FREMANTLE PORTS

CONTAINER MOVEMENT STUDY 2017

FREMANTLE PORTS

INTRODUCTION

A new study has been completed to provide current information on containers travelling to and from Fremantle Port for a period incorporating August 2017, including identifying their origin and destination and other core information.

The work was undertaken on behalf of Fremantle Ports, the WA Department of Transport and Main Roads WA. It updates information from the previous Container Movement Study carried out in August 2011 which has provided the basis for much of Fremantle Port-related supply chain infrastructure decision making since that time.

The main aim of the recent study was to gain an up-to-date understanding of the transport, storage and distribution of full import and export containers as well as the movement of empty containers and other core information based largely on the format of the previous study. This study sought to build on the previous analysis by including information on overall container cycle times and vehicle routing.

The findings will assist in improving industry planning and understanding, particularly in terms of:

- inland origins and destinations of full containers (i.e. pack and unpack locations)
- mode of transport used
- staging of containers between container origins and destinations (location and use)
- timing of elements of the inland logistics chain (day of week and time of day)
- routes used by port-related container carrying vehicles.

The report provides valuable comparative data to that of other major Australian ports.

STUDY METHOD

In addition to collecting and analysing data on container sizes, types and weights, the project focused primarily on six phases of the port's inland container logistics chain, including:

1. Import full containers from container terminal to unpack point
2. Import empty containers from unpack point to dehire at empty container parks
3. Empty containers from container terminal to empty container parks (import repositioning)
4. Export empty containers from empty container parks to packing point
5. Export full containers returned from packing point to container terminal
6. Empty containers from empty parks to container terminals (export repositioning).

The study involved 45 participants, including 28 transport operators, and also:

- container terminals
- empty container parks
- Approved Arrangement premises (AA)
- government entities
- rail operators.

The main survey was undertaken over a four-week period, with 84% of the transport operator data (six providers) and 100% of the data from the other provider categories being received between 7 August and 3 September 2017. The remaining transport operators provided information for a two-week period from 14 to 27 August.

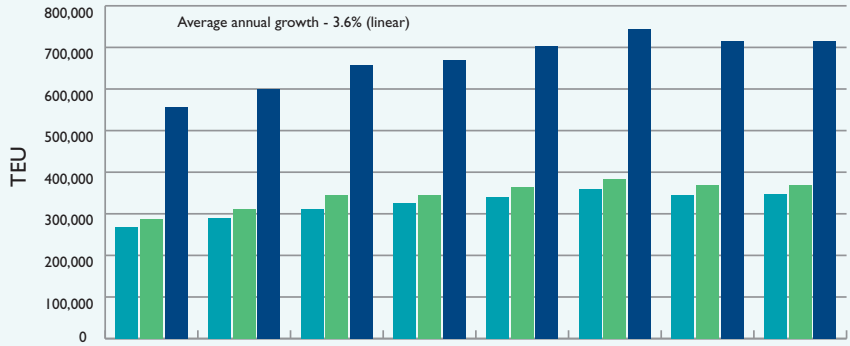
Statistical analysis of the monthly import and export TEU data for the 2009-10 to 2016-17 period (the period available to the consultants at the time of the analysis) generated estimates of the underlying trends and seasonal variations. With this, a 12-month moving average procedure was used, giving estimates of the underlying trend through to December 2016 and the monthly seasonal variations to May 2017. This was used to annualise transport operator data.

The aim of the study was to gain three quarters of all transport activity. Trends in staging, delivery/pick-up locations, transport and importer/exporter activity timings should be considered in the context that the findings are based on a sample only.

GENERAL INFORMATION FROM THE STUDY

The growth of container trade at the port can be seen in Figure 1. Trade totals for 2016-17 indicate that freight levels continue to exceed 700,000 TEU per annum, which is consistent with the previous three years.

Figure 1: Observed trend in import and export TEUs: 2009-10 to 2016-17 financial years



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
EXPORT	268,984	288,796	312,459	326,382	339,410	360,563	346,035	347,277
IMPORT	288,474	310,180	344,453	343,900	363,917	382,932	369,072	368,670
TOTAL	557,458	598,976	656,912	670,282	703,327	743,495	715,107	715,947

Source: Fremantle Ports trade statistics

Each container is moved by either road or rail at some point in the import or export cycle (transhipments being minimal in Fremantle, at less than 0.01%).

Within each of the six phases noted above, a container may be moved a number of times, that is, picked up from one location and delivered to another. In the report, these are referred to as container movements.

