USAID | DELIVER PROJECT

South Sudan: Central Medical Stores Warehouse Assessment

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South Sudan: Central Medical Stores Assessment

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Abstract
A joint systems assessment was conducted in Juba, South Sudan, to determine the Ministry of Health's Central Medical Stores capacity to store emergency medical fund (EMF) pharmaceuticals. This report presents the findings and recommendations from the assessment, in preparation for the arrival of the EMF commodities.

Cover photo: The photograph above shows the main entrance to the South Sudan Riverside warehouse. It was taken by the authors of this document in November 2012 in Juba.

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Contents

Introduction 1
Methodology 3
Findings 5
General Findings for All Warehouses 5
CMS Main Warehouse 10
Riverside Warehouse 15
Airport Warehouse 17
Warehousing Concepts Applied to Calculate CMS Storage Capacity and Requirements 19
Pallet Size, Storage Capacity, Racking, and MHE Relationships 20
WiB Package 23
CMS Available Warehousing Capacity 27
Recommendations 29
Short Term: 6–12 months 29
Medium-Term Goals (12–24 months) 39
Long-Term Goals (24–36 months) 44
Other Recommendations 45
Next Steps 47
References 49
Appendix
A. Persons Contacted 51
Figures
1. Central Medical Stores Warehouse Organogram 5
2. mSupply Menu Items 7
3. *mSupply Menu Interface* 8
4. mSupply Menu Interface: Expiration Tracking 8
5. mSupply Menu Interface: Inventory Management 9
6. mSupply Menu Interface: Stock Status 9
7. A Hypothetical Room 10
8. Current Central Medical Stores Main Warehouse Layout 12
9. Central Medical Store Riverside Warehouse Layout 16
10. CMS Airport Warehouse Layout 18
11. An Empty Pallet and a Loaded Pallet 19
12. Floor Layout and Sectional View Drawings 21
13. Warehouse in a Box Concept 22
14. Roof Pitch and Adjustable Pallet Racking Configurations—Conventional versus WiB 24
15. Example Process Flow Diagram—Loading 30

16. Proposed CMS Main Warehouse Layout for Block A—Short Term 35
17. Proposed Sections Layout in Block A of CMS Main Warehouse—Short Term 35
18. Proposed CMS Riverside Warehouse Layout—Short Term 37
19. Proposed CMS Riverside Warehouse Layout—Medium Term 41
20. Proposed CMS Riverside Warehouse Layout—Long Term 44

Tables

1. Loaded Pallet Dimensions 19
2. Current Stock Holding Translated into Equivalent Number of Pallets 27
3. Estimated Volume and Correspondingly Pallet Positions Required for Emergency Medicine Fund Commodities 28
4. Racked and Block Stack Pallet Position Status at End of Short- to Medium-Term Period 38
5. Racked and Block Stack Pallet Position Status at End of Medium-Term Period 43

Acronyms

APR	adjustable pallet racking
CCTV	closed circuit television surveillance
CHD	county health department
CMS	Central Medical Stores
DFID	Department for International Development (UK)
EMF	emergency medicine fund
FEFO	first-to-expire, first-out
GFR	gravity flow racking
GWP	good warehousing practice
JHPIEGO	[only uses acronym]
Kg	kilograms
MDTF	Multi-Donor Trust Fund
MHE	material handling equipment
MOH	Ministry of Health
mSupply	[a warehouse management system]
NA	Narrow Aisle (truck)
NGO	nongovernmental organization
NMFA	Norwegian Ministry of Foreign Affairs
PEPFAR	President's Emergency Plan for AIDS Relief
PHCC	Primary health care center
PHCU	Primary health care unit
PSI	Population Services International
SIAPS	Systems for Improved Access to Pharmaceuticals and Services
SOP	standard operating procedure
TA	technical assistance
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UPS	United Parcel Service
USAID	U.S. Agency for International Development
VNA	Very Narrow Aisle (truck)

WA	Wide Aisle (truck)
WHO	World Health Organization
WiB	Warehouse-in-a Box
WMS	warehouse management system

Introduction

The U.S. Agency for International Development (USAID)/South Sudan, with its partners—the Department for International Development and the Norwegian Ministry of Foreign Affairs (NMFA)—will procure emergency medicines kits and malaria commodities under the emergency medicine fund (EMF) program, for the Government of South Sudan. This will continue the supply of commodities provided by the World Bank–managed Multi-Donor Trust Fund (MDTF).

Anticipating the arrival of the EMF commodities into South Sudan, the Ministry of Health, with technical assistance from USAID | DELIVER PROJECT, conducted a joint assessment of the Central Medical Stores' (CMS) capacity to store and distribute pharmaceuticals and supplies. The focus was to include and involve the CMS during the process.

This assessment builds on the previous assessment conducted in mid-2012, which looked at the distribution and warehousing of the MDTF commodities. As part of that trip, field visits were made to counties in Central and Western Equatorial states. Based on the findings, the staff recommended a distribution plan for the commodities. To finalize plans on the warehousing and distribution of the EMF commodities, this assessment focuses on the current warehouse conditions, management, and inventory management practices at the CMS. The findings informed the short- and medium-term plans to improve warehouse practices for the CMS.

Methodology

The assessment findings in this document are based on a combination of document reviews, key informant interviews with partners involved with either the storage or distribution of health commodities in South Sudan, meeting with stakeholders, and site visits to the Central Medical Stores (CMS) facilities.

This CMS assessment builds on and complements previously reviewed assessments and reports:

- *Strategic Approach to Strengthen Pharmaceutical Management in Southern Sudan* (South Sudan Directorate of Pharmaceuticals Services 2008)
- *Assessment of Southern Sudan Pharmaceutical Management System* (Management Sciences for Health 2010)
- *Pharmaceutical Logistics Assessment in South Sudan* (Mochache 2011)
- *Local Fund Agent's Assessment Riverside Warehouse for the Global Fund* (Salhotra 2012).

Interviews with other partners were also conducted, including the Systems for Improved Access to Pharmaceuticals and Services (SIAPS) project, Population Services International (PSI), JHPIEGO, United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), the World Bank, and the World Health Organization (WHO).

The visit also included meetings with the Ministry of Health (MOH): the Pharmaceutical Supplies Management Division, quality assurance staff, and CMS controller; plus meetings with the UK Department for International Development (DFID), Norwegian Ministry of Foreign Affairs (NMFA), and the U.S. Agency for International Development (USAID), to discuss the details of the distribution options. The two main distribution options discussed were the distribution of kits from the port directly to the county and from the port to Juba to the county (malaria commodities would most likely originate from Juba since they arrive by air), details of the procurement process, roles of the MOH and partners, role of the counties, timelines, and considerations. The assessment team presented their preliminary findings and recommendations from the assessment to the MOH, DFID, NMFA, USAID, and SIAPS.

The assessment included site visits to the CMS main warehouse (Konyokonyo), Riverside (Gumbo), and the Airport facility across from the Juba International Airport. Staff from the CMS accompanied the team during warehouse visits. An assessment tool was used to guide the assessment, which included the warehouse layout, infrastructure assessment, general operations, material handling equipment (MHE), inventory management, and distribution. During the site visits, the team took measurements to assist with the illustrations presented in this report.

Findings

The CMS in South Sudan operates three warehousing facilities in Juba: the CMS Main warehouse, the Riverside (Gumbo) warehouse, and the Airport warehouse. The MOH owns the first two; the Airport facility is rented. The following findings apply to all three locations.

General Findings for All Warehouses

Buildings and Support Services

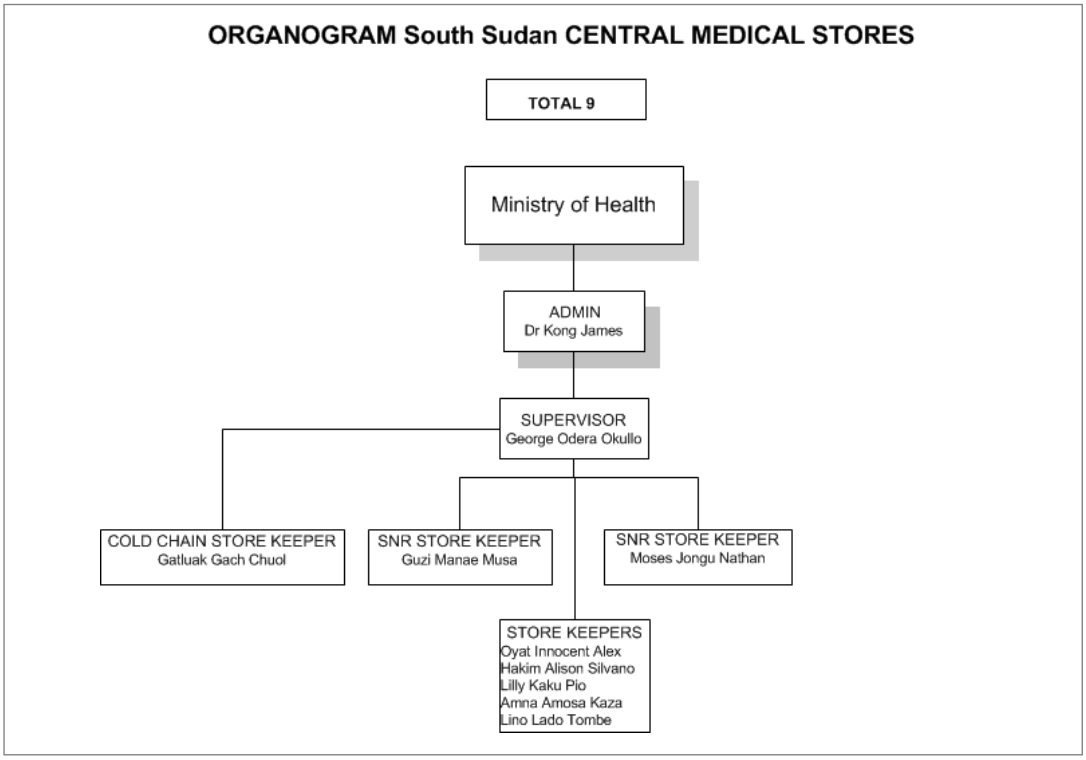
The roofs on all the buildings are made of corrugated metal roofing sheets and gutters. The dropped ceiling below the eaves of all the buildings is cracked or, in some areas, torn; signs of water damage are obvious, probably because of the leaks in the roof and other areas.

All the rooms in the warehouses are accessed through one double door; it has louvered windows placed at 3.5 meters high and 2.5 meters apart.

Human resources

As shown in figure 1, the CMS has nine staff members. The warehouse staff work out of the main CMS, at any of the warehouses, depending on the level of activity needed at each location. A CMS warehouse supervisor, three senior storekeepers, and five storekeepers manage all the CMS locations. In addition to the supervisor, staff have had limited training on logistics management and warehousing. When commodities are distributed, storekeepers direct the loading of the cartons onto the trucks.

Figure 1. Central Medical Stores Warehouse Organogram



Security considerations

The assessment team found that security at the locations was weak to non-existent. During the three days when they visited the sites, they observed the following:

- No one stopped or questioned the team before they entered the premises.
- Guests were not required to register.
- Guests were not searched when they left the premises.
- Security staff opened the gates; they remained at their post (guard room) for the entire time the assessment team was onsite. Security is outsourced to a private company under a contract with the MOH.

Process flow

While the CMS supervisor was very knowledgeable about the process for receiving, putting away, and loading the commodities, the processes are not documented. When the trucks are loaded for distribution, the corresponding kits and lots are counted, selected for each respective county, and loaded onto the trucks. The process to receive, store, and load the commodities is very labor-intensive; it could be streamlined.

Standard operating procedures

As noted earlier, the CMS does not have a set of standard operating procedures (SOPs) onsite but there is evidence of knowledge for the need for processes. However, it is widely accepted that SOPs are necessary to ensure documentation of and adherence to processes and methods. They also provide checks and balances for the processes, which can be a reference and job aid for staff to use, when needed.

Photograph 1. Warehouse Kitting and Safety

Material handling equipment and pallets in use at CMS warehouse

The three facilities use non-standard pallet sizes (see photograph 1), with the following dimensions:

- 1,300×1,100 millimeters
- 1,300×900 millimeters
- 1,200×900 millimeters.

The facilities did not have ladders. They only had two pallet jack trolleys, with a capacity of 1,400 kilograms (kg) each. Without considering the damage to over-loaded cartons at the bottom of the block stacks, it is unclear how the staff safely accesses cartons from the very high block stacks.

