DEPARTMENT OF THE ARMY
Holston Army Ammunition Plant
4509 West Stone Drive
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March 28, 2019

REPLY TO
ATTENTION OF

JMHS-EN

Ms. Michelle Walker Owenby, Technical Secretary
Tennessee Department of Environment and Conservation
Division of Air Pollution
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Ave, 15th Floor
Nashville, TN 37243

Dear Ms. Owenby,

Holston Army Ammunition Plant (HSAAP) is pleased to present the "Evaluation of Open Burning at HSAAP- Phase One" report for your records. The purpose of this report is to present a summary of the data and information collected under this first phase of a four-phased approach established at HSAAP to seek alternatives to open burning. If you have any questions please contact Laura Peters of my staff at phone: (423) 578-6193 or email: laura.l.peters15.civ@mail.mil.

Sincerely,

LUIS A. ORTIZ
COL, CM
Commanding

EVALUATION OF OPEN BURNING AT HSAAP – PHASE ONE

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EXECUTIVE SUMMARY

In 2015 Holston Army Ammunition Plant (HSAAP) initiated this study to evaluate the waste streams currently sent to the Open Burning Ground (OBG) for thermal treatment and decontamination. In addition, the Department of Defense (DOD) released a revision to DOD Instruction (DODI) 4140.62, Material Potentially Presenting an Explosive Hazard. This study also evaluated the changes in the DODI to determine a path forward for implementing the new guidance at HSAAP.

Currently, HSAAP open burns explosive waste, as well as combustible and non-combustible wastes that have come into contact with explosives. Open Burning (OB) of these wastes is the current standard at HSAAP to ensure that its workers and the surrounding community are safe from any risk of an explosive incident. Realizing that technology demonstrations for treatment of this waste have improved greatly over the past several years, and in conjunction with requests from the Tennessee Department of Environment and Conservation (TDEC) for a more detailed analysis of these technologies against HSAAP wastes, this study was created. The Army developed a phased approach to thoroughly evaluate alternative technologies and ultimately implement any that are identified as safe for use at HSAAP. This report marks the completion of the first phase. The purpose of this phase was to determine the volume, type, and sources of waste sent to the OBG. This information will then be utilized in the second phase of this study which will evaluate the available technologies against the identified waste streams.

The Phase 1 approach included data collection for material movement and waste creation throughout the production process. The main data gathering and analysis was associated with the contaminated waste streams and not the explosives themselves. The explosives themselves are generated from the cleanout of building catch basins and generation of off-specification products that cannot be re-worked or re-used. This information was reviewed from the records kept for the burning pans and was relatively simple to generate. The understanding of the contaminated waste streams was the main purpose of this portion of Phase 1.

To understand the contaminated waste streams, information about the production inputs was gathered from the warehouse and facility stores. This data created a means of understanding the material inputs into production, many of which eventually end up as waste materials sent to the OBG. These material inputs were organized by cost center, a departmental budgetary tracking number that links the purchase cost of certain materials to the appropriate department that is using them. The cost center information was determined to be the most reliable material tracking information that allowed the project team to track material movement across the plant. This information was then compared to the waste slips at the OBG. All waste streams coming into the OBG for treatment are documented and recorded in a ledger. This information is recorded by load and lists the building(s) where the waste is picked up, a general description of the waste, and the estimated volume in cubic yards. Comparison of the cost center and ledger records allowed the team to complete the waste stream analysis. This analysis resulted in waste quantification by cost center and type of material (wood, metal, etc). In addition to production waste streams, waste is also sent to the OBG from building modernization, maintenance, and demolition projects. Ledger records were also compared to the list of modernization and demolition projects to determine the volume of and types of waste generated by those efforts. Together, the explosives waste, production waste, and demolition waste totals created an overall understanding of total waste treated at the OBG.

At the conclusion of the waste analysis, the team determined that some changes in how the waste was recorded would allow the waste volume to be more accurately understood. This included the recommendation to install a scale and record all waste by weight. In addition, the team recommended that the waste slips be clearer in which materials in each load were collected from each building. Because of the challenges the team encountered in determining a path forward for the changes in DODI 4140.62, Phase 1 lasted longer than expected and the waste stream quantification recommendations were implemented in 2017.

In August 2015, the DOD released a revision to DODI 4140.62 that included a third method to clear Material Potentially Presenting an Explosive Hazard (MPPEH) to Material Documented As Safe (MDAS). The 2015 change added a means to use expert knowledge. The Phase 1 included a requirement to evaluate this change and determine how to implement it at HSAAP. The evaluation was significantly more complex than originally anticipated at the beginning of Phase 1. Candidate waste streams that may not pose an explosive risk have been identified for evaluation under this new method. However, challenges related to training and material controls presented themselves when HSAAP attempted to develop a program to safely utilize this new method. Over time, HSAAP has determined solutions to these challenges and has drafted an approach. In order to implement this approach, process change approvals, contract changes, and staffing for these changes need to take place. HSAAP is pursuing these needs and expects to implement the guidance received in the revised DODI 4140.62 in the near future. While final implementation will increase the volume of material being diverted from the OBG, it is not expected to have a significant impact on the total volume of waste processed at the OBG.

1.0 INTRODUCTION

BAE Systems Ordnance Systems Inc. (OSI) and Holston Army Staff, evaluated potentially explosive contaminated waste streams that are currently thermally treated at the Open Burning Grounds (OBG) at Holston Army Ammunition Plant (HSAAP). The objective of this study is to provide a quantification of those waste streams and also determine a path forward for implementation of the recently revised Department of Defense Instruction (DODI) 4140.62, Material Potentially Presenting an Explosive Hazard (MPPEH). Open Burning (OB) of explosive wastes and production wastes that have come into contact with explosives is the current standard at HSAAP. This ensures that all employees and the surrounding community are safe from any explosive hazard associated with this facility. Realizing that technology demonstrations for treatment of this waste have improved greatly over the past several years, the Army has initiated a deliberate and thorough process to evaluate these technologies and their applicability for safe implementation at HSAAP. This quantification portion of this study is the precursor for a future evaluation of potential alternatives to OB at HSAAP. The DODI review looks to understand its 2015 changes and what needs to be done to implement it at HSAAP. The study in its entirety is referred to as Phase 1. The following sections provide the background information, purpose, characterization methods, waste quantification, and review of DODI 4140.62 that was part of the Phase 1 study.

2.0 BACKGROUND INFORMATION

HSAAP is an Army owned/contractor operated facility that occupies more than 6,000 acres in Kingsport, TN. HSAAP is a primary supplier of RDX, HMX, and IMX-based bulk explosive materials. The facility includes acid production, concentration, and recovery facilities, nitration buildings, and other chemical-processing operations that is split between two main areas, Area A and Area B. HSAAP was originally constructed in support of World War II and has continued to be an asset to the nation as a supplier of nitramine-based high explosives to other Army/DOD manufacturing facilities. OSI became the operating contractor for the HSAAP facility in 1999.

The production process for these explosives generates several waste streams that require safe disposal. Some waste streams are production byproducts that are not contaminated with explosives and can be disposed of off-site. However, waste explosives themselves, along with explosives contaminated solid wastes cannot be disposed of off-site. These waste streams are currently treated at the OBG.

2.1 Open Burning Ground Description

The OBG is located at the HSAAP Area B facility in Hawkins County, approximately 0.85 miles from the closest facility boundary and approximately 1.5 miles from the closest resident. The OBG has been safely operated since the facility began operation in 1942. The intent of the area is to safely decontaminate contaminated waste and treat unusable explosives while minimizing risks to workers and the surrounding community. These intents are realized through minimizing shipment, handling, and processing of potentially explosive material.

There are three main types of waste units at the OBG. The first waste unit is used to burn bulk raw explosives that are either out of specification and are unsuitable for use/reprocessing, or have become contaminated through contact with the manufacturing floor. This waste is burned in one of four burn pans that can be burned daily. The second waste unit is used to burn potentially explosives-contaminated small articles such as plastic bags and liners, paper towels, filters, personal protective equipment, and dewatering filter socks. This light-weight material is burned in one of two steel cages which ensure that the material cannot be blown away. The third waste unit is used to burn/decontaminate large articles that may be contaminated with explosives and includes a wide range of materials, such as: piping from buildings, process vessels, building demolition material including concrete, and soil. This material is placed in one of two piles at the OBG that can be burned quarterly. Since many of the materials in the pile requiring thermal treatment are not combustible, large amounts of clean wood are used along with small quantities of kerosene or diesel fuel to start and then facilitate the time required to burn/decontaminate the pile material. This allows the explosives contaminated material to reach the required temperatures for the required duration, allowing safe transportation and disposal/recycling of the non-combustible materials.

Figure 1.1 Satellite view of Holston Open Burn Area

2.2 Current Open Burning Ground Requirements

The purpose of the OBG is to ensure safe destruction or decontamination of waste explosives and contaminated solid waste in accordance with all Army, Federal, State, and Local regulations. The activities at the OBG are permitted through the Title V Air Permit and/or the RCRA Subpart X Permit. All storm water runoff from the area is collected and diverted to the on-site NPDES permitted waste water treatment facility. The pans are regulated by both, the facility Title V air permit and the RCRA Subpart X permit. Both the cages and piles are regulated by the facility Title V permit. The permits and regulations create the basis for how waste is managed at the OBG to ensure compliant operations.

In addition to the permits listed above, several DOD and Army documents are used to ensure safe operations at the OBG. The primary DOD guidance used at HSAAP at the time this study was initiated includes: DoD Manual 6055.09-STD (Aug 2010), DoD Contractor's Safety Manual 4145.26 (Mar 2008), and DOD Instruction 4140.62 (Nov 2008). The primary Army guidance is DA Pam 385-65. Under this study, understanding operations related to DODI 4140.62 was the main focus for requirements review. Discussion of the evaluation of the changes to DODI 4140.62 is addressed in Section 7.

