RE-DESIGN WAREHOUSE PLANT LAYOUT FOR A FOOD COMPANY

by

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A Research Paper

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ABSTRACT

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This research paper presents a comprehensive look at the issues involved in increasing production by expanding the number of operating lines within a food company at Eau-Claire, Wisconsin. Nestle was the company specifically selected for this study, which includes re-design warehouse storage methods and needs, re-design warehouse layout, and improvement in efficiency of their existing warehouse.

Nestlé has been making food and beverage products for families around the world for more than a century. Nestles' Eau Claire, Wisconsin factory produces wet and dry mixes of infant formula and health supplements. The facility contains a number of wet and dry mixing and packaging lines. The facility is supported by 2 warehouses, at either end of the facility, and 4 off-site

warehouses. The North warehouse primarily stores corrugated and labeling packaging materials, and packaged finished goods. The South warehouse stores empty cans, can ends, ingredients, and staged materials. The off-site warehouses store additional bulk ingredients and packaging materials. This study will be focused on the South warehouse.

The proposed layout must be robust, able to meet future needs without additional equipment or re-design. Long-term goals are to reduce the amount of ingredients inventory in stock, to reduce dependence on outside warehouses.

The quantitative technique was used to describe the current receiving process, warehouse layout, and inventory status. The plant layout design offered potential improvement by trying to optimize quality, promoting effective use of the people, equipment and space and increasing production.

Important recommendations are that weigh-up should only work one day ahead based on the next day's production. Staged items from weigh-in should be stored together in groups of 3 pallets by batch. The location should be adjacent to weigh-up. All full pallets of bulk materials should be sent to the outside warehouses, because of the FIFO policy. Full pallets of bulk materials should be sent to the South warehouse one day in advance of production, based on the next day's schedule. Full pallets of other ingredients should be stored by lot in the South warehouse.

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Finally, I want to thanks my parents, Rolando and Elsie, for being what I am.

Rolando Jose Vetencourt

DEDICATION

To my parents for their continuous support

To my daughter, niece and nephews because I have to be an example for them

To my wife for her support

To my mother in law and sisters for their constant interest in my professional development

Thanks to all of you.

Rolo

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Chapter I

Introduction

Despite every effort in lean manufacturing to eliminate warehousing and inventory, warehousing will continue to play a critical role in assuring high levels of customer service and overall logistics performance.

Warehousing minimizes the effects of supply chain inefficiencies, improves logistics accuracy and inventory management, and allows product accumulation, consolidation, and customization. The cost of warehousing should be commensurate with the contribution of warehousing to overall logistics performance - typically between 2% and 5% of corporate revenue. In world-class warehousing these costs are minimized while improving customer service. (Frazelle, 2002, p.25-28).

For well over a century, Nestlé has been making quality food and beverage products for families around the world. Nestlé USA is owned by Nestlé S.A. of Vevey, Switzerland, the World's largest food company, with $8 billion in sales in 2000. Currently Nestlé has 17,300 employees nationwide and 33 manufacturing facilities, 6 distribution centers and 17sales offices around the country. The 7 divisions are Beverage, Confections & Snacks, Food Services Foreign Trade, Nutrition, Pet Care, and Prepared Foods.

Nestlé vision as part of the world's leading food company is to provide families with the best food and beverages throughout their lives. Nestlé success is based on the quality of their products and on relationships Nestlé continually

builds with their customers, their employees, their communities and their suppliers who continually look to Nestle Company to be the very best. Nestlé commitment to achieving this vision is a source of Nestlé pride.

Nestlé Eau Claire, Wisconsin factory produces wet and dry mixes of infant formula and health supplements. The facility contains a number of wet and dry mixing and packaging lines. The facility is supported by 2 warehouses, at either end of the facility, and 4 off-site warehouses. The North warehouse primarily stores corrugated and labeling packaging materials, and packaged finished goods. The South warehouse stores empty cans, can ends, ingredients, and staged materials. The off-site warehouses store additional bulk ingredients and packaging materials. This study will focus on the South warehouse.

Problem Statement

Nestlé is planning to increase production by expanding the number of lines operating in the facility in the next few years. They are looking to improve the efficiency of their existing warehouse both in terms of space utilization and efficiency. The proposed layout must be robust, able to meet future needs without additional equipment or re-design.

Long-term goals are to reduce the amount of ingredients inventory in stock and to reduce dependence on outside warehouses. The design will improve the efficiency of the material moves and provide separate space for the different type

of storages. The continuing recommendations will change the process and reduce the number of moves.

CHAPTER 2

Literature Review

2.1 Plant Layout Design

Plant Layout is the organization of the physical facilities of a company to promote the efficient use of equipment, material, people and energy. The goals of a Plant layout design are to minimize unit costs, optimize quality, promote effective use of people, equipment, space and energy, provide for employee convenience, safety and comfort, control project costs, and achieve production deadlines. (Frazelle, 2002, p.189-200)

The procedure followed in Plant Layout Design consist in 4 phases, starting with gathering data and information, continuing with production and flow analysis, ongoing with identifying and supporting services, and ending with the implementation and a follow up evaluation.

2.2 Flow Analysis

The flow analysis considers the operations, transportations, inspections, delays, and storages required as a part moves from receiving to shipping in a plant. The purposes of this kind of analysis are to minimize distance traveled to minimize backtracking, to minimize cross-traffic, to eliminate unnecessary steps in the process, to combine steps in the process, and to minimize production costs. (Meyers, 1993, p.45-70)

The most commons flow analysis techniques used in a plant are flow process charts, flow diagrams and operation charts.

Flow Diagram

A flow diagram is a graphical diagram which shows the path traveled by each part from receiving to stores to fabrication of each part to final assembly to packout to warehousing to shipping.

Operations Charts

An operation chart graphically shows the raw material, the buyouts, the fabrication sequence, the assembly sequence, the equipment needs, the time standards, and an indication of plant layout.