Warehouse Management Systems

In September 2010, the UNDP installed a warehouse management system (WMS) at the CMS—mSupply™. Staff had a one-week practical training on its use, followed by a refresher training six months later. mSupply is used at the UNDP-rented warehouse, where CMS staff observed the software as it was being used by the staff. However, various reports note that the staff did not complete the training. Also, adapting mSupply for use with the kits requires additional customization of the software, which prevented its full implementation. As a result, currently, mSupply is not being used at the CMS.

Information about mSupply was extracted from the website http://mSupply.org.nz/. Screen shots from the free single-user copy of the system was downloaded from the site listed below. Free tutorials are also available on the website. See figure 2 for a list of menu items.

Wikipedia http://en.wikipedia.org/wiki/MSupply, states that "Since release, mSupply has been available for free for use by not-for-profit use in developing countries."

The following limitations apply to the trial version (free copy) downloaded from the website:

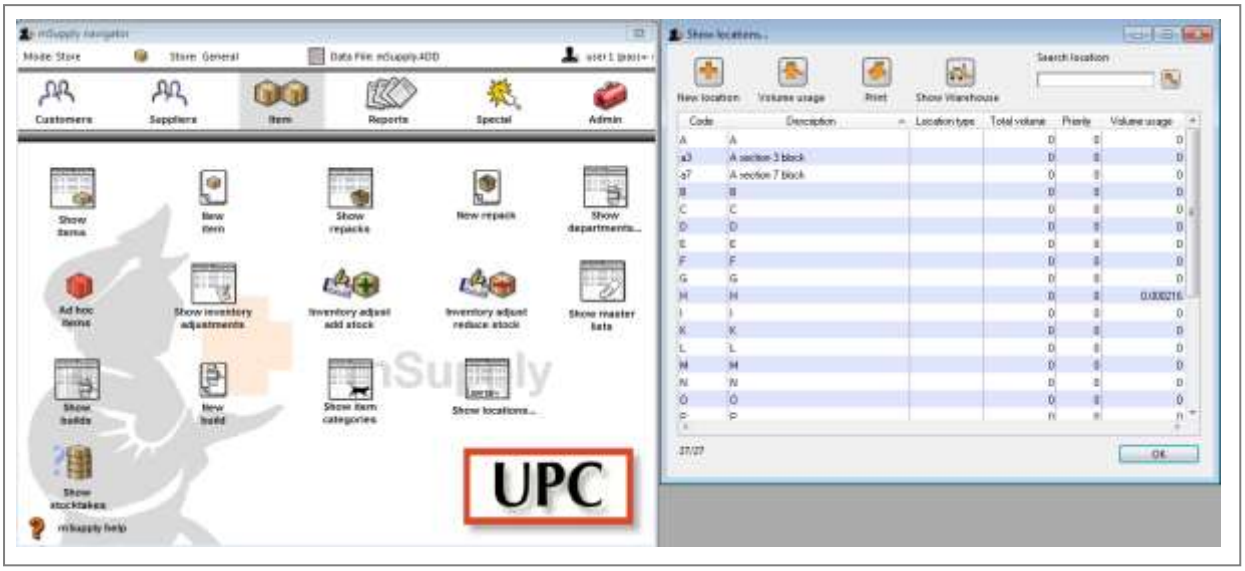
- The single-user version of mSupply is available, at no cost, for use in any situation (commercial or not-for-profit). Generally, a 3- to 5-user license will be needed for concurrent entries, especially during cycle counts.
- The single-user version does not entitle the user to support, although the staff for mSupply may answer email queries, if they are not too busy.
- The single-user version can be used for six months, or 2,000, transaction lines.

Figure 2. mSupply Menu Items

Source: Wikipedia

Figure 3 shows that mSupply has bin location capability.

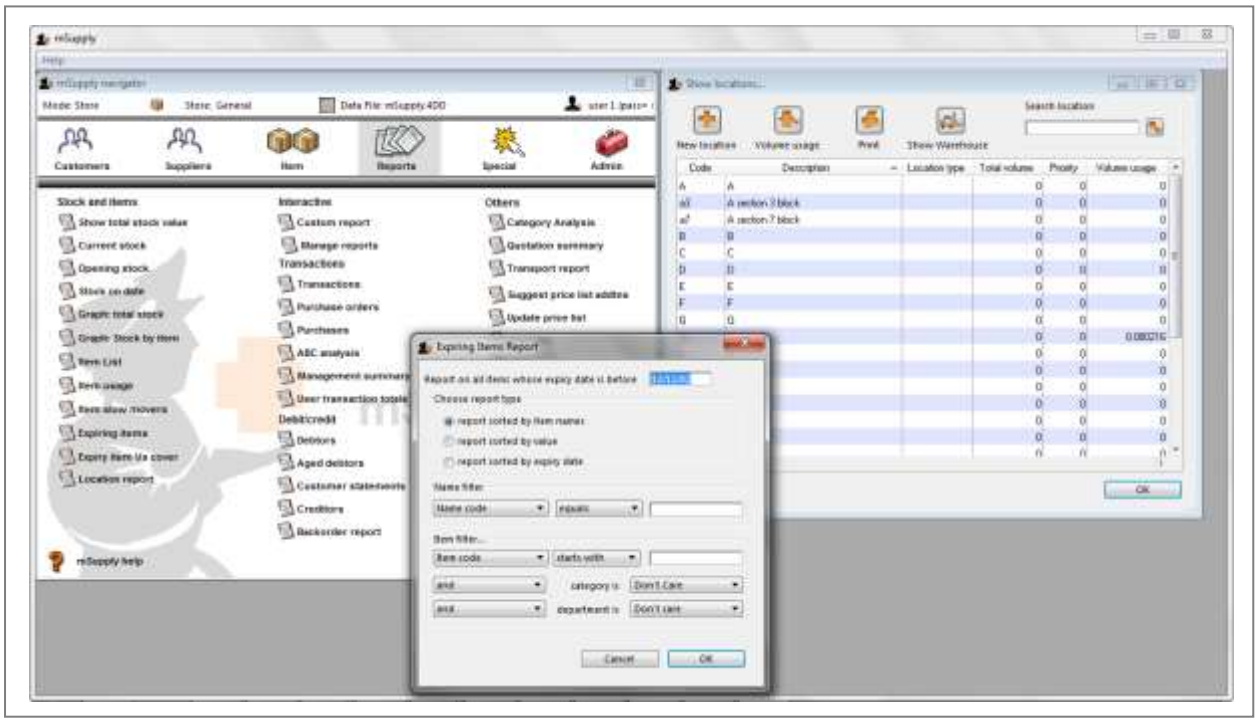
Figure 3. *mSupply Menu Interface*



Source: mSupply™ Evaluation Demo

Figure 4 shows the software's ability to highlight inventory near its expiration date.

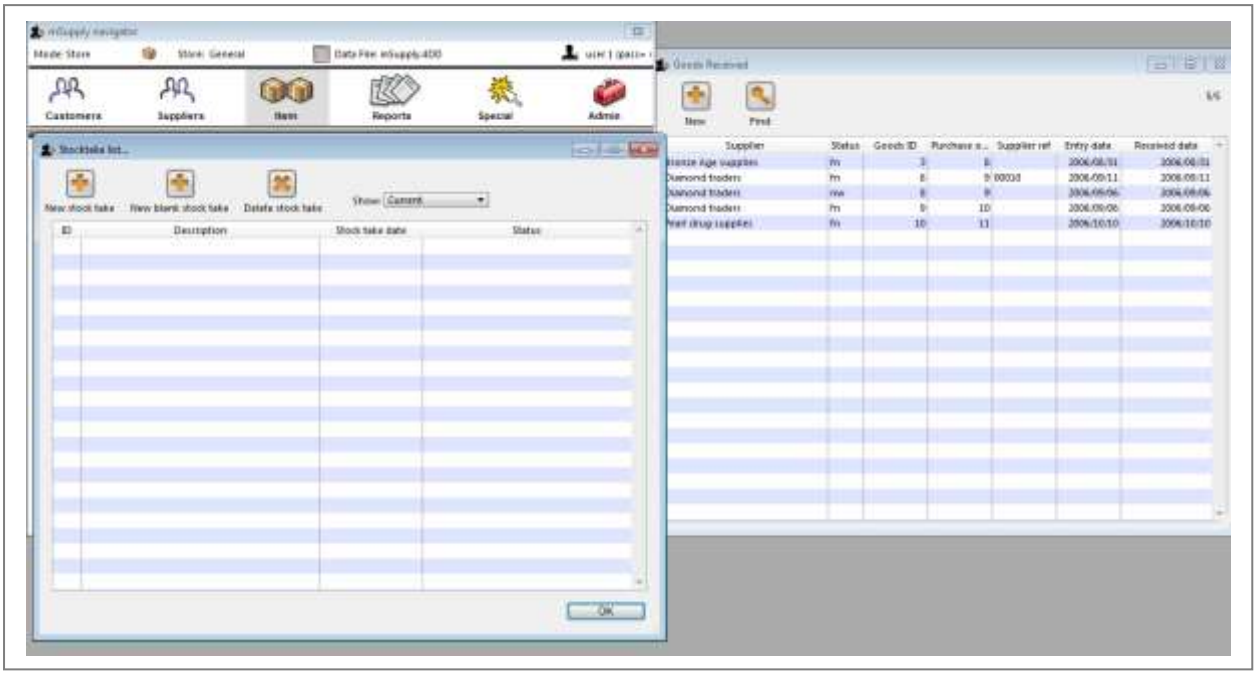
Figure 4. mSupply Menu Interface: Expiration Tracking



Source: mSupply™ Evaluation Demo

Figure 5 shows goods receipts and stock taking capability.

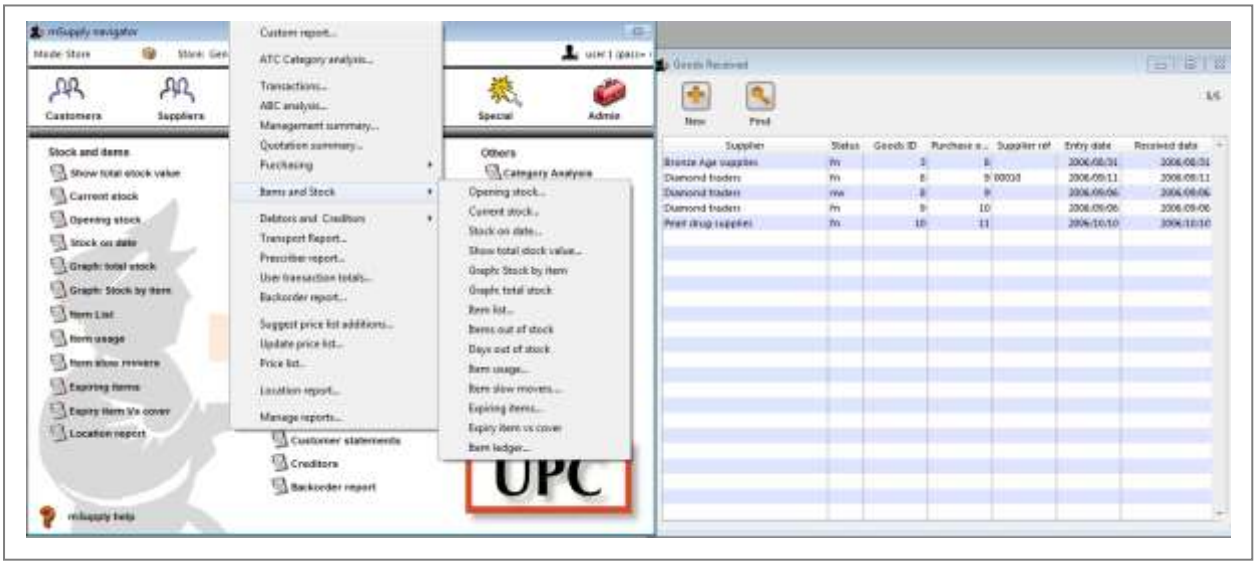
Figure 5. mSupply Menu Interface: Inventory Management



Source: mSupply™ Evaluation Demo

Figure 6 shows various items and stock status reporting capabilities.