3.0 PURPOSE

The purpose of this study is to provide a thorough review of the waste streams processed at the OBG to determine the volume of wastes, types of wastes, points of generation, and generation point break down. The Tennessee Department of Environment and Conservation (TDEC), Division of Air Pollution Control (TDAPC) has requested OSI provide a more detailed analysis to determine if current alternatives to OB can be implemented at HSAAP. In response, the Army has developed a phased approach to create a means to thoroughly evaluate alternative technologies and implement any that are identified as safe for HSAAP wastes.

Without a better understanding of the volume, type, and sources of waste currently treated, any evaluation of technologies would be difficult. The feasibility of any alternative technologies being implemented at HSAAP will require thorough knowledge of the volume and types of waste that is treated at the facility in order to screen each stream against applicable technologies. This information is critical in determining future throughputs, technology limitations, pre-processing needs, safety concerns, technology applicability, and overall feasibility of any alternatives for HSAAP.

In addition to the review of waste streams, this study will also evaluate the recently revised DODI 4140.62, MPPEH. Changes from the last revision may provide for additional opportunities to evaluate waste streams at the production level and reduce the overall volume of waste sent to the OBG. However, since HSAAP is a Government Owned Contractor Operated (GOCO) facility, a thorough understanding of the new instruction will be required in order to accurately incorporate this requirement into the facility contract. This study will look at the changes to DODI 4140.62 to determine its impacts to current operations and a path forward to implement it.

At the conclusion of this Phase 1, the data will be used to support subsequent study phases which will evaluate technologies and their ability to treat the type and quantity of wastes currently treated at the HSAAP OBG. In addition, recommendations to better quantify and track this waste to further facilitate future evaluations will also occur. The evaluation of this data against alternative technologies will be completed in what is referred to as Phase 2- Evaluation of Thermal/Non-Thermal Solutions to Open Burning. The additional phases of the Army's approach will cover the design, permitting, and construction of any alternatives identified as feasible for HSAAP in the Phase 2.

4.0 WASTE CHARACTERIZATION

The following sections detail the process used for the waste characterization portion of this study. The date range of data evaluated includes the years 2012-2015. Characterization was not only complex to complete, but also done thoroughly to ensure the waste streams at the OBG were completely understood and quantified. All waste was characterized by both, material type and production source (building/cost center). An overview of the process to achieve this characterization is described in the sections below. The evaluation in Section 4.1 is dedicated to the materials in the production process and does not include waste generated from demolition efforts. Evaluation of demolition waste is discussed in Section 4.2. Section 4.3 covers the assumptions used in the production and demolition waste characterization.

4.1 Production Waste Characterization

In order to ensure all waste was captured and able to be attributed to a specific function, a general characterization process was established. Production wastes were characterized following these four steps:

1. Collect information related to plant products and processes.
2. Create an inventory of raw materials used and waste materials generated at the facility.
3. Eliminate materials from the inventory determined to be used outside of the production processes (material not sent to the OBG).
4. Categorize waste based on type, quantity, and location.

The first step in categorizing production waste was to generate an overall understanding of the production process and general flow of materials through it. This understanding was evaluated by personnel interviews, building walk-throughs, and discussion of production processes with the associated process engineers.

Once the production process was understood in terms of distinct processes and facilities, the second step was to develop an inventory of plant materials. This inventory of materials was compiled by querying the facility database system to collect records of items ordered for use at various plant buildings from both, the warehouse and the facility stores department. The items requested from the warehouse for distribution throughout the plant were typically final product packaging and shipping materials, process containers, raw materials, and various product additives. Items requested from the facility stores department were typically non-bulk materials which consisted of personal protective equipment (PPE), clothing, maintenance items, hardware, probe socks, fittings, filters, and household use items. The warehouse and facility stores records show the materials that were sent to the various locations in the plant. This information could then be used to determine the volumes of materials that come from the two supply points and which areas of the plant receive that material. The result was a large database of material volumes and flow across the facility.

In addition to the information from supply points, ledger records generated at the OBG were also reviewed. When waste comes into the OBG for processing, they are accompanied with waste disposal slips. Information from these slips is compiled into the ledger records. The information contained in these records include the date, a general description of the waste, an estimated volume in cubic yards, the building or buildings that generated the waste, which OBG unit will treat the waste, and the group delivering the waste. This information could then be used to both generate an overall understanding of the waste as well as understand the supplies that moved through production to the OBG.

The third step in categorizing production waste was to review information collected from the supply points to remove items unlikely to be sent to the OBG. Such items removed from the inventory included:

- Items used in buildings outside of the production area,
- Items used in areas segregated from explosives,
- Items in permanent or long-term use.

Some examples of items removed from the inventory are: underclothing such as socks and t-shirts; bath towels and laundry items such as soap, detergent and laundry bags; office supplies such as batteries and printer cartridges; bathroom supplies such as paper towels, paper cups, and cleaning supplies; and long-term use items such as piping, fittings, and flanges.

Some similar items were considered for exclusion but were left on the inventory because of their potential for contamination with explosives and/or eventual transfer to the OBG. Some examples of these items retained in the waste inventory are: exterior clothing such as coveralls, boots, boot covers, lab coats, PPE, hats, cleaning rags, hoses, tubing, buckets, filters, strainers, steam traps, rope, clamps, gauges, and tools. Care was taken to ensure that duplicate entries for items shipped out of the warehouse or stores, and subsequently returned for non-use or reassignment were characterized properly and not counted more than once.

Step four includes the categorization of waste based on type, quantity, and location. The database of material that resulted from steps 1-3 identified items that were the primary waste contributors to the OBG. These wastes were categorized according to the building where the items were collected and their associated cost center. A cost center is a departmental budgetary tracking number that allows OSI to attribute the purchase cost of certain materials to the appropriate department that is using them. Because the actual cost center is considered confidential business information, generic cost centers have been used in this document.

The final waste material inventory included items associate with buildings and cost centers that produce waste that are transferred to the OBG. Ultimately, all materials were organized by cost center for this evaluation. The following cost centers were used for the final waste material inventory:

- 1- General: Includes the following cost centers with small, irregular waste generation rates.
    - Storage Warehouse and Pilot Plant
    - Area A Acids
    - Area B Acids
- 2- Lab
- 3- Finishing
- 4- HMX Intermediates
- 5- RDX Recrystallization
- 6- Hexamine / Nitration
- 7- HMX / PBX Processing / Finishing
- 8- Castables
- 9- Castables / Material Handling / Magazines / Shipping
- 10- Explosives
- 11- Special Products

Several cost centers were combined into the general category after careful consideration for several factors. These factors primarily included low volume, limited types of contaminated waste, and irregular generation of contaminated waste. Some examples of this material includes maintenance activities and clean wood.

Once the cost center evaluation was completed, all wastes were also evaluated by type. In this evaluation, all wastes on the OBG ledger records were categorized by the dominant type of material. Because the ledger records recorded the source building generating the waste material, a volume of waste by material was able to be calculated. Each building was then attributed back to its cost center to be able to determine the breakdown of waste types by cost center.

4.2 Demolition Waste Characterization

The waste totals for demolition were mainly derived from the ledger records maintained at the OBG. This information was determined from collecting the ledger records and sorting based on buildings, dates, or contractors identified from a comprehensive list of historical demolition, maintenance, and modernization projects during the time period of data evaluated. The resulting data was cross-checked through comparing the ledger totals with calculations of the shipments for specific demolition phases as a comparison. These totals were further subdivided into the main waste types.

4.3 Characterization Assumptions

The following basic decisions and assumptions were established by the team and used in development of the final waste streams and their associated quantities.

- The final unit of measurement should be in volume and the most readily available volume information is cubic yards.
- Based on the current operations, material entering the production building is considered to be contaminated and is therefore processed at the OBG when it becomes a waste.
- The OBG ledger records were mainly used to quantify the volumes of waste.
- When quantifying material from the ledger records, the waste picked-up by material handling generally consolidated the material such that multiple buildings were listed for the total load. When no additional information could be obtained, these totals were split equally between the building numbers.
- The itemized lists of supplies from each source was sorted by cost center.
- The following breakdown categories were established and applied to each cost center based on the content of the OBG ledger records. Wastes were classified into each category based on the dominant material composition of each waste item.
    - Metal, such as tanks, structural steel, piping, valves, flanges, ladders, etc.
    - Plastics, such as drum liners, PPE, packaging, PVC piping, Teflon, etc.
    - Cardboard, such as fiber drums, boxes, packaging, etc.
    - Wood, inclusive of all wood materials, whether clean, treated, manufactured, or modified. The clean wood category is lumber or wood that has not been coated, treated, or processed by man such as plywood.
    - Dirt, such as contaminated soil, rock, gravel, etc.
    - Concrete, such as concrete, block, and brick.
    - Other- includes items that did not fit in any other category and mainly consists

of cotton and rubber.

- The ledger totals for varying combined entries (eg. wood, metal) were split up specifically for each material item. This was based on assumed percentages that were consistently applied across each cost center and for each material.

5.0 WASTE TYPES AND QUANTITIES

The data collection efforts described in Section 4 resulted in a large volume of data that was evaluated from multiple perspectives. The information was compiled from 2012-2015 data. However, the evaluation of DODI 4140.62 was more complex than originally thought and caused delays in overall reporting of Phase 1. Thus, some additional information has been collected since the 2012-2015 data was analyzed. These updates are discussed in Section 9.

The series of waste evaluations completed under this study are described in the sections below. The initial evaluation included total volumes of waste from the cages, piles, and burn pans. From there, this information was broken down further to be evaluated by both cost center and material type.

