BLUE NORTH

THINKING. FUTURE

Packhouse Action Group Water and Energy Project

2020 Water Benchmark Results

February 2022

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1 Introduction

In 2017, Blue North Sustainability was contracted by the Packhouse Action Group (PAG) to conduct a study on the water risks faced by pome fruit packhouse and cold storage operations and provide water consumption benchmarks for these facilities. Since 2017 Blue North has concluded two further rounds of benchmarking (Phase 2 & 3).

This report concludes the fourth phase of this project, and includes data from January to December 2020. The objectives of the fourth phase were to:

- replicate the water use benchmark study undertaken in Phase 1, Phase 2 and Phase 3;
- increase packhouse participation;
- provide a year-on-year comparison of water use in the packhouse and cold storage operations;
- collect more detailed data around water management and recycling practices; and
- incorporate an electricity benchmarking component into the project.

This report presents the results from Phase 4 (2020 data) and draws a comparison between the Phase 1 (2017), Phase 2 (2018), and Phase 3 (2019) results in terms of water benchmarks. Lastly, the report summarises the different water management and recycling methodologies applied at the packhouses. Electricity benchmark results were compiled in a separate report.

2 Methodology

All new participating packhouses were onboarded with a virtual call to introduce them to the project and provide them with training on the data collection tool. Packhouses that participated in the previous phases of the project were given the option to request a training session in the new data collection tool if they deemed it necessary. A guidance video on the new data collection tool was also sent to all the participating packhouses.

2.1 Development of the data collection tool

Data was collected via the data collection tool and sense checked by the project team. Data anomalies were discussed with participants and, where applicable, rectified or reasons for the anomalies were recorded.

Phase 4 followed a similar approach to the previous phases, but included the following updates and changes to the data collection tool:

- additional data capture fields for drenching and pre-sorting;
- additional data capture fields for water sources;
- moved the "pack line processes" section to a "water management practices" tab;

- added a tab with data fields to capture information on water recycling technologies applied;
- incorporation of electricity use and cost data capture fields;
- added a tab with data fields to capture information on the energy management practices applied.

2.2 Scope of the data collection

The following five areas in pome fruit packhouses were benchmarked in terms of water consumption:

- **Drenching** – This includes water consumption for the drenching of fruit.
- **Pre-sort** – This includes all dedicated pre-sort line water consumption.
- **Packing Lines** – This includes all packing line water consumption, of which flume water use makes up the majority.
- **Cold Storage** – This includes Regular Atmosphere (RA) and Controlled Atmosphere (CA) facilities. Cooling tower water consumption made up the majority of cold storage water consumption.
- **Ablutions, Canteen & Offices** – This benchmark includes staff water consumption.

2.3 Participation

Twenty-one packhouses were invited to participate, of which 12 packhouses provided data.

- Of the 12, four had participated in Phase 1 and 2, in Phase 3, and three packhouses participated for the first time.
- One packhouse committed to providing data, but no further response was received after multiple follow-ups.
- Three more packhouses did not provide data for Phase 4, but committed to participating in future data collection rounds.

2.4 Notes on the data

- All data sets for Phase 4 correspond to the 2020 calendar year (January to December). Packhouses are anonymised in the report (named A to N).
- Caveats apply to some data points and where applicable, they are acknowledged in this report under "Notes".
- In graphs, blue bars always indicate accurate/metered data, whereas the yellow bars indicate calculated or estimated data.

3 Water Benchmarks

3.1 Drenching Benchmark

3.1.1 Calculation

The Drenching benchmark is calculated as follows:

Drenching water consumption (m^3) x 1000 / Tonnes of pome fruit drenched

The benchmark's Unit of Measure is: Litres per Tonne of pome fruit drenched.

3.1.2 Results

Only packhouses who provided drenching data are shown.

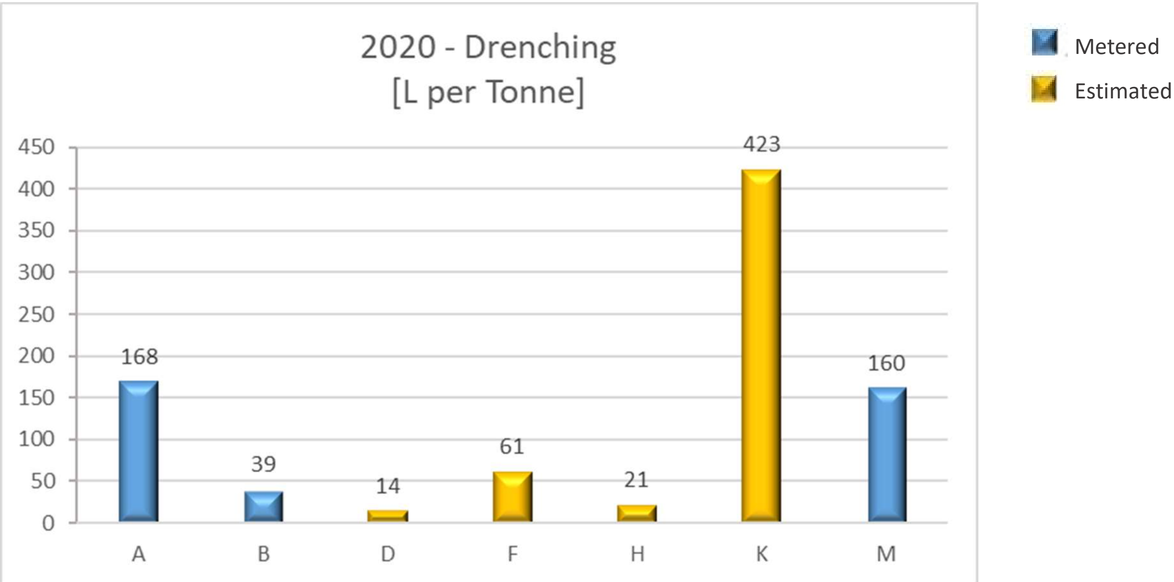

Figure 1: Drenching benchmark results

<u>Figure 1 Notes:</u>

Water consumption of Packhouses D, F, H and K were estimated due to insufficient metering.