2.3 Flow Process Charts

The flow process chart combines the operations chart with the process chart. It is a Quality Improvement Tool used specifically for a process. It is defined as a pictorial representation describing a process being studied or even used to plan stages of a project. Flow charts tend to provide people with a common language or reference point when dealing with a project or process. Four particular types of flow charts have proven useful when dealing with a process analysis: top-down flow chart, detailed flow chart, work flow diagrams, and a deployment chart. Each of the different types of flow charts tends to provide a different aspect to a process or a task. Flow charts provide an excellent form of documentation for a process, and quite often are useful when examining how various steps in a process work together. When dealing with a process flow chart, two separate

stages of the process should be considered: the finished product and the making of the product. In order to analyze the finished product or how to operate the process, flow charts tend to use simple and easily recognizable symbols. The basic flow chart symbols below are used when analyzing how to operate a process. (Cedarleaf,1994, p.13-22)

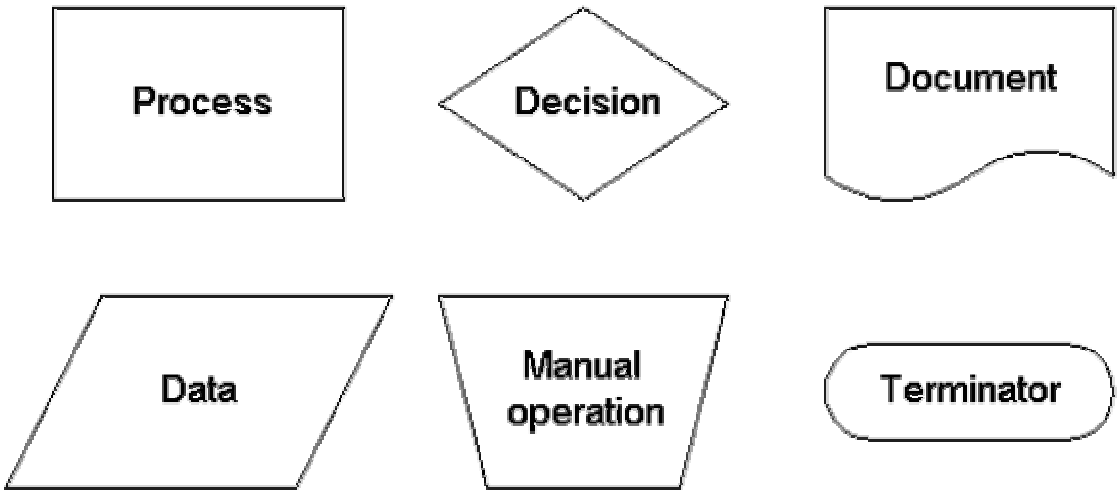

Figure 1. Flow chart symbols

In order to analyze the second condition for a flow process chart, one should use the ANSI standard symbols. The ANSI standard symbols used most often include the following:

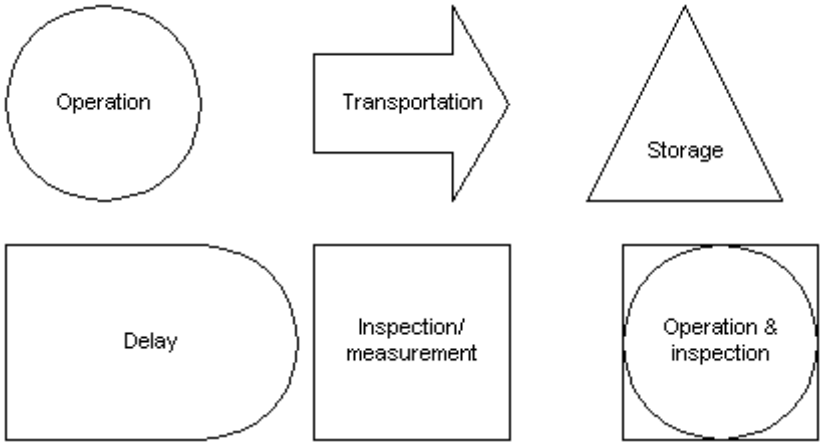

Figure 2. ANSI standard symbols for flow charts.

2.4 Inventory

Inventories are tangible assets that incur costs, tie up working capital, consume space, and must be managed in and out. Most operations, capacity planning and scheduling and depend on inventory. Inventory are held for sale in the normal core of business, or used in producing goods and services for sale. Stocks fill the timing gaps in the rates of supply and demand. Inventory offers insurance and good planning/ control can minimize the associated costs and satisfy efficiency/effectiveness requirements. Basic inventory decisions involve how much to order (replacement quantities), when to order (timing), and how to control the stock system security (issues, safety levels, issues from stock etc). (Sule,1994, p.385-400)

Types of inventory

The inventory depends on the nature of the company. The different types of inventory are:

- Merchandise inventory: goods held for sale, ready for sale without further processing.
- Raw materials inventory: materials stored that are used in production.
- Work-in-process inventory: partially completed goods.
- Finished goods inventory: manufactured goods, ready for sale.

There are two common ways on how to use the purchased goods after they are stacked up in piles, and the oldest items are at the bottom of the pile. **LIFO** (last in-first out) take from top of the pile, and **FIFO** (first in-first out) take from the bottom of the pile.

The types of inventories are commonly recognized by their SKU. SKU stands for Stocking Keeping Unit and is a number associated with a product for inventory purposes. Most of the companies use this number to identify an individual product. Because of this, each product must have a SKU, and each SKU must be unique.

2.5 Storage Rack Systems

There are many designs of racks to be used in pallet storage. The most common are flow rack system, single deep rack, double deep rack, push back

rack. Some other storage systems are carton flow rack, cantilever rack and drive-in rack.

Flow Rack System

Flow storage rack consists of two elements: a static rack structure and dynamic flow rails. The flow rails are track/roller system set at a decline along the length of the rack. Flow rails allow loads to move by gravity from the loading end to the unloading end. Each flow lane should include speed controllers to gently control the speed of the movement within the flow lanes. As the load is removed, the loads behind it move forward to the unloading position. The flow system dimensions are limited only by the size of the facility and the capabilities of the material handling equipment. This kind of system is used in situations where storage density and inventory rotation is a priority. Some of the advantages are: works for FIFO inventory control, reduces handling costs as it eliminates labor and fork truck operations, reduces handling equipment costs as fork lifts are used needed for initial loading and final unloading, saves time and labor as members can just be dedicated to specific functions (loading and unloading), traffic is more orderly, employees are more efficient helping to increase overall productivity, space savings as storage density can be doubled, construction cost savings as the need for a new area can be eliminated by increasing storage capacity within existing facilities. (Frazelle, 2002, p.85-108).

Single-deep Rack

Selective rack is that configuration which places all loads on an aisle. This configuration is the most commonly used in industry today. It provides efficient use of space, yet it allows you immediate access to everything in storage. The height of a selective rack system is determined by the facility dimensions, available lift equipment, and use considerations. The rack itself consists of horizontal load-supporting members (beams) and vertical members (frames) which suspend these horizontal members off of the floor. Rack frames consist of front and rear column sections which are tied together by horizontal braces. Beams are connected to these frames using welded endplates, allowing for a connection of inherent rigidity. This rack design is ideal if you have product which you need separated for individual and immediate picking. Loads do not need to be stackable, and may be of varying heights and widths. In instances where the load depth is highly variable, it may be necessary to provide load supports or decking. The biggest advantage of this system is for items whose storage requirements is less than six months. (Frazelle, 2002, p.85-108)

Double Deep Rack

A double-deep rack is simply a single-deep selective rack that is two unit load positions deep. The advantage of the double-deep feature is fewer aisles, resulting in a more efficient use of floor space. This configuration is used when the storage requirements for an SKU is six units or greater and when product is received and picked frequently in units of two unit loads. In order to get to the furthest pallet from the aisle, the load on the aisle would need to be removed.