5.1 Total Waste Volumes

Overall waste numbers were totaled from the waste disposal records maintained by the Safety Department at the OBG. These numbers provided the best overall volume totals in cubic yards for contaminated materials and pounds for explosives.

5.1.1 Pile and Cage Materials

Materials burned/decontaminated in the piles and cages are generated as a result of both, production and demolition activities. To further understand the quantities of material burned, the amount of waste generated from demolition was evaluated as stand-alone information. Table 5-2 summarizes the percentage of demolition materials decontaminated to the total volume of waste decontaminated. The team decided that demolition waste was important in order to understand how the volume of waste decontaminated may change over time as the facility transforms to meet the mission needs.

Table 5-2 Demolition Percentages by Year

	2012	2013	2014	2015		Average
Percent of Demolition Materials Decontaminated	59.17%	50.42%	77.82%	5.62%		48.26%

5.1.2 Explosives

Waste explosives are processed in the RCRA permitted burn pans and can be divided into two categories, D003 and K044/D003. "Waste Explosives D003" represents the off specification materials burned. "Waste Settled Catch Basin Explosives K044/D003" captures all other collected explosives. The following materials are included in that group: explosive waste derived from material spilled onto the operating floor and collected in catch basin systems, material collected in filters that cannot be recycled into manufacturing, quality assurance samples that cannot be returned to the product lot, and material coming from equipment during building shutdowns. The waste settled catch basin explosives are typically sensitized with debris, grit, cross-contamination, and may be more susceptible to detonation.

5.2 Production Material Breakdown

As described in Section 4, production waste was thoroughly evaluated and quantified in terms of both, cost center and waste type. Descriptions of each evaluation are described in Sections 5.3 and 5.4 below.

5.3 Material by Cost Center

The following sections describe the data from the analysis of all production waste to its associated cost center. The total waste is divided out and graphically presented by type. Since the cost centers are used to track material that moves through the production process, no materials attributed to demolition are included in this analysis. Figure 5.1 provides a summary of this data.

Relative breakdowns of material in each cost center is demonstrated in Figures 5.2-5.12. General areas accounted for the largest volume of material and includes (Storage Warehouse and Pilot Plant), Area A Acids, and Area B Acids as well as other areas. The waste from the general areas, Lab, Finishing, HMX, PBX, Castables, and MH and IMX Castables, all had wood as the largest generated material. RDX and Special Products had cardboard as the largest generated material. Nitration had metal as the largest generated material. RDX Filtration had plastic as the largest generated material. Figure 5.2 provides the relative breakdown of material in the general areas. Figure 5.3 provides the relative breakdown of material in the Lab, with wood being the largest generated material. Figure 5.4 provides the relative breakdown of material in Finishing. Figure 5.5 provides the relative breakdown of material in HMX. Figure 5.6 provides the relative breakdown of material in RDX. Figure 5.7 provides the relative breakdown of material in Nitration. Figure 5.8 provides the relative breakdown of material in PBX. Figure 5.9 provides the relative breakdown of material in Castables. Figure 5.10 provides the relative breakdown of material in MH and IMX Castables. Figure 5.11 provides the relative breakdown of material in RDX Filtration. Figure 5.12 provides the relative breakdown of material in Special Products.