Packhouse I – This packhouse drenches their pome fruit, but the water used for drenching is not recorded and could not be estimated.

Packhouse N – This packhouse drenches their pome fruit, but the water used for drenching is not recorded and could not be estimated. Metering was installed in 2021.

When comparing the metered data received (blue bars in graphs), Packhouse A and Packhouse M used four times the amount of drenching water per tonne of fruit when compared to Packhouse B. Packhouse B reuses drenching water approximately 5 to 6 times before the drenching tank is drained and refilled. Packhouse B drench a total of 600 crates (approximately 9000 litres of water) with the same water before the water is replaced with fresh water. The water drained from the drenching tanks is then re-used in the bin storage area to minimize dust build up.

3.2 Dedicated pre-sorter benchmark

3.2.1 Calculation

The pre-sort benchmark is calculated as follows:

Pre-sort water consumption (m^3) x 1000 / Tonnes of pome fruit for dedicated pre-sort line

The benchmark's Unit of Measure is: Litres per Tonne of pome fruit for dedicated pre-sort line.

3.2.2 Results

Only packhouses with a dedicated pre-sort line are shown.

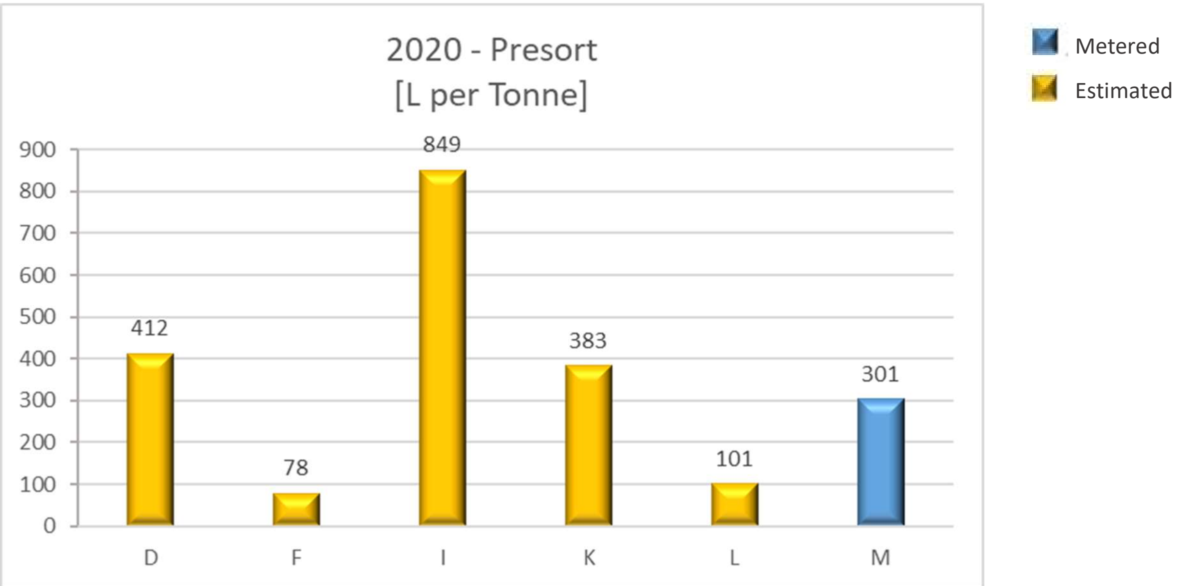

Figure 2: Dedicated pre-sort line benchmark results

Figure 2 notes:

Only packhouse M could provide metered water use data for the pre-sort line, the benchmarks for the other packhouses are all estimates due to a lack of metering.

3.3 Packing Line Benchmark

3.3.1 Calculation

The Packing Line benchmark is calculated as follows:

Flume & pack floor water consumption (m^3) x 1000 / Tonnes of pome fruit packed

The benchmark's Unit of Measure is: Litres per Tonne of pome fruit packed.

3.3.2 Results

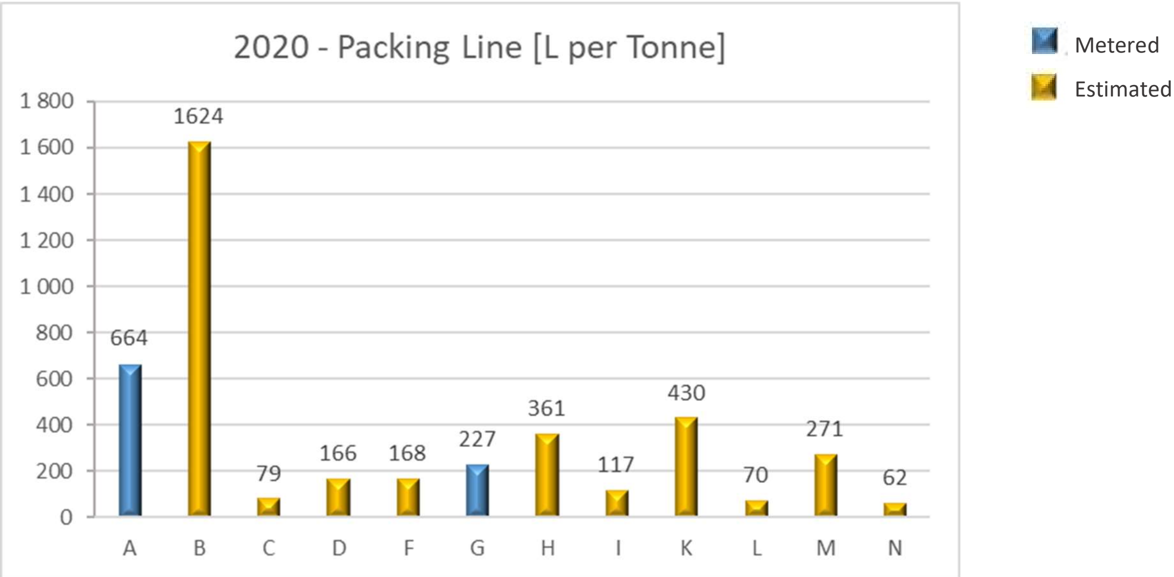

Figure 3: Packing line benchmark results

Figure 3 Notes:

Water consumption of Packhouses D, F, H, K and M were estimated due to insufficient metering.

