Deloitte.

Deliverable 2: Design of the interventions

Technical studies for the improvement of the transport logistics in Dr. Jules Sedney Terminal

November 30th 2018

Content

1. Introduction

Dr. Jules Sedney Terminal, the Port of Paramaribo is located about 34 km from the estuary of the Suriname River. The port is Suriname's main cargo gateway, accounting for approximately 90% of the total seaborne trade (excluding oil and alumina). The port is run by NV Havenbeheer Suriname[1] (hereinafter HBS), who acts as a landlord, responsible for its daily management operations and its long-term development; meanwhile, the cargo handling is responsibility of two private stevedoring companies, VSH Transport and DP World Paramaribo.

The port handled just over 100,000 TEU in 2016 and slightly more than 80,000 TEU in 2017. Additionally, 200,000 tons of breakbulk cargo and 160,000 tons of liquid bulk are handled in the port, which account for a daily traffic of over 250 heavy vehicles that are coming in and outside the port.

The agricultural, fishing and forestry sectors make up 38% of the volume of foreign trade and 8% of the total value, according to 2017 customs data. The Dr. Jules Sedney Terminal is the exit point for more than 80% of the rice exports and more than 95% for bananas, shrimp and fish exports. Also, the importance of this port lies in the fact that supplies and equipment for crops arrive to the country by sea. In recent years, imports and exports of the agricultural sector have been affected by increasing freight costs and transit times due to limitation in the roads that connect the producing areas to the port, as well as operational difficulties in the port access.

As the main entry and departure point for international trade in Suriname, access to Dr. Jules Sedney Terminal is vital for the economic development of many industries. In this regard, transport companies are one of the most important stakeholders as it allows products form Surinamese agricultural, fishing and forestry industries to send their products abroad and import necessary supplies and equipment. Currently, the access roads to the port are presenting congestions that is making the trade operations inefficient.

Van 't Hogerhuysstraat, the main road to the Dr. Jules Sedney Terminal, has a traffic of more than 50,000 vehicles per day. This traffic includes the trucks heading towards the port, which has deteriorated the road, road shoulders and parapets. Also, the drainage along the road has proven inadequate for current rainfall levels of Paramaribo, failing to prevent flooding that worsens the traffic. This road represents a major bottleneck for trucks going in and out of the port, increasing the cost of agriculture exports and manufactured products imports.

The high congestion within the road, has limited the competitiveness of transportation due to the difficulties in its access. As a temporary solution to the Van 't Hogerhuysstraat congestion issue, NV Havenbeheer Suriname had to made adjustments in the port, reducing its capacity and competitiveness. This includes the closure of the main truck gate, the use of a 470 m internal road for truck traffic, and the temporary use of a storage area of 12,914 m^2 for transit and parking. This has been due to the lack of schedule planning for transportation and the limited access capacity.

Furthermore, NV Havenbeheer has recently made physical and administrative improvements, having implemented new port management and information systems that improved access control to the port, and enabled the company with better statistical information. However, these improvements are still in development and there are several investments regarding equipment, IT development, and stakeholder's training that has to be done in order to fully automate the port access.

The Inter-American Development Bank (IDB) is promoting an improvement initiative to help Suriname's transport in the Port of Paramaribo and its adjacent roads. The Improvement of Logistic and Transport in Paramaribo Program aims to increase Suriname's competitiveness and productivity in the agricultural sector by improving the transport logistics within and near the Dr. Jules Sedney Terminal. The program considers investments and activities throughout four inter-related fronts:

a) Improvement of port access and land utilization;
b) Optimization of port operation and customs inspections;
c) Upgrade and climate adaptation of road infrastructure, bridges and secondary roads; and
d) Modernization of traffic management.

To determine the scope of these components, the IDB has created a Technical Cooperation that seeks to prepare the key technical analysis for the design of the program, as well as to help identify strategic interventions that will help to fulfill the objectives.

Some of the main problems identified in the operation of the port, that will be considered by the Technical Collaboration include the following:

[1]Created in 1971, NV Havenbeheer Suriname is an autonomous, state-owned limited liability company in charge of the administration of the two main ports of the country, the Port of Paramaribo and the Port of Nieuw Nickerie.

- The current dwell time for the trucks within the Dr. Jules Sedney Terminal can be up to 5 hours as the trucks arrive before the cargo is cleared by Customs and the terminal operator.
- Lack of scheduling for transportation and limitation by the customs´ schedule, which generate high peaks in the operation, having a 100% container inspection instead of risk analysis assessment based on IT to determine what containers should be inspected.
- Lack of scanning equipment for the inspection of containers.
- Lack of a permanent regulated parking space for trucks, causing truck lines as they wait to be granted for access to the port.
- Lack of spaces to perform value added services to the foreign trade cargo.
- Lack of commercial spaces for the allocation of transport and logistic companies: custom broker agencies, shipping line's offices, logistic operators, etc.

The improvements and future capacity of the road infrastructure have to be aligned with the Dr. Jules Sedney Terminal's Development Plan in order to guarantee that the efficiency and sustainability of the transport and logistic operations.

1.1. Purpose of the report

The objective of the report is to present the design of the proposed interventions based on the issues identified on the initial assessment, the diagnosis of the access roads current traffic situation, and the port's current operations. Information provided by the project's stakeholders (e.g. Ministry of Public Works, Port Authority, Roads Authority, Customs), available information from public sources, and regional studies were used to further complement the designed solutions. Additionally, the consulting team experience with similar projects as well as the Technical Visit gathered data were considered.

1.1.1. Structure of the report

The report has an Executive Summary with the overall description and design of the proposed interventions on Dr. Jules Sedney Terminal access roads and its internal operations.
After this section, the design analysis is presented in two main subjects:

1. **Introduction:** This sections includes the description of the project objectives and methodology.
2. **Port's Market overview:** The section includes the analysis of the port markets overview, the inbound and outbound traffic generated, and its perspectives.
3. **Proposed interventions in the operations and access to Dr. Jules Sedney Terminal:** These interventions consist mainly on a proposed new import process, the adoption of a Port Community System and the creation of a Truck Center to reduce queues within the port's roads and waiting times by transport companies.
4. **Proposed infrastructure for the road network:** This section details the access roads proposed interventions and how the address the main traffic congestion and problematics. Also, the infrastructure characteristics and particularities are detailed, including a microsimulation of the situation with interventions.
5. **Annexes:** Relevant documents and analysis generated in order to generate the conclusions of the study, including the microsimulations.

Finally, the main conclusions of each section and an overall presentation of the interventions is presented.

1.1.2. Methodology

The proposed methodology for the Technical Cooperation is made up of an initial phase consisting on the Technical Visit, and three work Phases in order to determine the interventions to improve transport in logistics in Paramaribo, and to determine its feasibility with a socioeconomic point of view.

Methodology

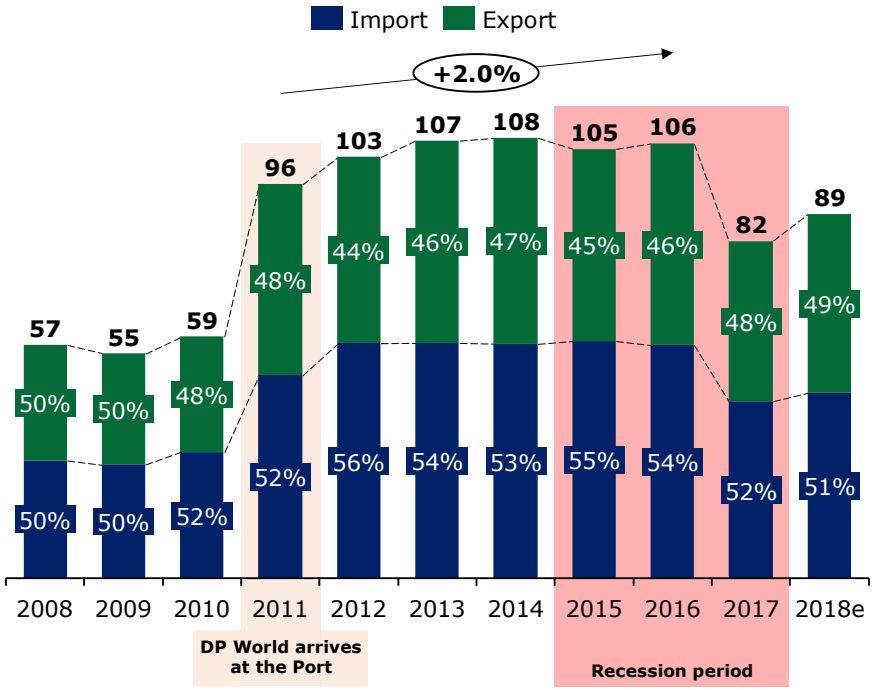
	Phase 0 Technical visit	**Phase 1** Diagnosis	**Phase 2** Design	**Phase 3** Cost-benefit analysis
Objective	**Gather information** by conducting measurements, and interviews to diagnose the port and access roads	Generate a **diagnosis** of the **current port and access roads situation**	**Propose interventions** to improve the access roads and the port's operations for future efficiencies	**Estimate the economic feasibility** of the proposed interventions based on their costs and benefits
Main activities	**Field work and data gathering** • Pneumatic traffic counts • Manual traffic counts • Travel time measurements • Drone flight tours **Port operation analysis** • Port operation documents gathering • Interviews with key stakeholders • Site visits **Contrast of preliminary findings**	**Port market assessment:** • Current maritime traffic • Traffic projections **Analysis of port operations:** • Current situation diagnosis • Process benchmark • Operational gap analysis **Road's traffic and infrastructure analysis:** • Analysis of traffic in access roads • Level of Services analysis • Infrastructure diagnosis	**Definition of port interventions:** • Proposed new infrastructure • Definition of new traffic flows and process improvement • Best practices in port operations: Truck Center and PCS **Definition of roads interventions:** • Roads main issues and proposed interventions • Microsimulation of roads intersections	**Cost Benefit-Analysis** • Potential revenues of proposed interventions • CAPEX of proposed interventions • Cost efficiencies of proposed interventions

2. Port's market overview

2.1. Current maritime traffic

Dr. Jules Sydney Terminal is Suriname's most important port with almost 90% of the country's import and export seaborne traffic, excluding oil and alumina. Nearly all of the containerized agricultural products exports traffic goes by ship from this port; the rest is transported by private terminals. Currently, the port has an annual throughput capacity of approximately 100,00 TEUs, with the potential to double it in accordance with future demand. The total TEU traffic of the port has increased since two terminals started operations in 2011 as seen in the next figure:

Dr. Jules Sedney Terminal imports/exports
Thousand of TEUs, 2010-2018e



The first important milestone was the entry of DP World in two of Dr. Jules Sedney Terminals. DP World acquired a controlling interest in Integra Port Services and Suriname Port Services; and, since the activities in the increased, so did the annual throughput. DP World provided the infrastructure and professionalization needed to improve the port's operations.[2] Under this new capabilities, the port had a compound average growth rate (CAGR) of 2% between 2011 and 2016, which was interrupted by 2017 due to the effects of the recession period.

The GDP annual growth for Suriname was negative -2.6%, -5.1%, and -1,2% in 2015, 2016, and 2017 respectively. The period of economic contraction was largely caused by a sharp decline in the international prices of the country's main exports (gold and crude oil) and the cessation of bauxite production (Suralco closure). The recession caused the government to allow floating exchange rates (from a fixed rate of $3.35 SRD per USD since 2011 to $7.35 SRD per USD in 2016), which caused inflationary pressures that reached a monthly inflation of 19.2% in October 2016.[3] The country is expected to exit this economic struggle in 2018, which should also help to normalize the maritime activities. Currently forecast for the end of the year suggests that imports would reach 51%, while exports 49% of the total throughput. In the recent decades, Suriname's trade balance has been slightly higher on import, although remaining near to a 50/50 distribution.

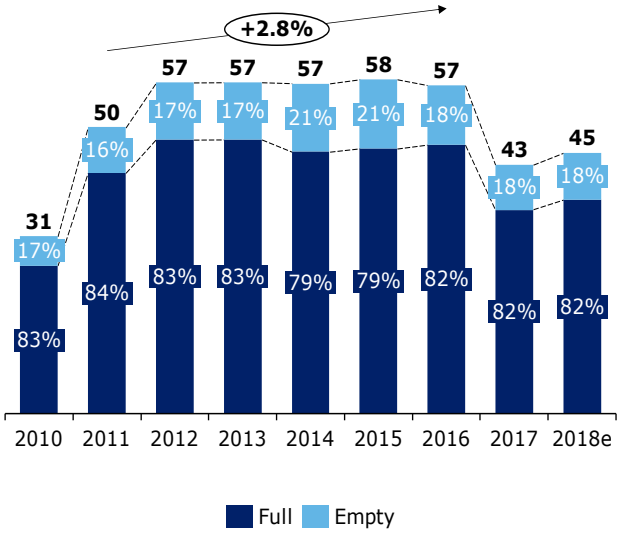
Moreover, the decline of the maritime traffic had been also a consequence to the aggravation of conditions regarding the draft in the Port. The lack of dredging in the navigation channel has limited the operation to half full vessels of 1,100 TEU capacity. According to the interviews with key stakeholders, this implies that shipping lines have to unload the vessels in Guyana and French Guyana before docking into Paramaribo.

[2] DP World is the third largest port terminal operator, handling over 60 million TEUs yearly in 78 operating marine and inland terminals located in 40 countries.

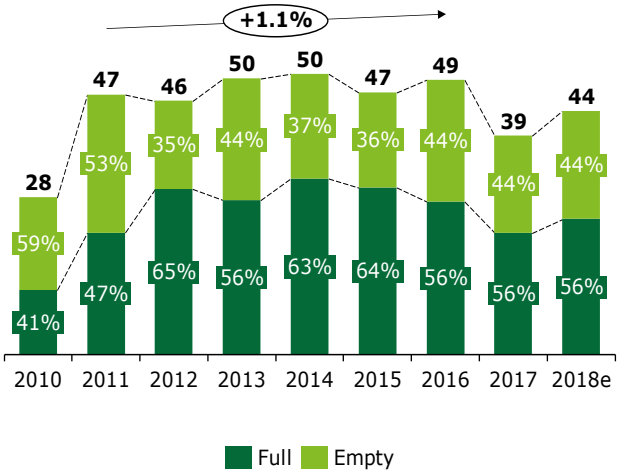
[3] "Development Challenges in Suriname"; Khadan, Jeetendra; Inter-American Development Bank; May 2018

Zooming into each of the operations, we see that while imports TEUs are mainly full containers; exports has an almost equal share of full and empty containers (56% and 44% respectively). For 2018, out of the 89 thousand estimated TEUs, 63% will correspond to full containers and 37% to empty ones:

Dr. Jules Sedney Terminal full and empty import TEUs
Thousand of TEUs, 2010-2018e



Dr. Jules Sedney Terminal full and empty export TEUs
Thousand of TEUs, 2010-2018e

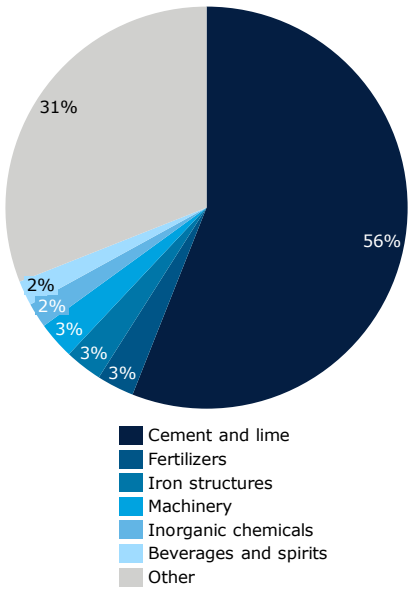


The import activity in Surinamese trade consists mainly on full containers that arrives to the country (82%), while empty containers imported are expected to be loaded with Surinamese products to then be exported as full containers. Import TEU activity showed a CAGR of +2.8% from 2011 to 2016, being the main driver of the total trade growth.

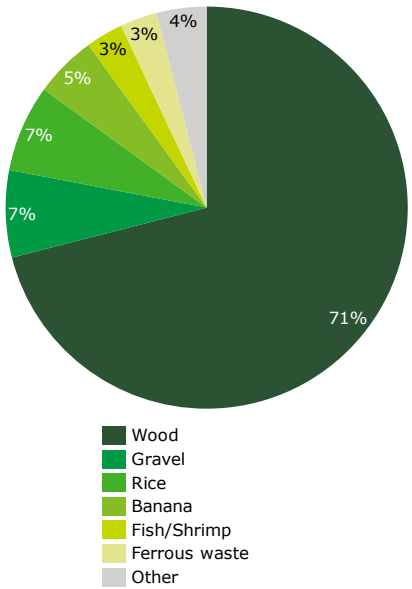
Export activity, on the other hand, has a considerable amount of empty containers that have increased from 35% to 44% since 2012. This means that the number of imported full containers that are being reutilized and exported as full ones is low. Full container export activities, has increased from 47% in 2011 to 56% in 2018, showing that more Surinamese products are being taken abroad. Export TEU activity had +1.1% CAGR from 2011 to 2016, al contributing to the total trade growth.

One of the most relevant aspects of Dr. Jules Sedney Terminal is that, as the main gate to international trade, it connects almost all the relevant agricultural, forestry, fishing and mining production areas of the country for import and exports.

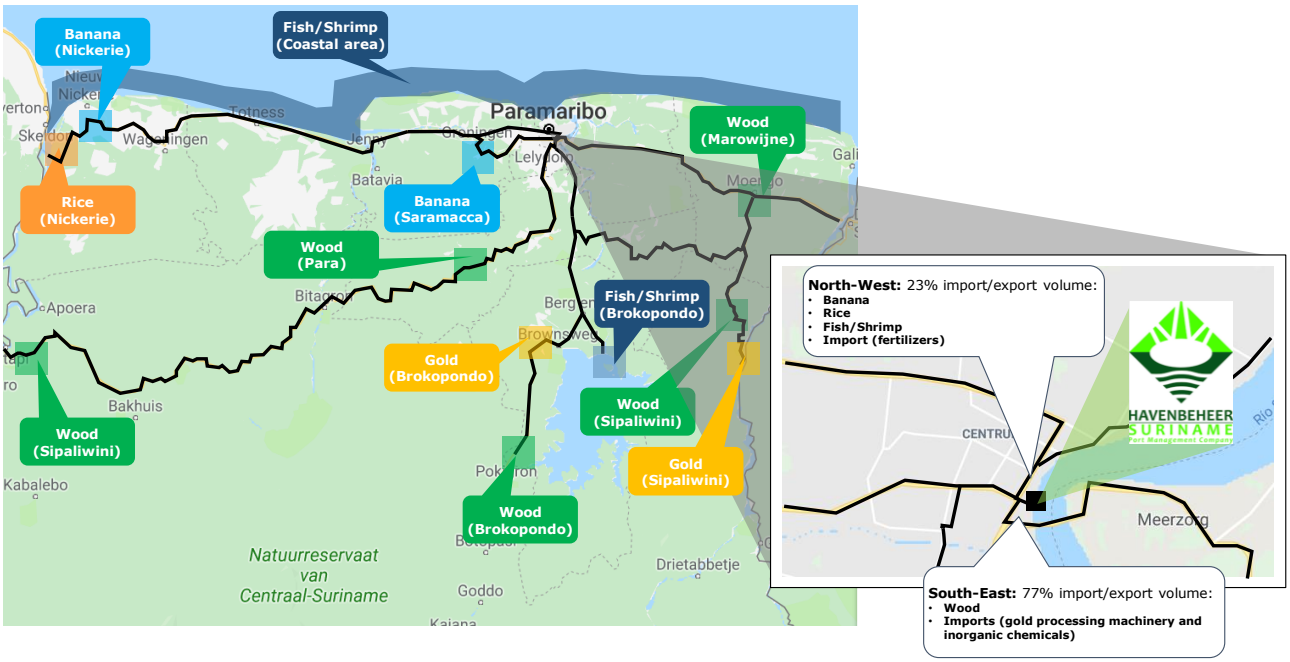
Dr. Jules Sedney Terminal main imports (excl. petroleum)
% of total volume, 2017



Dr. Jules Sedney Terminal main exports (excl. petroleum)
% of total volume, 2017



Main land transport routes to Dr. Jules Sedney Terminal



- **Rice:** Imported supplies such as fertilizers arrive to Dr. Jules Sedney Terminal and heads Northwest to rice productions areas in Nickerie. Export rice and chaff, containerized and in bulk, leave the production areas and head to Paramaribo where are exported from the port. Containerized rice usually ships in 20 ft containers weighting 25 ton in average.
- **Banana:** Banana production areas are primarily located in Saramacca (West of Paramaribo) and Nickerie (Northwest of Paramaribo). Imported goods to these areas include mainly fertilizers; production is usually shipped in 40ft reefer containers abroad. Both activities rely mainly on the operations of Dr. Jules Sedney Terminal.
- **Fish/Shrimp:** Imported goods for fishing/shrimp industries are not as intensive as with others, yet most of the export activity is shipped through the port as chilled products.
- **Wood:** For its volume, wood exports are some of the most relevant to the country. Most of the raw wood is shipped from the port in Paramaribo.
- **Supplies for gold mining:** Gold export volume might not be as relevant, but it makes more than half of the total exports value for Suriname. The relevance of Dr. Jules Sedney Terminal is that gold machinery and inorganic chemicals use for its extraction arrive through it.

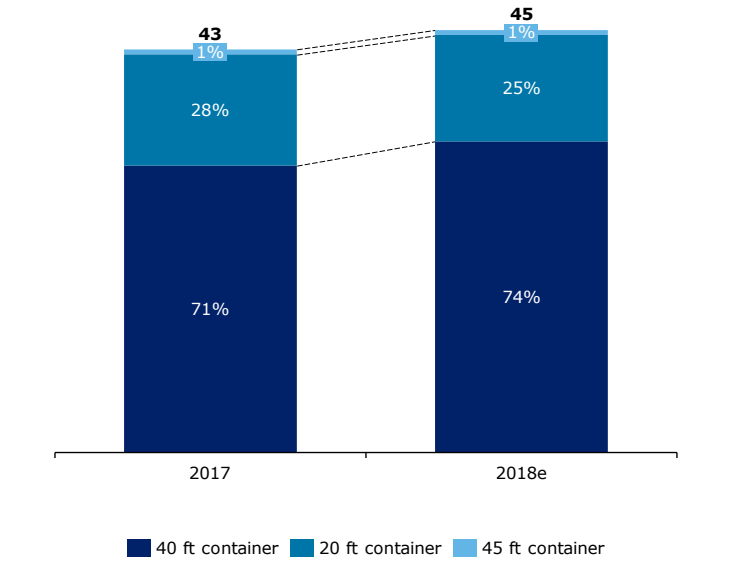
According to the previous origin and destination, and the distribution of products handled by the port, it can be concluded that 77% of the total import/export volume arrives to the port by the South-East roads, while the 23% remaining comes from the North-West routes.

2.1.1. Import

Import trade dynamics is mainly regional in Suriname, 2017 data for origin of arriving ships show that 90% of ships arriving to Dr. Jules Sedney Terminal come from South America and the Caribbean. The rest of the ships origin of precedence is 6% Europe and 4% other regions. Imports arrive to other ports such as Guyana, Panama and Trinidad & Tobago before reaching Suriname.

In 2017, import throughput was 43 thousand TEUs, and 2018 is estimated to end with 45 thousand. As for the type of container used for import throughput, Dr. Jules Sedney Terminal has the following mix:

Dr. Jules Sedney Terminal import throughput by container size
Thousand of TEUs, 2017-2018e



Forty feet (40 ft) containers represents the 74%, while twenty feet (20 ft) containers the 24%. The remaining 1% is represented by a small amount of 45 ft containers. This mix means that fewer trucks are moving more TEUs, as 40 ft and 45 ft containers represents 2 TEU and 2.25 TEU respectively.

Based on customs information for 2017, Dr. Jules Sedney Terminal handled 1.511 million tons of imported products, representing $1,443 million USD. Based on the first two digits of their Harmonized System (HS) chapter, 79% of the total imported volume and 42% of the total value correspond to 10 categories:

Dr. Jules Sedney Terminal imported volume and value
Thousand of tons and million USD, 2017

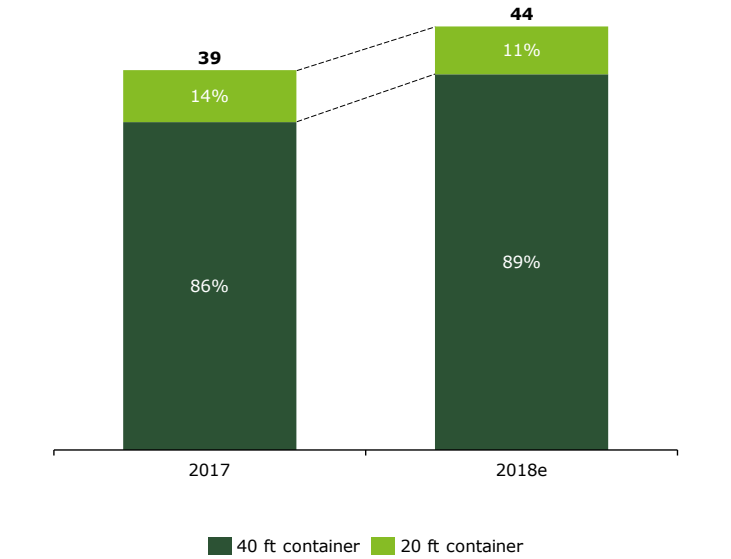
Volume rank	Imported product	Industry	Outbound traffic	Volume Mix %	Value Mix %	Volume (k ton)	Value (MM USD)
1	Lime and cement	Construction	National	48%	2%	721	$22
2	Refined petroleum	Oil & gas	National	15%	9%	226	$132
3	Fertilizers	Agriculture	North-West	3%	1%	38	$15
4	Articles of iron/steel	Construction/Manufacture	National	2%	4%	35	$56
5	Machinery and mechanical appliances	Gold mining/Consumer goods	South-East	2%	17%	33	$239
6	Inorganic chemicals	Gold mining	South-East	2%	2%	31	$35
7	Beverages and spirits	Consumer goods	National	2%	1%	29	$21
8	Plastics	Construction/Manufacture	National	2%	4%	28	$59
9	Sugars and confectionery	Consumer goods	National	2%	1%	27	$18
10	Cereals	Consumer goods	Natonal	2%	1%	26	$8
	Others			21%	58%	317	$838
	TOTAL			**100%**	**100%**	**1,511**	**$1,443**

Of the main 10 imported products, Fertilizers is the most relevant one for agriculture and forestry industries. Lime and cement, articles of iron/steel, and plastics primarily consist on building materials. Refined petroleum corresponds to products derived from exported crude oil. Machinery and mechanical appliances and inorganic chemicals are related to mining activities. The rest, corresponds to consumer goods. The Others category involves all imported goods not included on the ranked products, including ceramic, vehicles, meat, paper and paperboard articles, soaps and cleaning materials, glass, etc.

2.1.2. Export

Exports dynamics are also mainly regional, with 96% of the departing ships heading to South America and the Caribbean, before reaching other destinations. Only 4% departs directly from the port to the rest of the world. Export throughput was 39 thousand in 2017, and it is expected to end in 44 thousand for 2018. Analyzing the type of container used for export throughput by its size, Dr. Jules Sedney Terminal has the following mix:

Dr. Jules Sedney Terminal export throughput by container size
Thousand of TEUs, 2017-2018e



As with imports, TEUs throughput by 40 ft containers is the main size representing the 89%. The remaining 11% is transported by 20 ft trucks. This means that a higher number of TEUs are transported by fewer trucks.

Based on 2017 Dr. Jules Sedney Terminal customs information, the port handled 1.480 million tons of exported goods, representing $1,769 million USD. Using the first two digits of their Harmonized System (HS) chapter, 98% of the total exported volume can be grouped, representing 17% of the total value correspond to 8 categories:

Dr. Jules Sedney Terminal exported volume and value
Thousand of tons and million USD, 2017

Volume rank	Imported product	Industry	Inbound traffic	Volume Mix %	Value Mix %	Volume (k ton)	Value (MM USD)
1	Wood	Forestry	South-East	54%	3%	802	$59
2	Petroleum	Oil & gas	National	24%	8%	352	$142
3	Gravel and sands	Construction	National	6%	0.1%	83	$2
4	Rice	Agriculture	North-West	5%	2%	79	$31
5	Banana	Agriculture	North-West	4%	1%	60	$21
6	Fish and crustaceans	Fishing	North-West	2%	2%	37	$40
7	Ferrous waste and scraps	Metallurgy	National	2%	0.2%	30	$3
8	Beverages and spirits	Consumer goods	National	1%	0.3%	9	$5
	Others			2%	83%	28	$1,466
	TOTAL			**100%**	**100%**	**1,480**	**$1,769**

It is important to note that gold makes up for 60% of the total export value ($1,061 million USD with 525 tons), which is not included in the previous table as it is handled by other means of transportation.

Dr. Jules Sedney Terminal relevance for forestry, agriculture and fishing industries is evident, as wood (ranked 1 by volume), rice and banana (ranked 4 and 5, respectively) and fish and crustaceans (ranked 6)

are the main exports, excluding gravel and petroleum. For the agriculture industry, the relevance of the port is vital to three main products:

- **Bananas:** Food & Agriculture Industries (FAI) is the main banana production company in the country. It operates two plantations, one near Paramaribo and another one in Nickerie, with an estimated traffic of 5,000 TEUs annually that leave Dr. Sedney Jules Terminal each year.
- **Rice:** Annual exports of rice in Suriname were 79,000 tons, of which 80% is containerized and transported in 20 ft containers weighting up to 25 ton each. Total TEUs for rice and chaff leaving Dr. Jules Sedney Terminal is up to 3,160.
- **Fish and crustaceans:** Annual exports of 37,000 tons which is containerized, accounting up to 2,300 TEUs.

Officials figures are not available, but estimations for 2017 suggest that agriculture exports could have represented a total of 10.5 thousand TEUs departing Dr. Jules Sedney Terminal. This amount is 43% of the total full container exports according to data provided by the port.

2.2. Inbound and outbound traffic from the port

To estimate the inbound and outbound traffic from the Dr. Jules Sedney Terminal, HBS provided the registers for land transport access and departures from the different gates from January to August of 2018. A methodology was proposed to calculate the current daily truck traffic and to estimate the behaviour of the growth as well as the number of trucks that would get a direct access due to complete documentation and arrival on schedule, and the ones that would be waiting to get inside their terminal.

2.2.1. Methodology and projections

Proposed methodology for inbound/outbound traffic estimation

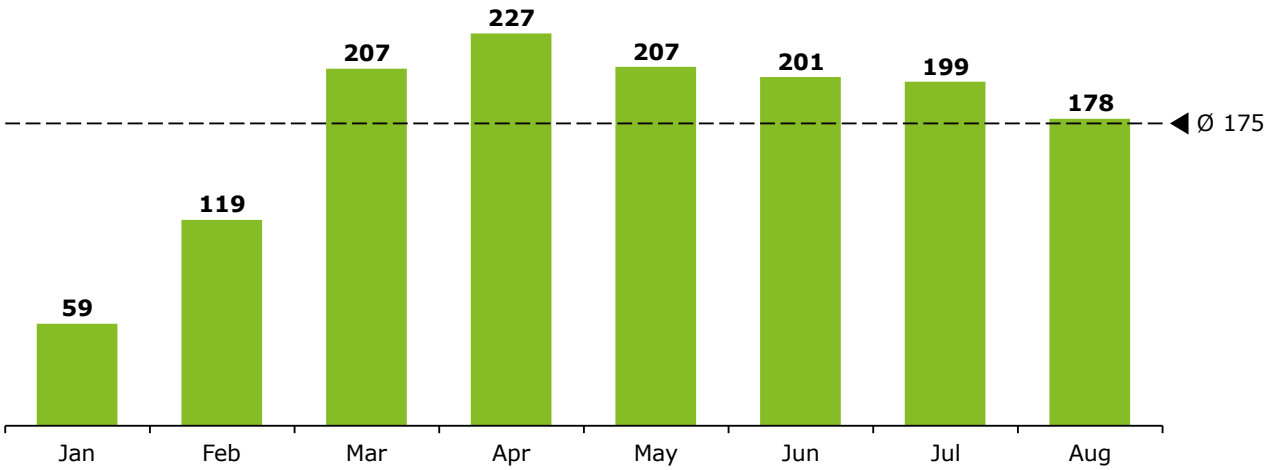
Current import traffic	Current export traffic	Total traffic projections
• Analysis of registered monthly departures from the port • Estimation of daily truck traffic per month • Calculation of average daily truck traffic for import activity	• Analysis of registered loaded containers in the port • Estimation of daily truck traffic per month • Calculation of average daily truck traffic for export activity	• Growth rate assumptions • Projections of total daily truck traffic • Direct traffic behavior assumptions

2.2.2. Inbound and outbound traffic form the port

The proposed methodology for the estimation of inbound and outbound traffic is based on the analysis of current import and export traffic. The estimations for each of these come from the analysis of several databases provided by the HBS.

- **Current import traffic:** As part of their regular operations, Dr. Jules Sedney Terminal has a register of trucks that use each of their access gates (North Gate currently used as the entry point, Main Gate which is used sporadically, and South Gate used as the departure point). The register has the singularity that only loaded trucks are being considered, while empty ones are not being registered. Due to this, the information for the North Gate and Main Gate potentially has omissions on the total trucks that actually use them. On the other hand, loaded trucks that leave through the South Gate and are being registered make up the import traffic of the port. Only workdays are considered for the calculations (Monday to Friday) as they're the ones were most of the operations take place.

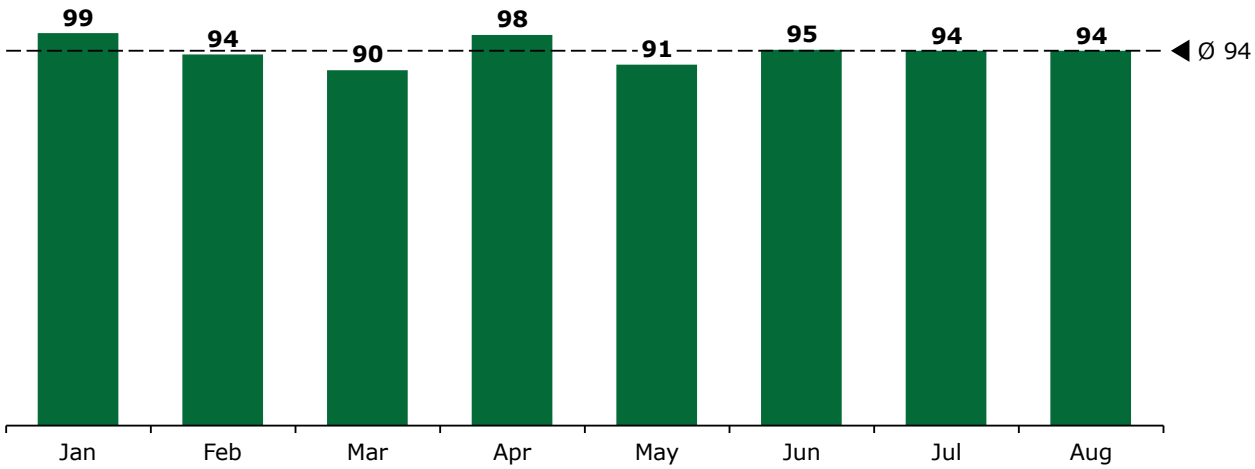
Dr. Jules Sedney Terminal daily traffic for import operations
Monthly average, 2018



For import operations, an average of **175 trucks per day traffic** was estimated as the current levels.
As it is later explained in the port operation analysis, it is a common practice for these traffics to wait outside the port until they have the complete documentation.