Figure 5.1 Average Waste Produced Per Cost Center

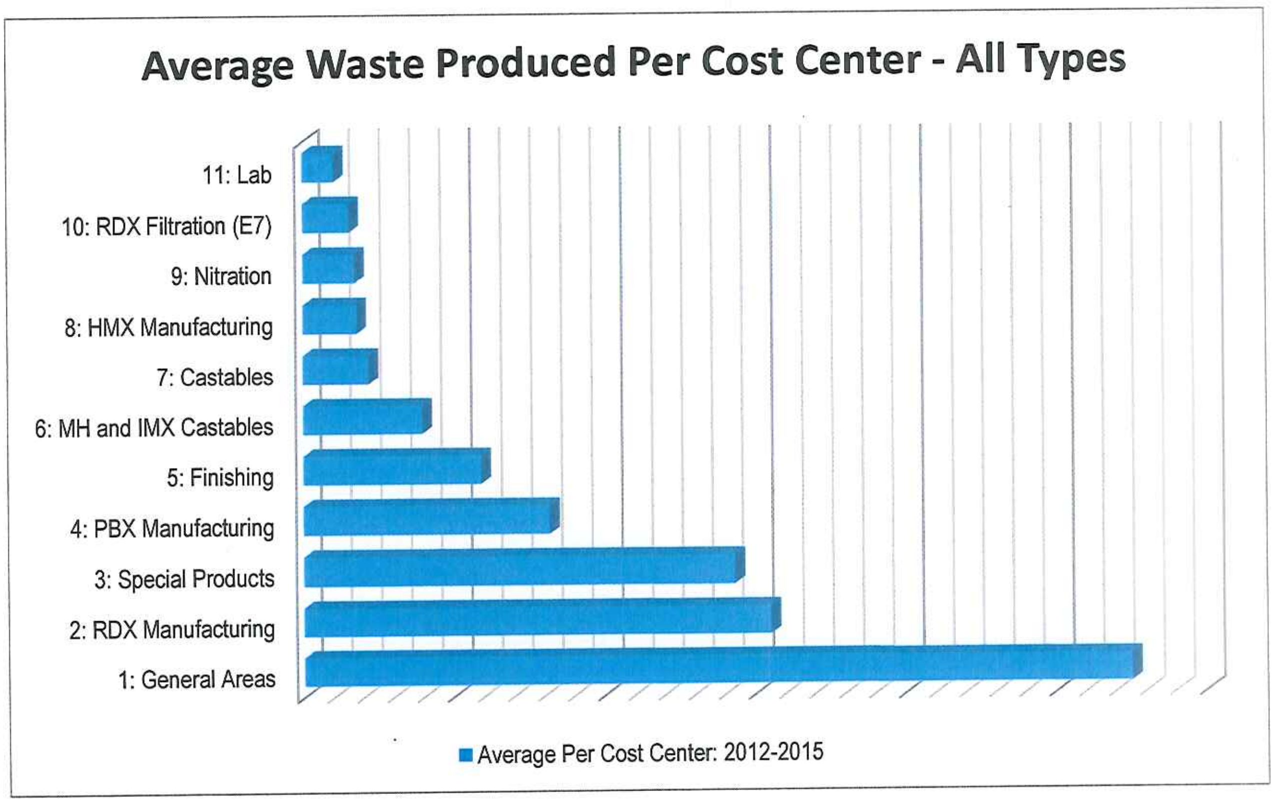


Figure 5.2 Waste by Type for Cost Center 1

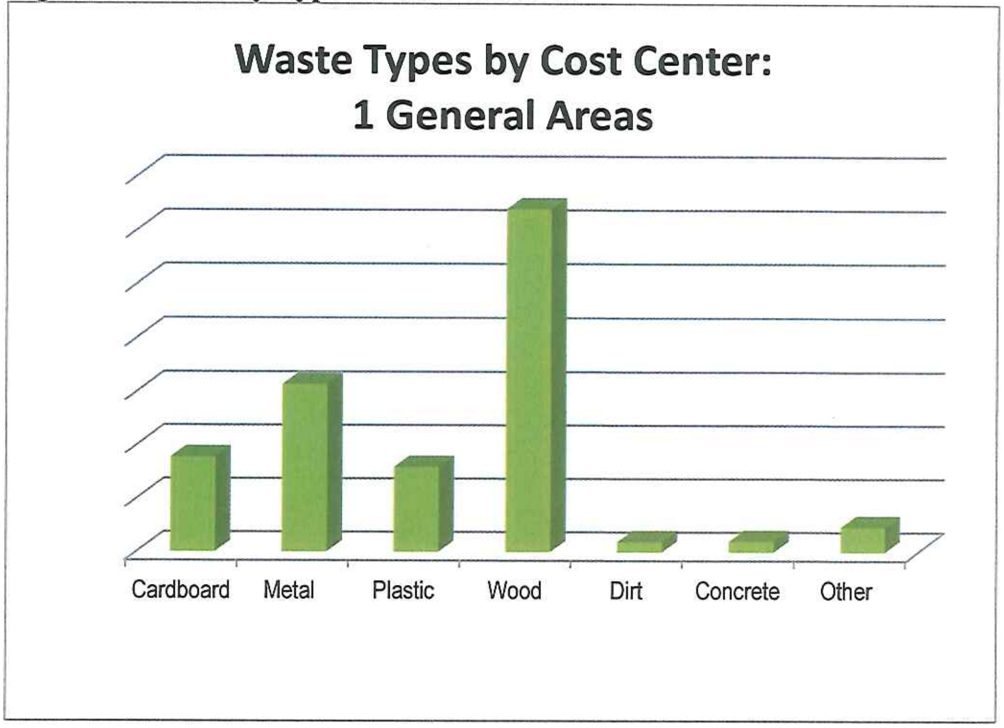


Figure 5.3 Waste by Type for Cost Center 2

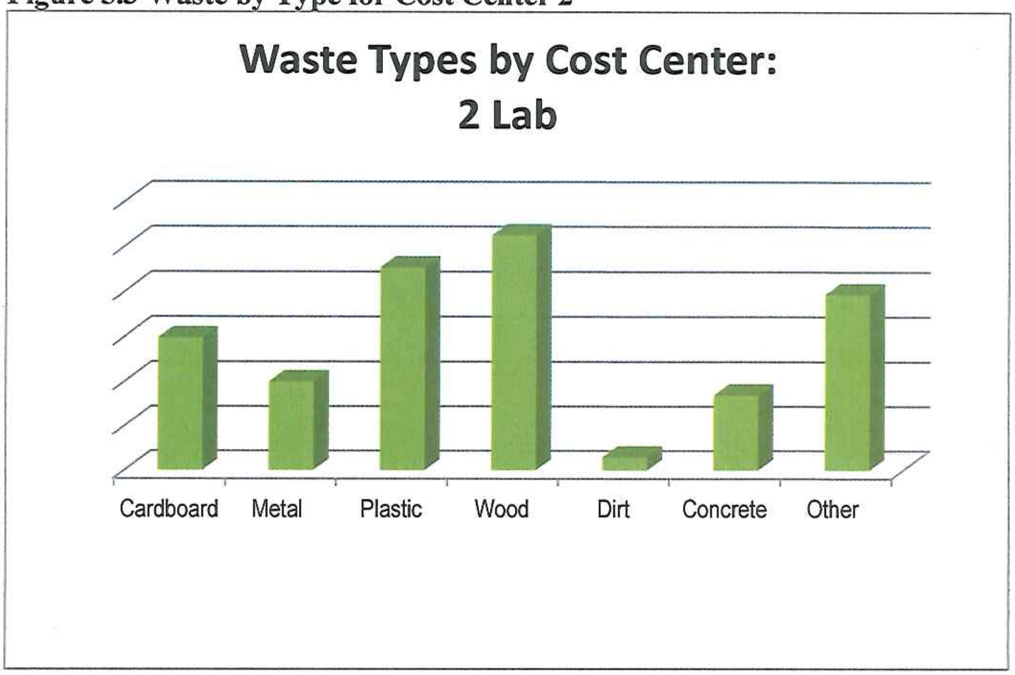


Figure 5.4 Waste by Type for Cost Center 3

Figure 5.5 Waste by Type for Cost Center 4

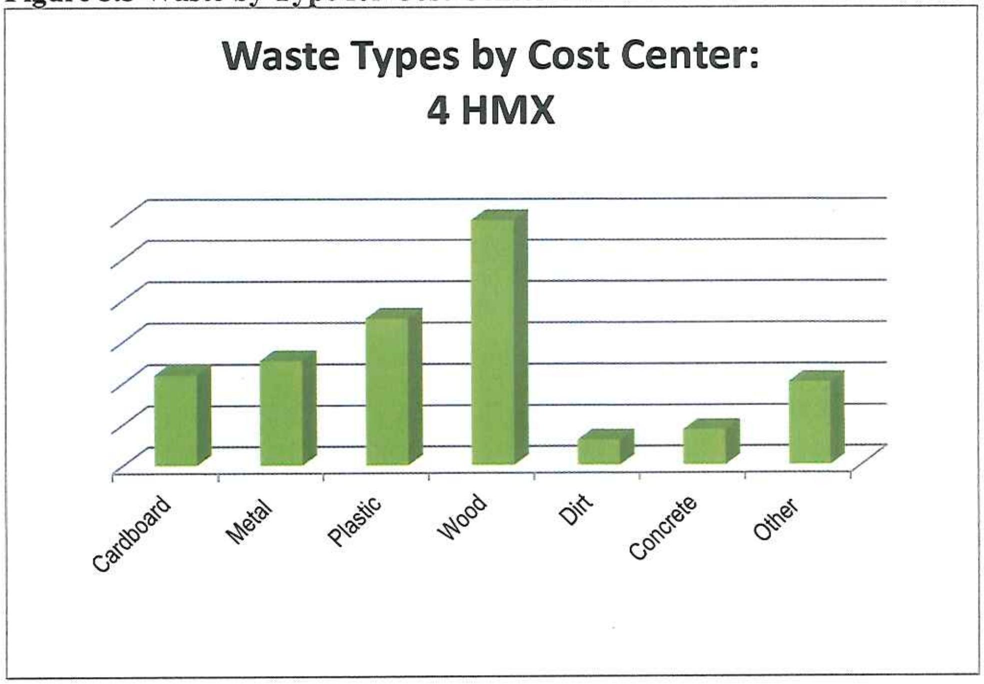


Figure 5.6 Waste by Type for Cost Center 5

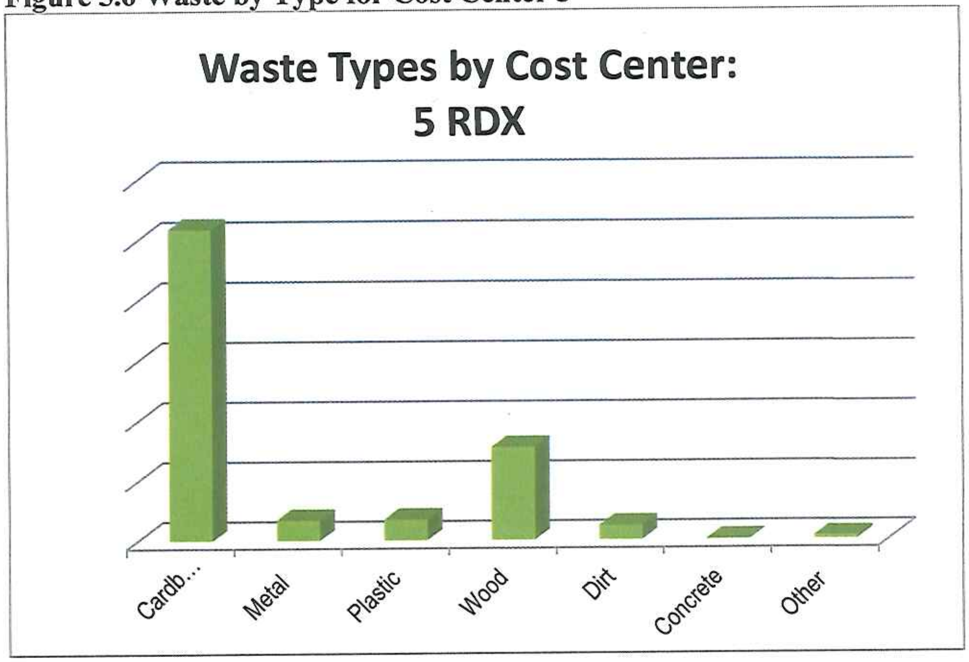


Figure 5.7 Waste by Type for Cost Center 6

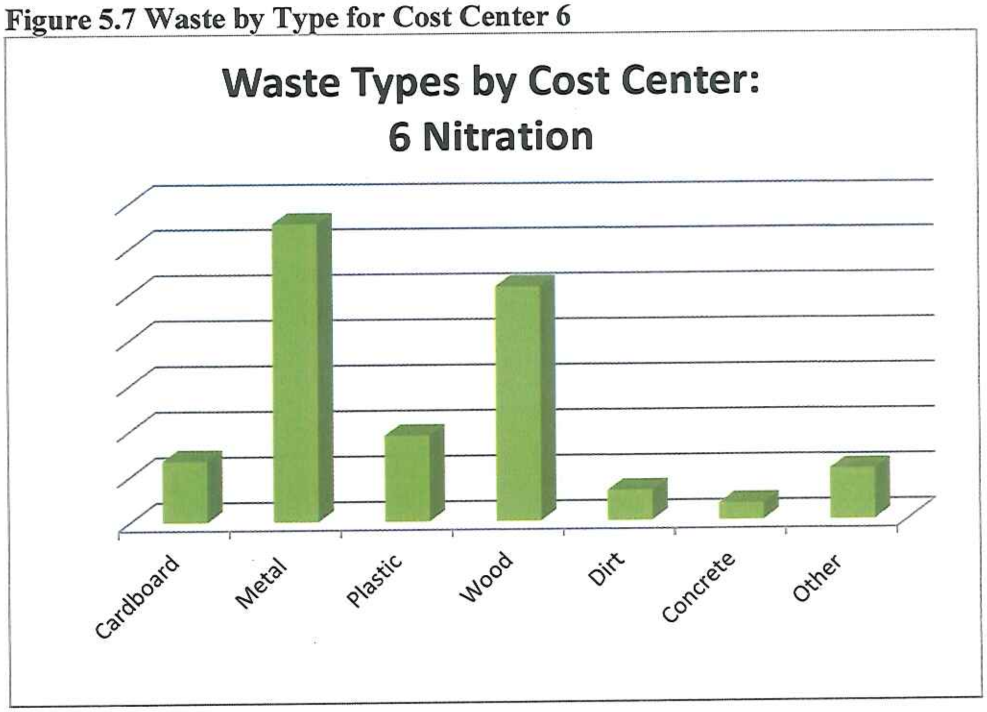


Figure 5.8 Waste by Type for Cost Center 7

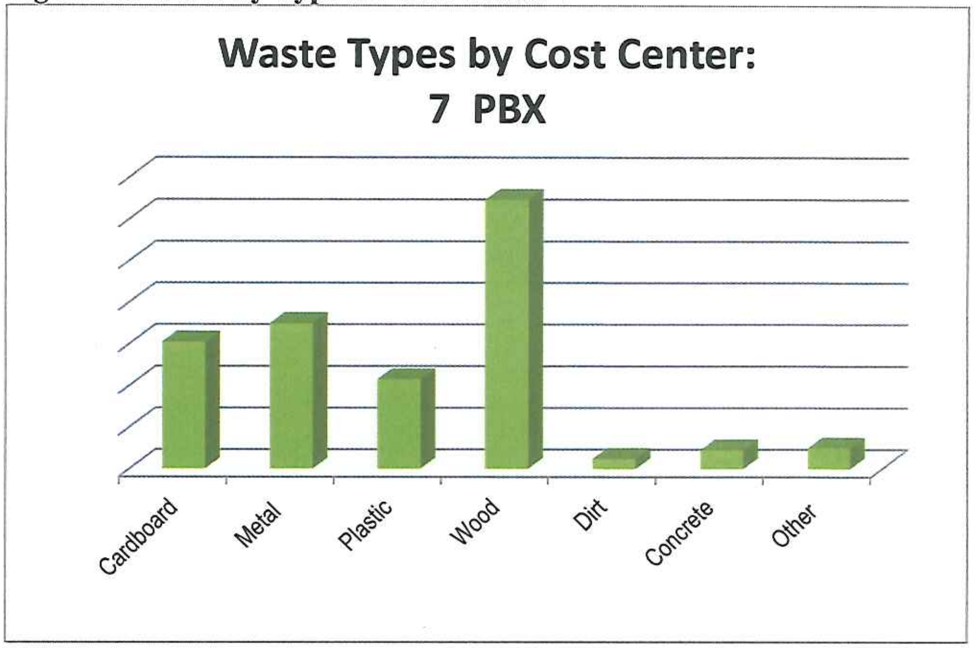


Figure 5.9 Waste by Type for Cost Center 8

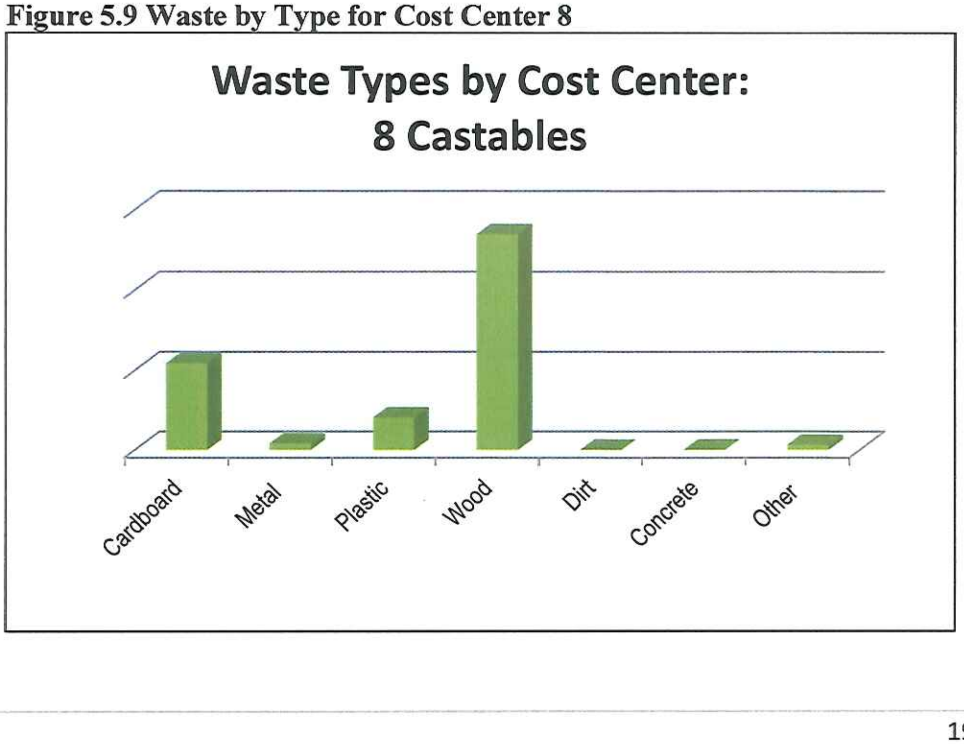


Figure 5.10 Waste by Type for Cost Center 9

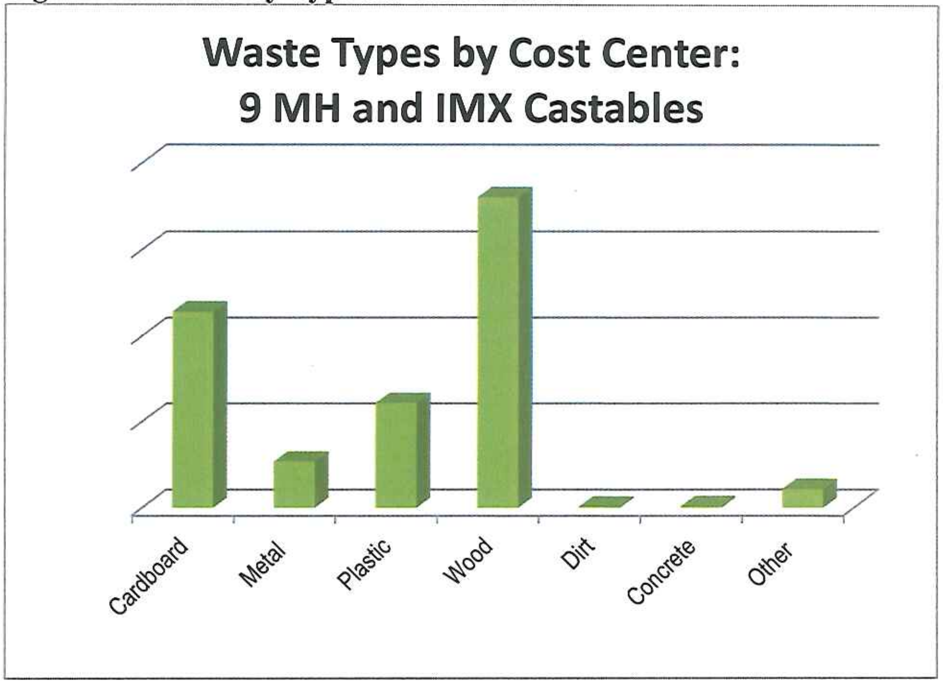


Figure 5.11 Waste by Type for Cost Center 10

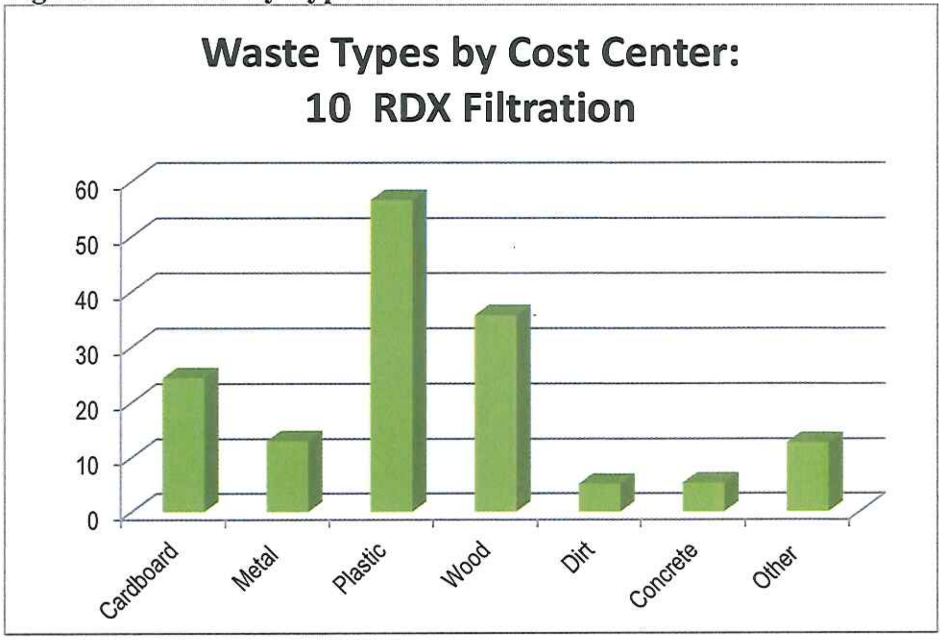


Figure 5.12 Waste by Type for Cost Center 11

5.4 Material by Type

The following sections describe the data analysis of waste by material type. An analysis was conducted for both production and demolition categories. In addition, special analysis was also completed for all metals and clean wood sources.

5.4.1 Production Material by Type