Additionally, not all lift equipment is capable of reaching back far enough to pick the rear load, and this is a major consideration. (Frazelle, 2002, p.85-108)

Push-back Rack

Push-back rack provides, with a rail-guided carrier provided for each pallet load, LIFO deep lane storage. It gets its name from the manner in which it operates, where loads are placed on carts on inclined rails, which are then pushed back into the rack with subsequent loads. Push back rack uses a common entrance and exit (the forklift loads and recovers from the same position), requiring only one aisle for proper operation. Each storage lane has its own set of carts, so they operate independently. The last load inserted rests on the cart rails, and the first load inserted is placed in front the top cart of the group. When the next load is inserted, the lift truck driver pushes the top cart and its load back to expose the next cart, in front which the second load is set. This sequence is repeated until, when the loads are all pushed back, only the set of rails in front which the carts ride is exposed. The last load is placed directly in front the rails. Unloading is done in reverse order, and because the loads are free to flow toward the front of the lane, the lift truck driver must control the removal speed to keep subsequent loads from free-flowing to the front of the system. The increase in selectivity and the potential for higher system utilization makes push back a logical choice for most operations, especially for those requiring high throughput. (Frazelle, 2002, p.85-108)

2.6 Random Storage

In random storage there is no assigned slot for any of the SKUs. Items are stored in any available location. Most commonly, this policy is implemented by storing items at the most convenient storage location available and retreiving on a First FIFO basis. This allows for inventory to be rotated while still providing some handling efficiency. The resulting storage pattern is very similar to a completely random policy if the throughput of the warehouse is high and the utilization is close to the warehouse capacity. (Frazielle, 2002, p.35-40).

2.7 Dedicated Storage

In dedicated storage systems, each SKU has a number of pre-assigned storage slots. During operation the closest empty slot that has been pre-assigned to the SKU is used for storage and retreival is on a FIFO basis. (Frazielle, 2002, p.35-40).

2.8 Warehouse Optimization

Training

Training employees is inexpensive and will likely have the greatest return on investment. Operations that lack adequate procedures and employee training are likely to suffer from poor quality, low productivity, safety issues, low employee morale, highly stressed supervisors and managers, and a general lack of control. These chaotic conditions caused by poor training tend to contribute to the ongoing cycle of inadequate training by making it difficult for supervisors and

managers to find time to define procedures and train employees. The only way to break the cycle is to take the time to define and document the procedures and implement an employee-training program.

Tools

Making sure employees have the proper tools readily available to perform their job functions can also have significant impact on operations. Time wasted by employees wandering around the warehouse searching for a pallet jack or a tape dispenser will certainly be more detrimental to the bottom line that will the cost of purchasing more of these low cost items. Also it is important to ensure purchasing quality tools and supplies. (Piasecki, 2002)

Chapter III

Methodology

This study was designed to improve the efficiency of the existing warehouse in terms of space utilization and efficiency. The quantitative technique was used to describe the data necessary to draw assumption about the effects of the current receiving process, warehouse layout, and inventory status.

Several assumptions and limitations were part of the project. The quantitative evaluation of the data chosen came from information gathering of the current receiving process, warehouse layout, and inventory status. The data was reviewed as a baseline and were drawn conclusions that demonstrated that the current process could be improved. The plant lay out design offered potential improvement by trying to optimize quality, promoting effective use of the people, equipment, space and increasing production. The design was challenged to eliminate as many steps as possible, combine steps, remove backtracking and cross-traffic, reduce distance traveled, decrease production costs, improve quality and increase safety.

The limitations of the project were:

A.- Process:

- Truck unloading process will not change.
- Standard fork trucks are used.
- Lab samples will always be required of several items.

- All items are perishable and must use first-in-first-out (FIFO) inventory.
- Partial pallets of ingredients must be used up before breaking new pallets.
- Recipes will not change. They are designed around full pallets of bulk ingredients.
- Each recipe contains 20-35 ingredients that are stored on 3 pallets.
- Each recipe also contains 3 or 4 filler ingredients stored on 6 to 13 pallets.
- Emergency batches of primary products may be required with little lead time.

B.-Layout:

- Warehouse will not expand – no growth space.
- Receiving area is sufficient for growth, and will not move.
- All perimeter doors to dock, weigh-up, production, etc. must be accessible.
- Liquids in tank farm will not move.
- Chemicals in secure room locations will not move.
- Cans and can ends will stay in South warehouse up to 3 more years, but can be moved.
- All racks can be moved.
- All pedestrian/truck aisles will be 14’ wide, internal truck aisles will be 11’ wide.
- No storage may be within 18 inches of walls for pest control.
- Building clear heights generally permit 4-high storage in bulk or racks.

- Pipes and sprinklers limit vertical space to 3-high is some areas, and these areas will not change.

C.- Inventory:

- Packaging of bulk materials will not change, as recipes are designed around the quantities.
- Currently 16 batches per day, plan for growth to 22 batches per day.
- Currently 15 bulk/cereal items and 174 other items. Plan for these numbers to remain stable.
- Inventory level on 5/29/02 was 10-15% low.
- With normal levels of inventory and production increases, plan for 30-40% increase in inventory.
- Cereal base can only be stacked 1 high, but can fit in flow-through racks.
- Bulk bags can only be stacked 2 high, but can fit in flow-through racks.
- Other bagged items can be stacked 3 high.
- Other bagged items may overhang pallets, but as long as each pallet is not too high, they can fit in push-back racks.
- Items in drums can be stacked 4 high, and can also fit in push-back racks.

Chapter IV

Analysis and Results

The current receiving process is generally summarized in the Figure 3 process flow chart. The figure assumes that the item is stored in an outside warehouse. Items stored in the South warehouse do not need the steps to move the item from the outside warehouse. Bulk items that are used in full pallet quantities do not require the weigh-up and partial pallet steps. The process requires 11 material moves and 3 separate storages. In general, the new warehouse design will use the same process. The design will improve the efficiency of the material moves and provide separate space for the different type of storages. The long-term recommendations will change the process and reduce the number of moves.