Figure 6. mSupply Menu Interface: Stock Status



Source: mSupply™ Evaluation Demo

A generator provides power for the computers and the office; it also provides around-the-clock power to the cold room. UNICEF provides the fuel for the generators. Except for mSupply, the CMS does not have an inventory management system to track commodities. The CMS maintains copies of waybills, as often as possible. During distribution, the CMS prepares a packing list for each county and facility; listing the consignee, county name, and a list with the number of

cartons, by lot, for each destination. Multiple copies are made for the CMS, the consignee, and the MOH.

Distribution of commodities

The CMS does not have a fleet of vehicles to transport commodities. Currently, the distribution of the essential health commodities is done, on an ad hoc basis, by contracting with transportation vendors. Budgeting issues prevent the MOH from negotiating long-term contracts with vendors. Therefore, for each distribution, they must complete a new procurement process for each cycle of distribution. It has been reported that vendors often over-state the actual number of vehicles they have; then they are unable to provide the service, when needed. Nongovernmental organizations (NGOs) have facilitated the delivery and pick up of commodities from the main CMS to the counties.

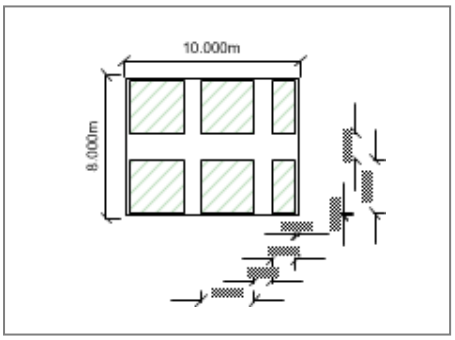
CMS Main Warehouse

Methodology Used to Estimate Current Storage Capacity

Currently, cartons are loaded on skids, light-duty blocks, and pallets of various sizes; stacked to a height up to 4 meters. Walkways are placed between the clusters of block stacks; with an average width of 1.5 meters. The stacks are disorganized.

To estimate the utilized space, the authors have made certain assumptions, as shown in figure 7 and listed below the figure.

Figure 7. A Hypothetical Room



- Figure 7 represents a room 10 meters by 8 meters wide.
- The height to the apex of the roof is 6 meters.
- The height to the eaves is 4.5 meters.
- Housekeeping has been done in this room and block stacks are arranged correctly; the stacks measure 3×3 meters and they are placed in marked areas in the available space.
- Passages measuring 1.5 and 1.0 meters separate the block stacks.
- Gaps along the walls measure 150 and 100 centimeters.
- Block stacks are stacked with cartons up to 3 meters high.

Available room volume	= 10×8×4.5	= 360 cubic meters
Volume used	= 4×(3×3×3) +2×(3×1.335×3)	= 132 cubic meters
Therefore, space (volume) percentage used	= 37%	

It should be noted that unless a sliding door leads into this room, the stock is inaccessible. This method is used to calculate how the current space is used in all the CMS warehouses.

General Layout and Location

The CMS main warehouse is located in the Konyokonyo area of Juba, on an almost flat piece of land, measuring 4,755 square meters.

A six-foot wall, with shaped wrought iron bars, is the perimeter boundary and security feature for this property. Within the site are three main brick and mortar buildings of storage or office space; they are plastered and painted; they occupy 21 percent of the total area.

The floor of each building at the Konyokonyo warehouse is composed of relatively compact cement, which has developed crevices and pot holes in some areas. Also, evidence of invasion by termites was seen in some corners of the warehouses and on some of the wooden pallets. See photograph 2.

Photograph 2. Central Medical Stores (clockwise from left to right)

1. Product destroyed by overstacking

2. Block stacks, and ceiling and overhead fans

3. Damaged floor requiring repairs

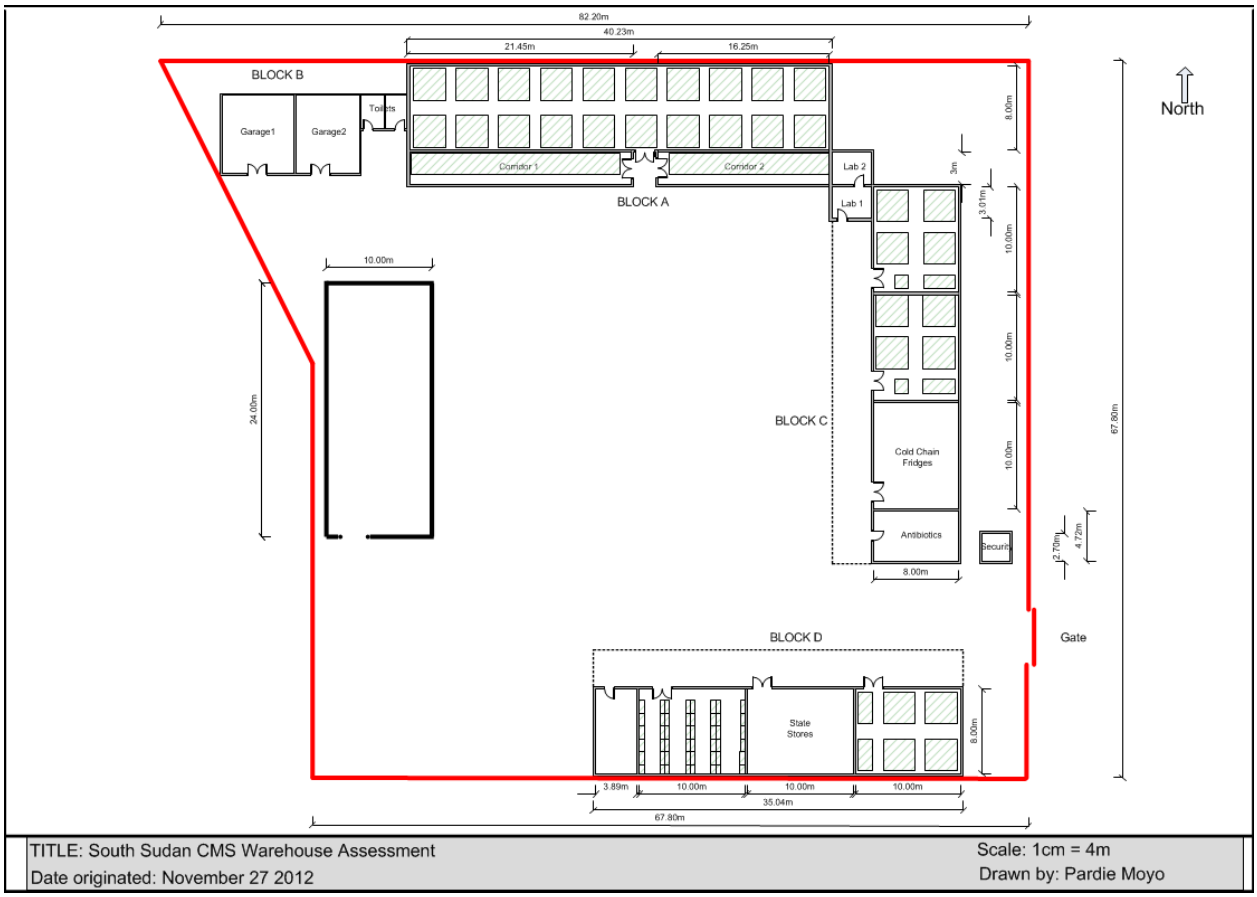
4. Evidence of termites.

Key findings at the CMS main warehouse

Figure 8 shows the layout of the CMS main warehouse.

All comments made under the section *General Findings for All Warehouses* also apply to the CMS main warehouse.

Figure 8. Current Central Medical Stores Main Warehouse Layout



Although the site has national grid electric power connections, the power has not been turned on for a long time. As a result, power cabling on the premises has been neglected (see photograph 3). All the distribution boards and switchgear must be checked before the power supply service is resumed, or before larger generator units are brought onto the main supply line.

Photograph 3.

A live electric cable that has come to the surface.

A tree, which is too close to the security wall and wrought iron bars, is compromising both structures.

Because there is no electrical power, and the warehouses have limited natural lighting, the light intensity levels in all the warehouses are very low. Also, during the assessment, because of the lack of power, the installed ceiling fans were not working. The warehouses did not have fire extinguishers or a sprinkler system.

All the sites have water supply, but, reportedly, the service is unreliable and erratic. The team assumed that the water pressure is too low to operate a fire sprinkler system.

The height of all the rooms is considered high: 4.65 meters to the eaves and 5.80 meters to the apex.

The warehouse complex has five main sections:

1. Block A

   The main room in Block A measures 320 square meters in area; with a volume of 1,485 cubic meters.

   Currently, 270 cubic meters, or 18 percent of the available capacity, is being used. The passage area that should have been cleared of all inventory is, instead, being used to hold additional inventory; it accounts for another 174.5 cubic meters of inventory.

   The total volume of stock in Block A is 444.5 cubic meters. Cobwebs were seen in some corners of the block. Some of the stock in the passages is damaged or expired.

2. Block B

   Block B comprises two large garages and two staff toilets.

   The garages were not accessible; reportedly, they hold stock that does not belong to the CMS. The toilets were accessible and acceptably clean.

3. Block C

   Block C comprises four storage rooms:

   a. Unit C1

      This unit area is 80 square meters, and has a maximum volume of 360 cubic meters.

      The inventory, which is block stacked in this area, occupies the equivalent of 125.2 cubic meters, or 35 percent of the available capacity.

   b. Unit C2

      This unit is the same size as Unit C1; it has the same inventory as Unit C1.

   c. Unit C3

      This unit is the same size as Unit C1; it is used for storing and packing cold chain products. The room has 15 deep freezers and refrigerator units for storage, as well as for constituting ice packs to maintain acceptable temperatures in shipping (cold) boxes. It was noted that staff periodically record and maintain the temperature records for each unit. The generator powers the cold chain equipment, which is currently operating 24 hours a day.

      The team assumed that the inventory in this area occupies the equivalent of 60 cubic meters.

d. Unit C4

This unit is 38 square meters; it has a maximum volume of 170 cubic meters. Reportedly, this room is used to store antibiotics. However, we could not access the room because the supervisor was away from the area.

The team assumed that the inventory in this area is the equivalent of 50 cubic meters.

4. Block D

Block D comprises four storage rooms:

a. Unit D1

This unit is 80 square meters; it has a maximum volume of 360 cubic meters.

The inventory, which is block stacked, occupies the equivalent of 125.2 cubic meters or 35 percent of the available capacity.

b. Unit D2

This unit is the same size as unit D1, and it has the same inventory. The unit is used to store non-CMS inventory.

c. Unit D3

This unit is 80 square meters; it has a maximum volume of 360 cubic meters. Currently, this unit is being used to store single stock units. The units are on bolted steel shelving. Because the space being used in this room is very low, it will be necessary to better rationalize use of the space.

It is estimated that the inventory in this area occupies the equivalent of 20 cubic meters, or only 6 percent of the available capacity.

d. Unit D4

This unit is 140 square meters. The room is the common office area for the CMS. In the room are six computer terminals and a hub for networking and Internet connectivity. Reportedly, the computers are primarily used for Microsoft Office-type documentation; the Internet connection has been inoperable for some time.

This unit is also powered by the same generator that operates the cold room; it has a working split system air conditioner unit.

5. Concrete Slab

A concrete slab, measuring 24 meters by 10 meters, is on the premises (see photograph 4). To accommodate any future expansion projects, the slab must be removed.

Photograph 4. CMS Main Warehouse (clockwise from left to right)

1. Damaged product
2. Concrete slab referred to above
3 and 4. Inventory stacked in the corridor.

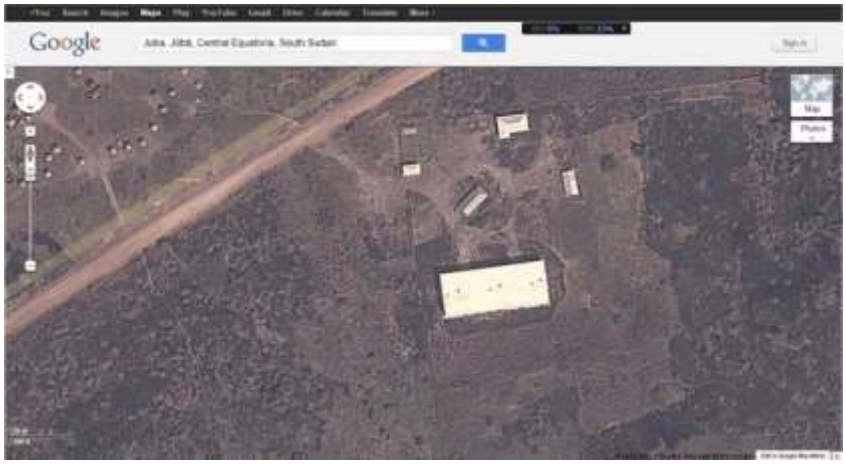
Riverside Warehouse

General Layout and Location

The Riverside warehouse is on a flat piece of land in the Gumbo area of Juba; it is reported to be approximately 22,000 square meters (see photograph 5). There is ample space for development; the CMS indicated that they intend to use it for the main warehouse site in the long term.