Packhouse B – The pack line water benchmark is very high. This figure includes water used for the ablutions and garden irrigation around the packhouse and thus forms part of the packing line water use figure. The volume of water is also estimated as the borehole, where the water is sourced from, is not metered (the borehole water quality causes the water meters to breakdown).

Packhouse C – The pack line benchmark is very low. This packhouse drains their flumes once every two weeks. The water consumption for each section of the packhouse was estimated (not metered). Thus, the low value could also be due to a water allocation issue.

Packhouse I – Water is kept in flumes for three months before being drained into reedbeds for natural filtration. Water consumption for each section of the packhouse was estimated (not metered). Thus, the low value could also be due to a water allocation issue.

Packhouse L – The pack line benchmark is very low. This packhouse only drains their flumes two to three times a year, otherwise, flumes are only topped up. Total water consumption was metered, but water consumption for each section of the packhouse was estimated (not metered). Thus, the low value could also be due to a water allocation issue.

Packhouse N – The pack line water consumption was estimated due to insufficient metering. Metering was installed in 2021.

When comparing the metered data received (blue bars in graphs) Packhouse A's pack line water consumption is 3 times that of Packhouse G. Both packhouses drain their flumes once a week. Packhouse A's flume technology is however older than Packhouse G's.

3.4 Cold Storage Benchmark

3.4.1 Calculation

The cold storage benchmark includes all cold storage water consumption, of which cooling towers make up the majority.

The benchmark is calculated as follows:

Cold storage water consumption (m^3) x 1000 / (CA & RA Tonne.Days)

The benchmark's Unit of Measure is: Litres per Tonne.Day of fruit stored. Tonne.Days is not an intuitive unit of measure and is explained in more detail below.

The cold storage benchmark cannot be based on tonnes stored only, as cold storage protocols vary widely from one operation to the next. Some packhouses store pome fruit for short periods (days or weeks), while other store fruit for long periods (several months to almost a year). Tonne.Days deals with this neatly as it calculates the amount of water used to store one tonne of pome fruit for one day. An example is:

200 Tonnes stored for 1 day = 200 Tonne.Days

200 Tonnes stored for 3 days = 600 Tonne.Days

3.4.2 Results

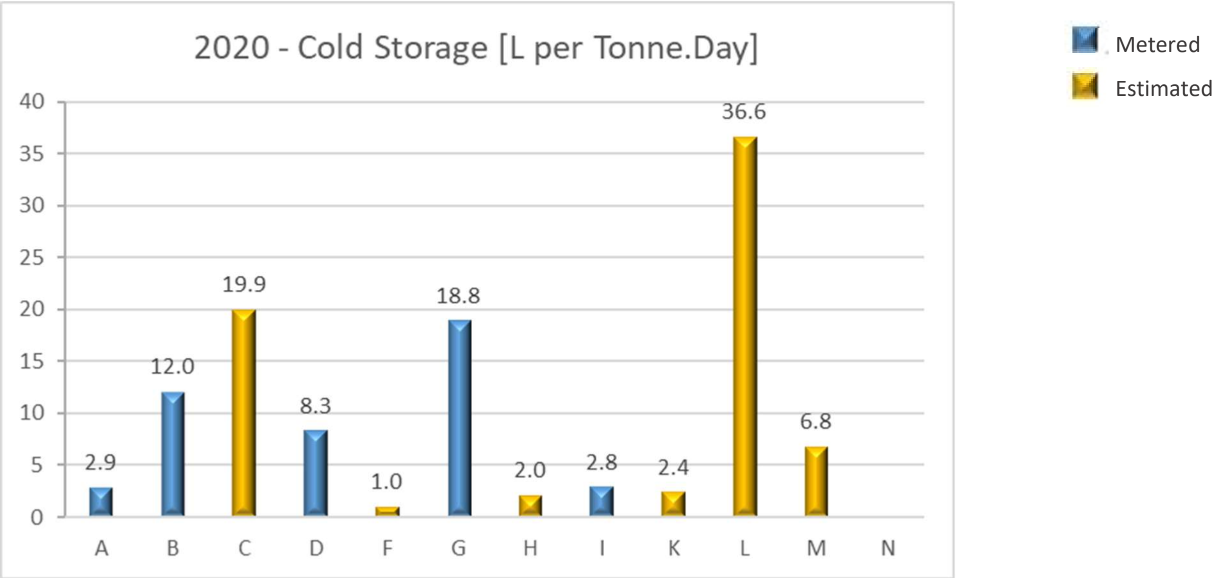

Figure 4: Cold Storage benchmarks

<u>Figure 4 Notes:</u>

Water consumption of Packhouses C, F, H, K and M were estimated due to insufficient metering.

Packhouse L – The cold storage water consumption was not metered, but all other water use was metered. Thus, the cold storage water consumption was used to "balance" the total water consumption.

Packhouse N – The cold storage water consumption was not metered and could not be estimated. Metering was installed only in 2021.

Considering only packhouses with good quality data (A, B, D, G & I), cold storage water consumption varies greatly (up to seven times) between them. This suggests that there are areas for improvement and learning in cold store water management processes.

