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## **A. GENERAL INFORMATION**

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### **A.1 Purpose and Intent of Application**

The purpose of this application document is to detail the process, facility, and operations proposed for CS Clean Solutions, Inc. (CS Clean) pursuant to Arizona Administrative Code (AAC) R-18-8-264 for permitting the facility as a Treatment, Storage, and Disposal Facility (TSDF) at their 2453 West Parkside Lane Phoenix, Arizona location. CS Clean's current business is designing and supplying dry gas scrubber columns to end customers, which includes a spent column return and decontamination operation, with CS Clean subsequently acting as a TSDF to treat and store onsite hazardous spent column granulate waste. The process covered under this permit application is defined as:

- The receipt of spent scrubber columns containing hazardous spent granulate from end product users;
- Removal of the spent granulate from the columns, which is then transferred into approved shipping containers at the CS Clean facility, followed by either:
  - Treatment and transportation of the spent granulate offsite for disposal via a third-party environmental services vendor.

**OR**

- Transferal of the spent granulate to a permitted reclamation facility for the recovery of precious metals, where possible.
- Decontamination, fine cleaning, testing, and refilling of the spent columns with virgin granulate; and
- Shipping of the cleaned and regenerated columns to service at the end users' facilities.

This application is submitted on behalf of CS Clean for a Commercial Hazardous Waste TSDF permit with the state of Arizona, in which waste generated offsite from spent columns is treated onsite, stored onsite, and later disposed of offsite utilizing an appropriately licensed third-party environmental services vendor.

### **A.2 Company Background, Facility Information, and Process Overview**

#### **A.2.1 CS Clean Company Background**

Founded in 1986 near Munich, Germany, CS Clean is a manufacturer of dry bed scrubbers and components for the semiconductor industry. The integral component of the dry scrubber is the Cleansorb column, a reusable SAE 316 stainless steel vessel filled with a blend of CS Clean's proprietary absorbent granulates, which utilize chemisorption technology.

CS Clean's North American Industry Classification System (NAICS) code is 333413 for Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing while their Standard Industrial Classification (SIC) code is 3564 for Blowers and Fans.

CS Clean is privately owned by CS Clean Systems AG, a German corporation. CS Clean is incorporated in the state of Nevada.

## **A.2.2 Facility Information**

CS Clean signed a seven-year lease in 2023 at its existing facility located at 2453 West Parkside Lane, Suite 150 Phoenix, Arizona. The owner of the property is Toda America, Inc. of 111 Pacifica Street Ste 135 Irvine, California.

## **A.2.3 Chemisorption Technology Overview**

CS Clean's proprietary absorbent granulates are engineered to utilize the principle of chemisorption to irreversibly remove hazardous gases from end users' manufacturing process exhaust. The porous granulates in the Cleansorb column are engineered to have a large surface area to facilitate the mass transfer of hazardous molecules from the gas phase to the chemisorbent surface. The hazardous molecules subsequently react with the active ingredients in the granulate creating a chemically stable, solid byproduct. This reaction occurs at room temperature and the specific chemisorbent granulate type is selected based on the target hazardous gases in the end users' process exhaust waste stream(s).

## **A.2.4 Cleansorb Columns and Current Process Description**

Cleansorb columns are SAE 316 grade stainless steel shelled, hermetically sealed gas scrubbers that are filled with a blend of proprietary absorbent granulates, ranging in volumetric capacity from 25 to 200 liters (L). The absorbent granulate blend for each Cleansorb column is developed specifically for its properties to abate hazardous gases in the end user's process exhaust, which are identified and specified by the end user. Cleansorb columns are exclusively used to abate hazardous exhaust gases from customers' semiconductor manufacturing processes.

Cleansorb vessels are designed to be reusable. A Cleansorb column, filled with virgin granulate, is installed in a manufacturing process exhaust scrubber, and will abate hazardous gases until such time that the granulate within is spent. At that time, the end user purges the column with inert gas to remove any hazardous vapors which may remain in the column, remove the spent column for shipping, and install a new Cleansorb column filled with virgin granulate. At present, spent columns are shipped to a third-party environmental services provider where they are emptied, decontaminated, and returned to CS Clean, who then refills them with virgin granulate and ships the regenerated columns back to the end users for reuse. The intent of the proposed process is to offer turn-key service in which CS Clean exclusively controls and manages the spent column return, transfer of waste, and decontamination operations.