This property has a six-foot diamond mesh fence that marks the boundary and secures the area. Because the site is large (150 meters×150 meters), and in a remote area, it is vital that security be strengthened on the buildings, instead of the fencing.

Photograph 5. Google Map Scan of the Riverside Warehouse Site



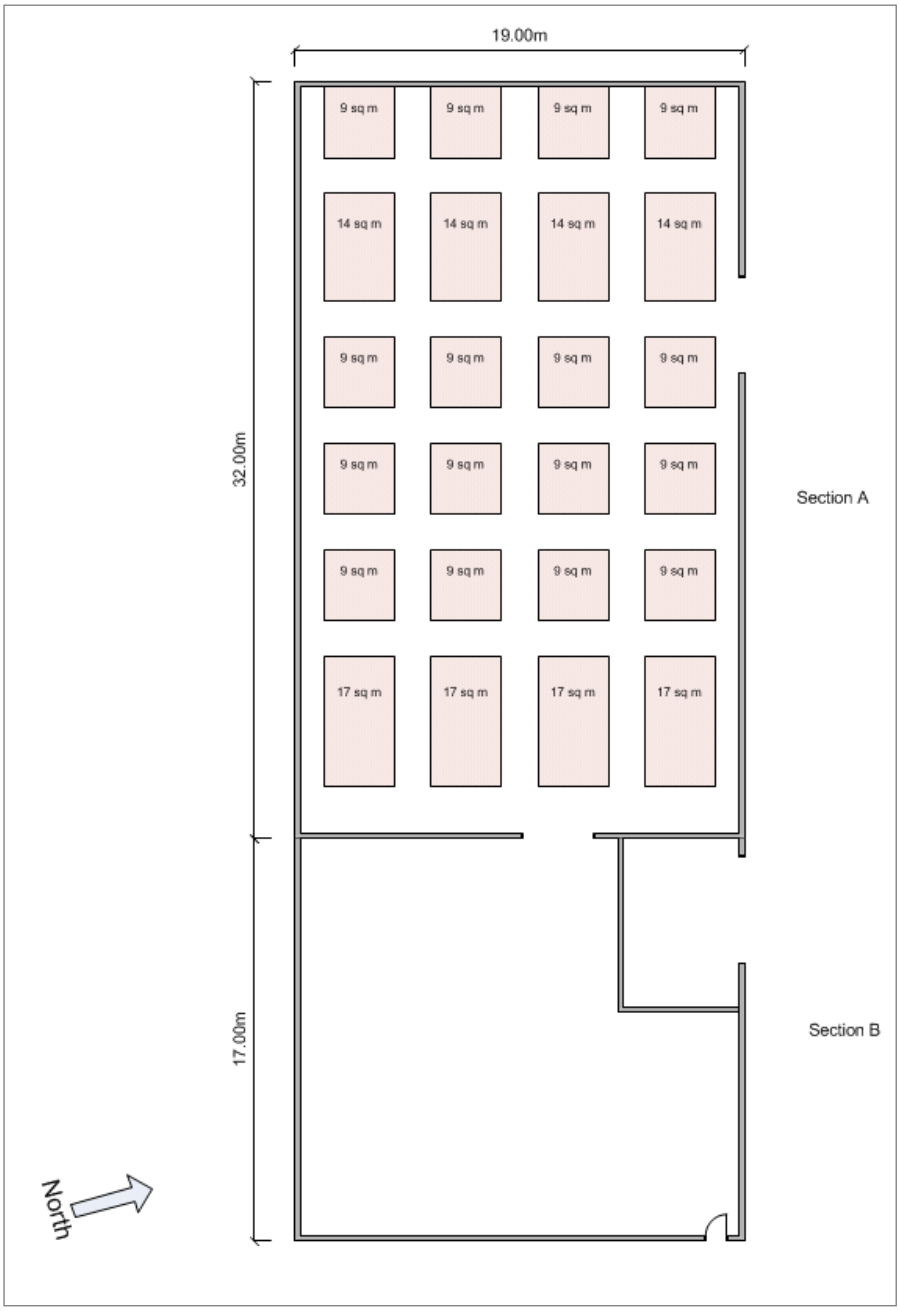
At this time, the site is not powered by a grid network electric supply or a generator. The site has no water service, although a tap is in place. The building has two sections: the CMS is on one side; on the other side, divided by a sliding door, is the area where the Global Fund–procured commodities that UNDP and PSI will manage in the near future will be stored. It was reported

that the generator from the UNDP site will be moved to the Riverside site at the same time the products are moved. However, it was unclear when that would take place.

Because there is no electrical power, lighting levels in the warehouses were low and the ceiling fans were not working. This warehouse does not have fire extinguishers or a sprinkler system.

Currently, in addition to the single structure warehouse, an office, a canteen, a toilet, and a generator room are also on the property.

Figure 9. Central Medical Store Riverside Warehouse Layout



Key Findings at the Riverside Warehouse

Figure 9 shows the layout of the Riverside warehouse. All comments made under *General Findings for All Warehouses* also apply to this warehouse.

The warehouse is 49×19 meters; it is divided into two sections: one section for the Global Fund and one section for the CMS commodities. The CMS section occupies the largest part of the warehouse, with a total area of 608 square meters. The warehouse is quite high, measuring 6.2 meters to the eaves and 7.5 meters to the apex.

As is the case at the CMS main warehouse, the cartons are stored on skids, light duty blocks, and pallets of various sizes; they are loaded into block stacks up to a height of 4 meters. Between the clusters of block stacks are walkways, with an average width of 1.5 meters. The stacks are disorganized (see photograph 6).

Photograph 6. Block Stack, Low Light, and Narrow Passage

1. Overloaded block stack with some damaged cartons

2. Low lighting levels and a narrow passage

Using the method described previously to estimate storage capacity—

The available volume for this warehouse is 3,770 cubic meters.

- The stacked inventory equals the equivalent of 792 cubic meters, or 21 percent, of the available capacity.

The CMS section of the warehouse is full. Some of the stock in the warehouse is damaged or has expired.

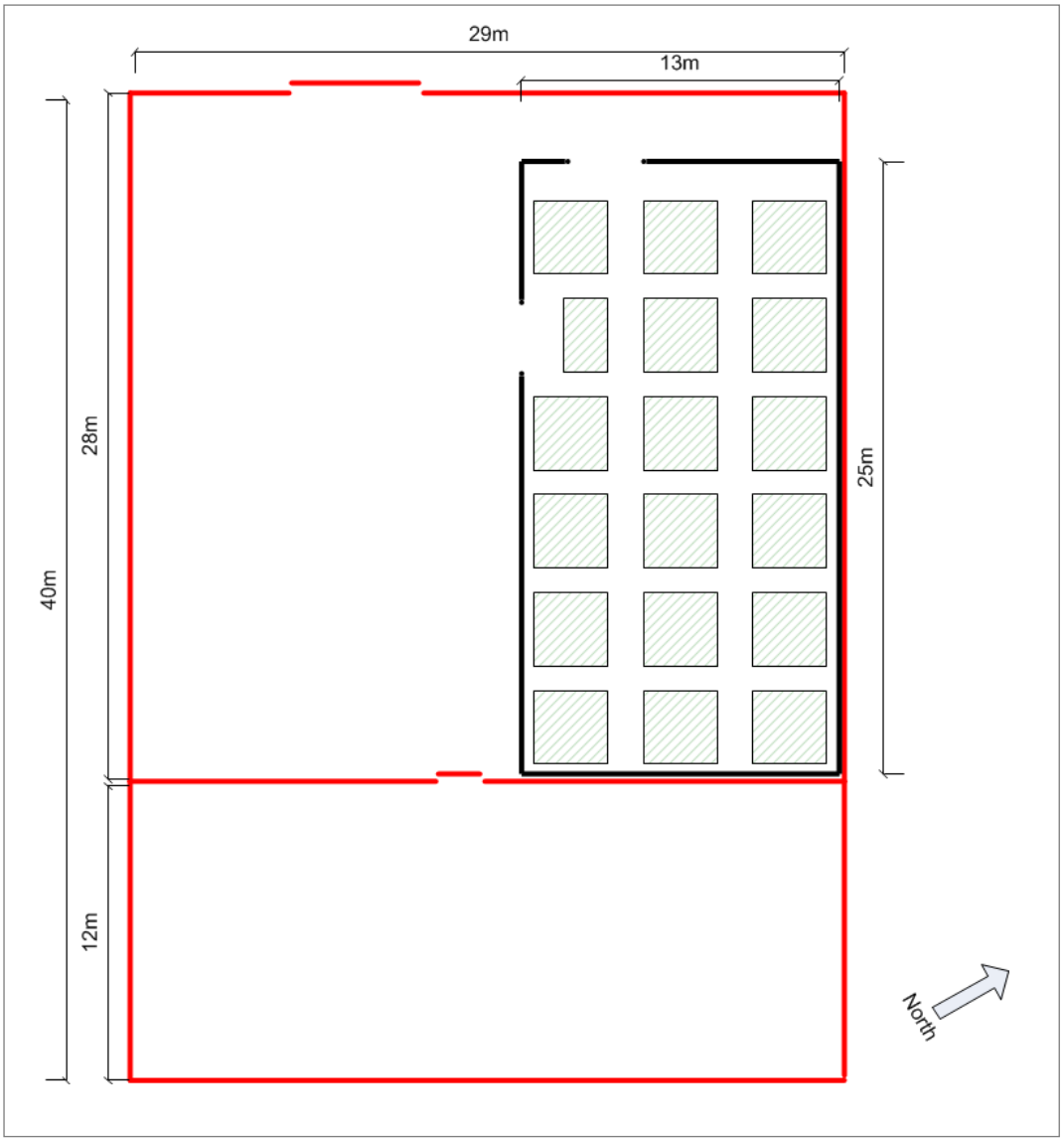
Airport Warehouse

General Layout and Location

The Airport warehouse is rented; it is across the road from the Juba International Airport on a flat piece of land, which is approximately 325 square meters.

The perimeter boundary and security feature for this site is a two-meter-high wall. At this time, the site does not have a grid network or a generator for electricity; it does not have water service. Because there is no electrical power, the lighting intensity in the warehouse is low. The warehouse does not have fire extinguishers or a sprinkler system. See figure 10.

Figure 10. CMS Airport Warehouse Layout



Key Findings at the Airport Warehouse

Figure 10 shows the layout of the Airport warehouse. All comments made under *General Findings for All Warehouses* also apply to this warehouse.

The warehouse is very high, measuring 6.8 meters to the eaves and 7.8 meters to the apex.

As it is at the other warehouses, cartons are stored on skids, light duty blocks, and pallets of various sizes; they are loaded onto block stacks up to a height of 4 meters. Walkways with an average width of 1.5 meters are between the clusters of block stacks. The stacks are disorganized.

Using the method described previously—

- The available volume for this warehouse is 2,275 cubic meters.
- The stacked inventory occupies the equivalent of 486 cubic meters, or 21 percent, of the available capacity.

Some of the stock in the warehouse is damaged or has expired.

Warehousing Concepts Applied to Calculate CMS Storage Capacity and Requirements

Current Capacity Calculation

The loaded pallet dimensions are particularly important when calculating capacity, as shown in table 1. See figure 11.