- **Current export traffic:** For the export activity, the monthly loaded container data was considered as the main input to estimate the daily truck traffic in the port. Dr. Jules Sedney Terminal provided the total TEUs registered monthly for different container sizes. The available information had to be converted to trucks, as a TEU is the unit for a 20 ft container. A 40 ft container is equivalent to 2 TEUs and a 45 ft container to 2.25 TEU. The monthly trucks were then divided by the same workdays considered in the imports to get the average daily traffic for export operations:

Dr. Jules Sedney Terminal daily traffic for export operations
Monthly average, 2018



For export operations, the average of **daily truck traffic in the port is currently 94 vehicles.**

- **Total traffic projections:** When summed, import and export operations make a daily traffic activity **of 269 trucks (77% arriving from the south and 23% from the north, based on the export/import activities)**. For the total traffic projection, the 2011-2016 CAGR of 2% was considered as the increase rate based on maritime traffic projections. The rationale used is that under normal conditions and assuming that 2018 is the year where the Surinamese bounces back, the port's operations should reach levels similar to the ones it had before the recession.

3. Proposed interventions in the operations and access to Dr. Jules Sedney Terminal

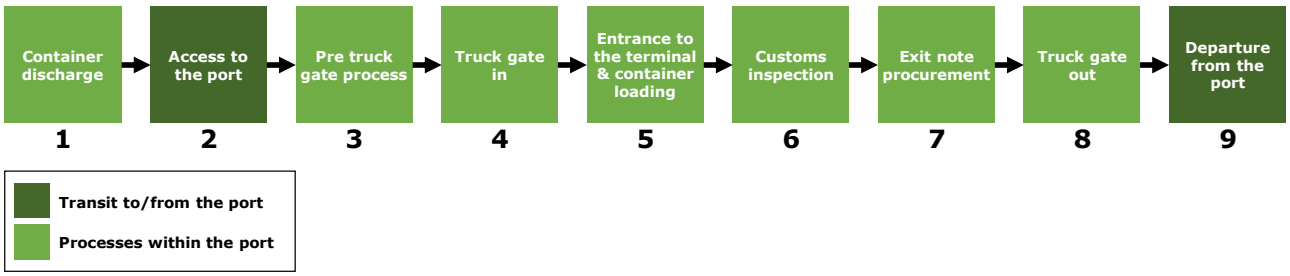
The information provided by the IDB and the Suriname liaisons regarding the port operations included two of the main operations that could be optimized, import and export processes. For the analysis of the port operation, we first conducted an in depth understanding of the current import and export processes (As Is), identifying the main tasks, parties involved, duration and other considerations relevant for the initial mapping. Then, we researched other port operations in other countries (e.g. Mexico and Colombia) to identify best practices, and optimized processes. The comparison between the current process at Dr. Jules Sedney Terminal and the benchmark process, allowed us to identify gaps that can be filled to improve operation and competitiveness. The processes are being studied from the point of view of the land transport and its implications in the vicinity and within the port.

3.1. Current situation diagnosis (As Is)

3.1.1. Import process

The import process has been analyzed throughout 8 sub-processes that include form the discharge of the container to the departure of the port throughout the roads that connect it to its hinterland. These process has an average overall time of 300 minutes (5 hours), in which the truck and its driver is involved, having a low use of one trip per day or less.

Import Process (As Is)



No.	Process	No.	Subprocess	Responsible	Systems	Duration (min)
1	Container discharge	1.1	Operation planning and preparation	Terminal operations	TOS	
		1.2	Container discharge	Terminal operations	TOS	
2	Access to the port	2.1	Arrival to the port by the truck	Transport company	NA	
3	Pre truck gate process	3.1	Preparation of truck gate in documentation	Customs broker	PCS	15
		3.2	Delivery of truck gate in documentation	Customs broker	PD	15
4	Truck gate in	4.1	In line waiting time	Transport company	NA	18
		4.2	Port entrance documentation validation	Port entrance security	PD	2
5	Entrance to the terminal and container loading	5.1	Terminal entrance documentation validation	Terminal entrance security	TOS	5
		5.2	Container search and loading	Terminal operations	TOS	30
6	Customs inspection	6.1	Container positiong	Transport company	NA	10
		6.2	Inspection preparation	Customs broker	NA	15
		6.3	Inspection	Customs authority	NA	90
		6.4	Report inspection results	Customs authority	PD	0
		6.5	Cargo release	Customs authority	PD	0
7	Exit note procurement	7.1	Return to terminal	Transport company	NA	10
		7.2	Container clearance validation	Terminal operations	TOS	20
8	Truck gate out	8.1	Prior to the truck gate out	Transport company	NA	60
		8.2	Port exit note validation	Port exit security	PD	10
9	Departure from the port	9.1	Departure from the port by truck	Transport company	NA	
		Process duration, only land transport processes (minutes)				**300**
		Process duration, only land transport processes (hours)				**5**

TOS: Terminal Operative System

PCS: Port Community System

PD: Physical documents

NA: Not applicable.

Current process relies heavily on manual register of trucks and cargo throughout each step, though some initiatives are being implemented to make it more efficient. Land transport logistics outside and within the port are complicated, making the overall import process lengthy and causing congestion in the road leading to the main entrance.

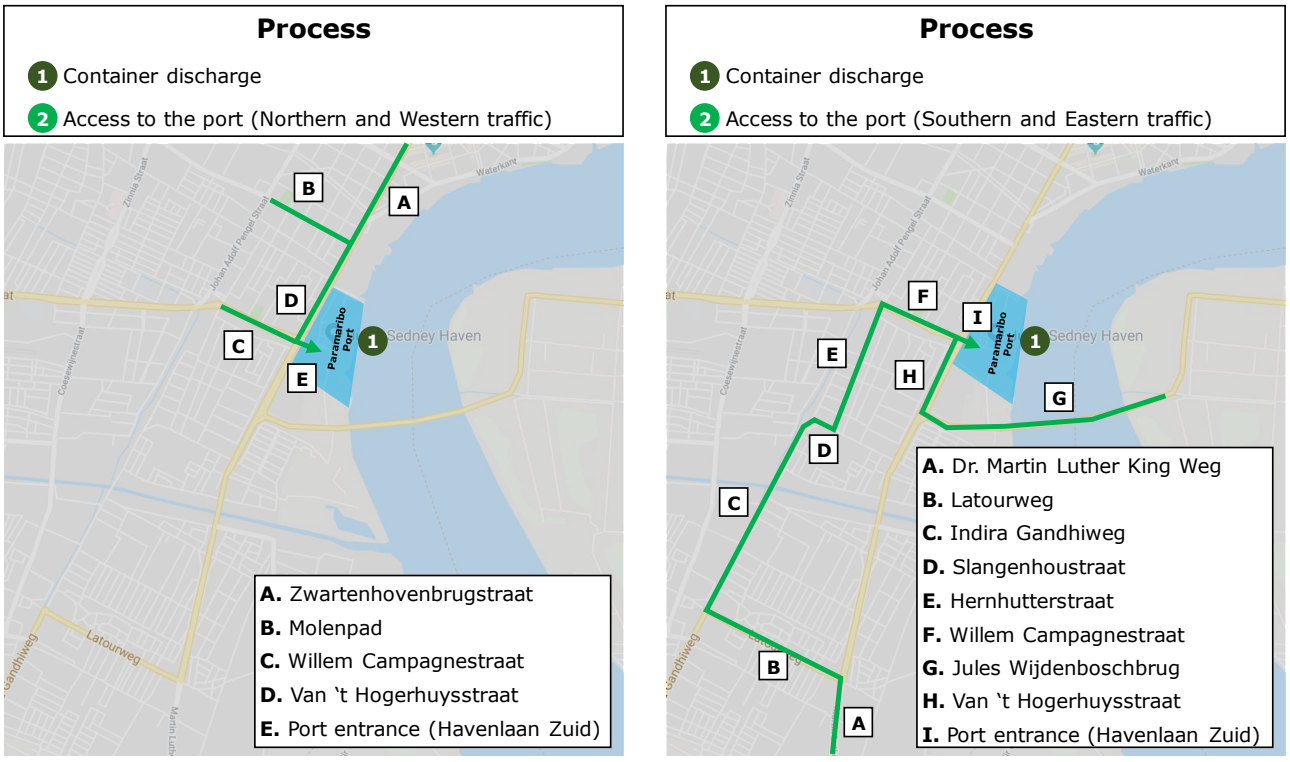
Following there is a detailed description of the complete process:

Process description

1. **Container discharge**:
   1.1. **Operation planning and operation**: The terminals in Dr. Jules Sedney Terminal (DP World and VSH) will design an operation plan upon a vessel arrival in order to efficiently discharge the upcoming containers. Using its Terminal Operative System (TOS), the terminal will coordinate with the customs brokers and customs authorities to inform the estimated schedules.
   1.2. **Container discharge**: The terminals the will do all the container discharge and handling, updating the customs broker and the customs authority. Once all containers have been organized on the yard and properly identified, the customs brokers will notify the transport companies to schedule their arrival to the port. As the first phase of the PCS system, HBS has introduced a x-port system that will then be integrated, which consists on non-intrusive equipment for scanning containers in the dock as they are downloaded.

2. **Access to the port:**
   2.1. **Arrival to the port by truck:** The Dr. Jules Sedney Terminal is accessed from Van 't Hogerhuysstraat by trucks either by the north or the south of Suriname.

Import Process: Transit to the Port (As Is)



***Inbound traffic from the north and west*:** Trucks come from Molenpad or Zwartenhovenbrugstraat, before they become Van 't Hogerhuysstraat. Other vehicles might use Willem Campagnestraat as their access road.
***Inbound traffic from the south and east*:** Trucks usually come from Dr. Martin Luther King Weg, but they can't cross the bridge connecting that road to Van 't Hogerhuysstraat due to its lack of capacity for large trucks. Because of the latter, trucks have to take a detour through Latourweg, followed by Indira Gandhiweg (whose bridge has greater capacity enough for heavy vehicles), and then taking Slangenhoustraat, Hernhutterstraat and using the roundabout to finally enter Willem Campagnestraat. Also, they come from Eastern Suriname crossing Jules Wijdenboschbrug.

3. **Pre truck gate process:**

3.1. **Preparation of truck gate in documentation**: The custom broker agency is in charge of the document gathering required for the access to the port and port terminals. This includes the following documentation:
- Entry Note: Access permit processed throughout the PCS containing the general details, terminal destination, applicant type/stakeholders, purpose of the visit type (i.e. import, export, empty container, inspection, services, visitor, and other) with each access, the cargo details (vessel, container number, VN, type of cargo, and container type). This process is done the same day that the container is picked up at the port.
- Terminal gate pass: containing the drivers name, truck vehicle data, and terminal being visited previously processed by the TOS); and
- Equipment Interchange Receipt (EIR): document that includes general information about the container and its location inside the terminal given by the terminal operator.

It is important to mention that Customs does not have notification in advance of the containers that will be collected until they arrive for the inspection process (Process No. 6). This does not allow them to have better planning of their operations or perform risk analysis in advance.

> Starting September 2018, an Access Permit has been required before heading to the port, where a notification would be sent in advance. This permit seeks to reduce this sub-process time, which is done throughout the Port Community System (hereinafter PCS).

Currently, the custom broker process this documents in separate systems. There is no information exchange between the PCS, TOS, or the Automated System for Customs Data (hereinafter ASYCUDA). This limits the effectiveness of the PCS as it is an extra process to be executed which is not aligned with the terminal process.

3.2. **Delivery of truck gate in documentation:** The custom broker hands the documentation to the truck drivers so that they can identify themselves at the entry truck gates. When trucks enter the Dr. Jules Sedney Terminal, they usually wait in Havenlaan West, one of the internal port roads, where they notify their custom broker that they have arrived so they deliver the documents. The average waiting time is 30 minutes in total for both sub-processes. Due to the lack of space in Havenlaan West, the port security will sometimes ask trucks to move if they don't have their documents; this has caused some trucks to wait outside the port on other urban areas.
With the new process these documents can be delivered throughout email to truck drivers and downloaded in mobile phones. However, these type of delivery has not been successful because the drivers don't have internet in their mobile phones to download the documents.

4. **Truck gate in:**
4.1. **In line waiting time:** Due to the traffic caused by other trucks in Havenlaan West, driver must wait an average of 18 minutes to get to the entry truck gates.
4.2. **Port entrance documentation validation:** The port's security guards will check the trucks documentation to see if everything is in order before giving access to the port. This process takes up 2 minutes.

5. **Entrance to the terminal and container loading:**
5.1. **Terminal entrance documentation validation:** Once inside the port, the trucks head towards their corresponding terminal (VSH or DP World) and identify themselves to the terminal entrance security. After validating that the EIR is correct, the truck will be granted access to the terminal. This takes 5 minutes in average. If the EIR is incorrect, the driver will have to register again. This subprocess is conducted using the TOS and it is not related to the one done with the Port Authority.
5.2. **Container search and loading:** While the trucks wait, the terminal operation team will search for the container mentioned in the EIR using the TOR. Then, the container will be attached to the truck and it'll be ready for the next step. In cases when vessel operations are being held at the terminal, waiting times can increase according to stakeholders. The average time for this process is 30 minutes.

6. **Custom inspection:**
6.1. **Container positioning:** The loaded truck then moves to the Stuff, Strip & Scan Area in Havenlaan Oost. Internal traffic lines can sometimes delay this process, but it usually takes 10 minutes to get from the terminal to the designated place on the Strip Area.
6.2. **Inspection preparation:** Custom authority usually is ready to start the inspection after the container is positioned on the Stuff, Strip & Scan Area. Customs does not have a notification previous to the arrival of the containers, which limits their availability to perform risk analysis of the containers inspected each day or to assign the resources according to the expected demand. It is also important to mention, that the inspection process requires the custom broker to be also

present, which usually causes 15 to 30 minute delays can occur while waiting for the latter to arrive.

6.3. **Inspection:** Current customs procedures states that 100% of the containers need to be inspected. The thoroughness of this inspections depends on the type of products and the custom authority usually takes between 90 and 120 minutes to finish the task.

6.4. **Report inspection results:** If the inspection concludes satisfactorily, the trucks will be notified and the customs authority will register the results of their inspection. If inconsistencies are found, the customs authority will notify the customs broker.

6.5. **Cargo release:** The trucks will be granted clearance to leave with the cargo, previous notification to the terminal.

7. **Exit note procurement:**

7.1. **Return to terminal:** As with the Arrival at Stuff, Strip & Scan Area, trucks will return to the container's terminal using Havenlaan Oost. Each one of the terminals has its own procedures regarding this task. VSH terminal requires the drivers to return with the container to the terminal in order to process the exit note; while DP World, requires the driver to walk back to the terminal and do the process. Depending on the internal traffic, the duration of this travel will vary, but it takes an average of 10 minutes.

7.2. **Container clearance validation:** In the corresponding terminal, the drivers will hand all required documents to the operations team in exchange for an exit note. The terminal's operations team will validate de container clearance information in the TOS. This process takes up to 20 minutes in both terminals.

8. **Truck gate out:**

8.1. **Prior to truck gate out:** Due to the traffic caused by other trucks in Havenlaan Zuid, where the exit is currently located, driver must wait an average of 60 minutes to get to the exit truck gates.

8.2. **Port exit note validation:** At the exit of the port there are two control entities, the HBS Security and the customs organization. The port documents for the HBS security will be replaced from with the Access Permit. The exit note is checked by the customs organization to ensure that the loaded container matches. This process takes 10 minutes in average.

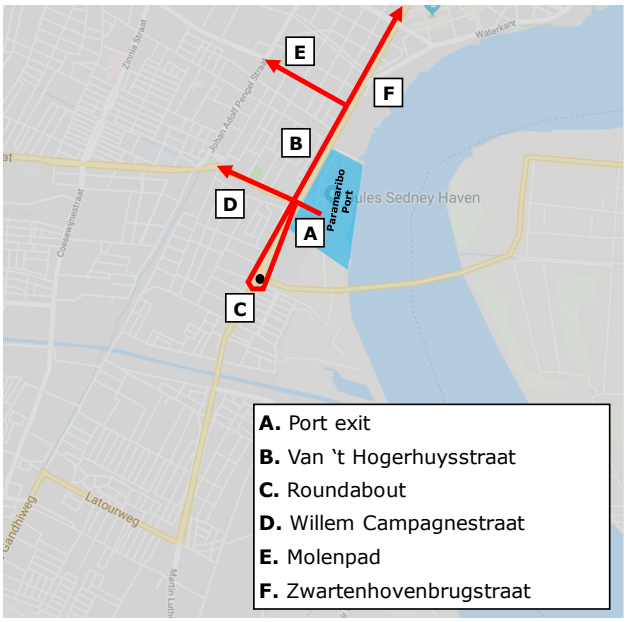
9. **Departure from the port:**

9.1. **Departure from the port by truck:** All trucks coming out of the Dr. Jules Sedney Terminal need to turn left in Van 't Hogerhuysstraat disregarding if they will head north or south. For trucks heading south, they'll keep past Van 't Hogerhuysstraat roundabout; in the case of trucks going north, they'll have to use the roundabout to change direction in Van 't Hogerhuysstraat.

Import Process: Transits from the Port (As Is)

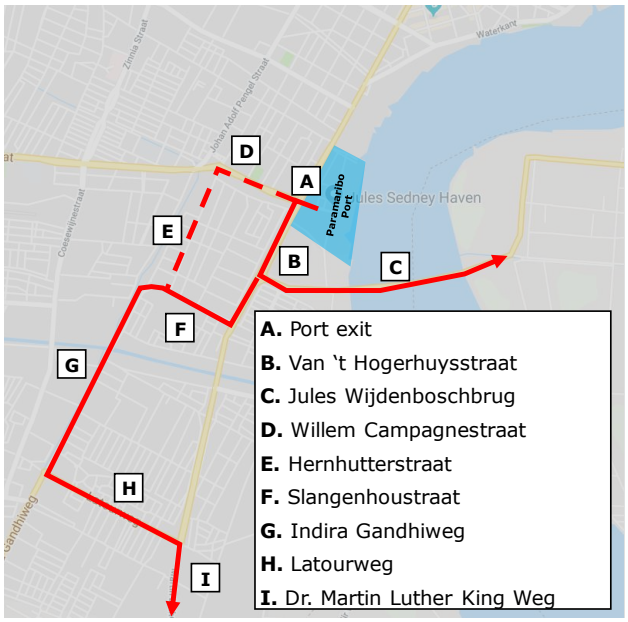
Process

9 Departure from the port (Northern and Western traffic)



Process

9 Departure from the port (Southern and Eastern traffic)



Graphically, the process can be mapped in the adjacent roads and within the Dr. Jules Sedney Terminal as travel trajectories made by the trucks and their drivers. As seen in the next figures:

Import Process: Within the Port (As Is)

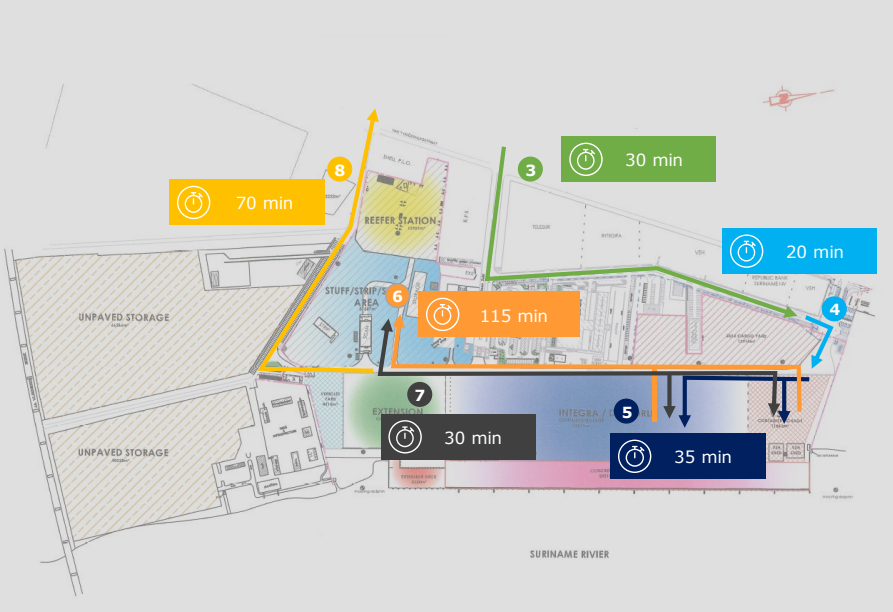
Process

- 3 Pre truck gate process
- 4 Truck gate in
- 5 Entrance to the terminal & container loading
- 6 Customs inspection
- 7 Exit note procurement
- 8 Truck gate out

Total duration: 300 min (5 hours)

Observations: Steps 3, 6 and 7 could be optimized due to the amount of waiting time for the truck drivers that could be reduced. Some current initiatives are:

- Step 3: Access Permit
- Step 6: Modern scanning system
- Step 7: Coordination with Terminal



Preliminary findings

A first analysis of each process and subprocess allowed us to identify particularities of the Dr. Jules Sedney Terminal's current operations, both internal and external, that are jeopardizing efficiency and competitiveness:

1. Van 't Hogerhuysstraat is currently the only road to access the port, which can cause congestion when regular vehicles traffic mix with the trucks heading to the container terminals. Also, trucks coming from the southern roads are faced with inefficiencies due to the fact that the bridge connecting Dr. Martin Luther King Weg with Van 't Hogerhuysstraat is not suitable for heavy traffic to cross; this causes the truck drivers to take a detour that can add up to 30 minutes to their route.

2. There is lack of coordination between the different stakeholders due to manual process and the lack of intercommunication between the systems. This causes several delays throughout the process such as: i) waiting time that trucks spend before they receive the documentation needed to access the port, ii) access to the port terminals, iii) delays in the inspection process due to lack of planning and waiting for the custom broker agent to arrive, and iv) procurement of the exit note.

3. The truck turnaround time is over 5 hours average, due to the fact that the truck and its driver have to stay in the port for the hole process. This is due to the fact that the custom's clearance and inspection of the container it's not done beforehand.

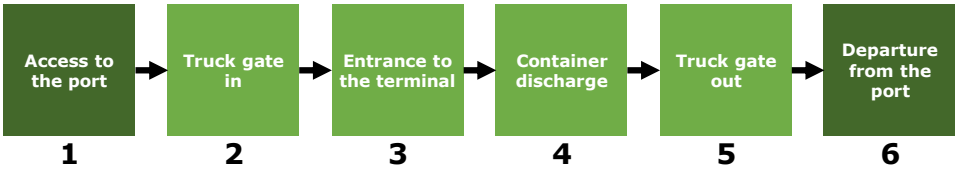
4. The main problematic with the departure from the Dr. Jules Sedney Terminal is that currently all trucks have to turn left on Van 't Hogerhuysstraat. Even if the need to head north, they would have to go all the way to the roundabout, and then head their way. This is currently stressing the traffic capacities of Van 't Hogerhuysstraat, and without a suitable solution that spread trucks to their different destinations efficiently, the congestion will remain.

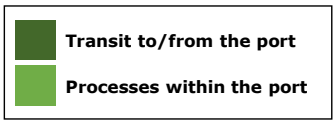
According to the previous problematic, it can be seen that there is opportunity to create a truck central with a waiting parking as well as to implement a Port Community System that allows efficient communication between every stakeholder of the process across each of the chain's links.

3.1.2. Export process

The export process has been analyzed throughout 5 sub-processes that include form the access of the truck arriving from the main roads that connect it to its hinterland through its departure from the port. These process has an average overall time of 60 minutes (1 hour).

Export Process (As Is)





No.	Process	No.	Subprocess	Responsible	Systems	Duration (min)
1	Access to the port	1.1	Arrival to the port by the truck	Transport company	NA	
2	Truck gate in	2.1	In line waiting time	Transport company	NA	8
		2.2	Port entrance documentation validation	Port entrance security	PD	2
3	Entrance to the terminal	3.1	Terminal entrance documentation validation	Terminal entrance security	TOS	10
4	Container discharge in the terminal	4.1	Container unloading	Terminal operations	TOS	30
5	Truck gate out	5.1	Prior to the truck gate out	Transport company	NA	8
		5.2	Port exit note validation	Port exit security	PD	2
6	Departure from the port	6.1	Departure from the port by truck	Transport company	NA	
			Process duration, only land transport processes (minutes)			**60**
			Process duration, only land transport processes (hours)			**1**

The export process is only available for transport companies late in the day, an initiative that has helped to make it quicker than its import counterpart. However, as with the aforementioned process, land transport logistics can prove difficult due to the lack of options when heading to or from the port.

Following there is a detailed description of the complete process:

Process description

1. **Access to the port:**
   1.1. **Arrival at the port by truck:** The export process starts in the same way as the imports regarding the access to the Dr. Jules Sedney Terminal.

Export Process: Transit to the Port (As Is)

Process

1 Access to the port (Northern and Western traffic)

Process

1 Access to the port (Southern and Eastern traffic)

It is accessed from Van 't Hogerhuysstraat by the northern or the southern roads of Suriname. Trucks coming from the north arrive using Molenpad or Zwartenhovenbrugstraat, before they become Van 't Hogerhuysstraat. When arriving from the south, trucks come from Dr. Martin Luther King Weg, but they have to do the detour route using Latourweg, followed by Indira Gandhiweg (and the suitable bridge crossing), and then taking Slangenhoustraat to enter Van 't Hogerhuysstraat. Eastern traffic coming from Jules Wijdenboschbrug also use the southern entrance. Finally, trucks that come from Willem Campagnestraat will cross Van 't Hogerhuysstraat to access the Dr. Jules Sedney Terminal through its current entrance in Havenlaan Zuid. The main difference of the export process is that it takes place only after 17:00 hours, while imports take place in the morning.

Starting September 2018, an Access Permit has been required before heading to the port; after a notification is sent in advance. This permit seeks to reduce this sub-process time, which is done throughout the Port Community System (hereinafter PCS).

The same as in the import process, there is no information exchange between the PCS and TOS, which limits the effectiveness of the PCS as it is an extra process to be executed which is not aligned with the terminal process.

2. **Truck gate in:**
   - 2.1. **In line waiting time:** Trucks don't need a pre truck gate preparation for export. The driver heads directly to the port's entrance truck gate using Havenlaan West, waiting in line an average of 8 minutes.
   - 2.2. **Port entrance documentation validation:** The port's security guards will check the truck ID before giving access to the port. This process takes up 2 minutes.

3. **Entrance to the terminal:**
   - 3.1. **Terminal entrance documentation validation:** The trucks will then head towards their corresponding terminal, either VSH or DP World. The terminal's security team will confirm that the truck documents are in order and that de container is expected to be unloaded by the operation's team by checking in the TOS. This process can take up approximately 10 minutes.

4. **Container discharge:**
   - 4.1. **Container discharge:** Once inside the terminal, the truck will head to the designated area where the operation's team will carry on all the tasks necessary for the discharge of the container. After doing it and giving the truck the proper documentation, the process is over. This takes an average of 30 minutes to be completed.

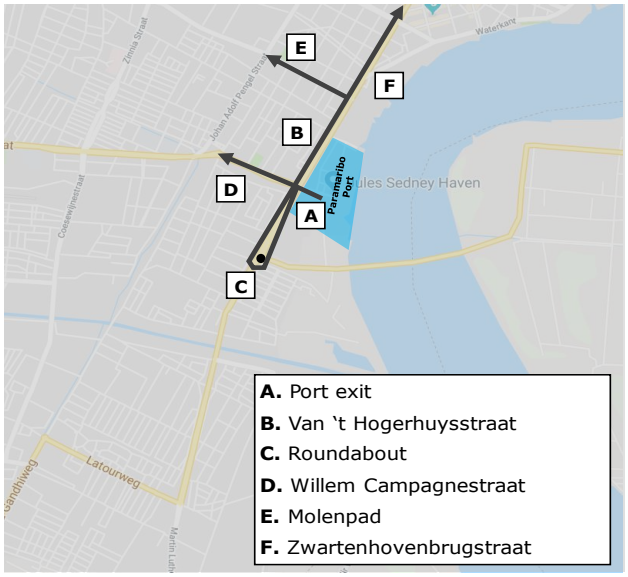
5. **Truck gate out:**
   - 5.1. **Prior to truck gate out:** The driver will head to Havenlaan Zuid, to the current exit. Traffic for exports is less than that of imports, so the average waiting time decreases to an average of 8 minutes until reaching the exit truck gates.
   - 5.2. **Port exit documentation validation:** The security guards will check the documents given to the truck driver by the terminal in order to give them clearance to leave the port. The customs organization will check that delivered cargo organization is in order. This process usually takes 2 minutes.

6. **Departure from the port:**
   - 6.1. **Departure from the port by truck:** As with the imports, all trucks coming out of the Dr. Jules Sedney Terminal need to turn left in Van 't Hogerhuysstraat. Trucks heading south will head to Van 't Hogerhuysstraat roundabout and keep going; while the ones going north will change way at the roundabout.

Export Process: Transits from the Port (As Is)

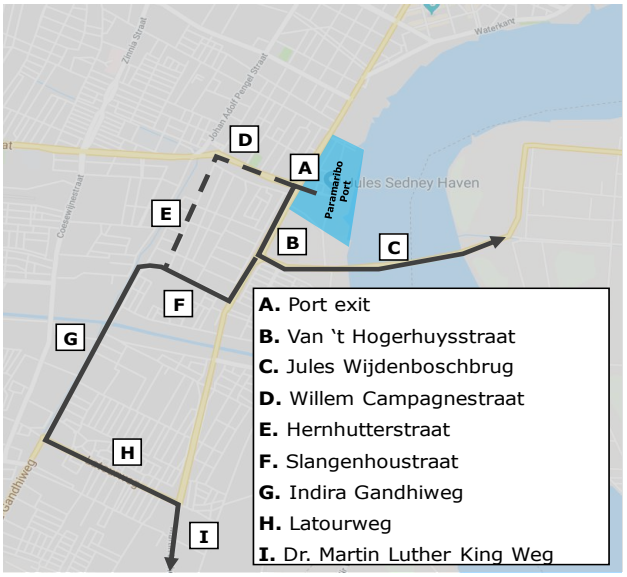
Process

6 Departure from the port (Northern and Western traffic)



Process

6 Departure from the port (Southern and Eastern traffic)



Mapping the process in the adjacent roads to the port and its internal ones, we can visualize the trucks trajectories during each step:

Export Process: Within the Port (As Is)

Process

2 Truck gate in

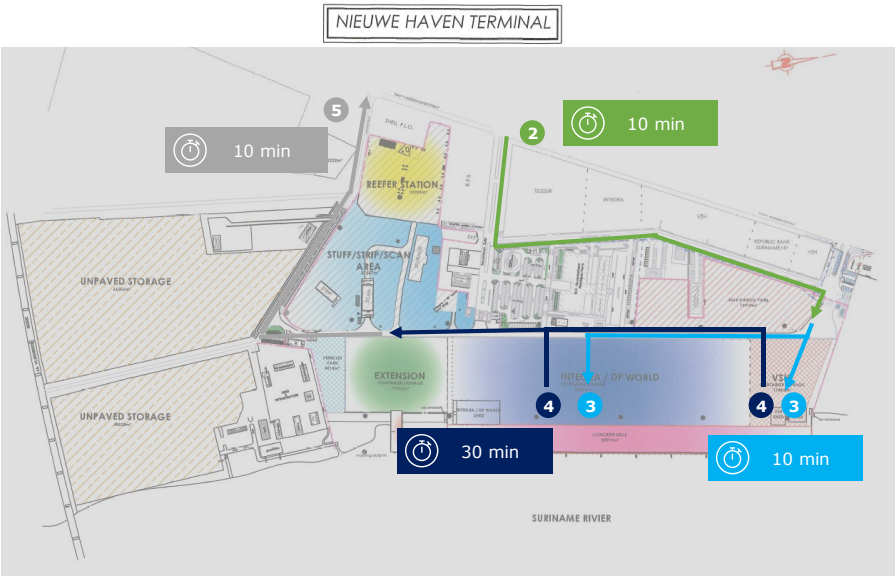
3 Entrance to the terminal

4 Container discharge

5 Truck gate out

Total duration: 60 min (1 hours)

Observations: Export traffics are directed after 17:00 hours, reducing the number of trucks in the port. Companies are able to do up to 2 trips per truck when required, but this can increase costs due to overtime wages.



Preliminary findings

Analyzing each of the process and sub-process for the exports in the Dr. Jules Sedney Terminal, helped us identify particularities of current operations. We used an external (outside the port) and internal (within the port) scope to detect what can be affecting efficiency and competitiveness:

1. Even though the afternoon schedule for exports have proven helpful, the port faces the same problematic as with imports. Van 't Hogerhuysstraat is the only road to access the port, which can be difficult for transportation coming from the south as it has to take a detour due to inability by the bridge in Dr. Martin Luther King Weg to support heavy vehicles.

2. The pre truck gate preparations makes the process more agile in general. The schedule also helps alleviate the waiting time before entering the port.

3. Loading the container is the process that takes up the most time for exports, however, these times are controlled by terminal operators and they are within the normal range in comparison to other ports. Efficiencies in this task depend on the operations of the terminals. DP World keeps record of its operations and ratios which are published in their website.

4. The exit has the same issues than in the import process. Traffic in Van 't Hogerhuysstraat is concentrated due to a single transit option. Trucks need to turn left and until the roundabout will be able to head north. By opening alternative exits, the trucks could directly head to their desired direction.

As with imports, the truck central should prove helpful although less used as the export have simpler process previous the arrival of the container. Furthermore, the Port Community System could make communication between stakeholders easy and agile.

3.1.3. Port Community System

N.V. Havenbeheer hired Experion Global Technologies, an Indian company, to develop PCS services and modules which are currently in use by the port. The project started in April of 2014 with an 9-month development period in which a 30 people team was involved. The system was developed using iPort Software, and include some tailor-made functionalities that have worked well for the port operations, however, they have been limited in terms of information exchange with stakeholders. According to the port Authority, the total investment for this initial development was of approximately $2.5 million USD.

After that, a team of 5 people has been available for maintenance and support operations since 2015. After that, a team of 5 people has been available for maintenance and support. The provider remote communications with the port have proven to be less than ideal for the daily operations; the port requires a local functional consultant to provide them *in situ* services for small developments. Remote services include data maintenance, but it doesn't contemplate modifications to the applications.