## **A.3 Waste Streams and Characteristics**

The spent granulate waste profile for each used Cleansorb column is determined solely by the chemical composition of the virgin granulate blend and its reaction byproducts with hazardous gases used in the end user's manufacturing process. The specific procedure used to manage each spent column necessarily depends on the characteristics of the spent granulate, since hazardous constituents vary widely depending on the abatement application with which the column was used for.

There are six end user manufacturing processes that compose CS Clean's used Cleansorb column waste streams. The waste streams resulting from these processes are discussed in detail below and in **Section C** and **Table A.1** of this permit application.

### **A.3.1 Ion Implantation**

Spent granulate waste derived from columns used to abate ion implantation process exhaust. Spent ion implant column granulate typically consists of copper salts of hydride gases, such as arsine, phosphine, silane, and germane. The granulate waste stream generated through ion implantation processes typically contains reduced copper, fluorides, and very small concentrations of arsenic.

### **A.3.2 Chemical Vapor Deposition**

Spent granulate waste is derived from columns used to abate Chemical Vapor Deposition (CVD) process exhaust. CVD spent column granulate waste typically consists of copper salt forms of hydride gases. Additionally, columns used with CVD processes may also contain magnesium, aluminum salts of metal organic compounds, reduced copper, elemental white phosphorous, and/or arsenic in minor concentrations.

### **A.3.3 Chemical Etching**

Spent granulate waste is derived from columns used to abate chemical etching process exhaust. Chemical etching spent column granulate waste is composed of magnesium and aluminum salts of typical etching gases (primarily halogens and acid gases). Common etching gases include fluorine ( $F^2$ ), hydrogen fluoride (HF), chlorine ( $Cl^2$ ), hydrogen chloride (HCl), and boron trifluoride ( $BF^3$ ). The granulate is also used to abate the fluorinated plasma breakdown byproducts of perfluorocarbon (PFC) gases such as compressed air, nitrogen or argon fluoride ( $NF^3$ ), and sulfur hexafluoride ( $SF^6$ ).

### **A.3.4 Nitride**

Spent granulate waste is derived from nitride processes. Nitride spent column granulate is composed of copper and zinc salts of ammonia and hydride converted wastes.

### **A.3.5 Silicon Epi (Epitaxy)**

Spent granulate waste is derived from chlorosilane gases and a small amount of hydride gas. Silicon Epi (Epitaxy) spent column granulate contain chloride salts of aluminum, magnesium, and copper salts of arsenic and phosphorus.

### **A.3.6 Cobalt**

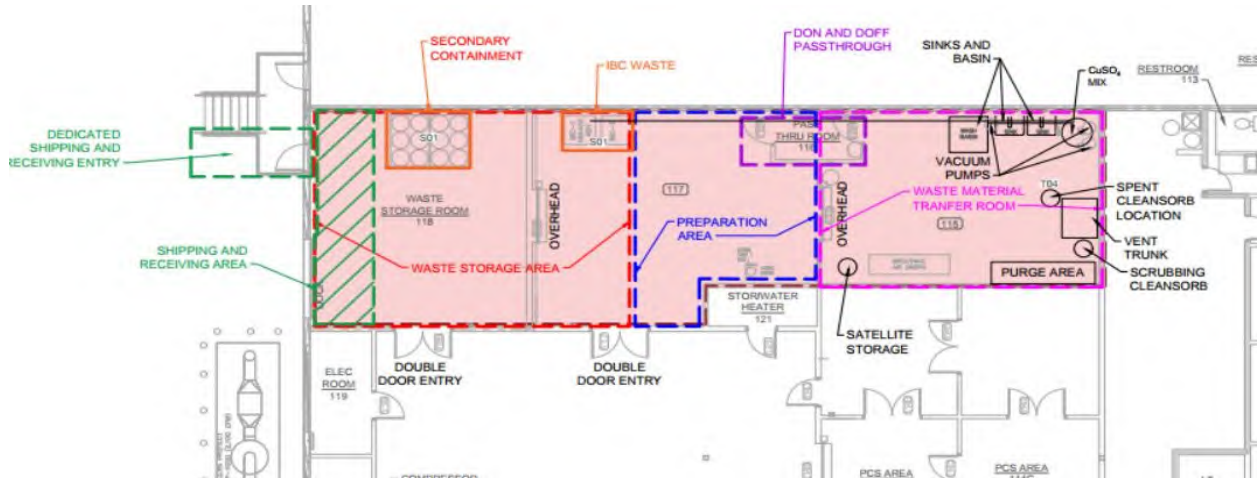
Spent granulate waste is derived from columns used to abate ammonia and cobalt precursors. Spent cobalt column granulate contains aluminum and magnesium salts, cobalt, copper oxides, and ammonia complexes with copper compounds.