Figure 11. An Empty Pallet and a Loaded Pallet

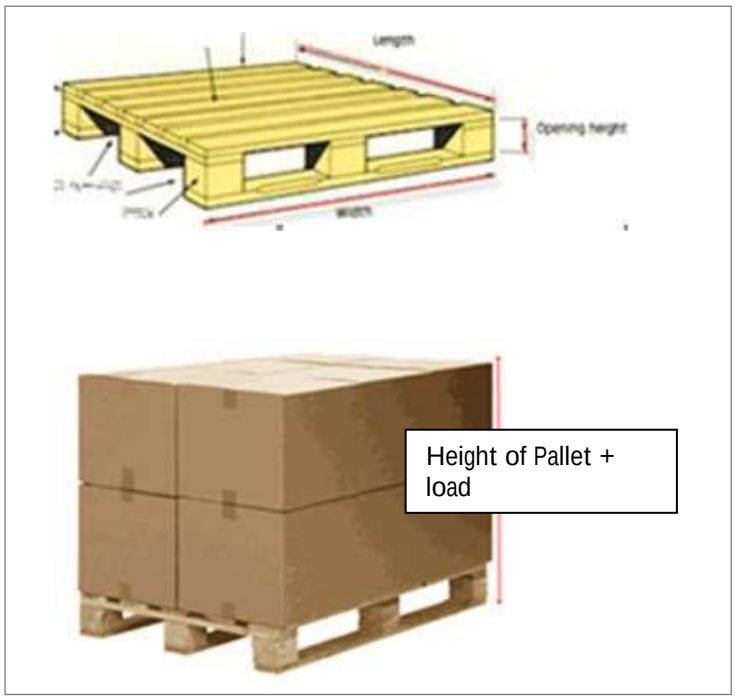


Table 1. Loaded Pallet Dimensions

Length	= 1.2 meters
Width	= 0.8 meters
Total loading height	= 1.5 meters
Pallet height	= 0.144 meters
Loading height	= Total loading height–pallet height = 1.356 meters
Maximum laden weight	= 700 kg

Based on the factors above, the laden volume of the pallet is 1.356 cubic meters.

Pallet Size, Storage Capacity, Racking, and MHE Relationships

In addition to the calculations shown above, the following are important factors when estimating pallet racking needs. In the following example, it is assumed that the room has the following dimensions:

Length of room= 18 meters

Width of room= 13 meters

Height to the apex= 8.28 meters

- This is the distance between the floor and the ridge, or the highest point on a roof.

Height to the eaves= 6.78 meters

- In warehouse racking, the height to the eaves is the most important parameter.
  - It is the distance between the floor and the part of the roof that overhangs the building walls.
  - It is approximately the height where a suspended ceiling is secured.

Pallet length = 1.2 meters

Pallet width = 0.8 meters

Total loading height = 1.5 meters

Pallet height = 0.144 meters

Effective loading height = 1.356 meters

Maximum laden weight = 700 kg

Number of pallets per beam = 3

Loaded beam weight = 2,100 kg

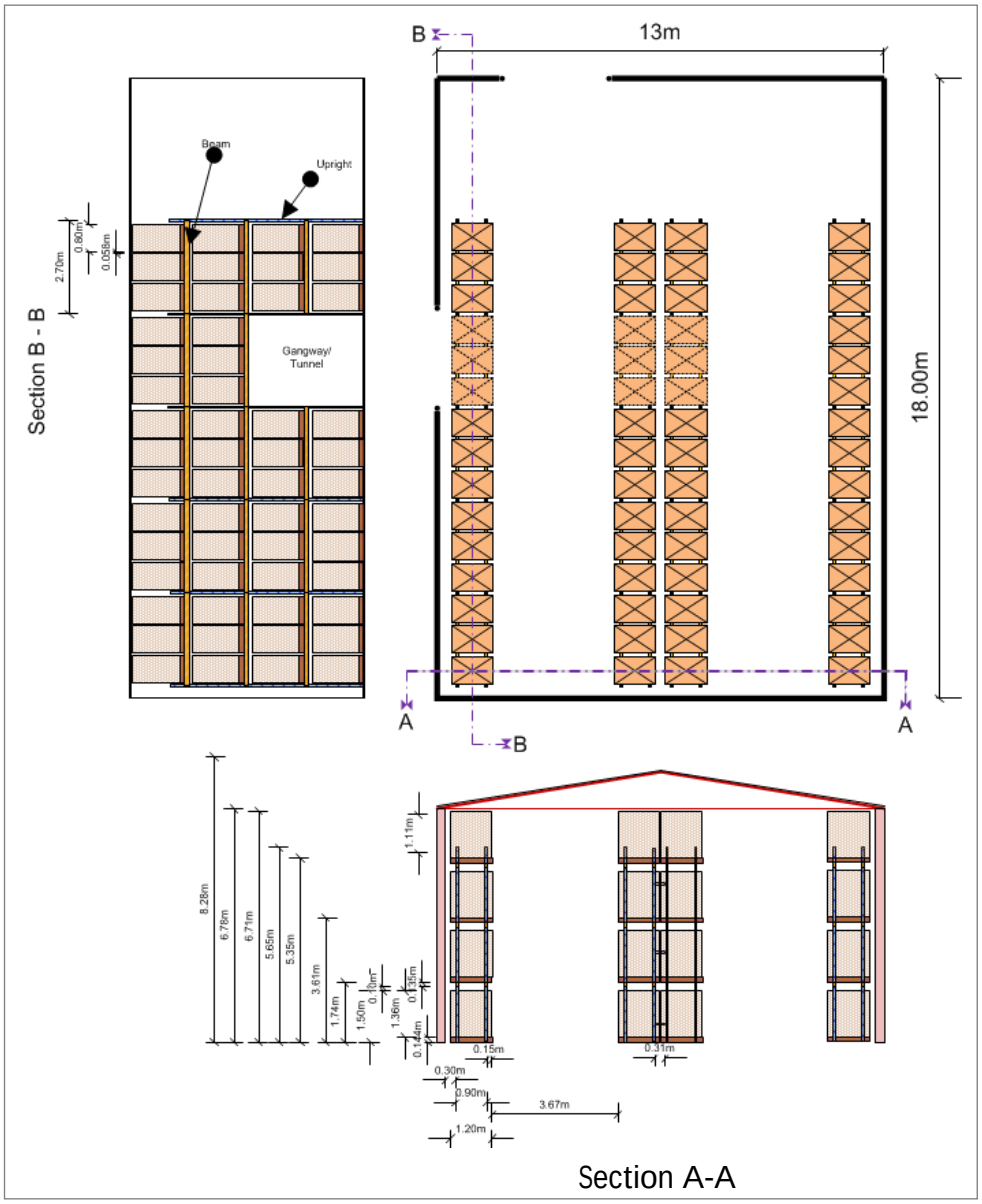
Assumed beam length = 2.70 meters

Design gap between loaded pallet and next beam = 100 mm

Therefore, the aperture size = 1.74 meters

Using the factors above, figure 12 is an example of the resulting racking design:

Figure 12. Floor Layout and Sectional View Drawings



The results are summarized as follows:

- Some space was left for staging—enough space for 15 pallet positions per row.
- The width of the room allows for two-single rows and one-double row of pallet racking.

Section AA (see figure 12) shows the following:

- An aisle width of 3.67 meters, enough space for a standard forklift.
- The height to the eaves allows for five pallet levels.

Section BB (see figure 12) shows the following:

- Because of the door's position, a gangway will be needed to allow for entry and movement of the personnel and the MHE.

Provision of Material Handling Equipment

Lift trucks used for handling unit loads in racked storage are categorized by the aisle widths they are designed to be operated in.

- *Wide Aisle (WA)* trucks usually operate in aisles wider than 3.35 meters.
- *Narrow Aisle (NA)* trucks operate in aisles between 2.45 and 3.00 meters wide; they are usually twice as expensive as *WA* trucks.
- *Very Narrow Aisle (VNA)* trucks usually operate in aisles less than 1.82 meters wide; they are usually five times more expensive than *WA* trucks.

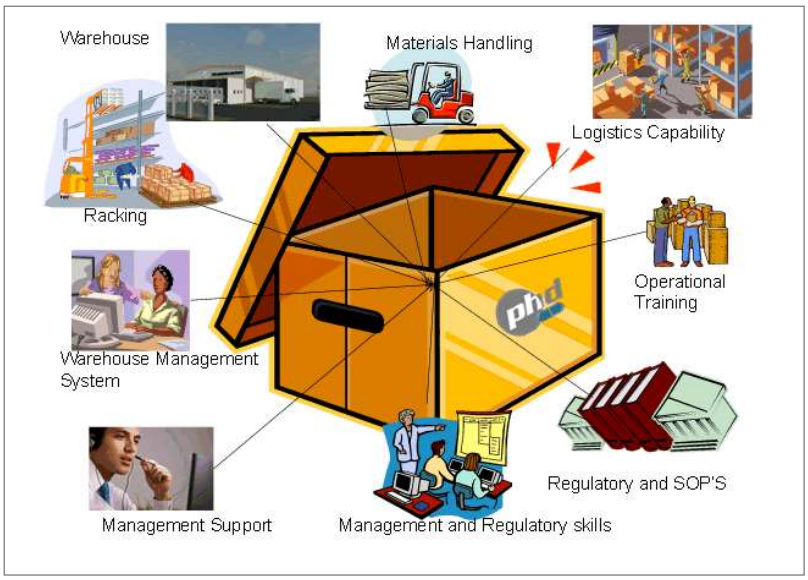
In the following example, WA forklifts are appropriate.

RTT Warehouse-in-a-Box™ Concept

The RTT Warehouse-in-a-Box (WiB) concept is a turnkey approach to pharmaceutical warehousing; it provides a total solution and offers substantial technical advice and the required inputs from one supplier. Under this concept, a provision is not only made for the pre-fabricated structure, but also for the various facets that support the warehousing functionality.

Figure 13 highlights some of the solutions offered by the WiB concept.

Figure 13. Warehouse in a Box Concept



The WiB was registered under USAID and the President's Emergency Plan for AIDS Relief (PEPFAR) as a product; it was installed in Tanzania and Ghana (see photograph 7).

Photograph 7. WiB Units Installed in Tanzania

WiB Package

The main feature of the RTT WiB is the pre-fabricated warehouse structure, which has the following components:

Floor

A plinth and concrete floor is put in place, preferably by an in-county construction company.

Steel structure

The steel structure allows for flexibility, adaptability, and capacity expansion.

Paneled walls and roof

The prefabricated panels are installed with Insulated Chromadek™. The cladding provides Class 1 fire rating; it is used for both the walls and the roof.

Benefits of the WiB structure

Cost: The WiB structure costs 35 percent to 50 percent less than conventional warehouse structures.

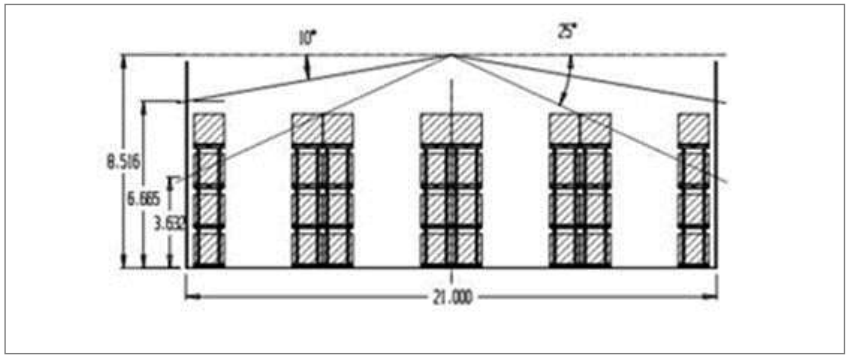
Timing: Subject to approvals and the availability of funds, and the fabrication and the shipping time, installation of a standard WiB can be completed in four to six months.

In addition to a relatively short installation time, two other advantages should be specifically mentioned—roof pitch and modularity.

Roof pitch

Conventional warehouse roof structures have a roof pitch (slope) between 22 and 26 degrees, which limits the building width. The results are low roof structures that restrict the number of pallet beam levels (apertures) to three or less (see figure 14).

Figure 14. Roof Pitch and Adjustable Pallet Racking Configurations—Conventional versus WiB



The WiB roof configuration accommodates four or five levels of adjustable pallet racking (APR) beams. This configuration substantially increases storage capacity-to-area utilization ratio.

Figure 14 illustrates the 10° roof pitch of a WiB; it also shows the increased storage capacity-to-area utilization.

Modularity

The WiB is modular in form, with a fixed width of 21 meters and a standard length of 25 meters. Size can be increased, in multiples of 5 meters, along the length side (see photograph 8).

To support this modularity, two or more warehouses built adjacent to each other can share between spans by pre-configuring the main columns.