The modules and services that are currently implemented in the port are:

- Vessel Services:
  - Vessel profile
  - Vessel calls
  - Notification of arrival
  - Berth application
  - IMO-ISPS Form (e.g. crew list, manifest, dangerous goods, ships, etc.)
  - Vessel services (i.e. waste disposal, bunkering, ship maintenance, and water delivery)
- Security Module:
  - Gate-in/gate-out for pedestrians and light vehicles
  - RFID (planned as a next step)
  - A database of the registered transport companies, trucks and drivers is available (140 transport companies, customs agencies personnel information, and more than 600 trucks registered)
- Inspection services (planned as a next step)
- Commercial services and invoicing (i.e. leasing of buildings and port areas)

This current PCS is a foundation for further developments and additional services that could help the port operations; however, there is an important characteristic that is yet to be accomplished by the PCS, and that is the integration with other services. There is currently a lack of integration with important stakeholders. The only interoperations are between N.V. Havenbeheer ERP and the PCS throughout XML. The integrations that are needed include the Maritime Authority of Suriname (MAS) systems, port terminal's TOS and the ASYCUDA. These integrations could improve operations planning to increase security and reduce times of operations.

Furthermore, it is also important to automate remote process held by the port administration such as the entry and exit of trucks. The equipment currently available for the gates are a computer and internet connection. This needs to be expanded to be able to provide the services in a more effective way.

3.2. Proposed benchmark process

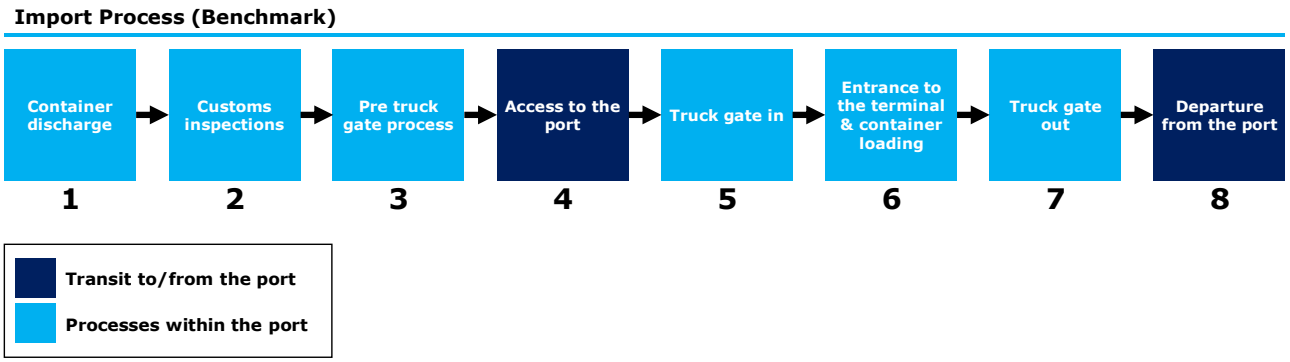
To further analyze the current state of the port's operations regarding import and export processes, we used previous experiences in other ports. Import and export processes in Mexican ports such as Manzanillo, Veracruz and Lazaro Cárdenas have proven to be a suitable benchmark for the American context. Using these processes as a benchmark, we were able to identify good practices and considerations that can

potentially be beneficial for the Dr. Jules Sedney Terminal. The ports analyzed have implemented several best practices due to the traffic congestions seen in the port and the cities in order to reduce the impact in the city and improve its service level.

Next, each of the benchmark processes will be detailed:

3.2.1. Import process

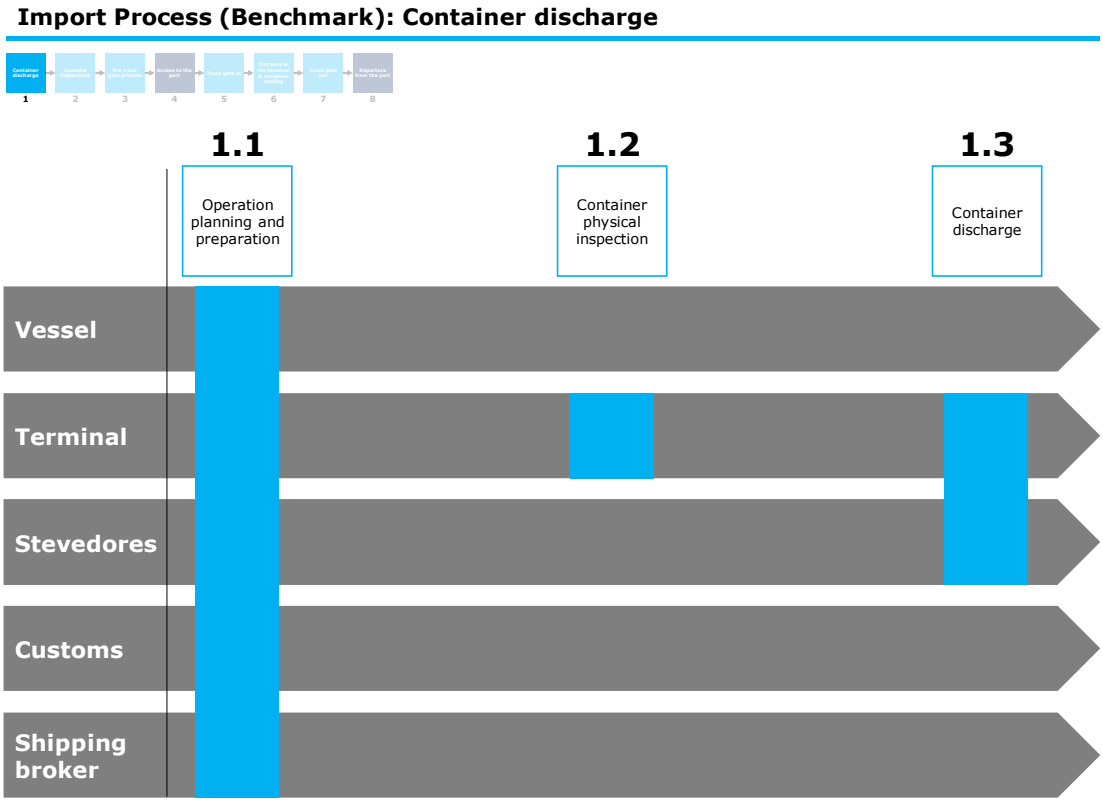
The import benchmark process has been analyzed throughout 8 sub-processes that include form the discharge of the container to the departure of the port throughout the roads that connect it to its hinterland. These process has an average overall time of 140 minutes (2 hours) that could potentially increase the truck productivity.



The benchmark import process starts with the vessel arriving to the port and ends when the truck exits the port:

Process description

1. **Container discharge**:

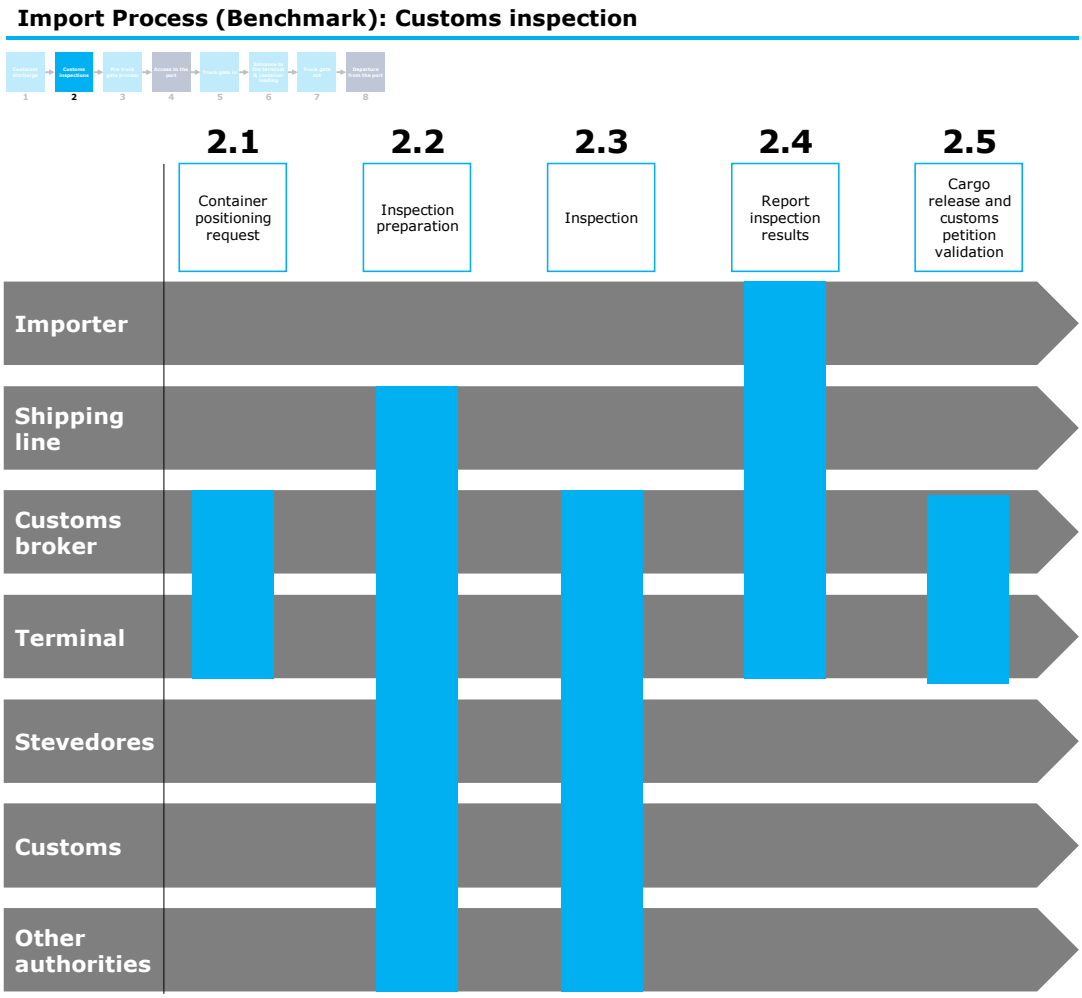


1.1. **Operation planning and preparation**: To discharge the vessel imported containers, a Loading Master Plan is needed where a complete list is compiled with the units to be handled. The shipping line provides this Master Plan to the Terminal, who then communicates it to the rest of the involved parties (Stevedores, Customs, and Shipping broker). The shipping line will then provide a final loading list to the vessel, including information related to restows, IMO, reefer and out of cage cargo for both, load and discharge. The terminal estimates the time to complete the operations detailed on the final loading list, and communicates them to the shipping broker. The shipping broker will program the vessel departure according to the estimated times in the Port Community System, and communicated to the other parties. The terminal plans and prepares the necessary resources to complete the operations within the estimated times. The required stevedores will be assigned to achieve this, as well as pre-assigned slots on the yard to segregate discharge containers from transshipment cargo. Once the operation is planned, the stevedores receive the work plan.

1.2. **Container physical inspection**: The terminal conducts a physical inspection of the cargo upon the vessel's arrival (if necessary).

1.3. **Container discharge**: The state of the container seals will be checked, and then the stevedores will start with the discharge operation, while the terminal coordinates the yard movement so that containers are taken to their pre-assigned position. The terminal registers each of the discharged container on the Terminal Operation System (TOS) and assigns an EIR. Then, it registers this information on the Port Community System to notify customs about the details of discharged containers. The information and operations progress is updated hourly. The customs authority might want to x-ray check some of the containers as a preliminary inspection, to contrast them with the original Import Cargo Manifest. During this sub-process, the customs authority might decide to inspect the container.

2. **Customs inspection:**



2.1. **Container positioning request:** Once the containers has been discharged by the terminal, the custom broker requests an inspection to the terminal using an internal website. The submitted request should include the schedule to perform the inspection, the number of bundles contained, whether the cargo is palletized, as well as specific considerations. Also, the request should be submitted before 18:00 hours of the inspection's previous day so that the terminal can confirm the date and hour when the containers will be positioned on the inspection yard.

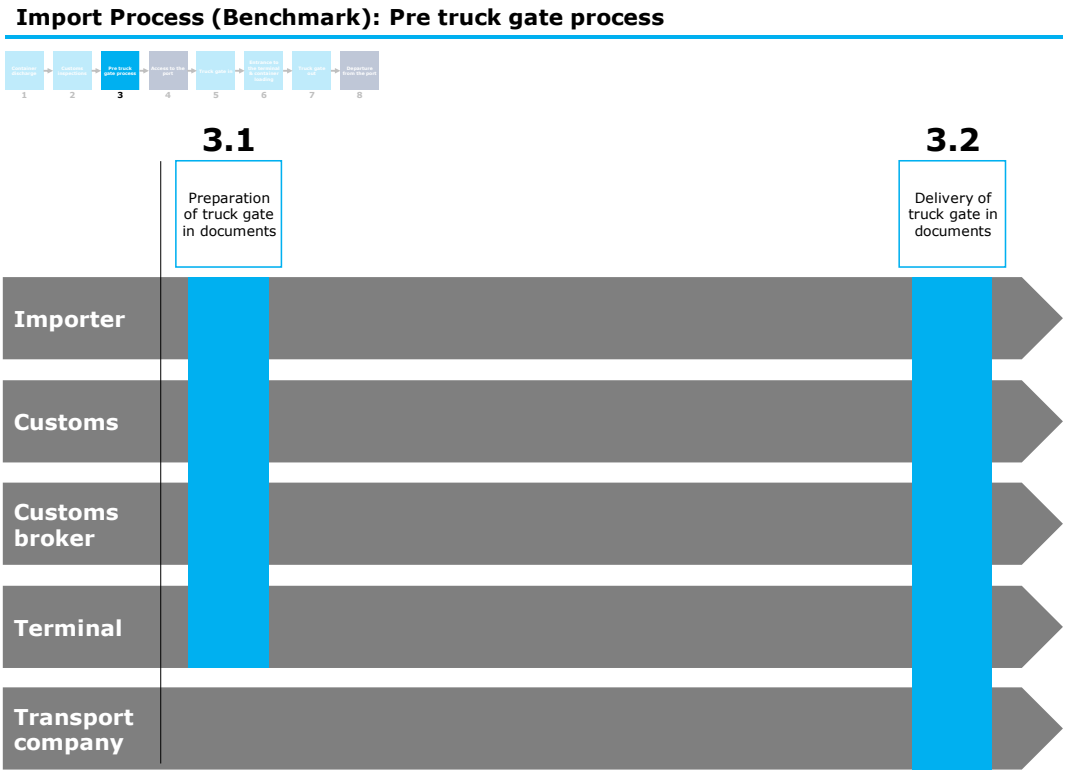
2.2. **Inspection preparation:** On the programmed inspection day, the terminal will instruct the stevedores to place the container in the inspection yard before 8:00 hours (beginning of operation from Customs). The customs broker will present the B/L revalidated to the customs and other authorities; then, they'll verify the validity of the documents with the shipping line before opening the containers doors. With the documents checked, and under the presence of the customs broker, the customs agents and other authorities will proceed with the opening of the container.

2.3. **Inspection:** The customs broker, customs agents and other authorities will quantify the declared goods, verify serial numbers, value their integrity and check that no deviations are in place. Once the inspection is completed, stevedores will stow the cargo back inside the container and the doors will be close. Finally, the terminal will issue the customs broker documents proving the closure of the container before releasing it.

2.4. **Report inspection results:** The terminal will report the closure of the container in the Terminal Operating System; if there are any discrepancies between the physical inspection and the B/L (lack or surplus), the customs broker inform the importer and the shipping line the findings. The shipping line make amends to the B/L and resends de document to the customs broker. Once the B/L matches the container's goods, the customs broker releases the cargo in the cashier of the terminal. Customs report in its system that the cargo has been inspected and its ready to be released. This might be consulted directly by the TOS in an automated process.

2.5. **Cargo release and customs petition validation:** After the inspection and the amendments in the B/L (if needed), the customs broker releases the cargo in the cashier of the terminal, validation the customs petition for further payment.

3. **Pre truck gate process:**



3.1. **Preparation of truck gate in documentation**: To release the goods, a non-debt document is needed by the terminal to allow access and clearance to the transport companies. First, the customs broker pays the validated petition for customs and requests the transport that will take the container out of the terminal. Then, either the customs broker requests funds or the importer

pays directly to the terminal for the operations and storage of the container. Once the payment is fulfilled, the customs broker sends the terminal de payment receipt, the customs petition and a copy of the revalidated B/L via the terminal's web service. After receiving all the documents from the customs broker, the terminal checks the customs authority system to confirm that no payment is due and the container can be released and deliver. This last consult is made automatic by the TOS or PCS.

3.2. **Delivery of truck gate in documentation:** If everything is in order, the terminal will post the release documentation on its web service and update the container status on the Terminal Operating System for all the corresponding stakeholders to see. The customs broker will take the release documentation and send it to the transport company for the truck driver to hand out when arriving for the container.

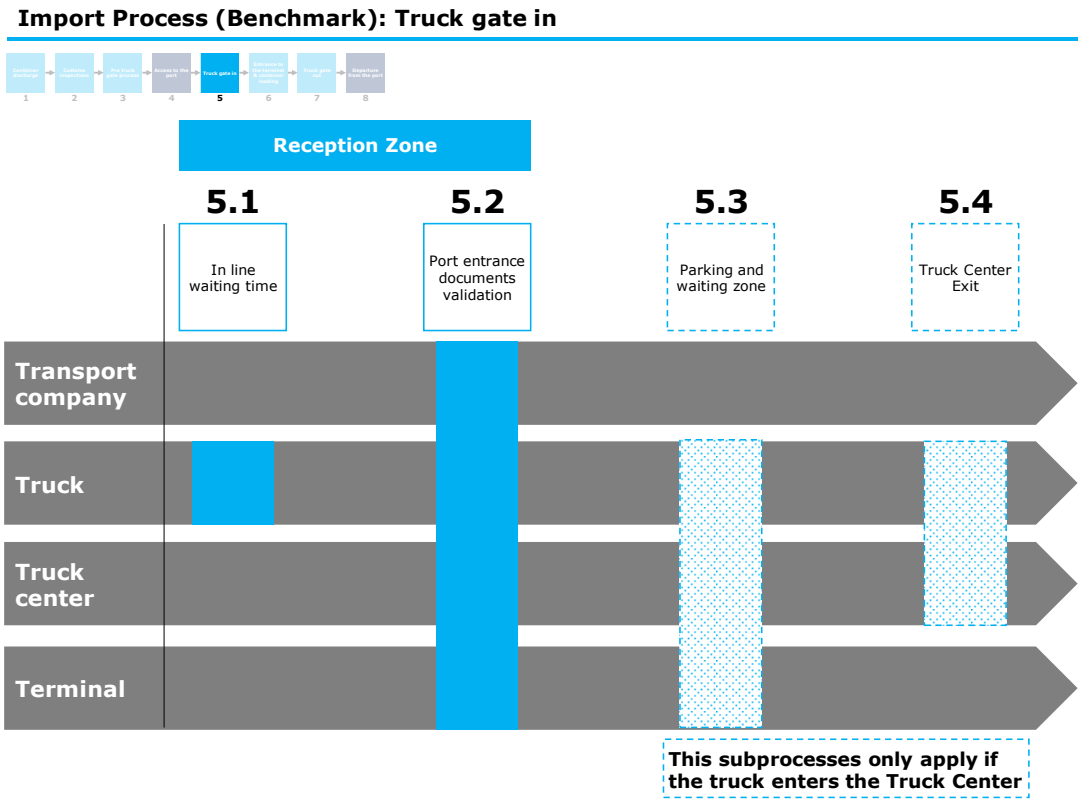
4. **Access to the port:**

Import Process (Benchmark): Access to the port

The infrastructure that the port and the corresponding authorities should seek for the access to the port include:

- Physical separation for heavyweight and lightweight transport. Heavyweight transport roads should be technically adapted to withstand the stress of operations in time.
- Access and exit from the port should avoid making cuts on main streets, preventing the traffic on and off the port from causing congestions.
- The entrance sentry could be optimized by creating an exclusive lane for arriving trucks to line up. The is lane should have the adequate capacity to prevent congestions outside the port and inside the truck center waiting area.
- The turn radius for the heavyweight trucks should be considered on the entrance, exit and within the port to make transport flow efficient.
- Signaling should be clear and sufficient in quantity and quality before arriving to the port, in the entrance/exit sentries, as well as within the port and terminals.
- Safety conditions to prevent accidents should be taken into account, especially with other transports (e.g. private cars, public transport, bicycles, etc.) before arrival to the port.

5. **Truck gate in:**



5.1. **Reception: In line waiting time:** Once the load is ready to leave, the custom transport company will give the paid customs petition and release documents to the truck driver, while programming the day and hour for the container to be picked up at the terminal. Upon arrival, the transport vehicle will head to the truck center where it will inform the truck's and driver's ID, and the container to be picked up.

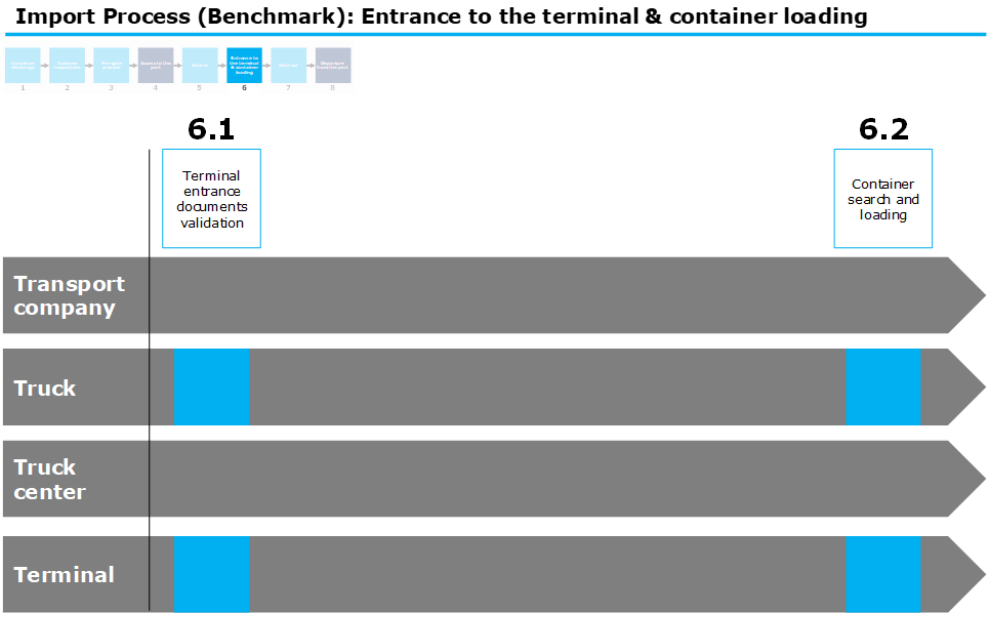
5.2. **Reception: Port entrance documentation validation:** A terminal cabin in the truck center will automatically check the maneuvers in the terminal system (TOS), validate the documentation and allow the entrance of the truck in case the validation confirm everything is ready. If the entry for the truck is not yet available, the truck will be asked to go to the parking area and wait for further instructions.

5.3. **Parking and waiting zone:** The truck driver will be handled a printed ticket with the information regarding the truck plates, driver ID, assigned terminal, and container specifics, as well as an assigned waiting space inside the Truck Center. The truck driver will be asked to wait until its scheduled time or the terminal has given notice of the container clearance and availability.

5.4. **Truck Center exit:** The driver will be notified using megaphones, SMS or by the display screens that his has received clearance to exit the Truck Center and access the port.

Subprocesses 5.3 and 5.4 are fully detailed as part of the Truck Center in the Best Practices in Port Operation chapter

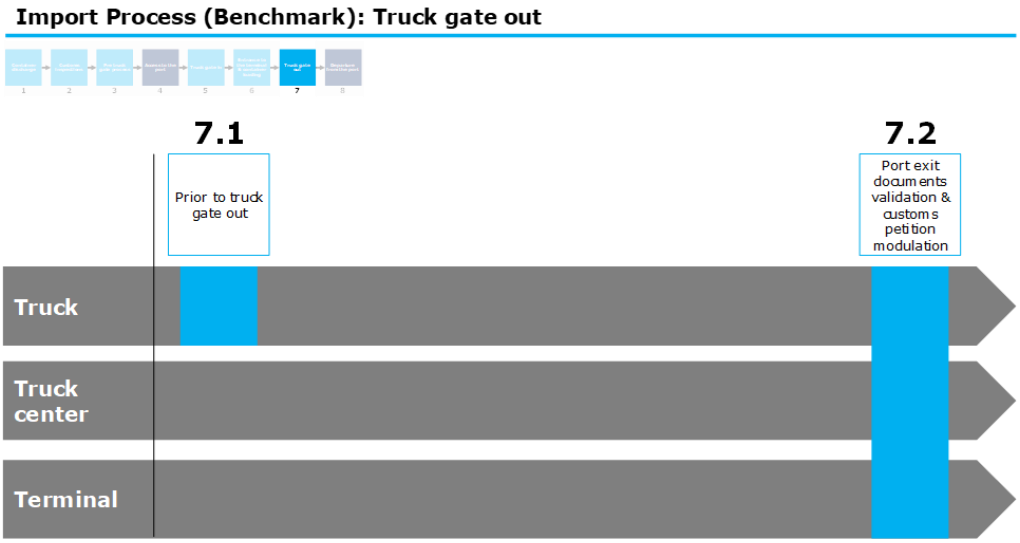
6. **Entrance to the terminal & container loading:**



6.1. **Terminal entrance documentation validation:** When it's time for the trucks turn to enter the terminal, the cabin in the truck station informs the position where the container will be loaded. The truck moves to the terminal, where the container's documentation will be checked once more as well as the registration number, and then heads to the designated position. Meanwhile, the terminal will review the release documentation in the Terminal Operative System.

6.2. **Container search and loading:** After everything is checked, the loading operation is carried out and the terminal changes the container status on the Terminal Operative System. The EIR is prepared and printed.

7. **Truck gate out:**



7.1. **Prior to truck gate out:** As the container is already cleared, the truck will be able to head directly to the exit truck gates without delays, unless there is traffic within the port.

7.2. **Port exit documents validation & customs petition modulation:** With the EIR, the truck heads to the exit of the port and through the customs petition modulation where a random inspection might take place. Each truck requires to press a button that will either light a red or a green sign. Green lights mean that the truck is free to go; and the red lights, that a random customs inspection will take place as a measure for additional safety and control.

8. **Departure from the port:**

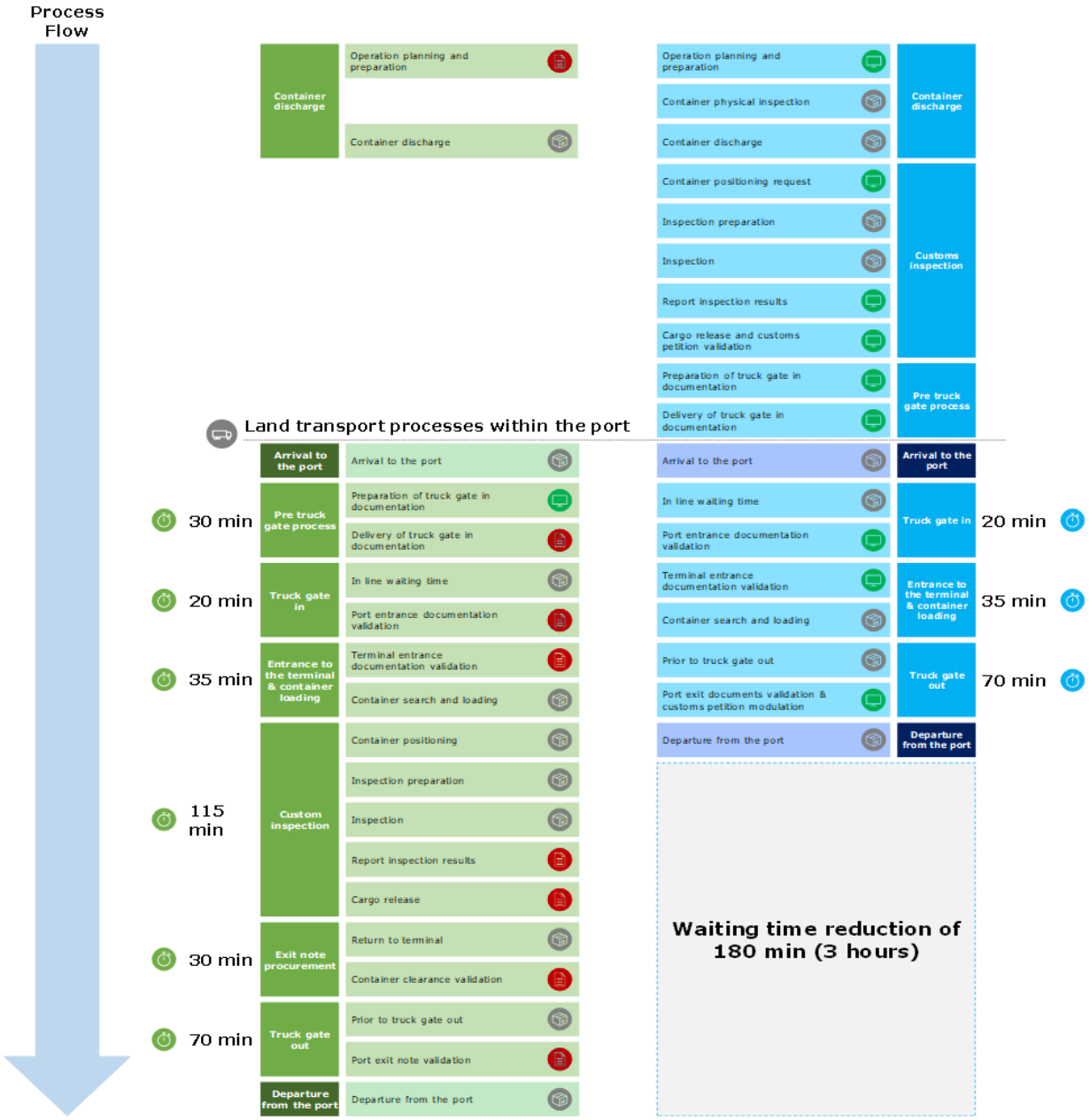
Import Process (Benchmark): Departure from the port

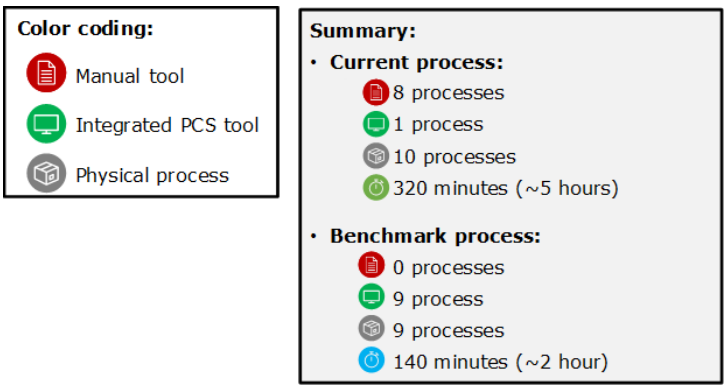
The infrastructure that the port and the corresponding authorities should seek for the departure from the port include:

- Light signaling systems outside the port to organize traffic and enable heavy traffic vehicles to maneuver freely when incorporating to main roads.
- Exit truck gates that connect to multiple road options so that transport companies can directly head to their planned routes without further delays. Also, the connecting roads should avoid congestion zones such as cities downtowns and high density areas to prevent congestions, delays for transport, and deterioration on the road infrastructure.

Gap between As Is and Benchmark processes

The main gaps between the current Import process in the Dr. Jules Sedney Terminal and the benchmark process are that there is a lot of waiting time on the land transport part that could be avoided if some tasks where completed before the truck arrives to the port. Considering a similar process for the Container Discharge on the terminal for both scenarios, we would have a mapped process as the following:





In the current Dr. Jules Sedney Terminal import process, trucks arrive after the container is unloaded from the vessel and then the whole process takes place, whereas in the benchmark the customs inspections and container release first and then the land transport arrives to the port, only to carry the cargo away. For the current process to migrate to an operation similar to the benchmark, the next gaps can be closed:

- The container inspection should be carried on before the land transport companies enter the process, involving only the customs brokers, the terminal, customs authority and other authorities such as agriculture, health, etc. Traffic in Van 't Hogerhuysstraat and Havenlaan West could be reduced, alleviating congestions as transport companies would no longer need to go to the port unless the container is already inspected and they wouldn't need to stay inside the port for the inspection to take place. Also, all stakeholders would be informed about the inspections results allowing the import process to be more agile.

- The release of the container should also occur before the land transport companies are involved, this way the terminal, customs broker and customs authorities could conclude all the payment and documentation procedures beforehand. This would eliminate the Exit Note Procurement step from the current process as the released container would already have the needed documents for transport companies to exit the port without delays.

- With the container inspection and release documents ready, transport companies' processes within the port should be agile consisting only on registering at the entrance, waiting to be assigned a position for the loading, and exiting the port, thus improving the traffic within and on Van 't Hogerhuysstraat.

- A customs petition modulation could be implemented as an additional security mechanism for the port. Before exiting, the truck drivers would be subjected to a random inspection to double-check that the container's goods and the revalidated B/L information match, as well as making sure that no payments are due and that all tariffs have been covered.

- A truck center facility is needed to help with the organization of the traffic within the port under a new import process. This facility would work as access and exit control points where transport's data is verified and clearance granted in accordance to the port's planned schedule. When the cargo conditions aren't ready or if the appointment is until later, the truck center will provide sufficient space to wait, preventing congestion within the port.

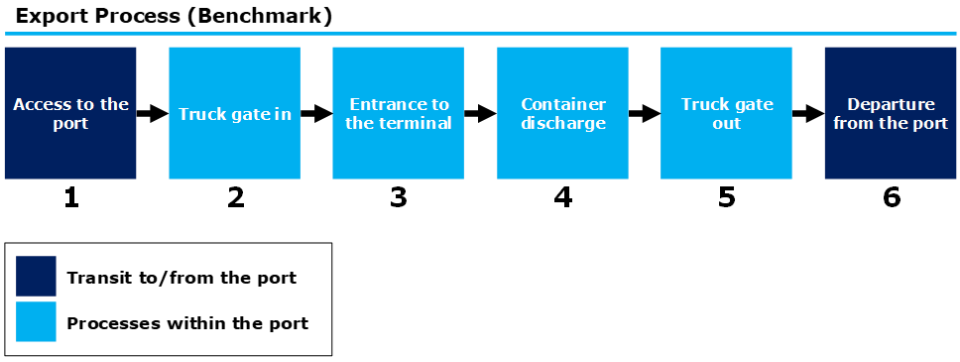
- Finally, the port could implement a Port Community System to optimize, manage and automate its port and logistics processes through a single flow of data, connecting all the logistics chain. This system could help by:

  - Allowing easy, fast and efficient information exchange and transaction recordkeeping;
  - Implementing electronic handling of the information for containerized, general and bulk cargo;
  - Enabling coordination between stakeholders in the port process by centralizing information in a single database and allowing the download of clearance and identification documents for transport companies;
  - Facilitating the elaboration and approval of customs declarations;
  - Updating status information for control, tracking and tracing throughout the logistics chain; and
  - Contributing with time and cost reductions.

- Potentially, the process optimization could reduce 3 hours of transport time waiting, freeing space inside the port for more agile operations. Also, the PCS could be the foundation for a future port automation.