MOVEMENTS OF CONTAINERS IN THE LOGISTICS CHAIN

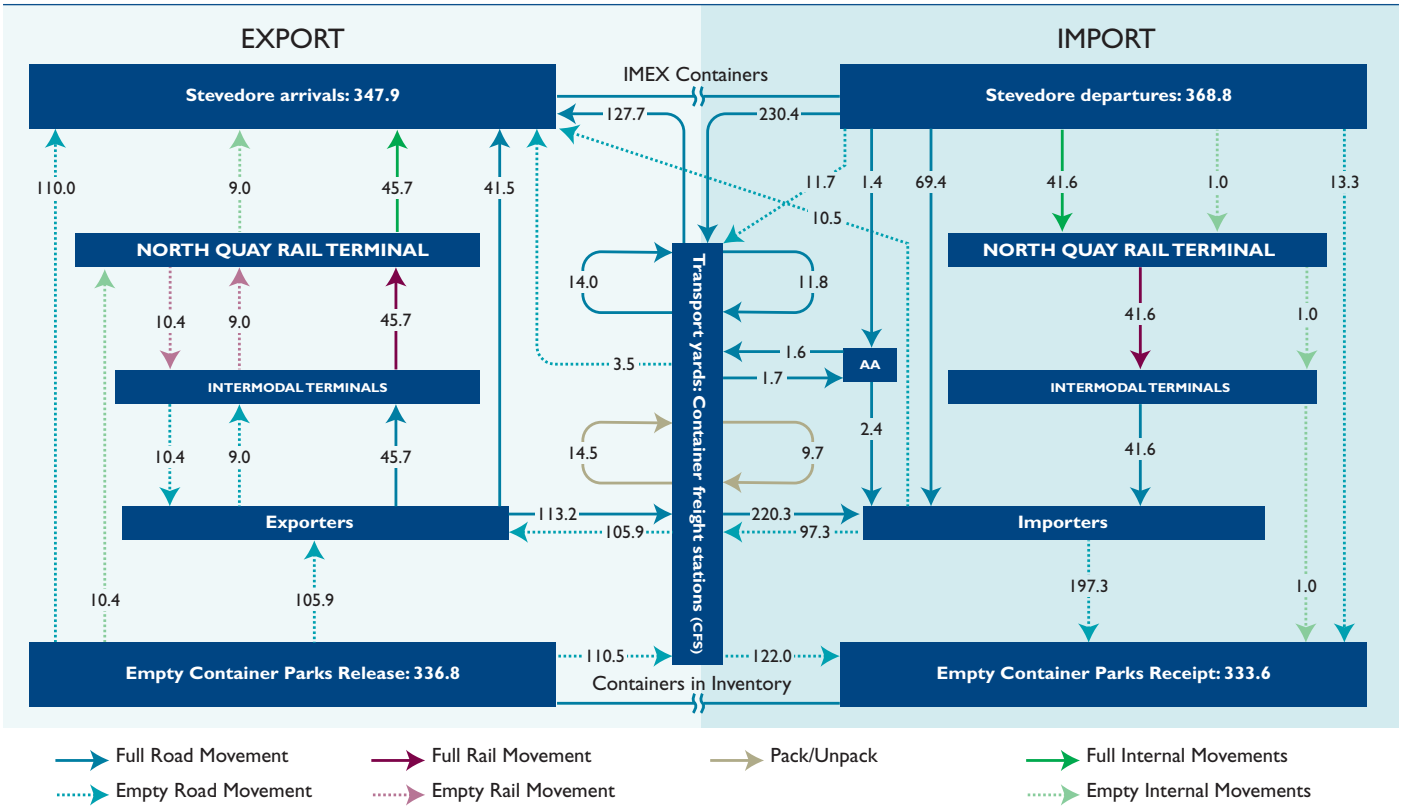
Of all the containers observed, about half were full imports, about one quarter were full exports and the remaining quarter were empties exported to meet requirements elsewhere in the world. Similar proportions were observed in 2011 based on actual full-year data. In contrast to the previous study, the 2017 survey found that significantly more container packing activity now takes place outside the Perth metropolitan area.

The various container movements (in TEUs) noted during the study and annualised for 2016-17 are shown in Figure 2 below. The movements to the left of centre represent the Export Cycle, while those to the right represent the Import Cycle. The diagram gives an overview of all the key flows within the port's landside container supply chain and demonstrates the complexity of the overall chain, with a number of movement variations possible in the import and export cycles.

It clearly confirms the growing importance of staging in the import and export chains. Around 80% of both full import and export container movements (as TEUs) were staged at intermediate (road and rail-based) facilities during the 2017 study. This has changed significantly since the previous study where full imports and exports were at around 65% and 45%, respectively.

Empty container parks play a vital role in the supply chain, as the final repository or the initial starting point for the import and export chains respectively, with nearly all containers passing through empty container parks at some stage in the cycle.

Figure 2: 2017 - Movements of full and empty containers in the import/export logistics chain



Figures represented are TEUs ('000s) for 2016-17. Some minor movements are not shown. The source for the total numbers of container terminal arrivals and departures was *Fremantle Ports Annual Report 2017*. All other figures are annualised estimates based on study data. In this diagram AA = Approved Arrangement premises (i.e. sites handling biosecurity arrangements). IMEX = import export.

MAJOR STUDY FINDINGS

Imports

The average number of container movements in the import cycle has increased by 10% to now average 2.9 movements per container since the previous study.

Apart from the port precinct, the two major import container destinations continue to concentrate around the Canning Vale/Jandakot/Bibra Lake and Welshpool/Kewdale/Forrestfield areas, with the latter expanding further eastwards to include Hazelmere and other growth industrial suburbs in the north-east metropolitan sub-region (refer Figure 3).

As expected, unpack locations are concentrated in core industrial zones (refer Table 1). The concentration of unpack activity continues, with two thirds of all unpacks taking place in just eight industrial suburbs (compared to 10 in 2011). There have also been some significant changes in locus with that east of Perth Airport and around Jandakot Airport noticeably increasing their share of unpacks.

While nearly half of all unpacks took place in a band between 20-30km from the port at the time of the previous study, this has dropped to around 40% in 2017. Increases have occurred in the 11-20 and 31-50km bands and interestingly in regional WA 100km beyond the port (refer Figure 4). Delivery times to unpack locations continue to show a preference to receive containers earlier in the day.