Photograph 8. Modular Warehouse Structures Built Adjacent to each Another

The RTT WiB is supported by the following ancillary packaged components (see photograph 9):

- adjustable pallet racking
- gravity flow racking (GFR)
- temperature controlled storage space
  - cold rooms
  - temperature and humidity data loggers
- adequate lighting and electrical points
- air conditioning

- material handling equipment that includes—
  - forklift(s)
  - reach trucks
  - pallet jacks
  - dock levelers.
- generator
- United Parcel Service (UPS)
- Office space
  - furniture
  - washroom facilities
  - change rooms
  - plumbing requirements
- Security/loss control
  - access control
  - closed circuit television surveillance (CCTV) facility
  - fire hoses
  - fire extinguishers
  - pest control kit and rodent bait traps
  - signage for health and safety.

Photograph 8. Racking and layout Inside WiB Units Installed in Tanzania

CMS Available Warehousing Capacity

At the time this assessment was conducted, all the warehouses were stocked to full capacity. This volume parameter can be used to calculate the equivalent number of pallets for each CMS warehouse and Block, with the following results:

The methodology outlined in *General Findings for All Warehouses* applies to all CMS warehouses.

Table 2. Current Stock Holding Translated into Equivalent Number of Pallets

Site	Warehouse/Block	Unit	Volume Cubic Meters	Equiv. No. of Pallets
CMS Main	A	Main	270.50	199
	A	Passage 1	99.00	73
	A	Passage 2	75.50	55
	Sub-total Block A		*445.00*	*327*
	B		0	0
	C	1	125.20	92
	C	2	125.20	92
	C	3	0	0
	C	4	50.00	36
	Sub-total Block C		*300.4*	*220*
	D	1	125.2	92
	D	2	0	0
	D	3	40	29
	D	4	0	0
	Sub-total Block D		*165.20*	*121*
CMS	Main		910.60	668
Riverside	Main		792.00	584
Airport	Main		486.00	358
Grand Total			2,188.60	1,610

All the stock currently held at the CMS facilities will occupy 1,610 Euro-type pallets, with each pallet loaded to 1.5 meters high (see table 2).

Estimated Capacity Requirements

Table 3 provides the estimated amount of volume and equipment pallet positions needed, based on the previous distributions of kits. A reassessment will need to be conducted after better estimates of the future EMF commodities are known to evaluate actual storage needs.

Table 3. Estimated Volume and Correspondingly Pallet Positions Required for Emergency Medicine Fund Commodities

Category	# of Outlets	3 Months EMF Commodities		6 Months EMF Commodities		12 Months EMF Commodities	
		Volume cu m	Equiv. Pallet Positions	Volume cu m	Equiv. Pallet Positions	Volume cu m	Equiv. Pallet Positions
Hospitals	47	1 022	786	2 044	1 571	4 088	3 141
PHCCs	250	758	582	1 515	1 164	3 030	2 328
PHCUs	1 000	630	484	1 260	968	2 520	1 936
TOTALS		2 410	1 852	4 819	3 703	9 638	7 405

The prime objective is to ensure through the CMS Improvements effort, all inventory shipments planned under the EMF initiative, and some MOH stock is stored as per Warehouse Best Practice guidelines.

The following section explores what can be achieved in the short to long term as follows:

Short term - 6 to 12 months

Medium term - 12 to 24 months

Long term - 24 to 36 months

Recommendations

The following sections provide short-, medium-, and long-term recommendations. Before these recommendations can be followed, the stock currently stored at the CMS facilities must be removed.

Short Term: 6–12 months

Second Advisor to CMS to Build Capacity

To facilitate the emergency medicines fund (EMF) program and the related preparations, and to help strengthen the capacity of the CMS, a warehouse advisor should be seconded to the CMS. The advisor could provide assistance in implementing the agreed-upon recommendations, including inventory management, housekeeping, and training on good warehousing practices (GWP); the advisor could also assist, supervise, or monitor any of the CMS improvements.

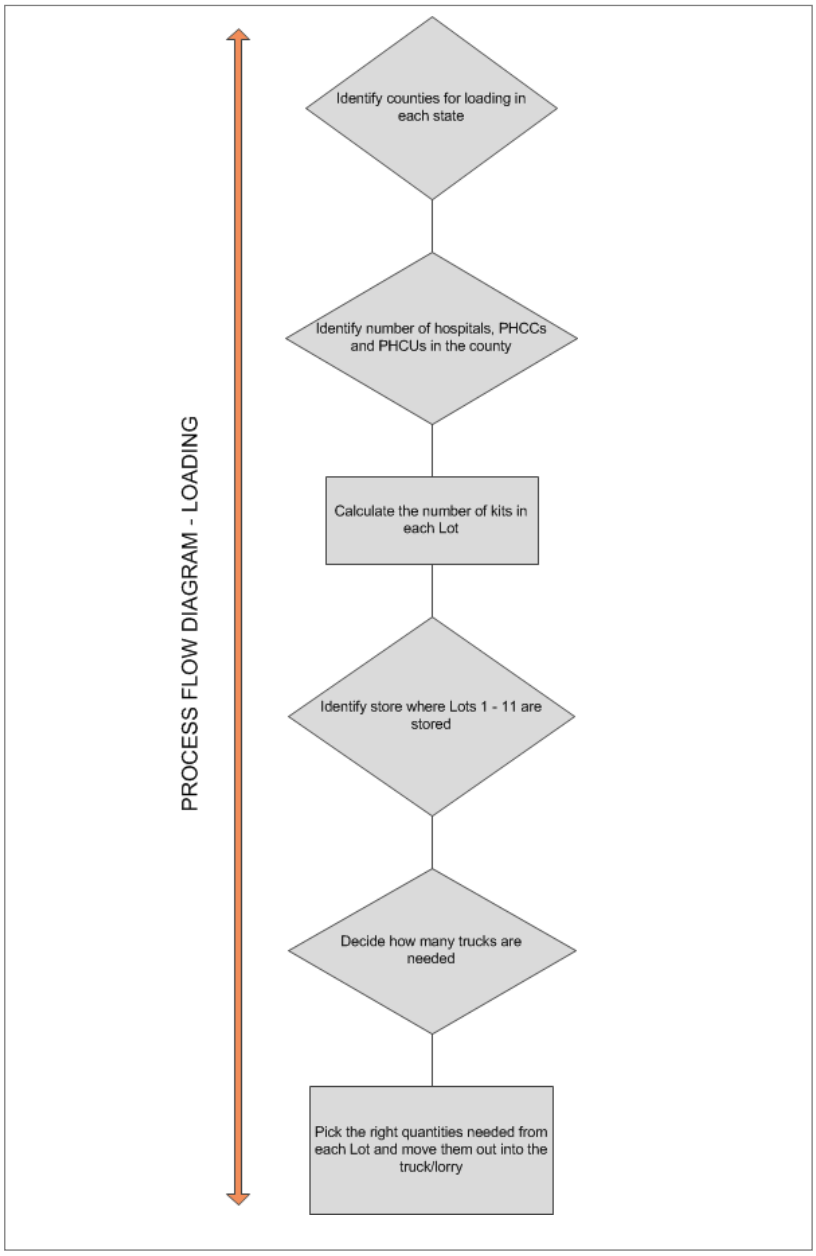
Deploy Stock Cards and Excel-based Inventory Control System

To manage the inventory, it is recommended that the CMS expand the use of stock cards to all their warehouses. This should be in addition to developing an MS Excel-based inventory report to manage the stock at the CMS; and, also, to facilitate the generation of packing lists.

Train on Good Warehousing Practice

If roles and responsibilities are streamlined for the staff, their time could be used more efficiently; especially between distributions, when on-the-job training and general housekeeping could take place. Developing and implementing SOPs would facilitate GWP for the CMS staff. The CMS operations staff will need training specifically tailored for the core operations. Some of the training needs identified include developing and documenting process flow diagrams and SOPs, as outlined below. See figure 15.

Figure 15. Example Process Flow Diagram—Loading



The following section includes sample SOPs, which will be needed for the CMS warehouse operations (see photograph 9).

Receiving

- control of goods receipt.

Distribution

- distribution and forwarding consignments
- distribution and picking of county consignments
- dispatch.

Inventory Management

- cycle counts
- stock take control of orders
- procurement
- transport contract management.

Quality Assurance

- sampling and inspection of goods
- handling of product complaints
- recall of product.

Warehouse Operations

- control of cold chain goods
- destruction of rejected goods
- transportation of product from warehouse
- cleaning of the warehouse
- refrigerator and warehouse temperature record and control
- control of stolen and damaged goods
- containment and control of spillage of hazardous substances.

Photograph 9. Some Results from the Structured Training Program in Tanzania

Kitting at All Warehouses

Install generators

Currently, the CMS has five diesel-powered electric generators at the Konyokonyo warehouse. While installing the equipment adds operational costs, the following will improve the CMS operations:

- sustenance and control of the cold chain
- better use of computers
- enhanced security
- lighting at acceptable lumen levels
- better ventilation
- new air conditioning equipment.

It is recommended that five generators be installed at the following locations:

CMS Main Warehouse (two generators):

- one generator with a rating of 230kvA
- one generator with a rating of 100kVA.

Total installed power onsite = 330kVA

Riverside Warehouse (one generator):

- one generator with a rating of 230kvA.

Airport Warehouse (one generator):

- one generator with a rating of 100kVA.

Install air conditioning

Consideration must be given to installing *airport type*, fully contained, vertical air conditioner cabinets in the CMS Main storage blocks and the Riverside warehouse. The cooling capacity of the units varies from 9 to 55 kilowatts; they require very little maintenance (see photograph 10).

Photograph 10. Examples of Low Maintenance Air Conditioning Units

Introduce rodent control campaign

A fumigation program must be put in place to combat an invasion by termites and rodents.

Enhance loss control systems

Measures must be taken to improve facility security by carrying out one or more of the following:

- Enhance security by installing razor wire on top of the existing wrought iron bars at the CMS main warehouse.
- Install closed circuit television surveillance (CCTV) systems at each site.
- Strengthen the roles and activities of the security guards.
- Install electric fencing at the Riverside warehouse.

Refurbish CMS warehouse—roof, ceiling, and floor repairs

Patched repairs must be completed on the roofing sheets, some of the ceiling (see photograph 12), and the floors. A local building company will be able to complete this work.

Photograph 11. Ceiling Damage from Leaking Roof; Sample of a Stock Card

Repair electrical supply wiring and improve lighting level

All electrical cabling and switch-gears must be checked and repaired before the generators are turned on. The local company working on the roof repairs could also substitute some of the roof sheets with translucent panels—similar to those used in greenhouses or patios—to take advantage of the natural light.

Providing standard pallets and adjustable pallet racking at CMS Main and Riverside warehouses

Before CMS can begin a racking exercise, they must standardize to one pallet size. Because a standard pallet size is a key factor in the design for racking in the warehouses, it is recommended that the CMS begin to acquire the most widely used pallets—in Europe, Africa, and Asia—that measure 1,200×800 millimeters.

Using standard size pallets on standard length beams will greatly improve the storage capacity. The following recommendations are for the racking and palletizing of the CMS Main and Riverside warehouses (see figure 16 and figure 17).