3.2.2. Export process

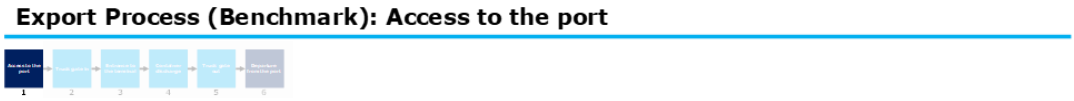
The export benchmark process has been analyzed throughout 6 sub-processes that include form the access to the port, to the departure from it throughout the roads that connect it to its hinterland. These process has an average overall time of 60 minutes (1 hour). The export benchmark process doesn't vary in duration from the current port process, but it involves an increased usage of the PCS.



The benchmark export process starts with the transport company's truck arriving to the port and ends when the container's departure on the vessel:

Process description

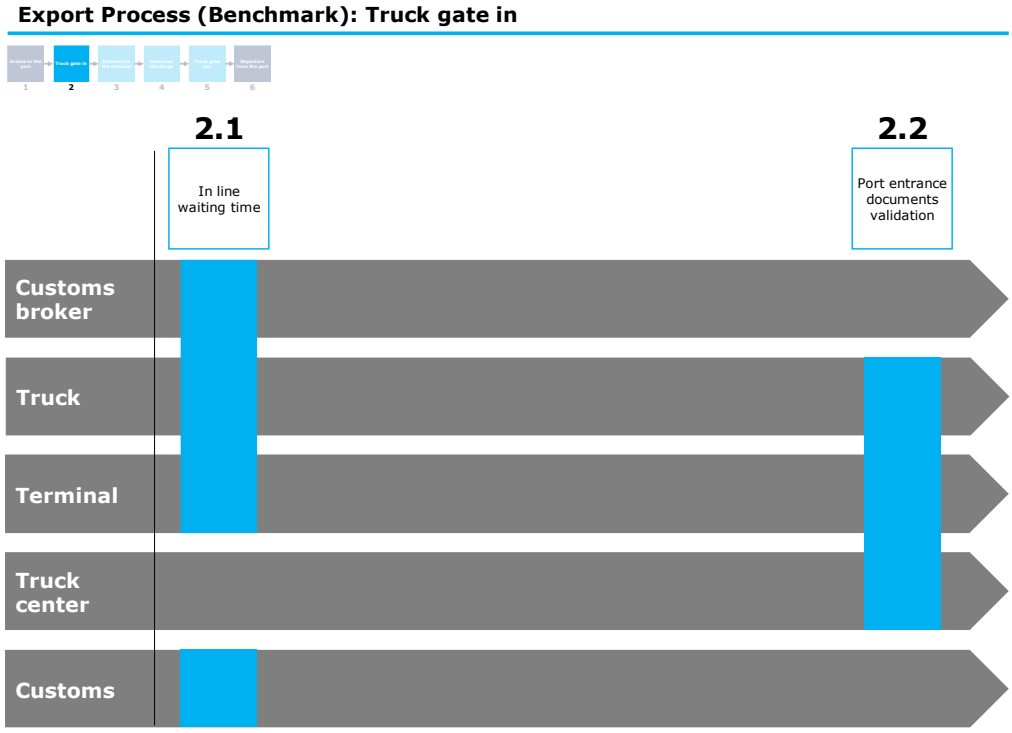
1. **Access to the port:**



Just as with the import process, the infrastructure that the port and the corresponding authorities prioritize is:

- Physical separation using different roads for heavyweight and lightweight transport. Each one, should have the technical capabilities to support each transport type characteristics.
- Access and exit from the port should prioritize locations that allow land transport to rapidly get on route, heading in their desired direction without create congestion or avoidable detours.
- The exit sentry could be optimized to allow a quick flow if trucks, and also with a specific area for a random customs inspection.
- The turn radius for the heavyweight trucks should be considered when trucks exit to prevent road obstruction due to the maneuvering.
- Signaling should be used within the port and outside to notify trucks and upcoming cars on the main roads about safety indications.
- Safety conditions should be considered to prevent accidents when trucks leave the port with pedestrians and other urban transports.

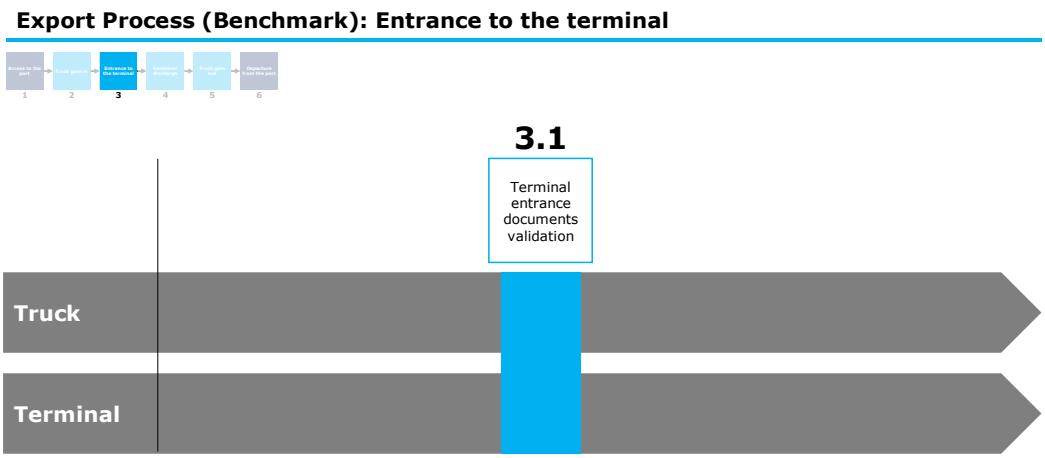
2. **Truck gate in:**



2.1. **In line waiting time:** The customs broker makes an export cargo operation request on the terminal website, fulfilling all the information needed. Then, the terminal will send an acknowledgement notification. The truck will arrive on the programmed day and a non-intrusive inspection could take place.

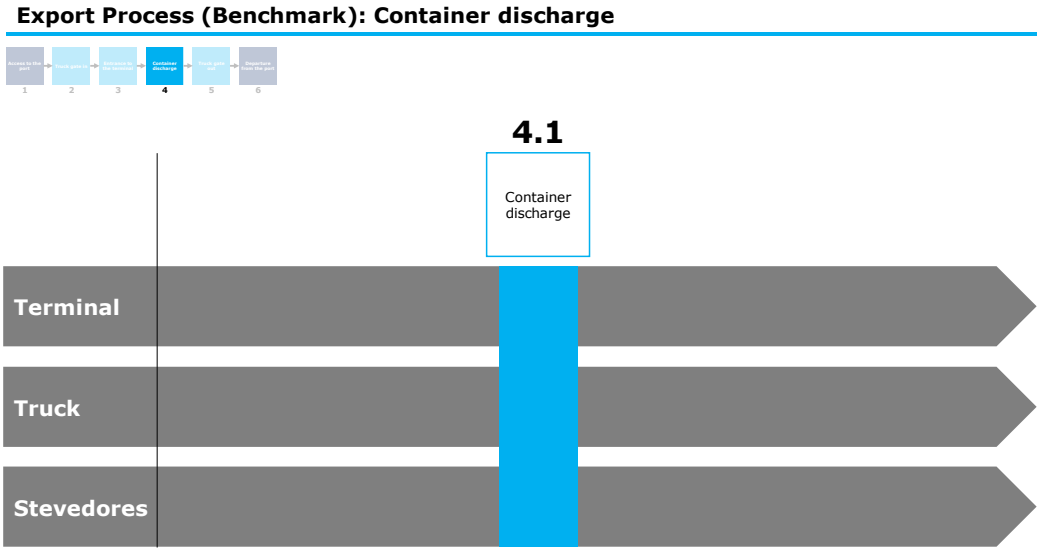
2.2. **Port entrance documentation validation:** Then, it will move to the Truck Center where the process will be the same as with the imports. The truck will identify itself and the container to be exported, waiting in the truck center until its appointment time comes.

3. **Entrance to the terminal:**



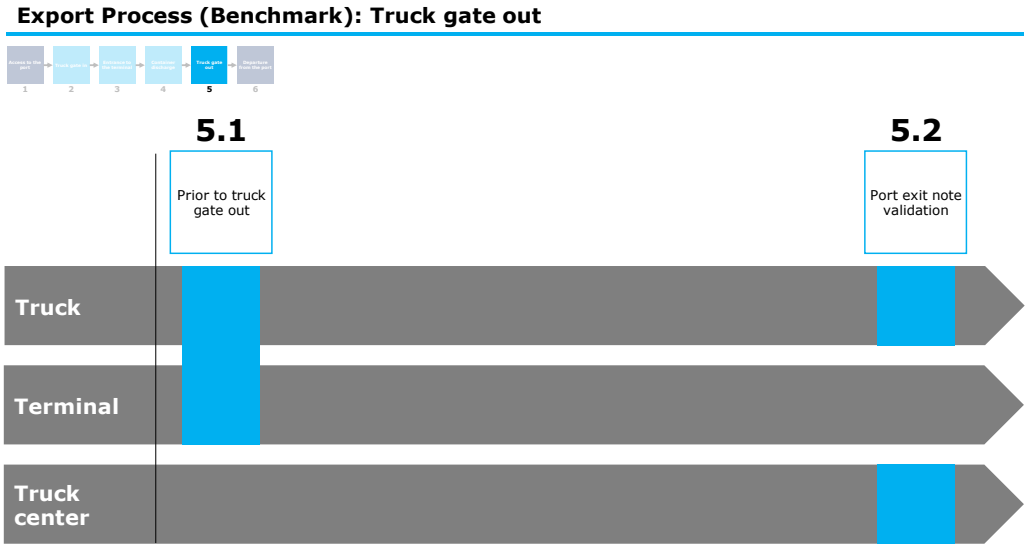
3.1. **Terminal entrance documentation validation:** Once in the terminal, the physical conditions of the container and its seals will be checked before the discharge and the truck driver will be registered.

4. **Container discharge:**



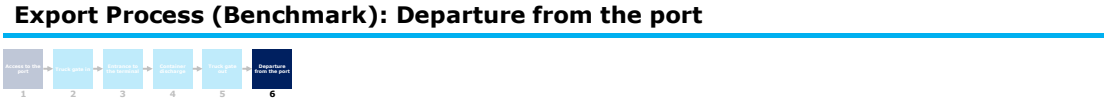
4.1. **Container discharge:** Then, it will be weighted, if requested. The terminal will register the entry of the container on the Port Community System and the customs authority will be notified. Customs stores the documents required for the inspection of the export container. The truck will head towards the indicated position and the stevedores will go ahead with the discharge and sorting of the containers. Container could be subjected to a customs inspection if requested by the authority, yet is not a common practice (the process would be the same as with imports).

5. **Truck gate out:**



5.1. **Prior to truck gate out:** The terminal will give clearance to the truck, and the latter will get to the exit line before going to the exit truck gate.
5.2. **Port exit documentation validation:** The truck driver's exit will be registered by the truck center and clearance will be granted.

6. **Departure from the port:**



For the departure from the port, the corresponding authorities should consider:

- Light signaling systems outside the port to prevent congestions and help heavy vehicles to incorporate to city roads.
- Exit truck gates should allow connection with multiple roads and directions, to allow vehicles trucks to head their route quickly. If possible, the connecting roads should avoid high traffic areas to prevent further congestions and maintenance road problems.

Gap between As Is and Benchmark processes

The main gap between the current Export process in the Dr. Jules Sedney Terminal and the benchmark process is the usage of technological tools for the subprocesses. The Port Community System helps the process by making register data available and safe for the involved parties. On the efficiency side, time reduction might be obtained, but it's not the main focus of the benchmark, as these would not be significant. The process comparison looks as follows:

For the current process to migrate to an operation similar to the benchmark, the next gaps can be closed:

- The truck center will help alleviate congestion within the port by providing an area where trucks will be organized before entering the terminal.
- Complementing the first point, and as the main improvement to the export process, the Port Community System will help with the automation of the transactional tasks. Added control and security will be enabled as systems will help validate and verify information for the transport companies, making operation efficient.

3.3. Best practices in port operations

Additionally, to the detailed process analyzed previously, two practices that have been implemented in order to reduce traffic jams within the ports and nearby areas are the implementation of PCS, to improve coordination and optimize process, and the development of truck centers to reduce congestion and automate the entrance and exit of trucks. Up next, there are some of the most relevant characteristics that have to be considered in their development.

3.3.1. Port Community System

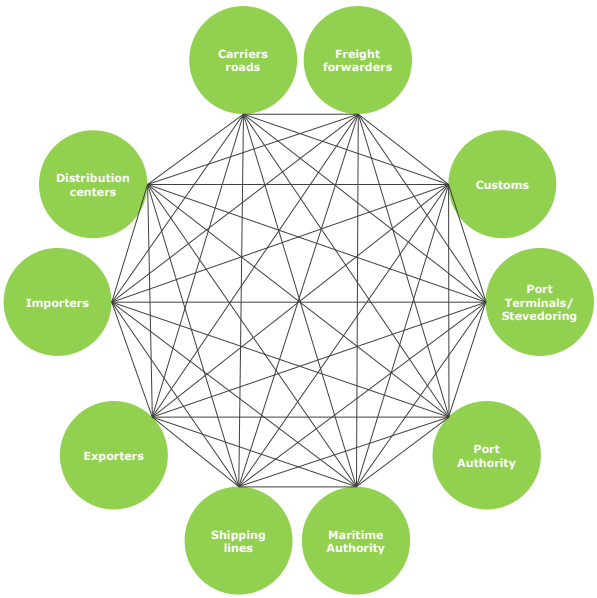
A Port Community System (PCS) is an electronic platform that allows the connection of multiple systems from different organizations that make up the seaport community. The platform should be neutral an open, enabling intelligent and secure information exchange between both, public and private stakeholders, to improve the efficiency. As stablished before in the Paramaribo Port, the stakeholders to be included are the Maritime Authority of Suriname (MAS) systems, port terminals (Terminal Operation System) and Customs (ASYCUDA System). The PCS helps to optimize, manage and automate port and logistics processes.

A Port Community System provides full information related to the maritime operations, arrival berthing, anchorage, and departure on live time and scheduled. Some of the main benefits of implementing such a system are:

- Allowing easy, fast, and efficient information exchange and transaction recordkeeping.
- Electronic handling of all information regarding import and export of containerized, general and bulk cargo. Faster collection of customs duties from traders and more effective detection of smuggled goods.
- Facilitating the coordination of stakeholders in port processes and the centralization of information in a single database.
- Enabling the elaboration and approval of customs declarations.
- Port authority is able or provide several port related online services to shipping agents, including controlling and tracking of cargo status information though the whole logistics chain.
- Improved management and efficient use of space for vessels.
- Time and cost reduction. Better coordination for shipping agents in terms of booking, procurement and document processing using a single interface; faster declaration of goods bu customs agents through online submission of documents.

An efficient collaboration between all involved organizations is the essential prerequisite to optimize the logistic processes through a single data submission. As trade evolves, and a faster movement of goods is required, faster authorization and clearance procedures are needed. The substitution of paper documents with electronic communications is recommended; thus, the PCS not only improve coordination of all good transferal between the involved stakeholders, but also the controlling activities of port authorities and customs.

Port community communication without a PCS



Port community communication with a PCS

Ideally, there is no need for bilateral or multiple communications methods between the parties when using a PCS, because every port-related actor send is information to a central system that can be accesses by the rest of the stakeholders to look for their relevant information. PCSs offer the users a Single Window which enables the lodging of standardized information and documents with a single entry point. The way information is exchanged between parties can be described with three information models:

a) **Bilateral Information Model (BIM):** In this model, the data is exchanged directly between the actors on a bilateral basis. If regular communication channels such as telephone or e-mail are used, BIM is an easy and cost-effective way to implement data sharing.
b) **Centralized Information Model (CIM):** An independent operator provides centralized information services and also stores, forwards and retrieves data. Service providers can offer value-added services to improve logistic processes. In this model information is not exchanged from one

actor to another as in the BIM, but retrieved on demand. The centralized model is usually a good choice for small and medium size companies in communication with big stakeholders who own their own internal systems.

c) **Decentralized Information Model (DIM):** The decentralized model still uses a central broker, but it isn't responsible for the control of the information. It is also aware of the information that is stores, and when it is updated and retrieved. Information is exchanged once it is needed.

Information security is one of the main challenges when implementing a PCS. Cooperation between stakeholders is vital as well as internal education for users to achieve a proper organizational security. To ensure the continuity of the system, standardization of the information security practices and risk management is recommended.

The PCS should have a disaster recovery plan that outlines in a clear manner the measures to be executed to eliminate threats or remedy a contingency.

The PCS works as a facility that allows all stakeholders to safeguard standardized information and documents at a single entry point to fulfill trade and transit regulatory requirements, as well as to make their operations simples and more efficient. The PCS also allows a port to provide added values services to the maritime community. The most frequent services offered by PCS are related to access controls (gate-in/gate-out) and reporting the status changes of the containers and cargo. Recent trends involve the offering of web based services to cover specific client requirements and information needs.

Surveys by the International Association of Ports and Harbors (IAPH) have studied the different PCS experiences in several geographies to analyze the success factors and main obstacles for the implementation of such systems. The key factors for success identified by the IAPH are:

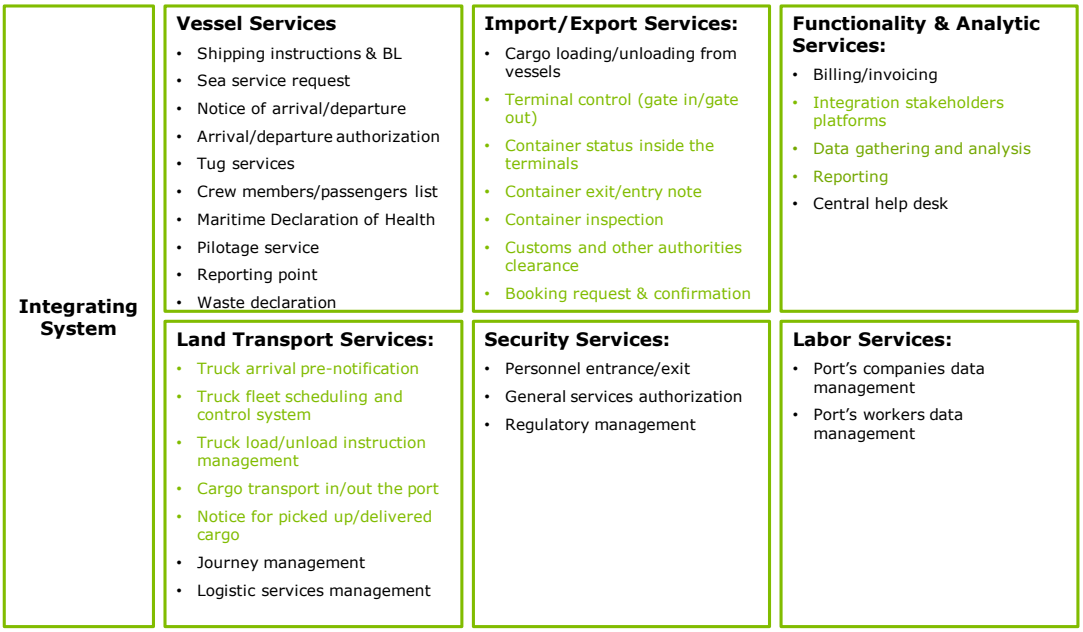
- Operators need to understand and know the daily logistics processes
- A strong and stable financial capacity
- Neutrality and confidentiality of the PCS operators
- Involvement of all the stakeholders of the port operations in setup, usage and maintenance of the PCS
- Agreement and clear identification of the benefits that the PCS can potentially bring to each of the stakeholders
- Creating a public-private relationship of cooperation

As for the main obstacles during a PCS implementation, the IAPH mentions the following points:

- Lack of technical standards
- Adaptation of the IT systems with the PCS interface and platform
- Change management issues regarding dissemination, training, and/or lack of pilot tests

The typical PCS provides different services that can be grouped depending on their type and to whom they are directed to. The next figure shows a typical PCS structure and some of the potential services to be developed in Dr. Jules Sedney Terminal, which will be detailed in the next chapter.

Port Community System (PCS) typical services



Potential services for Dr. Jules Sedney Terminal PCS

- **Integrated system:** This is the foundation layer of the PCS were all the services will be included as well as the current systems of the stakeholders (e.g. terminal operating system, customs services, transport companies' systems, etc.)

- **Vessel services:** These services are focused on the management of the shipping companies' vessels. This module allows for documents and scheduling to be exchanged digitally, and for shipping companies to request specific operative services in advance before arriving to the port.

- **Land transport services:** The services provided under this category are focused on the coordination with land transport companies in order to allow trucks in and out of the port in an automated and ordered manner. It also helps to keep an updated status of the access to the port by land transport and the cargo that they're carrying in and out of the port.

- **Import/export services:** Import and exports operations related services are mainly focused on the status and procedures that the containers and cargo need to undergo within the port and the terminals. These solutions allow the stakeholders to know the status of the containers and to program and request customs inspections.

- **Security services:** The security services consist on the control of personnel access to the port, and the requests for general services. It also helps the community to manage the regulatory compliance.

- **Functionality & analytic services:** These developments allow the PCS to connect with other stakeholder systems and platforms to enable interoperability. It also allows to safeguard and manage the information and generated data of daily operations for its analysis.

- **Labor services:** These services are related with the port's internal organizational structure and its workforce including their operations and the management of the registered companies' data.

3.3.2. Truck Center

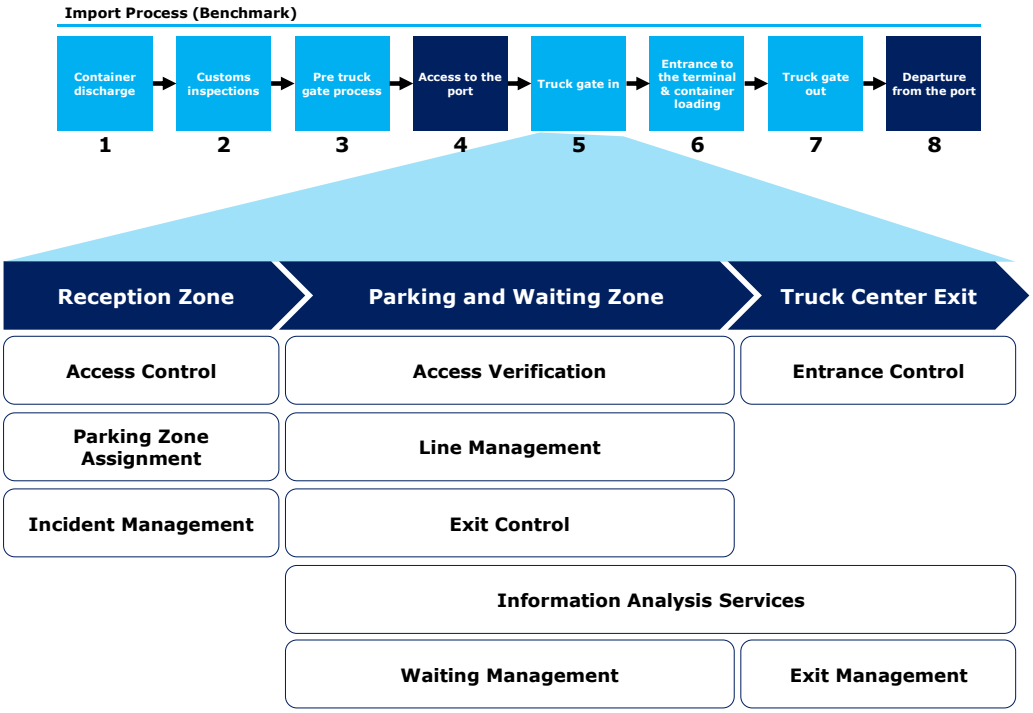
A Truck Center as a special designated area before the access to ports has become a common solution to solve different issues related to the land transport management in the facilities. This initiative involves several components including infrastructure, Information Technologies and process reengineering. Its development can also enable other actions such as:

- Access controls to the port facilities for carriers and trucks;
- Scheduling system and procedures development;
- Vehicles and cargo tracking and increased visibility;
- Quick win strategies to deal with peaking;
- Planned handling of the truck gate capacity;
- Reporting on the port's import/export demand;
- Truck and drivers census; and
- "No booking, no entry" policy.

The truck center should be close the entrance and the terminal areas so that the transit time doesn't affect the port's performance. Benefits resulting from the Truck Center can be divided between the different stakeholders:

Benefits to the shipping lines	Benefits for transport companies	Benefits for local communities
• Consistent high level of service, allowing flexibility • Elimination of import errors (i.e. no wasted truck journeys due to import container not being available) • Significant improvement in reliability of service • On time deliveries on other ports have increased from an average of 65% to 95%	• Significant reduction in operating costs • Effective management of truck fleet due to predictability of service, and ability to view live information • Confidence in the service of trucks on the scheduled times	• Reduced congestion on local roads • Reduced air pollution in local area • No waiting trucks • No wasted journeys

Overall, a Truck Center works based on the internal process described below. In order to implement this solution, the Paramaribo port's process will require to be modified.



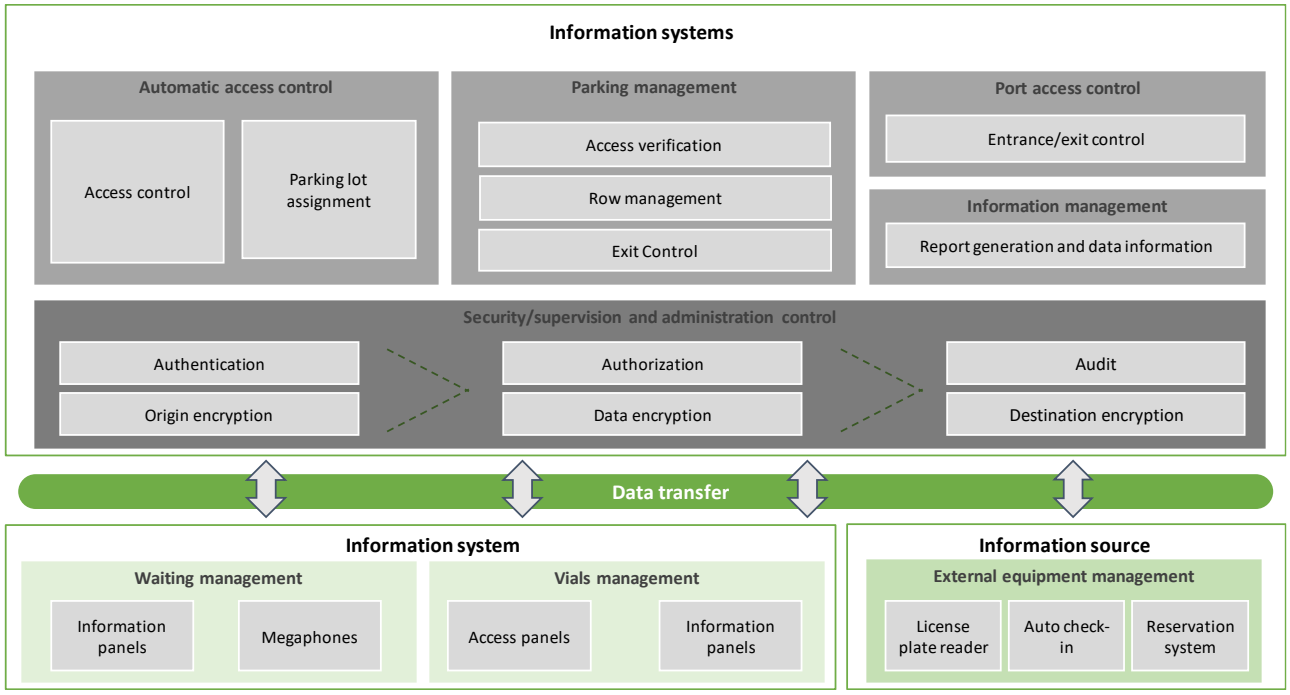
1. **Reception Zone:**
   - 1.1. **Control Access:** First, the trucks will head towards the access control point where they will be assigned a turn number. To do this the port would have installed systems that allow dynamic entrance lanes management and drivers data reading. Also, a truck plate reading will be conducted, as well as the verification of the appointment (to the PCS, TOS and ASYCUDA systems).
   - 1.2. **Parking Zone Assignment:** For imports, the Truck Center will confirm with the terminal if the cargo is ready to be loaded to the truck. In the cases of exports, Truck Center usage should be minimized to avoid as documents should be ready when arriving to the port; however, the center could be used to prevent internal traffic. The port will identify the destiny and typology of the vehicle, and then the truck will be assigned a place in the waiting zone. Before heading there, the parking lot space will be enabled, gates will be open and the driver will be handled a print ticket with notices, instructions and waiting location.
   - 1.3. **Incident Management:** If there are any incidents and/or issues with the systems, manual input of information should be available as well as a constant information panel update.

2. **Parking and waiting zone:**
   - 2.1. **Access Verification:** Systems will be used to read the front plate of the truck and the parking zone assignment will be verified.
   - 2.2. **Line Management:** The truck center will have an occupancy control of the waiting lines to assign space in the parking lot.
   - 2.3. **Exit Control:** Each truck will be assigned a vehicle number to head to its destination within the terminal that should be communicated to the TOS. When the trucks head out of the parking and waiting zone, the gates will be open automatically and the parking occupancy will be updated.
   - 2.4. **Information Analysis Services:** Systems will be used to gather and analyze data regarding accesses and pass zones within the Truck Center. This allows to have time analysis; police and customs reports; and goods control.
   - 2.5. **Waiting Management:** Waiting line management consist on optimizing communication with the truck drivers and transport companies to make the process easier inside the port. Information panels on the waiting zone need to be updated regularly; notices can be generated using SMS; and finally, systems can be used to enable an auto check-in option.

3. **Truck center exit:**
   - 3.1. **Entrance Control:** After being assigned their number, the truck drivers will head to the Truck Center exit (Port Entrance) where the plate will be read again. A verification will tell if the truck effectively passed through the Truck Center, and the overbook will be identified. The port gate will be opened.

3.2. **Information Analysis Services:** Systems will be used to gather and analyze data regarding accesses and pass zones within the Truck Center. This allows to have time analysis; police and customs reports; and goods control.
3.3. **Exit Management:** The Truck Center will give their exit orders and keep record of them to have data on the movements inside the center.

One of the main key points of a successful Truck Center is the leverage on technology to make the process easy, accessible and capable of collecting relevant data for the port, customs and other stakeholders. A functional model for the technological requirements of the Truck Center can be as the following:



- **Information System**
  - **Automatic access control**
    - **Access control:**
      - **Dynamic management of entrance lanes:** This functions allows to enable the lanes based on the traffic levels and the usage meant to them. Lanes can be open and closed at will; lane controls can be equipped with video cameras and presence detection sensors; and each one of them can be classified to suit the ports operations such as "frequent usage lanes" or "VIP lanes".
      - **Truck plates reading:** The front and back truck plate reading can be automated using OCR/LPR and the length can also be measured using other technologies such as lasers. The compiled data would be storage on the informatics systems, sent to the terminal and to the truck center displays, if applicable.
      - **Truck driver's information reading:** This action can also be automated by reading a contact-less card with the driver's information, which would be sent next to the data storage. Biometric readings can also be implemented to have a more robust profile.
      - **Appointment verification/ticket printing:** Consultation process of the information linked to the appointment. If the appointment is positively verified, the truck will be assigned a waiting space; if not, an incident will be activated capturing the information manually. The ticket with instructions will be printed and the gates will be opened.
      - **Incident management:** When incidents happen with the vehicle appointment, it's important to have tools for their management such as: manual forms to gather vehicles and drivers' information; links to an image control system to have life time available information; control occupation systems with cameras; information panels displayed near the incident areas; plate reading tools; totems with incident auto management providing solutions for drivers.
    - **Parking lot assignment:**
      - **Destination and vehicle typology identification:** This function allows to identify the destination of the truck based on the appointment data to assign a waiting zone lane that suits the vehicle.

        - **Waiting zone assignation:** Using the previous information gathering and computing, the waiting line will be assigned and a ticket will be printed.
    - **Parking management:**
        - **Access verification:**
            - **Allowed vehicles publication:** This function allows to publish the plate of the next truck allowed to access the waiting zone on the display panels inside the Truck Center. This data will also be storage for further usage.
            - **Front plate reading:** This function allows the reading of the frontal plate previous to the verification of waiting zone location. Data can be obtained using OCR/LPR and then sent to the parking lot system.
        - **Row management:**
            - **Parking zone access verification:** This module allows the port to validate that the vehicle is parked on the assigned area by the systems. It can also communicate any incidents and an incorrect location with further instructions using the display panels or SMS.
        - **Exit control:**
            - **Order assignation for vehicle exit:** This functionality allows the port to know in real time the amount of vehicles authorized to leave the waiting area and proceed to the terminal. By knowing this, available slots on the waiting area can be updated.
            - **Gate control:** This system allows to remotely control de gates and grant access once the Terminal's authorization is received. Vehicle counting can also be enabled to keep track of the movements within the Truck Center.
            - **Exit plate reading:** Free-flow front plate reading system located on the exit gate of the Truck Center for security and statistical reasons.
    - **Port access control:**
        - **Entrance/exit control:**
            - **Front and back plate reading:** Automatic front and back reading system using OCR/LPR. The information is sent to verify that it matches with the systems data in order to open the gates to the port or specific terminal.
            - **Passing through the Truck Center verification:** This allows to verify if the vehicle passed through the Truck Center in order to grant or deny access to the terminal. In cases where it didn't, further information will be processed.
            - **Overbooking control:** This system identifies overbooking vehicles that should wait on a specific area planned for that purpose. If there is space left, it'll be let in, otherwise the truck will have to wait.
    - **Information management:**
        - **Report generation and data consulting:**
            - **Access and passage area report:** Statistical report generation with client typology; incidents number and typology; number of admitted vehicles in any given period; occupancy level of lanes in parking area; etc.
            - **Time report:** Statistical report generation on average passage in any given period; expected average transit before exiting the docks; incident resolution average; etc.
            - **Police report:** Regular listing reports for police and other authorities regarding vehicles and people data; goods being transported; etc.
            - **Goods control:** This system allows the exchange of information with competent authorities within the scope of risk management involving criminal activities that should be identified as soon as possible. The information exchanged is data related to goods that required a specific control or tracing; alerts informing of technology and goods that could be potentially risky.

- **Security/supervision and administration control:**
    - **Anonymization or encryption:** Using diverse techniques, a clear set of information can be encrypted or anonymized to guarantee confidentiality at all time.
        - **Anonymization or encryption of client/origin information:** Encrypting operations are done ate the client/origin side before the information is sent, ensuring data transit and its destination.
        - **Anonymization or encryption during transport:** The usage of safe protocols such as TLS and SASL is recommended to encrypt transport information.
        - **Anonymization or encryption at the destination:** If the received data is already cyphered when it arrives at the destination, it'll be storage like that. If not, it is recommended to cypher them before their storage.
    - **PKI keys management:** HTTPS cyphering requires the usage of public-private password pairs. Systems for password storage and management are needed such as Key Management Server (KMS) and Key Trustee Server (KTS). Component installation is also required such as Cloudera Navigator Data Encrypt, Cloudera Navigation Key Trustee Server and Navigator Key Trustee KMS.