Figure 3: Map of import container destinations – Greater Perth

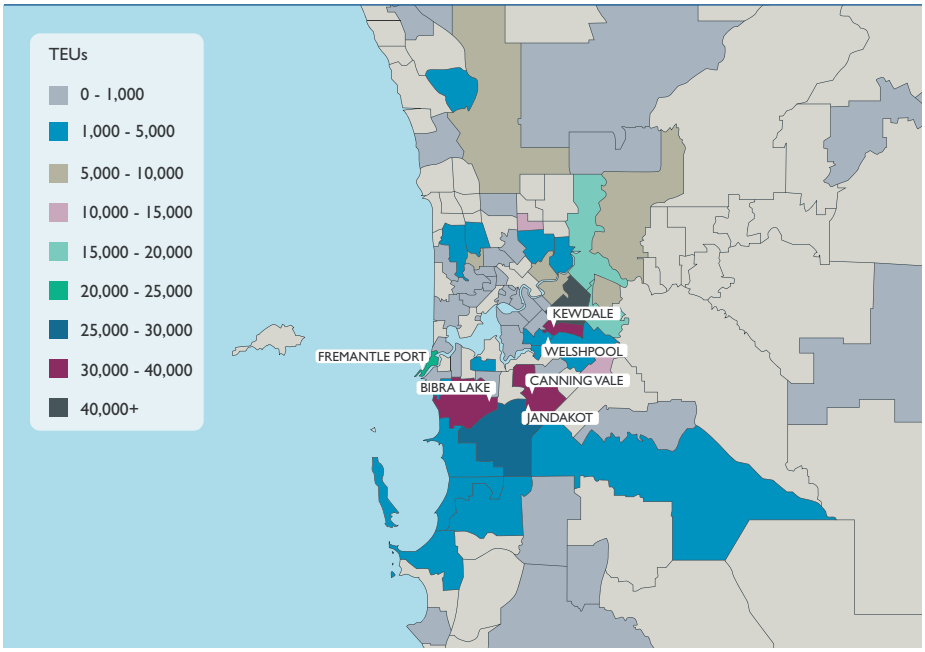


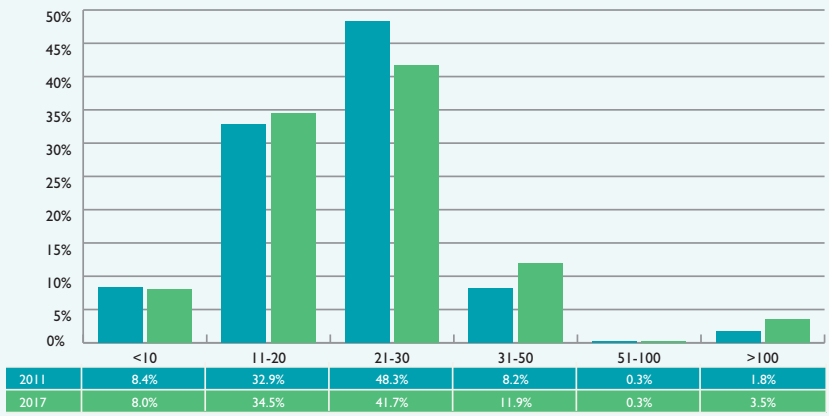
Table 1: Distribution of unpack locations – study comparisons

Location	2004	2011	2017
Bayswater/Morley/Malaga	6%	8%	9%
Inner Harbour	3%	6%	7%
Kewdale/Forrestfield/Welshpool	39%	35%	41%
Canning Vale/Jandakot	*	10%	19%
Kwinana/Rockingham/Naval Base/Henderson	2%	3%	4%
O'Connor/Spearwood/Bibra Lake	14%	16%	10%
Outer Perth**	5%	10%	2%
Perth Central	11%	10%	5%
Country	20%	2%	3%

* Note: 2004 totals included in Kewdale.

** Note: Some areas that may previously have been considered Outer Perth, such as Hazelmere, Midvale, etc. are now in the Kewdale/Forrestfield locus area, while others, such as Wangara and Balcatta are now considered in the Malaga locus area.

Figure 4: Radial distance from the port for unpack locations – combined

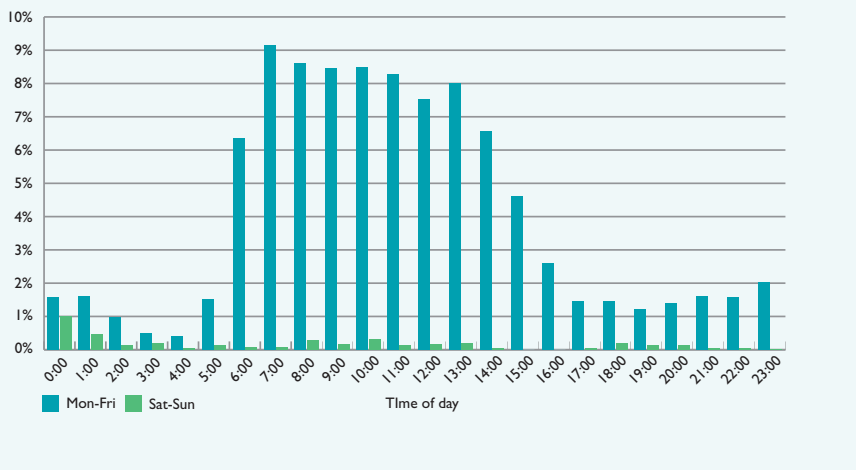


Prior to arriving at customers, nearly 80% of all full import container movements by road are staged (held at an intermediate location) rather than running direct from the container terminals. This compares to 65% during the previous study. Staging can help to overcome the pressures that can occur within the system when many transport operators attempt to obtain their containers at the same time. Staging can facilitate a more even spread of pick ups from, and deliveries to, terminals and a greater guarantee of delivery times to customers.

The data indicate that the concentration of staging within the metropolitan area has increased. The top four suburbs have increased from 84% to 94% of all the staging activity detected since the last study, with the North Fremantle port precinct having increased its dominance.

The Perth market is slowly maturing in terms of the level of after-hours unpacks occurring. While there is a significant and steady decline in numbers of deliveries to unpack locations after 1pm, encouragingly there is a steady level of activity still occurring between 6pm and 2am, with only a short drop off until 5am when it ramps up quickly again (refer Figure 5).

Figure 5: Arrival of full containers and departure of empty containers at importers



After-hours operations have been enhanced by the activities of both empty container parks and container terminals since the previous study. Empty container parks have extended their opening hours and container terminals have promoted large-scale movements of containers at off-peak times by consolidating containers into dedicated stacks for ease of after-hours retrieval. Although there is still a dominance of activity in the core operational hours with 80% of arrivals taking place between 6am and 3pm, the trend towards extended operating hours is slowly being reflected in the wider market.

Around 30% of import unpacks are completed on their day of arrival. In practice, after arriving full at the unpack location the containers are unpacked, and the empty container retrieved the same day. Over two thirds of all containers are unpacked within two days or less after arrival at the import site.