Central Medial Stores Main

Figure 16. Proposed CMS Main Warehouse Layout for Block A—Short Term

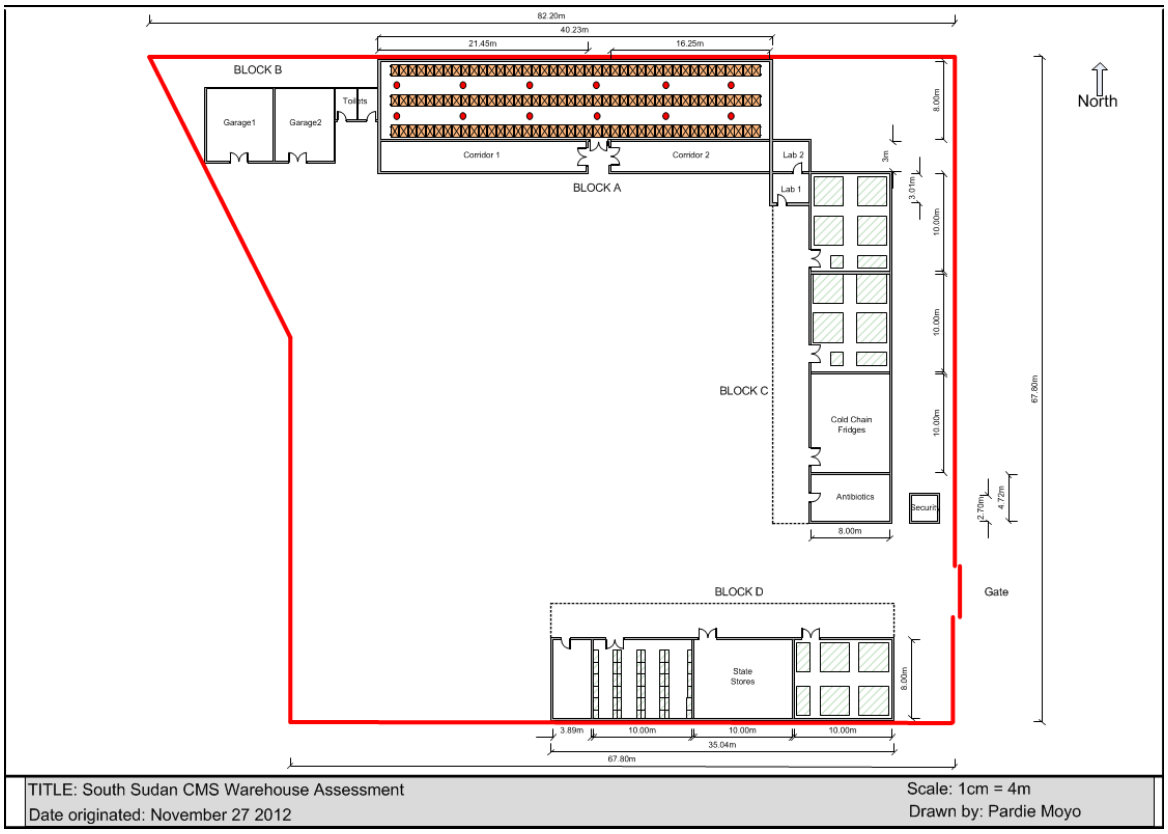
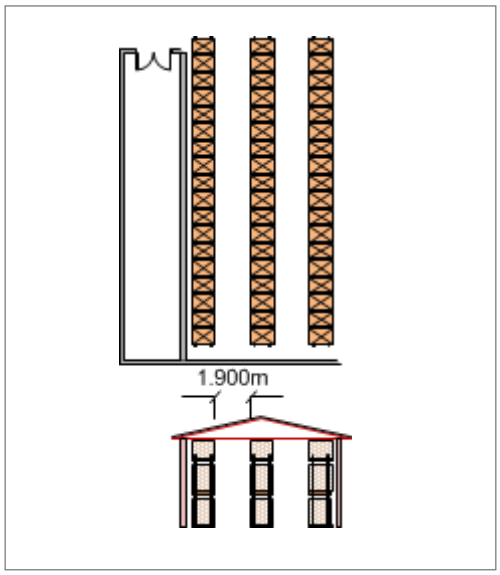


Figure 17. Proposed Sections Layout in Block A of CMS Main Warehouse—Short Term



The proposal for installing adjustable racking at the Konyokonyo warehouse is summarized as follows:

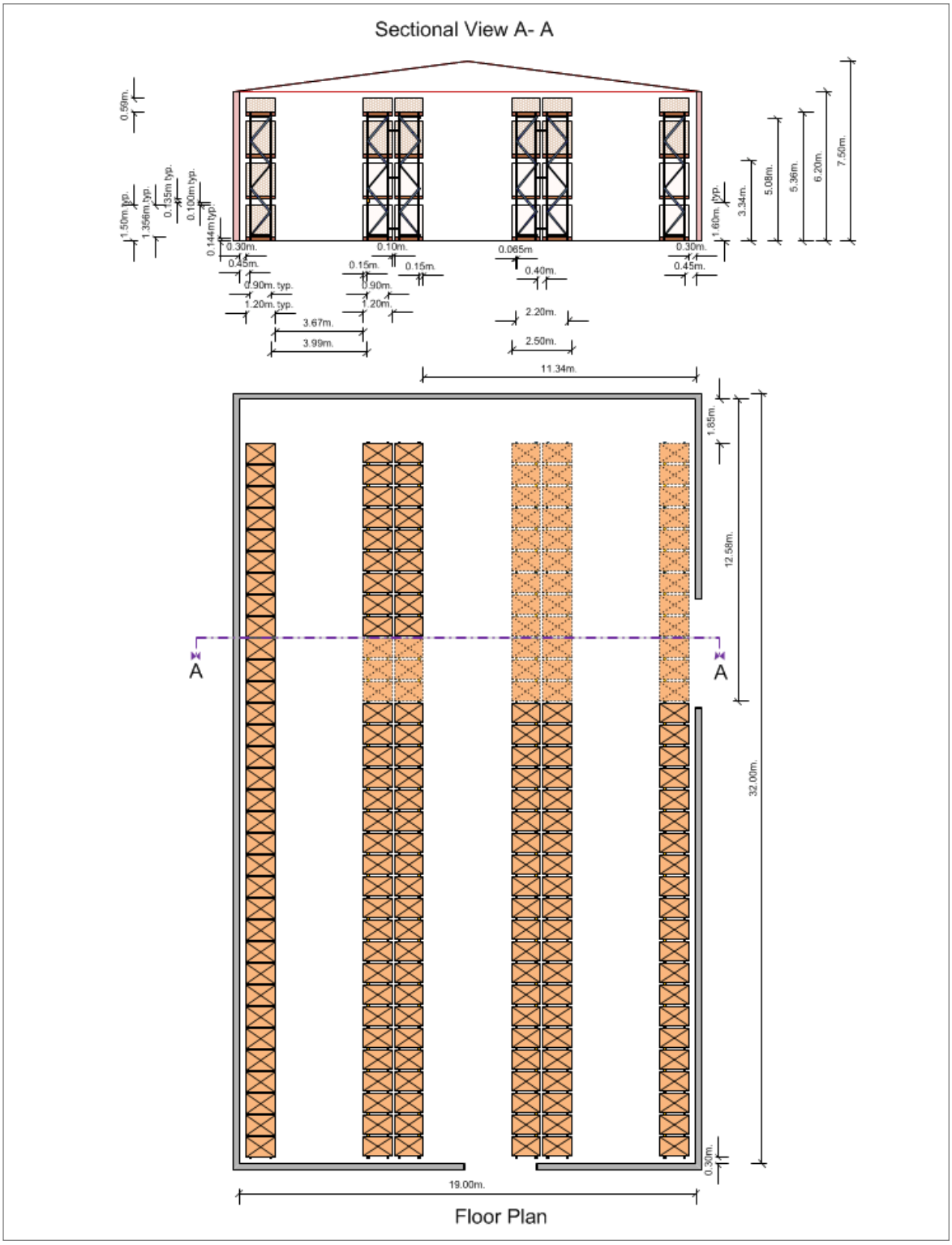
- Install three single rows of pallet racking across the width of warehouse A.
- Include 42 pallet positions in each row.
- Place two aisles between the rows of pallets, with each aisle 1.9 meters wide.
- Purchase or obtain a VNA or side-loading forklift that can be maneuvered in the 1.9 meter narrow-width aisle. xxx
- Install two full pallet levels, equal to 252 pallet positions.
- Ensure the height to the eaves allows for an additional level of half-full pallets, which are the equivalent of 87 full pallets.
- Install a gangway that will accommodate the position of the door—it must allow for the entry and movement of personnel and MHE. Twelve pallet positions must be removed.
- Warehouse A will have 327 pallet positions created.

The proposed procurement and deployment of MHE for the site is as follows:

- 2 × VNA forklifts
- 3 × pallet jacks
- 868 Euro pallets.

Riverside Warehouse

Figure 18. Proposed CMS Riverside Warehouse Layout—Short Term



The proposal for the installation of adjustable racking proposal at the Riverside warehouse site is summarized as follows:

- Install two-single plus two-double rows of pallet racking across the width of the warehouse.

- Each row will include 33 pallet positions.
- Place two aisles between the rows of pallets, with each aisle 3.47 meters wide.
- Purchase or obtain a WA forklift.
- Install three full pallet levels, equal to 594 pallet positions.
- Ensure the height to the eaves allows for an additional level of half-full pallets, which are the equivalent of 87 full pallets.
- Install a gangway that will accommodate the position of the door—it must allow for the entry and movement of personnel and MHE. Thirty pallet positions must be removed.
- The warehouse will have 651 pallet positions.

The proposed procurement and deployment of MHE for the site is as follows:

- 2 × WA forklifts
- 3 × pallet jacks
- 858 Euro pallets.

Table 4 summarizes the racked and unracked CMS storage space at the three sites after the proposed short-term period improvements were completed (Phase 1).

Table 4. Racked and Block Stack Pallet Position Status at End of Short- to Medium-Term Period

Site	Konyokonyo Warehouse	Riverside Warehouse	Airport Warehouse	Total
Max. volume (cubic meters) based on building dimensions	910.6	792	486	2,188.6
Equivalent no pallet positions	668	584	358	1,610
Short-term CMS improvements (Phase 1)				
Pallets positions introduced by racking	325	651	0	976
Equivalent volume on racked pallets (cubic meters)	440.7	882.8	0	1,323.5
Balance volume unracked (cubic meters)	227.3	-298.8	358	2,86.5
Equivalent pallets still in block stacks	168	-220	264	211

Highlights are listed as follows:

- Riverside site
  - All stock currently at the Riverside warehouse will be on racked pallet positions.
  - There will be 220 empty racked pallet positions.
- Airport warehouse
  - At least 83 percent of the stock at Airport warehouse can be transferred to the extra racked pallet positions at the Riverside warehouse.
- Konyokonyo site
  - At least 49 percent of current stock at Konyokonyo warehouse will be racked.

- Only 25 percent of current stock (equivalent of 168 pallets) will be stored on block stacks.

Space requirements for EMF commodities—

Assuming that all stock currently stored in the CMS warehouses has been distributed to the counties—

- The implementation of Phase 1 inputs will not be adequate for proper storage of the EMF shipment scheduled for three months (1,852 pallet positions).
- Only 52 percent of EMF shipment scheduled for three months will be stored on racks.

Medium-Term Goals (12–24 months)

Redeployment of WMS System

Currently, the CMS has one computer at the mSupply Konyokonyo warehouse loaded with the package.

It is recommended that the CMS increase the short-term use of mSupply; they can move all the stock card and Excel-based operations to mSupply in the medium term. The CMS must take advantage of the lessons learned by other current local users of the package.

To network the existing six computers, mSupply can be used; and, it can be used to improve inventory control.

Implementation should be phased in the following:

Short-Term

Capability to—

- enter inventory receipts
- determine bin location
- use system-assisted putaway
- trace batch/lot
- use first-to-expire, first-out (FEFO)-based picking process.

Medium-Term

Integrate with—

- supplier data
- customer data
- financial module.