- **Access control:** Access control for the systems and data is nuclear for their protection.
  - **Authentication:** This functionality provides a robust authentication and an integration with LDAP and the directory.
  - **Authorization:** This functionality allows to control access based on roles (POSIX, ACL, RBAC) via the user creation, user groups, roles and privilege assignment to control the resources (screens, applications) that can be accessed by determine users under a specific role. It has integration capacity with directory systems such as LDAP or Active Directory as repositories of users and group definitions.
  - **Audit:** This functionality registers the access to the services and resources of the systems such as user data reading and writing; change of permits; configuration changes; login trials; privileges; session tracking; password operations.
- **Management and supervision:** Functionalities that provide supervision and management services of the Truck Center systems:
  - Real time visibility of the passage elements, their status and basic information.
  - Manual execution of operations interfaces.
  - Manual operation tracking systems.
  - User management.
  - User access control based on roles.
  - System incidents and task supervision management. Incident management allows to know the status of the different relevant elements (access pathways, display panels, etc.); status of the communication channels between the Truck Center System and the Reservoir System; status of the information reception. Task supervision management allows to the have an alarm register related to the services presenting issues and the vehicle access issues.
- **Security control:** Service continuity mechanisms are needed as a way to guarantee that there are no breaks in the service. This is achieved by implementing high availability architectures and security copies. Operatively, procedures for security copy and restauration; and to replicate reserve information can be adopted, as well as a real time visualization of key elements and basic data.

- **Waiting management:**
  - **Information panels:**
    - **Terminal status visualization:** This functionality sends information regarding terminal status and turns for their validation and publishing on the display screens.
    - **Incident management visualization:** Information concerning the status of the plate reading validation and admission clearance is displayed on screens. The truck drivers can wait until their clearance is published to avoid unnecessary movements within the Truck Center.
  - **Megaphones:** This functionality allows to send information using a megaphone system in the Truck Center or SMS. Notices can be filtered and selected to avoid non authorized information sharing.

- **Vials management:**
  - **Access panels:**
    - **Access activation/deactivation:** This functionality allows to remotely change the status of a lane by opening or closing it.
    - **Access lane information:** When a lane is activated, this allows to present information regarding specifics like contact-less card priority, appointment only, etc.
    - **Information panels:** Internally, display panels allows to visualize the plate of the trucks that have permission to access the Truck Center and/or the port. It helps to filter trucks that have received clearance from the ones that hasn't.
  - **Information panels:** This panels are used to show different destinations and the lane that each truck should follow to get to their destination.

- **External equipment management:**
  - **License plate reader:**
    - **Reading and data sending:** Front and back plate image registration using OCR/LPR. The system can also integrate a length detection mechanism using lasers or other technologies to support the reading and data gathering. Additionally, other external equipment such as ILU (Intermodal Loading Units) code readers, and weighing scales can be used.
    - **Image visualization:** Camera selection system and image visualization in access controls to passageways to visually verify plates and other relevant aspects of the vehicles. The proposed functionality allows to link the image control analysis to the other systems to remotely do the camera selection.

- **Interphone notice:** A communication system can be enabled to allow truck drivers to contact the Truck Center in case of incidents.

- **Auto Check-in:**
  - **Contact-less card reading:** Automatic driver's data recollection using a radio frequency sensor and a card for frequent users. The system can also include image capture for security tracking. Data collection can be printed for further support.
  - **Biometric data collection:** Systems can be used to collect biometric driver's information to prevent identity theft as a complement to the contact-less card reading. This information can also be included in the printed ticket.
  - **Service zone check-in totem:** In case there is a service zone for waiting drivers, check-in totems can be enabled to gather information.
- **Reservation system:** This system allows to send and receive the appointments planned for a given day, updating any changes. The information associated with each appointment should be the truck's plates and driver's ID.

3.4. Proposed interventions in Dr. Jules Sedney Terminal

3.4.1. Port Community System

As mentioned in the gap analysis between the current port operations and the benchmark for other ports in the region, efficiencies and improvements can be obtained. The implementation of a Port Community System (PCS) can help to achieve these and also to lay the foundation for future technological developments in Dr. Jules Sedney Terminal.

The current processes and sub-processes of the import operations that could be included as part of the PCS are shown in the next figure:

As Is Import Process	Sub-processes	System	Stakeholders
Container discharge	Operation planning and preparation	TOS	
	Container discharge	TOS	
Arrival to the port		-	
Pre truck gate process	Preparation of truck gate in documentation	PCS	
	Delivery of truck gate in documentation	PD	
Truck gate in	In line waiting time	-	
	Port entrance documentation validation*	PD	
Entrance to the terminal & container loading	Terminal entrance documentation validation*	TOS	
	Container search and loading	TOS	
Custom inspection	Container positioning	-	
	Inspection preparation	-	
	Inspection	-	
	Report inspection results	PD	
	Cargo release	PD	
Exit note procurement	Return to terminal	-	
	Container clearance validation	TOS	
Truck gate out	Prior to truck gate out	-	
	Port exit note validation*	PD	
Departure from the port		-	

Terminals
Customs authority
Customs broker
Transport company
Port

To be included in the PCS

TOS: Terminal operative system

PCS: Port Community System

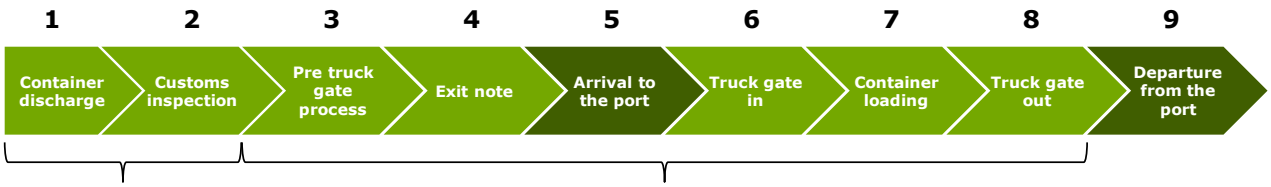
PD: Physical documentation

*The automation of these sub-processes will also help the export process
Source: Port Authority | Interviews with transport companies | Deloitte analysis

Nine of the of the eleven mapped sub-processes that uses a system could be enabled with the PCS. First, the Terminal Operating Systems (TOS) of DP World and VSH need to integrate with the PCS to allow communication between current used platforms and the new ones. The port has already started to build a PCS used primarily to prepare de land transport documentation for import and export operations; this platform would be expanded with additional capabilities. Finally, some processes use physical documentation that is not ideal for traceability and tracking, or to safeguard relevant information; the PCS will help to enable these actions technologically.

In the case of Dr. Jules Sedney Terminal, the potential services that could be integrated in the PCS are comprised in three groups. Each of the services will play a role as an enabler for the to-be import process:

To-be import process for Dr. Jules Sedney Terminal



1. Import Services (Customs inspection):

- Container status inside the terminals
- Booking inspection request & confirmation
- Container inspection
- Customs and other authorities clearance
- Container exit/entry note

2. Land Transport Services:

- Terminal control (gate in/gate out)
- Truck arrival pre-notification
- Truck fleet scheduling and control system
- Truck load/unload instruction management
- Cargo transport in/out the port
- Notice for picked up/delivered cargo
- Visibility of trucks within the port

Functionality & Analytic Services:

- Integration stakeholders platforms
- Data gathering and analysis
- Reporting

It's important to note that these are the services considered for the implementation of the PCS based on the process gap analysis and the current situation of the port's systems; however, further development could be made in the future and the initial services could be modified based on the port's strategic goals.

To-be import process PCS services and involved stakeholders

	Sub-processes	PCS Services	Stakeholders (Systems)
1. Import/ Export Services	Container discharge	Container discharge	• Terminal control (gate in/gate out) • Container status inside the terminals	
	Customs inspection	Report inspection results	• Booking request & confirmation • Container inspection	
		Cargo release	• Customs and other authorities clearance	
	Exit note	Container clearance validation	• Information on cargo status • Container exit/entry note	
2. Land transport services	Pre truck gate process	Preparation of truck gate in documentation	• Truck fleet scheduling and control system	
		Delivery of truck gate in documentation	• Truck arrival pre-notification	
	Truck gate in	Port entrance documentation validation	• Terminal control (gate in/gate out)	
	Container loading	Terminal entrance documentation validation	• Container status inside the terminals • Cargo transport in/out the terminal • Notice for picked up/delivered cargo	
	Truck gate out	Port exit note validation	• Terminal control (gate in/gate out)	

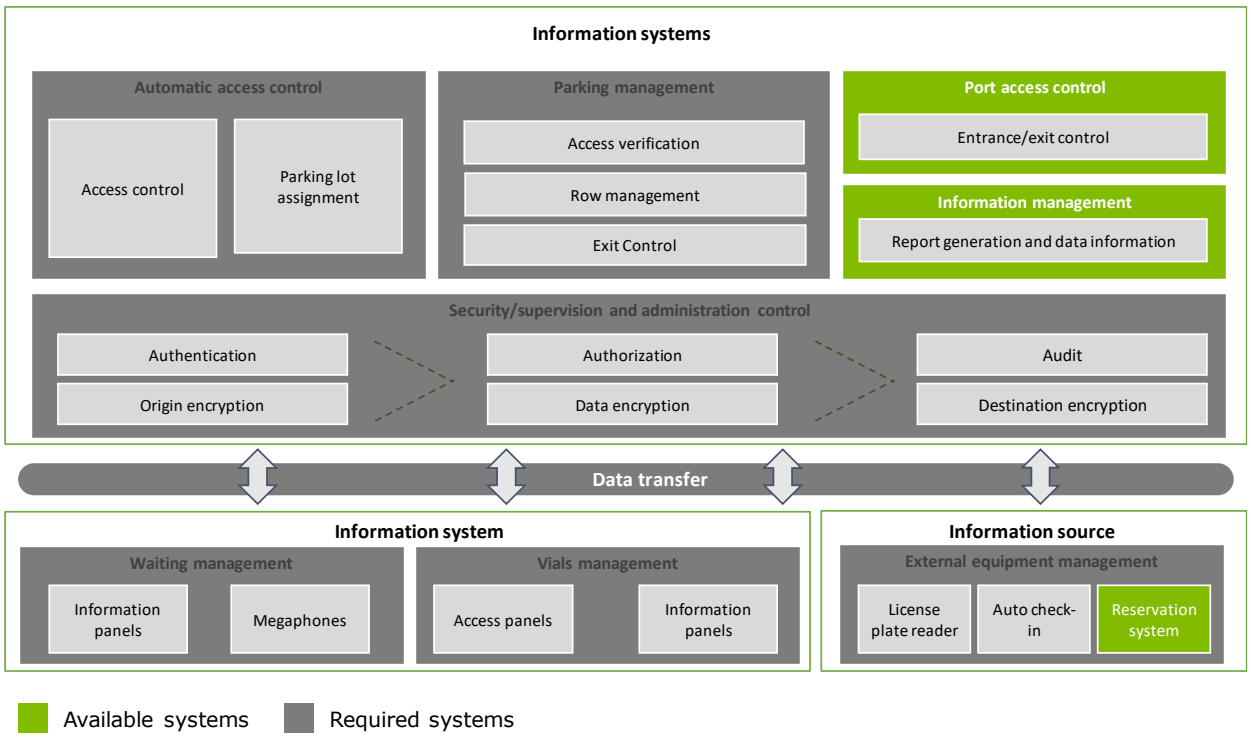
Terminals (TOS) · Customs broker (site) · Port (PCS) · Port (BI & statistics)

Customs authority · Transport company · Truck Center (new system) · Mobile apps (optional)

Each of the potential services proposed for the PCS could take a role for the sub-processes as is shown in the previous figure. Once of the main changes of the operations when implementing the PCS is that the different stakeholders' systems will have to be integrated and connected to ensure the proper communication flow and information exchange. If possible, mobile apps can also be developed as an additional source of information exchange and also to efficiently allow data display on the go.

In order to provide these services, Dr. Jules Sedney Terminal needs to develop the following PCS modules, based on the functional definitions previously described in the Best Practices of Port Operations Chapter (3.3.1):

PCS Transport module required information systems



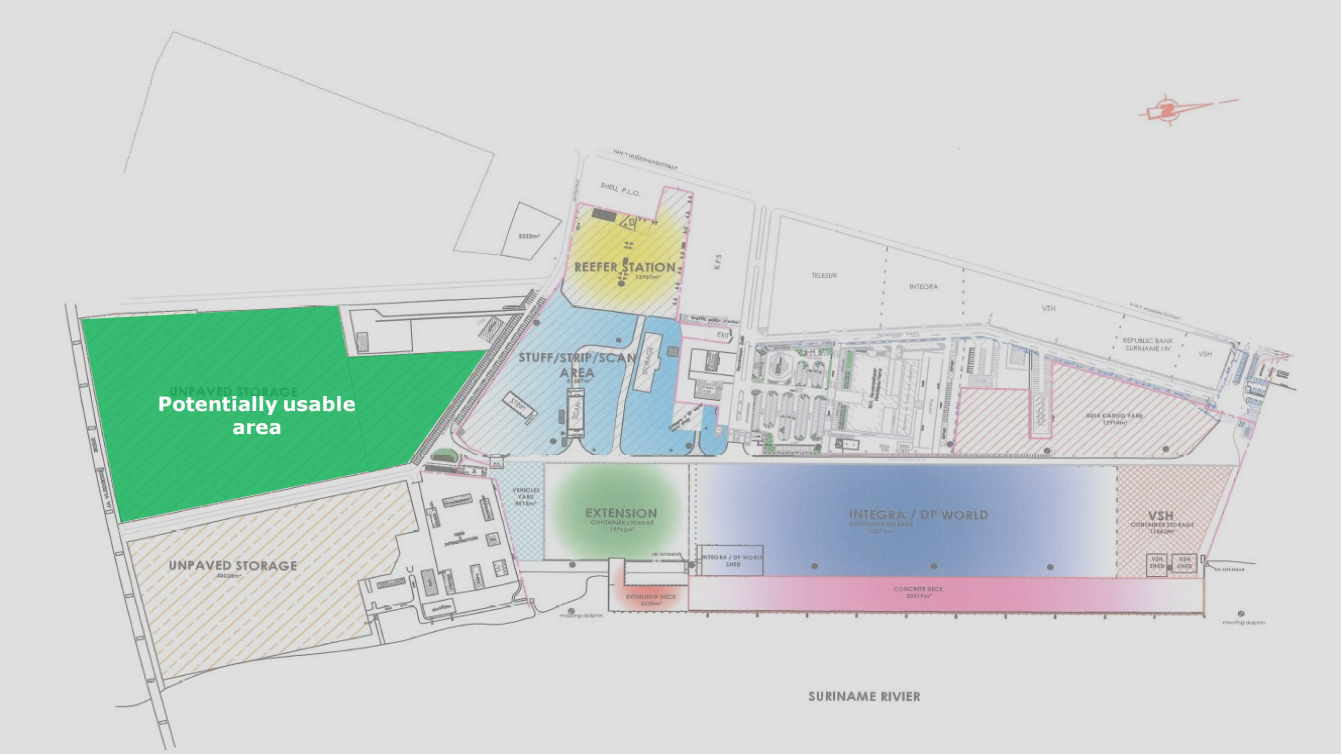
Even though the port currently has developed some PCS solutions and has the support of a technological provider, the proposed services would need an additional team to be able to implement all the solutions within a relatively short period of time.

For the implementation of these modules is required to have a team *in situ* in charge of performing the functional design and the change management. The change management needs to be conformed with a representative of each of the stakeholders as a responsible figure responsible of promoting the PCS adoption and ensure communication of relevant issues in an opportune manner.

3.4.2. Truck Center

As mentioned on the benchmark, a Truck Center can be a feasible solution to make port operations more efficient. The Dr. Jules Sedney Terminal can be enabled to held this kind of facilities by taking advantage of current spaces, as seen in the port layout.

Potentially usable are in Dr. Jules Sedney Terminal for a Truck Center and complementary services



The potentially usable area for the Truck Center has an approximate surface of ~65,000 m^2. However, the Truck Center would be smaller in size, leaving additional space for other uses that could help to create other sources of revenue for the port.

Usually ports have four additional uses that can complement the whole operation and could potentially be implemented in Dr. Jules Sedney Terminal and should be considered as part of the Port's Master Plan:

- **Transportation logistics:** Services that give an added value to drivers and vehicles, mainly the Truck Center and its support areas.
- **Cargo logistics:** Logistics operations services to foreign trade cargo.
- **Container logistics:** Logistics operations services for containers, especially empty ones.
- **Other services:** Though not as regular, additional services can be provided such as commercial areas, public transport stations, emergency centers, and waste management services within the port.

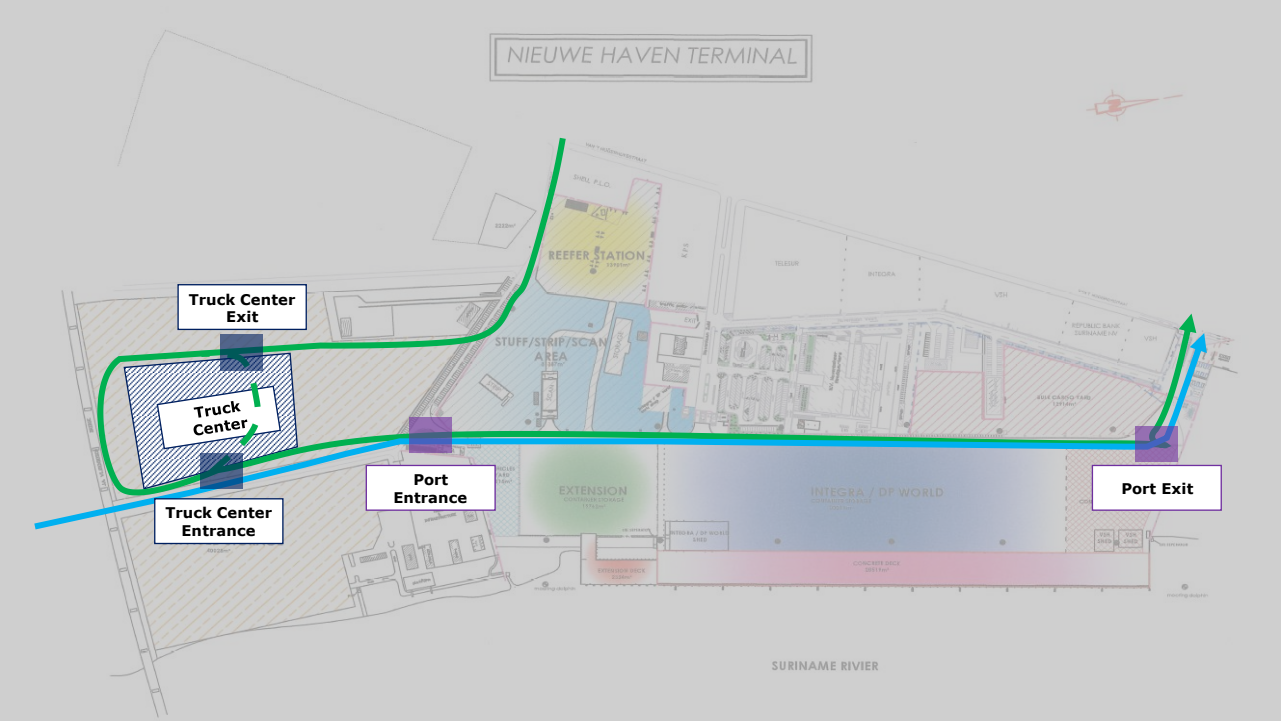
These uses are described below, however due to the scope of the cooperation in order to improve transport and logistics, this project will only consider the development of the transportation logistics area and parking for light vehicles[4].

Transportation logistics (Truck Center and support areas)

For the Truck Center and support areas, the daily traffic is considered as the main input to be able to dimension the number of space needed to service the operations. The first proposed change in the port is the flow of vehicle transit within Dr. Jules Sedney Facilities. Currently, the North Gate is sued as the main entrance and the South Gate as the exit route. This should be reversed to allow trucks to depart the port and head to their desired destinations without delays; also, another access point is expected to be available heading to the South Gate.

[4] Due to the potential impact to companies in adjacent areas that park in the street, the project will consider the development of a light vehicle parking area.

Heavy vehicle circulation flow in the proposed Dr. Jules Sedney Terminal



The continuous green line shows the flow of heavy vehicles inside the port. This new flow would also change the access and exit to the port's facilities, this change will be further explained in the Road's Interventions.

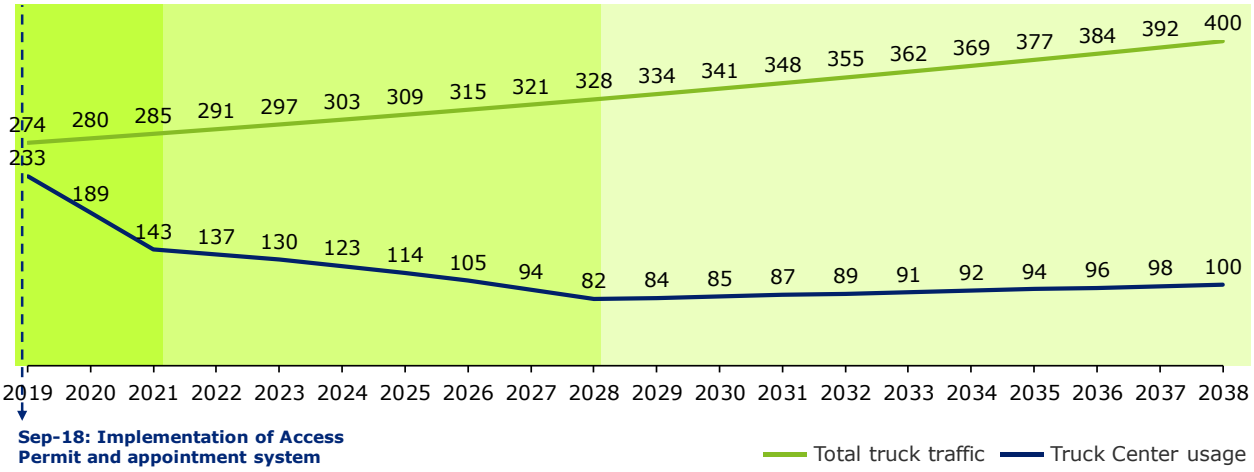
An additional blue line is included in the layout. This second line represents the future access to the port that could avoid the congestion in Van 't Hogerhuysstraat. However, this route will require that the Port gain ownership of lands that are now in dispute. The proposed layout had considered the potential future flow, for the positioning of the Truck Center.

To estimate the Truck Center required capacity, we estimated the traffic forecast for future years based on the TEU growth before the recession (1% annual average). We also made assumptions regarding the number of trucks that will have direct passage and the ones that would have to wait and actually use the Truck Center based on other similar developments in the region. This is relevant because direct passage trucks go directly to its assigned terminal to deliver/load their cargo and proceed to leave the port's facilities without causing traffic. The trucks that wait are the ones that cause congestion within the port internal and the external access roads. For this assumptions a three phase projection is considered:

- **Introductory Phase:** This period is used to train the main clients (80/20) in the procedures and characteristics of the Truck Center. A 3-year goal is set in which 50% of the trucks should achieve direct passage as observed in other ports with similar conditions (i.e. Mexico and Colombia ports).
- **Growth Phase:** During this period, the procedure of the Truck Center is adopted by the rest of the port community. A 10-year goal of 75% direct passage is considered as an achievable scenario.
- **Maturity Phase:** This phase consists mainly on improvements to the program, but the direct passage percentage remains the same (75%). As such, the waiting truck numbers increase as the total traffic does.

The final projections are the following:

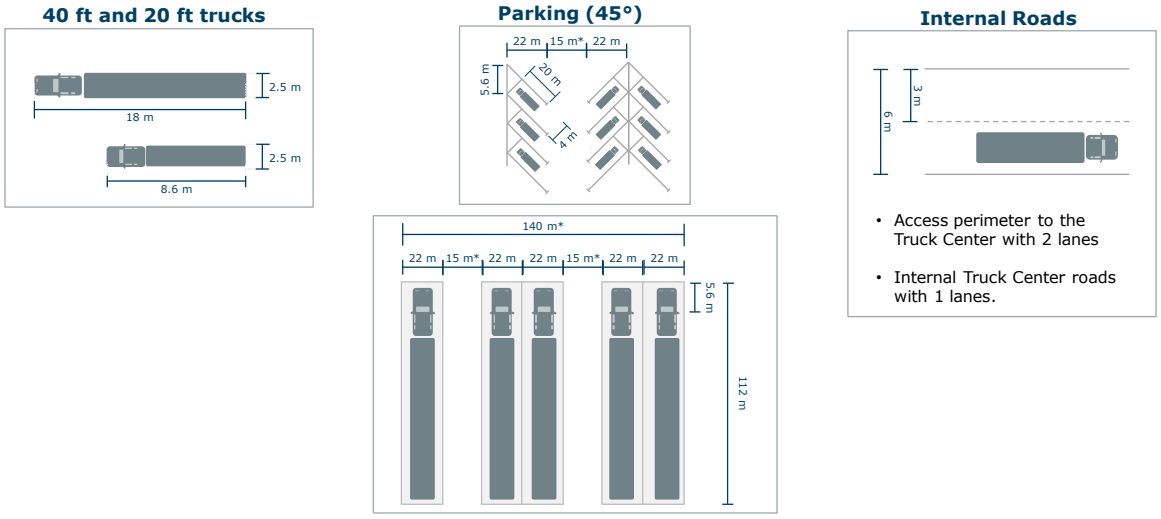
Daily truck traffic in Dr. Jules Sedney Terminal in the Truck Center
Truck number, 2019-2038



Introductory phase	Growth phase	Maturity phase
Training of the main clients (80/20). • 3 year goal of 50% direct passage as seen with other ports. • Dwell time in Truck center: 3-4 hours • Required parking: **85-140 spaces**	Adoption by the port community. • 10 year goal of 75% direct passage as seen in other port implementations • Dwell time in Truck center: 2 hours • Required parking: **35-55 spaces**	Improvement programs • Daily trucks that use the Truck Center increases as the total traffic does • Direct passage rate: 75% • Dwell time in Truck center: 2 hours • Required parking: **35-40 spaces**

The Truck Center should be equipped with a parking lot designed as a pre-gate process for the port, with complementary services that could be monetized by Dr. Jules Sedney Terminal. Standard dimensions were used to model the heavy vehicles, the parking lot and the internal roads:

Truck, parking and internal roads sizing



*The length between static positions are calculated to allow free truck movement from both sides

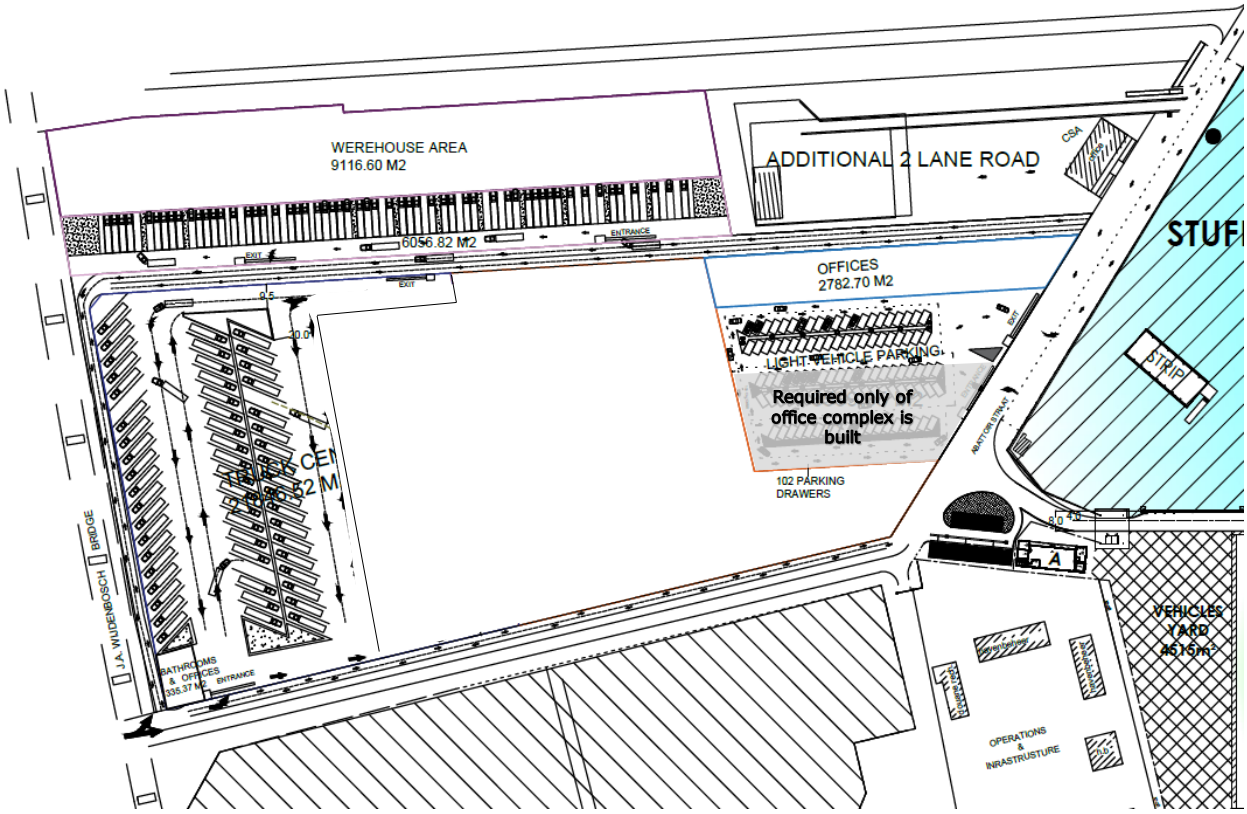
For the trucks, 40 ft container and 20 ft container vehicles are considered, although a single parking lot can be used by both of them. For the parking area, a 45° array was considered, where the internal lane between both parking boxes has a sufficient turn radius to allow the trucks to easily get in their designated spot by following the lane's direction. Preliminary, an array with 3 columns, each with 19-20 truck boxes can be enabled for a total of 58 spaces as the maximum required surface that would be needed. For the internal roads leading to the Truck Center, a 2 lane, one-way path is considered; inside the Truck Center only one lane is needed.

The preliminary design and layout considered turn radius of 14.75 m for the access to the Truck Center as recommended by the Transport and Communications Secretary in Mexico. Within the Truck Center parking space, double lanes were considered to allow for trucks to park and maneuver without slowing the traffic

in internal roads. The number of parking spaces will depend on the requirements and plans from the port, but we designed the Truck Center with 58 spaces based in the daily traffic forecast.

The Truck Center proposed layout is the following:

Proposed layout for the Truck Center



Additionally, other facilities can be built on the rest of the available surface, like the next proposition:

- **Parking for heavy traffic (Truck Center):** This is the main area of the Truck Center, consisting on the parking lot were the heavy vehicles will be parked and kept safe. It is also the most space intensive service as the trucks need sufficient space to maneuver and the parking spaces need to prevent congestions within the port roads.
- **Waiting area:** It is the space on which drivers can sit and wait for their turn to leave the Truck Center. This area usually has chairs and display screens where information is updated regularly.
- **Rest area:** This area is designed for the drivers to rest and wait, as an alternative to the waiting area. It can be equipped with shower facilities, bathrooms, Wi-Fi, laundry equipment, convenience stores, etc.
- **Parking for light vehicles:** This parking area is reserved for employees and visitors.

Additionally, other facilities can be built on the rest of the available surface, to increase revenue generation, which include the following. These are not included in the scope of the proposal

- **Repair and maintenance area:** This area can also be a new revenue stream, depending on the operation model designed for it. This space can have a repair area with services such as glass repair, oil and lubes changes, tires service, battery replacement, engine repairs, etc. Another space for cleaning and basic maintenance can be enabled as well.
- **Food court:** This area usually has catering services such as restaurants, fast food joints, cafeterias and/or vending machines. The space can be rented to other parties or a catering companies.
- **Offices:** The offices facilities can have multiple uses and services. Administrative offices for port and Truck Center employees can be located there, also services for documental processes such as printing, internet connection, stationary store, couriers, etc. Space can also be leased for customs broker agencies and logistical companies. The offices should also have their own parking spaces, complementary to the previously mentioned ones.
- **Gas station:** A mid-size facility can be built to host a gas station servicing fuel, oil, water and air for tires to name a few to light vehicles and heavy vehicles, providing a new revenue stream to the port.

Truck Center and support areas

Proposed Service	Criteria used for sizing and characteristics	Required surface (m²)
Parking for heavy traffic (Truck Center)	• Ratio of ~240 m² per static position • Parking spaces: 58	13,918
Parking for light vehicles	• Light vehicles parking benchmark for similar infrastructures • Parking spaces: 42 (parking replacement for Abattoirstraat)	3,265
Waiting area	• Number of drivers using the area (30% of total static positions) • Ratio of ~10 m² per person	335
Rest area	• Market ratio based on the number of drivers that will use the service (50% of total daily truck traffic) assuming one driver per unit	200
	TOTAL	**17,718**

Potential Additional Services	Criteria used for sizing and characteristics	Required surface (m²)
Food court	• Market benchmark for an mid-size restaurant on other similar infrastructures	400
Gas station	• Market benchmark considering a mid-size gas station	3,000
Repair and maintenance area	• Market ratio limits based on the number of heavy vehicles that will require maintenance services (326 vehicles)	2,800-4,700
Offices	• Office size benchmark for similar infrastructures.	400-800
Light vehicle parking for offices complex	• Additional static positions as an expansion of the proposed light vehicle parking • Parking spaces: 60	3,334
	TOTAL	**9,934-12,234**

Cargo logistics

Logistics operations can entail benefits due to the proximity to the terminal as well as lower storage, transport and labor costs. This will allow to increase the value added to products and increase the quality of logistic activities in the area. Some of the cargo logistics services that can be provided are:

Cargo logistics operations and services

Services	Description	Benefits
Cargo consolidation	Consolidation and deconsolidation activities such as ITR or stuffing/stripping; LCL; and transloading, to name a few.	• Optimization of the load capacity of the truck (up to 20% in heavy cargo) • Reduction of transport costs of empty containers and container rent • Facilities for container handling
Cross docking	Unloading, screening, sorting and reloading on the cross dock platform.	• Elimination of secondary transports • Storage costs reduction (between 13% and 65% depending on the city an other factors) • Handling material costs reduction
Storage	Room and controlled temperature storage of products to be distributed to different markets via the port	• Lower storage costs • Proximity to the port reduces transport costs • Elimination of secondary transports • Non-nationalized merchandise storage • Partial nationalization (unsold products)
Value added services	Other services such as picking, packing, repacking, sacking, labeling ant tagging, handling, cleaning, etc.	• Lower material handling costs • Logistics costs reduction to due the adjustment of products for direct distribution

In order to warranty the security of the merchandize storage in the facilities, some of the basic characteristics that are encouraged include:

- **Security:** CCTV covering de 100% of the perimeter and common areas; security personnel 24/7; access control system with personal cards and visitor controls.
- **Connectivity:** Road direct connectivity; access to roads connecting to the main terminal, without obstructing operations; public transport connections for workers.
- **Warehouse characteristics:** 13 m to 19 m height; no interior pillars and natural ventilation; thermo-acoustic materials covering for walls.
- **Additional characteristics:** Lower cost utilities (water, energy, gas, internet); cleaning, canteen, administration, hotels; customs services.