The Figure 3 below shows the receiving area process flow at Nestlé South warehouse.

The current warehouse layout is shown in Appendix A. It contains different sections shown in table 1 and table 2 below.

Figure 3. Receiving area process flow:

→ Truck arrive at south WH

□ Operator checks bill of lading

→ Truck directed to proper WH (WOW, WOW2, South)

→ Unload items to staging area

□ Operator checks for damage

○ Bill of lading signed

○ Pallet tags printed and placed on pallets

D Wait for samples to be taken

○ Lab takes samples

→ Pallets put into locations

▼ Stored in locations until lab release lot + is needed at weigh-up 0-30 days ahead

→ Move pallets onto truck

→ Drive truck to south warehouse

→ Place pallets to any locations

▼ Store in location 2-3 days ahead

→ Full pallet or partial load moved to weigh-up

○ Proper quantity weighed + placed in separated container on staging pallet

→ Unused quantity returned to partial pallet

D For other ingredients to be measured

→ Batch moved to storage location

▼ Stored in stage area waiting for production, 1-5 days

→ Move to production

Where symbols mean:

○ Operation

□ Transport

→ Inspect

D Delay

▼ Storage

Table 1. Current section distribution

Area	Sections	Pallets
Tank farm	16	
Bulk floor stacking	40	750 (assuming 2-high stacking)
Push-back rack	44	592 (assuming filled 3 to 4 deep)
Flow-through rack	5	80 (assuming filled 4 deep)
Can/ends storage	10	
Total pallets of materials		1442

The inventory status as of 5/29/02 was found as a baseline. With 1271 pallets in stock, the south warehouse was about 90% full, the separation of the data was do it per location: pallets in out side warehouses, pallets on floor and pallets in racks, after the classification of the inventory was do it per packaging in Bulks, bags/drums and stage materials in the south warehouse . A summary of the dry ingredient items and pallets is listed below. Assuming 160 pallets per day usage and that the sample inventory level is about 15% low, there is about 19 days of inventory in the warehouses.

Table 2 below shows how the ingredients are distributed.

Table 2. Distribution of ingredients.

		Pallets		
Item	**No. of item**	**Outside**	**On floor**	**In racks**
Bulk/cereal	15	569	361	0
Other ingredients(bags, drums)	174	803	526	344
Staged materials				40
Total pallets of materials		1372	887	384
Total pallets overall		2643		

The contents of each individual storage location were also surveyed. Randomized storage was used in all locations. In randomized storage, items are not permanently assigned to locations, permitting more efficient use of storage space. About 75% of the rack and floor locations contained multiple lots of materials, most of which would require removal and later replacement of the items in front to reach the items in back, adding greatly to the inefficiency of the warehouse. Additionally, staged lots and raw ingredients were found in the same locations, adding to the confusion and increasing the probability that an incorrect ingredient would be added to a product.

Re-designed warehouse storage methods and needs

Table 3 shows the square footage per pallet for different types of storage methods, including the aisle space in front of the pallets. However, the numbers can be unreliable, because the deeper the storage space, the higher probability that some of the spaces are not always used.

From this table, it can be seen that the flow rack is more efficient for storing any bulk or cereal items. Floor stacking is the best way to store pallets of drums that can be stored 4 high. Floor stacking to store pallets of bags 3 high is roughly equivalent to push-back rack for storing bags. Overall, deep rows of floor storage offer only marginal increases in storage space efficiency, while making specific pallets harder to access.

Table 3. Square feet per pallet for different types of storage

Bulk/cereal items			**Pallets**		**Feet**
Method	**Deep**	**High**	**Deep**	**Wide**	**Square feet/pallet**
Floor stacking	5	1	27’	4’6”	24.84
Floor stacking	10	1	47’	4’6”	21.62
Floor stacking	5	2	27’	4’6”	12.42
Floor stacking	10	2	47’	4’6”	10.81
Flow rack	4	4	32’	5’	10.00
Drum/bag items			**Pallets**		**Feet**
Method	**Deep**	**High**	**Deep**	**Wide**	**Square feet/pallet**
Floor stacking	3	3	19’	4’6”	9.71
Floor stacking	5	3	27’	4’6”	8.28
Floor stacking	3	4	19’	4’6”	7.28
Floor stacking	5	4	27’	4’6”	6.21
Flow rack	4	4	32’	5’	10.00
Push-back rack	3	4	20’	5’	8.33
Single pallet rack	1	4	11’	5’	13.75

Ingredients need a variety of storage location sizes. Floor storage is flexible and low-cost, and push-back racks permit storage of 4 items in one rack section. The inventory of 5/29 showed a wide mix from 1 to 30 pallets per lot.

The proposed layout has a combination of 2-deep bulk (6 or 8 pallets per location), 3-deep bulk (9 or 12 pallets per location) and 3-deep push-back rack (3 pallets per location, 4 locations per rack section). The type of space to use depends on the size of the lot. A lot of 7 drums can fit 4 high in a 2-deep floor storage area with one empty spot. A lot of 12 bags can fit 3 high in a 3-deep floor storage area and 3-deep in one push-back location. There is room for 1553 pallets in the proposed layout for these ingredients, 1 to 2 locations per item and 6 pallets per item average. This is sufficient space if one moves a few large lots to the outside warehouses. Opening additional space in the future could accommodate more of these larger lots.

Staged items can use push-back racks**.** Each batch from weigh-in has 3 pallets (salts, vitamins, and minerals). One push-back rack location can hold one batch. Six push-back rack sections will hold 24 batches (72 pallets), enough to cover the proposed 22 batches per day for the Kanban system.

Staged bulk items can use flow-through racks. The large bulk bags require flow-through racks for efficient storage, since they do not stack well. One day's production will require about 220 pallets of bulk items. The proposed layout has 368 pallet locations. The excess locations can be used to get a little over 1 day ahead, to organize items by batch, and to hold safety stock for emergency batches.

Partial pallets can use single-deep pallet racks. There are about 170 ingredients that go though weigh-up. Each will always have one partial pallet that must be easily accessible to the weigh-up area. Single deep pallet rack insures that each pallet is always accessible and not buried behind another pallet. The proposed layout has room for 192 ingredients, allowing for a few new ingredients.