#### A.4 Process Area Design

CS Clean has modified the existing facility located in Phoenix, Arizona to implement the ability to conduct processing operations onsite by constructing five main areas, collectively known as the process area, each of which is described below.

1. **Shipping and Receiving Area** – This area is utilized to ship, receive, and stage spent Cleansorb columns and waste shipped to and from the facility. Prior to entry into this area, columns are inspected, and documentation is reviewed prior to acceptance as detailed in **Section A.5.1**. Once received, spent Cleansorb columns are transferred from the shipping and receiving area to the waste storage area as detailed below.
2. **Waste Storage Area** – This area is used to hold spent columns prior to evacuation, treatment, and decontamination. This area also hosts spent granulate that has been received, treated, or removed from spent columns. The waste storage area is equipped with electrochemical gas detection to continuously monitor the ambient interior atmosphere within the area for fugitive vapors and/or oxygen deficiency, along with an audio-visual alarming notification system to notify site staff immediately in the event of a hazardous atmosphere. Two intermediate bulk containers (IBC) are stored in the waste storage area to collect rinse water, spent copper sulfate ( $\text{CuSO}_4$ ) and water solution liquids generated from this onsite decontamination process.
3. **Waste Material Transfer Room** – This room is used for secondary purging of compressed air, nitrogen or argon through spent columns,  $\text{CuSO}_4$  treatment of certain spent column types, and transfer of spent granulate from spent columns into Department of Transportation (DOT)-approved waste containers. To mitigate the generation of hazardous dust/particulate during spent granulate transfer operations, a specialized high-efficiency particulate air (HEPA) dust collection vacuum is used in this room to reduce airborne particulate. To further mitigate hazards, the room is also equipped with electrochemical gas detection and audio-visual alarming notification system to notify site staff immediately in the event of a hazardous atmosphere. Finally, a dedicated exhaust system which provides a minimum of ten air changes per hour and is used during all process activities within the room. The waste material transfer room is used for decontamination of the used Cleansorb columns after they have been emptied in the waste material transfer room. This includes disassembly and detailed cleaning of the columns and associated parts in a dedicated wash basin. Additionally, the  $\text{CuSO}_4$  mixing tank and associated treatment process for certain used Cleansorb columns are stored in this room.
4. **Preparation Area** – This area is utilized to receive the columns from the waste storage area and is utilized to help control access to the waste material transfer room. The preparation area is utilized to house key supporting equipment such as the controls for electrochemical gas detection, personal protective equipment (PPE),  $\text{CuSO}_4$  pumps, and  $\text{CuSO}_4$  process piping. Once decontamination is completed in the waste material transfer room, this area supports reception of spent columns and removal of the decontaminated columns for final reassembly and reuse purposes.
5. **Donn and Doff Passthrough** – This area allows employees to don and doff PPE. This area serves as employee's ingress and egress from the waste material transfer room to the preparation area.

The process area design layout is provided in the diagram below shaded in red. This drawing is also provided in **Appendix A.2**.



### A.5 Process Description and Flow

The step-by-step process by which a trained CS Clean technician will receive a spent column, remove the spent granulate and transfer the waste offsite, and regenerate the column for shipping back to the end user is described below. More detailed information on the proposed facility, operations, and process safeguards is provided as **Sections D** and **F** of this permit application.

1. **Acceptance/Storage** – Any spent column shipped to CS Clean from an end user will be accepted only if it arrives with all proper waste profiling, transportation, and CS Clean-required documentation. Spent column shipments that arrive without all the required documentation will be refused. After determining that the waste shipment has met the acceptance criteria, all columns are transferred from the shipping and receiving area to the waste storage area, where columns are temporarily staged until the CS Clean technician is ready to continue the processing operation. The designated waste storage area is isolated from the preparation area to ensure the efficient flow of work in and out of the site. The waste storage area is equipped with spill pallets and has its outer walls bermed to ensure secondary containment and safe storage of wastes outlined in **Table A.1** and **Section C** of this application. This room is utilized for both inbound and outbound solid waste storage.
2. **Preparation** – When the CS Clean technician is ready to start the processing operation, the spent column is transferred from the waste storage area to the preparation area. Here the spent column is uncrated and placed in a mechanical assisting device. The CS Clean technician will adorn all required safety equipment, uncrate the spent column, transport the column over to a mechanical assisting device, and then move the equipment into the waste material transfer room to begin processing the spent column.
3. **Air, Nitrogen or Argon Purging** – After the CS Clean technician moves the spent column into the waste material transfer room at the designated purge area, the inlet port of the column will be connected to an atmospheric air connection or a compressed air, nitrogen, or argon cylinder. Then, the outlet port will be connected to a clean Cleansorb column.