Container logistics

Finally, other services that could be included are related to the logistic of the containers. The development of a empty depot outside the port, could also help reduce the number of trucks within the ports. This will help reduce the saturation of the internal roads, which only have space for a two lane road (one lane each way).

Services provided to container include depot services and transportation in import/export flows or on-demand short-range distances. The main services offered are:

Main services offered to containers

	Services	Description
Depot Services	1 Gate in/Gate out - Handling	• Movements of containers from truck to yard and the other way around.
	2 Storage	• Storage of empty containers.
	3 Inspection	• Exhaustive inspection of container once reception or delivery is made in order to identify necessities of cleaning and repairing.
	4 Repairing	• Wielding, painting or replacement of structures such as floor, walls or corner posts or castings.
	5 Cleaning	• Cleaning of empty containers to remove stains or other sludges.
	6 PTI	• Pre Trip Inspection of reefer containers including check of motor, ventilation, systems, etc.

4. Proposed infrastructure for the road network

4.1. Current traffic conditions

In this section we have characterized and analyzed the traffic current situation in the roads in and around the Port. As the roads included in the scope of the study have an important share of urban traffic (over 97%), we have analyzed the traffic flows of: i) private cars and motorcycles, ii) heavyweight trucks, and iii) public transportation.

As summarized on the Technical Visit section, access roads to the port have shown different kinds of issues in recent years, this has not only affected the traffic with congestion, but also the infrastructure as roads have the coexistence of heavy and light vehicles, thus damaging the pavement and sidewalks. The studied corridor has multiple access routes that converge in Van't Hogerhuystraat and Willem Campagnestraat as the main access points to Dr. Jules Sedney Terminal, thus making the zone complicated for urban traffic and freight transport. As explained in the port operations, traffic coming or going to North-Western areas and from South-Eastern ones have different routes, each with its limitations and opportunities. As part of the Technical Visit, different measurements were conducted to gather information for further analysis.

4.1.1. Traffic characterization and analysis

To gather information, several devices and manual/visual stations were installed during the Technical Visit including pneumatic and manual traffic counters in specific points of the access roads; statistics were requested to Roads and Public Works Authorities; a flight plan for visual inspection with drones was planned but delayed due to a clearance negative by the corresponding authorities, which resulted in the hiring of an approved local company. Blueprints and information regarding the state of the infrastructure was also requested to corresponding stakeholders including water pipes and drainage facilities in main roads; electric lines and underground connections; telephone lines and underground connections. Finally, during the visits, the team physically went to the access roads and experimented firsthand the current congestions and traffic situations.

Traffic counts

For the analysis, de Weekly Average Daily Traffic (WATD) was calculated using the measurements of the installed counters. These were installed in strategic points that allowed a valid sample of measurements to characterize the traffic and vehicle dynamics of the corridor. Also, the manual counters where complementarily installed not only to register the number of vehicles, but also their direction and vehicle type:

WADT in each of the installed traffic counters

Counter No.	Counter Type	Location	WADT
1	Pneumatic + Manual	Van 't Hogerhuysstraat at the exit of the port	50,089
2	Pneumatic + Manual	Molenpad	10,494
3	Pneumatic + Manual	Van 't Hogerhuysstraat after the Saramacca Bridge	47,367
4	Manual	Van 't Hogerhuysstraat befoe Molenpad	46,553
5	Manual	Van 't Hogerhuysstraat/Jules Wijdenboschbrug roundabout	24,508
6	Manual	Slangenhoutstraat	15,572
7	Manual	Hernhutterstraat	24,158
8	Manual	Willem Campagnestraat	12,559
9	Manual	Martin Luther Kingweg	32,880

As can be seen from the de WADT of every counter, the section with the most congestion is Van 't Hogerhuysstraat after Saramacca Bridge and all the way to Molenpad, where some of the traffic is scattered to alternative roads. In this section, WADT reach more than 50,000 vehicles daily.

The traffic has the following composition:

- **Private cars and motorcycles:** 93%
- **Heavyweight trucks:** 3%
- **Others:** 4%, mainly public transport and motorcycles

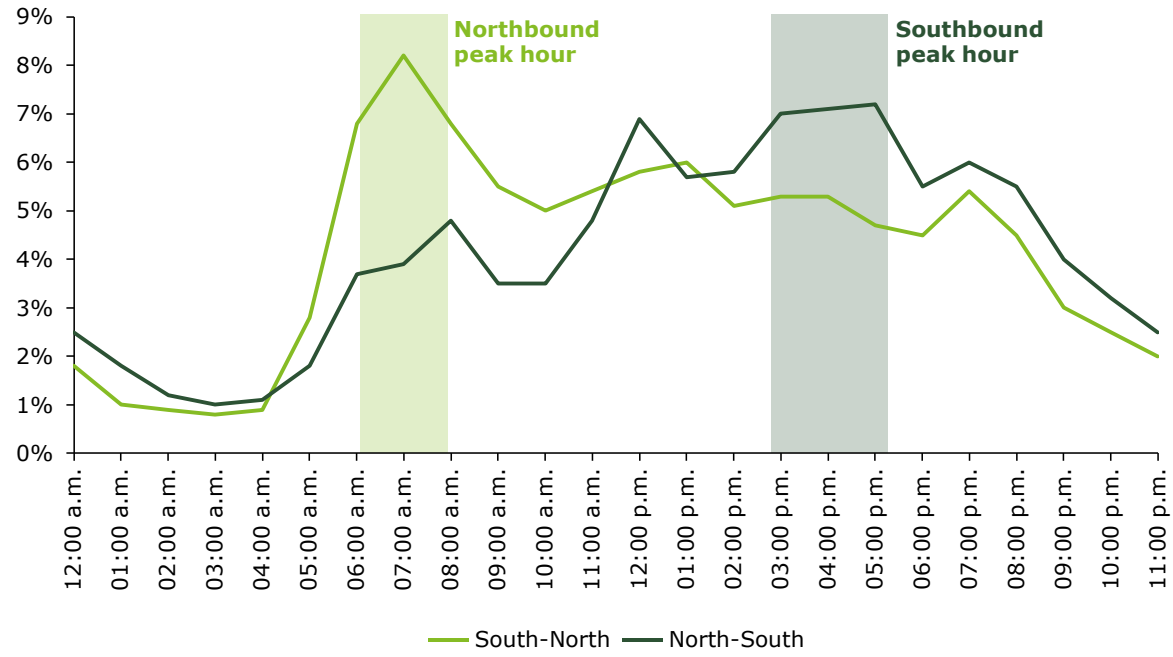
Some particularities of the analyzed roads are the following:

- Van 't Hogerhuysstraat has external lanes in each side of the road for motorcycles while other vehicles use internal ones. Pedestrian activity was observed, but it's marginal in access roads.

- Saramaccabrug, connecting Martin Luther Kingweg and Van 't Hogerhuystraat doesn't have the capacity to withstand heavy traffic, thus making trucks to take detours that delay their trips.
- Illegal parking in some of the internal roads of the access roads to the port and on the proximity of the Historical Center of Paramaribo can also cause congestions or delay traffic.
- Current traffic lights are being manipulated by transit police at the morning peak hour

Analysis of the data from pneumatic counter allow identify the maximum demand hour (Peak hour). Peak hour was identified from 7:00 to 8:00 on traffic headed north.

Daily Traffic Profile per Direction
Percentage of daily traffic per hour, 2018



Source: Pneumatic and manual traffic counts, Paramaribo, 2018.

The morning traffic has high volumes from 6:00 to 9:00 hours is caused for trips with purpose work and/or studies, generated in housing areas at south of Paramaribo with destination the center of the city.

To this traffic, we had to add transports heading to the port and other industrial areas nearby that creates further congestions.

There is another peak time with lowest intensity from 16:00 to 17:00 hours on the opposite direction (traffic headed south), due return to home from work and/or schools. However, this traffic is distributed in a larger time interval, which cases that the peak is not as accentuated for southbound traffic.

Peak hour traffic was estimated from the counts of videos of 20 minutes over the main intersections of the network. A factor of 4.012 was used to expand the data to an hour. This factor was estimated based on the analysis of manual traffic counts. Data from other studies contracted by IDB was included to improve analysis.

Next figure shows the traffic flows for all movements in the intersections of study at peak hour.

Counter No.	Location	Peak Hour (no. vehicles)
1	Van 't Hogerhuysstraat/Jules Wijdenboschbrug roundabout	3,997
2	Van 't Hogerhuysstraat/Willem Campagnestraat intersection	4,886
3	Van 't Hogerhuysstraat at the exit of the port	3,622
4	Willem Campagnestraat/Hernhutterstraat intersection	5,152
5	Martin Luther Kingweg/Latourweg intersection	3,615
6	Molenpad/Van 't Hogerhuysstraat intersection	2,883
7	Van 't Hogerhuysstraat after the Saramacca Bridge	3,486
8	Slangenhoutstraat/Hernhutterstraat intersection	2,198
9	Saramaccastraat/Zwartenhovenbrugstraat intersection	2,833

As it can be seen, the roads attend from 2,000 to 5,000 vehicles per hour in all movements. The locations with most traffic are located in Van 't Hogerhuysstraat at the vicinity of the port, which ranges between the 4,000 and 5,000 vehicles.

The most important movement is northbound direction with an average of 1,800 vehicles.

Directional flows

Additional to all the estimation of the total traffic flows in the roads, we have elaborated an analysis on the directional traffics in the eight main intersections in the peak hours. As stated previously the analysis of the drone flights that were done was done with help of specialized software.

In this section it is shown the directional traffic counts for the main three intersections, however, all the information of directional traffic was analyzed.

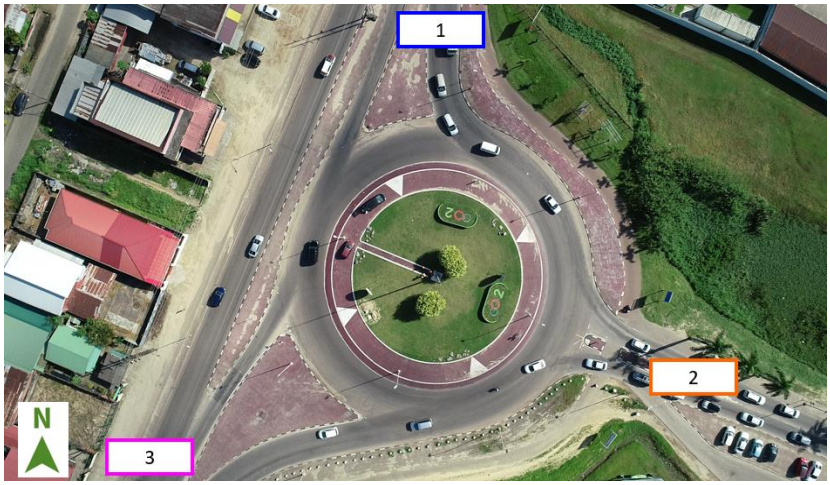
1. Roundabout Jules Wijdenbochbrug
2. Intersection Van't Hogerhuysstraat- Willem Campagnestraat
3. Roundabout of Willem Campagnestraat and Herhutter

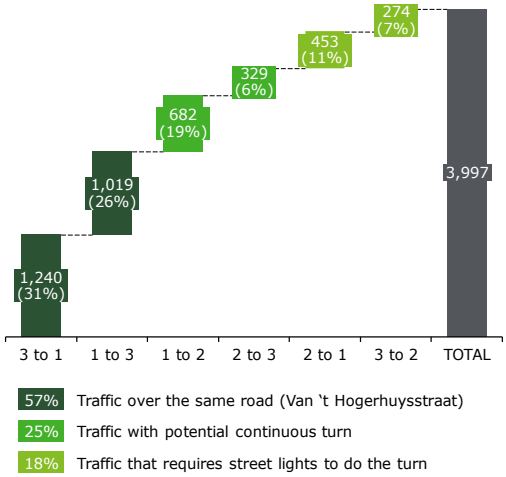
The following figures show the vehicular flow by movement that takes place at intersections. Labels in figures correspond to accesses of intersection as follows: 1) north, 2) eastern, south, and 4) west.

- **Roundabout Jules Wijdenboschbrug**

One of the main bottlenecks identified in the roads is in the Jules Widenboschbrug roundabout, located in the southbound lane of Van't Hogerhuysstraat and the bridge. In the peak hours, this intersection has a WATD of 3,997. The directional traffics are shown in the graphs below:

Directional traffic: Jules Wijdenboschbrug roundabout
Number of movements, 2018





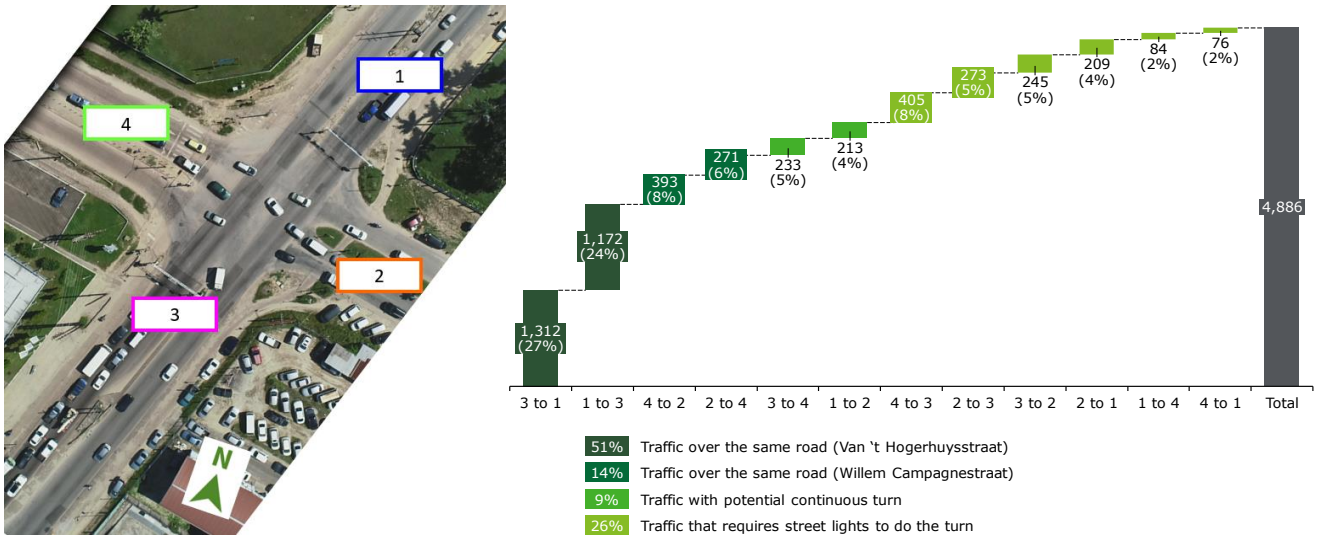
Source: Drone flight measurements, Paramaribo, 2018.

It is important to mention that Van't Hogerhuysstraat accounts for 57% of all the traffic in the intersection (2,259 movements). Furthermore, 25% of the traffic can access/ exit this road from the Jules Widenboschbrug with continuous turns.

- **Intersection Van 't Hogerhuysstraat-Willem Campagnestraat**

The second intersection analyzed is the Van't Hogerhuysstraat-Willem Campagne Straat, which has a WATD of 4,886.

Directional traffic: Van 't Hogerhuysstraat and Willem Campagnestraat intersection
Number of movements, 2018



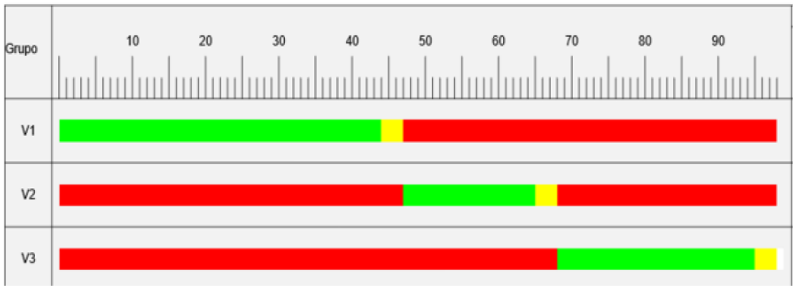
Source: Drone flight measurements, Paramaribo, 2018.

Movements over the Corridor Van 't Hogerhuysstraat (north and southbound traffic) provides 51% of all the traffic in the intersection. The rest of movements are significant lower (<400 vehicles/hour).

This is the only signalized intersections within the roads included in the scope of the study. This intersection was identified as one of the most critical bottlenecks in the physical inspections. By comparing the traffic flows and directional traffics in the intersection, it can be seen that the intersection might be improved by changing the current phases for the traffic light.

The current traffic light has a cycle of 98 seconds divided in 3 phases of green as shown in the next figure:

Semaphoric Cycle of the intersection of Van't Hogerhuysstraat and Willem Campagnestraat



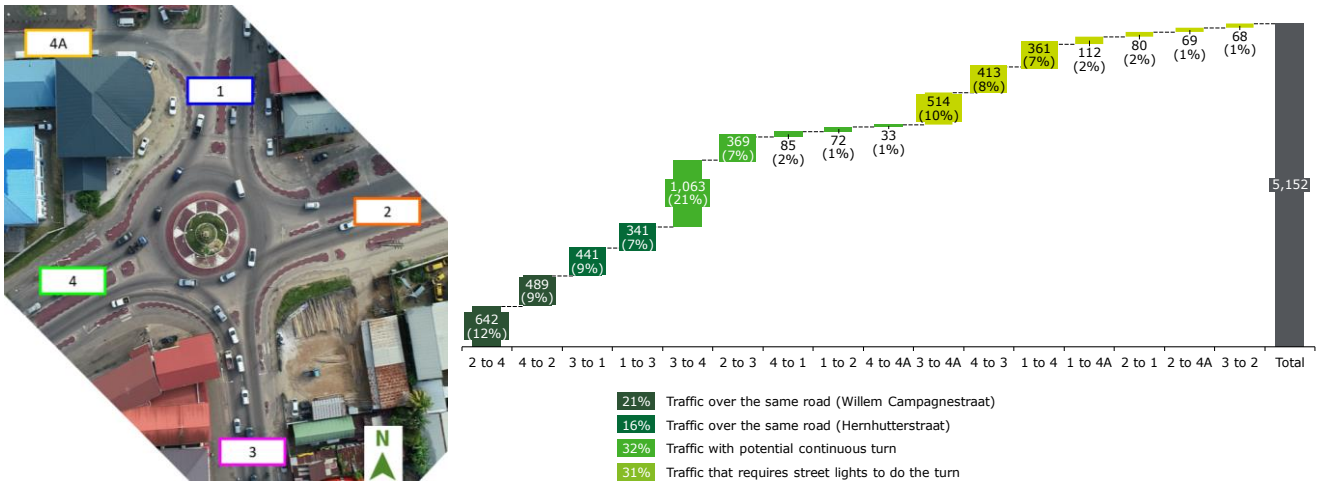
Traffic flows	% Time	% Traffic
3-1, 3-4, 1-2, 1-3	48%	60%
1-4, 3-2	21%	7%
2-1, 2-3, 2-4, 4-1, 4-2, 4-3	21%	33%

The analysis shows that traffic lights phases are uncoordinated with the traffic volumes, generating queues over Van 't Hogerhuysstraat and Willem Campagnestraat. As it can be seen in the previous chart, the V1 phase has 47% of circulation time and 60% of the volume, while the V3 phase has 21% of the circulation time (green and amber) and only 125 of the volume.

- **Roundabout of Willem Campagnestraat and Hernhutterstraat**

The last analyzed intersection is the roundabout of Willem Campagnestraat and Hernhutterstraat. The current operation of this intersection contributes to log traffic jams located over Hernhutterstraat.

Directional traffic: Hernhutterstraat and Willem Campagnestraat intersection
Number of movements, 2018



Source: Drone flight measurements, Paramaribo, 2018.

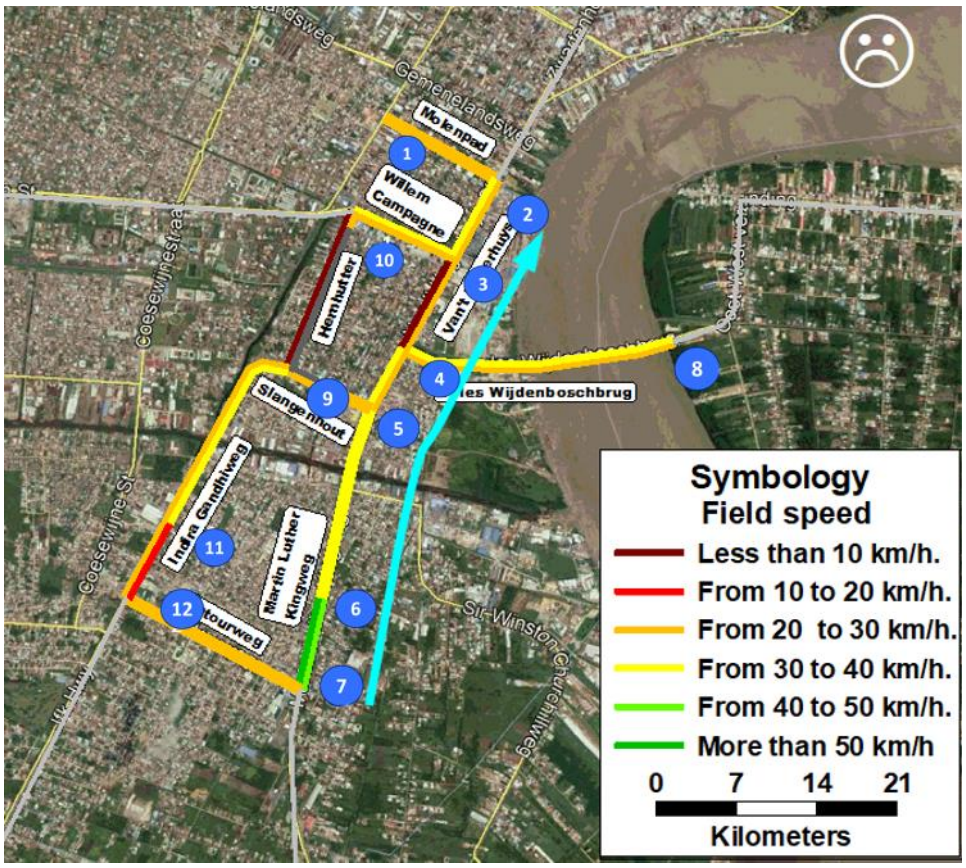
The main movements in this intersection are coming from south to west (3 to 4) and north (3 to 4a, and 3 to 1) accounts for 30% of all the movements. Some of these traffics are rerouted to this road due to the congestion and/or limitations over Van 't Hogerhuysstraat. Hernhutterstraat circulation is mainly northbound, but in this section there is a dedicated lane for north-south-movement to access Kankantriestraat, which adds friction to the vehicles that circulate in the roundabout.

Other main movements are east-west (2 to 4) and vice versa (4 to 2) that accounts fro 16%

Speed in the network

The study road network was divided into 12 sections due to speed or geometrical changes in the corridors of study.

The average speed of the study road network is 29 km/hr. The section 4-3 and 9-10 located in Van't Hogerhuysstraat and Hernhutter Straat respectively, have speeds lower than 10 km/hr because the traffic volumes exceeds the capacity of the roundabouts.



As vehicles moves towards the urbanized areas, congestion worsens and the average speed decreases. Specifically, Hernhutterstraat presents the lowest average speeds for vehicles before reaching Willem Campagnestraat as well as the Van 't Hogerhuysstraat section before arriving to Dr. Jules Sedney Terminal entrance. Also, Jules Wijdenboschbrug presents a moderate speed when heading to Van 't Hogerhuysstraat that will eventually decrease if vehicles keep going north.

4.2. Parameters for the simulation of the current situation

The previous data has been used to construct a simulation of the roads, in order to have a better understanding of the bottlenecks in the operation.

The VISSIM software was used to analyze the operation conditions of the transit system. Developed by PTV firm, this is a state-of-the-art software used in international practice, the advantages it offers are: possibility of assigning the use of lanes for different modes of transport, for example, the use of bicycle lanes, managing driver behavior and implementation of various traffic control systems.

Besides, VISSIM allows the evaluation and planning of urban and interurban infrastructure using current versions of international traffic manuals, such as the Highway Capacity Manual (HCM).

The main parameters that have been considered for the design of the simulation include the following.

4.2.1. Modeling periods

The model simulates under peak hour because it must plan and design under critical conditions, allowing estimate with a high level of precision the impact of proposed interventions. This analysis was carried out from 7:00 to 8:00 in the morning in a weekday.

4.2.2. Network coverage

The microsimulation network is integrated by roads mention previously. Complementary roads have been integrated to represent inputs and / or exits of flows originally not included.

The main roads incorporated into the network are the following:

- Zwartenhovenbrug Straat
- Saramacca Straat

- Johan Adolf Pengel Straat
- Kankantrie Straat
- Calcutta Straat
- Jules Wijdenboschbrug
- Oud Pan Wanica
- Indira Ghandiweg
- Local streets in Hernhutter Straat and Martin Luther Kingweg

Additionally, it was included entrances and exits of the port and some internal roads and parking areas around the port. Next figures show the network considered for this analysis.

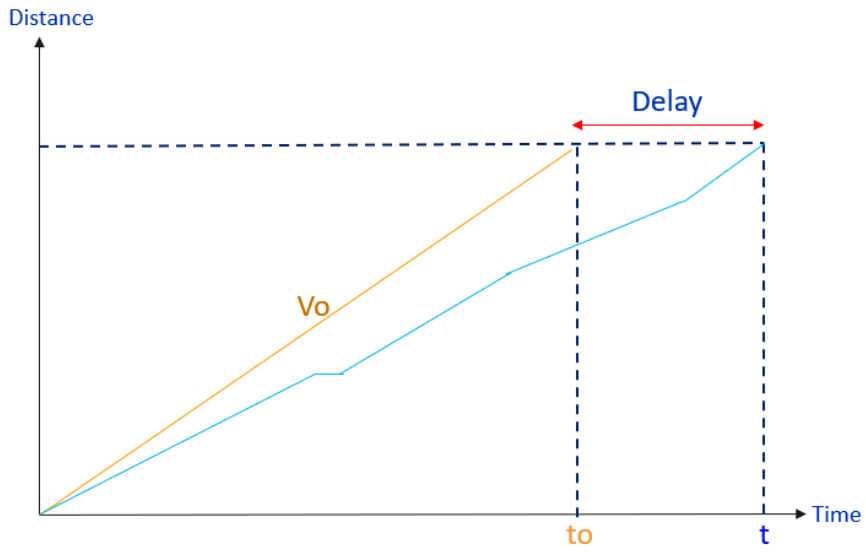
4.2.3. Performance metrics

The development and calibration of the model focuses mainly on achieving the representation of reality on a simulation platform (software) to test the conditions in two scenarios (current situation and with proposed interventions). The following metrics were considered for the analysis:

- **Speed road**: Arithmetic mean of the speeds of all vehicles that at a given moment are within a specific stretch of road

- **Travel times:** Travel-time analysis describes the amount of time it takes to get from one point to the next. Traffic volumes, traffic control devices, signal timing, and delay are all elements that affect actual travel time. Vehicular travel time is measured by driving a route with the regular flow of traffic and timing the duration of the trip.

- **Magnitude of the delay:** Delay is defined as the excess time consumed in traversing a distance at a speed lower than speed of a free flow (Vo) that operates of vehicle under conditions without congestion, as show in figure. Delay is a measure that most directly relates driver´s experience.



- **Level of service:** The Level of Service (LOS) represents a measure of satisfaction of the user in the intersections given by the average delay of all movement of all the movements that interact in it.

- **Queue lengths:** The Highway Capacity Manual, HCM (2010), defines a Queue as: A line of vehicles, bicycles, or persons waiting to be served by the system in which the flow rate from the front of the queue determines the average speed within the queue. Queues are formed when the arrival rate is higher than the service rate.

4.3. Microsimulation of the current situation

The Consultant have elaborated a model with the data gathered during the technical visit, which have been validated with information from previous studies. This microsimulation has been calibrated with the observations on site in order to effectively represent the operation of the road system. As a result, the Consultant have delivered the microsimulation as well as a video that shows the current situation of the roads, included in the ***Annexes***

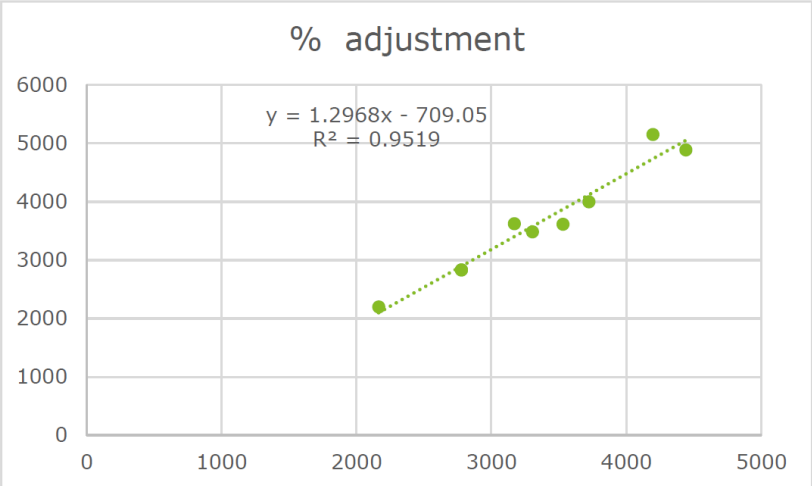
Annex 1: Video of the microsimulation of the current situation.

The performance metrics have been evaluated in the current situation's microsimulation.

4.3.1. Calibration of the model

The model was calibrated to ensure that the traffic flows within it were consistent with the volume obtained from the data collection. The most used parameter to measure the adjustment degree of the model is the R^2 parameter. Values of R^2 closer to 1 will mean that the adjustment is adequate.

The microsimulation model was calibrated with a R^2 value of 0.95, which indicates a correct representation of the current situation of the corridor. The next figure shows this adjustment:

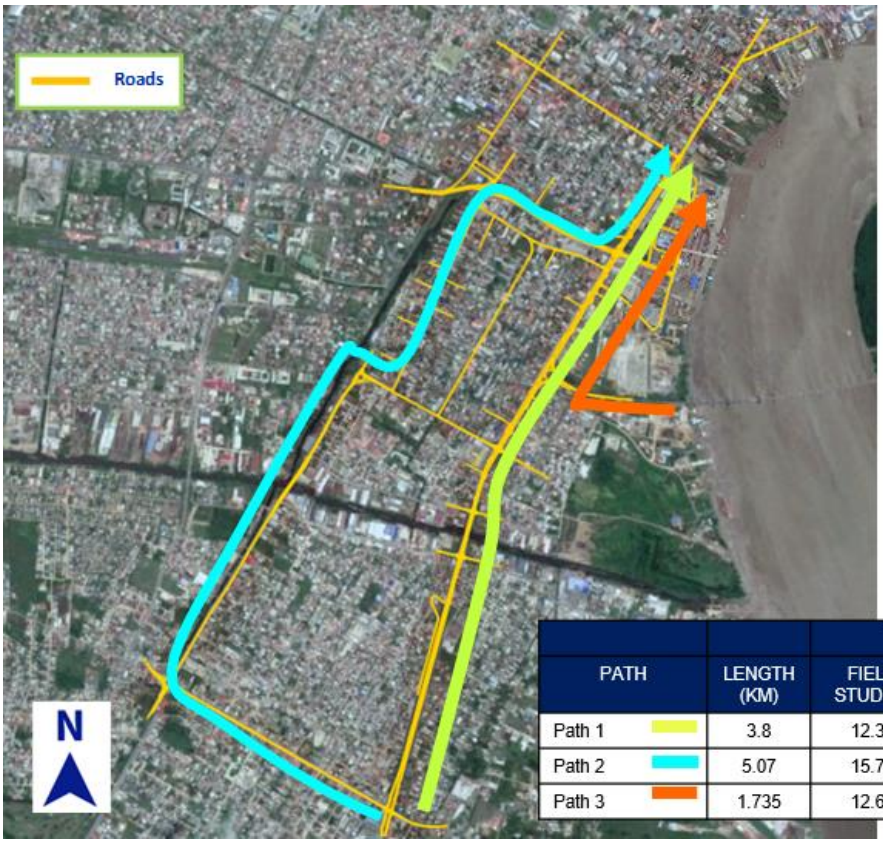


4.3.2. Travel times

The travel times were calibrated comparing speeds measured in the field, against the ones estimated by the model to ensure that the model correctly represents the observed conditions of the network. As an example, these are three possible routes in the peak hour:

- **Route 1 -** Martin Luther Kingweg (intersection with Latourweg) to Van 't Hogerhuysstraat (intersection with Molenpad): This route is used for urban traffic coming from the south to Paramaribo's center.
- **Route 2** - Latourweg-Indira Gandhiweg-Slangenhout-Hernhutter-Willem Campagne Straat - Van 't Hogerhuysstraat -Molenpad: This route is used for urban traffic coming from the south-east to Paramaribo's center, as well as all heavy vehicles coming to the port, which are detour due to the weight restrictions of the current bridge.
- **Route 3** - Jules Wijdenboschbrug - Van 't Hogerhuysstraat (intersection with Molenpad): This route is used for urban traffic coming from the west to Paramaribo's center.

Next table and figure shows the analysis for 3 routes that illustrate this process:



PATH	LENGTH (KM)	TIEMPO (MIN) FIELD STUDIES	TIEMPO (MIN) MODEL
Path 1	3.8	12.33	14.15
Path 2	5.07	15.72	14.06
Path 3	1.735	12.68	12.34

	Path	Speed (km/hr)		
		Field Measure	Modeled	% Error
1.	Martin Luther Kingweg (intersection with Latourweg) to Van 't Hogerhuysstraat (intersection with Molenpad)	18	16	9%
2.	Latourweg-Indira Gandhiweg-Slangenhout-Hernhutter-Willem Campagne Straat- Van 't Hogerhuysstraat-Molenpad	19	22	15%
3.	Jules Wijdenboschbrug - Van 't Hogerhuysstraat-Molenpad	8	8	2%

However, it is important to mention that, although travel times form the routes range from 8-22 km/h, there are sections where speed average declines to less than 10 km/h (i.e. Van 't Hogerhuysstraat between Jules Wijdenboschbrug and Willem Campagne Straat).