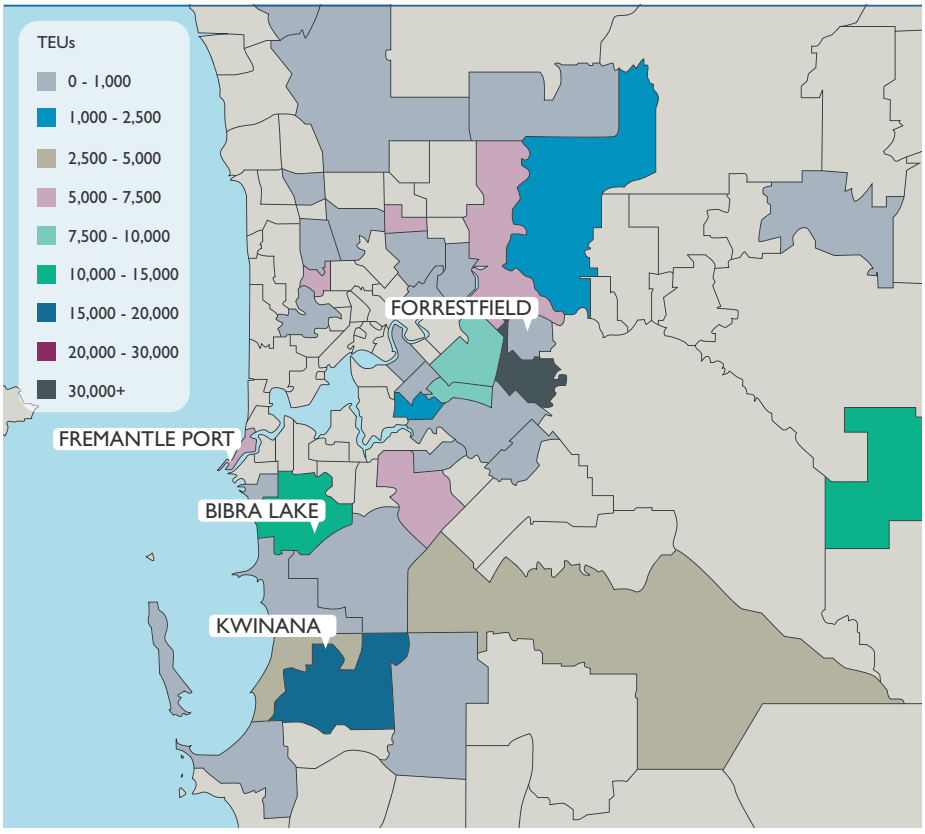
Exports

Even more noteworthy than the increases in the number of movements required for imports are the changes in exports. With the increase in staging at transport yards and use of rail, the number of export moves has increased by around 35% to now be 2.6 movements per container according to the most recent results.

There has been a noticeable shift in full versus empty export containers. While half of all export containers were empty at the time of the previous study, this has reduced to 38% in 2017, meaning the State is reusing its containers for loading export product far more effectively than six years ago. A favourable agricultural season and increases in exports of scrap products accounted for the increased reuse of containers. Another key finding is that 21% of all full export containers are now moved by rail.

The top 10 exporting localities continue to account for two thirds of all exports (refer Figure 6). Compared to the previous findings, there appears to have been some significant shifts in the location of key export areas. As was the case with imports, the Kewdale/Forrestfield area retained its importance as an export origin area, though with less of a noticeable eastwards drift towards the newer industrial localities of Hazelmere and other growth industrial suburbs in the north-east metropolitan sub-region.

Figure 6: Map of export container origins – Greater Perth



Of the top 15 container pack locations seven were in non-metro localities, confirming the importance of regional Western Australia in terms of export container packing, particularly the Wheatbelt, Avon Valley and Goldfields. Country totals between the 2011 and 2017 surveys are quite different. In 2011, there was no Kalgoorlie rail service operating and export pick-up locations were determined based purely on transport operator data. Accuracy of the 2017 study data was enhanced through access to Australian Border Force data to enable findings to be cross checked.

Henderson was previously the largest pack location and no longer appears in the top 15, while nearby Kwinana has increased from seventh position at the time of the previous study to second by 2017 (refer Table 2 below). The reduced volume from the Henderson area is due to the completion of major project work associated with oil and gas and mining industries and the relocation of mineral sands operations, both of which had been operating in Henderson in 2011.

The proportion of export container staging taking place in North Fremantle has increased which is reflective of new developments in North Quay following completion of the Rous Head Industrial Park. Interestingly, export packs at North Quay have decreased significantly (annualised survey data shows 15,508 TEU in 2011 compared with 3,049 TEU in 2017) which may be due to the closure of some older, existing warehouses during the development process.

Table 2: Distribution of pack locations – study comparisons

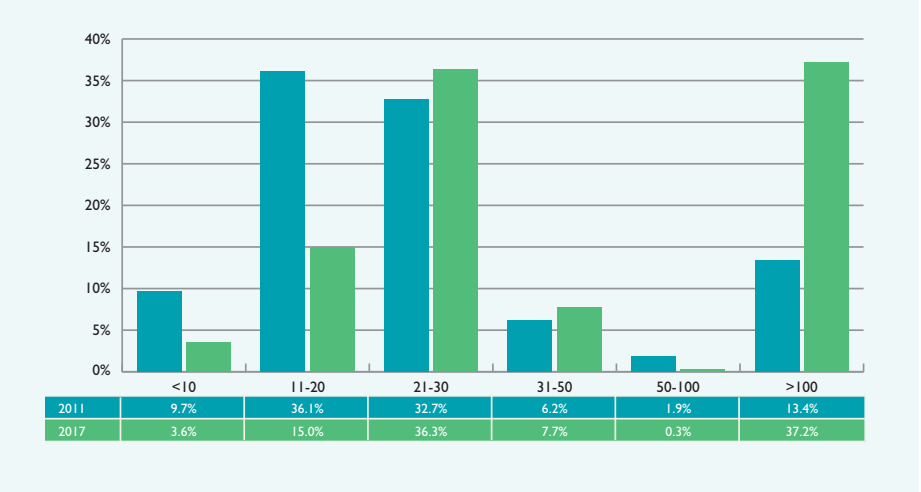
Location	2004	2011	2017
Bayswater/Morley/Malaga	2%	2%	3%
Inner Harbour	2%	9%	3%
Kewdale/Forrestfield/Welshpool	16%	25%	30%
Canning Vale/Jandakot	*	5%	3%
Kwinana/Rockingham/Naval Base/Henderson	5%	26%	12%
O'Connor/Spearwood/Bibra Lake	18%	8%	5%
Outer Perth**	9%	7%	2%
Perth Central	5%	2%	3%
Country	43%	16%	39%

* Note: 2004 totals included in Kewdale.

** Note: Some areas that may previously have been considered Outer Perth, such as Hazelmere, Midvale, etc. are now in the Kewdale/Forrestfield locus.

Figure 7 graphically shows the importance of regional WA to the State's export container supply chain. The comparison between the two study results may indicate a move of location of some exporters, particularly in the Henderson region, and the recommencement shortly after the last study of the Kalgoorlie rail service, but also reflects a change in the way export packs were considered between the two studies.