Each spent column is purged strictly as a redundant safety measure to eliminate any potential for CS Clean's process technician to be exposed to any residual hazardous gases which may remain within the column.

#### 4. **Treatment**

4a. **CuSO<sub>4</sub> Treatment** – CuSO<sub>4</sub> treatment is performed only for spent column waste from CVD, ion implantation, cobalt, and epitaxy manufacturing processes (spent columns from chemical etching and nitride manufacturing process will proceed from Step 3 directly to Step 5). A ten percent (10%) CuSO<sub>4</sub> and water solution is utilized to quench and to passivate (make unreactive) by altering the surface layer of the spent granulate and adding a thin inert layer, to inert any reduced copper and/or elemental phosphorous which may remain within the waste. After completion of this treatment, the resulting spent CuSO<sub>4</sub> and water solution is pumped to an IBC located in the waste storage area and removed by a third-party vendor in accordance with applicable hazardous waste generator regulations. The treatment occurs by emptying the spent CVD, ion implantation, cobalt, or epitaxy columns to a 55-gallon drum filled with CuSO<sub>4</sub> solution to quench the waste. The CuSO<sub>4</sub> solution is then drained from the drum, reused, and recirculated or disposed of to a 275-gallon drum once it meets its useful life. The remaining spent granulate waste material is packed into a 55-gallon drum for offsite disposal.

5. **Emptying** – In the waste material transfer room, a mechanical assisting device is used to lift and invert the column to evacuate spent granulate into a DOT-approved waste container using a specialized funnel to minimize dust generation and prevent any accidental spills of granulate.

5a. **Disposal/Reclamation** – Spent granulate removed from each column is transferred into an individual, DOT-approved waste container and stored in the waste storage area. This spent granulate container is managed in one of two ways depending on whether it is qualified for reclamation or not:

- Spent granulate that has been qualified for reclamation based on presence of precious metal content will be shipped offsite to a permitted reclamation facility for the recovery of precious metals.
- Spent granulate that is not qualified for reclamation is managed strictly as waste and is shipped offsite for disposal via a licensed transporter and to a licensed facility for ultimate disposal.

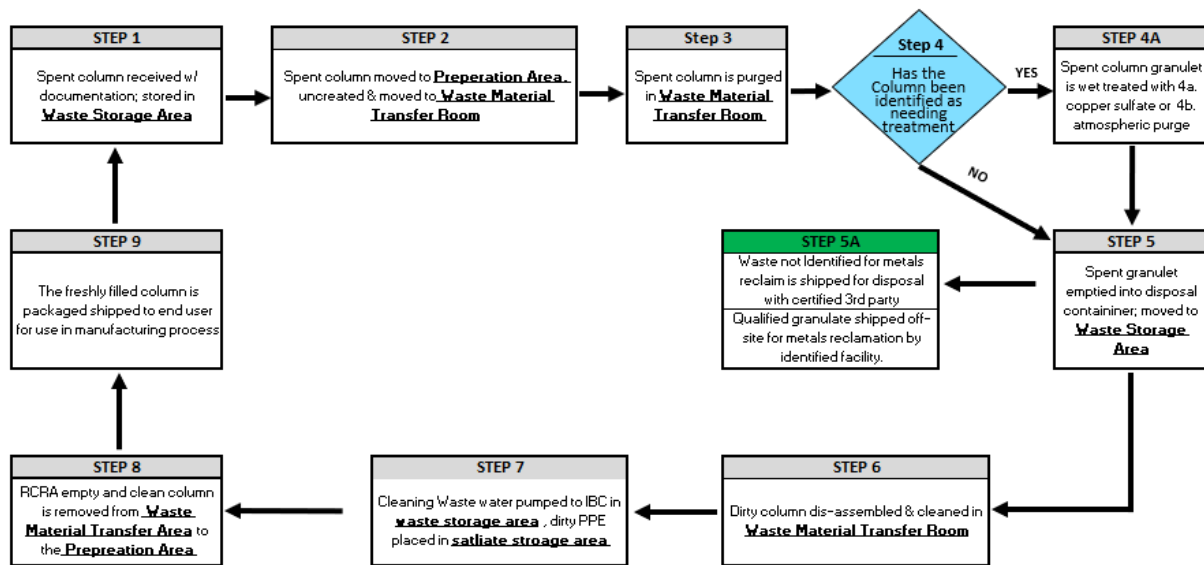
6. **Cleaning** – The empty spent column is disassembled, decontaminated, cleaned with a non-toxic cleaning agent, and rinsed with water to remove any residual granulate solids and particulate that may still be present in the column. Individual spent column parts such as valves, seals, and clamps are cleaned and rinsed in a dedicated sink and wash basin. After all column parts have been thoroughly cleaned, they are placed on a dedicated cart to dry and transported to the preparation area. The columns at this point are RCRA empty and taken to a non-RCRA (Resource Conservation and Recovery Act) controlled area.