4.3.3. Level of Service (LoS)

The main indicator to estimate the LoS at an intersection is the magnitude of the delay. The shorter the delay, the better. Categories of delays chan change from signalized to unsignalized intersections. The next tables show classification of LoS based on the delay for both intersection types:

Level of Service Criteria for Unsignalized Intersections	
Level of Service	**Control Delay (sec/veh)**
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

Level of Service Criteria for Signalized Intersections		
Level of Service Average	**Control Delay (sec/veh)**	**Description (Signalized Intersections)**
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasional delay for more than a cycle[5])
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

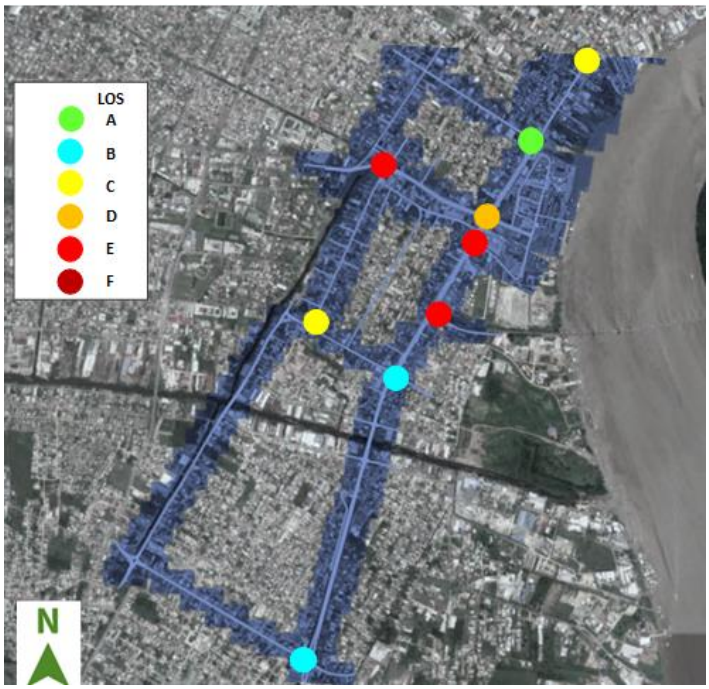
Currently the network has eight unsignalized intersections and only one that is signalized.

Based in the analysis performed with the microsimulation model for the main intersections, the conclusions are:

[5] Semaphoric cycle: Time that takes a complete sequence of all signal indications of a traffic light.

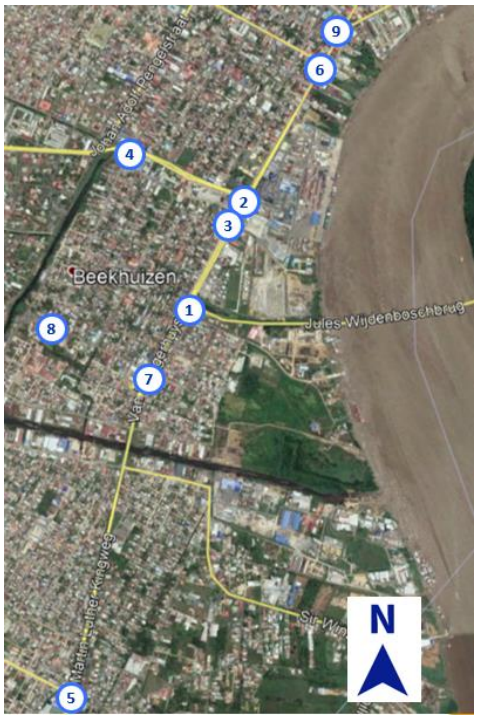
- Three intersections are at level of service E which indicate delays in travel time not acceptable to users due that demand overpass the capacity of the intersection. These intersections are located in the adjacent roads to the port.
- One intersection is at level of service D. This node corresponds to the only signalized intersection and is at the limit of user acceptance.
- Two intersections are at level of service C.
- Two intersections are at level of service B which are located at the south end of the system.
- One of the intersections is at level of service A, due to the traffic jams located in the previous intersection.

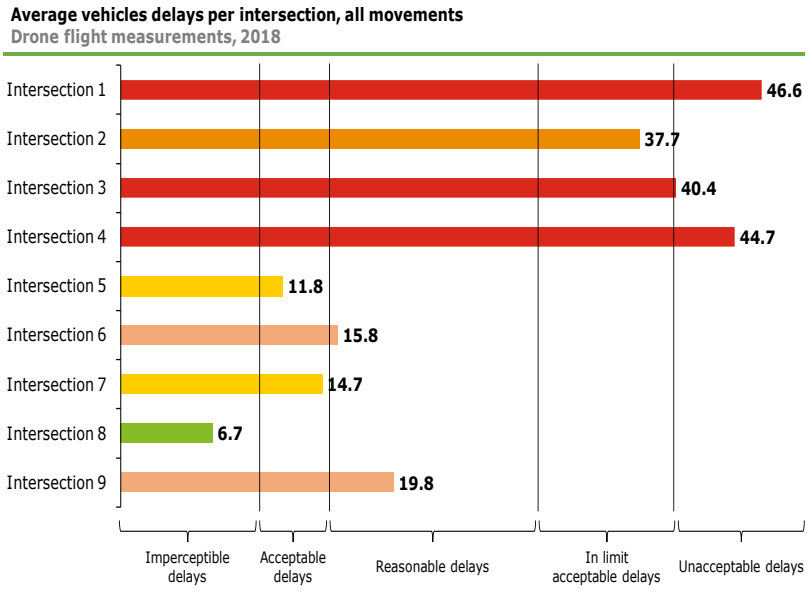
The levels of service A and B, means for the user is travelling through the intersection without major delays.



4.3.4. Delays

Next table and figure shows average delay for all movements per intersection in the current situation





- Intersections 1,3 and 4 present delays bigger than 40 seconds. This means that vehicles that are in the middle of the vehicles queue must wait half minute on average to cross the intersection.
- Intersection 2 has a delay of 37.7 seconds average for all movements that provoked that cars keep accumulating generating significant queues.
- These 4 intersections are the bottleneck of the system of study. The proposed alternatives will be focused in this area.
- The other intersections present delays with a range of 6 to 20 seconds. For drivers these magnitudes are acceptable detentions.

4.3.5. Queue length

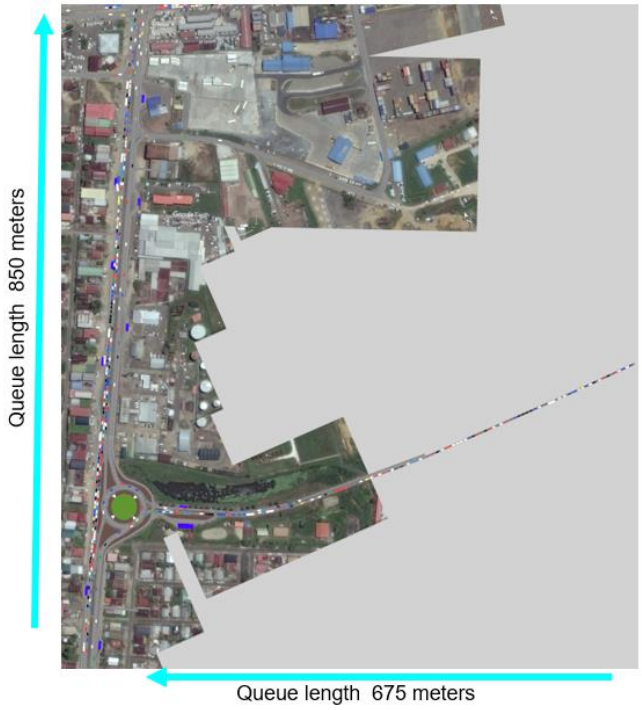
The maximum queue length it is an indicator of capacity of the intersection to clear its vehicular flow.

The critical queue lengths presented in the model are:

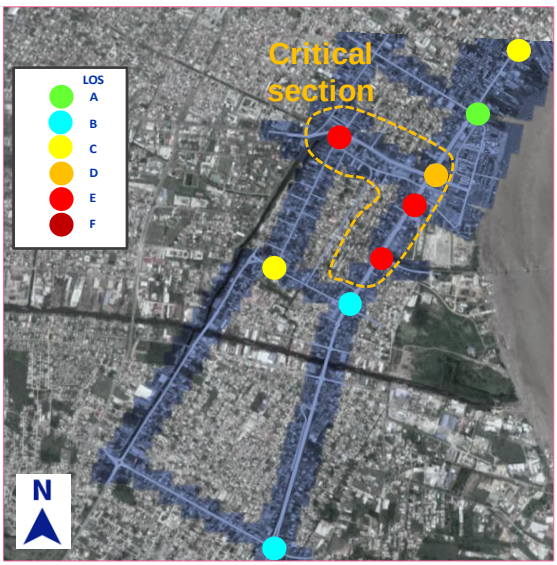
- At the intersection of the Van't Hogerhuysstraat and Willem Campagnestraat (intersection 2)
  - There is a queue length of 850 meters in Van't Hogerhuysstraat.
  - The queue length in Jules Wijdenbochbrug is 675 meters.

- At the roundabout Poelepantje (intersection 4)
  - There is a maximum queue length of 965 meters in Hernhutterstraat (The length of the street is 1.08 kilometers)
  - In the same intersection, the queue length is 236 meters in Willem Campagne Straat

Next figures show the queue length for intersection 2 and 4



According to these, it might be concluded that the most critical intersections are located in Van 't



In these intersections, demand overpassed the capacity making unacceptable delays, that impacts in speeds lower than 10 km/hr that creates queue lengths that exceeds 500 meters of length in the most charged direction. Therefore, the propos interventions will be focused in the main intersections.

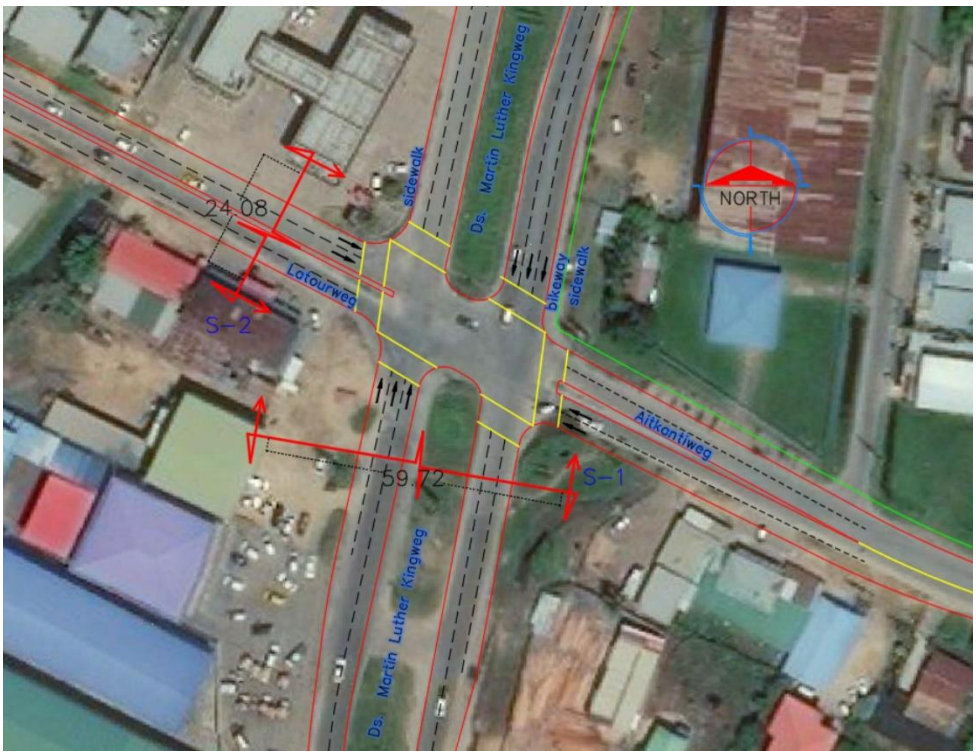
4.4. Proposed road interventions

To alleviate current congestions, and prepare the road network for future traffic increase, different types of interventions were presented and discussed with the project's stakeholders (i.e. Ministry of Public Works, Road Authority, and Port Authority). The 4 proposed interventions are:

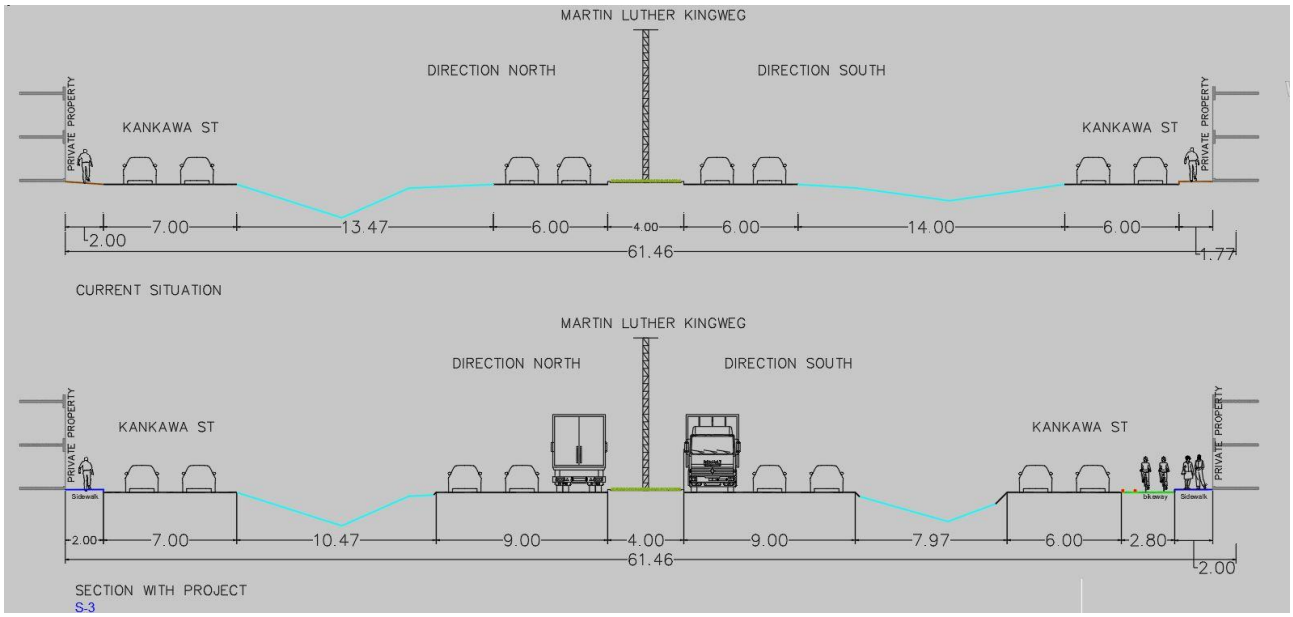
4.4.1. Martin Luther Kingweg and Van 't Hogerhuysstraat capacity expansion

The corridor comprising Martin Luther Kingweg and Van 't Hogerhuysstraat includes the studied sections with the most traffic. It is also the main route to get to Dr. Jules Sedney Terminal (except for trucks, as they have to take the explained detour) and to the Historical Center of Paramaribo for southbound vehicles.

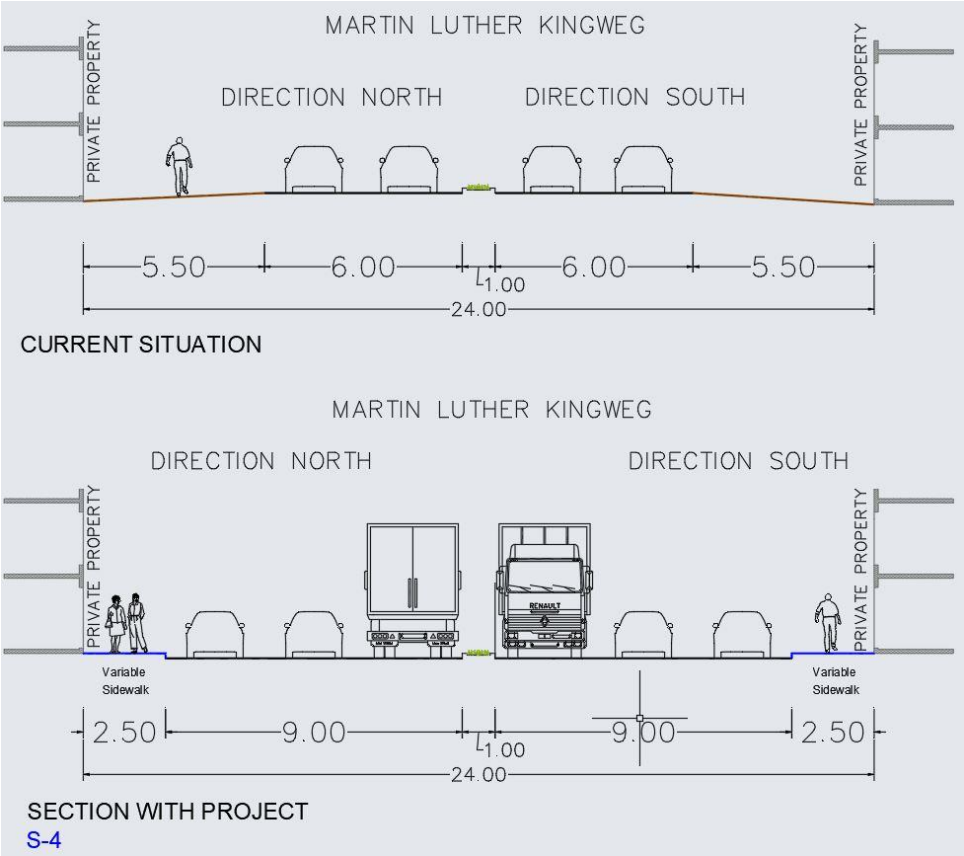
As the current situation showed, the intersections with the most congestion issues are the ones connecting Jules Wijdenboschbrug with the main road, and the intersections that lead to the port's main entrance and exit. To face this present congestion and prevent further ones in the future, a capacity expansion on the corridor is proposed from Martin Luther Kingweg and Latourweg to Van 't Hogerhuysstraat and Willem Campagnestraat. This expansion consists in an additional lane in each of the road sides, as well as some dedicated lanes to turning vehicles. The works are presented in the next images:



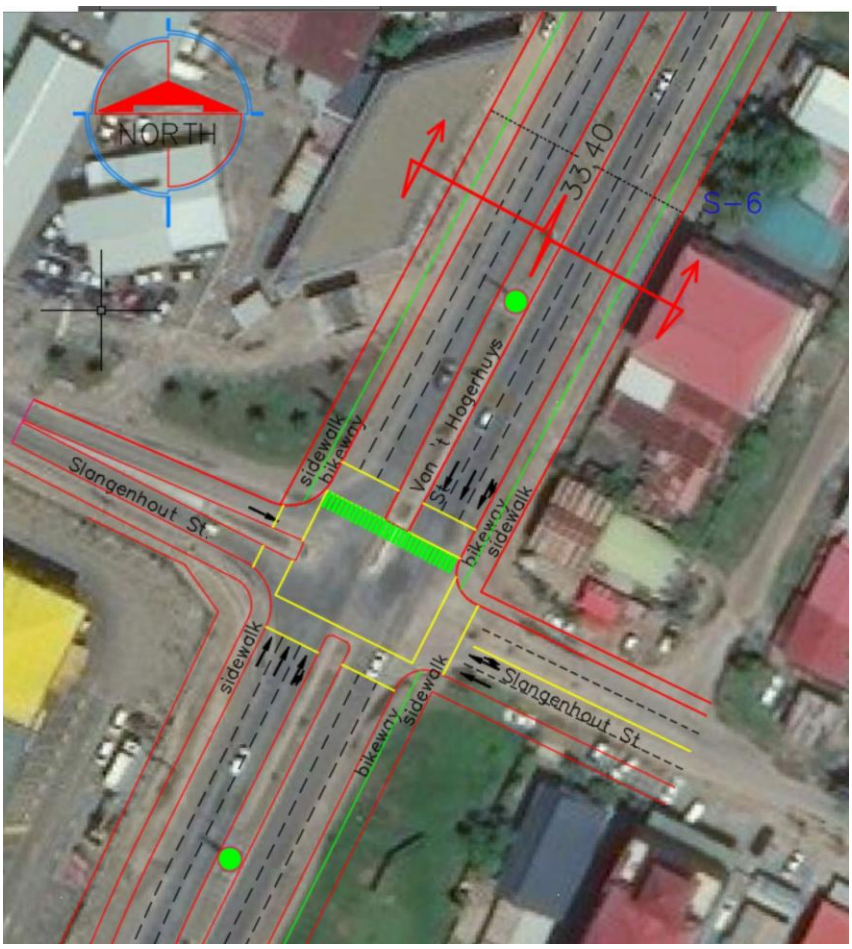
The road expansion begins in Martin Luther Kingweg after the intersection with Latourweg and Aitkantiweg. An additional lane would be made for each of the road sides; additionally, a new bikeway and sidewalks would be built.



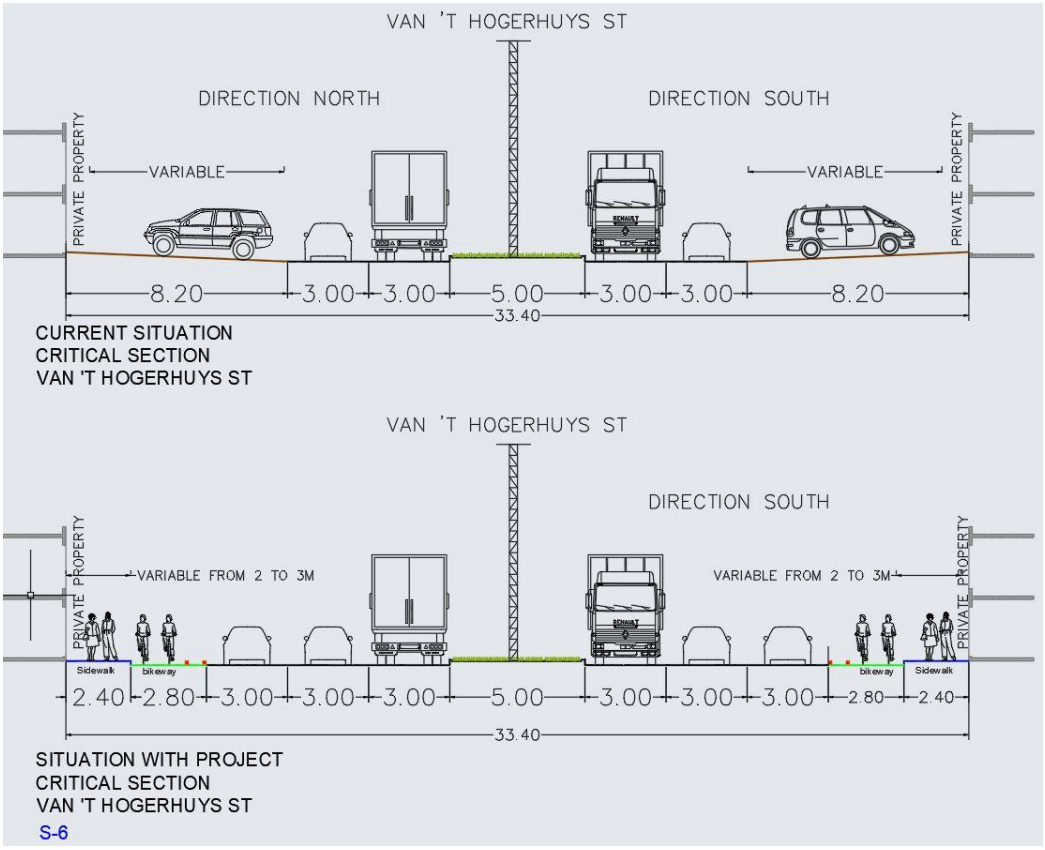
This would mean a reduction of the space between Kankawastraat reutilized for pedestrians and the bikeway.



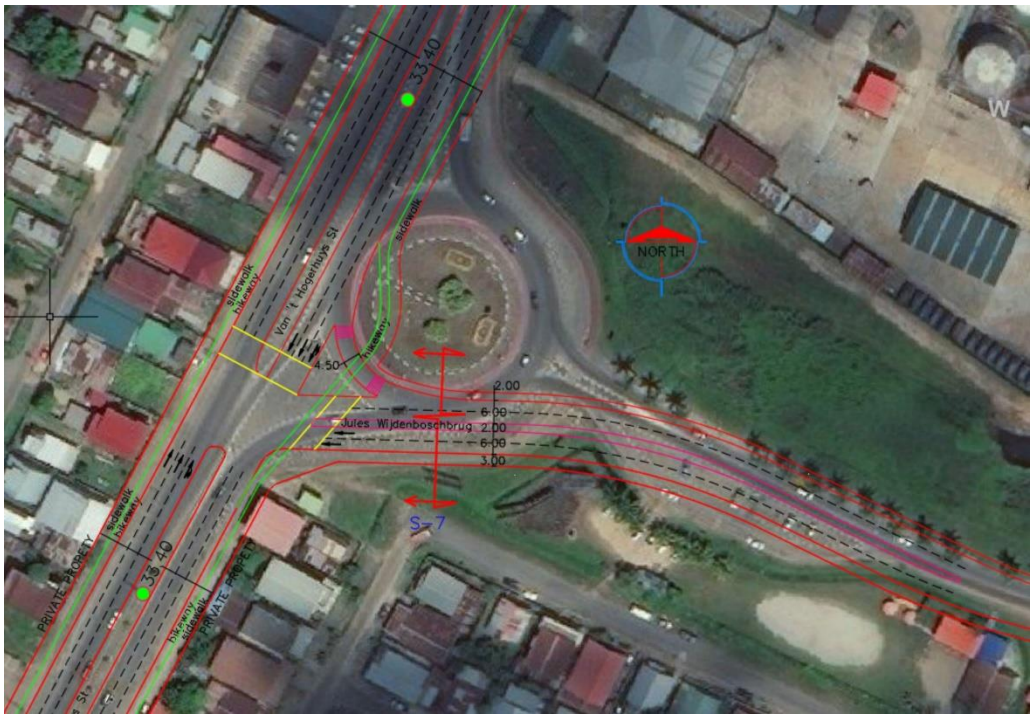
For the section approaching the Saramacca Channel, it would not be possible to make a bikeway, so only a path for pedestrians is considered.



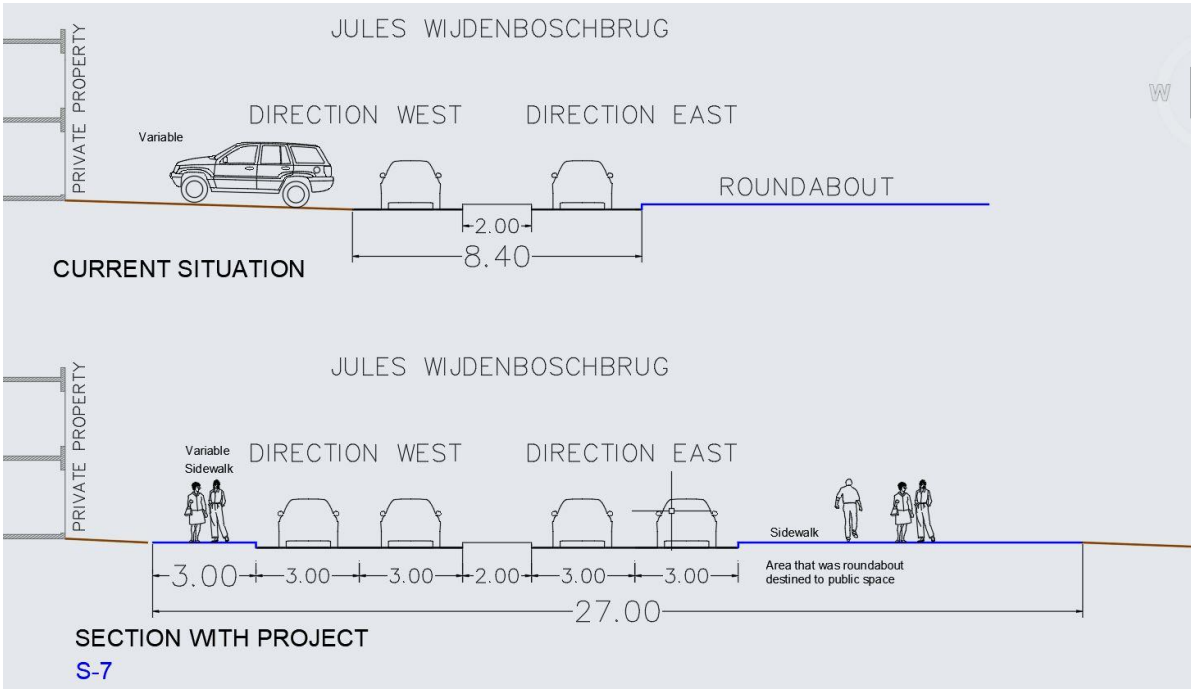
As observed, the corridor capacity expansion continues after crossing the Saramacca Channel, maintaining the additional lane, new bikeway and sidewalks for each of the road sides.



This extension will help Van 't Hogerhuysstraat to withstand the current and future traffic, as well as to have specific delimited areas for pedestrians and bikes. Currently, there is underutilized space that is private vehicles sometimes use for illegal parking.



In the case of the intersection corresponding to the roundabout for Jules Wijdenboschbrug, a geometric modification is proposed. The roundabout doesn't have the capacity to withstand the movements from and to the bridge, as the queues have shown. In addition, the intersection proves to be problematic as the movements with the most traffic are not always prioritized as shown in the diagnosis. The geometric modification consists in having direct lanes instead of a roundabout to allow vehicles to quickly incorporate on their required route, as well as an additional lane in each direction.

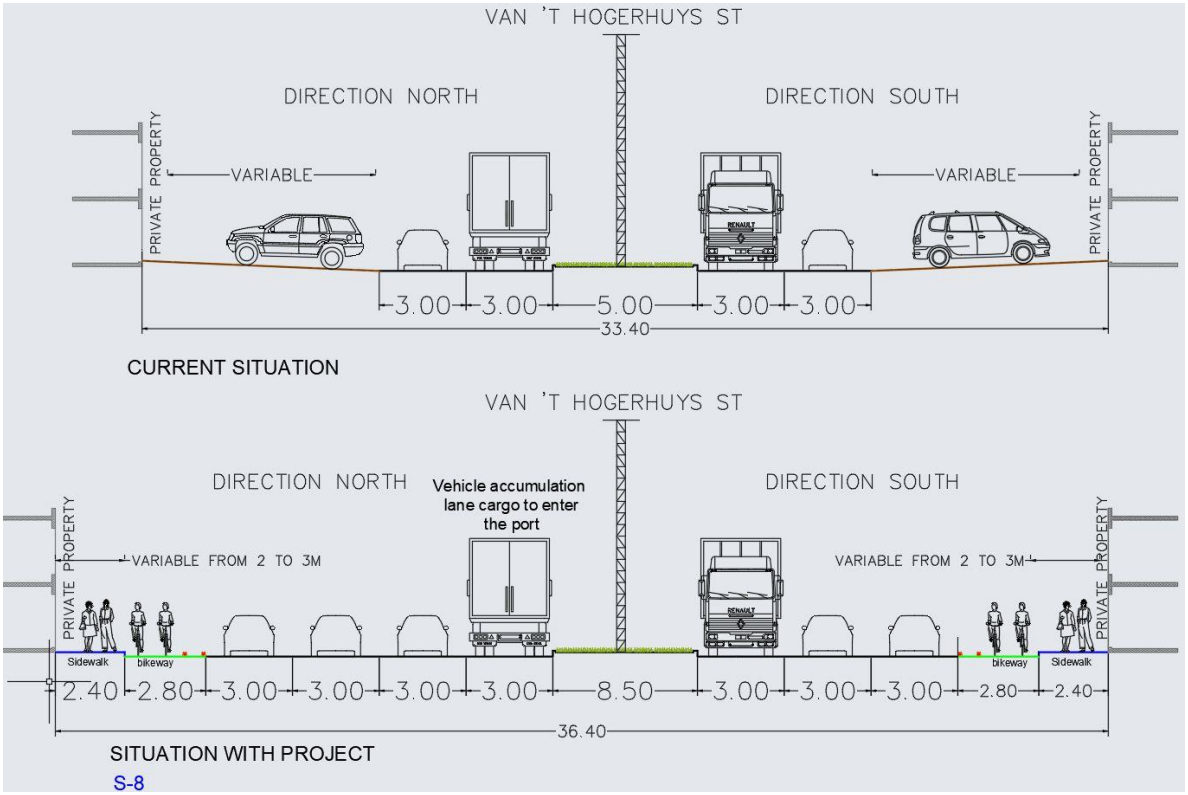


The additional lane would also have sidewalks in each side to help pedestrians move with more safety. As for the space of the roundabout, it could be recovered as a new public area for the people of Paramaribo. The public space could be used as a green area to create a king of urban park for the community. Conceptually, the next scheme presents an illustrative idea:

After the Jules Wijdenboschbrug roundabout, the vehicles approach the sections with the most congestion near the port's accesses.

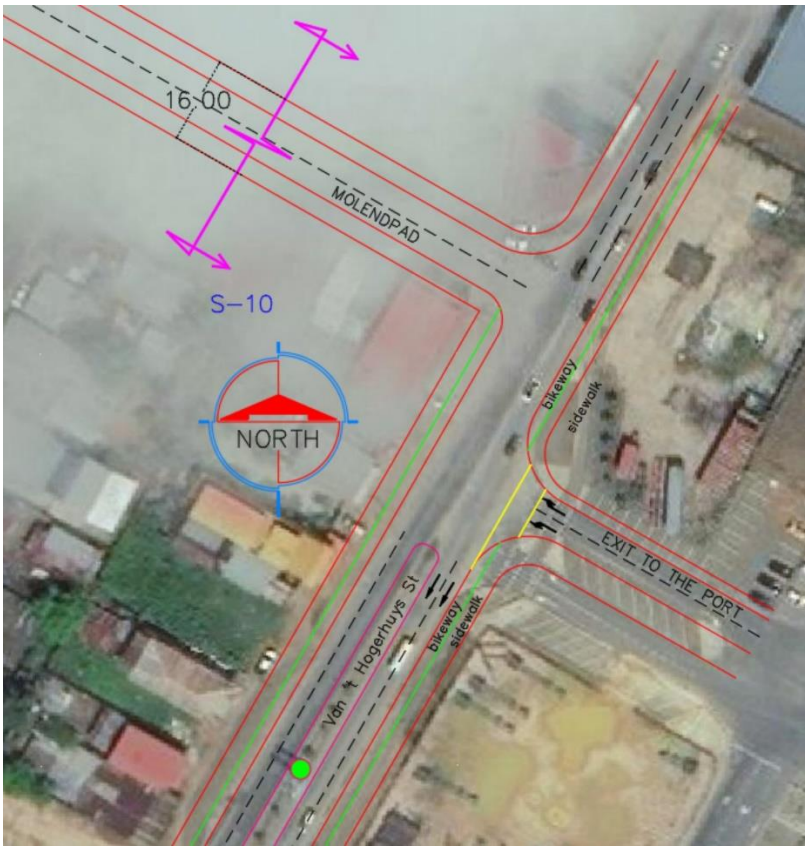
To improve the access to the port and prevent trucks to create congestion, an accumulation extra lane is proposed to allow them to enter the port using Abattoirstraat, instead of the current entrance in Havenlaan Zuid. The usage of Abattoirstraat will prevent trucks from reaching the intersection of Van 't

Hogerhuysstraat with Willem Campagnestraat, a current area with a lot of congestion, and arrive to the port before, using internal roads for their operations.

