y	In > Out	Act > The
GB	Y	In < Out	Act > The
GT	Y	In < Out	Act = The
AL	Y	In < Out	Act > The
TM	Y	In < Out	Act < The
TGL	N	In < Out	Act > The
MD	N	In > Out	Act > The
AAB	N	In > Out	Act < The
SP	N	In = Out	Act > The
DM			



Planning - Data & Knowledge

- **Temperature Network**
 - 9 sites, 32 units
 - Source variability
 - Air - Water relationships
 - Link with existing networks / models
 - Potential for risk assessment or warning system
- **Research Partnership (PhD)**
 - The Glenlivet water gathering lands
 - Nature based solutions
 - Water & snow retention
 - S-T water storage & infiltration
 - Change base flow
 - Limit maximum water temperatures
 - Site selection tool
 - Value of Ecosystem Services



Issues for the Future

- Temperature Profiles & Distribution Datasets
- Vulnerability assessment of spring supplies
- Legacy infrastructure (CAR & Lades)
- Update of Future Flows Model
- Simple water scarcity planning framework
- Mitigation measures (payment for public goods)
- Strategic development planning information



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