Also, it should have reporting capability:

Based on the current activities at the CMS, the operations must have a WMS with the following capabilities:

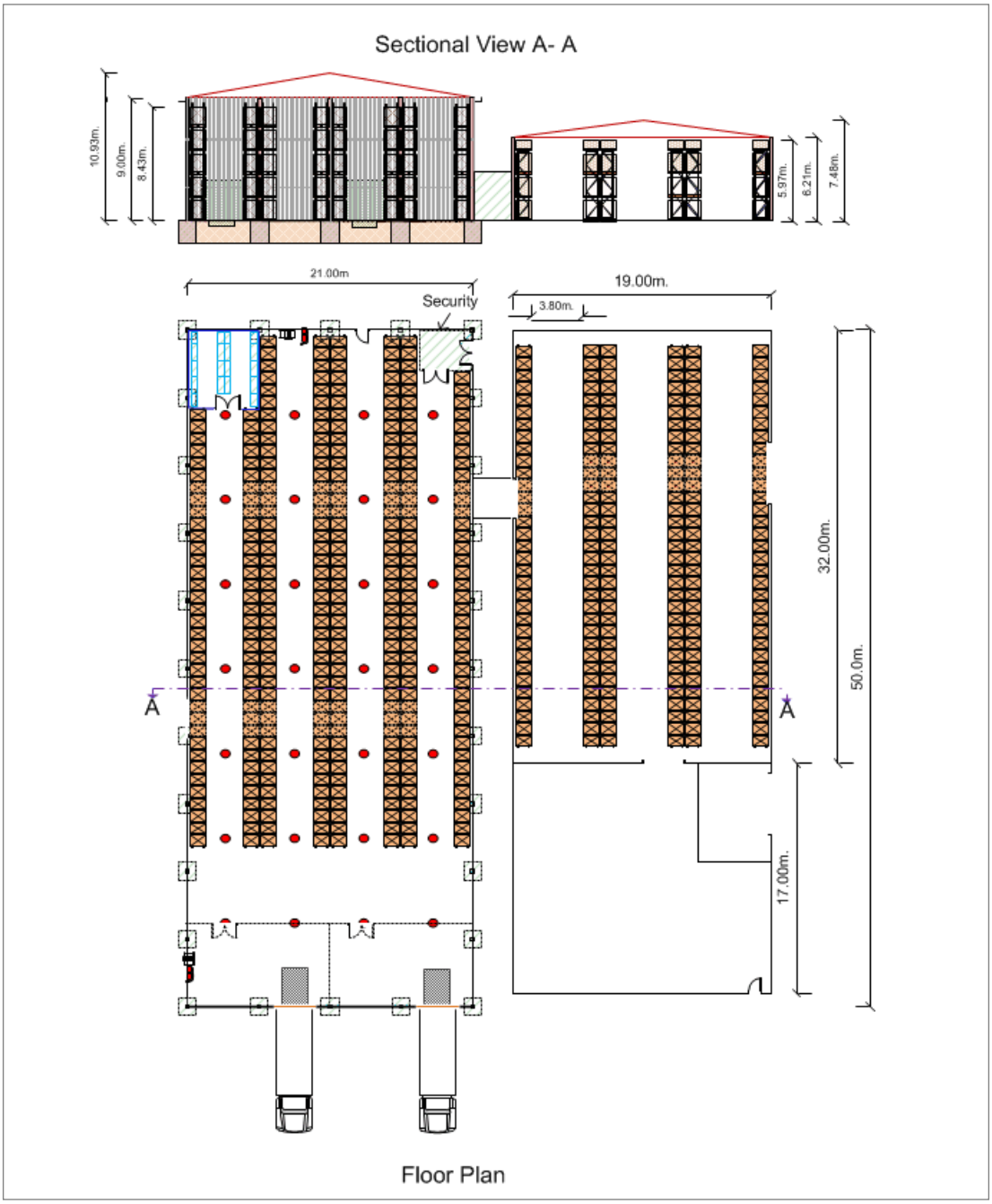
- enter inventory receipts
- determine bin location
- use system-assisted putaway

- trace batch/lot
- use FEFO-based picking process.
- integrate with supplier data
- integrate with customer data
- integrate with financial module
- have reporting capability.

Provide WiB at the CMS Warehouse Site

It is recommended that the CMS install one module of the WiB at the Riverside warehouse site during the next 12 to 24 months.

Figure 19. Proposed CMS Riverside Warehouse Layout—Medium Term



The proposed design, based on the WiB template in figure 19, has a 1,050 m2 warehouse, with the following features:

- a single WiB module, measuring 50 meters long, 21 meters wide, and 10.9 meters high.
- a cold room, measuring 5.9 meters long, 5.4 meters wide, and 6 meters high.
- passage running under the APR provides access across the warehouse for both staff and MHE; installing a *passage mirror* will minimize accidents.
- two fire hose reels, 30 meters long each.
- four fire extinguishers.

- an alarmed fire escape door.

The following must be provided:

- adequate lighting and electrical points
- air conditioning, with temperature and humidity data loggers
- MHE, including forklift(s), reach trucks, and pallet jacks
- pest control kit and rodent bait traps
- signage for health and safety.

The following optional items should be considered:

- generator
- UPS
- access control
- CCTV facility.

The proposed design will provide storage capacity for the facility:

- warehouse that measures 1,050 m2, standing at 9.00 meters at the eaves
- the width of the room to allow for two-single, plus three-double, rows of pallet racking
- aisle width of 3.80 meters to allow for a WA forklift
- height to the eaves to allow for five full pallet levels, yielding 1,605 pallet positions
- gangway to allow for entry and movement for the personnel and MHE (84 pallets less than the total) because of the door's position
- total of 1,521pallet positions.

The following procurement and deployment of MHE for the site is recommended:

- 2 × WA forklifts for the site
- 4 × pallet jacks
- 1,521 Euro pallets.

Table 5 summarizes the racked and unracked CMS storage space at the three sites after the proposed medium-term period improvements were completed (Phase 2).

Table 5. Racked and Block Stack Pallet Position Status at End of Medium-Term Period

Site	Konyokonyo Warehouse	Riverside Warehouse	Airport Warehouse	Total
Max. volume (cubic meters) based on building dimensions	910.6	792	486	2,188.6
Equivalent no pallets positions	668	584	358	1,610
Short-term CMS improvements (Phase 1)				
Pallets positions introduced by racking	325	651	0	976
Equivalent volume on racked pallets (cubic meters)	440.7	882.8	0	1,323.5
Balance volume unracked (cubic meters)	227.3	-298.8	358	286.5
Equivalent pallets still in block stacks	168	-220	264	211
Medium-term CMS improvements (Phase 2)				
Pallets positions introduced by racking	0	1,521	0	1,521
Equivalent volume on racked pallets (cubic meters)	0	2,062.5	0	2,062.5
Balance volume unracked (cubic meters)	227.3	-2,361.2	358	-1,775.9
Equivalent pallets still in block stacks	168	-1,741	264	-1,310

Highlights are listed as follows:

- Riverside site
  - The single WiB unit will be configured for 1,521 pallet position.
  - The total racked pallet position total for CMS will be 2,497.
  - All stock at Riverside warehouse will be racked.
- Airport warehouse
  - All stock at the Airport warehouse will be at Riverside, which will be racked.
- Konyokonyo site
  - All stock at Konyokonyo will be racked, with 67 percent of stock at Konyokonyo, and 33 percent at Riverside warehouse.

Space requirements for EMF commodities—

Assuming that all stock currently stored in the CMS warehouses will have been distributed to the counties:

- The implementation of Phase 2 inputs will be adequate for proper storage of EMF shipment scheduled for three months (1,852 pallet positions).
- The exercise will also make 645 racked pallet positions available for other CMS commodities.
- At this point, CMS could choose to centralize their operations at Riverside warehouse, and close down the Konyokonyo site.

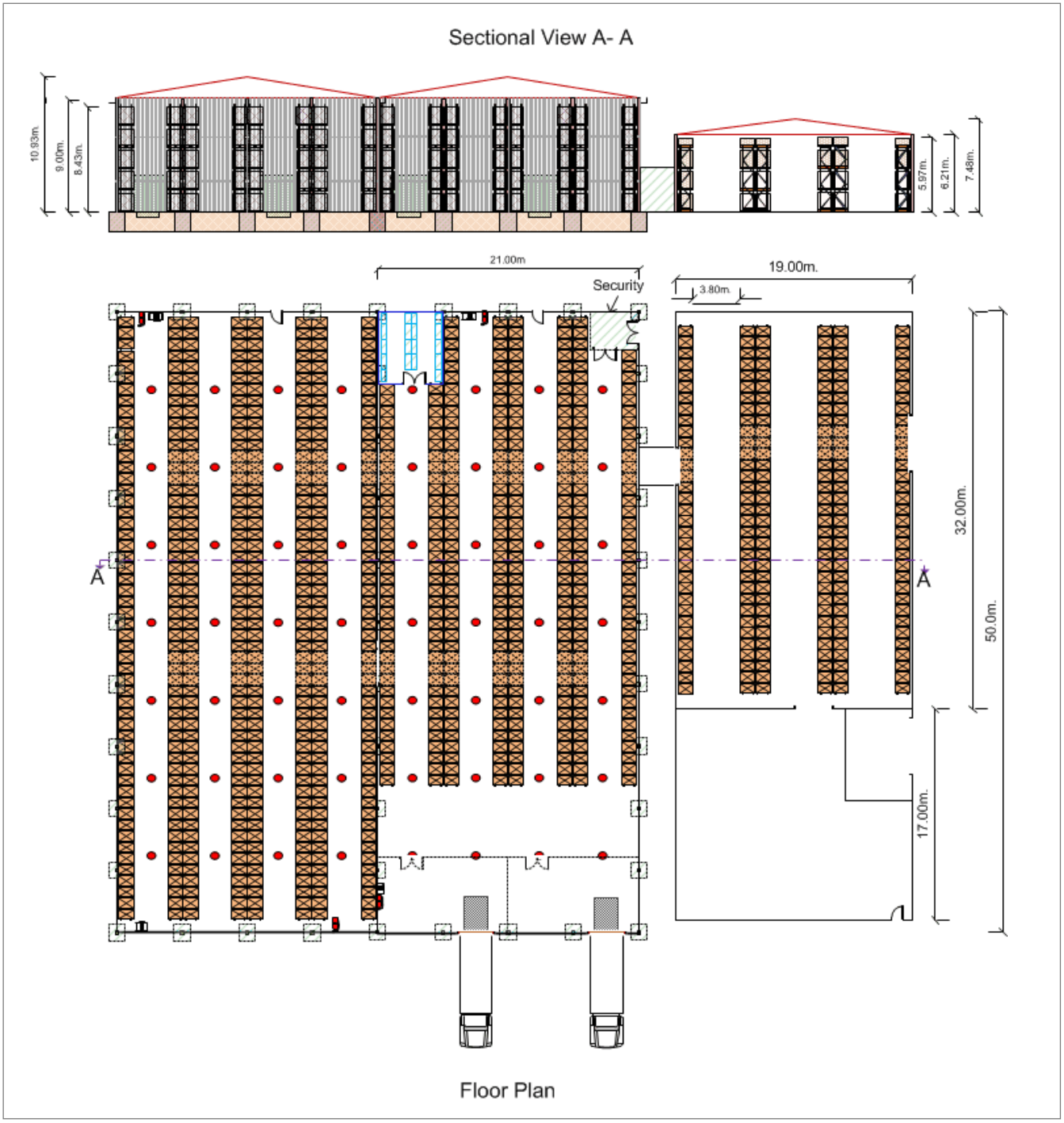
Long-Term Goals (24–36 months)

Providing Storage Capacity at the Riverside Warehouse

In the long term, it is also feasible to expand storage capacity at Riverside warehouse by erecting a second WiB module at the Riverside site.

Figure 20 shows the suggested expansion.

Figure 20. Proposed CMS Riverside Warehouse Layout—Long Term



The proposed design provides an additional 2,076 pallet positions for the facility.

The following MHE is recommended for the site:

- 4 × WA forklifts
- 8 × pallet jacks
- 2,076 Euro pallets.

Space requirements for EMF commodities—

- After implementation of the long term (Phase 3), CMS will have an installed capacity of 4,248 racked pallet positions at the Riverside site.
- The Riverside warehouse installed capacity is 545 pallet positions more than the required storage capacity of the EMF shipments scheduled for six months.
- The 545 will be available for the storage of other CMS commodities.

Strengthening of Distribution Chain as Agreed to by Principals

As part of the long-term strategy for the CMS, it is probably advisable to provide smaller size capacity warehousing for selected regions. This will reduce the pressure for the main warehouses in Juba, while it strengthens these hubs.

Other Recommendations

Before the racking installation, and the repair or patching of the CMS facilities, can begin, all the CMS facilities must be empty—the stock currently in the warehouses must be removed. Before the EMF commodities arrive at the county level, it is recommended that the MOH work with the state and county health departments' CHD to remove expired products; this will increase space and alleviate space constraints at some of the lower-level facilities. In addition, it is recommended that the MOH develop a formal process and policy for redistribution or sharing of excess goods between facilities. To avoid expiries and wastage, as well as add space for needed products, the commodities not being used at one facility can be transferred to another facility.

Next Steps

The following steps will help facilitate the operationalization and implementation of the recommendations:

- The partners should review the recommended CMS improvements and provide feedback, including agreement on which recommendations to undertake for developing and refining the timeline and workplan submitted by the USAID | DELIVER PROJECT.
- Determine, with the MOH and CMS, when the CMS warehouse facilities will be emptied of the commodities currently at the facilities; this will impact the timeline for the CMS improvements.
- Reassess storage space needs after better estimates of the incoming volume of EMF commodities are known.
- Determine other possible technical assistance (TA) and who will provide the TA to strengthen and build the CMS' capacity.

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Appendix A

Persons Contacted

Ministry of Health

- Dr. Markur Karom, Undersecretary
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