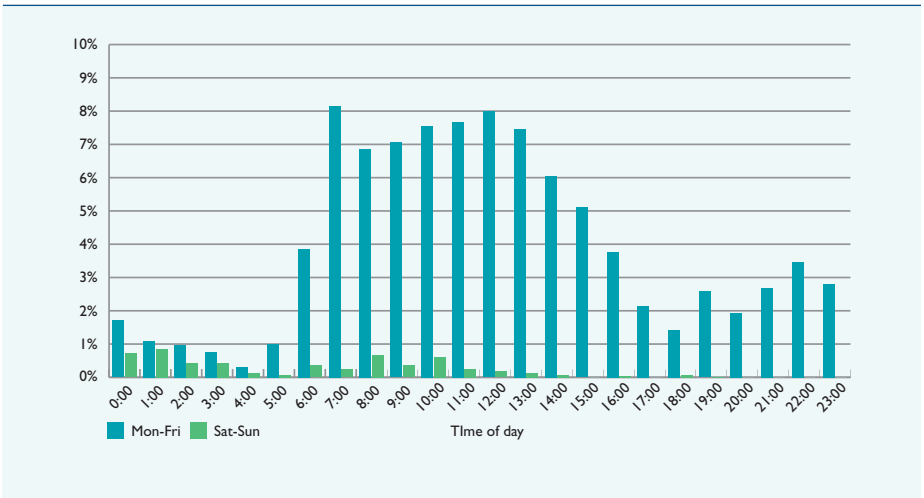
Figure 7: Radial distance from the port for pack locations – combined



There has been a significant increase in importance of staging for full export containers, with rail increasing its share of the export market which, by definition, involves staging of all containers. Of all full containers arriving for export at container terminals for the largest transport operators, around 80% are staged at intermediate locations prior to delivery to a container terminal, compared to around half in the previous study.

Figure 8 below indicates a spike in export-related activity at 7am, being the highest level throughout the day, followed by generally steady activity until just after noon, and dropping at around 6pm. A positive level of activity is then seen throughout the evening until after midnight.

Figure 8: Arrival of empty containers and departure of full containers at exporters



Around 40% of export packs are completed on day one of arrival. That is, after arriving at the pack location, empty containers are packed and ready for immediate delivery to a terminal the same day. Nearly two thirds of all containers are packed in two days or less after arrival at the site.

Quarantine-related activity - Approved Arrangement

A further finding of this study is the reduction in activity at what were known as Quarantine Approved Premises (QAP) and are now known as Approved Arrangement (AA) premises. These operations perform work as directed by the Department for Agriculture and Water Resources (DAWR, previously Australian Quarantine and Inspection Service - AQIS). As an example, nearly 10% of all full export TEU movements to container terminals went via an AA in 2011, compared to no measurable external movement activity identified in the current study, as a result of export agricultural enterprises progressively carrying out treatments on their own premises. Import volumes through AAs fell by more than half, in physical TEU terms, despite the increase in import trade. This was largely due to changes made following the 2011 study period to the designation of suburbs within the Perth metropolitan area requiring a 'rural tailgate' inspection and in biosecurity legislation dealing with a more targeted screening process for goods that may provide a biosecurity import risk.

CONTAINER TYPE USE

Figure 9 shows the size of containers noted at container terminals. In terms of physical containers (noting that each 40-foot equivalent container is equal to two TEUs), 20 and 40 foot import containers are handled in equal numbers.

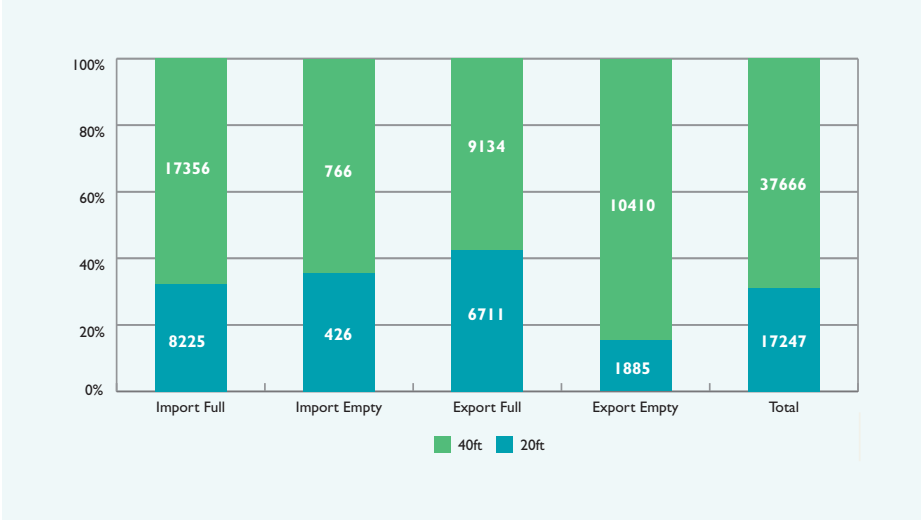
Looking at physical containers leaving the country, Western Australia still exports significantly more loaded 20-foot containers, compared to loaded 40-foot containers. This also means that the State is reutilising incoming 20-foot containers better. The result is that, in both physical and TEU terms, Western Australia is exporting many more 40-foot containers, unused and empty, than 20-foot containers.

A notable finding from the container terminal totals noted in Figure 9 is the increase in reuse of empty containers for export. In the past six years, full exports have risen to 56% compared to only half (50%) being reused previously.

There is a significant number of 'high cube' containers (9'6") in use for about 40% of both full imports and full exports. This is a slight drop from the 2011 results. As can be seen from Figure 10, the result is that comparatively more high cubes tend to be exported empty.

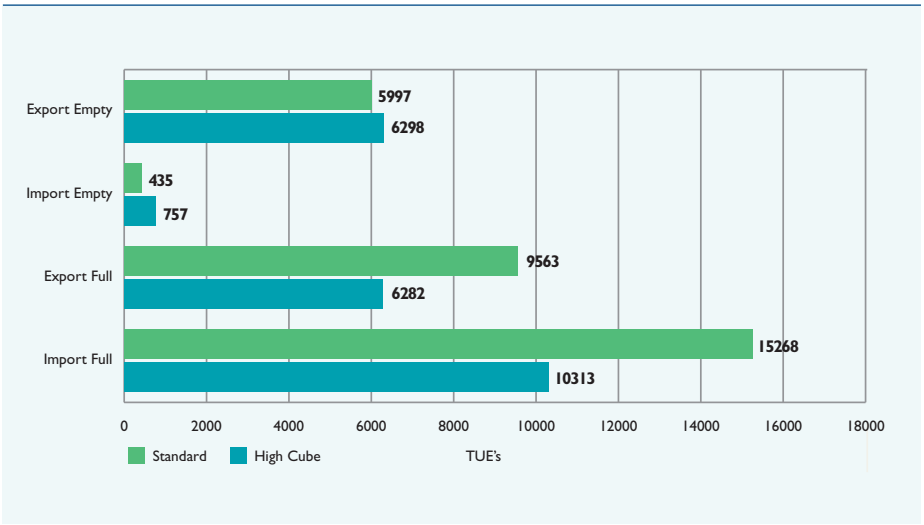
It should also be noted that a major line carried out an unusually large 'repositioning' (in this case, export of empties) action during the study period, which has affected empty export totals.