Figure 5.13 provides a graph, while Table 5-5 provides the summary and percentage breakdown of production waste materials by type. Sections 5.4.1.1 through 5.4.1.7 describe metal, wood, cardboard, plastic, other, dirt, and concrete waste breakdown for these categories.

Figure 5.13 Average Production Waste by Type

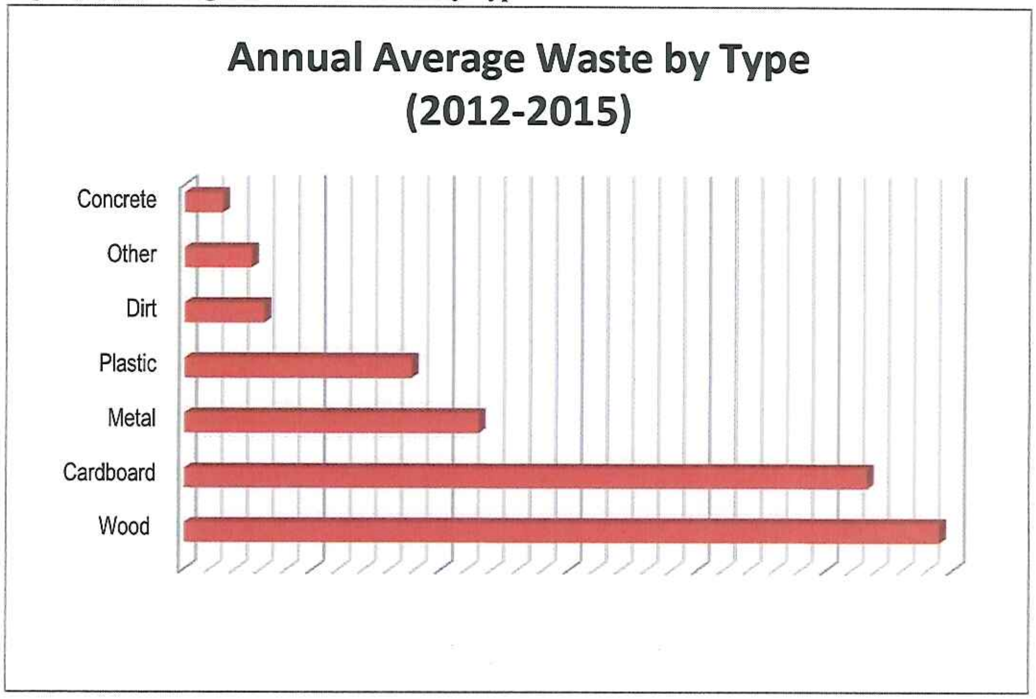


Table 5-5: Cost Center by Year and Material

Cost Center Percentage Break Down By Year and Material					
	2012	**2013**	**2014**	**2015**	Average
Cardboard	16.40%	23.41%	25.39%	52.90%	31.82%
Metal	16.35%	12.15%	15.48%	11.59%	13.89%
Plastic	9.02%	11.52%	14.98%	8.29%	10.95%
Wood	47.91%	43.99%	31.34%	22.86%	36.52%
Dirt	2.42%	3.82%	7.68%	2.01%	3.98%

5.4.1.1 Thermally Decontaminated Metal

The main type of metal thermally decontaminated at the OBG in the pile is stainless steel. Stainless steel is used to meet engineering specifications for explosive operations. There is no coating to this metal. The connections are also minimized as much as possible. For this reason explosives have been known to collect in welds, in fissures and cracks, and in flanges. There is no current inspection process that can 100% verify if the clean-out process has removed all explosives from these collection points. For this reason, metal used in explosives service is currently being thermally decontaminated at the OB pile.