Re-designed warehouse layout

Appendix B shows the proposed layout. Table 4 shows current pallets and Table 5 shows proposed pallets space. Materials are stored in the following sections, from the east side:

- Behind B-section – scrap items, unchanged
- B-section push-back rack – can ends and ingredients
- Can storage – unchanged, later to become more bulk storage for ingredients
- C-section push-back rack – ingredients storage
- D-section push-back rack – 6 sections for staging, then ingredients storage
- E-section - flow-through rack – bulk ingredients, staged pallets
- F-section - single pallet rack for partial pallets, 2 rows
- G-section - push-back rack – ingredients storage

Table 4. Current pallet spaces

Existing	**Pallet Spaces**
Push Back B9-B23	135
Push Back C1-C13	192
Push Back D7-D15	112
Push Back Stage	63
Flow Through D1-D5	80
Floor Stacking E1-E40	750
Total	1442

Table 5. Proposed pallet spaces

Existing	**Pallet Spaces**
Push Back B20-B24	45
Push Back C1-C13	192
Push Back C14-C29	192
Single Rack F1-F48	192
Floor Stacking E1-E42	315
Flow through D1-D33	368
Push Back G1-G25	300
Total	1604

Advantages of the new layout:

- Stores more pallets than the current layout (1604 vs. 1442)
- Reduces amount of staged materials
- Eliminates multiple lots in one location
- Improves efficiency of fork truck drivers
- Reduces risk of retrieving the wrong lot or item
- Improves efficiency of weigh-in personnel
- Maintains safe aisles, access, and clearances
- Requires little equipment movement. Only the can end push-back rack, staging push-back rack, and the flow through rack are moved
- Requires moderate investment. The only investment is in racking – a combination of single-deep pallet rack, flow-through rack, and push-back rack
- Robust to ingredient and product mix changes
- Easily expandable when can storage space becomes available.

Chapter V

Conclusion and Recommendations

Re-designed warehouse process

Weigh-up should only work one day ahead of production to control inventory and efficiently use warehouse space. There were some staffing irregularities in weigh-up, but the process should dictate the staffing needs, not the other way around. On our visit, there were about 4 days worth of batches built ahead. This excessive build up caused the following problems:

- 192 pallets of weighed up ingredients (16 batches x 4 days x 3 pallets), taking valuable pallet space.
- 640 pallets of bulk ingredients on the floor (16 pallets x 4 days x 10 pallets)
- inability to respond to production changes
- inventory purchased sooner to prepare for weigh-up
- risk of mixed, damaged, or spoiled batches
- overtime in weigh-up area

Segregate the inventory based on the steps in the weigh-up process. The four areas are:

- Ingredients, full pallets
- Ingredients, partial pallets
- Staged materials, full pallets
- Staged materials, from weigh-up

All full pallets of bulk materials should be sent to the outside warehouses, because of the FIFO policy. Only large shipments of other ingredients should go to outside warehouses. Full pallets of bulk materials should be sent to the South warehouse one day in advance of production, based on the next day's schedule. Space will be dedicated to stage bulk materials along a main aisle, since the inventory turns over daily in these locations. Full pallets of other ingredients should be stored by lot in the South warehouse.

Batches should be weighed up one day ahead based on the next day's production. Staged items from weigh-in should be stored together in groups of 3 pallets by batch. The location should be adjacent to weigh-up. Only enough locations for one day's production should be allotted to weigh-up. The locations should operate as a production Kanban. If there is an empty location, weigh-up can make another batch. If all locations are full, weigh-up should not make another batch.

Partial pallets should be conveniently stored close to weigh-up, since they are pulled daily. Partial pallets should not be put in the same location as other pallets or lots, to insure that they are used up first. Since there is exactly one partial pallet for each ingredient (other than bulk), one can use a dedicated storage system for the pallets. The most commonly used ingredients will be stored closest to the weigh-up area.

Each storage location should contain only one lot of one item. Multiple lots in a location increase the risk of taking the wrong lot or item. Floor stacking and push-back racks are inherently last-in first-out (LIFO). Retrieving a pallet

from behind another pallet takes 4 times as long as retrieving a pallet from the front of a location. One must pull the front pallet, pull the desired pallet, replace the front pallet, and then take the desired pallet away. If there are multiple pallets in front of the desired pallet, it takes even longer. Adherence to this rule could save 83 minutes of fork truck driver time per day (16 batches x 13 pallets/batch x 40% x 1 minute). Weigh-up time would also be saved when partial pallets were behind other pallets.

Some recommendations about inventory reduction can be a good communication between departments purchasing and material control to work just in time (JIT). Reduce lead and testing time, some materials do not need too much time to be release and reducing the days of weight-up area to one day can reduce the inventory changing the purchase to less quantities more frequently (weekly).

The appendix B shows the proposed layout. The re-design of the south warehouse improves the efficiency of the existing warehouse in terms of space utilization and efficiency. With the proposed layout, Nestlé can increase production and reduce the amount of inventory in stock and reduce dependence on outside warehouses. The design will improve the efficiency of the material moves and will provide separate space for the different type of storages. The continuing recommendations will change the process and reduce the number of moves.