Packhouse A uses harvested rainwater and defrost water from their refrigeration, which may explain their low cold storage water consumption. Packhouse B, D, G and I do not use any recycled water in their cold storage.

3.5 Ablutions, Canteen & Offices Benchmark

3.5.1 Calculation

This benchmark includes water consumption from Ablutions, Canteen & Offices.

The benchmark is calculated as follows:

Ablutions, Canteen & Offices water consumption (m^3) x 1000 / (Staff man days)

The benchmark's Unit of Measure is: Litres per Person per Day.

3.5.2 Results

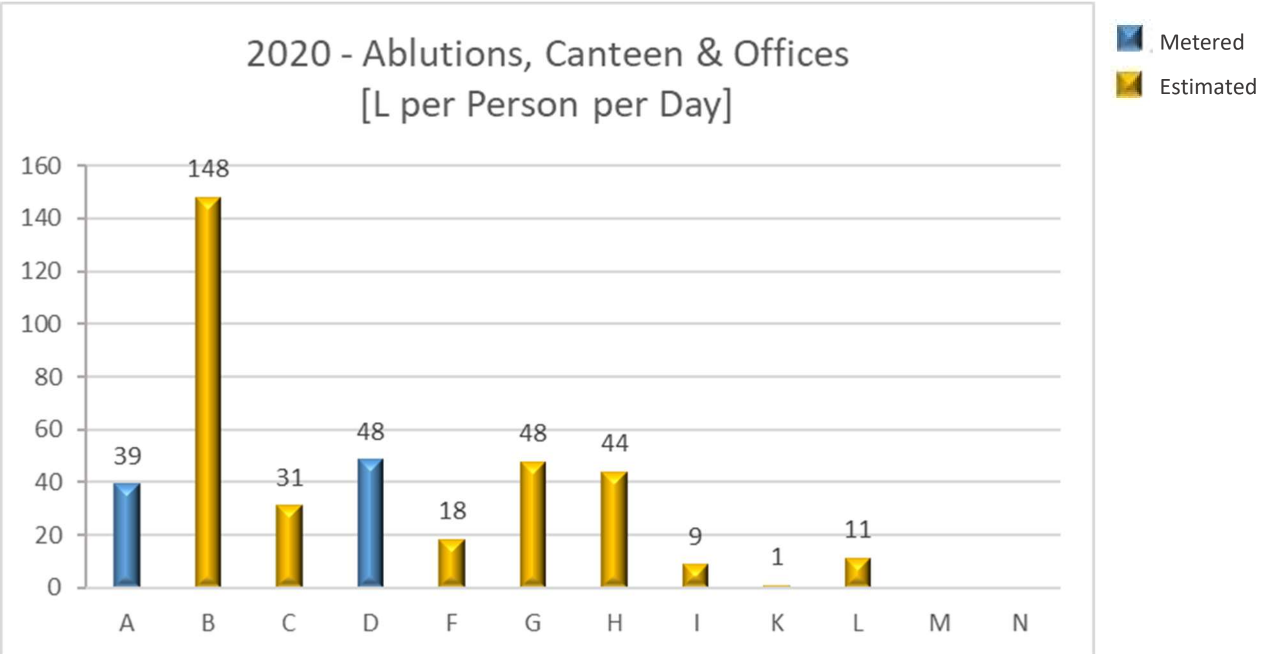

Figure 5: Ablutions, Canteen & Offices benchmarks

<u>Figure 5 Notes:</u>

Water consumption of Packhouses B, C, F, G, H and I were estimated due to insufficient metering.

Packhouse M – Water consumption of ablutions, canteens and offices forms part of "other" water consumption calculation and could not be clearly allocated.

Packhouse N – The ablutions, canteens and offices water consumption were not metered separately and could not be estimated. Metering was installed in 2021.

When considering only the good quality data submitted (Packhouse A & D), the water consumption ranged from 39 to 48 litres per person per day. This is high considering the 50 litres per person per day allowance during the "Day Zero" drought which included a showering allowance.

As noted in the previous report, there remains space for improving ablutions, office, and canteen water consumption. Key solutions would be raising awareness, training, and inexpensive recycling technology solutions in especially the ablutions section.

3.6 Overall Packhouse benchmark

The overall benchmark for each packhouse incorporates water use for all sections of the packhouse, excluding water consumption allocated as "other". The unit of measure for this benchmark is m^3 per tonne of pome fruit packed and the January to December 2020 benchmarks are presented in Figure 6 below.