The general areas cost center accounted for much of the production metals. However, the general area includes the maintenance shop that works on some of the explosive equipment. This equipment and the parts used in this area contribute to this total. The remaining sources of metal from the general area is mainly lightly contaminated wastewater equipment in explosives treatment service, equipment from the acid area in explosives service, and other lightly contaminated material throughout the remaining buildings from this grouping. Figure 5.14 breaks down the distribution of this waste across the cost centers.

5.4.1.2 Wood Waste

Figure 5.15 breaks down the distribution wood waste across the cost centers. The majority came from the general areas which includes clean wood from many of the maintenance areas as well as the Storage Warehouse. The Storage Warehouse is the main warehouse that receives pallets from the production operations and thus this is a significant source of wood. On average, approximately 80% of the wood waste is clean and is only used to ensure the pile burns achieve the required decontamination time and temperature.

5.4.1.3 Cardboard Waste

Figure 5.16 breaks down the distribution of cardboard waste across the cost centers. This material type includes fiber drums, boxes, and packaging. The majority of this was from the RDX cost center. The main bulk of the cardboard comes from the Nitroguanidine cardboard drums and the Triazolone cardboard drums.

5.4.1.4 Plastic Waste

Figure 5.17 breaks down the distribution of this waste across the cost centers. The general area has the largest percentage of items.

5.4.1.5 Other Waste

Figure 5.18 breaks down the distribution of other waste across the cost centers. The general area again has the largest percentage of items, with the majority of the other cost centers being equal contributors in the 8-12% range.

5.4.1.6 Dirt Waste

Figure 5.19 breaks down the distribution of dirt waste across the cost centers, with the majority coming from special products.

5.4.1.7 Concrete Waste

Figure 5.20 breaks down the distribution of concrete waste across the cost centers. Four cost centers (general, finishing, special products, and PBX areas) account for approximately 80% of the concrete waste treated at the OBG.