7. **Cleaning waste** –The resulting rinse water is pumped to a dedicated IBC in the waste storage area and subsequently removed from the site by a third-party vendor in accordance with applicable hazardous waste generator regulations. The associated

disposable cleaning materials and associated PPE are placed in the satellite storage area within the waste material transfer room.

8. **Refilling** – RCRA empty and clean columns are moved from the waste material transfer area to the preparation area, where they are then taken outside the waste processing air for final column regeneration with a virgin blend of absorbent granulate. The refilled column is then checked for leaks via compressed air, nitrogen, or argon pressure testing. This portion of the process is non-RCRA and is not part of the process for which this permit application has been prepared, and as such, is not detailed any further.
9. **Packaging and Shipping** – Finally, CS Clean packages the freshly refilled column for shipping and ships the column back to the end user.

A spent column treatment flowchart depicting this process is provided below.



Detailed spent column air, nitrogen, or argon purging, CuSO<sup>4</sup> treatment, atmospheric air purge treatment and column emptying procedures are provided in **Section D** of this application package.

CS Clean will look to qualify waste granulate treated by the above methods to an approved reclamation facility for the recovery of precious metals, when possible. Spent columns that are qualified for reclamation would be considered exempt from this Part B permit per Federal RCRA solid waste exemptions under the Code of Federal Regulations (CFR): 40 CFR 261.2(c)(3), 40 CFR 261.1 Table 1, and 40 CFR 261.4(a)(24).

## A.6 Estimated Waste Quantities

CS Clean has prepared the following quantity estimations in **Table A.1** for the waste streams as described in **Section A.3** that they estimate to receive a treat in the first year of operating a TSDF.

<b>Table A.1 Spent Granulate Quantities Processed Annually</b>			
<b>End User Waste Type</b>	<b>Number Columns</b>	<b>Estimated Total Weight (lbs.)</b>	<b>Hazardous Waste Code(s)</b>
Ion Implant	8	4,800	D001, D004
Silicon Epi	41	24,000	D002, D003, D004
Cobalt	41	24,000	D003
CVD	5	3,000	D001, D003, D004
Chemical Etching	5	3,000	D002
Nitride	3	1,800	D004