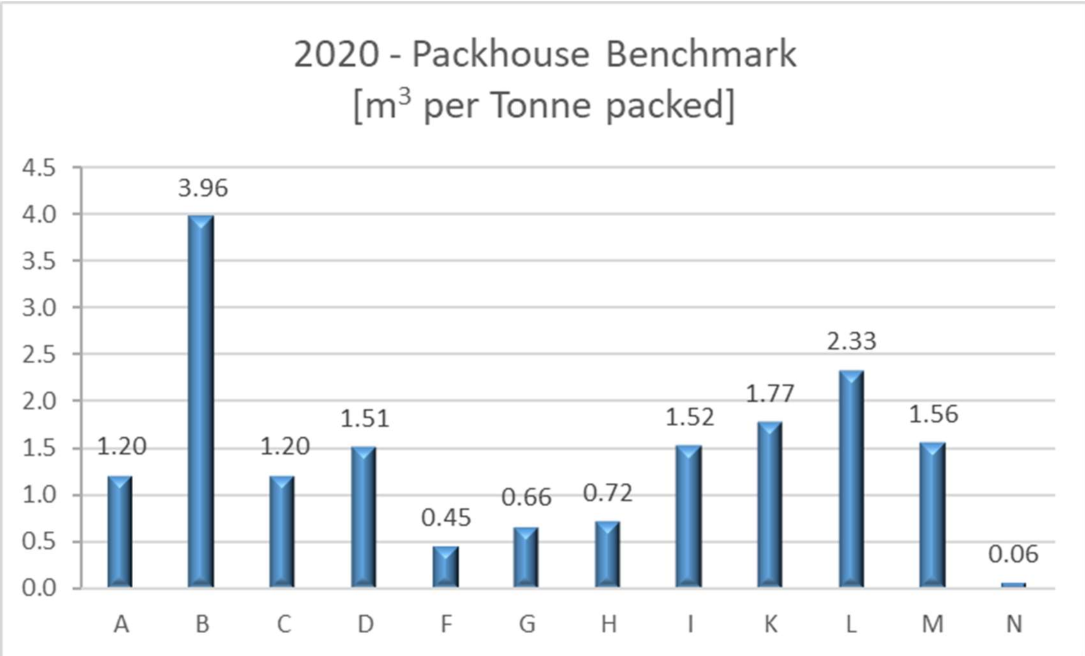

Figure 6: Overall pome fruit packhouse water use benchmarks for January to December 2020

There is a large variation in the overall water use benchmarks, which can be ascribed to a lack of metering and accurately allocated water consumption data. Regardless, the consensus appears to be that in 2020 a packhouse used approximately 1 to 1.5 m^3 of water per tonne of pome fruit packed.

4 Water Usage Profiles

It is useful to compare the water use profiles of different packhouses. Figure 7 below displays the percentage of water consumed for the different areas/activities in each of the participating packhouses.

4.1 Results

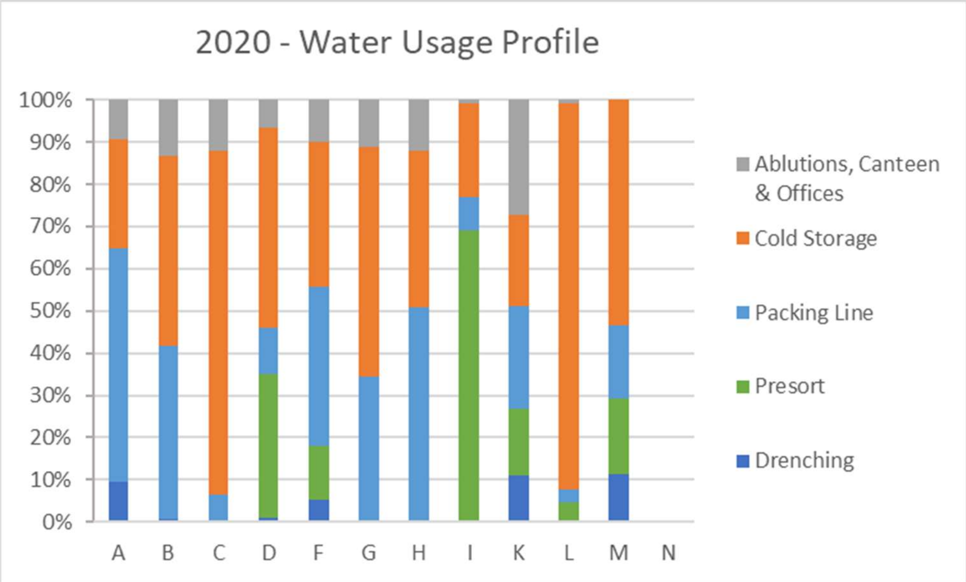

Figure 7: Water Use Profiles

<u>Figure 7 Notes:</u>

Packhouse A – Provided accurate data and this profile can be used for comparison.

Table 1 below summarizes the quality of the data received from each of the participating packhouses, for each area/activity.

Table 1: Summary of packhouse data quality for the different areas/activities

Packhouse	Drenching	Pre-sort	Packing line	Cold storage	Ablutions, canteens and offices
A	Metered	N/A	Metered	Metered	Metered
B	Metered	N/A	Estimated - allocation issue	Metered	Estimated
C	N/A	N/A	Estimated	Estimated	Estimated
D	Estimated	Estimated	Estimated	Metered	Metered
F	Estimated	Estimated	Estimated	Estimated	Estimated
G	N/A	N/A	Metered	Metered	Estimated
H	Estimated	N/A	Estimated	Estimated	Estimated
I	No data	Estimated	Estimated	Metered	Estimated
K	Estimated	Estimated	Estimated	Estimated	Estimated
L	N/A	Estimated	Estimated	Estimated- allocation issue	Estimated
M	Metered	Metered	Estimated	Estimated	No data
N	No data	N/A	Estimated	No data	No data

4.2 Variation in water use profiles

There are large variances in the water use profile of participating packhouses. This could be attributed to:

- A lack of metering (thus estimations).
- Water consumption that is metered, but that cannot be allocated to the specific areas of the packhouse ("crow's nest" of piping distributing water throughout the packhouse).
- Lack of water consumption records.
- Errors in water consumption records.
- Different types of flume technology used.
- Different water recycling technologies applied.

5 Year-on-Year Comparison of Water Use Benchmarks

A benefit of undertaking water benchmarking is that it not only supports consumption target setting, but also allows for year-on-year comparisons. A year-on-year water benchmark comparison for Phase 1 (2017), Phase 2 (2018), Phase 3 (2019), and Phase 4 (2020) of this project is discussed below.

For the pack line (Figure 8) and the cold storage (Figure 9) comparison, it is best to use Packhouse A's data over all four years. For the ablution, offices, and canteen comparison (Figure 10) it is best to use Packhouse A's results for 2018, 2019, and 2020 (2017 data was not allocated correctly).