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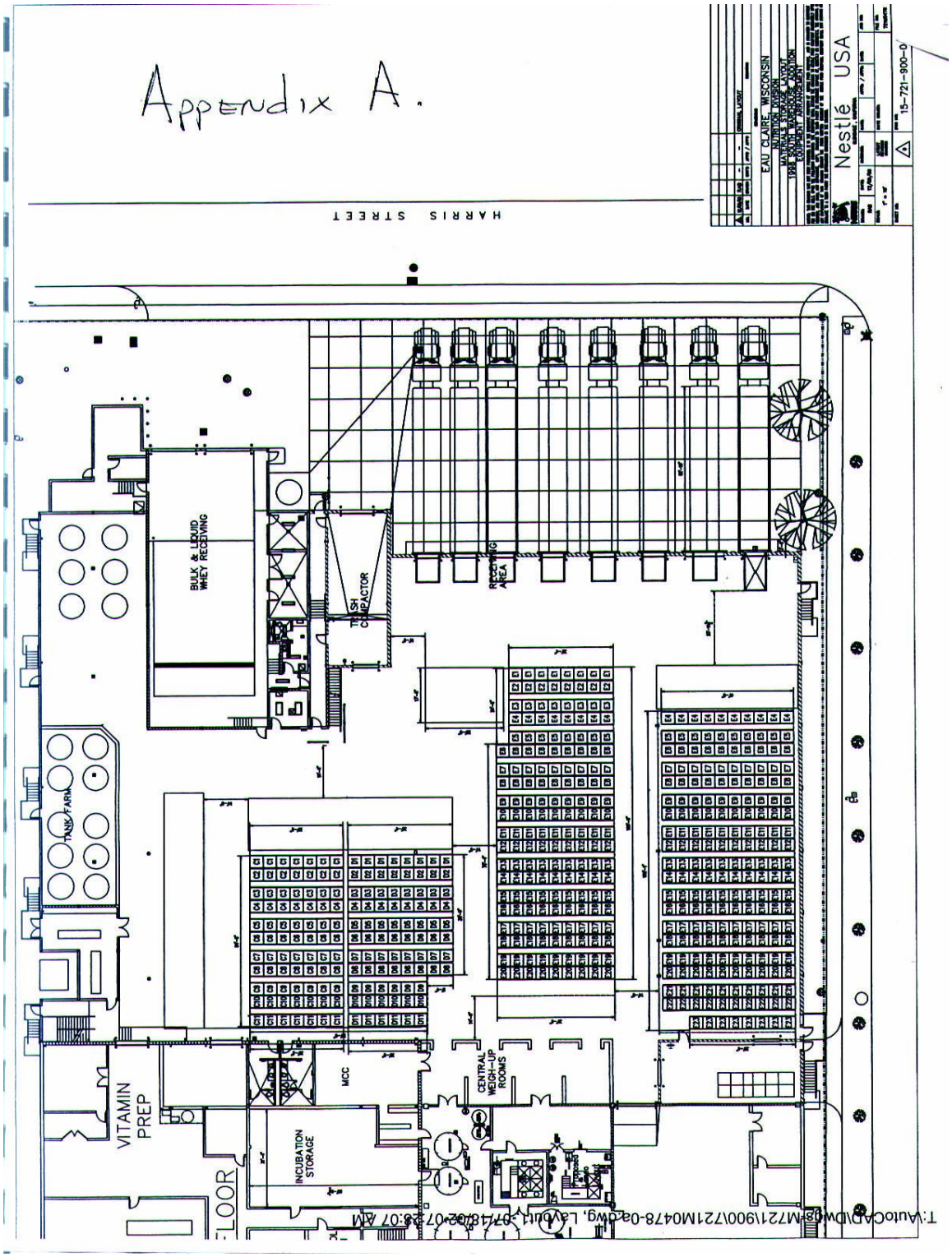
Appendix A.
Nestlé USA
EAU CLAIRE, WISCONSIN
HARRIS STREET
BULK & LIQUID WHEY RECEIVING
TRASH COMPACTOR
RECEIVING AREA
TANK FARM
VITAMIN PREP
INCUBATION STORAGE
MCC
CENTRAL WEIGH-UP ROOMS
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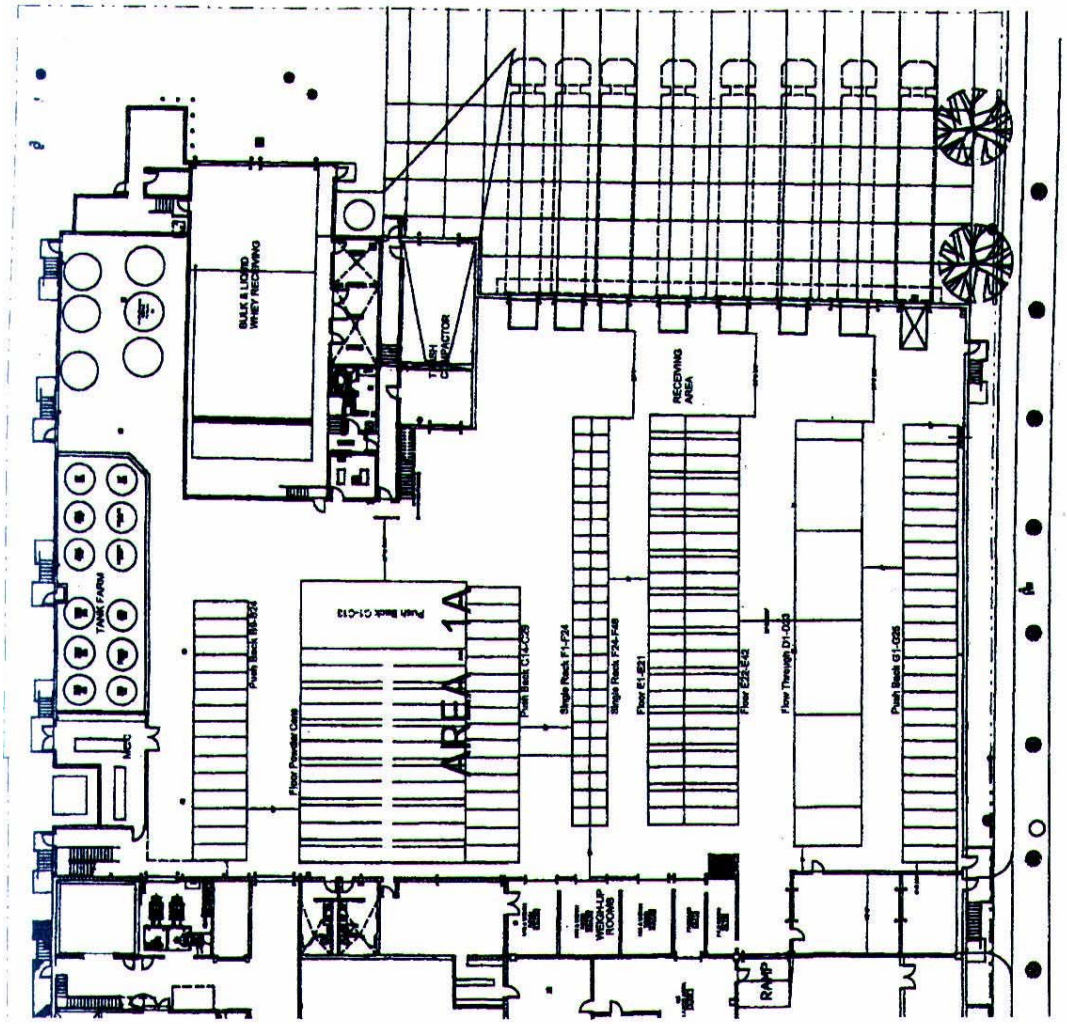
Appendix B