Figure 9: Breakdown of size – proportion (%) and number of 20ft & 40ft containers (TEUs) (Four-week survey period only)



Source: Container terminal information

Figure 10: Breakdown of standard and high cube containers (TEUs) (Four-week survey period only)

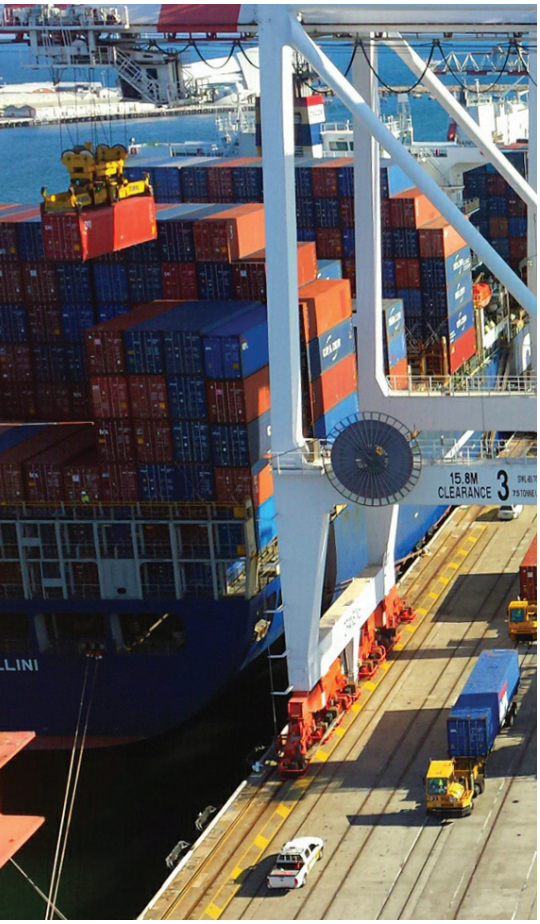


Source: Container terminal information

Cycle times

Using a series of statistical techniques to estimate container mean times, the study showed that the mean cycle time for a container remaining in Western Australia was around 24 days.

Of the containers that completed the import phase of the cycle (discharge from ship at container terminal via transport operations to importer and return to empty container park), the average time was 5.5 days. For exports involving the reverse via an exporter, the average time was 6.7 days. This does not include times spent at empty container parks.

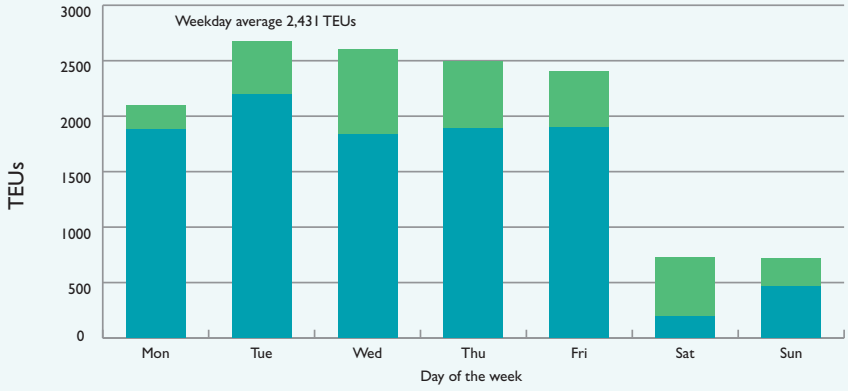


CONTAINER TERMINALS

There have been significant operational changes at container terminals in the past six years. Much work has been done to promote after-hours operations, including making mass movement of containers in the form of stack or bulk runs more available to receival and delivery transport operators.

During the study period, Tuesday was the busiest day (refer Figure 11). When looking purely at full movements Tuesday again stood out with all the other weekdays being roughly equivalent. Wednesday shows noticeably more empty activity than any other day.

Figure 11: Full and empty import and export container arrival and departure at the container terminal (daily average)



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
FULL	1,865	2,175	1,818	1,874	1,879	196	463
EMPTY	213	465	758	600	507	535	254
TOTAL	2,078	2,640	2,576	2,474	2,386	731	717

While weekend days account for around a quarter of the activity of an average weekday (refer Figures 12 and 13), in comparison to the previous study six years ago, there is now significantly more activity on weekends. Saturday now exhibits double the activity and Sunday over three-and-a-half times more activity than at the time of the previous study.

Figure 12: Full and empty import container departure at the container terminal (daily average)

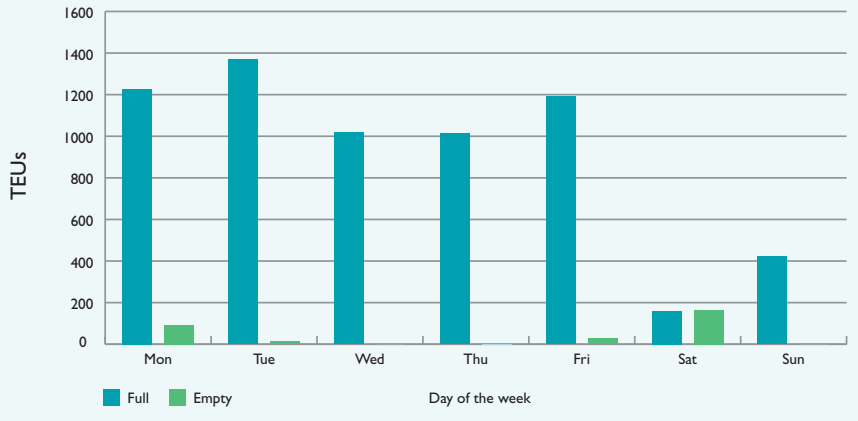
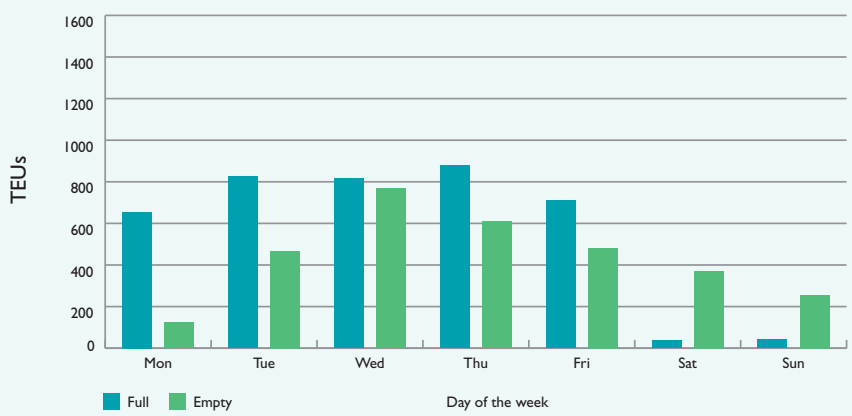
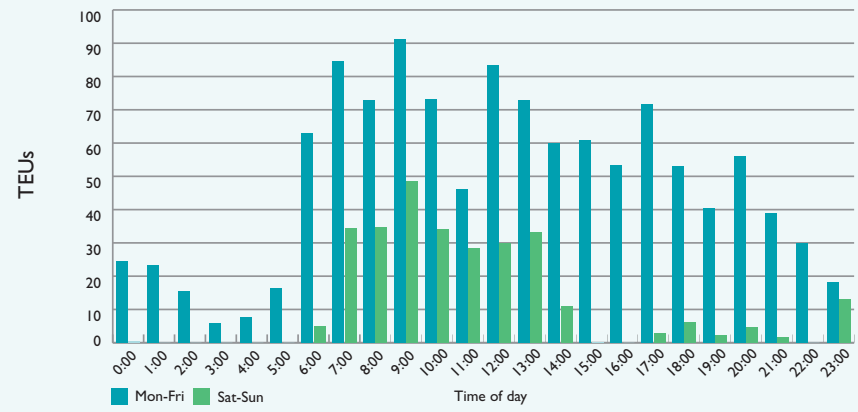