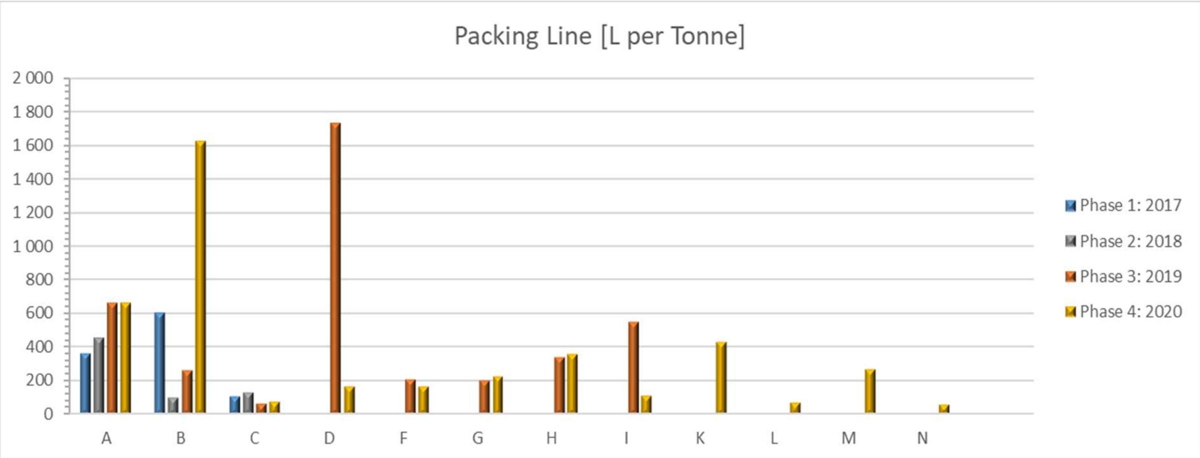

Figure 8: Year-on-year comparison of Packing Line benchmark results

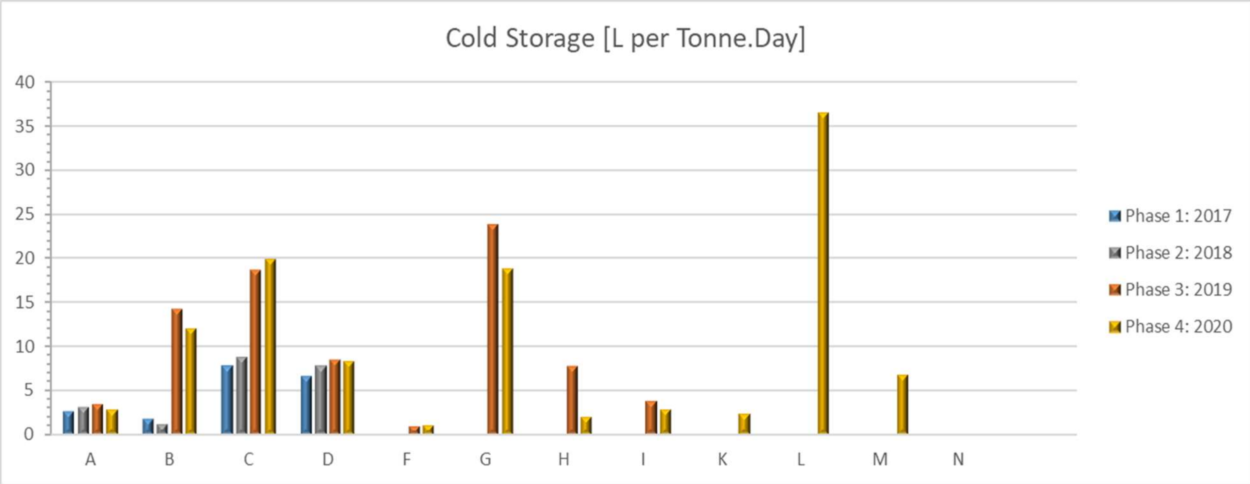

Figure 9: Year-on-year comparison of Cold Storage benchmark results

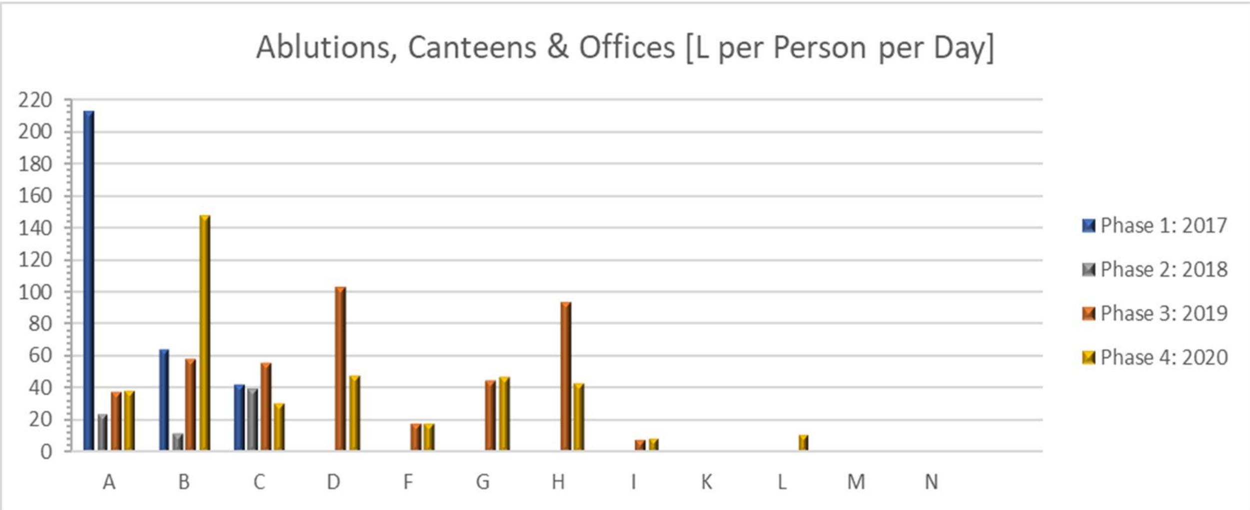

Figure 10: Year-on-year comparison of Ablutions, Canteen & Offices benchmark results

The upward trend in water consumption seen from 2017-2019 could be attributed to the lifting of water restrictions subsequent to the Western Cape "day zero" drought being broken in 2017.