Figure 5.14 Metal Distribution

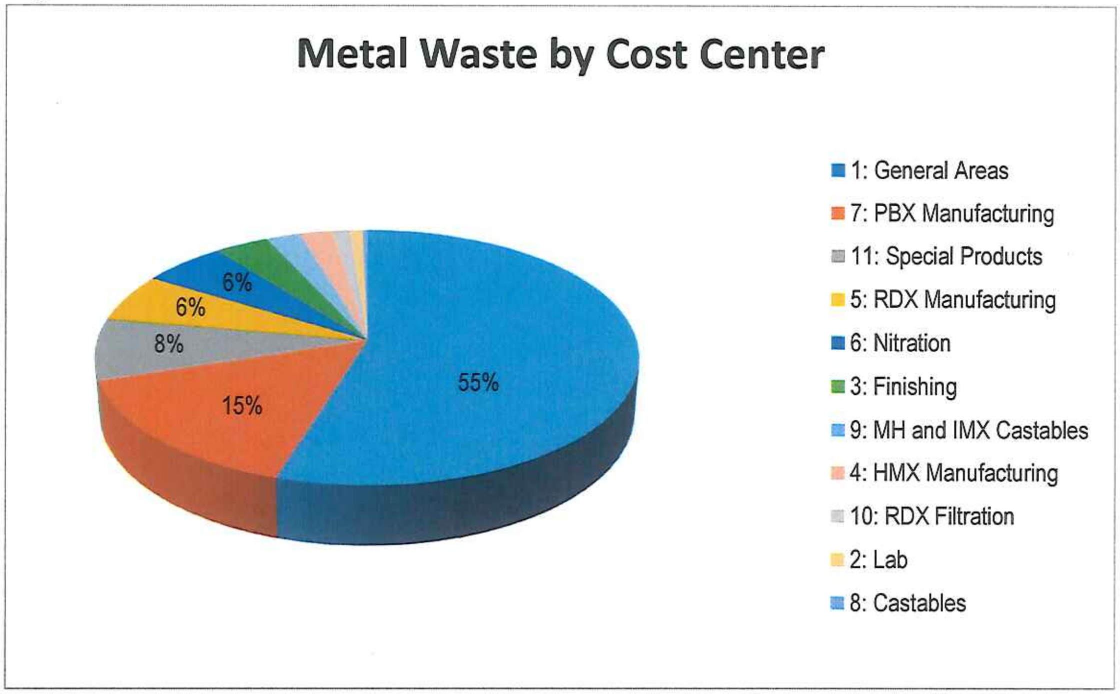


Figure 5.15 Wood Distribution

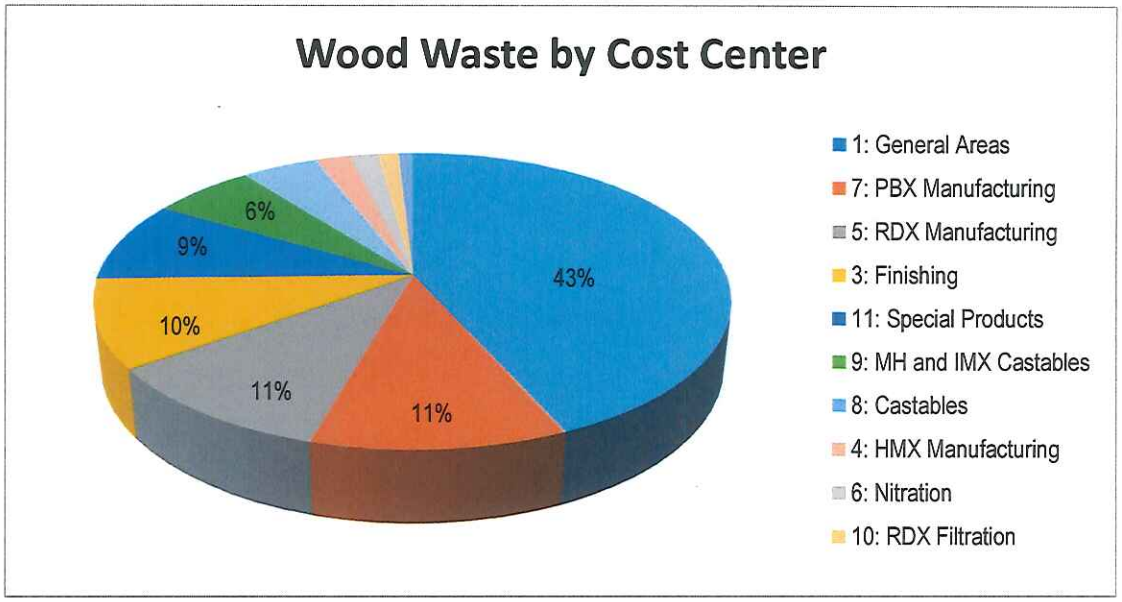


Figure 5.16 Cardboard Distribution

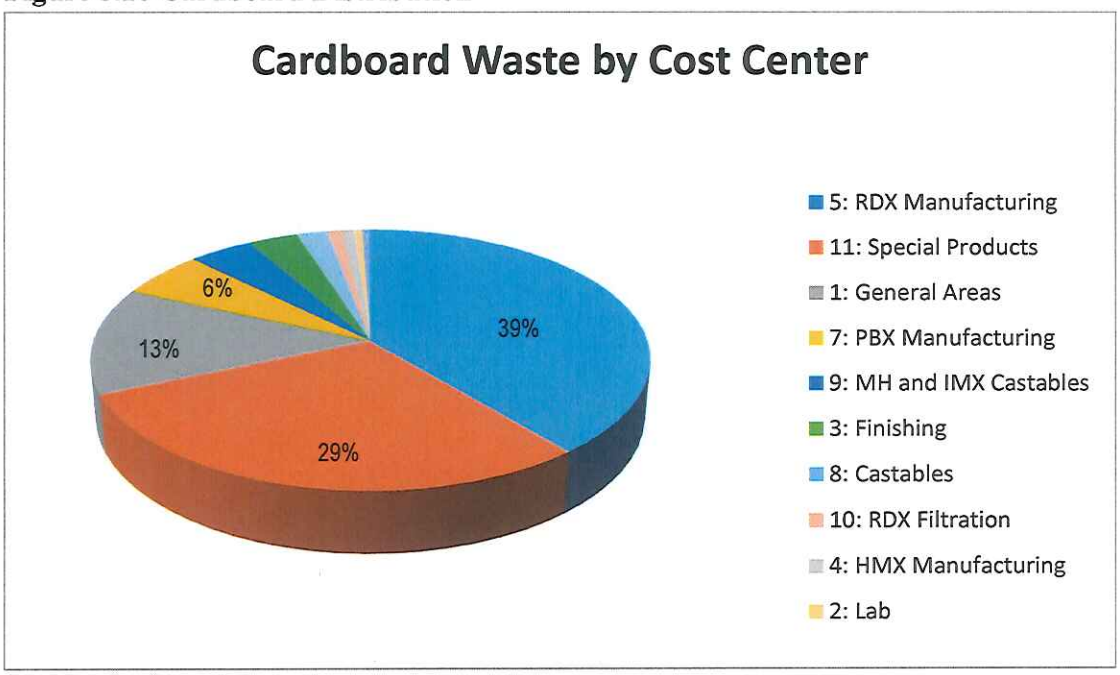


Figure 5.17 Plastic Distribution

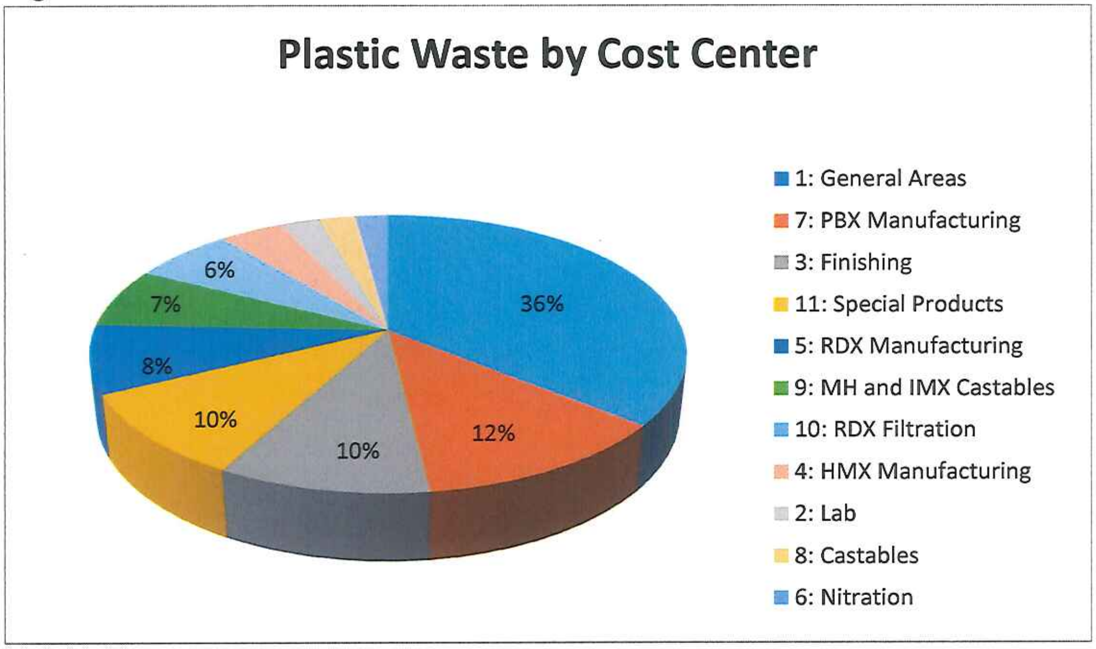


Figure 5.18 Other Waste Distribution

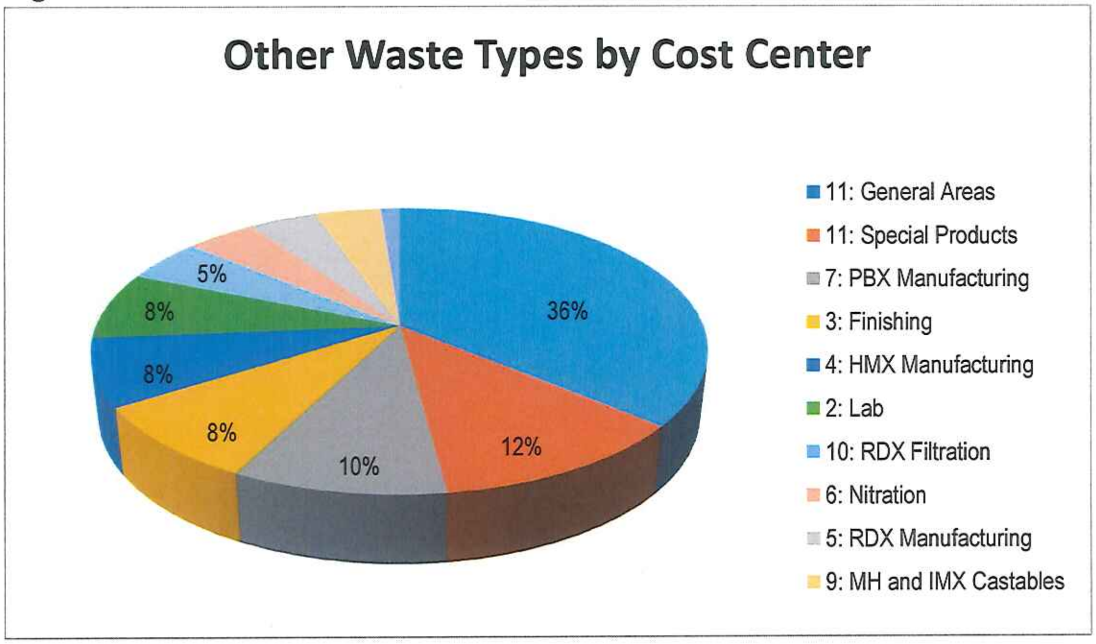


Figure 5.19 Dirt Distribution

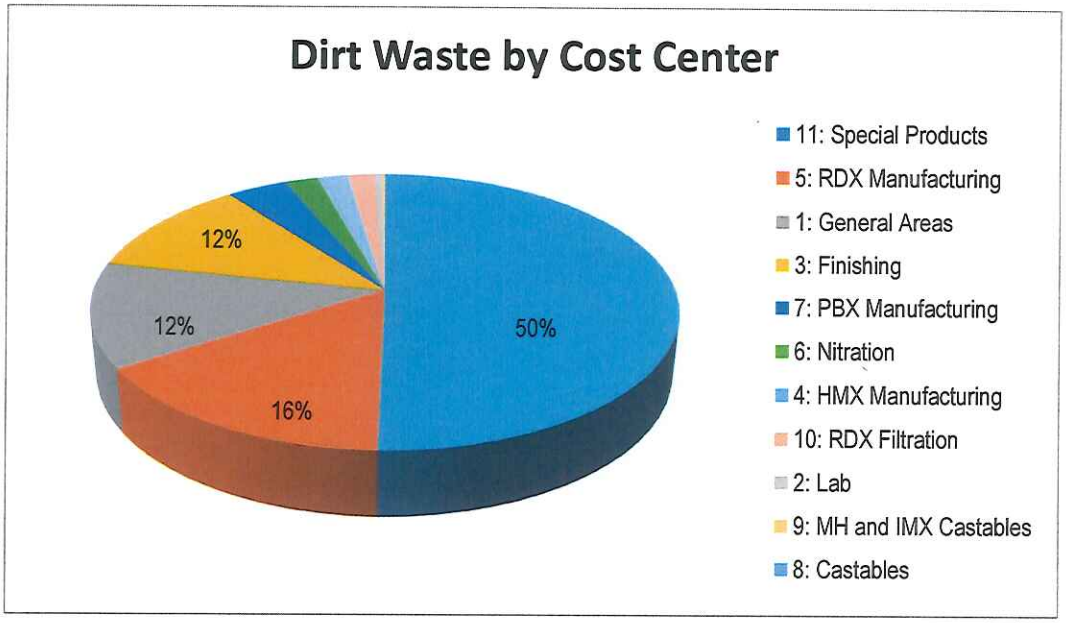
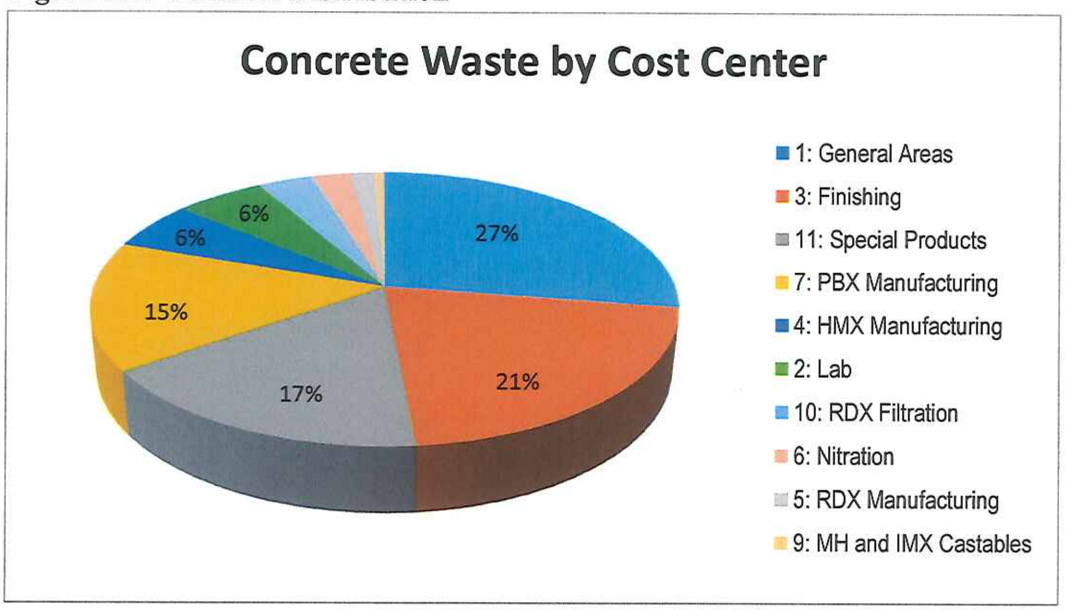


Figure 5.20 Concrete Distribution



5.4.2 Demolition Material by Type

To be able to fully understand the volumes of materials treated at the OBG, the demolition waste was also broken down into material types. These breakdowns can be used to help determine how future demolition projects will impact the OBG operations and therefore plan accordingly. Table 5-6 provides the breakdown of demolition materials. Metal, wood, and concrete wastes account for 96% of the demolition waste. Approximately 66% of the wood from demolition is clean and is only used to ensure the pile burns achieve the required decontamination time and temperature.