Appendix C

Ingredient Tables

	Item Code	Description	Pallet Tag	Packaging	Quantity	Location
1	D000528 00	ACD PHOS7	4	Barrels	100	x
2	D000536 00	L-METHION	2	Barrels	110	C4B
3	D002534 00	FIBER SOY	59	Bags		X
4	D002564 00	L-ARGININ	2	Barrels	110	C6A
5	D004538 00	COCO10/12	22	Bags	50	E14
6	D004540 00	COCOA D11	4	Bags	50	E2/E9
7	D005556 00	CLR TUMER	2	Drums		C13A
8	D005576 00	BETA CARO	13	Box	55	C9B
9	D005600 00	CLR RED31	2	Plast.Drum	40	C5A
10	D005612 00	CLR CAR05	1	Plast.Drum	40	B5B
11	D005828 00	CLR ORA40	3	Plast.Drum	40	C5A
12	D005830 00	CLR YEL40	1	Plast.Drum	40	NONE
13	D006528 00	DIMODAN P	1	Not List		C7A
14	D006542 00	EMUL PS80	1	Barrels	490	X
15	D006572 00	DIMODAN P	3	Bags	55	C13A
16	D006624 00	LECTHN3 FU	34	Barrels		X
17	D008506 00	TRYPSIN P	7	Barrels	792	X
18	D010592 00	OIL CANOL	25	Barrels		X
19	D010604 00	OIL SAFFL	2	Tanker	47000	X
20	D010640 00	OIL POSBC	4	Tanker	47000	X
21	D010644 00	OIL CA/CO	2	Tanker	47000	X
22	D010672 00	OIL CORN	2	Not List	Cooler	MISPLACED
23	D010678 00	OIL FISH	2	Barrels		X
24	D010710 00	OIL SOYBE	5	Barrels	400	X
25	D014676 00	VANIL 705	26	Box	50	E2
	D014716 00	FLV CHOC GI				NONE
26	D014802 00	FL VAN GI	3			C11C
27	D015222 00	FL CRM MT	4	Plast.Drum	40	D7A
	D015468 00	FLV STRAW		Plast.Drum	40	NONE
28	D015494 00	VN CRM453	3	Barrels	700	VTIS
29	D015786 00	VN CR#F47	3	Not List		B5A
30	D015788 00	BTR VN#48	2	Not List		B5B
31	D015824 00	VAN 56845	4	Barrels	1800/450	X
32	D015826 00	STW FC911	2	Barrels		BC4
33	D015828 00	FL FDG GI	2	Barrels		B5B
34	D015830 00	FL STR GI	2	Barrels		B4C

35	D015834 00	FL STR DR	1	Not List		B5B
36	D027504 00	CASEIN AC	1	Bags		X
37	D027510 00	MLK NFD H	40	Bags		X
38	D027574 00	MLK NFDME	27	Bags	West WI	X
39	D027592 00	ALANATE25	185	Bags		X
40	D027626 00	PWC DI809	1	Bags	50	C9B
41	D027632 00	MPH 948	7	Bags		X
42	D027638 00	PWC DI892	46	Bags	50	
43	D027670 00	CMP-HP ML	16	Not List		wow2
44	D027676 00	WPC DI879	19	Bags		E16
45	D027698 00	DARITEK D	87	Paper Bag	2000	E3
46	D027710 00	ALAPRO485	5	Paper Bag	1760	E30
47	D028180 00	DARITEK L	4	Tanker	47000	X
48	D028235 00	M/P GS206	21	Cdbrd Drum	1200/100	E3
	D029217 00	TRYPSIN NOVO		Barrels		
49	D030522 00	SODM CITR	15	Bags		E14
50	D030528 00	FRC ORTPH	3	Not List		NONE
51	D030530 00	SODM CHLO	17			
52	D030540 00	CALC CHLO	17	Paper Bag	110	E11
	D030548 00	SODIUM BICAR				NONE
53	D030554 00	SODM HYDR	7	Box	1108/26.5	E17
54	D030564 00	M/P1250-1	3	Cdbrd Drum	1000	C8A
55	D030574 00	POTS HYDR	26	Box	1980/44	E1
56	D030594 00	DISOD PHO	12	Bags	50	E1
57	D030606 00	POTS CITR	17	Paper Bag	2500	E14
58	D030636 00	HYDRCHL A	3	Box	149	X
59	D030646 00	MAG CHLOR	28	Cdbrd Drum	1200/100	E17
60	D030654 00	CALC HYDR	13	Bags	1600/50	D8B
61	D030658 00	MAG OXIDE	22	Cdbrd Drum	220/55	E14
62	D030666 00	M/P FU SO	3	Not List		SALTS
63	D030670 00	POTS CHLO	7	Cdbrd Drum	660/110	E11
64	D030672 00	M/P TE509	8	Cdbrd Drum	1200/100	E12
65	D030676 00	M/P TE21	1	Cdbrd Drum		C13B
66	D030680 00	M/P TE512	8	Cdbrd	/100	C11B

				Drum		
67	D030682 00	M/P AMINO	1	Cdbrd Drum	900/100	E12
68	D030684 00	M/P FU206	1	Not List		REJECT 2
69	D030686 00	DIPOT PHO	18	Paper Bag	2450/50	E9
70	D030716 00	DIMAG PHO	4	Cdbrd Drum	600/100	E2
71	D030740 00	TRCL PHS	33	Cdbrd Drum	250/50	E1
72	D030746 00	M/P TE514	3	Cdbrd Drum	/100	C12A
73	D030758 00	ZINC SULF	3	Cdbrd Drum		E1
74	D030760 00	M/P-PROBA	6	Cdbrd Drum	1000/100	C7A
	D030764 00	MIN PREMIX		Cdbrd Drum		C10A
75	D030770 00	CAL CITR	1	Cdbrd Drum		C13B
76	D030778 00	AMINO-RE2	1	Cdbrd Drum		D8C
77	D030782 00	TAURINE	1	Drums		X
78	D030794 00	CHOLINE B	12	Cdbrd Drum	1102/101	C2A
79	D030878 00	M/P CIB 2	8	Cdbrd Drum		D7A
80	D032388 00	ANTIFM152	4	Jug	176/40	B6A
81	D032389 00	HYLON VII	8	Paper Bag	2250/50	E5
82	D032907 00	V/PWNM141	1	Not List		REJECT 2
83	D032908 00	M/PWNM140	2	Cdbrd Drum		C5B
84	D033983 00	M/PP513AR	4	Cdbrd Drum		C4A
85	D033984 00	V/P FU206	1	Not List		C9A
86	D034074 00	V/P123832	5	Barrels		C7A
87	D034231 00	STRCH CLR	1	Paper Bag	1650/50	C1A
88	D035597 00	VAN 4058R	18	Box	750/50	E34
89	D035758 00	M180 BULK	7	Bulk Bags		WOW2
90	D035759 00	MED HT BL	56	Bulk Bags		WOW2
	D035954 00	FIBER PEA				D7B
91	D036308 00	BTTRSCTCH	3	Plast.Drum		B4B
92	D036365 00	RAFTILI G	1	Bags		X
93	D036366 00	OLIRFT P9	1	Bags		X
94	D036788 00	FERR FUMA	2	Drums		X