Figure 13: Full and empty export container arrival at the container terminal (daily average)



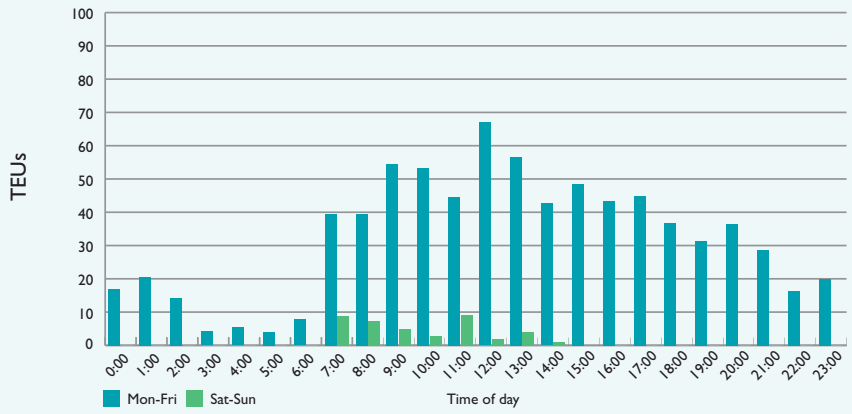
The stevedoring container terminals continue to display a relatively consistent level of container movement activity throughout the core working day for vehicle departures for full imports (refer Figure 14), although a series of variations largely align with employee breaks at one of the terminals.

Figure 14: Departure time of day from container terminals for full import containers (TEU/hr)



As shown in Figure 15, export delivery volumes to terminals basically build to the middle of the day and then decline until shift end.

Figure 15: Arrival time of day at container terminals for full export containers (TEU/hr)



Compared to the previous study, the level of full container activity during the night (after 10-11pm) until 2am has been a very positive development, with activity during this period more than doubling.

Also of significance since the last study has been the level of weekend full import activity. As an example, while there would have been an average of around 10 full import TEUs taken from terminals at around 9am on weekends in August 2011, the result was close to 50 TEU at the same time during August 2017.

The increase in activity at container terminals in the evenings and weekends reflects the concerted efforts on the part of key participants in the supply chain to promote after-hours operations.

EMPTY CONTAINER PARKS

The vital role of empty container parks in the supply chain is evident in Figure 2 showing movements of full and empty containers in the import/export logistics chain.

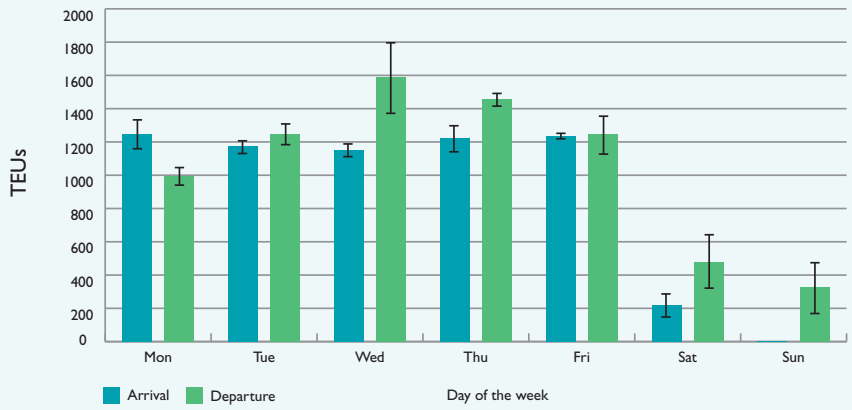
Since the previous study, there has been a series of major developments in the reverse logistics element of the container supply chain. A major new empty container park site has opened (with another major site also opening since the end of the 2017 study) and a further off-port park, in addition to that operating in Forrestfield, was operating in Bibra Lake at the time of the recent study (although this commenced closure during the study). The receival and delivery operating hours have also increased significantly, with all the major parks now open until at least 10pm and on Saturday mornings. The introduction of a notification system to assist in administrating arrival times was another major development.

There has been a noticeable growth in off-port empty container park holdings since the last study and even with the closure of a Bibra Lake off-port empty container park during the course of the study, off-port holdings are still around 50% more than they were (in terms of their percentage share of the total) compared to the previous study, showing there continues to be demand for off-port container returns. This reflects the value of having targeted containers for reuse located close to key client bases.

As reflected in the container terminals daily activity graphic (refer Figure 16), Wednesday is the busiest day of export movement activity at the empty container parks (refer Figure 16). The start and end of the week see larger levels of empty returns compared to other weekdays.

The growth in Saturday empty activity reflects the increased opening of the main empty container parks to receival and delivery. Over the weekend, there is also noticeable export empty repositioning activity. These appear to support efforts over the ensuing years to move volumes to non-core receival and delivery hour activities.