### **A.7 Other Permits**

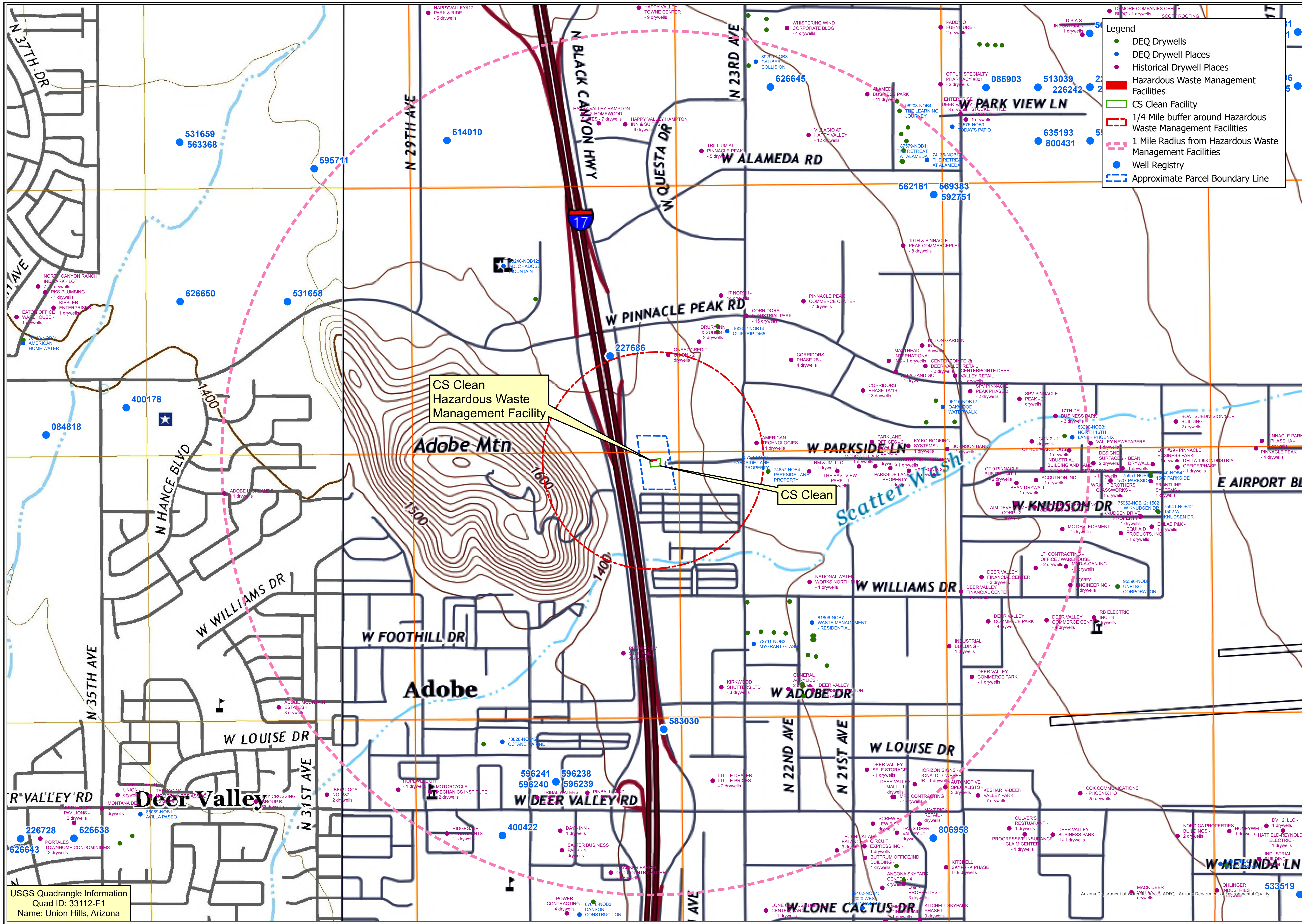
Currently, CS Clean only holds one other permit with Maricopa County for an air permit (permit # P0009591). CS Clean does not currently have any other environmental-related permits or construction approvals received or applied for.

### **A.8 Project Timeline**

Upon Arizona DEQ's review and approval of this permit, CS Clean is prepared to immediately operate their facility.

# APPENDIX A.1

## Topographic Map



**Legend**

- DEQ Drywells
- DEQ Drywell Places
- Historical Drywell Places
- Hazardous Waste Management Facilities
- CS Clean Facility
- 1/4 Mile buffer around Hazardous Waste Management Facilities
- 1 Mile Radius from Hazardous Waste Management Facilities
- Well Registry
- Approximate Parcel Boundary Line