95	D036792 00	FERRIC PH	8	Cdbrd Drum	400/100	E8
96	D036793 00	PEAR POWD	6			Central
97	D036794 00	APPLE POW	3			Central
98	D036795 00	APRICOT P	3			Central
99	D036796 00	BANANA FL	8	Box		C2D
100	D036797 00	CUPRIC SU	1	Cdbrd Drum		C1A
101	D036822 00	RICE CRL	1	Variable		X
102	D036823 00	MIXED BAS	100	Variable		X
103	D037984 00	DE10,MALT	12	Bulk Bags		D3A
104	D038094 00	CALC CARB	1	Cdbrd Drum		C3C
105	D039191 00	AMINO FAA	3	Cdbrd Drum	800/100	C11A
106	D039245 00	MALTO DE1	66	Bulk Bags	2000	E21
107	D039848 00	GL01922 B	24	Paper Bag	2500/	E4
108	D039849 00	GL01922 B	27	Bulk Bags	2000	E24
109	D040572 00	SUPRO 175	9	Paper Bag	2200/44	E8
110	D040640 00	SUPRO 150	6	Paper Bag	2200/	E17
111	D040891 00	ENZ SUBTI	2	Not List		REJECT 2
112	D040931 00	OIL VG MC	3	Tanker	47000	X
113	D042140 00	MLK DRYBL	21	Paper Bag	2475	E2
114	D043107 00	CALCIT224	51	Cdbrd Drum	550/110	E5
115	D043863 00	V/P 11020	5	Drums	100	X
116	D043986 00	SUGAR DRY	2	Paper Bag	2500/50	C2A
117	D044293 00	MP 149922	1	Not List		REJECT 2
118	D044294 00	VP 149921	2	Not List		REJECT 2
119	D044797 00	SUG LAC B	182	Bulk Bags	2000	E27
120	D045287 00	DEM DE18	18	Bags	50	WOW
121	D045303 00	DEM DE10	12	Bags	50	E25
122	D045304 00	DEM DE15	23	Bags	50	E9
123	D045305 00	DEM DE10B	101	Bags	50	E23
124	D045306 00	DEM DE15B	32	Bags	50	D5C
125	D045307 00	DEM DE18B	13	Bags	50	
126	D046267 00	ACESUFAM	2			D15
127	D046439 00	FOS NUTRA	2			D11A
128	D046657 00	PWC DI819	6	Paper Bag	1760/	E3
129	D047352 00	OAT CRL B	151	Not List		C24
130	D047535 00	PSI E0282	1	Paper Bag	2200/	E11
131	D048122 00	VPFU2061R	9	Cdbrd	1200/100	E8

				Drum		
132	D048123 00	VPGS2062R	30	Cdbrd Drum	1200/100	E7
133	D048124 00	VP 9302R1	1	Drums	1000/100	X
134	D048125 00	MP TE121R	9	Cdbrd Drum	1200/100	C3A
135	D048201 00	MPTE2061R	4	Cdbrd Drum	1200/100	E12
136	D048386 00	MPTE516AR	1	Not List		REJECT 2
137	D048638 00	GUM SCM61	2	Box		X
138	D048760 00	GUM GUAR	1	Bags	2000	X
139	D048762 00	GUM SCM51	14			C2A
140	D048764 00	GUM VSA35	10	Box		X
141	D048778 00	GUM PGL20	5	Bags	1409	C8A
142	D048780 00	SEKM CM61	1	Box	662/55	C11A
143	D048796 00	GUM TALHA	21	Paper Bag	2200/55	E11
144	D048800 00	GUMVGP209	2	Not List		C12B
145	D048832 00	PWC DI879	3	Bags		X
146	D048842 00	XANTHAN G	2			C4A
147	D048844 00	GUM SGP35	2	Box		X
148	D049217 00	VP141A R1	2	Cdbrd Drum		C13B
149	D050514 00	PRDNT B89	15	Paper Bag	2500	E2
150	D050534 00	MELOJEL S	1	Paper Bag	2250/50	E13
151	D054018 00	SUGAR FIN	39	Paper Bag	2500/50	E10
152	D054030 00	MALTO M15	22	Paper Bag		E2
153	D054040 00	C*GL01946	3	Not List		C6B
154	D054042 00	SYRUP COR	3	Tanker	47000	X
155	D054088 00	DE18,MALT	6	Bags	50	E12
156	D054096 00	LACTOSE	23	Paper Bag	2500/50	E6
157	D054098 00	KRYSTAR F	21	Paper Bag	2250/	E9
158	D054144 00	M100,MALT	12	Paper Bag	2500	E2
159	D058504 00	SODM ASCO	11	Cdbrd Drum		C9A
160	D058510 00	THMN MN-B	4	Drums		X
161	D058530 00	L-CARNITI	25	Drums		X
162	D058556 00	V/P1250-1	5	Cdbrd Drum	1000/100	E12
163	D058560 00	VIT FOLIC	5	Drums	100	X
164	D058616 00	V/P GS206	1	Not List		D8C
165	D058646 00	VIT A PAL	3	Drums	100	X
166	D058656 00	V/P VP247	3	Drums		X

167	D058680 00	CHOLN CHL	21	Cdbrd Drum	1268/55	E11
168	D058684 00	V/P VP248	2	Cdbrd Drum	100	X
169	D058698 00	VT A AC32	3	Drums		X
170	D058726 00	V/P VP207	2	Drums		X
171	D058734 00	V/P VP246	8	Drums		X
172	D058738 00	V/P CIB-C	1	Cdbrd Drum		NONE
173	D058780 00	V/P VP254	1	Cdbrd Drum		C1A
174	D058786 00	VIT K1 1%	2	Cdbrd Drum		D15
175	D058792 00	V/P CIB 2	4	Cdbrd Drum		D7A
176	D058796 00	NUCLEOTID	11	Drums		X
177	D058798 00	VP10992	2	Drums		X
178	D058804 00	V/P P2406	4	Cdbrd Drum		C3A
179	D142100 00	MILK FAT	12	Barrels		X
180	D250468 00	VP 9101R1	4	Box	1000/50	E8
181	D250681 00	VP 2072R1	11	Box	1000/50	E12
182	D251031 00	MP FUSOYR	2	Cdbrd Drum		C9B
183	D251476 00	VP2477 R1	2	Cdbrd Drum		C13B
184	D251498 00	VP2483 R1	2	Drums		X
185	D251499 00	VP2540 R1	1	Cdbrd Drum		C1C
186	D251597 00	MPTE516AR	3	Cdbrd Drum		C10B
187	D251598 00	MP 1244R1	2	Not List		C6C
188	D251923 00	OIL ARADH	1			Cooler
189	D532907 00	ACD CITRI	12	Bags		C8B