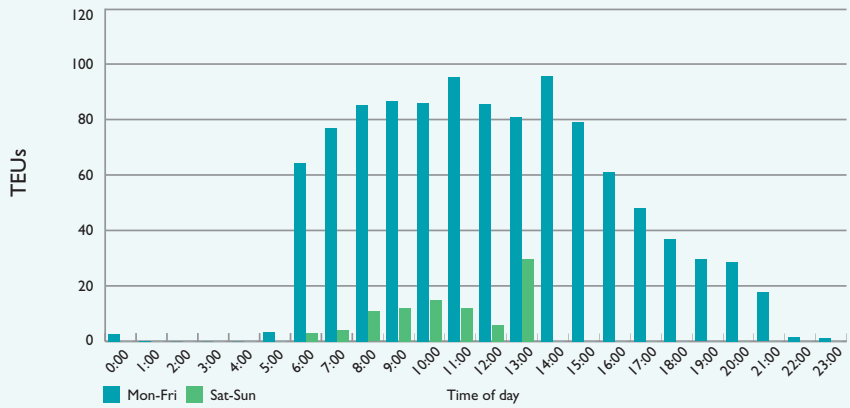
Figure 16: ECP empty container arrival and departure (daily average)



Note: The error bars indicate the variance in the averages.

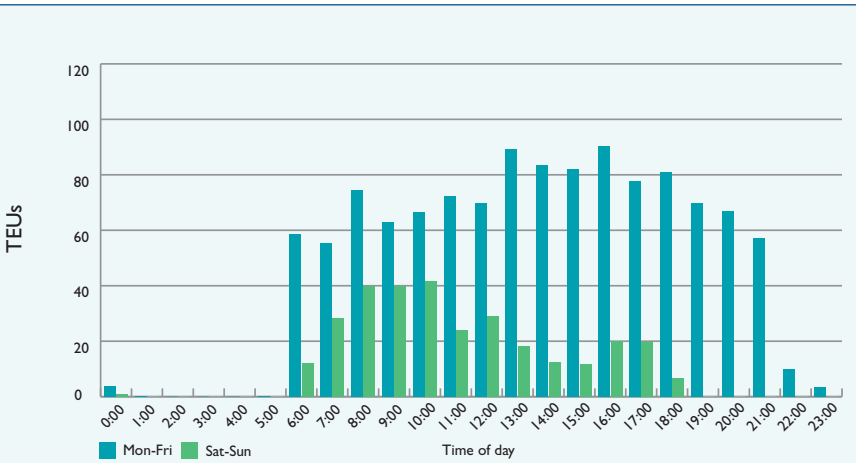
The daily activity charts (refer Figures 17 and 18) show that the main receival and delivery activity for transport operators still occurs in the mornings and early afternoon.

Figure 17: Arrival time of day for empty import containers at ECPs (daily average)



The difference for exports (refer Figure 18) where more activity continues later into the day largely reflects bulk-run activity taking empty export containers departing the country (export reposition) to terminals. This is a significant increase to the level of late afternoon/evening and weekend activity noted during 2011.

Figure 18: Departure time of day for empty export containers at ECPs (daily average)



An interesting finding is that around 10% of all repositioning of exports involved direct-to-wharf dehires. This will be a development worth watching into the future given the possible impact this may have on receival and delivery operations obtaining slots at times of heavy demand.

RAIL

At the time of the study, rail operated three services a day from the North Quay Rail Terminal (located within the port precinct) to an intermodal terminal in Forrestfield and, in comparison to the previous study, to terminals in Kwinana and Kalgoorlie.

Nearly 14% of the total number of containers were transported by rail during the study period, equating to 15.7% of all exports (full and empty) and 11.6% of all imports (full and empty). Of all full export containers transported, nearly a quarter (21%) are transported by rail.

Since the last study, the reintroduction of the Kalgoorlie service has assisted in attracting freight from distant locations with intermodal node facilities. At the time of the 2011 study, freight on rail beyond the metropolitan area was negligible. In the 2017 study, 2.4% of all imports were delivered by rail more than 100km from the port which equates to almost 20% of all imports moved by rail. More importantly, 9% of all container exports travel by rail from more than 100km from the port. This makes up over 40% of exports moved by rail, indicating that when intermodal facilities are provided in appropriate areas with the appropriate conditions rail appears competitive.

There is an emphasis to have rail containers despatched from North Quay Rail Terminal (NQRT) in a timely manner to meet customer demands. As an example, over 80% of containers arrive from terminals and empty parks at NQRT and are sent to the off-port intermodal terminals to allow pick up within 24 hours.

Rail also assists in taking pressures off the core receival and delivery hours at terminals with the majority of containers moving between NQRT and the terminals after 4pm until around 2am.

CONTAINER WEIGHTS

The average weight of a 20-foot import container (18.3t) is interestingly heavier than that of a 40-foot import (17.3t). For exports, there is a marked difference with 40-foot containers (27.4t) being heavier on average when compared to a 20-foot container (22.9t).

Export containers carrying over 20 tonnes continue to increase in number, with 85% of 20-foot (2011 = 76%) and 93% of 40-foot (2011 = 83%) containers now in this range. Imports remain relatively similar.

COMMODITIES

Manufactured goods continue to dominate Western Australia's imports. The top 10 commodity categories account for over 57% of imports.

Primary industry production unsurprisingly dominates exports, with 63.4% of export containers containing the top 10 commodity categories. The largest export is Hay, Chaff and Fodder (19%). Of note is that the second and third largest export commodity categories involve waste products. Waste paper and scrap together are nearly 15% of the State's total containerised exports.

An interesting finding is the drop in dangerous goods exported. While never high (around 3.5% of all exports at the time of the previous study), it more than halved by 2017 (1.5%).

Figure 19: 'Heat Map' of average daily container truck volumes on identified truck routes

ROUTES

The study gathered GPS information for a series of the container movements. The data gathered (refer Figure 19) indicate that port-related container-carrying trucks almost exclusively use major routes to deliver to and pick up from customers, particularly up to the last mile. 'Rat running' (using non-major freight routes) was negligible.

FUTURE STUDIES

Fremantle Ports' series of Container Movement Studies continues to produce valuable insights into the port's landside logistics supply chain.

By designing the study to allow repeatability, the intention is to continue to carry out follow-up studies in future years to build on the understanding gained of the port's supply chain and identify trends.

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