The water consumption in 2020 for the packing line and the ablutions, canteen and offices has gone up only by a very small margin, while cooling tower water consumption has shown a decrease in comparison to that of 2019. With increased efficiency, water consumption should start showing more of a decrease for all the areas of the packhouse in the future.

6 Water Management Practices

Packhouses were asked a series of quantitative and qualitative questions around packing line and water reuse technologies and practices. A summary of these results is shown below.

6.1 Flume technology age

As can be seen in Figure 11 , the majority of the packhouses (A, B, C, D, H & N) use flume technology that is more than 10 years old. Only packhouse I makes use of the latest flume technology.

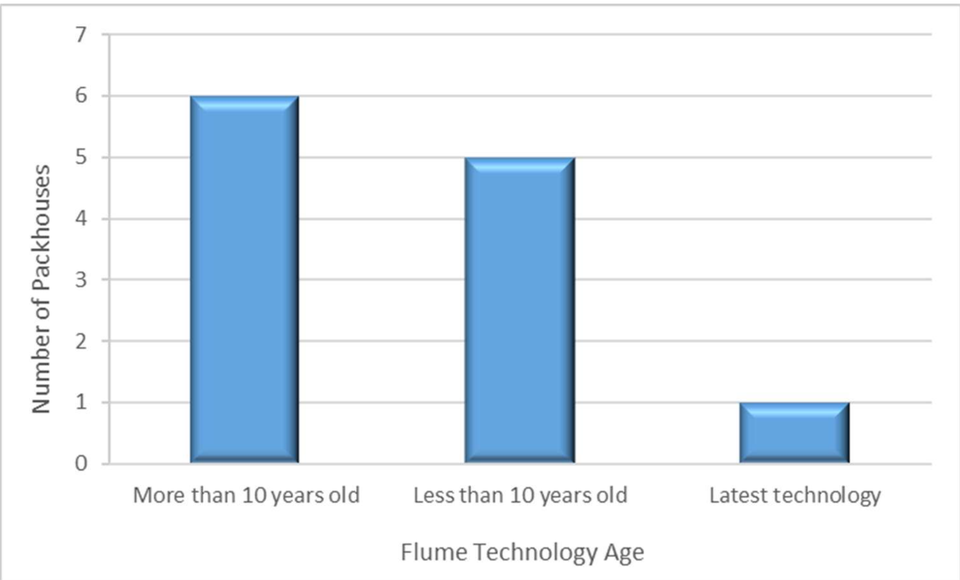

Figure 11: Flume technology age among the packhouses

6.2 Flume water management

All of the packhouses provided a detailed description regarding their flume water management processes.

6.2.1 Standard water management processes

6.2.1.1 PH management

- Five of the twelve packhouses monitor the pH levels at regular intervals throughout the day, although one packhouse does not make adjustments.
- Five packhouses don't have any pH management process in place.
- One packhouse only manages their Oxidation Reduction Potential (ORP) levels, which is done by an external company.
- One packhouse measures their water pH once a year by taking borehole water samples.

Acceptable pH levels were reported as:

- 6.5 – 7.8 by one packhouse;
- 7.0 – 7.5 by one packhouse; and
- Packhouses A, B, C, F, G, H, I, L, and M did not provide quantitative information for pH levels maintained in their flumes.

6.2.1.2 Chlorine Management

- Nine of the twelve packhouses indicated chlorine level monitoring at regular intervals throughout the day.
- One packhouse uses chlorine dioxide instead of chlorine in their flumes.
- One packhouse indicated the use of hypochlorite chlorine.
- Corrective actions are taken to restore chlorine concentration and pH to predetermined levels, as necessary.

Acceptable chlorine levels were reported as:

- 2-5 ppm by one packhouse;
- 4-5 ppm by one packhouse;
- 10 – 30 ppm by one packhouse;
- 25 ppm by one packhouse;
- 50 ppm by two packhouses; and
- Packhouses A, B, F, G, K, and L did not provide quantified information for chlorine levels maintained in their flumes.

6.2.2 Cumulative flume water holding capacity

11 packhouses reported their cumulative flume water holding capacity. This capacity ranged from 15 – 400 m^3. The average cumulative packhouse flume water holding capacity was 191 m^3.

6.2.3 Flume water drainage cycle

All packhouses reported their flume water drainage cycles. Eight of the 12 packhouses drain 100% of their flume water once a week.

Packhouse C drains their flumes once every two weeks. Packhouse I keeps the water in their flumes for three months, after which it is deposited into reedbeds to be filtered and returned to the river. Packhouse L drains their flumes only two or three times per year, otherwise they just top up their flumes. Packhouse M drains their packing line flumes twice per week and their pre-sort plants 4 to 5 times per season.

6.2.4 Flume Cleaning processes

All of the packhouses use the same method of cleaning their flumes which entails draining water from flumes, then washing/rinsing of flumes with high-pressure water and soap and using brooms to remove leaves and other foreign matter. Thereafter flumes are rinsed/flushed and refilled with clean water.

Packhouse H and Packhouse K indicated that they add chlorine to their flumes after filling them with clean water. Packhouse I indicated that no chemical treatment is added to their flumes after they refill.

6.3 Water recycling technologies

6.3.1 Flume water

- Four packhouses drain their flume water into a dam or a pond, after which it either runs into the river, is drained into ground water or gets channelled into a wetland area.
- Three packhouses do not recycle their flume water, the water ends up being total run-off.
- One packhouse recycles their flume water for three months before depositing it into reedbeds where it is naturally filtered.
- Two other packhouses also lets their drained flume water filter naturally via reeds or a wetland system.
- Two packhouses disposes of their drained flume water via a storm drain water system.