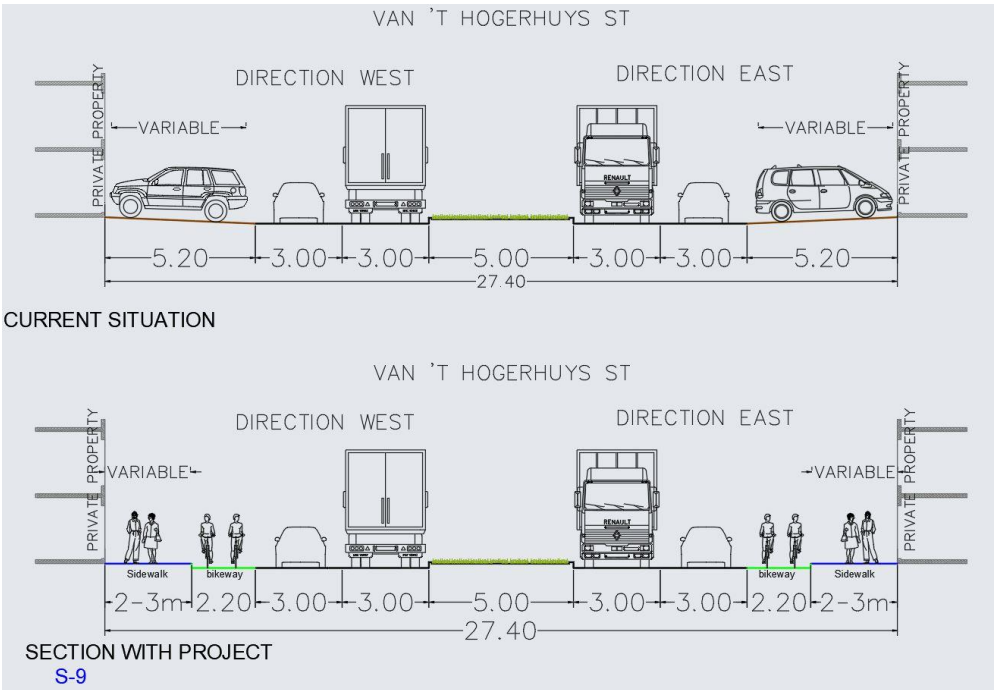


In this section, even with the additional accumulation lane it is possible to have the bikeway and the sidewalk. This accumulation lane will isolate trucks heading to the port.

The intersection of Willem Campagnestraat and Havenlaan Zuid would mainly be used by private vehicles and public transport if the new port entrance is enabled. Another accumulation lane is proposed in a small section of the road for vehicles in the intersection that goes to the south, and then head to Kankantriestraat.



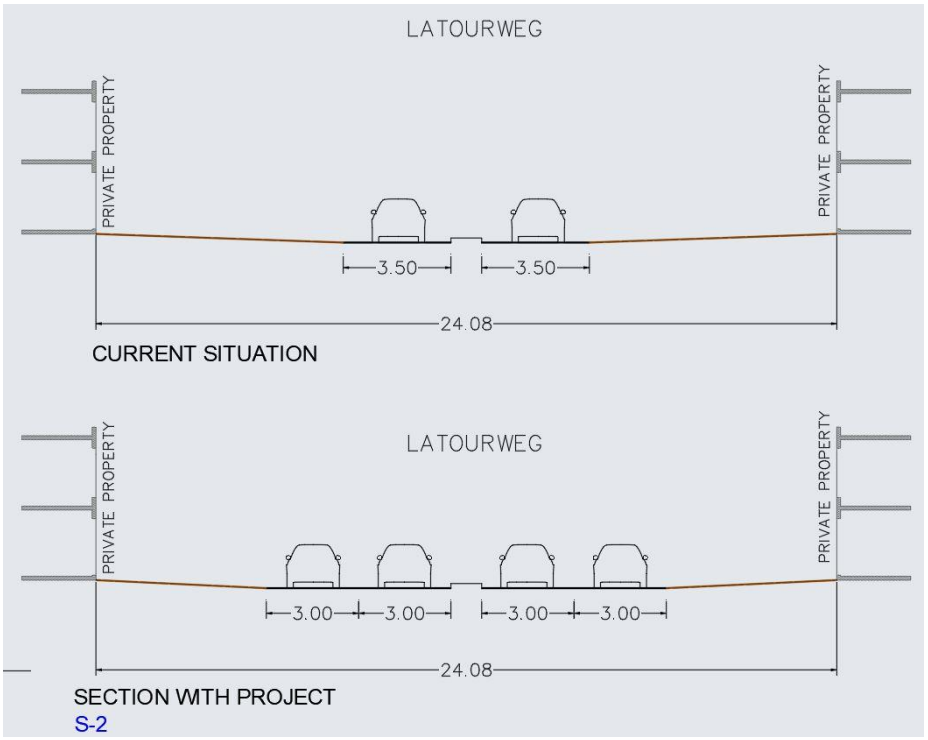
Finally, the exit of the port is proposed to be located in Havenlaan Noord, just before Molenpad. This is also the last portion of the corridor over Van 't Hogerhuysstraat to have a capacity extension. After that, the vehicles will reach Zwartenhovenbrugstraat.



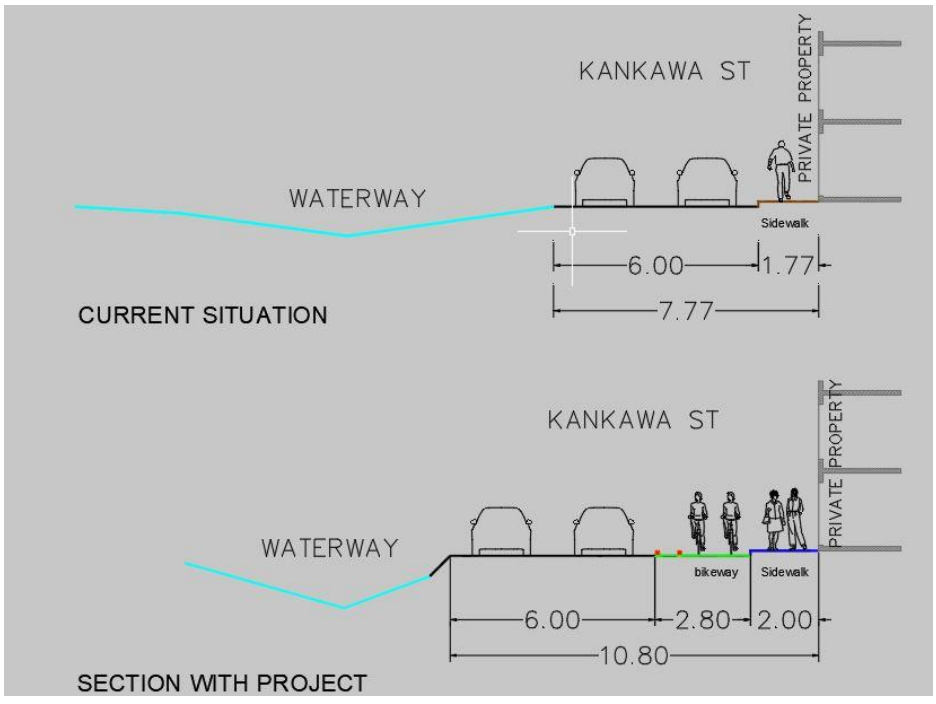
These last sections of the corridor returns to the expansion with only an additional lane, bikeway and the sidewalk for pedestrians.

4.4.2. Repaving and improvement of other corridors

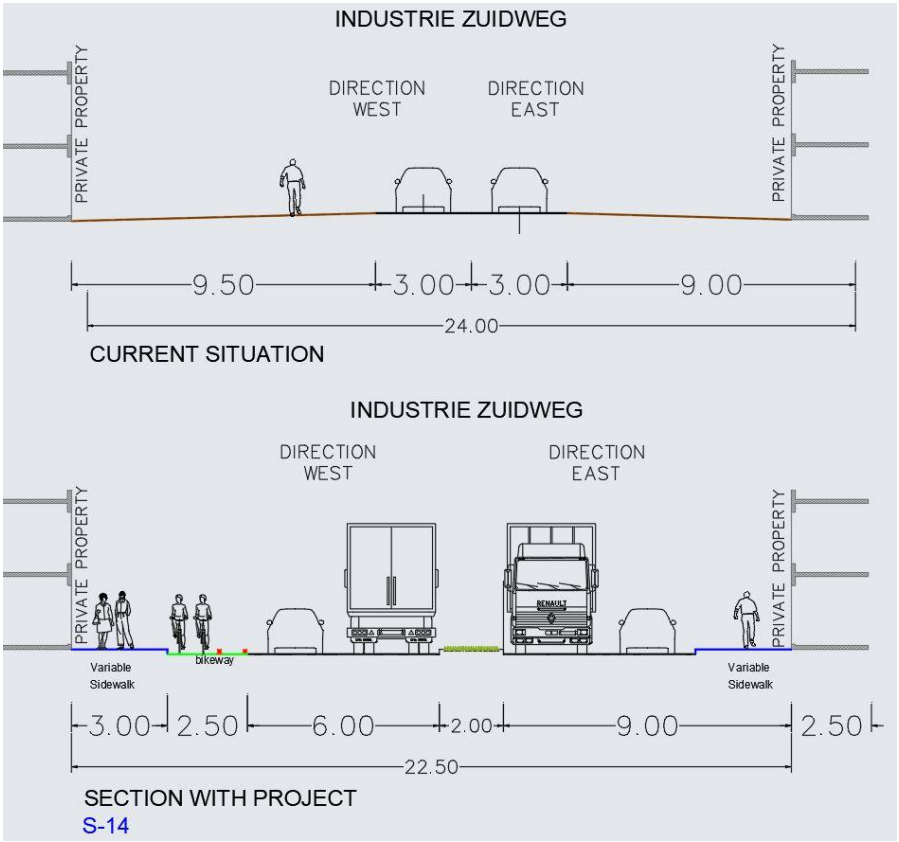
Repaving and improvement of the adjacent roads in the main corridor is also proposed in order to make circulation better and to make the network an integral project. The repaving method proposed consists on a process that includes the milling of the asphalt to ensure that the materials are evenly distributed and compacted on the roads. The roads considered for these proposal are Latourweg, Kankawastraat, Industrieweg Zuid, Slangenhoutstraat, Kankantriestraat, Molenpad, Willem Campagnestraat and Hernhutterstraat.



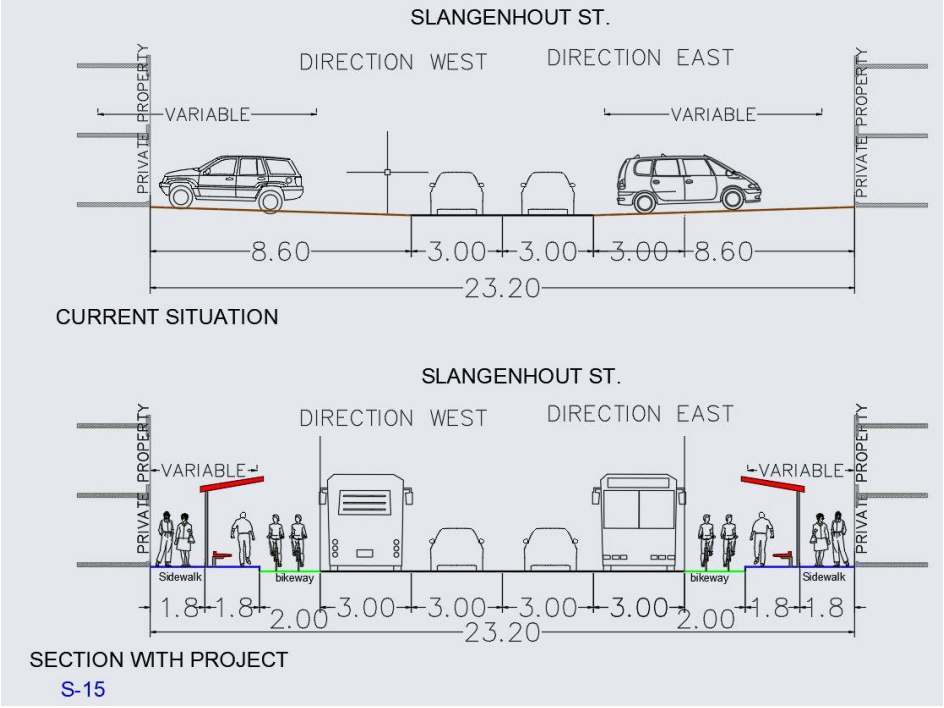
For Latourweg, a capacity extension might be feasible as there's enough space to reduce de current lane from 3.5 m to 3.0 m, and add a second one.



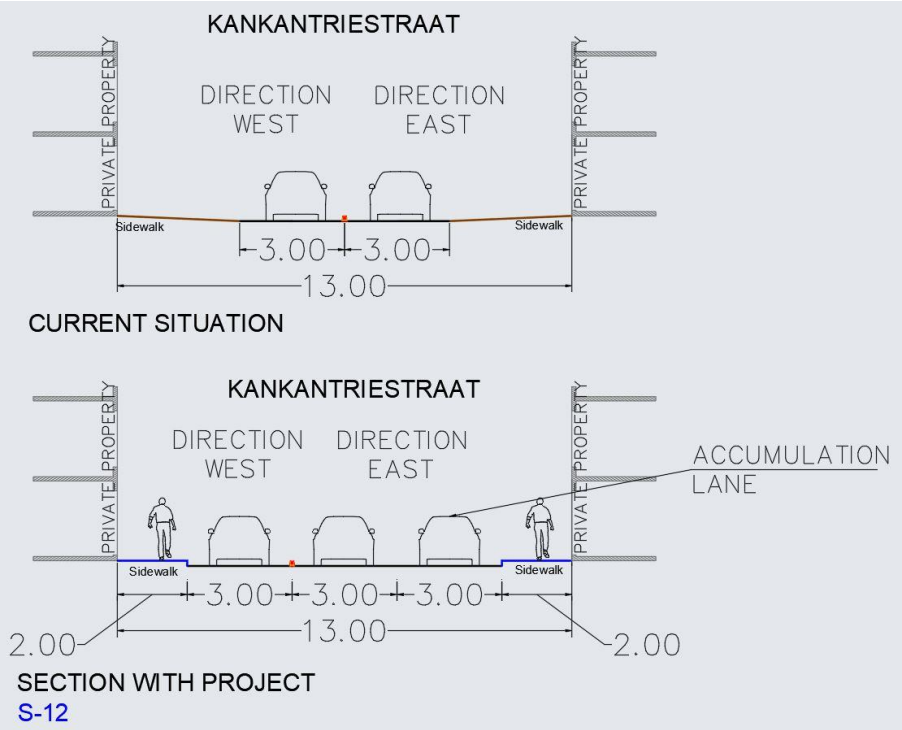
In the case of Kankawastraat the road section could be extended to make room for a bikeway and a sidewalk, giving pedestrians a specific area. The lanes would remain the same with two of 3 m each.



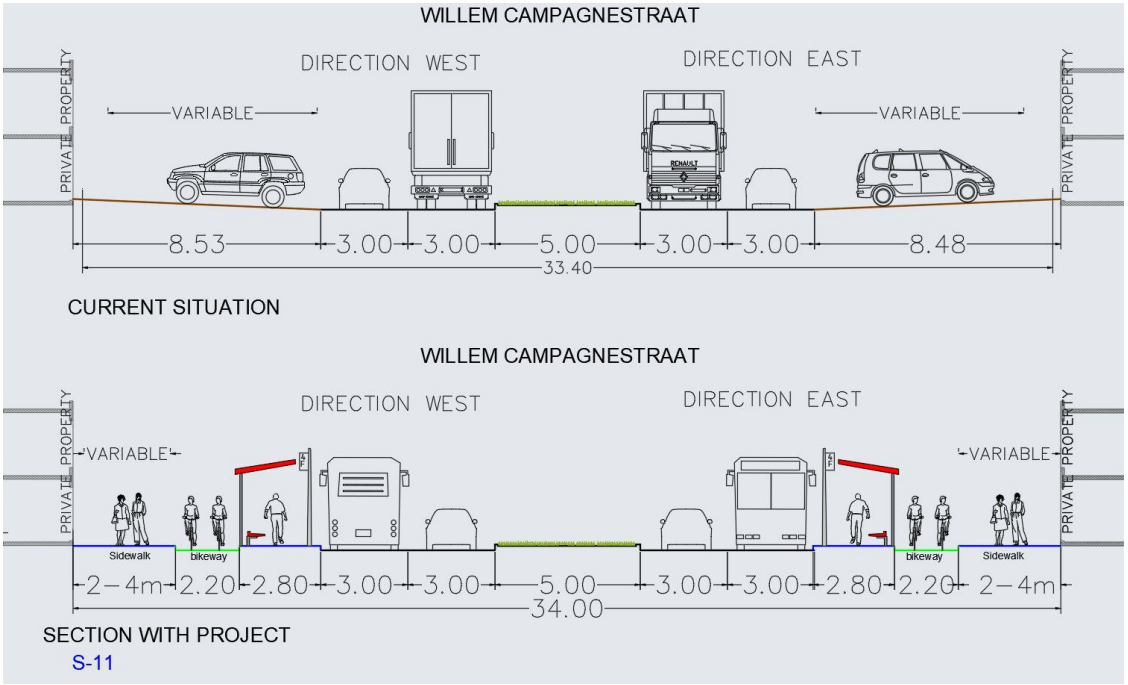
Industrie Zuidweg could also receive a lane extension at each side of the road, as well as a sidewalks and a bikeway.



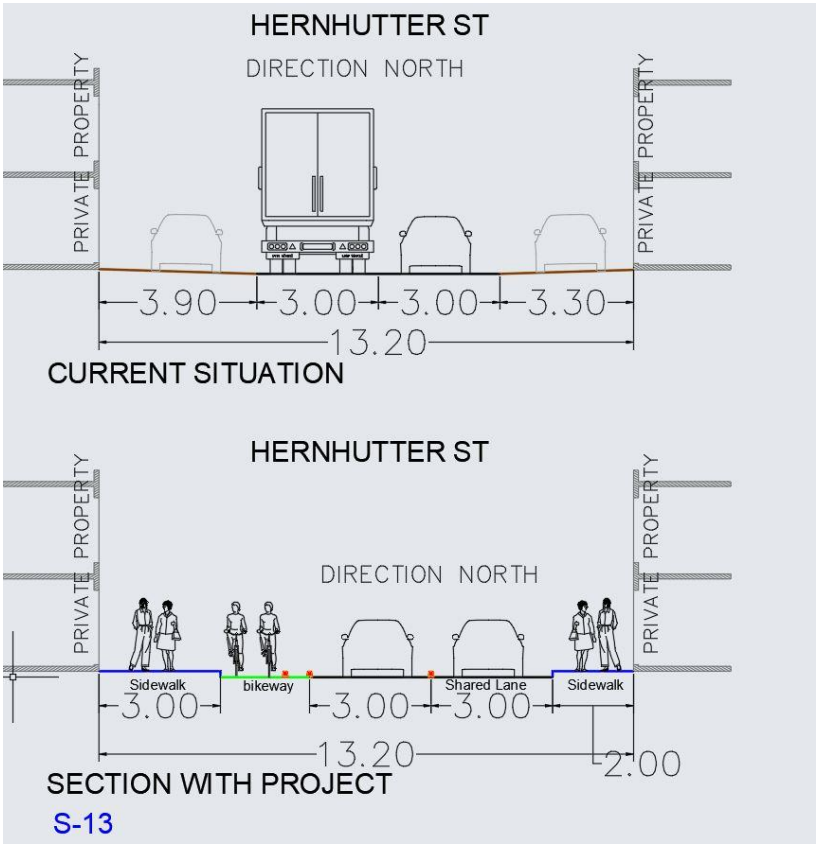
Slangenhoutstraat can have additional capacity as well by adding a lane in each way of the road. The available space allows to have, not only sidewalks and bikeways in both ways, but also a dedicated space for bus stops to protect pedestrians from the sun, and provide an organized route for the public transport.



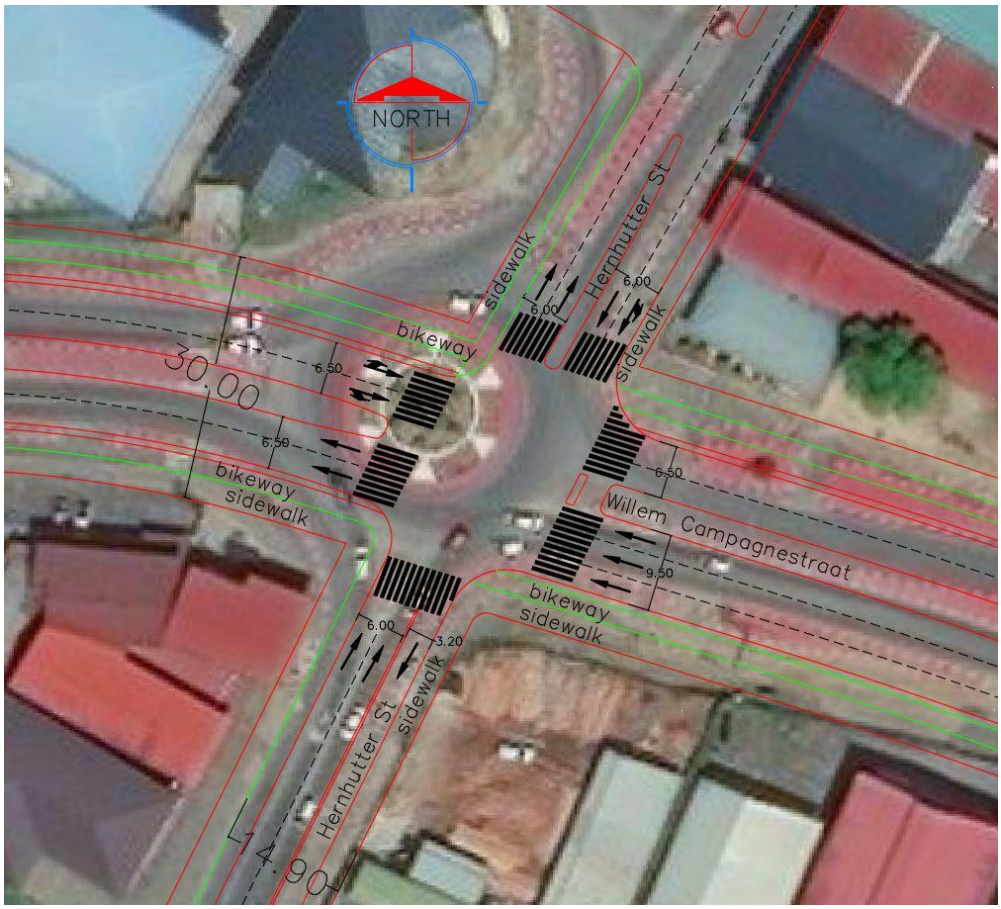
Kankantriestaat can also be improved not only with the repaving, but also with an accumulation lane for the vehicles that want to turn and head north in Van't Hogerhuysstraat. This could potentially help prevent congestion in the internal roads.



Willem Campagnestraat proposed improvements take advantage of the available space between the roads and the private property to add sidewalks, a bikeway and public transport stops for users and pedestrians to take advantage of.



Hernhutterstraat interventions would also take advantage of the available space for sidewalks and a bikeway. The lanes would remain being two.

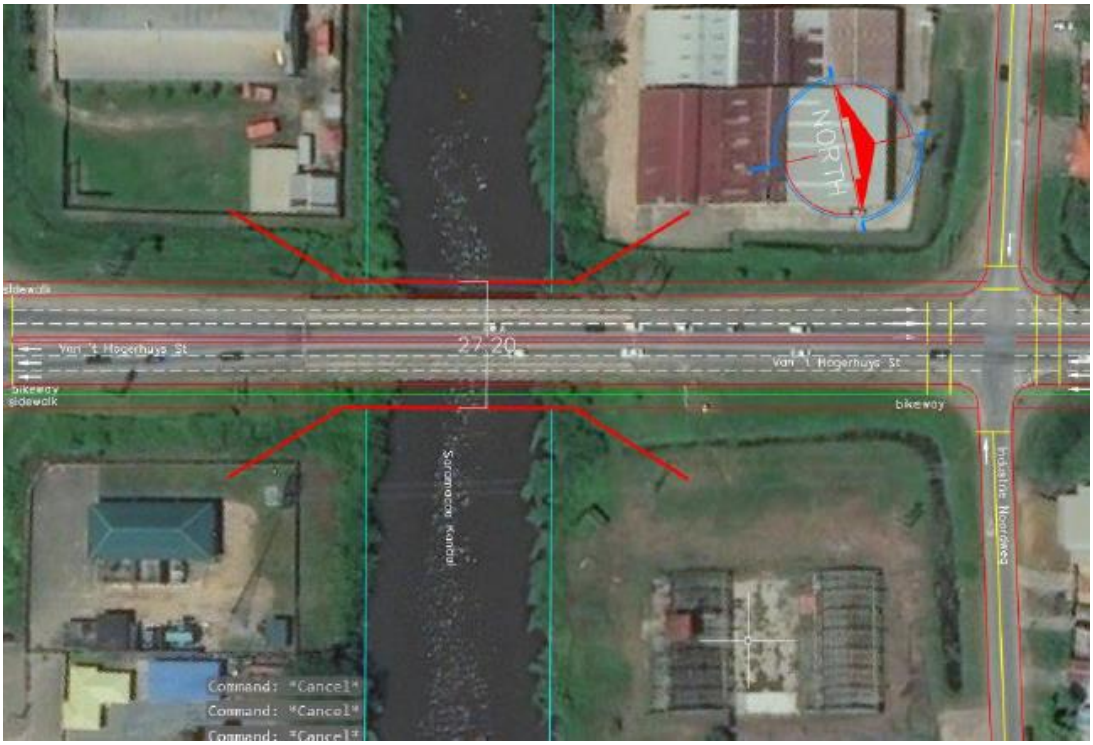


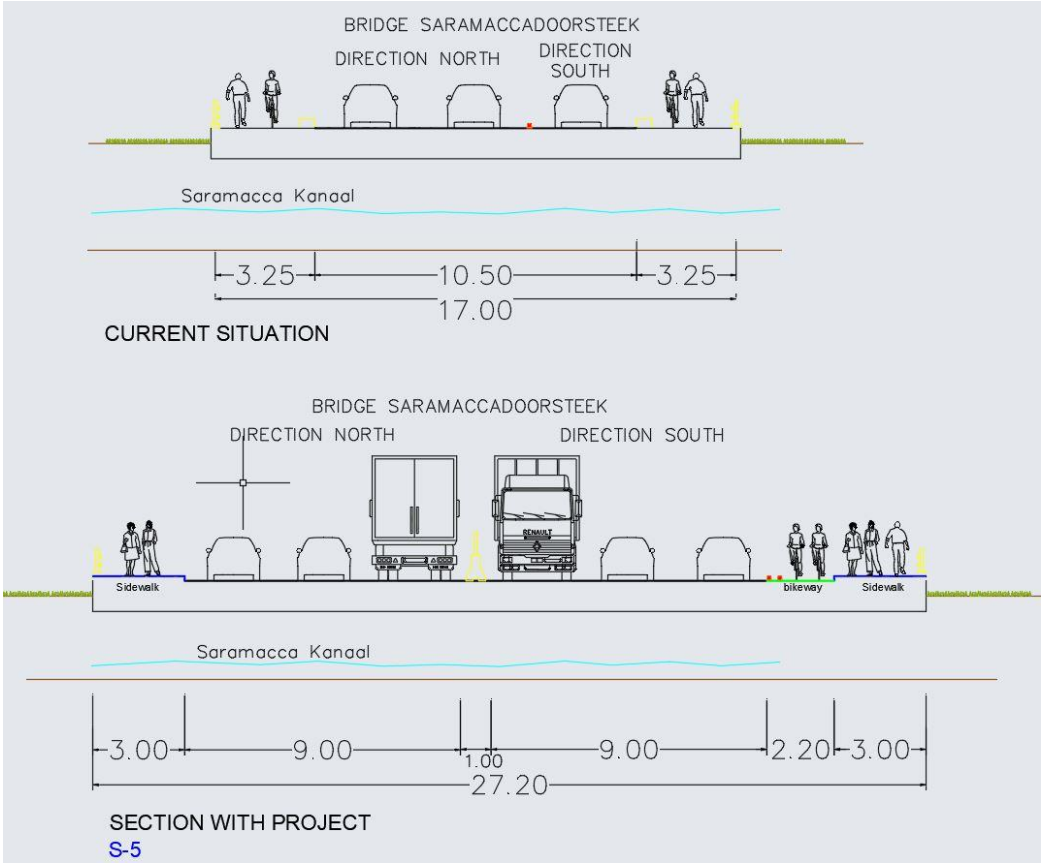
Finally, a second roundabout interventions is proposed in the intersection between Willem Campagnestraat and Hernhutterstraat. The queues in Hernhutterstraat can reach almost 1 km long, and the current roundabout doesn't allow a fluent vehicle movement. The intervention consists in removing the roundabout a create an intersection regulated by traffic lights that prioritize the movements with the most traffic and allows some continuous turns.

All the interventions were proposed taking into account the review of schematics sent by the electrical, water and telephone companies for the network. These documents showed that the interventions are preliminary feasible and can be achieved; however, for a detailed definition of the works, further studies need to be made.

4.4.3. Bridge construction over Saramacca Channel

The current bridge over Saramacca Channel can't withstand the traffic of heavy vehicles, which causes trucks to detour to reach the port and areas near Downtown Paramaribo. The proposed intervention would maintain the additional capacity of Martin Luther Kingweg and Van 't Hogerhuysstraat to have a three lane bridge per side, and also be built with the strength to allow the traffic of heavy vehicles. This new weight capacity improvement could potentially help not only trucks, but also the overall network as it would alleviate stress from secondary roads.





This new bridge would increase the total width by 17.20 m compared with the current bridge, to make space for the additional lane in each side, but also to create pedestrian sidewalks and a bikeway.

4.4.4. Implementation and synchronization of traffic lights and a traffic control center

For the proposed interventions to work properly and in an organized manner, it is also required to have traffic lights in specific intersections that currently don't have them. As for the traffic lights that exist, they need to be synchronized with the new ones to provide green waves for the network, prioritizing the directions and routes with the most traffic. The only traffic light currently in place is the one in the intersection between Willem Campagnestraat and Van 't Hogerhuysstraat. Eight additional traffic lights are proposed for other intersections as the next map shows:

Current and proposed traffic lights for the intervened road network

ID	Intersection
1	Van 't Hogerhuysstraat and Willem Campagnestraat
2	Martin Luther Kingweg and Latourweg
3	Van 't Hogerhuysstraat and Slangenhoutstraat
4	Van 't Hogerhuysstraat and Jules Wijdenboschbrug
5	Van 't Hogerhuysstraat and Abattoirstraat (proposed new port entrance)
6	Van 't Hogerhuysstraat and Kankantriestraat
7	Hernhutterstraat and Willem Campagnestraat
8	Van 't Hogerhuysstraat and Molenpad
9	Zwartenhovenbrugstraat and Saramaccastraat

For the synchronization of the traffic lights and the future operations, a Traffic Control Center should be installed as it will help to modify the overall phase if future traffic requirements in the network change as well as to face daily issues.

5. Annexes

5.1. Annex 1: Video of the microsimulation of the current situation

The consultant has handed out a video with the microsimulation of the current situation of the roads and current access to the port. This video shows the bottlenecks in the current operation of the system.

File name: Microsimulation Current Situation.avi (1,212,245 KB)

5.2. Annex 2: Video of the microsimulation with the proposed interventions

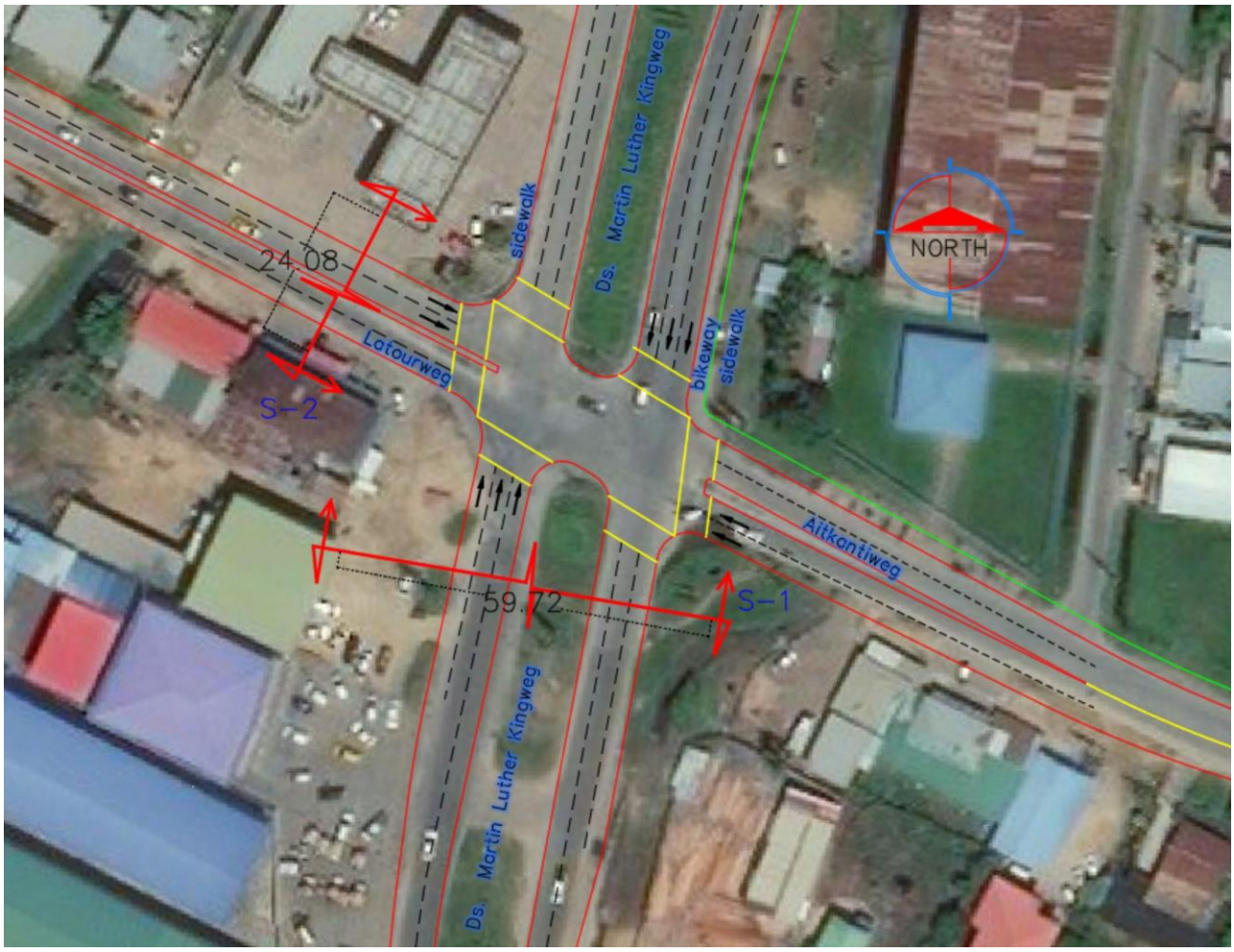
The consultant has handed out a video with the microsimulation of the roads and port's access with the proposed interventions. This video shows the expected level service in the roads once the interventions are made.

File name: IDB Suriname_Proposed interventions.avi (1,258,696 KB)

5.3. Annex 3: Interactive map of the proposed interventions

The proposed interventions have been included as interactive layers in Google Earth software, in order to be easily presented to the IDB and other relevant stakeholders. The following is an example of how these interventions have been handed out to the IDB.

Illustrative example of the proposed interventions



Deloitte.