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↑ NORTH

0 250 500 Feet

REVISIONS		DESCRIPTION
NO.	DATE	

1"=600'	ISSUE DATE: 10/22/2025	PROJECT NUMBER: CSC0016RC	SHEET SIZE: 24"X36"
DW	BB	DW	DW
DRAWN	REVIEWED	APPROVED	

**CS Clean Systems, Inc.**  
 2453 W Parkside Lane  
 Suites 150  
 Phoenix, Arizona

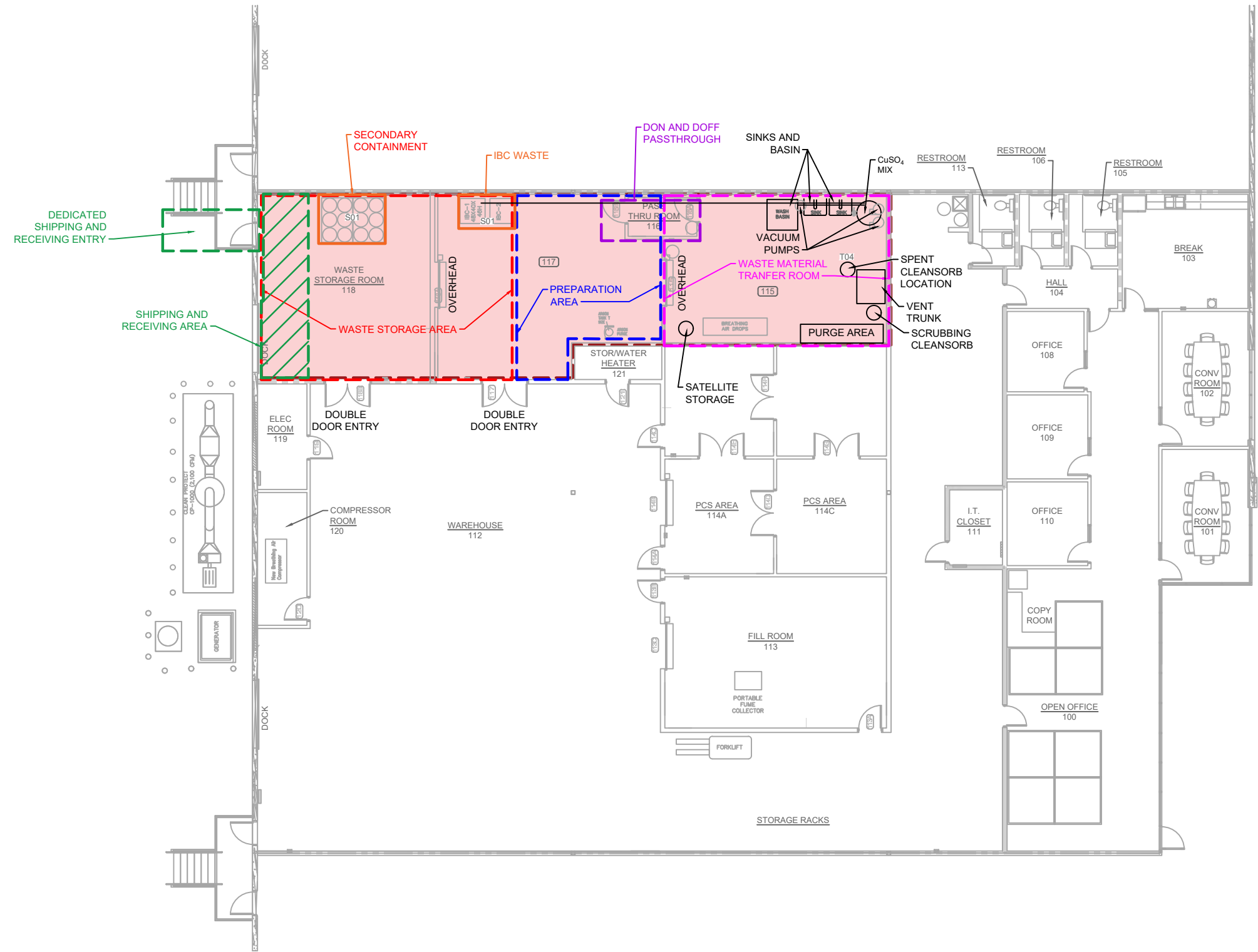
**Facility Location**


SHEET NO.  
**1**

USGS Quadrangle Information  
 Quad ID: 33112-F1  
 Name: Union Hills, Arizona

# APPENDIX A.2

## Process Drawing



 -INDICATES AREA IN WHICH ALL EXTERIOR WALLS AND DOORS ARE BERMED

REVISIONS	
NO.	DATE

DESIGNED BY:  
**DSW**  
 DRAWN BY:  
**BOB**

REVIEWED BY:  
**DSW**  
 PROJECT NUMBER:  
**CSC0016.RC**

ISSUE DATE:  
**06/23/2025**  
 SHEET SIZE:  
**11"x17"**

**BUILDING PLAN**  
 CS CLEAN SOLUTIONS  
 26 COMMERCE DRIVE  
 DANBURY, CONNECTICUT

**FIGURE**  
**2**