6.3.2 Rainwater

Only four out of the 12 packhouses harvest rainwater.

- Two packhouses use harvested rainwater for the condensers of their refrigeration plant.
- The harvested rainwater from another packhouse forms part of their production line and borehole water and they also use it for their gardens.
- A fourth packhouse pumps their harvested rainwater into a natural filtration system, before it is accumulated into their supply dam.

6.3.3 Drenching

Four packhouses use technologies in their drenching process.

- One packhouse has a perforated grid in place in their drenching line that separates particles from the water flow, with a mesh size of 3mm.
- One packhouse lets their drenching water drain into a dam, after which it is mixed with the packhouse water and goes into the municipal water source.
- One packhouse uses lime filtration, activated filter media (AFM) filtration, granular activated carbon (GAC) filtration, auto backwash, ozone contact, micro bag filtration, UV sterilisation and chlorine sterilisation technologies. After use, 70% of their drenching water gets sprayed on roads.
- One packhouse has a sand filter system in place in the borehole from where drenching water is sourced, to filter out iron.

6.3.4 Pre-sort/packing line

Five out of the 12 packhouses make use of technologies in their pre-sort line and/or packing line.

- One packhouse has lime filtration, AFM filtration, GAC filtration, auto backwash, ozone contact, micro bag filtration and chlorine sterilisation technologies.
- One packhouse uses standard MAF RODA filtration plant equipment.

- One packhouse uses only gas filters.
- Four packhouses use sand filters
- Four packhouses use UV sterilization
- Three packhouses use carbon filters

6.3.5 Cold storage

Four out of the 12 packhouses make use of recycling technologies in their cold storage.

- One packhouse directs its defrost water to each refrigeration plant room's make -up tank.
- One packhouse uses a TDS (total dissolved solids) controller which measures the water levels and bleeds water into the system as needed.
- One packhouse recycles 60% of defrost water to a natural filtration system.
- One packhouse re-uses water from condensers which is captured in holding tanks

6.3.6 Ablutions, canteens and offices

Two out of the 12 packhouses make use of recycling technologies in their ablutions, canteens and offices.

- One packhouse pumps all their wastewater to a central municipal facility next to the packhouse and they provide their workers with fresh drinking water from other rainwater tanks as the municipal water is not always clean and drinkable.
- Another packhouse makes use of a Biozone sewage treatment system.

7 Conclusion

Nine packhouses that participated in Phase 3 returned to participate in Phase 4. This is encouraging as it indicates that the packhouses are getting value out of this process. In addition, 3 new packhouses participated for the first time. As the number of participating packhouses increases, the value of these benchmarks will also increase.

While contacting packhouses during Phase 4, awareness was raised for the project and it was encouraging to see that three additional packhouses committed to participating in future rounds of data collection. The most common reason for not participating was not having sufficient water metering, technologies, and procedures established in the packhouse. Additionally, changes in packhouse management resulted in a reduced capacity for data collection.

The year-on-year comparison builds value and raises discussion points that participating packhouses can use to start internal discussions. In Phase 3 there were signs of increased water consumption in all areas since the project was started, but it was positive to see that in Phase 4 the water consumption barely increased and, in some cases, even decreased. More accurate data from more packhouses is required to confirm these trends.

From a data collection point of view, the collection of drenching and pre-sort water use data, as well as water management practices and recycling technologies applied, has proved to be valuable.

Splitting out drenching and pre-sort water use allows for more accurate packing line benchmarks for those packhouses who drench and/or pre-sort their fruit.

Differences in water management practices and recycling technologies applied across packhouses could be used to explain some of the variances in the benchmarks. However, more accurate data is required to confirm the effect of these practices and technologies on water consumption trends.

The following points remain areas of concern:

- A large number of packhouses do not meter specific areas and therefore packhouses do not have an accurate picture of how and where water is consumed.
- In some cases, water meters are not read, or the readings are not recorded. This results in poor water usage history and undermines the value of the data and any management decision based on the data.
- Rainwater harvesting and recycling technologies have been shown to result in lowered water consumption but is only applied by a few packhouses.

It is positive to find that more and more packhouses are indicating a shift towards installing meters for more accurate measurement of water use in the future, which will drastically improve the value of this report.

8 Recommendations

The following recommendations are made:

- It is crucial to communicate the impact that metering, record keeping, and data issues can have on the benchmark results and to illustrate this with examples. This will be addressed in the close-out sessions with packhouses for Phase 4 and during onboarding sessions for future data collection.
- Subsequently, it is key to understand the reasons for metering issues experienced by packhouses. This could be implemented in the next round of data collection.
- Packhouses could consider implementing good water management practices to reduce water consumption, including:
    - Metering and consistent record keeping of water consumption on a monthly/annual basis.
    - Ensuring that a formalised strategy/water policy is in place and implementing a water management plan.
    - Setting water reduction targets.

- Training staff on water use efficiency and implementing water wise behaviour.
- Using alternative water supplies: rainwater, ground water, surface water or basement water.
- Re-using water in the packhouse where possible e.g., production water for floors, handwashing water for toilets; pump seal/defrost/condenser water for cooling tower make up tank.
- Maximising cooling tower cycles of concentration to six or more.
- Longer retention of drenching and flume water.
- Regular inspection and repair of leaks, regular repair and service of faulty equipment.
- Using efficient fittings and technologies (flow restrictors, tap aerators, autostop sensors, automatic shut off valves, waterless urinals, hold flush/dual flush toilets etc.).

- Participating packhouses could be asked for suggestions to improve the data collection tool and processes.
- It is recommended to include questions on preventative maintenance (leak detection and repair) applied by packhouses in the next round of data collection.