Table 5-6 Demolition Totals by Material Type

Demolition by Material							
	Cardboard	**Metal**	**Plastic**	**Wood**	**Dirt**	**Concrete**	**Other**
Average Percent	0.35%	17.97%	0.16%	27.66%	2.88%	50.83%	0.14%

5.4.3 All Metals

Metals were evaluated as a single category because they are a unique category of waste. The majority of waste that is burned/decontaminated at the OBG turns to ash and is then disposed of in the on-site landfill. However, metals treated at the OBG do not turn to ash, but are sent off to be recycled instead. Table 5-7 provides the breakdown of metals treated at the OBG.

Table 5-7 Summary of Metals Processed

Thermally Decontaminated Metal				
	2012	**2013**	**2014**	**2015**
Percent of Cost Center Total	16.3%	12.1%	15.4%	11.5%
Percent of Demolition Totals	31.4%	13.2%	11.9%	57.7%
Metals Percent of Treated Material	25.3%	12.7%	12.7%	14.2%

6.0 RECOMMENDATIONS FOR WASTE QUANTIFICATION

Based on the process of evaluating the ledger records and overall characterization process, the following changes were recommended to improve future recordkeeping and knowledge of waste streams. Because the estimated volume of material is not exact, a scale should be installed and transition material tracking to weight based. The quantity records should be improved to separate the buildings, provide more detail in the specific type of material, and make the descriptions consistent (potentially using a checklist).

7.0 WASTE CLASSIFICATION

As discussed in Section 2.2, current operations at the OBG follow the 2008 revision of the DODI 4140.62. Under this version, all contaminated combustible and non-combustible material are classified as MDEH and are thermally treated. The MPPEH primarily comes from the production area of the plant and has visibly come into contact with or was present in an explosive production building. (Note: clean wood is also included in the non-combustible thermal treatment process to ensure the burn event meets the required time and temperature requirements.) Any equipment or material that meets these criteria are thermally treated in the OBG. This is a conservative approach to ensure that all employees are as safe as possible while on-site.

In August 2015, DODI 4140.62 was revised and included a third method for transitioning MPPEH to MDAS. In the previous version of the instruction, the first two approved methods are two independent 100% inspections by qualified individuals or thermal treatment. The third method in this latest major revision is expert knowledge. Understanding this method and seeking ways to implement it at HSAAP are included in this study.

7.1 DODI Revision

Because this study was initiated soon after the revision to DODI 4140.62 was released, understanding the new revision was time consuming. Guidance for implementation at the facility level did not accompany the DODI. At HSAAP expert knowledge was defined as the intimate knowledge of the waste stream, the process that created it, and the level of contact that the waste had with the explosives. Initially, the project team thought defining how expert knowledge could be developed into a method that could clear certain MPPEH items as MDAS was straight forward. However, as the team moved forward with developing a system that would use expert knowledge, it became clear that it was not. Some of the challenges related to this were training and controls. In order to designate an employee to be able to use expert knowledge and clear a waste as MDAS, he/she had to have training to make this determination. However, which training and what kind of training was adequate to support this was unclear. Separate from this issue was how to design controls for both the production and waste evaluation processes to prevent cross-contamination of waste and material streams that were identified as candidates for expert knowledge evaluation. The candidates included both specific material streams that could have production handling improvements to avoid contact with explosives and waste streams coming out of production that have not likely contacted explosives to the extent that they could pose an explosive hazard. In order to implement the expert knowledge process effectively, these streams would have to be containerized and segregated at certain points and with certainty that non-candidate streams could not be accidentally mixed in.

7.2 Implementing the DODI Revision

HSAAP has been diligently working through the challenges of implementing a process that utilizes the expert knowledge method. As such, a draft program has been developed. The basic approach to this program is to first assess the candidate waste streams that could have production handling improvements to avoid contact with explosives and determine which candidates are feasible. Those feasible waste stream handling changes will have a procedural change request initiated. Second, the plant will assess the candidate waste streams coming out of production that have not likely contacted explosives to the extent that they could pose an explosive hazard and determine a process for characterizing and sorting these waste streams into MDAS or MDEH.

All changes under this program must pass through the procedural change process and then be staffed to cover the additional work. This will be implemented in a systematic manner. HSAAP expects the full process across all candidate waste streams to be lengthy and not contribute significantly to the total volume of waste sent to the OBG. Any waste streams cleared as MDAS from the production area are only approved for disposal in the on-site landfill. No cleared waste from this program will be sent off site.

8.0 RECOMMENDATIONS FOR WASTE CLASSIFICATION

HSAAP continues to work towards implementing a program that can minimize the waste streams that are thermally treated at the OBG. Both Army and OSI personnel have been working together to ensure the program can implement processes that are safe for its employees and prevents any waste streams that can be classified as MDAS from being sent to the OBG. Because of the challenges identified in 7.1 and 7.2, HSAAP does not have a final timeline for implementation. Once it is implemented, all changes will be incremental and methodical to ensure safe operations.

9.0 2018 WASTE CHARACTERIZATION UPDATE

Since the conclusion of the original waste characterization of this study, 2016 and 2017 data has been released. The original 2012-2015 waste evaluation was completed and recommendations were made in late 2016. Therefore, all 2016 data was collected under the original process of estimated cubic yards. At the end of 2016 a scale was purchased and placed at the OBG. That incorporated the recording of waste by weight and so all waste for 2017 and beyond has been recorded in pounds. Since the explosives were always recorded in pounds, there was no change to the units of measurement for that stream.

In addition to the generation of 2016 and 2017 waste data, some additional processes have changed. Processes associated with RDX Filtration under cost center 10 are no longer operating. Because that process is no longer operating, those materials are not being generated or sent to the OBG. Also, exterior clothing such as coveralls, boots, lab coats, and hats are no longer burned once laundered.

10.0 CONCLUSIONS

HSAAP has evaluated the waste streams sent to the OBG in order to have a better understanding of the volume and types of wastes to be evaluated for alternative treatment technologies to OB. Since the original waste evaluation, improvements have been made to the data being collected to document the amount of waste treated at the OBG. This data has been compiled and used in the Phase 2 evaluation of alternatives to OB, which was awarded in September 2017. HSAAP will continue to collect data on the waste treated at the OBG and make refinements as necessary. In addition, HSAAP will continue to move forward with implementing its MPPEH evaluation program under DODI 4140.62 in a safe and effective manner.

Appendix 1: Definitions

The following definitions are related to this evaluation. The majority of these definitions were found in the DoD guidance documents DODI 4140.62.

Detonation - A supersonic decomposition reaction propagating through energetic material and producing an intense shock in the surrounding medium and very rapid plastic deformation of metallic cases, followed by extensive fragmentation. All energetic materials will be consumed. Effects will include large ground craters for items on or close to the ground; holing, plastic flow damage, and fragmentation of adjacent metal structures; and blast overpressure damage to nearby structures.

Disposal - End-of-life tasks or actions for residual materials resulting from demilitarization or disposition operations.

Disposition - Reusing, recycling, converting, redistributing, transferring, donating, selling, demilitarizing, treating, destroying, or fulfilling other life-cycle guidance, for DoD property subject to these standards.

Explosive - For the purposes of these standards, a substance or a mixture of substances that is capable by chemical reaction of producing gas at such temperature, pressure, and speed as to cause damage to the surroundings. The term "explosive" includes all substances variously known as High Explosives and propellants, together with igniters, primers, initiators, and pyrotechnics (e.g., illuminant, smoke, delay, decoy, flare, and incendiary compositions).

Explosive Hazard - Defined in Volume 8 of DoD 6055.09-M as a condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capability, or the environment.

Management and disposition of MPPEH, MDEH, and MDAS – Includes the identification; recovery; collection; inspection; determination of the material's explosives safety status; marking; storage, including segregating by the explosives safety status; security; demilitarization; the accountability, when appropriate; and the transfer or release, including sale.

MDAS – Material Documented As Safe. MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

MDEH – Material Documented as Explosive Hazard. MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

MPPEH – Material Potentially Presenting an Explosive Hazard. Material owned or controlled by the DoD that, before determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are:

> Military munitions and military munitions-related materials, including wholly inert components (e.g., fins, launch tubes, containers, packaging material), that are to be used or reused for their intended purpose and are within a DoD Component-established munitions management system.
>
> Non-munitions-related material (e.g., horseshoes, rebar, other solid objects) and munitions debris that are solid metal fragments that do not realistically present an explosive hazard
>
> Other items (e.g., gasoline cans, compressed gas cylinders) that are not munitions or munitions-related material but may present an explosion hazard.

Risk - The product of the probability or frequency that an accident will occur within a certain time and the accident's consequences to people, property or the environment.

Secondary explosives - For the purposes of this document, secondary explosives are generally less sensitive to initiation than primary explosives and are typically used in booster and main charge applications. A severe shock is usually required to trigger a reaction. Examples are TNT, RDX or cyclonite, cyclotetramethylene-tetranitramine (HMX) (also known as octogen).